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ANNUAL REPORTS ON THE PROGRESS OF APPLIED CHEMISTRY.

In 1916 the Publication Committee of the Society decided to issue an Annual Report on the Progress of Applied Chemistry, the object of which should be to present to the chemical technologist a comprehensive and critical survey of progress effected in each branch of the chemical industry. Such success has attended the publication of the admirable reports on pure chemistry issued annually by the Chemical Society that the need for a similar compilation to deal exclusively with the departments of applied chemistry had for some time been very apparent. Although it was realised that the Transactions and Abstracts Section of the Journal of the Society of Chemical Industry provided a valuable and most complete reference book of researches and inventions in the chemical industry, it was nevertheless evident that many advantages would be gained by preparing an annual review of progress effected. The Annual Reports Sub-Committee agreed that these sectional reviews, whilst presenting a comprehensive *résumé* of new work and ideas, should be written in the form of monographs in order to present the individual aspect of the expert compiling each section; and it was further considered advisable to change the contributors from time to time.

Vol. I. of the Report covers progress to the end of 1916, whilst Vol. II., recently published, is divided into about twenty sections, and deals with the period up to the end of 1917. The subjects dealt with, together with the contributors, are given below:—

Plant and Machinery: by J. W. Hinchley, F.I.C.
Fuel: By J. S. S. Brame, F.I.C.
Gas, Destructive Distillation, Tar Products: by E. W. Smith, M.Sc., F.I.C.
Mineral Oil: by W. J. A. Butterfield, M.A., F.I.C.
Colouring Matters and Dyes: by Gilbert T. Morgan, F.I.C., D.Sc., F.R.S.
Fibres, Textiles, Cellulose, and Paper: by J. F. Briggs, A.C.G.I.
Bleaching, Dyeing, Printing, and Finishing: by S. H. Higgins, M.Sc.
Acids, Alkalis, Salts, etc.: by H. A. Auden, M.Sc., D.Sc.
Glass, Refractory Materials, Ceramics, and Building Materials: by W. J. Rees, F.I.C.
Metallurgy of Iron and Steel: by C. O. Bannister, F.I.C., A.R.S.M.
Metallurgy of Non-Ferrous Metals: by C. Patchin, A.R.S.M.
Electro-Chemistry: By Arthur J. Hale, B.Sc., F.I.C.
Oils, Fats, and Waxes: by E. R. Bolton, F.I.C., and Cecil Revis, F.I.C.
Paints, Pigments, Varnishes, and Resins: by R. S. Morrell, Ph.D., F.I.C.
Indiarubber, etc.: by H. P. Stevens, M.A., Ph.D., F.I.C.
Leather and Glue: by Joseph T. Wood, F.I.C.
Sugars, Starches, and Gums: by T. H. P. Heriot, F.I.C.
Fermentation Industries: by Arthur R. Ling, F.I.C.
Water Purification and Sanitation: by S. Rideal, D.Sc., F.I.C.
Fine Chemicals, Medicinal Substances, and Essential Oils: by Frank Lee Pyman, D.Sc., Ph.D.
Photographic materials and processes: by B. V. Storr, M.Sc.

Although some time must necessarily elapse before these Reports can reasonably be expected to attain the standard of perfection which the Committee responsible for their compilation has set itself, it should be realised that the two issues already published represent the result of a vast amount of work, and it is confidently anticipated that industrial chemists will take full advantage of them. The volumes have been well received in the chemical industry, perhaps the greatest tribute paid being a request from the Société de Chimie Industrielle for permission to translate them into French. Suggestions for the improvement of subsequent volumes would be welcomed by the Society, and letters on this subject should be addressed to the Secretary, Dr. Longstaff.

The price of Vol. II. is 4*s*. 6*d*. to members, 6*s*. 6*d*. to non-members, post free in each case. Orders, accompanied by remittances, should be sent as soon as possible to the Publishers, Messrs. Harrison and Sons, 45, St. Martin's Lane, London, W.C. 2. Copies of Vol. I. may be obtained from the Secretary to the Society, price 3*s*. to members, 5*s*. 6*d*. to non-members.

PHYSICAL CHEMISTRY AND CHEMICAL TECHNOLOGY.

In some quarters it is customary to regard the link between physical and applied chemistry as being very slight, but the truth is that physico-chemical principles are of great significance in relation to many industrial processes. The character and extent of this relationship have lately been the subject of three Cantor lectures delivered by Prof. J. C. Philip at the Royal Society of Arts, in the course of which the bearing of physical chemistry on the chemical and allied industries was discussed.

Prominence was naturally given to matters connected with equilibrium, reaction velocity, and catalysis, and it was shown that the law of mass action, coupled with the principles of thermodynamics, permits a definite formulation of the "yield" obtainable in a chemical reaction, in so far as this depends on changes in the proportions of the reacting substances, in the pressure and in the temperature. The points at issue here were discussed in connexion with the contact process for sulphuric acid manufacture, the synthesis of ammonia, and the water gas equilibrium. In all these cases physico-chemical investigation has made it possible to express quantitatively the influence of the various factors which affect the yield of the desired product.

In regard, for example, to the influence of pressure on the ammonia equilibrium, theoretical considerations show that where the amount of ammonia formed is small, as it is at high temperatures, the volume percentage of ammonia in the equilibrium mixture is proportional to the pressure under which the reaction takes place. In conformity with this it has been found that at 800° C. and 1 atmosphere pressure the volume percentage of ammonia at equilibrium is 0·012, whilst at the same temperature and 30 atmospheres pressure, the value is 0·34, that is, nearly 30 times as great.

From the technical standpoint, a knowledge of the equilibrium conditions, however complete, does not go far enough. The manufacturer desires to know, not only what are the maximum quantities of any desired product obtainable under given conditions of pressure, temperature, and concentration, but also whether these results can be achieved in a reasonably short time. In other words, the rate factor has to be considered, and in relation to this question the systematic study of reaction velocity on physico-chemical lines is of great value.

A higher speed of reaction may be secured by a rise of temperature, but this frequently involves,

as in the case of the sulphuric acid contact process and the ammonia synthesis, an undesirable shift of the equilibrium in the direction of a smaller yield. The other recognised method of increasing the rate of chemical change is the use of catalysts, and the lecturer dealt at considerable length with this topic, showing that in heterogeneous catalysis, to which category most of the technical catalysed reactions belong, the principle of mass action is very often masked by the operation of other factors. In such heterogeneous catalysis, the rate of change appears to be determined by the velocity of some physical process, such as occlusion in the surface layers of the catalyst, and not primarily on the velocity of a purely chemical reaction. Examples of this kind are found in the catalytic combination of inflammable gas and air at hot surfaces, and in the hydrolysis of carbohydrates under the influence of enzymes.

The condition of the catalyst surface in technical heterogeneous catalysis is accordingly to be regarded as a factor of prime importance. The extent to which the activity of a solid catalyst may be affected by its previous history and by the treatment it has received is abundantly evident in connexion with the catalytic influence of nickel in the hydrogenation of oils, and that of platinum in the oxidation of ammonia. In these and other cases, notably the sulphuric acid contact process, certain substances are found to act as "polsons" for the catalyst, and these must be absent if the catalyst is to have a reasonably long life.

Another portion of the lecture course was devoted to the physico-chemical principles governing the absorption of gases and dissolved substances, and in connexion with the solubility of gases in liquids reference was made more especially to the storage of acetylene in acetone under pressure, and to the separation of carbon dioxide and hydrogen sulphide from ammonia in the working up of ammoniacal gas liquor. The features of the absorption (or "sorption") of gases by solids were also brought under review, and the special influence of the surface of the solid in this phenomenon was emphasised. When a gas is taken up by charcoal, the first stage, in which this surface effect ("adsorption") is predominant, has to be distinguished from the subsequent slow penetration of the gas into the interior of the charcoal mass ("absorption").

The phenomenon of adsorption is of significance also in the well-known effect of such materials as charcoal and fullers' earth in removing dissolved substances, notably colouring matters, from solutions. In numerous cases the relation between the concentration of the dissolved substance, (1) in the solution, and (2) on the absorbent solid, can be quantitatively expressed in a so-called adsorption formula, which is found applicable to cases of widely differing character. From this point of view the relation between a dye and an animal or vegetable fibre, the function of charcoal in the refining of raw sugar, and the retention of dissolved substances by soil, were discussed.

In connexion with adsorption, no less than equilibrium, reaction velocity, and catalysis, there are thus many points of contact between physical and applied chemistry. It may indeed fairly be claimed that, as in other branches of the science, so in technology, physical chemistry has contributed in no small degree to the introduction of quantitative, as distinct from qualitative, methods of handling chemical problems. It will be generally admitted that all factors which make for rational interpretation and quantitative control in technical processes are of the highest importance, and on this ground the closer co-operation of physical chemists and practical technologists is eminently desirable.

SOME PRESENT-DAY ASPECTS OF THE PAINT AND VARNISH INDUSTRY WITH SPECIAL REFERENCE TO THE WAR.

A. DE WAELE.

The war has been responsible for many changes in several industries, but in the case of the paint and varnish industry in particular it has produced results which should favourably influence future development. This industry is essentially one in which the inner knowledge of the mechanism of manufacture has not been furthered to a great extent by the help which pure chemistry has lent to its service. It has, however, attained a very considerable degree of perfection by the methods of empiricism. In spite of the practice of the more up-to-date firms to introduce scientific control into the factory, comparatively little progress has resulted which might be directly attributable to the influence of pure scientific research. One need not elaborate on the highly involved chemistry and physics of paint and varnish manufacture to seek a reason for this. The industry is particularly one which calls for a close collaboration between the academic chemist and his works' confrère. The furtherance of our knowledge of many problems relative to an industry which is at once utilitarian and decorative is hindered, however, by the difficulty of bringing together the work of the two schools. The "secrecy" of the industry, and the fact that the financial importance of the majority of the paint and varnish firms does not warrant the establishment of a "research department," such as we know it in many other more purely chemical industries, are mainly responsible for this condition of affairs. Our knowledge of the chemistry of the reactions occurring during the oxidation and "boiling" of drying oils is lamentably small, more attention having been devoted to the constitution of the glycerides in their raw state. In spite of this, however, the technology of the treatment of drying oils has attained a high degree of perfection, and were it possible to place at the disposal of the pure organic chemist such information without jeopardising the trade value of the processes involved, there is little doubt but that a more scientific conception of such reactions would speedily result.

As has been pointed out, the paint and varnish chemist has progressed in his work by an uncanny combination of science and empiricism. An instance of this is to be found in the ready manner in which the exacting demands of the aeroplane industry have been met in so far as paint and varnish products are concerned. With the introduction of the aeroplane as a new weapon in warfare, a problem presented itself which involved several new considerations of the resisting properties of protective surfaces. In the aeroplane we have a structure which moves quickly from a warm to a cold atmosphere, and the rapidity of transition is such that one cannot but assume that at the first entry into the freezing air, the temperature of the body supporting the protective covering must be many degrees higher than that of the protective surface itself. We have thus a case of an extreme mechanical strain on the very thin film of protecting paint or varnish. The importance of the non-failure of such protective coating on such an important part as, for instance, the airscrew cannot be exaggerated. In addition, the centrifugal force acting on the airscrew revolving at high speeds is such that an absolute state of perfection is required in the material of its construction. An important factor in the latter is the efficient protection of the sealing of the laminations of the airscrew against moisture, etc., and in view of the

considerable bending which the propeller undergoes during its rotation, the question of elasticity of the protective film is of paramount importance. The liability of the airscrew to splashing with hot lubricating oil and petrol is also to be noted. In addition to this *resumé* of the necessary properties which protective coatings for airscrews should possess there comes the economic question of speed of output in so far as application is concerned. This brings forward the old-time tenet of the varnish and paint maker to the effect that the antithesis of reliability and durability is rapidity in drying after application.

The authority responsible for the examination of aircraft products used in the war early grasped the nature of the problem which resulted from a demand for high efficiency, and wisely decided to leave the fulfilling of the necessary requirements to the discretion of the manufacturers by specifying the conditions obtaining in use, and, as far as was practicable, refraining from specifying the composition of the products to be manufactured. As a result now of expert inspection by Government technologists, varnishes and paints for aircraft are regularly supplied which efficiently fulfil the exacting requirements referred to above, whilst permitting of a rapidity of output in so far as speed of application is concerned, hitherto considered impossible.

The production of varnishes for the protection of the "dope" on wings has also proved a new and very difficult proposition, necessitating an entire revision of the preconceived ideas on oil varnish, the details of which cannot be discussed in this article. Another interesting problem which has been successfully solved is the production of an acetone-resisting paint for use on parts which come in contact with this solvent on application of the dope. The interest in this product lies in the fact that acetone has been the constituent of most commercial "paint removers."

The question of the shortage of many raw materials is one which has arisen during the present war, but with the exception of the staple raw material linseed oil, modern paint technologists had for some time past placed on a secure foundation their knowledge of the properties and uses of many substitutes for what were previously considered indispensable ingredients. Amongst these may be mentioned white lead and turpentine.

The absolute stoppage of supplies of the basic raw material of the paint maker, to wit linseed oil, for other than purely Governmental work was, however, a serious question to the manufacturers. As an alternative to linseed oil, the paint manufacturers were offered linseed oil fatty acids. Since the characteristic drying of linseed oil to a hard elastic film is intimately dependent on the triglyceridic structure of the oil, and early consideration on the paint chemists' part showed the inexpediency of relying on the commercial possibility of synthesising the fatty acids to polybasic esters, it became apparent that an absolute stoppage of the industry was threatened if the problem were not attacked on unorthodox lines. The paint manufacturers therefore formed a Federation, which decided to pool the scientific resources of its members for the solution of the problem of the adaptation of linseed oil fatty acids to paint manufacture. As an outcome of the research undertaken, many hundreds of tons of quite excellent paint have been manufactured from the fatty acids.

To turn now to a more general review of the industry, it may be noted that of late years a distinct change has been taking place in the nature of the products manufactured by the paint firms. I here refer to ordinary paint, a product which is very simply defined as heavily pigmented linseed oil. From time immemorial such a product had been generally accepted as the standard of a pigmented protective surface, in spite of its general inferiority of properties. The selection of pigments, with a view to employing the optimum of durability, had in recent years occupied the attentions of many of the technological associations. Looking at the results obtained, however, we are struck by the absence of definitiveness of the conclusions arrived at. The fact of the matter is that there is little to be done in attempting by means of the added pigment to modify advantageously the weather resistance of the medium used—raw or boiled linseed oil. One only has to call to mind what one might call the purely accidental composition of linseed oil as a mixture of glycerides of saturated and unsaturated fatty acids and the variety and amount of its soluble and volatile oxidation products to find a reason for this. After all, the oil only serves its purpose as a protective agent during a short intermediate period of its history after application, characterised by that comparatively short period when its increase in weight by oxidation is at or near a maximum. Even at this point it possesses the disadvantages of considerable porosity to air and water and giving off volatile products of an acid nature often reactive with the pigment used in a paint. That indefinite preparation—"boiled" linseed oil is little better. A certain degree of stabilisation of the molecules of unsaturated glycerides has undoubtedly been obtained by slight ring-forming polymerisation obtained during the boiling process, but a considerable impetus to further destructive oxidation has been given by oxygen absorption at an elevated temperature, with the result that disintegration of the protective film occurs if anything earlier than in the case of raw oil.

The improvement and change referred to is in the manufacture of enamels in the place of paints. Enamels are characterised and basically to be distinguished from paints in the greater stability of the medium used, a highly polymerised "stand oil" or lithographic varnish with or without the addition of an elastic weather-resisting varnish being employed. Other characteristics of enamels are the greater degree of fineness of the pigments used, and the greater gloss obtaining in the dry film. For the production of white or light coloured enamels zinc oxide is used as the base on account of its greater degree of fineness. From this there results a high gloss and a very permanent suspension of the pigment during storage, the latter being due to the formation of oil-soluble zinc soap and the presence of zinc oxide mainly in the suspensoid state, a fact which is clearly shown by the tendency of an ether-diluted zinc oxide enamel to pass through a fine filter paper. It being generally recognised that a surface of porcelain-like gloss is one of the important factors in maintaining effective weather resistance of the dried film, it was found that this was only obtainable by causing the degree of pigmentation of the product to be in the nature of half that usually obtaining in oil paints. This, and the relatively lower opacity of zinc oxide as compared to white lead, results in considerably less body or opacity being obtained in enamels. This shortcoming, however, is rectified by the employment of undercoatings of high opacity but lower degree of elasticity, impermeability, and resistance to weather than the final coat. The two latter factors do not adversely affect the general structural excellence of the whole coating, whilst the former has been shown in practice to be an actual advantage.

A class of preparation which, as the basis of protective coatings, bids fair to become a serious competitor of oil products, is the so-called flexible pyroxylin. This has for many years past been used as a substitute for the oil basis in artificial leather cloth under a registered trade name. A solution

of cellulose nitrate in solvents of comparatively high boiling-point was mixed with a substance conferring flexibility such as castor oil, nitrated castor oil, etc., the proportion of the latter being such that flexibility and chemical stabilisation were given to the unstable and inelastic film of cellulose nitrate without any of the properties of castor oil as a liquid becoming apparent. The stability of castor oil to atmospheric oxidation and its apparent inhibiting effect on the spontaneous decomposition of cellulose nitrate, rendered it particularly adaptable as the agent for securing that degree of elasticity which would allow of the film obtained comparing with an oil varnish film. Owing, however, to the necessarily low content of total solids in the solution which would allow of a working viscosity being obtained, the film yielded on evaporation is so thin that for most decorative purposes the product would not replace oil varnishes satisfactorily. Moreover, much development is needed before the cost of the raw materials used would allow of serious commercial competition with oil varnishes.

It is probable that the future developments of the paint and varnish industry will lie firstly in the direction of internal improvements in manufacture and economisation of time in the present-day lengthy processes. An appreciation of the fact that linseed oil is by no means the ideal oil to employ when accurately controlled processes are involved and more perfect and exact results are required, will lead to a more extensive investigation of the properties of oils of "simple" glyceridic structure, such as China wood oil. The recent discovery of "Oiticica" oil (Bolton and Revis, this J., 1918, 430 A) shows promise of the possibility of utilising an oil possessing the "pure glyceridic" properties of China wood oil to an even greater degree.

CHEMISTRY AT THE INDIAN INSTITUTE OF SCIENCE, BANGALORE.

The appendix to the ninth annual report of the council of the Indian Institute of Science at Bangalore (1918), contains a summary of the work carried out in pure and applied chemistry during the past session. The following information has been derived from this source.

Department of Applied Chemistry.

The chemical and bacteriological study of the fermentative production of acetone from grain has been continued, and the subjects investigated include: Analytical methods for determining carbohydrate, limits of inflammability of acetone vapour and air, purification of acetone, densities of butyl alcohol mixed with water, treatment of waste products. The bacteriological work was mainly directed to discovering the best means of ensuring sterility in the large scale fermentation, and with maintaining cultures of maximum efficiency.

The occurrence of starch, tannin, latex and sugars in mahua flowers (*Bassia latifolia*) has been investigated. The cane-sugar content increases till the flowers drop, and may reach 28·8 per cent. of the weight of dry flowers. The presence of α-dextrose, lævulose, maltose, pentoses and cellulose has been confirmed, but whether practicable quantities of cane sugar can be obtained has not yet been decided. The analytical results show that in the growing stage lævulose is always present in greater amount than dextrose; in the final stage the quantities approximate but do not become equal. The following enzymes have been detected during growth: invertase, cytase, pectase, amylase, oxidase, catalase, maltase. The production of alcohol from the flowers has been studied, and a 60 per cent. yield obtained.

Fermentation studies have included the investigation of the acetic fermentation of mahua syrup, with a view to increasing the yield. To isolate calcium acetate, the fermented liquor was neutralised with calcium carbonate, but the organism did not resist a concentration of more than 2 per cent., and the calcium acetate solution could not be evaporated economically.

A flannel-like pellicle was observed when *Mycoderma aceti* was grown on a medium containing custard apple juice; its formation does not occur when other media, such as cane sugar or glucose, are used, and appears to be dependent upon the presence of pectose.

The problem of isolating a pure lactic acid bacillus, for the commercial preparation of the acid, has proved complicated owing to the vitality of sporing organisms in India, but some success has been achieved.

Good progress has been made in obtaining the dye from red sanders wood in a powdered form convenient for use, and actual dyeing trials have given encouraging results. Experiments have been made in the extraction of yellow colouring matter from *Butea frondosa* flowers, and annatto from the seeds of *Bixa orellana*.

Much work has been done on the recovery of lac from stick lac by solvents. The use of butyl alcohol as a solvent instead of ordinary alcohol appears to offer no advantages. A variety of lac with a very low melting point was prepared, which could be admixed in any proportion with ordinary lac to obtain products of varying plasticity and melting point. Successful trials were made of this material as a basis for felting cheap fibres.

The experimental soap plant of the Mysore Government has been transferred to a new factory at Bangalore where work was commenced in February, 1918. Methods of soap analysis and production are being studied.

As a result of research work on the production of glue and gelatin from bones and sinews, a large scale plant is being erected for this purpose near Bombay.

A considerable number of forest products have been investigated, and in particular samples of bark, twigs and wood from certain trees suitable for the growth of lac have been examined together with their associated gums.

Research on activated sludge has been carried out since November, 1917. At a small experimental plant for dealing with sewage erected outside the Applied Chemistry Department, data have been obtained for the construction of the larger installation at Sakchi and also valuable information concerning the character of the sludge under different conditions from the point of view of its use as a fertiliser.

Other investigations included: The determination of the solubilities of potassium and sodium carbonates in presence of each other with a view to the working up of naturally occurring salts; experiments on the refining and bleaching of native bees' wax for the Government of Mysore; a preliminary investigation of the cause of deterioration of paper, for the Imperial Librarian; and the examination of various mineral products.

Department of General and Organic Chemistry.

1. *Pure chemistry.* V. K. Bhagvat has completed a series of experiments, started in 1912, which show that the esters of strong acids such as oxalic and pyruvic undergo alcoholysis in the absence of a catalyser much more readily than the esters of feeble acids.

In a study of the action of alkalis on the isomeric phenyllitbromopropionic acids and their esters, P. Ramaswamy Iyer has shown that the αaβ acid loses hydrogen bromide more readily than the αββ acid and that the two acids yield different amounts

of the stereoisomeric dibromo-cinnamic acids. The results of a research on the determination of vapour pressures of concentrated solutions of alkalis and salts and of acetone, by G. R. Paranjpe, have been published in the Institute Journal (vol. 2, part V.). Preliminary experiments by the same author on the occlusion of gases by quartz at low temperatures indicate that at the temperature of liquid air, oxygen and nitrogen are occluded but that hydrogen is not.

B. Technical work. Samples of sandalwood oil have been regularly analysed for the Mysore Government; and samples of wood from the Coimbatore District, sent by the Madras Forest Department, have been distilled, one sample yielding 8 per cent. of oil. A method of refining the dark coloured oil has yielded a product of excellent colour and good quality; 1866 lb. of oil has been distilled.

The chemical examination of the oleoresins from *Dipterocarpus indicus* and from *Hardwickia pinnata* has been completed (Instit. Jour., vol. 2, parts III. and IV.), and samples tested therapeutically in the Campbell Hospital, Calcutta, show encouraging results.

The production of thymol from Ajwan seed has been studied from the point of view of simplifying the process and of obtaining a colourless product equal to that previously manufactured in Germany. The experiments led to successful results, about 1 cwt. of colourless thymol crystals being obtained and sold at about 30*s.* 8*d.* per lb. Manufacture by this process has been started by Lakhani at Sind.

A small quantity of cardamom seed oil prepared and sent to London has been reported as of excellent quality, and 56 lb. has been ordered.

A report on wood distillation has been submitted to the Indian Munitions Board. Trials are being continued with an electrically-heated retort holding 100 lb. of wood.

Methods of manufacturing high-grade glycerin have been reported upon, and experiments have been made on the castor seed lipase method of production. A pale yellow crude glycerin containing 37 per cent. of glycerol and 1·15 per cent. total solids has been obtained.

Experiments have been made on electrolytic and quick chemical methods of manufacture. Electrolytic methods are not suitable for India.

Investigations undertaken at the request of the Munitions Board to determine the comparative results of refrigeration and of scrubbing at 35° C. the gases produced during the distillation of acetone, showed that refrigeration was not necessary, as at 35° an 85 per cent. recovery of the acetone vapour can be effected by means of a simple scrubber.

Experiments on the manufacture of straw boards from lantana and bamboo fibres showed that with lantana alone the boards are too brittle. The common bamboo yields good quality boards, and those obtained from a mixture of the two fibres are of fairly good quality. An experimental factory has already been started.

Excellent emery wheels have been made from Mysore corundum in a matrix of magnesium oxychloride. Investigations on the concentration of chrome iron ore and on the elimination of iron from Mysore pyrites have so far not given satisfactory results. A qualitative method for detecting the drug ganja has been devised. Benzene and toluene have been isolated from the oil known as "hydrocarbon" (Instit. Jour. vol. 2, part VI.).

In addition to the work recorded above medicinal preparations have been made for the Madras Government Medical Stores, many analyses and assays have been carried out, and reports issued on a variety of subjects. (See also this J., 1918, 106 R, 193 R).

NEWS FROM THE SECTIONS.

NEWCASTLE.

The Newcastle Section held its December meeting on the 18th. Prof. P. P. Bedson was in the chair.

After a vote of thanks had been accorded to Dr. Budde for allowing the members of the Section to visit the Hendon Paper Works, Sunderland, it was announced that a series of lectures had been arranged for February 19 and 26, March 5, 12, and 19, by Dr. J. W. Mellor, on "Refractory Materials."

A paper was then read by Mr. D. W. Jones on "Notes on the Wet Extraction of Copper." In former days the residue from pyrites burning was usually smelted in a blast furnace in order to recover the copper which it contained (4 per cent.). A Mr. Henderson, however, introduced the idea of roasting the cinders with salt, subsequently extracting the copper by leaching with water, and precipitating it with scrap iron. By this method much of the silver and gold could also be removed in a payable form by precipitation with an iodide. The "grist" or grinding of the cinders is of importance for ensuring proper percolation. Adequate control of the unburnt sulphur in the cinders repaid any amount of trouble; a good figure to work to was 4·5 per cent. sulphur. The usual hand-rabbled type of roasting furnace was described, and also the more modern mechanical furnaces, such as the Wedge, MacDougall, and Ramen-Beskow, these latter showing a considerable saving in fuel.

In describing the extraction of the gold, the author showed how important a part chemical control played in obtaining good recovery. He then referred to the large amounts of sodium, zinc, and iron salts which were wasted in the effluent, and to the attempts made to recover them.

In replying to the discussion, Mr. Jones said that selenium was entirely volatilised in the calcination, but in leaching, without previous calcination, it found its way into the copper. The copper precipitate produced generally contained about 78 per cent. of metal, and the arsenic precipitated with the copper was easily removed in the smelting. In the freshly burnt material the sulphur in the cinders existed as sulphide, but, after weathering, as sulphate. A preliminary roasting would be beneficial, but not profitable. The method of removing arsenic by partially neutralising the leach liquors with alkali was not in use now. He did not think that brass ash tailings could be profitably treated by this method. The quantity of cinders treated by Germany and this country would be about two million tons 18 years ago; he could not give later figures. The permissible amount of copper in the treated and de-copperised ore would be from 0 to 0·25 or even 0·4 per cent., the presence of copper in iron or steel being now regarded with favour. Nitre cake was helpful from a chemical, but not from a mechanical point of view.

YORKSHIRE.

At the third meeting of the session, held at Leeds, on December 16, Dr. Dufton gave a paper on "Limits of Separation by Fractional Distillation: A New Still Head." The paper, which is not intended for present publication, was replete with details and records of experimental results. The characteristic feature of the new still head is that it is so constructed that there is an annular space between the outer and inner tubes, with a spiral wire round the inner tube, serving the double purpose of holding it in position and providing a pathway for the descending liquor, which does not mix with the ascending vapours. In his general observations, Dr. Dufton said that chemists of the

past had been rather obsessed by the gigantic size of the commercial still, and had given up as hopeless the problem of making a perfect still. In other words, they had been content with a very modest sort of separation when, if they had had a little more confidence, and had given more attention to the efficiency of their apparatus, they might have produced pure products straight away. It had been thought that the separation of a chemically-pure benzene from a mixture of benzene and toluene was quite a hopeless task, but really it was not so; and at the close of his address the author gave a demonstration of the direct separation by distillation of pure benzene from a mixture of benzene and toluene.

In replying to a vote of thanks, Dr. Dufton said he wished to suggest that it might be much cheaper in commercial practice to build the still head on the conical system with condensation all the way up. He wanted to see a commercial still head which would yield benzol, toluol and xylol in such a way that they could be run off at different taps, and he was convinced that the scientific plan was to cool all the way up.

A short note was submitted by Mr. C. A. King on a piece of apparatus devised for the continuous testing of gases. A current of gas is led upwards through a small absorption chamber having projections on the inner walls, to effect more efficient contact with a solution of a suitable indicator which is caused to trickle slowly down the chamber. The indicator solution flows into and out of the absorption chamber through "U" shaped tubes, and forms liquid lutes against the pressure of gas in the apparatus. The outlet tube also acts as an observation tube, in which the colour of the indicator after contact with the gas is noted, and thereby the presence or absence of traces of ammonia in the gas can be immediately observed. The use of a similar form of apparatus is suggested for the detection of other constituents in gases, though obviously only where a colorimetric test may be applied.

MEETINGS OF OTHER SOCIETIES.

SOCIETY OF GLASS TECHNOLOGY.

The 21st meeting of the Society was held in the University of Sheffield on December 18. Mr. W. F. J. Wood, the president, was in the chair.

A paper was read by Mr. S. English on "An Apparatus for the Accurate Calibration of Burette Tubes." The method employed is based on that for the pipette (this J., 1918, 718 A), since it involves the use of a standardised pipette of precisely known volume and time of drainage. Both the burette and the standard pipette into which it drains are filled with water, and in order to calibrate under the same conditions as obtain in ordinary use, water is placed above the mercury level in the burette. This meniscus is viewed through a telescope attached to a cathetometer and a needle is made to produce a mark on the burette precisely at the level of the meniscus. The author stated that a burette could be calibrated in five minutes, and the accuracy was far greater than was usually observed in calibrating these instruments.

Dr. Turner then gave an address on "Bottle Glass and Glass Bottle Manufacture." In regard to quality he pointed out that it was useless to produce a bottle if the glass of which it was made was unsuitable for contact with the material it was intended to hold. Medical bottles in particular should be subjected to tests in order to ascertain that they conformed to a certain standard. One test was suggested in which solutions of the alkaloids and mercury solutions were kept in contact with the bottle for 24 hours and the absence or production of a sediment noted. The results of heating a number of different types of bottle in contact with water and steam under pressure were also described and tabulated, and emphasis was laid on the necessity of avoiding excessive use of soda ash in melts. In the case of bottles made from sand, soda ash, and lime spar, it was pointed out that lime spar should not fall below 7 to 8 per cent. of the batch mixture, otherwise the glass was acted on by water to a marked extent.

The lecturer also dealt with the problem of workability, both from the point of view of hand working and machine working. The effects of different constituents present in bottle glass were discussed and described, and the importance of arranging a batch so that the resulting glass should set quickly was emphasised, if production at a rapid rate were desired. The limits of workability for glasses containing sand and soda with either lime, magnesia, or alumina were set out.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.

Mr. Cosmo Johns read a paper entitled "The Solid and Liquid States of Steel" at the third meeting of the session, held on December 20 last, in Glasgow. The lecturer, having described the surface phenomena of liquid steel as it flows from the launder of an open hearth furnace, proceeded to point out that the laws governing surface tension applied to the samples of steel taken from the bath of the furnace, and showed that the differences in surface tension observed were governed by the amount of occluded gases present. He then emphasised the necessity for studying the heating curves of a quenched steel, explained the effect of uniform as contrasted with non-uniform pressure in depressing transformation points, and, finally, expounded the modern view which postulates the actual fusion of a small portion of any solid (with steel as a striking example) when it undergoes deformation.

INSTITUTE OF CHEMISTRY.

At a meeting of the Council held on December 20, 1918, 3 Students were admitted, and 23 new Associates and 6 new Fellows were elected.

Amongst other business the Council decided to address a circular letter to Local Government authorities recommending, in view of the prevailing economic conditions, a revision of the terms of the appointments of Public Analysts and of Official Agricultural Analysts. It was also decided that a meeting of Public Analysts should be held at the Institute to consider their position in relation to the Committee of the Local Government Board, which has now under consideration the question of the superannuation of Local Government officers.

The meeting discussed preliminary arrangements with regard to the election of the new Council. The following officers and members of the Council retire at the next annual general meeting (March 3, 1919):—Vice-presidents: Mr. H. Ballantyne and Dr. A. Harden. Members of Council: Mr. C. O. Bannister, Mr. H. C. H. Carlyl, Prof. G. G. Henderson, Prof. P. H. Kirkaldy, Dr. A. Lauder, Prof. G. T. Morgan, Mr. D. Northall-Laurie, Mr. G. Stubbs, and Mr. T. Tickle. The new method for the election of the Council, which is now under consideration, will not come into operation until 1920 owing to the circumstance that it must first be incorporated in the by-laws and approved by the Privy Council.

NEWS AND NOTES

CANADA.

Lyons Fair.—The Minister of Trade and Commerce of the Dominion of Canada has applied for thirty booths at the Lyons Fair, which will be opened on March 1, 1919, and continue for two weeks. A few of the booths will be used for a general Government exhibit of agriculture, forestry and fisheries, minerals and metals, but most of them will be placed at the disposal of the Canadian Manufacturers' Association for allotment to manufacturers for a display of samples and catalogues or photographs of articles which will be available for exportation to France.

Munition Workers as Miners.—The Government has sent out notices to mine managers in Northern Ontario asking them to absorb as many as possible of the men released from the munition plants. During recent months the mines of Northern Ontario have been worked with a deficiency in numbers of about ten per cent., but with the present prospect of a surplus of labour to draw from there should not only be an increased output but the net earnings should also grow.

Removal of Excise on Industrial Alcohol.—A recommendation from the Honorary Advisory Council for Scientific and Industrial Research has been sent to the Dominion Government that the excise on alcohol for industrial purposes should be taken off, and that the Government should buy from the distillers all the alcohol to be used in the industry. It is suggested that the Government should then re-sell this alcohol, at a slight advance, to every firm using alcohol for industrial purposes, and that any firm using ethyl alcohol for industrial purposes should be licensed to that end, a monthly report being made to the Government of the amount consumed. It was also recommended that ethyl alcohol should be allowed duty free to hospitals and university and college laboratories for teaching and research purposes.

Research Institute for Canada.—The Dominion Government has been asked to make a grant of $700,000 towards the erection of a central research institute, to be allocated as follows: $500,000 for the building; $100,000 for apparatus; $100,000 for salaries. It will probably be located at Ottawa. This is a further development of the idea of assisting industrial research in Canada by the formation of Trade Guilds. As planned at present, each Trade Guild will pay the salaries of its own workers, and the Dominion Government will supply the facilities for carrying on the work of research.

Anniversary Meeting of the Royal Canadian Institute.—On the occasion of the seventy-first anniversary of the founding of the Royal Canadian Institute, held in Toronto on November 23, 1918, Dr. W. S. Stratton, Director of the United States Bureau of Standards, gave an address on the work of the Bureau, which is in reality an industrial research institution, organised under the general departments of Chemistry, Physics and Electricity. Dr. Stratton's address was designed to stimulate the faith of industrial research workers in the value of their work.

Organisation of Canadian Chemists.—The work of the Committee appointed at the Convention of Canadian Chemists held in Ottawa last May has met with a favourable reception. The chemists of every province in Canada are represented on this committee, and their general aim is to obtain legislation from the Dominion Government recognising the professional status of industrial and academic chemists. The feeling is that this will greatly benefit the chemical profession, and at the same time place qualified men in charge of all chemical work. In Canada, as elsewhere, the public has not yet learned to distinguish between the chemist who is an industrial or professional man, and the chemist who is a druggist or pharmacist.

UNITED STATES.

Award of the John Scott Legacy Medal and Premium.—The City of Philadelphia, acting on the recommendation of the Franklin Institute, recently awarded the John Scott Legacy Medal and Premium to E. J. Sweetland, of Upper Montclair, N.J., for the Sweetland Filter Press. This invention is to provide a self-dumping filter press, which will reduce to a minimum the labour involved in discharging the solid residue left in the press after filtration, and also the labour of cleaning the press by hand.

Physiological Action of Mustard Gas.—A research by Dr. G. H. A. Clowes has yielded results indicating the action of mustard gas on the live cell. Substances soluble only in the aqueous phase cannot penetrate the cell, but mustard gas is fat or lipoid soluble and so enters the cell before it is hydrolysed. Within the cell hydrolysis takes place, forming hydrochloric acid, and it is the destruction of large numbers of cells by this acid which produces the characteristic mustard gas burn. The experiments were made with marine organisms.

Candelilla Wax.—In the continued search for sources of potash it has been found that the candelilla plant after wax extraction may be burned to an ash which yields a high percentage of potash. In fact the candelilla contains more potash than any other plant thus far examined. It grows in great quantities in Mexico and Texas and has lately attracted much attention because of the excellent wax obtained from it.

The Zinc Industry.—A series of instructive pamphlets has been prepared by the New Jersey Zinc Co. for free distribution dealing with the composition and uses of zinc dust, pigments, rolled zinc, spelter and other zinc products. The zinc industry is faced with at least two important problems: greater efficiency in roasting the ore and new uses for zinc. Work begun on these lines just prior to the war will undoubtedly be resumed again soon.

Artificial Leather.—One of the more promising artificial leathers, still in the experimental stage, makes use of cotton batting treated with a special rubber solution. One of the fundamental advantages lies in the absence of direction of weave or pattern in this base material, the interloaded fibres imparting strength and giving a foundation for the finished leather not unlike the texture of animal tissue.

Saccharin as a Substitute for Sugar.—The harmlessness of the use of saccharin as a flavouring agent and its worthlessness as a provider of energy are facts which have been fully established on many occasions, but the question of its stimulatory action on the oxidation processes in the body has hitherto received little attention. In this connexion W. E. Burge has communicated to *Science* (Nov. 29, 1918) the results of experiments conducted by him to find out if the ingestion of saccharin produces an increase in catalase (the enzyme which liberates oxygen from hydrogen peroxide, an action which Burge and Neill found to increase when sugar and other foods are ingested), and hence an increase in oxidation in the body. The main result was that saccharin produces a much greater increase than sugar, and the conclusion is therefore drawn that saccharin is a positively helpful element of diet, particularly in a disease such as diabetes where the principal trouble is defective oxidation. The experiments were performed on dogs.

SOUTH AFRICA.

Facilities for Industrial Development.—The recent expansion of industrial activities in the Union of South Africa has induced certain municipalities and similar public bodies to offer specially favourable terms to manufacturers in regard to water and power rates as well as sites for the establishment of industries. The Trade Commissioner for the Union has been notified that the Pietermaritzburg Corporation is prepared to offer suitable sites on very reasonable terms, and to submit plans with additional information as to supply of labour, raw materials, railway communications, etc. The water rate varies from 1*s.* 6*d.* per 1000 galls. for a monthly consumption of 250,000 galls. to 9*d.* per gal. up to 12,000,000 galls. Electricity can be supplied on a graduated basis of 3*d.* to 0·84*d.* per unit per month and for industries of a kind not already established a reduction of 33⅓ per cent. will be granted.

GENERAL.

Industrial Fatigue Research Board.—A Research Board has been appointed by the Department of Scientific and Industrial Research and the Medical Research Committee jointly to consider and investigate the relations of hours of labour and of other conditions of employment, including methods of work, to the production of fatigue, having regard both to industrial efficiency and to the preservation of health among the workers. The chairman of the Board is Prof. C. S. Sherrington, of Oxford University, and the secretary, Mr. D. R. Wilson (Industrial Research Board, 15, Great George Street, Westminster, S.W. 1).

Labour Shortage in the Heavy Chemical Industry.—The secretary of the Chemical Trade Industrial Council and of the Chemical Employers' Federation states that owing to the imminent exhaustion of stores of alkalis and acids and to the lack of labour necessary to replenish them, several industries employing a total of 200,000 workers will soon be seriously affected. This condition of affairs is attributable to the omission of the heavy chemical trade from the list of pivotal industries, although several industries which have been so scheduled are essentially dependent upon chemical products. Two companies which together produced about 75 per cent. of the alkali consumed in this country have stocks in hand sufficient to meet demands for only nine days. Of the 6000 men allocated for release from the forces to the quarrying industry, but 1750 have been allotted to the lime quarries, scheduled as pivotal, and none has returned to work in spite of the fact that lists of these men were submitted to the War Office more than a month ago.—(*The Times, Dec.* 28, 1918.)

The Library of the Chemical Society. With a view to meeting the growing demand for technical literature, the Council of the Chemical Society decided early in 1917, to increase the scope of the library by a more liberal provision of suitable technical works and journals. It was also thought that by placing the existing library of 23,000 volumes and the proposed extension at the disposal of members of other societies and associations, they might relieve themselves of the necessity of collecting and maintaining the literature relating to their special subjects, and assist in the formation of a representative Library of Chemical Literature, such as would be difficult to obtain by individual effort. A conference of representatives of societies and associations connected with chemical science and industry was held to consider the means by which other societies, etc., might co-operate in this extension, and financial assistance was subsequently offered by the following:—Association of British Chemical Manufacturers; Biochemical Society; Faraday Society; Institute of Chemistry; Society of Chemical Industry; Society of Dyers and Colourists; and Society of Public Analysts. Members of these contributing societies, etc., will be permitted to consult the library and borrow books from January 1, 1919. The hours during which the library will be open are as follows:—Mondays, Wednesdays, and Thursdays, from 10 A.M. to 6 P.M., Tuesdays and Fridays, from 10 A.M. to 9 P.M., Saturdays, from 10 A.M. to 5 P.M.

Indian Mining Industry. The Annual Report of the Chief Inspector of Mines for 1917 shows that there has been a considerable shortage of labour, especially in coal mines, although the number of hands employed has increased 7 per cent. above that of the previous year. There are 211,809 persons now engaged. The coal production reached a record figure of 17,326,000 tons of which nearly 15,000,000 was actually despatched. The mines of Bengal, Bihad and Orissa account for 95 per cent. of the production. The output per person is extremely low when compared with England:—(*a*) per person below ground 182 tons, (*b*) per person above and below ground 113 tons; the corresponding English figures for 1916 were 323 and 251 tons respectively. With sufficient supply of labour it is estimated that the present workings could yield an increased production of 50 per cent. The mica production of 35,900 cwts. is practically the same as in 1916, but that of manganese decreased from 568,000 to 497,000 tons. To meet the war demand for tungsten, the wolfram output has been substantially increased, the total production amounting to 79,300 cwts. The systems of mining wolfram at present in use are wasteful, but there is a tendency to introduce more modern methods and plants, such as pneumatic drills and hydro-electric power plants. A magnetic separator has been working successfully at Tavoy (Burma). The output of gems (rubies and sapphires) shows a slight falling off, and the markets have been somewhat erratic. 22,900 ounces of gold has been produced. Of the other minerals mentioned in the report, the copper output of 20,000 tons (compared with 2670 tons in 1916) is noteworthy; also the first recorded production in India of bismuth, which is being won from a wolfram mine in Tavoy. (*Bd. of Trade J., Dec.* 19, 1918.)

Drug Plant Production in India. The price of jalap (*Ipomoea purga*) has risen considerably during the war, the local market price being now about 1*s.* 4½*d.* per lb. It has been grown for many years on the Government's cinchona plantations in the Nilgiri Hills, and an attempt has been made to increase the stock in the botanic gardens with fair results. An acre of jalap yields about 5000 lb. of green tubers, which is equivalent to 1000 lb. of powder.

Experiments are being made in the same plantations in the cultivation of a number of drug plants, successful results having been obtained with foxglove, henbane, common mint, fennel and rosemary, but not with belladonna, aconite and ipecacuanha. Experiments with Indian tobacco and *Chenopodium anthelminticum* are in progress.—(*U.S. Com. Rep., Nov.* 16, 1918.)

Alsace-Lorraine and the Iron-ore Output.—The total production of iron-ore in the German customs area amounted to approximately 34 million tons, of which 20 million tons was obtained in Alsace-Lorraine alone; 5·2 million tons was produced in Prussia. The output in Luxemburg, which has hitherto belonged to the customs area, was 6·5 millions. If the latter achieves independence and Germany loses Alsace-Lorraine, the total annual production of iron ore in Germany will fall to about 7 million tons, or a fifth of the former quantity. France, on the other hand, was already producing

more iron than could be used in her foundries, and about 4 million tons of her total output of 22 million tons was exported to Germany. Even before the war and with the supply from Alsace-Lorraine, the German output did not cover the requirements of her blast-furnaces, but 14 million tons had to be imported, of which 4·6 million tons came from Sweden, 3·8 million tons from France, and 3·6 million tons from Spain. German exports of iron ore only amounted to 2·6 million tons, of which 1·8 million tons went to Belgium. The supply from Spain is likely to be uncertain, partly owing to increased home consumption, and partly to the Entente Powers having secured a considerable proportion of the Spanish output.—(*Neue Freie Presse, Nov.* 3, 1918.)

Alsace-Lorraine and the Coal Problem.—Before the war France suffered from a coal shortage, and this shortage will be much more serious after the war owing to the destruction of mines and machinery by the Germans. The latter will be compelled to hand over to France the amount of coal of which they have deprived her, but however just this restitution may be, it will not solve the existing problem of increasing the coal supply for industrial purposes. Before the war, coal production in France amounted to 40 million tons, and the consumption was 63 million tons, leaving a deficit of 23 million tons. After the war the mere fact of the restoration of Alsace-Lorraine will increase the deficit to 31 million tons, because these provinces produce only 4 million tons and consume 12 million tons.—(*Europe Nouvelle, Nov.* 23, 1918.)

Ore Discoveries in Sweden in 1917.—During 1917 there were registered 1,042 claims for newly discovered minerals. The majority related to iron-ore, and of these 139 were in the Kopparberg district; 195 related to pyrites, of which seventy-five were in the Orebro district; 184 to manganese (chiefly in the Norrbotten district), and 126 to copper (thirty of these claims were in the Kopparberg district, twenty in the Kalmar district, and twenty in the Orebro district).—(*Aftonbladet, Nov.* 1, 1918.)

Yield of Venezuelan and Bolivian Mines in 1917.—During 1917 the yield of the Venezuelan mines was as follows:—Gold, 30,809 oz.; copper ores, 42,721 tons; petroleum, 54,072 tons; coal, 20,165 tons. The effect of the war on the Bolivian ore output is shown by the following figures:—

Ore	1916 Tons	1917 Tons	Tons
Tin	34,523	45,418	+10,895
Wolfram	2,371	2,804	+433
Antimony	25,845	21,287	−4,558
Bismuth	487	492	+5

(*Export, Sept.* 24, 1918.)

Recovery of Animal Fats with Benzine.—The greatly diminished importation of fat into Sweden has induced research into the best way of recovering fatty products from dead animals. A company has been formed to exploit a process of boiling out carcases with benzine instead of with water. Collecting depôts will be established where carcases can be flayed and partly cut up preparatory to dispatch to the main factory, where the material will be placed in large, horizontal, enclosed steel vessels of 2½ tons capacity, and extracted with benzine. The residual matter will be dried and ground to a meal containing 60 per cent. protein, of which 80 per cent. is soluble, which is said to form a good cattle food when mixed with molasses. Fish offal can be treated similarly, but, as this material contains 75 per cent. of water, time and space are saved by drying the material before treatment.—(*Teknisk Tidskrift, Oct.* 19, 1918.)

Slate in the U.S.A. in 1917.—The domestic slates sold in the United States amounted to 70,366,700 sq. ft. of roofing slates of a value of £700,000, 5,478,151 sq. ft. of mill stock of a value of £255,000 (used for structural and sanitary purposes), and slates used for other purposes of a value of £200,000. This shows a decrease of over 40 per cent. in the quantity of roofing slates since 1912, but the mill stock remained fairly constant and variegated coloured slates showed a considerable increase.

The average selling price in different States varied considerably, though the general demand was poor except in Vermont and New York. The prices have been steadied in some districts by the establishment of selling companies each representing numerous producers. The Marne slates are specially suitable for electrical work and the demand for this purpose has been good.

Slates for blackboards decreased nearly 17 per cent. in quantity, but increased 2 per cent. in value. School slates decreased 12 per cent. in quantity, and 7 per cent. in value. The substitution of slates for paper in the American schools is under consideration. There has been a growing demand for black slate tombstones, particularly in Massachusetts. Three firms have erected plants for the manufacture of roofing material from ground slate, which is also used for coating asphalt shingles and in finishing linoleum and wall-coatings. The suggestion is made that the waste slate should be sawn into blocks of uniform size for building foundations and partition walls. The selling companies contemplate avoiding unnecessary competition, standardising the output, reducing the costs of marketing, and, above all, conducting a much-needed publicity campaign, as hitherto roofing slates have scarcely been advertised at all in the trade, technical and popular journals.

The bulk of the slate exported from the United States in 1917 went to Canada, but Mexico, South Africa and Australia received noteworthy amounts. Slate exported for purposes other than roofing consisted chiefly of electrical slate, structural slate, blackboards, school slates, slabs and billiard tables. It went chiefly to Canada (16%), Central and South America (17%), West Indies, Cuba, Denmark, Russia and India (about 8% each), the total value of these exports in 1917 being £40,000. The school slates amounted to two-thirds of the total slate (other than for roofing) exported in 1917.—(*U.S. Geol. Surv., July,* 1918.)

The Nettle as a Source of Textile Fibre.—The common stinging-nettle is likely to become an important factor in agriculture and in the development of the textile industry. Among the many fibrous plants experimented with, the nettle alone has fulfilled all the conditions of a satisfactory source of textile fibre.

Investigations and practical tests, made in 1916 at Brünn and Reichenberg, confirm the hopes raised concerning the possibilities to be realised in nettle fibre. There exists now in Germany a "Nettle Cultivation Company." The price of 10 marks per 100 kilo. of air-dried nettle stalks ensures sufficient profit to the growers, while the cost of preparation is not high. In 1915, 1·3 million kilo. of this material was collected in Germany, and this was increased to 2·7 million kilo. in 1916. From the standpoint of the factory it is affirmed that goods woven from this fibre are, for most uses, equal to cotton goods. Hence for middle Europe at least a large and increasing use of nettle fibre seems assured.—(*Technische Blätter*, Part 3/4, 1918.)

Synthetic Mineral Oil.—It is reported that the Baden Aniline and Soda factory has taken the initial steps in the production of synthetic mineral oil, and has succeeded in obtaining liquid or easily liquefiable hydrocarbons synthetically.—(*Pester Lloyd, Oct.* 17, 1918.)

LEGAL INTELLIGENCE.

SALE OF CHEMICALS (CONTRACT) DISPUTES. *Gibson and Co.* v. *Biggs, Gwyer and Co.*

In the King's Bench Division, on December 16, Justices Lawrence and Shearman heard the appeal of the defendants from a judgment of Judge Mellor in the Manchester County Court, on April 23 last, in favour of the plaintiffs for a balance of £35 9s. due to them for the supply of light magnesia, soda ash, and other chemicals. The ground of the appeal was that the case was one coming within the Statute of Frauds, and that there was no evidence before the judge on which he could find that there was any undertaking by the defendants to pay the money claimed, which was, in fact, owed by somebody else. There were several items in the claim which were admitted by the appellants and for which they had paid money into Court. The appeal was allowed, with costs.

British and French Manufacturing Co. v. *Biggs, Gwyer and Co.*

Before the same Court on the same day, the British and French Manufacturing Co. appealed against a judgment given by Judge Mellor at Manchester in favour of the defendants in respect of a claim for the supply of magnesium sulphate, valued at about £44.

Mr. Justice Lawrence, in giving judgment, said that the Epsom salts were sold by the plaintiffs to the defendants for shipment to Alexandria, and by a term of the contract they were to be delivered f.o.r. Manchester. They were delivered by October 9. At Hull, where the goods were sent, samples were taken, and it transpired that the salts were not of the stipulated B.P. quality, but of a quality used for commercial purposes and totally inconsistent with the contract. Upon this analysis the defendants rejected the goods. The judge had held that the rejection was not too late and that it was within reasonable time. The appellants maintained that the buyers could not rely on rejection as the goods had been allowed to go on ship. He thought there must be a reasonable time for the examination of goods to ascertain whether or not they conformed to the contract, and the defendants could not reject until they had received the results of the analysis. It could not be truly said that there was any act on the part of the buyers that was intended to be inconsistent with the ownership, or that was intended to waive the right to reject which was incident to the contract. Mr. Justice Shearman concurring, the appeal was dismissed, with costs.

SODA ASH CONTRACT ARBITRATION. *Perry, Mills and Co.* v. *Adamson, Gilfillan and Co.*

On December 17, in the King's Bench Division, before Justices Lawrence and Shearman, a motion was heard on behalf of Perry, Mills and Co., London, to set aside an award of an umpire in an arbitration that took place between them and Messrs. Adamson, Gilfillan and Co., Ltd., also of London, arising out of contracts of June, July and August, 1917, for the sale by appellants of quantities of heavy soda ash.

Counsel for the sellers said there had been three awards in three arbitrations, and the ground for the motion to set them aside was that the umpire had been guilty of misconduct in law in the conduct of the arbitration. The three contracts were in identical terms and the sellers duly made delivery of the goods, but later received a complaint that analysis showed only 40 per cent. quality. The two arbitrators appointed failed to agree and the umpire's award was adverse to the sellers.

In the course of his judgment, Mr. Justice Lawrence said the motion to set aside was put forward on three grounds, which were all based on the principle that there was misconduct by the umpire in the hearing of the arbitration. It was quite true that there might be what was called misconduct by an umpire or an arbitrator in refusing a special case, but it was only so where the special case was asked for in a reasonable and proper way, and where it was made clear what the point was for which the special case was required. Here it was said there was no evidence that the samples produced were samples of the goods as delivered, but it was clear upon the evidence that no such point was taken before the umpire when the samples were produced, or when they were sent to be analysed. This was done without objection at the time, and the present ground of complaint was that when the analysis came in the parties were not called upon to argue and the analyst was not called to be cross-examined. The sending of the samples to the analyst was acquiesced in, and it was only after the award that the objection was taken. The application failed and must be dismissed with costs. Mr. Justice Shearman agreed.

NITRATE CARGO DISPUTES. *Aktieselskabet Yuba* v. *Dansk Svovlsyre Superphosphat Fabrik (Copenhagen). Aktieselskabet Olivebank* v. *The Same, and Aktieselskabet Geysir* v. *The Same.*

The above three separate actions, involving different contracts, were heard by Mr. Justice Bailhache in the Commercial Court of the King's Bench Division on December 10 and 12, 1918. The plaintiffs were Norwegian sailing ship companies and the total sum involved was between £20,000 and £30,000. The shipowners claimed that they had a right to discharge the cargoes of nitrate in the United Kingdom on the terms of being paid freight and damages for detention. The defendant company maintained it was entitled to have the cargoes carried on to Denmark, or alternatively, it was entitled to treat the adventure as frustrated, and it based a counter-claim on this view. The difficulty arose through the action of the British Government, in 1915 and 1916, in stopping all nitrate cargoes which arrived in the United Kingdom, and refusing permission to proceed to Danish ports. There was a clause in the contracts stipulating that the contracts were conditional on the British Government granting permission to the ships to proceed. At that time there was no permission to re-export, and there was a rationing agreement between the British and Danish Governments whereby the former allowed a certain amount of nitrate to go through, but the amount agreed upon for 1916 (33,000 tons) was already exceeded when the ships in question were detained.

In the case of the *Yuba*, his Lordship said the shipowners were relieved from completing the voyage, but that did not entitle them to require payment of freight. There was no obligation on the consignees to name any other port at which they were willing to take discharge of the cargo. Therefore the shipowners could not recover. The restraint amounted to a frustration of the adventure, and therefore the defendant company could not succeed in its counter-claim for damages for breach of contract. A similar judgment was given in the case of the *Geysir*. In regard to the ship *Springbank*, there was no port of destination mentioned. By the time she arrived at Falmouth the rationing agreement was in full force. When ordering her to proceed to Aalborg the consignees knew that it was impossible for her to go there. The defendant company could have nominated a port of destination in the United Kingdom, but did not do so. Therefore the plaintiff company suc-

ceeded in the claim for freight and damages for detention, and the defendant company failed on the counter-claim. Judgment was therefore given for the defendant company in the first two cases, and for the plaintiff company in the third case.

REPORT.

REPORT OF THE GOVERNMENT CHEMIST UPON THE WORK OF THE GOVERNMENT LABORATORY FOR THE YEAR ENDED MARCH 31, 1918. WITH APPENDICES. [Cd. 9205, 2*d*.]

The number of samples examined during the year was 200,453 as compared with 258,456 in the previous year, the decrease in number being principally in the Excise and Customs samples. Work for several new Departments, including the Air Board, the Ministry of Food, and the Coal Controller, was undertaken during the year; 20,020 samples were examined in connexion with the food supply of the Expeditionary Forces, a part of this work being carried out at the various supply bases. The samples of brewing materials numbered 394, and 275 samples of finished beer from brewers' premises were examined for saccharin, saponin, etc., but nothing of a deleterious character was found to be present. A few of the non-alcoholic beers analysed contained more than 2 per cent. of proof spirit, but 5 so-called non-alcoholic wines contained from 7·0 to 17·3 per cent. of proof spirit. Of 1469 samples of beer and brewing materials examined for arsenic, 75 contained arsenic in excess of the permitted limits. Only 23 samples of imported beer were received, the importation of beer having practically ceased. Compared with previous years, there was a decrease in the number (877) of samples of naphtha examined, this naphtha being intended for use in the preparation of methylated spirit; there was an increase in the use of pure alcohol for manufacturing purposes. The other samples examined for the Customs and Excise comprised wines, tobacco, sugars, tea, coffee, cocoa, matches, medicines, etc. During the year, 1076 samples, mainly alloys, were analysed for the Air Board. The samples received from the Board of Agriculture and Fisheries numbered 1568, including 139 samples of imported condensed milk, 18 of dried milk, 14 of cream, 431 of butter, 617 of margarine, and 48 of cheese. All the samples of condensed milk were free from preservatives and the percentage of fat ranged from 6·5 to 10·9; the samples with a low fat content were consignments of evaporated milk from America. A considerable quantity of this class of milk was imported; it is generally described as "evaporated" milk, and consists of whole milk which has been evaporated to about one-half its bulk. The samples of imported butter were all genuine and free from excess of water; 254 of these samples contained boron preservative and 123 added colouring matter. The imported margarine was of satisfactory composition, but 10 of the samples contained excess of water; all the imported cheese was free from foreign fats. Amongst the samples received from the Home Office were various samples from the London police, including chocolates given to children and others under suspicious circumstances, drugs taken in connexion with the regulations limiting the use of cocaine and opium, and samples of liquors. The Ministry of Munitions submitted 41 samples for examination, including petrol substitutes, peat, fire extinguishing fluids, mainly of the chlorinated hydrocarbon type, and a so-called substitute for platinum, which proved to be an alloy of nickel, chromium, and tungsten. Samples of coal were examined for the Coal Controller, the usual determinations being made. Samples examined for the Admiralty Marshal and Treasury Solicitor numbered 396, and consisted of materials seized as Prize; the substances included thorium nitrate, pigments, polish, drugs, and tanning materials. A large variety of foods was analysed for the War Department, the number of samples being 20,020; nearly 17,000 samples were taken from contractors' deliveries in course of transit to the Expeditionary Forces. Investigations were also carried out with reference to the waxed paper containers now being used in place of tin for packing supplies to the Forces; the wax was examined as to its suitability for the purpose, and inquiry was made regarding the keeping qualities of the goods in these containers. The War Trade Department required analyses of a great variety of substances, including soaps, disinfectants, printing ink, ceramic colours and glazes, pitches, rubber solutions, paints, coal tar oils, metallic capsules, drugs, etc. A method was worked out and published (see this J., 1917, 842) for the determination of carbolic acid or phenol in disinfectants. Numerous samples of materials supplied by contractors for the public service and of materials used in the construction and maintenance of public buildings were examined for the Office of Works, London. Samples of water from public buildings, munition works, and camp sites were also analysed. The samples referred by magistrates under the Sale of Food and Drugs Acts of 1875 and 1899 numbered 102, including 81 samples of milk, 3 each of nut lard, Epsom salts, and cream of tartar, 2 each of butter, dripping, rum, sweets, and vinegar, and 1 each of whiskey and baking powder. The results of the analyses differed from those of the public analyst in 13 cases. Twenty samples, consisting of 8 fertilisers and 12 feeding stuffs, were submitted under the Fertilisers and Feeding Stuffs Act; the fertilisers comprised phosphates, guano, shoddy, and special manures; the feeding stuffs consisted of feeding meals and cakes, milling by-products, and poultry foods. Several of the feeding stuffs contained a considerable proportion of substances unsuitable for feeding purposes.

GOVERNMENT ORDERS AND NOTICES.

EXPORT PROHIBITIONS.

Further relaxations of existing export prohibitions have been announced by the Board of Trade as follows*:—

Headings transferred from one list to another.

From List A to List C:—

Burettes and their component parts; capsicum, including oleo-resin of capsicum; glue, osseine, and concentrated size (and other sizes and sizings made from glue), finings and other kinds of gelatin; hydrometers made of glass; nitrometers and their component parts; tar, vegetable; uranium, alloys of uranium and uranium ores; vanilla and vanilla pods. Chemicals:—Aluminium nitrate; cassia pods and pulp; phosphorus compounds not otherwise prohibited.—(Jan. 2.)

From List B to List C:—

Rubber (raw, waste, and reclaimed), solutions, jellies, and other preparations containing rubber.—(Dec. 26.)

Aluminium, and alloys of; aluminium powder; antimony and alloys of; antimony, sulphides and oxides of, and mixtures containing.—(Jan. 2.)

* Goods on List A are prohibited to all destinations; goods on List B to all destinations outside the British Empire; goods on List C are prohibited only to countries neighbouring enemy countries.

Altered Headings.

(A) Guanos, not including whale guano; (C) whale guano.—(Dec. 26.)

(A) Cream of tartar; (C) tartaric acid and alkaline tartrates not otherwise prohibited.—(Jan. 2.)

Export of Cutch to France.—The Director of the War Trade Department is prepared to entertain applications for licences to export limited quantities of cutch to France.

General Licences for Exports.—On and after January 9, the exportation of the following goods became permissible to all destinations, except those specified in Section C of the prohibited list: Mixtures and preparations containing not more than 10 per cent. aniline colour, not otherwise prohibited; phenalgin; adhesives containing not more than 25 per cent. of starch, or other cereal substance, etc.

ORDERS SUSPENDED AND CANCELLED.

The Minister of Munitions has suspended until further notice:—The Copper (Sale or Purchase) Order, 1916. The Copper (Use in Manufacture) Order, 1916. The Copper (Control) Order, 1917. The Brass and Copper (Returns) Order, 1916. The Brass (Swarf and Scrap) Control Order, 1917. The Cupro-Nickel Scrap (Dealings) Order, 1917. The Spelter (Control) Order, 1917. The Spelter Control (Amendment) Order, 1918. The Lead Order, 1917, and the two Lead Control (Amendment) Orders, 1918. The Type (Metal) Returns Order, 1918. The Tin (Dealings) Orders of 1917 and 1918. The Chrome Ore Order, 1918. The Platinum Order, 1915, and the Platinum Metal Order, 1916. The Aluminium Order, 1916. The Aluminium (Returns) Order, 1917. The Aluminium (Scrap and Swarf) Order, 1917. The Refractory Materials (Maximum Prices) Order, 1918.

The Benzol and Naphtha Order, 1917. The Naphtha Order, 1917. The Tar (Coal and Water Gas) Order, 1917. The Chlorine and Chlorine Compounds Order, 1918. The Acetic Acid Order, 1917, and the Acetic Acid (Extension) Order, 1917. Until further notice, grey acetate of lime and acetone cease to be specified as war material.

The following Orders have been cancelled by the Board of Trade:—The Lighting, Heating and Power Order, 1918. The Motor Spirit (Consolidation) and Gas Restriction Orders, 1918.

The Admiralty has cancelled the Hydrogen Order of June 11, 1918. The Army Council has cancelled the Hides (Restriction of Tanning) Order, 1918.

OTHER ORDERS AND NOTICES.

The Paper (Relaxation of Restrictions) Order, 1918, Board of Trade, Dec. 18.

The Articles of Commerce (Relaxation of Restrictions) Order, 1918, Board of Trade, Dec. 21.

Paper Regulations for 1919, the Controller of Paper, Dec. 14.

The Ministry of Munitions announces that the suspension of the operation of Regulation 30a of the Defence of the Realm Act on acetic acid, grey acetate of lime, and acetone, covers in addition products associated with acetone, which have also been restricted under the Acetone Order, including methyl acetone, methyl-ethyl-ketone, and acetone oil. Trading in all of the above-mentioned articles abroad, as well as at home, is now entirely free with the exception of those cases where export licences have still to be obtained from the War Trade Department. No formalities are now necessary in regard to the import of these materials from the U.S.A.

COMPANY NEWS.

LEVINSTEIN, LTD.

Presiding at the annual meeting, held on December 23, Lord Armaghdale said that an overwhelming majority of the shareholders had approved the proposed amalgamation with British Dyes, Ltd., and that amalgamation is now practically an accomplished fact. The future success of the textile trades of this country depends largely upon the outcome of the impending struggle between the British and German dye industries. Prior to the war the Germans had acquired a control over the textile trades of all countries in the world, and had used it as one of their principal means of peaceful penetration. The danger of dependence upon Germany is now realised and all that is required is adequate financial support; on the scientific side success is certain.

During the past year the company's factory at Port Ellesmere was compelled by governmental restrictions to go on short time for over two months, thereby creating a temporary shortage of synthetic indigo; full output has since been restored, and now that the war is over large developments may be expected. The company has acquired at Ellesmere Port two options to purchase land in close proximity to its existing works. The site possesses a two-mile frontage to the Manchester Ship Canal, the land is suitable for building purposes, is near the North Wales coalfields, and generally compares favourably with the site of any chemical works in the country, and with those of the dye factories situated near the Rhine.

In addition to manufacturing an extended range of dyes, including vat dyes which were previously only manufactured in Germany, much research work has been carried on, and valuable assistance has been given in connexion with the preparation of lethal gases for the army. Had hostilities not ceased when they did, it is probable that the enemy would have been overwhelmed by a particularly deadly gas which the Gas Warfare Department had in store for him, and of which the large-scale manufacture had been successfully worked out by this company.

Owing to delay in settling with the Inland Revenue authorities, it was impossible to present any accounts, or to state the number of shares in the British Dyestuffs Corporation which would be received in exchange for their own, but both will be found entirely satisfactory when announced.

The increase in production of intermediates (over 150 in number) in 1918 was nearly 11 times greater than in 1914 (15,169,122 lb. against 1,403,490 lb.), and of finished dyes 7¼ times greater. The nitric and sulphuric acids required for the former had to be made by the company; the output of these in 1918 was 22,619,363 lb., as against none in 1914. In pre-war days, the average profit was equal to £1 per cent. on the share capital; the overhead charges for research and for the selling organisation were unduly high owing to the small output. Had the reduction of dyes in 1914 been equal to that in 1918, the profits would have approached those made by one of the more important German firms, and provided they had been sold at the same prices as the German dyes, they would have been far more than 7 times those actually achieved. The estimated net profits on dyes during 1918, excluding intermediates, was about 6·15 times those in 1914, but they are much below those made by the Germans in this country prior to the war. The plants in Germany are for the most part intact and are more than sufficient to supply the home demand. Moreover, we have yet to erect a large amount of plant at high cost, whereas the German plants were erected at a much lower cost and have already been written off; hence the necessity for financial aid from the State.

CASTNER-KELLNER ALKALI CO., LTD.

At the Cannon Street Hotel, on December 18 last, the Rt. Hon. G. W. Balfour presided at the twenty-third ordinary general meeting of the company. Dealing first with the report and accounts, he said the figures ran curiously parallel with those for the previous year; the net profit was £2000 smaller at £261,339, and the available balance was £3000—£4000 higher owing to a larger carry-over. Accordingly, the appropriation of the latter would be the same, *viz.*, £50,000 to depreciation (making that fund now £587,500), 20 per cent. dividend for the year, leaving £48,819 to be carried forward. Although the past year has not been an easy one, practically all energies having been concentrated on war work, the results are distinctly satisfactory. Experiments in the manufacture of new chemical products have been carried out for the Government, and the large extensions of buildings and plant undertaken at its request have been proceeded with. The question of the completion of the extensions is one for negotiation with the Munitions Department, but the company's interests appeared to be adequately safeguarded. Owing to difficulties arising from the awards issued by the Committee of Production in regard to wages, the Profit Bonus system became a source of friction rather than a bond of union between the company and its employees. Hence it has been abandoned, and a new arrangement has been substituted under which additional payment is made in respect of length of service, and which results in the employees being rather better off than before. Much assistance has been received during the past year from the Chemical Employers' Federation and it is intended to establish Works Councils on the lines of the Whitley Reports at an early date.

PEAT-COKE AND OIL SYNDICATE.

At the annual meeting held in London on December 5, Mr. J. W. Leadbeater, chairman, said that the syndicate was established to work out a process for the production of a good coke or smokeless fuel from peat, with by-product recovery. One complete gas plant had been adapted to the process, and it was intended to bring others, now under option, into operation as soon as possible. At the present time the syndicate was renting spare plant at two gas works. The decolorising agent obtained as a by-product had been very favourably reported upon. The coke employed in the process, in conjunction with peat, was the very smallest gas coke, and these, with a certain binder, made an excellent but not a smokeless fuel, which was now being sold at £2 per ton at the works. No special retorts have been used up to the present, the carbonisation being effected at a low temperature.

CASSEL CYANIDE CO., LTD.

Sir George Beilby, chairman of the company, presided over the annual meeting held in Glasgow on December 11. In moving the adoption of the report, he said that during the past year the company had produced sufficient cyanide to meet all demands. During the war there had been a reduction of quite 20 per cent. in the world's consumption of cyanide for the treatment of gold ores, which was due partly to economy in use, and partly to the diminished demands from low-grade gold mines. No immediate improvement on the Rand is to be expected. In normal times, Mexico is a large buyer of cyanide, and as conditions there improve American competition becomes keener. It was further stated that during the twenty-six years of the company's existence it had held its own against German competition, and during the war it had supplied the entire requirements of the Empire and of the Allies.

BRITISH COALITE, LTD.

At the ordinary general meeting held December 18, in London, Mr. J. W. Fisher (chairman of the company) said that they had now passed from the region of promise into that of performance, and would reap the fruit of the when the managing company, Low Temperature Carbonisation, Ltd., began to pay the agreed royalty of 1*s.* per ton upon an annual minimum of 700,000 tons of coal carbonised. The plant at Barnsley had run for a year and was turning out thoroughly good coalite, and a satisfactory yield of other substances. Owing to the badness of certain materials supplied, the output of tar has been below expectations; the company had also suffered from the scarcity and inferiority of labour. Good prices had been obtained for all products, and the coalite had fetched an average price of 40s. per ton at the works.

NEW ISSUES.—*The Mond Nickel Company* has issued £1,520,000 of seven per cent. non-cumulative preference shares at par, the proceeds to be used in extending the company's refining works which when completed will be increased by 50 per cent. The prospectus states that the products manufactured comprise nickel, copper sulphate, nickel salts, and concentrates of precious metals (platinum, palladium, gold and silver), all derived from the company's mines in Ontario. It is claimed that the quantity of platinum and palladium recovered therefrom is by far the largest produced within the British Empire.

The Morgan Crucible Company has issued £500,000 six per cent. £100 redeemable debentures at 98. The issue was sponsored by the British Trade Corporation, formed under Government auspices in 1916 to help British industrial ventures after the war.

OFFICIAL TRADE INTELLIGENCE.

(From the *Board of Trade Journal* for December 27 and January 2.)

OPENINGS FOR BRITISH TRADE.

An agent at Townsville, Queensland, desires to obtain agencies for U.K. manufacturers of paper, chemists' and druggists' requirements. [Ref. No. 422.]

A firm at Montreal desires to get into touch with U.K. manufacturers of fire-clay bricks, silica bricks, crucibles and hardware. [Ref. No. 425.]

An agent at Toronto wishes to obtain agencies for U.K. manufacturers of certain kinds of paper, samples of which may be seen at the Department of Overseas Trade. [Ref. No. 430.]

An agent at Ceuta, Morocco, seeks agencies for U.K. manufacturers of paper, pharmaceutical products, paints, varnishes, sugar and preserved foods. [Ref. No. 436.]

A partner in a firm at Cape Town now in this country wishes to obtain agencies for U.K. manufacturers of enamelled ware, pottery, glass, paper, rubber, cement, paints, leather and superphosphates. [Ref. No. 442.]

Firms in the Netherlands desire to get into touch with U.K. manufacturers of rubber tyres and thermometers. [Ref. Nos. 447 and 448.]

Inquiries have been received at the British Chamber of Commerce, Milan, from persons and firms in Italy for agencies for U.K. manufacturers and exporters of aluminium ware, metals, chemicals, dyes, hides, skins, rubber, oils, soap, perfumery and scientific instruments. Inquiries should be addressed to the Secretary as above.

TARIFF. CUSTOMS. EXCISE.

Australia.—The importation of tinplate is prohibited, save with the consent of the Minister for Trade and Customs, as from September 25.

Canada.—The Orders in Council dated January 26, 1918, and April 11, 1918, prohibiting the transportation of silver spruce and the exportation and transportation of Douglas fir respectively are cancelled.

France.—The export and re-export of liquorice juice, hops and lupérline are prohibited from French Colonies other than Tunis and Morocco to destinations other than France and French Colonies, as from November 21.

St. Lucia.—The export of gold, manufactured or unmanufactured, including coin and articles containing gold, is prohibited, except under licence, as from October 29.

South Africa.—As from October 1, all imports of wood pulp from Norway, Sweden, Denmark, Holland, Switzerland and Finland must be accompanied by a certificate of origin and interest.

United States.—Recent rulings of the War Trade Board affect hides, skins, rubber, raw cotton, salvarsan, neosalvarsan and arsphenamine.

With certain exceptions, all export licences which were unexpired on November 15 and all export licences issued on or after that date will be valid until used, unless revoked, notwithstanding such licences are stamped as expiring on November 15 or subsequently thereto.

All import licences issued on or after August 25 will be valid indefinitely unless revoked, provided it is not otherwise expressly stated in the licence.

The export from the United States to all parts of the British Empire of articles not included in the "Conservation List" will be permitted under general licence.

Licences may now be issued for the import of calcined spathic iron ore originating in and coming from the United Kingdom when shipped as backhaul cargo.

The procedure for the licensing of goods in transit from Canada or to Canada through the United States has been simplified. The special Import Licence for this glass of goods is to be known as "P.B.F. 25" and the Export Licence as "R.A.C. 56."

TRADE NOTES.

FOREIGN.

Foreign Companies, etc. *Germany.*—The Chemical Factory "Rhenania" at Aachen has acquired all the assets of the Rhenish Portland Cement Factory at Cologne for the sum of 1,675,000 marks.—(*Wirtschaftszeitung, Oct.* 18, 1918.)

An Association of the Lime Works of Central Germany has been formed with headquarters in Magdeburg.—(*Köln. Zeit., Oct.* 15, 1918.)

Opposition to the Lime Works Association is shown by the Gross-Hartmannsdorf (Bunzlau) Lime Works, which in a public print has stated that only 100 of the total of 1400 German lime companies have joined the Association, and of these 100 the majority was previously united by a joint selling agency. It condemns the formation of a trust, as this would only lead to restricted production and high prices—very undesirable ends in view of the present serious shortage of dwelling houses.—(*Z. angew. Chem., Nov.* 8, 1918.)

The Bavarian Nitrogen Works Co., Munich, has made a net profit of 1,195,213 marks as against 1,547,264 marks in the previous year. Over half a million marks has been placed to depreciation account, 85,452 marks is carried forward, and the dividend has been reduced from 14 to 11 per cent.—(*Z. angew. Chem., Nov.* 1, 1918.)

According to the *Tägliche Rundschau*, the Allgemeine Elektrizitäts Gesellschaft has floated a company—the Ukrainische A.E.G., Berlin—with a capital of 300,000 marks, to operate in the Ukraine.—(*Köln. Zeit., Nov.* 5, 1918.)

The report of the German (Auer) Incandescent Gas Light Co. for 1917-18 records a gross profit of 27,218,654 marks, but a fall in the net profits from 14,353,674 to 8,530,828 marks. This result is due to increased working costs and higher war taxes, and to the fact that war contracts now bring in much smaller profits. Preference shares get 5 per cent. and founders' shares 25 per cent. dividend.—(*Berliner Tageblatt, Oct.* 16.)

The United Aluminium Works in Frankfort, a subsidiary of the Griesheim-Elektron Chemical Works, has recently purchased a large plot of land in the Bautzen district, and it is presumed that the erection of a new aluminium works is contemplated. On adjoining Prussian soil this company has built the Lauta Works, which are nearly completed.—(*Köln. Zeit., Oct.* 22.)

At the general meeting of the German Gelatin Factories, Höchst a. M., the dividend was fixed at 16 per cent., and it was decided to move from Höchst to Frankfort. Discussing the outlook, it was agreed that the political situation would not greatly affect the company, provided always the Bolshevist tendencies did not get the upper hand. The close of the war would not do much to improve the supplies of raw material. The net profits equalled 539,846 marks, and a balance of 59,846 marks was carried forward.—(*Köln. Zeit., Nov.* 5.)

The Düsseldorf Dye Co. made a net profit of 41,529 marks in 1917-18 and has declared a dividend of 6 per cent.—(*Köln. Zeit., Nov.* 18, 1918.)

The Dresden Cellulon Manufacturing Co. has made a net profit of 1,339,631 marks and has declared a 20 per cent. dividend.—(*Köln. Zeit., Nov.* 18, 1918.)

Turkey.—An Export and Import Co. has been floated in Smyrna with a capital of £T200,000. A number of new mining concessions has been granted by the Government, *viz.*, for a quicksilver mine in the Aidin vilayet, an emery mine in Sandjak Mendishi, two chromium mines and a coal mine in Adrianople vilayet, and a lead mine and petroleum wells in the Kastamuni vilayet. A new company has been formed in Afium-Kara-Hissar for the production of textiles and woven goods. Electrical works, agricultural schools, and settlements are to be established, the entire scheme involving a capital of £T500,000.—(*Wirtschaftszeitung, Nov.* 1, 1918.)

Rumania.—Since the Peace of Bucharest Rumania has suffered from a boom in company promoting. Among the recent foundations figure the Industrial Requisites Co. (Lei 100,000), dealing mainly in machinery and implements for the oil industry, and the Agricola Industry (Lei 1 mill.), which will engage in the wholesale production of legumes (Lei = 9½*d.*). The chemical industries in Jassy and Bucharest have been enlarged by several new ventures. — (*Wirtschaftszeitung, Oct.* 25, 1918.)

The "Orion" oil company in Hoesti (capital 20 million Lei) is issuing shares to the value of 2 million Lei to enable it to sink at full capacity after the war.—(*Z. angew. Chem., Nov.* 22, 1918.)

Denmark.—A new chemical works, with the title "Koge Kemiske Fabrik A.-S.," is to be erected at Koge.—(*Wirtschaftsdienst, Oct.* 11, 1918.)

Italy.—The Industrie Chimiche Siciliane, at Palermo, which carries on the extraction of essential oils, etc., has raised its capital by 1 million lire.—(*Sole, Nov.* 16, 1918.)

REVIEW.

TREATISE ON APPLIED ANALYTICAL CHEMISTRY. VOL. II. *By* VITTORIO VILLAVECCHIA. *Translated by* T. H. POPE. *Pp. xiv and* 528, 105 *Illustrations and* 11 *Plates. (London: J. and A. Churchill,* 1918.) *Price* 25*s. net.*

The time is fast approaching, if it has not already arrived, when the general treatise on Applied Analytical Chemistry must give way to the specialised monograph. The amount of knowledge which has accumulated and been recorded during recent years in every department of commercial analysis is so great that only the monograph can conveniently accommodate it, and only the specialist can deal properly with the selection of matter and supply the discriminative element which make the best works of this kind so valuable to the ordinary worker. It is true that in the compilation of this volume, Prof. Villavecchia has had the advantage of the assistance of a number of well-known Italian chemists and that, consequently, the defects usually associated with the individual limitation are less apparent than is frequently the case in composite works of a similar character. As an example of an admirable and successful encyclopædic work on commercial chemical analysis, Allen's Organic Analysis occupies by general consent an outstanding position, but Allen only dealt with organic analysis, and even so, his treatise extended to eight very substantial volumes. In the volume under review—the second of the complete work—the author deals with meat products, with milk and its products, with starchy food-stuffs, with the various sugars and food-stuffs containing them, with alcoholic beverages, essential oils, varnishes, rubber and gutta percha, tanning materials of various kinds, inks, leather, colouring matters—both mineral and organic—textile fibres and fabrics. To say that this very large amount of ground has been in the main creditably covered within the space of some 530 pages, is to pay a high compliment to the distinguished author and his colleagues.

A detailed criticism of this work, even if any one person were competent to undertake it, would obviously be outside the limits of an ordinary review, and the points to which attention is drawn below must be regarded as a few examples of the main defect of this book, namely, the compression inseparable from the attempt to deal with so much and such widely varied subject matter within the covers of a single medium-sized volume. The wonder is that the sins of omission are not more numerous, and even an experienced chemist may peruse the sections which deal with the subjects with which he is most familiar, and find the perusal not unprofitable.

Dealing with individual points, it may be noticed with regret that for the estimation of nitrogen in meat and meat-products, the author recommends the use of oxide of copper and, finally, of potassium permanganate. It is very generally recognised that the permanganate has a marked tendency to cause low results and it is somewhat surprising that the Gunning-Arnold modification, which is now almost universally employed, should not have been recommended. The method described for the estimation of the various groups of nitrogenous substances in meat extracts, also, leaves a good deal to be desired. Thus, the method given for the estimation of the albumoses would obviously include gelatin. Gelatin, it is true, is referred to in an explanatory note, but no method for its estimation, or, indeed, for its detection, is given. Again, a not very satisfactory method for the detection of peptone is described, but no method for its estimation. Jaffé's method for the detection and estimation of creatinine is described, but there is no adequate reference to recent work on this subject. The statement that "this investigation is of particular importance in testing for meat extract in vegetable or yeast extracts" is obviously rather wide of the mark. The operator, moreover, is informed that the orange colour with alkaline picrate is also given by acetone and, should the meat extract contain that substance, the liquid should be boiled before testing. No reference is made to the fact that the same coloration is produced by glucose and other sugars which are very much more likely to be present than acetone.

Some of the numbers given in the statement at the end of the chapter on Meat Extracts dealing with the analytical data which should characterise a satisfactory product, will certainly not be generally assented to. Instructions given in the section on Tinned Meats for the detection and estimation of metallic impurities are open to some criticism. In the detection of tin, for example, the method described is such that even heavy traces would be very liable to escape detection, the method involving the treatment of the ash with nitric acid, and the operator being told to test the residue on the filter paper "for tin and antimony by the ordinary methods." Working on 50 grms. of the sample and dealing with such quantities of tin as would be likely to be present in most tinned meats, the "ordinary methods" would scarcely suffice. No mention is made of Schryver's colorimetric process, which is admirable for this purpose.

In dealing with the estimation of arsenic, no reference is made to the necessity for the use of lead acetate paper in the calcium chloride tube of the Marsh-Berzelius apparatus. In this section, instructions are given to destroy the organic matter and to test the resulting liquid in the Marsh flask. No information, however, is given as to the method of estimation by comparison of mirrors, and the operator is informed that the amount of the arsenic may be determined by weighing the deposit in the heated tube!

The chapter on the analysis of Sugars and Saccharin Products is very disappointing, and is an excellent example of the disadvantage of attempting to cover too much ground in too little space. The methods to be adopted for the analysis of mixtures containing the various sugars have, in order apparently to save space, been generalised in the form of numerous equations, and certain portions of this chapter have rather the appearance of a mathematical treatise than of a text-book of chemical analysis. If descriptive matter had taken the place of the equations and an example of each problem had been given and worked out, the result would have been vastly more useful. As it is, the expert sugar analyst is scarcely likely to experience the need of consulting this volume, whilst the more or less inexperienced analyst could scarcely fail to find himself hopelessly at sea. It may be noticed, in passing, that Wein's table for converting reduced copper into its equivalent of maltose and which is generally recognised to be incorrect to the extent of about 5 per cent., is reproduced. In the special part of this chapter a good many matters for criticism have obtruded themselves upon the reviewer's notice. Thus, the question of the determination of the various carbohydrates in commercial glucose is dismissed with the statement "the exact determination of the separate sugars is not easy. . . . It is usual, therefore, to calculate the whole of the reducing sugars as glucose." The water in these sugars is to be determined by drying at 105° C., a method which is known to be exceedingly inexact. For the estimation of dextrin, the author recommends hydrolysis with acid and the calculation of the whole increased reducing power as dextrin, thus obviously ignoring the maltose present. In solid glucose it is well known that there is, as a rule, little or

no dextrin, but appreciable quantities of maltose. In the case of liquid glucose, on the other hand, there is much maltose and the method would give startling results. It may be noted, by the way, that in the explanatory note referring to the composition of glucose syrups, no mention whatever is made of the presence of maltose, which usually constitutes over 30 per cent. of this product. Conversely, in dealing with the estimation of dextrin in malt extracts and malto-dextrin products, no provision is made for the dextrose almost invariably present. In dealing with the estimation of the diastatic power of malt extracts, no mention is made of Lintner's method, which is almost universally employed.

The chapter on Beer has been very largely rewritten for the English edition by Mr. T. H. Pope, in order to bring it more into line with English conditions. It need scarcely be said that it has been well done and that it constitutes a safe guide to the analyst. The statement that the presence of organic matter prevents the estimation of the arsenic in beer is not in accordance with the writer's experience. In dealing with such an important matter as the estimation of arsenic in food-stuffs, it is surprising that, notwithstanding the frequent reference to the Marsh-Berzelius method, nothing is said of the "insensitiveness" of much of the zinc supplied specially for the purpose. In a book intended for the general practitioner and not for the expert, this is a rather serious omission.

The sections dealing with Wines and Spirits have been in the main well written. It should be pointed out, however, that for the determination of the higher alcohols no mention is made of the Allen-Marquardt method, which is generally recognised to be one of the most accurate for the purpose. The colorimetric methods given in the book and described at some considerable length are both inexact and greatly inferior.

The chapter dealing with the Essential Oils is, like the chapter on the Sugars, a very good example of the disadvantage of endeavouring to crowd too much matter into a small amount of space. This chapter, which extends to only 24 pages, actually attempts to deal with essential oils in general and in detail with some of those which are of outstanding commercial importance. It is not to be wondered at that there is not much to be found of value to the expert, whilst there is no real guidance for the less experienced worker, and there are many omissions which might possibly lead him astray. To criticise this at any length is out of the question, but attention may be drawn to the fact that in the section on lemon oil, the very incorrect method of Bertè for the estimation of citral is given. The statement that, by this method, lemon oil contains 6 to 7·5 per cent. of citral is in itself enough to condemn it, seeing that, as a matter of fact, this oil does not as a rule contain more than about 3 per cent. Incidentally it may be mentioned that hop oil does not contain carvacrol.

The chapter on the mineral pigments appears to be on the whole accurate, but it is clear that here again it is impossible to deal adequately with so large a subject in so small a space, a criticism which applies with even greater force to the section dealing with organic colouring matters.

In the section on Indigo, it may be noted that no reference is made to Bloxam's tetra-sulphonate method for the estimation of indigotin, which is certainly more accurate than that described.

Whilst there is, throughout the book, evidence of too great compression, one finds, on the other hand, that an undue amount of space has been devoted, in certain of the chapters, to methods of detecting and estimating impurities and adulterants which are rarely, if ever, met with in ordinary practice and which might well have been dismissed with a very brief reference.

There appear to be very few typographical errors and the paper and printing are good. Mr. Pope's share of the work has been excellently done, but one feels inclined to wonder whether the value to the analyst of a book such as this bears any adequate proportion to the amount of work involved in its preparation.

A. Chaston Chapman.

PERSONALIA.

The death is announced of Prof. Nietzki, professor of chemistry of the University of Bâle, at the age of 71. Prof. Nietzki made important contributions to organic chemistry, more particularly in the field of organic dyes. He was the discoverer of "Biebrich Scarlet" and nitranilic acid, and was the author of important investigations on aniline black, the quinones, azo-derivatives, safranines, oxazines, and the thiazines.

The following candidates connected with the chemical industry were returned as Members of Parliament at the recent General Election:—Lieut.-Col. Grant Morden, of the British Celluiose and Manufacturing Co., Ltd., for Brentford and Chiswick (Middlesex). Sir Wm. Pearce, of Messrs. Spencer, Chapman, and Messel, Silvertown, E., for Limehouse (Stepney). Mr. J. W. Wilson, of Messrs. Albright and Wilson, Oldbury, for Stourbridge. Sir Alfred Mond, of the Mond Nickel Co., etc., for Swansea (West). Col. Sir E. A. Brotherton, of Messrs. Brotherton and Co., Leeds, for Wakefield. Sir Richard Cooper, of Messrs. Wm. Cooper and Nephews, Berkhamsted, for Walsall. Mr. A. F. Bird, of Alfred Bird and Sons, Ltd., for Wolverhampton (West).

The Order of Knight Commander of the British Empire (Civil Division), K.B.E., has been conferred upon: Prof. W. J. Pope, President of the Chemical Society and member of the Chemical Warfare Committee, Ministry of Munitions; Dr. A. Strahan, Director of the Geological Survey of Great Britain; and Mr. W. J. Jones, member of the Iron and Steel Production Department, Ministry of Munitions.

The Order of Commander of the British Empire, C.B.E., has been bestowed upon: Prof. J. W. Cobb, Deputy Inspector of High Explosives, Ministry of Munitions, and Principal J. C. M. Garnett, of the Municipal College of Technology, Manchester. The new Officers of the same Order, O.B.E., include: Mr. C. S. Gibson, Mr. F. Holt, of the Castner Kellner Alkali Co., and Dr. W. E. S. Turner, Secretary of the Society of Glass Technology.

PUBLICATIONS RECEIVED.

The Natural Organic Colouring Matters. *By* A. G. Perkin *and* A. E. Everest. *Monographs on Industrial Chemistry, edited by* Sir Ed. Thorpe. *Pp.* 655. *(London: Longmans, Green and Co.* 1918.) *Price* 28*s.*

Recent Advances in Organic Chemistry. *By* A. W. Stewart. *Third edition. Pp.* 350 *(London: Longmans, Green and Co.* 1918.) *Price* 14*s.*

Catalysis in Industrial Chemistry. *By* G. G. Henderson. *Monographs on Industrial Chemistry, edited by* Sir Ed. Thorpe. *Pp.* 202. *(London: Longmans, Green and Co.* 1919.) *Price* 9*s.*

THE TECHNICAL CHEMIST AFTER DEMOBILISATION.

The problem of providing useful and fitting occupation for those who will shortly be leaving H.M. forces, munition works and ancillary branches of war service is nowhere more difficult than where it relates to the technical chemist. It is of paramount importance to the nation that his very special and indispensable knowledge and training should be utilised to the full, yet, notwithstanding the universal application of chemical principles to modern industrial processes and to the provision and maintenance of healthy and comfortable conditions of living, it may not be easy to allocate all the technical chemists whose services will shortly cease to be required in connexion with war work to other work in which they will be able to do full justice to themselves, their training and experience, and the occupation which may present itself to them. The difficulty will be greatly minimised if the authorities and the public at large will refrain from regarding technical chemists leaving the services, etc., as so many "hands" seeking employment, and will instead take the proper view that they are national assets of enormous potential value, for the realisation of which it is only essential that each should be afforded the occupation for which his special attainments best fit him.

Some men will undoubtedly return to their former work in the honourable but hitherto poorly remunerated profession of teaching, the better equipped therefor in virtue of their transient first-hand acquaintance with, *e.g.* the application of chemistry to industrial work, the foibles of the artisan and skilled labourer, the inspiring confidence of the engineer, or perchance with technical research pure and simple. Others who have not hitherto essayed to instruct may also find their rôle in our technical colleges, where many more students of chemistry may be expected than hitherto, and undoubtedly the pupils will benefit from the war-time experiences of their instructors. Many men again will return to former positions in connexion with the public services—*e.g.* sanitation, water and gas supply, etc.—from which they have been ill-spared during the war, and with them also will go others, whose acquaintance with such services has been made through military requirements. There is scope for many more trained chemists in these services than were generally engaged therein prior to the war, both at home and abroad—where, especially in the territories in the East and in Africa which have recently come under the control of the Allies, the chemist, with the assistance of the engineer and the medical man, has tremendous opportunities of contributing to the health and prosperity of large populations, hitherto little cared for. War experiences will in many instances have fitted him to act in administrative capacities which have commonly been filled in the past by the non-technical civil servant, or by the engineer, or the medical officer, though chemistry should have played a larger part in them than letters, engineering or medicine. It is to be hoped that the war will have dissipated the widespread impression that the chemist, as such, is incapable or inefficient as an administrator. Certain it is that administrators (who may be born not made) are the better for a sound training in chemistry, and that they may be sought for and found in the ranks of technical chemists now returning from the field of war or leaving munition works.

There are other opportunities for the released technical chemist to play his part which need not be detailed here, but it is obvious that his greatest scope will be in chemistry directly associated with industry. Apart from chemical manufactures proper there are allied manufactures and industries in which the chemist can render very great service. Those manufacturers who are setting out to capture new branches of trade, or to revivify by new methods old branches, should consider whether they cannot avail themselves with advantage of the assistance of a trained chemist. It is a fact that much of the industrial success of the German manufacturer in the years before the war was due to his appreciation of the value of a chemist's services and advice, and to the lack of the same on the part of his rivals in other lands. The war has demonstrated, however, that the British chemist—little appreciated though he may have been in his own country—has, in the emergency, equalled and surpassed in inventiveness, resourcefulness and thoroughness, the much-vaunted German chemist. The lesson is one which the British industrialist and manufacturer should take to heart. If he does so, he will seize the present unequalled opportunity of securing, for the benefit of his undertaking and business, services which have stood the country in such good stead during the last few strenuous years of what has been aptly called "the chemist's war." The men who have done more than any other group of equal numbers towards winning the war only need fair play and reasonable opportunity to enable them to win for British industry an unqualified predominance over its erstwhile rivals.

How can the manufacturer, the public authority or other body which seeks to grasp the present opportunity of enlisting the help of a technical chemist get into touch with the man who is best qualified to fulfil the particular requirements of the case? In the first place, the requirements and expectations should be specified fully and frankly, so that there may be no ground for misconception on the part of any chemist who offers his services, with perhaps consequent mutual dissatisfaction after a brief period of attempted collaboration. On the other side it is incumbent on the technical chemist, in common fairness to a man or body of men who seek his aid but do not realise the wide ramifications of chemistry, to state the range of his technical experiences, his limitations and the prospects of research in the branch of work dealt with. If advertisement in the technical press is the means selected by either party to the proposed engagement for acquainting the other with his needs or aspirations, a sufficiently full, though concise, statement is desirable with a view to avoiding futile correspondence and trouble. The same caution may be tendered to those offering or seeking engagements through bureaux such as that which the Institute of Chemistry has established, to which we take this opportunity of drawing the attention of manufacturers and others who may be needing the services of a technical chemist at the present juncture.

Chemical manufacturers proper need no suggestions from us as to how and when to increase their staffs of trained chemists, but it may be useful to remind others that our technical colleges have been almost devoid of students during the last two or three years, and that consequently there can be no appreciable increase in the number of trained chemists available for appointments until those now entering the colleges complete their three or four years' course of training. Hence when the technical chemists now leaving the services, etc., have secured appointments, it is likely that—in say 6 or 12 months' time—it will be difficult for those then needing the assistance of one to obtain it without delay.

THE FEDERAL COUNCIL FOR PURE AND APPLIED CHEMISTRY.

That union gives strength is widely recognised in theory, though in practice the tendency, of late years, has been towards the multiplication of small states even within the realm of chemical science. Nevertheless, it has long been felt that, whilst the interests of chemists are now represented by a large number of special Societies, these are in need of co-ordination and unification, as well as social development. On the professional side, we have to recognise that an indubitable advance has been made during the war by the Institute of Chemistry—a body clearly destined to be the agency through which professional standards of competency and conduct will gradually be formulated and determined; ultimately this should rank with similar institutions controlling the legal and medical professions. Trade interests, in like manner, are now satisfactorily cared for by the Association of British Chemical Manufacturers; though of recent origin, on account of its representative character, the magnitude of the interests it covers and its activity, this body has already taken a commanding position.

Action was called for on behalf of the interests of Chemical Science, pure and applied, the effect of which would be ultimately to secure for the profession of Chemistry—as distinct from Pharmacy—the recognised status and homogeneity enjoyed by other learned professions by uniting the various sections for all the purposes of scientific service. From this point of view, the recent establishment of a Federal Council, composed of delegates appointed by the several Societies, will be generally welcomed as a step of the first importance. That the time was ripe for such action is clear. During the war, the value of the chemist has been constantly under notice and probably the public now realise, as they never did before, how indispensable his work is both for the welfare and the defence of the country. On the offensive side, the war has been essentially a chemists' war and had it been continued, in the near future, the horrors of the earlier period would have been far exceeded, owing to the development of the means of attack by poisonous vapours. The safety devices which have played so great and successful a part in countering this new means of warfare have been entirely the product of the chemist's ingenuity, but he has played an alleviating part in not a few other directions.

Not only is there much overlapping and duplication of effort, especially in the matter of publications, but no machinery existed whereby the collective and considered opinion of all workers in chemistry could be made fully operative, either constructively or in defence of privileges and interests; moreover, there was no means by which the advice of the body in general could be taken and tendered for public purposes, the result being that limited and incompatible views were not infrequently expressed when inquiries were made by official bodies.

The need of securing the co-operation of the various agencies now in existence was brought prominently under notice by the President of the Chemical Society in his address to the Fellows in April last. Impressed by the necessity of taking time by the forelock, he soon afterwards took the further step of calling together a few of those who were specially concerned in forwarding the advance of chemical interests to discuss a scheme of Federation, with the result that it was resolved that action be taken forthwith to secure the formation of a Federal Council with certain defined aims and objects. It was agreed that the ultimate aim should be the establishment of a Federation of all the bodies specially interested in the development and application of Chemical Science. In such an Association, the constituent bodies representative of particular interests should maintain their individuality and each be the organ of its proper branch of activity; but they would unite in considering all matters of concern to the general body, as well as in supporting the publications of the Federation and in maintaining a House where all meetings could be held and the official staff find accommodation, together with a complete library.

It is to be foreseen that not only will it be necessary to maintain the publication of Abstracts such as are now prepared, but to undertake also the preparation of such works of reference as may be required by chemists for scientific and industrial purposes.

A necessary feature of the enterprise would be the foundation of a Club open to all members of the Federation who were prepared to pay the Club dues.

A precedent for the Federation of Chemical Interests in the manner outlined is afforded by the Royal Society of Medicine, established in 1907, in which are incorporated all the various Societies—to the number of 20—concerned with the development of the Science of Medicine but excluding the Colleges which have professional interests in their charge. This Society publishes proceedings in which the work of the several Sections is recorded—but with distinct pagination, so that the publication of each Section may be issued or bound separately. Each Section is represented on the Council of the Society by its President. The Royal Society of Medicine has its quarters in a large building in Wimpole Street, constructed at a cost of £50,000. Originally it was proposed to afford Club accommodation on a story at the top of the building: from motives of economy, this proposal was not carried into effect; it is now much regretted that such was the decision.

The scheme was communicated in broad outline to the various bodies more or less closely concerned, with the request that they would appoint delegates to a Council which might seriously take the matter into consideration. It may be mentioned that the Institute of Chemistry was not included as a constituent body, as it was felt that possibly there might be occasions when the Council and the Institute would need to be free to take an independent course. It was specially provided for, therefore, by co-opting its President or such other member as the Institute might determine. The Chemical Society was requested to act through its representatives as Convener of the Council should the bodies consulted or a preponderating number thereof approve of the proposal.

As the result of the deliberations of the delegates appointed by the various bodies, a Federal Council has recently been constituted which is to be composed of nominees of the corporate Societies covering all aspects of Pure and Applied Chemistry, the purpose of the Council being to take such action as will ensure the adequate appreciation of the due claims of Chemical Science.

The Council will consider all matters involving the common interests of its constituent bodies and take appropriate action in connexion therewith after consultation with any bodies more immediately concerned or identified with the matters under consideration. Further, it will consider such references as it may from time to time receive from its constituent bodies or otherwise and act thereon if desirable.

The Institute of Chemistry, whilst not a constituent body, is associated with and represented on the Council, freedom being reserved to the Institute as the professional body to carry out its duties in accordance with its Charter.

The action taken by the delegates has been reported to the several Societies, who have confirmed their adhesion and the appointment of their representatives.

The Council is to be known as "*The Federal Council for Pure and Applied Chemistry (to advance, safeguard and voice the interests of Chemical Science*").

The constituent bodies already included are:—*The Chemical Society* (3 delegates: Profs. Armstrong and Pope and Sir Wm. Tilden); *The Society of Chemical Industry* (3 delegates: Prof Louis, Drs. Keane and Miall); *Association of British Chemical Manufacturers* (3 delegates: Mr. R. G. Perry and Drs. E. F. Armstrong and C. Carpenter); *Institute of Chemistry* (co-opted: Sir Herbert Jackson); *Society of Public Analysts* (Dr. Rideal); *Faraday Society* (Mr. W. R. Cooper); *Biochemical Society* (Dr. Plimmer); *Institute of Brewing* (Mr. A. Chaston-Chapman); *Society of Dyers and Colourists* (Mr. C. F. Cross); *Ceramic Society* (Dr. J. W. Mellor); *Society of Glass Technology* (Dr. W. E. Turner).

Prof. Pope is Chairman and Prof. Armstrong will act as Honorary Secretary of the Council, which is to enjoy the hospitality of the Chemical Society's Rooms in Burlington House.

The steps to be taken towards establishing an Association or Guild of Chemical Societies and the provision of a House for the accommodation of such a body have already engaged the attention of the Council, and a Committee has been appointed to deal with these problems.

The Council has addressed a letter to the President of the Board of Trade urging the need of the representation of Chemical Science on the Advisory Board appointed to assist the Dyes Commissioner.

A letter has been forwarded to the Vice-Chancellor of the University of London, with reference to recent announcements as to the appointments to University Chairs of Chemistry in the University, expressing the opinion that the salaries attached to such Chairs should be more in accordance with the scale prevailing in offices which may be regarded as likely to be in competition with Professorial appointments.

On reference from the Chemical Society, the Council has appointed a Committee to take into consideration the production of the special chemicals required in research work; and has also addressed a letter to the Royal Society expressing the opinion, that the grants available in the past for chemical research have been inadequate, and that in future much larger sums should be made available under conditions more likely to encourage an increased number of competent workers; also asking whether the Society would be prepared to advocate a large increase in the sum placed by Government at the disposal of the Society and whether it would desire to see the whole situation reviewed and a more comprehensive and unified scheme developed for the administration of grants.

BULLETIN OF SCIENTIFIC AND TECHNICAL SOCIETIES.—A very useful diary of forthcoming meetings is now being issued fortnightly by the Conjoint Board of Scientific Societies (Royal Society, Burlington House, W. 1). Announcements of meetings should be sent by secretaries of societies to: Prof. R. A. Gregory, "Nature" Office, St. Martin's St., W.C. 2.

SOCIETY FOR THE ADVANCEMENT OF CHEMICAL EDUCATION.—A new society with the above title has recently been formed in Germany to promote chemical education in universities by providing funds for teaching purposes and for research. The society is to have a capital of 30 million marks, and the minimum subscription has been fixed at 10,000 marks, which may be paid in ten annual instalments of 1000 marks.

THE CONCEPTION OF THE CHEMICAL ELEMENT AS ENLARGED BY THE STUDY OF RADIO-ACTIVE CHANGE.

In a lecture before the Chemical Society on December 19, 1918, Prof. Soddy has summarised very clearly the modifications which have been brought about in the conception of the chemical element and in our views of the ultimate constitution of matter by the study of radio-active change.

Prior to the discovery of radio-active disintegration, the expansion of chemical knowledge had not rendered necessary any fundamental change in the simple and practical definition of an element which we owe to Boyle, who described the element as a substance which could not by any means be separated into different substances. The first phase of radio-active research, which was concerned mainly with the disentanglement of the long and complicated series of successive changes in the uranium and thorium series, had the effect of robbing the chemical element of its time-honoured title to be considered the ultimate unchanging constitutent of matter, but in so far as the transmutations revealed by these investigations were spontaneous and uncontrollable by any known agency, this phase had no essential influence on the conception of the element as originally defined by Boyle.

The introduction of the atomic theory tended to divert attention from the element to the atom as the ultimate constituent of matter. The element became a plurality of atoms supposed to be in every respect identical. This assumption of the identity of the atoms, implicitly accepted throughout the nineteenth century as a characteristic of each and every chemical element, was in conformity with all the known facts, and history records no alternative hypothesis other than that put forward by Sir W. Crookes in his theory of the meta-elements as applied to the rare earths.

The effect of the discovery of the periodic law was merely to replace the older practical definition by a theoretical conception, according to which the occupancy of a particular place in the periodic table became the fundamental criterion of an element. Associated with this place were unique chemical properties, unique atomic weight and unique spectral characteristics.

It is the second phase in the development of radio-active research, however, which has revealed the necessity for modifications in the nineteenth century conception of the chemical element. These changes are the result of the study of the chemical nature of the successive disintegration products, of the recognition of the law connecting this with the type of ray expelled in the radio-active change, of the discovery of elements which differ in their radio-active properties but are chemically identical, and finally of the recognition of these as isotopes or elements which occupy the same place in the periodic table.

The theory and practice of radio-activity have been greatly simplified by the proof of the fact that the expulsion of the α-particle is accompanied by a shift of two places to the left in the periodic table and that the β-ray emission causes a shift of one place in the opposite direction. The known radio-active series extends over twelve places in the table, the places corresponding with the halogen and alkali metal groups being entirely skipped. In the ten occupied places there are forty-three distinct types of matter, characterised by distinct radio-active properties, but these forty-three types represent only ten chemically different elements. The chemical and spectroscopic characters of seven of these, namely thallium, lead, bismuth, emana-

tion, radium, thorium and uranium, are firmly established, and the seven places which these occupy in the periodic table accommodate all but nine of the known radio-elements. Isotopy is here manifested on a considerable scale. The isotopes may have different atomic weights (heterobaric isotopes) or the weights of the atoms may be the same (isobaric isotopes). Similarly, elements which occupy different places in the periodic table (heterotopes) may be differentiated as heterobaric and isobaric, according to whether their atomic weights are different or are identical. It may very well be that elements which up to now have been considered homogeneous are in reality mixtures of chemically identical isotopes.

In explanation of these relations, the structure of the atom is supposed to correspond with a miniature solar system in which the externally revolving particles (electrons) determine the chemical and spectroscopic characters of the atom, whilst the mass and the radio-active properties are determined by the nucleus or core.

Although, as Prof. Soddy points out, Nemesis has indeed overtaken the most conservative conception in chemical science, yet the newer discoveries do not in the least affect the practical importance of the conception of the element which was in vogue before the radio-active era; this will continue to have a real significance as representing the limit of the spectroscopic and chemical analysis of matter.

CASTOR OIL FOR AIRCRAFT ENGINES.

An enormous demand for castor oil for aircraft engines has sprung up within the last year or two, and very important developments in the castor seed and oil industry have accordingly taken place, especially in the United States. India has hitherto been the chief source of supply; the exports of seed and oil from that country during the last few years having been as follows:—

	Castor seed	Castor oil
1911–12	120,194 tons	1,404,403 galls.
1912–13	110,630 ,,	954,495 ,,
1913–14	134,888 ,,	1,007,001 ,,
1914–15	82,815 ,,	898,269 ,,
1915–16	87,950 ,,	1,451,655 ,,
1916–17	92,447 ,,	1,723,469 ,,
1917–18	86,100 ,,	2,086,038 ,,

Both before and during the war about half the seed exported has been sent to the United Kingdom, the bulk of the remainder going to France, Italy, and the United States. Belgium took large quantities before the war, probably for re-export to Germany. Most of the oil exported from India before 1914 was shipped to Australia and other Colonies, but during the war increasing quantities were consigned to the United Kingdom. The total imports of castor oil into this country in 1916 were 1,322,000 gallons, and the figure for 1917 would probably be about 2,000,000 gallons. The imports of castor seed in 1917 were 45,000 tons, the bulk of which went to Hull either direct or *via* Liverpool. Assuming a practical yield of oil of 40 per cent., 45,000 tons of seed would yield about 18,000 tons of oil, which, at 232 gallons to the ton, is equivalent to 4,176,000 gallons. Adding this to the import of oil we arrive at a total of 6,176,000 gallons of oil, the greater part of which has probably been used for aircraft engine lubrication.

In the United States it was realised at an early date that at least 5,000,000 gallons of castor oil would be required for aeroplane engines, and, as the imports of seed and oil would only supply a very small fraction of this quantity, arrangements were at once made for cultivating the crop on a very large scale. The U.S. Government has entered into contracts with the farmers in the Southern and Pacific Coast States, undertaking to supply the necessary seed and to pay up to 3·5 dollars per bushel when harvested. It is understood that the British Government has released about 7,000 tons of Indian seed for planting in the United States, and that the total area planted will be over 100,000 acres.

In addition to this castor oil the U.S.A. Signal Corps has, as a result of protracted experiments, introduced another lubricating oil manufactured from petroleum, and called "Liberty Aero Oil." This is intended to eke out the castor oil supply pending the harvesting and crushing of the seed, and will be used more especially for the stationary cylinder aircraft engines, including the famous Liberty engine, the castor oil being used exclusively for rotary engines.

Stringent specifications have been drawn up by the U.S. War Department both for the Liberty Aero Oil and also for castor oil (specifications Nos. 3501 and 3500A respectively). The castor oil specification No. 3500A stipulates that the oil must be colourless; sp. gr. 0·959—0·968 at 60° F.; completely soluble in four volumes of 90 per cent. 0·834 sp. gr. alcohol at 60° F.; maximum acidity not to exceed the equivalent of 1·5 per cent. oleic acid; iodine number, 80—90; saponification number, 176—187; unsaponifiable below 1 per cent.; must contain no rosin, rosin oil or cotton seed oil; viscosity (Saybolt) 450 secs. at 130° F. or 95 secs. at 212° F.; flash-point 450° F. in a Cleveland open flash cup; freezing point, below zero F.

Owing to the very great and ever increasing demand for castor oil, attention is being given to the cultivation of the castor bean all over the world. Small quantities of seed or oil have been exported in the past from Brazil, Cochin China, and Manchuria, and the industry is being rapidly extended in these countries. The Brazilian crop in 1918 has been nearly destroyed by frost, but it is hoped that the yield for 1919 will be 2,000,000 bags of seed.

In the West Indies about 100,000 acres have been planted with Indian seed. In Malaysia the Federated Malay States Railways have had about 50 acres planted on the railway reserve, and managers of coconut and rubber estates, as well as native farmers, are interesting themselves in the cultivation. In Malaga (Spain) one or two firms of olive oil refiners are entertaining the idea of castor oil extraction, and are encouraging the local farmers to grow the castor bean. One of these companies expects to produce about 60 tons of oil this year, and another is inquiring for American machinery capable of turning out 10 tons in a 10-hour day.

In regard to American oil-milling machinery it may be here stated that some tests on castor seed crushing recently took place at Jacksonville, in Florida, with four types of American oilseed crushing machinery. One of these was built by the Southwest Manufacturing Co. of Oklahoma City, two were built by the Seminole Manufacturing Co., and one by the Appomattox Iron Works, Petersburg, Va. A very large oil-mill has lately been completed at Gainesville, Florida, and is said to be one of the largest in the world. It will deal with the bulk of the U.S. castor seed crop for 1918.

Other countries interested in the castor bean cultivation include Japan, where the possibilities are very great, although little has been done hitherto. Venezuela is also well suited for the castor bean, and a grower at Caracas has collected several varieties for test. The Venezuelan Agricultural Experiment Station has published a booklet containing instructions for growing the *tartago*, as the castor bean is known locally. Java is growing the plant on a commercial scale. In Siam it is found growing wild nearly everywhere, and a Bangkok

merchant has cultivated a large crop from which he expects to harvest about 1000 tons of seed. In New South Wales some seed has been grown near Gosford, and the oil expressed therefrom. In Africa the plant is already found in the Congo, Uganda, East Africa, and it has been suggested as a very suitable crop for French West Africa. Attempts are being made to introduce it into the Transvaal. According to an American consular report, the Italian Minister of Agriculture has appealed to the farmers in Catania to take up the cultivation of the castor oil plant, offering to furnish seed and buy the crop at a good price. Very large quantities of castor oil are wanted in Italy for aircraft engines.

SUGAR BEET SEED.

F. V. DARBISHIRE.

When the war broke out the world's annual sugar beet seed requirements were roughly 79,000 tons, an amount which represents the seed sown annually on, say, 6 million acres of land. In peace time Germany had enjoyed an undoubted and well-established monopoly in the export trade of beet seed, no less than 78 per cent. of all beet sugar produced outside Russia and Germany being from German grown seeds. In the United States the beet sugar industry needs annually about 6000 tons of seeds, 4000 of which was formerly bought from Germany. Cantley, our one and only beet sugar factory, was closed down early in 1916 owing to lack of seed—another striking illustration of the danger of depending on a foreign country for some essential raw material. France, Austria, Holland and Russia grow and even export some of their native seed, and for quite a number of years efforts have been made in the United States to establish the native beet seed industry on a more extensive scale and on a thoroughly scientific basis. Good progress has been made in that country, especially since 1915. In 1917 the production reached 2773 tons of seeds, an increase of 6 per cent. on the 1916 crop.

It is interesting to note that on the Kelham Estate in Nottingham, where 5600 acres was purchased for the purpose of erecting a beet sugar factory, a small area is under beet cultivation for seed, in order to ensure an adequate supply of good seeds for planting in 1920. Sugar chemists and others interested in developing beet seed production in the States are fully alive to the many difficulties which confront them. Marggraf himself in 1747 discussed the possibility of raising the sugar content of the beet artificially, though it was not until Vilmorin, the father of modern beet breeding, started his researches in 1830 that the study of the creation of new varieties of beet became serious. The beet has now been so highly developed during many generations that its tendency to revert to a previous inferior type, *Beta maritima* or *Beta vulgaris*, is very pronounced: only by continuous and persistent application of the most modern scientific methods can it be kept up to its high standard. For sixty years German beet seed producers at Klein Wanzleben in Saxony have been labouring continuously to improve the original beet and have succeeded in creating new forms or types. Remembering that these investigations are carried out by reliable experts with the greatest possible care and patience, it is not surprising to find that the best German grown seed is also the best seed that can anywhere be procured. It is called super-élite seed, and never gets into the market: if it did it might fetch anything up to about £12 an ounce. In addition to the super-élite variety, there are also the élite and commercial seeds. Super-élite and élite seeds are obtained from carefully selected mother beets which have passed all prescribed chemical and physical tests. Super-élite seeds are obtained from mothers truest to type; they are kept separate, and from them are bred further generations of super-élite and élite seeds. These latter seeds are obtained from mothers which are found to be somewhat inferior to the truest type. The commercial seeds are the next generation to the élite seeds, grandchildren so to speak of the original mother beets. It is perhaps not generally known that it takes at least five years of very strenuous scientific work to harvest a crop of commercial seeds. In the first year the original selected strain of super-élite seeds is planted, and after ripening in the autumn all those roots which pass the physical and chemical tests are siloed through the winter and are known as mother beets. In the second year the mother beets, after further testing, are planted out, and in the autumn yield, as already explained, super-élite and élite seeds. The former are withdrawn for breeding purposes, and the latter are sown in the third year. These are placed so close together, however, that the plants grow long and slender and are known as stecklings. They are gathered in the autumn and siloed during the winter months. In the fourth year these stecklings are planted out and in the autumn yield a crop of commercial seed, which may be sown in the following spring, ripening five to six months later in time for the opening of the autumn sugar campaign of the same year.

We owe to Mr. Palmer, who is well known through his Loose Leaf Beet Sugar and other publications, the appearance of a small book* on the production of beet seeds of which he has made a special study. It is full of interesting, accurate and up-to-date matter, and contains many excellent photographic reproductions. It does not pretend to be a text book, but has been written for the purpose of giving general information. In one of the concluding sections he touches briefly upon a problem which is causing much discussion among specialists and to which much scientific energy is being devoted, more specially in America. This problem concerns the possibility of creating single germ seed balls by selective breeding. Each seed ball of the sugar beet contains 1—7 distinct seeds, and on an average 3½ plants germinate from each ball. The seed balls are drilled into the ground towards the end of April; a couple of weeks later, when the plants possess about four leaves, thinning out takes place, so that the single plants stand about 8—12 inches apart in the row. Thinning out is a slow and tedious process, and although usually performed by children, an expensive one. Moreover, since several plants grow up together on the very same spot, their respective rootlets are generally tightly grown together. The removal of the superfluous, weaker plants is bound to act injuriously on the growth and health of the single remaining plant; and hence the necessity of breeding single in the place of multiple seed germ balls. Since the year 1903, the possibility of realising this change has been investigated in the United States. Judging from the results already obtained, there appears to be no longer any doubt, according to Mr. Palmer, that this new character can be acquired by the beet, and that it will become permanently fixed. In the fourth generation already many plants produced 60—70 per cent. of single seed balls; on a few individual plants as many as 85 per cent. of single germ balls were counted. When, finally, chemists and botanists have increased the disease-resisting power of the beet, they will by their united efforts have produced a very perfect new farm crop.

* Sugar Beet Seed. History and Development. By Truman G. Palmer. (New York: John Wiley and Sons Inc.; London: Chapman & Hall, Ltd.)

NEWS FROM THE SECTIONS.

LIVERPOOL.

At a meeting held jointly with the Liverpool Engineering Society on December 18, 1918, a paper was read by Mr. H. S. Rowe on "The Growth and Arrangement of Industrial Boiler Plants." The paper reviewed the many aspects of the subject in some detail and contained many valuable statistics; it will be published *in extenso* in the Transactions of the Liverpool Engineering Society.

The type of plant considered was one which had started in the smallest way with one boiler and had grown and developed in a quite unsystematic manner according to the expansion of the business for which it was required. The industrial conditions both as regards supply of fuel and the efficient production of an adequate supply of steam were reviewed, and the causes of defective steam supply were considered.

Heating surface and economisers were the next aspects dealt with, the latter being discussed in some detail. The extent of output, average rate of firing for the practical limit of fuel-burning capacity of the furnace, amount of labour required by the plant and the important question of draught were all reviewed, much statistical matter dealing with draught and the percentage of carbon dioxide in the chimney gas being given.

Finally the space occupied by a plant was discussed, as also the growth and arrangement according to the principles described under the previous headings in the paper; and tables showing how the capacities of boiler plants lend themselves to be increased were given as well as diagrams showing the lay out of typical plants.

BRISTOL.

An informal meeting, held at Bristol on December 19 last, under the chairmanship of Mr. T. Howard Butler, was given up to the reading and discussing of two papers.

Mr. J. Bernard in his contribution "A Few Remarks on India" said that the productive activity of that country lay principally in the field of agriculture, but many of the products constitute the raw materials of manufacture in chemical and allied industries in Europe. Among the more important of these materials are cotton and cotton-seed, hides and skins, ground nuts, coconuts, jute. In addition, much sugar is produced, also beer, indigo, paper, rubber, quinine, etc. Among the more important mineral products are gold, salt, nitre, iron and manganese ores, monazite and mica. A great handicap to the establishment of a sulphuric acid industry is the non-existence of deposits of native sulphur or pyrites. Owing to this fact, the acid produced in the country cannot be sold much under £14 per ton, compared with £2—£3 per ton in Britain before the war. The Indian railways will not carry sulphuric acid in carboys, therefore it has to be packed in as expensive a manner as the acid imported from overseas, *i.e.* in lead-lined cases, or stoneware jars, packed in wooden cases with whitening. In recent years the number of sulphuric acid works has increased; these are mostly quite small and erected as adjuncts to other manufactories, *e.g.* the refining of petroleum oil. They use the lead chamber process with brimstone, imported from Sicily or Japan, the cost of which compares favourably with that of pyrites; the chambers require much greater protection from the weather than is necessary in this country. Much of this acid is used for making carbon dioxide for aerated waters, the taste for which has spread tremendously among the Indians; liquefied gas from breweries is also much used for this purpose. The high price of this acid precludes the development of a superphosphate industry.

Mr. E. Walls in his paper on "Rancidity in Oils and Fats" discussed the composition, characteristics, and uses of various oils, fats and fatty acids.

MANCHESTER.

At the third meeting of the Session held on January 3, with Mr. Wm. Thomson in the chair, Prof. J. W. Hinchley gave an address on "Progress in Chemical Engineering."

Owing to national necessity and to the natural development of chemical industry, chemical engineering was now recognised as a distinct profession. A chemical engineer was to be defined as one engaged in designing or directing the use of plant for large scale operations involving physical and chemical changes. Steam boiler plants and gas producer plants, whether for power production or for chemical operations, belong to the province of the chemical rather than to that of the mechanical engineer.

Prof. Hinchley then gave illustrations of the employment of "utility formulæ," and drew attention to the usefulness of graphical methods. Very few people realised the potential value of a 6H. pencil and the degree of accuracy to which graphical methods could be carried by a good draughtsman. He also gave a description of a vacuum crystallising pan, and explained a calculation based on the use of the "utility formulæ" given by which the time of an operation could be determined. In conclusion he strongly emphasised the need for an organisation like the Chemical Engineering Group of the Society of Chemical Industry for the promotion of detailed study of the problems confronting the chemical engineer.

LONDON.

At the meeting of the London Section, held on January 6, the chairman, Dr. Charles A. Keane, reported that although up to the present the Committee had not received any suggestions from members as to the arrangements for the Annual Meeting of the Society, to be held in London in July next, it would still be pleased to do so. He also announced that in future the time of the meetings would be altered back to 8 p.m. The Chairman further called attention to the arrangements which came into force on January 1, under which the Chemical Society has generously allowed to members of certain other "contributing" societies, of which the Society of Chemical Industry is one, the use of its Library, on the same conditions as to reading and lending as to its own Fellows.

The first paper by Dr. P. E. Spielmann and Mr. H. Wood dealt with "The Estimation of Cyanogen Compounds in Concentrated Ammonia Liquor." The methods of Linder and others for use with crude gas liquor were not found suitable for the routine examination of concentrated ammonia liquor for cyanide impurities. The chief impurities are ammonium thiocyanate, ammonium cyanide and ammonium ferrocyanide, and the method adopted by the authors was to convert the cyanide and thiocyanate into the ferric salt, and to measure the depth of colour obtained by means of the Lovibond Tintometer and to compare it with that obtained with standard solutions. A method of correcting for the colour due to any ferrocyanide originally present is described in the paper.

The second paper was by Dr. Thole on "The Estimation of Benzene and Toluene in Petroleum." The simplest method is to distil the liquid up to 150° C. and fractionate the distillate. The differences between the refractive indices of the liquid before and after treatment with liquid sulphur

dioxide have also been used to estimate the amounts of benzene, toluene, etc. Chemical methods, however, are not entirely satisfactory; treatment of the petroleum, for example, with fuming sulphuric acid may also attack non-aromatic compounds, and treatment with nitrating mixture gives results which are too high. The author's process consists mainly in segregating the aromatic constituents by fractionation, the two most important points being 95° C. and 122·5° C., and after absorption by shaking with 98 per cent. sulphuric acid in a cylinder, determining the specific gravity. The percentage of aromatic hydrocarbons is calculated from the formula :—

$$\frac{\text{Initial Sp. Gr.} - \text{Final Sp. Gr.}}{\text{Sp. Gr. of Aromatic} - \text{Final Sp. Gr.}} \times 100$$

The accuracy of the results is increased by adding a correction calculated from curves giving the results of actual experiments on mixtures.

Mr. Arnold Philip described a method of determining very small quantities of water in mineral oils, which has been applied especially to so-called "Transformer" oils, used in high frequency electrical apparatus. A stream of dry air, under a reduced pressure of about 25 inches of mercury, is sucked through the sample at a rate of about 2 or 3 bubbles a second, and then passed through U-tubes surrounded by a mixture of ice and hydrochloric acid; in this way the water can be effectually removed, condensed and weighed. As the author pointed out, one great advantage of the process is that if supplied in a suitable drum, the whole sample can be treated without taking out any portion of it and when the experiment is finished the drum can be re-fastened and returned to the manufacturer with the water eliminated.

YORKSHIRE.

A meeting was held on January 13, at the Queen's Hotel, Leeds, when Dr. H. M. Dawson read a paper on "Sodammonium Sulphate—A New Fertiliser." In the absence of the chairman, Mr. F. W. Richardson, of Bradford, presided. It was intimated that the committee had passed a resolution congratulating two of the members of the Section—Prof. J. W. Cobb and Mr. W. F. Wood—upon their distinctions in connexion with the Order of the British Empire.

Dr. Dawson explained that the idea of the production of the new fertiliser, of which he was about to speak, arose out of the shortage of sulphuric acid during the war. Sodammonium sulphate, $Na_2SO_4.(NH_4)_2SO_4.4H_2O$, is formed by the interaction of Glauber's salt with ammonium sulphate at the ordinary temperature, and may be obtained by crystallisation from aqueous solutions containing the two sulphates when the temperature and the relative concentrations are appropriately adjusted.

Solutions of the two sulphates obtained by the neutralisation of nitre cake or mixtures of nitre cake and sulphuric acid may be made to yield Glauber's salt and ammonium sulphate, or may be utilised for the production of sodammonium sulphate. In the former process, the separation of Glauber's salt is effected by crystallisation at low temperature, and the mother liquor, containing ammonium sulphate in relatively large excess, is then evaporated at or about 100° C. with the deposition of ammonium sulphate crystals until the ratio of ammonium sulphate to sodium sulphate in the hot solution has fallen to about 2·7 : 1.

In the second process, the neutralised solutions, which should contain ammonium sulphate in excess of sodium sulphate, are adjusted to appropriate total salt concentration and allowed to cool to the ordinary temperature when the double salt separates out in pure condition. As described, this process involves the conversion of a mixture of nitre cake and sulphuric acid directly into the double salt, the mother liquor remaining on removal of the double salt crystals being used for dissolving further quantities of nitre cake and sulphuric acid.

The cost of fixing ammonia in this process is very much less than that in the ordinary sulphuric acid process, and preliminary trials of the use of sodammonium sulphate as an artificial manure indicate that the fertilising value of the ammonia is not impaired by the sodium sulphate present.

Discussion was taken part in by Dr. Calvert, Mr. C. P. Finn, Mr. James Ogilvie, Mr. B. A. Burrell (hon. secretary); and Professor Perkin and Mr. Hatley spoke to a vote of thanks.

Dr. Dawson, in reply to some of the comments made, said he recognised that the commercial possibilities of sodammonium sulphate would depend upon the price of sulphuric acid and nitre cake. This was where the effect of many vested interests might operate. He added that trial experiments on a small scale at Garforth had been quite satisfactory.

MEETINGS OF OTHER SOCIETIES.

ROYAL INSTITUTION.

The first Friday Discourse was given on January 17 by Sir James Dewar on "Liquid Oxygen and the War," the Duke of Northumberland presiding.

The lecturer first recalled the fact that at the outbreak of hostilities the Royal Institution had proffered its assistance to H.M. Government by undertaking chemical and physical researches that might help in the conduct of the war. He then drew attention to the address he gave before the British Association in 1902, in which he compared and contrasted the facilities for higher scientific teaching and research in this country with those obtaining in Germany; then as now, want of education was the root cause of many of our difficulties. The prognostications made in that speech had been fully justified by recent events.

Coming to the immediate theme of the lecture, Prof. Dewar referred to the disappearance of the barium oxide process of manufacturing oxygen, and its replacement by that involving the fractionation of liquid air. For a time there was no demand for the nitrogen thus liberated, but now it found extensive application in the manufacture of nitric acids and nitrates, of cyanamide, and of ammonia by the Haber process. The German dye manufacturers had exploited the electrical method of fixation and had invested some £3,000,000 in acquiring cheap water-power in Sweden. So much importance was attached to the Haber process in Germany that it had been made a national monopoly, and, in effect, it had been the principal means of enabling that country to satisfy its requirements of explosives during the war. For the Haber process the hydrogen was obtained electrolytically and by freeing water gas from admixed gases with the aid of low temperatures. In this country the total output of the 12 factories manufacturing liquid oxygen was 1 million cub. ft., say 118 tons per day, 85 per cent. of which was used for cutting and welding metals and 15 per cent. for medical purposes: in Germany one plant alone was turning out 100 tons per day.

Liquid oxygen was now much used by airmen flying at high altitudes. For this purpose it is stored in vacuum vessels provided with a mechanism for controlling the evaporation, and with tubes leading to a mouth-piece for the aviator to inhale through. There are three types of mechanism.

In the first, the liquid is heated electrically; in the second, the evaporation is promoted and controlled by thermal conduction through a rod of copper or aluminium in the liquefied gas; in the third the liquid is siphoned out into an evaporating chamber, from which the gas is conducted through tubes—to bring it to air-temperature—to the airman's mouth, the rate of evaporation being controlled by adjusting the conical stop-cock through which the gas is passed.

Liquid air is stored in spherical metallic vacuum vessels holding from 5 to 30 gallons, the high vacuum required being maintained by keeping absorbent charcoal, cooled to the temperature of the liquefied gas, in a chamber attached to the lowest part of the external wall of the inner vessel, whereby the annular space is very highly exhausted. These vessels are very durable, and the rate of loss of material from the largest of them does not exceed 5 per cent. per day.

The lecture was illustrated by numerous experiments, among the most remarkable of which were the demonstration of the magnetic property of liquid oxygen by placing an electro-magnet near drops of it falling from a pipette, these being drawn to the pole in the form of a thin stream: and the stopping of the motion of a radiometer wheel by creating a vacuum around it with liquid air and charcoal, the pressure being reduced to about $\frac{1}{10}$ millionth of an atmosphere.

Speaking of the Royal Institution, Sir J. Dewar said that a few years before the war Prof. Haber had paid it a visit with the object of studying the best means of establishing similar institutions in Germany, as there it was felt that many of the research workers were too much dominated by manufacturing and academic influences. Since then five or six Kaiser Wilhelm Institutes had been founded on the model of the Royal Institution. The latter had always been conducted on individualistic lines, being maintained by the members, and at an average cost of not more than £1200 per annum during the first 100 years; he feared for its security now that State interference was the order of the day. Although the endowments had increased six-fold during his tenure of office, there had been a very serious fall in the membership during the war, and he hoped that both increased endowments and a large influx of new members would be forthcoming to enable the Institute to carry on its work to the fullest advantage.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

At the meeting held on January 21, a paper was read by Messrs. A. Campbell and W. J. Wilson on "Paraffin Wax and its Manufacture."

In this paper the authors gave a general historical account of the discovery, constitution and uses of paraffin wax, and then dealt with the process of manufacture and its development from the early stages (prior to the original patent of John Hodges in 1871 in which the present methods of "Sweating" had their birth) down to the efficient process in use at the present day, in which the wax is handled with a minimum amount of labour as compared with the large amount necessary when the old system of cake sweating was in vogue.

Paraffin wax does not assume the crystalline form, which ensures its easy separation from the accompanying oil, until after distillation, when the crystalline paraffin comes over in the distillates after the kerosene, the lower melting wax coming over with the lower distillates, and the higher melting wax coming over at the end of the distillation. The crude scale is separated from these paraffinoid fractions by means of filter presses working at definite temperatures, the operation usually being carried out in two stages, one much cooler than the other: a scale of higher melting point being obtained from the higher temperature pressing, than in the lower.

On the question of the sweating of these two separate fractions, the authors gave a detailed account of experiments performed both in sweating the two fractions separately and in sweating them when mixed in the proportions obtained. The main result of the investigation was that sweating of the total scale produced a much greater yield of white paraffin in less time than the treatment of the hard and soft scales separately.

Corrigendum.—British Association of Chemists, p. 474 R (1918), line 37 from top: for "Institute" read "National Union of Scientific Workers."

PERSONALIA.

Dr. F. L. Pyman, at present Director of the Wellcome Chemical Research Laboratories, has been appointed Professor of Technological Chemistry in the Manchester Municipal College of Technology, and in the University of Manchester.

Dr. O. E. Mott, O.B.E., Chief Chemist at H.M. Factory, Site "B," Oldbury, will shortly join the research staff of Boot's Pure Drug Co., Ltd., as head of the Technical Research Laboratory.

Dr. E. K. Muspratt has been appointed Hon. President of the United Alkali Co., Ltd., on the occasion of his retirement from active participation in its affairs.

The death is announced of Captain A. Gemmell from the effects of lethal gases. Captain Gemmell was an analytical chemist by profession. In 1917 he entered the Anti-gas Department of the Royal Engineers, and undertook research work on poison gases under the late Col. E. F. Harrison, who died from a similar cause.

Messrs. W. G. Gardiner and F. C. Gardiner, Glasgow shipowners, have presented £60,000 to the University of Glasgow for the foundation of professorships in organic chemistry, physiological chemistry, and in bacteriology. The stipend attached to each post is £1000 per annum.

Among the recent recipients of the Order of the British Empire were: *Commanders* (C.B.E.), Mr. G. C. Clayton, director of the United Alkali Co., and Mr. W. E. J. Wood, President of the Society of Glass Technology, chairman and managing director of the Derby Crown Glass Co., etc. *Members* (M.B.E.), Dr. A. Rule, late superintendent H.M. Wood Distillation Factories, Ministry of Munitions, and Mr. A. Stevenson, Chief Chemical and Technical Assistant in the Optical Munitions Department, Ministry of Munitions.

A letter signed by the President and the Registrar of the Institute of Chemistry has been addressed to Mr. K. B. Quinan, of the Ministry of Munitions (Department of Explosives Supplies), thanking him for the valuable services he has rendered to the Empire and the Allies during the war, and not least for the excellent technical training which he initiated for chemists engaged under the Department. In his reply, Mr. Quinan records his deep appreciation of the unswerving loyalty and support he has always received from chemists and other scientific men, and states his conviction that the past four years have completely altered the position of the chemist in Great Britain. He predicts that manufacturers will now see the urgency of the need for highly trained chemical supervision of manufacture, and also that the chemists and the teaching institutions will view their obligations to industry in an entirely new light.

NEWS AND NOTES.

CANADA.

A Rich Asbestos Find.—A rich asbestos deposit has been discovered at Lake Frontier, Montmagny County, in the Province of Quebec. Asbestos recently reached record figures both in value and tonnage, the average price per ton being $52·45 against $38·87 in the previous year. The total quantity of asbestos-bearing rock mined and hoisted was 2,634,410 tons. The value of asbestos extracted from it, counting stocks on hand at the end of the year, was $8,120,409. This represents a value of $3·08 of asbestos extracted from each ton of rock.—(*Official.*)

Standardising Dairy Products.—At a recent session of the Dominion Dairy Conference held in Ottawa, the Canadian Dairy Commissioner announced the intention of the Federal Department of Agriculture to organise a Dairy Research Division, which should investigate the scientific problems constantly arising in the manufacture of dairy products. It was decided that the Council should be composed of two representatives from each province of the Dominion, with power to add to its number.

Lignite in Western Canada.—The Lignite Utilisation Board of Canada recently issued a bulletin giving some details concerning its work for the information of those who may become interested in a business way in the project. The Board was created by an Order-in-Council of the Dominion of Canada, and by supplementary agreement $400,000 was appropriated for its use. The Order sets forth the reasons for the creation of the Board: "That there are large deposits of lignite underlying various districts of the Provinces of Saskatchewan and Alberta, some of which, in the raw state, can only be utilised when freshly mined, and are, moreover, unsuited in such state to household use; that by carbonising this lignite, a coke or charcoal is obtained which briquettes readily and, without consideration of the by-products such as oil, pitch, ammonia sulphate, gas, etc., the result is to turn two tons of inferior fuel into one ton of briquettes approximating, in heating value, anthracite coal with practically the same heating value in the domestic furnace as the two tons from which it was made."

At the present time two engineers in the employ of the Utilisation Board are investigating every plant, method and type of machinery in the United States and Canada which have to do with binders, carbonisers, briquetting and heat treatment of coals. The plant is to be constructed in southern Saskatchewan, of a capacity of not less than ten tons per hour, and it is expected that by the spring of 1920 the new demonstration plant will be in full operation, and that a successful outcome will result in the establishing of an industry of national importance.

Shipment of Wheat from Vancouver to Great Britain. A bulletin prepared by F. J. Birchard and A. W. Alcock has been recently issued from the Department of Trade and Commerce, Ottawa, recording the experimental work undertaken by the Department of Trade and Commerce through the agency of its Grain Research Laboratory to determine the feasibility of shipping grain from Vancouver *via* the Panama Canal to the United Kingdom. All the grain was carefully selected and examined previous to shipment, and a representative of the Laboratory accompanied the shipment in order to make the necessary observations *en route*. The grain used and the arrangement of the cargo are described, and the placing of the electric resistance thermometers in the grain is outlined and illustrated by the use of numerous diagrams. The data obtained are tabulated, and it is concluded that if sound grain containing probably not more than 14·5 per cent. water is kept free from water, and the portions near the stokehold kept cool by ventilation, the cargo will probably arrive at its destination in good condition. It is recommended that further trials be made.

SOUTH AFRICA.

Industrial Developments, etc.—The manufacture of fertilisers has been commenced at Parow, Cape Province.

A Johannesburg company proposes to establish a factory in Pretoria for the manufacture of starch, glucose, sago and tapioca. If sufficient raw material can be obtained, the factory is expected to be in a position to manufacture the whole of the South African requirements of these commodities.

According to an Imperial Institute report, sugar-cane wax (which is now being produced at Durban) appears to be quite suitable for the purpose of coating cardboard containers for jam, syrup and other semi-fluid products.

At the annual congress of the Transvaal Agricultural Union, a resolution was passed urging the Government to provide for the erection of an oil-expressing factory, and to institute inquiries concerning the profitable cultivation of oil-bearing seeds and plants in the Transvaal.

A preliminary report issued by the Director of Census, embodying the principal results of the Census of Factories and Productive Industries in the Union for 1916-17, states that the total number of factories engaged in the chemical and allied industries (fertilisers, by-products, paints, varnishes, etc.) was 90. Of these, 37 were situated in the Cape, 21 in Natal, 31 in the Transvaal and 1 in the Orange Free State.

According to an American paper, a representative of the Walmer Papyrus Pulp Company, Ltd., has been visiting the United States with a view to securing machinery for a mill which he proposes to erect in the St. Lucia district of Zululand for the purpose of dealing with the large quantities of papyrus growing in that area. The machinery, which is now ready for shipment to South Africa, will be capable of turning out 20 tons of pulp a day. It is not proposed to undertake the manufacture of paper, but simply the pulp or "half-stuff," which will be exported. The company hopes to begin turning out pulp by March or April, 1919.—(*S. Afr. J. Ind., Sept.*, 1918.)

AUSTRALIA.

Tinplate Manufacture.—Mr. Watt, acting Prime Minister, expects shortly to announce the establishment of the manufacture of tinplate in Australia; hitherto the country has been dependent on overseas supplies.—(*Official.*)

Australian Zinc and Subsidiary Industries.—A review of the development of the zinc and related industries has recently been communicated to the acting Prime Minister of the Commonwealth by the Electrolytic Zinc Company of Australasia, Ltd. Following on the rapid progress of electrolytic zinc processes in Canada and the United States, the Amalgamated Zinc, Ltd., turned its attention to the establishment of this industry in Australia, where in pre-war days zinc concentrates equivalent to 200,000 tons of spelter were exported annually. The Zinc Corporation, Ltd., joined the project later and the Electrolytic Zinc Company of Australasia, Ltd., was formed. Operations were started in January, 1917, at Risdon, near Hobart, Tasmania, where hydro-electric power was available. Production commenced in March and an output of 25,000 lb. per day has now been reached. The product has a purity exceeding 99·9 per cent. and is suitable for all classes of high grade work.

The zinc concentrates are being de-sulphurised at Broken Hill and sulphuric acid to the extent of 100 tons weekly is being obtained by this means. The calcined ore is then shipped direct to Tasmania and the ships are loaded back with Tasmanian timber, thus affording assistance to the latter industry which is now supplying 250,000 super. feet per month to the Port Pirie smelters and to the Broken Hill mines. Over £300,000 has already been spent by the Electrolytic Zinc Company and further large expenditure is anticipated in order to establish the production of other zinc derivatives—lithopone, zinc oxide, alloys and salts. As soon as additional supplies of electric power become available it is proposed to undertake other electro-chemical processes, such as the production of aluminium, caustic soda, chlorine and bleaching powder.—(*Bd. of Trade J., Jan.* 9, 1919.)

JAPAN.

The Chemical Industry Exhibition.—The Chemical Industry Association has decided to hold the second exhibition in Uyeno Park, Tokyo, in 1921, during the ten weeks beginning March 16. Mr. K. Uchida, late vice-minister of the Department of Communications and actual president of the Association, has left for the United States to make arrangements for the participation of American manufacturers. Among the exhibits will be raw materials from China, Siberia and other Eastern countries.

The Japanese Potato Starch Industry.—Last year the export trade in Japanese farina or potato-starch was very brisk, and farmers were encouraged to increase the area of land under potatoes. There are now over 200,000 acres under cultivation. In 1917 about 80,000 tons of starch was exported, and the production for the present year, although reduced somewhat by the outbreak of potato disease, is expected to reach 100,000 tons. Export prospects are far from bright owing to freight difficulties and to the prohibition of imports to both Great Britain and United States. As, however, prices continue firm, it is suspected that certain speculative transactions are holding up the market.—(*U.S. Com. Rep., Nov.* 1, 1918.)

Potassium Chlorate Industry in Japan.—Potassium chlorate was first made in Japan in 1908, but it was not till 1912 that any considerable quantity appeared on the market. During the war, the increase in prices stimulated the production very greatly, but overproduction, high freights and shipping difficulties are now causing considerable depression. The trade now depends chiefly upon exports to the United States and to South America.

At the end of 1917, there were 49 factories engaged in the manufacture, the capital represented being 6,000,000 yen. The total capacity amounted to 10,000 tons a year but the production was only 6000 tons, 60 per cent. of which was made by 3 factories. The average domestic consumption of the product is about 3700 tons. Prices are still high, £5 per barrel being quoted in October last, as against 25*s.* before the war (see also this J., 1918, 320 R).—(*Bd. of Trade J., Jan.* 9, 1919.)

UNITED STATES.

Output of Manganese Ore.—According to reports received by the Geological Survey, a great increase in the output of domestic manganese ore has recently been effected. Whereas in 1917 only one-sixth of the home requirements of high grade ore was produced, the supply now amounts to nearly one-third. The shipments of ore containing above 35 per cent. of manganese were 136,554 tons during the first six months of 1918, and the total for the year will probably be about 324,000 tons. The shipments of ore containing 10—35 per cent. metal are estimated at 832,868 tons for the whole year.

Sterilisation by Pressure.—Prof. B. H. Hite has experimented on the influence of high pressures upon bacteria and has found that even a momentary pressure of two hundred atmospheres will kill them. There is a possible large scale application of his work to the sterilisation of milk etc., where under present methods the taste is affected and chemical changes are liable to occur.

Proposed New Chemical Museum.—The possibility of establishing a chemical museum of a new sort has recently been discussed. When the war shut out many organic chemicals needed for research, those engaged in making them were handicapped through the lack of type samples for study and comparison. It is suggested that a reasonable quantity of every chemical obtainable be filed with data, and that as new compounds are discovered they be added to the collection. We would have, therefore, a materialistic Beilstein which could always be drawn upon as needed. Those interested in the plan fully realise the difficulty of keeping some compounds, and our lack of knowledge regarding the ultimate decomposition and rate of decomposition of many of them. A number of isolated and very incomplete collections already exist.

GENERAL.

The Government Dye Scheme.—In accordance with the provisions of the memorandum relating to the Government scheme for assisting the dye industry, the Board of Trade has appointed the following as members of the Trade and Licensing Committee:—Lord Colwyn, chairman; Messrs. H. Allen, Milton S. Sharp, and Lennox B. Lee, nominated by the Colour Users' Committee; Mr. T. Taylor, nominated by the National Federation of Associations of Paint, Colour and Varnish Manufacturers; Mr. J. Turner and Dr. H. Levinstein, nominated jointly by British Dyes, Ltd., and Levinstein, Ltd.; Mr. W. J. U. Woolcock, nominated by the Association of British Chemical Manufacturers; Mr. W. H. Dawson, nominated by the President of the Board of Trade. The secretary of the Committee is Mr. W. Graham, of the Board of Trade (7, Whitehall Gardens, S.W. 1), to whom all communications should be addressed. The functions of the above Committee were set out in our issue of November 30 last, p. 429 R.

Chemists: Pivotal Men.—With regard to the release of pivotal men from the forces for employment as chemists, the Demobilisation and Resettlement Department of the Ministry of Labour has authorised the Institute of Chemistry to assist in the selection of names of chemists (professional consulting, analytical and research) whose prompt return to civil life will prove of the most value to the country for the purposes of reconstruction and absorption of unemployed labour. The Institute is asked to select officers and men who can be classed as pivotal, preference being given to those with the longest service and to married over single men. Works chemists are not to be included in the selection, as their employers are required to apply for them under the industry in which they are engaged. The names of selected men will be forwarded by the Registrar of the Institute to the Department of Demobilisation.

Scientific Research Association.—In order that the interests of pure science may not be lost sight of amongst the increased activities of applied science which have resulted from the war, the formation of an Association having the above title has been proposed. Many eminent men of science have notified their adherence to the proposal the aims of which are defined as follows:—(1) To be prepared to offer advice and information to those who wish to

devote themselves to scientific research. (2) To be prepared to give advice to bodies administering public funds for research as to the most useful ways in which such funds could be applied. (3) To impress upon the attention of the public the importance of scientific research, and thus to promote a wider understanding of the fundamental value of scientific method. (4) To consider the possibility of organising a scheme of permanent national endowment so as to afford opportunities for young and promising students to establish themselves in research work, and to secure to the ablest of these the possibility of a career devoted mainly to the continued pursuit of scientific investigation. By keeping in touch with all workers in science the Association hopes to be able to render collaboration easier and to avoid unnecessary duplication of work. All persons over 21 years of age who have published research or who are engaged in research for publication are to be eligible for membership, and all others who are interested are also to be eligible as associate members.

The Association is to be governed by a President and Council, and Subject, General Purposes and Propaganda Committees are to be formed. The promotors disclaim the idea of interference with any existing body, or that the activities of the proposed organisation are to be limited to Cambridge although the first steps were taken there. Copies of literature on the subject and forms of application for membership may be obtained from Mr. A. G. Tansley, Acting Secretary, Grantchester, Cambridge.

Indian Indigo Crop Forecast, 1918-19.—The Director of Statistics, in a forecast issued on October 17, 1918, estimates the total area sown with indigo in British India at 280,500 acres, a decrease of 55 per cent. on the revised estimate of last year. The total yield of dye is now roughly estimated at 32,100 cwts., as compared with 87,800 cwts. forecasted last year. Weather conditions at sowing time were unsuitable owing to deficient rainfall, and the condition of the crop, on the whole, is only fair.—(*Bd. of Trade J., Jan.* 9, 1919.)

Indian Industries during the War.—In a statement submitted to the Imperial Legislative Council by the Hon. Sir G. Barnes, it is recorded that with the co-operation of the Government a number of new industries have been started during the war. These include, caustic soda, magnesium chloride, thymol, sandalwood oil, copperas, zinc chloride and refined nitre. Ferro-manganese is being produced in large quantities and has even been exported. The manufacture of micanite has been taken in hand by a private firm and by the East Indian Railway. The production of silica bricks for lining furnaces has progressed so far that India will soon be independent of foreign supplies. There has been an immense increase in the output of industries which were already established before the war, *e.g.*, the output of steel ingots by Messrs. Tata Sons and Co. has doubled since 1913, and excellent progress has been made in the glass and coir industries, and in the exploitation of indigenous tanning materials. The expansion in output of the Ordnance Factories, since the Munitions Board assumed control in January 1918, has been very great, and a large scheme for extension is now being carried out at a cost of about £500,000. This, with the new acetone factory at Nasik, will render the country less dependent on outside supplies of military stores. The extension of the works of the Tata Iron and Steel Co. at Sakchi has increased the annual steel capacity to 200,000 tons. Considerable success has attended the special attention given to the manufacture of anti-friction metal, ferro-manganese, glass, pottery, refractory bricks, disinfecting fluids, asbestos boiler composition, glucose, coir articles, and graphite crucibles; and plans are already advanced for the establishment of the following new industries:—Distillation of coal tar, manufacture of galvanised sheets and tin plates, refining of copper and zinc, construction of electric furnaces for making steel castings and ferro-alloys, and various engineering enterprises.—(*Bd. of Trade J., Jan.* 2, 1919.)

Mineral Wealth of Finland.—Very important discoveries of iron ore have been notified at Jussarö and on the northern Ladoga lake near Pitkäranta. In the latter district mining was already in progress in 1820, but after many ups and downs was abandoned in 1904. During that period about 250,000 metric tons of iron ore was mined, in addition to some silver, copper and tin. The presence of ores of molybdenum, bismuth and tungsten was also proved. In other parts of Finland there are deposits of limonite, 60,000 tons of which was mined in 1891. Large copper deposits occur in Orijärvi as well as in Lappland where they have never been worked. Finland is also very rich in first quality building stones particularly in granite, and these occur near the sea. The clay and limestone deposits should be of great value to the cement industry, which is yet in its infancy; and the large areas of peat should in the future acquire great industrial importance.—(*Z. angew. Chem., Nov.* 22, 1918.)

Reconstruction of French Iron and Steel Industry.—A new company called "La Société Corporative des Mines de Fer et de la Siderurgie des Régions Sinistrées" has been formed in France. The capital amounting to 1,000,000 francs is held by the chief iron and steel companies of the invaded regions. The company is affiliated with the "Comptoir Central d'Achats Industriels pour les Régions Envahies" to which it acts as a technical commission. The Société is collecting all the detailed information necessary for compiling estimates of the material and plant required for the restoration of the damaged mines and steel works. From these estimates a programme of reconstruction will be drawn up and handed over to the Comptoir Central for execution. Some idea of the magnitude of the undertaking can be gathered from the fact that before the war the invaded provinces accounted for 90 per cent. of the French iron ore ouput, 86 per cent. of the pig iron and 74 per cent. of the steel production. The 1913 figures for total French outputs were:—Iron ore, 21,714,000 tons; pig iron, 5,300,000 tons; steel ingots, 4,600,000 tons. It is expected that a large amount of equipment for the mines and furnaces will be obtained from the United States.—(*U.S. Con. Rep., Nov.* 13, 1918, *and Bd. of Trade J., Dec.* 19, 1918.)

The German Iron Industry.—Notwithstanding the secrecy with which all production figures are now kept, it is quite certain that the German iron production has fallen off considerably during the war. The annual outputs are given as follows (in metric tons):—1913, 19,310,000; 1914, 14,383,000; 1915, 11,785,000; 1916, 13,150,000; and 1917, 11,000,000. The last figure is an estimate and is thought to be far too high.

The Government is encouraging the continuance of the Steel Syndicates, such as the Stahlwerks Verband, as being the best protection for the industry during the transition period. Germans fears that France may refuse to sell iron ore from the Longwy and Briey basins, in which case German reserves of iron ore will only last about 60 years at the present rate of output of the steel works. No official figures are available for the home prices but the following were in force in October, 1917:—Bar iron 235 marks per ton, sheet 295 marks, and girders 250 marks. The prices for export were considerably higher and at the end of 1917 were about four times the above figures

The object has apparently been to keep the export prices just below the Swedish prices and neutrals have been forced to pay these high figures for their essential requirements. Exports, however, have been below normal, and were completely stopped from September, 1916, till April, 1917 During the present year Denmark continues to receive fairly big consignments of ordinary commercial sorts, but practically no shipbuilding materials have been supplied, this being in conformity with Germany's policy to keep the tonnage at the disposal of neutral countries as small as possible.—(*U.S. Com. Rep., Nov.* 12, 1918.)

Chemical Industries in Sweden.—The new rubber factory in Landskrona is to restart operations at the end of 1918. The factory and plant are valued at 300,000 kroner (about £17,000). It is intended, in the first place, to concentrate on the manufacture of "war rubber," for which the demand is very great. The patent to be worked is a Danish one, the Swedish rights of which have been acquired by a syndicate in Stockholm.

The "Elektrolys" company of Stockholm is to manufacture hydrogen peroxide, which is in very short supply in Sweden.

During the years 1914—16 the greatest advances were made in the manufacture of aluminium compounds, caustic soda and bleaching powder, the output of these materials being (in metric tons):—in 1914, 5858, 179 and 426, respectively; in 1916, 17,574, 613 and 1546, respectively. Considerable progress was also made in the production of ammonium compounds (except ammonium sulphate), green vitriol, calcium carbide, caustic potash, chlorate, blue vitriol, sodium sulphate and hydrochloric acid. Among new manufactures were potassium nitrate, nitrobenzene, silicium carbide and trinitrotoluene. On the other hand the production of the following decreased, or in some cases was temporarily abandoned:—Potassium ferricyanide, phosphoric acid, gypsum, washing soda, sodium bisulphate, nitric acid and sulphuric acid.—(*Z. angew. Chem., Nov.* 22, 1918.)

The Swedish Cellulose Industry.—Although the mechanical wood pulp process was working some 13 years before the chemical processes were started, the latter have far outstripped the former, as is shown by comparing the outputs; in 1892 the quantities produced were 40,000 tons of chemical pulp and 46,000 tons of mechanical pulp, whereas in 1915 the figures were 910,000 tons and 306,000 tons respectively. Both the sulphite and sulphate chemical processes are in operation, but the sulphite is predominating. The spirit which forms a by-product of the latter process is becoming an important item. It is estimated that shortly, when a number of new plants are working, an aggregate production of 4,000,000 gallons per annum will be reached, a considerable quantity when compared with the normal benzine import of 5,600,000 galls. Sweden is the largest exporter of cellulose in the world; the total amount exported in 1915 was 722,000 tons, valued at over £5,000,000, of which about one-half was delivered to England.—(*U.S. Com. Rep., Oct.* 24, 1918.)

Chemical Industries in Norway.—Prof. N. Lindeman has recently published the following information concerning the Norwegian chemical industries:—When the big works at Aura and Bjolvefossen reach the production stage, the total potential annual output of cyanamide will reach 7—800,000 metric tons. According to Birkeland and Eyde, 100—120,000 tons of nitric acid could be produced yearly at "Norsk Hydros" in Telemark, but the actual output in 1916 did not exceed 4000 tons as most of it was fixed with lime, soda, or ammonia. Only 46,000 tons of Norwegian saltpetre was exported in 1916, as against 70,000 tons before the war. Norway has become independent of foreign supplies of phosphorus; all she needs for her match industry (the output of which was valued at 4·4 million kroner in 1915) is made in two factories by the electric furnace method. There is one factory producing zinc white and white lead, of which no less than 2400 tons was imported in 1916, and a new establishment is now making titanium white from indigenous materials. A single factory is producing, from native material, sufficient aluminium sulphate to meet the country's requirements (about 3000 tons in 1916). Factories in Frederikstad and Vadeim are turning out metallic sodium; they exported 600 tons of the metal, and also 280 tons of potassium chlorate, in 1916. There are eight factories making ferrosilicon, of which 25,000 tons was exported in 1916, while the whole production in 1911 was only 5700 tons. The exports of ferro-chrome fell from 33,000 tons in 1915 to 2900 tons in 1916. The smelting of aluminium is an industry of great importance. Of the four factories, the largest, in Höivaag, will shortly start working, and all of them use, or will use, imported raw materials. Copper and nickel are produced electrolytically in Kristiansands; 700 tons of nickel was exported in 1916. Tin is recovered from scrap in Stavanger. Norway's dependence upon foreign countries for electrodes is diminishing; only 300 tons was imported in 1916. The estimated value of the Norwegian electrochemical products was 89 million kr. in 1911, 134 million in 1913, and 368 million in 1916 (krone = 1*s.* 1⅛*d.*).—(*Z. angew. Chem., Nov.* 1, 1918.)

Salt, Bromine and Calcium Chloride in the U.S.A.—The supplies of salt in the United States are more than sufficient to meet the requirements. In 1917 these amounted to seven million short tons, valued at £4,000,000, an increase of 10 per cent. in quantity and 46 per cent. in value over the previous year. The higher cost was largely due to higher wages and dearer fuel. The relative proportions of the different grades of salt produced in 1917 were: Rock salt, 1,605,025 short tons, mined by 18 firms in 8 States, chiefly in New York and Kansas; brine salt 5,373,152 tons, chiefly from Michigan, New York, Kansas and California. Of the brine salt, 688,022 tons were for table and dairy use, 1,542,087 tons common packer's salt, both fine and coarse, 159,361 tons coarse, solar evaporated salt, 93,094 tons pressed blocks, etc., and 2,890,588 tons were sold for brine. The quantity of brine used by chemical works shows an increase. Three million tons of brine salt was used in the manufacture of salt-cake, soda ash, caustic soda, sodium bicarbonate, carbonate, acetate, chlorate, phosphate and silicate, Glauber's salt, calcium chloride, chlorine and hydrochloric acid. The consumption of domestic salt averaged 140 lb. per head in 1917. About 66,000 tons of salt were imported into the United States in 1917, about half of this being from the British West Indies and one-quarter of it from England. Most of the imported salt is coarse, solar evaporated salt used for curing fish and meat. About 114,000 tons of salt were imported in 1917, more than 90 per cent. of it going to Canada, Cuba and Mexico. A great increase occurred in the amounts exported to Newfoundland, Labrador, Jamaica, Dominica and other West Indies. A considerable quantity is also exported to Japan, Australia and New Zealand.

About 450 short tons of bromine with a value of £100,000 was derived in 1917 from the bittern left after extracting the salt from the brine wells of Michigan, Ohio and West Virginia. The production was retarded by steadily increased costs.

Three processes are employed for extracting bromine: (1) The intermittent process in which the bittern is concentrated to a sp. gr. 1·37—1·4 Bé,

and is then distilled with sodium chlorate and sulphuric acid in sandstone stills holding 400 to 1200 gallons, a jet of steam being used as the heating agent. The resulting gas is freed from chlorine by passing it through washers containing milk of lime, and the bromine is condensed and collected in glass or stoneware receptacles.

(ii) The "continuous process" in which chlorine gas is passed through bromine-bearing brine, the bromine liberated being then removed by a current of air and passed over iron filings to convert it into ferric bromide. This is dissolved in water and treated with sodium, potassium or ammonium hydroxide, the ferric hydroxide is separated and the solution evaporated until the bromide crystallises out.

(iii) The electrolytic process, in which the brine is subjected in wooden tanks to a current of 4 to 5 volts applied through carbon electrodes. The electrolysed liquor trickles down a lattice work and the bromine is removed by a counter-current of air which is then passed through water and the resulting solution is converted into ferric bromide.

About 30,000 short tons of calcium chloride with a value of £90,000 were made from brine in 1917 in Michigan, Ohio, West Virginia and California; an increase of 10 per cent. over 1916. This is in addition to the large quantities obtained as a by-product in the ammonia-soda process in New York, Michigan, Ohio, Kansas and Virginia. Calcium chloride in solution is largely used as the circulating fluid in refrigerating apparatus, in the water-jackets of motor cars, in automatic sprinklers and in fire-buckets. In the solid state, it is used for laying dust, drying gases, vegetables and fruit and in dehydrating organic liquids. When prepared from brine, the bittern is heated, treated with milk of lime and the clear liquid is decanted and evaporated until all the salt crystallises out. The liquid is then evaporated to dryness and the residue is run into metal drums where it solidifies.—(*U.S. Geol. Surv., Aug.*, 1918.)

Casein in Soap.—Casein is recommended for use in the manufacture of toilet soaps owing to its favourable action on the skin, although it does not appreciably add to the detergent power of soap. It is soluble in alkaline lyes, and in hot process soaps is incorporated as follows: In a steam-jacketed vessel 25 kilos. of casein is covered with an equal weight of cold water, and allowed to soak. A solution containing 1 kilo. borax in 50 litres of water is then added, and the whole heated and stirred. As soon as the casein is dissolved, 1 kilo. of 30—32° Be. soda lyes made up to several litres in boiling water is added, and heating continued without bringing the mass to boiling point. The paste thus obtained is thoroughly incorporated with the hot soap before it goes to the frames. The soap is really a "milk soap" and on this account is recommended for the toilet. The exact quantity of casein required for one operation should only be prepared at a time, as it does not keep in a moist condition; antiseptic essences such as cloves, cinnamon, citronella, however, help to preserve it. In the case of soap powders, the casein in powdered form is mixed with the dried soap chips before they are ground, forming a homogeneous mass which is easy to work. It should not be used with neutral soaps or soaps slightly acid as it provokes rancidity and tends to deteriorate. It has soothing properties, gives an agreeable texture to the soap, often improves the bad odour of fat, and in ordinary times is cheaper than fat.—(*Parfumerie Moderne, Sept.*, 1918.)

Nationalisation of Lignite Mines in Greece.—The lignite mines at Florina are to become State property. This is the first step towards the acquisition by the State of all the mines in Greece.—(*Messager d'Athènes, Sept.* 19, 1918.)

Superphosphate Manufacture in Russia.—The Russian Department of Industry has planned the erection of a superphosphate factory to be associated with the State chemical factories in the Volga and Kama district. For this purpose the Soviet for Industrial Affairs has passed a credit of 2 million roubles.—(*Z. angew. Chem., Nov.* 22, 1918.)

Radium Ore in Devonshire.—A correspondent to *The Times* (January 18) states that an important discovery of pitchblende has been made on the Kingswood estate, Buckfastleigh, Devon, by the present landowner, Mr. F. Sykes. Analysis of a representative sample by Dr. H. Terry, of University College, London, shows a uranium oxide content of over 26 per cent. Preparations are being made for working the lode on a large scale.

LEGAL INTELLIGENCE.

SUPPLY OF ROAD-SPRAYING MATERIAL. *Bristowe and Co., Ltd., and Abbott and Co.* v. *The Gas Light and Coke Company.*

In the King's Bench Division, on November 28 last, Lord Coleridge heard consolidated actions, in which the plaintiffs claimed damages in respect of loss or damage occasioned through the supply by the defendants from their Beckton Works of a barrel of cyanogen gas liquor as one of a lot of 32 barrels of "Tarvia," which is a preparation of tar used for road dressing. In the course of road dressing operations at Wanstead, the plaintiffs' workmen were emptying the barrels of "Tarvia," as required, into a boiler in which it was heated preparatory to spraying on the road surface. When the barrel, which was found by subsequent analysis to contain cyanogen gas liquor instead of "Tarvia," was emptied into the boiler, in which there was already hot "Tarvia," the latter was caused by the violent generation of steam to froth over from the boiler. The overflowing "Tarvia" caught fire from the fire-box beneath, and a trolley, horse and other property were burnt by it.

The defendants pleaded that the barrel containing the gas liquor had not been supplied from their works, and that, if it had, the plaintiffs should have discovered the mistake, as the barrel was coloured and marked differently from the barrels containing "Tarvia."

His Lordship, after hearing evidence, found for the plaintiffs, and awarded them £166 as damages.

PHOSPHATE CONTRACTS WITH ENEMY SUBJECTS. *D. T. Boyd and W. A. Pratt* v. *Beer, Sondheimer and Co. D. T. Boyd and Co.* v. *Chemische Fabrik "Honnigen" and its Successor, Chemische Fabrik "Rhenania."*

On December 18 last, the plaintiffs brought an action in the King's Bench Division against the defendant company of Frankfort, Germany, claiming declarations that a contract made in May, 1914, for the sale of a total of 18,700 tons of Florida phosphate, to be shipped in the autumn of 1915 and in succeeding years up to 1920 to Bremerhaven, was dissolved by reason of the outbreak of war between England and Germany. The case was brought under the Legal Proceedings Against Enemies Act, 1915.

Mr. Pratt said that if he had had to carry out this contract he could not have supplied the Government as he had done during the war. If they had to deliver within six months after the war they would have the greatest difficulty in finding the necessary freight room; freights had risen from 14*s.*—15*s.* to £7—£8 per ton, and the American railroads had put up their rates.

Mr. Justice Bray said it would be against public policy for the plaintiffs to have this contract hanging over their heads, as the Germans could use

such contracts to their advantage by denuding themselves of their phosphates, knowing that they had got this contract still in existence. This case was completely covered by the Rio Tinto case (this J., 1918, 77 R), where it was decided that the contract could not be split in two, one to apply during the war and one afterwards. The defendant company maintained that by German law the parties were bound to go to arbitration, but he had no reason to suppose that such a law existed. The plaintiffs were entitled to the declarations, but there would be no order for costs.

The second case, involving the supply of 3000 tons of phosphate rock, was similar to the above, and was undefended. His Lordship granted the declarations asked for.

BORAX CONTRACTS WITH ENEMY SUBJECTS. *Borax Consolidated, Ltd.* v. *Vogel and Others.*

In the King's Bench Division, on January 15, Mr. Justice Roche made declarations that contracts between Borax Consolidated, Ltd., and nine German and Austrian firms for the supply of crude material for the manufacture of borax and boric acid, were abrogated and avoided since the outbreak of war under the Legal Proceedings against Enemies Act.

According to the *Chemiker Zeitung*, said counsel for plaintiff company, a precisely similar process had been adopted in Germany. This journal stated that all contracts for delivery made before the war or prolonged during the war which related to overseas goods were to be considered according to a judgment of the Imperial Supreme Court of October 15, 1918, as abrogated in consequence of the complete revolution in all the conditions of commercial intercourse. Therefore on a different ground and in a different way they had arrived at the same result.

Mr. T. W. Daniells, joint manager of the company, said that, judging from the price, there appeared to be only a very small supply of raw material in Germany for the manufacture of borax. The price of the refined product in Germany was £180 a ton as against £40 in England. Before the war the price was £17 to £20.

SULPHURIC ACID CONTRACT. *E. Packard and Co.* v. *S. J. Feldman and R. Partridge.*

In the Court of Appeal, on January 14, 15, the defendants in the above action appealed from a decision given in favour of the plaintiffs by Mr. Justice Roche, in July last, who awarded them damages for breach by the defendants of a contract to take delivery of sulphuric acid (see this J., 1918, 366 R).

Lord Justice Bankes, in the course of his judgment, said that he agreed with Mr. Justice Roche that at the interview between the parties in June, they were merely contracting about a temporary arrangement (*viz.*, that the plaintiffs should supply the acid to the Ministry of Munitions), and that the defendants were wrong in saying that they had the right to continue the arrangement as long as they pleased. It appeared, however, from the correspondence that plaintiffs were not anxious for the defendants to take delivery, because they were not satisfied with the latter's financial position. Plaintiffs consented to a course which allowed of the continuance of the arrangement originally intended to be temporary, but which actually continued until the expiration of the period covered by the contract; in fact, both parties were willing for business reasons that the temporary arrangement should continue. It did continue, and there was no breach of the contract as originally made, and as varied by the originally intended temporary arrangement in June.

Lords Justices Warrington and Duke concurring, the appeal was allowed, and judgment entered for the defendants with costs.

REPORT.

MINES AND QUARRIES: GENERAL REPORT, WITH STATISTICS, 1917. *By the* CHIEF INSPECTOR OF MINES. PT. I.—DIVISIONAL STATISTICS AND REPORTS (Cd. 9120). PT. II.—LABOUR [4*d.*]. PT. III.—OUTPUT [3*d.*]. [H.M. Stationery Office.]

LABOUR. There were 8047 mines and quarries working during the year 1917, a decrease of 744 on the previous year, but the number of workers increased from 1,065,714 to 1,085,471. This last total was made up of:—Males underground 852,433, males aboveground 221,416, females aboveground 11,622.

Considering the various industries, we find that the bulk (92·7%) of the total workers was employed in coal mining, the remainder being distributed as follows:—Iron ore, 1·95%; limestone, 1·30%; igneous rocks, 0·87%; clay and brick earth, 0·60%; oil shale, 0·47%; sandstone, 0·47%; tin ore, 0·46%; slate, 0·35%; lead and zinc ores, 0·28%; other minerals, 0·55%. During the year there were 83 explosions of firedamp or coal dust resulting in 20 deaths and 111 persons injured.

Laboratory Research Work has been carried out at Eskmeals on (1) The propagation of flames of firedamp-air mixtures through tubes of small diameter. (2) The igniting power of sparks from magneto exploders and magneto telephones. (3) The ignition of firedamp-air mixtures by sparks from rocks and tools. The first research has been completed during the year, the remaining two are in progress.

There has been an increase in the use of coal cutting machinery, especially in Scotland, Yorkshire and North Midlands. The number of machines in use was 3799 (3459 in 1916) consisting of 1739 electrical and 2060 pneumatic. The quantity of coal won by machine cutters was 28,196,486 tons.

OUTPUT. The statistics of outputs compared with those of 1916 (see this Journal, 1918, 436 R) show an important decline in the coal production of nearly 8,000,000 tons but an increase in value of nearly £8,000,000. The production of iron ore was higher by 1,300,000 tons, and oil shale and salt from brine show small increases. On the other hand there were noticeable declines in the output of barium compounds, chalk, sandstone, and slate. Generally speaking, the quantities of the other minerals are of the same order as in the previous year with a tendency towards decline.

Coal and Coke. Of the 248,499,240 tons of coal produced the following amount was exported:—

	Tons.
As coal	34,995,787
1,278,646 tons coke equivalent to	2,131,077
1,526,272 tons manufact. fuel equivalent to	1,373,645
Bunkers for ships engaged in Foreign Trade	10,227,952
	48,728,461

Leaving 199,770,779 tons for home consumption, or 4·725 tons per head of the civil population. The percentage of the output shipped abroad continues to diminish being now 19·6; last year it was 21·5, while in 1913 it was as high as 34·2. As in the previous year the largest foreign buyer was France, who received over 17½ million tons; Italy took over 4 million and Norway and Russia over 1 million tons each.

Taking the statistics for the last 45 years (1873—1917), it is found that coal accounts for 85·4% of the total value of minerals raised (£4,273,436,842). The average pit-head prices for coal show considerable increases:—England, 16*s.* 1·6*d.*; Wales, 20*s.* 5·6*d.*; Scotland, 15*s.* 7·4*d.*; Ireland, 18*s.* 2·7*d.*; average price for the whole of the United Kingdom, 16*s.* 8·7*d.* (15*s.* 7·2*d.* for 1916). The total quantity of

coal carbonised was 39,300,504 tons, made up of 8,440,074 tons at gas works and 13,555,051 tons at coke ovens (in 1916, 37,624,162 tons were carbonised). As regards the number and kind of coke ovens in operation, it is noticeable that the proportion of beehive ovens (42·4% of the total) remains practically the same as in 1916, and that in actual numbers they have increased from 6892 to 7013. The total number of ovens was 16,540 against 16,320 in 1916. The briquetting industry shows a small decline in the quantity of coal used (1,681,253 tons in 1917 against 1,760,717 in 1916) with a slight rise in the value of the products. In terms of coal used South Wales accounts for 89% of the total production.

Copper. From the 11594 tons of ore mined, 187 tons of metal was obtained. The ore was therefore much poorer than in the previous year when 1028 tons yielded 278 tons of metal. During the year the imports were 16,554 tons ore; 28,238 tons regulus; and 145,392 tons metal (wrought and unwrought), while over 13,000 tons of metal was exported.

Iron. The following table gives the statistics for the chief centres of production of iron ores:—

County	Quantity	Price per ton
Under the Coal Mines Act (average 30% of iron)—	Tons	*s. d.*
Northampton... ...	135,884	3 5
Stafford (North) ...	754,061	13 6
York (N. Riding) ...	4,821,596	7 8
Ayr	124,852	22 5
Lanark	83,717	20 10
Renfrew and Inverness	114,490	11 9
Under the Metalliferous Mines Regulation Act—		Per cent. of iron
Cumberland	1,261,002	52·16
Gloucester	22,990	35·35
Glamorgan	54,930	51·00
Lancaster	308,312	51·07
From Quarries—		
Leicester	697,353	26·18
Lincoln	3,301,258	25·05
Northampton	2,269,410	32·10
Oxford and Rutland...	525,848	31·77

The following figures show the quantities of iron ore available for the furnaces of Great Britain:—

Total ore from mines and quarries in United Kingdom	14,845,734 tons.
Foreign ore imported (chiefly from Spain)	6,189,655 ,,
"Purple ore" (cinders from cupreous iron pyrites)	640,681 ,,
Total (less 667 tons exported)	21,675,403 ,,

Pig iron production	1917	1916
Works in operation ...	118	115
Furnaces built	487	485
Furnaces in blast ...	318	294
Pig iron made	9,338,104 tons	8,919,469 tons
Iron ore used (including cinders)	22,901,714 ,,	21,505,556 ,,
Coal used	2,816,318 ,,	2,612,543 ,,
Coke used	10,961,784 ,,	10,300,888 ,,

The average prices of pig iron during the year were:—Cleveland No. 3, quarterly ascertained prices, £4 17*s.* 4*d.*, quoted prices, £5 1*s.* 2*d.*; and all kinds of pig iron exported, £9 4*s.* 7*d.*

Iron Pyrites. In addition to the 8515 tons of native iron pyrites, 854,241 tons (chiefly cupreous iron pyrites) was imported.

Lead. The 15,322 tons of dressed lead ore yielded 11,250 tons of lead, and 73,094 ounces of silver. The mean monthly price of lead in 1917 was £30 per ton.

Manganese Ore. Only 9942 tons was obtained in North Wales (5140 in 1916), but 331,264 tons was imported during the year.

Oil Shale. The Scotch shales gave average yields of 20 gallons of oil and 40 lb. of sulphate of ammonia per ton of shale (in 1916, 20 galls. and 44 lb. respectively). The price at the mines was 8*s.* 2·5*d.* per ton, compared with 6*s.* 10·3*d.* in 1916.

Petroleum. Imports show a large increase from 451,556,152 gallons in 1916 to 826,895,771 gallons in 1917.

Mercury. Imports amounted to 2,173,434 lb. and exports to 434,215 lb.

Salt. 360,708 tons of British salt was exported.

Tin Ore. From the 6575 tons of ore 3936 tons of metal was obtained, the average yield from ordinary ore being 65·6%. The mean monthly price of standard tin was £237 13*s.* 1*d.* per ton. Imports amounted to 41,208 tons of ore and 27,143 tons of metal, while 19,265 tons of British and 18,124 tons of foreign tin were exported.

Tungsten Ore. The production of 241 tons shows a considerable decrease on the previous year's figure (394 tons). Cornwall produced 205 tons, Cumberland 32 tons, and Devon 4 tons. The average percentage of metal in the Cornish dressed ore was 62·75.

Zinc Ore. The quantity of metal obtained from the 7484 tons of ore mined was 2735 tons. The mean monthly price of spelter was £52 3*s.* 6*d.* per ton. The imports during the year were 87,368 tons of ore, 76,105 tons of crude zinc and 4105 tons of manufactured metal; the exports were 5 tons of ore and 8560 tons of manufactured zinc.

TRADE NOTES.

BRITISH.

Dominion Rubber System, Ltd.—Notice appears in *The Canada Gazette* of December 7 of the incorporation in the several Provinces of the Dominion of the Dominion Rubber System, Ltd., as follows:—Dominion Rubber System, Ltd., Montreal, $500,000, Alberta $500,000, Manitoba $500,000, Maritime $500,000, Ontario $1,000,000, Pacific $250,000 Quebec $1,000,000, and Saskatchewan $500,000.

The Fertiliser Situation.—The Food Production Department announces that the supply of fertilisers generally for the current season is much greater than it was last year, but considerable difficulties still exist in regard to transport, and prompt delivery cannot therefore be assured. The prices prescribed by the Fertiliser Prices Order for sulphate of ammonia, superphosphate and basic slag will remain unchanged up to June 1 next, and consumers will gain nothing by postponing their orders till later in the season. Arrangements have been made for the importation of a considerable quantity of phosphate rock. The demand for basic slag at the present time is greatly in excess of the production, but the total output for the whole season is likely to be about one-fifth more than it was in 1917-18. The slag is being despatched from the works as it is ground. Sulphate of ammonia is available in greater quantities than last year. It is understood that a number of makers have bone meal and bone flour for sale at lower prices

than those ruling a few months ago and immediate delivery of these materials can probably be obtained.

Board of Trade Returns for 1918.—According to statistics issued by the Board of Trade, the imports into the United Kingdom during 1918 had a value of £1,319,388,591 (*C.I.F.*), and the exports of home produce and manufactures were valued at £498,473,065 (*F.O.B.*), the former showing a gain of 24 per cent. and the latter a decline of 5·4 per cent. over the corresponding figures for 1917. The net excess of imports over exports increased by 52.8 per cent. The value of the imported oil seeds, nuts, fats and gums was nearly £41,000,000 higher at £116,643,336 (54 per cent.), and the imports of cotton were about £40,000,000 higher at £150,286,308. Those imports classified as chemicals, drugs, dyes and colours were valued at £38,563,957, as against £28,027,543 in 1917, and the exported value was £22,740,983, compared with £23,583,139. There was a notable decline of nearly 70 per cent. in the value of exported leather and manufactures thereof, and of over 65 per cent. in the value of exported oil seeds, etc.

FOREIGN.

Chilean Nitrate Trust.—At a meeting held at Valparaiso on January 10, the nitrate producers approved, by a majority of 84 per cent., of the articles of the Nitrate Producers' Association, an organisation which will control prices and production. These articles will now be presented to the Chilean Government for approval, and will come into conflict with another project already introduced into Congress by the Finance Minister, and which is supported by a minority representing 16 per cent. of the nitrate industry.

Twenty nitrate works have closed down, and in consequence there is much unemployment at the nitrate ports.—(*The Times, Jan.* 14, 1919.)

The Chemical Market in Japan (November, 1918).—The market for chemicals is very depressed, consumers having agreed to wait until more normal prices have been re-established. Soda descriptions are at a very low level, apparently as a reaction against their too rapid advances in the past and also because their production is steadily increasing. Soda ash is quoted at about 25*s.* per 100 lb. The price of caustic soda is still falling and at a much faster rate than soda ash, business is now done at about 67*s.* per 100 lb., or lower. Bicarbonate is overstocked and the market is extremely weak, but the price keeps steady at 58*s.* per lb. Nitric acid fetches 30*s.* per 100 lb., sulphuric has fallen from over 8*s.* to 7*s.*, but hydrochloric acid has risen to 10*s.* per 100 lb. The price of acetic acid has been advancing sympathetically with that of salicylic acid (a result of the Spanish influenza), 96 per cent. acid being quoted at £6 per 100 lb. as against £5 8*s.* a few weeks before. The market for potassium compounds is slack, notwithstanding an improvement in the match trade and an increased demand for potassium chlorate, now selling at £7 per 100 lb. Potassium bichromate is also dull and foreign business has fallen off; the price is stationary at about £9 18*s.* per 100 lb. (yen = 2*s.*).

The Department of Agriculture and Commerce has issued a modification of the embargo on the re-export of certain chemicals. Sodium nitrate and potassium cyanide have been transferred from the list of articles conditionally embargoed to the "absolutely prohibited" list. It is hoped, officially, that the new ruling will protect home manufactures from the threatened shortage of raw materials, and control more effectively the supply of nitrate and other goods entirely supplied from overseas.

The Paint Market in Japan.—Before the war, Japanese manufacturers aimed merely at supplying the home demand, the overseas markets being regarded as negligible, but now they command a large trade, amounting almost to a monopoly, in China and the South Pacific. The value of exported paints, excluding red lead and other miscellaneous goods, at the end of July last was £186,219, compared with £22,987 and £14,198 at the corresponding time in 1917 and 1916, respectively. Japanese paint manufacturers and dealers have been working hard to improve their wares and their business methods in order to retain their new markets as a permanent asset; but it appears to be inevitable that foreign buyers should wait to see the effect of peace upon prices. The export trade, recently very brisk, is now sinking fast, and no new big orders are to be expected. Blue paints are quoted at 19*s.* 3*d.* for A grade and 11*s.* 3*d.* for B grade; yellow is quoted at 12*s.* per can (A) and 10*s.* 4*d.* (B), dark blue at 17*s.* 3*d.* per can (A) and 10*s.* (B), dark brown at 9*s.* 3*d.* (A) and 8*s.* 2*d.* for B. Zinc white is well maintained, but owing to the weakening tendency in the spelter market its tone is also very weak; grade "Treasure Sword" is quoted at 27*s.* per can containing 28 lb. Red lead is also weak at 19*s.* 3*d.* per can of 28 lb. Putty does not share in the general depression as visible stocks are small; the best grade is quoted at 13*s.* per 28 lb. (red) and 12*s.* (white).

Market Outlook in France for Chemicals and Dyes.—In order to combat the German chemical monopoly, the French Government organised, in 1917, the "Compagnie Nationale des Matières Colorantes et des Produits Chimiques" with a capital of 40 million francs. This company has now been operating for nearly twelve months, but it is believed that it will not be able to cope with the country's needs for many years to come, and that French consumers of chemicals and dyes must look abroad for such products. Before the war, Germany exported annually to France chemical products of the value of 61,292,000 francs. To this figure must be added the output of seven factories erected in France by German companies to escape import duties and cost of transportation. The German success was due, not merely to cheapness, but also to the large staff of carefully selected technical and research chemists at their disposal, and to the care taken to ascertain the exact requirements of consumers.—(*U.S. Com. Rep., Dec.* 6, 1918.)

Poland.—A new undertaking, called "Prosna," has been launched in Kalisch to exploit a process for welding metals with oxygen and to manufacture apparatus connected therewith.—(*Z. angew. Chem., Nov.* 22, 1918.)

Dutch East Indies.—The Quinine Factory in Bandong, in 1917, made a profit of 1766 million florins, and paid dividends amounting to 89·3%. The value of bark consumed was 2903 million florins, as against 2535 million in 1916, and the output of quinine was valued at about 1 million florins, in excess of that of the previous year. The prices of chemicals have risen very greatly. (Dutch florin = 1*s.* 8*d.*)—(*Z. angew. Chem., Nov.* 26, 1918.)

Spain.—The "Union Española de Productos Quimicos" produced 66,000 tons of sulphuric acid and 84,000 of superphosphate in 1917. In the first half of 1918 mineral phosphate was difficult to obtain, but since the conclusion of the agreement with France, three Spanish ships have been running regularly between Spain, Algiers, and Tunis, and the four factories belonging to the company have been in full operation.—(*Z. angew. Chem., Nov.* 26, 1918.)

French Indo-China.—A syndicate has been formed in Tonkin to erect a works for smelting indigenous zinc ores. Owing to freight difficulties, there are very large supplies of ores on hand, and for this reason the Japanese, who have pur-

chased practically the total production during the war, have not renewed their contracts. The prospecting and mining of zinc ores were formerly in German hands, closely connected with the "Metallgesellschaft."—(*Z. angew. Chem., Nov.* 11, 1918.)

Germany.—An arrangement has been made between the Government of Georgia and a group of heavy chemical manufacturers, including the firm of F. Krupp, whereby a new railway company ("Tschiaturi") is to be formed with the object of conveying manganese ores from the Caucasus to Germany. In peace time Germany imported 20 million poods annually from this source.—(*Z. angew. Chem., Nov.* 5, 1918.)

Sweden.—The I. L. Rose Company in Upsala is about to extend its works, where only scientific instruments have hitherto been made, in order to take up the manufacture of optical glass. Such glass was previously imported from Germany, France and America, and as the supply from these countries has ceased entirely, the shortage is at present very great.—(*Z. angew. Chem., Nov.* 8, 1918.)

Holland.—The glass works "Leerdam," formerly Jeekel, Mijnssen and Co. in Leerdam, has raised its capital by the issue of 500,000 florins of 6% preference shares. The works employ over 1300 hands, and it is intended to raise the capital further, to a total of 3 million florins.—(*Allgem. Handelsblad, Oct.* 15, 1918.)

COMPANY NEWS.

BOOTS, CASH CHEMISTS (EASTERN), LTD.

The twenty-sixth ordinary general meeting was held in London on January 15, Sir Jesse Boot (chairman and managing director) presiding. In his address, the chairman referred to the large reserves and carry-over possessed by the Company, the latter being sufficient to pay a full year's dividend on the ordinary shares. He then made special reference to the valuable work in connexion with the war carried out by the parent company—Boots Pure Drug Co., Ltd. Collaboration between the late Col. E. F. Harrison and the Company's research staff had resulted in the production of a material for charging the box-respirators which had proved most effective. For several months the Company made and prepared all the box-respirators that were turned out; further, it had manufactured almost the whole of the chemicals for the 20 million box-respirators produced, and delivered 7¼ millions complete for the use of the British, American and Italian forces. The work undertaken for the military authorities had led to no excessive profits: the Company had received 8–10 per cent. on war contracts, subject to tax, and the net profit was only 1¼–1½ per cent. The additional buildings and the power-house were erected at the Company's expense, the only help received from the Government being in regard to priority for building materials. During the war, 115 million tablets for sterilising water had been supplied to the army, and latterly great progress had been made in the manufacture of saccharin; no less than 1785 million tablets—the whole of the production—had been supplied to the Government. While the Company was being urged to manufacture on a large scale by the Sugar Commission, another State Department had tried to restrain it under the threat of heavy penalties. The branch businesses had only received their due proportion, and none had sold the imported material, which was not controlled and upon which the selling profit was very much greater.

In regard to the future of saccharin manufacture, the Government might reasonably be expected to give encouragement to a business mainly undertaken to assist it, until its infancy is past and until business conditions generally resume their normal course. Foreign stocks, which accumulated under the impetus given to foreign manufacture through unrestricted prices, threaten to swamp the market, and the home producer, who has had no time to overcome all the difficulties incidental to new work started under very adverse conditions, will have to compete in a market where saccharin will be offered at unremunerative prices. Moreover, certain conditions are imposed upon the home manufacture for revenue purposes, which involve an extra cost and from which the imported product is exempt.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for January 9 and 16.)

OPENINGS FOR BRITISH TRADE.

Canadian firms wish to represent British manufacturers of preserved foods, sugar syrup and malt vinegar. Inquiries should be addressed to The Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

A firm at Vancouver seeks agencies for U.K. manufacturers of linoleum; and a Canadian wishes to get into touch with U.K. importers of mica and phosphate. Inquiries to The High Commissioner for Canada, 19, Victoria Street, S.W. 1.

Agents at Montreal desire to represent U.K. manufacturers of chemicals and tungsten lamps. [Ref. Nos. 20, 22.]

A merchant at London, Ontario, wishes to obtain agencies for U.K. manufacturers of hardware, sheet glass and linoleum. [Ref. No. 24.]

A firm at Calcutta wishes to obtain agencies for U.K. manufacturers of ink. [Ref. No. 17.]

An agent at present serving with the New Zealand forces desires to represent in New Zealand U.K. manufacturers of colours, paints, oils and varnishes. Inquiries to The High Commissioner for New Zealand, 415/6 Strand, W.C. 2.

A firm at Wellington desires to get into touch with U.K. manufacturers of preserved foods and artificial manures. [Ref. No. 40.]

A Netherlands firm wishes to get into touch with U.K. manufacturers of sheet copper, copper ingots, wire and tubes. [Ref. No. 13.]

A merchant in Milan desires agencies for U.K. manufacturers of ceramic manufactures. [Ref. No. 43.]

An agent at Ceuta, Morocco, wishes to represent U.K. manufacturers of pharmaceutical products, paints, varnishes, preserved foods and sugar. [Ref. No. 12.]

TARIFF. CUSTOMS. EXCISE.

Brazil.—Recent customs decisions affect the import duties on porcelain (faïence), machine belting, aluminium wire and linseed oil.

Canada.—Malt sugar, malto-dextrin, rennet powder and vinegar are among the articles the export of which is prohibited, except under licence, as from October 26.

The import duties on spermaceti wax and rit dye have been amended.

France (Algeria).—As from January 1, importations of chicory root, glucose, sugar, mineral oils and alcohol will be subject to the municipal *octroi de mer* duties in addition to the ordinary customs duties.

French Colonies.—The decree of October 15 concerning the prohibition of the exportation of certain

articles from France is now extended to the French Colonies, other than Tunis and Morocco, as from December 22.

Liquorice juice may be exported without special authorisation from French Colonies to the U.K., Belgium, Italy, or extra-European countries as from December 16.

Japan.—The export and re-export of the cyanides of potash and soda nitrate of soda and tinplate are prohibited.

Netherlands East Indies.—The export of kapok and other fibres, oil seeds, tanning materials, rubber and all kinds of gutta is prohibited, except under licence, as from November 5.

New Zealand.—Recent customs decisions affect the import duties on bronze, bottles, camphenol, certain kinds of glass and tincture of cantharides.

Nigeria.—"Common gunpowder" or "trade powder" is defined as large grain black powder similar to and not of appreciably better quality than that commonly known as trade powder at the date of the coming into force of the General Act of the Brussels Conference, *viz.*: April 1892.

Sweden.—The customs duties on oleomargarine, condensed milk, etc., are suspended for a further period to June 30.

United States.—The instructions contained in the War Trade Board Ruling No. 231, issued on September 18, have been revoked as from December 18, and Consuls have been instructed to certify invoices without official notification from the War Trade Board upon production of a letter or cablegram from the consignee giving the import licence number, commodity and quantity thereof licensed.

Individual export licences are still required for, *inter alia*, camphor, chestnut and quebracho extracts, cinchona bark and extracts, copra, glucose, lard, certain edible oils, paper and sugar.

Further recent rulings of the War Trade Board affect rubber, tanning materials, corundum, asphalt, asbestos and manufactures containing gold.

GOVERNMENT ORDERS AND NOTICES.

EXPORT PROHIBITIONS.

The Board of Trade has announced the following relaxations of existing export prohibitions, to be valid on and from the dates specified:—

Headings transferred from one list to another.

From List A to List B:—

Carborundum, alundum, crystolon, and all other artificial abrasives and manufactures thereof.—(Jan. 9.)

From List A to List C:—

Beeswax; lacs, not including lac dye; lubricants not otherwise specifically prohibited and articles and mixtures containing such lubricants; mineral jellies; motor spirit; oil fuel; oil fuel shale; paraffin oil; petroleum fuel oil; petroleum gas oil; petroleum lighting oil; petroleum spirit and articles containing; petroleum and its products not otherwise specifically prohibited and mixtures thereof; turpentine (oil and spirit) and articles containing; turpentine substitute and articles containing; acetic acid; acetic anhydride; acetylsalicylic acid (aspirin) and its preparations; anti-tetanus serum; arecoline; buchu leaves; calcium carbide; calumba root; cascara sagrada and its preparations; culvers root; formic acid; formic aldehyde; hydrastis canadensis and hydrastine; liquorice root and juice; male fern rhizome; mannite; paraformaldehyde; podophyllum rhizome; sassafras root; scammony root; senega root; trional; trioxymethylene; valerian rhizome; witch hazel bark and leaves; zinc oxide and mixtures containing.—(Jan. 9).

Cobaltchrom and similar alloys; gum arabic; gum tragacanth; hemp of all kinds; packing cases; platinum, alloys of platinum and manufactures containing; titanium, titanium alloys and titanium ores; tungsten alloys; tungsten (except tungsten filaments for electric lamps); wire, galvanised; manganese, peroxide of, and mixtures and preparations thereof; platinum, salts of; soda crystals; zirconium compounds.—(Jan. 16.)

From List B to List C:—

Oiled insulating cloth, paper, silk and tape; vulcanised fibre; osmium and its alloys and manufactures containing; rhodium and its alloys and manufactures containing; ruthenium and its alloys and manufactures containing; tin, manufactures of not otherwise specifically prohibited; carbon disulphide; chlorates, metallic, other than potassium chlorate (which remains on List A); rhubarb, medicinal.—(Jan. 9.)

Ferro-manganese; ferro-silicon; ferro-titanium; gums containing caoutchouc; manganese and manganese ore; nickel, its ores and alloys; oil waste; resinous substances containing caoutchouc; selenium; silicon manganese; spiegeleisen; thorium and its alloys; tungsten ores (including ferberite, hubnerite, scheelite and wolframite); chromium acetate; chromium chlorate; chromium nitrate; hydrogen peroxide.—(Jan. 16.)

Altered Headings.

(B) Nitrate bags; (B) henbane; (C) preparations of henbane not otherwise prohibited; (A) oils, fixed, all animal and vegetable, including blended oils and paint oils; (C) articles and mixtures containing fixed oils, not otherwise specifically prohibited; (A) potash, muriate, sulphate and crude manurial potash salts, and mixtures containing any of these substances; (C) potash nitrate (saltpetre); (A) tin, oxide of; (C) mixtures and preparations containing tin oxide not otherwise prohibited; (A) zinc sulphide; (C) mixtures containing zinc sulphide not otherwise prohibited. (Lithopone remains on List A.)—(Jan. 9.)

(A) Ammonia, sulphate of, and mixtures containing; (C) ammonia and its salts not otherwise prohibited; (B) bichromate of soda; (C) chromium compounds and mixtures containing such compounds, not otherwise prohibited; (B) gall nuts; (C) extracts of gall nuts.—(Jan. 16.)

Exports to Switzerland.—The Director of the War Trade Department announces that an open general licence has been issued permitting the export to Switzerland of the goods specified below. Applications for specific licences in respect of these goods are not now required, and it is not necessary for any of them to be consigned to the Société Suisse de Surveillance Economique.

Celluloid wares; china clay; arsenobillon; arsenious acid; cacodylicate; chromic acid; eucaine; paraldehyde; phenacetin; salicylic acid; sodium arsenate; marble, raw and manufactured; photographic goods, but not chemicals therefor.

In the case of the following goods licences are still required, but consignment to the S.S.S. and production of S.S.S. Certificates are not necessary:

Aconite, preparations and alkaloids; amidopyrine; betanaphthol; essential oils; fructus fœniculi; hydrobromic acid; liqueurs; nitrate of silver; opium, preparations and alkaloids; sodium bromide; sodium nitroprusside.

Formaldehyde.—All restrictions on the sale and purchase of formaldehyde have been removed by the Government of the United States, and free export as in pre-war times is permitted as from January 1, 1919.

The Army Council gives notice that further consignments of this chemical will not be requisitioned on arrival, and that the Formaldehyde (Dealings)

Order of July 8, 1918, fixing prices, will be cancelled as from March 1, 1919.

Export of Leather and Tanning Materials.—The Director of the War Trade Department announces that applications will now receive consideration, in approved cases, for licences to export the following goods:—

Upper leather produced from East India tanned, home tanned, vegetable or pyrotanned kips; myrobalans, nuts and extract; mangrove bark and extract; mimosa bark; cutch.

Paraffin Wax.—The Director of the War Trade Department announces that he is prepared to grant licences for the export to all non-enemy destinations of reasonable quantities of Scottish paraffin wax of melting-point under 120° F.

STEEL AND IRON (PURCHASE AND RETURNS) ORDER, 1919.

The Minister of Munitions gives notice and orders:—

(1) On and after January 7, 1919, no purchase shall be made or delivery taken of iron or steel by any person holding at the date of such purchase any stock of iron and steel, or either of them, exceeding by more than 100 tons the amount of such stocks held by him on October 31, 1915, or October 31, 1918, whichever shall be the greater amount, except with a special permit from the Minister of Munitions.

(2) All persons who on April 30 shall hold a stock of iron and steel, or either of them, of 100 tons or more, shall, within fourteen days after April 30, furnish to the Controller of Iron and Steel Production, a return of the stock held by them on either of the dates in (1) above, whichever shall be the greater, and also of the stock held by them on April 30, on a special form.

(3) All iron and steel not actually incorporated in any building or structure or work in progress shall be deemed to be stock, but the iron and steel referred to shall not include scrap.

[The full text of the Order is given in the *London Gazette* of January 7.]

THE BISMUTH (AMENDMENT) ORDER, 1919.

The Minister of Munitions, under date January 10, has modified the Bismuth Order, 1918, by eliminating the obligations contained in Clause 2 (5), and by enlarging the class of persons exempted by Clause 2 (6) from the necessity of making any returns. The exemption applies to holders whose stocks have not exceeded 56 lb. of bismuth metal or alloys during the period for which returns were compulsory, provided the material was not intended for use in the manufacture of steel or steel alloys.

OTHER ORDERS AND NOTICES.

The Icelandic Wool and Tops Permit, 1919. War Office, January 7.

The Sale of Coal (Ireland) Order, 1919. Board of Trade, January 10, 1919.

The Electricity (Restriction of New Supply) (Revocation) Order, 1919. Ministry of Munitions, January 10.

The South African Wool and Tops Permit, 1919. Army Council, January 11.

The Silk Waste or Noils (Returns) (Suspension) Order, 1919. Ministry of Munitions, January 14.

The Tar Oils Control (Suspension) Order, 1919. Ministry of Munitions, January 15.

The following Orders were cancelled by notice given by the War Office on January 11:—The Flax Yarns (Shipment from Ireland) Order, 1918. The Flax Yarns (Shipment from Ireland) Amendment Order, 1918. The Cotton Cuttings (Control) Notice, 1917.

The Admiralty has cancelled the Oxygen Order, 1917.

The Secretary of State for the Home Department has given notice that on January 6, 1919, he made a Scheme of Compensation under the Workmen's Compensation (Silicosis) Act, 1918, for the refractories industries. Copies of the scheme can be obtained through any bookseller or from H.M. Stationery Office.

With reference to the Household Fuel and Lighting Order, 1918, the Controller of Coal Mines gives notice that the conversion equivalent for gas in terms of fuel shall be increased to 18,750 cub. ft. to the ton, and for electricity to 1000 Board of Trade units to the ton, as from meter readings taken for the close of the quarter ended December 31 last. The allowances for lighting are also increased by 25 per cent.

REVIEWS.

DYEING WITH COAL TAR DYESTUFFS. *By* C. M. WHITTAKER. *Pp.* x + 214. (*London: Baillière, Tindall and Cox,* 1918.) *Price 7s. 6d. net.*

After a brief historical summary of the art of dyeing, the author devotes the succeeding ten sections to a discussion of the coal tar dyes classified from the viewpoint of the dyer, although the more elaborate classification required by colour chemists is also indicated.

The basic dyestuffs, a group which includes the first coal tar colouring matters to be synthesised, are still widely used, in spite of their general fugitiveness to light, because of the brilliancy of their shades especially when applied to silk. The employment of these colours in cotton dyeing introduces the subject of mordanting, and the tannic acid and tartar emetic process is treated fully.

The acid dyestuffs, largely used for wool and silk dyeing, form a numerous section of colouring matters including at least nine important chemical series of dyes. Their application to the animal fibres is relatively simple, but due attention is paid to the use of assistants in producing level shades.

The section on mordant dyestuffs includes not only the truly adjective alizarine colours but also the acid mordant colouring matters which behave as substantive dyes, the shades of which are modified and rendered faster by the intervention of a mordant. The intricate art of producing satisfactory shades of Turkey red on cotton is illustrated by two complex recipes. The three methods of chroming are also mentioned, and the important fast chrome blacks for wool are fully discussed, especially those brands which show marked resistance to "potting."

The direct cotton colours have the largest vogue of any class of synthetic dyes on account of the ease with which they are applied to unmordanted vegetable fibres. The resulting shades are not as a rule fast to light and washing, but these disadvantages have been overcome in certain instances by after-treatment with bichromate, formaldehyde, or copper sulphate. Diazotised paranitroaniline is used in increasing the depth of shade in certain cotton blacks, but it is scarcely necessary to give full details for the preparation of this reagent on p. 77 when the recipe is repeated almost word for word on p. 87 in connexion with the production of insoluble azo-pigments ("azoic" dyestuffs) on the vegetable fibres. The latter process, patented by Messrs. T. and R. Holliday in 1880, has been the subject of much subsequent research. Naphthol A S, the anilide of β-hydroxy-3-naphthoic acid, introduced shortly before the war, is a valuable

substitute for β-naphthol in the production of these insoluble pigment dyes.

The application of sulphur dyestuffs is exemplified by several recipes for the dyeing of sulphur blacks. Where prescriptions are so extremely practical, much may be forgiven to the author in the way of phraseology, but more drastic editing might have been exercised in many of the technical descriptions, of which the one set forth on p. 106 may be cited as a representative specimen:—

"Then the cotton is allowed to feed in the simmering bath for at least half an hour, when unless the cistern is required, shut off steam and allow the cotton to feed in the cooling bath . . . one lot being put in at the end of the day, and taken out first thing in the morning, another lot put in straightaway and taken out in time to get the lot in for the night."

This paragraph may represent sound dye house practice, but it is curious English. The following sentence (p. 153) "These dye on fades though they are not practical politics in the garment dyeing trade" is an unnecessary colloquialism which has not even the merit of being informing.

The section on vat dyestuffs contains references not only to indigo but also to the most modern vat dyes, including hydron blue. The section on colours produced by oxidation, which introduces the principal methods of producing aniline black, is followed by sections on other uses of coal tar dyestuffs, vegetable and mineral dyes, and the valuation and detection of dyestuffs.

This treatise, which throughout contains an immense amount of first-hand practical information, may be recommended not only to students of dyeing but also to all chemists who are likely to encounter problems connected with the manifold applications of the coal tar dyewares.

G. T. MORGAN.

A MEMOIR ON BRITISH RESOURCES OF REFRACTORY SANDS FOR FURNACE AND FOUNDRY PURPOSES. *Part I. By* P. G. H. BOSWELL. *With Chemical Analyses by* H. F. HARWOOD *and* A. A. ELDRIDGE. *Pp.* xii + 233. (*London: Taylor and Francis,* 1918.) *Price* 8*s.* 6*d. net.*

Of the many books originating from the exigencies of war conditions, the work here reviewed is not the least notable. As is well known, before the war many refractories—both finished products and raw materials—were imported into Britain from abroad. Among them were refractory sands, and their employment had become so much a matter of course that no one seriously attempted to use native materials in their stead. When the foreign sources of supply were cut off, efficient substitutes had to be found quickly in order to meet the demands of steel manufacturers. In these circumstances the freightage, which in many instances before the war would probably have been a serious consideration, became quite a secondary matter. The author was commissioned by the Ministry of Munitions to undertake systematic investigations with a view to reporting as early as practicable, and a Memoir (second edition since issued) on British sands suitable for glass manufacture appeared previously (this J., 1918, 63 R). The present part treats mainly of the chief supplies of British refractory sands available. The first three chapters are simply reprinted from the Glass-Sands Memoir, being of an introductory nature and common to both subjects. Indeed, many of the refractory sands with high-silica content are used for making glass.

The author has attempted—and on the whole very successfully—to give a clear account of the ways in which the sands are actually used for different purposes, and discusses the properties most important for these several purposes. For convenient treatment he has grouped them into high-silica sands and moulding-sands. High-silica sands are used for making and repairing the baths of acid steel furnaces, for the beds of soaking pits and reheating furnaces, for making silica bricks and crucibles, and with the addition of a binding material as moulding-sands for casting metals and alloys. The moulding-sands in general use mostly have a strong natural bond.

The results of Prof. Boswell's survey have apparently provided good grounds for his opinion that many sands were unnecessarily imported, and others were equally unnecessarily moved from one part of the country to another. The information collected (including prices) concerning sands for use in furnaces and foundries should greatly facilitate the selection of sands for trial with a view to adoption of the most suitable. The necessary particulars have not hitherto been available for the purpose.

With reference to laboratory work, details are given of the chemical composition of sands (in bulk and also of the separate grades), of the mineral composition, and of the mechanical composition. It is remarkable to what an extent the mineral composition—which is not in itself very important apart from the relative proportions of quartz and felspar—is characteristic of the sands from certain geological formations. The nature of the heavy detrital minerals which occur as minor constituents of the sands often affords a valuable indication of the identity and source of a particular sand.

Mechanical analysis may be effected by sifting or screening in the case of coarse sands, but elutriation is necessary for fine materials, which cannot be accurately graded by sifting. A simple form of single-vessel elutriator is described. The graphical representation of the mechanical composition of sands serves to bring out many interesting points.

For such a work, typographical errors seem to be exceptionally few and unimportant. Of the misprints noticed, only those in two consecutive lines on p. 40 (concerning minor inversions) are likely to cause any mystification.

Part II., which is to deal with further sources of supply, and additional results of tests, will doubtless be looked for with keen interest.

J. A. AUDLEY.

PUBLICATIONS RECEIVED.

A SYSTEM OF PHYSICAL CHEMISTRY. *By* W. C. MCC. LEWIS. *Second Edition. In three volumes. Volume I., Kinetic Theory. Pp.* 494. *Volume II., Thermodynamics. Pp.* 403. (*London: Longmans, Green and Co.* 1919.) *Price per volume* 15*s.*

TECHNICAL HANDBOOK OF OILS, FATS AND WAXES. *By* P. J. FRYER *and* F. E. WESTON. VOL. II., PRACTICAL AND ANALYTICAL. *Pp.* 314. (*Cambridge: The University Press.* 1918.) *Price* 15*s.*

SUGAR BEET SEED. *By* T. G. PALMER. *Pp.* 120. (*New York: J. Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1918.) *Price* 6*s.* 6*d.*

SURFACE TENSION AND SURFACE ENERGY AND THEIR INFLUENCE ON CHEMICAL PHENOMENA. *By* R. S. WILLOWS *and* E. HATSCHEK. *Second edition. Pp.* 115. (*London: J. and A. Churchill.* 1919.) *Price* 4*s.* 6*d.*

CATALYTIC HYDROGENATION AND REDUCTION. *By* E. B. MAXTED. *Pp.* 104. (*London: J. and A. Churchill.* 1919.) *Price* 4*s.* 6*d.*

THE ORGANISATION OF A FACTORY LIBRARY.

W. BARBOUR.

Readers of the Journal of the Society of Chemical Industry may be interested to hear particulars of the actual working of the system of indexing referred to in the issue of the Journal for February 28, 1918 (67 R). The description which follows refers not only to the work of indexing but to that of organising library procedure.

The library is maintained for the purpose of collecting and supplying for the use of members of the staff all available information relating to the products, methods and processes in which the firm is interested.

Every document in the library is filed under one or other of the following classes:—

Class A, patents; B, books or pamphlets; E, extracts and cuttings; P, periodicals; Q, general typescripts and manuscripts; R, reports; G, record charts.

Class A, patents, is divided into sections as follows:—

Patents of the United Kingdom ...	A1
,, ,, ,, British Colonies ...	A2
,, ,, France	A3
,, ,, Germany	A4
,, ,, Belgium	A5
,, ,, United States	A6
,, ,, other countries	A7
Books of Patents	A8

In each section the individual patents are numbered consecutively thus:—A1.1, A1.2, etc.

Class B, books and pamphlets, is divided into sections as follows:—

Science	B1
General Technology	B2
Explosives Technology	B3
Engineering	B4
General	B5
Trade Catalogues	B6
Books, written or typewritten, and not subject to alteration	B7

In each section the individual books or pamphlets are numbered consecutively, thus:—B1.1, B1.2, etc. Pamphlets are numbered in each section from 901 onwards.

When a new edition of a book is filed it receives a call number which allows it to be filed alongside the earlier editions of the same work. If the first is B2.1, the second edition filed will be B2.1/1 and the third edition B2.1/2. If duplicate copies of books which will be in constant demand are filed the respective copies are marked thus B2.1, B2.1 1 2 for a first edition and B2.1/1 and B2.1/1 for a 1 2 second edition. A third copy would be B2.1/1. 3

The individual volumes of a given work are also marked in the same way, *e.g.* B1.251/1, B1.251/2, etc. In Class E, the extracts and cuttings are numbered consecutively, thus:—E1, E2. These cuttings are taken from issues of publications which are not filed regularly. The issues obtained are of interest on account of one or more articles to which reference has been made in the literature. These articles are cut out, pasted in a scrap book and marked as indicated.

Class P, periodicals, is divided into sections; each section contains all the issues of a given periodical, and each issue has its individual call number. The *Zeitschrift für Analytische Chemie*, for instance, is P22. The last volume of the periodical filed was P22.59. The volume now being received in parts is P22.60.

Class Q, general typescripts and manuscripts, is divided into sections according to origin. These sections range from Q1 to Q5. Translations of typescripts are filed with the originals in the Q class. All other typewritten translations are filed in Q5. Where possible, the original of each translation is also filed in its appropriate class. The original bears in a prominent position the call number of the translation, thus:—"For translation see Q5.9" and the translation, similarly, carries a reference to the original, thus: "For original see E1586."

Class R, reports, is divided into sections also according to origin. The form of reports is standardised.

Class G, record charts, is divided into sections, *e.g.* barograph charts G1, Hyetograph charts G2, etc.

The various classes of documents are arranged in alphabetical order on the shelves, excepting Classes Q and R, which are filed in vertical cabinets. The progression on the shelves is from left to right and from top to bottom, two vertical sections of the shelves counting as one width. Class A is filed in cardboard cases and arranged on the shelves. Class B is arranged on the shelves in seven sections. Class E follows on and consists of bound extracts and scrap books. Class P follows, and under each P number come together the bound volumes, and then the current issues in a pamphlet box. In the vertical cabinets are filed Class Q in red covers and Class R in green covers.

Each document has its call number, in the right hand top corner, either on the outside page, or on the title page or on both. Class B also has its call number on the back. All documents are arranged or filed by these call numbers:—(1) in order of their class initial A, B, E, G, P, Q, R, (2) in order of their class sections if any, (3) in order of the consecutive numbers after the sectional numbers.

The arrangement of the documents on the shelves is shown by movable label holders. Call numbers are given to all materials on their receipt in the library.

Class D, drawings, are filed in the drawing office and Class C, correspondence, in the correspondence department, the system of call numbers adopted in the latter cases being somewhat different from that given above.

For the purpose of securing quick access to all the documents bearing on any given point, card indexes have been developed. The index dealing with drawings is housed in sixty drawer cabinets in the drawing office. Exigencies of space prevent a detailed description of this. In the library itself are the two card reference systems in which the information contained in documents other than drawings is systematised. These two card systems which are contained in similar sixty drawer cabinets are known as the Dictionary Catalogue and the Central Index.

The Dictionary Catalogue deals with Class B only. Every book or pamphlet is entered in it under its title, its author, and such of its subjects as are of interest. The Dictionary Catalogue author cards are blue, title cards are pink, and subject cards are white. They are all arranged in one continuous alphabet and all bear in their top right hand corners the call numbers of the documents to which reference is made. The author cards contain the names of the authors in the top left hand corners. These are the terms which determine their position. Lower down on the author cards is given the title of the document. The title cards bear the titles in the top left hand

corners. Definite and indefinite articles at the beginnings of titles are ignored for purposes of filing. Lower down on the title cards is given the name of the author. The subject cards bear the subject term in the top left hand corner; lower down on the subject cards are given the title and author of the document. The terms on the top left hand corners of subject cards, which we shall speak of as filing terms, may be either substantival, participial or gerundive. For each book there is a main card in the Central Index. This is described below. Connexions between terms, relating of synonyms, etc., are effected by means of buff guide cards by a method similar to, but somewhat less elaborate than, that adopted for the Central Index. Stated briefly the main function of the Dictionary Catalogue is to act as the complement of the Central Index.

The Central Index brings together, by means of cards, all useful information from whatever source. The documents from which the information on the index cards is drawn are indicated by the colour of the cards as follows:—

Class A, Patents	White Cards
,, B, Books and Pamphlets ...	Pink Cards
,, C, Correspondence	Salmon Cards
,, D, Drawings and Illustrations	Blue Cards
,, E, Extracts and Cuttings ...	Brown Cards
,, P, Periodicals	Green Cards
,, Q, Typescripts, etc.	Yellow Cards
,, R, Reports	Buff Cards

The Central Index consists of two sections, main cards and index cards. The main cards are arranged by classes, each document being represented by a card and the cards being arranged in exactly the same order as the documents on the shelves and in cabinets. All main cards are white and give on the front (1) the call number at the top right hand corner, (2) the author, (3) the title, (4) the number of pages and illustrations, (5) publisher, (6) price, (7) dimensions. On the back of each main card are given in alphabetical order all the subjects under which a particular document has been indexed and catalogued, each term representing one card. Correspondence, periodicals and extracts or cuttings have no main cards. In the case of Extracts, cards bearing in the top left hand corner the names of the various documents obtained for cutting purposes at various times are filed alphabetically and on these are given the call numbers and titles of the articles indexed with date of appearance. A glance at this drawer suffices to show exactly how many articles have been indexed from a given journal in a definite period. In this way a judgment may be formed regarding the advisability of taking a journal regularly and filing it. When a journal is taken regularly and filed it is placed in class P.

The index cards are arranged alphabetically, the filing term being placed in the top left hand corner. The filing term in the central index is substantival and must be confined to "concretes." A fairly good definition of a "concrete" for indexing purposes is to the effect that it is a term denoting something marketable or capable of being marketed. Light and electric energy are concretes. At the top right hand corner of the card is the call number. Below this is the "process" term. The "process" term is a subsidiary filing term, denoting action, quality, property, etc., *e.g.* toxicity, stability, detonation velocity, purification, solubility. The cards filed under the concrete "guncotton" are arranged in alphabetical order of "processes," and so for any group of cards filed under the same concrete. If cards contain a country term this occupies a midway position between the concrete and the process terms at the top of the card. The country term when it is present is the term which ranks next to the concrete for filing, the process term being that used last. Below these filing terms is given (1) date on which the information was known, (2) a digest of the information in so far as it is of interest in connexion with the filing terms, (3) name of document or publication, (4) date of publication, (5) author's name, (6) in the case of an abstract the name of the journal, etc., in which the original information appeared. A definite position is assigned to each of these items on the card. A reproduction of an index card is given here.

GRENADE B3.258

DESCRIPTION

1917. Constructional and operating details are given of British, French and German grenades used at present. In most cases a diagram is given of each and explosive charge is specified. Descriptions are also given of the Nobel and Brock Fuse Lighters and Detonators used on some British grenades. It is stated that when mixed with a lead oxide, tetryl is safer and less sensitive than mercury fulminate for use in detonators.

Hand Grenades, 1917
Major G. M. Ainslie

Five position guides are used; they serve a two-fold object, to indicate the alphabetical position of the term on the tab, and to show the relationship of the term on the tab with other information in the index.

We now come to the procedure followed in the work of indexing:

The papers and periodicals which arrive each morning are first of all marked with their call numbers and stamped with a dating stamp which bears the name of the firm. Leaves are cut if necessary. These documents are then passed to the Indexer who selects material for indexing. The latter has access, later in the morning, to the previous day's correspondence from which he selects material also. Correspondence and communications are also sent to him from various departments for indexing. The Drawing Office send slips bearing particulars of drawings which require indexing. All members of the Q and R classes are indexed. Books may be indexed throughout for the Central Index, or in part for the Central Index and as to the remainder for the Dictionary Catalogue, or wholly for the Dictionary Catalogue and not at all for the Central Index.

The indexing of the selected material is carried out by writing on paper slips the material to be typed on cards or this may be dictated to the typist directly. The cards typed on a given day are checked on the following morning. Each item indexed is marked in the original with a blue ring by means of a rubber stamp. Readers of the document can then see at a glance what has been indexed and are enabled to suggest further indexing if they think this necessary.

When this has been done the cards are put away in a drawer of the card cabinet and this procedure is continued till a week has elapsed, when the cards for that week are assembled and those which bear the most comprehensive digests of matters of interest are arranged in alphabetical order under headings such as "Science," "General Technology," "Explosives Technology," "Engineering," and "General," and transmitted to the printer who makes up this material into a periodical issued weekly to members of the factory staff. This periodical contains also particulars of addi-

tions to the library and other matters affecting the work of the staff. The periodical is not an essential part of the organisation however.

When these selected cards have been returned from the printer the whole of the cards for the week are taken in hand again for consideration with regard to actual filing in the index. Those bearing names of firms, of authors, or of persons mentioned in articles indexed are placed by the typist in the drawers together with their guide cards in the positions to be occupied by them, but they rest on the rods which pass through the perforations at the bottom of the cards already filed and thus project above the latter. They are not let down finally till their positions have been carefully checked by someone having thorough knowledge of the principles of filing. The remainder of the cards are then very carefully scrutinised in order to select entries to be made in the "process" section of the index. The "process" section of the index is constituted as follows. It will be remembered that the subordinate filing term appearing in the top right hand corner of the card below the call number is called the "process" term and partakes generally of the nature of a gerund, *e.g.* stabilising, separating, purifying, though terms like accident, fire, explosion, solubility, etc., also occur. When an index is started a list of the terms of this type which may conceivably prove useful is compiled, and extreme care should be taken to make this list as exhaustive as possible from the very start. Should it occur that a "process" term must be added to this list after the index has been established for some time, this will involve a close scrutiny of all the cards filed in order to secure the references to this particular term. If the age of the index is appreciable the labour involved will be proportionately formidable.

To resume the description of the treatment of the cards accumulated in a week—the indexer scans each card and dictates to a typist the terms in the "process" section which should be entered in connexion with that card. He does not confine himself to the single "process" term appearing at the top right hand corner of the card. Other terms may be mentioned explicitly in the text appearing on the card, or they may be involved implicitly in the text. The typist makes shorthand notes lightly in pencil on each card and when the whole of the cards have been scrutinised in this way she withdraws to enter up the references and returns later to have them checked as regards accuracy. This completes the week's work as regards the "process" section. A reproduction of a typical process section card is given below:

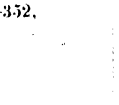
(2) ACCIDENT

to Electric Arc Welder.....E2380

to Electric Plant Worker.....P39.45—352,

with Ether Drum.....P82.11—75,

with Evaporator.....P82.11—65,



in Glycerin Nitrator House.....R1.1711,

with Glycerin Nitrator Lead Fume Pipe.....
R1.1711

In the course of selecting "process" section references many cards will have been ignored for that purpose since they involve no ideas which can be brought under the limited number of terms occurring in the process section, or on account of the fact that their utilisation would involve duplication. If, for instance, two cards are made for a given article, one for nitroglycerin—solubility (in water—B3.1156—7) and the other for water—dissolving (N/G—B3.1156—7) the process term "solubility" is chosen, the entry "of N/G in water . . . B3.1156—7" is made on the "solubility" card of the "process" section and the card for "water—dissolving" is neglected if it involves no other "process" term.

During the work of bringing the "process" section up to date, the opportunity is taken of simplifying subsequent work in connexion with "related terms." A short explanation of this phrase is necessary.

It is claimed for the Kaiser system of indexing that by the use of guide cards, bearing related terms, not only is all cross-referring necessary made possible, but the total number of cards required for quick and accurate consultation of the index is greatly reduced. A guide is a buff coloured card similar in size to all the other cards but differing from these in the possession of a projecting tab which may occupy any one of five different positions along the top of the card. Terms for guidance in consultation are typed on these tabs and are readily seen. Every card or set of cards filed under a given concrete term is preceded by a buff guide card having that concrete term typed on its projecting tab which in this case occupies the top left hand corner position. When the number of cards filed under that concrete term increases and cards bearing names of countries appear, a guide card having the tab in the middle position is inserted before each sub-group of cards for the various countries and bears on the projecting tab the name of the country. Also when the cards under a given concrete term become numerous, it is advisable to insert at intervals other guide cards having the projecting tabs in the top right hand corners and bearing on these tabs the "process" term of the card which they precede.

Nitro-glycerin

=Glonoin Oil
=Glyceryl tri-nitrate
—N/C propell- —Solution ant Explosive

Liquid Explos-ive Compound

Impure —
Frozen —



We are concerned at present mainly with the functions of the "main guides," *viz.* those preceding the whole of each set of cards filed under a given "concrete" term, and shall content ourselves with remarking that "country guides" and "process guides" serve mainly to facilitate scrutiny of the groups in which they themselves appear. The main guides have much more important work to perform. It is by means of these that the consulter of the index, having exhausted the possibilities of the group filed under the term appearing on the top left hand corner of the guide, proceeds to other terms in the index related to that first consulted. These other

"related" terms are typed in alphabetical order on the main guide card. A specimen main guide card is given in the preceding column in order to make the description clearer.

On this main guide card we have first of all the synonyms of the term nitroglycerin, *viz.* glonoin oil and glyceryl trinitrate. Then there are terms in which the word nitroglycerin appears first, *e.g.* nitroglycerin nitrocellulose propellant explosive, and nitroglycerin solution. Then there are higher collective terms, *e.g.* liquid explosive compound, and lower, more specific terms, *e.g.* impure nitroglycerin, and frozen nitroglycerin. If explosives are the main subjects of interest in an index it is advisable to draw up as sound a scheme of classification of explosives as is possible and to allocate the name of each explosive to its appropriate position in that scheme, the position being indicated on the main guide card. This scheme is now being introduced into the index at Ardeer Factory.

We return once more to the question of treatment of the weekly collection of cards. As was mentioned above, these are scrutinised in connexion with "related terms" at the time that the process section is being dealt with. A card having for "concrete" a term filed previously may contain matter which necessitates a fresh entry or two in the process section or a fresh connexion as regards "related terms," but many of the cards of this type will require no further treatment and are placed in position in the drawers of the cabinet above the rod as explained in the case of cards bearing proper names and names of firms. There remain now all cards bearing terms not filed previously, that is new concretes. Buff coloured main guides are made for each of these, and on every main guide are entered the synonyms, higher collective terms and lower specific terms appropriate to each case. At the same time cross references are entered on main guides affected which have been filed previously. If the term nitroglycerin is referred to "liquid explosive compound" then on the guide for "liquid explosive compound," which must be inserted if it has not been filed previously, the term "nitroglycerin" is typed. It will be noticed, by the way, that guides will appear in the index which have no cards behind them bearing the same concrete. Again if the term "glonoin oil" is entered on the "nitroglycerin" guide, "nitroglycerin" is entered on the guide for "glonoin oil," etc. Then as regards literal connexions, if the term consists of two or more words, *e.g.* "colloidal nitroglycerin nitrocellulose powder" the guide for powder may be selected and on this the entry "colloidal nitroglycerin nitrocellulose—" would be made. An alternative procedure which is to be preferred in many cases is to connect a quadruple term like this in two or more stages, *e.g.* first to "nitroglycerin nitrocellulose powder" on the guide for which "colloidal —" would appear. The further connection of "nitroglycerin nitrocellulose powder" to "powder" on the guide for which "nitroglycerin nitrocellulose —" would be entered would probably meet requirements.

It remains to mention that five years' working of the Central Index necessitated the use of three sixty drawer cabinets. The Dictionary Catalogue occupied in the same period one sixty drawer cabinet. The library staff comprises two chemists, acting as librarian and indexer respectively, one assistant chemist, who acts as assistant indexer, and eight typists. Four of the latter are employed in work connected with the index. The remaining four are occupied in typing reports, etc.

The author's thanks are due to Nobel's Explosives Co., Ltd., and to Mr. William Rintoul, Manager of the Research Section, Ardeer Factory, for permission to contribute this account.

NEWS FROM THE SECTIONS.

NEWCASTLE.

To the January meeting, which was of an informal nature, the members brought exhibits of apparatus and other objects of interest. Mr. O. Smalley showed specimens of charcoal blocks made from fine material which had been agglutinated with non-sulphurous binding material; and he also exhibited a portable punch hardness-testing machine, which was but little larger than a black-lead pencil. Two forms of Forster base-metal pyrometer were shown and explained by Mr. C. Patterson and Dr. J. H. Paterson, respectively; the latter also exhibited a Pointolite lamp and a microscope for micro-metallurgical work with a special illuminating device. Mr. W. S. Coates raised considerable interest in demonstrating the probable causes of boiler-tube failures, including bursts, corrosions and pittings, a large number of specimens being shown. The Michell viscometer, an Australian instrument which is shortly to be made in this country, was exhibited by Mr. H. T. Newbigin. Mr. A. Trobridge brought some specimens of soda crystals which he had collected at Lake Magadi in British East Africa, and of calcined soda prepared therefrom; he also gave an account of his travels in that colony. Other exhibits included a modified Jones Reductor, by Mr. G. Weyman; graphite made in an electric furnace, by Mr. J. C. Shenton; and flue dust and potash products, supplied by Mr. E. Bury of the Skinningrove Iron Co.

Dr. F. C. Garrett announced that as the result of a recent meeting of the Section and of the appointment of a small committee to inquire into the formation of a local chemists' club, suitable rooms had been found in Brunswick Place, Newcastle. It was decided to circularise all the chemists in the district with a view to obtaining support for the project.

LIVERPOOL.

A meeting was held jointly with the Liverpool Geological Society at the Royal Institution on January 14, when Mr. H. W. Greenwood delivered a paper on "Geo-Chemistry, its Problems and Potentialities," the President of the Geological Society of Liverpool (Dr. J. C. Given) being in the chair.

During the last four years more attention has been paid to geo-chemistry in this country than during the 20 years prior to 1914, owing to exigencies arising out of the war. Geo-chemistry might be said to deal chiefly with inorganic materials, *e.g.*, potash and its sources, silicates, refractories, rare earths, etc. The Phase Rule is of great importance, and is involved in problems of salt formation and generation of silicate systems from molten silicates in the earth's crust. In this subject, as in others, research pays, and America leads the way, as shown by the good work done in the Geophysical Laboratory of the Carnegie Institute, Washington, and by the U.S. Geological Survey.

England, relying in the past on her natural deposits of coal and iron, has used these lavishly and must now efficiently survey her natural mineral resources, and by investigation and research into mining and smelting put these industries on a more scientific basis. If the necessary steps are taken to establish Mr. K. Chance's process for the recovery of potash, it should be possible for this country to be self-supporting in regard to this material after a few years. Although in England there is a good knowledge of furnace materials and their uses, little work has been done on refractories for the highest temperatures, as required in electric furnaces; further research is necessary before we

an obtain the temperature-control which will be required in furnace work in the future. The cement industry offers many problems which might well be investigated from a geo-chemical standpoint; the properties of cement depend on properties of such a phase system as $CaO—SiO_2—Al_2O_3$, the equilibrium relations of which (at different temperatures) must be known. A works in Germany has recently commenced making cement and sulphuric acid from gypsum; in England there should be a good prospect of making arsenic-free vitriol by this process from our deposits of gypsum and anhydrite. There is a big field of research in discovering methods of working poor ores and reworking "residues," and scientific surveys might bring fresh sources to light.

In the future coal must be (universally) carbonised in the most economic fashion so as to give the maximum yield of high-grade gas, fuel oil and other important by-products, and coke which can be efficiently burnt to give electrical energy. Peat and lignites and the possible existence of petroleum deposits in this country are other fields of interest open to the geo-chemist. Rare metal ores are nearly all imported, yet there must be large quantities of tungsten, uranium, titanium, etc., combined in minerals in this island, but up to now they have not been considered as available for "working" on account of the very small proportions in which they occur in our rocks. Rutile, tourmaline, monazite, etc., occur in sandstones from Yorkshire and the Midlands, but in small quantity—nearly always less than 1 per cent. In the processes of treating, dressing and grading these sands for the glass and ceramic industries, it might be possible to introduce methods of separating the heavier rare earth portions by electro-magnetic, electro-static, or pneumatic means.

In conclusion, geo-chemical research and adequate geological survey are national necessities for the future; there must, therefore, be suitable inducement offered to our professors and lecturers, as well as to our young men who might wish to make geo-chemistry their profession. It must also be borne in mind that a scientific or technical department should be under the control of a scientific and technical head and not a legal gentleman or a classical scholar- if we wish to progress on the right lines.

NOTTINGHAM.

Dr. A. D. Denning gave an address on "The Factory Manager after the War" at the meeting held on January 22, with Mr. F. H. Carr in the chair.

At the present time there is a growing conviction that industry is a branch of national service, and that it must be conducted from this point of view. The industrialist will be well advised to embrace this ideal, since collectivism, in some form or other, was sure to come either voluntarily from within or by State compulsion. The emotion of a strong ideal was needed to produce efficiency, as well as to dignify industry, which was still to some extent open to the reproach made by Ruskin, that while men of other professions made service their principal aim, that of the industrialist was profit.

The lecturer showed how efficiency of production could be increased by a scientific analysis of functions, and by the distribution of activities in accordance with this analysis. The manager should be regarded primarily as a strategist co-ordinating and regulating the activities of others. Most businesses are out of adjustment in some way, it may be from the manager's partiality for the activity in which he won his spurs, or from a general lack of organisation. When proper organisation has been secured, the manager in his capacity of strategist must ever be trying to "sense" the problems ahead. The qualities required of a good manager vary somewhat with the size of the business. In a small business, knowledge of material is the more important; in a larger, knowledge of men; and in the largest of all, abstract thought, the ripe fruit of experience. In the very largest industrial units administrative power is of the very first importance, and technical skill occupies a minor position. The great administrators and captains of industry were usually not trained experts in the first place, but possessed this administrative power. An "Institute of Efficient Managers" was suggested, which would grade its members and deal in a summary manner with those who, by their mistakes, fostered labour troubles and brought the present system into disrepute. A chart was shown on which functions in a factory were classified and sub-classified. Thus the sub-section "employment" is in the section "comparison," which is a part of the "facilitative" function, intermediate between production and distribution. This sub-section is one of the most difficult and important. We have been very casual in the selection of men for definite posts, and some improvement might be effected by the appointment of specialist "employment managers." There are now courses for the training of such managers at six universities in the United States. In another chart the different aspects of work, *e.g.*, consultative, determinative, etc., are plotted against specific parts of factory work, *e.g.*, design, equipment, etc., and it was shown how each employee could be fitted into one of the squares thus formed.

The lecturer also touched on the proper use of works committees (consultative only), chart rooms in factories (to convey information at a glance), the possibility of kinematograph demonstrations to the workers (showing output, etc.), and standardisation of production and fatigue studies.

A discussion followed.

LONDON.

At the meeting held on February 3, the chairman, Dr. Charles A. Keane, explained that the Committee had considered that a useful purpose might be served if from time to time collaborated accounts of various subjects of importance in chemical work could be considered at a single meeting, and with that object in view it had been arranged to devote the evening to the subject of "Refractometry and its Applications in Technical Analysis."

Prof. J. C. Philip, after referring to the value of the determination of physical constants in identifying compounds or in establishing their purity, gave a very clear and concise account of the physical principles underlying the construction of refractometers. By means of diagrams he showed the paths of the incident and refracted rays in the prisms of the Hele, "Dipping," Abbe, and Pulfrich instruments. For accurate measurements monochromatic light should be used, but in most instruments its use is obviated by the introduction of a "compensator" whereby ordinary composite light can be employed. Due regard must always be paid to temperature control, as variations cause considerable differences in the refractive indices of substances examined.

Mr. Stanley gave an account of improvements which have been introduced in the Abbe refractometer. During the past few years his firm has had a number of these instruments for repair and has come to the conclusion that no advances have been made in the construction during the past 25 years. Among the improvements, dense flint has been substituted for crown glass in the prisms and the prism-box has been made to open away from the observer. A slow motion adjustment has been

provided for the reading arm, and in the new instruments of the "Dipping" type the prisms can be easily removed for cleaning.

Mr. Simeon also emphasised the importance of temperature in measuring refractive indices, and explained some of the means that have been taken to ensure control of accuracy of the parts of the instruments. To secure uniformity in the glass used for the prisms, portions of every rough piece of glass received are taken, ground flat and cemented together by a special process, and the composite block obtained examined by a sort of interferometer method. Great care is also necessary in the graduation of the arc itself.

Among applications of the refractometer, Mr. Main explained that the refractive index of sugar solutions can be used to determine the water content, and this method is much more expeditious than, and as accurate as, the determination of the specific gravity which was formerly employed. Mr. Berry gave an account of the use of the instrument in the examination of chlorhydrin, which can be determined far more easily in this way than by purely analytical methods, and this application has proved of great value during the war. Miss A. Homer described the work done in the concentration of sera, which has also been a serious problem during the war, and the use of the refractometer has saved an enormous number of protein determinations, which by the ordinary gravimetric process would have been quite impracticable under recent conditions. Mr. Bolton gave a clear idea of the value and limitations of the refractive index in the examination and identification of oils and fats, and also drew attention to the necessity of always recording the temperature at which the observation is made and urged that 40° C. should be adopted as a standard temperature. He also drew attention to the desirability of a "continuous-reading" instrument being devised.

MEETINGS OF OTHER SOCIETIES.

THE FARADAY SOCIETY.

The General Discussion on "The Present Position of the Ionisation Theory," held on January 21 in London, attracted contributions from Prof. S. Arrhenius, Prof. S. F. Acree of America, and from a large number of workers in this country.

Although the ionisation theory has now secured general acceptance, there are still many unsolved problems in connexion with the nature of solutions of electrolytes. Among these may be mentioned the question of possible association between solvent and solute, the reason why strong electrolytes do not follow the law of mass action, the question of the mechanism of ionisation, and the relative chemical reactivity of non-ionised molecules of electrolytes and their ions.

Some workers, including Mr. W. R. Bousfield, who contributed two papers to the discussion, consider that most of the remaining difficulties regarding electrolytes can be accounted for on the assumption that ions (and also non-ionised molecules) are associated with the solvent. On this view the cause of ionisation is to be found in the affinity of ions for the solvent, the energy required for ionisation coming from the heat of hydration of the ions. Bousfield proceeds to calculate the average hydration of the ions in an aqueous solution by regarding them as small spheres moving at a steady rate through the solvent water, and applying Stokes's law to find the radius of the complex (ion plus associated water molecules), which is then compared with a probable value for the radius of the water molecule. Dr. H. Sand, in a contribution to the discussion, shows that Bousfield's method leads to a value for the volume of the hydroxyl ion which is only about one-thirtieth of that obtained by other methods, and he concludes that Stokes's law does not apply to particles of molecular magnitude. For this and other reasons, very little confidence can be placed in the work so far published on the extent of the association between solvent and solute. Further, for a reason given in the next paragraph, it is improbable that an adequate explanation of the mechanism of ionisation can be based on assumed association between solvent and solute.

Although the second difficulty mentioned above, the deviation of strong electrolytes from the law of mass action, has not yet been fully accounted for, the recent careful conductivity measurements of Washburn and Weiland, who used as solvent "ultra-pure" water of specific conductivity 0·05—$0·07\times10^{-6}$ reciprocal ohms, promise to throw considerable light on the subject. Their results show that in the case of solutions of potassium chloride the law of mass action is followed from 0·00002 molar to 0·00007 molar; from 0·00007 molar to 0·001 molar the dissociation constant K increases regularly with increasing concentration. The fact that the deviation appears in such very dilute solutions is very interesting, and is difficult to reconcile with any explanation based on association between solvent and solute. For the same reason it is improbable that the formation of complex ions can be adduced in explanation of the phenomenon. Moreover, Dr. J. W. McBain and Mr. F. C. Coleman, in an important contribution to the discussion, show that other suggested explanations of the problem of strong electrolytes, due to Arrhenius and to Walden, are not in accord with the experimental facts. Further progress on this subject is likely to be attained on the experimental side from the prosecution of conductivity determinations with specially purified solvents, and on the theoretical side from an examination of the nature of interionic forces and of the forces between ions and undissociated molecules.

It is now generally admitted that both non-dissociated molecules and their ions may be chemically active, and illustrations of this view were given in papers by Dr. G. Senter and by Prof. Acree contributed to the discussion. Further investigation of the relative activity of ions and non-ionised molecules promises to throw light on the nature of chemical action in general.

THE INSTITUTION OF CIVIL ENGINEERS.

On January 28 last, the Hon. R. C. Parsons read a paper on "Centrifugal Pumps for Dealing with Liquids containing Solid, Fibrous, and Erosive Matters."

The first part of the paper was devoted to an account of the author's "Stereophagus" pump which was designed some seven years ago for use in sewage-disposal works. Although this pump has proved very successful in dealing with liquids containing fibrous and solid matters, it appeared to be possible to construct another type of pump which would be more suitable for dealing with liquids of a corrosive nature. The result has been the designing of the Flexala pump, which, as its name implies, has flexible vanes. This pump is of the ordinary single-inlet centrifugal type. The impeller consists of a cast-iron centre, the boss of which screws on to the spindle of the pump: in one with this boss is a flat-circular plate, on to the surface of which is vulcanised a layer of pliant rubber, and out of it spring the curved rubber blades of the impeller. This impeller is in close proximity to the centre face of the cover of the pump, and in this face spiral grooves are placed in the direction of the track of the water passing

through the impeller. This face may also be coated with rubber, and in cases where the erosive action is very marked, or where the liquid is of a very corrosive nature, the whole of the internal surface is lined with rubber.

In both the Stereophagus and Flexala pumps the impeller is provided with the usual balancing vanes at the back, but in addition to these an automatic balance is obtained by the admission of a small quantity of air into the pump when in operation, which causes the centrifugal action of the vanes at the back of the impeller to equal that of the vanes at the front, through which the head of the pump may vary.

A large number of Flexala pumps have been constructed and have yielded satisfactory results.

SOCIETY OF PUBLIC ANALYSTS.

The annual general meeting was held in London on February 5. After Dr. S. Rideal had delivered the presidential address, he announced the names of those who had been elected to serve on the Council during the ensuing year. Dr. Rideal was re-elected president.

At the ordinary meeting which followed, Mr. D. Pullman described a method for the "Recovery of Nessler Solution," by which the whole of the mercury and iodine is recovered from the used solution by the addition of a soluble mercury salt to the neutralised residues. The mercuric iodide thus obtained is converted by means of metallic zinc into zinc-mercuric iodide and mercury. The double salt, with the addition of sodium hydroxide, forms an efficient nesslerising reagent, whilst the mercury is dissolved in nitric acid and used to precipitate further residues.

Mr. J. Allan then contributed a paper on the "Technique of Iodine Determination," in which he described the sequence of the operations comprised in the determination of the iodine value of oils, and the method adopted by him for carrying out a large number of determinations in a minimum of time. In a supplementary note he described "A New Machine for Sub-dividing Oleaginous Seeds," the chief merit of which was its capacity for delivering a product particularly well suited for subsequent treatment in analysis.

ROYAL SOCIETY OF ARTS.

On February 5, Mr. S. C. de Segundo read a paper on "The Removal of the Residual Fibres from Cotton-Seed and their Value for Non-Textile Purposes."

Owing to the recent introduction of mechanical devices for recovering the residual short fibre on cotton-seed, which escapes the action of the gin or other saw-linting machines, one of the world's most abundant natural products, hitherto neglected, has been rendered available for industrial purposes in the manufacture of explosives, paper, artificial silk, and other cellulose derivatives. Probably over 95 per cent. of the 11,000,000 tons of cotton-seed annually produced is of the white (or woolly) variety, from which residual fibre is recoverable.

The superior character of the products obtainable by the American system of crushing the kernels alone, as compared with the British system of crushing the seed in its entirety, was dealt with, and it was pointed out that from the residue of the kernel, after extraction of the oil on the American system, a valuable and highly nutritious flour is prepared in the United States, which is practically starch-free and contains over five times as much protein and fat as wheat flour, and has been officially recommended by the United States Government as a diluent for wheat. Also a higher percentage extraction of oil from the seed is obtainable by the American method.

Statistics relating to the Indian cotton-seed crop show that the products obtainable from an average crop, if wholly employed in the production of oil and cake, and if the residual fibres are turned to account, should be worth, on the basis of pre-war values and after deduction of all manufacturing expenses, about £7 per ton of seed as compared with about £3 per ton, the estimated value of the seed hitherto obtained. This represents a potential increase in revenue of about £6,000,000 per annum.

During the lecture a machine removing residual fibre from Indian cotton-seed was shown in operation; and there were also exhibited a sample of cotton-seed flour, loaves of bread made with a mixture of cotton-seed flour and wheat flour, and samples of paper, artificial silk and vulcanised fibre manufactured from the residual fibre. (See also this J., 1918, 132 R, 118 T.)

PERSONALIA.

Dr. T. A. Henry, Superintendent of the Laboratories at the Imperial Institute, has been appointed Director of the Wellcome Chemical Research Laboratories in succession to Dr. F. L. Pyman.

Mr. R. G. Perry, chairman of the board of Messrs. Chance and Hunt, Ltd., and Messrs. C. F. Chance and D. A. Bremner, directors, have resigned their positions.

The Institution of Civil Engineers has elected upon its roll of distinguished honorary members Marshal Foch, Field-Marshal Sir Douglas Haig, and Admiral Viscount Jellicoe of Scapa.

The Admiralty announces that Mr. W. McClelland has been appointed Director of Electrical Engineering in succession to Mr. C. H. Wordingham.

Mr. George Martineau, C.B., an authority on the subject of sugar in its economic aspects, died on February 5, aged 85.

Dr. W. Marshall Watts, an investigator in the field of spectroscopy and author of valuable contributions to its literature, died last month in his seventy-fifth year.

Sir A. Strahan, Director of the Geological Survey, and Engineer Vice-Admiral G. G. Goodwin have been elected honorary members of the Institution of Petroleum Technologists.

Dr. A. E. Dunstan and Dr. W. R. Ormandy have been elected members of the Council of the same Institution.

Dr. F. G. Cottrell has been awarded the Perkin Medal of the New York Section of the Society of Chemical Industry for his distinguished services in applied chemistry. Dr. Cottrell, whose name is identified with the electrostatic process of separating suspended solids from gases, is now chief metallurgist of the United States Bureau of Mines.

The death is announced from Cape Town of Dr. G. S. Corstorphine, the well-known geologist and Principal of the South African School of Mines and Technology. Dr. Corstorphine was the first Professor of Geology and Mineralogy in the South African College, and did much valuable work in connexion with the mining of gold and other minerals in South Africa.

The residue of the estate of the late Mrs. Purdie, widow of Prof. T. Purdie, was bequeathed by her to the University of St. Andrews for the promotion and maintenance of post-graduate research scholarships in chemistry. The monetary value of the bequest is about £25,000.

NEWS AND NOTES.

CANADA.

Oil Concession in Alberta.—A recent despatch from Ottawa states that the Government is considering a proposal to concede to the Shell Transport and Trading Company, Ltd., the right to enter upon and develop all the oil-bearing lands in the Province of Alberta north of the Athabasca River. This concession is to be in the nature of a monopoly for five years, except in so far as the rights of leaseholders and prospectors already on the ground are concerned. In return, the company is to pipe the oil to Vancouver, or to the head of the lakes, and after receiving six per cent. on its investment is to divide the remaining profits equally with the Government.

Acetic Acid.—Among the many new industries which have been developed in Canada during the war, none has attracted more interest than the development of the process used by the Canadian Electro Products Co., Ltd., at Shawinigan Falls, Que., for the synthetic manufacture of acetic acid. Although much has been written during the last two years regarding this plant and process, a brief summary may not be out of place.

The process consists of (1) the conversion of acetylene gas to acetaldehyde in the presence of sulphuric acid and a mercury salt. The acetylene gas used in this process is generated at what is probably the largest generating station in the world. 2. The conversion of the acetaldehyde to acetic acid by oxidation in the presence of a catalyst. 3. The catalytic decomposition of glacial acetic into acetone.

In each process the crude materials are carefully distilled, so that only pure products are used for the next step, *i.e.*, refined acetaldehyde is used for the manufacture of acetic acid, and the glacial acid is used in the final process.

One of the most striking features of this new process is the fact that glacial acetic acid of over 99 per cent. strength is obtained from the stills on first run, thereby assuring quick and economical production.

Another feature is the purity of the crude acid obtained by this process. This crude acid does not contain any of the impurities which are always present in the crude acid made by the wood distillation process. It is quite free from sulphuric acid, tar, or resinous matter, and is absolutely water white in colour. Such purity is a decided advantage in the manufacture of colours, etc., and also when used in dyeing. It has been found by actual experience in several colour manufacturing plants and dye houses that the results obtained by the use of the crude acid made by this process are decidedly superior in many ways to the results obtained by the crude acid previously used. In every case the colours have been brighter, shades and tints truer and more easily duplicated, and the results have in every way been more uniform. These results are due not only to the purer quality of the crude acid, but to its absolute uniformity.

Two plants were erected for the manufacture of acetic acid by this process, each plant having a capacity of approximately 700 to 800 gross tons of glacial acid per month. One of these plants has been in operation since 1916, and has proved beyond doubt that the process is commercially successful.

Much research work has been undertaken by the chemists responsible for the development of this process, with a view to developing other synthetic materials. These investigations have proved that many other commonly-used organic products can readily be made "synthetically" from the acetylene base, and intermediate products made available in the manufacture of acetic acid. It is quite possible that at least some of the following products will be manufactured synthetically at no distant date:—Alcohol, acetic anhydride, acetylene tetrachloride, chloral hydrate, chloroform, dichlorethane, ethyl acetate, formaldehyde, monochloracetic acid, and paraldehyde.

Many of the chemicals mentioned above are now being made synthetically from acetylene in Europe, particularly in Switzerland, France, and Germany. While there is no doubt a certain similarity in the different developments in these various countries, those responsible for the Canadian undertaking feel certain they can meet foreign competition in this field, owing to many advantages their process has over any similar development elsewhere.

The production of synthetic chemicals is a new addition to the industrial life of Canada, and while it is as yet in its infancy it is expected to develop quickly into one of Canada's industrial giants.

Owing to the favourable location of the plant at Shawinigan Falls, which is the electro-chemical centre in Canada, and to the Company's connexion with the Shawinigan Water and Power Co. and the Canada Carbide Co., the future supply of raw material is assured. This industry, therefore, looks forward to the return of normal times with every confidence of success and further expansion.

SOUTH AFRICA.

Industrial Developments.—At Dornfontein (Transvaal) a firm is producing caustic soda of over 90 per cent. quality, and after certain improvements to the plant have been effected the output is expected to reach 1 ton per day. Washing soap and Epsom salts are also being manufactured. In addition to manufacturing anhydrous ammonia for refrigerating plant, a Natal firm is undertaking the production of hydrogen peroxide.

Oil from Mgongo Nuts.—The Imperial Institute has recently reported upon the oil of Mgongo nuts, which grow plentifully in Northern Rhodesia and which are said to be identical with the Manketti nuts of South-West Africa formerly exported to Germany for the extraction of the oil content. The true kernels, states the report, with the seed-coat removed, yield 58·1 per cent. of oil (Manketti nuts, 57·2 per cent.), equivalent to 37·8 per cent. of oil from the entire seeds. In view of the fact that the seed-coat could not be satisfactorily removed by mechanical means, and that therefore it would be necessary to crush the whole seed to extract the oil, it is considered unlikely that the nuts could be utilised for this purpose on a commercial scale.—(*S. Afr. J. Ind., Oct.*, 1918.)

UNITED STATES.

Patents. The question of patents assigned to the public is again receiving attention. Since 1883 such patents, principally taken out by Government employees, have been thrown open, with the result that no one cared to invest the money required for development, as there would be no protection. One plan now proposes leaving all rights with the patentee, excepting that the Government and its licensees shall have free use of the patents. The other contemplates empowering the Federal Trade Board to control patents assigned to the public, license their use and expend the fees in development work and rewarding the patentee.

Glycerin from Dextrose.—The war has been instrumental in furthering the development of a process for making glycerin by the fermentation of dextrose or sucrose. It is stated that about half the sugar is converted into glycerin and the remainder into alcohol. The recovery of the

glycerin economically presents some technical difficulties which are said to have been overcome in the large plant in Illinois. One of the big powder companies is putting in a commercial unit. The price of glycerin has fallen from about 57 cents to 16 cents per lb. since the armistice was signed, and soap makers have said it would help them if glycerin became so cheap that they would not be required to recover it. The process comprises nearly two-thirds of their labour of manufacturing.

The Government Chemical Factories.—An effort is being made to co-ordinate all the researches undertaken by the War Department, and the future of the Government-owned chemical plants is being actively discussed. The great nitrate plants have been in operation in complete units although the entire plants have not been worked. The same applies to the cyanide plant. Several installations are being taken down and carefully stored pending decisions on future policy.

The American Chemical Society.—An unusually important meeting of the Council of the American Chemical Society was held on December 14 at which questions of reconstruction were discussed and various committees appointed. The matters acted upon included:—The question of co-operation with England in the work of compiling a compendium of chemical literature in English: approved, and report from committee appointed to be heard in the spring. Formula index for "Chemical Abstracts": approved. It was recommended that the duty-free privilege for schools in regard to chemicals and apparatus be abolished. Steps were taken to secure better co-operation between universities and industries. Federal aid for research was approved. The metric system was shown to be of material aid in foreign commerce and its early introduction throughout the country was urged. To the Advisory Committee of the Society was detailed the careful consideration of the future research work of the War Department, the complete compilation of data and records of the work of the Chemical Warfare Service and the publication of this material in so far as it is of no military value.

New Process for Making Parabolic Mirrors.—One of the great factories entirely devoted to war work has succeeded in making satisfactory parabolic mirrors by chemical processes thereby saving time and reducing weight. A highly polished glass mirror formed the pattern. Silver was deposited chemically, the layer increased electrolytically. $\frac{1}{16}$ in. copper added by a special plating method, and this backed by a suitable thickness of a cementing material. The difference in expansion between glass and metal served to separate the metallic portion from the glass mould, after which the silver surface was protected with a waterproof, chemically-prepared lacquer capable of withstanding the necessary temperature. Such mirrors gave satisfactory results, and they can be made very quickly as compared with grinding and polishing glass. The mountings required were also much lighter.

Federal Aid for Scientific Research.—The benefits of research have been emphasised to such an extent by the war that much interest is being shown in Federal aid for research. It is proposed that $15,000 be spent the first year in each State, to be increased by $5000 annually until $30,000 is reached, and continuing then at that sum. The money would be expended under the direction of a board in each State in whichever institution was found to be best equipped for the work. A central body would correlate the research, advise, publish and exercise general supervision without actually directing the work. Its secretary would be changed annually, giving way to the assistant secretary, so that continuity could be secured together with the advantages of an ever new view-point

JAPAN.

The Vegetable Oil Industry of Kobe (Japan).—The process of crushing seeds for oil has been in use in Japan for centuries, but it is only in recent years that the production of vegetable oils has been sufficiently large to allow of a big export trade. The real prosperity of the seed crushing industry may be said to have only commenced during the war, when the world shortage of oils raised prices. Kobe is the centre of the industry and is admirably situated as regards shipping facilities and labour supplies. While there has been a lack of tonnage all over the world, the Japanese have maintained their steamship lines to practically all the Far East ports, and Kobe has been supplied with copra from Singapore and Java, soya beans from Dairen and Vladivostok, peanuts from Tsingtao, cotton seed from Tientsin and Shanghai, rape seed from Hankow and India, and castor beans from China and India. The resulting oils have also been shipped direct to all parts of the world. The output of oils from the Kobe district is now about 5700 tons per month divided approximately as follows:—Soya 2100 tons, cocoanut 1700, rape seed 1400, cotton seed 500, but the proportions vary with the quantities of raw materials available. The variety of raw materials is a great advantage as the mills can be turned from one product to another, generally with little alteration, to meet special demands or to fit in with the seasons of the various plants, and are thus kept continuously at work. The mills vary in size from a productive capacity of 10,000 to 360,000 gallons per month, they are all situated on the coast and all except one use the pressure system, the one exception uses the benzine extraction method. The pressure processes are very similar to those used in America. In the round type hydraulic press the amount of oil extracted at each crushing is generally small, and as many as 3 or 4 operations are necessary with copra and peanuts. The flat bed rectangular presses give a higher yield of oil per crushing but the oil needs more refining. One plant is using the latest type of rotary screw expeller mill with great success. The benzine extraction process is at present suffering from the high cost of spirit. The Japanese mills clarify the oils by filtration, but do not remove the free fatty acids. The war has created an enormous demand for castor oil as a lubricant for aeroplane engines and the production has been increased to the limits of the available supply of castor beans. Perilla oil obtained from the seed of an Asiatic mint (*Perilla ocumoides*) is made in considerable quantity; it is a drying oil used largely in Japan as a substitute for linseed oil. This product should become better known.

The oils are generally shipped from Kobe in secondhand tins which have previously been used for kerosene or petrol. This usually entails a leakage loss of about 5 per cent., but the use of more efficient and costly packages such as barrels and drums is prohibited by the high freights for returned empties, whereas the old petroleum tins are not returnable. Attempts to use tank steamers have so far failed owing to the want of large storage tanks and pumping machinery.

The general outlook of the industry is good although it is thought in some quarters that the apex of prosperity has been reached. One very important factor is the sale of the pressed cake, and, generally, Japanese mills have been able to dispose of their output locally, but occasionally mills have had to close down owing to the low price of cake. The importance of oil cake prices is shown by the fact that at the June prices of

this year, 70 per cent. of the proceeds realised from soya beans came from the cake and only 30 per cent. from the sale of the oil. (See also this Journal, 1918, 439 B.)—(*U.S. Com. Rep., Oct.* 30, 1918.)

Investigations of Vegetable Dyes in Japan.—The British Consul in Shimonoseki reports that as a result of investigations instituted by the Department of Agriculture and Commerce, some sixty varieties of trees and twelve varieties of plants have been found to have value as raw material for dyes. Some of these are enumerated below:—

Pinus densiflora (Japanese: Aka-matsu).—The leaves of this tree, found throughout Japan in a wild state, yield a dark brown dye used for cotton yarn. *Pinus Thunbergii* (Kuro-matsu).—This common variety of pine gives a dark dye which may be extracted as follows:—10 parts of fresh leaves are added to 3·3 parts of sulphur and ten parts of sodium sulphite and the mixture heated with water for five hours. The resulting dye commands a ready sale. *Chestnut* (Kuri).—Treated with copper sulphide, the bark yields a dye for saddlery wares. The leaves and bark yield a black dye for silk, and the root a yellow dye for staining furniture. *Quercus dentata* (Kashiwa).—A decoction of the bark gives a material used for dyeing hemp, cotton, etc., a khaki colour. *Quercus serrata* (Kunugi).—The fermented leaves yield both brown and deep green dyes. *Pomegranate* (Zakuro).—The bark of this tree gives a leather dye. *Pasania cuspidata* (Shii) yields a dye used on fishing nets. *Camellia Japonica* (Tsuboki).—The leaves when pressed yield a green which is used for dyeing cheap mosquito nets. *Myrica rubra* (Yamaromo).—The juice extracted from the leaves and bark gives a dye for fishing nets, also a priming for indigo dyeing, and is used for dyeing khaki uniform cloth. *Elaurites cordata* (Abura-giri), *Quercus-Gilva* (Ichii), Pagoda-tree (Enju), *Juglans Sieboldii* (Onigurumi), *Raphiolepis Japonica* (Sharimbai); and several other trees yield dye material from their leaves, bark or roots. The following plants also yield dyes of value:—*Swertia Chinensis* (Senburi), *Lespedeza pilosa* (Neko-hagi) and *Coptis* (Oren).—(*Bd. of Trade J., Jan.* 9, 1919.)

GENERAL.

The Imperial College of Science and Technology.—At a meeting of past and present students of the Imperial College, held on January 29, it was resolved, with but one dissentient, to forward a petition to the governors of the College urging them to take immediate steps to raise the College to the rank of a university, distinct from the University of London, with power to confer its own degrees in science and technology. The petition states that in the past the Empire has suffered from lack of men and women trained in the methods of science, and particularly in the application of scientific principles to industry: that public interest needs to be stimulated at the present time when, owing to the war, there has arisen a dearth of trained students; and that the creation of such a proposed Imperial University of Technology is needed to meet the ever-increasing demands of industry for men trained efficiently in scientific and technological work. Up to the present, students of the College who wished to obtain university degrees have had to enter for external examinations, and this has entailed the expenditure of much energy, without improving their knowledge or powers of research.

Destruction of Opium.—A Reuter telegram from Shanghai of January 21 last, states that one-half of the opium stocks purchased by the Chinese Government in 1918 has been burnt by order. The balance will be burnt immediately. The value of the stock, if it could have been sold locally, would have been £5,000,000.—(*Scotsman, Jan.* 27, 1919.)

Proposed New Cyanamide Works at Workington.—The St. Helen's Colliery and Brickworks Co., Ltd., Workington, has been acquired on a cash basis of £12 for each £5 share of its issued capital by Nitrogen Products and Carbide Co., of which Mr. A. E. Barton is chairman. This company, it is stated, is to establish a works on the site of the old West Cumberland Works at Workington for the manufacture of cyanamide. Coal, limestone and cheap water supply are all near at hand in the district. Carbide will be an important product of the new industry, and the plant will provide for the working of all the by-products of coal. The works will need 3000 tons of coal per day, and turbines will generate 120,000 horse-power. A capital of £5,500,000 is involved. The works will take two and a-half years to complete and will ultimately employ 4000 hands.

Engineering Training Organisation.—Subsequent to the conference of engineers and educational workers held at the Institution of Civil Engineers in October, 1917, an organisation was formed with the object of promoting engineering training in its widest sense. A secretary, who must be a qualified engineer, is now to be appointed at a salary of £1000 per annum to take charge of its operations, which will include giving advice to parents and youths, encouraging employers to give full educational facilities to their pupils and apprentices, and co-ordinating the interests of different branches of the profession. The funds necessary for the support of the organisation are being supplied by voluntary contributions.

The Australian Chemical Institute.—Mr. C. P. Callister desires us to state that he is acting as representative in Great Britain of the above organisation, and that all Australian chemists now in this country who wish to have particulars concerning it should apply to him at: 6, Maiden Lane, London, W.C. 2.

Status of University Lecturers and Assistants.—At a recent meeting of the General Council of St. Andrews University, a report of the conference of General Council delegates of the Scottish Universities on the status and emoluments of lecturers and assistants was submitted. In moving the approval of the recommendations of that conference, Mr. J. Thomson said that for a long time lecturers and assistants had felt that they occupied a rather anomalous position in the University. Since the war began they had also felt that their salaries were quite inadequate, and they further desired representation on the administrative bodies. Professor Burnett seconded the motion, and pointed out that with the interruption of University work caused by the war, and the inducements the Civil Service were offering, it would not now be possible to get the kind of man they required for their higher teaching work at the old salary and the old status. The meeting approved generally the conference's recommendations, and instructed the clerk to convey its decision to the University Court. —(*Scotsman, Jan.* 27, 1919.)

Manganese in Egypt.—The Sinai Mining Co. made its first shipment of manganese-iron ore—4000 tons—to the United Kingdom in October last. The mines are situated in the south-west of the Sinai Peninsula, about 15 miles from the coast of the Gulf of Suez, and they are connected by rail for 11 miles and by ropeway for 6 miles with the port of Abu Zenima which is well equipped for storage and loading. According to the Egyptian Ministry of Finance, the average ore contains about 35 per cent. manganese and 23 per cent. iron;

large quantities of this grade are available.—(*Bd. of Trade J., Jan.* 16, 1919.)

Clays in Nigeria.—The Comptroller of Customs at Lagos has forwarded the following analysis of a sample of clay (used by the natives as a dusting powder) from Ozuakole, a village about 80 miles up the Eastern Railway in Nigeria :—Silica 47·4%, alumina 31·2%, ferric oxide 0·0%, lime 0·2%, water 10·55%, undetermined 3·75. This clay therefore closely approximates to Chinese kaolin.

Fire-clay of good quality has been discovered in the Udi coalfield, and is available to merchants in Nigeria or other Colonies at the following prices (f.o.b., in small quantities and exclusive of bags) :—Port Harcourt 2*s.* 6*d.* per cwt.; Lagos 4*s.* 6*d.* per cwt. A copy of a report furnished by the Imperial Institute may be consulted at the Department of Overseas Trade.—(*Bd. of Trade J.*, Jan. 16, 1919.)

Minerals and Manufactures in Mesopotamia.—Little can be said about minerals in Mesopotamia, for little is known. The prospects of petroleum boring have attracted some attention. Petroleum was formerly imported almost wholly from Russia, but in 1906 Austrian and American low-grade oils obtained a footing and advanced in favour. Oil engines and oil lamps came more and more into use and consumption increased. Just before the war the development of the Anglo-Persian Company's oil fields naturally altered the situation, and Anglo-Persian oil promised to monopolise the local market unless petroleum was discovered in considerable quantities in Mesopotamia itself. A belt between Kirkuk and the Persian Gulf is certainly oil-bearing in parts, though production has not been attempted upon any scale. A large portion of this belt lies over the frontier in Persia. There are other belts on the Middle Tigris and on the Euphrates south of Hit, but the economic prospects in both cases are quite uncertain. Coal, lead and iron deposits exist in Northern Mesopotamia, and in the remote past gold was recovered in the Bohtar Valley.

The manufactures of Mesopotamia are few and primitive. Steam machinery was used in the military cloth factory at Baghdad, but the other industries may properly be classed as handicrafts. Milling, tanning, boat-building and brick-making are carried on for native supply, and there are a few luxury trades, such as silk weaving, metal working and the distilling of the spirit called araq from dates. The silk factories of Baghdad are famous, and the cultivation of the silkworm was at one time a flourishing industry. Tanning is a solid industry, though the methods are primitive, and bricks are made all over Mesopotamia. They are either used unburnt or burned in rough wooden kilns. When the Hindia Barrage was constructed the native method of making bricks was found to be the best and cheapest.—(*Bd. of Trade J., Jan.* 16, 1919.)

The Mineral Wealth of Montenegro.—It is probable that large mineral deposits exist in Montenegro. A very prolific vein of iron ore, which may well contain millions of tons, runs from Southern Dalmatia, *via* the Sutorman Pass, into Montenegrin territory. Coal has been found at Berane, mineral oil at Virpazar, and quicksilver near Ulcinj. During the war the prospects of this mineral wealth have much improved owing to the development of the roads. In future the Bocche di Cattaro will be the natural harbour of Montenegro.—(*Weltwirtschaftszeitung, Dec.* 6, 1918.

Kaolin Deposits in Bavaria.—In peace time Germany obtained the bauxite for her aluminium production from Southern France and Dalmatia. During the war geological investigations have shown the presence of valuable clay deposits, containing 35 per cent. of kaolin, at Tittling, Metten, Deggendorf, and Passau (Bavaria), but these clays contain more silica and iron than bauxite.—(*Z. des Ver. deutsch. Ingen., Dec.* 7, 1918.)

Discovery of Graphite Deposits in Finland.—The graphite deposits discovered at Berttula in Tyrvis are, according to expert opinion, the largest yet found in the north. A company with a capital of 7 million marks has been formed to exploit them; and the necessary machinery has been ordered from Germany.—(*Hufvudstadsbladet, Dec.* 2, 1918.)

New Manganese Iron Field in Java.—The works established in Central Java, with a capital of 500,000 florins, to develop the manganese iron field there, is said to be meeting with great success, and, according to the *Soerabaja Handelsblad*, promises to prove a serious rival to the British Indian manganese undertakings.—(*Nieuwe Courant, Nov.* 27, 1918.)

The Alsatian Potash Works.—Seven of the fifteen works are in a position to produce. Four are entirely French, seven are German, and the remaining four are capitalised as to one-third by the Government of Alsace-Lorraine and two-thirds by Germany. Very little work has been done during the war and serious flooding has occurred in many parts. The Germans have carried off most of the workmen, and there is a shortage of labour.—(*Echo de Paris, Dec.* 28, 1918.)

Iron Ore Deposits in Russia.—The iron ores of the Governments of Rjätsan, Vladimir and Nijnii Novgorod are of high metallic content and very extensive. The deposits in Lipetsk in the Government of Tambov are exceedingly valuable and yield an excellent cast iron. Prospecting in the Alapajewer district of the Urals has disclosed the following ore reserves (in millions of poods) :—Sinitschihinske group 400, Syrjanover group 1000, Alapajewer 1200, total 2600 million poods. Up to the present about 5 million poods has been produced annually (pood=36 lb.). The average iron content of the ore is 45 per cent.—(*Z. angew. Chem., Nov.* 29, 1918.)

German Mining Operations in Serbia.—Among the discoveries made by German engineers in Serbia during the war were 10 deposits of metalliferous ore, 2 of magnesite and 1 of asbestos. At Pustenik, north-west of Elishan, experimental work was carried on for some months with a view to exploiting serpentine asbestos, but had to be abandoned owing to the smallness of the deposits.

In July, 1918, experiments were commenced on a bismuth deposit at Gradiste, 15 kilos. south of Kniazevac. In the then occupied area work could only be carried out with the chromium deposits of Gorantza and Grechane. The copper mines and smelting works at Bor were left to Germany by Bulgaria to work for the duration of the war. The chrome-ore mines at Uskub, situated in the Vardar Valley, were worked by Bulgarians, whilst the Plakalnitza-Elisseina Copper Mines and Works were operated under the authority of the Prussian War Ministry. Most of the copper ore was treated in a special furnace at the works.

The Probeda manganese mines at Posharevo were worked by the Bulgarian War Ministry, the Berlin Manganese Ore Co. supplying staff and materials for the purpose.—(*Z. des Ver. deutsch. Ingen., Dec.* 7, 1918.)

The Dannemora Iron Mines in Sweden.—The Dannemora mines supply hæmatite ore containing 59·2 per cent. of metallic iron, 1·59 per cent. of manganese, 0·0025 per cent. of phosphorus, and 0·056 per cent. of sulphur; nearly 80 per cent. of the ore is pure oxide of iron, and the minute traces of phosphorus, copper, arsenic, and zinc present are not sufficient to affect the quality of the iron. The sulphur is eliminated by roasting the ore, and

the high-class steel produced is chiefly due to careful treatment and the fact that no other fuel than charcoal is used in smelting. The ore is principally derived from open quarries situated below sea-level. One thousand gallons of water per minute is pumped from different points by means of electrically-driven centrifugal pumps. The deposits occupy about 32 acres, and the output is 53,660 metric tons per annum.—(*Teknisk Tidskrift, Nov.* 27, 1918.)

Tin in the U.S.A. in 1917.—During 1917 the United States imported 77,866 short tons of tin or 57 per cent. of the world's total output. This amount is the sum of two quantities, *viz.*, 72,166 short tons in metallic form and 5,700 tons estimated as recoverable from 9,054 tons of Bolivian concentrates imported during the year.

The high price of tin has created an intensified investigation of U.S. deposits, but the outlook is unpromising, the 1918 tin output being estimated at not more than 200 tons of metal. Alaska is still the main ore-producing centre, where the tin ore is mainly a by-product of alluvial gold mining operations. Developments are taking place in Nevada, where ore has been found, but so far is too thinly distributed to be workable. There has been a little activity in S. Dakota and N. and S. Carolina and there is prospect of some in Texas.

In 1917 three-fourths of the ore exported from Bolivia was sent to England for smelting and the equivalent in metal re-exported to the United States. Previous to the war Germany had treated much of this, and it is claimed that it would be more economical for the ore to be shipped directly to the States and smelted there. The two American smelting firms hope to have an estimated capacity of between 14,000 and 18,000 tons of metal for 1918. Seventy tons of tin were electrically smelted in Bolivia in 1917, and a new Chilian plant is expected to produce thirty tons per day.

The quantity of tin imported as metal has risen from 47,509 short tons in 1914 to 72,100 in 1917, the Straits Settlements, England and Dutch East Indies supplying the bulk. The price of Straits tin steadily rose during the year from 44·19 cents in January to 85·35 cents per pound in December. A comparison between price and world's output, illustrated by two plotted curves, shows that the price of tin had risen at a somewhat faster rate than the world's output. The war, however, has had a considerable effect upon the price and supply. The complete blockade of the Central Empires has added 21,000 short tons of tin to the available supply of the rest of the world.

The world's production in 1913 was estimated at 146,230 short tons of tin, and in 1917 at 137,200 tons; the steady yearly decline of the Federated Malay States being counterbalanced by the increased Bolivian production. This decline is attributed partly to a decrease in labour supply, but it is probably due to the approaching exhaustion of the richer, more easily worked deposits. Expensive installations will be necessary to work the lower-grade deposits profitably. Between 70 and 75 per cent. of these Malayan mines are under Chinese management and the district is second only to Cornwall in the production of lode tin. Fifty per cent. of the world's tin is produced within the British Empire.—(*U.S. Geol. Surv., Sept.*, 1918.)

Saving Coal in Boiler Plants.—A Technical Paper (No. 205) on this subject has been issued by the United States Bureau of Mines in the interest of more efficient utilisation of fuels. The author, H. Kreisinger, is of the opinion that large plants are usually well equipped and operated with efficiency, but that small and medium-sized plants are badly equipped and inefficient. In the average steam plant about "57 per cent. of the heat in the coal burned under the boilers is utilised in making steam and about 43 per cent. is lost." The opinion is expressed that the average efficiency can easily be raised to 67 per cent. and exceptional instances are mentioned where efficiency of 80 per cent. is obtained. The automatic CO_2-recorders are recommended, but manufacturers are cautioned against depending entirely on the figures given by apparatus of this class. Such a recorder does not indicate the incompleteness of combustion, and therefore an Orsat or other suitable apparatus is essential, not only for checking the accuracy of the figures indicating the percentage of carbon dioxide, but to show how much, if any, carbon monoxide is present. An average of 10–12 per cent. of the former in flue gases, the author thinks should be considered good, provided the percentage of monoxide be low. In some up-to-date factories the highest possible percentage of dioxide consistent with the elimination of monoxide is aimed at. The advantage of a rapid and convenient method of regulating the air supply is referred to, and, as a guide to accuracy in setting the damper, draft gauges which can be easily seen by the fireman are recommended. The importance of checking the temperatures of exit gases is emphasised, and reference is made to the necessity of keeping accurate and reliable records of fuel used, water evaporated, etc. The paper deals with an important subject and gives useful information in a concise form.

The Fuel Problem in Brazil.—Before the war it was easier and cheaper to import coal than to attempt the development of native resources. Where coal could not be obtained wood was used, and except in Rio de Janeiro little capital was put into hydro-electric schemes. In 1913, 2,530,000 tons of coal was imported (86 per cent. coming from England), whilst in 1917 only 877,675 tons came into the country (21 per cent. from England and over 78 per cent. from the United States).

The Federal Government has recently been taking steps to encourage the exploitation of native fuel resources, which consist of:—(1) Coal deposits of the 3 southern states, Rio Grande do Sul, Santa Catherina and Parana; (2) some inferior seams of coal in Sao Paulo and lignite in Para and Amazonas; (3) oil from the Bahia region; (4) oil shale from Parahyba; (5) wood, which is abundant everywhere; (6) water power from the cascades and falls of the coastal highlands. The average of the analyses of 21 samples of South Brazilian coal gave:—Moisture, 2·64 per cent.; volatile matter, 22·31 per cent.; fixed carbon, 42·04 per cent.; ash, 32·26 per cent.; sulphur, 0·22 per cent.; phosphorus, 0·023 per cent.; calorific value, 9909 B.T.U.

The two chief mines now working are the Sao Jeronymo and the Jacuhy. The first has two shafts and is producing 650 tons daily, and expects with a third shaft to produce over 1000 tons per day. The Jacuhy mine was expected to turn out about 10,000 tons per month by July, 1918. The latter mine is partly owned by the Government.

Considerable interest is being shown in the development of the Bahia oil wells and of the Parahyba shale. The latter is reported to be richer than Scotch shale, yielding 16½ per cent. of oil (about 35 gallons per ton of shale). The forest area of Brazil, estimated at 1,500,000 sq. miles, yields abundance of timber fuel, which has been used extensively; but only recently has attention been paid to re-afforestation. The eucalyptus tree has been successfully introduced; this tree yields wood at the end of 5 years. During the fuel shortage wood has been largely used on the railways and river steamships, but its use has not been entirely satisfactory, especially on the heavy climbs over the coastwise range from the manganese and iron mines of Minas Geraes. Powdered

waste coal has been used on a number of locomotives specially equipped for burning coal dust.

When normal conditions once more prevail it is anticipated that Brazil will again become dependent almost wholly on imported fuel. The Itabira Iron Co. (English), which is exploiting iron mines in Minas Geraes, proposes to run a fleet of vessels to Europe carrying iron ore and returning with European coal. Water power developments are afoot in the State of Sao Paulo, and already a number of small factories depend on the hydro-electric power from the plant in Sao Paulo City.—(*U.S. Com. Rep., Nov.* 23, 1918.)

Vegetable Oil in Brazil (Para).—A report from the British Consul in Para states that during the war the manufacture of salad oil from the Brazil nut (castanha) was established at Para. In ordinary times the price of these nuts is too high for the manufacture of oil, and it is not yet certain that the new development will be permanent. One cwt. of seed will yield 2¼ galls. of oil, and of the two factories at present engaged on the work one of them has a maximum output of 133 galls. per day. The process is simple and practical. The kernel has first to be taken from the shell, and in order to facilitate this process the nut is subjected to heating by means of steam, or in an oven. Female hand labour is employed in shelling, on completion of which the kernel is placed in a revolving crusher, and the oil is extracted from the resultant paste by hydraulic pressure. The filtered oil has a pure light golden colour, and both in flavour and odour is very palatable and agreeable. The residue is at present used for fuel in the factory, but it has every appearance of being admirably suited for the manufacture of cattle food. The nut-shells are consumed in the factory furnace, and the ashes could no doubt be utilised for the manufacture of alkali.

During the past year the same factory utilised 50 tons of ucuuba nuts in the manufacture of a fat used in candle and soap making. Both shell and kernel are used in the process, and it is stated that the raw material yields only 30 per cent. of fat owing to the existing deficient mechanical installation, but that better results are expected from the application of a chemical process which is at present being studied. The fat now produced is sold for 1·4 milreis (1*s.* 4*d.*) per kilo. The exports of ucuuba nuts during the first six months of 1918 amounted to 485,337 kilos., of which 413,690 kilos. went to Europe and the remainder to the south of Brazil.—(*Bd. of Trade J., Jan.* 9, 1919.)

Crisis in the German Sugar Industry.—The sugar industry is threatened with a serious crisis, leading possibly to a complete collapse, on account of the sudden demobilisation. The chief need is of coal and the means of transporting the beetroot, which is now exposed to the cold and may spoil. The sudden withdrawal of prisoners of war has led to a shortage of labour which has hitherto by no means been made good by the introduction of demobilised workers. In addition, the Workmen's and Soldiers' Councils in some districts have already introduced the 8-hour day, which is economically unworkable in the sugar industry. Pressing representations have been made to the Government and other authorities, which have promised every consideration.—(*Welthandel, Nov.* 29, 1918.)

Alcohol from Swedish White Moss.—The County Syndicate Aktiebolag has petitioned the Swedish Government for permission to make 5,000,000 litres (1,321,000 gallons) of alcoholic spirit from white moss, of which there are enormous quantities available. The quality of such alcohol is said to be very good, and its cost less per litre than spirit made from grain or potatoes. It can be easily denatured. The petition proposes that the alcohol be manufactured under official supervision and that the Government be taken in as a partner.—(*U.S. Com. Rep., Dec.* 21, 1918.)

Protest against Nationalisation of the German Dye Industry.—Considerably more than two thousand technical and commercial officials of the Leverkusen Dye Works (formerly Fr. Bayer and Co.) have sent a telegram to the Imperial Chancellor protesting against any attempt to nationalise the dye and medicaments industry. They point out that dyes and pharmaceutical products are among Germany's chief exports, that the raw materials for their production are entirely of home origin, and that their sale in foreign countries is the means of bringing much money into the fatherland. The industry, which has been built up by unremitting scientific and commercial activity, was only able to attain its commanding position by reason of its freedom from bureaucracy and its disregard of costs, however great. Nationalisation would be the quickest and surest method of completely wrecking this example of German industry.—(*Z. angew. Chem., Dec.* 13, 1918.)

REPORTS.

THE MANCHESTER STEAM USERS' ASSOCIATION.

MEMORANDUM FOR 1917-18, BY C. E. STROMEYER, CHIEF ENGINEER.

An investigation into a number of water softening plants showed that the principles of the various types had not been materially changed during the past fifteen years. The Permutit process, which involves no diminution of mineral matter but simply the conversion of salts of calcium and magnesium into the corresponding sodium salts, is expensive by reason of the quantity of common salt required for regeneration. Two tons of salt are required for every ton of lime removed from the water; moreover, the salt must be as pure as possible, the output being nearly doubled by using pure salt instead of rock salt or natural brine. The treated water contains a relatively large quantity of dissolved salts which accumulate in the boiler and necessitate frequent blowing down. The process is sometimes used as a means for removing the residual hardness left by the lime and soda process.

The degree of completion of the softening reactions in the lime and soda process are dependent on three factors: temperature, time and contact. It has been found that by allowing pure calcium carbonate to act on sodium sulphate solution, a reaction takes place which is equivalent to the production of 2·43° of hardness; other similar experiments indicate that the ordinary cold softening processes cannot reduce the hardness below 2·4°. Ample time and agitation must be allowed for the completion of the reactions before any attempt is made to separate the precipitated matter from the softened water. Further, in order to facilitate removal of the precipitated matter by sedimentation and filtration, large particles should be allowed to form. The conditions governing this are:—The slower the chemical process, the higher the temperature at which it should be carried out; and the more violent the agitation of the water under treatment, the larger will be the sediment particles.

The majority of continuous softeners operate on the principle that, in the absence of eddy currents, the downward velocity of the majority of the particles is greater than the upward velocity of the water, those particles which are too small to sink being carried forward with the water and caught

in the filter; this would include all solid matter produced by any softening which had taken place in the settling tank. By causing the treated water containing the suspended matter to flow horizontally in such a manner that eddy currents are eliminated, the particles, being heavier, naturally sink, and a depth of clear water will be produced depending on the length of horizontal flow. In only one softener, and in a somewhat modified form, has this principle been adopted. Insufficient attention appears to have been paid to the time necessary for reaction, and to these settling and filtering problems.

The tendency in some cases of softened water to cause corrosion is attributed to the co-existence of sodium chloride, sodium carbonate, and dissolved air in the water; sodium carbonate acting as a polariser, and sodium chloride, having the reverse effect, will produce patches of polarised and depolarised iron, resulting in electrolytic corrosion of the depolarised areas. Good preventives are the use of a slight excess of sodium carbonate in the softening operation, or the addition of tannin to the feed-water. In no case was corrosion detected where Permutit-treated water was in use.

The possibility of employing hot softeners or even distillers depends on the completeness of the heat exchange, and the costs on the plant required to effect this. The removal of scale and sediment gives trouble.

It is important to keep a close watch on the concentration of salts in the boiler, more particularly, as might be expected, where the feed-water is highly charged with sodium chloride, than where sodium sulphate is the main constituent. Collapses are recorded where in one case the concentration of the former reached 8 per cent. and in another case not until the latter reached about 30 (of the anhydrous salt) per cent.

A unique case of external uniform corrosion is reported connected with the use of coke as a fuel. Anhydrous ferrous sulphate was found near the corroded part, and the cause is attributed to the absorption of sulphur trioxide by the scale during the run, and its subsequent conversion into sulphuric acid by absorption of moisture from the atmosphere when lying idle.

THE PRESERVATION OF LIQUID EGGS WITH BORIC ACID.

REPORT BY DR. A. W. J. MACFADDEN ON THE WORK OF INSPECTORS OF FOODS DURING THE YEAR 1917-18. (H.M. Stationery Office. Price 3*d*.)

In connexion with the importation of liquid eggs from China and with the use of boric acid in preserving them, the Report states that prior to the war such eggs were mostly sent to Germany, and that the few which came to this country were used mainly for industrial purposes such as leather dressing, and to a small extent for confectionery. Since 1914, however, large consignments have been received in the United Kingdom, the egg yolk and egg albumen usually being packed separately. Samples of yolk analysed by the City of London Analyst were found to contain from 1·35 to 2·08 per cent. of boric acid, and in some cases common salt up to 10 per cent. was found, together with a smaller amount of boric acid. The use of these eggs was formerly confined to the manufacture of cakes, biscuits, etc., but latterly large quantities have arrived packed for domestic use in small tins and jars containing the equivalent of 9—12 eggs, or more. In this form the product has been available to the general public for use in puddings, etc., and as the amount of boric acid present has been found excessive, its employment for domestic and restaurant use is open to very serious objection. The Government Chemist has examined a series of samples packed in this manner. The results showed amounts of boric acid varying from 40 to 113·4 grains per lb., together with added water, some of which was probably due to the addition of this acid in aqueous solution. It was also observed that the proportion of yolk to white was very different from that in genuine eggs: and the statements on the labels regarding the egg equivalent of the contents of the packages were often quite misleading.

The public health authorities of the districts concerned have made it a condition of allowing the importation of preserved liquid eggs that a guarantee shall be furnished by the importers (1) that the material will be sold only to firms engaged in the bakery, wholesale confectionery and allied trades, and that when used in products prepared for human consumption the ultimate amount of boric acid contained in such products will be negligible in amount; and (2) that the eggs will not be sold to the general public by retail over the counter, and that with a view to ensuring this they will not be put up in receptacles containing less than 7 lb.

As the importation of egg products from abroad will necessarily increase in the future it would be very advantageous, both from the point of view of the health of the consumer and of the economy in shipping space, if arrangements could be made for the product to be shipped as dried egg instead of in a liquid form. Dried egg imports have proved very successful and if the eggs are prepared and packed properly in this form they are a wholesome and useful foodstuff.

Other subjects discussed or referred to in the Report are:—Army food manufacture, food poisoning, botulism, and dried milk.

THE REPORT OF THE INDIAN INDUSTRIAL COMMISSION.*

During the years just preceding the war a new spirit had arisen in India, which demanded industrial development of the country on Western lines. This spirit, which was strengthened by the new economic conditions brought about by the war, found concrete expression in the resolution moved in the Imperial Legislative Council for a clear declaration of the industrial policy of the Government. Consequently in May 1916 the Government appointed the Indian Industrial Commission with a view to examine and report upon the possibilities of further industrial developments of India. The Commission was presided over by Sir Thomas Holland, Kt., of the Manchester University. After two years of deliberations and examination of evidence, submitted by 472 witnesses, a bulky report has just been published, which gives the conclusions arrived at, the detailed evidence being published separately in six other equally bulky volumes. These reports contain amongst other things much interesting information regarding the future prospects of chemical industries in India.

The Commission recognises that Indian industries are now, and will be in future, based chiefly on the agricultural produce of the country, the chief of which is cotton. Recommendations are made for increasing the production of long-staple cotton in the country by systematic agricultural and botanical research. Sugar is of almost equal interest to Indian consumers and will prove the foundation of a great industry. Proposals are made for improving the indigenous types of sugar cane by cultural methods and for increasing the yield of sugar per acre and per ton of cane. Various fibre crops are noted, *viz.*, hemp (*Crotalaria juncea*),

* This Report has been issued in India; the Home Edition is not yet to hand.

jute, flax, and rhea, some of which, such as flax, are required for manufactures of national necessity. Oil seeds are grown all over the country and are of extreme importance; over £18,500,000 worth of these were exported in 1913-14. The success of large-scale oil mills and the manufacture of soaps, candles, etc., in the country for the utilisation of these oil seeds will mainly depend on tariff policy. In hides and leather the trade before the war was mainly in the hands of the Germans. The principal difficulty at present is lack of organisation and expert skill. Chrome tanning, so far, has made comparatively little headway, but progress of late has been rapid. Vegetable tanning materials like Acacia arabica, Cassia auriculata, divi-divi and myrobalans are obtainable in large quantities but are chiefly exported; suggestions are made for their retention in the country and for the manufacture of tannin extracts. For this industry the question of tariffs also plays an important part, though it will not be possible for some time to come for India to tan all her hides.

The Commissioners then proceeded with the examination of the mineral deposits of India, and came to the conclusion that these are sufficient to maintain most of the "key" industries, except those that require vanadium, nickel and possibly molybdenum. Indian coal is very unevenly distributed and generally poor in quality. Broadly speaking, there is a general scarcity of good cooking coal for metallurgical purpose. Iron ore is found in many parts of the country but as a rule ore of good quality is not found in proximity to satisfactory coal supplies. Rich deposits of lead and zinc ore exist in Burma and arrangements are being made to smelt the latter in India. The copper ore mines of Singhbhum will soon be developed, and smelting works have been erected and have already started operations. High-grade chromite is produced in large quantities. Bauxite deposits have been found and a large hydro-electric scheme is in progress for the manufacture of aluminium. Manganese ore is extracted in very large quantities for export, but measures have been taken for making considerable quantities of ferro-manganese. The richest sources of tungsten ores have been in Burma, where also are to be found ores of tin and antimony. India occupies the first place as a mica-producing country, and mica of the highest grade is produced in Bihar. Large cement works have been started and equipped with plant of modern designs; there are still great possibilities for cement manufacture in India.

Experiments on various clays for pottery have been recently made, and promise great results. Glass manufacture has now received attention, for suitable sand and lime occur in many parts of the country. India at one time possessed a practical monopoly of saltpetre. Owing to its admixture in natural state with salts its manufacture was considerably restricted, but it has recently expanded under the stimulus of war prices.

Among forest products, lac and caoutchouc are of importance. Owing to want of exploitation incomplete use has been made of forest resources. The extension of research and facilities for transport will add considerably to the economic utilisation of these and many other valuable products.

Very definite recommendations have been made for the manufacture of paper pulp, and excellent paper has been manufactured from bamboos. Development of this industry will prevent the dumping of wood pulp from Scandinavia or North America.

Wood distillation and manufacture therefrom of acetone, alcohol, acetic acid and a number of other important products offer the greatest field for large-scale undertakings. A very large wood distillation plant is being set up by the Mysore Government in connexion with its charcoal-steel production.

Turpentine and rosin are now produced and more work is being done in this direction. No other country offers such good prospects for the establishment of a national essential oil industry. The production of sandal wood oil has made rapid progress, as has also the manufacture of thymol. The Commissioners note with considerable assurance the immense future which awaits the development of fisheries in India.

Indian Chemical Industries.—India imports chemicals to the value of more than £670,000 a year, but owing to the relatively small quantities of the different kinds used, the Indian manufacturers have confined their attention to the manufacture of heavy chemicals. Simple drugs and extracts are also produced to some extent, but the output has been considerably restricted by excise regulations.

India is dependent on outside sources for sulphur. Very few sulphide ores have been found in the country, and until arrangements have been made for the production of sulphuric acid in different parts of India, matches, oils, explosives, disinfectants, drugs, dyes, etc., will have to be imported. Attempts are being made in Bombay and at Sakchi to instal fairly large sulphuric acid plants, but it will be a long time before India will be self-sufficing in this respect. With the exception of sulphur other raw materials for heavy chemical manufacture are found in abundance. Salt occurs plentifully everywhere in India except in Bengal, where it is very urgently needed in large quantities for chemical purposes. Messrs. Tata Sons & Co. have already in hand a very large scheme for the production at Chilka Lake of from five hundred thousand to a million tons of salt per year. This scheme will provide India with extremely cheap salt necessary for the starting of chemical industries, especially caustic soda, for which there is a growing demand for paper pulp and soap manufacture. A very large plant has been set up in Sakchi for the recovery of by-products from coke ovens, which will be able to supply India's whole demand for benzol and related products.

To make good many of the deficiencies, the Commissioners recommend the Government to encourage foreign firms, which have special knowledge of and interests in the country, to open branches of their works in India, especially for the manufacture of heavy chemicals, rubber and vulcanite. The Commissioners propose that for the development of industries on sound lines the Government should create a new Department of Industries, which should be in charge of the various scientific services, of which the Indian Chemical Service is the most important. The headquarters of the chemical branch of the Department will be at Dehra Dun under the charge of a Chief Chemist to the Government. Under him directly would be a staff of several chemists and specialists. The results of the work of these chemists will be published in a new Government chemical journal. The necessary *personnel* for these Chemical Services will be recruited from the Indian universities, so far as junior appointments are concerned, but the senior appointments will be filled at least for some years from English universities. The Chief Chemist will get an annual salary of £2400. There will be eight other senior officers with salaries of £800 per annum; and the yearly expenditure of the Chemical Service is estimated to be over £34,000. The total of capital expenditure involved in the proposed schemes is one million pounds, a sum which includes provision for industrial schools, technological institutes, etc. In addition to this the Government would also aid nascent industries in various other ways, such as, *e.g.*, by land acquisition, concessions in railway rates, and by giving direct financial assistance.

LEGAL INTELLIGENCE.

CLAIM FOR INCREASED IMPORT DUTY ON SACCHARIN. *American Commerce Co., Ltd.*, v. *Frederick Boehm, Ltd.*

In the King's Bench Division on January 22, the American Commerce Co. claimed to recover from F. Boehm, Ltd., the sum of £300 for increased import duty on 100 lb. of saccharin, sold by them under a contract, to be shipped in February-March, 1918, from New York to a British port, at 220*s.* per lb., c.i.f., duty paid. Subsequent to the contract, but before the goods had been delivered, the import duty was raised by 60*s.* per lb., which the plaintiffs paid. They, however, claimed that under the Finance Act of 1901 they could recover the increased duty as there was no agreement to the contrary. Mr. Justice Bray upheld this claim, and gave judgment for the plaintiffs, with costs.

APPLICATION TO RESTORE TO REGISTER AN AVOIDED ENEMY TRADE MARK.

Before the Comptroller of Patents (Mr. H. Temple Franks), on January 30, in the Patents Court, an application was made by Genatosan, Ltd., that an order for the revocation of the trade mark "Sanatogen" should now be rescinded. The application was opposed by Boot's Pure Drug Co., the British Sanatogen Co., Ltd., the Chemists' Supply Association, Casein, Ltd., John Lorimer, the Drug Club, and Southall Bros. and Barclay, Ltd.

Counsel for the applicants said that the "Sanatogen" business, being an enemy property, was seized after the beginning of the war and a Receiver appointed, who sold it to a syndicate of the late Lord Rhondda which took the name of Genatosan, Ltd. Prior to the conveyance there had been a suspension of the registration of the trade mark "Sanatogen" so that the trade mark as a registered trade mark did not exist but it continued to exist as a common law trade mark. Therefore the applicants, as the purchasers, had the exclusive right to the mark, and they submitted it was desirable that the word "Sanatogen" should be restored to the register.

The Comptroller said the application would have to be considered.

GOVERNMENT ORDERS AND NOTICES.

EXPORT PROHIBITIONS.

Further relaxations of existing export prohibitions have been announced by the Board of Trade; they became valid on the dates specified.

Headings transferred from one list to another.

From List A to List C:—

Carbon, coke oven; carbon, gas; carbon, pitch; cotton rags and rags containing cotton; esparto grass; hemp waste; jute waste; linen rags; linen waste; nightlights; oil of cedar wood; oil of peppermint; oil of sassafras; sisal strings, old; sisal waste; tinplate scrap, including scrapped and disused receptacles wholly or partly made of tinplate. Chemicals:—Agowan seeds; areca nuts (betel nuts); benzol and its compounds and preparations; cantharides; dimethylaniline; hydroquinone and mixtures containing; jalap; meta-cresol; methylaniline; para-cresol; paraffin, liquid medicinal; squills.—(Jan. 23.)

Arrowroot; banana meal and banana flour and preparations containing; barometers and their component parts; caramel, liquid or solid; cassava powder; celluloid; "celluloid" sheet, non-inflammable, and similar transparent material, non-soluble in lubricating oil, petrol, or water; cornflour; corn grits; dextrin and all articles and mixtures and preparations containing; farina; hominy; milk sugar (lactose); potato flour; sago and sago flour and meal; soap, including soft soap; soups, compressed and desiccated; spelter and spelter dross; starch, articles containing starch and mixtures and preparations of starch; stellite and similar alloys; tapioca and tapioca flour; zinc, alloys of zinc, manufactures of zinc and zinc dust; zinc ashes. Chemicals:—Saccharin, and articles, mixtures and preparations containing; zinc sulphide.—(Jan. 30.)

From List B to List C:

Cadmium, alloys of cadmium and cadmium ore; carborundum, alundum, crystolon, and all other artificial abrasives and manufactures thereof; cylinders, metal, capable of use for the storage of gases or liquids under pressure; ferro-cerium; fustic (chips and extracts); oil, sandalwood; salt (other than rock salt, which is already on List C); sandalwood for medicinal purposes; silicon spiegel.—(Jan. 23.)

Cloves; coir yarn; ginger; mandioca; palladium and its alloys and manufactures containing; vanadium; vanadium ore; vanillin; wolfenite; zinc ore.—(Jan. 30.)

Altered Headings.

(A) Bromine; (A) hydrobromic acid; (C) bromides not otherwise specifically prohibited; (A) fibres, vegetable, not otherwise specifically prohibited, except China grass (ramie fibre); (C) China grass (ramie fibre); (A) lead, dry white; (C) lead in all forms not otherwise prohibited; (A) manures, compound, containing either sulphate of ammonia, superphosphate of lime, or potash; (C) manures, compound, not otherwise prohibited; (B) molybdenum filament; (C) molybdenum and molybdenite, except molybdenum filament; (A) quebracho extract, and extracts containing quebracho; (A) liquid chestnut extract; (C) tanning materials not otherwise prohibited; (A) wood and timber of all kinds, hewn, sawn, or split, planed, or dressed, except lignum vitæ, mahogany and hardwoods; (C) mahogany and hardwoods; (A) woollen rags, shoddy and mungo applicable to use otherwise than as manure or as roofing felt rags.—(Jan. 23.)

(A) Cereals, prepared foods derived wholly or partly from, containing milk; (C) cereals, prepared foods, derived wholly or partly from, except such as contain milk; (A) glucose; (C) articles, mixtures and preparations containing glucose not otherwise prohibited; (A) tinplates; (C) gas meters and component parts thereof made wholly or partly of tinplate; (A) wire rods; (B) wire of iron or steel. (Jan. 30.)

Validity of Export Licences.—1. The Director of the War Trade Department announces that Privy Council Licences are now as a general rule issued without a time limit, except in the following cases:—(*a*) All licences for export to: Norway, Sweden, Denmark, Holland, Switzerland, Iceland, Faroe Islands, Greece; (*b*) all licences for the following goods, irrespective of destination: raw cotton, kapok, coal, coke and manufactured fuel.

2. The right is still reserved to insert a time limit in any licence issued after the date of this notice should circumstances demand.

3. Subject to the foregoing exceptions, all licences valid for shipment on or after July 1, 1918, may, unless specially revoked, be regarded as still valid irrespective of the date of issue or of any time limit they contain.

Scottish Paraffin Wax.—With reference to the notification concerning the export of Scottish paraffin wax (this J., 1919, 35 R), the War Trade Department now states that applications for export to approved destinations will be considered irrespective of the melting point of the wax.

Sulphate of Copper and Coal Tar Pitch.—The Director of the War Trade Department announces that an open general licence has been issued permitting the export of (1) sulphate of copper and (2) coal tar pitch to all destinations except destinations in European and Asiatic Russia and in other foreign countries in Europe or on the Mediterranean Sea other than Italy and Italian Possessions, Belgium, Portugal, Spain, Greece, Morocco, other than French Morocco, Palestine and Syria, as far north as a line from Alexandretta to Aleppo inclusive, and as far east as the Hejaz railway inclusive. Applications for licences to export the above-mentioned goods will therefore in future only be required when it is desired to export them to France, French Possessions, or any of the neutral destinations to which goods on List C are prohibited.

Blended Oils, Resins, etc.—The Director of the War Trade Department announces that an open general licence has been issued permitting the exportation of the following goods to all destinations except those specified in the preceding note:—Blended oils containing not less than 50 per cent. mineral oil, and of "Phosto" animal food, kava kava resin, scammony resin, varnishes of all kinds, floor and other polishes, paint other than gold paint.

IMPORT PROHIBITIONS.

The following temporary General Licences which have been issued since the armistice, and which were announced as being terminable on March 1, will be withdrawn with effect from that date:—

Aluminium, manufactures of; aluminium powder; cement; diatomite or infusorial earth; electrotypes; fatty acids; fire extinguishers; methyl alcohol; oil cloth; perfumery and toilet preparations; photographic apparatus; salt; slide rules for engineers and draughtsmen; soap; straw envelopes for bottles; weighing machines, scales and balances of all descriptions.

The following General Licences will be continued till July 1:—

Aerated mineral and table waters (unsweetened); cocoa (raw); gum copal; gum kauri; horns and hoofs; ivory (vegetable); nuts; sugar cane; goat and sheep skins, tanned; sheep and lamb skins, dressed.

The following additional General Licences are being issued and will also be valid till July 1:—

Cassia lignea; hides, wet and dry; marble; pimento.

PETROLEUM PRODUCTS (WHOLESALE PRICES) ORDER, 1919.

This Order, which was made by the Board of Trade on January 31, revokes previous similar Orders, and came into effect on February 1. The schedule gives the maximum prices of the different products, as follows:—

Spirit in cans, per gallon: Aviation, 3*s.* 0½*d.*; special boiling points, 2*s.* 11½*d.*; No. 1, 2*s.* 10½*d.*; No. 2, 2*s.* 9½*d.*; No. 3, 2*s.* 8½*d.*

For delivery to commercial consumers (not for re-sale) in steel barrels, 1*d.* per gallon less than can price, and for delivery in bulk to commercial consumers (not for re-sale), 1½*d.* per gallon less than can price.

1*d.* per gallon may be added to all above prices when sold for delivery in Scotland or Ireland.

Kerosene, per gallon: Long time burning oil in bulk, 1*s.* 3*d.*; No. 1, 1*s.* 3*d.*; No. 2, 1*s.* 2*d.*

For delivery in barrels ex wharf, 2½*d.* per gallon additional.

1*d.* per gallon may be added to all above prices when sold for delivery in Scotland or Ireland.

Raw white spirit as imported, ungraded and unrefined, sold to manufacturers for distribution in accordance with licences issued by the Ministry of Munitions, 2*s.* 3*d.* per gallon.

Gas oil in bulk ex wharf, 8½*d.* per gallon. For delivery in barrels ex wharf, 3¾*d.* per gallon additional.

Fuel oil in bulk ex wharf, £7 10*s.* per ton. For delivery in barrels ex wharf, 3¾*d.* per gallon additional.

OTHER ORDERS.

The Radio-active Substances Control (Suspension) Order, 1919. Ministry of Munitions, January 21.

The Whale Oil (Suspension) Order, 1919. Ministry of Munitions, January 31.

The Imported Flax (Dealings) No. 2 Order, 1919. Army Council, January 30.

Orders Cancelled by Notice.—The Raw Asbestos Order, of January 5, 1918. Admiralty, January 16. The Imported Hides (Control) Notice, 1916, and the Imported Hides (Dealings) Order, 1916. Army Council, January 23. The Bung Gut and Goldbeater Skins Order, 1917. Admiralty, January 23.

Permitted Explosives.—By an Order of the Home Secretary, under the Coal Mines Act of 1911, the use of the explosives Samsonite No. 2 and Samsonite No. 3 is now permitted.

Linseed, Rape and Castor Oils.—The Ministry of Food announces that supplies of these oils are sufficient to permit distribution to any consumers in quantities not exceeding 5 tons in 1-ton lots during any one calendar month.

Sulphate of Copper.—The Food Production Department announces that the Government does not propose to control the selling price of copper sulphate this year.

TRADE NOTES.

BRITISH.

General Trade Outlook.—Speaking at Huddersfield on January 23, Sir Albert Stanley, President of the Board of Trade, said he must confess to some measure of disappointment concerning his earlier hopes of a speedy solution of the problem of the dye industry, but he believed that this vital industry had now finally been established upon a firm and lasting foundation. Speaking generally, the trade of the country was not advancing as might reasonably have been expected. It was no exaggeration to say that the war had left an empty world which was only waiting to be refilled, and it was incumbent upon them to look for reasons why the demand, which certainly existed, had not been met with greater enterprise. It was the deliberate policy of the Government to abolish the restrictions upon trade as rapidly as possible; but it could not be done in a day. Many restrictions upon exports had been removed, but those which referred to enemy countries, and countries bordering thereon, could not be relaxed until the peace had been secured. It was also proposed to bring the system of priorities to a speedy end, and to terminate those now in existence in the early part of March. As regards the shipping question, there was more tonnage available than there were cargoes to carry, and by the coming summer the world's available shipping would be at least as great as existed before the war. There was no fear of a shortage of raw materials. The Government had

been urged by various interests to retain its control over imports until the manufacturers were able to re-establish themselves on a peace footing; this was a fair proposition and one which the Government should accept. One of the first matters to be dealt with in the new Parliament would be to stop "dumping," and he could not understand why it had been allowed in the past. The equipment of a new Ministry of Commerce, he believed, was about to be realised; its function would be to advise, and not to control or interfere with trade interests. Nothing could be more disturbing to the development of our trade and industries than constant labour unrest, and some way must be found of settling disputes without resort to strikes.—(*Bd. of Trade J., Jan.* 30, 1919.)

Opportunities for British Chemical Manufacturers in Holland.—There are a number of laboratories in Holland, writes Dr. F. M. Jaeger, professor of chemistry at Groningen University, to the British Science Guild, which will certainly purchase chemicals and scientific preparations from England and France, instead of from Germany as hitherto, if they can be supplied in adequately large quantities, in sufficient variety, and at competitive prices. What is needed at the moment is a large number of priced-catalogues so that orders may be given before the Germans re-enter the market. A radical alteration is required in the manner of advertising. The Germans send price-lists and prospectuses with full details, together with views of their country and full information for travellers. Up to now both the English and the French have failed in this respect.

FOREIGN.

The Post-War Trade of Sweden.—H.M. Consul-General in Sweden has transmitted a statement concerning the prospects of various trades and industries after the war.

Lubricating oils and greases, and fats for the manufacture of soap, are now being made from meat and fish offal. It is anticipated that this manufacture will continue, and it will, doubtless, affect the import of oils, but only to a very limited extent, as the demand will always be greatly in excess of local supplies. There will be a great demand for all kinds of oils directly supplies become available, as stocks are completely exhausted. This applies also to manufactured articles, such as margarine and soap. Sweden was, before the war, an increasingly large consumer of margarine, which was imported or manufactured within Sweden to release butter for export

The Government has concluded contracts with a shale crushing company, thus granting the equivalent to a bounty. The shale oil industry will be permanent.

Rosin, which is now being extracted from the refuse from sawmills and other wood, is very largely employed in Swedish industries. The production will probably be continued after the war, and may even be extended, but it will not be able to supply the demand, which must continue to be met by importations.

Paper yarn, or spun paper, has been employed during the war as a substitute for wool, cotton, hemp and jute, and has been used for all textile purposes, for floor coverings and machine belting. It has been used with some success in the manufacture of sacks and wrappings, but cannot compare with jute, being very susceptible to damp. Possibly spinning of paper may develop, but in its present stage it is quite unable to compete successfully with cotton, wool, etc.

Cattle foods are being prepared from cellulose, heather, fish offal, and meat offal, etc. Seed crushing mills have been erected for the treatment of imported seeds, when such again become available. The experiments with substitute cattle foods have not been successful, though all continue to be used for want of the genuine articles. Foods made from meat and fish offal are found to be of more value than the other substitutes, and will continue to be made after the war. Considerable capital has been invested in factories for the treatment of these offals, and the promoters are evidently persuaded that these foods have a permanent value, and will be in demand after the war. Though the output of the Swedish seed-crushing mills, together with the substitutes above referred to, will meet some proportion of the demand, there will still be a considerable demand for imported cake, etc.

Ship's paint, hitherto almost exclusively imported, is being manufactured in Sweden. The demand is at present greatly in excess of the supply, but, given the necessary materials, the production will expand, and there seems little reason to suppose that independence of foreign supplies may not eventually be achieved.

The production of electrolytic copper has been directly assisted by Government subsidy. Before the war this material was not produced in Sweden. This industry will certainly be permanent.

There are no stocks of imported manufactured goods in Sweden. The small supplies which from time to time become available are at once absorbed. The building trade is probably the only one which has been stopped on account of the high cost of materials. There is little or no accumulation of manufactured goods awaiting export, with the possible exception of glass. Such small stocks as may exist will certainly be absorbed without any great fall in prices.

After-war Competition.—The bulk of the chemicals has been obtained from Germany, the most important being carbonate of soda, caustic soda, potash, bicarbonate of potash, chloride of lime, sal volatile, chalk, borax, Glauber's salt, waterglass, and dyes. Large applications have been placed in the United States for the following chemicals:—Boric acid, bichromate of potash, ceresin, chrome alum, coconut oil, palm oil, varnish, raw asbestos fibre and rosin. Sweden is a large producer of window and bottle glass, but imports medical and laboratory and optical glass from Germany. China and earthenware are largely imported from Germany. Large orders have been placed in the United States for sanitary ware.

Electrical factories are dependent on a large import of copper for cables, as the copper found in the Falu Mine and Atvidaberg does not supply a small proportion of Sweden's requirements for electrical fittings.

Iron and steel are main productions of this country, and consequently the export is greater than the import. Steel rods, beams, and profile iron are imported from the United Kingdom, but rails, pipes, and a certain amount of pig-iron are imported from Germany.—(*Bd. of Trade J., Jan.* 30, 1919.)

Panama in 1917.—Business in Panama during 1917 was dull and unsettled and much below the pre-war standard. The total imports were valued at £1,900,000 and the exports at £1,170,000. These were distributed as follows:—Imports: U.S.A. 77%: England 4·4%; China 2%. Exports: U.S.A. 98·5%. The ports handling the export trade were Colon (10%), Panama (4%) and Bocas del Toro (86%). The imports included chemicals valued at £45,000; paints £11,400; soaps £45,000; cotton textiles £78,000, and the following oils:—Cottonseed, £13,500; fuel £16,000; linseed £2080; lubricating £4000; medicinal £2900, and olive oil £2700.

Colon.—The planting of abandoned banana land with coconuts and cacao is proceeding at a rapid rate as is also the cultivation of vegetable ivory (tagua nuts). The Mandenga manganese mine has

shipped nearly 18,000 tons of ore to the U.S.A. since 1916 and 4000 tons await shipment. Other deposits are being investigated. Boring for oil is being started, the indications being promising. A new gas system was installed during the year by an American company and there are factories for making ice and coconut and palm oils. A small works for making laundry soap was obliged to close down for lack of caustic soda. There was a large increase in the number of coconuts exported (19,528,845 as compared with 10,708,705 in 1915), but this was largely made up of re-exports from the Colombian island of St. Andrew.—(*U.S. Com. Rep., Nov.* 5, 1918.)

Quinine in Brazil.—Further regulations, relative to the combating of malaria, have been promulgated in Brazil which affect the preparation and distribution of quinine. Cinchona bark, in addition to quinine salts, will be imported and extraction plant will be installed in the Oswaldo Cruz Institute. Regulations are laid down for the sealing, stamping and marking of the tubes in which the drug is to be sold, and the retailer's profit is limited to 10 per cent.—(*U.S. Com. Rep., Dec.* 11, 1919.)

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for January 23 and 30.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73 Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Numbers
Sydney, N.S.W....	Soap, essential oils, pharmaceutical products	58
" " ...	Aluminium, enamel ware, glass, crockery	
Wellington, New Zealand ...	Copper-plate, wire and tubing, zinc sheeting, etc.	124
Cape Town ...	Drugs and chemicals ...	127
Toronto	(i) Drugs and chemicals ...	83, 84, 85
"	(ii) Fine chemicals ...	86
"	(iii) Dyes	91
"	(iv) Glass, pottery, enamel ware	95
"	(v) Leather, glass, colours, dyes, essential oils, etc.	89
"	(vi) Paint and varnish ...	96
"	(vii) Nitrate of soda ...	105
Vancouver ...	Chemicals, pottery, stained glass	110
Paris	Tin, tinplate	162
Genoa	Chemicals and drugs ...	137
Spain, Portugal and S. America	Chemicals, drugs, perfumery	170
Lisbon	Chemicals and drugs ...	142
Barcelona ...	Chemicals, drugs, oils, artificial manures	145
Amsterdam ...	Lamp glasses	167
Panama	(i) Soap, washing soda (sal soda), caustic soda, silicate of soda	78
"	(ii) Soap	79
Sao Paulo (Brazil)	Chemicals, oils, greases ...	130
Rio de Janeiro ...	Chemicals and drugs ...	131
Guadalajara (Mexico)	Gauge glasses	165

A Canadian firm able to supply electrolytic zinc and lead wishes to get into touch with importers in the U.K. Inquiries should be addressed to the Canadian Government Trade Commissioner, 3 Basinghall Street, E.C. 2.

Apply to the Agent-General, N.S.W., Cockspur St., S.W. 1.

TARIFF. CUSTOMS. EXCISE.

Australia.—A recent Customs by-law, No. 384, specifies the methods to be adopted in denaturing amyl alcohol and fusel oil in order that they may be imported duty-free into the Commonwealth.

Belgium.—Among the articles for which import licences are not required are edible oils and fats, soap, raw rubber, cork, bones, horns, clay, gravel, sand, cement, lime, plaster, bricks, porcelain, pottery, glass, scientific instruments, matches, starch, varnish, oil or spirit, blacking, polish and pharmaceutical products

Canada.—Shipments of goods destined for Canada will be allowed to pass the Customs at Portland, Maine, U.S.A., under "P.B.F. No. 12" without production of proof of Canadian Import Licence.

From January 1, oleomargarine will only be admitted upon the presentation of a new licence from the Department of Agriculture.

The import and export of all goods, except certain foodstuffs, are now covered by general import and export licences.

Ceylon.—The export duty on rubber has been reduced to Rs. 3 per 100 lb., as from November 19, 1918.

France.—A general derogation of export prohibition has been accorded with respect to the following goods:—

(1) For consignments to Allied or neutral countries, except Switzerland: Carbon brushes for dynamos, silk, spirits and liqueurs, aluminium ware, rubber (with some exceptions), celluloid, photographic plates and papers, saffron and artificial silk.

(2) For consignments to all Allied and neutral countries: Many kinds of paper and cardboard.

France and Algeria.—The revised list of articles the export of which is temporarily prohibited, except under licence, as from January 21, includes hides, hair, grease from hides, bones, hoofs, fats and oils, sugar, gums, alcohol, turpentine, cinchona bark, cellulose pulp, paper, corundum, natural phosphates, lime, cement, petroleum, coal-tar derivatives, certain metals and chemicals, soap, glass, and rubber.

The revised list of goods for which no import licences are required after January 21 includes hair, feathers, hoofs, horns, bones, hides, skins, leather, ivory, fats, oils, waxes, certain foodstuffs, organic manures, vegetable tar, resin oil, certain gums and fibres, tanning materials, certain metals and ores, many chemicals, colours and dyes, perfumes, dextrins, starch, glue, camphor, rubber, mica, felt, etc.

Kedah: Perlis.—The export duty on cultivated rubber was temporarily remitted as from October last.

Netherlands.—The export of bricks, tiles, lime, sandstone, firebricks, etc., is prohibited as from January 17.

New Zealand.—Recent Customs decisions affect the import duty on felted paper and lactogen.

Sierra Leone.—The export of cocoa to the U.K. is now permitted.

Spain.—The export of olive oil is now authorised up to a total quantity of 90,000 tons, subject to permit and certain other conditions. The export tax is reduced to 25 pesetas per 100 kilo. for oil in barrel and skins, and to 20 pesetas per 100 kilo. for Spanish trade-mark brands in tins and bottles.

United States.—Alcoholic liquors may not be imported as from November 21, 1918, except those shipments which were *en route* at that date.

Recent rulings of the War Trade Board affect liquorice root, vanilla beans, furs, skins, tallow, copper ore, copra, rubber goods, shellac and other lacs, cocoa, leather, etc.

REVIEWS.

THE NATURAL ORGANIC COLOURING MATTERS. *By* A. G. PERKIN *and* A. E. EVEREST. *Monographs on Industrial Chemistry, edited by* SIR ED. THORPE. *Pp. xxii* + 655. (*London: Longmans, Green and Co.*, 1918.) *Price 28s. net.*

During the past fifty years the main trend of organic chemistry has been in the direction of the synthetical preparation of substances likely to be of use in medicine or industry, and the great success which has attended this has led to neglect of the study of naturally occurring substances and the processes by which they are formed.

The living organism, by means of reactions occurring at the ordinary temperature, "manufactures" important substances, such as carbohydrates, dyes, alkaloids and proteins, some of which have, indeed, been synthesised in the laboratory but only by the aid of drastic agents incompatible with the life of an organism. Although the statement that many of these naturally occurring substances are not surpassed by any of our laboratory products is more applicable to carbohydrates and proteins than to dyes, Nature has even in the latter case introduced to us two valuable dyes —alizarin and indigo—the study of which greatly facilitated the progress of certain portions of the dye industry. We may, perhaps, even say that it is not improbable that the study of those natural dyes the constitutions of which are at present unknown may throw new light on the relations between constitution and colour and therefore contribute to the progress of the whole dye industry.

Much research still remains to be carried out in this field which has a peculiar fascination for anyone who likes variety and difficulty in the problems he investigates. To such a chemist we have no hesitation in recommending this book as one thoroughly deserving his study. He will find in its nineteen chapters clear and interesting descriptions of work on substances of the most diverse character, such as alizarin, carminic acid, brazilin, berberin, catechin, curcumin, ellagic acid, indigo, lapachol, the flavones, the xanthones, the tannins and the anthocyanins. He will be indebted to the authors for placing at his disposal a book which covers practically the whole scientific literature of the group and which, moreover, in some places contains the results of investigations which are now published for the first time.

Notwithstanding the wide range of the book it is, with the exception of some obvious typographical mistakes, singularly free from errors. The only omission from it of any importance is that of the investigations by Liebermann and his pupils of the dye azafrin, which is closely related to bixin. Also, in a *monograph on industrial chemistry* we should in this case have expected a chapter dealing in a general manner with the manufacture of extracts of dyes, describing for instance the "cutting" and "curing" of dye-woods and some modern types of extraction-batteries. In not including such a chapter in their book the authors have, perhaps, adhered too rigidly to the instructions of the general editor, which exclude "technical *minutiæ* of manufacture" from the scope of these monographs.

It is satisfactory to find the tannins very fully described, all the more since several plants, which are still used as "dyes" in some remote districts, owe their tinctorial properties to the tannins. In addition to the better known poly-depsides described in the chapter on the lichens, the authors might well have given a brief description of the work, however imperfect it may be, which has been carried out on some of the less well-known lichen constituents such as divaricatic and usnic acids. The attention of the younger chemists might thus be drawn to the desirability of investigating the many compounds (about one hundred and sixty) of unknown constitution isolated by Hesse, Zopf and others from lichens, which possibly fulfil important physiological functions in the Cryptogams as the flavones and the anthocyans do in the Phanerogams.

HUGH RYAN.

MODERN COKING PRACTICE. *By* J. E. CHRISTOPHER. *Including the Analysis of Materials and Products, by* T. H. BYROM. *Second edition, in two volumes.* (*London: Crosby Lockwood and Son*, 1917.) *Price per volume 7s. 6d. net.*

The second edition of Messrs. Christopher and Byrom's work on Modern Coking Practice retains the advantage of conciseness—the first volume now comprising 104 and the second 120 pages of text and illustrations, to which must be added some 25 plates, mostly reproductions of views of plant. Speaking broadly it presents a very serviceable *epitome* of the principles and practice of the coking of coal for metallurgical uses, with references to sources of more exhaustive information on particular items.

The first volume embodies descriptions of various types of coal washing plant, varieties of coke ovens and of the mechanical appliances used in connexion therewith. The descriptions are good, but only rarely do the authors offer critical observations to guide the reader on the merits of the different types of apparatus or plant. Neither does the book give him sufficiently full data or information to enable him to form for himself a just opinion therefrom on the comparative utility of the various types. Perhaps, when a third edition is called for, the authors will give the reader the advantage of their considered opinion and experience on these points. The methods given for the proximate analysis of coal are in many instances—*e.g.*, the estimation of ash and volatile matter—insufficiently definite to give concordant results in the hands of different analysts. This is especially true of the determination of volatile matter, which, being an empirical test at best, must be carried out in precisely defined conditions.

The second volume deals with the By-Products of Coking, including the principles and methods of their recovery and the tests of quality usually applied to them. In the chapters on condensers and exhausters the authors follow their practice in the first volume of refraining from comparative criticism of the different forms of plant described, but in an excellent chapter on "Direct" processes of ammonia recovery there is this useful opinion as to the relative merits of direct and semi-direct processes, *viz.*: "definite advantages peculiar to one system are counterbalanced by equally definite disadvantages, and so far the writer, from observations at several plants of both types, is unable to express any preference for either type." If only the authors could have seen their way to express the results of their experience equally explicitly in other chapters, they would have added immensely to the value of their book. The analytical methods given in the second volume vary greatly in merit, and necessary precautions are often omitted. For instance, in the determination of "free carbon" in tar, the use of a Soxhlet apparatus is rightly recommended, but there is no direction to dry the empty thimble before weighing, though the thimble and contents are dried before the final weighing. Parenthetically the reviewer may observe that in this determination he invariably uses a similarly-treated empty thimble as a counterpoise, and finds the results obtained are much more nearly concordant than when no such counterpoise is used. The book as a whole is, however, free from any serious faults and errors, and is likely to prove useful.

W. J. A. BUTTERFIELD.

INDUSTRIAL UNREST.

What is the meaning of the flood of insurgent labour that has been gathering momentum since the cessation of hostilities?

It is not by examination of the petty details that we shall find a solution, for the unrest is deep-seated. It is not confined to these Islands, nor indeed to the working-class. It is the universal aftermath of 4½ years of slaughter, of strain and affliction, borne by the peoples of the warring countries. We are suffering from social high temperature, and we are all badly in need of a febrifuge.

Labour in this mood and environment turns naturally to its many grievances, real and fancied. Those grievances existed before the war, which but served as a searchlight to reveal them in their nakedness. Many promises were made to labour during the war, and it was universal doctrine that labour, which had borne so great a share of the human sacrifice, must receive its square deal when hostilities ceased. And now labour looks, impatient and suspicious, for its promised charter, and sometimes a long way beyond it.

That many present-day labour demands are unreasonable and impossible is not in the least surprising, when we consider how many of the preconceived ideas of political economy have been falsified by events. At a time when we were piling up debt at the daily rate of £1 per head per adult worker, we were advancing wages every three months, we were employing more people than ever before, and the demand for commodities exceeded all experience. Yet within a month or two of every increase in wages the cost of living was found to have risen *pari passu*. Is it strange that the worker, plunged into this economic topsy-turvydom, is under the impression that he can ask for an ever bigger share, and that it depends only on the will or subjection of the controlling capitalist whether he gets it or not?

Turn to the *conditions* of labour. One of the chronic conditions is unemployment. The reserve of labour which in the early days of the industrial system might have been shouldered by the employer was thrust on the workers. Nearly all the rules and restrictions of the trade unions originate from the fact that in the past they have had to bear almost the whole burden of the reserve of labour. Starting with the assumption that there has never been enough work for everybody, regulations have been introduced to spread it over as many people as possible. This is the historic origin of restriction of output, and equally of trade union demands for reduction of working hours in the past. It is the reason for the present demands for the short week—a manœuvre that seems the only possible one to labour, which sees a million people already unemployed, and anticipates that demobilisation, involving displacement on a large scale, will probably double this total.

Whether it be just or unjust to rail at labour for its short-time policy, there can be no question that we should be much better employed in setting up, once and for all, national machinery for dealing with the problem of the aforementioned reserve of labour. The assumption by the State of this burden would be a logical and rational alternative to the restoration of trade union conditions to which we are so definitely pledged.

Much attention has been paid during the war to this and cognate problems of industrial government. The scheme of Joint Industrial Councils, proposed in the well known Whitley reports, was generally accepted as a sound and practical plan for the mutual control of industry by employers, acting through their associations, and by employed, through their trade unions. In the *interim*, unfortunately, labour has grown somewhat shy of these Councils, in some cases because they are too constitutional for the hotheads, who refuse to have anything to do with them, in others because the interminable delay in their creation and operation has led to impatience and distrust. And on the whole employers may be said to have cooled off also. Yet the Joint Councils, in principle, should be capable of saving us from anarchy in industry. Their establishment in all industries, and active operation where already established, seems essential for the just settlement which labour has been promised time and again. But if they are to be successful the Councils must be invested with authority; they must have the fullest publicity; and they must receive from the Government something more than faint praise. Above all they must *act*: if they are to be mere talking shops and hobby horses for doctrinaires on both sides, it were better they should not exist at all.

The Industrial Councils should forthwith put into operation constructive schemes for dealing with the reserve of labour, that is with unemployment; they should determine agreed minimum rates of wages (having before them facts and figures of the industry), agreed maximum hours of labour, agreed arrangements for holidays and all extra payments; agreed minimums of safety and convenience in every industry. They should not wait for agitation, but set out immediately with the deliberate object of creating a complete charter for the industry. Associated with the Councils would be impartial Courts of Conciliation and Arbitration for dealing with all cases of dispute within each industry.

With such machinery in existence, strikes and lock-outs could and should be declared illegal by Act of Parliament. To begin with, a logical result of the establishment of Joint Councils would be the legal recognition of trade unions as the only authentic voice of the workers. There would probably ensue a reconstruction of the trade unions by industries rather than by crafts, and a great federating movement—for the unwieldy and overlapping organisation of the unions, to say nothing of anarchy within them, is itself in no small measure the cause of many of our present troubles. Under such circumstances the old justification of strikes would pass away, because the solidarity of labour and employers in each industry would be assured.

At earlier stages in industry strikes and lock-outs were only incidents; in the complex world of to-day they are anti-social developments, and as such cannot be tolerated in a democratic State. But until the "industrial parliaments" come into operation, strikes unfortunately seem to impatient and extreme men their only resource, just as social rebellions were to the pioneers of political democracy. Legislative bodies like the Industrial Councils can at best deal with minimums, and it is useless to deny that labour seeks a higher *status* quite as much as a higher wage. Labour has experienced successive wage advances during the war, which have forthwith been passed on as part of the cost of production—often enough with enhanced profits to the employer. Labour wants a *real* advance in wages in relation to the cost of living. Further, labour suspects that in the ultimate division of the proceeds of industry, wages do not get a fair share with profits; it therefore seeks a more intimate share in the proceeds as well as in the government of industry.

A fair proportion of workers see no hope of attaining these aims save by collectivism—State ownership and control of the means of production—

or by guild socialism—a trustee control by the trade unions. And realising, as every industrialist must, that progress and development, research and invention, in the world as we know it, are mainly the fruit of individualist effort and enterprise, all engaged in chemical industry, who desire to see that industry develop and excel in the British Empire, and who equally desire to give labour the square deal and to bring to an end this strife of destruction, would do well to consider seriously at this time the claim of copartnership to provide that closer sharing of the National Dividend, while at the same time retaining our present system of individual enterprise.

Copartnership is at present practised by a comparatively small number of firms, and what it most needs to-day is an accession of strength; given this, most of its defects would disappear immediately. Copartnership by Act of Parliament is unthinkable, but it does not seem beyond the range of practical politics to encourage its adoption by means of some concession to firms working on copartnership plans. The Italian Government has recently applied this idea in the collection of excess profits.

It is a mistake to suppose that the unrest of labour is purely material. There is a general—often enough incoherent—desire for opportunities for a higher and fuller life. Improvements in education (it is truly a timorous State that provides one half its population with that little learning which is more dangerous than ignorance) as well as in housing are of equal importance with any economic improvements which may be made. It is to-day within the power of each industry to create a solid basis for industrial peace in its own domain by a prompt, whole-hearted co-operation with labour, for which the Joint Industrial Councils seem to provide suitable and adequate machinery.

Reverting to the common assumption of labour that there has never been enough work for everybody, it really remains to be demonstrated that there is not ample work available in the country to give full-time employment to every fit and willing potential worker, provided there is organisation to place him in his proper niche and to furnish a sufficiency of cheap raw materials and implements. There is no question that work breeds work, and restriction of output, whether effected by reduced hours of labour without correspondingly intensified effort, or by reduced effort with unaltered hours of labour, in the long run breeds unemployment. A vital question of the moment, if national industrial suicide is to be averted, is the provision of cheap power and transport. Given these, unemployment need not be feared, for the whole world is an open and practically unlimited market for the proceeds of labour and industry backed by cheap power and transport. In this country at least the cheapness of power and transport must depend mainly on economy in the raising and distribution of coal, and in the utilisation of that coal. If the miner and the mine-owner will do their part in providing cheap coal, the chemist and engineer must and will do theirs in circumventing waste, and the whole world of labour will have no cause to anticipate any appreciable degree of unemployment.

Whitley Councils and Government Employees.—At a conference of Government officials and representatives of trade unions having members engaged in Government industrial establishments, held on February 20, it was resolved to form Whitley Councils for Government Departments, and to appoint a provisional committee to set up machinery to put the scheme into operation. In the event of the Treasury or an employing Government Department exercising a veto over a recommendation of a Joint Industrial Council, the question is to be referred to arbitration.

DETERIORATION IN THE HEATING VALUE OF COAL DURING STORAGE.

G. CECIL JONES.

In Bulletin 136 of the United States Bureau of Mines H. C. Porter and F. K. Ovitz present a full account of the elaborate series of tests begun in 1909 by the United States Geological Survey and continued for five years by the Bureau of Mines with the co-operation of the United States Navy Department (this J., 1918, 615A). Experiments were made with several varieties of coal, but the most elaborate series was concerned with New River coal, a West Virginian variety largely used by the United States Navy. It is shown that storage under water, whether salt or fresh, effectively prevents deterioration of this coal, but the authors express the opinion that the expense of such storage is not justified, except as a preventive of fires by spontaneous combustion. This opinion is based on the supposition that the experiments described in the Bulletin establish the fact that the New River coal and all the other coals tested, except a black lignite from Wyoming, suffer very little deterioration during ordinary storage in air. "Except for the sub-bituminous Wyoming coal, no loss was observed in outdoor weathering greater than 1·2 per cent. in the first year or 2·1 per cent. in two years."

The writer ventures to doubt whether the data given in the Bulletin do justify this conclusion and proposes to show that these very same data suggest that the authors have overlooked a form of loss which may be several times as great as the small loss they have measured with such care. What the authors measured was the heating value of one pound of coal at each stage of storage. Combining this result with a determination of the percentage of moisture, ash and sulphur in the small portions withdrawn for analysis, they calculated the calorific value of one pound of pure coal substance at each stage of storage. The published data demonstrate clearly enough that one pound of the pure coal substance remaining at the end of a year developed on combustion only about 1 per cent. less heat than was developed by one pound of the original pure coal substance, but there is no evidence that the number of pounds of coal substance remaining at the end of the year was as great as the number originally placed in storage. In other words, the bulks were not weighed and the deterioration measured was only that resulting from the fixation of oxygen, no account being taken of possible loss of coal substance in volatile form. That there was such loss, the increase in the percentage of ash throughout the experiments seems to prove. Everyone with experience in the sampling of coal will recognise that the unavoidable error of a single determination of ash is high; it was this circumstance which led the authors to make their basis of comparison the heating power of a pound of pure coal substance, that is to say of ash-free, moisture-free and sulphur-free coal and not merely moisture-free coal. The figures given in the paper amply demonstrate the fact that the unavoidable error of sampling is large, but nevertheless they point almost irresistibly to the conclusion that there was a steady and far from insignificant loss of coal substance on storage.

To reduce to some extent the sampling error, the following table has been constructed from data contained in five separate Tables in the Bulletin, all referring to experiments with New River coal.

Percentage of Ash in Coal.

	Table 5	Table 7	Table 8	Table 10	Table 11	Mean
As stored...	6·68	5·67	7·97	6·08	7·45	6·8
After 3 months	7·29	5·88	8·61	6·69	8·75	7·4
,, 6 months	6·48	6·02	9·98	6·52	7·23	7·2
,, 9 months	6·70	5·71	8·45	6·12	7·79	7·0
,, 1 year	6·94	5·63	8·89	6·68	8·33	7·3
,, 1½ years	6·67	5·88	9·52	6·64	9·49	7·6
,, 2 years	7·04	6·04	10·84	8·83	9·31	8·4
,, 3 years	6·91	6·66	10·83	10·27	8·75	8·7
,, 4 years	6·90	7·14	12·49	8·55	8·60	8·7
,, 5 years	7·92	6·84	10·62	9·25	7·19	8·4

The numbered Tables referred to in the top line are the original Tables of the Bulletin and the figures in the first five columns are taken from these numbered Tables. The column of mean values has been calculated by the present writer. It should be added that the data given by Porter and Ovitz in one other Table have been excluded because the series of experiments dealt with in that Table was incomplete, also that the figures selected for presentation here are those obtained from the series of experiments with coal crushed to ¼-inch size, as the sampling error must be much less in these experiments than in those with run of mine coal.

Whilst the figures in the first five columns of the table, and even those in the last, show that the experimental error is high, those in the last column can leave no doubt that the percentage of ash increased continuously on storage. In view of the magnitude of the sampling error, which gives even the column of calculated mean values an irregular appearance, it is not proposed here to subject the figures to mathematical treatment nor to occupy space by plotting them on a system of rectangular co-ordinates. Any reader, however, can soon convince himself by either of these methods that the figures point to an increase in the percentage of ash from 6·8 to nearly 7·5 during the first year and thereafter at a gradually diminishing rate.

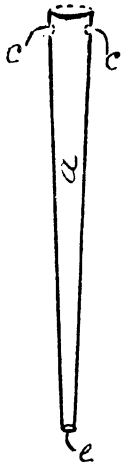
If this be the fact, what conclusion may be drawn from it? If a heap of coal, originally weighing 100 tons and containing 5 per cent. of ash, be sampled at the end of a year and found to contain 10 per cent. of ash, it would seem reasonable to conclude either that 5 tons of inorganic dust had entered into the heap during the year or that approximately half the coal substance had disappeared. Weighing the heap, supposing the conditions to be such that only an insignificant portion could have been blown away during the year, would decide to which of these two causes the increased ash percentage was due or the proportion due to each. In the American experiments under review, the percentage of ash did not double but it appears to have increased about one tenth in the first year and not much less in the second. If foreign inorganic dust did not gain entrance to the experimental heaps, it would appear that something like one tenth of the original coal substance had disappeared within the year. It is difficult to believe that the loss was so large as this, but since the American investigators did not weigh the coal remaining at the end of the year, it is by no means certain that the total loss on storage was not several times as great as they think to have proved it.

The point raised in this note involves an issue of such magnitude that it has been thought well to state it somewhat fully. Unless the writer is wrong, further experiments are required. These experiments need not extend over five years but they will involve considerable expense and are not likely to be undertaken except at the instance of the British Admiralty or the United States Navy Department, to which Departments the results should be of far more value than to any other class of coal user.

A NEW SIMPLE DEVICE FOR SAMPLING.

L. J. RILEY.

This device is particularly suitable for sampling dust (*e.g.*, blast-furnace dust), loose soil, earth-like material, and the like, and has for its object to facilitate obtaining a representative sample.



The end (*e*) of a tapering tube (*a*) of suitable dimensions is inserted into the material to be sampled and pushed to the bottom with a rotary motion by means of the easily removable handle (*b*) inserted through the two holes (*c*), and then withdrawn. The sample is then obtained by removing the handle and inverting the tube. The samples obtained from various parts are then mixed by a usual method for obtaining a representative sample.

This sampler is of great simplicity, is capable of easy manipulation, and ensures obtaining a sample of the material along the whole course through which it travels, as proved by tests consisting of sampling heaps of blast-furnace dust made up of approximately equal layers of dusts of different colours. Out of one hundred wagon-loads, representing every type of blast-furnace dust, sampled *vertically*, the device failed to work thoroughly satisfactorily only in the case of one very abnormal type of dust, the potash content of which was worthless.

FEDERAL COUNCIL FOR PURE AND APPLIED CHEMISTRY.

Gratifying progress has been made during the past month. The Iron and Steel Institute, one of the bodies originally invited to enter the Federation, has joined the Council. Invitations are now being sent to a number of other societies in which chemistry is of primary importance, though not the dominant interest.

A sympathetic reply has been received from the authorities of the London University to the letter the Council addressed to the Vice-Chancellor, calling attention to the inadequate initial salaries attached to chairs of chemistry at King's College and the East London College. Meanwhile, in the case of the latter college, the initial salary advertised has been raised from £600 to £750.

The representation made by the Council to the Royal Society, that the grants at the disposal of this and other societies for the purpose of chemical research are inadequate, has led the Royal Society to refer the matter to a special committee. It is the intention of the Council to go thoroughly into the whole question of the promotion of research, as there is reason to believe that the methods now in operation are in many respects ill calculated to produce the effects desired.

The representation made to the War Office and to the President of the Board of Education, that experimental science appeared to be left out of account in the Interdepartmental Committee formed to co-ordinate the educational training scheme of the Army, has also been attended with success. The President of the Board of Education and Colonel Lord Gorell agree in thinking that a scientific adviser should be added to the Committee

and the President has asked that names may be suggested. This has been done.

Considerable progress has been made in discussing the measures that can be taken to provide chemicals for research. It is proposed to put the elaboration of a working scheme in the hands of a committee on which the trade element is fully represented as well as the academic; this committee is asked to establish a permanent smaller committee and the central organisation required to give practical effect to the scheme.

Much attention is being given to the consideration of the steps most likely to promote the union of the various sections representative of the collective interests of chemical science—especially to the provision of a suitable house.

THE TRADE IN CINCHONA BARK.

B. F. HOWARD.

An article on "The Future of the Trade in Cinchona Bark" appearing in the last issue of the *Bulletin of the Imperial Institute* (XVI., Pt. 3, 1918) contains much information of value to those who desire to have an authoritative *résumé* of this important subject.

An interesting introduction traces briefly the history of the natural *Cinchonaceæ* of the forests of the Andes, and the botanical classification of the varieties best known on the market at the present day. Turning to the production of cultivated bark, the author gives the output in recent years from the plantations in the Dutch East Indies, India and Ceylon, and shows clearly the enormously important part played by the Dutch plantations in Java. In recent years, Java heads the list of producers with an annual output of 22,880,000 lb., India supplying 2,000,000 and other countries 440,000 lb. Perhaps these figures should be taken as a general indication of the pre-eminence of Java rather than as an exact comparison, for whereas the Java production is based on an average of the years 1911-1913, the Indian output given is the average of the years 1912-1913 to 1915-1916, and this must surely have been affected by the difficulties of production and shipping during the war.

The commercial or market aspect is then briefly dealt with and the efforts—successful in the main—described which were adopted to prevent over-production in the years before the war. Under a heading entitled "Trade in Cinchona Bark and Quinine," the author shows that although the Indian plantations and factories are unable to supply the needs of that portion of the Empire, yet the bulk of the imports of manufactured quinine into India have hitherto been from British sources.

A series of import and export tables follows showing the high percentage of the quinine requirements of the United Kingdom which was formerly supplied by Germany—a typical example of the position of the fine chemical industry in this country before the war, and a state of affairs which, we trust, has now gone for ever.

The great importance of local manufacture of quinine salts in Java and its possible future bearing on the world's quinine trade is not mentioned, probably owing to the complexity of the problem and the difficulty of obtaining accurate information. It is obvious, however, that no account of the cinchona industry which ignores this important factor can be considered complete.

The final portion of the article deals with bark produced in St. Helena and East Africa. Although from a commercial point of view these plantations are at the moment negligible, yet from the scientific aspect the typical analyses given are of considerable interest as they show a high percentage of quinine and prove the bark to be well up to the Java standard, thus indicating most successful cultivation—which may have been either deliberate or accidental. Viewed in detail the tables giving the results of examination of these barks appear to be somewhat inadequate and to lack uniformity. Although the total alkaloid figure and the percentage of quinine sulphate are given, a complete separation of the four principal alkaloids has apparently not been attempted. Again, the results are complicated by the inclusion of the percentage of moisture found, but as bark is valued on its alkaloid contents as shipped, moisture is not a factor of any importance. A more practical method of stating the results would be to give the percentage of (hydrated) sulphate of each of the alkaloids (quinine, cinchonidine, quinidine and cinchonine), together with the percentage equivalent of alkaloid in each case; also the sum of these figures and the amount of amorphous alkaloid. So tabulated, the results of the analyses of these very interesting samples would have enabled the reader to evaluate the barks commercially, as well as to derive useful additional scientific information from them.

NEWS FROM THE SECTIONS.

CANADA.

On January 23, Dr. A. B. Macallum, chairman of the Honorary Advisory Council for Scientific and Industrial Research, addressed one of the largest meetings ever held by the Toronto Branch of the Society. In reviewing the work undertaken by the Canadian Research Council, he described some of the problems which were of pressing national importance, such as, *e.g.*, the briquetting of lignites in Saskatchewan, the utilisation of the tar sands of Alberta, studies in re-afforestation, the organisation of guilds for industrial research, the stimulation of post-graduate work in science at universities, and the establishment of the Central Research Institute at Ottawa. It was the opinion of those present that an organised campaign or propaganda should be undertaken jointly by the Research Council and the Society of Chemical Industry in order that manufacturers, industrialists, and the public generally might be brought to understand the vital necessity for carrying on intensive industrial research along all these lines immediately.

BRISTOL.

The members of the Section attended at the University on January 23 to hear a lecture on "Explosives" by Prof. F. Francis, who gave a brief outline of the whole subject, and then referred more particularly to the events of the past four years.

In the discussion that followed, Mr. M. W. Jones, referring to lyddite, said that in the War Department specification for paints for shells the absence of lead was an essential feature, and pointed out that we owe the discovery of lyddite to an accidental and destructive explosion at the Cornbrook Works of Messrs. Roberts, Dale and Co., Manchester, in 1887. This explosion, which could not be explained at the resulting inquiry, was investigated by the late Sir F. Abel and Dr. Dupré, who finally arrived at the conclusion that the explosion was caused by the ignition of picric acid and litharge (Blue Book No. LXXV., 1887). From subsequent experiments on a large scale at Lydd, the explosive known as lyddite was evolved, and this was used for the first time during the Boer War.

EDINBURGH.

A special meeting was held on January 29, at Castle Mills, Edinburgh, by invitation of the North British Rubber Co. Ltd. Mr. B. D. Dott presided.

Mr. W A. Williams, works manager, received the members on behalf of the company, and gave a short description of the various departments of the works which were to be visited. In speaking of the war work in which the company had been engaged, he referred particularly to the manufacture and testing of rubber-proofed fabric for balloons and airships, and paid a high tribute to the work of the chemical research laboratory in connexion therewith. The members were then conducted round numerous departments of the works, where they inspected the storing, washing, and purifying of the raw rubber, the manufacture of rubber shoes, rubber hose and tubing, etc. Much interest was taken in the special laboratory where balloon fabric is tested for its permeability to hydrogen. The fabric under examination forms a septum in a gun-metal drum immersed in an electrically heated and controlled thermostat: hydrogen is maintained at a certain pressure on one side of the fabric, and through the other division of the apparatus a uniform current of purified air is passed. The hydrogen carried over by the air is, after drying, oxidised by an electrically heated platinum spiral and weighed as water. The installation enables thirty-two tests to be carried on at the same time.

There was a large attendance of members, and the feeling was general that more of the sectional meetings might advantageously be held at works.

LIVERPOOL.

A joint meeting with the Liverpool Engineering Society was held at the Royal Institution on February 5, Prof. J. Wemyss Anderson presiding. A paper on "Electric and Oxy-Acetylene Welds and their Defects," was read by Mr. E. A. Atkins, who demonstrated the use of micro-projection by showing the structure of metals directly on a screen.

The two chief physical defects found in all kinds of welds, are low tensile strength and poor elongation, resulting in brittleness, and poor bending qualities of the joint and small resistance to fracture by shock. The tensile strength of a welded joint may vary between 5 and 100 per cent. of the strength of the unwelded piece. Although the mechanical defects are well known and easily detected, their causes are not easily discovered; in this direction microscopic research can give considerable assistance. It is of paramount importance that a welding wire (or "filling-material") should pass the most stringent chemical tests, and that its surface should be free from oxide or other foreign matter that will affect the physical properties of the weld. The alteration in the chemical composition of the welded material (in the neighbourhood of the joint) and of the filling material used, which results from the intense heat applied in the presence of air during welding, inevitably leads to considerable change in the physical properties of the joint. It must therefore be concluded that if the various processes of fusion welding are to have the wide application they deserve, some exact data must be drawn up to serve as a guide to practice. This, the author is convinced, can only be done after prolonged research. In arc-welding and in resistance-welding, the microscope readily shows up any defects, and with its aid the effects of after-heat treatment are also easily observable. Oxy-acetylene welding depends mainly for its success upon the skill of the operator. It is not sufficiently well known that mild steel is a most complex material which when subjected to high temperatures, especially in the presence of gases, can have its structure and, therefore, its physical properties, entirely altered. These defects, too, can be observed with the microscope.

MANCHESTER.

The fourth meeting of the Session was held on February 7, Mr. Wm. Thomson presiding. The honorary secretary, Mr. L. E. Vlies, announced his resignation, for business reasons, after six years' tenure of office. A brief discussion was held on the probable effects of the multiplication of Subject Groups, and it was decided to make opportunity for a full discussion.

Dr. T. J. Craig then read a paper on "The Volumetric Determination of Sulphurous Acid." The sulphite is dissolved in water and an excess of standardised hydrogen peroxide solution added. After cooling and adding dilute sulphuric acid, the excess of peroxide is found by titrating with $N/2$ permanganate. Examples were given showing results comparable in accuracy with those obtained by the iodine method. A second paper by the same author on "The Determination of Alkali in Permanganate Liquors" described a method of determining the excess of alkali at different stages during the manufacture of permanganate. The liquor is treated with neutral hydrogen peroxide until it is decolorised. After heating to decompose the excess of peroxide, a slight excess of standardised sulphuric acid is added to decompose manganite, the liquid filtered, and the filtrate and washings titrated with standard alkali at the boiling point. This gives the total alkali. By deducting the alkali equivalent to the permanganate present, the alkali present as hydroxide and carbonate is obtained. The carbonate can be found by determination in a separate portion.

Mr. J. A. Crockett and Dr. R. B. Forster described "A Device for Measuring Small Quantities of Moisture in Gases," which depends on the principle that certain fibres expand when their moisture content increases. One end of an artificial silk fibre is attached to an adjustable hook on a rod, and the other end to a series of magnifying levers connected with a pointer. The instrument is placed in a bell-jar containing the gas to be tested, and the degree of moisture is deduced from the altered position of the pointer on the scale, one division of which corresponds to a change of about 0·05 per cent. in moisture content.

At the close of the meeting a cordial vote of thanks was accorded Mr. L. E. Vlies for the excellent work he had done for the Section. During his tenure of office, the membership of the Section had increased from 290 to 520. His successor will be Mr. L. Guy Radcliffe, of the Municipal College of Technology.

YORKSHIRE.

On February 10, a paper was read by Dr. H. Ingle and Mr. Woodmansey on "Polymerised and Oxidised Linseed Oil," before a representative gathering at the Queen's Hotel, Leeds. The authors had studied the changes which took place in the production of boiled and blown linseed oil, with special reference to their permanence when exposed to air, or without exposure by mere ageing or by the action of heat. Analyses of various products at different stages were discussed, but for details the reader must be referred to the original paper. The composition of Reid's superoxidised oil was considered and various chemical theories based upon an examination of a sample of oxidised oil (linoleum scrim-lead drier) seventeen years old were advanced. The authors' main contention seemed to be the superior permanence of a polymerised oil (stout boiled) over a blown (or cold boiled) oil in paints. They also drew attention to the fact that oils containing manganese are, when dried, more liable to change than lead oils and consequently recommend for permanent paintwork —especially for artists—a stout boiled oil with a lead drier in preference to a steam-heated blown oil with a manganese drier.

NEWCASTLE.

Prof. P. P. Bedson presided over a well-attended meeting of this Section on February 12, when Mr. G. Sisson read a "Note on the Extraction of Thallium from Pyrites Flue Dust," by himself and Mr. J. S. Edmondson. At the request of the Ministry of Munitions they had first investigated their waste products from sulphuric acid manufacture with a view to recovering selenium, but they had failed to separate any appreciable quantity of it, probably because the flues from which the dust was taken were too hot.

They then turned their attention to thallium which was present to the extent of 0·25 per cent. in the flue dust. Some 15 cwt. of dust was collected, containing 4 lb. of thallium, and this represented 6 months' accumulation, or the burning of 1500 tons of pyrites containing 1 part thallium per million.

It is interesting to recollect that Sir W. Crookes discovered this element from such material, the total quantity he separated being only two grains. The method of separation depended upon the comparative insolubility of the chloride and the solubility of the sulphate. The metal was finally obtained by fusing the dried chloride with alkali cyanide and sodium carbonate. Thallium is used as a constituent of optical glass of high refractivity.

Dr. F. C. Garrett, in the absence of the authors, read a note on "The Softening Point of Pitch" by Dr. P. E. Spielmann and Mr. G. C. Petrie. The authors spoke of the difficulty of characterising by a numerical value a property which is non-existent, and stated that any test proposed must be empirical. A *résumé* was given of the various tests that had already been proposed, *viz.*:—1, Biting test; 2, change of appearance; 3, twisting test; 4, bending and sagging test; 5, powder compression by weight; 6, dropping test; 7, miscellaneous tests. The test now proposed by the authors consists in taking a block of pitch, 1½ in. long by ½ in. square section, and a rectangular piece of copper wire of 17 gauge. The wire is heated, and the foot pressed into the pitch ½ in. from one end and at right angles to the length of the block. After setting, the test piece with the wire is suspended in a beaker of water, the latter being warmed up at the rate of 1° C. per minute. The softening point is taken as the temperature at which the block of pitch turns on its axis to a nearly vertical line.

The "Newcastle Chemical Industry Club" was definitely organised at a meeting held on February 15, when the following officers were appointed:—President, Prof. P. P. Bedson; Chairman, Dr. F. C. Garrett; Hon. Treasurer, Mr. O. Smalley; Librarian, Mr. F. Hirsch; and Hon. Secretary, Mr. A. Trobridge. The above, with six other members, constitute the Committee of Management. It was resolved to secure suitable rooms in Brunswick Place, and to open a subscription list for the provision of a technical library.

CHEMICAL ENGINEERING GROUP.

The inaugural meeting and dinner of the Chemical Engineering Group of the Society of Chemical Industry will be held in the Hamilton Hall, Abercorn Rooms, Liverpool Street, London, E.C. 2, on March 21 next. The meeting will commence at 6.30 P.M., and Prof. J. W. Hinchley, chairman of the Provisional Committee of the Group, will preside. The business will include the formal adoption of the Draft Rules, copies of which have been circulated to members, and the election of Committee as prescribed by the Rules so adopted. A report of the work so far accomplished by the Provisional Committee and a statement of the position of the Group will be submitted, and the general programme of work for the immediate future will be discussed. The dinner will be served at 8 P.M., with Prof. H. A. Louis, President of the Society, in the chair. Representatives of the Government and learned Societies and Institutions, as well as leaders of education and chemical industry in this country, are expected to be present. Tickets, price 15*s.* each, exclusive of wines, may be had from the Honorary Secretary, Chemical Engineering Group, 15, New Bridge Street, London, E.C. 4, and early notification of prospective attendance is requested.

MEETINGS OF OTHER SOCIETIES.

THE CHEMICAL SOCIETY.

At the ordinary meeting held on February 6, with Dr. A. Scott in the chair, Dr. F. Challenger presented two contributions embodying work done by Prof. P. F. Frankland, himself and N. A. Nicholls. In the first, he described the preparation of monomethylamine by reducing chloropicrin with iron and very small quantities of hydrochloric acid. The experiments showed that the optimum yield of 98.5 per cent. monomethylamine is obtained by using the following proportions:—Chloropicrin 25 g., iron 50 g., water 200 c.c., and hydrochloric acid 32 c.c. The use of the theoretically necessary quantity of hydrochloric acid gave rise to much ammonia. The chloropicrin is run into the acid and iron, and after reduction, caustic soda is added, and the base distilled off with steam. The method is suitable for making large quantities of monomethylamine, such as are required in the preparation of tetryl, adrenalin, etc.

The results of an investigation of the production of monomethylaniline by reducing methyleneaniline (from aniline and formaldehyde) were also described, in addition to those obtained by the reduction of certain similarly constituted compounds. An excess of formaldehyde gave rise to the formation of much dimethylaniline.

The authors have also experimented upon methods of preparing monomethylaniline by heating aniline and methyl alcohol in an autoclave or in sealed tubes at 180° C., by the interaction of aniline hydrochloride and dimethylaniline, and of dimethylaniline hydrochloride and aniline. The yields obtained were not very good; the first method was the most satisfactory, giving yields of from 51 to 56 per cent. of the mono-derivative.

Among other papers put down for presentation but not read were two by Prof. J. T. Hewitt and W. J. Jones, entitled respectively "The Estimation of the Methoxyl Group" and "The Estimation of Methyl Alcohol in Wood Distillates and their Concentrates."

Presiding at the meeting held on February 20, Sir W. J. Pope announced the names of the Fellows who had been nominated by the Council to serve upon it during the ensuing year. Sir J. Dobbie has been nominated President. The annual general meeting will be held on March 27, at 4 P.M., and on that date the series of Anniversary Dinners, discontinued since 1913, will be revived. The dinner will be served at 7 P.M. at the Connaught Rooms, Great Queen Street, W.C., and Fellows who wish to be present should communicate with the Assistant Secretary of the Society. Among the guests will be Mr. Winston Churchill, Lord Moulton, Lord Sydenham and Mr. Herbert Fisher. The informal meeting previously arranged for the same evening has been cancelled.

A paper on "Nitro-, Arylazo-, and Aminoglyoxalines," by R. G. Fargher and F. L. Pyman, was presented by the latter.

NEWS AND NOTES.

CANADA.

British Columbia.

Vegetable Oil Industry.—The International Food Products, Ltd., of Vancouver, has arranged with a firm of chemical engineers in Chicago, U.S.A., to erect the first unit of a vegetable oil pressing plant to be located on Industrial Island in Vancouver harbour. Flax seed from the Canadian prairies will furnish the raw material at first. Other units will be erected later for pressing imported oil seeds, especially soya bean, cotton seed, coconut and palm kernel.

Minerals, Metals, Etc.—*General.*—The value of the mineral production of British Columbia in 1918 is estimated to be about $37,000,000, which is almost equal to that of 1917. The output of coal and gold increased markedly, that of copper, lead and zinc decreased, while silver and miscellaneous products changed but little.

The Canadian Geological Survey has issued a report on the mineral deposits adjacent to the Pacific Great Eastern Railway, including metalliferous ores, diatomaceous earth, talc, clays and magnesite. A summary report is included on the Lardeau and Slocan districts in which particular reference is made to the recently discovered deposits of manganese, one of which has an area of 600 × 200 ft. with a manganese content of about 48 per cent.

Copper.—The Dominion Government proposes to make a thorough exploration and examination of the copper deposits on the shores of the Arctic Ocean at Coppermine River and Bathurst Inlet.

The Britannia Mining Co. is diamond drilling a new group of copper claims several miles east of its main zone on Indian River, where stripping has disclosed already a large area of high grade chalcopyrite ore.

The Granby Consolidated Mining and Smelting Co. has struck a good grade of copper ore by diamond drilling the immense body of pyrites on the Ecstall River, a tributary of the Skeena River.

The Consolidated Mining and Smelting Co. has established at its Trail Smelter a department for the manufacture of copper rods and wires. The new plant will have a capacity of 50 tons a day, sufficient to supply the Canadian market.

Platinum.—The diamond drilling of the Tulameen River gravels by the Dominion Government has proved that platinum can be recovered in payable quantities. Further exploratory work is considered unnecessary. Assays of platinum-bearing ores and sands will be continued at the Dominion Assay Office.

Iron.—Investigations by the Dominion Geological Survey of the limonite deposits at Alta Lake indicate a surface area of 450 × 250 ft. Analyses give iron 41—48%, sulphur 0·2—1·8%, phosphorus 0·1—0·9%, and silica 1·2 to 2·2%.

Dr. A. Stansfield, professor of metallurgy at McGill University, has submitted an exhaustive report to the British Columbia Government in which he concludes that it would be economically possible to develop the electric smelting of the iron ores of British Columbia. It is estimated that 50,000 tons per annum of magnetite ore, practically free from phosphorus, titanium and copper and low in sulphur, could be delivered at a suitable smelter site. With the abundance of water-power, the cost of electrical horse-power per annum should not exceed $10. Twenty to twenty-five tons of charcoal per day could readily be obtained from the enormous supplies of sawmill waste, the charcoal thus costing from $6 to $8 per ton. Assuming power to cost $15.00 per h.p year for an experimental plant, pig iron could be produced initially at $29.75 per long ton. Government bounties are discussed and recommendations for future developments are appended. A subsequent report will describe technical details.

Carbide and Coal.—The Pacific Smelting Co. at Edmunds, B.C., has now installed a double calcium carbide furnace which will shortly be in operation.

The Granby Consolidated Mining and Smelting Co. has opened up a new coal mine at Cassidy, B.C., preparatory to manufacturing coke, etc., in new by-product recovery ovens.

The Barrett Co., of New York, has purchased a site at Marpole on the Fraser River for the erection of a plant to refine coal tar products. Negotiations are being carried on with the Granby Consolidated Mining and Smelting Co., to secure its coal tar by-products for the manufacture of materials both for local and for export trade.

AUSTRALIA.

Embargo on Copper Ore.—The Commonwealth Government has declined to allow the Pilborra Copper Fields, Ltd., Western Australia, to export copper ore to Japan on the ground that the Australian refineries are capable of treating all such ore, matte, etc., locally.—(*Official.*)

Steel Works for Western Australia.—Steps have been taken by the Australian Electric Steel Co., Ltd., to establish electric steel works at Guildford, Western Australia. The company has been exploiting the electric furnace process successfully in Sydney for the past eighteen months, and its products are high-grade steels in various forms for tools, axles, mining and other machinery. Most of the plant has been ordered from England. —(*Official.*)

BRITISH INDIA.

The Salt Industry.—In 1914 India produced about 1,203,765 tons of salt, most of which was consumed in the country for domestic and agricultural purposes, very little being available for the chemical industries. In addition to this, about 600,000 tons of salt was imported, all of which was used in Bengal, where the manufacture had failed owing to a variety of causes. From 1873 this province has practically been dependent upon overseas supplies, mainly from England. At a later date Spain and the ports on the Red Sea also sent large quantities, and in 1914 it seemed as if salt from these sources would be able to drive the English product from the market. During the war, shipping difficulties created a very serious situation in Bengal, and if the Government had not taken action, a serious crisis would have followed. As the result of investigations, two companies have recently been formed to engage in salt production. One of these, with a capital of £46,000, will have works at Contal and extract salt from sea-water by natural evaporation followed by the use of vacuum evaporators. The second company will work on a much larger scale, with a capital of £650,000. Its works will be located at Chilka Lake and its annual production will be about 500,000 tons. The process to be employed will be mainly natural evaporation, supplemented by up-to-date plant for refining and for recovering by-products, such as magnesium chloride, potassium salts and bromine. It is not proposed to use the water of Chilka Lake owing to its low salinity, but sea-water, which will be pumped into large reservoirs. Not only will the output of salt be sufficient to meet the demand for domestic consumption, but a very large proportion of it will be available for new chemical industries in Bengal, Bihar and Orissa. It thus appears that in the near future India will become independent of external sources of supply, and that salt will be available for chemical manufactures at a price which will be about the same as that which obtains in Lancashire and Cheshire.

UNITED STATES.

Developments in Chemical Industries.—*Potash in Utah.*—The chief sources of potash in Utah are the alunite deposits, the waters of the Great Salt Lake, and the cement factories. Several companies are working the alunite deposits near Marysvale and producing sulphate of potash of 95 per cent. purity, while others are making a low grade material for fertiliser purposes from the waters of the Salt Lake. Various discoveries of potash-bearing minerals and waters have been announced, but it is doubtful if their exploitation is commercially feasible. Potash recovery plants have been installed at a number of cement works, and about 1½ tons of high grade potash per day is being obtained. The total production of potash in Utah in 1916 was 35,739 tons; this year it is expected to be about 55,000 tons.

Sulphur.—In order to develop the large underground deposits near Matagorda, adjacent to the Gulf of Mexico, the Texas Gulf Sulphur Co. has recently increased its capital from $750,000 to $3,000,000. The erection of plant and railway sidings has already commenced.

The Dye Industry.—At a recent conference of dye manufacturers and the War Industries Board, the proposal was made that all incoming dye shipments from abroad should be imported under a licence system.

New Companies.—The total authorised capital of new chemical manufacturing companies from August, 1914, to November, 1918, is $394,795,000. During last November 14 new companies were formed.

Platinum Substitute.—The Chemical Division of the U.S. War Industries Board has announced the discovery, at the Mellon Institute, of a new catalyst to replace platinum in the sulphuric acid contact process. A plant has been erected for producing the material on a commercial scale. The material is cheaper than platinum, and is less sensitive to "poisoning"; it has also been used successfully for the manufacture of chlorine by the Deacon process.

Glycerin Substitute.—The Mellon Institute has also succeeded in producing a substitute for glycerin, suitable for use in tobacco manufacture.

Petrol Substitute.—The War Department Research Division has produced a petrol substitute ("Liberty Fuel") which is stated to have a kerosene base, and to be superior to petrol in nearly every respect.—(*Bd. of Trade J., Jan.* 23, 1919.)

Production of Rolled Zinc.—The great demand for sheet zinc for lining packing-cases for the export of munitions has led to a great increase in its production. It is now to some extent displacing copper and brass sheets as well as tinplate. The War Industries Board has ordered the substitution of sheet zinc for galvanised steel in refrigerator linings, a use which will require about 10,000 tons per annum. It is suggested that zinc should be used instead of galvanised iron for roofing, etc. The price of rolled zinc has fluctuated considerably; in 1914 it was 7—8 cents per lb., and since then it has generally varied between 15 and 20 cents, but rose as high as 33 cents in the middle of 1915. At the beginning of 1918 the Government fixed the price at 15 cents. The following statistics have been issued by the U.S. Geological Survey:—

Rolled Zinc (lb.)	1915	1916	1917
Exported*	—	25,024,182	33,027,991
Home consumption	—	70,618,102	84,224,960
Total production	90,425,811	95,642,284	117,252,951

—(*Bd. of Trade J., Jan* 23, 1919.)

* Exclusive of metal used in shipping munitions overseas.

GENERAL.

The Chemical Industry Club.—That this club is successfully meeting an urgent want is evidenced by the rapid influx of new members since it took possession of its new quarters in Whitehall Court, S.W. The membership now totals 517, comprising 371 town and 146 country members; and applications are coming in continually. At the last monthly meeting it was resolved to extend the club's hospitality to chemists who have served in H.M. Forces but who have not since entered civilian employment, by granting them honorary membership for a period of three months.

Coal Conservation.—In the course of an article on this subject in the January number of the *Edinburgh Review*, Prof. J. W. Cobb of Leeds University criticises some of the proposals regarding the establishment of electric super-stations and inferentially discusses the relative value of steam-generated electricity and coal gas as sources of heat for domestic and industrial purposes. As regards the thermal efficiency of electricity generated by steam-driven turbines, out of 100 heat units originally present in the coal only 13 are to be delivered to the consumer as electricity, 87 being lost even when the super-station efficiency claimed is attained; whereas by carbonising coal in gas works, after allowing for the heat required for carbonisation, at least 70 units become available as gas, coke and tar; and a large proportion of these 70 units can be made directly available for heating, as in a gas fire, or for generating power, as in a gas-engine. Assuming that the heat which escapes up the chimney of a gas fire is lost entirely, and that the efficiency of an electric heater is 100 per cent., the combined efficiency of the gas works plus the gas fire may be placed at 50 per cent., as against 13 per cent. for the calculated efficiency obtainable from electricity generated at one of the proposed super-stations. Above and beyond this, there is in the case of carbonisation the economic value of the chemical by-products to be considered.

The author also makes some suggestive remarks concerning possible improvements in gas manufacture. He thinks that a larger proportion of the total heat energy stored in coal should be obtained in the form of gas, *e.g.*, by gasification of the coke. It is quite possible to obtain some 50 per cent. of this heat as gas by using a mixture of two volumes of water gas and one of coal gas. The calorific power of such a mixture would be about 400 B.Th.U. The question of relative efficiency of different grades of gas is now under investigation; so far as can be seen at present, it appears that the efficiency of a gas fire or a gas ring is over a wide range independent of the thermal value of the grade of gas consumed. Prof. Cobb calculates that the exclusive use (for domestic purposes) of a gas containing 50 per cent. of the energy of the coal from which it was obtained by carbonisation, would not involve the consumption of any more coal than is now consumed by direct combustion (35 million tons); moreover, the residual coke would be available for replacing coal in other uses and the light oil, fuel oil, and other by-products would be produced in the most efficient manner known. *Per contra*, even assuming electricity to be 50 per cent. more efficient in use than gas, at least 90 million tons of coal per annum would be required to be burnt at the electric power stations to do the same work, and there would be no by-products more valuable than clinker. The above conclusions apply in the main also to industrial heating, but here the outlook is more hopeful for electricity in certain directions, particularly for high-temperature work such as steel refining and the manufacture of electrochemicals.

Oil from British-Grown Linseed.—The British Flax and Hemp Growers' Society, Ltd., having undertaken during the last few years investigations as to the possibilities of growing linseed in this country from the standpoints of yield, quality of seed, value of oil obtained, etc., have now published preliminary notes on the results obtained. The variety of seed which has been found to give the best results in so far as yield per acre and oil content is concerned proved to be that known as "La Plata" or "Plate," this seed yielding from 10–20 cwt. per acre according to the richness of the soil, with an oil-content as high as 40 per cent. This latter figure exceeds that obtainable from the imported seed, whilst the average weight of the English-grown imported seed shows a similar superiority. The high yield of oil, moreover, is successfully maintained season after season.

From an agricultural point of view it has been found that no special soil is required for the cultivation of linseed, the best results being obtained with the heavier types of loam, a high state of fertility indeed being actually found undesirable. The linseed crop follows well on a straw crop whilst wheat follows well on the linseed crop. The best period for sowing is between the end of March and the end of April, the crop being ready for harvesting about 100 days after sowing. The harvesting at this period includes both ripe and green seed, it having been shown that the oil-content of the seed is increased to the high figure above mentioned by after-ripening in the stook.

From an examination of the oil from the standpoints of its analytical constants and its behaviour in large scale practice, it is inferred that its properties may be described as those of a "super-Baltic" oil. The most notable point in the former respect is the higher iodine absorption of the English-grown oil over Calcutta oil, whilst the yield of ether-insoluble bromo-glycerides from the former exceeds even that from Baltic oil. These properties, which indicate that English-grown oil contains a higher proportion of linolenic acid than does that from Calcutta, are well confirmed by the trials carried out on a manufacturing scale, where superiority of drying power and greater rapidity of thickening on heating were found. Manufacturing trials of various types of varnishes under works conditions also showed technical advantages of the English-grown oil, a notable point being the non-tendency to "bloom" in that type of varnish which is commonly liable to this defect, and quicker drying and hardening of the more elastic varnishes.

The project of Great Britain supplying herself with home-grown linseed oil and thus rendering herself independent of Russia is shown to be feasible from an economic standpoint, the total value of a linseed crop being £26 10*s.* per acre against a cost of production of £9 per acre.

Quality of Milk Supply in Scotland.—Tables have been compiled by the City Analyst of Dundee showing the quality of the public milk supply in forty different localities (town and country) over a considerable area in Scotland. The average fat content was 3·58 per cent., and non-fatty solids, 8·82 per cent. The maximum fat content was 4·53 per cent., at Tillicoultry (Clackmannan), and the minimum 3·23 per cent., at Ladybank (Fife); the non-fatty solids were at a maximum at Cupar-Fife, 3·56 per cent., and at a minimum at Ladybank, 8·50 per cent. The localities from which the samples were taken were mostly in Fifeshire and Forfarshire.

Fatty Acids in Human Dietary.—In a lecture delivered on February 5, at King's College, W.C., on "Physiology and the Food Problem," Prof. W. D. Halliburton said that during the great shortage of fats in 1917 a special sub-committee of the Food War Committee of the Society had investigated the possibility of [illegible] the accumulated stocks of fatty acids in the preparation of a butter substitute. The material first utilised, although of very bad taste and smell, proved to be a suitable food for rats. The butter substitute ultimately prepared was found to be a suitable diet for human beings when alternated at intervals of one month with the fats from which the fatty acids had been prepared. The curious fact was elicited that these acids passed into the blood of the animal fed upon them in the form of fat; in other words, the glycerin was supplied by the system and the fat was synthesised in it. The increased popularity of margarine was largely due to the success achieved in imparting a very agreeable flavour to it. Margarine, prepared from vegetable oils, contains no vitamines, hence it should not be used exclusively for the children of the poor.

Utilisation of Coke Oven Gas for Town Use.—An interesting development occurred in Sheffield in December last when the city gas company took over the surplus gas from the Tinsley Park coke ovens for utilisation in its own mains. The quantity amounts to about 1,500,000 cu. ft. per day and the gas has an average calorific value of 500 B.Th.U. When Prof. W. G. Fearnsides first put the matter before the Board of Trade in 1916, the price of coke oven gas was about 9*d.* per 1000 cub. ft. compared with 1*s.* 4*d.* for coal gas (prices have since increased). The scheme has been put into operation without any extensive capital expenditure as the coke ovens are very close to the city gas main. It is anticipated that eventually the whole of the coke oven gas production will be utilised in this way, and that low grade producer gas will be used for heating the ovens. It will be remembered that Middlesbrough has used coke oven gas for town's lighting for several years past, and that the Birmingham Corporation erected a bench of Koppers ovens for a similar purpose. Like developments are expected to take place in other towns on the South Yorkshire coal field.—(*Times Eng. Suppl., Dec.*, 1918.)

Acetaldehyde Production in Norway.—The Carbide Industrial Company at Fredrikstad has recently completed a factory for the production of acetaldehyde, and the experimental work which has been in progress since July has had very good results, the daily output now amounting to 11 kilo. aldehyde. The factory will, however, shortly be able to produce 3000 to 7000 kilo. daily.—(*Tidens Tegn, Dec.* 16, 1918.)

New Method of Denaturing Spirit in Sweden.—The Union Co. has patented a new method of denaturing spirit, the great advantage of which is that the means of denaturing can be procured in sufficient quantities in the country and at comparatively reasonable prices. The raw by-products from the cellulose factories can be used straight away. Especially suitable is the material which is obtained from the distillation of turpentine. Spirit denatured in this way possesses an extremely disagreeable smell and flavour, but is not so poisonous as spirit denatured with methyl alcohol.—(*Tidens Tegn, Nov.* 28, 1918.)

Anti-Acid Coating for Iron.—If heated clean iron be exposed to hydrogen containing about 5 per cent. of silicon hydride (the gas evolved on treating magnesium silicide, $SiMg_2$, with dilute hydrochloric acid) silicon is deposited upon it as an even coating, and the protected metal will completely withstand the action of hydrochloric acid for at least two weeks. Silicon is not deposited in this manner on copper, nickel or aluminium.—(*Z. des Ver. deutsch. Ingen., Dec.* 7, 1918.)

Resumption of Alcohol Manufacture in Russia.—In view of technical, medical and military requirements, it has been decided to recommence the manufacture of alcohol. Existing stocks are very low. Potatoes unfit for human consumption are to be used exclusively, instead of 80 per cent. potatoes and 20 per cent. grain as before the war.—(*Hamburg. Correspond., Dec.* 5, 1918.)

The Russian Iron Industry and the Ukraine.—In the former Russian Empire the iron industry was mainly concentrated in three districts, of which the South Russian was by far the most important. Next in value came the Ural district and then the Polish iron fields; middle Russia and Finland were quite of minor value.

The iron and coal production of Russia in 1912 amounted to:—

	Tons, coal.	Tons, iron.
South Russia	21,284,172	5,358,553
Urals and Siberia ...	776,412	413,104
Poland	6,461,910	293,857
Middle Russia	211,302	291,236
Caucasus	68,796	—

The largest production of iron comes from Krivoi Rog, South Russia, which has now been incorporated with the Ukraine Republic. The Krivoi Rog output amounted to 65 per cent. of the whole Russian iron ore production, the ore containing Fe 58 to 67%, Mn 0·1%, P 0·04 to 0·08%, and SiO_2 2 to 10%. So far ore with less than 55% Fe has been rejected. Ore was occasionally exported to Germany. The total supply available has been estimated at 500,000,000 tons. Kertsch, the second largest iron district in South Russia, is situated in the east of the Crimea, and the ore here is of sedimentary origin. Two kinds of fine grained iron ore can be distinguished, which vary in colour according to the quantity of manganese they contain. Their composition is as follows:—

	Fe.	Mn.	P.	SiO_2.	As.
Yellow ore ...	40—42	1—2	1	12—14	0·04
Brown ore ...	35—37	5—7	1	13—15	0·05

The supply is estimated at 500,000,000 tons. The brown iron ores of the Donetz basin and the ores of the Korsak-Mogila are of little importance. In addition to possessing the most valuable iron-ore district, the Ukraine has also the largest and richest coal area of the South Russian Donetz basin. The new Republic has, therefore, very large deposits of both coal and iron at its disposal.—(*Stahl und Eisen, No.* 12, 1918.)

Use of Reeds in the German Textile Industry.—Now that improved processes for winning fibres from reeds have been worked out, it is safe to conclude that their use in the textile industry will remain permanent. The fine fibres which are now extracted are sufficiently soft to allow of their use in manufacturing articles of apparel. Many factories have taken up the extraction, and a number of new works have been planned for the purpose. The latter are being erected in localities where reeds are abundant, *e.g.*, in the Mark of Brandenburg, Eastern and Western Prussia, Mecklenburg, Pomerania, Holstein and Hanover. The treatment processes can generally be carried out in conjunction with agricultural work, for waste products are obtained which can be used on the land. It is estimated that up to the end of 1918, some 15 million kilo. of dry Typha fibres will have been produced from about 45 million kilo. of seeds. By systematic cultivation it is thought that the yield could be considerably increased.—(*Textil-Z., Nov.* 25, *Dec.* 3, 1918.)

The Bohemian Glass Industry.—It is reported that the German-Bohemian glass industry is threatened with partial suspension owing to shortage of silica. The silica occurring in German-Bohemia is not suitable for the manufacture of crystal glass, and the Government of Saxony has refused to allow the export of high-grade silica, of which the town of Hohenlock possesses a virtual monopoly. The threatened restricted production would be very serious as America demands glass in return for food supplies.—(*Zeit, Jan.* 12, 1919.)

Proposed University at Cologne.—The Prussian Government has sanctioned the proposal to create a university of a modern type at Cologne. The new university will be under State control, will be formed by extending scientific institutions already existing in the city, and will include four faculties, *viz.*, economic and social science, law, medicine and arts.—(*Köln. Zeit., Jan.* 11, 15, 1919.)

Ammonium Sulphate Production in Germany.—As concentrated solution of ammonia is no longer required for munition factories, the coke and gas works have been requested to cease its production, and where possible to convert their plant for the production of ammonium sulphate. The sulphuric acid needed for the latter purpose will be available, as it, too, is no longer required in munition works. The increased production of ammonium sulphate will lead to a very welcome and needed increase in the output of artificial manures. The sale of ammonia will be regulated by the Ammoniak-Verkaufs-Vereinigung of Bochum, the Badische Soda u. Anilin Fabrik, and the Upper Silesian coke works and chemical works.—(*Welthandel, Nov.* 29, 1918.)

Fire Tests on Ferro-Concrete Buildings.—In 1914 fire tests were made by the German Ferro-Concrete Committee on a number of buildings constructed of concrete reinforced by iron. A remarkable variation was found in the behaviour of several buildings constructed in the same manner and with the same qualities of materials. One building in particular was broken up by an explosive blasting action accompanied by loud detonations, pieces of the walls being projected as far as 40 m. from the building. Various explanations of this phenomenon were examined, and it was ultimately concluded that the cause was to be found in the occlusion of water in the body of the cement, but it is surmised that special conditions are required for the destructive action to take place, as this was shown in one building alone of the series that was tested. Further tests showed that the explosions could be avoided with certainty by using certain mixtures of concrete and by leaving appropriate passages in the walls for the liberation of occluded air and water.—(*Schweiz. Bauzeit., Nov.* 30, 1918.)

Prospects of the German Chemical Industry.—The suddenness of the armistice, the extent of the industry's participation in war production, and the enormous extensions of plant, make the work of transition very difficult and impose enormous financial burdens on the chemical factories. The works are in the first place resuming the manufacture of aniline dyes, the stocks of which in Germany and in other countries have greatly diminished. The great demand must first be satisfied and thereafter stocks be accumulated. In trade circles it is hoped to find foreign markets within a measurable time. Foreign competitors, apparently, will be unable to meet all the demands, so that on quantitative grounds recourse will have to be had to German products. The efforts of foreign countries are not underrated, but it is unlikely that they will have serious consequences for Germany. Competition is more likely to be felt in the simpler dyes than in the more complicated products. Switzerland, however, in the last years of the war has made great advances in connexion with the latter, and may, therefore, compete on ground which was formerly Germany's. Thus a considerable reduction in

exports—possibly as much as 40 per cent.—must be reckoned upon. Supplies of fuel and labour are sources of great anxiety. Works which enormously increased their staffs for war requirements have difficulty in keeping them occupied. The introduction of the 8-hour day, therefore, presents no special obstacle. The agreements made during the war with the explosives group for the elimination of competition in peace time are proving very useful. The chemical factories are stopping the manufacture of explosives, and the explosives works are ceasing to make intermediate products. How the works will utilise the extensive plant exclusively erected for war purposes is not yet clear. Whilst several factors combine to make the outlook far from cheerful, those in the leading circles of the industry are nevertheless free from any exaggerated pessimism.—(*Frankfurt. Z., Dec.* 7, 1918.)

Resources of Mexico.—Enormous deposits of bituminous coal exist in the State of Coahuila, but have scarcely been touched owing to transport difficulties. There are rich deposits of petroleum along the Eastern Coast, and hydro-electric power has been little developed compared with what might be done. At Conchos, to the south of Chihuahua, an isolated effort has been made to develop water power for the surrounding towns and mining centres.

There is plenty of sulphur and iron pyrites in Mexico, and much sulphuric acid is consumed; but the only important sulphuric acid factory is one owned by a United States company at Dinamita, Dgo. There are large deposits of sulphur at Conejos, between Torreon and Chihuahua, which might be developed profitably.

A modern cement plant at Hidalgo has provided for the harbour works at Tampico and Vera Cruz, and water works in Mexico City. There are inexhaustible deposits of raw material: and crude oil from the coast supplies power.

Bottles for the brewing industry are manufactured at an extensive factory at Monterey.

Dried-up lakes containing "tequesquite," a natural crude carbonate of soda, exist in different parts; also almost pure sulphate of soda from which caustic alkali can be manufactured.

There are also considerable deposits of common salt, which are controlled by an English corporation. Besides "tequesquite," there are in Sonora, 60 kilometres from the northern end of the Gulf of California, some of the largest existing deposits of almost pure carbonate of soda, which belong to the Federal Government, but for lack of transport facilities have not been exploited. Unlimited amounts of caustic soda, soda ash, and silicate of soda might be manufactured from these raw materials, and consumed within the Republic.

Mountains of phosphate rock, containing millions of tons of phosphatic material, exist in Coahuila, near Zecatecas, south-west of Saltillo, which have never been exploited for lack of transport facilities.

Ammonia, derived from oil cake produced in cotton seed industries, is being manufactured on a small scale at Dinamita, Dgo. The only nitric acid factory is situated at Dinamita. Much raw material for dyes and explosives, derived from coking at the Coahuila mines, is being wasted. All aniline dyes for wool and cotton are at present imported.—(*Bd. of Trade J., Jan.* 30, 1919.)

Melting Points of the Elements and Standard Temperatures.—In response to numerous requests, the United States Bureau of Standards has issued a table giving the melting points of the chemical elements together with a number of standard temperatures. It is pointed out that some of the values are quite uncertain; thus, while the melting point of platinum may be considered accurately known to 10° C., that of tungsten is possibly uncertain by 50° C. or more. In the subjoined tables the values have been rounded off except in cases where very accurate determinations have been made. Those substances of which the melting points, etc., are used as standard temperatures are printed in italics.

MELTING POINTS OF THE CHEMICAL ELEMENTS.

Element.	Degrees Cent.	Element.	Degrees Cent.
Helium ..	<—271	Neodymium ..	840?
Hydrogen ..	—259	Arsenic ..	850
Neon	—253?	Barium ..	850
Fluorine ..	—223	Praseodymium	940
Oxygen	—218	Germanium ..	958
Nitrogen ..	—210	*Silver*	960.5
Argon ..	—188	*Gold*	1063.0
Krypton ..	—169	*Copper* ..	1083.0
Xenon	—140	Manganese ..	1230
Chlorine ..	—101.5	Beryllium (Glucinum) ..	1280
Mercury ..	— 38.87	Samarium ..	1300–1400
Bromine ..	— 7.3	Scandium ..	?
Caesium ..	+ 26	Silicon ..	1420
Gallium ..	30	*Nickel* ..	1452
Rubidium ..	38	Cobalt ..	1480
Phosphorus ..	44	Yttrium ..	1490
Potassium ..	62.3	*Iron*	1530
Sodium ..	97.5	*Palladium* ..	1549
Iodine	113.5	Chromium ..	1615
Sulphur ..	S_δ 112.8 S_β 119.2 S_m 106.8	Zirconium ..	1700?
Indium ..	155	Columbium (Niobium) ..	1700?
Lithium ..	186	Thorium ..	>1700<Mo.
Selenium ..	217–220	Vanadium ..	1720
Tin	231.9	*Platinum* ..	1755
Bismuth ..	271	Ytterbium ..	?
Thallium ..	302	Titanium ..	1800
Cadmium ..	320.9	Uranium ..	<1850
Lead	327.4	Rhodium ..	1950
Zinc	419.4	Boron ..	2200–2500?
Tellurium ..	452	Iridium ..	2350?
Antimony ..	630.0	Ruthenium ..	2450?
Cerium ..	640	Molybdenum ..	2550
Magnesium ..	651	Osmium ..	2700?
Aluminium ..	658.7	Tantalum ..	2900
Radium ..	700	*Tungsten* ..	3400
Calcium ..	810	Carbon ..	>3600
Lanthanum ..	810?		
Strontium ..	>Ca<Ba?		

OTHER STANDARD TEMPERATURES.

Substance.	Phenomenon.	Degrees Cent.
Oxygen	Boiling	—183.0
Carbon Dioxide	Sublimation ..	— 78.5
Sodium Sulphate $Na_2SO_4+10H_2O$	Transformation into anhydrous salt	32.384
Water	Boiling	100
Naphthalene	,, ...	217.96
Benzophenone	,, ...	305.9
Sulphur	,, ...	444.6
Ag_2Cu_2	Eutectic freezing	779
Sodium Chloride	Freezing	801

—(*U.S. Com. Rep., Jan.* 16, 1919.)

Fuller's Earth in the U.S.A.—The fuller's earth industry in the United States first assumed commercial importance in 1895; at the present time the production is about eleven times and the value nearly nineteen times, greater than it was then.

The quantity, value and average per ton of fuller's earth sold in 1917 in the United States were the largest on record, the increase in quantity being 4200 short tons, or 7 per cent., and in value £14,000 or nearly 10 per cent. over 1916.

The amount and value of the fuller's earth produced in the United States in 1917 were more than four times as great as those of the imported earth, and formed 81 per cent. of the total as compared with 80 per cent. in 1916. The average price of the domestic earth (43*s.* 4*d.* per short ton) was 1*s.* 2*d.* per ton more than the imported earth, and 1*s.* per ton above the average in 1916. The total quantity of fuller's earth imported in 1917 was 14,000 tons, an increase of 100 tons over 1916.

Fuller's earth is widely distributed in the United

States, but it was mined and marketed only in the following States (mentioned in the order of their importance):—Florida, Georgia, Texas, Massachusetts, Arkansas and California—98 per cent. of the earth being marketed in the Southern States in 1917. Fuller's earth is now little used for its original purpose of fulling cloth; its chief use is in bleaching and filtering fats, greases and oils, the manufacture of pigments and as a toilet powder.—(*U.S. Geol. Surv., Sept.*, 1918.)

Camphor Production in Japan.—The production of camphor in Japan and Formosa for the year ending March 31, 1918, was 4,854,000 kilo., of which 4,710,000 kilo. was sold through the National Camphor Monopoly Bureau.—(*Chem.-Z., Dec.* 28, 1918.)

World Production of Chromium Ore.—The following table gives the output of chromium ore, containing an average of about 50 per cent. of chromic oxide, in the principal producing countries:—

Metric tons	New Caledonia	Rhodesia	Canada	U.S.A.
1906	57,307	3,308	7,936	109
1907	31,552	7,273	6,528	294
1908	46,890	12,118	6,554	364
1909	40,000	37,024	2,470	606
1910	40,000	40,002	279	208
1911	82,806	47,000	143	122
1912	51,516	62,850	--	204
1913	63,370	63,384	--	259
1914	48,852	49,009	123	601
1915	67,000	61,590	11,196	3,326
1916	74,116	88,871	24,522	18,943
1917	?	?	36,352	41,000

—(*Wirtschaftsdienst, Jan.* 10, 1919.)

LEGAL INTELLIGENCE.

SOAP TRADE DISPUTE. *Lever Bros., Ltd.* v. *Brunner, Mond and Co., Ltd., and Others.*

In the Court of Appeal, on February 10, Brunner, Mond and Co., J. Crosfield and Sons and W. Gossage and Sons appealed from an interim injunction granted recently by Mr. Justice Bray, at the instance of Lever Bros. and Associated Enterprises, Ltd., restraining defendants from adopting a scheme for reorganising the capital of J. Crosfield and Sons and W. Gossage and Sons.

Mr. Upjohn, for Brunner, Mond and Co., said that in July 1917 Lever Bros. and his clients compromised litigation in which they were engaged in regard to a pooling agreement by a contract under which Lever Bros. were to acquire half of the ordinary share capital in Crosfields and Gossages from Brunner Mond, and in return to transfer to Brunner Mond preferred ordinary shares in Lever Bros., Ltd. Neither of these transfers had yet been carried out and litigation had been started in respect of the agreement. Lever Bros. claimed that with Brunner Mond they were entitled to control the policy of Crosfields and Gossages, and further that the directors of these two companies nominated by Levers should not only learn all the trade secrets of the companies but should be at liberty to disclose these to their nominators. Both contentions the defendants strenuously denied. After the armistice was concluded, Crosfields and Gossages, in view of expanding trade, both discussed the desirability of adding to their capital, and a scheme was prepared by Crosfields' Board for reorganising the capital of that company.

Sir John Simon, for Lever Bros., argued that by the compromise of July 1917 his clients had obtained equality with Brunner Mond in the direction and control of the business of Crosfields and Gossages. The action was being brought to define the nature of the control thus obtained.

The Master of the Rolls, in giving judgment, said that for the last 18 months proceedings had been in abeyance in respect of the agreement of July 1917, because when the plaintiffs prepared a draft agreement the defendants introduced matters which in the plaintiffs' view were entirely new. As a result an action was now pending and Lever Bros. did not own or hold any shares in Crosfields or Gossages. Crosfields had prepared a scheme of capital reorganisation of which details had been given. The scheme was a *bona fide* one and there was nothing said against it except that it might prejudicially affect some interest of Lever Bros. Lever Bros.' action was brought to obtain two declarations. In regard to the first, Lever Bros. had not at present been excluded from any control. In fact they had never been in a position to exercise or nominate directors. As to the second, the duties of directors were regulated by statute. The proposed reorganisation of capital was urgently necessary, and yet it had been disturbed at the instance of persons who were not shareholders. The injunction should never have been granted and must be dissolved.

Lord Justice Scrutton and Mr. Justice Eve concurred.

The appeal was accordingly allowed, the injunction dissolved, and an inquiry directed as to damages.

PRE-WAR ENEMY CONTRACTS. *Borax Consolidated, Ltd.* v. *Chemische Fabrik auf Aktien vorm. E. Schering and Others.*

Before Mr. Justice Roche in the King's Bench Division, on February 10, Borax Consolidated, Ltd., asked the Court to declare void, as from August 4, 1914, certain pre-war contracts relating to the supply of raw material for the manufacture of borax and boric acid to the defendants, who were refiners. The contracts covered a period of 10 years from January 1, 1913.

His Lordship, in giving judgment, said the case was fully covered by authority, and he must decide in favour of the plaintiffs, and grant the declarations which they sought. The defendants relied on a suspensory clause in the agreement, but that clause did not refer to a war like the present one, and even if it did the agreement would be contrary to public policy.

A similar judgment was given in another group of cases (Borax Consolidated, Ltd. *v.* Eisenhütte Silesia A. G. and Others).

FAILURE OF A FIRM OF MANUFACTURING CHEMISTS. *Pickard, Ive and Rankin, Ltd.*

The compulsory winding up order against Messrs. Pickard, Ive and Rankin, Ltd., of Notting Hill, London, was made on the petition of the Abbey Chemical Co., Ltd., in October last. The statement of affairs filed in the proceedings disclosed liabilities of £35,234 and assets estimated to produce £12,119 and a total deficiency as regards contributories of £16,112. The company was registered as a private company in 1916 with a nominal capital of £3025, and was formed *inter alia* to carry on the manufacture of antipyrin and aspirin by methods stated to have been discovered by Pickard and Rankin. In 1917, the company acquired by purchase from the same, secret processes for manufacturing para-nitraniline, pure ortho-anisidine, guaiacol, and acetic anhydride. Disputes arose with the Abbey Chemical Co., Ltd., in connexion with contracts for the supply of chemicals, and when these were arbitrated upon, the company was liable for £4400. The failure is attributed by Pickard to want of sufficient capital to pay the damages awarded in the arbitration.

The Receiver reports that negotiations are pending between him and proposed purchasers for an offer of substantial amount to be submitted for the company's assets.

At the statutory first meeting of creditors and shareholders, held on February 11, a liquidator and a committee of inspection were appointed.

APPLICATION FOR EXCLUSIVE USE OF ENEMY PATENT.

Before the Comptroller of Patents on February 7, an application was made by the Liquid Air and Rescue Syndicate, of London, for an exclusive licence to use the German patent No. 1663 of 1912, for an "improved metallic vessel for liquefied gases," the patentee being C. W. P. Heylandt, of Hamburg. The invention was a bottle with a thin flexible neck which allowed of the ready discharge of the contents, no siphoning being required. The applicants said that they had been selling the vessels under an agreement with the patent owners, but had now erected a plant for the putting together of them for the sale of liquid air.

The Comptroller said that he would hesitate to grant an exclusive licence unless special reasons were shown; he would communicate the decision in due course. A case had certainly been made out for a licence, and applicants could come to the Court and oppose anybody else's application.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Munition Factories.

Mr. F. C. Kellaway, replying to Mr. Kennedy Jones, said the process of reconversion of war factories to civil uses was making steady progress in many districts. A more speedy change was hindered by the uncertainty as regards the future prices of raw materials, industrial unrest, and, until recently, by inability to secure the demobilisation of skilled men.—(Feb. 13.)

Electric Power Supply

Mr. W. C. Bridgman, in answer to Mr. Rose, said he hoped it would be possible to introduce a Bill dealing with the reorganisation of electric power supply at an early date. Full consideration is being given to the question of ownership of the super-stations, but he did not think that provisions relating to the price of coal could be included in such a measure.—(Feb. 17.)

Alsatian Potash.

Capt. Sir B. Stanier asked whether the Government was taking steps to secure the importation of potash salt from Alsace into this country. Sir A. Griffith-Boscawen replied that no arrangements have yet been made, but the Government is conferring with the French Ministry of Agriculture on the subject.—(Feb. 17.)

The Fine Chemical Industry.

Mr. Herbert asked the President of the Board of Trade if he is aware that the manufacture in this country of certain fine chemicals, such as saccharin, which was started during the war with the support of the Government as a key industry of national importance, is seriously threatened by the removal of restrictions on import or the removal by foreign countries of restrictions on export; and whether he will consider the advisability of restricting the import of such fine chemicals, in order to preserve the new industry in this country pending the proposed legislation against dumping and for protection of key industries.

Mr. W. C. Bridgman replied that the whole question as to the means to be adopted for the maintenance of new industries is now engaging consideration, and he hopes that it will be possible to make a statement on the subject shortly.—(Feb. 19.)

Sewage Sludge.

In reply to questions put by Lieut.-Col. Sir J. Norton Griffiths concerning the utilisation of sewage sludge, Major Astor stated that the present price of the dried sludge marketed by the Rivers Department of the Manchester Corporation is 53*s.*—55*s.* per ton, f.o.r. During 1918, 1349 tons of this material was sold, representing 8000 tons of wet sludge out of a total of 264,000 tons produced. It is not possible to cause local authorities to develop schemes for the utilisation of waste sewage; but a small committee, upon which the Local Government Board is represented, is at present looking into the question.—(Feb. 19.)

REPORT.

REPORT OF THE ENGINEERING TRADES (NEW INDUSTRIES) COMMITTEE. MINISTRY OF RECONSTRUCTION. [Cd. 9226. 6*d.*]

The Committee was appointed in December 1917 to compile a list of articles suitable for manufacture by the engineering trades, which were either not made in the United Kingdom before the war or were made only in small quantities. The method of procedure adopted was to form a number of branch committees to study and report in detail, leaving the main committee to make general observations with regard to the conditions under which new industries should be set up.

General Observations.—The chief difficulties that hinder the British manufacturer are (1) Financial embarrassment due to the excess profits tax; (2) inability to give long credit to foreign customers; and (3) competition from large and well established undertakings abroad. As methods of improving the prospects of success in new enterprises, the Committee recommends: (1) The wide adoption of specialisation and standardisation; (2) the fuller development of the National Physical Laboratory and the wider dissemination of the results of its research work among manufacturers; (3) the holding of exhibitions, with Government support, of articles not previously made in this country; and (4) the education of both employers and workpeople, —the former in the adoption of modern quantity production, and the latter in removing the deep-seated impression that quantity production creates unemployment. The Labour Advisory Committee recommends that no new industry should be established unless good wages can be paid, neither should industries be introduced that involve special liability to industrial disease to the workers. It is further pointed out that the obligation on employers to pay fair wages involves a corresponding obligation on the part of the workpeople to give a fair return.

Of the Branch Committees' Reports the following are of interest to the chemical industry.

Chemical and Dye-making Machinery.—The heavy chemical trades were strongly established before the war and all the ordinary chemical plant was produced in this country. The electrolytic plant in connexion with bleach and caustic soda manufacture was of the best and latest type. Oleum manufacture was developed only to a very small extent, but in order to meet the requirements of explosives production, it has been greatly increased, and a number of very large Griller-Schroeder plants have been built. The Committee found that such plant as multiple effect evaporators, centrifugals, homogeneous lead linings, grinding mills, vacuum stills, aluminium vessels, electric motors and dye plant were being satisfactorily

produced in this country. Great developments have taken place in the production of acid-resisting silicon iron, but a metallic alloy that satisfactorily resists hydrochloric acid has still to be found. The filter press, although a British invention, was largely manufactured in Germany and imported in large numbers before the war. All the home and colonial needs can now be met by British manufacturers. Vacuum drying ovens are now made in this country of superior design to the German type previously imported. The lining of metallic vessels with glass and vitreous enamel requires further research work before really satisfactory products can be obtained. Autoclaves for carrying out caustic and other fusions at high temperature and pressures up to 500 lb. per square inch are now being made in quantity.

Scientific Apparatus.—In pre-war times our dependence on foreign productions was largely due to the foreigners having free access to our markets without any reciprocal advantage on our side. During the war great strides have been made in the production of instruments for military use, and the Committee is of the opinion that we possess the necessary manufacturing, technical and labour facilities for securing a leading place in the world's manufacture of scientific apparatus provided that we meet foreign competition on equal terms. It recommends that no foreign apparatus be imported into the Empire except under licence for a period of 10 years. A very important element necessary to the establishment of this industry is greater specialisation by the makers, which would promote economy and efficiency in production and allow of co-operative selling to be arranged by non-competing firms. German chemical balances have been sold to a great extent in this country under the names of English dealers; microscopes were supplied by Germany, United States and Italy; saccharimeters and refractometers came almost entirely from Germany. All these very important instruments can be produced in this country if proper encouragement be given. It is estimated that the types of labour required for their production are, approximately, equal numbers of skilled men, unskilled men, and women.

Carbon Manufacture.—An account of this industry is given in an appendix. The Witton Carbon Works was laid down in 1902 by the General Electric Co. and until quite recently was the only factory of its kind in the kingdom. The difficulties encountered, such as obtaining plant and raw materials (tar and lampblack), educating workpeople and accumulating the necessary technical knowledge, were increased by the policy of price-cutting immediately adopted by the Continental producers. As a result of this, in two years prices were reduced by one half, and by 1914 the company had lost over £70,000. Since the outbreak of war the manufacture of carbons in this country has been fully justified, for otherwise serious difficulties would have arisen in meeting the requirements of arc carbons for searchlights. The company's soot factory has been much enlarged, and it is now producing material not only for carbon manufacture but for other very important industries developed during the war. In the future it is estimated that the demand for arc carbons will decline, and that the Witton Works, as now extended, will be able to supply the Empire's needs. The manufacture of carbon electrodes for electric furnaces and electrolytic work is one of increasing importance, and is being developed by the General Electric Co. and other firms. Every encouragement should be given to the production of electrodes, which must be regarded as a key industry. Carbon dynamo brushes have been successfully made by the Morgan Crucible Co. since 1905, and during the war the entire supply for the electrical industry has come from this source.

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED EXPORTS.

Further alterations in the existing regulations have been announced as follows:—

Headings transferred from one list to another.

From List A to List C:—

Aerated and mineral waters; jute yarns; hair, animal, and tops noils, mixture waste and yarns thereof; tin and alloys of tin; tin ore. Chemicals: Cream of tartar; phosgene (carbonyl chloride); tin, oxide of.—(Feb. 6.)

Asbestos, raw, crude and open fibre; bones in any form and bone ash; leather waste; manures, organic; rattans. Chemicals: Radium and its compounds.—(Feb. 13.)

From List B to List C:—

Iridium and its alloys and manufactures containing iridium. Chemicals: Tin, compounds of, except chlorides and oxide of tin.—(Feb. 6.)

Altered Headings.

(A) Fats, all animal and vegetable; (C) articles and mixtures containing fats, not otherwise prohibited; (A) fatty acids; (C) articles and mixtures containing fatty acids, not otherwise prohibited; (A) kapok; (C) fibres, vegetable, not otherwise specifically prohibited; (A) feeding stuffs containing molasses; (C) molasses; (A) wool grease; (C) articles and mixtures containing wool grease, not otherwise prohibited.—(Feb. 13.)

Exports to Norway, Sweden, Denmark and Holland.—The Director of the War Trade Department has announced that the quantities of certain goods which may be imported by the above countries under the agreements with the Allied Governments, have been largely increased. The goods specified include many chemical products (*v. Bd. of Trade J., Feb.* 6, 1919).

Exports without Licence.—The list of goods which may now be exported to all non-enemy destinations without application to the War Trade Department, or the production of certificates, etc., which are usually required for exports to neutral countries in Europe, has been extended and will shortly be the subject of a new Proclamation (*v. Bd. of Trade J., Feb.* 13, 1919).

Resumption of Trade with various Countries.—Permission has been granted, by Royal Proclamation, for the resumption of commercial transactions with the following countries, etc.:—Finland, Alsace-Lorraine, Czecho-Slovakia, Austria-Hungary (occupied territories), Germany (occupied territories on left bank of the Rhine), Serbia, Rumania, Siberia, Turkey (including Turkey in Europe, Asia Minor, Armenia, Kurdistan, Mesopotamia and Syria), Bulgaria and Black Sea Ports.

NEW ORDERS.

The Priority of Work (Partial Suspension) Order, 1919. Ministry of Munitions, February 7.

The Railway Material (Second-hand) (Partial Suspension) Order, 1919. Ministry of Munitions, February 7.

New Maximum Prices for Imported Timber, under the Timber Control Order, 1918, as from February 10, 1919. Board of Trade, February 4.

Orders Cancelled by Notice.—The Raw Cotton Order, 1917, and the Cotton (Restriction of Output) Order, 1918, as from February 8. Board of

Trade, February 4. The Raw Goatskins Order, 1918. War Office.

Revocation of Proclamation.—The Proclamation of July 28, 1915, prohibiting the importation of unset diamonds into the United Kingdom, was revoked by a Royal Proclamation on February 10, 1919.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for February 6 and 13.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73 Basinghall Street, London, E.C. 2, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Numbers
Calcutta	Paints, varnishes, chemicals and patent medicines	194
Colombo	Nitrogenous manures ...	207
Ontario...	Coal tar distillates, tanners' oils and greases, soluble gums, etc.	192
Vancouver	Chemicals, glass, gelatin, tinfoil	189
Johannesburg ...	Enamelware, galvanised iron, paper	185
„	Glycerin, sodium cyanide, paper	183/166
Belgium	Chemicals, drugs, paper...	202
Ste. Marie aux Mines, Haut Rhin	Dyes	226
La Baneza, Spain	Chemical manures, minerals	182
Lausanne	Chemicals, sugar, cocoa, oilcakes	197
Messina	Margarine	176
Palermo	Soap, perfumes, paper ...	228
Sao Paulo, Brazil	Drugs	217
Sao Paulo and Rio de Janeiro ...	Heavy chemicals, pharmaceutical products	184

Canadian firms able to supply ferrochrome and chromite concentrates upon a large scale wish to get into touch with importers in the U.K. Inquiries to The Canadian Government Trade Commissioner, 73 Basinghall Street, E.C. 2.

South African firms able to export hides, skins and talc wish to get into touch with importers in the U.K. Apply to The South African Government Trade Commissioner, 90 Cannon Street, E.C. 4.

An opportunity exists at present for the establishment of a coconut factory in North Borneo, where over 20,000 acres are under coconut. An oil-press of modern design and a factory for dealing with the many by-products are badly needed. Particulars from The Secretary, British North Borneo Co., 37 Threadneedle Street, E.C.

TARIFF. CUSTOMS. EXCISE.

Alsace-Lorraine.—A Ministerial Decree dated January 30 defines the Customs *régime* in Alsace-Lorraine.

Australia.—The prohibition of the importation of certain goods in tinplate containers is withdrawn.

British Honduras.—The import of firearms and ammunition is prohibited, except in accordance with a special permit, from January 3 to December 31, 1919.

Canada.—New regulations for determining the strength of imported acetic and pyroligneous acids and vinegar for Customs duty came into force on January 1.

France—Netherlands.—Several commercial agreements have been denounced.

Gold Coast.—The prohibition of exportation of cocoa to the U.K. is cancelled as from December 23.

Morocco (French Zone).—The export of vegetable hair (*crin végétal*) is now permitted.

Netherlands.—The export of pumice-stone and freestone is prohibited as from January 16.

Russia.—The Customs Tariff at Odessa for imports from the U.K., British Dominions, and Allied Countries is the general tariff of 1915 and the conventional tariff which came into force in September last.

Spain.—The export of ground nuts is limited to 100,000 quintals for the present year and an export duty of 13 pesetas per 100 kilo. has been levied thereon as from January 24.

United States.—The Export Conservation List, revised to January 16, includes ammunition, oil-cakes and feeding stuffs, lard and compound lard, condensed milk, hydrogenated cottonseed oil, manufactures of gold, quinine, and sugar.

Licences for the import of all commodities hitherto controlled, with few exceptions, may now be issued without the clause requiring endorsement to any Trade Association.

A new Import Licence known as "P.B.F. 31" has been issued to cover all in transit shipments of unrestricted goods where shipment was made from abroad after January 21.

Recent rulings of the War Trade Board affect many chemicals, animal and vegetable oils, paraffin, paints, varnishes, minerals, foodstuffs, beverages, metals and their ores, paper, glue, bones, horns, tanning materials, dyewoods, synthetic indigo, and gutta percha.

COMPANY NEWS.

GAS LIGHT AND COKE CO.

The ordinary general meeting of the proprietors was held on February 8, Mr. D. Milne Watson, governor and managing director, presiding. In the course of his address, Mr. Watson said that notwithstanding a diminution of 7 per cent. in the output of gas, the expenditure had risen from £6,000,000 to £6,691,000, the result of increased costs of raw materials and labour, the latter accounting for about one-half of the total increase. The price of gas had accordingly to be raised to 4*s.* 4*d.* per 1000 cu. ft. at midsummer, a rise of 73 per cent. over the pre-war figure, but much less than the rise in the price of raw materials. The price of coal has gone up 100 per cent., fire bricks 118 per cent., timber 224 per cent., lubricating oil 293 per cent. Parliamentary sanction was obtained to permit the company, and other companies working under the sliding scale, to pay a dividend equal to three-fourths of its pre-war dividend, excluding all accruing under the scale; hence it was now proposed to pay a dividend at the rate of 3 per cent. per annum for the past half year. The decrease in the company's business above alluded to was mainly due to the Orders relating to the rationing of gas, the last Order in particular having enormously damaged the industry. During the war the company has taken a prominent part in the supply of raw

materials for explosives manufacture. Seventeen million gallons of oils and 13,000 tons of disinfectants were supplied to the services, and over five million gallons of tar was provided for road construction in France. The company's steamers now number only 6 owing to 12 having been lost by enemy action. Nearly 5000 of the employees have been serving with the colours and about 500 have lost their lives. Since the issue of the June Order the quality of the gas supplied has averaged 486 B.Th.U., a reduction of 7 per cent. below the pre-war figure. With regard to the proposals to develop greatly the supply of electricity, the gas industry claimed to participate in any financial aid that might be forthcoming from the State. Where light and power are concerned, gas and electricity have their joint and several fields, but where heat is required the case for gas is overwhelming, alike in cost to the consumer and in economy of coal to the nation.

SOUTH METROPOLITAN GAS CO.

Addressing the ordinary half-yearly meeting on February 12, Dr. Charles Carpenter, the chairman, dealt at length with the work undertaken by the company in the prosecution of the war. Attention was first directed to the manufacture of dye intermediates, but this work was soon interrupted by the more imperative demands of the explosives industry. Within two months a plant was running for the production of the material required. When, in 1916, a serious shortage of toluene for making T.N.T arose, the company submitted a scheme for the rapid utilisation of all the gas works in the country. In a very short time the industry had completely organised itself for this purpose, and the nation undoubtedly owes much to it for the magnificent response it made to the appeal. Almost all the charcoal required for gas-masks was produced at the West Greenwich works; and at the close of hostilities a factory designed to prepare material for lethal gases was on the point of production. Only one of the six gas works was struck by an enemy bomb, and the damage was quickly repaired. On the other hand, the largest gas holder, containing 8 million cub. ft. of gas, was wrecked and some chemical plant damaged by the Silvertown explosion. Ten of the company's ships were sunk by enemy action. No hindrance was placed in the way of employees who wished to enlist, with the result that of the 6600 workers and officials employed before the war, 3744 joined up. The resulting labour shortage was overcome by the excellent work of the women dilutees. For a year the trade union fought against the employment of women in retort or houses. "Trade Unionism has either been betrayed

Dealing w[illegible]ayed itself during the Great War."
penter said t[illegible]with present-day difficulties, Dr. Carrisen to a figu[illegible]hat the cost of coal and labour had hopes must be ceas[illegible] alarming in the extreme, and being found by the [illegible]ained upon a general solution 1913, the company had [illegible]overnment. Compared with coal and freight, and £48[illegible]paid £1,075,380 more for although the gas consumption[illegible]751 more for wages, less. If State aid is to be given [illegible] was 4·3 per cent. industry, it must also be forthcomin[illegible] to the electrical takings, for these utilise coal to bet[illegible]g to gas undertaken can even be promised by the a[illegible]er advantage electric super-stations. The gas indust[illegible]vocates of ever, must put its own house in order, a[illegible]ry, how*alia* it is essential that gas should be sold [illegible]d *inter* basis of its calorific power. Another imp[illegible]on the consideration is the remuneration of capita[illegible]portant vested in gas undertakings, for it cannot be d[illegible]d in that the present rate is both insufficient an[illegible]enied equitable.

TRADE NOTES.

BRITISH.

The Plumbago Situation in Ceylon.—H.M. Trade Commissioner in Calcutta reports that the plumbago industry in Ceylon is at present in a difficult position owing to the elimination of the United States as a market; and it is feared that with the rapidly-increasing competition from Madagascar, the Ceylon industry is to some extent imperilled. While exports remained fairly steady until the year 1917, during the first nine months of 1918 they decreased by almost 50 per cent. As the United States, however, must be short of stocks it is considered that there should be a revival in demand before the coming spring. The total exports in 1907 were 32,026 tons, of which the United Kingdom took 8507 tons, the United States 14,170 tons, Germany and Austria 4884 tons. In 1917 the United Kingdom took 4602 tons, and the United States 21,964 tons. In 1918 (Jan. 1—Oct. 4) the United Kingdom received 3826 tons, and the United States 14,415 tons.—(*Bd. of Trade J., Feb.* 13, 1919.)

British Industries Fair, 1919.—The British Industries Fair, organised by the Board of Trade, was opened in the Pennington Street premises of the London Dock on February 24, and will remain open until March 7. The number of firms exhibiting is 570, of which 114 represent the glass and pottery trades. The Fair is confined to trade buyers, the general public not being admitted.

Analysis of Pre-war Chemical Imports.—The method used by the Board of Trade for recording the imports into the U.K. of chemicals and drugs involved their sub-division into two main groups, as shown by the following lists for 1913:—

I.—Imports of Chemical Manufactures and Products (other than Drugs, Dyestuffs and Manures).

	£
Acetate of lime	49,342
Acetic acid (other than for table use)	85,790
Acetone	162,633
Bleaching materials:	
Bleaching powder	32,189
Other sorts	2,183
Boracite	39,743
Borate of lime	148,187
Borax	15,029
Brimstone	92,712
Carbide of calcium	272,445
Coal products, not dyes	164,447
Cream of tartar	331,974
Glycerin, crude	255,718
Glycerin, distilled	84,570
Muriate of ammonia	9,953
Potash compounds:	
Saltpetre (nitrate of potash)	240,966
Other sorts	630,234
Soda compounds:	
Soda ash	884
Soda bicarbonate	940
Soda caustic	4,692
Soda crystals	5,202
Other sorts	160,322
Sulphuric acid	8,960
Tartaric acid	247,377
Unenumerated	1,488,034

II.—Imports of Drugs Containing no Dutiable Ingredient.

	£
Bark, Peruvian	58,003
Cocaine and cocaine salts	14,378
Morphia and morphia salts	32
Opium	507,262
Quinine and quinine salts	102,102
Unenumerated (including medicinal preparations)	1,302,860

Owing to the very large proportion of substances classed as "unenumerated" or "other sorts" such lists convey relatively little information. Of the chemicals in I., valued at £4,534,536, 50·3 per cent. was "unenumerated," and of the drugs in II., valued at £1,984,037, 65·6 per cent. Since 1914 the need for fuller information has been felt, and the Board of Trade, in conjunction with the Statistical Office of the Customs, has analysed the principal unenumerated items. The results are given below:—

(a) POTASH COMPOUNDS—OTHER SORTS.

Article.	Total Imports in 1913.	Of which		
		Imports from Germany	Other Principal Sources of Supply.	
	£	£	£	
Potassium Bromide ...	8,708	7,909	799	U.S.A.
,, Carbonate ...	108,550	33,909	58,499	Russia.
			10,315	France.
Potash—Caustic and Lyes	116,252	90,806	12,832	France.
			8,827	Belgium.
Potassium Chlorate ...	26,324	2,101	14,020	France.
			6,595	Sweden.
,, Cyanide ...	10,342	9,763	—	—
,, Iodide ...	41,217	10,351	30,654	Japan.
,, Muriate ...	100,457	99,996	—	—
,, Perchlorate ...	5,122	—	3,880	Sweden.
			1,242	France.
,, Permanganate	7,715	7,451	—	—
,, Phenylglycine	38,832	38,832	—	—
,, Prussiate ...	34,289	14,781	15,201	France.
			3,244	Belgium.
,, Sulphate ...	88,089	85,175	1,601	France.
,, Sulpho-Muriate	22,935	22,935	—	—
39 Other Sorts	21,402	17,427	—	—
Total of above ...	630,234	441,436	—	—

(b) SODA COMPOUNDS—OTHER SORTS.

	£	£	£	
Sodium Acetate	14,487	6,388	4,645	Belgium.
			2,030	U.S.A.
,, Chromate and Bi-chromate ...	20,730	20,549	—	—
,, Chlorate	19,716	642	14,614	France.
			3,411	Spain.
,, Glycero-Phosphate	5,776	5,716	—	—
,, Hydrosulphite ...	26,361	16,377	9,930	France.
,, Hyposulphite ...	7,128	7,122	—	—
,, Nitrite	10,067	1,158	5,406	Norway.
			2,957	France.
,, Perborate ...	6,222	6,222	—	—
,, Phosphate ...	9,541	6,183	3,096	Belgium.
,, Salicylate ...	16,147	15,264	845	France.
39 Other Sorts	24,097	14,162	—	—
Total of above ...	160,322	99,783	—	—

(c) CHEMICALS—UNENUMERATED.

Aluminium Compounds:	£	£	£	
Sulphate...	50,861	35,909	11,923	Belgium.
Hydrate...	4,854	4,510	344	Netherlands.
Alum	3,645	2,196	1,294	Netherlands.
Other	9,462	4,406	4,925	Australia.
Ammonium Compounds:				
Nitrate	51,166	461	43,339	Norway.
Oxalate	10,179	9,919	—	—
Perchlorate	4,180	—	3,573	Sweden.
Phosphate	6,017	1,300	3,149	Belgium.
Other	3,582	2,960	318	Belgium.
Antimony Compounds:				
Sulphide	11,327	8,388	2,909	France.
Other	7,396	5,791	1,605	France.
Arsenic	40,741	3,230	13,146	Belgium.
			8,447	Australia.
			8,402	Portugal.
			6,966	France.
Baking Powder	26,803	1,500	25,303	U.S.A.
Barium Compounds:				
Binoxide...	19,050	14,614	4,436	France.
Chloride...	10,452	7,389	2,262	Belgium.
Other	13,162	12,344	567	Netherlands.
Boracic Acid and Powder	51,115	1,154	32,274	France.
			14,316	Italy.
Bromine and Compounds	12,380	12,380	—	—
Butter Colouring	7,294	303	3,436	Denmark.
			2,335	Netherlands
Camphor	105,669	1,556	101,616	Japan.
Carbonic Acid Gas ...	12,805	9,955	2,581	Netherlands
Chromium Compounds (except Chromic Oxide)	4,294	3,076	919	Belgium.
Citric Acid	23,161	10,787	6,475	France.
			4,578	Italy.
Copper Compounds:				
Copper Oxide	25,711	24,768	—	—
Other Sorts	5,752	3,043	1,631	France.
			1,021	Italy.

(c) CHEMICALS—UNENUMERATED—(*cont.*)

Article.	Total Imports in 1913.	Of which		
		Imports from Germany	Other Principal Sources of Supply.	
	£	£	£	
Disinfectants	14,239	13,752	211	U.S.A.
Formaldehyde	9,449	6,509	2,137	Netherlands.
Formic Acid	42,949	35,028	7,536	Netherlands.
Glass Gold	35,506	14,105	21,401	Belgium.
Hardening Powder ...	6,540	4,586	1,954	Netherlands.
Iodine	80,432	465	70,703	Chile.
			8,064	Peru.
Lactic Acid	13,809	10,910	2,681	Netherlands.
Lead Compounds:				
Acetate	29,398	15,861	9,057	Netherlands.
Other	1,477	1,449	—	—
Lime Compounds:				
Citrate	60,418	—	54,192	Italy.
			6,079	Br. W. Ind.
Other	1,272	1,272	—	—
Magnesium Compounds:				
Chloride	25,656	25,559	—	—
Other	1,828	1,065	390	Netherlands.
Nitrate of Soda*	166,704	12,000	127,009	Chile.
			21,945	Belgium.
Oxalic Acid	20,083	18,166	1,887	Norway.
Phosphorus	23,866	81	19,243	Canada.
			4,542	France.
,, Compounds ...	573	241	285	U.S.A.
Photographic Chemicals ...	12,140	11,948	—	—
Rennet	12,115	1,372	9,246	Denmark.
Salicylic Acid	10,621	10,293	225	Switzerland.
Silver Nitrate	29,031	2,587	26,444	France.
Sodium	9,499	—	9,302	Norway.
Sulphur Compounds:				
Dioxide	7,277	7,255	—	—
Chloride	3,112	3,096	—	—
Other	1,463	1,433	—	—
Tartar Crystals, Tartar and Compounds	17,396	306	17,085	Italy.
Thermit	6,656	6,656	—	—
Thorium Nitrate	41,544	23,078	16,668	France.
			1,798	Austria-Hungary.
Tin Chloride	10,646	10,354	—	—
33 other items ranging in value from £5000 down to £1000	68,931	43,336	—	—
390 items under £1000 in value	54,419	33,111	—	—
Various details unspecified	147,957	116,559	—	—
Total of above	1,488,034	614,372	—	—

* The bulk of the imports of Nitrate of Soda is recorded under "Manures."

(d) DRUGS—UNENUMERATED.

(i) Manufactured or Prepared:				
Albulactine	7,074	7,074	—	—
Aspirin	19,799	19,677	—	—
Epsom Salts	8,602	6,534	983	Belgium.
Ergot of Rye	15,846	3,280	5,945	Russia.
			2,664	Spain.
Guaza (Ganja)	7,168	392	6,623	Br. India.
Hæmoglobin	6,624	64	6,543	Switzerland.
Magnesia	18,055	10,741	3,872	U.S.A.
Menthol	63,108	3,128	56,306	Japan.
			2,200	France.
Aniseed	25,304	335	16,767	Hongkong.
Cod Liver	101,044	501	88,985	Norway.
			7,651	Netherlands
Eucalyptus	37,855	528	33,821	Australia.
Other	2,563	528	—	—
Proprietary Articles:				
Patent Medicines ...	172,519	77,435	90,225	U.S.A.
Emulsion	39,563	—	39,447	U.S.A.
Liniment	10,439	—	10,439	U.S.A.
Ointment	19,482	12	19,438	U.S.A.
Pills	6,993	1,146	1,900	U.S.A.
			3,540	France.
Plasters	26,910	1,294	25,493	U.S.A.
Other	6,050	351	1,570	U.S.A.
Papain	6,756	27	6,446	Ceylon.
Pepsin	5,679	538	5,011	U.S.A.
Phenacetin	7,951	6,183	1,349	Switzerland
Salvarsan and Neo-salvarsan	11,383	11,383	—	—
Sugar of Milk	16,226	7,160	6,526	Netherlands
Tartar Emetic	5,067	4,766	240	Belgium.
31 other drugs ranging in value from £5000 to £1000	53,218	22,703	—	—
306 other drugs ranging in value upto £1000 ...	72,669	36,117	—	—
Items unspecified	141,600	79,103	—	—
Total of above ...	915,547	301,000	—	—

(d) DRUGS—UNENUMERATED.

Article.	Total Imports in 1913.	Of which		
		Imports from Germany	Other Principal Sources of Supply.	
(ii.) Leaves, Roots, Seeds, Barks, etc., raw or simply prepared :	£	£	£	
Aloes	18,424	365	13,034	Cape of Good Hope
			2,712	U.S.A.
Aniseed	14,206	835	8,712	Russia.
			2,294	France.
Asafœtida	5,072	-	3,430	Persia.
			1,256	U.S.A.
Balsams	12,052	3,161	3,304	U.S.A.
			1,989	Brazil.
Buchu Leaves	7,684	-	7,547	Cape of Good Hope
Calabar Beans	5,504	216	5,231	Sierra Leone
Cardamoms	47,939	339	35,323	Ceylon.
			3,125	Java.
Coca Leaves and Powder	5,873		2,025	Ceylon.
Fenugreek Seed	18,336	38	6,747	Egypt.
			5,199	Turkey in Asia.
			4,789	Morocco.
Herbs, unspecified ...	18,935	5,092	5,662	France.
			5,069	Japan.
Nux Vomica	13,761	-	12,760	Br. India.
Quassia	8,541	-	8,095	Br. West Indies.
Roots :				
Gentian	5,508	50	5,084	France.
Ipecacuanha	33,675	3,695	12,651	Uruguay.
			5,696	Brazil.
Liquorice (incl. Powder and Sticks)	8,199	758	2,816	France.
			1,635	Italy.
			1,077	Turkey in Asia.
Orris (incl. Powder) ...	6,563		3,316	Morocco.
			2,868	Italy.
Rhubarb...	11,287	198	10,572	China.
Sarsaparilla	10,882	163	6,927	Panama.
			2,055	Br. West Indies.
Senega	8,373	1,636	3,982	U.S.A.
			2,755	Canada.
Unspecified	7,516	1,853	2,322	U.S.A.
			2,141	France.
Sandalwood	5,436	8	5,428	Netherlands.
Senna	17,381	189	13,132	Br. India.
			3,251	Egypt.
15 other items ranging in value from £5000 to £1000	40,790	6,851	-	-
98 other items each under £1000	55,630	6,037	-	-
Total	387,313	31,461	-	-

From the above figures it is seen that 70 per cent. of the unenumerated potash compounds came from Germany, 60·4 per cent. of the sodium compounds, and 41·3 per cent. of the chemicals unenumerated. Of the unenumerated drugs, 27·5 per cent. was imported from the same country. (*Bd. of Trade J., Feb.* 6, 1919.)

FOREIGN.

Sugar Production in Santa Clara, Cuba.—The production of sugar in Cuba during 1917-18 was 3,446,083 long tons, and about one-fourth of this quantity came from the province of Santa Clara. A production at least equal to this is forecasted for 1918-19, but labour shortage may seriously affect output. The price for the forthcoming crop has been fixed at $5·50 (£1 2*s.* 7*d.*) per 100 pounds, f.o.b. Cuban ports. Inactivity of the molasses market is attributed to American Prohibition.—(*U.S. Com. Rep., Dec.* 13, 1918.)

Organising the Metal Industry of Finland.—The Finlanders are rousing themselves to protect and strengthen their staple industries. According to the *Hufvudstadsbladet*, an association of representatives of the metal industry has been formed at Helsingfors to organise and direct the import and export trade, and to promote new undertakings in connexion with the metal industry.—(*Metall u. Erz, Nov.* 8, 1918.)

A National Fair for Finland.—At a recent meeting of the National Industrial League of Finland it was decided, in accordance with a suggestion made by the Commission of Commerce and Industry, to organise a national fair, or exposition, to be held at Helsingfors or Tammerfors during the summer of 1919.—(*U.S. Com. Rep., Dec.* 21, 1918.)

The Bordeaux Fair of 1919.—The date of the Third Sample Fair has been fixed for May 16 to 31, 1919. Applications for space, regulations, etc., should be made to the Comité d'Organisation et Administration de la Foire de Bordeaux, Hôtel de Ville, Bordeaux, France.

Opportunity for Chemical Trade in Mexico.—There is considerable opportunity for chemical trade with Mexico, in which British exporters have at present no share. This applies more particularly to drugs, aniline dyes, acids and heavy chemicals for use in mines. A German firm at present manufactures some sulphuric, nitric and hydrochloric acids, and superphosphates; whilst dyes, formerly supplied by Germany, are now imported from the United States. British pure chemicals are unknown in Mexico, and a British exhibition, especially of dyes, would be welcomed.—(*Bd. of Trade J., Jan.* 30, 1919.)

Markets for Soda Products in Latin America.—In consequence of war demands, the output of caustic soda in the United States has been doubled since 1914, and the industry is now seeking markets for the large surplus available for export. The various states of North, Central and South America have been studied from this point of view. At the present time the best markets for sodium products (mainly caustic soda, soda ash and sodium silicate) are Argentina, Uruguay, Paraguay, where the meat packing industry produces a large amount of tallow. Large quantities of caustic soda are imported by these countries for converting this tallow into soap. In 1917 Argentina alone imported over 23,000,000 kilo. of soda products, the bulk of which came from Great Britain. In addition to some 200 soap factories, this country also possesses a considerable number of paper mills. In Brazil, where, it is stated, there are 91 soap factories and 161 cotton mills, the shortage of caustic soda has been so great that the Government is now encouraging local production. The west coast countries are for the most part occupied in mining, and there is no great demand for soda. Local soap manufacture is carried on in Chile and Peru, which import about 2,000,000 kilo. and 1,000,000 kilo. respectively of caustic soda. As agricultural conditions prevail in most of the countries of Central and Northern America, most commodities are imported in the fully manufactured state and there is little demand for industrial chemicals. In Mexico there should be a fair market for soda products as soon as the country becomes settled again; before the revolution over 8,000,000 kilo. of caustic soda was imported annually.—(*U.S. Com. Rep., Dec.* 16, 1918.)

Magnesite in the Salonica District (Greece).—The increasing demand for magnesite has led to shipments during the past two years from the peninsula of Chalcidice. Of the five localities where magnesite is obtainable, Yerakino is the most important; the deposits there have been worked since 1905 and are still far from being fully developed. Before the war, the ore was calcined and shipped to Holland, whence it was re-shipped to various other countries. The annual shipments of calcined ore amounted to 10,000 metric tons, representing 21,000 tons of the crude ore. In addition, 2000 to 3000 tons of the crude ore was

exported to Italy, France and Holland. On the outbreak of war, shortage of fuel stopped the calcination. In 1916, the exports to Holland had fallen to 320 tons of crude ore and 730 tons of calcined ore, while no exports to that country are on record for 1917. The United States received 12,914 tons of crude ore in 1916, but none in 1917. The British Government was the principal purchaser, the shipments in 1915, 1916 and the first half of 1917 amounting to 40,000 tons, at an average price of 30*s.* to 50*s.* per ton, f.o.b. Yerakino. An increase in price made in July, 1917, however, has practically stopped further sales.—(*U.S. Com. Rep. Supp., Oct.* 2, 1918.)

REVIEWS.

L'Aluminium dans l'Industrie. *By* Jean Escard. *Métal pur, Alliages d'Aluminium. Pp.* 272. (*Paris: H. Dunod et E. Pinat,* 1918.) *Price* 14 *frs.* 40 *c.*

In spite of the fact that aluminium has now, 92 years after its discovery, become one of the most important metals in common use, and in spite of the continuous growth of the proportion of current periodical literature which it monopolises, the text books devoted to this metal remain remarkably few in number, and, it must be added, disappointing in quality. English readers are confined to the original publication of Richards which was written when the electrolytic process of production was still in its infancy, and to Waldo's translation of Minet's very inadequate "Die Gewinnung des Aluminiums und dessen Bedeutung für Handel und Industrie." In the German language there is further, Mierzinske's "Die Fabrikation des Aluminiums" of 1885, and a short treatise by Winteler, "Die Aluminium Industrie," written sixteen years ago, whilst France has given us the original work of Sainte Claire-Deville "De L'Aluminium" published in 1859, Moissonier's "L'Aluminium," dating from 1903, and finally the book now under review.

This poverty is doubtless due to the fact that the number of workers who have actual experience of the metallurgy of aluminium and at the same time the scientific and technical equipment necessary to enable them to pass their knowledge on is still very small, whilst most of those who could do so are debarred by vows of secrecy or heavy pre-occupations. To this must also be ascribed the fact that most of the books referred to above are unsatisfactory in that they do not bear the impress of first hand knowledge or accurate information.

Escard's book forms no exception in this respect. It is true that according to his title the author limits himself to a description of the applications of aluminium and its alloys to industry, but in point of fact he has attempted the much more ambitious task of writing a text book on the metal. As a scientific treatise the book suffers from the defect that no critical consideration appears to have been given to the various processes, observations or data enumerated, and the author consequently makes himself responsible for describing as being in actual operation methods of manufacture which never got further than the laboratory or the patent office, gives as the physical properties of the metal values which have long ago been discarded, and recommends it for uses for which it has been shown to be unsuited, whilst neglecting modern developments. The book is also unscholarly in that the author seems to shut his eyes to much of the work which has been done upon aluminium outside of France, whilst he gives but sparingly the names of authors whose work he does use or references by which their original communications can be consulted. Thus in his opening paragraph dealing with methods of manufacture in current use no room is found for the name of Hall.

In his first chapter Escard describes the nature and origin of the raw materials used in the manufacture of aluminium, and gives an account of the production of the metal and statistics of production and consumption. The figures given of yields, output, consumption of electrodes, etc., should be accepted with caution.

In his second chapter the author describes the physical, mechanical and chemical properties of the metal, whilst one section deals with soldering and welding, and another with methods of working. Here the author has been entirely misled by his unquestioning acceptance of the figures of others. The account given of the work of Heyn and Bauer upon the effect of atmosphere and waters upon aluminium is welcome, as this research, which merits close study, is inaccessible to most English readers. Although the next chapter contains a good description of the "Thermite" process, it is on the whole disappointing. Ten lines cover all that the author finds to say about the use of aluminium for aircraft, and he still recommends the use of aluminium for the hulls of boats and ships! An adequate account is given of the manufacture of aluminium powder with illustrations of the machines used, which have not been published here before. The process of coating other metals with aluminium, which is known as "Calorising," is described, whilst the Schoop process of spraying metal coatings on to various objects also finds mention. The claims made for the aluminium coating thus produced (p. 108) cannot, however, be conceded.

More than half the book is made up of a description of alloys of aluminium which, whilst catholic in its embrace, does not discriminate between just and unjust claims, or between useful and useless alloys. Thus twelve pages are devoted to the zinc-aluminium alloys, while as many lines serve to convey all the information given about the light ternary zinc-copper-aluminium alloys which form the bulk of all the alloys of aluminium in actual use. There is a section dealing with Duralumin, but the heat treatment of this material and its amazing effects on the metal are not considered worthy of mention.

A full table of contents at the end of the book does not make up for the lack of an index.

Richard Seligman.

A Short Hand-book of Oil Analyses. *By* Augustus H. Gill. *Revised eighth edition. Pp.* 209. (*Philadelphia and London: J. B. Lippincott Company.*) *Price* 10*s.* 6*d. net.*

This little hand-book has been proved, by the exhaustion of seven editions in 21 years, to have met a demand, which, to judge from its contents, must have been chiefly on the west side of the Atlantic. It is in two parts, of which the first relates to physical and chemical tests, very many of which, as described, are peculiar to the North American continent. For instance, the Abel flash-point apparatus, the Redwood viscosimeter, etc., are not described, and, except for a few graphs of comparative readings of different viscosimeters given in an Appendix, there is no relation indicated between them and the corresponding American standard testing apparatus. On this account, the first part of the book, though good within its limitations of space and scope, is not likely to be much used in Great Britain.

The second part of the book, on the derivation, description and examination of certain oils, is of more cosmopolitan service. But in many respects

it is disappointing. Example being better than precept, it is useless for the author to say on one page (in the first part) that, in expressing viscosity it is necessary to give the name of the instrument with which it is determined, and later to cite figures for the viscosity of oils and greases for various lubricating purposes without indicating—so far as the reviewer can discover—the instrument to which they refer. Presumably they are, like certain viscosities given in the Appendix, for the "Sayboit universal" viscosimeter, but the reader should not be left at the mercy of guesswork in a matter of this kind. This and other similar failings suggest that the text is unlikely to be of much direct service to the analyst or user of oils, though indirectly he may find the book quite useful for its foot-note references to original papers, reports, etc. The text will serve well the purpose of the general student who merely requires a compact review of the characteristics and methods of testing the commoner oils—mineral, vegetable and animal.

W. J. A. BUTTERFIELD.

PUBLICATIONS RECEIVED.

RECENT ADVANCES IN PHYSICAL AND INORGANIC CHEMISTRY. *By* A. W. STEWART. *With an Introduction by* SIR WILLIAM RAMSAY. *Third edition. Pp.* 284. (*London: Longmans, Green and Co.* 1919.) *Price* 12*s.* 6*d.*

TRATTATO DI CHIMICA GENERALE ED APPLICATA ALL' INDUSTRIA. VOL. I.—CHIMICA INORGANICA. PARTE SECONDA. *By* DR. E. MOLINARI. *Pp.* 1190. (*Milano: Ulrico Hoepli*, 1919.) *Price* 26 *lire.*

PHARMACEUTICAL AND MEDICAL CHEMISTRY. A TEXT-BOOK OF CHEMISTRY INTENDED FOR THE USE OF PHARMACEUTICAL AND MEDICAL STUDENTS. *By* S. P. SADTLER, V. COBLENTZ, *and* J. HOSTMANN. *Fifth Edition. Pp.* 765. (*Philadelphia and London: J. P. Lippincott Company.*) *Price* 21*s.* net.

BULLETIN OF THE IMPERIAL INSTITUTE. VOL. XVI. *No.* 3. *July-September*, 1918. (*London: John Murray.*) *Price* 2*s.* 6*d.*

INTRODUCTORY LECTURE TO THE CLASSES IN METALLURGY IN THE ROYAL TECHNICAL COLLEGE, GLASGOW. *Session* 1918-1919. *By* PROF. C. H. DESCH. (*Glasgow: J. Maclehose and Sons.* 1919.)

NOTES ON FLAX. *Issued by the British Flax and Hemp Growers' Society, Ltd.* (*Registered Office:* 14, *Victoria Street, S.W.* 1.) I.—*The Cultivation of Flax in Great Britain. II.—The Separation of Vegetable Fibres. III.—Linseed as a Farm Crop in Great Britain. IV.—The Cultivation of Flax for Fibre in Great Britain. V.—The Cultivation of Flax for Seed in Great Britain. VI.—Oil from British-grown Linseed. VII.—The Isolation of Improved Strains of Flax Seed for Sowing Purposes.*

REPORTS I. AND II. ON COSTS AND EFFICIENCIES FOR H.M. FACTORIES CONTROLLED BY FACTORIES BRANCH, DEPARTMENT OF EXPLOSIVES SUPPLY. *Pp.* 79 *and* 134. (*H.M. Stationery Office.*)

STATISTICS OF THE SYNTHETIC DYESTUFFS IMPORTED INTO THE UNITED KINGDOM DURING THE YEAR 1913. *Report of the Commissioner for Dyes, Board of Trade. Pp.* 168. (*H.M. Stationery Office.*)

FOUR YEARS' WORK. *An Account of the Progress of the Coal-tar Chemical Industry during the War. Pp.* 23. (*Levinstein Ltd., Manchester.*)

DYES AND OTHER COAL-TAR CHEMICALS. *Report of the United States Tariff Commission, Recommending Amendments to Title V. of Act of September* 8, 1916. *Pp.* 83. (*Washington: Government Printing Office.* 1918.)

INDIGENOUS DRUGS OF INDIA. *Their Scientific Cultivation and Manufacture, with Suggestions for the Development of New Industries. By* J. C. GHOSH. *Pp.* 32. (*Calcutta: Butterworth and Co., Ltd.* 1918.) *Price* 12 *annas* (1*s.*).

REPORT ON THE BUILDING AND ORNAMENTAL STONES OF CANADA. VOL. V., PROVINCE OF BRITISH COLUMBIA. *By* W. A. PARKS. *Pp.* 236. (*Ottawa: Government Printing Bureau.* 1917.)

MINERAL SPRINGS OF CANADA. PART II., THE CHEMICAL CHARACTER OF SOME CANADIAN MINERAL SPRINGS. *Bulletin No.* 20. *By* R. T. ELWORTHY. *Pp.* 173. (*Ottawa: Government Printing Bureau.* 1918.)

NATURAL GAS: ITS PRODUCTION, SERVICE, AND CONSERVATION. *By* S. S. WYER. *Bulletin* 102, *Part* 7, *of the Smithsonian Institution, United States National Museum. Pp.* 67. (*Washington: Government Printing Office.* 1918.)

THE PRODUCTION OF PRECIOUS STONES FOR THE YEAR 1917. *By* G. F. KUNZ. (*Reprinted from Mineral Industry, Vol. XXVI.*) (*New York: McGraw-Hill Book Co., Inc.*, 1918.)

SOILS OF SOUTHERN NEW JERSEY AND THEIR USES. *By* J. A. BONSTEEL. *United States Department of Agriculture Bulletin No.* 677. *Pp.* 78. (*Washington: Government Printing Office.* 1918.) *Price* 40 *cents.*

PUBLICATIONS OF THE UNITED STATES BUREAU OF MINES. DEPARTMENT OF THE INTERIOR. (*Washington: Government Printing Office*, 1918.)

ROCK QUARRYING FOR CEMENT MANUFACTURE. *By* O. BOWLES. *Bulletin* 160. *Mineral Technology* 22. *Pp.* 160. *Price* 25 *cents.*

MELTING BRASS IN A ROCKING ELECTRIC FURNACE. *By* H. W. GILLETT *and* A. E. RHOADS. *Bulletin* 171. *Mineral Technology* 23. *Pp.* 131. *Price* 20 *cents.*

COLLOIDS AND FLOTATION. *By* F. G. MOSES. *Technical Paper* 200. *Price* 5 *cents.*

ECONOMIC OPERATIONS OF STEAM TURBO-ELECTRIC STATIONS. *By* C. T. HIRSHFELD *and* C. L. KARR.

HOW TO IMPROVE THE HOT-AIR FURNACE. *By* C. W. BAKER.

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. DEPARTMENT OF THE INTERIOR. (*Washington: Government Printing Office.* 1918.)

FLUORSPAR AND CRYOLITE IN 1917. *By* E. F. BURCHARD.

ASPHALT, RELATED BITUMENS, AND BITUMINOUS ROCK IN 1917. *By* J. D. NORTHROP.

GOLD, SILVER, COPPER AND LEAD IN ALASKA IN 1917. MINES REPORT. *By* G. C. MARTIN.

STONE IN 1916. *By* G. F. LOUGHLIN.

INTERNATIONAL CONTROL OF MINERALS. *By* C. K. LEITH.

THE ECONOMIC LIMITS TO DOMESTIC INDEPENDENCE IN MINERALS. *By* G. O. SMITH.

PEAT IN 1917. *By* C. C. OSBON.

MAGNESIUM IN 1917. *By* R. W. STONE.

SOCIETY OF CHEMICAL INDUSTRY.

ANNUAL REPORTS OF THE PROGRESS OF APPLIED CHEMISTRY.

Volume III. of Reports of the Progress of Applied Chemistry is now in the press and will be published before the end of the present month. The reports included in the volume review the literature of the various subjects for the year 1918 in most cases, though in certain sections the work of earlier years is also considered. Two new sections are included in this volume, *viz.*, those on Agricultural Chemistry and on Foods, whilst several other sections have been contributed by fresh authors so as to give readers the advantage of reviews written from a somewhat different point of view. The sections on ceramics, building materials, and fermentation industries are not included, as the authors failed to send in their MSS. in time.

The following is a list of the sections of the volume and their authors: Plant and machinery; J. W. Hinchley. Fuel; J. T. Dunn. Gas, destructive distillation; Alwyne Meade. Mineral oils; Arnold Philip. Colouring matters and dyes; G. T. Morgan. Fibres, textiles, cellulose, paper; J. F. Briggs. Bleaching, dyeing, printing, finishing; S. H. Higgins. Acids, alkalis, salts, etc.; H. A. Auden. Glass, refractories; W. J. Rees. Metallurgy of iron and steel; C. O. Bannister. Metallurgy of the non-ferrous metals; G. Patchin. Electro-chemistry; A. J. Hale. Fats, oils, and waxes; C. Revis and E. R. Bolton. Paints, pigments, varnishes, and resins; L. M. Nash. India-rubber; D. F. Twiss. Leather and glue; F. C. Thompson. Agricultural chemistry; E. J. Russell. Sugars, starches, and gums; J. P. Ogilvie. Foods; H. W. Bywaters. Sanitation, water purification; E. Ardern. Fine chemicals, medicinal substances, essential oils; G. Barger. Photographic materials and processes; B. V. Storr.

The volume, which contains over 500 pages, may be obtained from Messrs. Spottiswoode, Ballantyne and Co., 1 New Street Square, London, E.C. 4; price to members 5*s.* 6*d.*, post free.

Volumes I. and II. may still be obtained, as announced recently in the Journal (Jan. 15, 1919, p. 1 R).

LIBRARY FACILITIES.

It has already been mentioned in the "Journal" that our Society has contributed £100 to a scheme proposed by the Chemical Society, whereby certain other societies might enjoy the privileges of its Library. Under the arrangements made, all members of the Society of Chemical Industry are entitled to use the Library of the Chemical Society, subject to the observance of the Library Rules applicable to Fellows of the Chemical Society. The Council of our Society, in drawing the attention of members to the valuable privilege thus afforded them, expresses the hope that they will make the fullest possible use of the facilities provided. The following digest of the Library Rules at present in force is given for the guidance of our members, and indicates the scope of the library service afforded them.

The Library is housed in the Chemical Society's rooms at Burlington House, Piccadilly, London, W. 1, and opens at 10 a.m. every weekday, and closes on Tuesdays and Fridays at 9.0 p.m., on Saturdays at 5.0 p.m., and on other days at 6.0 p.m. It is closed on Bank Holidays and the day following, and for a fortnight annually (for cleaning, etc.). The Library may be used, during the hours it is open, by members of our Society, for reference, and for borrowing books, not exceeding six at one time. Dictionaries and certain other reference and exceptional books may not ordinarily be taken out on loan, and journals (unless the Society has duplicate copies) may be borrowed only for one night or from Saturday to Monday. The latter must, however, be personally applied for 10 minutes before the usual hour of closing, and must be returned not later than 1 hour after the hour of re-opening on the following day. Books newly acquired may not be had on loan until one month has elapsed. All members entering the Library sign in a book provided, and borrowers sign a voucher which is given back when the book to which it refers is returned. Books are also issued on loan on receipt of a written order, the borrower paying the whole cost of carriage. Books are lent at the borrower's risk; he is liable to make good books lost, detained or damaged. A book may be retained for one calendar month unless the borrower is notified to return it earlier, but single parts of journals must be returned within one week. Books will not be sent out of the United Kingdom.

The full Library Rules are exhibited in the Library, and applications for the loan of books, by members who cannot call for them, should be addressed to the Librarian of the Chemical Society, Burlington House, Piccadilly, W. 1, and should state that the application is made in virtue of membership of the Society of Chemical Industry.

COMMITTEE ON THE STANDARDISATION OF LABORATORY GLASSWARE.

The Council of the Society, acting upon a suggestion made by Dr. Morris Travers when reading his paper on Scientific Glassware at the annual meeting of the Society at Bristol in July last, has appointed the following Committee to deal with the question of the standardisation of laboratory glassware:—Sir Robert Hadfield, Bart., Sir Herbert Jackson, Mr. Kenneth Chance, Dr. C. Carpenter, Mr. W. F. Reid, Dr. Morris Travers (Convener), with the President and Honorary Treasurer of the Society as *ex officio* members.

This Committee, at its first meeting, felt that it would be of great importance before proceeding further to obtain the views of the glassware manufacturers, the users, and the retail trade. They therefore approached the Council with the object of obtaining permission to secure the co-operation of representatives of these bodies, and this being granted, the following additional members have now been added to the Committee:—Mr. G. F. Baker (British Lamp-blown Scientific Glassware Manufacturers' Association), Mr. F. W. Branson, of Leeds, Mr. D. J. P. Berridge (Public School Science Masters' Association), Dr. J. J. Fox (Government Laboratory), Mr. J. R. Griffin (British Laboratory Ware Association), Mr. Arnold Stevenson (Glassware Supply, Ministry of Munitions) and Mr. V. Stott (National Physical Laboratory).

The Committee has already had several meetings and a considerable amount of important work has been accomplished.

All communications regarding the Committee should be addressed to the General Secretary at the Society's offices.

CHEMICAL COMPOUNDS FOR THE DETECTION OF OVERHEATED MACHINERY AND BEARINGS.

H. T. PINNOCK.

It is an axiom, theoretically established and proved practically, that some degree of friction and consequent heat generation is inseparable from machinery in motion. Half a century ago, breakdowns of machinery from this cause were more the rule than the exception, but with modern improvements in design and construction and more specialised knowledge of lubrication and lubricants, trouble from this cause has been reduced to an extent that was previously thought impossible. There can, however, be few, if any, industrial undertakings where trouble has not, at some time been caused by overheated bearings and the like; trouble due to dirt, inattention, or failure of the lubrication system. Such occurrences, even to-day, are not infrequent and the result may often mean a complete or partial stoppage of the machinery involved, coupled with expensive repairs owing to "galling" of the moving parts. Trouble of this kind naturally occurs most frequently with machinery in inaccessible places; for instance, in a line of overhead shafting, the first visible indication may be the emission of blue smoke from the overheated oil in the vicinity of the bearings, by which time both bearing metal and shaft may be badly galled.

It is obvious that if warning could be given as soon as heating up occurred, but before it became serious, much trouble and expense could be avoided and the matter could be rectified in time. With this object in view, various devices have been introduced from time to time, which have consisted mostly of indicators operated by thermo-electric couples, or of expansion methods. Tonner, in America, suggested the use of copper mercuric iodide on the axles of railway rolling stock as an indicator of overheating. This suggestion, however, does not appear to have been carried out to any extent; it is difficult to see why, as under suitable conditions some such compound appears admirably suited to the purpose.

The attention of the writer was directed to the matter about 1908, and he was then in ignorance of Tonner's suggestion, but was led to investigate the properties of the double iodides of mercury with other metals, for the purpose of finding a suitable compound which would serve as a detector of overheated bearings. These double iodides were all found to possess the property of undergoing a reversible transition involving change of colour when heated and subsequently cooled. With most of them the change was comparatively slow, and the transition was so gradual and spread over so large a range of temperature as to be unsuitable for the purposes required. Other compounds changed fairly sharply, but the range of colour passed through was too slight to be of any practical value.

Two compounds were, however, eventually prepared which gave promise of considerable utility. The first of these was the double iodide of silver and mercury, $AgI.HgI_2$, which is a pale lemon yellow powder at ordinary temperatures, and changes to a vivid carmine colour at about 90°—100° C. the change in both directions being fairly sharp. The other was the copper mercuric iodide, $Cu_2I_2.2HgI_2$, which Tonner had previously described. This substance is a very vivid scarlet vermilion at ordinary temperatures and at 60°—70° C. it changes to a chocolate brown. Both these compounds are adapted for use under suitable conditions, but it was found that a mixture of the two, consisting of 85 per cent. of the copper salt and 15 per cent. of the silver salt, was more sensitive and gave a greater colour range from ver million to almost black, the transition being ex ceedingly sharp. (Other mixtures were prepare for special conditions, but the above was mos generally applicable.)

The compounds may be prepared in a variety o ways; for instance, a very simple method of pre paring the copper salt is by well triturating i a mortar 380 grams of cuprous iodide with 91 grams of mercuric iodide, sufficient water being added to form a paste. When thoroughly mixed the mass is dried in the water oven, and the dried mass ground to an impalpable powder. Another method is to dissolve the mercuric iodide in excess of potassium iodide solution and precipitate the double salt by the addition of copper sulphate solution. The silver salt can be prepared in a similar manner by double precipitation. Whichever method is adopted, the product should be well washed to eliminate soluble impurities, as these appear to retard the colour change, as well as to affect its character.

Having prepared the double salts and mixed them in the proper proportion, the means of applying them arises. It has been found convenient to convert them into a varnish-paint or enamel, by incorporating the powder with a colourless varnish medium that will stand moderately high temperatures without softening. A good white shellac spirit varnish such as is used on electrical machinery has been found suitable for most occasions as this will stand a low stoving temperature, but for more elevated temperatures, a medium such as is used in the high temperature aluminium paints used for steam pipes, etc., and which will resist temperatures up to 200° C. is excellent. About 10 grams of compound to 70 c.c. of medium will be found a mixture of suitable consistency.

A convenient method of applying this heat detector is first to paint a white circle or ring on the bearing or other place which it is desired to keep under observation, using a zinc white paint. This white circle is applied to the journal or housing of the bearing, and the detector paint is applied as a vivid red bull's eye in the middle of this, thus forming a very striking object which is visible from considerable distances. It must of course be applied to the block of metal as near as possible to the point at which the heat is likely to be generated. It is sometimes desirable to apply the paint to the shaft itself, just where it extends beyond the bearing metal, and in this case, a convenient method is to apply a broad band of white paint with a narrower band of the red detector paint in the centre. This red band in the centre of the white one is then easily seen as the shaft rotates. In any case after the paint is dry, it should be protected with a coat of colourless oilproof varnish, so that the surface may be occasionally wiped free from dust and dirt.

The visibility of the paint against its white background is very high, the bright scarlet colour being visible from long distances without effort and the change at 60°—70° to black is very easily observed, the visibility of the black on the white ground being very much lower. It is generally easy to arrange matters so that the detector is placed in a position where it is visible almost without conscious effort; and experience has proved that a workman is easily trained to cast his eye occasionally on the detector, while he could not be depended upon to climb up to the spot and feel the bearing on the remote chance of finding it heating up. When the paint changes colour, there is certainly something wrong, but generally speaking, it will be found that the matter is taken in time, and that no damage is done, the bearing simply requiring cleaning and adjustment without serious stoppage and expense

This detector has also been successfully used on a gas engine, one of the main bearings of which was frequently heating up, owing to a slightly distorted shaft, and it was possible to place good big "bull's eyes" upon it, which on many occasions gave warning of impending trouble, enabling the load to be reduced before damage was done. It was also found of service on the water-jackets of large internal combustion engines to give warning of insufficient circulation of cooling water.

Many other instances occur in which this property of the double mercuric iodide compounds may be taken advantage of, for instance, it may be used in the reverse way on air-heating towers and the like. A case in point is that of a producer gas plant where the air supply is saturated with water vapour at about 70°—75° C. If the outside of the tower has a white circle about 3 feet in diameter painted on it, with a centre about 1 foot in diameter of the detector paint, the appearance of a red colour, visible all over the plant, is a sign that the saturation temperature has fallen too low and requires attention. The same applies to feed water heaters for boiler feed water.

Where rather higher temperatures require indication, the silver compound which undergoes transition at about 90°—100 C. may be employed, to draw attention to the fact that the water is boiling away and may need replenishing. The application to vacuum evaporators, exhaust turbines etc., is also indicated.

The writer has had some of these indicators in action for the past ten years and the colour change is just as sharp and distinct now as when originally installed. The varnish medium has in some cases called for renewal, but as no special precautions were, at that time, taken in the selection of the most suitable medium, this result is not unnatural. If a really good medium such as is employed in radiator paints be selected, the varnish should endure under normal circumstances for very many years.

CURRENT ACTIVITIES IN DYE PRODUCTION.

An estimate of the extent to which certain British industries were dependent on the pre-war German monopoly of dyes may be gained from a report recently issued by the Board of Trade, giving statistics of the synthetic colouring matters imported during 1913. Although only 18,000 tons of dyes came into England, valued at £2,000,000, the industries dependent on this importation had a yearly output of over £200,000,000. In 1914 a committee was appointed by the Society of Dyers and Colourists to compile a census of the dyestuffs used in Britain, but owing to various difficulties the returns obtained were very incomplete, and remained so until 1916. The Board of Trade, however, took up the matter, and the above-mentioned report is the outcome. The contents of the book consist chiefly of a list of the colours imported, together with the quantities and the makers' names. Each specific variety of dye is given; for instance, there are 155 distinct kinds of methyl violet, and it is pointed out that this multiplicity must cause needless expense in manufacture; accordingly British makers would be well advised to limit the number to two or three varieties, leaving the consumers to alter the shade by admixtures with other dyes.

Although about 10,000 colours are listed, this quantity is really very much greater than the actual number of distinct dyes, owing to the use of multiple names for the same colour. Benzo Sky Blue appears under at least nine different synonyms. Moreover, many commercial dyes are complex mixtures.

In the summary of imports, the cheap direct cotton colours head the list with just under seven million pounds weight. This great vogue is due to ease of application rather than to the permanence of the dye. Chrome and other mordant dyes were imported to the extent of 6,477,065 lb., while the extremely fast but expensive vat dyes total only 388,445 lb. Nearly the whole of the dyes mentioned in the report came from Germany, a small minority coming from Switzerland, and a few from France. The dyes mentioned in Part I. of this report are indexed in Part II. of the same publication.

It is interesting to compare the above report on imported pre-war dyestuffs with the progress made since August 1914 in the manufacture of coal tar colours in England. Some light is thrown on the latter subject by an attractive twenty-three page booklet issued by Messrs. Levinstein, Ltd. This brochure emphasises the importance of dyes for war purposes in the dyeing of military and naval uniforms, and calls attention to the employment of colouring matters in the production of "camouflage," a military use of tinctorial chemistry which was developed extensively in the later phases of the war. An historical summary of "Indigo through the Ages" introduces the subject of British synthetic indigo. This pigment was not manufactured completely in England before the war, but a factory, established at Ellesmere Port by a combination of several German firms, was utilised in the last stage of indigo production from German intermediates, a procedure adopted by these aliens in order to comply with the Patent Act of 1907. The factory was acquired by Messrs. Levinstein, who within three months had placed synthetic indigo successfully on the market. This enterprising firm, which has not limited itself to indigo, now produces several related vat dyes, including thioindigo, Durindone Red B and Durindone Blue 4B. The last of these, which is a dibromindigo, is of special interest, as being an isomeride of the famous Tyrian purple. Carbindole Blue R is a vat dye of the valuable hydrone blue series which is now prepared by Messrs. Levinstein. Other outstanding items in the rapidly increasing lists of this firm's productions are the drugs acriflavine and novocain and the important series of eosin dyes.

The magnitude of the task before the British dye industry will be appreciated by realising that the German capital invested in dyestuff production is £50,000,000, whereas the corresponding British capital is only £5,000,000. Our rejuvenated dye industry will therefore need careful nursing.

That Americans are very much alive to the corresponding facts in their own country is shown by their Dyestuff Tariff Act of September 8, 1916, and the proposed Bill to amend it. This Act, which protected the dye industry in the United States at the time and made home manufacture the criterion of future tariffs, has apparently accomplished its object in encouraging the investment of capital in the United States dye industry, but it now appears that there are several loopholes in the wording of the Act through which foreign competitors might succeed in evading the import taxes and might thus capture the trade. A draft Bill to remedy these defects in the Act has been issued by the United States Tariff Commission.

One possibility of evasion resides in the fact that many dyes could be imported as leuco bases under the title of intermediates, and could then be converted easily and cheaply into finished dyes by simple oxidation in one process. For instance, indigo could be imported in the unfinished form of indoxyl and converted into indigo simply by blowing air through the aqueous solution of the inter-

mediate. The Act could also to some extent be evaded by importing highly concentrated dyes instead of the usual commercial brands produced by diluting with salt, dextrin, &c., or a paste of the dye could be diluted further after importation. In the Act of 1916 certain dyes (anthracene and carbazole) were exempted from the specific 5 cent import duty. In the new Bill it is proposed to include these important vat dyes, as it is just in the manufacture of such colours that the United States is backward. This leeway will be made good now that anthracene, which was not available before the midsummer of 1917, and carbazole are being produced on a commercial scale. Another developing branch of manufacture which it is intended to protect is that of synthetic tannins, obtained by condensing phenol and formaldehyde by the agency of sulphuric acid. These substances, which were discovered about 1912 and are being manufactured in England, seem likely to become of great importance in the future, and may provide an outlet for the large quantities of synthetic phenol which should soon be on the market.

The foregoing summary of recent activities in dye production shows plainly that supremacy in this important branch of chemical industry will, as in the past, be gained by the nation or group of nations in which research is most closely co-ordinated with industrial requirements and developments.*

CHEMICAL INDUSTRY ON TYNESIDE.†

P. PHILLIPS BEDSON.

In taking for a second time the position of chairman, it is natural that my thoughts should turn to a like occasion when I addressed the members of this Section some 32 years ago. I recall that I then spoke of the benefits conferred by research, pursued for the advancement of knowledge for its own sake, upon industry and its contribution to the amenities of life. The past years have afforded innumerable examples, and the war has produced such an awakening to the importance of the spirit of science, that the clamour has penetrated even to the ears of those who had been accustomed only to listen for and attend the behests of the "division bell." As you are aware, research has received State recognition, and there exists a Government Department to organise research and to distribute funds to aid the carrying on of investigations, scientific and industrial. This is certainly all to the good, yet in the administration of the funds there lurks the danger that attention may be focussed on the apparently immediately useful, giving but scant encouragement to those investigations which have in view the object of advancing knowledge. Viewed from the standpoint of utility, what more unpromising subject than the investigation of the chemistry of the rare earths? Yet I was able in my address to this Section in 1886 to point to the promise of a great advance in the gas lighting industry, afforded by the facts which were enshrined in von Welsbach's researches on the rare earths, out of which has grown the gas mantle industry. The dimensions of this industry may be estimated from the fact that the world's consumption of gas mantles in 1912 amounted to about 222 millions, and that in the course of the development of this industry the price of "thoria" has been reduced by one half.

What again could be said at the time of their initiation and progress of the industrial utility of the investigation of the phenomena of dissociation, associated with the name of St. Claire Deville? Apparently of but purely theoretical import, they have led to conclusions of the greatest possible service to industries so diverse as the manufacture of oxygen from the air, the manufacture of iron and steel, and many others. Or again let me quote the words of Dr. Thomas Young, the physicist:—"No discovery however remote in its nature from the subject of daily observation, can with reason be declared wholly inapplicable to the benefit of mankind." What can be conceived as more remote from industry, than the fact that the weight of a litre of atmospheric nitrogen exceeds that of a litre from other sources by 6·7 milligrams? Yet the investigation of this difference has resulted in the discovery in the air of a new class of elements, distinguished by their chemical inactivity. Nay, more, this very inactivity of the chief of these has already, within twenty years of its discovery, found an industrial use in the manufacture of electric lamps.

In addressing a body of industrial chemists, there is no necessity for me to press the point, still I would ask you to impress on others the importance to the well-being of the nation, of having in its midst schools of chemistry, where those who possess the divine afflatus may unreservedly devote themselves to the exercise of their gift, and inoculate others with the desire to extend the bounds of knowledge, so that there may arise in this country an army of workers devoted to the pure science.

Turning next to a contrast of chemical industry on the Tyne and district between now and 1886, I will take first the alkali industry, which, to the ordinary mind, is *the* chemical industry of the Tyne. Whilst from the historical point of view much might be said for this position, still as you know there are few of our industries which cannot be designated chemical, or to the carrying on of which a knowledge of chemistry is not essential.

Already in 1886, the Leblanc process for the manufacture of alkali was throughout the country suffering from competition with the ammonia-soda process; and at that time the number of chemical works was ten, a considerable decline from the position in the early 70's, the steepness of which was moderated by two influences, one being the exploitation of the salt field of South Durham. The knowledge of the existence of this salt deposit was allowed to remain dormant for nearly 30 years. Each of the three most important Tyneside firms, viz., the Newcastle Chemical Co., Messrs. Tennant & Co. of Hebburn, and the Jarrow Chemical Co., took part in the enterprise, which resulted in making these firms independent of the supplies of salt from Cheshire. Another factor which has contributed to lengthening the lease of life of the Leblanc process on Tyneside was the installation at Gateshead of the "Chance" process for the recovery of sulphur. In 1890 was founded the United Alkali Co., upon which many and drastic changes followed, the sum total of these changes resulting in leaving practically two alkali works, proper, viz., Allhusen's at Gateshead and Tennant's at Hebburn. Under the *régime* of the United Alkali Co. these works have been carried on in close co-operation, producing a variety of products nearly related to the main articles of manufacture, such as hyposulphite, sulphide, sulphite, and silicate of sodium. These years have also seen the re-introduction to Tyneside of the Deacon process for the production of chlorine, which it would appear is capable of competing favourably with the Weldon process. We may note, by the way, that the war has brought again into prominence the use of

* References:—1. "Statistics of the Synthetic Dyestuffs imported into the United Kingdom during the year 1913." Board of Trade Report. 1918.

2. "Four Years' Work." An account of the progress of the Coal Tar Colour Industry in England during the war. Levinstein, Ltd.

3. "Dyes and Other Coal Tar Chemicals." Report to Congress, United States Tariff Commission. 1918.

† From the Chairman's address to the Newcastle Section on October 30, 1918.

bleaching powder as an antiseptic, *e.g.*, its employment as "Eusol" as a source of hypochlorous acid in the treatment of wounds. In this and in other ways have the antiseptic properties of chlorine and its compounds been rehabilitated. Although the operations of the Leblanc process have attained a completeness in the conversion of each of the components of salt into merchantable materials without the material waste which was associated with it in 1886, we are told that we are witnessing its death throes. Were we permitted at this stage to draw aside the veil, we should find evidence of the attempt to retain the alkali industry on Tyneside by the use of electricity in the first stages of the production of alkali and bleaching powder from salt. Whether the Tyne will retain the position which it has held since 1796, as a seat of the manufacture of alkali, with its disability as regards the salt, in competition with factories having an easy command of brine, remains to be seen. In other words, will the proximity of salt or of coal be the determining factor?

In passing, we may recall the fact that the manufacture of alkali in Great Britain had its origin at Walker, where Lord Dundonald and Mr. Losh commenced operations for the manufacture of soda from the brine spring at Walker Colliery.

Amongst the allied industries, which during the past 30 years have found a *locus* on the Tyne, is the manufacture of barium peroxide, the chief product of the Hedworth Barium Co., the introduction of which to the Tyne was largely due to the pioneer work of Mr. W. Rowell. The present processes of this interesting manufacture are very largely based upon the original investigations of Dr. Charles Rollin.

The cheapening of the cost of the manufacture of metallic sodium by the decomposition of caustic soda led to a revival of interest in the manufacture of aluminium, and in the '80's an attempt was made to establish this industry on Tyneside at Wallsend. Although short-lived, it exhibited many points of special interest, for Netto's process for the manufacture of sodium embodied a material simplification of Castner's method, and by using the mineral cryolite, as the source of aluminium, a very material simplification was possible, as compared with the Wöhler-Deville process, which involved the manufacture from a pure alumina of the double chloride of sodium and aluminium as a preliminary stage. Despite these advantages the operations were short-lived owing to the discovery of the more direct electrolytic process. We have not, however, completely lost touch with the manufacture of aluminium, for at Hebburn the extraction of alumina from bauxite by Baeyer's method is in operation, a process which affords an excellent illustration of the utility of a reversible reaction and an exemplification of the law of mass action.

The most prominent change which has taken place in the years under review has been the rise and development of the production of electricity, both by private and public enterprise. In this field Newcastle occupies the prominent position of a pioneer, as is befitting, when we recall the names of Swan, Parsons, and others who are identified by their achievements with the use and industrial production of electricity. We have seen the gradually increasing use of the facilities offered by the existence of these enterprises, and how they have contributed not alone to the amenities of life, but to growth and development in industries, chiefly as a mechanical aid. The employment of the thermal effects produced by electricity are seen in the manufacture of vitreosil, of which Dr. Bottomley has given the Section an account, and exhibited chemical appliances made by his ingenious devices (this J., 1917, 577).

My predecessor in this chair, in his opening address, gave us some remarkably interesting examples of the use of the chemical effects produced by the aid of the electric furnace. All who were present on that occasion will recall with interest not only the products of the electric furnace, but also the account which Mr. Pelle gave of how he had employed waste products of the coke oven to produce the electricity required. It will always appeal to me as an epic of the utilisation of waste. This naturally directs our thoughts to the changes which the last few years of the period I am contemplating has witnessed in the practice of coking, —changes which are responsible for the rise of a new chemical industry, pregnant with the possibility of further extension, and which owe so much of their development to the inspiration derived from the purely speculative conceptions enshrined in Kekulé's theory of the constitution of benzene. Time forbids more than a brief reference to the complete scientific utilisation of coal, but I may be permitted to express the regret that its advent into industrial practice has been so slow and long delayed. I have a vivid recollection that, about 1883, considerable interest was aroused locally in the attempt to adapt the recovery of by-products to the coking of coal in beehive coke ovens. But such interest was quite evanescent, and for some years methods of coking with recovery of by-products received but scant attention, for the reason advanced by the old coal philosopher, Stauf, "the enterprise did not pay." I do not think that we can accept Goethe's explanation of the non-success of Stauf's enterprise, who said that the object was not only to desulphurise the coal for the use in iron works, "but at the same time they wished to turn the oil and resin to account; nay, they would not lose the soot, and thus all failed together, on account of the many ends in view." Still Goethe's view influenced, sub-consciously, the views of many for upwards of a century, and with other prejudices retarded the use of those processes for the complete utilisation of coal, both as a source of material and of energy, which happily we see in operation to day.

In concluding this sketchy review of the progress of chemical industry on Tyneside during the past 30 years, I should not omit to mention the establishment in our locality of the manufacture of compressed gases, under the auspices of the British Oxygen Co., and also at the various rescue stations at which the liquefaction of air and the separation of its constituents are practised. Further one must chronicle the fact that for some few years sodium has been manufactured on Tyneside by the Castner-Kellner Co., and that latterly attempts have been made to work a process for the manufacture of zinc, an enterprise which does not appear to have been altogether successful.

NEWS FROM THE SECTIONS.

BRISTOL.

An ordinary meeting of the Bristol and South Wales Section was held at Bristol University on February 20, when Mr. T. H. Butler presided and Dr. H. W. Bywaters gave a lecture on "Cocoa and Chocolate." Cocoa was known in Mexico some 3000—4000 years ago, and was introduced into Spain about 1520. So well did the Spaniards guard their secret that 100 years elapsed before the knowledge of it was introduced into England. It came to Bristol in the 18th century. Attention was drawn to the cultivation on the Gold Coast, which has been greatly developed in recent years, three-quarters of the cocoa used in this country emanating from that source. The lecturer also described the cocoa tree, the nature of the bean, and the various processes of manufacture.

LONDON.

At the meeting held on March 3, under the chairmanship of Dr. Charles A. Keane, the adjourned discussion on "Refractometry and its Applications in Technical Analysis" was opened by Mr. A. R. Ling. After referring to the importance of minute and rapid physical measurements in modern scientific control, the speaker suggested that discussions similar to the present might profitably be started on other instruments such as the microscope and the polarimeter. The refractometer is probably the most rapid in its application of all physical instruments, and in the sugar industry has been specially employed to determine the total solids in commercial sugars, worts, etc. As mineral and nitrogenous matters raise the specific gravity of solutions more than sugar, the results by the refractometer are more accurate than those by the older specific gravity method. In taking the refractive index of such solutions, however, difficulty is often experienced owing to their dark colour, and the obvious method of reducing this by dilution with water is open to the objection that a dense solution, like molasses, when diluted undergoes a marked contraction. This has been overcome by diluting with a solution of pure sugar instead of water. Mr. Ling also referred to Tornöe's refractometer, designed to extend the use of this instrument to the determination of the "original gravity" of beers. He also suggested that English makers would do well to consider the possibility of putting on the market an interference refractometer working on the lines of that used by Lord Rayleigh. Dr. Lowry emphasised the importance of temperature control and the wave-length of the light employed in refractometry. The temperature jacket in the Pulfrich instrument, for example, is very imperfect and he had found that a difference of 10° C. made a difference of 1° in the reading. In place of the ordinary sodium light, he considers that the green mercury line with a wave-length of 5461 would be preferable; a cadmium lamp would of course be good, but at present requires so much skill and experience in its use. Other applications of the refractometer were discussed by various speakers, for instance its use in following the hydrogenation of oils, and the examination of "blown oils" in which the iodine number decreases as the refractive index increases. Again, in the examination of protein substances the amount of protein is a linear function of the refractive index and is independent of electrolytes present. Mr. E. T. Brewis called attention to the value of refractometry in detecting adulteration in essential oils, and expressed the opinion that a temperature of 20° C. would be a convenient standard to adopt. This question of the temperature at which readings should be taken was followed up by Mr. S. G. Thomas, who suggested that a committee might be formed to investigate the general question of standardising the conditions under which physical measurements should be determined. Prof. J. C. Philip drew attention to the fact that the refractive index of the prism must be borne in mind. Mr. Browning pointed out that essential oils have to be examined in tropical countries where a temperature of 20° C. would not be easy to adopt. He also referred to one form of refractometer to which very little attention had been given in the discussion, namely, the Oleo-refractometer, one useful feature of which is that the readings of vegetable oils are to the right of the scale and those of animal oils to the left.

The meeting was favoured with the presence of Mr. S. R. Church, a member of the Committee of the New York Section, who in the course of an interesting speech expressed the feeling of respect and appreciation with which the Society is held in the United States.

Mr. F. Esling described some work on "The Setting Time of Portland Cement," which showed that the setting time of a medium cement is influenced to a considerable extent by the nature of the solids contained dissolved in the water.

Mr. Yeoman described very briefly the work he had carried out in conjunction with Dr. G. H. J. Colman on the determination of benzol, toluene, etc., in coal tar. The paper will appear shortly in the Transactions.

NOTTINGHAM.

The members of this Section assembled on February 26 to nominate officers for election and to hear two papers. The first, by Messrs. J. M. Wilkie and J. H. Rice, described a simple and efficient electrolytic Gutzeit apparatus for the determination of arsenic. The parchment diaphragm used to separate kathode and anode, as *e.g.* in the apparatus of Sand and Blackford, has a number of disadvantages, including liability to rupture, so for this the authors substitute a porous pot surrounded by a cylindrical lead anode cut from a piece of two-inch lead pipe. The porous pot is closed gas-tight by a rubber bung through which are inserted the kathode, a rod of lead with enlarged end, and a glass tube of 5 mm. diameter packed with lead acetate wool and fitted at the upper end with the spring-clip device holding a piece of mercuric chloride paper (see this J., 1916, 672). Electrical connexions are made by lead studs fitting into holes in the electrode lugs, thus avoiding all danger of contamination with copper and brass. The electrolyte is 10 per cent. sulphuric acid and the current 4 ampères at 5 to 6 volts. With solutions containing arsenic as arsenite, and free from organic matter, the production of a quantitative stain is complete in about ten minutes. With arsenate the deposition was found to be very incomplete in the same time. Previous and possible methods for the conversion of arsenic present in organic matter into a form suitable for estimation were tested and criticised. In the method finally adopted, the sample mixed with magnesia is ignited in a vitreous silica beaker (fusible alkali being carefully excluded), the ash is dissolved in sulphuric and hydrochloric acids, reduced by the addition of sodium metabisulphite and the excess of sulphur dioxide boiled off. No arsenic is lost if the amount of hydrochloric acid is kept below a certain limit. The solution, thus prepared, introduced into the kathode compartment of the above cell, also gives quantitative results. The Chairman, Mr. F. H. Carr, then called upon Major S. R. Trotman, recently returned from a long absence on military duties, to open the discussion. Major Trotman spoke of the difficulties and uncertainties of the Marsh test, alluded to the necessity of testing parchment membranes for arsenic, and expressed his intention of adopting the authors' method, which possessed the great merit of not requiring the constant attention of a skilled manipulator.

The second paper was a preliminary note on a new method for the determination of sodium thiosulphate and compounds of other sulphur acids by Messrs. J. M. Wilkie, E. H. England and T. W. Thornhill. The analytical determination of these acids has chiefly attracted interest in connexion with the Feld process of purifying coal gas, and the analysis of the lime sulphur washes used in agriculture: it was originally applied by Wilkie to the determination of sulphur and sulphides in a paper read before this Section in 1916. The method depends on the oxidation of sulphur by means of bromine, the acidimetric determination of the sulphuric and hydrobromic acids, and the

iodine absorbed by the original sulphur compounds. These data also give information as to the proportions of two or even more sulphur compounds present in solution together. Different compounds will show different values of the characteristic ratio, total acidity developed to iodine absorbed. The experimentally determined ratios agree very closely with the calculated values.

MEETINGS OF OTHER SOCIETIES.

THE CERAMIC SOCIETY.

In a paper read on February 13 at Stoke-on-Trent, on "Recent Work on the Bone China Body," Dr. J. W. Mellor described and offered explanations of the phenomena observed on firing the bone china body. This material, which is made from quartz, felspar, clay (introduced in the form of "Cornish stone"), together with bone-ash and china clay, undergoes very great contraction on firing, but above the finishing temperature there is a marked tendency towards expansion. This peculiar result is due to the development of small cavities in the interior of the over-fired ware, evidently caused by the development of gas. The gas bubbles developed in the body of bone china during the firing of the oven mark the start of the same reaction as that which takes place in the manufacture of phosphorus from charcoal, bone-ash, and quartz, the reducing atmosphere in the former taking the place of the charcoal in the latter. The iron content (1·0—1·5 per cent.) of the bone china body is one of the first constituents to be attacked by the liberated phosphorus to form iron phosphate. Indications of the formation of greenish blue, blue, and brown colours, similar to those shown by the mineral vivianite, are to be seen in the bone china body by holding it in front of a strong light, and these changes are attributed to the presence of iron phosphate. Blue china can be made quite readily by enclosing some charcoal or organic matter in the saggar with the china while it is being fired, or by using bone containing a little carbonaceous matter. This explanation does not altogether agree with the facts that the bone used for the very best china is sometimes rather above the average in carbon, and that blue china can easily be obtained with bone-ash practically free from carbon and fired throughout under highly oxidising conditions. Much seems to depend on the state of the carbon, one form of which burns out readily and another does not. The particular form present is believed by the author to depend upon the method of calcining the bone, the slow-burning harmful form being produced when the bone is heated rapidly to a high temperature.

The effect of composition on colour of china was shown by means of special triangular diagrams, which explained some of the anomalies previously alluded to. There is a much greater margin of safety in varying the proportion of bone-ash than that of either stone or clay. The tendency to produce the blue or brown china increases as the proportion of stone diminishes and as the proportion of clay increases; in other words a high proportion of alkalis hinders the formation of iron phosphate. Slight changes in the character of the stone or clay used may give to an otherwise perfect body a tendency to form blue china or to blister, etc. Similar considerations apply to subsequent firings to fix the glaze, or to over-glaze decoration. The change from white to blue and brown china may even result from prolonged exposure to the action of ordinary air, and such discoloration sometimes occurs by exposure of china in a shop window.

From the fact that the phosphate decomposes as the proportion of stone increases, it appears as if the stone favours the decomposition of the bone-ash. The author believes there are two distinct actions. The alkalis first start to vitrify the body, but at the higher temperature the free silica (quartz) in stone acts as an acid and decomposes the phosphate.

SOCIETY OF GLASS TECHNOLOGY.

The February meeting was held at the University, Sheffield, on the 19th, Mr. J. Connolly occupying the chair.

The first paper, entitled "The Properties of the Lime Soda Glasses, 2.—The Resistance to Water and other Reagents," by J. D. Cauwood, Constance Muirhead, and W. E. S. Turner, was read by the last-named. Several glasses had been melted on a small scale, and the lime content had been increased by definite amounts. The resistance of each glass to water, caustic soda solution, sodium carbonate solution, and hydrochloric acid, was tested, and in every case it was found that increasing the lime content brought about increasing resistance. In the second paper, "The Properties of the Lime Soda Glasses, 3.—The Thermal Expansions," by S. English and W. E. S. Turner, the same series of glasses mentioned above (*i.e.* with lime content increasing up to 10 per cent.) was tested in regard to thermal expansion, and it was proved that the expansion decreased as the lime content increased.

Prof. P. H. Boswell then addressed the Society on "Impressions of the Glass Industry of the United States gathered on a Recent Visit." Dealing with the supplies of raw materials in the States, Prof. Boswell stated that six sands were in general use, one of them—a beautiful sand from Rockwood, Detroit—was used exclusively for optical glass. The American "sands" are not found as such, but in the form of fairly soft sandstone. This is blasted, and washed by water under pressure into the bottom of the pit, whence it is dredged up to the top of the pit. It is emptied into concrete bins, and works down through steam pipes until it emerges as dry, clean-running sand. The diameter of the steam pipes constituting the top layer is 3 in., that of the bottom pipes 1 in., and there is about 1 in. clearance between the pipes. The sand is then loaded into covered wagons, each of which contain 50 to 80 tons of sand. The cost of labour in the sand pits is greater than that in this country, the workmen being paid about 1*s.* 6*d.* per hour, and yet the price of sand is less than that of English sand. The washed, dried sand, which on the whole was superior to English sand, varied in price from 5*s.* to 9*s.* per ton at the pits. The cost of transportation also was less than in this country, the highest rate being about 5*s.* per ton. The fact that American sandstone firms can put their sand on the market so cheaply is due to the immense output. One firm alone quarries nearly half a million tons per year. It is calculated that the overhead charges for 200,000 tons are not much greater than for 50,000 tons. The quarrymen work about 9 hours per day, but contract to keep the bins full, and thus work considerable overtime to make up for loss of output due to bad weather. Prof. Boswell afterwards dealt briefly with American supplies of potash and felspar, and then passed on to the question of refractories. He showed a specimen of a glasshouse pot, developed by Dr. Bleininger, which after the melt had been performed was perfectly white in colour and very close in texture. In making their pots the Americans were substituting kaolin from Georgia for Cornish kaolin, and were using ball clays from Tennessee and Kentucky in place of those from Devon and Cornwall. Considerable advances have been made in slip casting pots. One firm, which formerly built pots in the English fashion, now uses

raw fireclay and grog. Tank blocks were also being made very successfully, and considerable research has been carried out on "humidity drying." Silica bricks are manufactured on a considerable scale in the States, the methods employed being much the same as in the United Kingdom, except that the bricks are burnt for a much longer period. Dr. Boswell then dealt briefly with the various types of glass manufactured in the States, and laid special emphasis upon the number of labour saving devices in use, which resulted in a huge output.

SOCIETY OF PUBLIC ANALYSTS.

At the meeting held on March 5, Dr. S. Rideal presiding, the following papers were presented:—(1) "Approximate Method of Analysis of Sausages and Meat Pastes," by G. Stubbs and A. More; (2) "Analysis of Sausages, Meat Pastes and Army Rations," by A. W. Stokes; and (3) "Method for the Determination of Small Quantities of Acetone, Alcohol and Benzene in the Air," by Major S. Elliott and Capt. J. Dalton.

(1) The determination of moisture, fat, proteins and ash is carried out in the usual manner, and the proportion of carbohydrates taken by difference. The estimation of lean meat is based on the absence of carbohydrates in meat and the amount of proteins in the cereal products used as fillers.

(2) The Food Control authorities limited the percentage of meat which might be contained in sausages to be sold at a given price, but did not limit the quantities of bread, water and fat. The desirability of limiting the quantities of water, bread and fat was shown by a particular sample which contained about equal parts of added water, bread, fat and meat. Since meat contains 70 per cent. of water and bread 40 per cent., no added water should be allowed. In the United States the use of bread in sausages is prohibited and, as the bread is often soaked in water before use thereby increasing the percentage in the finished product, the author pointed out that this prohibition might with advantage be enforced in England.

(3) A measured quantity of the air is drawn through suitable apparatus, the vapours being absorbed simultaneously as follows:—The acetone in alkaline iodine solution and the excess of iodine titrated with thiosulphate. The alcohol in dilute chromic acid, and after oxidation to acetic acid, the excess of chromic acid is titrated with iodine. The benzene in a mixture of concentrated sulphuric acid and fuming nitric acid, converted into dinitrobenzene, and after extraction with ether, reduced by a known excess of stannous chloride and the excess of the last reagent titrated with iodine.

THE INSTITUTE OF CHEMISTRY.

At the 41st annual general meeting, held on March 3, Sir Herbert Jackson, the President, referred to the work of the Institute during the war. The record afforded an example of the value to the country of organised professional bodies in times of crisis. The Report contained a concise statement indicating the various directions in which chemists had rendered good service both with the Forces and in industries connected with the war. The Institute is now co-operating with the Appointments Department of the Ministry of Labour in the resettlement in civil life of those who have been so engaged, and it is hoped that with the return of more normal conditions chemists will be utilised to the fullest benefit of the industries of the country. The President, in referring to the losses sustained by the profession, mentioned especially Lieut.-Colonel E. F. Harrison, who will always be remembered for his exceptional work in the provision of means of defence against poisonous gas attacks, to which work he undoubtedly sacrificed his life.

The Institute has before it a period of reconstruction and will endeavour to bring together in one body the trained and competent chemists both for their own benefit and for that of the community. The Regulations had been modified on such a broad basis that it was hoped all qualified chemists would be able to take part in promoting the welfare of their profession. The Council hoped in the near future to arrange a conference to review the subject of the training of chemists. Local Sections are being formed in various parts of the country and the method of the election of the Council will be amended to ensure that its constitution is properly representative of all districts and all branches of professional work.

Sir Herbert Jackson was re-elected President; Prof. G. T. Morgan and Mr. G. Stubbs were elected Vice-Presidents; and the following were elected new Members of Council: Prof. A. Findlay, Drs. A. C. Cumming and E. W. Smith, and Messrs. W. Bacon, F. H. Carr, G. W. Gray, F. W. Harbord, A. More and B. D. Porritt.

PERSONALIA.

Lord Moulton has accepted the position of chairman of the British Dyestuffs Corporation, Ltd.

Sir J. J. Thomson has resigned his post of Cavendish Professor of Physics at Cambridge University after 35 years' service.

Mr. J. Kewley has been appointed chief chemist to the Asiatic Petroleum Company, Ltd.

Among the fifteen candidates selected by the Council of the Royal Society to be recommended for election to the Society are:—Dr. G. Barger, Dr. J. W. Evans, Prof. B. D. Steele, Mr. G. I. Taylor and Prof. T. B. Wood.

The death is announced of Prof. G. Carey Foster, professor of physics at University College, London, from 1865 to 1898, and first president of the Physical Society of London.

Sir Oliver Lodge, Principal of the University of Birmingham, announced at a recent meeting of the Governors that it was his intention to retire from that position within the next few months.

Sir Lazarus Fletcher has retired from his post of Director of the Natural History Museum, having reached the usual age limit. Prior to his appointment in 1909, he had been Keeper of Minerals for 29 years.

Dr. A. Rée, representing the Association of British Chemical Manufacturers, is one of the delegates of the Federation of British Industries now on a visit to Paris to confer, under governmental auspices, with representatives of France concerning industrial reconstruction in that country, and the promotion of co-operation between British and French manufacturers.

The Edinburgh University Court has appointed Dr. G. Barger to the chair of chemistry in relation to medicine. Dr. Barger was formerly professor of chemistry at the Royal Holloway College, University of London, and prior to that head of the chemical department at the Goldsmiths' College, New Cross, S.E.: he has lately been serving as research chemist to the Medical Research Committee, National Health Insurance.

NEWS AND NOTES.

CANADA.

New Chemical Industries. — Brunner, Mond (Canada), Ltd., has now completed its plant for the production of soda ash at Amherstburg, Ontario. This firm will be the first to produce soda ash in the Dominions. The normal imports amount to 50,000 tons, and many industries were greatly handicapped for lack of supplies during the war period. The company is self-containing, generating its own power, and obtaining salt and limestone practically on its own property.

The Chemical Commonwealth Corporation of Walkerville, Ont., is now manufacturing benzoic acid, benzoate of soda, benzaldehyde and coumarin, and will probably produce vanillin in the near future. It is a large undertaking and is producing for export trade to all parts of the British Empire.

Canadian Water Power.—A very recent census gives the developed water power of the Dominion as 2,305,310 horse power, of which 1,727,471 h.p. is generated at central electric stations. About 450,000 h.p. goes to the pulp and paper companies. Norway and Sweden are the only countries where the *per capita* utilisation of water power exceeds that of Canada. All information regarding Canadian water power developments may be obtained from the Water Power Branch of the Dominion Government, Ottawa.

Nickel Export in 1918.—According to figures supplied by the Dominion Bureau of Statistics, the value of the nickel exported from Canada increased from $8,631,851 in 1916 to $10,707,743 in 1918.

Gold Refining.—Since the outbreak of war gold and bullion to the value of $1,300,000,000 have been received at Ottawa by the Dominion Department of Finance, acting as trustee for the British Government and the Bank of England. The heavy demand on the gold refinery at the Mint has necessitated the construction of a second plant with a monthly output of 1,000,000 oz. of fine gold. As a result of this extension the Canadian Mint has now the largest capacity of any gold refinery in the world.

Steel Industry in British Columbia.—The British Columbia Advisory Committee for Scientific and Industrial Research has reported to the Research Council at Ottawa the preliminary results of an investigation into the possibilities of developing an iron and steel industry on the Pacific coast, the conclusion reached being that, while there is room for one large plant, provided it is assured of the whole Pacific coast market, there is not a sufficient quantity of iron ore in prospect to warrant the establishment of more than one. (See also this J., 1919, 63 R.)

Canadian Chemists.—It is expected that the Second Annual Convention of Canadian chemists will be held in May at Montreal in connexion with the annual meeting of the Society of Chemical Industry. A committee has prepared plans for the organisation of Canadian chemists and will present them to the convention. There is a feeling that closer organisation among chemists is necessary, and it is quite probable that a successful effort will be made to unite the various chemical organisations at present operating throughout the Dominion. This has been the best season ever experienced by the Society of Chemical Industry in Canada. Business men have joined with chemists in discussing industrial affairs, and the Honorary Advisory Council for Scientific and Industrial Research has succeeded in stimulating a general interest in science and chemistry. A further step by the Research Council towards facilitating the application of science to industry, has been the appointment of a committee to devise ways and means of aiding scientific journals in Canada, and of securing the publication and circulation of scientific papers.

Constructional Work of the Canadian Steel Corporation.—Constructional work on a very large scale has been carried out by this company even during the period of the war. A complete steel plant is being erected at Ojibway, Ont. Docks, coke ovens, blast furnaces, complete milling machinery and a new town based on a population of 20,000 are items on the programme of construction. The available steel business in Canada is shown by the imports for 1917. During that year Canada imported United States steel to the value of $119,754,365, which was about 95 per cent. of the total imported. There is ample room for the operations of such a company.

BRITISH INDIA.

Olibanum.—The Indian Forest Research Institute has investigated the possibility of preparing turpentine, resin and gum from *Boswellia serrata*, a tree which grows abundantly in the Khandesh district and which is widely distributed throughout the whole country. The yield of gum-oleoresin obtained from the tree varies with its age and with the methods of tapping employed. Trees having a girth of over 30 in. yield 1½—2¼ lb. during the season (December—June), and the cost of production is estimated to be 1*d.*—1½*d.* per lb., but much less than this in certain districts. An average sample of the gum yields 8—9% oil, 55—57% resin, and 20—23% gum. A technical separation of the three constituents was undertaken by the Department, which found that the products obtained could be marketed successfully, and that their manufacture might initiate an important industry. The oil consists mainly of *d*-pinene mixed with *β*-pinene; it closely resembles the superior American or French turpentine, and could be successfully employed as a substitute for oil of turpentine. It has a rapid drying power and will probably be found to compete successfully with the American oil. It gives a slightly dull varnish, but is superior to the American oils in accelerating drying. The resin could be used as a substitute for colophany and is well suited for varnishes. The gum is a little inferior to the ordinary gums but extensive trials in the textile mills have shown that it is suitable for use in sizing and finishing. In the process of separation, extraction of the resin with petroleum spirit was found to be best, although the use of trichlorethylene is also recommended. Distillation with steam followed by extraction gave better results than the reverse process. The separated products were submitted to manufacturers in Great Britain and India who pronounced very favourably upon them.

UNITED STATES.

Rotary Limekilns at Muscle Shoals.—At the Government Nitrate Plant at Muscle Shoals, Alabama (designed and constructed to produce 110,000 tons per annum of ammonium nitrate), the seven limekilns employed are of the continuous rotary type, and made of steel lined with fire brick. They measure 125 ft. long by 8 ft. diameter, are nearly horizontal, the pitch being 1 in 25, and are rotated at the rate of ½ revolution per minute by means of a bevelled gear. The limestone is fed in at the upper end, and at the lower end the kilns are fired with powdered coal by an air blast. The temperature attained is 700°—1095° C., and the conversion is complete in 3—4 hours. The capacity of each kiln is about 200 tons per day of raw lime-

stone; when the plant is in full working order the combined capacity of the seven kilns will be 1400–1600 tons.

Potash from Alsace.—The War Trade Board announces that it has received official information from the French High Commission in the United States to the effect that for the next few months practically the entire potash output of the Alsatian mines will be urgently required for agricultural purposes in France. It is the view of the War Trade Board, based upon this information, that even under the most favourable circumstances, no potash from Alsace could be available in the United States for agricultural uses before June, 1919, and that therefore it will be necessary for the United States to rely entirely upon its domestic production for the coming spring season.

GENERAL.

British Scientific Products Exhibition, 1919.—The King has graciously consented to act as Patron of the British Scientific Products Exhibition, 1919, which will be held at The Central Hall, Westminster, during the month of July. The President of the Exhibition is the Marquess of Crewe and Prof. R. A. Gregory is Chairman of the Organising Committee. The British Science Guild has been encouraged to organise this exhibition by the success which attended those held in London and Manchester last year. Now that many inventions can be shown which could not be put before the public during the war, there is every prospect that this year's exhibition will be even more successful than its predecessors. The objects of the exhibition will be to illustrate recent progress in British science and invention and to help the establishment and development of new British industries. Such an exhibition will enable new appliances and devices to be displayed before a large public and will provide manufacturers with an opportunity of examining inventions likely to be of service to them, thus serving as a kind of clearing house for inventors and manufacturers, as well as illustrating developments in science and industry. The exhibition will include sections dealing with chemistry, metallurgy, physics, agriculture and foods, mechanical and electrical engineering, education, paper, illustration and typography, medicine and surgery, fuels, aircraft and textiles. Firms desirous of exhibiting are invited to communicate with the Organising Secretary, Mr. F. S. Spiers, 82, Victoria Street, London, S.W. 1.

Industrial Research.—The Department of Scientific and Industrial Research has issued a revised description of its scheme for encouraging such research. The document lays stress on the policy of the Department to secure the utmost possible autonomy to the industries which form research associations, and includes the following paragraph on "ownership of the results of investigations":—"The whole of the results of researches conducted by any research association will belong to the association itself, which will hold them in trust for the benefit of its members. The Government is, however, specially bound to safeguard the national interests where new discoveries are made with the assistance of Parliamentary funds, and accordingly, besides the powers it already possesses under the Patents and Designs Act, 1907, it will keep in its own hands two additional powers, which may be said to limit the absolute ownership otherwise reserved to the association—the right of veto in case any proposal is made by a research association to communicate any results of research to a foreign person or to a foreign corporation, and the right, after consultation with the association concerned, of communicating the results of discoveries to other industries for their use on suitable terms. The Department will not, however, make any results obtained by a research association available to firms or individuals who are eligible for membership of that association but have not joined it."

National Benzol Association.—This new association was officially inaugurated at a luncheon held in London on February 26. Mr. D. Milne Watson, who presided, announced that the Association will undertake the distribution of benzol independently of the organisation administered by the petrol companies. The total petrol requirements of England, Scotland and Wales are estimated at 200 million gallons per annum; the output of benzol is about 32 million gallons, but it is thought that this total might be increased to 40 millions if the gas companies were given the necessary powers. The Government does not propose to put the Excise tax on benzol.

The objects of the Association include the marketing of a standardised motor spirit, and the stabilising of market conditions so as to encourage the production of benzol at coke-ovens, gas works and tar distilleries. The coke-ovens produce about two-thirds of the present output of benzol and as they are mostly concentrated in the colliery districts, the question of transport and distribution presents difficulties. This consideration also applies to the benzol produced at gas works, and in this case the question is further complicated by the fact that some 90 per cent. of the gas works produce the material in the crude form, which has then to be sent to the comparatively few centres where rectification is carried out. The increased charges due to handling and the special railway rates could be obviated by the erection of rectifying plant at all the works, and a simple installation designed for treating 50 gallons per day is already on the market.

Scientific Management in Industry.—An outstanding feature of the Industrial Conference held under Government auspices on February 27 is the demand of labour for shorter hours and higher wages. Lord Leverhulme and other broad-minded employers believe that this can be done without lessening output. Appeals are made to the working man to abandon the "ca' canny" attitude and other means of restricting output, and it is pointed out that the average output per man in America is three times that of a man in England working under similar conditions. This is one side of the question; the other is the effect on efficiency of scientific management. America and other countries have led the way in this respect and the astonishing results obtained by English firms who have adopted these methods should be more widely known. It is a mistake to suppose that it is applicable only to engineering trades; it would be difficult to find any industry the efficiency of which would not be improved by adopting scientific management. The Industrial Reconstruction Council, 2 and 4, Tudor Street, has taken up the matter, and at a public meeting held on February 28, elected a sub-committee to arrange a series of fortnightly conferences which would deal with this subject in all its bearings. Further particulars may be obtained from the Organising Secretary, I.R.C., 2 and 4, Tudor Street, E.C. 4.

Coal in Ireland.—The Government has granted the sum of £15,000 towards the cost of experimental borings in the vicinity of Lough Neagh (Co. Tyrone), under which coal is supposed to lie. The experimental borings are being carried out under the advice of experts from the English coalfields, and are being supervised by Sir Lionel Phillips.—*(Iron and Coal Tr. Rev., Feb. 21, 1919.)*

Waste in Coal Mining in Germany.—It is estimated that of the 190 million tons of coal mined in Germany in 1913, 140 million tons passed through the classifying plant and sustained a loss of 8 per cent. in that treatment. In addition, the getting of the coal involved the waste of 14 million tons, 10½ million tons was left behind in the form of unworkable seams, and 8½ million tons as safety pillars. The total of these losses therefore amounted to nearly 24 per cent. of the production. The remedies suggested include less exacting requirements of consumers in respect of ash-content and size, and the gasification of inferior coal at or near the pit's mouth for generating power, light and heat for local consumption.—(*Technik u. Wirtschaft, Dec.*, 1918.)

Use of Pulverised Coal in Blast-furnaces.—Determined and organised efforts are about to be made to introduce the practice of burning pulverised coal in blast-furnaces. A company formed in New York to carry this intention into effect has acquired the necessary patents, and has made arrangements for the use of the same at the blast-furnace plant of the Tennessee Copper Co., and at the smelting works of the International Nickel Co. of Canada. Already a large amount of experimental and development work has been done, with encouraging results.—(*Eng. and Min. J., Dec.* 28, 1918.)

Coal Supply in Switzerland.—In consequence of lack of transport and the occupation of the Saar basin, Germany has had to cease exporting coal to Switzerland. The latter country is now negotiating for supplies with France; meanwhile 1200 tons of coal from the Saar collieries is being delivered at a lower price than that formerly paid to Germany.—(*Z. angew. Chem., Jan.* 24, 1919.)

Aluminium from Labradorite.—A Norwegian company, styled the "A.-S. Labrador," was formed in November last with a capital of 2 million kroner for the purpose of producing aluminium oxide and nitrolim by the treatment of labradorite with nitric acid. This mineral occurs abundantly in Norway, in many places in close proximity to undeveloped water power, and hopes are entertained that Norway will become an important producer of aluminium.—(*Farmand, Dec.* 21, 1918.)

Mineral Wealth of Morocco.—The potentialities of Morocco in regard to the supply of raw materials for the chemical and related industries are still comparatively unknown; nevertheless some information is available concerning deposits of manganese ore, iron ores, petroleum and bituminous shale. During the war the manganese deposits have played an important part in the French metallurgical industry, which requires some 10,000 metric tons of ore per annum. France is practically depleted of her native ores; supplies from the Caucasus are shut off, the United States practically monopolises the Brazilian supply, and India is too far off. The phosphate deposits are capable of great development. At the present time the boundaries of the phosphate region are being determined prior to the construction of a railway to connect them with the chief agricultural districts. Indications of petroleum are plentiful in North Morocco, notably in Gharb, on the shores of the Sebu and Uergha, in the valley of the Innau and in the Tasa district. Bituminous shale is found at various places in Gharb, near Meknes, Fez and Tasa. Other mineral deposits include salt, gypsum and slate.—(*Le Matin, Dec.* 5, 1918.)

Electrolytic Iron.—In the process of manufacture, electrolytic iron occludes hydrogen, which renders it hard and tends to make it brittle. The occluded gas is easily removed in the annealing process, the whole of it being expelled at 1000° C. The metal can then be cut with a knife, and is superior to the best Swedish iron. The practical difficulties involved in annealing large masses are being overcome.—(*Giesserei-Z., Nov.* 1, 1919.)

Iron Ore in China.—Although the Shansi iron industry is claimed to be the oldest in the world, the deposits of iron throughout China have, in general, been very little developed. Dr. H. Foster Bain, Assistant Director of the U.S. Bureau of Mines, estimates that China possesses 300,000,000 tons of ore available for treatment by native methods and an additional 400,000,000 tons which could be smelted by modern furnaces. The iron ore deposits are now controlled by Chinese and Japanese interests. The production of pig iron in 1918 may be estimated at 500,000 tons, half of which was made in Shansi.—(*U.S. Com. Rep., Nov.* 27, 1918.)

Copper and Gold in China.—China appears to be poor in copper ore, Yunnan, which is the chief source of supply, producing less than is necessary for the coinage of the country. South-eastern Manchuria is mining copper, and a Japanese company has erected a copper smelter at Autung. The gold produced in 1915 amounted to 200,000 oz., 120,000 oz. coming from Manchuria and 60,000 from Outer Mongolia. The alluvium worked in Manchuria contains on the average 1·07 dwt. of gold per ton, but quartz veins are not considered workable if the gold content is below six dwt. per ton.—(*U.S. Com. Rep., Nov.* 27, 1918.)

Nitrate Production in Germany.—The nitrogen industry is suffering from the steadily diminishing supplies of coal. Some of the factories have ceased production. The total output to date is only about one-half of the pre-war normal demand (1914: 200,000 tons for agriculture, and 40,000 tons for industry), and in consequence prices will soon be increased. The present capacity of all factories is 300,000 tons, and the projected increase to 500,000 tons has been in complete abeyance since the outbreak of the Revolution.—(*Z. angew. Chem., Jan.* 31, 1919.)

Industrial Substitutes in Germany.—Since April, 1915, no cotton has been used in the manufacture of smokeless powder in Germany, its place being taken by cellulose obtained from German woods. Camphor, which up to seven years ago was imported from Japan, was then replaced by a product made synthetically from American oil of turpentine, but when the importation of this oil was stopped, the whole of the camphor required for explosive purposes was prepared from German materials. It is claimed that the new synthetic product is cheaper and better than that derived from oil of turpentine. A substitute for manganese in steel was discovered in February, 1916, and has been used ever since. New works for the production of the ferro-manganese substitute are also in course of erection. The introduction of nettle fibres as a substitute for cotton in textile fabrics has given excellent results, especially when they are spun with a small proportion of cotton waste. Nettle leaves have been used both as a feeding stuff for cattle and as a raw material for paper.—(*Weltwirtschaft Z., Nov.* 22, 1918.)

Petrol Substitute in Greece.—Owing to the shortage of petrol in Greece consequent on the Allied blockade in 1916, a new petrol substitute, "Motorine," was put on the market. It was composed of 80—90 per cent. of very pure turpentine, distilled from resin from the pine forests of Greece, and 10—20 per cent. of ether, which was also produced from native sources. The fuel was expensive and deposited a comparatively large amount of carbon in the cylinders, but this was easily removed.—(*U.S. Com. Rep., Nov.* 20, 1918.)

Prospects of the Swedish Chemical Industry.—The chemical industry of Sweden has rendered that country much service during the war. For example, the manufacture of carbide and of new explosives has been extended. Nitrogen manufacturers may expect strong competition from Germany, but having constructed their plant at peace prices should be able to meet this competition. The match trade has suffered from shortage of materials, and has lost part of its Eastern market to Japan, but it is hoped that the superiority of the Swedish match will again reinstate it in this market. Further, developments await the resumed import of raw materials, which is dependent on the amount of tonnage available and the conditions of exchange.—(*U.S. Com. Rep., Dec.* 27, 1918.)

Claims of Employees in German Technical Industries.—The Hamburg section of the Association of Employees in Technical Industries has sent a circular to the different political parties to ascertain their attitude towards the fundamental demands of the Association. These demands include:—A legalised 8-hour working day, Summer holidays, and no Sunday work. Amelioration of the system of giving characters; the duty will be laid on the employer of stating exactly the special qualifications of the employee. Legal guarantee of the personal right of the employee to any inventions he may have discovered and to a share in any profits derivable from the same. Appropriate representation of technical employees in the Chambers of Labour, National Labour Office, and the central offices of the separate States. Penalties for employers who injure employees by confidential communications (black lists). The decision in all technical matters shall rest exclusively with professional experts; similarly all teachers of technical subjects in private and public schools must have had a technical training.—(*Hamburg. Correspond., Jan.* 19, 1919.)

Barytes and Barium Products in the U.S.A.—The domestic output of crude barytes in the United States in 1917 was 18,808 short tons, valued at £234,000, a decrease of 7 per cent. in quantity and an increase of 16 per cent., or 4*s.* 7*d.* per ton, value over 1916. The chief production was from Georgia, Missouri and Tennessee. The crude barytes is principally used by manufacturers of ground barytes, lithopone and barium chemicals, in the industrial districts east of the Mississippi, north of the Ohio, in St. Louis, Mo., West Virginia, Tennessee, and Georgia. The imports of crude barytes are negligible. The expansion of the American trade in barium chemicals and lithopone in 1917 was very considerable, an increase of 5200 tons, or 30 per cent., being recorded. The sale of ground barytes decreased from 59,400 to 44,000 tons. The barium compounds imported into the United States in 1917 were chiefly lithopone with some precipitated barium carbonate, ground barytes and blanc fixe, valued at only £10,000, a decrease of 88 per cent. on the figure for 1916. This decrease was due to shipping restrictions on account of the war.

The domestic output of 44,000 tons of ground barytes in 1917 was ground by seven firms (chiefly in Missouri) and sold at an average price of 75*s.* per ton, as compared with 61*s.* 5*d.* in 1916. Ground barytes of fine white grade was quoted at £5 to £7 per ton early in 1917, but in March the minimum rose to £5 12*s.*, whilst the maximum fell to £6 8*s.* per ton, but rose to £7 4*s.* in September, 1917. Lithopone was made at 13 plants in the United States in 1917, the total output being 58,000 tons, chiefly produced in Philadelphia and New York. The average price in 1917 received by the manufacturers was 29*d.* per lb., as compared with the wholesale price of 3*d.* to 5*d.* per lb. Other barium compounds manufactured in the United States in 1917 were 7500 tons of barium carbonate, 4400 tons of barium chloride, 5700 tons of barium sulphate (blanc fixe) and 2700 tons of barium dioxide, hydroxide, sulphide, etc. The prices fluctuated considerably, but averaged 2*d.* per lb. for blanc fixe, 2*s.* 3*d.* per lb. for barium chlorate, 8*d.* per lb. for barium nitrate, 1*s.* 7*d.* per lb. for barium dioxide and 2*d.* per lb. for barium chloride.

A list of the chief manufacturers of lithopone and barium chemicals is published in *Mineral Resources of the United States*, 1917, 2, 285—291.—(*U.S. Geol. Surv., Oct.*, 1918.)

LEGAL INTELLIGENCE.

NAPHTHALENE CONTRACT DISPUTE. *Collins and Burch, Ltd.* v. *Is. Poliakoff and Co., Ltd.*

In the Divisional Court, on February 17, before Justices Avory and Lush, Messrs. Collins and Burch, Ltd., moved to set aside the award of an arbitrator in favour of Messrs. Is. Poliakoff and Co., in connexion with a contract dated August 16, 1917, for naphthalene flakes. Under the contract respondents sold to the applicants 100 tons of material to be delivered at the rate of 25 tons monthly between September and December at £33 odd per ton, net cash against delivery. Only 30 tons were delivered. In the arbitration, applicants claimed damages in respect of failure to deliver the balance, also in regard to 8 tons not up to contract requirements and to applicants' refusal to take delivery of 9 tons which the latter said were too late and out of time. By the award the applicants were ordered to pay respondents £200 for breach of contract, and the ground for the motion was that the award was bad, because it was made by one arbitrator, whereas the submission to arbitration provided that an arbitrator should be appointed by each side, with a third to act as umpire.

Their Lordships held that the award was bad and must be set aside on the ground that the tribunal of arbitration was not properly constituted. The applicants were awarded costs.

CAUSTIC SODA CONTRACT DISPUTE. *William Drug Co., Ltd.* v. *Comet Chemical Co., Ltd.*

On February 18, in the Divisional Court, the Comet Chemical Co. moved to set aside an award, dated April 16, 1918, made in favour of the William Drug Co. in an arbitration relating to the supply of caustic soda to the latter, the damages awarded being £500.

The ground of the motion was that the award had been made by an arbitrator, who represented the William Drug Co., in the absence of the arbitrator appointed by the Comet Co., and that the award was not communicated to the latter company, which only heard of it accidentally months afterwards. Mr. Justice Avory ordered the award to be set aside, with costs.

PRE-WAR ENEMY PHOSPHATE CONTRACTS. *Pacific Phosphate Co., Ltd.* v. *Chemische Fabrik Aktiengesellschaft vorm. Karl Scharff u. Co. and Others.*

Twelve actions brought by the Pacific Phosphate Co., Ltd., under the Legal Proceedings against Enemies Act, were heard in the King's Bench Division by Mr. Justice Bray on February 19. The defendants were: Chemische Fabrik A.-G. vorm. Karl Scharff und Co. of Breslau, Union Fabrik Chemischer Producte of Stettin, Merck'sche

Guano u. Phosphat Werke A.-G., of Hamburg, Anglo-Continentale (vorm. Ohlendorff'sche) Guano Werke of Hamburg, Chemische Fabrik A.-G. vorm. Moritz Milch und Co. of Posen, Silesia, Verein Chemischer Fabriken Breslauer Zweigniederlassung, Breslauer Chemische Fabrik A.-G., vorm. Oscar Heymann of Breslau, Schroeder u. Petzold Gesellschaft mit beschränkter Haftung, of Breslau, Dr. Roman May of Posen, Ceres A.-G. für Chemische Producte vorm. Th. Pyrkosch, "Clotilde" erste Ungarische A.-G. für Chemische Industrie, of Budapest, and "Donica" A.-G. für Chemische Industrie, of Budapest.

The cases related to contracts with enemy firms under which the plaintiff company was the seller of phosphates amounting in the aggregate to over half a million tons, for delivery over various periods of the years 1914-1923. The plaintiffs asked for declarations to the effect that all the contracts were dissolved as from August 4, 1914, by reason of the outbreak of war between England and Germany and Austria-Hungary.

Mr. Justice Bray granted the declarations asked for in every case, but made no order as to costs.

EXCESS PROFITS DUTY ASSESSMENT. *Hedley and Co., Ltd.* v. *Income Tax Commissioners.*

On February 21, before Justices Avory and Lush, in the Divisional Court of the King's Bench, Mr. Palmer moved for a rule *nisi* for a mandamus directed to the General Commissioners for Income Tax for the Beacontree Division of Essex, calling upon them to hear and determine an appeal by Messrs. Hedley and Co., of Leytonstone, manufacturers of anæsthetics and dyes, against a decision of the Income Tax Commissioners assessing the company to excess profits duty. The rule raised a question of great importance under the Finance 1915 No. 2 Act in relation to the basis of assessment of excess profits duty.

Prior to the war a deduction had been allowed by the income tax authorities for development expenses, with the result that not only were the net profits for the pre-war years unduly low, and the basis upon which excess profits were to be assessed, but in addition the assessment of the excess profits for the post-war period was too high. The Commissioners had decided they were precluded from applying principles in determining the profits arising from appellants' trade or business for the purpose of excess profits duty other than those which had been applied in determining the profits of the said trade for the purpose of income tax. Their Lordships granted the rule.

SOAP TRADE DISPUTE. *Lever Bros., Ltd., and Associated Enterprises, Ltd.* v. *Brunner, Mond and Co., Ltd., and Others.*

Before Mr. Justice Bailhache in the King's Bench Division, on February 25 and 26, the plaintiffs sought for declarations, (1) that they were entitled to control and to have an equal voice with Brunner, Mond and Co., in the conduct and management of J. Crosfield and Sons, Warrington, and W. Gossage and Sons, Widnes, and (2) that the directors of these two firms nominated by Lever Bros. should have equal rights with the directors nominated by Brunner, Mond and Co. The case was a sequel to an action heard in 1917 which was settled on terms agreed, the plaintiffs now claiming that the defendants had not abided by the terms of the settlement. After Lord Leverhulme had given evidence, it was announced that a settlement had been arrived at, Lord Leverhulme proposing to withdraw the action, and to pay the taxed costs. Mr. Justice Bailhache assented and said that he felt there would be the very greatest difficulty in granting the declarations.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

The Margarine Industry.

In answer to Mr. N. G. Doyle, Mr. G. Roberts, Minister of Food, said that this industry has now been developed to such an extent that it is not only able to supply all the needs of this country, but is also in a position to compete on favourable terms with foreign manufacturers in their own markets.—(Feb. 19.)

Excess Profits Duty.

Mr. S. Baldwin, Financial Secretary to the Treasury, replying to Capt. Shaw, stated that the Chancellor of the Exchequer is of the opinion that the present excess profits duty is not suited to be part of our permanent post-war system of taxation.—(Feb. 20.)

Waste Amatol.

Asked by Sir R. Winfrey concerning the disposal of waste amatol, Mr. F. G. Kellaway, Deputy Minister of Munitions, replied that instructions have been given to destroy 1400 tons of waste amatol: it will not be deposited in the Wash, but dumped into the sea, after consultation with the Board of Agriculture and Fisheries. The amatol in question contains about 10 per cent. only of ammonium nitrate. Whilst the extraction of the ammonium nitrate from this material would not be a paying proposition in view of the low ammonium nitrate content, he would be prepared to hand it over for use in agriculture at a nominal price, subject to any necessary safeguard.

Sir A. Griffith-Boscawen, answering another question put by the same member, said that the dumping of waste amatol into the sea was postponed until it was assured that no appreciable harm would be done to fish life.—(Feb. 20.)

Coal Mines (Output).

In a written answer to Commander Hamilton Benn, Mr. Bridgeman stated that the output of anthracite coal per man employed, based on the first six months of 1918, is 207 tons per annum, and of other coal in South Wales, 222 tons per annum. The corresponding figures for the United States, in 1916, were: Anthracite 548, and bituminous 896 short tons.—(Feb. 25.)

Coal Industry Commission Bill.

In introducing "a Bill to constitute a Commission to inquire into the position of and conditions prevailing in the Coal Industry," the Prime Minister urged the miners to postpone the projected strike until their demands had been thoroughly sifted by an impartial tribunal. These demands included: specially favourable treatment of miners in regard to demobilisation, an immediate rise of 30 per cent. in wages, a six-hour day, and better conditions generally. The probable effects of conceding these claims would be: to throw into unemployment thousands of workers in other industries, to cripple our export trade, to injure seriously shipping, smelting, engineering, and even the coal trade itself, and to endanger our food supply from overseas. The miners contended that other industries would not be damaged by the increased cost of coal; that even if they were, the claim for a higher standard of living would still be legitimate; and that the industry could bear the burden if waste were prevented. Mr. Lloyd George doubted if the increased cost of production (8*s.*—10*s.* per ton) could be covered by increased economies: that was a fit subject for inquiry. Some erroneous ideas were prevalent as

to the profits reaped by proprietors, but, taking all the collieries in the United Kingdom for the five years before the war, these were only 1*s.* per ton, with 6*d.* for royalties. The average wage of coal-getters was estimated at 81*s.* per week of 5 working days: that was not a starvation wage. However, he fully sympathised with the demand for better housing conditions. The terms of reference of the proposed Statutory Commission allowed of the compulsory attendance of witnesses, their examination on oath, and the compulsory production of documents. Mr. Justice Sankey would act as chairman. The Prime Minister then dealt with the demand for a reply on the question of wages and hours by March 15, *i.e.*, 16 days earlier than the Commission would be able to report. He could not believe that the miners would throw the whole country into confusion for the sake of 16 days. A protracted debate followed, in the course of which the miners' representatives urged that the demands for higher wages and shorter hours should be granted forthwith, leaving nationalisation and other questions to be settled by the inquiry. The second reading was carried by 257 votes to 43.—(Feb. 24.)

On the following day, when the Bill was considered in Committee, a motion to exclude the questions of hours and wages from the scope of the inquiry was negatived by 270 votes to 40. Mr. J. H. Thomas stated that in the event of a strike the miners, railway-men and transport workers would act together. Ultimately, the Prime Minister announced that if the miners would nominate representatives on the Commission, the latter would be able to report by March 20. This compromise was accepted, and the Bill was read a third time.—(Feb. 25.) The next day the Bill was passed by the House of Lords.

Ministry of Ways and Communications.

A Bill to set up a Ministry of Ways and Communications was introduced by the Home Secretary (Mr. Shortt). It is proposed that the new Ministry shall control all railways, light railways, tramways, canals and inland navigation; roads, bridges, vehicles and traffic: and the supply of electricity. In answer to interpellations, the Minister stated that the Bill would apply to the whole of the United Kingdom, including the Manchester Ship Canal.—(Feb. 26.)

Ministry of Health.

In opening the debate on the second reading, Dr. Addison explained that the main idea of the Bill is to centralise authority and to fix responsibility in matters appertaining to public health. First, the various Government Departments would be brought together, and the powers of the Local Government Board, the Insurance Commissioners, the Board of Education and the Privy Council would be amalgamated, the first two of these ceasing to exist. Later on it is proposed to take over certain powers of the Board of Control, the Ministry of Pensions, and of the Board of Education (medical inspection, etc.). The Medical Research Organisation with its Medical Research Committees would not be taken over, but be transferred to the Privy Council.—(Feb. 26.)

Gold Coast (Oil, Seed, and Kernel Legislation).

Colonel Wedgewood asked if the introduction into the Legislative Council of the Gold Coast of the oil, seed, and kernel legislation met with the unanimous opposition of the unofficial members; if the Governor stated that in these circumstances he would refer to Downing Street for instructions; and whether any instructions have been sent which will have the effect of forcing this legislation upon the Colony and Protectorate.

The Under-Secretary of State for the Colonies (Colonel Amery) replied that the facts were as stated, and that no instructions had as yet been given in the matter.—(Feb. 27.)

Munition Factories.

Mr. Kellaway informed Mr. A. Short that the Government does not propose to utilise the national factories to produce goods for sale in the open market, but it is considering the possibility of devoting some of them to the production of goods required for public services.—(Feb. 27.)

Quality of Gas Supply.

Asked by Sir Kingsley Wood if it was still necessary to depreciate the quality of London coal gas by "stripping" it of benzol, Mr. Bridgeman answered that, after careful investigation, the Board of Trade had decided that it was impracticable to revert at once to pre-war standards. Hence the Board had suggested to local authorities throughout the country that, until the end of June, no proceedings should be taken in respect of deficient calorific power so long as this did not fall below 450 B.Th.U., provided that the content of inert gases was not excessive.—(Mar. 4.)

REPORT.

REPORT OF THE DEPARTMENTAL COMMITTEE ON SULPHURIC ACID AND FERTILISER TRADES, 1919. [Cmd. 23, 2*d*.]

This report was drawn up early in 1918, but could not, in the national interests, be published in its complete form at that time. In view, however, of the importance of the subject a modified report was issued in February 1918 (this J., 1918, 118 R). The complete report, as now issued, contains in addition to the matter already published, statistical and other information regarding H.M. Factories. The following summaries must be read in conjunction with the previous abstract above mentioned.

The principal consuming trades, with their estimated annual consumption of acid (pre war) are set out in the following table:—

Annual Pre-War Consumption of Acid by the more Important Trades.

	Tons 100 per cent. acid per annum.	Equivalent Chamber Acid.
Superphosphates	300,000	450,000
Sulphate of Ammonia ..	280,000	420,000
Bleaching Powder, Hydrochloric Acid, Alkali and Alum	186,000	279,000
Iron Pickling	70,000	105,000
Recovery of Grease in textile trades	20,000	30,000
Copper Sulphate	25,000	37,000
Dyeing and Bleaching ..	25,000	37,000
Dyes	Very small.	
Oil Refining	20,000	30,000
Explosives	30,000	45,000
	956,000	1,433,000

The above figures are merely approximate estimates as no detailed statistics for the consumption of sulphuric acid before the war are available.

The comparison of the pre-war and post-war positions as regards productive capacity (also in terms of 100 per cent. and per annum) shows:—

	Pre-war Tons	Post-war Tons
Oleum	22,000	450,000
Chamber	1,040,000	1,265,000
	1,062,000	1,715,000

i.e., there will be a post-war surplus of 653,000 tons, of which the Government plants will produce 315,000 tons. The increased consumption which the Committee looks for after the war, especially in the

superphosphate industry, will absorb only about 300,000 tons, leaving a final surplus of about 350,000 tons. It is to avoid this surplus that the policy of scrapping and closing the least efficient works is recommended. As already reported, the Committee finds that the surplus acid can best be utilised in the development of the superphosphate industry; and in this connexion there is inserted in the new Report a recommendation to the effect that the Government should take immediate steps to secure an effective and permanent control or command of an adequate supply of phosphate rock, and make arrangements in advance for the importation of large quantities immediately after the termination of hostilities.

Some interesting figures are given of the production of fixed nitrogen in Germany.

GERMAN PRODUCTION OF NITROGEN.

(Calculated as Sulphate of Ammonia.)

1913		1917 (estimated)		Fixed Nitrogen
480,000 tons	Sulphate of Ammonia	700,000	=	140,000 tons.
30,000 ,,	Cyanamide	400,000	=	80,000 ,,
20,000 ,,	Ammonia Haber ..	500,000	=	100,000 ,,
750,000 ,,	Nitrate of Soda Imports ..	nil.		—
				320,000 ,,

The cyanamide and Haber processes may ultimately attain similar importance in this country, but at present they are, comparatively speaking, without influence. On the other hand, the introduction of synthetic methods for making nitric acid, now being put into operation, tends to diminish the consumption of sulphuric acid for the manufacture of nitric acid.

The following is a list of acid factories owned or leased by H.M. Government, with their output of 100 per cent. acid in tons per annum :—

A. *Oleum Plants Erected During the War.*

		Tons per annum
H.M. Factory, Avonmouth ..	10 Grillos	89,200
H.M. Factory, Queensferry	10 Mannheims 10 Grillos	111,500
H.M Factory, Gretna ..	8 Mannheims 4 Grillos	53,500
R.N. Cordite Factory, Poole	2 Tentelew	8,900
H.M. Factory, Oldbury ..	2 Mannheims	4,500
H.M. Factory, Pembrey ..	6 Tentelew	26,700
S. Metropolitan Gas Co. ..	1 Grillo	8,900
		303,200

B.—*Chamber Plants Leased by H.M. Government.*

H.M. Factory, West Gorton ..	6,200	tons per annum.
Dalton Main Collieries	5,200	,, ,,
	11,400	
Total acid under Government management	314,600	

The Avonmouth plant had already been leased to Mr. Tilden Smith for use in connexion with zinc concentrates before the Committee was appointed, and therefore the latter is obliged to regard the agreement as a *fait accompli* and to restrain from comments. However, it points out that this factory is badly situated from the point of view of disposal of sulphuric acid, considerations of transport demanding that the acid should be utilised in manufactures carried out in the factory itself. The Committee recommends that this question be referred to the Joint Committee (representing manufacturers and users of sulphuric acid), and that if the latter so recommends, the Government should reopen the whole question of the agreement. The Gretna factory is very badly placed for the manufacture of acid or superphosphate for sale, and the Queensferry plant is poorly situated both for consuming centres and for import of raw materials.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for February 20 and 27.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73 Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Numbers
Australia ..	Metals, chemicals and dyes	244, 309
,, ..	Chemicals, drugs, paper ..	311
,, ..	Glassware for incandescent and electric lamps	312
,, ..	Heavy chemicals ..	313
,, ..	Carborundum discs, heavy oils, greases	*
,,	Chemicals, drugs, etc. ..	293/4/11†
Canada ..	Glass and china	248
,, ..	Soap, druggists' sundries	318
,, (Nova Scotia)	Fireclay and firebrick ..	‡
India (Cocanada)	Dyes, paints, matches, etc.	289
Belgium (Liége)	Faience and earthenware tiles, waterproofing material for cement, etc.	238
Paris	Colours, varnish, paints	294, 296
,, ...	Iron, steel and other metals	299
Lyons	Colours, oils, fats ..	326
Italy (Turin) ..	Plant to produce 1 to 1½ tons per day of lithopone (tender for) ..	266
Spain (Vigo) ..	Lead, tinplate, copper-sulphate, paper, etc. ..	263
,, (Barcelona)	Chemicals, dyes, drugs, vegetable oils, copra, etc.	264
Dominican Republic ..	Iron, steel, textiles, glassware, etc.	325
Norway ..	Pig iron, iron wire ..	328
South and Central America	Chemicals, soap, paper ..	333

* Official Secretary, Commonwealth of Australia, Commercial Information Bureau, Australia House, Strand W.C. 2.

† High Commissioner for Australia, Australia House, London, W.C. 2.

‡ High Commissioner for Canada, 19 Victoria Street S.W. 1.

H.M. Consul-General at Antwerp reports that persons and firms in Belgium desire agencies for U.K. manufacturers of metals, chemicals, candles, soap, cement, drugs, dyes, earthenware, glass, china, enamelware, gums, inks, leather, linoleum, matches, margarine, oils, ores, paint, varnish, rubber, paper, starch, etc. Inquiries to Department of Overseas Trade (Belgian Section), Canada House, Kingsway, W.C. 2, quoting reference number Ex. 889 T. and R.

TARIFF. CUSTOMS. EXCISE.

British India.—Among the articles included in the new Schedule of Tariff Valuations are alcoholic beverages, vinegar, margarine, sugar, gums, resins, hides and skins, ores, oils, tallow, stearin, candles, wax, manures, wood pulp, ferrous sulphate, many dyes, drugs and chemicals, glass, earthenware, metals, paper, matches, oilcakes.

Brazil.—The articles affected by the new Customs law include leather, earthenware, porcelain, cardboard, certain chemicals, oils and colours.

Canada.—All goods imported from Belgium must be accompanied by a certificate of origin and interest issued by a British Consular Officer in Belgium.

A drawback of 99 per cent. is allowed, under certain conditions, on all the duties paid on liquid sulphite pulp used in the manufacture of newsprint paper on or after March 1, 1917, and on or before June 30, 1918.

Costa Rica.—Certain chemicals and serums are exempted from Customs duties, under certain conditions, as from November 30 last.

Federated Malay States.—The import duty on petroleum is fixed at 5 cents per gallon as from December 16, 1918.

France.—The import of Russian money is prohibited, except under licence, as from January 22.

A Bill has been submitted to the Chamber of Deputies which proposes to place under Customs control all factories engaged in refining petroleum and to limit the importation of crude oils to such factories.

Japan (Corea).—All export duties now in force in Corea will be abolished on April 1 next.

New Zealand.—The Orders in Council prohibiting the import of soap except when manufactured in or exported from the U.K., British Possessions, France, Italy or Japan are revoked as from December 2, 1918.

Spain.—A system of export control has been established whereby the Government will fix the total quantity of any commodity which may be exported during the current year, and will levy an export duty to vary with the price of the article in the Spanish market.

United States.—It is proposed to amend the Customs duties on dyes, intermediates, photographic chemicals, medicinals, flavours, synthetic phenolic resins and explosives, in order to promote the development of the coal tar and dye industries.

TRADE NOTES.

FOREIGN.

The Bordeaux Fair.—H.M. Acting Consul, Bordeaux, reports that the Annual Fair opens on May 31 and will continue until June 15.—(*Bd. of Trade J., Mar.* 6, 1919.)

The Aniline Dye Situation in Italy.—Practically all the aniline dyes imported into Italy prior to the war came from Germany, and there was always a large demand in the Italian market for them on account of their excellent quality and cheapness. At the outbreak of hostilities the large stocks of dyes on deposit with Italian firms were immediately purchased at prohibitive prices by the principal factories, leaving the market completely bare. Several manufacturers attempted to produce dyewares similar to those furnished by Germany, but after a series of experiments and financial losses, only a poor red and reddish black, not at all "fast," were obtained, which buyers were forced to accept. In consequence, local dealers and importers have since experienced much difficulty in inducing customers to accept unknown qualities of dyestuffs of foreign manufacture. The managers of several new plants for the manufacture of aniline dyes state that they cannot produce solid, guaranteed colours owing to lack of proper machinery, which has not been imported because of the high rates of exchange and the difficulties of ocean transit.

There is still a strong prejudice in favour of German dyes, and the establishment of a market for American dyes can be effected only by personal investigation, and by convincing buyers that the products offered are as good as those of German origin. The opinion has been expressed in the Turin district (one of the most important manufacturing centres) that were an American firm to establish a branch factory in Italy the products would find a ready market at good prices. The system of selling goods in deposit and quoting prices in lire is much in favour with Italian firms, and it would be well to consider this established custom in endeavouring to develop a dye trade with Italy.—(*U.S. Com. Rep., Jan.* 29, 1919.)

American Dyes Institute.—An amalgamation has been ratified between the American Dyestuff Manufacturers' Association and the American Dyes Institute, the new association to be known as American Dyes Institute (an association of American dyestuff manufacturers).

Both of the old organisations are the outgrowth of war conditions. The American Dyestuff Manufacturers' Association was limited in membership to actual producers of dyes in the United States to the exclusion of those who were simply dealers or importers. Its object was to consolidate the domestic industry in order that there might be a united effort toward the furtherance of their general commercial and governmental interests. The American Dyes Institute was formed simply to further the "open price" idea, a proposition that has been subjected to more or less violent discussion. It is proposed that while the two organisations will be united, there will still be independent action between them and the members of one section will not necessarily subscribe to the actions of the other. It is hoped, however, that some method may be formulated whereby the interests of all parties will be mutually served. A committee, composed of Messrs. F. Hemingway, M. R. Poucher and W. F. Miller, is to nominate officers for the new association.—(*Textile Colourist, Jan.*, 1919.)

Chilean Nitrate Industry.—The Allied Committee having declared that it will make no new purchases, the situation of the Chilean nitrate industry is becoming serious. In order to provide relief the Minister of Finance is about to present to Congress a bill for the appropriation of £1,200,000 sterling to be used to purchase nitrate on Government account, to enable *oficinas* to resume work. A 40 per cent. export duty is to be imposed upon companies which do not associate themselves with the Government plan.—(*U.S. Com. Rep., Jan.* 22, 1919.)

Ecuador in 1917.—The demand for Ecuadorian products during 1917 made that year a very prosperous one for the Republic. The exports included 83,000,000 lb. of cacao, 2,217,529 lb. of hides, 352,804 lb. of ivory nuts and 239,018 lb. of rubber. Ecuador produces annually about 12,000,000 lb. of lard, all of which is consumed in the interior, while in addition 2,502,063 lb. was imported in 1917. About 45,000 cases of petroleum were imported from the U.S.A. and the American-owned oil wells in Peru. The common soap imported from the U.S.A. in 1917 amounted to about 2,000,000 lb. Towards the close of the year there was a grave soap shortage which was ameliorated by large shipments from Great Britain.

Ecuador is the home of the cinchona tree and of numberless medicinal plants which will repay research. Many curious Ecuadorian vegetables and fruits are being investigated by the United States Department of Agriculture, and the Smithsonian Institution is making a thorough study of the botanical resources of the Republic.—(*U.S. Com. Rep., Nov.* 18, 1918.)

The Monazite Sand Situation in Brazil.—Brazilian monazite sand is usually sold in the Rio de Janeiro or the Victoria market. Before the war, when the German trust ruled the market, all shipments were made through Rio de Janeiro firms. The following are the only firms at present engaged in the business and operating their own mines:

P. S. Nicholson and Co., Rua Visconde de Inhaúma 8, Rio de Janeiro; H. M. Sloat, Avenida Rio Branco 109, Rio de Janeiro; and the Société Minière, Rio de Janeiro. The inclusive cost of mining, transporting and concentrating the sand averages between $17 and $23 (£3 9*s.* 9*d.* and £4 7*s.* 3*d.*) per ton. The only mines worked at present are in the Carapebus district, but those in the Guarapary district will soon be re-started. The present uniform price for material delivered at Victoria is approximately $25 (£5 2*s.* 8*d.*) per unit of thorium. Owing to storage cost, stocks of sand at Victoria and Rio de Janeiro are kept at minimum quantities. Thorium content cannot be satisfactorily determined locally, so that estimates are subject to modification.—(*U.S. Com. Rep., Dec.* 13, 1918.)

Trade Prospects in China.—It is only within recent years that the wonderful wealth of China in natural resources and raw material has attracted the attention of Western nations. The Chinese themselves have done little to develop these resources, and foreign nations have had to do the little that so far has been done. Germany was particularly active in this respect, and it is estimated that 75 per cent. of the Chinese exports to the United States was in German hands. The war offered China great opportunities, but lack of ships, internal disorders and absence of trained native organisations, together with currency difficulties, prevented her from taking full advantage of them. Nevertheless, trade has expanded enormously during these years, and one has only to study the case of Japan, whom the war has converted from a debtor to a prosperous creditor nation, to realise how great this expansion might have been. Japan, by means of preferential freight rates on its Government-subsidised ships, is able to assure its merchants more and cheaper shipping space than any foreign merchant, so that it is rapidly capturing Chinese trade.

Among the many products essential to Western industries may be mentioned bean oil, wood oil, rapeseed oil, peanut oil, etc. (the total trade in which amounts to £20,000,000), vegetable tallow, nutgalls, hides and skins, egg products, peanuts, antimony, tin and tungsten. Western importers and manufacturers will have to pay heavily for these products, unless they can handle them through their own organisations and on their own ships. The exportation of Chinese products has developed into a big trade, but it is small compared with its potentialities. Railways, roads, a stable currency and internal peace in China will open to the world a storehouse of mineral, vegetable and animal products of incalculable value.—(*U.S. Com. Rep., Nov.* 27, 1918.)

The Japanese Camphor and Celluloid Industries.—According to the Japanese Press, steps are being taken to amalgamate into a large company a number of small undertakings engaged in producing crude camphor in Formosa. This company, it is said, will have a capital of 6,000,000 yen, and it proposes to increase the output of crude camphor. Celluloid manufacturers in Japan have recently suffered from the cessation and cancellation of orders, and the new official inspection system has interfered with the business of the smaller manufacturers. A petition has been presented to the Government to have these regulations removed. It is considered that the boom in the manufacture of celluloid is over, and the prospects of allotting larger supplies of camphor to consumers abroad are stated to be better. The monthly camphor allotments from January 1 to March 31 are: Great Britain, 87,000 kilo.; France, 37,500 kilo.; United States of America, 282,000 kilo.—(*Bd. of Trade J., Mar.* 6, 1919.)

COMPANY NEWS.

BRADFORD DYERS' ASSOCIATION, LTD.

At the annual meeting held in Bradford on February 28, Mr. Milton S. Sharp, chairman, in the course of a lengthy speech, referred to the present industrial unrest, to the British dye industry, and to the financial position of the company.

Owing to the policy of limitation of output, Sir A. Yarrow is contemplating the removal of his shipbuilding works from the Clyde to Vancouver, and similar proposals are being considered by other industrial firms paying an aggregate total of £2,000,000 per annum in wages. The directors of the company have closely investigated the probable effects which would result if the present demands of labour were conceded, and have come to the conclusion that a large percentage of the company's export trade would be immediately lost, and a still larger percentage placed in most serious danger.

The paramount importance of possessing an independent national dye industry is now recognised both by H.M. Government and by the Colonial Governments; and the fact that in its latest report the Bayer Company admits that 96 per cent. of its production during hostilities was for the German Government shows the national value of such establishments in time of war. The acceptance by Lord Moulton of the chairmanship of the British Dyestuffs Corporation has given unbounded satisfaction to colour users generally, and is of particular importance as he possesses in most remarkable measure the confidence of the Swiss colour makers; and it is to be hoped "that one of the first fruits of his appointment will be some arrangement with the Swiss which will appreciably further the attainment of the great object we have in view." The oft-repeated statement that in this country production to the value of £200,000,000 per annum is dependent on aniline dyes is an underestimate; in the United States the value is £500,000,000, in France and Italy £200,000,000, giving a total for the four countries of at least £900,000,000 a year. As with two exceptions all the German dye works are within the territory occupied by the Allied Forces, the Peace Conference will not fail to protect this vast production from any peril arising out of the dye situation. These works should be at once surveyed in order to determine what action should be taken to protect all production in Allied countries dependent on dyes.

The trading profits for 1918 show a considerable decline, partly owing to the exhaustion of the good forward purchases made in 1914, and partly because the profits of the United States branch have not been included, the question of excess profits duty being still in abeyance. The net profits were £576,900 as against £760,200 in 1917. In spite of this the dividend and bonus distribution is maintained at 17½ per cent.

SOUTH STAFFORDSHIRE MOND GAS CO., LTD.

The annual meeting was held on February 25 at Dudley Port, Mr. Robert L. Mond presiding. In moving the adoption of the report he stated that despite the fact that a Bill for extending the plant was brought in, at the request of, and by arrangement with, the Ministry of Munitions, the Government had refused to allow the company to make use of its provisions, and had compelled it to pay the whole cost of the promotion. The demands of customers had been met until the armistice was signed; since then they had fallen

off slightly. The uncertainty as to the costs of fuel and labour unsettled everything; until these were put upon a reasonably stable footing it was not possible to forecast the future. Research work with regard to the better utilisation of residuals had had encouraging results; and the directors had ordered plant to deal with the tar as the first instalment. This should be at work by the early summer. Owing to sulphate of ammonia being controlled and having to be sold at fixed prices out of all proportion to the increased cost of manufacture, the net revenue from this item was much lower than it ought to have been. Application would shortly be made to the Board of Trade to allow the company again to increase the price of gas, and he had no doubt that it would be granted.

The report was adopted and a dividend at the rate of 6 per cent. per annum authorised to be paid to the preference shareholders.

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED IMPORTS.

By the Prohibition of Import (No. 28) Proclamation, 1919, made on February 25 last, the unlicensed importation of intermediates and of all synthetic dyewares was made unlawful. The following materials are specified:—All derivatives of coal tar generally known as intermediate products capable of being used or adopted for use as dyestuffs, or of being modified or further manufactured into dyestuffs.

All direct cotton colours, all union colours, all acid wool colours, all chrome and mordant colours, all alizarine colours, all basic colours, all sulphide colours, all vat colours (including synthetic indigo), all oil, spirit and wax colours, and any other synthetic colours, dyes, stains, colour acids, colour bases, colour lakes, leuco acids, leuco bases, whether in paste, powder, solution or any other form.

This prohibition does not apply to any such goods which are imported under licence given by or on behalf of the Board of Trade, and subject to the provisions and conditions of such licence.

With reference to the above Proclamation, the Board of Trade has given notice that this prohibition will be administered by the Trade and Licensing Committee. For the present, however, a general licence has been given for the import of all dyestuffs and other products covered by the prohibition which are of *bona fide* French, American or Swiss origin, and it will, therefore, not be necessary at present to obtain licences in respect of individual consignments proceeding from these countries.

Any communications regarding the prohibition should for the time being be addressed to the Secretary of the Trade and Licensing Committee, Dyes Department, Board of Trade, 7 Whitehall Gardens, S.W. 1; but the Committee proposes shortly to open offices in Manchester, when it will be prepared to deal with inquiries and correspondence there. A further announcement will be made later of the address of the Manchester office.

Importation of molasses, etc.—The Board of Trade has issued a General Licence to the Board of Customs admitting on and after February 24, "Molasses and invert sugar and all other sugars and extracts from sugar which cannot be completely tested by the polariscope, and on which Customs duty is not otherwise charged." So long as this General Licence remains in force no import licence will be required in respect of those articles.

PROHIBITED EXPORTS.

The following is a list of materials and articles upon which existing export prohibitions have been relaxed:—

Headings transferred from one list to another.

From List A to List C.

Candles; flax waste.—(Feb. 20.)

Baking powder; fatty acids; machinery, textile; tallow and articles, mixtures and preparations containing; wax, carnauba; waxes, composite; enamelled copper wire; wool grease. Chemicals:—Tolu balsam; nux vomica.

From List B to List C.

Iron tubes; molybdenum filament; steel tubes; tungsten filaments for electric lamps.—(Feb. 20.)

Waxes, animal, mineral and vegetable not otherwise prohibited.—(Feb. 27.)

Altered headings.

(A) Hides, wet, salted, cattle. (C) Hides not otherwise prohibited. (A) Honey. (C) Articles, mixtures and preparations containing honey not otherwise prohibited. (A) Invert sugar. (C) Articles, mixtures and preparations containing invert sugar not otherwise prohibited. (A) Yeast. (C) Articles, mixtures and preparations containing yeast not otherwise prohibited. (A) Woollen rags (other than pulled rags) applicable to use otherwise than as manure or as roofing felt rags. (C) Shoddy and mungo.—(Feb. 20.)

(A) Oils and fats, edible, including blends of two or more edible oils or fats. (C) Oils and fats other than edible, and articles, mixtures and preparations containing such oils and fats. (A) Resins. (C) Resinous gums and resinous substances.—(Feb. 27.)

Export of albumin, egg yolk, etc., to Holland and Sweden.—The embargo on the import of albumin, egg yolk and dried eggs into Holland and Sweden has now been raised. Applications for export from the United Kingdom will be granted freely, subject to the production of the usual guarantees against re-export, and until such time as the quantities which may be imported by those countries have been reached.

Resumption of trade with the Adriatic Coast.—The Board of Trade has issued a General Licence authorising the resumption of trade with Croatia and Slavonia, Bosnia and Herzegovina, Montenegro and Albania. Export and import licences must still be obtained from the War Trade Department before shipping or importing. The whole of the Adriatic Coast and all the countries of the Balkan peninsula are now open to trade.

NEW ORDERS.

The following Orders have been made by the Minister of Munitions:—

The Flax Scutching (Ireland) Order, 1919. (Feb. 21.)

The Magnesite (Suspension) Order, 1919. (Feb. 25.)

The Building Bricks Control (Partial Suspension) Order, 1919. (Feb. 28.)

The Small Tools (Suspension) Order, 1919. (Feb. 28.)

The Converter Plant Control (Suspension) Order, 1919. (Mar. 4.)

The Rosin Control (Suspension) Order, 1919. (Mar. 4.)

The Calcium Carbide (Suspension) Order, 1919. (Mar. 7.)

REVIEWS.

RECENT ADVANCES IN ORGANIC CHEMISTRY. *By* A. W. STEWART, *with an Introduction by* J. NORMAN COLLIE. *Third edition. Pp.* xiv + 350. *(London: Longmans, Green and Co.* 1918.) *Price* 14*s. net.*

Since 1904 the Chemical Society has published annual reports on the progress of chemistry, and recently a similar publication has been issued by the Society of Chemical Industry on the progress of applied chemistry. These volumes are excellent in themselves, but lack continuity. No decision, apparently, has yet been made to publish decennial reports which would collate the material of the annual reports, although there is little doubt that such publications would be of the greatest value to chemists. Until official action is taken the gap must be filled by private enterprise.

The book under review is an attempt to do this in the section of organic chemistry and it suffers from the chief disadvantage of its class—namely, that there is not enough of it. Limitations of space have undoubtedly caused much important matter to be excluded and some of the chapters would have been improved by expansion. However, until some energetic organic chemist writes the ideal text book, which should be a series of volumes starting with a general treatise on the principles of the science followed by monographs on special sections, which could be kept up to date as occasion requires, we must perforce be content with an incomplete and therefore unsatisfactory treatment of the subject.

Surely no one in their senses would think of teaching organic chemistry on the lines of Richter's Handbook. Indeed if any lecturer attempted to do this he would, without doubt, be subjected to personal violence long before his course was half through. Yet this handbook is the standard publication for advanced students both in this country and in America; and there is, at present, no alternative unless one has recourse to a number of books no one of which is complete in itself and all of which overlap.

Where the author of the present book has given himself full scope, as for example, in the chapters on the terpenes and the alkaloids, his treatment of his subject is so admirable and the general descriptive account so well put together that disappointment is all the more acute when one realises what he has omitted in his treatment of other sections. For example the chapters on "Rubber," "Some Aromatic Derivatives of Arsenic" and "The Polypeptides" should either have been treated more fully or excluded altogether.

Chapter X is entitled "Some Theories on the Natural Synthesis of Vital Products" and embodies certain notes which the author has received from Prof. Collie. This section is of absorbing interest and will well repay perusal. It contains numerous suggestions, many novel, all fascinating, and is indeed one of the most striking contributions to the subject which has yet appeared.

The book starts with a chapter on "Organic Chemistry in the Twentieth Century," which might have been extended with advantage, and finishes with a chapter on "Modern Formulæ and their Failings," in which the author discusses the present system of notation and points out some of its shortcomings. There is, however, no necessity to make remarks on the condition of the scientific mind, because the system serves admirably for the present purposes of the organic chemist. The main trouble has arisen because physical chemists will strive to read into our formulæ properties they were never intended to connote, and the author himself is not guiltless in this matter, because the theory of isorropesis, which was advanced by him in conjunction with Baly, while not supported by one shred of chemical evidence, was, nevertheless, given expression in terms of our notation. By all means let physical chemists devise their own notation, and if it explains the occurrence of absorption bands no one will be more willing to offer his congratulations than the present writer.

Occasion is taken to express disapproval of "the flood of synthetic material which pours chiefly from the German laboratories." But surely the need for any such expression has now disappeared. It is exceedingly unlikely that any publishing body—certainly not the Chemical Society—would nowadays publish any paper which contained merely a list of compounds and their properties without any fundamental point being involved. The "chief object" is not "merely to supplement the already existing myriads of laboratory-made organic compounds" but to obtain advances, however slight, in our knowledge of the science.

In conclusion one cannot help feeling that the author has attempted to cover too wide a field in too small a space, and that this may affect the value of the book from the point of view of the student. For the research worker, however, who is competent to read between the lines as well as between the chapters, it should prove of the greatest value as it will enable him to obtain a clear view of the activities in fields other than his own.

The book is well put together and reflects great credit on the printers and proof-readers. The usual pentavalent carbon atom is absent and the formulæ are clearly printed. A purist might object to the use throughout of the Kekulé formulæ as being expensive and unnecessary as well as misleading, but this is a minor disadvantage in a work which is really wanted. J. F. THORPE.

APPLICATIONS OF ELECTROLYSIS IN CHEMICAL INDUSTRY. *By* A. J. HALE. *Monographs on Industrial Chemistry, edited by* Sir ED. THORPE. *Pp.* viii + 148. *(London: Longmans, Green and Co.* 1918.) *Price* 7*s.* 6*d. net.*

This book forms an excellent text-book for students commencing the study of industrial electrochemistry. The older processes are fully and well described, including many no longer in use, more recent developments receiving very brief notice. The general arrangement of the subject matter is, however, clear and good.

The introduction is quite elementary, and little modern theory is discussed. The decomposition voltage of water is given without comment as 1·7 volt instead of the usually accepted value of 1·13, and the section on overvoltage is out of date. The first chapter, on methods of generating the current, includes a short account of primary and secondary cells, dynamos and converters, together with a section—rather too short—on the cost and distribution of power. In the chapter on metal refining, copper, silver, and gold are very well and fully treated, complete data as to costs, composition and treatment of slimes, and output from certain works being given. Lead receives rather less attention, and the short section on electrolytic iron is inadequate. The account of aluminium manufacture is rather too short and not up to date, but the sections on sodium and calcium are good, especially the former. The preparation of cerium for the important pyrophoric alloys is not referred to.

A chapter on the electrolytic manufacture of oxygen and hydrogen forms a useful feature of the book, but that on chlorine and caustic soda is certainly the best in the volume. Seventeen cells are described and illustrated by eighteen diagrams, a useful table of comparative efficiencies for some of the cells is given, and the chapter concludes with a short discussion of the future of this industry.

The book would be greatly improved by the introduction of illustrations showing actual plant in operation. References are given throughout to scientific journals and patent literature, but most of them are from 10 to 20 years old. E. NEWBERY.

INDIGENOUS DRUGS OF INDIA. *By* J. C. GHOSH, *B.Sc.(Manch.). Pp.* 32. *(Calcutta: Butterworth & Co. (India) Ltd.* 1918.) *Price* 1*s.*

The principal value of this brochure lies in its suggestion of the potentialities for the development for the benefit of the Empire of some of the natural resources of India. The European war has taught us the necessity for independence in the provision of chemicals and medicinal products for our own need, and it is comforting to learn from Mr. Ghosh's treatise that about 50 per cent. of the total number of vegetable drugs in the British Pharmacopœia is indigenous to India and Ceylon, and that nearly all the remainder could be cultivated. Moreover, many of these are important drugs, such as belladonna, digitalis, henbane, ipecacuanha, nux vomica, from which valuable alkaloids are isolated. In this connexion Mr. Ghosh advocates a systematic and scientific cultivation of the B.P. vegetable drugs, properly trained manufacturing pharmacists working in collaboration with drug growers. He also advocates the establishment in India of alkaloid manufacture as an industry, either under Government control or by private enterprise. He points out that in India there already exists an important nucleus for an alkaloid industry in the production of Government quinine. There are likewise great possibilities, he states, in the still unexplored fields of Ayurvedic drugs, but he strongly urges the need for a Food and Drugs Act for India to control the indiscriminate foisting on an ignorant native population of worthless drugs by unscrupulous manufacturers. A very useful appendix gives a list of the vegetable drugs mentioned in the B.P. 1914, with the names translated into eight native languages—Sanskrit, Tamil, Telugu, Canarese, Malayalam, Bengali, Hindustani and Mahrati. W. CHALMERS.

"COAL TAR DYESTUFFS," by C. M. WHITTAKER.—In connexion with the review of this work published in our issue of January 31 (35 R—36 R), we have received a letter from a correspondent complaining of the unfairness of the reviewer in criticising the "curious English" used by the author. The first quotation given by the reviewer is admitted to deserve that stigma, but excused on the ground that it is "the language of the practical man and is readily understandable by anyone with dye-works experience." The second quotation is condemned as unfair because the paragraph-heading "Mordant Dyes" was omitted, thus creating the impression "that the author was writing in an incomprehensible manner." On referring to the review in question we find that the main criticism of this passage was directed against the unnecessary use of a colloquialism; and the added remark that the sentence "was not even informing" appears to us to be fair criticism.

We should like to take this opportunity to emphasise the necessity for the use of lucid and grammatical English in scientific and technical publications. Apart from violating the canons of literary taste, the use of workshop slang, or of nebulous or redundant language entails a considerable waste of time to the reader, in addition to causing him unnecessary "vexation of spirit." Devotees of the classical cult have long jibed at the scientist who cannot express his thoughts in clear and polished phrases, and they are wont to associate this defect with modern education in the natural sciences. The evidence rather points to the contrary. An educational experiment carried out a few years ago at one of our Naval Colleges showed unmistakably that an increase in the time devoted to workshop and other practical studies, at the expense of the purely literary portion of the curriculum, was attended by a marked improvement in literary expression. "Sloppiness" of style, unless it is a result of carelessness, is a natural consequence of unclear thinking, of which scientists are certainly not more guilty than others. There is nothing in the nature of his occupation to debar the writer on scientific subjects from attaining a style as clear, terse, grammatical and finished as that of some of his literary compeers. Although literary style is to a very considerable extent a matter of taste, and as such not amenable to the rules of logic, we venture to express the opinion that our reviewer not only kept his remarks within the limits of honest criticism, but rendered a distinct service in drawing attention to certain crudities of style in the book which he reviewed.

OBITUARY.

THOMAS FAIRLEY.

It is with great regret that we record the death, on February 21 last, of Mr. Thomas Fairley, the Leeds City Analyst, at the age of 76.

Mr. Fairley was born in Glasgow and had the good fortune to study chemistry under the late Lord Playfair at Edinburgh University, subsequently serving under him as tutorial assistant. After a few years devoted mainly to teaching, he set up as an analytical and consulting chemist, and his first important appointment was that of public analyst for Leeds and the North Riding. During his long period of activity he filled many honorary posts, including that of chairman of the Council of the Association of Technical Institutions of Great Britain and Ireland.

Mr. Fairley took a great interest in the Society of Chemical Industry, and the Yorkshire Section, which he served both as chairman and as secretary, owes much to him for his keen interest and support. He retired from the secretaryship only last year. Mr. Fairley had extensive knowledge of many subjects and was of wide literary sympathies; his scientific writings include contributions to the Journal of the Chemical Society, to the Journal of this Society, and to Thorpe's Dictionary of Chemistry.

PUBLICATIONS RECEIVED.

OSMOTIC PRESSURE. MONOGRAPHS ON INORGANIC AND PHYSICAL CHEMISTRY. *By* A. FINDLAY. *Second edition. Pp.* 116. *(London: Longmans, Green and Co.* 1919.) *Price* 6*s.*

COAL TAR DYES AND INTERMEDIATES. *By* E. DE BARRY BARNETT. INDUSTRIAL CHEMISTRY, *edited by* S. RIDEAL. *Pp.* 213. *(London: Baillière, Tindall and Cox.* 1919.) *Price* 10*s.* 6*d.*

AMERICA AT SCHOOL AND AT WORK. *By* H. B. GRAY. *Pp.* 172. *(London: Nisbet and Co.* 1919.) *Price* 5*s.*

CHEAP STEAM, VOL. II., 1918. *Pp.* 96. *(Bolton: Ed. Bennis and Co.) Price* 10*s.* 6*d.*

PRELIMINARY NOTE ON THE RESEARCH WORK UNDERTAKEN FOR THE DEVELOPMENT OF INDIGENOUS DRUGS OF THE GWALIOR STATE. MONOGRAPH NO. 1. *By* PROF. M. J. GAJJAR *and* M. R. ENGINEER. *(Gwalior: Alijah Durbar Press.* 1918.)

A SCHEME OF INDUSTRIAL FELLOWSHIPS FOR INDIA. *Compiled by* M. J. GAJJAR. *Pp.* 32. *(Bombay: C. S. Deole at the Bombay Vaibhav Press.* 1918.)

CHEMICAL ENGINEERING GROUP.

That the formation of the first Subject Group of the Society of Chemical Industry has met with general approbation may be inferred from the very satisfactory progress which has resulted from the preliminary efforts of those who are primarily responsible for the innovation. In less than three months since the first appeal was published in this Journal, some 400 members have joined the new branch, and from the vigour that is being displayed it seems not improbable that this number may be greatly exceeded in the near future.

In one or two quarters the fear has been expressed that the concentration of effort in this direction may deflect its flow from the customary channels, in other words that the Local Sections may in future find it more difficult to obtain papers on chemical-engineering subjects than in the past. We believe this fear to be unfounded. In the first place the conferences projected by the new Group will be held only in those localities where they will be welcome; and secondly, the subject is such a vast one and its pursuit fraught with such great possibilities, that by stimulating interest in the subject the propaganda work of the Group is more likely to gather grist for the Sectional mill than the contrary.

It has also been urged that the promotion of chemical engineering was one of the original objects of the Society, and that the existing organisation affords all the means necessary to its development. This is undoubtedly true—on paper, but experience has shown that although many valuable contributions to this subject have been made to the Society in the past, this branch of industrial chemistry has not progressed to the extent which was, and is, desirable. Hence no objection should be taken to the institution of some new means of aiding its development.

The problem of defining the chemical engineer and his status does not appear to be an object of immediate importance, but it is essential that everyone should realise that the Chemical Engineering Group is open to all industrial chemists who have an interest in engineering, and to all engineers who are interested in industrial chemistry, and further, as the transition from laboratory to factory always involves the application of engineering knowledge, it follows that there can be but few industrial chemists who could not with advantage become members of it. It is, however, from the national point of view that we would especially emphasise the importance and potentiality for good of the new Group; at the same time we are not oblivious to the consideration that its success would react upon the parent body by increasing its membership and enlarging its sphere of influence and utility.

The inaugural dinner, which is referred to elsewhere in this issue, was a noteworthy event and in every way indicative of the spirit of progress which has been manifest in the Society for some time past. Although some disappointment was caused by the unavoidable absence of one or two of the more distinguished guests, the gathering was in all other respects worthy of the occasion. Those who had the good fortune to be present cannot have left the assembly without the impression that the Group had received the most hearty inauguration, and the conviction that its future will be one of activity and utility in the interests of chemical industry and of national prosperity.

NOTICE.—*Statements of opinion appearing in signed articles do not necessarily represent the views of those responsible for the publication of the Journal. Their insertion means that they are considered to be of sufficient interest and importance to warrant publicity.*

CHEMICAL STANDARDS IN RELATION TO THE IRON AND STEEL TRADES.

H. W. BREARLEY.

The paper on Chemical Standards appearing in the issue of February 15 (p. 15 T) revives a discussion which comes periodically into prominence. Whether Messrs. Ridsdale's effort will secure the unanimity they desire, or whether it will be ignored and pass into oblivion like previous efforts, cannot of course be predicted. It may, however, be suggested, apart from the merits of chemical standards in general, that such efforts in relation to steel at any rate have fewer chances of success nowadays than they had twenty or thirty years ago.

When cast steel was made only by the crucible process its quality and grade were determined by the brands of raw material used and the appearance of a fractured surface observed by the skilful eye of a trained man. In those days steelworks laboratories either did not exist or existed only in a very few works. When grades of hardness in steel classified by a skilled eye came to be expressed in percentages of carbon, and other constituents were likewise determined and expressed in concrete figures, the steelworks chemist shared with the steelmaker the responsibility not only of classifying material, but also of explaining why material which should have been right turned out in service to be wrong. The laboratory lived for a generation in a glamour which it never earned, and it left a legacy of misconceptions which still survive and will continue to live on for a generation or two.

Whereas the old craftsman depending on close observation and judgment could only suggest that defective tools had been overheated or burnt or spoiled in the forging, his new ally, or opponent, as the case might be, could say that the material contained 0·06% sulphur instead of 0·04% and was therefore red short, or 0·05% phosphorus instead of 0·03% and was therefore cold short. The expression of the cause of a defect in concrete figures had a magical effect. Now and again it could be shown that part of the carbon, for example in tool steel, had become graphitic and a correct explanation of an unexpected result could be given, but in most cases the explanations turned on the forlorn belief that the percentages of sulphur and phosphorus beyond the usual or specified limits were accountable for nearly every ill occurring in steel.

If one scans specifications for high-class steel material, their most notable chemical feature is that the sulphur and phosphorus shall not exceed 0·03%, 0·035%, or 0·04%. This feature is a direct heritage from the days when nearly all failures of materials were ascribed to chemical causes—mainly sulphur and phosphorus. Whilst it may not be argued that unrestricted amounts of sulphur and phosphorus confer any benefit on steel it is well known in these days that physical characteristics originating may be in the casting pit, in the forge or in the heat-treatment shop, are more vital in their effects on the reliability and suitability of materials than variations of 0·01 or 0·02% sulphur and phosphorus.

The advent of regular microscopic examination and what are called metallographic methods has caused a steady decline in the value of chemical analysis as a means of determining causes and effects. The old attitude is however adhered to in most British specifications, in some cases much to the detriment of national trade. Also it may

not be an easy task, and it will certainly not be a short one, to convince consulting engineers, to whom evidence comes indirectly, that the established limits of permissible sulphur and phosphorus have comparatively an imaginary value or an overrated value. It is so convenient to have a chemical basis of quality which can be appealed to at any moment during the life of the material that such a basis will be adhered to when its warranty no longer exists.

The bearing of these remarks on Mr. Ridsdale's paper lies in the fact that users are coming more and more to look upon steel as the embodiment of certain physical properties. In all structural work, of whatever grade, the designer counts on so much material withstanding so much stress. In terms of precise chemical composition he does not care whether this or that material of approved reliability is used. This seems to be a logical attitude and is likely to extend with the application of methods of heat treatment to wider classes of steel. The idea that the sum of certain chemical constants multiplied by certain factors can express reliably the physical properties of a steel is obsolete.

For materials such as ores, and alloys, the values of which are computable on a chemical basis, analysis is, no doubt, the proper means of valuation. For steels in general the chemical composition is fundamentally important to the steelmaker, but it may be of quite secondary importance to the steel user, and on that account labour spent on chemical standards may be less enthusiastically appreciated than formerly. The user will, no doubt, continue to be interested in the chemical composition of the steel he buys, and it is to be hoped that his specifications will indicate the class of material he wants. He should, however, regard the chemical clauses as an indication and not as a condition to be punctiliously enforced. In the light of present knowledge, the chemical clauses of a specification might be looked upon as a first line of defence against the delivery of unsuitable material. Material held up at this barrier may be no worse; it may be better; but the closer scrutiny of it will ease or tighten the conditions according to actual experience; in that way lies progress.

The writer is, on the whole, out of sympathy with Messrs. Ridsdale's efforts. Many of the proposals made are already being carried out. There are occasional differences relating to the composition of steel between buyers' and sellers' chemists, but they are not serious, and it is very rarely that such differences cannot be composed by friendly visits to each other's laboratories. The one aspect of chemical standards which may be permanently valuable lies in the confidence their use may inspire in the minds of operators who are not sure of themselves. An appeal to authorised standards may comfort such men.

Standard samples prepared by the works themselves have been in use for more than twenty years in some laboratories. Such standards may give comfort or bring confusion to an operator depending on whether or not he knows the standard has been issued to him. When issued without the operator's knowledge amongst ordinary routine work, the standards are, and have for a long time, been regarded as a useful check.

In the writer's opinion, the confidence of youths who are being trained as laboratory assistants should be strengthened by teaching them analytical methods on a synthetic plan. When they are able to determine an element in a sample of steel under the simplest conditions they should be encouraged to investigate for themselves the influence of interferences which may arise either from the presence of unusual elements in the steel or from the presence of impurities in the reagents. A man trained on these lines is perhaps not very respectful towards either statements or specimens issued under authority, but he is usually capable, if a mistake has occurred, of finding out how it originated and of taking precautions to avoid its repetition. However prevalent chemical standards may become and with whatever authority they may be issued, they are of limited value, and if reverenced overmuch, may weaken the most valuable characteristic of a reliable chemist, *i.e.*, the sense of confidence in his own work and the sense of responsibility for its actual accuracy.

CHEMISTRY AT THE INDIAN SCIENCE CONGRESS, 1919.

At the sixth annual Indian Science Congress held in Bombay, the presidential address was delivered by Lt.-Col. Sir Leonard Rogers, M.D., F.R.S., who chose for his subject the utility of the sciences of physiology, chemistry and physics in solving problems connected with the treatment of deadly diseases. This was the first occasion upon which medical science was included within the scope of the meetings.

Emetine and other alkaloids of ipecacuanha have proved of immense value in controlling amœbic dysentery and liver abscess, and the preparation of soluble salts of the unsaturated fatty acids of chaulmoogra and hydnocarpus oils, and of a similar preparation (sodium morrhuate) from cod-liver oil, have been used successfully in the treatment of leprosy and tuberculosis. Important results have been obtained by Capt. Shorten in his investigation of the vitamine-content of the Quetta sun-dried vegetables. Sir L. Rogers had frequently found that sodium antimony tartrate was safer and less irritating to the tissues than tartar emetic in the treatment of kala-azar, the mortality from which has been reduced from about 90 per cent. to nearly nil; and quite recently he had been using a colloidal antimony sulphide for kala-azar, and found it more effective and much less toxic than other antimony salts; there is hope that it may prove of great value in the treatment of sleeping sickness. Sir L. Rogers then sketched the history of the treatment of cholera. The mortality from this disease was initially reduced by using injections of isotonic salt solutions; when these were replaced by hypertonic solutions the mortality was further reduced by nearly one-half; and further notable reductions were effected by the use of permanganates to destroy the toxins in the bowel, and of sodium bicarbonate to combat fatal renal complications. The net effect of these discoveries—in which Col. Rogers played a notable part—was to reduce the mortality from cholera from 59 per cent. in 1895-1905 to 19·1 per cent. in 1915-17, while in 1917 it fell to 14·9 per cent. Such results prove the extreme value of scientific research, and indicate the urgent desirability of furnishing ways and means to extend it.

The following are brief abstracts of some of the chief papers read in the Section of Chemistry:—

Colloidal antimony preparations: by F. L. Usher.

Attempts were made to prepare stable solutions of metallic antimony for medical use. Chemical reduction methods invariably gave the metal as a precipitate; electric dispersion methods in organic media gave very unstable solutions except in the case of ethyl alcohol. Transference from alcohol to water, however, makes the solution unstable, even when air was excluded. Paal's protalbic acid method is inapplicable to antimony compounds. Solutions of the sulphide, 1 in 500, are now used; they are very stable when protected with gum arabic.

Note on an alkaloid in Argemone mexicana: by D. N. Chatterji.

Argemone mexicana, or prickly poppy [N.O. Papaveraceæ], is widely distributed in India. Opinions differ as to whether the seeds are poisonous; they may contain morphine, Dragendorff having obtained from them an alkaloid responding to morphine tests. The juice is not regarded as narcotic. The author obtained only a trace of alkaloid from the seeds, in the form of yellowish-white crystals, bitter, and alkaline. It differed from morphine in reactions, a characteristic test being the appearance of a violet colour followed by grey with a bluish-green tinge, and a sepia colour on heating, when a trace of nitric acid was added to a sulphuric acid solution of the alkaloid.

The purification of Indian sesame (til) oil: by H. Rai and H. B. Dunnicliff.

"Til" oil is used for soap manufacture, perfumes, margarine, and as an edible oil. Experiments were undertaken on decolorisation, deodorisation, hardening and bleaching, with the following results: (1) Bone charcoal and French chalk are the best decolorisers by filtration, but they do not deodorise. (2) Sunlight bleaches progressively, but does not deodorise. (3) Treatment with air improves colour, but does not deodorise. (4) Air and sunlight, combined, markedly affect colour, and leave the odour not unpleasant. (5) Sulphuric acid removes odour, and reduces colour very slightly. (6) Caustic soda is a good decolorising and deodorising agent. (7) The colour slowly returns to bleached samples. (8) The odour of deodorised samples is perceptible on heating, but not on cooling again.

Note on a new method of preparing nitrogen: by H. Rai.

Nitrogen, containing less than 0·2 per cent. of oxygen, can be prepared by the electrolysis of ammonium chloride solution in a cell with a porous diaphragm. It should be collected over caustic soda to absorb chlorine.

Salts of porphyroxin: by J. N. Rakshit.

An alkaloid, porphyroxin, has been isolated in a pure state from Indian opium, and various salts have been prepared and studied.

The resolution of the systems: nitric acid—sulphuric acid—water and nitric acid—water on an industrial scale: by G. S. Butler.

The theory of the process, a description and criticism of former processes, and an account of the author's work in the laboratory and on the large scale are given, leading up to the design of a large scale industrial plant.

An improved process and apparatus for obtaining on an industrial scale concentrated nitric acid from liquors in which this acid is present together with water: by G. S. Butler.

The process, based on the principles outlined in the former paper, is continuous, and is claimed to be the most economical and efficient existing method for obtaining concentrated nitric acid from mixtures of this acid with water and sulphuric acid.

The examination of the potash content of the ashes of Indian indigenous plants: by P. Neogi.

A list is given of Indian plants from the ashes of which potash has been obtained, together with the potash contents.

A note on the adsorptive power of coconut charcoal: by H. E. Watson.

The adsorptive power of charcoal was found to increase with the temperature at which it is made, *i.e.*, it increases as the quantity of volatile matter decreases.

The manufacture of glycerin by means of castor seed lipase: by J. J. Sudborough, H. E. Watson and P. S. Varma (v. this J., 1919, 5 B).

The authors are of the opinion that the method should be able to compete with the Twitchell process for the manufacture of glycerin and of free fatty acids for use in soap and candle-making.

MALT RESTRICTIONS AND THE VINEGAR INDUSTRY.

C. AINSWORTH MITCHELL.

The restrictions on the use of malt during the past year have affected the vinegar industry even to a greater extent than the brewing industry, for whereas the brewer has been able to produce a greater quantity of beer from his rationed material, the vinegar manufacturer has been precluded by the action of the Food and Drugs Act from altering his method of brewing. The allowance of malt to the vinegar manufacturer was fixed first at 75 per cent. and then at 50 per cent. of his usual consumption, and it is only recently that he has again been allowed to contract for the amount of malt required to meet his trade. Simultaneously with the decrease in the output of the manufactured article the stoppage of the sale of acetic acid put a temporary end to the production of the so-called "wood vinegar," and increased the demand for the brewed product. Hence, as soon as the manufacturers had used up their reserve stocks, there was a sudden shortage of vinegar, and it became necessary to ration the retailers, who, in a large number of cases, did not lose their opportunity of exacting a profit of several hundred per cent. upon the sale of an uncontrolled article to the public.

After the exhaustion of their stores of crude vinegar, the manufacturers were forced to send out a newly-made product, since there was no time to allow it to mature as under normal conditions; and this drawback was intensified by the difficulty of obtaining the malt which had been allotted to them. Hence vinegar which in ordinary times would not have left the works until three months after acetification had sometimes to be sent out within a fortnight after the malt had been received.

This omission of the usual period of storage has had several effects upon the vinegar. When crude vinegar is stored for a month or two in closed vats the acetic bacteria die, and the vinegar itself becomes more or less stable in composition, and acquires an aroma through the gradual combination of the acetic acid with traces of unconverted alcohol. Freshly-brewed vinegar, on the other hand, has very little aroma, and even though it has been rendered brilliant by filtration, soon becomes turbid and throws down a deposit, and, if exposed to even a restricted supply of air, will rapidly decrease in strength through the action of the acetic bacteria on the acetic acid. It is within the writer's experience that a crude vinegar may thus depreciate by as much as 0·5 in its percentage of acetic acid within the course of a day or two. Although there is no legal standard for the strength of vinegar the suggestion of the Local Government Board that vinegar shall contain not less than 4 per cent. of acetic acid is generally adopted, and most manufacturers send out their products at not less than 4·1 to 4·2 per cent. to allow for a slight possible depreciation in strength. In the absence of storage, however, it is not surprising that vinegar sent out at this strength should fall to 3·7 per cent. or less in acidity, through the action of the living bacteria supplied intermittently with air drawn into the cask through the spile hole. On these grounds there have been several prosecutions during the

past twelve months for the sale of vinegar containing less than 4 per cent. of acetic acid, but where it has been proved that the vinegar was originally sent out at or above that strength and that it has not been watered, the magistrates have usually held that only a technical offence has been committed.

Even now that the malt restrictions have been practically removed, it is difficult to obtain the malt to meet the present demand for vinegar, and many months must elapse before it will be possible for the manufacturers again to create a reserve store. Hence the conditions attending the sale of immature vinegar seem likely to continue for a considerable time to come. Of course sterilisation of the vinegar would obviate the principal drawback of the deterioration in the strength, but this course is not practicable in vinegar works dealing with thousands of gallons a day.

INAUGURATION OF THE CHEMICAL ENGINEERING GROUP.

The inaugural meeting and dinner of the Chemical Engineering Group of the Society of Chemical Industry were held at the Liverpool Street Hotel, E.C., on March 21. Prof. J. W. Hinchley, Chairman of the Group, presided at the meeting.

Mr. F. H. Rogers, in his report, said that the Committee had estimated the current year's expenditure at £500, and that 382 members had now paid their subscriptions. Mr. H. Talbot reported that the Finance, Bureau of Information, and Standardisation Committees had been formed. The membership was at present made up as follows:—London, 143; Manchester, 43; Liverpool, 29; Edinburgh, 17; Nottingham, 30; Ireland, 6; Egypt, 1; Spain, 2; France, 3; Bristol, 22; Yorkshire, 34; Newcastle, 19; Glasgow, 20; Birmingham, 18; U.S.A., 4; South Africa, 3; and India, 1. Propaganda meetings had been held in Glasgow, Manchester, Liverpool and Nottingham, and one was shortly to be held in Birmingham. Both reports were put to the meeting and adopted. The draft rules were also adopted and the following were elected to the Committee:—Prof. J. W. Hinchley (chairman), E. A. Alliott, H. J. Bush, C. S. Garland, Capt. C. J. Goodwin, H. C. Greenwood, H. Griffiths, E. Hill, H. F. V. Little, A. J. Liversedge, Dr. W. R. Ormandy, J. A. Reavell, F. H. Rogers (Hon. Treas.), and H. Talbot (Hon. Sec.).

Prof. H. Louis, President of the Society, presided at the subsequent dinner. After the toast of "The King" had been duly honoured, the chairman proposed that of "His Majesty's Ministers." In doing so he expressed regret at the absence of Sir Auckland Geddes, owing to labour troubles, of Sir Albert Stanley (President of the Board of Trade), through illness, and of Sir Frank Heath.

In proposing "The Chemical Engineering Group," Prof. Louis said this toast was to have been in the hands of Dr. Charles Carpenter who, unfortunately, was indisposed. The Society of Chemical Industry, after long and very careful consideration, had decided that the formation of subject groups was one which deserved encouragement, and the Chemical Engineering Group was the first to be formed in that way. Personally he greatly rejoiced that he was president of the Society at the time this new departure was made, because chemical engineering had always had his keenest sympathies. He had a strong conviction that chemical engineering had very great possibilities. He did not think the war could have been brought to a successful issue but for the efforts of chemical engineers. Much of the work had been done by chemists who had no engineering training, but who had what he might call the average British aptitude for engineering. He felt confident that the combination of engineering and chemistry would lead to excellent results.

Prof. J. W. Hinchley, replying to the toast, said that the Group had only just come into being, and it had to justify its existence. There were many who were still unable to appreciate the existence of the chemical engineer, and there were many engineers to-day who would not agree that such a person existed. The Chemical Engineering Group was insisting on a special kind of training for the chemical engineer.

The toast of "Our Guests" was proposed by Mr. A. J. Liversedge, who coupled with it the names of the following speakers:—

Mr. Stanley Hicks said that the Salters Company, which had been in existence for 500 years, had recently resolved to march with the times and to establish the Salters Institute of Industrial Chemistry, but the available funds were not to be put into bricks and mortar. Fellowships were now being granted for 1, 2, 3 or 5 years to the best graduate of any recognised university or college with a view to helping these men to return to their colleges and continue their studies. Arrangements were also being made so that some of these men might gain practical experience with some of the large manufacturers.

Mr. Milne Watson spoke as a representative of the gas industry, and acknowledged the great debt which it owed to chemical science. To achieve success the workers in the gas industry must ally themselves with such bodies as the Society of Chemical Industry and the new Group, and cultivate a very close relationship with them.

Dr. E. F. Armstrong said that the future of the chemical industry both here and abroad depended very largely upon the application of engineering to chemistry. Unless engineers came to the rescue of industry, and especially the chemical industry, the outlook was a serious one. Among the great obstacles to chemical industry at the present time were high labour costs, dear and bad coal, and Government control. During the past few days he had been speaking to some of their colleagues who had been visiting the occupied territories of the Rhine, and who had seen the works put up by the great German chemical firms during the war. In England, owing largely to the facts that the chemist had never been interested in engineering and the engineering trades had taken precedence over everything else, the chemical industry came a very bad second in the race for any materials which it required. Those who had been to the Rhine reported that the German companies had never been stinted for a single thing, with the result that they had been able to build factories regardless of cost. In this country the industry had been strained to the utmost. Repairs had been allowed to go undone, depreciation had not been properly provided for, and temporary Government factories had been built which had done admirable work, but they were mostly constructed in a way which made them unsuitable for peaceful purposes, and they had been put down in places which made them totally unsuitable for ordinary methods of industry. He made no reflexion upon the policy of the Department of Explosives supply. German chemical engineers had still a good deal to teach us, and we must not run any risk of disparaging our German competitors in the future. He regarded the foundation of the Chemical Engineering Group as a portent of very great promise.

Mr. Frank Hemingway congratulated the Society on the formation of the Group and upon the fact that it was part of the parent Society. On

the other side of the Atlantic there were many societies pursuing the same end, and in consequence their efforts were somewhat diluted: it would have been better if they could have held together, as was being done in England.

Sir Alfred Keogh said that in his capacity as head of the Imperial College he had been acquainted with the importance of chemical engineering for many years. It was owing to their knowledge of its great importance that some few years before the war they started instruction in that subject. Unfortunately, owing to lack of funds they were unable to build a department worthy of it, but the matter was continually before the governors, and when the time came it was hoped to include in the new buildings a department of chemical engineering.

The final toast was that of "The Chairman," proposed by Mr. C. S. Garland, and responded to briefly by Prof. Louis.

NEWS FROM THE SECTIONS.

CANADIAN PACIFIC.

Owing to the prohibition of public meetings by the Provincial Board of Health, the first meeting of the Section in the present session was not held until December 14 last.

After the customary dinner at the University Club of Vancouver, an open discussion was held on "The Organisation of the Profession of Chemistry in Canada." Prof. McIntosh reported on the action taken at the Convention of Chemists, held last June at Ottawa under the auspices of the Canadian Section of the Society, by which a Chemists' Organising Committee was appointed. The progress which had been made in this work was indicated particularly with regard to the definition of a "chemist." Following this, the various British organisations of chemists and analysts were discussed and the progress made by the British Association of Chemists in negotiations with the Institute of Chemistry. In this regard it was pointed out that the Institute had no legal status in Canada although it doubtless had considerable moral or professional effect. It was concluded that no further action by the Section was in order, especially in view of the memorial presented by Mr. Berkeley, who represented the Section at the Convention in June.

On December 11, members of the Section attended a lecture under the auspices of the University Club of Vancouver, when Prof. D. McIntosh, of the University of British Columbia, gave a most interesting description of "War Gases." The development of those offensive materials was described, the method of manufacture, projection and absorption by masks. Compared with equal weights of explosives, it was shown that the various types of war gases had a very great advantage on account of their diffusive and penetrating properties and their effect in demoralising transportation and reducing *morale*. The quantity production of these gases in the United States was described, and also the development of new gases (in which research Prof McIntosh had been actively engaged). The possibilities of extending such barbarous methods of warfare to the extermination of whole armies made it necessary that chemists of the allied countries should not cease their investigations on this subject. Samples of the various substances used in filling shells and respirators were exhibited during the lecture.

NEW YORK.

At the January meeting, held at the Chemists' Club, the chairman, Mr. C. E. Sholes, announced that the arrangement made to hold joint meetings with the American Chemical Society during this session would be cancelled. Owing to the cessation of hostilities, the need for such an arrangement had now passed, and consequently the April meeting will be held as originally planned, and the Grasselli Medal will then be awarded. This medal has been founded by the well-known company whose name it bears, and is to be awarded each year for the best thesis which, in the opinion of the Committee, suggests or records the newest and best helps or accomplishments in applied chemistry.

As a part of the business of this meeting, and in view of the very great events which had happened since the last, the chairman had asked the vice-chairman, Dr. P. C. McIlhiney, to propose a congratulatory resolution to the parent Society. After some further remarks, the chairman called upon Mr. C. H. MacDowell, recently Chief of the Chemical Division of the War Industries Board, to address the members, after which Dr. C. F. Chandler, past-president of the Society, addressed Dr. C. F. Cottrell, of the Bureau of Mines, and presented to him the Perkin Medal for his distinguished work in the field of electrical precipitation. Dr. Chandler's speech, Dr. Cottrell's reply, and an appreciation of Dr. Cottrell's work on the de-emulsification of California oils by Mr. B. Speed will appear in the next issue of the Transactions.

LIVERPOOL.

A meeting was held on February 21 in the University to hear a paper by Mr. W. Clayton on "The Modern Conception of Emulsions." Mr. A. T. Smith was in the chair.

The author started with a brief account of the physico-chemical theory underlying the subject, *e.g.*, Willard Gibbs' mathematical relationships bearing on surface tension and adsorption at the interface of immiscible liquids, and the formulæ of Freundlich and Donnan. The electrical forces involved in the dispersion of an oil in a non-miscible medium so as to form an emulsion were then discussed, reference being made to Ellis's measurement of the potential difference (P.D.) between the oil globules and the continuous medium, *viz.*, about 0·05 volt, independent of the kind of oil used. This contact P.D. is intimately connected with the stability of an emulsion and can be decreased (and the stability diminished) by the addition of, say, mineral acid. Powis showed in 1914 that if the P.D. is decreased there is approached a critical value (about 0·03 volt) where an emulsion is most stable—and so the point of complete instability need not necessarily coincide with a zero potential, the so-called iso-electric point. Of the theories which have been advanced to explain the process of emulsification, those of Ostwald, Fischer, and the "Viscosity Theory" were discussed, and the work of Bancroft, Pickering, Briggs and Schmidt, Schlaepfer and others was referred to.

With regard to emulsion-formation in general, an emulsion of oil in water is produced if the emulsifying agent is a colloid soluble in water, or more easily wetted by water than oil, and an emulsion of water in oil is obtained when the emulsifying agent is an oil-soluble colloid or is more readily wetted by oil than water. In the investigation of emulsions the nephelometer and the drop-pipette or stalagmometer are useful instruments, and there are possibilities in research on the electrical conductivity, etc., of emulsions, in which direction little has been done hitherto.

MANCHESTER.

The adjourned discussion on the Chemical Engineering Group was resumed on March 1, with Mr. W. Thomson in the chair.

Dr. J. Grossmann, in a written communication, criticised the formation of the Group; in his opinion it might lead to disintegration, as membership would confer no special status unless a special charter were obtained. Under the conditions suggested, any workman or works foreman could set up as a chemical engineer. After a few remarks from Dr. R. B. Forster in support of the Group, Dr. W. R. Ormandy, replying to Dr. Grossmann, said that the new Group would confer no rights or title, being merely intended to enable its members to keep their knowledge up-to-date. If a workman had sufficient enterprise to join the Society and to attend the meetings of the Group, he would have a chance to attain a more important position in the profession. The tendency of the times was democratic, and it was necessary to democratise existing institutions. After a lengthy discussion, in which comparatively few members took part, the principle of the formation of the new Subject Group was approved by a large majority of those who voted.

In "A Note on a Deposit in Refined Soya Bean Oil," Mr. R. Brightman described an investigation into the nature of a white flocculent sediment which occasionally formed in the refined oil. The amount was very small but was sufficient to inhibit burning; after removal by filtration the burning power was restored, but in a diminished degree. By crystallisation from alcohol, a white neutral substance was obtained, which melted at 32° C., contained 7 per cent. of sulphur, and had a saponification value of 94·3. The experiments performed led to the conclusion that the deposit consisted of a complex sulphonated glyceride.

Mr. J. J. Bloch then contributed "A Note on the Reduction of the Nitrile Group," in which was recorded a number of experiments with benzyl cyanide and some of its derivatives. The yield of phenylethylamine by reduction of benzyl cyanide with sodium and alcohol was made very regular, at 35—40 per cent., by the addition of toluene. Attempts to obtain other reduction products from derivatives of benzyl cyanide proved unsuccessful.

EDINBURGH.

The Annual General Meeting was held on March 11, Mr. D. B. Dott presiding. The report on the work of the session (*v.i.*) was read, and Mr. J. Strachan then presented a paper on "The Origin of Errors in the Testing of Wood Pulp for Air-Dry Content."

After referring to the recent notable contributions to wood pulp testing by Lester (England) and Little (U.S.A.), the author stated that the adoption of official methods of sampling had not led to the uniformity of results expected. Errors are due to variations in distribution of moisture, and to variations in conditions of testing, the chief cause of the latter being inefficient methods of drying the samples. Specific errors in carrying out pulp tests are:—(1) Errors in selection of bales; (2) errors in drawing samples, in connexion with which the theory of pulp sampling as laid down by Lester, Griffin and Sindall was discussed and the mathematical reasons for varying the size of sample demonstrated by examples from actual practice; (3) errors in moisture estimation, which are mainly due to bad designs of drying ovens. The question of temperature of drying was fully discussed and a *résumé* given of the conflicting opinions of chemists in Europe and America. The error arising from drying at 100° C. until weight is constant may be quite appreciable, and in the case of badly designed ovens sometimes very large.

The second paper was by Mr. G. H. Gemmell on "The Duties of a Chemist in a Paper Mill." The author stated that, as a rule, the paper-maker does not employ a chemist, because he has no very clear idea of the kind of work he could give him to do. There are 55 paper mills in Scotland, and in 9 only of these are chemists employed. Six of the nine are in receipt of a weekly wage, having no control or responsibility for the working processes, and being entirely engaged in routine work in the laboratory. Why is this? One paper-maker is stated to have said that when he was making money he did not require a chemist, and when he was not, he could not afford one. This is where some think he was wrong. If he had had the right type of man when he was making money, he would have made more, and probably would never have been in the latter position. The range of work required from the chemist varies with the type of mill. In esparto mills, he should have control of the boiling, washing, evaporation, and causticising of the soda liquors, and in the laboratory should be able to make experimental boilings to determine the theoretical yield of fibre, the proportion of bleach required and the loss in bleaching; he should examine the lime sludge from the causticising kettles, the bleach sludge, and perform laboratory tests on the caustic bleach and alum liquors, etc. Dealing with the importance of checking wood pulp deliveries, the author stated that in 18 years his firm had sampled and tested for moisture 1806 deliveries, representing 159,182 tons of wood pulp. Of these, 1442 parcels were short weight, to the extent of 4442 tons, representing a money value of £71,300. It is strange, but true, that there are still paper mills in Scotland where the wood pulp is never tested. In others, the timekeeper, storekeeper, or office boy makes the test. The author then enumerated a number of other duties which should fall to the lot of a qualified paper-mill chemist, and concluded by asking, "Where can such a man be found?" Answer: he must grow and develop in the mill. The paper-maker should pick out some of his young men and give them facilities to obtain the necessary training.

Mr. Dott showed a specimen of sulphate of iron which had crystallised in stalactite form on the roof of one of the mines at Wallyford colliery (Midlothian). He found 95·5 per cent. calculated as $FeSO_4.7H_2O$. The remainder was mostly sodium sulphate with a small proportion of aluminium and magnesium sulphates.

The Hon. Secretary's report states that seven meetings were held during the session, and that the average attendance was 35. The informal meeting held in January was particularly successful, and it is proposed to have a similar meeting next session. Two interesting meetings were held at works, and the Section is greatly indebted to the managers of the North British Rubber Co., and of Messrs. Brunton's Research Laboratories, Musselburgh, for their hospitality. The invitations to attend the meetings extended to the members of the University Chemical Society met with a satisfactory response. The Committee urges the members of the Section to bring the meetings to the notice of the younger chemists of the district, and to give them a cordial invitation to be present.

The membership of the Section has increased during the past session from 111 to 136, an increase of 25; there are also several applications for membership at present before the Council. An appeal is again made to the members to do all in their power to increase the membership. Mr. D. B. Dott, who has been chairman of the Section for the last two years, retires by rotation at the end of the present session. The Section owes much to him for his

unfailing interest in its work. Four members of the Committee retire by rotation, *viz.*:—Messrs. J. G. Annan, J. Rutherford Hill, A. W. Sim, and Allan Smith.

It will be remembered that in February, 1918, the Section convened a meeting of chemists resident in Edinburgh and the East of Scotland, to consider the better organisation of the chemical profession. Arising out of this meeting, a local Section of the Institute of Chemistry was eventually formed in October, 1918. The work of this new society will not conflict in any way with that of this Section; on the contrary the Committee is fully confident that the best relations will obtain between the two, and that their mutual interests will be furthered by co-operating, when necessary. The new list of officers is as follows:—Chairman Dr. D. S. Jerdan, Vice-chairman Dr. H. E. Watt, Hon. Sec. and Treasurer Dr. A. Lauder. Committee: Mr. A. T. Adam, Dr. A. C. Cumming, Mr. A. M. Cameron, Mr. D. B. Dott, Prof. J. Hendrick, Mr. B. D. W. Luff, Mr. A. Middlemass, Mr. B. D. Porritt, Mr. J. W. Romanes, Mr. W. L. Thomson, Prof. J. Walker, Mr. A. W. Williams.

GLASGOW.

At the February meeting, Mr. J. Bibby presented a paper on some recent developments in the electro-metallurgy of iron and steel. Mr. Quintin Moore presided. After referring to the advantages possessed by the electric method of ore reduction, *viz.* the attainment of a much higher limit of temperature and the transference of heat energy to the material out of contact with oxidising gases, Mr. Bibby proceeded to describe the manufacture of pig iron by electric smelting, and to compare and contrast it with the ordinary blast furnace method. The electric furnaces are usually built in units of 4000 h.p. having a capacity of 1000 tons per month. The electric furnace is especially suitable for the refining of steel, since a reducing atmosphere can be maintained above the bath, but in order to ensure uniformity in the reactions it is essential to maintain a regular heat distribution over the bath. Four electrodes are found to be sufficient for a 30-ton furnace.

MEETINGS OF OTHER SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHIC SOCIETY.

A paper entitled "The Post-graduate Training of the Works Chemist" was read by Mr. F. H. Carr, at the meeting held on March 4. The President, Mr. W. Thomson, was in the chair.

The author said that the comparative dearth in this country of highly competent technical chemists had frequently given rise to discussions, but these had as a rule been critical rather than constructive. He suggested that there was scope for Institutions devoted primarily to the post-graduate training of chemical students who intended to specialise in the applied aspects of their science. In such institutions, instruction would be given not only on a wide variety of technical processes for the manufacture of chemicals, and in operations in each technical department, from the drawing office and the power house to the special chemical plants, but also in the whole question of economic and statistical control of works processes. The chemicals produced should cover an extremely wide range, and should be such as might be required in relatively small quantities such as existing manufacturing firms would not find it worth while to produce. In this way the Institutions in question might, in course of time, accumulate stocks of chemicals comparable in variety with those in the possession of certain German firms on whose resources research chemists in all parts of the world have had to rely.

SOCIETY OF DYERS AND COLOURISTS.

The paper on "Effluents," read by Dr. H. T. Calvert to the West Riding Section on March 6, was mainly concerned with waste liquors from the textile trades. To these trades (which in 1913 produced goods valued at £400,000,000) the question of water supply is of very great importance. Local supplies are becoming exhausted, and further supplies, if available, will have to be brought from a distance; so that quite apart from the increased cost of labour and materials, the manufacturer will have to pay more for his water. In the use of water for manufacturing purposes there are many opportunities for conservation, either by restricting the use, or by re-using water for more than one process with or without an intermediate purification.

At the present time about half the manufacturers in the country discharge their effluents into the public sewers, and it is very desirable that legislation applicable to the whole country should be passed at an early date, in order that manufacturers may make terms with the local authority for the reception of their effluents.

Dr. Calvert then suggested a number of lines of research in the recovery of by-products from effluents, and expressed regret that no serious attempt had been made during the war to recover potash from wool scourings. The trade processes which give rise to polluting liquids in the textile industry may be divided into those in which the raw materials are prepared for further operations by the removal of naturally adhering substances, and those in which the semi-manufactured goods are finished or dyed. The effluents from the former class contain as a rule much more organic matter than those from the latter, and the method of purification has to be selected in accordance with this fact. In all cases it is necessary to remove suspended solids and to neutralise the effluent before it undergoes further treatment by, preferably, filtration through biological filters. A plea was made for a more scientific consideration of sedimentation problems with regard to the removal of suspended solids.

Whereas the biological method has been applied mainly in the purification of domestic sewage, chemical treatment by water-softening has been the rule in the purifying of trade wastes. In both cases efforts have been made, with some success, to economise space in the construction of plant on limited sites. Further progress will be effected when manufacturers come to regard effluent treatment as one of their manufacturing processes, and to realise that such treatment, even if apparently unproductive, may be economical by allowing of the use of river water instead of towns' water.

THE CERAMIC SOCIETY.

At a meeting held on March 10, at Stoke, Dr. J. W. Mellor contributed "A Note on Blue Glass." In the early days of Zeppelin raids, there was a demand for a blue glass for lamp bulbs. Nothing seemed simpler than to colour the glass with a little cobalt oxide, but it was found that the incandescent filament appeared red through this coloured glass, and to a short-sighted person the lamp seemed to glow with a red light surrounded by a blue halo. It was therefore desired to cut out the red rays.

The ordinary use of blue in the laundry, and the similar application by potters of blue stain (made with cobalt oxide) to correct the creamy tint caused by iron oxide in their white bodies, suggested that the introduction of a green-colouring oxide into the glass might serve to cut out or mask the complementary red. Copper oxide was first tried, but failed to cut out all the red; a small proportion of chromic oxide with the cobalt oxide, however, proved perfectly satisfactory, giving a glass which transmitted nothing but blue rays.

Photographs of the absorption spectra of the various glasses showed their effects on the light.

The staining mixtures for the glass were composed of 20 parts copper oxide to 80, 40, 20, 10, and 5 cobalt oxide, the percentages used as stain being 2·5, 3, 4, 3, and 5 respectively. Also 20 parts chromic oxide to 200, 150, 60, 25, and 10 cobalt oxide, the percentages used as stain being 2·2, 1·7, 1·2, 0·9, and 0·6 respectively. The percentages used of the separate oxides were 4, 2, and 0·4 for copper oxide, cobalt oxide, and chromium oxide respectively.

The glasses were annealed and then ground down to plates of 0·5 mm. thickness. The spark spectrum of nickel (in air) was used as a standard, and each exposure was for thirty seconds.

In passing it was noticed that in the cure of the chromic oxide with cobalt oxide glasses, a tint approaching ruby red was sometimes developed.

A paper on "Pottery on the West Coast of Africa" was read by Mr. D. Roberts.

ROYAL SOCIETY OF ARTS.

At a meeting held on March 5, Prof. Wyndham R. Dunstan in the chair, a paper entitled "The Rubber Industry, Past and Present" was read by Mr. B. D. Porritt, chief chemist to the North British Rubber Co., Ltd., Edinburgh.

The first extensive use to which rubber was put was in making waterproof cloth, and this branch of the industry received a great impetus at the time when the making of coal gas began to be carried out on a large scale. Little further progress was made until 1840 when Goodyear in America made the discovery of "vulcanisation." The details of the process were kept secret, but Hancock, working in this country, succeeded in 1843 in reproducing the necessary conditions after a long series of experiments. Although Goodyear was undoubtedly the first to produce articles of vulcanised rubber, Hancock must be regarded as the "Father of the Rubber Industry," as his early work supplied us with the essential processes of milling, compounding, moulding and spreading rubber.

The development of the industry progressed rapidly at this period, but for the past sixty years no fundamental improvements have been effected in manufacturing operations. Enormous changes have, however, taken place in the character of the industry. Hancock was probably the first to suggest the possibility of cultivating caoutchouc-bearing plants, a project to which he drew attention in 1855. This was subsequently realised as a result of the enterprise of Wickham to whom the plantation industry largely owes its inception. It is as producer and not as manufacturer that Britain now retains a predominant place in the rubber world, 70 to 80 per cent. of the world's supply being now produced within the Empire.

Turning to manufacture, the lecturer pointed out that whereas in ten years the United States had increased its consumption of crude rubber from 24,000 to 177,000 tons, Great Britain, the next largest manufacturer, increased hers from 14,000 to 26,000 tons. If the British manufacturer is to compete successfully with his rivals in the world's markets the practical man of the early days must be supplemented by the modern trained specialist. The data necessary for developing factory control, evolving new processes of manufacture and devising fresh applications for rubber, can be obtained only by systematic and careful research into the chemical and physical properties of caoutchouc and other colloids.

In spite of the enormous amount of attention given to the problem of synthetic rubber during recent years, a satisfactory substitute has not yet been produced. Nevertheless, the rubber trade might well contemplate the future and decide whether the risks incidental to existing conditions are sufficient to justify, on commercial and national grounds, the cost of an investigation into the synthesis of rubber.

In his paper on "The Distribution of Heat, Light and Motive Power by Gas and Electricity," read on March 19, Sir Dugald Clerk dealt with the relative efficiency of gas and electricity with special reference to coal conservation. About 20 million tons of coal of an average calorific power of 13,000 B.Th.U. are carbonised yearly by the gas industry, and the average thermal efficiency, when all the products are burnt, is about 71 per cent., 25 per cent. of this being attributed to the coke and tar. If the whole of the 29 per cent. of heat lost in gasification is debited to the gas, the thermal efficiency of the gas-making process is reduced to 46 per cent. The electrical industry generated 4674 million units in the year ending March 31, 1918, from 7·3 million tons of coal of calorific power 11,600 B.Th.U. The amount of heat obtainable from the current produced was 8·5 per cent. of the heat of the coal. Hence the relative efficiency of gas and electricity was 46 : 8·5 = 5·4 : 1. Allowing for unutilised heat in gas fires, the relative efficiency becomes 4 : 1.

The inverted incandescent gas lamp requires 47 B.Th.U. for each candle-power-hour obtained by the consumer, the 1-watt electric lamp requires 54 B.Th.U. and the ½-watt lamp 31 B.Th.U.; but the high pressure incandescent gas lamp requires only 23 B.Th.U., and the electric arc lamps only 15 B.Th.U. Thus there must be keen competition between gas and electricity for lighting purposes. As regards power, an ordinary gas engine working at 75 per cent. of full load will deliver, in actual horse-power, 11 per cent. of the heat used at the gas works; an electric motor will give 6·8 per cent. of the heat used at the electric generating station. Therefore the relative efficiency of production and distribution in this case is about 1·6 : 1.

With regard to the proposed establishment of electric super-stations, the author pointed out that the anticipated efficiency of 19·6 per cent. was 2·3 times greater than that actually achieved, on the average, in the past. But the gas industry also anticipated great improvements, and in the near future expected to attain an efficiency in gas production of 75 per cent., and of 93 per cent. in distribution. Assuming the distribution of coal gas generated to be 55 per cent. for heating, 35 per cent. for lighting and 10 per cent. for motive power, the substitution of electricity, generated at existing power stations for all three purposes, would involve the consumption of 2·65 times as much coal: and even if the anticipated efficiency of the super-power stations were attained, and no improvements were effected in gas production, the coal consumption would still be 1·91 times greater. The use of electricity as the sole source of heat, light and power would be fatal to the prosperity of the country. There was plenty of scope for electricity for special purposes, and it could not be dispensed with. All coal should be carbonised before combustion, whether for domestic or industrial purposes; and where the conditions permitted, as in the case of municipalities, gas and electricity

should be generated at the same works so that waste heat could be utilised, and the coke employed in adapted steam-boiler furnaces for the production of electricity and for other purposes.

INSTITUTE OF CHEMISTRY.

The London and South-Eastern Section of the Institute of Chemistry was formed at a meeting held at 30, Russell Square on March 14.

Sir Herbert Jackson, President, in opening the proceedings, said that the Local Sections already formed had demonstrated their usefulness and were taking an active part in assisting the Council in promoting the interests of the profession of chemistry. The Council desired that Local Sections should have a free hand in the conduct of their business.

Dr. Bernard Dyer having been elected to the Chair, the Section was declared duly formed. A Committee was elected as follows:—Mr. C. T. Abell, Dr. O. L. Brady, Mr. A. J. Chapman, Miss E. M. Chatt, Dr. Bernard Dyer, Mr. A. V. Elsden, Mr. Norman Evers, Mr. J. A. Gardner, Mr. C. S. Garland, Dr. W. H. Gibson, Mr. W. H. Harrison, Mr. E. M. Hawkins, Prof. J. W. Hinchley, Prof. P. H. Kirkaldy, Mr. F. H. Lees, Mr. T. Macara, Mr. W. A. C. Newman, Mr. F. M. Potter, Mr. F. M. Ray, and Mr. J. Miln Thomson. Mr. W. Bacon was appointed Hon. Secretary, *pro tem.*

The draft rules for Local Sections were provisionally adopted and a general discussion ensued on the proposed revision of the bye-laws for the election of the Council of the Institute.

At a meeting of Fellows and Associates held recently at Newcastle-upon-Tyne, it was decided to form a Local Section. Prof. P. Phillips Bedson presided, and the Registrar of the Institute was also present. A Committee was appointed consisting of Prof. Bedson, Dr. J. T. Dunn, Prof. H. Louis, Mr. R. A. Moore, Mr. C. H. Ridsdale, and Mr. Thomas Wallace. The Committee was empowered to add three to its number, and Dr. Dunn was appointed Hon. Secretary, *pro tem.*

INSTITUTION OF MINING AND METALLURGY.

"The Volatilisation of Gold" was the subject of a paper read before this Institute by Sir T. K. Rose on March 20. The results of the investigation showed that at the temperatures of industrial melting furnaces, 1000°—1300° C., the volatilisation of gold, even in a strong draught, is so exceedingly small that it cannot be measured with accuracy. All alloys of gold with silver or copper suffer appreciable loss through this cause unless they are protected with a cover of slag. The loss is due to the ejection of very minute globules of the alloys when the occluded gases leave the molten material. Those alloys which when molten take up oxygen, spirt or effervesce when placed in a reducing atmosphere; those which occlude hydrogen, or carbon monoxide, behave similarly in an oxidising atmosphere. Fine silver and its alloys with copper also spirt freely.

THE SALTER'S INSTITUTE OF INDUSTRIAL CHEMISTRY.—Post-graduate fellowships have been awarded to the undermentioned students of chemistry whose training has been interrupted by war service. Their studies will be pursued at the universities or colleges indicated: W. H. Gough, B.Sc., and W. A. Haward, B.Sc. (Imperial College), Capt. L. J. Hudleston, B.Sc. (Reading University College), Lieut. K. H. Saunders and G. M. Wright, B.Sc. (Cambridge University), P. N. Williams, B.Sc. (Liverpool University), and Lieut. D. C. Vining (Finsbury Technical College).

NEWS AND NOTES.

CANADA.

Maple Sugar and Syrup.—The Canadian maple sugar and syrup crop of 1919 should be a good one. Dealers report many inquiries by the export trade, and prices will be profitable. Only 50 per cent. of the sugar maples in the average sugar bush are tapped for a crop of sugar and syrup each spring. Prices have been high during recent years, and the demand has been greater than the supply. There are prospects of large orders from France, where the sugar has been introduced by Canadian soldiers and a taste for it acquired.

The eastern townships of Quebec form the centre of the world's supply of maple products. The acreage under maple in Canada is 550,000, of which two-thirds is in Quebec. The number of producers of maple sugar and syrup in Canada is stated to be about 45,000 (see this J., 1918, 277 R).

Pulp and Paper.—The Canadian Bureau of Statistics places the total capital invested in the pulp and paper industry in the Dominion, including land, buildings, machinery, stocks on hand and "working" capital, at £37,274,981 for 80 companies, 31 of which are engaged in the manufacture of pulp only, 20 in the manufacture of paper only, and 23 in both pulp and paper production. The aggregate value of production in 1917 was £19,249,764.

The technical section of the Canada Pulp and Paper Association has organised an educational campaign for its workmen, and text books are being prepared. The sum of $30,000 has been subscribed by the paper industries in Canada and the North Eastern part of the United States for the purpose of developing technical education among the employees. In this way it is hoped to facilitate the provision of a greater number of workers capable of directing large scale plant and mill operations.

Engineering Institute of Canada.—The annual meeting of the Engineering Institute of Canada was held at Ottawa from February 11—15. The president-elect, Lieut.-Col. R. W. Leonard, is also president of the Coniagas Reduction Company, one of the largest producers of refined silver in Canada. Some four hundred members were present and various engineering topics were discussed, such as highway engineering, tunnelling, electrification of railways, and production of Cobalt silver ores. Both Provincial and Dominion Governments are preparing to spend large sums on national highways, and this particular branch of engineering will be very important in Canada for many years to come. In his address, Lieut.-Col. Leonard stated that there were three companies in Ontario engaged in the smelting and refining of Cobalt ores. Formerly the refining was carried out abroad, but this policy is found to be very detrimental to Canadian industries, and now most of the cobalt used in the world is made in the Canadian works by reduction of the oxide with carbon and melting the metal in an electric furnace. The cost of mining, milling and refining the fine silver produced in 1918 by the Coniagas Co. amounted to 41·35 cents per ounce.

AUSTRALIA.

Tasmanian Iron Ore Deposits.—The Australian Federal Government has acquired a twelve months' option over the Blyth River iron ore deposits in Tasmania. The price asked by the present owner is £110,000 in cash, or £60,000 cash and one-twentieth interest in any company to be formed, the capital of such company to be not less than £1,000,000.—(*Iron and Coal Tr. Rev., Mar.* 7, 1919.)

Coal Discovery in Queensland.—It is reported from Queensland that coal has been discovered on a large area of land held by the State on the Styx River, between Rockhampton and Mackay, and boring operations have disclosed a seam 5 ft. 6 in. thick. When the railway to Mackay has been completed, the new coalfield will be linked up with the northern sugar area, and supplies of coal will be of great importance to the nine sugar mills operating in that district. Shaft sinking has been started.—(*Iron and Coal Tr. Rev., Mar.* 7, 1919.)

SOUTH AFRICA.

Science and Industry in South Africa.—The Minister of Mines and Industries has approved of an amalgamation of the Industries Advisory Board and the Scientific and Technical Committee. The amalgamated body will be known as the Advisory Board of Industry and Science. The Minister has been pleased also to approve of the following nominations: Mr. C. G. Smith, chairman of the Industries Advisory Board, as chairman; Mr. Bernard Price, chairman of the Scientific and Technical Committee, as deputy chairman; and Mr. E. Chappell, vice-chairman of the Industries Advisory Board, as deputy-chairman.—(*Official.*)

Van Rhynsdorp Marble Deposits.—A report has been received from the Inspector of Mines, Cape and Free State Inspectorate, respecting a marble proposition which has been opened up in the Van Rhynsdorp district of the Cape Province, and which is about to be exploited on a commercial scale. The deposit contains large reserves of marble, which are readily accessible and easily mined; and the mineral is said to cut and polish splendidly. The company which is to develop the proposition has already bought cutting and polishing machinery, and is preparing to transport it from Johannesburg to the property.

The Salt Industry.—During the last five or six years the salt industry has made such strides that the local production is now sufficient to meet all demands, besides leaving a small margin for export. In 1913, the Union imported 11,364 tons of salt (including 1210 tons of rock salt), whereas in 1917 the imports had fallen to 2556 tons. On the other hand, exports during the same period rose from 47 tons to 3025 tons. The latter figures refer to coarse and table salt only, as rock salt does not occur in the Union, although there appears to be no reason why artificially prepared rock salt should not be produced locally at a price equal to that of the imported article. The total production of salt of all kinds in the Union increased from 47,992 tons in 1913 to 57,984 tons in 1917.—(*S. Afr. J. Ind., Dec.*, 1918.)

The Steel Industry.—In the Government Mining Engineer's Report for 1917 reference is made to the present position of the Union's steel industry. At the Union Steel Corporation's works at Vereeniging, rails, bars, angles, skip wheels, loco wheels, cast steel pistons for the South African Railways, and steel castings for hydraulic presses for baling wattle bark, etc., are being produced. The chief items of plant are a 10—12 ton Siemens gas-fired open hearth furnace, a 20-ton Siemens regenerative furnace, a 22-in. cogger complete with producers and steam-raising plant, a gas-fired regenerative furnace for the cogger, and a complete nut and bolt making plant for sizes up to 1½ in. diameter. Two 3½-ton Héroult electric furnaces are to be installed for the purpose of carrying out a contract for 10,000 shoes and dies for the mines, but they will also be capable of producing the highest grades of tool steel, etc. Steel castings up to 5 tons weight have been produced, and to meet exceptional circumstances castings up to 10 tons could be dealt with.—(*Official.*)

BRITISH INDIA.

Cinchona Cultivation in Bengal.—The output of quinine from the Indian factories for the three years 1916—18 is stated to be 192,000 lb., an average of 64,000 lb. per annum. The Indian plantations appear to be increasing their output, the figure for the year 1917—18 being 618,073 lb., and owing to the fact that the consumption of the quinine factories was only 654,093 lb., the amount of imported bark so used has shrunk from about one-third of the total consumption (as in former years) to quite a small percentage of the whole; and the country would appear to be very nearly able to supply the factories with their full requirements. The bark harvested is apparently of fair quality although not up to the standard of the average shipments from Java. The average percentage of quinine sulphate is given as 4·53, and from the production of other alkaloids for the year, one may deduce that the bark also contained, approximately, cinchonidine and cinchonine sulphate 2·0 per cent., quinidine sulphate 0·2 per cent., and amorphous alkaloid as sulphate 0·2 per cent. A considerable proportion of the factory output is in the form of febrifuge, 8518 lb. having been produced, as compared with a total output of quinine sulphate of 29,417 lb. This febrifuge contains presumably the bulk of the cinchonine present in the bark with small proportions of the remaining alkaloids.

The average cost of the bark is given as $0·05—$0·07 per lb., which would make the cost per unit of quinine in bark (assuming that the average test given above is correct) about 0·66*d.* As regards manufactured quinine the cost of extraction is given as $1·06 per lb., bringing the total cost of the quinine sulphate produced by the Indian Government to $2·40 per lb. The Indian Government was therefore able to distribute quinine sulphate at a cost of about 7½*d.* per oz., while the lowest market rate during the period was 2*s.* 4½*d.*—(*U.S. Com. Rep., Jan.* 28, 1919.)

Government Ironworks in Mysore.—A Government ironworks is to be erected at Benkipur, Mysore. The scheme will be entirely financed by the Mysore Government, and its management placed under the control of a board of three representatives of the Government and two of the Tata Iron and Steel Co., which will manufacture pig-iron for the Mysore Government.—(*Iron and Coal Tr. Rev., Mar.* 7, 1919.)

Mineral Output in 1917.—The notable increase of over 34 per cent. in the production of chrome ore was mainly due to the operations in Baluchistan and Singhbhum. The latter locality also contributed a very great increase in copper—20,108 tons as against 2173 tons in 1916. It is hoped that the smelting operations of the Cape Copper Co. will add further to the production of this metal. The Tata Iron and Steel Co. produced 167,870 tons of pig iron, and 114,027 tons of steel, including steel rails; whilst the Bengal Iron and Steel Co. produced 80,262 tons of pig iron and 2256 tons of cast-iron castings. The production of jadeite increased from 3783 cwt. to 3961 cwt. There was a very large increase in the output of lead from the Bawdwin mines, *viz.*, 71,000 tons in 1917 against 14,000 tons in 1916. The value of the salt production was £983,157, as compared with £728,358 in the previous year. Of the rarer ores, the output of molybdenite rose from 202 tons to 626 tons; and the 20 per cent. increase in the output of wolfram was contributed to by the Rajputana States, where, however, operations are limited by the scarcity of water. (See also this J., 1919, 8 R.)

UNITED STATES.

Change Over Plans and Activities.—The United States Government is said to have about $300,000,000 invested in chemical plants, and that it intends to dispose of some of these establishments at an early date. No decision has been made with reference to the future of the nitrate plants in which at least $75,000,000 is invested. A fairly adequate idea of what is involved in getting the American chemical industry upon a sound peace foundation may be obtained from a recent offer by one firm to sell its war plant costing $100,000,000 for a mere $6,000,000.

The great plant, costing $6,000,000, established in California to work upon kelp has been closed down. The primary product of this plant was acetone and not potash, as some think, and it is the property of a powder company which used all the acetone for its own purposes. Investigations upon solvents of other kinds, and upon a variety of kelp products, are being continued, some of the work being still upon a laboratory scale.

The Government is interesting itself in the permanency of the American potash industry and the Secretary of the Interior is interested in a Bill recently introduced with that object.

Now that toluol and other needed raw materials are plentiful the dye manufacturers are paying more attention to needed vat colours. At least three can now be obtained, including indigo, in ample quantity.

Solvent Recovery.—The solvent recovery plant now being installed by one of the great rubber companies is designed upon new lines and is calculated to save about 20,000 gallons a month. One of the novel features involves immersing an entire pump in a bath of oil in order to control the temperature and prevent undesirable condensation of vapours at that point.

Burnt Clay for Gravel in Concrete.—At one of the Southern shipyards no gravel for concrete ships was to be had, and the method adopted to remedy the deficiency has aroused some interest. The native clay was fired at the correct speed and temperature in a rotary kiln, and the resulting hard, porous lumps of the right size made a strong concrete more buoyant than the usual material. The resulting ships are of higher rating with respect to carrying capacity than those of ordinary concrete or wood, and nearly equal to steel ships.

Work of the Bureau of Mines.—During 1918 the Bureau of Mines devoted almost its entire efforts to war purposes. Perhaps its most notable achievement was the development of a great laboratory in Washington for the study of gases used in warfare. Starting with a small nucleus of men, about fifty in number, who had been engaged in the study of mine gases, the chemical staff had grown to 1700 by the end of 1918. The Bureau also contributed to the development of an efficient mine-rescue breathing apparatus, carried out numerous tests on explosives and acted as a central source of technical information on the subject of fuel conservation, advising the U.S. Fuel Administration in this connexion.—(*Coal Age, Jan.* 1919.)

GENERAL.

British Association for the Advancement of Science.—The annual meeting will be held at Bournemouth from September 9 to 13, under the presidency of the Hon. Sir Charles Parsons. The last meeting was held at Newcastle-on-Tyne in 1916, and it was intended to hold the 1917 meeting at Bournemouth and the 1918 meeting at Cardiff, but owing to difficulties created by the war these meetings had to be abandoned.

L'Entente Chimique.—A very important meeting of chemists is to be held in Paris during the week preceding Easter. The chemists of France are about to form a national federation of chemical societies, which will include the following representative bodies:—La Société Chimique en France, La Société de Chimie Industrielle, L'Association des Chimistes de Sucrerie et de Distillerie, La Société des Experts Chimistes, L'Association des Chimistes de l'Industrie Textile. The proposed federation will have similar objects to those of our Federal Council for Pure and Applied Chemistry, and advantage will be taken of the presence at the meeting of representatives from England, the United States, and Italy to discuss the formation of an Inter-Allied Federation of Chemical Societies. The Federal Council for Pure and Applied Chemistry will be represented by its chairman, Sir William J. Pope, K.B.E., and by Mr. A. Chaston Chapman, past-president of the Society of Public Analysts. Prof. H. Louis and Dr. C. A. Keane have accepted invitations to be present, and, in addition, the Society of Chemical Industry will also be represented by Mr. W. F. Reid and Dr. S. Miall. The provisional programme is as follows:—April 14: Reception of the President of the Society of Chemical Industry. April 15: Meeting to consider the formation of an Inter-Allied Federation of Chemical Societies. Conference to discuss the question of an international organisation for the preparation of chemical abstracts. April 16: The representatives will journey to Mulhouse to visit the Alsatian potash deposits. In addition, the proceedings will also include an address by Prof. Louis, and a banquet will be held under the presidency of one of the French Ministers.

British Association Fuel Economy Committee.—This Committee, which was originally appointed in 1915 and issued its first report in 1916, has, owing to the urgency and importance of the coal situation, been reappointed to continue its investigations upon the various economic, scientific, and technical issues connected with the production and utilisation of coal and other fuels.

Prof. W. A. Bone has been reappointed chairman, with Mr. H. J. Yates vice-chairman and Mr. R. L. Mond as secretary. The General Committee of 33 members includes representatives of the Association of British Chemical Manufacturers, Coke-Oven Managers' Association, Federation of British Industries, Institution of Electrical Engineers, Institution of Gas Engineers, Institution of Mechanical Engineers, Institution of Mining and Metallurgy, Institution of Mining Engineers, Iron and Steel Institute, Society of British Gas Industries, and the Society of Chemical Industry. It is divided into three sub-committees:—(A) Chemical, General, and Statistical, presided over by Prof. H. Louis, with Prof. W. W. Watts as vice-chairman. (B) Carbonisation and Metallurgical, presided over by Sir R. Hadfield, Bart., with Mr. A. Hutchinson as vice-chairman; and (C) Power, presided over by Mr. C. H. Wordingham, with Mr. W. H. Patchell as vice-chairman. The Executive Committee, which consists of Sir R. Hadfield, Sir J. Walton, Professors W. A. Bone, H. Louis, and W. W. Watts, Dr. H. S. Hele-Shaw, Messrs. A. Hutchinson, R. Mond, W. H. Patchell, H. Woodall, C. H. Wordingham, and H. J. Yates, meets in London on the second Wednesday in each month. The Committee is now compiling data and information concerning a number of subjects of public interest, including such questions as:—(1) The economic aspects of coal production in Great Britain, (2) low temperature distillation of coal, (3) future standards for public gas supplies, and (4) the pro-

posed Electric Power Scheme, etc., and invites individuals, firms, or institutions to place at its disposal any valuable information they may possess.

All communications should be addressed to Prof. W. A. Bone, F.R.S., at the Imperial College of Science and Technology, South Kensington.

Ammonium Nitrate as a Fertiliser.—The Board of Agriculture draws the attention of farmers to the fact that large quantities of ammonium nitrate are now available. Hitherto the disadvantage of this material for manurial purposes lay in the readiness with which it absorbed moisture from the air, sometimes setting into solid lumps which made it difficult to drill into the land. This defect has, however, been overcome, and the material now at disposal may be stored for a considerable period without absorbing moisture, and remains in good condition and quite suitable for drilling. Experiments made recently at Rothamsted (J. Board Agric., Feb, 1919) show that ammonium nitrate is more effective than ammonium sulphate for mangolds and wheat, when applied on an equal nitrogen basis. Its use for potatoes is considered more risky, as although it gave as large a crop, it induced a large growth of haulm, which would be a disadvantage in a season of blight. It will be remembered that Prof. J. Hendrick obtained equally satisfactory results with ammonium nitrate for hay and oats (this J., 1918, 146 B). Some of the material now purchasable may contain TNT, but provided the amount of this does not exceed 1 per cent. it may be regarded as harmless. The Disposal Board is prepared to issue ammonium nitrate at £25 per ton f.o.r. store, packages free, and buyers should apply to the Secretary, Disposal Board (D.B. 4C), Ministry of Munitions, Storey's Gate, S.W. 1, stating that the material is required for use as fertiliser.

Newfoundland Cod Liver Oil.—The Imperial Institute has recently been investigating the medicinal value of cod liver oil from Newfoundland. Thirty tuberculous patients in a London hospital were given this oil in place of the Norwegian product for a period of three weeks, with the result that no difference could be distinguished between the two oils. The results are considered to be very satisfactory, and there appears to be no reason why the Newfoundland oil should not find an increasing market in this country. Excessive shipping freights have recently been a serious handicap; the freight per gallon was approximately 3*s*., compared with 6*d*. during 1914-17, and about 2*d*. in normal times.

Margarine Production in the United Kingdom.—Since the outbreak of war the production of margarine in Great Britain has increased almost tenfold. The maximum output before the war was 1000 tons per week and to-day the output varies from 7000 to 8000 tons. Raw materials are mainly obtained from West Africa, Nigeria and India. In the year before the war the total exports of palm kernels from West Africa amounted to 250,000 tons, valued at over £4,000,000, together with 100,000 tons of palm oil and palm kernel oil valued at £2,000,000. It is estimated that not more than one-tenth of the West African harvest is gathered, the remainder being allowed to rot on the trees. This source alone would amply repay commercial exploitation. —(*Manch. Guard., Mar.* 7, 1919.)

German Dyeworks under French Control.—According to a Berlin telegram, the Höchst dyeworks have not been sequestrated, but merely put under the supervision of two French chemists. The work goes on unhindered. Both stocks and newly manufactured chemicals are to be used in the first place for the Allies; the remainder to be exported to the unoccupied part of Germany, subject to the approval of the French authorities. Adequate stocks of salvarsan are still available. According to a Höchst telegram, the French officials in occupation are having all the business books of the Höchst Dyeworks examined and copies made from them, particular attention being paid to the books describing foreign clients. The entire export of the dyeworks is subject to enemy supervision.—(*Rhein. Westfäl. Z., Feb.* 12, 1919.)

The French garrison in Höchst has taken possession of the local dye works. A large number of French chemists are working with the German employees, and the results, particularly those relating to dyes and salvarsan, are transmitted to the Allied countries. The exportation of salvarsan into Germany has been rigorously prohibited, and in consequence a serious shortage of this medicament has arisen in the German hospitals and nursing homes.

The Badische Anilin- u. Sodafabrik at Ludwigshafen has called an extraordinary meeting for March 1, with the object of raising a further 50 million marks of capital at 4½ per cent. The money is to be devoted in the first instance to the extension of the ammonia works in Leuna near Merseburg. No financial assistance from the State is to be expected under present conditions.—(*Z. angew. Chem., Feb.* 14, 1919.)

Proposed Nitrate Production in Denmark.—According to the *Berlingske Tidende*, the urgent need of providing Denmark with fertilisers and rendering her independent of other countries has been engaging serious attention. Experiments are to be undertaken to initiate an artificial nitrate industry, for which the State has promised 20,000 kr., to be spread over 3 years, and the Danish Fertilisers Company 80,000 kr. for the purpose of erecting an experimental factory. The preparatory experiments are to be undertaken in the Polytechnic at Copenhagen under the direction of Professors Raaschow and Meyer (krone = 1*s*. 1½*d*.).—(*Z. angew. Chem., Jan.* 3, 1919.)

Artificial Fertilisers in Holland.—An idea of the insufficiency of the quantities of fertilisers allowed to Holland by the Allied Powers (Chile saltpetre, 45,000 metric tons, mineral phosphate, 40,000 tons) can be gathered from the following figures showing the excess of imports over exports during the years 1912, 1913:—

	Metric tons 1912	1913
Chile saltpetre	74,406	82,490
Ammonium sulphate ...	7,958	12,475
Guano	2,344	11,345
Basic slag...	185,485	240,259

The fertility of Dutch soil has suffered considerably from the scarcity of fertilisers during the past few years, and at the present time the quantities required are greater than those formerly consumed. It is considered doubtful if the allotted quantities, especially of phosphate, will be available in time for the next harvest, and if adequate supplies of potash fertilisers will be forthcoming. In the latter eventuality the potato crops are likely to be seriously affected.—(*N. Rotterd. C.: Z. angew. Chem., Jan.* 21, 1919.)

Recent Developments in the Electro-Chemical Industry of Italy.—The first electrolytic plant to be established in South Italy is that of the Elettrochimica Pompilio at Naples, where the production of chlorine, caustic soda, hydrogen, and chlorine derivatives was commenced in March 1918. The total area available for the works is 1,500,000 sq. ft. of which one-tenth had been covered with buildings in November 1918. Owing to war conditions, it has

been necessary for the company to construct nearly all the plant and much of the machinery, and at present 300 workmen and 50 technical employees are engaged, but when the plant is completed only about 30 technical workers will be needed to run the entire plant, which will absorb approximately 2000 kilowatts per day.

Diaphragm cells are employed, fitted with carbon anodes, and the salt needed for the concentrated brine electrolyte, after being freed from sulphate by treatment with barium chloride, is pumped to the electrolytic cells of which there are three batteries each taking 500 h.p. The installation consists of electric power and evaporating plant, electrolytic cells in which chlorine, hydrogen and caustic soda liquor are produced, and compression plant for collecting hydrogen and chlorine in cylinders. During electrolysis the brine is circulated, and the evolved chlorine is either liquefied after drying in towers containing sulphuric acid, or converted into hypochlorite or other derivatives. The caustic liquor is conveyed to large concrete or iron reservoirs situated in cellars beneath the electrolysers. Rotary pumps are extensively employed and all mechanical parts are duplicated in order to avoid any stoppage through breakdown.

An excellent market exists in South Italy for caustic soda and chlorine derivatives, and much of the chlorine will probably be utilised in paper and textile mills. It is claimed that this plant is the most modern in the country and the company is prepared to adopt anticipated improvements in the electrolytic process as well as in the working up of the caustic soda and chlorine.—(*U.S. Com. Rep., Jan.* 22, 1919.)

German Substitutes for Manganese.—The German Luxemburg Mining and Smelting Co. has discovered the possibility of replacing a large proportion of the manganese required in the basic Bessemer process by calcium carbide. Quite recently the Haspe Iron and Steel Works has reverted to an old process which was designed to save manganese, but which was given up when the cheapness and abundance of manganese rendered it unprofitable. The old process has been so much improved that it enables steel to be produced at from 2*s.* to 3*s.* a ton cheaper than is possible by the calcium carbide process. The improved process has been placed gratuitously at the service of the Association of German Ironmasters.—(*Iron and Coal Tr. Rev., Mar.* 7, 1919.)

Fluorspar and Cryolite in the U.S.A.—According to the recent report by E. F. Burchard a record quantity of fluorspar—200,000 tons—was mined in the United States in 1917 in order to meet the great demand for this mineral as a flux in the basic hearth steel furnaces and for the chemical, ceramic and other industries. This amount represented an increase of 40 per cent. in quantity and it was sold at 40*s.* 7*d.* per ton f.o.r., as compared with 24*s.* 8*d.* in 1916. For prompt delivery at the furnaces, quotations rose to 89*s.* in 1917 and to 167*s.* in 1918. Some 30,000 tons were also mined at Madoc, Ontario, in 1917, representing about four times the output in 1916 and three times the amount required by the Canadian steel works. The chief demand was for gravel spar for the furnaces, which absorbed 83 per cent. of the whole output, the remainder consisting of 12 per cent. of lump and 5 per cent. of ground fluorspar. Three quarters of the American fluorspar was mined in Illinois, one fifth in Kentucky, and the remainder in Colorado, Arizona and Hampshire; but Nevada, Utah and Washington contain large supplies which were formerly worked. The works have a capacity of more than double their 1917 output, the difference being due chiefly to shortage of labour, wagons and boats, and to unfavourable weather. The imports of fluorspar have gradually diminished and in 1917 only amounted to 12,000 tons; this material is of lower grade than the Illinois, Kentucky product and is chiefly used where the American product is not available. For optical purposes, fluorite should be as clean and colourless as glass. Really good pieces fetch 22*s.*—45*s.* per lb.

No native cryolite is mined in the U.S.A. The whole requirements of the country—21,000 tons—are supplied by Greenland. The average price in 1917 was £10 per ton, which is just double that of the years 1911-15. Cryolite is admitted free of duty. —(*U.S. Geol. Surv., Nov.*, 1918.)

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

National Factories.

In Committee of Supply, Mr. Kellaway said that the estimated value of the goods which the Government had to dispose of varied from £200,000,000 to £1,000,000,000, and that probably the former figure would be realised. There are 130 national factories which the Government is now free to sell, and upon them some £60,000,000 had been spent. The total cost of all factories was £65,000,000 including £28,000,000 expended on explosives and chemical works. Seven of the 130 factories would be maintained to supply munitions to the post-bellum army, 13 would be leased or sold, and of the remainder the majority will be sold but 30 will be retained for storage purposes. So far only one factory had been disposed of; it cost £133,000 to build and the selling price was £140,000. He did not share the view of the Labour Party that the factories should be run by the Government and used to compete with private trade. The policy of the Government was not to try tinkering little experiments for producing a few things which could be produced better by men producing them in greater quantity, but to get the wheels of industry running smoothly and to restore confidence to all interests connected with industry.

In the course of the same debate, Sir W. Pearce said it would not be difficult to prove that large factories like Gretna have paid for themselves by the large quantities of explosives which they have produced. Gretna covers 9000 acres, of which 6000 are good arable land, and there is housing for 14,000 or 15,000 people. It would be extremely difficult to adapt the big plant there to produce only about 10 per cent. of its capacity, and he suggested that the buildings and land should form the nucleus of a very large settlement for discharged soldiers and sailors. Large sections of the chemical industry have been left in an extremely difficult position, and he knew a whole class of chemical manufacturers whose pre-war activities had been completely destroyed by the necessity of having to make chemicals for munitions of war.—(Mar. 5.)

Government Trade Policy.

In Committee of Supply, Sir Auckland Geddes, Minister of National Service and Reconstruction, said that the general policy of the Government was to reduce the prices of the raw materials it possessed or controlled to a level not higher than the anticipated pre-war prices; at the same time it is proposed to retain sufficient reserves of raw materials to enable the Government to defeat any attempt at a hold-up by merchants. If prices were brought down too low, production would be checked, and the ultimate consequences would be serious. This policy is being vigorously applied at the present time in the case of some of the non-ferrous metals. As regards imports, the transitional policy

was not to impose or continue any restrictions on goods produced or manufactured within the Empire, and raw materials required for our industries would now be admitted without restriction. Semi-manufactured articles necessary for our manufactures would also be admitted free from all restrictions, except in so far as they were produced by industries which require fostering or shielding. Manufactured articles will be subject to restrictions when not essential for consumption in this country, or when produced by industries which require to be shielded from foreign competition while they are being re-established, or which had been created or encouraged to extend owing to circumstances arising out of the war. The restrictions in such cases will continue until September 1 next, when the whole situation will be reviewed.

The new export policy involves the attempt to induce other countries to take our exports on the understanding that payment for them shall be a first charge upon the war indemnity they will receive. British traders will be kept informed of any variation of the restrictions which are imposed by other countries. There will be no restrictions upon exports except in the case of (1) goods required for naval and military purposes, (2) goods required for home consumption or manufacture, and (3) goods which have been benefited, directly or indirectly, by subsidy or by purchase by the State. Such goods will be liable to licence on export. The same three exceptions will apply to goods destined for blockaded countries. The maximum number of manufactured goods will be transferred to the free list, and of the rest the greatest possible number will be placed on List C. (exports under licence to any destination). All facilities possible, and consistent with inter-Allied agreements, will be given to the re-export trade.

Mr. Bridgeman said the President of the Board of Trade had decided that the existing Advisory Council, under the chairmanship of Lord Emmott, should be formed into a Commission and be reinforced by the addition of representatives of manufacturers, workmen, merchants, retailers and consumers, and the joint industrial councils would also receive representation. The duties of the Commission will be, *inter alia*, to go through the list of imports, including those now restricted, and to recommend what proportion of the normal amounts should be admitted. In this way it was hoped to produce in a very short time a list of all the restrictions that were to remain: upon receipt of the report of the Commission, the Board of Trade will come to definite decisions; in the meantime it will be necessary to issue a number of licences.—(Mar. 10.)

Export of Spraying Mixtures to France.

Mr. Bridgeman, answering Col. Wedgwood, admitted that heavy losses were threatened to manufacturers of, and dealers in, copper sulphate and spraying mixtures, owing to the repudiation of contracts by French importers, consequent on the lowering of prices by the French Government. —(Mar. 10.)

Empire Sugar.

In response to a question put by Mr. Grattan Doyle, Col. Amery, Under-Secretary of State for the Colonies, said that proposals for the development of the sugar industry in the British Dominions overseas have been received, and are under the consideration of the Secretary of State for the Colonies, and that experiment and research for the improvement of the sugar industry is being carried out with the assistance of H.M. Government, and of certain of the oversea Governments as well as by private enterprise.—(Mar. 10.)

Poisons and Pharmacy Act, 1908.

Sir J. Agg-Gardner asked the Home Secretary if any action has been taken under Section 4 (b) of the above Act to enable certified assistants to apothecaries to be registered as pharmaceutical chemists or chemists and druggists. In reply, Mr. Shortt stated that the Pharmaceutical Society is now considering the matter, and it is hoped that before long a by-law in the sense indicated will be submitted for the approval of the Privy Council. —(Mar. 10.)

Ministry of Ways and Communications.

The second reading of this Bill was moved by Sir E. Geddes, who said that the railways were earning 4·3 per cent. (on the capital expended) before the war, but were now run at a loss of 3—4 per cent. (£100,000,000 per annum); canals, excluding the Manchester Ship Canal, before the war earned 2 per cent., to-day they were working at a loss, although heavily subsidised. Roads cost the country 20 millions a year. Docks not railway owned were earning about 3 per cent. The object of the Government was to put back these means of transport on to a self-supporting basis. Private interest had made for progress in the past, but to-day it spelt waste. There was an enormous wastage in empty haulage, and one of the first things to be done was to acquire on fair terms the 70,000 privately owned wagons. Wagons should be enlarged, terminals improved, standardisation introduced throughout, and great economy would be effected by using heavy electric locomotives for goods haulage. Light railways, which covered 836 miles, should be developed: and docks and harbours must be taken over to make the control of transport complete and the projected economies effective. Unification of control will lead to the opening up of districts, and the development of industries. When the railway main lines are electrified—which should be done promptly—fully 20 per cent. of the electricity of the country can be used for traction. Such a change would be remunerative; not only would the price of current be reduced but it would allow of greater density of traffic over the line. It is a fallacy to suppose that it would be against the interests of the railways to develop the industrial use of electricity. Under the Bill, it is proposed that the Government should acquire temporary powers for two years, after which it would have to come back to Parliament for permanent powers. During the two years an endeavour must be made to lift the dead hand which is on development, and the mode of procedure would not be by Orders in Council, as originally intended.

Opposition to the measure was mainly centred on the provisions regarding the docks, harbours and roads, and exception was taken to the autocratic power which would be given to the Minister concerned. In closing the debate, Mr. Bonar Law said that the Bill involved a complete change in the economic policy of the country, but that existing conditions warranted its acceptance. The second reading was passed without a division.—(Mar. 17, 18.)

Recommendations of Coal Commission.

Mr. Bonar Law announced the terms of the Interim Report of the Coal Commission (this J., 1918, 89 R). The Report consists of three separate documents, *viz.*, (1) that of the chairman (Mr. Justice Sankey) and the three independent members nominated by the Government, (2) the report of the coalowners' representatives, and (3) the findings of the representatives of the miners. The first report recommends an immediate increase in wages of 2*s.* per day; a seven-hour day as from July 16 next, and a six-hour day from July 1921, if the

economic condition of the industry can stand such a change; judgment is suspended on the question of nationalisation, but the present system of ownership and management is condemned, and for it should be substituted either nationalisation, or a method of unification by national purchase or by joint control. In any case, the colliery workers should have an effective voice in the management. Further, 1*d.* per ton on the present output (£1,000,000 a year) should be allocated to the improvement of housing and amenities in each colliery district. These recommendations have been accepted by the Government.

The mineowners' representatives recommend an advance in wages of 1*s.* 6*d.* per day, a seven-hour day, and do not pronounce on nationalisation. The workers' representatives recommend the adoption of the full demands of the miners (this J., 1919, 89 B). —(Mar. 20).

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED EXPORTS.

Existing export prohibitions have been relaxed in the following cases:—

Headings transferred from one list to another.

From List A to List B.

Barium sulphate; potassium chlorate and mixtures containing; potassium cyanide and mixtures containing; potassium perchlorate; potassium prussiates and mixtures containing.—(Mar. 20.)

From List A to List C.

Binder twine; chestnut extract, liquid; flax shakings; flax tow; gluestock of all kinds, including animal hoofs, untanned hides and pelts, not otherwise specifically prohibited; hides and pelts, clippings of; invert sugar; lead-coated sheets; pigskins; pipes, cast-iron, and cast-iron pipe fittings and connexions; quebracho extract and extracts containing quebracho; terneplates; tinplates.—(Mar. 6.)

Cork and cork dust; cryolite; gold beaters' skin; lead, dry, white; paper, waste; resins; wax, paraffin.—(Mar. 13.)

Santonin and its preparations; sulphonal; casein and preparations thereof; jute threads; pulp-board waste; straw-board waste.—(Mar. 20.)

From List B to List C.

Chrome ore; ferro-vanadium.—(Mar. 13.)

Soda, bichromate of; gall nuts.—(Mar. 20.)

Altered Headings.

(A) Whisky. (C) Spirits, potable, not otherwise prohibited. (A) Sugar, cane and beet. (C) Articles, mixtures, and preparations containing sugar not otherwise prohibited.—(Mar. 6.)

(A) Cotton, Egyptian. (B) Cotton, raw, other than Egyptian. (A) Glucose, liquid. (C) Glucose, solid. (A) Rice, and rice-flour. (C) Articles, mixtures and preparations containing rice or rice-flour not otherwise prohibited. (A) Silk, raw, thrown and waste. (A) Artificial silk yarn. (C) Silk and silk manufactures not otherwise prohibited including artificial silk manufactures.—(Mar. 13.)

(A) Asphalt. (C) Articles containing asphalt not otherwise prohibited. (A) Bitumen. (C) Articles containing bitumen not otherwise prohibited. (A) Oils and fats, edible, including blends of two or more edible oils and fats, except the following, which are on List C:—Hemp seed oil, kapok seed oil, maize oil, mowrah seed oil, niger seed oil, olive oil, poppy seed oil, rape seed oil, shea butter, sunflower oil.—(Mar. 20.)

Consolidated List of Free Exports.—The Board of Trade has issued (March 15) a consolidated list of goods which may be exported without licence or guarantee and which has been adopted by all the Associated Governments. Certain articles (including barium sulphate, β-naphthol, henbane, opium and dyes) are retained upon the Prohibited List, but guarantees against re-export will not be required in respect of them. The List is given in the *Board of Trade Journal* of March 20.

Trade with North Russia.—It is officially announced that licences will be granted for the export to Archangel and Murmansk of the following goods: Cement (100 tons), candles (25 tons), starch, varnish, glassware, paints, common soap, caustic soda and silicates, kerosene, photographic chemicals, gum, etc.

PROHIBITED IMPORTS.

Import of Raw Materials.—The Board of Trade has notified (Mar. 11) that general licences have now been issued to the Customs which, together with the general licences already in existence, will exempt all raw materials from the operation of the Prohibitions of Import. The following are the raw materials which have from time to time been under prohibition and are now free:—Antimony ore; diatomite or infusorial earth; gum copal; gum kauri; hides, wet and dry; horns and hoofs; ivory (vegetable); jute; soya beans; stones and slates (including sawn and hewn but not dressed); sugar cane; tallow, unrefined; wood and timber, hewn and sawn, planed and dressed of all kinds, hardwoods and sleepers (but not including staves, pit-props and pitwood).

Any inquiry arising out of a doubt whether an article is to be regarded as a raw material or a semi-manufactured article should be addressed to the Department of Import Restrictions, 22 Carlisle Place, London, S.W. 1.

The President of the Board of Trade has appointed a Council to consider the existing list of prohibited imports (see p. 110 B, col. 1, of this issue). The *personnel* of the Council is not yet complete, but the following have consented to serve:—Lieut.-Col. Sir S. Hoare (chairman). Appointed by the Board of Trade: Sir F. Warner, and Messrs. A. F. Bird, J. D. Kiley, E. Manville, A. M. Samuel, J. Gavin, W. L. Hichens, J. A. Milne, G. A. Moore, P. Ashley and R. E. Enthoven. The Association of Chambers of Commerce have nominated: Messrs. A. B. Bell, J. W. Murray, E. B. Tredwen, F. Moore and J. Peate; and the Federation of British Industries: Messrs. G. E. Alexander, T. Bolton, F. R. Davenport, R. G. Perry (Association of British Chemical Manufacturers) and Mr. H. Summers.

In addition to these the following bodies have nominated representatives:—The National Union of Manufacturers (2), the Ministry of Labour (to represent Whitley Councils (4), the Association of Trade Protection Societies (1), the National Chamber of Trade (1), the Parliamentary Committee of the Co-operative Congress (1), the Parliamentary Committee of the Trades Union Congress (2), and the Treasury (1).

The Council has decided to appoint five sub-committees:—(1) Textiles and apparel, (2) Glass and leather, (3) Motor-cars and manufacturers of wood, (4) Machinery and hardware, and (5) Fancy goods and miscellaneous manufactures. The Secretary to the Council is Mr. H. J. Phillips, Department of Import Restrictions, 22, Carlyle Place, S.W. 1.

NEW ORDERS.

The Edible Oils and Fat (Maximum Prices) Order, 1919, Ministry of Food.—(Mar. 3.)

The following Orders, etc., have been made by the Minister of Munitions:—

The Ammonia and Ammoniacal Products (Suspension) Order, 1919.—(Mar. 11.)

The Waste Paper (Dealings) (Revocation) Order, 1919.—(Mar. 14.)

The Bismuth Control (Suspension) Order, 1919.—(Mar. 14.)

The Potassium Compounds (Partial Suspension) Order, 1919.—(Mar. 14.) [This Order suspends the Potassium Compounds Order, 1917, in so far as it relates to kelp.]

The Building Bricks Control (Complete Suspension) Order, 1919.—(Mar. 18.)

The Turpentine, etc., Control (Partial Suspension) Order, 1919.—(Mar. 18.) [This Order relates to the Turpentine, etc., Control Order, 1918, but does not apply to Turpentine Substitute, as defined in that Order (this J., 1918, 59 R).]

The Seeds, Oils and Fats General Licence, 1919. —(Mar. 18.)

The following Orders have been cancelled by Notice:—

The Imported Wool (Shipment) Order, 1917, as from April 1, 1919. Army Council, March 6.

The New Zealand Hemp (Maximum Prices) No. 2 Order. Army Council, March 6.

The Raw Cotton (Prices and Returns) Order, 1918. Board of Trade, March 14. [This revocation applies to all growths of cotton, except American and Egyptian.]

The Japanese Silk Order, 1917. Admiralty, March 17.

The Paper Making Materials (Home Produced) Order, No. 2, 1918.

The Sugar (Brewers' Restriction) Orders, 1917 and 1918. Ministry of Food.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for March 6, 13 and 20.)

TARIFF. CUSTOMS. EXCISE.

Australia.—The importation of kerosene in tins branded or labelled on the sides or bottom is now permitted.

The import of dyes of other than British origin is prohibited, save with the consent of the Minister for Trade and Customs.

Argentina.—It is proposed to revise the official valuation tariff.

Bermuda.—After January 6, import licences will only be required for certain foods and feeding stuffs.

British Guiana.—The import duties on paints, salt and spirits have recently been modified, and an export tax of 1 per cent. per lb. has been levied on balata.

China.—A copy of the proposed new Draft Tariff may be seen by persons interested at the Department of Overseas Trade.

French West Africa.—The export of ground nuts is prohibited as from March 4.

Federated Malay States.—The ordinary duty and the additional duty on exported cultivated rubber have been amended as from January 3.

Johore.—The export duty on cultivated rubber has been re-imposed as from January 1.

Kedah-Perlis.—The export duty on cultivated rubber has been re-imposed as from January 1.

Morocco (French Zone).—The export of hides and skins is now permitted.

Netherlands.—It is proposed to increase the export duties on mineral oil and by-products thereof from the Dutch East Indies.

South Africa.—The Customs and Excise duties at present in operation are to remain in force for the year 1919-20.

Spain.—The export duty on argentiferous lead is suspended until May 31.

Switzerland.—After February 16 the export of *kapok, albumin, asphalt,* and certain minerals and *chemicals is permitted under general licence.*

United States.—Recent rulings of the War Trade Board affect oil cakes, lard compound, lard substitutes, quinine and cinchona bark.

The special export licence "R.A.C. 42" for in-transit shipments has been revised and new provisions made, and certain other export licences have been modified.

Individual licences are still required for the import of emery, ferromanganese, spiegeleisen, nitrates, tin, tin ores, tin concentrates and many organic compounds of arsenic.

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent.	Materials.	Reference Numbers.
Australia ..	Chemicals, dyes, inks, gums, resins, waxes and lubricants ..	422
..	Drugs and edible oils ..	316/9/12*
Canada	Drugs	339
,, ...	Chemicals, medicines, soap	384
,, ...	Druggists' sundries ..	385
,, ...	Rubber, rubber tubing and filter paper ..	340, 434
India	Metals	428
,, ...	Machinery for making artificial manures ..	432
,, ...	Dyes, paints, oils, matches and paper	280
South Africa, South America and Australasia	Chemicals, tar oils and greases	388
Belgium ..	Metals and ores	351
,, ...	Paints and varnish ..	353, 354
,, ...	Chemicals and oils ..	448, 449
France	Chemicals	359, 454
,, ...	Glassware of all kinds ..	363
,, and Colonies	Paper	366
Italy (Milan) ..	Chemicals for agricultural purposes	370
,, ..	Celluloid and galalith ..	458
,, (Rome) ..	Lubricating oils	409
,, (Messina)	Margarine	408
,, (Rome)	Chemicals, oils and soap	1597, 1618†
,, (Genoa)	Paper, inks, paints, and varnishes	1596†
,, (Florence)	Chemicals, drugs, paints and soap	1598, 1615†
,, (Genoa)	Chemicals, metals, fire-clay and bricks ..	1603†
,, (Bologna)	Chemicals and fertilisers	1609†
,, (Bologna, Genoa)	Dyes, paints, colours, oils and varnish	1625, 1631†
Greece	Pharmaceutical goods ..	407
,, (Corfu) ..	Paper	369
Holland	Rubber and asbestos ..	374
Spain (Bilbao) ..	Chemicals, dyes, drugs, varnishes and paints	376
,, (Madrid) ..	Rubber, inks, drugs and celluloid	415
Switzerland ..	Drugs	170
Porto Rico ..	Paints	377
Venezuela ..	Soap, earthenware ..	473
Panama ..	Paper	413
Buenos Aires ..	Chemicals	—
,, ..	Iron, steel, tin plate, paper and cardboard	411

* Official Secretary, Commonwealth of Australia, Commercial Information Bureau, Australia House, Strand, W.C. 2.

† The Secretary, British Chamber of Commerce for Italy, 7 Via Carlo Felice, Genoa.

British manufacturers of plated soft copper wire in gauges ·004, ·006, ·011, ·015, ·018, ·0085, litmus paper, monochlor- and dichloracetone are invited to apply to the Department of Overseas Trade for the names of inquirers.

TRADE NOTES.

BRITISH.

Canadian Foreign Chemical Trade in 1918.—The summary of trade for 1918 is now available. Canada imported during the year drugs, dyes and chemicals to the value of $33,651,382, which was an increase of about $7,000,000 over previous years. Imported oils were valued at $44,724,175, showing an increase of $12,000,000 over 1917.

Exports	1917	1918
Hides and skins.....$	8,973,935	5,109,350
Leather.....$	10,647,428	13,370,371
Aluminium, ingots, &c. cwt.	223,246	216,165
,, ...$	7,620,953	7,223,570
Asbestos.....tons	146,020	141,598
,, ...$	5,334,282	8,014,769
Copper .....$	23,256,278	20,772,109
Gold .....$	15,929,051	10,040,813
Iron and steel.....$	43,929,069	50,794,850
Nickel.....cwt.	812,724	874,785
,, ...$	8,708,650	11,263,246
Silver.....oz.	21,718,784	19,357,076
,, ...$	17,621,398	18,382,902
Other metals .....$	11,752,630	11,616,974
Paper, printing .....cwt.	11,923,737	12,730,671
,, ,, ...$	32,561,020	37,301,269
Other paper.....$	3,372,931	6,379,713
Textiles .....$	16,884,601	17,350,979
Wheat flour.....barrels	8,770,698	10,070,881
,, ...$	79,141,990	108,301,840
Wood pulp.....cwt.	10,236,072	11,678,225
,, ,, ...$	26,192,906	33,359,923

FOREIGN.

The Swiss Chemical Industry.—In an article on the development of the Swiss chemical industry, the *Schweizer'sche Industrie-Zeitung* states that the disappearance of Germany from the world's markets has given such an impetus to the Swiss chemical industry that it has become one of the most important factors in the economic life of the nation. The manufacture of coal tar dyes, the most important branch, is likely to become more active with the advent of peace. During the past 10 years the Swiss chemical industry has practically written off the cost of all its plant, and it has accumulated reserves which bear a high proportion to the issued capital. These two factors, together with the recently effected combine of Swiss dye manufacturers (this J., 1918, 385 R), will add enormously to the competitive power of the Swiss industry. The very costly scientific experimental work will in future be so organised that duplication is avoided, and fruitless commercial efforts will also be obviated; further, the manufacture of any given dye will be centralised in one establishment, and profits will be pooled according to an agreed plan.

In the years before the war, over 80 per cent. of the sulphuric acid imported into Switzerland came from Germany, France supplying most of the remainder. As a result of the war, France has become the chief source of supply, but a large measure of independence has been achieved by the progress made in the home manufacture from gypsum: in 1917 the weight of acid imported was only about one-fifth of what it was in the pre-war years, and during 1918 about one-third. Germany had also a practical monopoly of the trade in acetic acid; this has been lost entirely, and the United States supplies some 70 per cent. of the total import. Here again the home manufacture (carbide process) has made great headway, and the imports have decreased by about 40 per cent. As regards coal tar derivatives and dye intermediates, the virtual monopoly possessed by Germany has been completely lost in favour of England and France, who have sent these materials to be worked up into finished products. The German monopoly in respect of aniline has been transferred to England and the United States. The manufacture of aniline compounds in Switzerland has made rapid strides during the war; those now imported come from England, the United States and France. The change has benefited Switzerland, for the dyes produced from these compounds are exported to the countries named, whereas formerly but very little went back to Germany.

In regard to exports of finished dyes, the pre-war trade was about equally distributed between Germany, England and the United States; at the present time Great Britain and her colonies are the largest customers. Although the total exports are less than before the war, the value is about four times greater. Switzerland has taken full advantage of the war to secure for herself those markets in which Germany previously held a monopoly. The exportation of indigo began in 1911, and this trade is still in its infancy.

The following statistics illustrate and amplify the foregoing information. As the returns for 1918 are not complete, the figures for that year have been calculated from those that were available.

IMPORTS

Material	Year	Metric tons	Price per ton in £'s	Source %
Sulphuric Acid ..	1913	9611	3·1	Germany, 92·4 France, 7·4
,, ..	1915	213	4·25	France, 13·0
,, ..	1917	1908	14·2	France, 64·6 Spain, 19·5
,, ..	1918	3286	7·9	France, 46·6 Austria, 32·4
Acetic Acid ..	1913	2018	11·9	Germany, 38 Holland, 23
,, ..	1915	1660	126	Germany, 40 U.S.A., 38
,, ..	1917	1941	112	U.S.A., 63 Austria, 16
,, ..	1918	1243	107	U.S.A., 73 Austria, 20
Coal Tar Derivatives	1913	3326	28·5	Germany, 86 U.K., 10
,,	1915	1177	69·5	U.K., 57 Germany, 20
,,	1917	4967	72·5	Austria, 30 Germany, 27
,,	1918	3497	129	U.K., 55 France, 16
Aniline	1913	1202	49	Germany, 98 U.K., 2
,, ...	1915	945	120	U.K., 89 Germany, 8
,, ...	1917	1031	208·5	U.K., 57 U.S.A., 40
,, ...	1918	1773	208	U.K., 72 U.S.A., 18
Aniline Compounds for Dye Manufacture	1913	887	125	Germany, 96 U.K., 4
,,	1915	92	268·5	U.K., 63 Germany, 35
,,	1917	250	477	U.S.A., 45 U.K., 44
,,	1918	413	496·5	U.K., 96 France, 4
Coal Tar Dyes ..	1913	698	165	Germany, 90 U.K., 2
,, ..	1915	234	300	Germany, 100
,, ..	1917	429	748	Germany, 100
,, ..	1918	337	804·5	Germany, 100

EXPORTS.

Material	Year	Metric tons	Price per ton in £'s	Destination %
Coal Tar Dyes ..	1913	7035	176·5	Germany, 20 U.K., 20 U.S.A., 18
,, ..	1915	4801	301·5	Brit.Emp., 52 Italy, 16 U.S.A., 15
,,	1917	5127	845	Brit.Emp., 50 France, 15 U.S.A., 14
,, ..	1918	4812	859	Brit. Emp.,48 France, 17 Italy, 14
Indigo	1913	1792	109	China, 72 U.S.A., 12
,, ...	1915	950	118·5	U.S.A., 38 France, 34
,, ...	1917	1472	371·5	U.S.A., 48 U.K., 36
,, ...	1918	777	391	U.S.A., 41 France, 23

—(*Z. angew. Chem., Jan.* 17, 1919.)

Medicines Employed in Chinese Therapeutics.—China exports annually more than £600,000 worth of medicines, and the internal trade is enormous. The materia medica is very rich, a consular report giving a list of 189 medicines of vegetable and 31 of animal origin which were made and used in Szechwan alone. Liquorice and rhubarb are of most interest to foreigners, but ginseng, pomegranate root, aconite, opium, arsenic and mercury are also of importance. Manufacturers of drugs will find in China some valuable sources of supply for raw material. Foreign exploiters of patent medicines have found China a rich field for their products.—(*U.S. Com. Rep., Feb.* 8, 1919.)

Lead and Zinc in China.—The principal lead mine in China is in Hunan, which in the last twenty years has produced 50,000 tons of lead and 126,000 tons of zinc concentrates. White lead is manufactured practically only for domestic use, the exports in 1917 amounting to 100 tons. The metal is rolled into sheets and treated at a slow heat with rice vinegar. The product is dried, pressed into cakes, or mixed with wood oil for use in common paint. The war has affected the zinc trade of China adversely, owing to the high freight rates and the unfavourable silver exchange. The export of spelter dropped from 38,000 piculs in 1915 to 7000 piculs in 1917, and the export of zinc ore from 140,000 piculs in 1915 to 4000 piculs in 1917 (1 picul = 133⅓ lb.). Hunan is the main source of supply; the output in 1914 was 12,000 tons.—(*U.S. Com. Rep., Nov.* 27, 1918.)

The Paint Trade of Brazil.—Before the war, the paint trade of Brazil was largely in British hands, although Germany was beginning seriously to challenge that supremacy. The following figures show the imports of unprepared dry paint in the last normal year, 1913, together with the countries of origin: Germany, 964,615 kilo., England 742,625 kilo., U.S.A. 7194 kilo., France 487,695 kilo. In the same way, the imports of prepared paints were: Germany 249,380 kilo., England 1,681,222 kilo., U.S.A. 334,819 kilo., and France 113,677 kilo. During the war, American suppliers have benefited largely at the expense of the British manufacturer, but it is felt that the quality and cheapness of the British product will regain most of this trade. A British company is utilising certain local clays which, ground into powder and worked up with linseed oil and turpentine, yield very good white, red, grey and yellow paints. Intending exporters from the United Kingdom should note that varnishes pay twice as much duty as ordinary paint, so that great care should be taken to specify correctly the class of paint invoiced.—(*Bd. of Trade J., Mar.* 6, 1919.)

Prices of Sugar in Principal Countries.—Dr. H. C. Prinsen Geerligs has compiled a list of wholesale prices of sugar in the principal producing and consuming countries on October 1, 1918. The list is given below, with prices expressed in pence per lb. These prices include excise taxes and other imposts, except in the case of Poland: Java, 1·14*d.* per lb.; Denmark, 3·34*d.* per lb.; Cuba, 3·62*d.*; U.S.A., 3·75*d.*; Germany, 3·88*d.*; Sweden, 4·50*d.*; Netherlands, 4·69*d.*; Switzerland, 4·90*d.*; United Kingdom, 6·27*d.*; Poland, 6·47*d.*; Norway, 6·68*d.*; Spain, 6·78*d.*; Austria, 6·86*d.*; France, 7·57*d.*; Hungary, 9·76*d.*; Italy, 9·85*d.*; Belgium, 12·52*d.*; Ukraine, 51·34*d.*; and Turkey, 227·10*d.*—(*U.S. Com. Rep., Feb.* 8, 1919.)

Uruguay in 1917.—Uruguay is primarily a pastoral country; mining is of little importance. It has numerous quarries which produce a wide variety of fine and common stone, and peat extraction is in the experimental stage. Among its few industries may be mentioned cement manufacture, but there is only one factory. As a result of the shortage of chemicals, the manufacture of a certain number of the commoner products has been carried out by the National Institute of Industrial Chemistry at Monte Video.

While Germany held first place in the Uruguayan export trade in 1913, in 1917 the first four countries were the United States, the United Kingdom, France and Italy. Imports were valued at £14,000,000, including drugs and chemicals, £140,000, and pharmaceutical specialities, £65,000. —(*U.S. Com. Rep., Dec.* 10, 1918.)

COMPANY NEWS.

COURTAULDS, LTD.

In the report for the year ended December 31, 1919, the directors state that they have given very full consideration to various plans for carrying out the proposed capitalisation of surplus assets (amounting to about £8,000,000, *v.* this J., 1918, 103 R), and also for the reorganisation of the Company. The scheme originally proposed failed to meet with the approval of the Treasury, and the opinion of the legal authorities consulted is that the proposals cannot be carried out until the points of law involved are satisfactorily settled.

During the past year an additional factory at Leigh, Lancashire, for the manufacture of textile materials, has been purchased, and the output therefrom has been very satisfactory. A research laboratory has been installed at Clapham. The cost of the shares acquired in the Russian Viscose Company has now been entirely written off. The profits of the year, after deducting all expenses, including excess profits duty and income tax, amount to £1,184,938 (issued capital, £2,000,000, debentures £14,170). After writing off sums amounting to £66,751 and placing £382,908 to special reserves, the payment of a final dividend of 3*s.* 6*d.* per share, free of tax, is recommended. A dividend of 3*s.* per share, less tax, was paid in August last. The reserve funds now stand at £1,940,465, no valuation is put upon the holding of $9,488,600 in the American subsidiary, Viscose, Ltd., and the carry forward is £148,210.

MAGADI SODA CO., LTD.

At an extraordinary general meeting held on March 17, the Chairman, Mr. S. Samuel, said that the Company had spent all its capital in consequence of the war, and that it had been decided to submit to the shareholders the proposal to create £500,000 ordinary shares of £1 each, and to issue £500,000 of debentures with the right to holders to convert into ordinary shares up to June 30, 1924. The new capital was required to pay off existing loans, to provide the necessary machinery so as to dispense with manual labour as far as possible, and to provide working capital. There was a great future before the Company, which possessed unlimited supplies of a material which was consumed in enormous quantities. The resolution to increase the capital was carried unanimously.

British Chemical Trade Association. This Association has been registered as a company limited by guarantee, not formed for purpose of profit. Its objects are, *inter alia*, to promote trade in chemicals, to provide for the accurate sampling, analysis, and examination of chemicals, to establish uniformity in commercial usages (forms of contract, charter parties, bills of lading, insurance policies, etc.), and to promote the voluntary adoption thereof, to act as arbitrators, etc. The president of the general committee is Mr. W. Mann, 7, St. Michael's Alley, E.C., and the registered office is at 80, Fenchurch Street, E.C. 2.

REVIEWS.

THE ZINC INDUSTRY. *By* ERNEST A. SMITH. *Monographs on Industrial Chemistry, edited by* SIR ED. THORPE. *Pp. viii + 223, with 4 plates and 9 figures. (London: Longmans, Green and Co. 1918.) Price 10s. 6d. net.*

Judging from the literature on the subject, the zinc industry has received scant attention at the hands of British metallurgists, for, while America, France and Germany has each produced within recent years at least one authoritative work, none has been published in this country since Percy's "Metallurgy of Copper, Zinc and Brass" appeared in 1861.

The author gives a general survey of the history of the industry from the days when brass was obtained by melting copper with zinc carbonate ore, by the process known as "cementation," through the various stages of progress up to modern retort practice in Europe and America. In an interesting introduction we read again (and it is well that it should be thus recorded in more permanent form) the melancholy tale of the position in which England found herself at the outbreak of war; that is to say, dependent on foreign countries for at least three-fourths of her requirements of zinc, although the Empire was possessed of adequate resources of raw material, which was, however, for the most part under contract to Belgium or enemy countries.

Statistics are fully quoted in the chapter describing the rise and progress of the production of zinc in the producing countries of the world. The United States takes first place with a production in 1913 of 320,000 tons, equivalent to 32 per cent. of the world's supply. Since then, the U.S. production has reached nearly twice the pre-war figure. The apparent neglect, hitherto, of the industry in Great Britain is attributed by the author to various causes, chief among them being that the British smelters, generally, have neither looked sufficiently ahead to the time when supplies of the easily smelted ores would have diminished, nor availed themselves to any extent of the enormous progress made by Continental smelters in furnace construction whereby fuel economies were effected and former considerable losses were reduced.

It is not to be expected, perhaps, that metallurgical operations should be described in very full detail in a monograph of the kind; nevertheless, the author has contrived successfully to give a concise and interesting outline of the main principles relating to the preliminary treatment of mine ore (concentration), the roasting and smelting, and to include descriptions of furnaces and appliances employed. It is pleasing to read that there has been a considerable advance in the methods of British zinc works during the past four years, and that wherever new plant has been installed it has been of the modern type and should be productive of results equal to those obtained on the Continent. The author discusses the difficulties in connexion with the sweet roasting of ferruginous and leady zinc blende at some length and is, perhaps, somewhat sanguine respecting the results obtained by the employment of mechanical muffle furnaces. Notwithstanding the notable progress made in their construction, generally speaking these do not seem to have yet been completely successful, in this country, in overcoming the several difficulties. The importance of by-product sulphuric acid is emphasised by the author, who points out that, in the recovery of the sulphur from blende roasting, the British smelters have been hitherto far behind the smelters on the Continent and in America. Summing up published results, the author states that electric smelting of zinc ores has now passed beyond the experimental stage and become a success. The text does not appear quite to bear this out, particularly in regard to the large amount of fume formed in the condensation of the zinc vapour, considerably exceeding that obtained in ordinary retort practice. Recently published researches in America by Prof. C. H. Fulton indicate that this is due to the difficulty of keeping the electric smelting furnace air-tight and of rapidly obtaining, and maintaining, a uniform temperature throughout the distillation chamber. Progress relating to wet methods of extraction and electro deposition is touched upon and it may be mentioned that, since the book went to press, some of the plants that are mentioned as being in course of construction are now being successfully operated. Other sections deal with the marketing of zinc, industrial applications of the metal, alloys and commercial compounds of zinc and the future of the industry. An admirably selected bibliography concludes a monograph that forms a notable addition to the literature of zinc; clear and concise in language and collecting in convenient form much valuable scattered information.

One of the most interesting sections is that devoted to the future of the zinc industry in Great Britain and the author is genuinely, and rightly, concerned at the inadequate measures taken to ensure a production to equal the demand. Since the book was published it appears that, after allowing for the proposed extension of existing works and the erection of new works at Avonmouth, the possible output will be less than one-half the pre-war consumption of, say, 200,000 tons yearly. It has recently been announced that a zinc smelter is to be erected at Sakchi, India, by the Burma Corporation conjointly with Messrs. Tata and Sons. This, together with other proposals for the expansion of smelting and electrolytic works in Australia, Tasmania and Canada, will help to make up the deficiency. The future position of the zinc industry is, moreover, one of great complexity. On the

one hand we have confident estimates that the requirements of this country will amount shortly to 300,000 tons per annum, all of which we are told must be produced within the Empire. On the other hand, our estimated requirements assume a revival of our galvanised sheet trade (largely export) which depends upon a supply of steel at competitive rates. We are also faced by the fact that the retort capacity and mining equipment of the United States are far in excess of requirements, as a result of that country meeting our own deficiency during the war. The reinstatement of the Belgian works will take some time, and it must be remembered that Belgium herself consumed only 76,000 tons out of a yearly production of nearly 200,000 tons. France is contemplating an increased production, and Japan is already producing upwards of 50,000 tons yearly, which may be increased so soon as her ore supplies are assured. Production in the States has already been curtailed since the armistice, and it is realised that there must be a great expansion in consumption of the metal or else a wholesale scrapping of plant. The recently formed American Zinc Institute, which covers the mining, smelting and trade interests, is actively engaged in efforts to extend the industry in the United States.

WILLIAM G. WAGNER.

CATALYSIS IN INDUSTRIAL CHEMISTRY. *By* G. G. HENDERSON. *Monographs on* INDUSTRIAL CHEMISTRY, *edited by* SIR ED. THORPE. *Pp.* 202. (*London: Longmans, Green and Co.* 1919.) *Price* 9*s. net.*

CATALYTIC HYDROGENATION AND REDUCTION. *By* E. B. MAXTED. *Pp.* 104. (*London: J. and A. Churchill.* 1919.) *Price* 4*s.* 6*d. net.*

Catalytic action, once a scientific curiosity, has now passed into the realm of every-day industrial life so that whilst the applications are already numerous the potentialities are enormous. Every chemical student in the future must have more than an elementary knowledge of catalysts without being expected to go deeply into the complex physico-chemical theories of the subject. Hitherto Sabatier's almost classic treatise has been the standard work on organic catalysts and therefore the appearance of G. G. Henderson's book will be greatly appreciated by English students, though no one, who can, should neglect to read Sabatier and so gain the inspiration contained in its pages.

Prof. Henderson describes in simple and straightforward language, such as will appeal particularly to all chemists engaged in industry, what has been already achieved in the application of catalytic reactions. No attempt is made to describe actual working processes or to draw comparisons between alternate methods, but the existing knowledge so far as it is available in published papers and patents, is dissected and summarised so that the reader with a minimum of effort can readily gain an insight into what has been accomplished in the field.

In dealing with the patent literature, though reference is in all cases given to the patent, the name of the patentee is omitted; many will regard this as a welcome improvement on the custom which has grown up during the last few years of labelling every process and piece of apparatus with a name, often without any regard to the true discoverer, if such a person can ever be said to exist in these days of gradual evolution.

Some of the most important applications of catalysis concern reactions between gases, which have the advantage, usually, that the formation of a large amount of bulky by-products is avoided and further that they can be effected in a compact and economically worked plant. Such, for example, is the elimination of carbon disulphide from coal gas achieved by Carpenter and Evans. The catalytic methods of production of ammonia from hydrogen and nitrogen and its oxidation to nitric acid are likewise far in advance of the old chemical processes though the former reaction has still to be worked out on the technical scale in Britain.

A large amount of the book is naturally devoted to hydrogenation, which still affords the example of the most successful application of catalysis in industry. The subject of fat hardening already has a literature of its own, but attention is directed in addition to a number of other reductions in which free hydrogen and a nickel catalyst are of service. Dehydrogenation also receives attention and is of growing technical importance—large quantities of aldehyde have been made from alcohol this way during the war; a brief section is devoted to catalytic oxidation, in which field the chief progress for the future is to be expected. Enough has been written to indicate the scope of the work and its value to the chemist.

Dr. Maxted's book is restricted in its scope to catalytic hydrogenation and reduction: it is one of the text books of chemical research and engineering edited by W. P. Dreaper. After dealing with the preparation of catalysts and the methods of affecting hydrogenation, the author discusses in turn the published work on the hydrogenation of unsaturated chains, unsaturated rings and miscellaneous reductions. The book is particularly clearly printed and the organic formulæ are a model of what such should be; this materially enhances the utility of the book. A final section is devoted to the technical hydrogenation of fats and oils.

PUBLICATIONS RECEIVED.

AN INTRODUCTION TO THE PHYSICS AND CHEMISTRY OF COLLOIDS. TEXT-BOOKS OF CHEMICAL RESEARCH AND ENGINEERING. *By* E. HATSCHEK. *Third Edition. Pp.* 116. (*London: J. and A. Churchill.* 1919.) *Price* 4*s.* 6*d.*

THE MANUFACTURE OF ALUMINIUM. *By* J. T. PATTISON. *Pp.* 104. (*London: E. and F. N. Spon. New York: Spon and Chamberlain.* 1918.) *Price* 7*s.* 9*d.*

COAL TAR AND SOME OF ITS PRODUCTS. COMMON COMMODITIES AND INDUSTRIES. *By* A. R. WARNES. *Pp.* 105. (*London: Sir Isaac Pitman and Sons, Ltd.*) *Price* 2*s.* 6*d.*

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. DEPARTMENT OF THE INTERIOR. (*Washington: Government Printing Office.* 1919.)

QUICKSILVER IN 1916. *By* H. D. MCCASKEY.

SAND AND GRAVEL IN 1917. *By* R. W. STONE.

CEMENT IN 1917. *By* E. F. BURCHARD. *With a Section on* CONCRETE SHIPS, *by* R. W. LESLEY.

SODIUM SALTS IN 1917. *By* R. C. WELLS.

GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA AND WYOMING IN 1917. *Mines Report. By* C. W. HENDERSON.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN UTAH IN 1917. *By* V. C. HEIKES.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA AND OREGON IN 1917. *Mines Report. By* C. G. YALE.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA IN 1917. *Mines Report. By* V. C. HEIKES.

GOLD, SILVER, COPPER, LEAD AND ZINC IN MONT. IN 1917. *By* V. C. HEIKES.

SECONDARY METALS IN 1917. *By* J. P. DUNLOP.

UNITY AMONGST THE TECHNICAL CHEMISTS OF THE EMPIRE.

Attention is drawn by the suggestions made in the topical address of Dr. Frank T. Shutt, as Chairman, to the Ottawa Branch of the Canadian Section of our Society, to the insistent problem of the collaboration and federation of technical chemists all over the British Empire, in the interests of industries throughout its scattered component countries. It is not a question of the furtherance merely of chemical industry proper, but of all industries in which chemistry and chemical products play a part. There is serious risk of waste and conflict of effort, with consequent postponement or dearth of results, if each country goes its own way in promoting advance in technical chemistry and progress in chemical industry. Dr. Shutt recognises to the full the advantages such a central organisation as the Society of Chemical Industry affords for collective effort and mutual support in the assembling of chemists for the discussion of chemical problems and their application to industry, and for the collection and dissemination of technical literature among the English speaking peoples. But we are not sure that the potentialities for good which the liberal and elastic constitution of our Society confers upon it are always and everywhere recognised by others —if they were more generally appreciated it seems unlikely that there would be so large a crop of distinct and specialised technical-scientific bodies, aiming chiefly at objects which could be more readily and effectively attained by Local Sections and Subject Groups of a well-established and representative body of wider scope.

The time is ripe for dwelling briefly upon the benefits which membership of our Society offers, not only to the isolated worker in applied chemistry in general, but to aggregations of chemists and the men who have specialised in particular applications of chemistry. First and foremost, they receive the Journal of the Society, which it cannot be gainsaid presents the most complete and concise continuous record in any language or country of literature relating to, and advances in, applied chemistry for thirty-seven years past. Other Societies have launched journals frankly imitative, but the Journal of the Society of Chemical Industry retains the predominance which is the meet reward of the pioneer. Last year witnessed an extension of the Journal, by the inclusion in its covers of a "Review" section, which has been well appreciated and is responsible for extended circulation of the Journal as a whole. The forthcoming developments in the aerial transport of important mail matter will greatly facilitate prompt publication and distribution of periodical technical literature from a few central sources. It will enable our Journal to print and publish the proceedings of its transatlantic and antipodean Sections almost as promptly as those of home Sections, and members will be thus kept in much closer touch than hitherto.

The approval by the Council of the formation of Subject Groups, of which a Chemical Engineering Group is the forerunner of others, affords an apt illustration of the flexibility of the Society's constitution; and the remarkable initial success of this Group in enrolling over 400 members within a very few months of its inception is a striking proof of the advantage accruing from connexion with a central society which is able and willing to place proper organisation at the disposal of a new body fitly engendered within its fold. If it were more fully realised that it is open to Local Sections and Subject Groups to raise funds to supplement the grant they receive from the Society's general resources, by collecting contributions from the sectional or group membership for the purpose of circulating information of peculiar interest to the local or group members, there would be less talk of the formation of new technical societies *ad hoc*. The Council of our Society will give every encouragement to the formation of new Local Sections or Subject Groups, and to the issue of local or subject "Proceedings" supplementary to the Journal, merely avoiding as far as may be any clashing of activities with those of existing Sections or Groups. A healthy spirit of rivalry within the Society's walls will do no harm, whereas rivals growing up outside may impair the Society's power for good, and cannot be as useful to their members as can a Section or Group of this Society.

THE ORGANISATION OF CANADIAN CHEMISTS.*

FRANK T. SHUTT.

The organisation of Canadian chemists is probably the most important matter of a general character that could engage our attention at this time. Many of us are of the opinion that the time has fully come when, alike in the interests of ourselves and of our country, there should be a closer linking up of the chemists at work throughout the Dominion. We all recognise the basic character of the relation that exists between the science of chemistry and our national manufactures and industries, and we are firmly convinced of the vital importance of the application of chemistry to their development and welfare. The same is also true in respect to chemistry and our great natural resources: chemistry must play a very large and important part in their future economic development. Of agriculture, Canada's largest and most important industry, 30 years' experience has taught me that all true and permanent progress will be and must be based on scientific work and investigation, and that of all the sciences taking part in this work, chemistry is the one that above all others will and must take the first place. There is a great future for profound chemical investigatory work in agriculture; would that those in authority had the knowledge and foresight to realise it!

Whatever chemists and chemistry can do towards increasing the wealth and promoting the welfare and prosperity of the peoples of this Dominion can be done more effectively and more economically if the chemists of this country have organisation. Whether this work be of the nature of the working out and control of processes, general analysis or profound research, we feel confident that a closer organisation than now exists among Canadian chemists will conduce to greater progress and greater efficiency.

But before pursuing this subject I wish from common gratitude to pay a tribute of thanks to that splendid British organisation to which we in Canada owe so much—the Society of Chemical Industry—and to place on record an expression of our high appreciation of all that it has done for chemists in Canada. It is this society that enabled Canadian chemists to take the first step towards organisation. This is something to be thankful for, something that we ought never to forget. As you are aware, as long ago as 1902 branches of this Society were formed in Canada, and these have been in successful operation for a number of years. In this the Society has done a good work. It has helped us

* From the Chairman's Address to the Ottawa Branch of the Canadian Section, December 1918.

with prestige, it has helped us financially and it has offered us an avenue for the publication of our work in the columns of its journal. For all this we would like to convey to our parent society our grateful acknowledgments.

It may be found after a thorough consideration of the whole matter that this relationship, which in a measure gives us a fellowship with the chemists of the Empire, is too valuable a one to cast off. A consensus of opinion and an inventory of our strength and resources may show that it is impossible for Canadian chemists to stand alone, and if such be the case we must loyally and enthusiastically continue our work under the present auspices. No one will more heartily support the present arrangement than myself. It has worked satisfactorily in the past and it is quite possible it may meet our needs for the immediate future. We have however to recognise that there has been a growing feeling of late among the chemists of this country that our affiliation with the Society of Chemical Industry does not offer the very best form of organisation for Canadian chemists. At this juncture I wish to state very frankly that I to a very large degree share in the opinion that the time has come to strike out for ourselves and form a Dominion-wide society—a Canadian Institute of Chemistry or a Canadian Chemical Society. I will therefore place before you for your consideration and discussion the desirability of one organisation of chemists for Canada, with a constitution that would enable it to enrol all *bona fide* chemists in good repute from the Atlantic to the Pacific. First, there is the raising of the status of the Canadian chemist. It may well be asked if the Canadian chemist, unless he hold a professorial position at a university, has any recognised professional status in this country. It is very doubtful if he has. Most certainly he does not rank with members of the medical and legal and engineering professions. Let me cite one or two instances in support of this statement. A few years ago a well-known Canadian chemist holding an important and responsible position in the country was subpœnaed to give evidence in a case involving several millions of dollars. He prepared himself for the case, studying its various phases and aspects. He was on the stand for two days and his evidence covered many folios. He sent in an account for $200.00, which he thought a modest sum under the circumstances. The Court ruled that he was entitled to $4.00 a day and expenses, and that is all he received. That is an illustration of how the courts of the land view or estimate the professional status of the Canadian chemist. Another instance:—The Civil Service Commission is to-day advertising for a chemist who must be an honours graduate in chemistry of a recognised university with at least one year's experience in analytical work of a certain specialised character, and the salary offered is $1300 per annum! This is how our Government views the importance of the science of chemistry and the status of the profession. Do you think the Government would have advertised for a medical man or a lawyer or a qualified engineer at such a salary?—I think not.

Well, if these instances are fair and representative—and I could cite many more, bearing on the same point—as for instance when a Minister of the Crown wanted me, not so many years ago, to accept as chief assistant in our laboratories at the Experimental Farm a clerk in a drug store, not discerning the difference between the nature of the work of a drug store and that of a chemical research laboratory—what, I ask, can we do to raise the status of the chemist? We certainly ought to do something. I do not see that there is any possibility of any advance in that direction until we have a national society with high standards of membership—a society that by its very constitution, its standing in the professional world, could in time create and exert an influence throughout the length and breadth of the land.

Then again I think a national society of chemists of the nature I have indicated would be the very best protection the profession could have against the half educated, poorly equipped and often not over scrupulous chemist that is found practising, often for a reduced fee, in every country. We have them in Canada, and this country as well as its responsible chemists needs protection against them. Much money has been thrown away, as I very well know, on propositions floated on the strength of inaccurate and misleading analyses.

Secondly, a national society would create a strength and an influence that could be used as occasion dictated in matters of moment to the country and its best interest. Of course, I refer only to matters of wide importance and which by their nature fall within the province of chemists to advise or offer an opinion upon. There ought to be, and I am sure there are from time to time, questions upon which a corporate body of chemists could by public pronouncement and by memorials well advise our people and their legislators, as for instance in establishing standards of quality for all classes of manufactured and industrial products, and in the making of regulations which should safeguard the health of the workmen and the public generally. The industries look well after their own interests in such matters—that is true the world over—the public needs education and protection, and we as chemists have a responsibility in all this which we ought not to neglect or ignore. There is in this a national work to be done and it is only a national society that can do it.

Thirdly, a national society of high standing and with high ideals would act as a stimulus to more thorough, profound and careful work by our Canadian chemists. It would furnish an incentive for the best work. Without a due realisation of the high character of our work we become but drudges. Once chemistry is on a plane with the so-called learned professions, the best of our men, the ablest, at our Universities would enter it; for chemistry not only ranks with the most interesting and fascinating of all sciences but, as you will all admit, it offers problems and a field of research that call for the brightest intellects, the finest scholars the country can produce. Canada as she grows will need and must have more and more chemists, and chemists of the very highest ability; how else, I ask, is she to take a place in the front rank of civilised peoples?

Fourth, a national society would make possible a journal for the publication in Canada of Canadian work in pure and applied chemistry. This is something that we ought to have for our use and information and in order to take our rightful place among the progressive nations of the world. It is true we have a *Canadian Chemical Journal*. We are very glad to have it; it is proving an interesting and useful publication from several points of view; but its sphere is necessarily limited and it is not within its province to print papers on theoretical, abstract subjects and matters of pure research, of interest only to those who are engaged in or interested in the science of chemistry apart from its application. The only avenue for the issue of such papers at present in Canada is in the transactions of the Royal Society of Canada, and this avenue does not seem to have appealed to very many of our chemists, possibly because of the restricted distribution of the Transactions.

It is not necessary to enlarge upon the advantage of such a journal as I have spoken of. There ought to be a sufficiency of material to maintain a quarterly of high quality, and if at first there were a difficulty in getting papers of the right stamp,

surely the very existence of such a journal would be an incentive, especially to our younger chemists, to enter upon investigatory work, for publication in its columns. It would be a matter of pride to us and all Canadians to have a journal of purely Canadian work. Presumably, at first, it would be a very modest affair.

As to the constitution of such a national society of Canadian chemists, I will merely outline what might be desirable or possible. Briefly my idea would be a society that would include Fellows, Associates and, if found practicable, general members. It might be modelled after the Institute of Chemistry of Great Britain and Ireland and the recently formed Australian Chemical Institute, though I am of opinion that a Canadian society should be built upon a broader basis than either. The election of Fellows and Associates should be by examination or based upon chemical training, qualifications and experience of the candidate. Each election should be approved by the central Council of the society. A high standard should be insisted upon, so that the status of Fellowship and Associateship should be tantamount to and generally and professionally recognised as equivalent to chemical degrees. The society should not be restricted in its function to registration, as, for instance, is the Institute of Chemistry in Great Britain. It should be a society that would bring its membership together for the reading of papers, for lectures and discussions on chemical matters generally, in as many branches as may be deemed necessary or desirable at centres throughout the Dominion. I am aware of the difficulties that would be met in establishing and maintaining a society which included the professional and non-professional member. Whether these difficulties are insuperable I cannot say. If it were possible I should like to see those interested in chemistry, but not professional chemists, find a place in the society.

The society would be governed by a council elected annually by the Fellows and Associates and meeting say three or four times in the year for business at headquarters, or at one or other of the large cities, as might be determined upon. The society would necessarily have its charter Fellows, and Associates, elected, say, during the first year of its existence and drawn from the ranks of Canadian university professoriate, from the ranks of Government practising and industrial chemists, etc. The Committee on Constitution could make out a list of good men for consideration of the Council. The fees of course would be graded and each branch would have its own local officers. The society would undoubtedly require some financial assistance on the part of the Government, if it were to support a journal. If it could be shown that the society was really a good thing for Canada such assistance should not be very difficult to obtain, and I think it could be demonstrated that a national society of chemists would prove a very valuable institution, not merely for the profession but for the country at large.

In discussing the more important and salient features of the establishment of a purely national society of Canadian chemists, it is not my desire in the least to impose my views upon you; but I trust that my remarks may be of assistance in leading our discussion into definite lines.*

* At the close of the meeting a resolution was passed to the effect that the work of organising Canadian chemists could be best undertaken by a new and separate institution.]

NOTICE.—*Opinions expressed in articles, etc., bearing the name of the author, are not necessarily those of the Council of the Society, or of those more immediately responsible for the publication of the Journal. The insertion of such articles, etc., means simply that the subject matter or the point of view taken is of sufficient interest or importance to warrant publicity.*

REVIVAL OF INDIGO.

In addressing the Textile Institute, at Bradford, on February 27, on this subject, Prof. H. E. Armstrong took exception to the application of the adjective *natural* to indigo as redundant, also to the use of the expression *synthetic indigo*—as indigo never has been and never can be made artificially. Indigo is a mixed material, produced in a particular way from a plant, containing, in the case of well-made samples, about 70 per cent. of the specific compound *indigotin*. This compound, not indigo, is the substance which is being manufactured and sold in an almost pure form. The term indigo should be used only in speaking of the natural product.

Indigo contains substances other than indigotin which have an influence in the dye vat, even if not actually dyestuffs. It has been the studied policy of the German manufacturers to disregard these associated materials as of no account; all but the old conservative school of dyers have fallen into the trap; these latter have always maintained that indigo has special qualities, which give it an advantage, in dyeing heavy shades, over manufactured indigotin pure and simple. Probably, in future, this difference will be one of determining influence on the industry.

In trials made with special care to contrast indigo with synthetic indigotin, in dyeing heavy shades on loose wool, the former has been found to have the advantage to a very marked extent. Hydrosulphite vats (1500 gallons) were set with equal quantities of indigo and of synthetic indigotin paste, each containing 20 per cent. indigotin, and equal quantities of loose wool were dyed simultaneously in the two vats in lots of 50 lb. at a time. In the case of the first 2 or 3 dyeings, deeper shades were obtained in the indigo vat: in consequence, the addition of paste before dyeing each lot of wool was gradually reduced, and it was eventually found that equal depths of shade were produced when the amount supplied each time was 8 lb. of synthetic paste and only 6½ lb. indigo. Indigo produces a rather redder and brighter shade even when these proportions are used. The difference is being made the subject of systematic inquiry.

After considering the history of the introduction of synthetic indigotin and the position of indigo prior to the war, especially the great reduction in output of the natural product, Prof. Armstrong gave an account of the efforts made to improve the industry in India, in particular of late in Bihar, under the direction of Mr. W. A. Davis. It has been shown conclusively that a paste containing a standard proportion of indigotin, comparable with that in the synthetic paste on the market, is easily prepared, and that the only disadvantage it has arises from the presence of a certain proportion of insoluble matter. An organisation for the preparation of such paste has been established, and probably this material will be put on the market in competition with synthetic paste. Other forms, more easily transported, are in contemplation, however.

The process of manufacturing indigo has been much improved under Mr. Davis' direction—in particular the yield has been raised considerably by the recovery from the "sect" water of the finely divided, suspended indigo, which formerly ran to waste: this has been effected by adding Dhak gum.

The extraction process is being studied in every particular, especially on the bacterial side.

The crop has been a declining one of late years, owing to the diminished yield per acre, the occur-

rence of wilt disease and the attack of the plant by an insect pest; also by reason of the difficulty of raising seed. A careful and extended survey of the results has led Mr. Davis to the conclusion that, at all events, the main cause of the decline is the depletion of the soils in available phosphate. Of late, even the Natal-Java plant has ceased to give a superior yield—the early success of this variety is shown to have been due to the fact that it is a very deep rooted plant and was able to appropriate from the subsoil the phosphatic supplies beyond the reach of the Sumatrana plant.

The future of the industry appears to be mainly contingent on the extent to which planters are able to apply phosphatic manures. Apart from the dyestuff it yields, the indigo plant is now of importance as a green manure; and as a leguminous crop it also has its definite, natural place in the rotation. It is clear that big crops can be obtained, if proper agricultural conditions be secured, and that there will be no difficulty in raising seed. There is also reason to believe that improved varieties of the plant, giving an enhanced yield of indigo, will soon be produced. In short, improvements are foreshadowed in many directions, so that indigo may well recover its position and enter into effective competition with the artificially made somewhat imperfect substitute.

PATENT LAW REFORM.

A. RÉE.

The Memorandum on Patent Law Amendment issued by the Institute of Electrical Engineers* is a document which should be read by everyone interested in the subject. A great deal of the matter incorporated in it is of a controversial nature, and, in particular, some of the recommendations (see this issue, p. 127R) cannot be regarded as other than harmful to the interests of British chemical manufacturers.

The question of a patents moratorium is dealt with at some length, but it appears doubtful if the recommendations under this head will be adopted, for although they would certainly benefit patentees, they would inflict grave injustice in many cases. In regard to compulsory licences, and the working of patented inventions, the Memorandum presents the case of those who have always been bitterly opposed to these measures, and it is lamentable that an agitation so fatal to the best interests of British chemical industry should be set afoot again, led primarily and almost exclusively by engineers whose interests in Patent Law affairs are so diametrically opposed to those of chemical manufacturers. It does not appear reasonable to recapitulate here in detail the case in favour of compulsory licences, or working, for it has been so often and convincingly stated that anyone interested can at once put his hand on various articles and pamphlets dealing with this part of the subject.

The question of patentability of articles for food and for medicinal purposes was probably introduced into the 1917 Bill (Clause 11, Section 28) in order to make our law conform to that of France. There is little doubt that this clause will not appear in the new Bill that is being drafted, or at all events, it will be framed on entirely different lines. It must, however, be strongly emphasised that product patents should be abolished, except with the modification recommended by the Manchester Chamber of Commerce, as well as by the Association of British Chemical Manufacturers. Germany has benefited enormously in the past by not having product patents herself, but by being able to secure them in certain other countries, such as England, France, and Italy. The last two countries are for that reason doing away with product patents, having fully recognised how, in this respect as well as in many others, their patent laws have helped German industry and damaged their own. It might be interesting in this connection to give the actual wording of the recommendations of the Manchester Chamber of Commerce and the Association of British Chemical Manufacturers:—"That there should be embodied in the Bill a definition of 'invention' in substitution for that in the existing Act, such definition to include chemical processes and the products of such processes, no patent to be granted for the products apart from the process or means by which it is produced. Subject to this limitation the field of invention should be absolutely free and unrestricted." It might also be interesting to quote the following recommendation by the above-mentioned bodies:—"With regard to patents for inventions relating to articles or substances for food or drink, or for medicinal or surgical purposes, or to methods or processes for manufacturing such articles or substances, power should be given to the Comptroller to prevent any abuse of the monopoly granted, with a view to making the patented invention available to the public at a reasonable price."

Certain recommendations are made in this pamphlet extending both the provisional term and the term for acceptance of complete specification. It is suggested that what is wanted is an extension of the term of priority under the International Convention. The great difficulty is in getting the English application through in the twelve months allowed by the International Convention. Very often, if the inventor exercises his full privilege of waiting six months before filing his complete specification, he may have reached the limit of the twelve months that are allowed before the complete specification is in order for acceptance in this country. The suggestion, contained in the Memorandum, to extend the period to nine months instead of six months as heretofore, would only aggravate the situation. It is true that this objection is said to be met by a proposal that a patentee should file his patent of origin elsewhere than in England; but this would prevent him from manufacturing at once in England, and if the patentee should have failed to secure protection in the foreign country where (under these proposals) he first applied, his position would be a most unenviable one. Further, every one, quite naturally, wants to produce first of all in his own country; and it should surely be obvious that the country or origin ought to be the country in which the invention was really originally made.

The suggestion of constituting a new tribunal to try cases involving scientific and technical questions will meet with general approval and acceptance. We should like, however, to point out that such a proposal emanated originally from the Manchester Chamber of Commerce, was adopted by the Association of British Chemical Manufacturers, and reads as follows:—"All orders of the Comptroller (under Clause 1, Sub-section 12) shall be subject to the appeal to the Court, and it is recommended that a Court of say five members, two legal and three technical, should be constituted, and that three members, one legal and two technical, should form a quorum."

At present appeals lie with the Officers of the Crown, except in those cases where they are referred to the High Court. The principal reason why various bodies are suggesting a special court composed of experts is that the Law Officers are

* Memorandum on Patent Law Amendment, based on a Report prepared by the Institution of Electrical Engineers and put at the disposal of the Technical Institutions' Conference by that Institution, Oct. 10, 1918.

extremely busy men, and hence appeals to them entail great delay, sometimes over 12 months, and cause patentees to incur risks and very considerable expense. Were such a new special Court created, it would be desirable that every variety of case should be referred to it, *i.e.*, not only those which lie with the Law Officers of the Crown or the High Court, but also any kind of patent litigation, and appeals arising in practice from the opposing of the grant of a patent, disclaiming, etc. Such a proposal, which involves a purely administrative matter, would have to be dealt with by the House of Commons.

NEWS FROM THE SECTIONS.

CANADIAN PACIFIC.

At the meeting held on January 10 at Vancouver, B.C., Mr. W. S. Barwick, of the Vancouver Engineering Works, read a paper on "Ferro-Alloys and the Hardening of Steel."

Mr. Barwick described the various ills that affect steel and iron during manufacture, their causes and the methods developed by metallurgical chemists in overcoming them. The production of ferro-alloys has evolved with the developments of the electric furnace. Ferro-alloys often not only act as cleansing agent by removing undesirable constituents such as oxygen, nitrogen, sulphur, but also impart very desirable properties to the product. A very complete description of the various types of steel was given, and special reference was made to the very considerable economy effected during the war by the use of certain ferro-alloys.

On February 24, Prof. E. H. Archibald, of the University of British Columbia, addressed the Section on "The Rusting of Iron."

The author reviewed the theories advanced to explain the phenomena of rusting and described experiments that had been made to substantiate them. The varying conditions in nature causing rust and methods of protection or prevention were reviewed, such as the solubility of oxygen and atmospheric impurities in water, depth of immersion in water, porosity of iron under normal conditions and under deformation, intensity of light, and the action of films of fatty or hydrocarbon oils on the surface of water or on the iron. The presence of rust accelerates corrosion owing to absorption of moisture by the rusted areas. Hence the rails of railroads rust more rapidly when not in use. The corrosion of cans coated with a film of linseed oil and baked at 150° C., is due to the oil combining with either oxygen or hydrogen and thus reducing the protection due to polarity. By baking at 250° C., better results have been attained.

Prof. Archibald favoured the electrolytic theory as the best explanation of most of the phenomena associated with the rusting of iron. After the address, he demonstrated experimentally the varying local composition of commercial iron. A small bar of polished iron immersed in distilled water containing phenol phthalin exhibited local areas of red over the cathode portions. The anodic areas may be demonstrated by the addition of potassium ferricyanide when the ferrous iron forms Turnbull's blue. A bar of chemically pure iron would not show areas of local polarity.

Mr. J. A. Dawson, chairman, reported on the progress made in organising a federation of technologists under the provisional title of the United Professional Engineers of British Columbia. It was hoped that through this organisation of architects, engineers, chemists, and other technologists, there would eventually develop co-operation as to programmes, club rooms, libraries, as well as the immediate aim of professional protection, including protection to the public as a result of the legislative definition of these professions.

CANADA.

Ottawa.

The third ordinary meeting of the Ottawa Branch was held on February 20, when an address was given by Mr. S. J. Cook, the local secretary, on the subject of "Paint Pigments: Their History and Development." Mr. Cook treated the subject briefly from a historical point of view and then, after offering a classification of the various pigments as they occur in commerce, proceeded to discuss particularly the white pigments and inert fillers. The Society was honoured on this occasion by a visit from the chairman of the Canadian Section, Dr. W. L. Goodwin, of Queen's University.

A special motion-picture meeting of the Society was held on February 6 in the Exhibits and Publicity Branch of the Trade and Commerce, Ottawa, at which about forty members and guests were present. Through the courtesy of the American Cyanamide Co., films portraying the processes in use at its Niagara Falls plant were shown. Dr. Shutt, in a few introductory remarks, traced the development of the various processes for the fixation of atmospheric nitrogen and discussed the importance of the nitrogen compounds to the vegetable and animal worlds; he also touched upon the uses of cyanamide as a fertiliser and as a source of nitric acid and ammonia. Films were also shown illustrating the manufacture of pottery and the construction of wooden ships in Canada.

NOTTINGHAM.

The annual meeting of the Section was held at University College on March 19. Prof. J. W. Hinchley first gave a paper on the aims of the Chemical Engineering Group. In the discussion which followed, officials and members of the Society expressed their approval of the objects of the Group as stated.

The Annual Report was then read; it showed a year successful from the point of view both of papers and discussions and also from that of membership. There are now 170 members, which is a net increase of 40 over last year's total. The number of nominations of officers and committee for the next session being equal to the number of vacancies, the following were declared elected:—

Chairman, Mr. F. H. Carr; Vice-Chairmen, Dr. S. R. Trotman and Mr. J. White; Hon. Treasurer, Mr. S. J. Pentecost; Hon. Sec., Mr. J. M. Wilkie; Committee—Prof. F. S. Kipping, Dr. O. E. Mott, Messrs. L. Archbutt, J. F. Briggs, S. F. Burford, B. Collitt, R. Duncalfe, J. H. Dunford, J. Marshall, W. P. Skertchley, G. J. Ward, and J. T. Wood.

BRISTOL.

The second annual meeting was held on March 27 at the University. Dr. Butler, the chairman, in the course of his address, referred to the success of the Society's annual meeting held in Bristol last year, and to the papers which had been read before the Section during the past session. The membership has increased to 152. The resignation of the Hon. Secretary, Mr. R. F. Easton, has been accepted with regret, and most of the initial success of the Section was due to the energy he displayed. Mr. Easton was presented with a silver cigarette box by the members of the Committee in recognition of his good services. After a vote of thanks had been passed to the University authority for facilities granted, the meeting proceeded to the election of officers for the coming session. These were

elected as follows:—Chairman: Mr. E. Walls; Vice-Chairman, Mr. W. R. Bird; Hon. Treas., Mr. J. Bernard; Hon. Sec., Dr. F. Rixon. Committee: Professors F. Francis, C. M. Thompson, Dr. Butler, and Messrs. E. C. Evans, E. F. Hooper, C. J. Waterfall, J. M. Dodds, C. E. Boucher, L. J. Davies, G. H. Hedley, M. W. Jones, and W. J. Cooper.

Mr. F. J. Popham then read a paper on "Peat," in which he pointed out that the world's resources of it were enormous, and its exploitation from the standpoint of fuel conservation was very important. He referred to the use of air-dried peat in producers, with ammonia recovery, and the principles underlying the so-called "wet-carbonising" process for the preparation of fuel briquettes from peat. He considered that the chief difficulties in the application of this process were of an engineering character, and not fundamental.

LIVERPOOL.

"Pulverised Fuel" was the subject of the paper read by Mr. A. Grounds to the meeting held at the University on March 21. The chair was taken by Mr. A. T. Smith. This question has received but scant attention in this country, except by the manufacturers of Portland cement and the inventors of the Bettington boiler, with the result that many English firms are now paying royalties to American patentees.

The efficiency of combustion of raw coal cannot compare with that of the pulverised material, and with regard to cost, it has been calculated from average data that the B.Th.U.'s delivered to the furnace per penny cost of operation are as follows: Fuel oil, 25,300; water gas, 28,700; powdered coal (screw conveyor system), 32,500; powdered coal (pneumatic system), 42,488. It is true that the increased cost of drying and grinding has to be set against increased efficiency and economy in fuel, but no heat is utilised in evaporating moisture from the coal inside the furnace, as is the case with the raw coal fired furnace. The objection as to scattering of the ash has no foundation, as, on the contrary, it slags and forms either a pool on the floor of the furnace or a troublesome deposit on the walls and tubes. It is false economy to use coal of too low a grade; the most suitable material is one containing less than 1 per cent. of moisture and more than 30 per cent. of volatile matter, although a fairly wide range of coals can be used.

The fuel is given a preliminary crushing, with magnetic separation of admixed iron and steel fragments, dried in a rotary dryer, and then finely pulverised in one of the various types of grinding machines (Krupp, Huntingdon, Bradley, Carr, Bonnot). The powdered coal is carried either by screw-conveyor, or pneumatic system, to the burners. In the Holbeck system, now coming into extensive use, the powdered fuel is fed into a storage-bin and from this into a high-pressure blower, which forces it into the distributing main—a wide pipe from which it is tapped off to the various furnaces. The supply of dust is made automatic; auxillary blowers and boosters can be placed in line to assist circulation. Among the advantages of this system are: (1) The air used for conveying coal dust is also used for combustion; (2) high cost of repairs for screw-conveyors is eliminated; (3) the need for a bin at each furnace is obviated; (4) a few minutes after the furnaces are shut off all coal dust in the system is returned to the pulverising plant, thus leaving no coal dust in storage in the works or at the furnaces. Great economy is effected by preheating the air, and wear and tear on furnace lining is reduced by water-cooling, by reduction of air pressure, and avoiding sudden changes in direction of flow of gases.

THE CHEMICAL SOCIETY.

ANNIVERSARY DINNER.

After an interval of six years, the anniversary dinner was revived on March 27 last, the President, Sir W. J. Pope, presiding. The attendance beat all previous records, over 360 Fellows and guests being present. Among the latter were the Rt. Hon. Lord Moulton, the Rt. Hon. H. A. L. Fisher, President of the Board of Education, the Rt. Hon. Sir Alfred Mond, First Commissioner of Works, Sir J. J. Thomson, President of the Royal Society, Dr. C. Poulenc, President of the Société Chimique de France, Sir Aston Webb, President of the Royal Academy, and representatives of other leading learned societies.

Lord Moulton, who gave the toast of the Chemical Society, spoke of the great part played by chemistry in the war. There is no doubt, he said, that the Germans held their hand until their great installations for producing ammonia by the Haber process were completed. They looked to their large chemical factories for the manufacture of ammunitions, and they relied on the potency of their poison gases. These things, together with the great advance they had made in artillery, emboldened them to anticipate a rapid victory. The struggle was really one in which each nation depended on its chemists. When he first took up the supply of explosives in November, 1914, England was practically destitute of factories which could be turned to warlike purposes, she was entirely destitute of any home source of nitric acid or nitrates, and was possessed of no plant for producing lethal gases. The way in which our chemists responded was marvellous, and except for a temporary inferiority in regard to the supply of "mustard" gas, it could truthfully be said that from end to end of the line we were at least equal to the enemy in all branches of chemistry as applied to warfare. Time and again when we appeared to be at the limit of our resources, some new method of increasing production, some new process, or some variation in an old process was devised to meet the occasion. Both England and Germany have learned that their natural resources are much wider than they were thought to be, and there seemed to be no limit to be set upon the possible achievements of chemistry and physics working hand-in-hand. In coupling the name of the President with that of the Society, Lord Moulton spoke in eulogistic terms of the excellent work he had rendered to the country in problems connected with poison gases, and in the more polite realm of aerial photography.

In the course of his reply, Sir W. Pope said that the nation must be prepared to pour out treasure into our educational establishments for securing the potential young energy of the country and directing it into scientific channels. It is, further, essential that money should be poured into our universities for the purpose of stimulating research and of acquiring a tremendous output of scientific knowledge; whether that knowledge be "pure" or "applied" did not matter, the return in any case would be enormous.

The toast of His Majesty's Forces was then given by the President, and responded to by Lieut.-General Sir William T. Furse.

The toast, "Our French Colleagues," was proposed by Prof. H. E. Armstrong, who said that this was the first occasion upon which the French society was officially represented at their anniversary meeting. In felicitous terms he quoted Wurtz' dictum, "La chimie est une science française, elle fut fondée par Lavoisier d'immortelle mémoire," and referred to the long list of distinguished French

chemists who had advanced the science. After Dr. C. Poulenc had replied, Sir J. J. Dobbie proposed the toast of the guests, coupled with the names of the Rt. Hon. H. A. L. Fisher, Sir Aston Webb and Sir J. J. Thomson. Mr. Fisher humorously referring to chemists as past masters in the fine art of murder, deplored that he was but a melancholy product of the dark ages of compulsory Greek. The educational cause which Huxley championed may now be regarded as practically won, and former sceptics must have been converted by the achievements of science in the war; there was, however, leeway to be made up and a great deal more money must be spent on science. If warfare is to be a thing of the past, chemistry will be the principal agent of that beneficent change. It will have done more than any League of Nations can possibly aspire to do. We realised, he hoped, that the best form of protection for national industry was not more tariff, but more chemistry. It is necessary to create in the whole country a general atmosphere of mind favourable to scientific ideas. Thirty years hence, when the educational changes which had recently been introduced had had time to bear full fruit, his successor at the Board of Education would have no reason to complain of the neglect of science.

Sir Aston Webb and Sir J. J. Thomson also responded.

MEETINGS OF OTHER SOCIETIES.

MINERALOGICAL SOCIETY.

Sir Wm. P. Beale, Bt., president, occupied the chair at the meeting held on March 18. After Mr. L. J. Spencer had read a contribution on "Curvature in Crystals," Lieut. A. B. Edge described the "Siliceous Sinter from Lustleigh, Devon." The district round Lustleigh, near Bovey Tracey, is mined on a small scale for a very fine quality of micaceous hematite, which occurs there in well-defined lodes traversing the granite. At the Plumley Mine (now disused), on the walls of one of these lodes is found a peculiar banded material, which on analysis proved to be a siliceous sinter or opal of sp. gr. 1·73, with an approximate percentage composition of, silica 70, water 21, hematite 6, alumina, soda and potash 3. It is hard and compact, shows a beautifully banded structure, but is very fragile, breaking concholdally even when most carefully handled.

A note on "An Anorthic Metasilicate from Acid Steel Furnace Slags," by Mr. A. F. Hallimond, was followed by a description of the meteorites from Adare and Ensisheim by Dr. G. T. Prior. The percentage amounts of nickeliferous iron and the ratios of iron to nickel support the view that in chondritic meteorites the quantity of nickeliferous iron present varies inversely with the nickel content. Dr. G. F. Herbert Smith described a students' goniometer, made by Messrs. J. H. Steward, Ltd. This instrument is of the type in which the direction of reference is given by the reflexion of some distant object in a mirror, and in which the axis of the graduated circle is horizontal. A ball and socket joint provides the mirror with all the necessary adjustments in direction, and it is also movable vertically in the plane of the axis of the circle. The crystal holder is provided with a simple form of adjustment which enables a crystal to be measured, as regards one half, without removal from the wax. A pointer on a swinging arm facilitates the setting of the crystal in the axis of the circle.

SOCIETY OF GLASS TECHNOLOGY.

On March 19, a meeting was held in the University, Birmingham, when a paper was read by Mr. B. J. Allen on "The Preparation of Raw Materials for, and the Casting of, Glass Pots."

The author first dealt with the deflocculation of clays, and showed it could be accomplished by electrical treatment. He described a simple apparatus for testing clays to show their suitability under this electrical treatment, and his experiments proved that many common fireclays altogether unsuited in their ordinary state for the manufacture of refractories could by the above treatment be made to produce a large proportion of highly satisfactory material fit to meet the specification for high grade work.

Mr. Allen dealt briefly with the manufacture of pots by the old method of building by hand, and referred to the limitations of this method. It is most difficult for the pot maker to guarantee a perfectly united homogeneous pot. It is very essential that clay and the grog be in intimate contact in the finished pot, and this is ensured by the casting of the pot. He then described in detail the preparation of slip and subsequent casting of pots. The lecturer expressed the opinion that research on all these matters should be carried out by the Society.

THE INSTITUTE OF METALS.

The spring meeting of the Institute of Metals was held in the rooms of the Chemical Society on March 25 and 26. The principal paper for discussion was the Fourth Report to the Corrosion Committee, by Drs. Bengough and Hudson, a lengthy document of 182 pages and 24 plates, embodying the results of a very long series of experiments and observations. The report differs from its predecessors in regard to the experimental method adopted, microscopical studies of the appearance of corroding surfaces taking the place of measurements of the loss of weight during corrosion. Some of the facts so recorded are very remarkable, and exceedingly difficult to interpret. The authors prefer the hypothesis of direct oxidation of metals to that of electrolytic solution followed by oxidation of the residual metal, but do not commit themselves to a definite theory of corrosion. On the practical side, they have added to our knowledge of corrosion under service conditions by their proof of the importance of the copper-rich surface layer on brass condenser tubes as ordinarily manufactured in determining their resistance to corrosive influences. They have also reached certain definite conclusions as to the limitations of the protection of tubes by the application of an external electromotive force.

Dr. Rosenhain and Mr. Hanson described the properties of some copper alloys which had been tested for special purposes, the chief interest of the paper lying in the method adopted to obtain sound castings by filling the mould under pressure. A lively discussion followed the communication of a note by Lieut.-Col. Jenkin, in which it was pointed out that there is at present little correspondence between the information required by the engineer as to the properties of the materials with which he has to work and that supplied by the metallurgist. The engineer wishes to know the endurance of steel or non-ferrous alloys under stress, their resistance to corrosion, etc., and is supplied instead with notes of micro-structure, Brinell hardness, Izod figure, etc., the exact relation of which to the data desired is unknown. In fact, the engineer and the metallurgist too often speak two different languages. There was some difference of opinion as to which of the parties should be responsible for the choice of the testing

methods, but the suggestion of Dr. Rosenhain, that the solution would probably be found in the determination of fundamental physical constants (specific heat, compressibility, etc.) and the establishment of definite relations between these and the working properties, seemed to be generally acceptable. The testing of materials has evidently to make a great advance before such a solution becomes practicable.

The second day's papers included several of practical interest. Messrs. Hanson and Archbutt described the micrographic constituents of light aluminium alloys, and showed how the compounds with copper, nickel, and iron may be distinguished from one another and from silicon. Two papers, by Messrs. Ellis and Johnson respectively, were suggested by the results of Mr. Alkins at the last meeting, and aimed at establishing a discontinuity in the change of mechanical properties of copper and brass with progressive cold work. It is evident, however, that much more exact determinations will be required before any speculation as to the causes of such a discontinuity can be more than guesswork. Some very interesting facts known to sheet rollers and tube drawers were brought out in the discussion, indicating a strongly marked time effect in the change of elasticity in cold-worked metals. This time factor has to be taken into account in any study of deformation by cold-working.

The final session was devoted to a general discussion on the relations of scientific research to works practice, the opener, Dr. Rosenhain, dealing with the general question, while Messrs. Barclay and Lantsberry dealt, from different points of view, with the organisation and functions of works laboratories. The remarks made by prominent manufacturers showed a keen appreciation of the services of science, and it is to be hoped that the newly established Non-Ferrous Metals Research Association, to which reference was made, will make a successful beginning and meet with adequate support. The veil of secrecy which has so long enveloped the non-ferrous metal industries is gradually disappearing, and it is to be hoped that the free interchange of information, which has rendered such great service in the manufacture of iron and steel, will become common in the sister group of industries.

THE CHEMICAL SOCIETY.

The annual general meeting was held at Burlington House on March 27. The report of the Council and the statement of accounts and balance sheet were adopted, and Sir W. J. Pope delivered the presidential address, which dealt principally with the achievements of chemistry in relation to the war. A report of the address will appear in an early issue of this Journal. The election of officers then followed, involving the following changes:—President, Sir J. J. Dobbie; Vice-Presidents, Sir W. J. Pope, Dr. H. J. H. Fenton, Prof. J. Walker; Council: Prof. F. E. Francis, Mr. J. A. Gardner, Dr. C. A. Keane, and Sir R. Robertson. The Anniversary Dinner was held the same evening.

At an ordinary meeting held on April 10, the President announced that the Society's Library would be open until 9 P.M. on every evening of the week, except Saturdays, as from May 1 next.

REFLUX CONDENSERS FROM BROKEN GLASS.—Mr. N. A. Masani, chief chemist to the Morarji Goculdas Laboratory, Bombay, in a communication concerning the shortage of chemical glassware in India, states that an accumulation of broken test-tubes suggested to him their utilisation in the construction of the jackets of small reflux condensers, ordinary glass tubing serving for the inner parts. The improvised apparatus proved very successful.

NEWS AND NOTES.

CANADA.

Convention of Canadian Chemists.—The second convention of Canadian chemists will be held in Montreal during the last week in May. At this meeting it is expected that a purely Canadian society of professional chemists will be organised. The feeling is that no existing body is exactly suited to the task of drawing together into one organisation the chemists now scattered throughout Canadian universities and industries.

The Canadian Mining Institute.—On March 5, the Canadian Mining Institute held its twenty-first annual meeting at Montreal. Some thirty papers were given covering the latest activities in Canadian mining industries. Both in Quebec and Manitoba new resources of great value are being opened up. In Gaspé Peninsula, Quebec, deposits of zinc and lead are receiving attention, and the copper deposits of Northern Manitoba have been found to be exceedingly rich.

Ontario Mineral Production in 1918.—The Ontario Department of Mines has just issued its preliminary report for the year 1918. Values have greatly increased, both in metallic and non-metallic products. Compared with 1917 production shows a falling off in some items, but increased prices much more than counterbalanced diminished outputs.

The total mineral production for the year amounted to $80,000,000, being a net increase over 1917 of $8,000,000. This is the highest mark yet set, and Ontario now furnishes nearly 50 per cent. of the total mineral output of the Dominion. During the year the International Nickel Co. of Canada took over the business of the Canadian Copper Company, and in its new refinery at Port Colborne treated 5334 tons of nickel-copper matte, from the time the plant started in July. Although comparatively little iron is produced, the output of steel is valued at $28,792,361. Electric furnace developments were greatly accelerated and various ferro-alloys were turned out in large quantities. The three silver refineries situated at Delora, Thorold and Welland treated 8354 tons of concentrates and residues. The new Mosa oil field in Middlesex county contributed 108,998 barrels, or 37 per cent. of the total output. The production of crude petroleum is, therefore, on the increase. The output of natural gas decreased greatly during the year owing to the action of the Ontario Legislature in conserving the supply for domestic purposes.

BRITISH INDIA.

Importation of Calcium Carbide.—The Department of Statistics publishes the statement that of the 23,320 cwt. of calcium carbide imported into India during the last three months of 1918, Japan sent 21,700 cwt. and the United Kingdom only 33 cwt. Java contributed 887 cwt. and the United States 500 cwt.

Coal.—Over 18¼ million tons of coal was mined during 1917, and the value at the pit's mouth was 4*s.* 11*d.* per ton, as compared with the lowest, 3*s.* 4*d.*, in 1905, and the highest, 5*s.* 3*d.*, in 1908. The quality of Indian coal is very inferior to that of British coal, and it is very difficult to obtain material suitable for metallurgical purposes. The low cost of production is due to cheap labour and to the fact that the coal is very near the surface. Of the total production, 31·5 per cent. is used on the railways, and in 1917 the paper mills consumed 170,000 tons, the oil mills 160,000, gold mines 84,000, sugar factories 77,000, and gas works 63,000 tons. The demand for coal is great and the supply

inadequate. One of the serious problems to be faced is the provision of coal suitable for the metallurgical and chemical industries.

AUSTRALIA.

The Sugar Industry.—A Royal Commission, consisting of Messrs. A. B. Piddington, N. C. Lockyer and S. Mills, has been constituted to report on the sugar industry. The inquiry will cover the national value of the industry, production, Government control, Protection and Imperial Preference.—(*Official.*)

Immediate Policy of the Commonwealth.—Speaking at the Victoria Chamber of Manufacturers on March 27, Mr. Watt, Acting Prime Minister, said that the Federal Parliament would meet as soon as possible to deal with the tariff question. The Prime Minister, Mr. Hughes, is in Paris contending for three principles: (1) to obtain for the Commonwealth the control of the former German colonies in the Western Pacific; (2) to obtain for Australia an indemnity from Germany to defray some of the cost of the war; and (3) to secure fiscal freedom for the Commonwealth.—(*Official.*)

UNITED STATES.

Charcoal for Gas Masks.—The best raw material for gas mask carbon is coconut shells, which must be broken to a certain size and sifted to take out dust and fine particles. This new class of work was taken up by the Astoria Light, Heat and Power Company, which provided for storing 5,000 tons of raw material under cover and 15,000 tons in the open. As the supply of coconuts decreased, large quantities of cahune nuts were imported from British Honduras. The cracking and removal of the kernels required special machinery, which was soon provided. A call was made to the public for fruit stones, and many tons of peach, apricot, and prune stones were sent to the Astoria works from the Pacific coast. Also large quantities were obtained from thousands of barrels placed in the streets of New York for their reception. Ninety per cent. of the material used for masks made in the U.S. was carbonised at Astoria.—(*Amer. Gas Eng. J., Jan.* 18, 1919.)

GENERAL.

Annual Meeting of the Society.—The Council of the Society has accepted the invitation of the London Section to hold its annual meeting in London on July 15, 16, 17, and 18 next. Every advantage will be taken of the opportunity and of the locality to provide a programme worthy of the occasion, and to bring together an assembly commensurate with the degree of importance which the chemical industries have attained in the national life. It is also hoped that representatives of French chemistry and chemical industry will be able to attend.

His Majesty the King has graciously consented to act as Patron and H.R.H. the Prince of Wales as Vice-Patron. A General Committee is being formed to include some of the foremost representatives of science and industry; and amongst those who have already promised to serve upon it are the Rt. Hon. the Lord Mayor, the Rt. Hon. the Marquess of Crewe, Sir George Beilby, Sir J. J. Dobbie, Sir R. T. Glazebrook, Sir Robert Hadfield, Sir Herbert Jackson, Sir Alfred Keogh, Col. Sir Frederick Nathan, Sir W. J. Pope, Sir Boverton Redwood, Sir T. K. Rose and Sir William Tilden. Sir William Crookes had also expressed his willingness to serve.

The opening meeting will be held at the Mansion House on July 15, when the Rt. Hon. the Lord Mayor will extend the civic welcome, and Prof. H. Louis will deliver his presidential address. Further particulars will be announced in due course, but it may be mentioned that arrangements have been made, for the delivery of an address by Sir William J. Pope, for the holding of conferences on Empire sugar production, and on the leather, dye, and fermentation industries. Also, the Chemical Engineering Group will make its *début* with a whole-day conference on "Power Plants in Chemical Works." The lighter and more convivial side of the meeting will be provided for by a luncheon given by the London Section, the Annual Dinner, a soirée at the Imperial College, a smoking concert, and a whole-day excursion to Windsor. All communications in regard to the meeting should be addressed to Dr. Stephen Miall, at the Society's Offices.

Chemical Engineering.—The Senate of University College has accepted the offer of the Ramsay Memorial Committee of a sum of not less than £25,000 towards the foundation of a laboratory of chemical engineering at the college.

Work of the Medical Research Committee.—In an appendix to a memorandum recently issued by the Local Government Board on the work of the Medical Research Committee (Cmd. 69, 1*d.*), Sir W. M. Fletcher, secretary to that Committee, draws attention to a particular aspect of the value of a centralised State Department for research in medicine or other branches of science. Such a centralised department is eminently suited for garnering the by-products of specialised research throughout the country, and of bringing to the knowledge of Government Departments the work of a single Department which might otherwise escape notice. After referring to the fact that research in one direction may bear valuable fruit in another, and instancing the classic examples of the work of Pasteur and Röntgen, Sir W. Fletcher gives the following illustrations from recent history.

The need for administering oxygen effectively to soldiers suffering from gas poisoning has led to improved methods in the use of oxygen-enriched air in the treatment of disease, and of the application of oxygen mixed with laughing gas as an anæsthetic in dangerous cases of shock, as well as to the supplying of oxygen to aviators; mine rescue apparatus, in which oxygen is employed, will probably also be improved. Experiments on chlorine compounds as antiseptics led to the "Dakin" solution, then to Chloramine-T, and later to Dichloramine-T. A side inquiry resulted in the production of "Halazone," which has a high disinfecting power and is useful for sterilising water; and the close study of Chloramine-T has led to the discovery of its action on protein substances and thus given a means of effecting new transformations in organic compounds of biological importance. The successful investigation of toxic jaundice, caused by tetrachlorethane, used as an aeroplane dope, and by TNT, has instigated an inquiry into salvarsan-poisoning, a subject which at the present time is of importance to six Government Departments. From the investigation of the impurities of TNT there has resulted the discovery of a modified form of this substance which can be utilised in the chemical investigation of the protein molecule. The chemical structure of a substance called Carnosin, previously recognised as occurring in the human body, has been discovered, and the product artificially synthesised for the first time.

British State Mines in Nigeria.—The British Government is now an owner of coal mines and a distributor of coal in Nigeria. The mines are at Udi, 50 miles from Port Harcourt on the coast, with which they are connected by a Government railway. In 1917 these mines produced 85,000 tons, and in 1918 110,000 tons, valued at £28,000. The use of the coal has so far practically been confined to Government services, but it is hoped that

the private tin-mining companies will be able to obtain supplies in future. The heating quality of the coal is about 75 per cent. of that of the best Welsh coal.—(*Manch. Guard., Mar.* 31, 1919.)

Oil Fuel Reservoir at Rosyth.—The construction of a large reservoir at Rosyth for the storage of oil fuel has been completed recently by the Admiralty. The reservoir has been built of concrete on a rock foundation, and is the first instance of a large reservoir being constructed from this material. The concrete deposited amounted to about 98,500 cubic yards.—(*Iron and Coal Tr. Rev., Mar.* 28, 1919.)

New Edition of Beilstein.—The forthcoming publication of a new edition—the fourth—of Beilstein's "Handbuch der Organischen Chemie" is announced from Berlin. The first volume will be issued in 64 parts and will cost 66 marks. The completed work will comprise 15 volumes. The compilers are B. Prager and P. Jacobson, assisted by P. Schmidt and Dora Stern.

Associations of Academic and Technical Workers in Germany.—An "Imperial Committee of Academic Professions" has been formed in Berlin to promote co-operation between all who possess academic qualifications, and to safeguard their common interests. The association includes 70 federated societies and 220,000 members. A second association, called the "Union of Technologists," has among its aims, to secure an active participation of its members in public life, decision in technical questions solely by technical workers, better conditions of living for its members, and enlightenment of the people concerning the significance of technical work and the importance of maintaining it. Both associations include in their membership corporative bodies as well as individuals. The Verein Deutscher Chemiker is represented in both, and has issued an appeal to its members to accord their support.—(*Z. angew. Chem., Jan.* 7, 1919.)

The Position at the Hochst Dyeworks.—According to an official communication from the directorate of the Höchst dyeworks to the *Zeitschrift für Angewandte Chemie*, these works are not in French occupation but under the supervision of two French chemists, and work is proceeding without interruption. All the products, both those in stock and those newly manufactured, are in the first instance earmarked for the use of the Allies, but the remainder may, with the special sanction of the supervisors, be sent to the occupied parts of Germany. Under the same condition, pharmaceutical products may also be exported thither, and for this permission is being freely granted. Otherwise no restrictions are imposed, not even in the case of salvarsan. In the view of the management, there are considerable supplies of salvarsan available in Germany, and there can be no question of a serious shortage (*cf.*, this J., 1919, 108 R).—(*Z. angew. Chem., Feb.* 21, 1919.)

The Mansfeld Copper Mines.—At a recent meeting of the directors and officials of the Mansfeld copper mines, the chairman took a pessimistic view of the outlook. The expenditure between October 1, 1918, and January 20, 1919, amounted to about 47 million mk. against sales of only 20 million mk. Sales had declined from 11 million mk. in October to 2¼ million in December, and while American copper, it is stated, could be delivered at 350 mk. per 100 kilo., the prime cost of Mansfeld copper was about 700 mk. Those leaders of the miners who are conversant with the facts will admit that the socialisation of companies already working at a loss would only accelerate their ruin. The directors were, however, ready to examine any scheme for ameliorating the situation, since they intended to maintain in employment 180,000 men directly dependent on mining for their living. The only remedy for the present dangerous situation was the goodwill of the Entente, and the harmonious co-operation of the workers.—(*Frankfurt Z., Feb.* 5, 1919.)

Anhalt Potash Works.—The Anhalt Potash Works in Leopoldshall are owned and conducted by the Anhalt Government. Up to the outbreak of war the annual surplus profit amounted to about 1 million marks, but lately, owing to limited market possibilities, increased wages and largely increased expenses, there has been a monthly loss of about 200,000 mk. and this is steadily increasing.—(*Köln. Z., Feb.* 25, 1919.)

Selenium and Tellurium.—The elements selenium and tellurium are by-products of the copper industry, and could be produced in much larger quantities if there were a sufficient demand for them. The processes of production are simple, so that the cost could be reduced materially if the output were larger. Tellurium is used in certain alloys, and, in small quantities, as a colouring material for glass and porcelain, and selenium is valuable on account of its photo-electrical properties. The chief use of selenium is in the glass industry, but small quantities are employed in photographic chemistry, and in medicine. Wassermann has taken out a patent for the application of organic selenium salts. Selenium has been applied successfully to the "vulcanising" of rubber goods in place of sulphur. Vulcanised by that means, the goods are said to be more durable. The total production of selenium was about 10,000 lb. in 1913 and 30,000 lb. in 1914. Since then war conditions greatly restricted production.—(*Metall und Erz, Dec.* 22, 1918.)

Mineral Salt Deposits in Sicily.—H.M. Consul at Palermo reports that two natural deposits of sodium sulphate are being worked at Manglabue and Sambuco, in the Province of Caltanisseita. The extension of the Manglabue mine is estimated to contain 1½ million cu. m. of material containing 30—70 per cent. of sulphate. A plant has been erected for purifying the product, but it has not yet been operated. The Sambuco deposit contains mixed salts of magnesium and sodium with a variable percentage of potassium, analysis of one sample showing 12 per cent. K_2O, but others considerably less. The mineral is pure, situated close to the surface, and easy to work. Some of it is already on sale.—(*Bd. of Trade J., Mar.* 20, 1919.)

Castor Oil Production in Spain.—A new company is being formed to plant the "ricino" (*Palma Christi*) and to produce castor oil therefrom. Experiments have shown that the plant grows well in Andalusia and that two or three crops can be obtained in one year. The leaves and shoots produce good fibre for papermaking, the pith is suitable for stuffing lifebuoys, and the "Palma Christi" oil, expressed from the seeds, now fetches 8*s.* per kilo., as against 1*s.* before the war.—(*Bd. of Trade J., Mar.* 20, 1919.)

Magnesium in the U.S.A.—The production of magnesium on a commercial scale started in 1915 as a result of supplies from Germany being cut off, and to meet the greatly increased demand for the metal for war materials. In 1915 the output of the three producing firms was 40 tons of magnesium with an average selling price of 20*s.* per lb.; in 1917 five firms produced 51 tons of the metal with an average selling price of only 8*s.* 4*d.* per lb., but two of these ceased to manufacture on account of the low price. The pre-war price of the imported metal was 6*s.* 10*d.* per lb. Most of the magnesium produced in the United States is made from magnesium chloride residue (bittern) from the salt brines at Midland, Mich., from magnesite and dolomite from California and from Grenville, Quebec. A probable future source is San Fran-

cisco Bay, Cal., but almost inexhaustible supplies of suitable magnesium compounds are available. Magnesium is cast into rods 14—18 in. long and ¼—2 in. diameter and is drawn into wire. The powdered material must pass through No. 200 screen in order that it may burn rapidly. The chief uses at present are (*a*) flashlights, (*b*) chemical reagents, (*c*) the ignition of thermite charges, (*d*) as a deoxidising agent, (*e*) as a constituent of alloys particularly in association with 8 per cent. of aluminium, which produces a metal of sp. gr. 1·75 with a strength equal to that of gun metal. Another aluminium-magnesium alloy containing only 2 per cent. of magnesium (magnolium) is used for making forks, spoons, etc., and, generally, where a light, white metal is required, (*f*) as a dehydrating agent, (*g*) for cathodes in the electrolysis of neutral or alkaline solutions free from heavy metals, and in the electrolysis of alkali chlorides. Magnesium anodes are used for producing galvanoplastic deposits of nickel and cobalt. It is considered probable that magnesium will shortly be used as extensively as aluminium.—(*U.S. Geol. Surv., Dec.*, 1918.)

Resources of China.—A very high quality of alum is produced in China and used for clarifying water, as a mordant in dyeing, and in sizing and whitening paper. About 13,000 short tons were exported in 1916, mainly to Japan for use in dyeing.

Asbestos is mined in Manchuria by a Japanese company. It is also found in North-Western Kwantung and in Hupeh province. The product is of short fibre.

Borax is found in Kansu, Anhui and Tibet, most of it coming from the Tibetan Lakes. It is used by the Chinese for glazing crockery, and as a flux.

Arsenical pyrites and orpiment occur in the north-western part of Yunnan. The exports of the latter from Yunnan and Hunan in 1917 amounted to 609,000 lb.

China at present supplies the greater part of the world's demand for antimony, 62 per cent. of the American imports of the metal in 1916 coming from that country. Most of the ore is mined in the Hunan province, where it occurs practically free from arsenic and contains from 20 to 64 per cent. of antimony. Smelting is done at Changsha, Hankow and Wuchang. Antimony is usually marketed in China in the crude form, containing 65 to 70 per cent. metal. The regulus assays at 98 to 99·8 per cent. The total exports in 1917 amounted to 15,000 long tons of regulus, 20,000 tons of crude, and 4000 tons of ore.—(*U.S. Com. Rep., Nov.* 27, 1918.)

Indigo and other Chinese Dyes.—Just before the outbreak of war, Germany was exporting to China indigo to the value of £2,000,000 and other dyestuffs valued at £600,000 to £800,000. To a great extent these had replaced the old Chinese vegetable dyes; in fact, indigo was no longer considered an agricultural product. With the war came a revival of the Chinese natural dyestuff industry and Chinese dyes are now beginning to figure in the export trade. Thus 5000 tons of liquid indigo and 2000 tons of other dyestuffs were exported in 1917.

Chinese indigo is a very weak product, containing about one per cent. indigotin. An acre yields about 60 lb. of pure dye. Other Chinese dyestuffs include a black obtained from gall-nuts and also from the capsules of acorns. The flower buds of the locust-tree (*Sophora japonica*) give a yellow on an alum mordant, whilst turmeric is also used for yellow shades. Safflower is used for red, and greens are produced from the bark of the *Rhamnus parvifolius* and the leaves of the *Rhamnus tinctorius*. Browns are produced from the false gambier. The vegetable dyes of China are particularly suited for rug dyeing.—(*U.S. Com. Rep. Supp., Feb.* 8, 1919.)

Memorandum on Patent Law Amendment.—The committee appointed by the Conference of Technical Institutions and Societies to formulate recommendations concerning the amendment of the Patent Law has duly reported, and the Institution of Electrical Engineers has prepared and published a memorandum based upon its findings. In the following summary of recommendations the Act referred to is that of 1907, and the Bill that of 1917, which was introduced into Parliament and later withdrawn.

Patents Moratorium.—It is recommended that an extension for a period equal to the total duration of the war should, on application, be granted in the case of those patents which were in force when the war broke out and are still in force when peace comes, and that in the case of patents which have expired by lapse of time during the war, the extension should be for a period equal to that from the commencement of the war to the end of the ordinary life of such patents, and that for patents other than war patents which have been taken out since war commenced, the extension should be for a period equal to that between the date of application and the end of the war.

It is recommended that provision should be made for opposition by any person alleging that he is prejudicially affected by the extension, but the onus of proof of injury of the same kind as is provided for in the case of restoration of lapsed patents should be on the opponent.

Compulsory Licences (Section 24 of Act).—That (*a*) petitions be made and heard by the Comptroller of Patents with final appeal to Court; (*b*) present power to order revocation under this section of the Act be cancelled.

Working of Patented Inventions (Section 27 of Act).—That this clause of the Act be deleted in its entirety.

Articles of Food, or for Medical Purposes, etc.—That the position under the present Acts should not be disturbed.

Clauses 5, 8, 9 and 15 of 1917 Bill.—That these clauses are approved, and should be adopted.

Term of Patents.—That the term of patents be extended to seventeen years.

Extension of Provisional Specification term.—That the term of provisional protection be restored to nine months, with right to extension for three further months on payment of a nominal fee.

Extension of term for Acceptance of Complete Specification.—That the term for acceptance of a Complete Specification be extended to eighteen months, with power on payment of fees to further extend to twenty-one months.

Patent to Bind Crown.—That all awards, royalties or payments to inventors for use of inventions by or on behalf of the Government should be decided by the High Court after hearing all parties, and that patentees should be entitled to apply to the Court for this purpose.

Cancellation of Registration of Designs.—That Clause 14 of the Bill of 1917 should be adopted, but restrictions of Section 56 of present Act should be removed.

Patents of Addition.—That provision should be made for maintenance of "Patents of Addition" through remaining available term of main patent, not only in event of revocation of main patent as proposed in the Bill of 1917, but at option of patentee on surrendering or lapsing of main patent.

Patent Fees.—That renewal fees should be reduced by one half.

Proposed New Tribunal.—That a special Division of the High Court of Justice be constituted to deal with patent and other litigation involving scientific and technical questions.

The reasons for the above recommendations are set out in the memorandum.

PERSONALIA.

With great regret we record the death of Sir William Crookes, President of this Society in 1913, in London on April 4 last.

Sir Auckland Geddes has resigned his office of Minister of National Service and Reconstruction, and has accepted the position of Principal of McGill University, Montreal.

Dr. A. Rée has been appointed Inspector of Research under the Government scheme for assisting the dye industry.

Sir Evan Jones is now officiating as Controller of Coal Mines, in addition to fulfilling his duties as Dyes Commissioner.

The death is reported of Sir E. C. Stirling, professor of physiology in the University of Adelaide, on March 20 last.

The Chair of Pathological Chemistry in the London University has been vacated by the resignation, owing to ill-health, of Prof. Vaughan Harley.

Major H. McCombie, lecturer in chemistry in the University of Birmingham, has been elected a Fellow of King's College, Cambridge.

The death is announced of Mr. Andrew King, assistant professor of chemistry in the Heriot-Watt College, Edinburgh.

The Council of the University of Leeds has appointed Mr. D. McCandish to the professorship of applied chemistry (Chemistry of leather manufacture) at Leeds University.

The offer of the Mason Chair of Chemistry at the University of Birmingham, vacant by the resignation of Prof. Percy Frankland, has been accepted by Prof. G. T. Morgan, professor of applied chemistry at the City and Guilds Technical College, Finsbury, London. Prof. Morgan was formerly professor of applied chemistry in the Royal College of Science for Ireland, and prior to that editor of the Journal of the Chemical Society.

Mr. A. J. Turner has accepted the appointment of professor of textile technology in the College of Technology, Manchester. Prof. Turner has been in charge of the Fabrics Laboratory of the Royal Aircraft Establishment, conducting investigations on textile fabrics mainly from the physico-chemical standpoint.

The Cavendish Chair of Physics at Cambridge University, vacant owing to the resignation of Sir J. J. Thomson, has been filled by the appointment of Sir E. Rutherford, now Langworthy Professor of Physics at the University of Manchester.

Sir J. J. Dobbie, Government Chemist and President of the Chemical Society, has been appointed to serve on a Royal Commission to determine what awards and royalties shall be paid to inventors in respect of the use of their inventions by Government Departments during the war.

Capt. J. R. Partington has been appointed to the Chair of Chemistry at East London College. Prof. Partington is a graduate and former Beyer research fellow of the University of Manchester, and after serving in the army, has recently been in charge of research work in the Inventions Department of the Ministry of Munitions.

Lieut.-Col. W. Watson, who died on March 3 mainly from the effects of inhaling poisonous gases, was professor of physics at the Imperial College of Science and Technology at the time when he was sent out to France as director of the Central Laboratory, B.E.F., in June 1915. During the exacting routine of his work he was frequently "gassed," and his death is undoubtedly to be ascribed mainly to this cause. Prof. Watson was the author of many valuable investigations in magnetism and optics; his experimental work was characterised by great accuracy, whilst as a teacher he excelled in clearness of exposition. His "Text-Book on Physics" is well-known to all students of that subject. In recent years he took up the study of the petrol motor and his researches proved of great practical utility in connexion with aero-engines during the war. He was elected a Fellow of the Royal Society in 1901 and was created C.M.G. in 1916. His loss to science will be keenly felt.

COMPANY NEWS.

BORAX CONSOLIDATED, LTD.

Addressing the 21st ordinary general meeting on March 20, the Rt. Hon. the Earl of Chichester, chairman, said that the Company's mines in Turkey were intact and would be handed back by the Turkish Government; thus the German plans to sequestrate them had proved abortive. The stocks at mines, factories, etc. were valued at £588,197, and the volume of business, including that of the export trade, during the last financial year had declined. In the current year, business has been everywhere on a reduced scale, and buyers are waiting for the exhaustion of accumulated stocks. It is anticipated, however, that an improvement will set in after peace has been signed, particularly as the countries with which the Company formerly did business are denuded of stocks, both of raw and refined products. The profits of the year to September 30 last amounted to £431,342, compared with £385,527 in the previous year (issued capital £2,300,000; debentures £1,979,534). The balance at disposal is £396,196, out of which sum £60,000 is to be placed to reserves etc., a dividend of 2*s.* per share paid on the ordinary shares, making 15 per cent. for the year, and £105,371 is carried forward.

ANGLO-PERSIAN OIL CO., LTD.

At the 9th ordinary general meeting, held on March 26, Mr. C. Greenway, chairman and managing director, stated that during the past year the capital resources of the Company had been increased by £5,200,000, of which £1,750,000 was paid-up capital. H.M. Government had completed the purchase of the ordinary shares held by it. After making ample allowances for depreciation, the trading profit came to £1,516,994. The available balance for distribution is £779,709, and it was proposed to pay 8 per cent. on the ordinary shares, and to carry forward £454,722. The return to H.M. Government on its investment, including excess profits duty, is about 30 per cent. per annum. Within a very few years the through-put will probably be 5—6 times that of the year under review. The supply of oil is practically unlimited, the wells already drilled still maintain their extraordinarily high rate of yield, and are estimated to be capable of producing 5,000,000 tons per annum. The extensions to the refinery at Abadan should be completed during the year, and a large refinery is being erected at Swansea, the initial capacity of which will be twice that of the whole of the Scottish shale oil companies. The political situation in Persia has greatly improved. A profit-sharing scheme has been adopted for the benefit of the Company's employees.

LEVER BROS., LTD.

The speech of Lord Leverhulme, at the 25th annual general meeting, held on March 28, was of unusual interest owing to the description he gave

of the scheme it is proposed to establish for introducing a 6-hour working day or a 36-hour week in the Company's factories. Day-workers and piece-workers are to work in two 6-hour shifts, the morning shift being from 7 A.M.—1.15 P.M. with a 15-minutes' interval for a quick lunch provided on the premises at the Company's expense. The afternoon work is to be divided into four shifts of 7½ hours and one of 7 hours per week, with a 30-minutes' interval for refreshments. Saturday afternoons and Sundays will be free. On the night shift, the employee will do 8 hours' work for one week out of four and 5 hours and 20 minutes for the remaining 3 weeks. The shifts will be changed weekly. The rate of wages will be the same as for a 48-hour week, and it is anticipated that production costs will not be increased, the staff recognising that any such increase would handicap the firm both in home and foreign competition. The scheme has yet to receive the sanction of the Home Office.

Lever Bros., Ltd., has now a capital of £60,000,000, with over 56,000 shareholders and about 100 associated companies. Co-partnership certificates to the value of £928,000 have been issued to employees, upon which £206,000 was paid in dividends during the past year. The rents of the thousand cottages and shops built on the estate have not been raised during the war, and there was a loss of £4000 under this heading last year. Notwithstanding the effects of Government control of trade and shortage of raw materials, the home and export trade increased enormously during the past year, the increases having taken place in countries like Japan, where no control has been in force.

After meeting all charges and paying off nearly £200,000 of debentures, and placing £1,679,000 to reserves, a dividend of 17½ per cent. is being paid on the preferred ordinary shares. In reply to criticisms as to the inadequateness of the reserves, Lord Leverhulme pointed out that the expenditure on repairs, renewals, depreciation and advertising amounted to £1,250,000, all of which was deducted from profits. The total amount spent on the above items up to date exceeds the issued capital of the Company—£17,000,000.

BRITISH ALUMINIUM CO., LTD.

At the annual general meeting, held on March 28, Mr. A. W. Tait, chairman, said that the output of aluminium during the last financial year was the largest in the Company's history, but owing to a reduction in price and to increased production costs, the trading profit showed a slight decline over that of the previous year, *viz.* £351,697, as against £368,509; on the other hand, dividends on investments were £16,500 higher at £68,577. The sudden cessation of hostilities in November last caused serious dislocation to the industry, involving immediate cancellation of large orders and accumulation of material. At the present time the Government is holding large stocks of aluminium, which it intends to dispose of gradually as the demand for the metal increases. This policy will entail, for a time, a diminished production in this country, but the more remote future of the industry is undoubtedly a bright one. The financial position of the Company is strong. The net value of the investments is £431,207, and the reserve fund stands at £470,599, compared with £220,599 a year ago, and nearly the whole of it is invested in Government securities. Debenture stocks have been reduced and now stand at £631,489. The profits are £420,420, the available balance £109,416, and the dividend on the ordinary shares is maintained at 10 per cent. per annum.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Export of Superphosphates and Compound Manures.

The Parliamentary Secretary to the Ministry of Munitions circulated the following reply to a question put by Lt.-Col. Sir F. Hall:—Arrangements have been made with the President of the Board of Agriculture for the release of certain quantities of superphosphates and compound manures for export under licence. Manufacturers to whom licences are issued have to pay to the Ministry of Munitions £4 a ton on compound fertilisers and £3 17*s.* 6*d.* on superphosphates, these sums being equivalent to the total loss incurred by H.M. Government in respect of raw materials used in the manufacture and packing of the exported goods. These figures represent maximum rates, and manufacturers have been informed that the average amount recovered by the Government would be £3 7*s.* 4*d.* for compound fertilisers and £3 0*s.* 4*d.* for superphosphates, a deduction of 18*s.* 4*d.* from these amounts being made in each case where the bags are provided by the manufacturers. The loss arises from the issue by the Government to manufacturers of pyrites, phosphate rock and bags at prices below cost, and the figures above quoted were calculated from data in the possession of the Explosives Supply Branch of the Ministry. The exact amount repayable will vary with the nature of the material exported. The trade has always been aware that the Government incurred a loss on the import of raw materials for fertilisers and that accordingly an appropriate proportion of this loss would be recoverable in case of export. I cannot agree with the statement that the condition in question imposes any handicap upon British manufacturers of compound manures and superphosphates, and no complaints to this effect have been received by the Ministry. The principle of recovering loss on the export of subsidised materials has been followed in the case of numerous commodities, and I therefore see no reason to reconsider the position.—(Mar. 24.)

Margarine Manufacture.

Answering Col. W. Thorne, Mr. Roberts said that on March 31 the prices per ton of the following raw materials would be:—Refined coconut oil, £64 10*s.*: refined American cotton seed oil, £64; refined, deodorised ground nut oil, £65; and refined, deodorised palm kernel oil, £33. These prices will entail a loss to the Ministry of Food. The present low retail price (8*d.* per lb.) is due to trade competition. The Ministry proposes to continue the arrangement by which manufacturers are licensed and weekly samples submitted.—(Mar. 25.)

Clinical Thermometers.

In reply to a question asked by Mr. Swan, Mr. Kellaway stated that in order to develop the supply of these instruments, which is now approximately twice as great as before the issue of the Order, arrangements have been made for the manufacture of the necessary kind of glass, and the makers are given expert advice in the production of the finished article. An average of 10 per cent. of the thermometers tested at the National Physical Laboratory has been rejected.—(Mar. 26.)

Glass Bottles.

Sir A. S. Benn was informed by Mr. Bridgeman that considerable efforts are being made by British factories to develop the production of glass containers, but the output is at present insufficient to meet requirements. Licences are, therefore, being granted to import glass containers when

there is evidence that adequate supplies of British-made goods are not available; and in the consideration of applications for licences particular attention is given to the requirements of the export trades.—(Mar. 31.)

Ministry of Ways and Communications Bill.

During the debate in Standing Committee, the Home Secretary accepted on behalf of the Government an amendment to exclude the supply of electricity from the scope of this Bill. The Government intends to deal with the whole question of electricity supply in a special Bill.—(April 8.)

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED EXPORTS.

Further relaxations of existing export prohibitions are notified, as follows:—

Headings transferred from one list to another.

From List A to List B:—

Malt sugar, and articles and preparations containing; potassium bicarbonate and mixtures containing.—(Mar. 27.)

From List A to List C:—

Wood pulp.—(Mar. 27.)

Goatskins; kapok; wire rods.—(April 3.)

Altered Headings.

(A) Sheepskins, haired or woolled. (C) Sheepskin pelts, dehaired or dewoolled. (A) Cod liver oil and preparations containing. (A) Malt extract and preparations containing.—(Mar. 27.)

(A) Copper and alloys of copper. (C) Bars, circles, plates, rods, sheets, strip, tubes, etc. of copper or copper alloy. The following compounds of potassium are deleted as separate headings in List B because they are already covered by the heading: (B) Potash salts and mixtures containing such potash salts not otherwise prohibited:—Potassium bicarbonate, cyanide, perchlorate, prussiates, chlorate, and mixtures containing.—(April 3.)

Exports to Occupied Areas.—The Board of Trade has issued regulations (Mar. 30) and modifications thereof (April 3) concerning the conditions under which goods may be exported to the occupied areas on the left bank of the Rhine. The "free" goods (v. *Bd. of Trade J.* of March 20) may still be exported without licence or permit, but a definite procedure must be followed in the case of certain specified goods. The latter include many metals, absolute alcohol, fats for industrial purposes, textiles, silk, wool, arc carbons, graphite, white and red phosphorus, phosphoric acid, hides and skins, resins and rubber, various tanning materials, and substances used for the manufacture of explosives and asphyxiating gases.

PROHIBITED IMPORTS.

A complete list of articles the importation of which into the United Kingdom has been prohibited, except under licence, by Royal Proclamations of February 15, 1916, and subsequent dates, was given in the *Board of Trade Journal* of March 27 last.

A general licence has been issued for the importation of red oxide of iron.

Trade with Poland and Esthonia.—In agreement with the other Associated Governments, H.M. Government has decided that commercial relations with Poland shall be free as from April 1, and the Board of Trade has issued a general licence to give effect to this decision. Trade with Esthonia may also now be resumed.

Acids and fertilisers.—The Minister of Munitions announces that control of acids and fertilisers by his department will be suspended on and after June 1, 1919. This will apply to sulphuric acid, sulphate of ammonia, superphosphate, basic slag, compound fertilisers. All questions relating to the distribution of fertiliser materials will, on the release of formal control, be dealt with by the Department of Agriculture. The continuance on a voluntary basis of the distribution of fertilisers at fixed delivered prices is now under discussion with the trades concerned, and communications should be addressed to the Commercial Secretary, Board of Agriculture and Fisheries, 72, Victoria Street, S.W. 1.

Import of Dyestuffs.—The Trade and Licensing Committee appointed by the Board of Trade to administer the Prohibition of Import (No. 29) Proclamation relating to the import of dyestuffs gives notice that as from and after April 14, the general licence given on February 27 last in respect of the import of products covered by the Proclamation but which are of *bona-fide* American, French and Swiss origin will be revoked. All consignments, however, which can be shown to the satisfaction of the Customs Authorities as having been en route from the place of origin in any of the countries mentioned above to the United Kingdom on a through bill of lading on April 9, 1919, will be admitted without special licence, but in all other cases a permit must be obtained from the Trade and Licensing Sub-Committee prior to the purchase abroad of dyestuffs or other products covered by the Proclamation. Applications for permits should be made on the prescribed form to be obtained from the Secretary, Trade and Licensing Sub-Committee, Board of Trade, Danlee Buildings, Spring Gardens, Manchester.

NEW ORDERS.

The Silver Bullion (Maximum Price) Order. H.M. Treasury, Mar. 25.

The Steel Supplies (Partial Suspension) Order, 1919. Ministry of Munitions, April 1.

The Coal Tar and Coke Oven Returns (Suspension) Order, 1919. Ministry of Munitions, April 4.

NOTICES.

The Army Council has given notice to cancel the following Permits and Orders:—

The Imported Goatskin and Sheepskin Leather Permit, 1919 (Mar. 21); the Imported Leather (British Empire), Permit, 1919 (Mar. 21); the Rough and Curried Leather Order, 1917, the Strap Butt (Conditions of Sale) Order, 1917 (April 1); and the Hides (Splitting) Order, 1917 (April 2).

The Lords Commissioners of H.M. Treasury have given notice that they have issued a general licence for issues of capital by companies resident or carrying on business in the U.K., for capital purposes within the U.K.

The Board of Trade gave notice on March 20 that the following Orders cease to have effect as from March 31:—The Matches Order, 1917, the Matches Order (No. 2), 1917, and the Wholesale Dealers' Prices for Matches, 1918.

The Food Controller has suspended, as from April 1, the maximum prices fixed for cattle cakes and meals, excepting all classes of cotton and linseed cakes and meals.

The Ministry of Munitions has given notice that on April 30 next all subsidies in connexion with the manufacture of iron and steel, including those on iron ore, coke and pig iron, will be withdrawn.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for March 27 and April 3.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Numbers
Canada	Drugs	487
,, ...	Artists colours	542
,, ...	China	552
,, ...	Soya bean oil & peanut oil	553
,, ...	Oils, greases and soap ..	554
,, ...	Sheet lead rolls for rolling chemically pure lead, and lead containing 2 to 7% antimony, in sheets 8 to 9 feet wide	*
,, ...	Chemicals and drugs ..	*
India	Paint	475
,, (Rangoon)	Dyes	476
,, ,,	Machines for crushing oil seeds and plant for pulverising and briquetting lignite	477
South Africa ..	Paper	494
..	China and glass ..	561
Egypt	Soda crystals, soap, paints, sheet metals, oils, glass and earthenware	563
Belgium ..	Antifouling paints and varnishes	502
,, ..	Chemicals, drugs, colours and varnish ..	507
,, ..	Oils, starch and fertilisers	573
France	Iron, steel, copper, etc. ..	515
,, ...	Machines for making condensed milk and milk powder	516
,, ...	Soap	580
,, ...	Cocoa and chocolate ..	579, 581
,, (Morocco)	Chemicals	582
Italy	Oil seeds, vegetable oils and oil cake	584
,, ...	Medicines, essences and soap	522
,, ...	Dyes and leather ..	1640†
,, ...	Nitrates, oil seeds, metals and tinplate	1642†
,, ...	Chemicals, copper sulphate, caustic soda, soda ash, oils, fats, paints and varnishes ..	1644†
,, ...	Photographic films and paper	1654†
,, ...	Chemicals	1657†
Trieste	Oils, fats, copra and fertilisers	566
Netherlands ..	Earthenware wall and floor tiles	525
Spain	Drugs	593
Switzerland ..	Chemicals	596
New York ..	Chemicals	534
Brazil	Chemicals	575
South America and British West Indies	Paints, varnish, starch and baking powder ..	590
Palestine ..	Metals, tinplate, rubber, asbestos, mineral oils, caustic soda, soda H, drugs and vegetable fats	529
Java	Chemicals, dyes, soap and fertilisers	496

* High Commissioner for Canada, 19, Victoria Street, S.W. 1.

† The Secretary, British Chamber of Commerce for Italy, 7, Via Carlo Felice, Genoa.

A Canadian correspondent desires to get into touch with U.K. importers of magnesite. Inquiries should be addressed to The Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

TARIFF. CUSTOMS. EXCISE.

***Belgium.*—The prohibition of the importation of spirits is still in force, but the question of liquor control is under consideration, and it is possible that the existing regulations may be modified in the near future. Import licences are no longer required for brewing malt.**

British West Africa.—The importation of all spirits is prohibited for the present, except under licence.

Canada.—The regulations governing prohibited exports have been amended as from March 1.

France (Algeria).—The visa of the Office National des Papiers is no longer required with applications for French import licences for vulcanised fibre.

France (Madagascar).—A copy of an Arrête of the Governor-General which fixes the amount of the statistical tax on imported merchandise may be seen at the Department of Overseas Trade.

France (Tunis).—The list of articles the export of which is prohibited is the same as that annexed to the French decree of January 20, together with certain other articles, including pimento, charcoal and sulphur.

Among the articles the import of which is now permitted are vegetable, mineral and fish oils, camphor, rubber, chemical manures, celluloid, window glass and bottles.

Italy.—The export of marble and alabaster is now permitted.

Japan (Corea).—As from February 5, a permit from the Chief of Police is required for the export and re-export of morphine, its compounds and derivatives, opium and manufactures thereof, hydrochlorate of cocaine, quinine sulphate and hydrochlorate, antipyrin, pyramidon, thymol, santonin, guajacolum carbonatum, radix scopoliæ, radix filicis and sandal wood oil.

Mexico.—The customs duties on alcoholic liquors have been increased as from February 17, and the import duty on caustic soda and potash fixed at 5 cts. per kilo. Cotton seed is admitted free, and the export duty on raw cotton reduced from 3 to 2 cents (Mexican gold) per kilo.

The export duties on alcoholic beverages, metal scrap, iron and steel scrap, hoofs and horns, have been modified.

New Zealand.—The prohibition of the importation of explosives containing more than 50 per cent. of nitroglycerin is cancelled.

Paraguay.—The export duty on quebracho logs has been reduced, as from February 15, from 5 to 3 dollars (gold) per metric ton.

Straits Settlements.—The Food and Drugs Ordinance has been amended to prohibit the importation of specified articles which are either dangerous or unsuitable as articles of food or medicine. The nature of any poison contained in medicines must be disclosed.

United States.—Licences will be issued for the importation of ferromanganese contracted for prior to April 6, 1917.

Individual import licences are now required for shipments of sugar to the U.S.

The special export licence "R.A.C. 42" for goods conveyed in-transit through the U.S. has been revised as from March 1.

Basic Slag Industry.—A Basic Slag Association has recently been formed with the object of safeguarding and promoting the interests of manufacturers. The officers are:—Mr. A. W. Thomson (Alexander Cross and Sons, Ltd.), chairman; Mr. G. V. Parker (The South Wales Basic Slag Co., Ltd.), vice-chairman; and Mr. W. H. Barnett (Alfred Hickman, Ltd.), hon. treasurer. **The Secretary is Mr. J. King Stewart, of 70, Fenchurch Street, London, E.C. 3.**

REVIEWS.

MODERN CHEMISTRY AND CHEMICAL INDUSTRY OF STARCH AND CELLULOSE (*With Reference to India*). *By* TARINI CHARAN CHAUDHURI, M.A., *Professor of Chemistry, Krasnath College, Berhampore (Bengal). Pp. v + 156. (London and Calcutta: Butterworth and Co.,* 1918.) *Price Rs.* 3.12.

In regard to the inception of this little book, the author himself may be quoted. Thus he states: "While engaged in the study of starch and cellulose, the writer felt the necessity for a handy compendium on the subject containing up-to-date information on all its bearings." This is not a little ambitious for so small a work.

It is evident from the text (which is divided into two parts, theoretical and industrial) that the author has not made himself acquainted with the subjects with which it deals. It abounds with the wildest and in many cases most inaccurate statements, whilst the sequence is rambling, and irrelevant matters are all too frequently met with; moreover the diction may, without carping, be severely criticised. A few quotations from the text will suffice to justify these strictures.

Admitting that more starchy food is consumed in the East than in Europe, we are not prepared to accept the author's dictum that all people are fed and clothed by starch and cellulose, nor can we agree with him that glycogen is an example of "animal cellulose." We read that "starting with the elementary substances—black carbon and gaseous hydrogen—the substance . . . has been prepared . . . known . . . by the name of formaldehyde." The fact is mentioned that according to Aubert and Giraud cane sugar is obtained by passing an electric current through acidified starch paste at 100° C. We were not aware that this observation had been "certified by subsequent investigators."

The manufacture of artificial perfumes, of alcohol, of rubber, and of gas mantles is dealt with, as are also tannin, turpentine, rosin, "*essential oil*" (the italics are ours) and cinnamic acid. From a chart showing the technical applications of starch we reproduce the first lines.

Most staple of Animal-Foods. Size in paper manufacture, stiffening and glazing material in textile industry and laundry, &c.	Starch $(C_6H_{10}O_5)_n$	Barley powder, sago, arrowroot, vermicelli, toilet powder, &c. Extensive use in condensed milk manufacture.

In the succeeding portions of the chart the following *inter alia* are mentioned as products obtained from starch:—Chloroform, iodoform, antifebrin, sulphonal, artificial perfumes, synthetic rubber and xylodine or white gun powder.

A similarly extravagant chart is given for the technical applications of cellulose. Thus the uses mentioned for cellulose include "Animal food, wood flour, oxalic acid, incandescent gas mantles, barks and leaves of tree as writing material, textile industry, ropes and nets, indestructible textiles from pure cellulose, artificial silk." For the inclusion of "tortoise shell" and of "mother of pearls" in this cellulose chart, the author may not unreasonably be asked for further explanation.

These are but a few citations from the book before us, which we feel compelled to condemn in every respect as one which not only fails to fulfil its objects, but which is also calculated to mislead the unwary student.

ARTHUR R. LING.

PETROLEUM REFINING. *By Andrew Campbell, with a Foreword by Sir Boverton Redwood, Bart. Pp.* 282 *with* 138 *illustrations, including* 29 *folding plates and* 3 *diagrams, also* 11 *tables. (London: Chas. Griffen & Co., Ltd.* 1918.) *Price* 25*s. net.*

The economic future of the world as we know it to-day is bound up with the development of the petroleum industry. Although there is much scientific literature on this subject, there was room for a work on the refining of petroleum products, and Mr. Campbell has given us a book, written with the gift of lucid expression, which describes in detail an industry which constant association has made a part of his life. The chemist and engineer interested in the petroleum industry will find this work not only useful as a book of reference, but one which is worthy of reading; at the same time business men and others whose interests are associated with the petroleum industry will gain much knowledge from its perusal without being confounded by abstruse technicalities.

The book has been divided into nine chapters, which deal respectively with the examination of the crude oil, the organisation of a refinery, storage, distillation, paraffin extraction, candle manufacture, chemical treatments, the distribution of products and engineering specifications. This form of treatment enables one to follow the crude oil from the time it enters the works until it leaves the works as a finished product.

The chemical treatment of petroleum, dealt with in Chapter 7, is a subject with a great future before it. In a work of such excellence, one objects to criticisms, but when a new edition of the book is prepared, one would like to see this chapter extended so as to give a more vivid idea of the importance of chemical treatment in the economics of petroleum refining. The inclusion of the Edleaneau process in this chapter for the refining of petroleum products at low temperatures with liquid sulphur dioxide is of great importance, because this method is only in its infancy, and it may eventually prove that the extraction of certain substances from petroleum by this physical means may prove more economic than the chemical methods at present mostly used for this purpose.

The appendix should appeal to all chemists, who are desirous of consulting literature dealing with the practical side of the industry. It may not be complete, but the references given are sufficient in themselves to enable cross-references to be found, from which a more complete list can be compiled. In conclusion, the author is to be congratulated on his first literary effort, and chemists can only hope that other leaders in the various industries will discover the same gift and write books of reference on their own specific subjects following the present author's example by the inclusion of many woodcuts and drawings, for these enable the reader to follow the description given and obtain a clear comprehension of the class of plant and details of plant used.

M. BENNETT BLACKLER.

PUBLICATIONS RECEIVED.

A SYSTEM OF PHYSICAL CHEMISTRY. *By* W. C. MCC. LEWIS. *Second Edition. In three volumes. Vol. III., Quantum Theory. Pp.* 209. (*London: Longmans, Green and Co.* 1919.) *Price* 7*s.* 6*d.*

THE PHYSICAL CHEMISTRY OF THE PROTEINS. *By* T. B. ROBERTSON. *Pp.* 483. (*London: Longmans, Green and Co.* 1918.) *Price* 25*s.*

EDUCATION SECONDARY AND UNIVERSITY. *A Report of Conferences between the Council for Humanistic Studies and the Conjoint Board of Scientific Societies. By* F. G. KENYON. *Pp.* 47. (*London: John Murray.* 1919.) *Price* 1*s.*

STATE-AIDED RESEARCH.

Sir Frank Heath's paper on the Government and the organisation of scientific research, read before the Society of Arts, gives a succinct account of the origin and aims of the Advisory Council of Scientific and Industrial Research, which are stated briefly to be:—(i) The encouragement of research workers, (ii) the organisation of research by industries, (iii) the organisation of national research.

The paper evoked an interesting discussion which is printed with it in the *Journal of the Society of Arts* for February 21.

The creation of the Advisory Council is essentially an experiment and as such invites criticism from the scientific men. It is hoped this will be forthcoming and taken into account by the Government in making alterations from year to year that will add to the efficiency of its scheme. The purpose of the Council is the spending of national money on research; the difficulty is to secure adequate Exchequer control over such expenditure without imposing conditions which will hamper the initiative and freedom which are essential for successful research.

The Council rightly puts in the forefront of its aims the encouragement of the worker in pure research by making grants "in liberal measure" to those who need assistance and "with no restrictions beyond the necessity of showing that they are continuing their work," the appointments being made mainly on the recommendation of teachers, heads of institutes and the like. This is most satisfactory, though there is a growing tendency at the present time to debase the word research and misapply it to much which is very little more than routine work carried out by imperfectly trained investigators. It is to be hoped that the Council will continue to endow adequately and to encourage the research worker so that he is not tempted from his proper sphere of work to more highly salaried positions of an administrative character.

The encouragement of research in the industries is to be effected in the main by the formation of research associations, at first sponsored by the Council on the principle of grants of a pound from the State for every pound subscribed by the industry, but which may be expected ultimately to continue without State assistance. The experience of these associations will be watched with interest. The proposal is best suited perhaps to some of the less scientific industries and smaller manufactures; it is of debatable applicability to those branches of chemical industry in which research must be a matter for each individual firm. Many chemists are of the opinion that it will be more satisfactory and more likely to lead to progress for every firm of sufficient size to employ its own staff to study its own problems rather than to rely on a State-controlled association. If State-aided research tends in any way to restrict or lessen private enterprise much harm rather than help is likely to result. Moreover, as industry as a whole will be taxed to support these research associations it behoves the professional societies to watch carefully lest the associations undertake work which is not really research, but which belongs more properly to the chemist, public analyst or consultant, or set out to duplicate and publish, at the cost of the State, information which has already been gained by firms which have realised the advantage of maintaining a research laboratory.

The Advisory Council is also willing, in special cases, to assist researches for the benefit of specific branches of industry, which are sponsored by recognised public bodies, such as the Society of Chemical Industry, and administered by committees of experts. We believe that its aid in such cases should be given far more freely than at present and on a more liberal basis than in the case of trade associations, seeing that the scientific societies seldom have funds available for such purposes; it is just in these cases that the restrictive conditions governing the grant are reputed to be most onerous, so that in more than one instance the work could not be undertaken.

With the exception of larger national problems, to which reference will be made later, few who have had any real experience of industrial research will do otherwise than urge that it is impossible and impracticable to divorce the research from the factory, and that no body of research workers however constituted can hope to achieve more than the preliminary, theoretical study of the process. The step from the laboratory to the factory is far greater than is generally admitted and any neglect of this essential factor will inevitably lead to failure and financial loss.

In the case of problems of wide national interest, such for example as fuel research, the policy of the Council is to set up separate research boards with salaried administrative officials. Such boards may administer special research stations, as that established by the Fuel Research Board, and will organise more or less comprehensive schemes for attacking their problems. This procedure is all to the good and highly creditable as an example of initiative by the State, provided always that nothing is done to restrict private enterprise in the same field, even for instance by refusing financial aid to apparently rival schemes. It is no doubt desirable to prevent overlapping in the case of committees, but duplication of work in the sense of investigations towards the same end on roughly parallel lines, to say nothing of an attack on the problem from other points of view, is the only real way to achieve success. Nature only gives up her secrets with difficulty: she must be wooed and cannot be driven even by legislator, administrator or research worker. Lastly, and this is all important, it should be urged that the leading directing positions in these research boards should be entrusted to men in the prime of life and at their period of greatest scientific activity, and that the tenure of office should be limited so as to ensure that a constant succession of new ideas and new ideals are applied to the problems involved.

The new Department will also act to carry out investigations for other Government departments and will no doubt seek to establish itself as scientific adviser to the administrative departments.

There can be no doubt that the establishment on a firm basis of the Advisory Council for Scientific and Industrial Research marks a great advance in the recognition by the British Government of the potentialities of science. The Council will have unique opportunities for doing good service both to science and to the State, and whilst it must expect criticism in detail from so exacting a public as the body scientific, this is only likely to be inspired by the warmest desire to assist in shaping its plans and in directing its activities to a successful issue.

GLASS RESEARCH ASSOCIATION.—The Controller of the Glassware Department of the Ministry of Munitions has called a meeting of manufacturers to discuss the formation of a Glass Research Association. A provisional committee has been appointed. The Government is being asked to provide £75,000, extending over a period of five years, and the manufacturers will probably contribute £25,000. The Association will first consider problems concerning machinery and labour-saving devices.

RECENT ADVANCES IN MILLING AND CLARIFICATION IN CANE SUGAR MANUFACTURE.

J. P. OGILVIE.

Economic limit of extraction.—During the past few years, a considerable advance has been made in the extraction of sugar from the cane by milling. This has been accomplished by increasing the number of the 3-roller units in the train of mills; by installing devices, such as shredders and revolving knives; by grooving the rollers; and by the more efficient application of water and weak juice to the crushed cane (maceration), as well as by closer attention to mill settings and the rate of grinding. Owing to these improvements, it has become possible to extract 96—98 per cent. of the sucrose originally present in the cane, a figure which formerly was deemed attainable only by the diffusion process, now solely used in beet sugar factories.

Some manufacturers, however, are pointing out that there may be an economic limit of extraction, and that yields of 96–98 per cent. may approach if not exceed it. An increased extraction not only necessitates the modification of the milling installation, but it also generally involves an expansion of a portion of the plant, since there is then more juice to be heated and subsided; more "mud" or insoluble impurities separated in clarification to be treated in filter-presses; and also more water to be eliminated in the evaporators. It may further require extra fuel, for when a 9-roller is converted into a 12-roller mill there is a further demand for steam, which cannot be supplied by the quantity of bagasse available as fuel. In contemplating, therefore, the improvement of the milling installation, several questions arise. It is necessary to estimate how much additional sugar will actually find its way into the bags; and against the value of this further recovery one must balance items such as the increased capital expenditure, the increased operating expenses, the higher rate of depreciation, and lastly the value of any extra fuel that may be used.

This matter of the economic limit of extraction has recently been debated in a symposium by plantation managers and chemists in Hawaii,* which country has been foremost in devising improved methods of milling. In general, the opinion in the Islands is in favour of high extractions; but it is realised that the root of the question is the extent to which the extra sucrose extracted as juice by the improved installation is actually recoverable in the form of commercial sugar. During milling, the last juices extracted by the maceration water contain appreciably more impurities than the first expressed, and these impurities have an inhibiting effect upon the crystallisation of sucrose from the concentrated syrup. It therefore follows that although an appreciable increase in the extraction by one or several of the devices mentioned may be effected, the extra sucrose may be accompanied by such a quantity of impurities that the further working of the juice may prove unprofitable. It is this condition that controls the economic limit of extraction.

Definite data are still rather insufficient; but in Hawaii it appears very generally to be thought that under the conditions prevailing there an extraction of 96—98 per cent. does not exceed the economic limit. It is estimated by W. Searby that by increasing the extraction to the extent under discussion, 75—80 per cent. of the additional sucrose passing into the juice can be recovered as commercial sugar; while figures collated by H. Johnson from the returns of a number of different factories indicate that with the gradual increase of the extraction there is a corresponding increase in the total recovery.

In one of the mills in the territory in which certain improvements had been installed, the extraction showed an increase of 1·6 per cent. It was determined that this represented 4 lb. of 96° commercial sugar per ton of cane milled as the gain resulting; and, using this figure as a basis, a useful example of the method of calculation employed to establish the profit or loss under different conditions is given by J. N. S. Williams, the superintendent of the mill concerned. The additions had comprised a new boiler, a shredder, 3 new rollers, and 3 pairs of mill cheeks, the total expenditure upon which was $32,986. With 120,000 tons of cane for a crop, and with the price of sugar at 6 cents per lb. in New York, the 240 tons of extra sugar yielded nett proceeds to the plantation of $23,190. From this sum must be deducted the interest on the increased capital expenditure, the increased cost of bags, and the increased depreciation and repairs, a sum amounting to $17,614, which taken from $23,190 shows a gain of $5,576 for the crop. If, however, 100,000 tons of cane had been ground, the extra sugar would have been only 200 tons, and the gain would work at $1,926 at 6 cents; and at only $766 if the price fell to 5 cents. On the other hand, if 100,000 tons were ground, and the price was still 5 cents, there would result a loss on the undertaking of $3,071.

These data are suggestive, and show that full consideration must be given to all items entering into costs when contemplating improved milling installation. On studying the question of the economic limit of extraction, it becomes certain that the expenditure of large sums of money upon different new devices is justified only when the factory is milling a large crop of cane; when the price of sugar is high; and finally when the cane is of good average quality, that is, when it contains juice of high sucrose content and of high purity.

Abolition of filter-presses in clarification.—At the present time, in clarifying the raw juice coming from the mills in cane sugar factories, the almost general practice is to treat with lime until the acids present are neutralised (or almost so); to heat nearly to boiling point; and to allow the precipitate formed to settle out in suitable subsiding tanks. This is the so called simple "defecation process." By the action of lime and heat in this way, the albuminoids of the juice are coagulated, while part of the acids combine to form insoluble calcium salts, the result after settling being the formation of a deposit consisting of the heavier solid constituents, and of a scum composed of the lighter impurities, which rises to the surface.

Hitherto, the usual procedure in dealing with this insoluble matter or "mud" obtained from the subsiding tanks after drawing off the clear juice has been to wash it in filter-presses until its sucrose content is sufficiently reduced, after which it may be utilised as fertiliser on the cane fields of the plantation.* In Australia, however, a process has been introduced into a number of the factories there, by means of which the use of filter-presses for the washing of clarification "mud" is entirely abolished. A considerable saving in labour installation, and filter-cloth, and the general simplification of the clarification process, are claimed to result from this new method of working.

* Report on Milling, by H. Johnson, S. S. Peck, R. S. Norris, J. N. S. Williams, and W. Searby; *Intern. Sugar J.*, 1919, 21, 17—22.

* In passing, it may be noted that in Natal the filter-press cake is treated for the extraction of the wax it contains. This product is said to resemble carnauba and beeswax and to find a ready demand among boot and furniture polish manufacturers in the Union. About 250 tons is stated to have been shipped to this country from South Africa during the past two years.

Briefly, this procedure, which has been protected by N. M. Thomas and C. F. Petree,* consists in returning the defecation mud to the train of mills, where crushing and maceration (spraying with water and weak juice) are proceeding. It is obvious that this must be done in a particular way. For example, the successful operation of the milling process would be checked by placing upon the cane undergoing extraction a mud containing more sucrose than is present in the juice with which the bagasse (crushed cane) is saturated. Such a step would mean, either that more sucrose would be lost in the final bagasse, or else that more water would have to be sprayed upon the bagasse in order to reduce its sucrose content to a reasonable figure, the increase of the cost of evaporation being thus entailed.

According, therefore, to the new procedure, the ordinary routine of clarification is modified somewhat so as to produce a mud having a low sucrose content. The richer juice expressed by the first mills is defecated separately, and the resulting mud is mixed with the weaker juice coming from the latter units of the milling train, which mixture is also defecated. It is the mud of reduced sucrose content thus produced from the weak juice that is distributed over the bagasse at a suitable stage of the crushing process. In a crushing installation having three 3-roller mills, this specially prepared mud would be applied to the bagasse leaving the first mill, at the same time macerating with weak juice from the third mill, while the bagasse after leaving the second mill would be macerated with water.

Possible objections to such a process that at first thought arise are that the purity of the juice might be lowered by the re-solution of certain of the constituents of the mud; and further that the burning properties of the bagasse when used as fuel under the boilers might be affected adversely. Experience in factories in Queensland would appear to prove that neither of these suspected defects arises in practice. Evidence is adduced by the management of eight factories (two of which are owned by the Government) that the juices obtained are as high in purity, and at least as clear, as those resulting from the method formerly in vogue; and that, moreover, there is no trouble with clinkering in the furnaces.

At present this new procedure is in use in about twenty factories in Queensland, Fiji, and it is being introduced into other sugar-producing countries.

THE IMPORTATION OF FOREIGN MANUFACTURED WOOD CHARCOAL.

The Association of British Chemical Manufacturers.

The fact that the manufacture of certain dyes, fine chemicals, etc., is entirely dependent upon the products of wood distillation, and that this country's production is at present inadequate, renders it essential that the expansion of the wood distillation industry should be encouraged. In the past the industry has been limited by the small home demand for charcoal and the competition of Continental charcoal imported at low prices.

The production of charcoal in tons per annum has been approximately as follows:—Pre-war period (1911-1913) B.W.D.A., 14,938; forest burnt, 5,600; total, 20,538. War period (1915-1917) B.W.D.A., 11,601; forest burnt, 5,600; total, 17,201. (B.W.D.A., British Wood Distillers' Association.)

In the pre-war period the imports of charcoal probably amounted to 6,000 tons per annum, but statistics are not available, as they are not separately stated in Board of Trade returns; neither are they so stated in the export returns of Germany, Austria, Scandinavia, France, or Holland.

During the war period the production of charcoal in Government factories has been considerable, but official figures are not available. During this period the demand was almost unlimited, but with the cessation of hostilities it fell away, and the present position is now as follows:—(1) Private wood distillers are continuing to produce charcoal; (2) Government factories are also producing charcoal; and (3) imported charcoal may very soon come into the home market.

The future of the wood distillation industry, and as a consequence that of the industries dependent upon it, rests entirely upon the policy to be adopted now.

(1) and (3) were co-existent in the pre-war period, and the result was a struggling industry which lacked entirely the prospect of reward necessary to stimulate research and aggressive organisation, and left the country dependent upon outside supplies for materials of vital importance at a time of national danger.

If (1) private wood distillation is to be encouraged (3) imports of charcoal will need to be restricted, or totally prohibited, unless they are required for Government purposes or are permitted by special Government licence.

(2) Government factories, although in existence to a certain extent prior to the war, are a new factor in the situation, and their disposal or administration arises naturally out of the question at issue. To prohibit importation of charcoal and to allow the product of the Government factories to enter into *unrestricted* competition with the private manufacturer would at the very least annul and stultify all benefit, but to allow (1) (2) and (3) to continue co-existent would first of all extinguish the private manufacturer, and then rob the Government factory of any contribution which the sale of charcoal would otherwise make towards cost of maintenance.

As to the anticipated production of charcoal in the post-war period, it will be worth while setting out the conditions which govern production, viz.:—(1) The supply and cost of raw material; (2) the supply of labour; (3) the demand and ruling prices for charcoal and wood tar (these being the products which have proved most difficult to sell and impossible to store). All these conditions are at present most uncertain, but, given sympathetic consideration by the Government Departments concerned, the production of charcoal will approximate very quickly to the pre-war standard, and in the near future will be increased substantially.

It is impossible to discuss the suggested prohibition of the importation of wood charcoal without reference to the disposal or administration of the Government factories concerned in its production. In spite of the consideration that on general grounds it is undesirable that Government-owned factories should manufacture chemical products except for use in other Government-owned factories, it is conceivable that the private wood distillation industry of this country will not be able to supply the full requirements of the various branches of chemical industry in the products of wood distillation other than charcoal, and the wood distillation industry might be willing to acquiesce in the continued working of the Government-owned factories to a degree, providing that suitable steps were taken to safeguard the interest of the private manufacturer.

It has already been proposed to the Ministry of Munitions that minimum sale prices should be fixed from time to time, such prices to be agreed by the Wood Distillers' Association or their representatives, and the Minister of Munitions or other

* U.S. Pat., 1, 266, 882; J., 1918, 557 A.

Government Department, or a representative thereof, and that the prices shall be equally binding upon the private manufacturers and upon the Government factories.

If this proposal be accepted it will go far to solve the problem of Government competition, but it should not be overlooked that the legality of a Government Department competing with a private trader (in the absence of the Defence of the Realm Act) remains to be decided.

It is well known that the Council of the Association of British Chemical Manufacturers does not look with approval on the possibility of the continuation of Government-owned factories, but there is no doubt that, if the anticipation and hopes which have been encouraged during the war of an extensive growth in our dyes and fine chemical industries are to be realised, it will be necessary to continue operations at these new wood distillation factories erected by the Government in order to ensure adequate supplies of essential materials. The conditions under which the factories shall be continued in operation are a matter for further consideration.

To conclude (1) private wood distillers, (2) Government factories, (3) importation of foreign charcoal cannot co-exist, and the suggested solution is that importation of charcoal shall be prohibited in order that there may remain an adequate market for private wood distillers and Government factories, provided only that material of satisfactory quality for decolorising purposes can be produced in this country to meet the reasonable requirements of home consumers.

THE MANUFACTURE OF PHARMACEUTICAL PRODUCTS IN FRANCE.

That French manufacturers of pharmaceutical products are confronted with the same problems and difficulties as their British *confrères* is disclosed in a well-informed article by Monsieur A. Detoeuf in the February issue of *Chimie et Industrie*.

In discussing the future of this industry, M. Detoeuf states that the pre-war idea that the French were tributaries to Germany for the greater part of their pharmaceutical products did not quite correspond to reality. He points out that two distinct classes must be recognised among medicinal products, based on the existence or non-existence of patents and trade-marks which enable the manufacturer to defend his products against competition. The French patent law of 1844 at present in force excludes medicinal products, but in practice this restriction is often overcome by taking out a process patent to cover the preparation of a substance which is the eventual "raw" material of a medicinal derivative; and with regard to the trade-mark, it is well recognised that a simple denomination authorised for pharmaceutical products, which is renewable indefinitely, confers on its possessor an equally indefinite proprietary right.

By reason of these prerogatives there are two clearly defined classes of medicinal products:—(1) Those not protected by any mark and of which the manufacture has either never been covered by patents, or is now protected by patents; (2) those put on the market under a mark and of which the manufacture is also protected by patents.

(1) Practically all these products are listed in the official Pharmacopœia, and a large proportion of them was made in France before the war. Among the products belonging to mineral chemistry we find such important substances as potassium permanganate, corrosive sublimate and the bichromates of potassium and sodium. The manufacture of saccharin requires large quantities of permanganate, and this must be produced in sufficient quantity to meet all future requirements. Small quantities of corrosive sublimate have been made in France, although the manufacture depends, apart from the supply of mercury, on the available quantities of chlorine. No doubt the electrolytic works, now free from war restrictions, will soon be equal to meeting the entire home consumption. Bichromates constitute a very necessary raw material for the manufacture of many products, and a trial factory has been established in France during the war. This requires patient development in order to free France from foreign influence.

The following organic products—and these constitute the majority—were not made in France before the war, or were made in chemical works now destroyed:—Chloral, valerianic acid and valerianates, monochloracetic acid, oxalic acid and oxalates, phosgene, urea, morphine, codeine and derivatives, phenol, guaiacol and salts, benzoic acid and benzoates, saccharin, phthalic acid and phenolphthalein. With the exception of morphine and its derivatives and chloral (which were not manufactured for special reasons), all the other products named have been manufactured in France during the war. It cannot be said, however, that these have yet been produced under the most economic conditions, and it is therefore uncertain if the manufacture can be maintained. The production of nearly all these organic products depends upon a cheap supply of primary materials, such as mineral acids, caustic alkalis and chlorine. These materials are likewise used in the manufacture of aniline colours and synthetic perfumes, and it is in this whole field that development is needed, for the production of pharmaceutical products is only auxiliary to the manufacture of dyes.

It was principally from the German chemical dye works that pharmaceutical products were issued before the war. One great service which the war has rendered to France (and incidentally to Great Britain) is that it has made both nations producers of these primary materials at first hand. The factories that have produced for war must now produce for peace. Works that can produce electrolytic chlorine cheaply will be best able to make chloral, monochloracetic acid, benzoic acid and phosgene. The present makers of benzene and phenol can turn out guaiacol and its derivatives most successfully. From cyanamide, urea can be obtained; from toluene, saccharin; from naphthalene and oleum, phthalic acid; from amyl alcohol, valerianic acid; and so on.

But although it is necessary to encourage by all possible means the development of chemistry in France, it is no less indispensable to warn manufacturers that pharmaceutical products cannot be produced with a small plant and scant material. They require a perfected plant, the processes must be scrupulously attended to, and above all there must be facilities for disposing of the by-products to good account. "One does not manufacture a pharmaceutical product," says M. Detoeuf, "one manufactures all the products appertaining to the same series and dependent on the same crude material."

(2) It was by means of trade-marked or patented medicinal preparations that the Germans formerly invaded the French market. With the German manufacturer every new organic or mineral derivative was a potential material for a medicament. Intensive research in the factory laboratories and systematic experiment in their laboratories of therapeutic physiology, enabled them to recognise to a certainty such products as were endowed with special therapeutic activity. The process of manufacture was then patented in Germany, and if possible in France, no mention being made of therapeutic properties. Then the product was put on

the market under cover of a *marque déposée* and introduced to medical men.

The pre-war attitude of the French manufacturer was that if the German product had a small sale he left it alone. If, on the contrary, the sale developed the French manufacturer produced a preparation of the same chemical composition and put it on sale either under its chemical name or under another name chosen by himself. In every case the use of the German trade-mark was denied him as constituting an international industrial property. This explains why before the war only such products which could by their popularity justify the expense and risk of their production were manufactured in France.

Among the more important of the organic or mineral products sold under a German mark were:—Adalin, anæsthesin, antipyrine, aristol, aspirin, atophan, bismon, bornyval, bromipin, bromural, citrophen, collargol, creosotal, dermatol, dionin, diuretin, euquinine, helmitol, heroin, lactophenin, luminal, lycetol, lysol, salvarsan and neosalvarsan, novocain, orthoform, phenacetin, protargol, pyramidon, salophen, somatose, sulphonal, trional, urotropin, veronal, xeroform. Of these all except anæsthesin, atophan, bismon, bornyval, citrophen, dionin, helmitol, lactophenin, luminal, orthoform, phenacetin, salophen, somatose, sulphonal and trional, are now made in France.

In suppressing German competition, the war has made it comparatively easy to launch on the market, under a new trade-mark name, certain of these products which are still in demand among medical men. On the other hand, some French manufacturers before the war were able to secure by judicial action that certain marks which had become the usual name of the product (for instance, antipyrine, pyramidon, etc.) should be put into general use.

Two ways are open to French manufacturers: either they can reproduce chemically the German products and face the competition, or they may build up new compounds of proved therapeutic properties and place them before the medical profession. The difficulties of the task must not be overlooked. Well-equipped laboratories are necessary, manned by chemists trained to research, particularly in organic chemistry, and, above all, the possibilities of physiological experiment must be attended to. On the other hand, the industry in pharmaceutical products sold under a trade-mark requires usually but a small, though perfect, plant, and there is less risk of such trade being submerged by the dye and synthetic perfume industries.

M. Detoeuf's illuminating review of the situation shows quite clearly that the question of the manufacture of pharmaceutical products is not so simple or so attractive as is often believed. Newcomers, he says, will find themselves very quickly in the presence of difficult situations, and bitter competition awaits them, both at home and abroad. It is imperative, he concludes, that the laws now under consideration regarding patents and trade-marks should ensure to these manufacturers sufficient guarantees for their enterprise without harm to the general interest. It is also necessary that they should be kept well informed of everything that is being done at home and abroad, and that official science should support them openly and without expectation of immediate reward. Finally, as the pharmaceutical industry, like other industries, has given the State all possible assistance during the war, it is the duty of the State to protect it now.

Rumania is taking active measures to free her industries from German influence. The Government has ordered the liquidation of all enemy enterprises established in the country during the German occupation.—(*Z. angew. Chem., Jan.* 28, 1919.)

NEWS FROM THE SECTIONS.

CANADA.

Toronto.

On March 20, Dr. A. J. Wilson, of the Department of Mines, Ottawa, gave an address on the production of potash in cement works in the United States and Canada.

Before the war a few cement works used dust collectors in order to protect the neighbourhood from fumes; now some fourteen factories are recovering potash from the collected dust as a part of their ordinary routine. Systems of electrical precipitation and spraying are used and very high efficiencies are claimed. The first plants erected have proved the most profitable as they were producing over a longer period of high prices. Others were not so successful, but it is expected that many of the plants will continue to treat their gases in this way as a means of doing away with a nuisance, and of reducing the cost of the cement by a few cents per barrel. The lecturer gave much information, which was released for the first time in Canada, regarding methods and types of plant, with dimensions.

In the discussion which followed it was brought out that prior to the war German interests had oversold the potash fertiliser market, and had developed the use of potash beyond the amount actually required by many Canadian soils under certain crops. Fertiliser users, therefore, had a small reserve of potash available in their soils. During the last year, however, the truck farmers have noticed the lack of potash more than others, and it is expected that Canada will offer a very large market for potash in the near future, provided the price is brought down to something like the pre-war level.

MANCHESTER.

There was an excellent attendance at the meeting held on April 4, when a paper was read by Mr. H. N. Morris on "The Industrial Development of India, with special reference to the Chemical Industries." The paper drew attention to and criticised the Report of the Indian Industrial Commission, 1916-18 (see this J., 1919, 50 R), but additional interest was imparted by the author's first-hand acquaintance with the subject. He urged the prompt and energetic carrying out of the recommendations in order to effect industrial stability, increased wealth and a higher standard of living, with their concomitants, greater purchasing power and increased demands for all kinds of goods. The meeting was attended by representatives from the Manchester Chamber of Commerce and by several Indian gentlemen, one or two of whom expressed their agreement with the author's views on the development of the resources of India, but pointed out that progress must necessarily be slow owing to the great lack of education among the mass of the people.

With reference to the report of the March meeting of this Section (this J., p. 102 R), we are informed that in the process of condensing the communication sent by Dr. J. Grossmann his views were unintentionally distorted, and we therefore append a *verbatim* version, coupled with an expression of regret that any mistake should have occurred.

"I have carefully considered the advisability of forming a Chemical Engineering Group in connexion with the Society of Chemical Industry, and as its work would come to a great extent under Section I of our classifications there appears to be no more

justification for its creation than for any of the other 22 Groups. It would confer no status on the members of the Group, unless the latter applied for a separate charter under which strict qualifications would be required for admission to membership. A desire for this appears to me to be the almost inevitable result, and as a loyal member I consider it against the interests of the Society of Chemical Industry to support such a dangerous precedent, which may ultimately lead to its disintegration. My personal view is that a chemical engineer should be a highly trained chemist with wide practical experience in chemical works, and particularly capable of designing plant for chemical work which cannot be obtained in the ordinary way. Such a person would naturally also have sufficient experience to select from manufacturers of specialities for his use in the designing and laying out of plant the best and cheapest means f producing steam, power, transmission, etc.

"Apart from these considerations, it appears from the membership application form which has been sent out by the Chemical Engineering Group that any foreman in a chemical works or any mechanical engineer with some knowledge of chemistry would be entitled to be classed as a chemical engineer."

LONDON.

At the meeting held on April 7, Dr. Charles A. Keane, the chairman, announced that the Committee of the Section had elected Mr. Julian L. Baker as chairman for the ensuing session, and that Dr. Stephen Miall had been re-elected hon. secretary and treasurer. In accordance with the suggestion made at the last meeting by Mr. S. G. Thomas, a committee had been appointed to report on Temperature Specification and Temperature Control in Refractometry. The annual meeting of the Section will be held on May 5. Dr. Keane also referred to the loss sustained by the death of Sir William Crookes.

Mr. E. A. Alliott read a paper on "Drying by Heat in conjunction with Mechanical Agitation and Spreading." The first considerations in drying, apart from the quantity of material to be handled, are the total amount of water to be removed and the degree of "dryness" to be attained, for the removal of the last portion of water is the most costly both as regards time and fuel. Driers may be classified either according to the method of heating employed (direct heat from a furnace, steam, hot water or hot air), or according to the method of working (stationary and "agitated" types). The type of drier to be selected is obviously governed by many factors. Besides those already alluded to, an important one is the "temperature sensitiveness" of the material, namely, the degree of temperature to which it can be subjected without injury. Perhaps even more important are the physical changes in the condition of the material during drying. In the case of film driers, some materials cling closely to the surface of the cylinder and require carefully designed scrapers for their removal. As the types of driers vary so widely and materials differ so much in the way in which they part with water, it is impossible to give any precise figure for the economy, but broadly speaking, the author considers that an evaporation of 4 to 5 lb. of water per lb. of fuel consumed, and an evaporation of 2 to 3 lb. per sq. ft. of heating surface per hour may be taken as representing fairly good practice. In this connexion the author gave illustrations of a number of types of driers and details of their performance. In the case of rotary driers, careful attention to the method of supporting the cylinder leads to economy in the power required for driving, a point which is often overlooked.

A very interesting demonstration was given of curves co-ordinating various factors operative in drying, such as the original moisture content and the time required to remove successive portions. The momentary rate at which water comes away at any particular degree of wetness varies in a curious manner. For example, with an initial moisture content of say 63 per cent. the rate at first may be nearly 90 lb. per hour. This rate falls rapidly to about 60 lb. per hour, at which point it remains constant for a wide range of moisture contents and below 12½ per cent. again falls away rapidly. Another important point in the economical working of driers is the temperature of the discharged air; at low temperatures a very large volume of air, even if half saturated, is required to remove water, and on the other hand the heat required to raise this temperature is by no means proportional to the total amount of heat involved. Some economy has, however, been effected by the application of the principle of "re-circulation," in which the air is withdrawn at a fairly high temperature from the drier, and a portion of this warm, moist air is again passed through the chamber, thus utilising the heat it carries and attaining the required degree of saturation. A type of rotary drier was also described which is fitted internally with a number of spiral volutes. The material is fed on to the periphery of the first spiral, and is carried up to the centre and passes to the centre of the next spiral, which is coiled in the reverse direction, and on reaching the periphery is caught by the next spiral. The material is prevented from falling off the spirals by interposed screens of wire gauze.

NEWCASTLE.

The annual meeting was held in the Bolbec Hall on April 9, Dr. J. T. Dunn presiding in the unavoidable absence of the chairman, Prof. P. P. Bedson.

The Hon. Secretary presented the annual report covering the past session. In addition to the enumeration of the papers which had been read before the Section, mention was made of the visits paid to various works in the neighbourhood. There had been an increase in the membership of 22 per cent., *viz.*, from 166 to 203. The average attendance at the recent course of lectures on Refractory Materials by Dr. J. W. Mellor had been 97. During the year the Section had been interested in the formation of a "Chemists' Club."

Dr. J. H. Paterson then read a paper on behalf of Mr. H. Blair and himself on "Electric Welding." In their introductory remarks the authors said that a great number of experiments in electric welding had been made by people with little or no scientific knowledge, with the result that many worthless processes and materials had been patented. He then dealt with the various methods adopted for improving the mechanical properties of welds, and he described in detail improvements in the procedure of determining nitrogen, and nitrogen and oxygen, in iron and steel. It was found very difficult in practice to get strictly concordant results from the same samples. Investigation showed that if any given sample of drillings were separated into three portions, coarse, fine and powder, the oxygen content varied very greatly. It was evident from the microscopic examination that there were considerable quantities of minute non-metallic inclusions in every weld, particularly when a flux-covered wire was used. Analyses of some large slag inclusions from a flux-coated electrode showed that they contained from 6 to 6·5 per cent. of oxygen which was removed as water when the slag was heated in hydrogen. No matter how samples were taken, the quantity of oxygen found must include

a certain amount which would have little or no effect upon the mechanical properties of the metal. Chemical analysis should always be supplemented by microscopic examination. The high percentage of nitrogen contained in the weld metal and the comparative uniformity of the amount was of great interest. It was a generally accepted fact that molten iron was practically unacted upon by the atmospheric nitrogen, and when it was remembered that the maximum time that the weld metal remained molten was about 30 seconds, it would be understood that the reaction which did take place was a powerful one. It was not unreasonable to suppose that the nitrogen existed in the metal in two forms, one form intimately related to the oxygen content and the other as a solid solution of iron nitride.

MEETINGS OF OTHER SOCIETIES.

PHYSICAL SOCIETY OF LONDON.

A paper on "Some Characteristics of the Spark Discharge and its Effect in Igniting Explosive Mixtures" was read by Messrs. C. C. Paterson and Norman Campbell on March 14. The object of the investigation was to determine the relation between the electrical characteristic of a spark discharge and its power of igniting explosive mixtures. The results show that the igniting power of a spark increases with both the capacity discharging and the spark potential, and that the energy required for ignition decreases rapidly as the spark potential increases. Various other properties of sparks were also described.

In the discussion Dr. Eccles pointed out that a given small quantity of heat is the more effective in promoting discharge the smaller the time and the mass in which it is developed, and the lower the thermal conductivity of the medium. The authors agreed with him that ignition takes place in two stages, the initiation of combustion and its propagation through the mixture, the latter stage being undoubtedly thermal, but probably not the former. Ignition is started by the development of a certain intensity of ionisation rather than by the development of a certain quantity of heat. This intensity may be produced by thermal, *i.e.*, thermionic, means, as when ignition is started by a hot wire, and possibly when started by a flame; but it may also be produced by ionisation by collision or the action of ionising rays. The first of these means is probably employed in the spark discharge, and the second when the ignition is started by the incidence of *X*-rays on a metal plate.

INSTITUTION OF SANITARY ENGINEERS.

On March 17, Mr. W. C. Easdale described a method of sewage disposal which was adopted during the war to treat the sewage from a large military camp near the River Swale, a tributary of the Yorkshire Ouse. The main objects of the scheme were to remove a maximum percentage of suspended solids, to maintain the sewage in a fresh condition while passing through the tanks, and to obtain an innocuous tank effluent. These aims were successfully attained owing to the effective design of the tanks employed and to the very favourable natural conditions, *viz.*, excellent gradients, very fresh sewage, uniform flow, and a highly oxygenated river water.

The sewage passes through a screen chamber into four tanks, each divided into three compartments (A, B, C). The width of A and B is twice that of the length in the direction of the flow, and the floor of each is steeply inclined. The sewage enters A near the bottom, flows down and across it, up under a baffle board and out over a long weir into B, from which it passes over another long weir into the effluent channel. The solids, the bulk of which is deposited in A, are discharged by gravity once weekly into C, which retains the sludge until digestion is complete. C is much larger than the others, and the bottom is shaped like an inverted cone, the greatest depth being 15 ft. The sludge accumulates in it to a depth of 6 ft., at which height it is discharged, once a month, through a horizontal pipe connected to a vertical stand pipe extending from the bottom of the cone to the top water level. It is dried on drying beds and applied to the land (H_2O 72%, N 0·9%). The supernatant liquid in C is returned to the fresh sewage.

The few analytical figures given showed that, roughly, 70—80 per cent. of the suspended solids is removed in A and B, and that the percentage of purification, as given by the 5-minute permanganate test of the effluent, is 30 to 48, the effluent being purified by chlorination. At a point 300 yds. below the outfall the dissolved oxygen content of the river water was found to have fallen about 50 per cent., but 1½ miles lower down it was again normal. From the bacterial standpoint, the effect of adding 4·5 pts. of chlorine per million of effluent was satisfactory when the ratio of dilution was high, although the destruction of *B. coli* was not complete: 1½ miles below the outfall the bacterial contents of the river were again normal.

ROYAL SOCIETY.

A paper "On the Inter-crystalline Fracture of Metals under prolonged Application of Stress" was read by Dr. W. Rosenhain and Mr. S. L. Archbutt on April 3.

The authors' observations have shown that in a number of metals, including lead, mild steel and an alloy of aluminium with zinc and copper, the prolonged application of stress will, in certain cases, produce an abnormal type of fracture in which the crystals become separated from one another, instead of being broken or torn across in the normal manner. An exact similarity to this type of fracture is found in the "season cracking" of brass. In the latter case the applied stress is an internal one arising from elastic deformation. The authors base an explanation of this type of fracture on the hypothesis, formerly advanced by one of them and widely accepted among metallurgists, that the constituent crystals of metals are held together by thin layers of an amorphous inter-crystalline "cement," whose properties resemble those of a greatly under-cooled liquid. When stresses are applied to such an aggregate, the viscous under-cooled liquid films behave, in the first instance, like a very strong and hard material (somewhat resembling glass), and when fracture is brought about at any ordinary rate it occurs by the failure of the crystals themselves and not by the tearing away of one crystal from another. Under the prolonged action of stress, however, the viscous cement will, in favourable circumstances, yield slowly, so that the crystals become detached from one another. Whether this will occur or not must depend upon the character of the inter-crystalline boundaries; if these are rough and irregular, viscous flow will be prevented, but if they are very smooth it will be facilitated. The authors' observations show that in the cases where inter-crystalline failure occurs the metal has been subjected to some annealing process which has allowed the crystals to acquire smooth, regular boundaries; where such smooth boundaries do not exist this type of failure is not met with. The practical importance of avoiding such "over-annealing" is pointed out. As the viscosity of a liquid rapidly decreases with rising temperature, it would follow that inter-

crystalline failure of this type will be favoured by a slight rise of temperature; this is known to be the case with brass, and the authors point out that cases of inter-crystalline cracking in steel have mainly been met with in the plates of steam boilers working at high temperatures.

SOCIETY OF PUBLIC ANALYSTS.

The first paper read at the meeting held on April 2, Dr. S. Rideal presiding, was "A Method for the Determination of Monochlorbenzene in Mixtures containing Benzene, Monochlorbenzene and Dichlorbenzene," by Messrs. N. G. S. Coppin and F. Holt. The method is based upon Northall-Laurie's method of determining toluene in commercial toluols (this J., 1915, 950), and consists in distilling, at the rate of 7 c.c. per minute, 200 c.c. of the dried sample, and determining the boiling points of the first distillate of 50 c.c. and of the residual 50 c.c. in the flask. The percentage weight of the constituents is then read off from a graph. The method gives direct results with an accuracy of 0·1 per cent. for all mixtures containing from 50 to 100 per cent. of monochlorbenzene.

In the second paper, on "The Electrical Conductivity of Milk," Messrs. J. H. Coste and E. T. Shelbourne drew the conclusion that the conductivity is not sufficiently well defined to be useful as an analytical datum except for milks which have been examined by this means before incurring the risk of dilution. They have examined the relation between conductivity and temperature, non-fatty solids, ash, chlor-ion content and free acid, and the effect of dilution, and the results obtained are consistent with the explanation given by L. C. Jackson and A. C. H. Rothera, that the conductivity is dependent on the extent to which the constant osmotic pressure of milk is due to electrolytes with which the milk sugar is complementary.

The last paper, "A Note on Soluble Lead in the Glaze of Casseroles," by Miss H. Masters, stated that a number of casseroles of various types were found to yield considerable proportions of lead on treatment with 4 per cent. acetic acid, and with dilute solutions of other acids such as would be present in certain cooking operations. The soluble lead is not all extracted by one operation, but after two or three treatments, each subsequent treatment appears to yield a fairly constant quantity.

THE CERAMIC SOCIETY.

At the meeting held on April 14 at Stoke, Dr. J. W. Mellor contributed a short paper on "The Heat Conductivity of Porous Materials and the Heat Insulation of Kilns." In 1914 the author called in question the commonly held view that at high temperatures porosity favours insulating properties. In ordinary circumstances the quantity of heat travelling by conduction through the solid material is much greater than that passing by radiation across pore-spaces, but for a given size of pore there is a particular temperature at which the two quantities of heat will be equal. According to a calculation by Dr. Mellor, if the pores are 0·1 cm. across, the heat carried across the air spaces per second at a temperature of 1400° C. is equal to the heat conducted through the solid material. With pores of 0·5 cm. the temperature is about 730° C., and with pores of 0·01 cm. the temperature would be about 3000° C., and so on. In these calculations the conductivity of air and change of conductivity with rise of temperature and the effect of convection of heat by air currents in the pore spaces, are ignored.

It would seem therefore that the temperature of the breaking down of the insulating properties—when the radiated heat equals the conducted heat—falls within ordinary kiln temperatures. A pore size of 0·01 cm. would not constitute a really porous material. In order to test the point experimentally, bricks having different degrees of porosity, etc. were prepared, with three holes extending different distances into the length of the brick. By inserting thermo-couples into the holes, the temperatures at different points of the bricks can be ascertained. The work is being carried out by Messrs. C. Edwards and A. Rigby, and the results will be presented in a subsequent paper.

A paper on "Apatite substituted for Bone Ash," read by Mr. N. B. Davis, dealt with the possibility of using Canadian apatite in place of bone in the preparation of English bone china bodies.

A third paper on "The Casting of Heavy Pottery" was read by Mr. B. J. Allen. This concerned the casting of such objects as glass pots, articles of fireclay like basins etc., and smaller special articles like high tension electric insulators. The author claims that pieces made by his vacuum process are much drier on leaving the mould, and contain more clay in a given space, than with any other commercial process.

NATIONAL ASSOCIATION OF INDUSTRIAL CHEMISTS.

A meeting was held in London on March 31 to hear an address by Mr. G. H. Todd, representing the Ministry of Labour, on the subject of the Whitley Councils, with special reference to the position of technical and scientific workers. In describing the Whitley Scheme, Mr. Todd pointed out that the Ministry of Labour had no mandatory powers thereunder. No provision is made under the Scheme for unorganised elements, representation being based entirely on association either as employers or employees. The association on the side of the latter is not necessarily that of a trade union. The only way for scientific and technical workers to obtain representation is by organising and agitating. The Ministry of Labour will do its best to further the demands of these workers, but they must take the first step. Replying to questions, the speaker said that it was of no importance to the Government whether these workers were registered as a trade union or not, but existing trade unions would not recognise them unless they were so registered. The difficulty of deciding whether an association should obtain representation as employers or employed might be solved by introducing into the Whitley Councils a third body representing scientific and technical workers. He thought that the Ministry would favour this suggestion.

The president, Mr. A. C. Charlier, said he was a convert to the policy of registering as a trade union, but that did not mean that trade union methods should necessarily be adopted. Before all, it was essential that the four or five bodies now acting separately should federate and show a united front. Mr. N. Wild, secretary of the Society of Technical Engineers, also addressed the meeting, and spoke in favour of organisation of all technical workers and of federation of the different groups.

INSTITUTE OF CHEMISTRY.

At a meeting of the Birmingham Section, held on April 7, Dr. E. W. Smith presiding, the functions of the Industrial Research Laboratory of the Gas Department of the Birmingham Corporation were considered. It was generally agreed that a municipally-owned research laboratory would fill a necessary want if restricted in its activities to matters which could not satisfactorily be dealt with by the well-established consultant chemists, and on lines approved by the Institute of Chemistry.

L'ENTENTE CHIMIQUE.

STEPHEN MIALL.

Monsieur P. Kestner and his colleagues have a genius for hospitality and organisation, and of this the recent conference of allied chemists in Paris is a striking piece of evidence. Not only was the gathering representative of most of the allied nations, brought together under circumstances of considerable difficulty, but every detail had been thought out in such a manner as to secure the convenience and happiness of the guests, and to provide them with a delightful and lavish reception which will long remain among their most cherished recollections. The delegates who were privileged to attend were from the outset made sensible of the kindly consideration which their French colleagues had shown in connexion with the important matters to be discussed, and it was obvious that a real effort was being made to deal with inter-allied co-operation in an adequate and worthy manner.

No one can suppose that a true co-operation can be established without plenty of hard work extending over a considerable period of time. A good deal of drudgery and attention to points of detail will be necessary and much time and trouble must be taken before real progress is made. To harmonise the views of several nations, speaking different languages, with different traditions, different points of view, different ways of looking at a problem, and a score of other differences, will be no easy task. But there is no doubt that the work can be done, must be done, and that this is the time to do it. France is in the position of requiring from her own government and from the allied countries a greater measure of encouragement in chemistry, both pure and applied, than other countries, and when we consider what France has done to preserve civilisation in Europe, we shall all be glad to see her make her position unassailable and outstanding in a science in which she has already taken so prominent and worthy a part. We must bear in mind that France has made far heavier sacrifices in the war than Britain or America and some other of the allies, and has had a heavier toll taken of her manhood and her wealth, and that consequently she will have to make, and undoubtedly will make, a greater effort to maintain the place she so well deserves in the chemical world than those nations whose geographical positions have enabled them to escape the devastations and losses which have fallen on her. Her geographical position and her close association with Belgium, Italy and Greece will probably make France the dominant partner in the new confederation. The impression left on one's mind is that the headquarters of the inter-allied chemistry will be at Paris and the diplomatic language of chemistry will be French. The English delegation was fortunate in including two or three who had a fluent knowledge of that language.

The Inter-allied Conference was presided over by Prof. C. Moureu and was fully attended. Among the French were Messrs. Kestner, Haller, Béhal, Poulenc, Hanriot, Marquis, Matignon, Marie and Gérard. The British deputation consisted of Prof. H. Louis, Sir William Pope, Messrs. Chaston Chapman, W. F. Reid, E. Thompson and S. Miall. The Americans included Mr. H. Wigglesworth, Lt.-Cols. Bartow, Norris and Zanetti, Major Keyes and Dr. Cottrell. Italy was represented by Senator Paterno, Doctors Pomilio and Giordani and others, while M. Chavanne represented Belgium. The first sitting took place on April 14 in a delightful room at the Hotel du Comité des Forges, and the thirty or so delegates sat round an oval table "too large to be conceived by any narrow mind."

Les Etablissements Kuhlmann gave us lunch at the Restaurant Laurent, and appropriate speeches were made by M. Kestner and M. Agache, after which we settled down to more serious business. Professor Louis read a paper on the magnetic separation of low grade iron ores; he did not profess to give us much new matter but he provided a convenient and useful summary of the processes now in vogue, some of which had been of great importance during the war. Dr. Cottrell's paper on the industrial production of helium was full of interest, and it is evident that a few weeks or months hence it should be possible to give a more complete account of this important investigation. In the discussion which followed a remarkable feature was mentioned by Professor Moureu. He stated that in France the rare gases, neon, krypton, xenon and helium were invariably present in the gases given off by springs and underground waters, and that although the proportion of helium was variable, the relative proportions of neon, krypton and xenon and of nitrogen were fairly constant. A possible explanation was suggested, *viz.*, that these four gases were all present in the nebular mass from which the earth was formed, and that nitrogen being nearly inactive and neon, krypton and xenon absolutely inactive, their relative proportions had remained the same to this date. On the other hand helium was continually being formed by radioactive minerals, which would account for the variations in the proportion of this element.

Good progress was made on April 14 and 15 in the organisation of an Inter-allied Federation for Pure and Applied Chemistry. It was made quite plain from the commencement that none of those present had any power to bind the organisations which they represented and that the decisions which, after considerable discussion, were unanimously agreed to would require to be remitted to the appropriate bodies for ratification.

The following resolutions were passed:—

1. The members of the Inter-allied Conference of Chemical Associations held on April 14 and 15, 1919, unanimously accept in principle the formation of a Confederation of Chemical Associations both Pure and Applied.

2. They express the hope that the Associations of each allied country will form National Federations or National Councils, and invite them to communicate their adhesion at the next meeting of the Conference which will be held in London on July 15–18 next.

3. They contemplate in due course affiliation with the Associations of the neutral countries.

4. A Committee is appointed on behalf of the Conference to draw up a general programme of organisation with power to consult Associations of allied countries not represented at the Conference.

5. This Committee should provisionally act as the Council of the Confederation, its power being limited to the carrying out of the decisions taken by the Conference.

The following regulations were also agreed to:—

1. The Confederation has for its aim to consolidate the bonds of esteem and friendship between the different allied countries which have already been strengthened during the war; to organise a permanent co-operation between the associations of the federated countries; to co-ordinate their science and technology and to contribute to the advancement of chemistry in all departments.

The Confederation will be governed by a Council whose members alone shall have power to take decisions.

2. Each nation shall be represented by not more than six members.

3. The members of Council shall be nominated for three years and one-third shall retire annually.

4. Members of Council shall be eligible for re-election.

5. The executive power of the Council shall be in the hands of officers, consisting of a President, Vice-President and General Secretary.

6. The officers shall be chosen annually by the representatives of each federated country in turn.

7. The International Council shall fix the date and place of meeting and have control of the expenses.

8. A permanent Secretary shall be appointed to carry out the decisions of the Council and have custody of the archives.

9. There shall be appointed in addition to the Council, a consultative committee formed from as many sections as are necessary to ensure complete representation of pure and applied chemistry.

10. In each section the various federated nations shall be represented by not more than six members.

11. The members of the committee shall have merely a consultative power and the right to make suggestions.

12. The reports of the committee shall be laid before the Council and distributed to the members thereof at least one month before discussion.

The original resolutions are not perfectly clear and consistent and the above translation has doubtless additional faults, but time and further consideration will remove both sets of defects.

The Society of Chemical Industry had the pleasure of inviting the Inter-allied Federal Council to meet in London on the occasion of the Society's annual meeting in July next and the invitation was accepted in the most gratifying manner. We hope to welcome six delegates each from France, America, Italy and Belgium and to continue the conferences so pleasantly begun in Paris. The French have set up an extremely high standard for such a welcome, a standard impossible to surpass and to which it will be very difficult to attain. We gladly accept the responsibility, relying on the co-operation of the British chemists to enable us to come out of the ordeal with credit.

No cut-and-dried programme for the future has been prepared and it is in the hope of receiving suggestions and criticisms that the following crude ideas are put on paper.

The Inter-allied Confederation or Council will be the guests of the Society of Chemical Industry and will be welcome at our conferences, discussions and social gatherings; nevertheless they will have to proceed with their organisation and hold their own meetings; suitable arrangements must be made for the conduct of their own special business. These meetings will require the occasional presence of the Society's President, and, perhaps, of other members. Special hospitality must be provided for the distinguished allies who attend, and though the annual meeting of the Society will derive additional importance and gratification from the Inter-allied Conference, the provisional programme now being drawn up will require a little amendment. It will apparently be the business of the Federal Council for Pure and Applied Chemistry to nominate the six members who shall represent Britain on the Inter-allied Council, and the arrangements for the Inter-allied Conference so far as Britain is concerned will be under the supervision of the Federal Council. The latter will probably be asked to appoint a small committee who will ensure that the Secretary of the Exhibition Section does not neglect due provision for the Inter-allied Council.

Space does not permit of an adequate account of the luncheon given by the Société Solvay et Cie, at which M. Talvard presided, nor of the banquet at the Palais d'Orsay with M. Loucheur, Minister of Industrial Reconstruction, in the chair. At this, in addition to the various delegates, a number of men well known in the chemical world were present including Lord Moulton and Dr. Herbert Levinstein.

On April 16, the delegates visited Chauny and were shown round the ruins by the Compagnie de Saint-Gobain whose works were destroyed at the same time as the rest of the town. This area was the scene of some fighting but the destruction was not caused in the fighting; it was a cold-blooded piece of work with two objects in view, one to make the country uninhabitable for the French when the Germans were driven out, the other to put an end to the industry there carried on, for the benefit of their German competitors. For about three weeks the Germans carried on their work of desolation, removing everything of value, blowing up the buildings, burning anything which would burn, smashing up any machinery which they could not carry away, and reducing a pleasant and prosperous little town to a deserted heap of ruins. We were told that many towns and villages in the district met with a similar fate. It was a most impressive sight and helps us to realise the unchanging attitude of the French, a nation whom our ignorant forefathers considered fickle and volatile. Some day the Peace Conference will finish its labours; the cities will again be held by their ancient masters, cities that hostile hands have utterly spoiled; the people will till the flowering fields and gather in the crops, and spiders weave their delicate webs over helmet and rifle. Since Sicily was devastated by the Carthaginians in B.C. 265, poets and idealists have dreamed of an enduring peace. It may be that this is now commencing; for the French it is a question of "Once bit, twice shy." They have no faith in their eastern neighbour and they fail to see any justice or common sense in allowing the Germans to utilise stolen French material with which to build up business, while their own salt pans and sugar refineries lie in fragments.

And if some time in the future, in our insular way, we are inclined to regard some problem which concerns both France and Germany rather from our standpoint than from the French, let us remember the barbarous destruction of Chauny and the great stretch of country similarly devastated. The people who did this were the Boches, which explains though it does not excuse their conduct.

NEWS AND NOTES.

CANADA.

New Manufactures.—Amyl acetate and refined fusel oil are being manufactured, for the first time in Canada, by the Cosmos Chemical Co., of Port Hope, Ontario.

Mining News.—*British Columbia.*—The Temiskaming Mining Co., of Cobalt, Ontario, has announced that it has taken over the Dolly Vardon and Wolfe silver properties in Northern British Columbia. The price paid was $1,350,000.

The position of the copper producers is an anxious one at the moment. About 60 per cent. of the total labour employed in the metalliferous mines is engaged in mining copper ore.

An International Mining Convention was held on March 17—19, which was attended both by technical and business men, with the object of arranging for the future development of the many valuable mineral resources known to exist in the province.

Western Provinces.—It is anticipated that the coming summer will see great developments in the

exploration of the copper deposits in Northern Manitoba, and in connexion with oil, gas and tar sand prospects in Saskatchewan.

AUSTRALIA.

Australian Metals.—In his recent Budget speech, the Federal Treasurer of the Australian Commonwealth referred to the sale to the Imperial Government of 300,000 tons of zinc concentrates annually. The Commonwealth's production of lead amounts to about 175,000 tons per annum, and the exportable output of this also had been sold to the British Ministry of Munitions, with the exception of lead for the markets of the East. The surplus of the copper output has been disposed of similarly. In future all Australian tin ores and concentrates will be smelted in the country, an embargo having been placed on their export. The Australian output of wolfram, scheelite and molybdenite has been acquired by the Imperial authorities; the production of these ores has increased almost 100 per cent. compared with 1914. The production of antimony has not advanced as it should have done, but the output of bismuth is well established.—(*Iron and Coal Tr. Rev., April* 4, 1919.)

BRITISH INDIA.

Cinchona Cultivation.—The Director of Botanical Survey for India has recently visited Burma to ascertain if a suitable locality could be found for the cultivation of cinchona on a large scale. His report will be published in due course.

Chemical Industry in the United Provinces.—Strenuous efforts are being made to develop the industries of the United Provinces. The Director of Industries is very hopeful as to the prospects of the leather industry, which is at present suffering from difficulty in obtaining suitable tanning materials, but arrangements are being made to establish factories for preparing extracts from barks and leaves. Several new glass works have come into existence during the war, and skilled glass blowers are being engaged. The progress of the match industry is disappointing owing to dependence upon foreign chemicals. Much of the work devoted to dyes and fine chemicals is of a routine character, and it is considered doubtful if the attention given to vegetable dyes will prove to be profitable owing to future competition with synthetic colours. The Government is also directing its attention to the manufacture of essential oils, and arrangements have been completed for the installation of a plant for comparatively large scale experiments on the production of oils and perfumes from raw materials available locally. Attempts have already been made with some success to prepare sodium carbonate and caustic soda from natural saline incrustations found in abundance in the province.

Blast Furnaces in Bengal.—The Indian Iron and Steel Company, Ltd., of Calcutta, has decided to erect at Asanol, in the Bengal coalfield, two 350-ton blast furnaces, a by-product cokery with a daily output capacity of 1000 tons, and a plant for the manufacture of sulphuric acid required in the recovery process. The by-product plant and the power plant will be obtained from England, but the contract for the blast furnaces has been placed with a Cleveland firm in the United States.—(*Iron and Coal Tr. Rev., April* 4, 1919.)

SOUTH AFRICA.

Spearmint Oil.—A sample of *Mentha longifolia* was recently examined by the Imperial Institute, which reported that the leaves gave on distillation with steam 2·4 per cent. of volatile oil, equivalent to a yield of 0·98 per cent. from the entire original sample as received. The oil was mobile and colourless, and had the characteristic odour and taste of spearmint oil; chemical examination showed it to be similar to English and American spearmint oil, but to contain a higher percentage of ketones than these oils. The report adds that there is little doubt that the oil would be saleable as spearmint oil.—(*S. Afr. J. Ind., Jan.*, 1919.)

Magnesite.—The Imperial Institute has also reported upon a sample of South African magnesite, which, it states, compares very favourably in composition with Grecian magnesite, except in the proportion of silica present. The analytical figures obtained were:—MgO 45·65%, CaO 0·63%, Fe_2O_3 0·22%, Al_2O_3 0·13%, SiO_2 3·27%, CO_2 50·00%. The best commercial magnesite from Greece contains about 1·5 per cent. of silica, and the poorer qualities about 2·5 per cent.—(*S. Afr. J. Ind., Jan.*, 1919.)

Resin.—There has recently been forwarded to the Department of Industries a sample of resin obtained in the process of sifting seed of the Oyster Bay pine, with the suggestion that its commercial value, if any, might be ascertained. It is stated that a large old tree yields from one to five pounds of resin with several pounds of seed, and that, though the demand for the seed is limited, it might be found a commercial proposition to cultivate the tree for the resin it yields as well as for its timber. Local investigation has shown that about 17 per cent. of the resin is insoluble in alcohol, and that the solution, on evaporation and after gentle heating, leaves a brittle resin which is not easily fused to a liquid and is not ordinary resin. A sample of the resin has been forwarded to the Imperial Institute for examination, the results of which will be published in due course.—(*Official.*)

UNITED STATES.

Research.—The intention of many manufacturers to engage in research to a greater extent than before is shown by the much increased demand for well-trained research chemists and a corresponding decrease in the call for junior men. There is also an encouraging tendency towards better co-operation in research.

Potash from Kelp.—Since the signing of the armistice it has become evident that the production of potash from kelp is another example of an industry which cannot exist in normal times unless it can also produce marketable by-products. Several of the Pacific coast factories have closed down. While in some cases the situations chosen for them were bad, and in others crude methods were employed, even those works which are well managed and have successfully produced potash will be dependent upon the successful exploitation of by-products.

Gas Masks.—The army gas mask has had such wide publicity that the majority of people has come to consider it as a sure protection against all kinds of gases and dusts. It has become advisable, therefore, for the United States Bureau of Mines to inaugurate an educational campaign on the industrial uses and limitations of gas masks, respirators, and similar devices. At the same time extensive research is being undertaken on breathing appliances with special reference to the mining and metallurgical industries, and to underground conditions.

Recovery of Wax from Waxed Paper.—Work just completed at the Forest Products Laboratory shows that oils and paraffin may be economically recovered from waste waxed paper by extraction with a volatile solvent, leaving the pulp in condition for re-use. Extensive experiments with steam and hot water failed to produce pulp free from wax and

oil and showed a prohibitive cost. At present there is just sufficient waste in wax paper mills to support one central recovery plant, but as the use of the paper increases it may be possible to erect others to serve different localities.

Concrete Protection.—The principal methods of protecting concrete were discussed at the Chicago meeting of the American Institute of Chemical Engineers. These methods are seven in number and include: (1) Applying a membrane, such as a fabric, with the aid of tar or asphalt; (2) application of a neutral hydrocarbon by means of a brush or spray; (3) use of an acid resin which reacts with the lime to form an integral part of the surface; (4) use of a dry powder to obtain greater density in concrete; (5) addition of a powder to the concrete to make it acid- and alkali-proof; (6) precipitation of silica into the pores of the concrete by the use of silicofluoride; and (7) use of two solutions which inferact to precipitate an insoluble substance into the pores, thus preventing the penetration of water and other substances. According to the author of the paper, Dr. M. Toch, several of these methods are often combined.

New Process for Manufacture of Sulphonic Acids.—There has been developed at the Colour Laboratory of the Bureau of Chemistry of the U.S. Department of Agriculture a new and promising process for the sulphonation of benzene, naphthalene, and other hydrocarbons in the state of vapour. It is believed that the process will be of value to manufacturers of chemicals and dyestuffs, and the chemists of the Colour Laboratory are prepared to give expert advice to those who adopt the process.—(*U.S. Com. Rep., Mar.* 11, 1919.)

New American Dye Trust.—A new body, known as the Chemical Foundation, has been organised in New York to fight the German dye trust. One hundred and fifty leading manufacturers have already been enrolled. The association is being modelled on the one now in operation in Allied countries, the purpose being to secure the licensing of certain dye imports and the exclusion of dyes reasonably obtainable in the United States. The Government has seized 4500 German patents, and the Foundation has bought these for $250,000.—(*Manch. Guard., April* 7, 1919.)

Ferro-manganese.—Before the war the supply of ferro-manganese was largely in the hands of British producers, and the output found a considerable market in the United States. When war broke out American steel interests were faced with serious conditions, and they set out to make themselves entirely independent of foreign supplies. The result is the establishment of a new industry, which has developed on a considerable scale. From a domestic output of less than 10,000 tons a month in 1913, American production of ferro-manganese is now about 25,000 tons a month, the supply of manganese-iron alloys being now in excess of the demand.—(*Iron and Coal Tr. Rev., April* 4, 1919.)

Reclaiming Waste Material.—The saving and reclaiming of waste material in the United States was carried out during the war by the Department of Commerce. It is estimated that in 1918 waste material to the value of $1,650,000,000 was reclaimed in the United States. This sum includes 600,000,000 dollars' worth of scrap iron and steel, and 300,000,000 dollars' worth of scrap non-ferrous metals. A new service is now to be organised on a permanent basis; but it will not initially include the salvaging of organic material, which is now under the direction of the Food Administration. The annual value of reclaimed waste is expected to reach $2,000,000,000 when the service is fully organised.—(*Manch. Guard., April* 2, 1919.)

GENERAL.

The Index to the Journal.—The Index to Volume 37 (1918) is being posted to members and subscribers with the current issue of the Journal. In addition to the combined index of the three sections, there is also included a special index to the Review to be used by those who may desire to have it bound separately. The Journal is steadily increasing in bulk and will doubtless soon become too unwieldy to handle as one volume; hence it has been considered advisable to provide means for facilitating the natural cleavage into "Review" and "Transactions and Abstracts."

Standardisation of Aircraft Materials and Parts.—It may not be generally known that during the past year and a half the British Engineering Standards Association has been responsible for the preparation of all specifications for aircraft materials on behalf of the Department of Aircraft Production. Particularly interesting have been those specifications dealing with materials which formerly were perhaps not considered as being of an engineering nature, such as chemicals used as ingredients for aeroplane dope, rubber, textiles, adhesives, paint and varnishes. Owing to the extremely useful part these specifications have played, it is now learned with considerable satisfaction that the British Engineering Standards Association has been requested to continue to prepare them as well as to undertake their distribution, together with the issue of manufacturing instructions and notes on testing procedure which were formerly prepared and issued by the Technical and Inspection Departments of the Department of Aircraft Production. The Association has undertaken this additional responsibility as from March 31, 1919.

New Salt Deposits in Holland.—The Royal Dutch Salt Industrial Company in Amsterdam, floated last year with Government help to alleviate the salt shortage in Holland, has found its first salt deposits near Boekelo at a depth of 325 m.—(*Deutsch. Allgem. Z., Mar.* 20, 1919.)

Discovery of Fluorite in Switzerland.—Prof Wehrli of Zürich has found a large deposit of fluorite in a disused lead mine near Sembrancher in Canton Valais. This mineral has hitherto always been imported, chiefly from Silesia.—(*Z. angew. Chem., Feb.* 25, 1919.)

Gold Discoveries in Siberia.—A telegram from Omsk reports that gold-bearing reefs have been discovered near the source of the River Angara, a tributary of the River Yenisei. It has also been ascertained that the River Titumen, which flows into the Aldan River, contains much alluvial gold.—(*Manch. Guard., April* 5, 1919.)

"Minette" Ore for Westphalia.—The French have promised to the Rhenish-Westphalian foundry industry the monthly delivery of 250,000 tons of minette iron ore from Lorraine, but it is doubtful whether delivery can be made immediately.—(*Weltwirtschaftszeit., Mar.* 7, 1919.)

Salt Production in Norway.—Works for obtaining salt and other products from sea-water are to be built on the island Osterøen, near Bergen. The first installation will have a production of 60-70,000 tons of crude salt per annum, and is to be finished by the end of the year, the capital expenditure being estimated at about £500,000. Electric power will be supplied from a large municipal power-station now in course of erection (*cf.* this J., 1918, 349 R).—(*Teknisk Ukeblad, Jan.* 31, 1919.)

Supplies of Fertilisers in Norway.—According to the Norwegian Agricultural Department, the following supplies of artificial fertilisers will be available in 1919:—Synthetic nitrate (Norwegian), 80,000

tons; cyanamide, powdered, 2500 tons, granulated 2500 tons; superphosphate, 43,000 tons. No information is given in regard to potash. The amount of the Government subsidies for synthetic nitrate production is estimated at 13·6 million kronen (£765,000) for 1918-19. Unlike potash and superphosphate, artificial nitrogenous fertilisers are not rationed.—(*Deutsch. Allgem. Z., Mar.* 19, 1919.)

Oil Shale in Sweden.—Two concessions covering an area of 1100 hectares have been granted for the exploitation of the very valuable oil shale deposits. Operations are to start almost immediately under the direction of mining engineer J. H. Nathorst.—(*Sydsvenska Dagbladet, Feb.* 8, 1919.)

Use of Peat Fuel on Swedish Railways.—Coal has been almost unobtainable, and substitutes produced in the country have been pressed into use. Many railroads resorted to wood-firing without any alteration to the locomotive other than the removal of the air inlet valve on the fire door. Some lines have used 34 per cent. birch mixed with 66 per cent. of air-dried peat briquettes, but such fuels have the disadvantage of emitting large quantities of sparks. Experiments made with mixtures of coal and peat showed that the addition of 50 per cent. of peat decreased the pull on the drawbar, and that they could only be used for trains with a speed not exceeding 31 miles per hour. By the "Ekelund" system of using powdered peat, introduced in 1890, the calorific value is used to better advantage than is possible with briquettes. The first trials were not altogether satisfactory, but the Swedish Government took the matter up in 1916 and voted £72,000 for a peat-powder factory, to produce 20,000 tons per annum. A number of locomotives are now using peat powder as fuel. The analysis of the powder is:—Moisture 16·16%, ash 4·55%, sulphur 0·18%, combustible matter 79·11%. The calorific value, exclusive of moisture, is 10,040 B.Th.U. per lb., but as fired gives only 7,780 B.Th.U. The cost before the war was about 9*s.* 6*d.* per ton, at present it is nearly 25*s.* It is estimated that it will not be economical to use peat powder for locomotives when coal can be purchased at 55*s.* 6*d.* per ton. —(*Teknisk Tidskrift, Feb.* 1, 1919.)

The Mineral Wealth of Germany.—A recent issue of the *Vossische Zeitung*, quoted in the *Board of Trade Journal* of March 27, contains the account of a lecture by Prof. Beyschlag on Germany's mineral wealth and her dependence on foreign minerals. Prior to the war, Freiberg had produced 5·2 million kilo. of silver to the value of about 1 milliard marks. The hopes placed in the gold and platinum discoveries in parts of Germany have proved disappointing, since the low percentage extraction obtained made exploitation unprofitable. This also applies to tin, nickel, chrome, wolfram, molybdenum, and vanadium. The tin deposits in the Erzgebirge had formerly sufficed for German needs, but before the war the annual consumption of tin had amounted to 19,500 tons, 11,500 tons of which was foreign tin smelted in German works. Germany possesses practically no quicksilver, asbestos, or mica, and only inadequate quantities of copper, lead, tin, iron, and manganese. In pre-war days, Germany consumed 260,000 tons of copper annually in her manufactures, but only produced 25—30,000 tons herself. During the war aluminium was used as a substitute for one-third of the copper requirement. Tin could also serve as a substitute. Germany's iron production has been severely threatened through the loss of the war, and France will now become the richest iron country in Europe. The German potash monopoly has also been destroyed by the war. As regards fuel, Germany possesses 140 milliard tons of coal, and 13·9 milliard cbm. lignite. Prussia alone possesses 2 million hectares of peat land, which represents sufficient power to meet industrial requirements for 750 years.

Output of Benzol in Spain.—According to a writer in the *Boletin Oficial* of the Ministerio de Fomento, the annual output of benzol in Spain before the war was 1150 tons, produced by four different firms. Three new plants have since been erected, and two of these are approaching completion. The production in 1918 was 2000 tons, of which 660 tons was secured by the Ministerio de Abastecimientos to satisfy urgent national demands.—(*Iron and Coal Tr. Rev., Mar.* 21, 1919.)

Iron Ore Resources of Spain.—A recent issue of the *Revista Industrial y Financiera* estimates the total reserves of Spanish iron ore at 700 million tons of an average iron content of 50 per cent. The largest deposits are situated in the districts of Léon (150 million tons) and Turel (135 million tons). —(*Bd. of Trade J., Mar.* 27, 1919.)

Potash Production in Chile.—In La Huayaca, in the Chanchones district, a factory has been built at a cost of $300,000, and over a ton of potash is being produced daily. The product is of very good quality, and is carefully packed in sacks for export. The cost of production is very moderate, as the factory is built practically on the pampas, where the potash lies at the earth's surface. In Tarapacá a small factory has been established, which is also giving good results.—(*Mercurio, Jan.* 13, 1919.)

Quicksilver in 1916.—The increased demand for mercury due to the war, and the failure to discover new ore bodies, caused heavy depletion of the reserves in the United States and inroads to be made upon the richer deposits. The profits also have not equalled expectations owing to the increased working costs. The use of mercury for antifouling paint for ships' bottoms has extended, and projected new uses, such as the conservation of heat in the generation of steam, give promise of development.

The United States produced 249,732 short tons of ore and other furnace material in 1916, against 158,817 tons in 1915. The total output of metal was 29,932 flasks (of 75 lb.) in 1916, the 1914 production being 16,548 flasks; it is hoped to maintain an output of 30,000 to 35,000 flasks until 1920. The other large producing companies are Austria, which probably produced about 25,000 flasks, Italy 32,129 flasks, and Spain 23,367 flasks, the world's total output for 1916 being estimated at 118,028 flasks. From 1908 to 1916 the American output has increased about 50 per cent. The recovery on 158,817 tons of ore treated in 1915 was 0·497 per cent. of metal, and on 249,732 tons treated in 1916 a yield of 0·45 per cent. was obtained, which is decidedly lower than the 1914 figure of 0·505 per cent. of metal, the quality of ore treated having obviously deteriorated.

The chief producing centre of the United States is California, which affords about two-thirds of the country's total yield, Arizona, Nevada and Texas being responsible for the rest. The value was no less than $3,768,139 in 1916, the price having risen from about $40 per flask in 1913 to $126 in 1916; allowance, however, must be made for the 10 per cent. import tax which is included in the latter figure.

It is stated that the Scott furnaces have been used with conspicuous success. These have capacities of from ten to fifty tons, and effect an almost quantitative yield; in one observed case the loss was less than 1 per cent. of the mercury content of the ore.—(*U.S. Geol. Surv., Feb.* 19, 1919.)

Wolfram Ore Deposits in Siberia.—Wolfram ore deposits were discovered in 1911-12 in the Nertchinsk mining district, Province of Transbaikalia,

Asiatic Russia, but have only been worked to a limited extent. They have been examined recently by Prof. Soutschinsky, of the Imperial Academy of Science, who found principally wolfram in quartz veins, running through granite rocks. The deposits in the Bakuka Mountain contain veins of ore averaging 6—7 in. in cross section, from which about 200 lb. per month was extracted in 1915. The deposits at Tchara-Nor, also on the Trans-baikal Railway, are of a poorer quality containing an undesirably high percentage of manganese. An analysis gave WO_3 76·02%, FeO 9·82%, and MnO 12·95%. Large quantities of scheelite, containing much manganese, have also been found at Tchara-Nor. It is estimated that 20,000 lb. of ore, with 68 to 72 per cent. pure wolframite, has been extracted from mines in the Borzia district. The future of these mines is considered to be promising, as not only are they near the railroad, but other minerals have also been discovered, including considerable quantities of molybdenum glance, yellow molybdenum ochre, and arsenical pyrites.—(*U.S. Com. Rep., Jan.* 23, 1919.)

Extraction of Bromine and Potash in Tunisia.—On the outbreak of war France sought to purchase bromine and bromides from America, but owing to high prices and insufficient supplies the attempt was unsuccessful. Increasing scarcity rendered the position serious, and in April, 1915, when bromine compounds were required for use as lethal gases, the salt marshes or lagoons of Tunisia were investigated, and found to be capable of furnishing a plentiful supply of bromide. In December, 1915, Sebkha el Melah, near Zarzis and one kilom. from the sea, was selected as a suitable site for operations. At this place there occurs a saline deposit covering a thick compact mass of black clay alternating with layers of gypsum mixed with sea salt, the whole being impregnated with a concentrated solution of sp. gr. 1·238 (at 21° C.), which contains, *inter alia*, 13 grm. per litre of potassium chloride and 2·24 grm. per litre of magnesium bromide. The situation rendered transport difficult, but wells were sunk, a railway laid, and works erected at El Hanèche, with six Kubierschky apparatus and other necessary equipment. This locality was able to supply all the bromine required in 1916 and 1917. Each apparatus treats 100 cu. m. of liquid per day and produces 160 kilo. of bromine from a solution of 27·3° Bé, 350—370 kilo. from a solution of 31—32° Bé, and 520 kilo. from liquor of 34° Bé. Very much lower yields are obtained from sea-water, of which only 80 cu.m. can be treated daily. From May 1 to December 25, 1916, the El Hanèche works produced 1050 metric tons of bromine. The chlorine necessary for the process is supplied from France. During the latter half of 1918, a new bromine works was started at Aïn es Serab, and the two works together are expected to produce 80 tons of bromine per month for the first few months of 1919, and afterwards, by treating liquor of higher concentration, 120—130 tons per month.

At Mégrine a process, proposed by Prof. Urbain, was adopted of precipitating potassium, free from sodium, as fluosilicate, by the action of fluosilicic acid on the mother liquor from bromine distillation. The fluosilicate is treated with milk of lime, the resulting solution of caustic potash concentrated in a Kestner evaporator and then over an open fire. The fluosilicic acid was at first specially prepared at Mégrine, but afterwards obtained as a by-product from the superphosphate works at El Afrane. High working costs and foreign competition stopped the manufacture after several tons of potash had been produced.

At the salt marshes of Sfax, the Lambert Rivière Co. has installed a plant for treating the mother liquors on the Merle system. The natural salts found there include a substance called sebkaïnite which contains:—KCl 19·5%, NaCl 10·0%, $MgCl_2$ 27·2%, $MgSO_4$ 9·3%, water and insoluble matter 34·0%. After removal of the potassium chloride, bromine is extracted from the mother liquor. The recovery of potassium chloride from this mineral was started in March, 1917, and, up to the end of January, 1919, the following quantities (metric tons) were produced at El Hanèche:—70% KCl, 700; 35—40% KCl, 1400; 90—95% KCl, 50. In 1918 the Tunisian government decided to erect a works capable of producing 4500 tons of pure potash salts near a marsh of 200 hectares area at Aïn es Serab. Electric power stations have been erected, but owing to delay in delivery of goods, the installation is not yet in operation, but is expected to be ready this spring. The plant will deal with at least 50,000 tons of sebkaïnite.

It is anticipated that, eventually, the Tunisian deposits will rival those of America and Germany. —(*Bull. Soc. d'Encourag., Jan.—Feb.*, 1919.)

OBITUARY.

SIR WILLIAM CROOKES, O.M., F.R.S.

We record with deep regret the loss of one of our most famous men of science, and a former President of the Society of Chemical Industry, in the passing of Sir William Crookes on April 4 last. Born on June 17, 1832, he had reached his eighty-seventh year and during that long life had enriched science by many important discoveries, largely in consequence of his singularly acute powers of observation, his marvellous experimental skill and his philosophical insight. His fine researches in chemistry and physics led Sir William into various fields of inquiry but chiefly those lying within the borderland of those two branches of science, while his alert mind was always open to the consideration of practical and economic problems. The short sketch which follows of so long and full a life is necessarily inadequate to do more than indicate a few of the achievements of so successful a scientific career.

Without entering into details of his early life we may say that Crookes passed from school about his seventeenth year, and without any further academic training, to his scientific studies at the Royal College of Chemistry, under Prof. A. W. Hofmann, and there laid the foundation for his scientific lifework with that inspiring teacher. During the early "fifties" Crookes was an assistant to Hofmann, and later, we find him lecturing on chemistry at the Training College in Chester. After this short teaching experience, he returned to London and founded the *Chemical News* which he edited nearly to the end of his life. Crookes reported for this periodical Faraday's charming Christmas lectures at the Royal Institution on "The Chemical History of a Candle," and thus came under the influence of that great master of experimental science, for whose methods he often expressed to the writer his profound admiration.

A little before that period the scientific world had been roused to enthusiasm by the researches of Bunsen and Kirchoff on spectrum analysis, and the discovery of two new elements, cæsium and rubidium, by the aid of that new and powerful means of research. Crookes early became an ardent student of the method and soon proved its value by the use of it in the discovery of another new element —thallium. The discovery of this element, while a triumph for the young chemist, also led him by a curious sequence of events to researches in a new and unexpected direction, as will presently appear. Before entering on that subject, however, we must refer to a purely chemical piece of work on selenium compounds. Berzelius, who discovered

selenium in 1817, traced points of chemical resemblance between that element and sulphur through its capacity for the production of analogous compounds, and succeeded in forming selenocyanides similar to the sulphocyanides; but he was content with the proof of the existence of the first named salts. Crookes saw that the selenocyanides required further examination, and, having a considerable quantity at hand of the crude seleniferous deposit from the sulphuric acid chambers of the Tilkerode works in the Hartz district, he set about the preparation of pure selenium from this material with which he produced a number of selenocyanides and investigated them in detail. During the purification of the selenium several by-products were obtained, and certain of them when examined by the new spectroscopic method gave the beautiful bright green line afterwards proved to be characteristic of thallium, and so named because the colour of the line suggested that of the young green shoots or twigs of early spring. This somewhat lead-like metal of high density (11·9) has a high atomic weight of 204, which Crookes determined with great accuracy, making his weighings on a balance which was enclosed in a case from which air could be exhausted to a great extent in order to diminish errors from unequal air displacements. When weighings were made *in vacuo* and in full daylight, irregularities in the action of the balance became evident to the keen observer for which he could not account. These observations were followed up when the thallium work had been completed, and it was found that light objects which were free to move in high vacua could be made to do so by mere exposure to light as in the now familiar "Crookes radiometer," the vanes in which are set in rapid motion when a beam of sunlight is allowed to fall on the apparatus. This study of such "repulsion resulting from radiation" was pursued by Crookes with extraordinary skill and ingenuity in devising experiments in various directions, and thus he opened up a new and wonderful field for research in molecular physics.

Crookes had a strong vein of mysticism in his character and a leaning towards the occult, as we know from his own writings, and he was at first rather disposed to regard the phenomena he was investigating as being due to a new and mysterious force; but this quickly gave way to the idea that the radiometer is a "light mill" in which there is a direct conversion of light into motion. This was in turn dissipated when G. Johnstone Stoney pointed out that the motion of the vanes in the radiometer was probably due to their bombardment by the residual molecules of the highly rarefied air in the bulb being projected from the relatively warm sides against the movable vanes. Crookes devised many beautiful experiments in order to test this theory of molecular bombardment and satisfied himself as to its essential validity. He was led on to the study of kathode rays and the bombardment with them of various forms of solid matter which became phosphorescent under their impact. The character of the light emitted under these conditions, when examined spectroscopically, showed bright lines which Crookes regarded as characteristic of the material. He considered the exciting agent to be "radiant matter" in these cases, and the method as "radiant matter spectroscopy" on which investigations he expended much time and labour. It so happened that Crookes had undertaken the separation of the rare earths of gadolinite and samarskite and used his new method, which he regarded as affording characteristic tests for the recognition of and as aiding in the separation of certain of those rare earths. There are doubts as to the value of this mode of identifying the substances, and also as to the existence of "radiant matter," but the phenomena observed materially assisted in the separations carried out by Crookes, and the extraordinary phenomena provided by radium and its "emanation" have disarmed criticism of the term "radiant matter." Needless to say Crookes was deeply interested in the modern work on radioactivity, and contributed many observations of interest, in addition to the production of the "spinthariscope" in which a screen of natural zinc sulphide is made to scintillate by the *alpha* particles projected from radium. He further studied the action of radium emanation on glasses, various gems and diamonds, and often exhibited a fine diamond which was originally colourless but had taken on a greenish-blue tint after retention for some time in contact with radium salts.

While Crookes' fame rests chiefly on the discovery of thallium and his long continued and brilliant researches in the chemico-physical directions above outlined, he took much interest at various times throughout his life in other subjects, including his well-known spiritualistic studies—which we but mention here—and his speculations on "The Genesis of the Elements." The latter was the chief topic of his address to the Chemical Section of the British Association in the autumn of 1886 at Birmingham. The present writer well remembers a day in the early summer of that year when his laboratory in the University was honoured by a visit from the President of Section B, whose keen eye noticed a diagram which was used as a pictorial illustration for lectures on the Periodic Law. He immediately caught the idea, saying "It is the very thing I wanted," and used it in modified form, and with generous acknowledgment, in his presidential address. He further expanded his speculations as to the origin of the elements from what he termed "protyle," when President of the Chemical Society some two years later. Again, Crookes took an active part in the examination of the double spectra of argon shortly after the discovery of the first of the inert elements by Lord Rayleigh in collaboration with Ramsay in 1894, and later on of helium.

Many other illustrations might be given of Sir William Crookes' varied activities in pure and applied science, but probably the most remarkable was his unexpected *excursus* into economics in his address on the "Wheat Problem" when President of the British Association at Bristol in 1898. Of this address he said later, with dry humour, that "he had afterwards to write a book in order to explain it."

In addition we can but mention such subjects as water purification and examination, sewage treatment, electric tanning, dyeing, disinfection in cattle plague, and, latest of all, the production of eye-preserving glasses for spectacles, and further to point out that he translated a number of foreign technical works of varied value, and compiled his well-known and useful "Select Methods of Chemical Analysis."

From 1861, when he discovered thallium, Crookes was the recipient of many honours. Elected a Fellow of the Royal Society in 1863, he presented to that body most of his scientific memoirs; he was three times selected as Bakerian Lecturer, and was the recipient of the Copley, Royal and Davy Medals; he became Foreign Secretary in 1908 and President in 1913. In 1912 he was awarded the Medal of the Society of Chemical Industry. Honorary science degrees from Cambridge, Oxford, and several other universities were conferred upon him; while he became President of several home societies, and many foreign academies and societies gladly enrolled his name amongst their specially honoured members. He was knighted in 1897 and received the Order of Merit in 1910.

Sir William Crookes married Miss Ellen Humphrey in 1856, and they commemorated their golden wedding in 1906. Lady Crookes predeceased Sir William in 1916.

J. Emerson Reynolds.

LEGAL INTELLIGENCE.

SOAP CONTRACTS DISPUTE. *Van den Hurk* v. *Is. Poliakoff and Co., and Is. Poliakoff and Co.* v. *King and Ramsay.*

In the King's Bench Division on March 31 before Mr. Justice Lush, Messrs. Van den Hurk claimed to recover from Is. Poliakoff and Co. the difference between the market price and the real value of 25 tons of white soap, sold by defendants to plaintiffs, and which was warranted to contain 63 per cent. of fatty acids. Messrs. Poliakoff and Co. in turn claimed against Messrs. King and Ramsay who were the sellers to them.

Mr. E. J. Dobbs, analytical and consulting chemist, gave evidence that a sample submitted to him was found to contain: fatty acids, 12·95%, water and glycerin 72·92%, and silica, as sodium silicate, 6·84%. Counsel for King and Ramsay denied warranty.

Mr. Justice Lush based his findings upon the results of the analysis, and gave judgment for the plaintiffs in both actions. The following day the parties agreed that judgment would be satisfied by the payment of £625 and costs in the first action, and of £560 and costs in the second. His Lordship fixed the damages at £760 and £720, respectively, in the event of the agreed terms not being carried out.

SALICYLIC ACID PLANT. *Lennox Foundry Co.* v. *Warrington Drug and Chemical Co., Ltd.*

This case came before the Court of Appeal on April 11, on the appeal of the defendants from a judgment of a Divisional Court in favour of the plaintiffs, and reversing a judgment of the Official Referee (this J., 1918, 156 R, 477 R). Lord Justice Bankes, delivering the judgment of the Court, said he agreed with the Official Referee that the plant as a whole was not of the contract capacity. The respondents were entitled to be paid the instalment due on delivery, viz., £220, and the appellants were entitled to £440 damages. Judgment would be entered for the appellants on the claim and counterclaim. The respondents would have the costs of the appeal to the Divisional Court, and the appellants the costs of the present appeal.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Sheffield Water Supply.

The Sheffield Corporation Bill, under consideration by the Local Legislation Committee, includes a novel scheme for conserving the water in the River Don, which is the main source of supply of Sheffield, and which is now found to be quite inadequate owing to the large quantities required for local industries. The proposal involves pumping water from the river below the town, treatment and purification, then, after utilisation for industrial purposes, re-treatment and restoration to the river. There is considerable opposition to the Bill.—(April 8.)

British Cellulose and Chemical Manufacturing Co.

The Chancellor of the Exchequer, in reply to Lt.-Col. Malone, stated he was aware that the above company was about to increase its capital by approximately £1,250,000 in preference shares; and that no licence to increase the capital was necessary as permission was granted prior to the promulgation of the Regulation involved. After careful deliberation it was considered inadvisable to suspend the issue pending the publication of the report of the special committee investigating the company's affairs.—(April 10, 14.)

The Royal Society of Edinburgh.

Mr. W. Graham asked if the Chancellor of the Exchequer would reconsider his refusal to increase the grant of £600 given annually to this Society for the publication of scientific researches, in view of the greatly increased costs of publishing. Mr. Chamberlain regretted that he could not do so at the present time.—(April 14.)

Scottish Oil Industry.

Mr. Kidd asked the Prime Minister for an assurance that the Scottish oil industry shall not suffer destruction owing to increased costs consequent on the recommendation of Mr. Justice Sankey's Commission, and that any injury will be avoided, if need be, by the imposition of a tariff operating against foreign products competing with those of this industry. Mr. Bonar Law replied that the whole question of the Scottish shale industry is receiving careful consideration, and no statement could be made at present.—(April 14.)

German Pre-War Mineral Output.

In a written answer to a question of Sir N. Griffiths, Mr. Bridgeman, for the Board of Trade, gave the following statistics of the production in Germany of coal, potash and metallic ores during 1912 (unless otherwise stated):—

	Production Metric tons	Approximate value at the mine £
Coal (1913):—		
Bituminous	191,511,000	105,793,000
Lignite	87,233,000	9,436,000
Potash, from mines:—		
Kainite	5,889,238	3,819,100
Carnallite (including kieserite)	5,271,964	2,162,650
Potash, from wells, etc.:—		
Potassium sulphate ...	123,407	1,018,650
Potassium and magnesium sulphate	54,435	221,200
Potassium chloride ...	506,744	3,434,200
Metallic ores:—		
Cobalt, nickel, bismuth, tin ores and bauxite	47,526	36,700
Uranium and tungsten ores	5,053	3,200
Iron ore	27,200,000	5,506,650
Lead ore (argentiferous)	107,563	962,450
Manganese ore	92,474	58,400
Pyrites	262,653	101,900
Copper ore...	974,285	1,596,800
Zinc-blende	516,358	2,490,500
Zinc-calamine	120,950	106,700

—(April 14.

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED EXPORTS.

The following relaxations of existing prohibitions are announced by the Board of Trade:—

Headings transferred from one list to another.

From List A to List B:—

Milk, condensed or preserved; milk, powder; tomato pulp.—(April 10.)

From List A to List C:—

Albumin, other than blood albumin; egg powder (dried eggs); levulose; sheepskins, haired or woolled.—(April 10.)

Asphalt; asphalt, coal tar; bitumen; wire, silk covered; vinegar essence and similar preparations containing more than 6 per cent. acetic acid.—(April 17.)

From List B to List C:—

Camphor; vinegar containing not more than 6 per cent. acetic acid.—(April 10.)

Altered Headings.

(B) Cotton, American; (C) Cotton, raw, other than American.—(April 10.)

An open general licence has been issued permitting the following foodstuffs to be exported to all destinations except those referred to in List C:—Egg yolk, dried; egg products, dried; liquid eggs, preserved, not including frozen eggs; beans, imported, other than soya, locust or Chinese horse beans.

PROHIBITED IMPORTS.

General licences have been issued for importation of the following goods:—Leather scrap and fillet; gold ores, auriferous; copper ores, and sweepings and residues containing gold; articles made of or containing gold when produced in and exported from any part of H.M.'s Dominions; cocoa powder; and various alcoholic beverages.

Resumption of Trade with certain Countries.—German Austria.—A general licence was issued by the Board of Trade on April 3 authorising the resumption of trade with German Austria, subject to licences being obtained where prescribed. "German Austria" includes Upper Austria, Lower Austria, Salzburg, Styria, Carinthia, Tyrol (northern or Innsbrück portion), Vorarlberg and Liechtenstein.

Poland.—Trade with Poland is also subject to licences issued by the War Trade Department in respect of all goods except those on the "free" list. Goods must be consigned to the Inter-Allied Relief Administration, Dantzig.

Jugo-Slavia, Montenegro, Albania.—H.M. Government has decided that, with a few exceptions, all goods not included in Lists A and B may now be exported to these countries without licence.

Lettland and Lithuania.—Trade relations with these territories may be resumed forthwith.

The Board of Trade has notified that it has taken over the War Trade Department, which will be known henceforth as the Export Licence Department.

The Minister of Munitions has announced that the control of nitrate of soda will be suspended on and from May 15 next. Until that date the issue of general licences will be continued.

NEW ORDERS.

The Coal Tar and Coke Oven Returns (Suspension) Order, 1919. Ministry of Munitions, April 4.

The Plywood Order, 1919. Board of Trade, April 14.

The Copper Sulphate (Suspension) Order, 1919. Ministry of Munitions, April 15.

The Blast-Furnace Dust (Suspension) Order, 1919. Ministry of Munitions, April 15.

NOTICES.

On March 31, the Army Council issued a Notice cancelling thirty Orders relating to Raw Wool (including Fleece and Skin Wool and Off-Sorts) and Sheepskins. The schedule of Orders so cancelled appeared in the *London Gazette* of April 8.

The Army Council has also cancelled the Jute (Control) Notice, 1917.

The Food Controller has revoked the Milk Products (Import Restriction) Order, 1918, the Milk Products (Returns) Order, 1918, the Wholesale Milk Dealers (Control) Order, 1918, and the Milk Requisition Order, 1917.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for April 10 and 17.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
Australia ..	Chemicals and edible oils	110/4/7 *
British India ..	Chemicals, steel and metals, matches, cement, paint, soap, glass	600
,, ..	Explosives, paints, varnishes, lubricating oils, cement, calcium carbide	656
,, ..	Photographic chemicals	655
,, ..	Chemicals and gold thread	662
,, ..	Iron, steel and other metals	663
Canada	Dyes and parchment paper	604
,, ...	Pottery, china and glass	692, 672
,, ...	Chemicals for the paint, varnish and soap trades	678
,, ...	Glass and china	†
,, ...	Chemicals, drugs, laboratory equipment ..	†
British West Indies ..	Paints	‡
Austria (Trieste)	Copper sulphate	608
Belgium ..	Nitrate of soda and fertilisers	611
,, ..	Chemicals, iron ore, ferro-silicon and manganese	687
,, ..	Benzine, turpentine, white lead, colours, glue, soap, etc.	698
,, ..	Dyes, cement, rubber, fertilisers, edible fats ..	2369 T and R §
Chile	Chemicals, drugs, iron, aluminium, rubber, paper, china, earthenware	618
France	Tallow, oils, wax, soap, starch	629
,, ...	Iron, steel, tin, etc. ..	705
,, (N. Africa)	Glass, china, porcelain ..	630
Greece	Paints, varnishes, colours	707
Netherlands ..	Chemicals, dyes, oils, greases	634
,, .	Gums, resins, waxes, glue	636
Norway ..	Chemicals, oils, rubber, paints, soap	713
Scandinavia ..	Chemicals, metals, crucibles, oils, paints ..	639
,, ..	Dyes, colours, oils, resin, alum	640
Spain	Metals, colours, varnishes	641
,, ...	Chemicals and tinplate ..	642
,, ...	Glassware	644
Switzerland ..	Chemicals, drugs, greases	647, 718
United States ..	Ores and metals ..	721

* Official Secretary, Commonwealth of Australia, Commercial Information Bureau, Australia House, Strand, W.C. 2.

† High Commissioner for Canada, 19 Victoria Street, S.W. 1.

‡ The Secretary, Statistical and Information Department, London Chamber of Commerce, 97 Cannon Street, E.C. 4.

§ Belgian Trade and Reconstruction Section, Department of Overseas Trade, India House, Kingsway, W.C. 2.

TARIFF. CUSTOMS. EXCISE.

Belgium.—The prohibition of the import of liquids containing alcohol does not apply to liquids which cannot be used for beverages, *e.g.*, perfumery, pharmaceutical products, and varnish.

French Colonies.—The list of goods the exportation of which from the French Colonies (other

than Tunis and Morocco) is prohibited, except under licence, as from March 29, is the same as the list of goods prohibited to be exported from France by the Decree of January 20.

France and Algeria.—It is proposed to reserve to the State until October 1, 1920, the manufacture of alcohol, except in certain cases.

France (Morocco).—The sale of alcoholic beverages, with certain reservations, is now permitted.

Italy.—A surtax of 100 lire per hectolitre is payable on imported pure spirit until July 31, 1919.

Portugal.—The surtax on imported alcohol has been increased by 5 escudos per decalitre.

South Africa.—It is proposed to increase the import duty on spirits.

Spain.—A copy of the new regulations governing the manufacture and sale of pharmaceutical specialities may be seen at the Department of Overseas Trade.

The export duty on lead ores is suspended until May 31 next.

Switzerland.—Several commercial treaties have been denounced.

United States.—A new general import licence, "P.B.F. 34," has been issued to cover the import of all unrestricted goods as from March 6. Among the articles expressly excluded from the terms of this licence are tin, tin ores, tin concentrates and alloys with more than 20 per cent. of tin, peanuts, salvarsan and other similar organic arsenic compounds, nitrate of soda, and sugar.

Lard and neutral lard have been removed from the export conservation list as from March 6, and the import restrictions on spiegeleisen and ferromanganese have been withdrawn as from April 10.

COMPANY NEWS.

THE SALT UNION, LTD.

The thirtieth ordinary general meeting was held at Liverpool on April 3. The accounts for 1918 show a net profit of £338,828 on an issued capital of £2,400,000 (debentures £1,200,000), as compared with £287,380 in 1917. The dividends for the year are maintained at 2s. 4d. and 3s. per share on the preference and ordinary shares, respectively. The chairman, Mr. G. H. Cox, referred in his speech to the trade of the past year, to the detrimental effects of Government control, and to the labour position. The leading feature of the salt trade during 1918 had been the shortage of tonnage, certain important markets having been wholly or partially lost owing to this cause and to Government interference. Prices had been maintained at a satisfactory level in the home trade, and such salt as had been shipped abroad realised a highly remunerative price. Since the cessation of hostilities there had been an excellent demand at extreme prices from those countries which had been suffering from a great shortage of salt. The policy pursued since November last of allowing Germany to export salt to Sweden, thereby robbing us of our customers, and of prohibiting shipments from this country, was incomprehensible. The Eastern trade had been disastrously affected by lack of shipping facilities, the total shipments for the year amounting to only 20,000 tons. As regards the current year, trade had so far continued on a profitable basis, but the outlook was very uncertain. More labour was becoming available, but at high rates; raw materials, such as coal and iron, were still scarce and very dear; freights had fallen, but so had prices in the export markets. The prospects for the home trade were, on the whole, not unfavourable.

UNITED ALKALI CO., LTD.

In his address to the annual meeting, held at Liverpool on April 16, Mr. Max Muspratt said that no other company manufactured such a range of vital chemical products, and the fact that many of these were barely remunerative before the war might easily have led to their abandonment. After nearly 100 years of service the Leblanc process had become obsolete owing to the constantly increasing cost of labour and fuel. The company was firmly established in the ammonia soda process, but that does not produce chlorine, and arrangements were made just before the war to make a complete transference from the Leblanc to the electrolytic process. Delay in carrying out this programme proved of incalculable benefit to the country, inasmuch as they were able to place their production of sulphuric acid at the disposal of the explosives factories. The necessary concentration of this acid was executed at the company's works, which had to be greatly enlarged for the purpose. Other services rendered to the explosives industry were the manufacture of picric acid, by a process devised by Prof. Green, and the supply to the Government of the chief ingredient of amatol. Sodium hyposulphite was supplied for the first gas masks used, and the company was instrumental in the production of six lethal gases, four of which were extremely effective. Superphosphate was issued free to the allotment-holders of Liverpool and district, and the cold storage industry was aided by the provision of calcium chloride. The large production of sulphur dyes during the war was rendered possible by the efforts of the United Alkali Company.

The unfavourable aspects of the general outlook are industrial unrest, the serious position of our foreign trade, the readjustment of the production of chemical products to meet the altered needs of peace, and the excess profits duty. On the other hand, many of the extensions of plant, which have cost the company £2,500,000, will be of great value, the recently acquired experience of the staff will be a most useful asset, and the tendency towards co-operation among manufacturers should lead to a mitigation of cut-throat competition. The company has assisted the movement tending to closer co-operation between labour and management. It is too soon to say if the Joint Industrial Council for the Chemical Industry will attain absolute success; collective bargaining has many advantages, but chemical processes are so diverse, and conditions vary so much in different works that automatic rises or reductions in wages for the whole country are liable to produce widely differing results. More autonomy will have to be sought, as a spurious uniformity may have disastrous results. The company employs some 10,000 workers; the wage bill has more than doubled, while payments for interest and dividends, after allowing for taxation, are practically at the pre-war level.

In conclusion Mr. Muspratt pleaded for removal of Government control. The introduction of cost accounting into many of the smaller works was a very valuable reform, but the system adopted had in many respects operated unfairly in the case of the United Alkali Co. After making the fullest allowance for the exigencies of the war, the unnecessary disturbance and interference caused by Government control had cost the country untold millions, and had enormously accentuated the general feeling of unrest and uncertainty. The wholesale scrapping of Government factories was due to the conviction that their manufacturing costs, irrespective of depreciation or management charges, were in almost every case higher than

most manufacturers are prepared to charge to cover all these items and include a profit.

The report was adopted, including the payment of the dividends recommended therein, and the meeting was adjourned to a subsequent date when the accounts and balance sheet could be presented.

RIO TINTO CO., LTD.

At the forty-sixth ordinary general meeting held on April 8, Sir C. W. Fielding, the chairman, said that the termination of hostilities and the stagnation of manufacture had left large stocks of copper to be disposed of. Even assuming a general reduction in output, it would be a long time before demand equalled supply, but owing to the increased cost of production, which to some extent is likely to be permanent, there is little likelihood of a return to the former low prices. The cost of production in America will probably again become the governing factor in regard to profits. There are exceedingly large supplies of pyrites in the United States, and in this country Government intervention has disorganised practically all markets without any regard for the future of producers or consumers. He looked forward to developments of a technical nature to counteract to some extent the lower prices that will be obtained from the sale of ore. The company possesses unlimited raw material; it can produce both copper and sulphur more cheaply than others; and the clean iron extracted from the cinders becomes more and more valuable.

EXPLOSIVES TRADES, LTD.

The statutory general meeting of this company, the important explosives combine (this J., 1918, 462 R), was held in London on April 11. Sir G. J. Smith, deputy-chairman, who presided, said that practical unanimity had been shown by the shareholders of the constituent companies in accepting the proposals for the exchange of their former shares for those of the amalgamated company. Active steps are being taken to give the various manufacturing establishments the benefit of technical co-operation and exchange of ideas; and on the commercial side important missions are being sent to various colonies and other countries to extend and consolidate the company's operations abroad.

SOUTHALL BROS. AND BARCLAY, LTD.

In presiding at the annual meeting of shareholders, held in Birmingham on April 11, Sir Thomas Barclay said that the turnover last year showed an increase of more than 400 per cent. over that of 1913. The profit for the year was £25,764, and it was proposed to pay a dividend of 10 per cent., plus a bonus of 1s. per share, to the ordinary shareholders. The German manufacturers of fine chemicals were making a bid for the business in neutral countries by quoting what were referred to as reduced prices, but these were far in excess of pre-war figures, and were higher than those quoted in this country for similar articles of British manufacture. To secure the permanence of this industry, a scheme like that adopted by the dye industry seemed to have much to commend it, and to be preferable to the imposition of tariffs. By prohibiting imports except under licences granted on the advice of a committee representing both manufacturers and users, dumping would be prevented and the home consumer protected against any artificial raising of prices owing to lack of competition.

REPORTS.

INTERIM REPORT OF THE WATER POWER RESOURCES COMMITTEE. *Board of Trade.* 1919. (Cmd. 79, 2*d*.)

The subject matter of this report deals mainly with suggested methods for utilising the water power resources of Scotland. It has been issued now because if development were taken in hand at once, immediate employment would be found for a large number of workers.

Nine separate schemes are described capable of providing a total of 183,500 continuous electrical horse-power. The cost of development based on pre-war contract prices plus 50 per cent. to allow for increased costs is estimated to be £7,075,000, or an average of £38·5 per e.h.p. at the power house. The estimate includes all civil engineering and hydraulic works, power house and plant, and a reasonable sum for compensation for the rights and property that would have to be acquired. If the work were spread over three years employment would be found for from 7000 to 18,000 men. The 183,500 e.h.p. corresponds to an output at the hydro-electric stations of 1200 million Board of Trade units per annum, which on the basis of the present average practice of coal-fired power stations represents 1,850,000 tons of coal. If all the nine schemes were fully developed and fully utilised it is estimated that the cost of generation of energy would not exceed 0·15 of a penny per unit at the power station. This figure includes all running expenses and capital charges, but would only hold good in the event of the continuous use of practically the whole output of energy at works situated near the power stations. The Committee, however, is of the opinion that electric energy could be transmitted to the industrial districts of Scotland, and delivered at a cost considerably lower than the present charges for current in those districts.

The development of hydro-electric power would provide employment for the local inhabitants and tend to the resettlement of many now sparsely inhabited districts. This in turn would lead to developments in agriculture and railway transport facilities.

There are other districts in Scotland where the development of hydro-electric power could be undertaken, and although the topographical conditions in England are not so good, there are districts available in the Lake District and in Devonshire. In North Wales alone there is one site where 4400 continuous e.h.p. could be developed at an estimated capital cost of £41·8 per effective e.h.p.

The Committee considers that certain fundamental principles must be observed:—(*a*) Each watershed area must be studied as a whole and no partial exploitation should be permitted which might in the future interfere with the most economical advantage being taken of the whole area. (*b*) The interests of domestic and trade water supplies, fisheries, drainage of adjacent land, canals and other inland means of navigation must be properly safeguarded. (*c*) Part of the available power must be reserved for the present or future needs of the local population of the watershed area.

There is need for further records of rainfall and the gauging of the flow of rivers, and provision should be made for this work as well as for facilities at the universities or elsewhere for training hydro-electrical engineers, as at the present these seem to be almost entirely lacking.

REPORT OF THE COMMITTEE OF CHAIRMEN ON ELECTRIC POWER SUPPLY. *Ministry of Reconstruction.* [Cmd. 93, 1*d*.]

The report (dated October 14, 1918) of the Committee of Chairmen of different sections of the Advisory Council to the Ministry of Reconstruction deals with certain administrative aspects of electric power supply. The Chairmen recommend that electrical power should be generated and transmitted throughout the United Kingdom upon a single unified system, organised and conducted upon commercial lines, under State regulation, and with such financial co-operation on the part of the State as may be found necessary in order to secure the speedy development of an effective system of electric supply throughout the United Kingdom.

The question of supplying current at a uniform price for all areas is answered negatively, as it would not be commercially sound to supply current irrespective of the conditions of demand or the circumstances attending supply. The Committee also recommends the appointment of an Electricity Board, consisting of six men of proved business capacity, accustomed to handle large commercial undertakings, and who should receive adequate payment for their services. The first duty of this Board would be to elaborate a comprehensive scheme of supply for the whole country, and then by degrees to apply it in practice, but the technical part of the execution and management should be in the hands of an "Operating Executive" which must conduct its operations on a strictly commercial basis. The actual constitution of this Executive and the financial methods to be adopted should be settled later on by the Board. Full advantage would be taken of existing local agencies, in whose hands the actual distribution of power might well be left, but the general idea is to have a network of inter-connected businesses, co-ordinated as to general policy and financial control by a Central Executive which would be responsible to the Electricity Board. The financial operations of the Board should be under Parliamentary control, and the interests of the public should be safeguarded by regulations issued by the President of the Board of Trade.

Attached to the report is a dissentient minute by Mr. L. Hichens, in which he records his opposition to ownership and management of such undertakings by the State. State management and sound commercial trading are mutually exclusive.

TRADE NOTES.

BRITISH.

Ceylon Graphite Industry.—The production of plumbago has recently declined as the United States has been importing the mineral from Madagascar and has also been stimulating its own production of flake graphite. England, on the other hand, obtained a larger proportion of her requirements from Ceylon than hitherto.

There have been considerable variations in prices. These fluctuated from Rs. 750 to Rs. 350 per ton, compared with Rs. 1350 to Rs. 600 in 1917. The price of "chip" stood between Rs. 500 to Rs. 175, as compared with Rs. 900 to Rs. 400. "Dust" ruled from Rs. 275 to Rs. 80, as compared with Rs. 400 to Rs. 150. This price will probably never be reached again, owing to competition from Madagascar. (*Cf.* this J., 1918, 396 B).

Trinidad and Tobago in 1917.—The imports of these islands during 1917 were valued at £4,789,719 and the exports at £5,308,996. The former included the following items, the figures in brackets indicating the proportion of the total provided by the United Kingdom:—Cattle and other animal foods, £43,974 (0·5%); cement, £48,748 (49·5%); calcium carbide, £3090 (0·3%); glass and glassware, £17,643 (17·6%); painters' colours and materials, £19,275 (59·5%); soap, £53,234 (89%); and starch £2665 (1%). The exports included the following (those to the United Kingdom being indicated as above):—Asphalt, 109,880 tons (7·3%); bitters, 22,667 galls. (48%); coconuts, 16,595,282 nuts (12%); copra, 7,201,448 lb. (61·5%); cocoa, 70,144,898 lb. (10%); molasses, 1,398,324 galls. (50%); rum, 87,192 galls. (85%); petroleum, 37,139,608 galls. (79%).

The cocoa crop was a record one, the United States taking 38,766,427 lb., the United Kingdom 7,074,265 lb., and France 21,549,580 lb. Sugar experienced a year of good prices and good crops, 62,651 tons being produced as against 57,755 tons in 1916. The coconut industry, which suffered severely during the drought of previous years, has quite recovered.

At the end of 1917, there were eleven companies drilling for oil in Trinidad. Out of 44 new wells sunk, oil was struck in 31. The total output of oil was 56,080,914 Imperial gallons, as against 32,475,695 galls. in 1916. Several refineries are engaged in the manufacture of petrol, and kerosene is manufactured for local use. Two large refineries are now in operation producing oil fuel to Admiralty specification.—(*Colonial Reports—Annual, No.* 984, *Feb.*, 1919.)

GENERAL.

The Nitrate Situation in Chile.—At the end of January the nitrate market in Chile was lifeless. Huge stocks were in existence at Antofagasta, Iquiqué and Mejillones; 21 oficinas in Tarapaca and 8 in Antofagasta had closed down or were running part time. The labour situation was acute, but the Government was handling it most intelligently. An offer was made by the Government to purchase the 1919 nitrate production at 13*s*. 2*d*. per quintal, but there are various obstacles to such a scheme, notably inability to store. The market views the situation hopefully, and expects a normal demand to return in 5 or 6 months.—(*U.S. Com. Rep., March* 19, 1919.)

The General Nitrate Position.—The announcement that the Nitrate Executive has been wound up may be regarded as a probable indication that this product will at an early date be removed from the prohibition list. During the past few months the trade has been passing through a crisis owing to the cessation of purchases by the Allied Governments, which were left with large stocks on their hands in Chile, in America, and in this country. Notwithstanding the blockade of Germany and rationing of neutrals, it is understood that the stocks both here and in America have now been absorbed. On the Continent the demand has been very active, despite the fact that the price charged by the Allied Governments has been £25 to £28 per ton. Chilean stocks have, owing to the restriction on shipping, gradually increased, and, as compared with a normal stock of 600,000 tons, they now stand at 1,150,000 tons, of which probably 150,000 tons remains in the hands of the Allied Governments. This total is, however, not so formidable as might appear, for immediately the market becomes free it is estimated that at least 500,000 tons will be immediately required by the countries which have been totally depleted during the war. Owing to the impossibility of shipping at present, many oficinas have closed down, and the production has fallen from 250,000 to 150,000 tons per month. This state is likely to continue till the end of June, but after that date it may be expected that most of the oficinas now closed, which are reasonably cheap producers, will reopen, and forward sales

on a large extent are to be expected as soon as the Government restrictions are removed. The position for 1919, of course, underwent a complete change on the signing of the Armistice, and owing to the fact that most companies will only produce to half their capacity this year profits will be curtailed accordingly. On the other hand, all the synthetic nitrate works in Germany are reported to have closed down, and that country may therefore be expected to become a large buyer of Chilean nitrate for next spring, which requirement, together with an increasing demand in all other countries, is likely to absorb the available supplies. While, therefore, large profits for this year may not be obtained, the future outlook for the industry looks promising.—(*Fin. Times, April* 9, 1919.)

The Zinc Market in 1918.—In the annual review of the spelter market, issued by Messrs. Rudolf Wolff and Co., it is stated that the average official price of spelter during 1918 was £52 4*s.* per ton. Up to November 25 last, the official prices were £54 to £50 per ton, but, it is stated, these were fictitious, as consumers were asked to pay £57 per ton for ordinary quality, delivered at consumers' works, and £75 per ton for 99·9 per cent. guaranteed metal. According to the United States Geological Survey the production in that country in 1918 was 537,500 (short) tons, as compared with 695,735 tons in 1917. Japan produced about 43,800 tons in 1918, as against 42,000 tons in 1917. The Canadian production is estimated at 12,500 tons (14,000 tons in 1917), the British 33,000 tons, which is rather less than in 1917, the Australian 5892 tons, and the French from 10,000 to 20,000 tons. The above figures, which are not final, show a general tendency towards diminished production. The position in the United States is unique. When prices rose to over £100 per ton, many new works were started and paid for out of the huge profits made by the older works. As the price of production was taken at about £60 per ton, the owners of these new works closed them down directly the price fell below this figure. The value of spelter in that country is now about 6 cents per lb. (say £27 per short ton) and it appears probable that production will be further drastically curtailed.

As regards consumption in this country, the output of galvanised iron has been stifled, and there are arrears of about 2¼ million tons, based on pre-war figures, to supply. This quantity is equivalent to about 200,000 tons of spelter—a normal year's output in the United Kingdom. There has been some disappointment about supplies of zinciferous materials, and our capacity for treating Australian concentrates is below what was expected.

German Zinc Statistics.—A recent issue of the *Deutsche Allgemeine Zeitung* gives the following approximate figures for the output and trade in zinc during 1918 (metric tons):—Production, 280,000; imported, 56,000; exported, 105,000; consumption, 231,000. A considerable proportion of the last-mentioned quantity was sent abroad in the shape of semi-manufactured and finished goods. In 1913, Germany smelted 260,000 tons of foreign zinc ores yielding 103,000 tons of zinc, and 541,000 tons of home ores yielding 175,000 tons of metal. The crude zinc output of the War Raw Material Section was 196,500 tons in 1916, 186,500 tons in 1917, and 198,000 tons in 1918 (up to October). These amounts fully covered war needs. At present the home zinc production exceeds the demand, and although the latter will increase after the signing of peace, there will be no necessity for some time to come to import either zinc ores or the finished material.—(*Bd. of Trade J., April* 3, 1919.)

REVIEWS.

THE MANUFACTURE OF ALUMINIUM. *By* J. T. PATTISON. *Pp.* 104. (*London: E. and F. Spon, Ltd. New York: Spon and Chamberlain.* 1919.) *Price 7s. 9d. net.*

This is a very small book on a very large subject. Two-thirds of Mr. Pattison's space is devoted to the analytical methods used to control the processes by which aluminium is produced, the remaining 41 pages being divided into chapters describing the manufacture of electrodes and alumina, the history, occurrence and founding of aluminium; its alloys, uses and application.

In the analytical section the author is clearly most at home. The methods he describes are on the whole workable, though recent developments are excluded, while much space is devoted to sampling, standardisation of solutions, gas and coal analysis and descriptions of every-day apparatus. Curiously, in view of the title, no chapter deals with the actual electrolysis, although in the historical section several pages are devoted to showing how the electrical efficiency of the process may be calculated without, however, arriving at any result. The occurrence of aluminium is interestingly discussed, while the chapters dealing with the manufacture of electrodes and alumina, although not generally representative, give an adequate outline of their subjects as applied to one factory. The remaining three chapters must be regarded as totally inadequate.

The book contains some very surprising statements. Few soldiers will share the author's view that "aluminium would make splendid field guns," or metallurgists back his statement that "in most alloys of aluminium an intra-physical (*sic*) change takes place," or that the Schoop welding process depends for its success upon first plating the metal with copper. Nor does "amethyst" appear to be a promising source of aluminium. There is a table of physical and mechanical properties from which the reader may gather, *inter alia*, that "the tensile strength of aluminium is about 17 tons per sq. in.," while "the breaking load in lb. per square inch section = 28,200." RICHARD SELIGMAN.

ORGANIC CHEMISTRY FOR ADVANCED STUDENTS. *By* JULIUS B. COHEN. *In* 3 *Parts. Second Edition. Part I. Pp. viii* + 366; *Part II. Pp. vii* + 435; *Part III. Pp. vii* + 378. (*London: Edward Arnold,* 1918.) *Price* 54*s. net.*

Whilst the plan and subject-matter of the more elementary text-books on organic chemistry present no great difficulties, the preparation of a handbook for those who have penetrated what Wöhler described as "the tropical forest primæval, full of the strangest growths," is a task requiring sound judgment and a first-hand knowledge of the requirements and aptitudes of advanced students. The objective may be approached either by a systematic extension of the fundamental data and principles following the sequence of the ordinary text-book, as in Victor Meyer's admirable "Lehrbuch der Organischen Chemie," or the systematic order may be abandoned in favour of summary accounts of selected portions of the subject-matter. There are complementary advantages in the two methods. The latter, which is that adopted by Prof. Cohen in the work under review, is in many respects the more stimulating as it brings the data and theoretical considerations drawn from a wide range of compounds under a common head, and thus permits of their discussion from a more general standpoint than would otherwise be possible. The reader is thus encouraged to build up and reconstruct his knowledge from within as well as from without, and provided the

reading is accompanied by careful thought, the result should prove in every way advantageous. This spirit of inquiry and introspection is fundamental for the application of the knowledge gained.

The new edition of Prof. Cohen's book is published in three parts, in place of the two volumes of the earlier issue, with the object of securing a more effective grouping of allied subjects and of linking them together, as far as possible, in a consecutive form. The three parts are entitled "Reactions," "Structure," and "Synthesis"; each part is provided with a separate index both of subjects and of authors.

Part I. commences with a concise historical introduction in which the rise and development of organic chemistry is sketched, and is followed by chapters on the Valency of Carbon, Nature of Organic Reactions, Dynamics of Organic Reactions, and Abnormal Reactions. In the first of these the tervalency of carbon as shown in the triphenylmethyl group and the evidence in favour of bivalent carbon in many cyanogen and allied compounds, together with modern theories of valency, are fully and fairly discussed, and although the space allotted to the subject might be regarded as somewhat too great, it is fully justified in view of the important part the element carbon has played in the development of both the earlier and modern views on valency. The subject serves as a good introduction to the succeeding chapter on the Nature of Organic Reactions in which additive reactions, conjugated double bonds, Thiele's theory and allied problems are first discussed. The concluding portion which deals with condensation reactions concerned with chain and ring formation is, however, unnecessarily long and detailed. It extends over 109 pages, and although most carefully dealt with, the examples selected are so numerous that they are likely to prove wearisome reading. Apart from the advanced student whose thoughts are too fully centred on the examination room, a more restricted choice should suffice to inculcate the main principles involved, and would give a happier stimulus to further inquiry for which references should suffice. The chapter on the Dynamics of Organic Reactions comprises a useful and well-selected choice of the applications of physical chemistry to organic problems. Reactions associated with steric hindrance form the subject-matter of the concluding chapter on Abnormal Reactions.

Part II., the volume on "Structure," deals entirely with theoretical considerations, and comprises Physical Properties in relation to Structure, Stereo-isomerism, Isomeric Change, and a full discussion of the elusive, time-honoured problem, the Benzene Theory. Each of these important subjects is described with exceptional clearness and lucidity; they are brought thoroughly up to date, and no bias towards any one view is apparent. This unbiassed attitude has its merits, but it would perhaps be more suggestive and stimulating to readers had the author drawn upon his store of ripe experience and knowledge to indulge in a somewhat fuller criticism of the subjects concerned; it would have added interest, for instance, to learn his views on asymmetric synthesis in relation to vitalism. The problems are, in the main, developed historically. Although this method of presentation has value, the present day view-point is enhanced, in many instances, by a less heuristic treatment; for example, the subject of tautomerism when developed from Lowry's theory of reversible isomeric change or dynamic isomerism gives excellent opportunity for placing all the phenomena concerned on a comprehensive and applicable basis.

The concluding volume, "Synthesis," gives a comprehensive and accurate account of the synthetical methods employed in the preparation and study of the Carbohydrates, the Purine Group, Terpenes and Camphors and the Alkaloids, together with a chapter on Fermentation and Enzyme Action. The subject-matter selected is no doubt representative and instructive, and with obvious limits of space much material must necessarily be excluded. There are, however, other subjects which might perhaps do more than some of these classical examples to arouse the interest of students towards research, such as the natural synthesis of vital products, and the services of modern organic chemistry to allied sciences such as pharmaco-therapeutics; nor would it appear out of place were some of the modern developments of industrial organic chemistry outlined as a stimulus to the association of academic work with industrial progress, or some account included of the practical methods of organic chemistry and their limitations. Perhaps some of these suggestions or similar material may be incorporated in a future edition.

These few criticisms, however, stand apart from the outstanding value of the work as a whole which is written with the very greatest care and authority. This new edition will continue the good work of the previous issue in aiding the study of organic chemistry, and the author is to be congratulated on the admirable manner in which he has carried out his task and on the timely publication of the work. Every stimulus to the study of organic chemistry is more than welcome to-day; the country has an opportunity of redeeming the neglect of the past by the retention and development of the organic chemical industries. Their future is dependent on those whose knowledge of organic chemistry leads them from studentship to research, for in no branch of the science can it be more truly said that "pure scientific research, carried out in the laboratory, is the soul of industrial prosperity."

CHARLES A. KEANE.

PUBLICATIONS RECEIVED.

THE SPINNING AND TWISTING OF LONG VEGETABLE FIBRES (FLAX, HEMP, JUTE, TOW, AND RAMIE). *By* H. R. CARTER. *Second Edition, Revised and Enlarged. Pp.* 434. (*London: C. Griffin and Co.* 1919.) *Price* 24*s.*

THE PRINCIPLES OF BLEACHING AND FINISHING OF COTTON. *By* S. R. TROTMAN *and* E. L. THORP. *Second Edition, Revised. Pp.* 347. (*London: C. Griffin and Co.* 1918.) *Price* 21*s.*

BULLETIN OF THE IMPERIAL INSTITUTE. *Vol. XVI. No.* 4. *October-December*, 1918. *Pp.* 605. (*London: John Murray.*) *Price* 2*s.* 6*d.*

THE CULTIVATION, COMPOSITION AND DISEASE OF THE POTATO. *Supplement to the Journal of the Board of Agriculture. March*, 1919. (*No.* 18.) (*London: The Board of Agriculture and Fisheries.* 1919.) *Price* 6*d.*

THE TRANSACTIONS OF THE CANADIAN MINING INSTITUTE, 1918. *Edited by the Secretary. Vol. XXI. Pp.* 444. (*Montreal:* 503, *Drummond Building.*)

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. DEPARTMENT OF THE INTERIOR. (*Washington: Government Printing Office.* 1919.)

POTASH IN 1917. *By* H. S. GALE *and* W. B. HICKS.

COBALT, MOLYBDENUM, NICKEL, TITANIUM, TUNGSTEN, RADIUM, URANIUM, AND VANADIUM IN 1916. *By* F. H. HESS.

NATURAL-GAS GASOLINE IN 1917. *By* J. D. NORTHROP.

THE PHOSPHATE INDUSTRY.

JAMES HENDRICK.

During the past half century the group of industries which deal with fertilisers has expanded enormously, and whereas at the beginning of that period the British market was the great fertiliser market, at the outbreak of war it occupied but a relatively unimportant position in the world-wide fertiliser trade. Of all the fertiliser industries that which deals with phosphates is the most extensive, and from many points of view the most important. Far greater weights of mineral phosphates, and of the superphosphates made from them, and of basic slag are handled in the world's markets than of any other class of fertilisers. Except under war conditions the sulphuric acid industry depends mainly on the fertiliser industry, and by far the largest use of sulphuric acid is as an intermediate in the manufacture of superphosphate. Bones were the earliest used of the distinctively phosphatic manures, and though the bone manures are very popular with farmers, and are still used as extensively as ever, their use is limited by the restricted supply, and has not expanded during the past half century, and cannot expand to any great extent. Mineral phosphates first came into use after 1840, and for 40 years the expansion was comparatively slow. During this period the chief concentrated manure was guano, and the chief centre of the manure industry was in Britain. After 1880 the supplies of guano began to fall off, as the main deposits were already worked out, but at the same time the use of these fertilisers began to extend greatly, and this expansion took place mainly in other countries while the British market remained comparatively stationary. The development of agriculture, and especially the promotion of agricultural science and education in other countries, both in Europe and elsewhere, had as a natural result the extension of the use of fertilisers in these countries, while the comparative neglect of agriculture and agricultural science in Britain accounts for our relatively slow progress.

Mineral phosphate deposits are found, and have been worked, in many parts of the world. A large proportion of the mineral phosphate used in Britain before 1880 was coprolites obtained from the English deposits in Cambridge, Suffolk, and other counties, but between 1880 and 1900 the production of coprolites gradually fell away and ceased, while at the same time the consumption of American and other foreign phosphates rapidly increased. In the present century the world's supply of mineral phosphates has been mainly derived from the United States and from North Africa.

The greatest expansion in the world's rock phosphate industry has taken place during the present century. In 1900 the total production was estimated at about 2 million tons; by 1913 it had increased to about 7 million tons. At the same time the industry tended to concentrate in a few places where great supplies are obtainable comparatively easily and cheaply, from which water transport can be readily obtained to the great consuming centres, and where the quality of the rock is suitable for the manufacture of superphosphate. For these reasons the production of phosphate has increased enormously in Florida and Tunis, while owing to their failure to comply with one or other of these conditions the production has fallen away or ceased altogether in other centres, such as South Eastern England.

In 1888, when the phosphate deposits in Florida first began to be worked, the total production of phosphate rock in the United States was about 440,000 tons; by 1895 it had risen to over 1 million tons, and in 1913 to over 3 million tons, of which over 2½ million tons were produced in Florida.

The first part of North Africa to develop a raw phosphate industry was Algiers, where production began about 1893. By 1900 the Algerian production was about 300,000 tons, but it has not increased greatly since, and in 1913 had reached about 450,000 tons. Production in Tunis did not begin till 1899, and in 1900 it reached about 170,000 tons, but by 1913 this had expanded to 2¼ million tons, and Tunis had become by far the greatest source of supply of rock phosphate for Europe. The latest of the North African countries to enter the field as a producer of phosphate is Egypt, which began production in 1910 with a little over 2000 tons, and in 1913 produced about 100,000 tons.

Next in importance to the United States and North Africa as producers of rock phosphates are certain islands in the Pacific, Christmas, Ocean, and Naura Islands, which produce rock of very high quality which largely goes to supply Far Eastern consumers like Japan and Australia. The production in these islands before the war had reached nearly half a million tons per annum. Other important producers of raw phosphates are France and Belgium, but the quality of the material produced in these countries is not so high as that of Florida and the Pacific Islands or even as that of North Africa, nor is the quantity produced so great.

While the United States exports large quantities of mineral phosphates, this country is now by far the largest consumer of its own phosphate which is used chiefly in the Eastern States. The chief importing countries, with the total quantity of raw phosphate imported in each of the years 1905 and 1913, are shown in the following table, the figures for which are drawn from the statistics published by the International Institute of Agriculture:—

	—Metric tons— 1905	1913
United Kingdom	427,744	547,666
France	446,722	940,791
Germany	501,048	928,798
Italy	240,144	529,776
Japan...	88,932	331,288
Australia	15,575	162,599

The table shows how very rapidly the import of mineral phosphates was increasing in all the countries mentioned with the exception of the United Kingdom. In addition, France produced at home during the period covered by the table an average of nearly 400,000 tons of rock phosphate per annum, most of which was used at home.

Rock phosphate is nearly all turned into superphosphate before being used as manure. The production of superphosphate therefore has increased in proportion to the production of rock phosphate. The statistics of the International Institute of Agriculture show that in 1904 the estimated production of superphosphate in the United States was 695,068 metric tons, and in 1913, 3,248,000 metric tons. In France, Germany, Italy, Japan and other countries the production also increased rapidly during the same period. This means that in these countries the production of sulphuric acid must also have been increased at a very rapid rate. In the case of the United States the expansion is so great as to indicate something approaching a revolution both in agricultural methods and in the heavy chemical industry. In the United Kingdom there was no such expansion in the same period.

The greatest rival of superphosphate in the world's markets as a phosphatic manure is basic slag. This by-product of steel manufacture began to be produced about 1880 when the total production

was estimated at about 10,000 tons. By 1900 the production had increased to about 1¾ million tons and by 1913 to over 4 million tons. Though first produced in Britain from a British process, Germany soon passed Britain as a producer and later France and Belgium did the same. At the outbreak of war these were the chief producing countries, but the production of Germany far surpassed all the rest and accounted for more than half the world's supply. Basic slag was also first used as a fertiliser in Germany and was always more appreciated in that country than in any other. Belgium exported the great part of her large production and Britain exported up to the outbreak of war a considerable part of her smaller production, but Germany, by far the greatest producer of all, was also the largest consumer and used at home nearly the whole of her production which in 1913 was estimated at 2½ million tons.

It is a natural question to consider whether the great expansion in the demand for phosphatic fertilisers which took place between 1900 and the outbreak of war is likely to continue after peace is restored, and if so whether the supply will be able to keep pace with the demand. There seems little reason to doubt that the expansion in the demand for these and other fertilisers will continue for many years to come, and one cannot at present put any limit to the dimensions which this demand may ultimately reach. It is no longer open to argument that crop production is increased by the proper use of fertilisers, and statistics of crop production show that it is just those countries which have been increasing their fertiliser consumption which have been increasing their internal production of food both per acre and absolutely. At present fertilisers are used only in a comparatively few countries to any great extent. Even in these the consumption has by no means reached its limits, but, as has been shown above, expansion was rapidly taking place in most of them right up to the outbreak of war, and will probably continue when things have settled down again. It is, however, in those countries or districts which have not yet begun to use fertilisers at all, or have only begun to use them in small quantities, that the greatest development is to be looked for.

The United States is already one of the greatest consumers of fertilisers in the world, but as yet it is only a few of the Eastern States which consume any large quantity. We have seen how the market for superphosphate has expanded during the present century, yet nearly the whole of the superphosphate is used on a very small fraction of the total agricultural land of the country. Before the whole of the United States can use superphosphate at the same rate as France or Germany or Britain, the production will require to be increased to an extent out of all comparison greater than anything which has yet taken place, for the productive agricultural area of the United States is greater than that of all the countries of Europe outside the Russian Empire as it existed before 1917. Canada has hardly yet learned to use fertilisers at all. Compared with the United States the cultivated area in Canada is as yet small, but it is capable of enormous expansion. Here is another immense market for fertilisers in the future. The case of Argentine is somewhat similar.

In Europe the country of by far the greatest agricultural area is that which used to form the Russian Empire, and if the possible productive area of Siberia is added, we have an area of agricultural land greater than that of any other country in the world. Yet the consumption of phosphates in the whole Russian Empire in 1913 was less than in Sweden or the Netherlands.

In the present century the thickly populated Empire of Japan has become an important consumer of phosphates, and no doubt will continue to increase its consumption, but a far greater and more populous country than Japan is China in which practically no phosphate is used. If China follows in the footsteps of Japan, as seems likely, there should be a market in that ancient agricultural and highly cultivated country for millions of tons of phosphatic manures. This is a market which only awaits intelligent exploitation.

One might continue to refer to other parts of the world, but enough has been said to indicate that there is no reason why the world's consumption of mineral phosphate should not reach 50 million tons by 1950 instead of the 7 million tons used in 1913. At the same time there is no reason why a similar great expansion should not take place in the consumption of basic slag, but in that case the production will be governed by the production of basic steel.

It is known that if the consumption of Chilian nitrate of soda continues to expand as it did before 1914 the deposits from which this important fertiliser is obtained will be worked out in a limited period of years. If the consumption of mineral phosphates expands as contemplated above, will the known deposits be able to meet the demand? At present the United States produces the largest amount of rock phosphate. The Bureau of Soils, U.S. Department of Agriculture, estimates that the reserves of natural phosphates in that country calculated as high grade material of 75 per cent. tricalcic phosphate, amount to 10,677 million tons. The United States alone, therefore, would be able to supply the world with rock phosphates for centuries to come. No similar estimate appears to have been made for the North African deposits, but these also are known to contain immense reserves of material, and the known reserves in other countries are also very large. It is probable also that deposits of workable phosphates will be found in other parts of the world which have as yet been only imperfectly surveyed. There seems then no reason to suppose that there will be a shortage of rock phosphates in any period which need be considered.

It is unfortunate that we have no important deposit in the British Isles, and that we shall therefore require to continue to import this valuable fertiliser. There are, however, important deposits in different parts of the British Empire and it is quite possible that others may be discovered. In recent years we have obtained our supplies almost entirely from the United States and from French North Africa, but it was pointed out above that the Egyptian deposits began to be worked in 1910 and are already assuming some importance. Probably more will be done in future to find out and develop our Imperial resources of rock phosphates.

In the past rock phosphates have been almost always turned into superphosphate before being used in agriculture and therefore the production of sulphuric acid has had to keep pace with the production of mineral phosphates. Is it necessary that this should continue in the future? No doubt there will be great supplies of sulphuric acid available in the immediate future, as the production has been greatly increased to meet the demands of war. For a time, it seems probable that the potential supplies of acid will much exceed the demand, but if the consumption of mineral phosphates increases as anticipated above the world's supplies of acid would soon require to be further increased if the phosphate is all to be used as superphosphate.

Our ideas on this subject have undergone some change and development in recent times. It was at one time commonly supposed that mineral phosphates were not of much use unless rendered soluble by the use of acid. This belief received a rude shock when basic slag came into use. We know

also that soluble phosphates when applied to the soil are rapidly and completely turned insoluble, and that practically no phosphate is washed out in the drainage even when large quantities of soluble phosphate are used. The agricultural public still to a large extent labours under the mistaken idea that superphosphate is a manure like nitrate of soda or sulphate of ammonia, the effect of which is short lived; but experiments have proved that the phosphate of superphosphate accumulates in the soil, so far as it is not taken up by crops, and effects a lasting improvement in fertility. The chief advantage gained by using a soluble phosphate is in distribution. The soluble phosphate passes into the soil in solution and is there precipitated and thus attains a better distribution than can be reached by distributing an insoluble powder, however fine. But this advantage is only a limited one and has to be paid for at a high price. The advantage appears to be still much overestimated. On certain types of soil at any rate it is not nearly sufficient to pay for the greatly increased cost of producing superphosphate. This is illustrated in the following table which is the average of 66 field experiments carried out upon turnips during the years 1911 to 1914 throughout the northern counties of Scotland by members of the staff of the North of Scotland College of Agriculture:—

FIELD EXPERIMENTS WITH PHOSPHATES UPON TURNIPS, 1911-1914.

Average of 66 experiments.

Plot	Tons	cwt.
1. No artificial manure	13	17
2. Sulphate of ammonia, potash manure salts, and superphosphates	20	12
3. Sulphate of ammonia, potash manure salts, and basic slag	20	0
4. Sulphate of ammonia, potash manure salts, and ground mineral phosphate	19	10
5. Sulphate of ammonia, potash manure salts, and steamed bone flour ...	20	7
6. Sulphate of ammonia, potash manure salts, and bone meal	19	11
7. Sulphate of ammonia, potash manure salts, and dissolved bones	20	3
8. Sulphate of ammonia, potash manure salts, and mixture of superphosphate and basic slag	20	15
9. Sulphate of ammonia, potash manure salts, and mixture of superphosphate and ground mineral phosphate ...	20	8
10. Sulphate of ammonia, potash manure salts, and mixture of superphosphate and steamed bone flour	20	15
11. Sulphate of ammonia, potash manure salts, and mixture of superphosphate and bone meal	20	11

N.B.—Manure was applied equally on all plots at the rate of about 12 tons per acre. Sulphate of ammonia and 30% potash manure salt were applied equally to plots 2 to 11 at the rate of ½ cwt. of each per acre. An equivalent amount of phosphoric acid, approximately 50 lb. per acre, was given to each of plots 2 to 11. In 8 to 11, one-third of the phosphoric acid was from superphosphate, and two-thirds from the other phosphatic manure.

As is to be expected in field experiments carried out under ordinary agricultural conditions where there are so many varying factors not under control, all sorts of irregularities were found in the case of individual experiments, and the results of different individual experiments differed greatly among themselves. Thus in some cases none of the manures produced much effect because the soil was in such high condition that a full crop was already obtained from plot 1, while in other cases plot 1 gave only a very poor result and all the other plots showed great increases of crop. Further it is recognised that to complete the experiments the crops should have been measured throughout a complete rotation. This was not possible under the conditions of working.

The general result of the experiments is to show (1) that the average effect of superphosphate is only slightly greater than that of insoluble phosphate, such as basic slag or ground mineral phosphate, when equal weights of phosphoric acid are applied, and (2) that if one-third of the phosphoric acid is given as soluble phosphate and the remainder as insoluble phosphate the average result is as good as when the whole of the phosphoric acid is given as soluble phosphate. Experiments with other crops and especially with grass give a similar result.

The only conclusion one can come to is that soluble phosphate is overvalued, and insoluble phosphate such as exists in basic slag and ground mineral phosphate, undervalued. It should be possible in future to use a large part of the rock phosphate in the form of finely ground powder instead of in superphosphate. This will effect a great saving in acid and in expense.

CHEMISTRY IN THE NATIONAL SERVICE.

FROM THE PRESIDENTIAL ADDRESS TO THE CHEMICAL SOCIETY, BY SIR WILLIAM J. POPE, MARCH 27, 1919.

Four years ago all available chemists were called to the Army, and many of those who formed the nucleus of the Gas Warfare Service are now returning to the industrial and scientific life of the Empire. The development of gas protection methods, which on account of their success were adopted by our Allies, formed a small part of the enormous chemical problem which led to the organisation under Lord Moulton of the Department of Explosives Supplies. Eventually all the resources of the Empire were called in to furnish the necessary war materials, among which were liquid chlorine for the manufacture of phosgene, sulphur chloride, carbon tetrachloride, bleaching powder, and explosives.

At the cessation of hostilities this country was manufacturing per annum 100,000 tons each of nitric acid and of sulphur trioxide with an efficiency respectively of 93 and 91 per cent. theoretical, as well as 60,000 tons of TNT and 35,000 tons of cordite. These productions were on a permanent basis, and centralised in Government factories not only for economy's sake, the cordite made being better in quality and only half as costly as that imported from America, but also for certainty of supply, risks of oversea transport being thereby avoided.

Economy has led to the elimination of pieric acid as an explosive. Pieric acid costs £185, ammonium nitrate about £50, and TNT about £100 per ton. A mixture of 80 parts of ammonium nitrate with 20 parts of TNT constitutes amatol, which is 5 per cent. more powerful than pieric acid, less "brisant" and more difficult to detonate. Consequently the cheaper amatol has completely displaced pieric acid in this country as well as in America, and is superseding the latter explosive in Italy and France.

The chemical factories of Central Europe were easily and quickly adapted to war purposes, whereas amongst the Allied nations the necessary plant could be developed only gradually. It is pertinent, therefore, to ask why such gradual development was permitted. The following example furnishes an answer.

In July 1917 the Germans first employed "mustard gas" — $\beta\beta$-dichlorethyl sulphide $(CH_2Cl{\cdot}CH_2)_2S$. This substance has little odour, and causes few fatalities, but induces pneumonia, pro-

duces painful sores, and temporary or even permanent blindness; it was used with great success, and the casualties were very numerous.

The preparation of $\beta\beta$-dichlorethyl sulphide, described by Victor Meyer in 1886, involves the following reactions:

(1) $CH_2:CH_2+HClO=CH_2Cl\cdot CH_2\cdot OH$.

(2) $2CH_2Cl\cdot CH_2\cdot OH+Na_2S=(HO\cdot CH_2\cdot CH_2)_2S+2NaCl$.

(3) $(HO\cdot CH_2\cdot CH_2)_2S+2HCl=(CH_2Cl\cdot CH_2)_2S+2H_2O$.

Operation (1) is difficult and the products of (1) and (2) are soluble in water; hence the whole manufacture by these reactions, which were undoubtedly carried out by the Germans, was troublesome, and the yield was perhaps 40 to 60 per cent. of the theoretical. Because of these difficulties the Central Nations thought they had a monopoly in the manufacture of "mustard gas." The German method of manufacture appeared amazing and irrational to British chemists, who by the end of January, 1918, had worked out a method of manufacture represented by the single equation: $2CH_2:CH_2+S_2Cl_2=(CH_2Cl\cdot CH_2)_2S+S$, which produced from 98 to 99 per cent. of the theoretical yield. The new method was employed by France and America, and at the conclusion of the armistice the Allies were making as much "mustard gas" in a day as the Central Nations made in a month. Thus the question is answered: the German chemical service was inefficient; the scientific chemists under its control were incompetent. Further, whilst the Allied potentiality for making "mustard gas" was thirty times that of the German, the German product was thirty times as costly as that of the Allies.

Although the German chemist was incompetent, the skill and perseverance of the German chemical manufacturer were of a very high order. Whilst our activities were of war-time importance, and our works will now need to be dismantled, the German expansions constitute a permanent addition to chemical plant. Consequently Germany now possesses vastly increased resources for the manufacture of essential chemical products.

The opinion that this country is superior to Germany in creative scientific power has been vindicated during the past four years. The previous superior position of Germany as regards applied science was due to a keen public and official appreciation of the economic fruits of scientific effort, in contrast with our neglect of the same. And although it will be long before Central Europe regains its former predominance, there appears to be little prospect of sufficient official encouragement being given in this country to scientific industry to ensure our position in competition with other nations.

Since her entry into the war in July 1917, America has thoroughly organised her chemical resources, but eighteen months was not time enough for the organisation to make its efforts properly felt. Indeed, practically all the American chemical equipment, both for offence and defence, was based on plans furnished by Great Britain and France, because time did not permit of American genius for novelty and magnitude of production having full play. Moreover, many American officers have had the run of chemical works in England and France, and have now returned to America with their experience. Consequently, an increasingly keen competition between Europe and America is to be expected, and it does not appear that this will turn in our favour.

During the first three years of the war, chemical industry, which flourished freely in America, was hampered here by State control of works, material, and labour. On the manufacture of saccharin, installed in England after the outbreak of war, a profit of only 10 per cent. was allowed, and this profit was subject to the excess profits tax; and further, to prevent competition with sugar, an extra 30*s.* per lb. was charged, and appropriated by the Government. Meanwhile America was manufacturing saccharin free from Government control, selling it in this country unrestricted, and securing the thirty shillings, in addition to a considerable profit on account of cheaper manufacture. Having thus accumulated large profits at this country's expense, America is now selling saccharin here at 11*s.* per lb.—a price at which we cannot produce it—with the view of destroying the English manufacture and then running up the price. Regulations of sale with regard to acetic acid, glycerol, acetone and methyl alcohol and their products furnish similar examples of the way in which British procedure has facilitated profiteering in foreign countries during the war. The question is how the problems thus introduced are to be solved advantageously for Great Britain in the coming reconstruction. And we are forced to consider, in view of the future, whether the free play given to scientific creation and production during the war is to persist unhampered. There is no reason to think that the lesson has been properly learnt, or to doubt a re-establishment of the former parsimonious treatment of scientific effort. The control of scientific research is again leaving the hands of the scientific man and being resumed by the lay administrator, for the non-technical administrator is suspicious of the scientific expert because he knows not how to distinguish him from the charlatan of alchemical times.

Scientific research, assisted by the State, must be administered by men of scientific training and eminence. In this regard a lesson may be learned from America. In 1916, President Wilson nominated a "National Research Council" under the presidency of Prof. G. E. Hale, one of the most eminent American men of science. Two points in connexion with the American programme were: first, the substitution of the professional lay administrator by the ordinary office staff; secondly, the recognition of the close interdependence of pure and applied science, which, chemically speaking, involves research work in intimate contact with manufacture, and the chemical investigator as the inspirer of new enterprise. For the nation possessing an extensive organic chemical industry controls not only chemical warfare, but many of the arts of peace. As illustrations of recent work done by this National Research Council may be cited the atmospheric oxidation of naphthalene to phthalic acid by means of a catalyst, with a 95 per cent. yield, and the establishment of a huge nitrogen fixation scheme. Unless British men of science are given similar power, our Empire will, as previously, continue to fall behind other great nations as a contributor to pure and applied scientific knowledge.

During the past year fifteen Societies have collaborated to establish a Federal Council for Pure and Applied Chemistry, the functions of which are to advance, safeguard, and voice the interests of chemical science. This Council is already making its influence felt; and a similar project is being executed in France. A central house to provide adequate accommodation for the various chemical societies should be provided, together with a great chemical library, and a comprehensive scheme for publication of chemical compendia. This is an imposing and costly programme for the Federal Council, but the universal approval of the creation of the Council augurs well for its success.

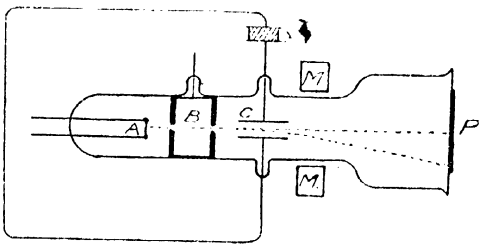
PIEZO-ELECTRICITY AND ITS TECHNICAL APPLICATION.

J. S. G. THOMAS.

In the older electrical text books, the electric eel, the torpedo or ray, percussion, pressure, evaporation, etc., were generally mentioned in a half apologetic manner as some of the more recondite sources affording electrification. The production of electrification by heating or cooling is best exhibited by tourmaline, the Lapis Lyncurius of Pliny, and the phenomenon is termed pyro-electricity. Curiously, the production of electrification by pressure, the phenomenon of piezo-electricity, is also exhibited very strongly by crystals of the same material, likewise by crystals of mica, calcite, quartz, and probably by all crystals possessing skew symmetry, these same crystals being those exhibiting the familiar colour phenomena, commonly referred to as "rings and brushes," when traversed by polarised light which subsequently passes through an analysing Nicol. The relation of these optical phenomena to the molecular arrangement of the crystal structure has been very thoroughly investigated in recent years. There is no reason for doubting that the phenomena of piezo-electricity are likewise very intimately connected with the molecular structure of the crystal. The main phenomenon as exhibited by tourmaline was accidentally discovered by some Dutch jewellers in 1703. They found that when pressure is applied at opposite ends of the crystal, electrification is induced on the surface of the crystal, the exhibition of electrification being most marked at the ends, which become, in the language of the older electrical terminology, positively and negatively electrified respectively. We can roughly visualise the process of electrification, if we regard the crystal molecules as in some way stratified askew to the line of pressure. The resultant molecular motion of the skew crystal surfaces resulting from pressure can be regarded as the cause of the electrification. The necessity for utilising crystals possessing skew symmetry with regard to the line of pressure is clearly seen from the theory briefly adumbrated. The inter-relation of the phenomena of piezo- and pyro-electricity was established by Curie, who showed that tension and compression of a tourmaline crystal were accompanied by heating and cooling of the crystal respectively. A tourmaline crystal under compression behaves electrically like a cooling crystal. The further discovery was made by Curie that the quantity of electricity developed by pressure was exactly proportional to the pressure, and the ratio of pressure to electrification is independent of the thickness of the crystal plate.

In a lecture delivered at the Royal Institution on April 11, Sir J. J. Thomson has re-directed attention to the possibilities of this little-explored domain. Incidentally, utilising the phenomena appertaining to another branch of so-called "pure science," he has shown how the two branches can be combined in a manner which has already yielded and promises to yield results of great importance scientifically and industrially. It required no little scientific discernment to realise in the phenomena of piezo-electricity the means of measuring with great accuracy the extremely large pressures developed during the explosion of a gas or gun-cotton, and to follow the variations in pressure occurring during the explosion. This has been achieved in the following manner. A plate of tourmaline can be subjected to pressure and the electrification thereby excited readily measured. The linear relation of electrification to pressure then enables one to deduce the pressure from the electrification exhibited by the crystal. The phenomena of the cathode discharge are amongst the scientific commonplaces of the present day. A stream of negatively electrified corpuscles is emitted from the negative electrode or cathode in an ordinary discharge bulb. These electrons are the fundamental units out of which all matter is built. They are emitted from a metallic filament raised to incandescence, a fact which is of no little consequence in the design of the more efficient types of electric incandescent filament lamps. Ordinarily, these electrons travel in straight lines, but owing to their negative charge they are deflected when exposed to an electric field, and the amount of the deflection can be made to serve for the determination of the strength of the field through which the electrons have passed. The strength of the electric field being known, the quantity of electricity producing such field is readily calculated.

The procedure adopted by Thomson for the recording of the pressure developed during the course of an explosion wave is illustrated in the accompanying figure, and is as follows:—A stream of electrons is emitted from the heated tungsten filament A contained within an exhausted vessel of the form shown. A narrow beam of electrons is determined by their passage through the narrow apertures shown at B. The opposite faces of a tourmaline



crystal cut at right angles to a principal axis are put in metallic connexion with the parallel aluminium plates C. So long as these plates are electrically uncharged, the electrons pursue a straight path, and their incidence centrally upon the screen or photographic plate P is marked by a central luminous spot. The tourmaline plate X being exposed to pressure developed during the course of an explosion within a chamber enclosing the crystal, the plates of C, being in electrical connexion with the electrified faces of the crystal, would become electrified, and the path of the electrons between the plates would become curved. Emerging from between the plates, the stream of electrons would now meet the screen P in a deflected position as shown, the direction of deflection—whether up or down—being determined by the signs of the respective electrification of the plates C. The amount of the deflection being proportional to the electrification of the plates C is readily seen to be proportional to the pressure developed within the chamber enclosing the tourmaline crystal. In this manner it could be quite easy to record the maximum pressure developed during an explosion lasting 1/100,000th sec., the limit of time being set by the sensitiveness of the photographic plate. In order to follow the fluctuations of pressure with time, the photographic plate might be moved across the beam of electrons, a time-pressure curve being obtained in this manner. The method, however, is difficult to apply in a vacuum. A much better method utilises another property of the electrons, a property ultimately based upon the classical researches of Oerstedt, *viz.*, the deflection of a conductor conveying a current in a magnetic field. The stream of electrons behaves like a conductor conveying a current, and being subjected to a mag-

netic field represented by MM situate just beyond the plates C, the beam would be deflected in a direction at right angles to the plane of the diagram, being towards or from the reader according to the direction of the magnetic field. Moreover, the magnitude of this magnetic deflection would depend upon the magnitude of the magnetic field. If, therefore, a rapidly alternating magnetic field were employed, the spot formed by the beam of electrons would move in a line at right angles to the plane of the diagram if the crystal were not subjected to pressure. The crystal being subjected to pressure, and the alternating magnetic field being simultaneously employed, the path of the spot is determined by a deflection in one direction determining the pressure, and in a direction at right angles determining the magnetic field. This latter varying harmonically, a subsequent analysis of the curve traced on the photographic plate enables a pressure-time curve to be readily constructed.

The method of explosive pressure measurement thus made available possesses the advantage over the forms of pressure indicators hitherto used in that inertia effects are reduced to an absolute minimum. The mass of the electrons is approximately 1/1800th part of that of the hydrogen atom, and their deflection, as described, can readily be effected in 1/100,000,000 sec. In guns and engines the pressure-changes develop with great rapidity, the whole explosion taking about 1/50,000th sec. On this account the interpretation of the indications of mechanical recorders of pressure is a doubtful procedure. The electron method, however, is not vitiated on this score. Its application to the elucidation of the power and time constants of high explosives, the explosive phenomena in guns and internal-combustion engines, the effects of different kinds of petrol, the explosion of mixtures of air and various gases, the explosive effect of magnetic sparks, promises to yield results important both scientifically and industrially. The propagation of an explosive wave through a tube or solid can be readily followed by employing two or more crystals in different parts of the tube or solid. To some of these problems the method has already been applied. Sir J. J. Thomson has investigated the explosion of gun-cotton in sea-water. The attainment of the maximum explosive pressure is succeeded by a smaller peak on the descending part of the pressure-time curve. The interpretation of this second peak is obscure. A later peak represents the arrival of the explosive-pressure wave reflected from the sea bottom.

The method above outlined is probably unique in that it combines a number of discoveries of pure science—the phenomena of piezo-electricity, cathode rays—their electric and magnetic properties—in such manner that the result promises to be of extreme importance industrially. The discovery of cathode rays led to that of Röntgen rays. It now promises to yield further fruit of technical importance. After this, who shall say "Pure science is a thing apart"? Pure and applied science are one and indivisible.

INDUSTRIAL RESEARCH AND THE SUPPLY OF TRAINED SCIENTIFIC WORKERS.—A report on this subject by the Education Committee of the British Science Guild contains statistical data showing the relative paucity of the provision for higher scientific studies in Great Britain as compared with the United States and Germany. In 1913—14 there were only 5000 full-time students of science and technology in the United Kingdom, in comparison with nearly 17,000 in Germany and 34,000 in America. The total income of Universities amounts to:—U.S.A., £20,000,000; Germany, £1,800,000; U.K., £2,000,000, or about £1,000,000 excluding Oxford and Cambridge.

NEWS FROM THE SECTIONS.

YORKSHIRE.

The annual meeting was held at the Queen's Hotel, Leeds, on April 14. After a vote of condolence to Mrs. Fairley had been passed and the officers and committee elected for 1919-20, Mr. B. G. McLellan opened a discussion on "The Separation of Solids from Liquids." The subject was divided into: (1) Sedimentation and (2) Filtration. Under the first heading the settling process as in water softening was discussed, and the closed basket centrifuge was included as a modification of sedimentation. During the latter part of the discussion the chairman (Mr. W. McD. Mackey) described his Inclined Tank System as installed at Bradford. Continuing with the second heading, Mr. McLellan subdivided filtration into (*a*) gravity, (*b*) pressure, (*c*) suction, and (*d*) continuous processes. As an example of the gravity type, the Taylor bag for sugar work and the ordinary perforated basket centrifuge or hydro-extractor were described. The working of the filter press was then given in detail. To decrease the time and labour of emptying and fitting cloths to the ordinary type of filter press, the American Leaf Presses of Sweetland and Kelly have been devised. Double-faced filtering leaves or plates are suspended in a closed cylindrical vessel into which the liquor is forced. Filtration occurs through the leaves inwards, the cake forming on the outside. At the end of the operation the lower half of the cylinder is dropped and the cake removed, when on closing the cylinder the plant is immediately ready for further work. The Oliver Continuous Filter was also described.

A short note on "The Iodine Value (Wijs) of Palm Kernel Oil," by Messrs. Ellis and Hall, was read by the latter. It was pointed out that the constants as given in the literature for expressed oil (varying from 10 to 17) were too low. The authors from tests of over a thousand commercial samples had found a range of from 15 to 23, the average being 18·5. A few preliminary laboratory tests seemed to show that extracted oil (by ether) gives lower values, namely, 15—19, with an average of 16·5.

BIRMINGHAM.

The newly formed Engineering Group was the subject of an address and discussion at a meeting held on April 10. Dr. R. S. Morrell presided. Prof. J. W. Hinchley, who had been invited, was unavoidably prevented from attending, and the address was therefore given by Mr. C. S. Garland. The aims of the new Group were explained. These included, *inter alia*, training and research, a circulating technical library, an information bureau to supply data but not advice, compilation of manufacturers' catalogues and price lists of plant and apparatus. The chemical engineer was defined as a chemist who transferred results obtained in the laboratory to operations conducted on an industrial scale. Commercial success in industrial chemistry depended upon a combined knowledge of the chemistry of a process and of the proper mechanical and structural means of applying it on a large scale. Mr. H. Talbot stated that the membership of the Group was about 500 and that interest in the Group was steadily growing. The discussion was generally appreciative and showed a strong desire amongst many members of the Birmingham Section to participate in the work of the Group. Several members stated that they were already forming a library for manufacturers' catalogues and offered to co-operate in assisting the Group in this valuable work. The dual character of the work carried on in operations in chemical industry was generally emphasised, and it was recognised that the attempts to carry on such

operations by the co-operation of chemists and engineers had frequently proved unsatisfactory and inefficient. The opinion appeared to be unanimous, that better results and smoother working could be obtained from the efforts of one individual possessing both chemical and engineering knowledge, *viz.*, the chemical engineer.

LIVERPOOL.

The annual meeting of the Section was held at the Liverpool University on April 11, Mr. A. T. Smith presiding. After the formal business followed a paper by Mr. W. Ramsay Sibbald on "Continuous Process Plant Design."

The aim of modern manufacture is to effect a continuous treatment of material from the raw condition to the finished product, with a view not only to a perfect return for energy expended, but also to uniformity of quality. In the laying-out of plant, therefore, due thought is directed towards eventual reduction of (*a*) maximum "power figure," (*b*) personnel of controlling staff, (*c*) amount of material under treatment at one time, (*d*) size of machine and parts, etc., and of space occupied. The desirable objects to be attained are—standardisation of products, highest percentage yields, effective use of heat otherwise wasted, etc. The term "chemical plant" covers appliances in which are carried out purely physical processes for the most part, and in designing such plant similar principles apply whether the aim of the chemist-engineer be to achieve the transference of a calorie of heat from one body to another or the removal of an atom or radicle from one molecule to another. The desiderata in either process are (i) thorough contact of materials, (ii) maintenance of this until the desired exchange or union has taken place, (iii) to permit no avoidable waste of heat, power, or material so far as may be possible.

The principal limits to chemical processes are set by the law of mass action and the phase rule, and to obtain the highest proportion of the desired products in the final resultant mixture it is necessary first to work out the optimum conditions of temperature, pressure and concentration. In physical processes, *e.g.*, heat transference, as in condensation, cooling, solution, etc., the physical laws are applied—for instance, condensers or coolers are designed so that one fluid flows in one direction through pipes or coils immersed in the other fluid which is made to flow in the contrary direction. Again, in industrial chemistry, the time occupied in the completion of a reaction is important, and is often required to be reduced to a minimum, *e.g.* by stirring apparatus, spraying devices, and air currents, etc.

Briefly the main feature of continuous process plant design is the provision of counter-current systems for the various physical and chemical exchanges or reactions, whether between gas and gas, gas and liquid, liquid and solid, or solid and gas, so that the end-product is brought away from the sphere of greatest physical or chemical action and its place rapidly taken by fresh material (while the reactant proceeds similarly in an opposite sense or direction) at a speed which is convenient and economical.

GLASGOW.

The following officers have been elected for the session 1919-20.—Chairman, Mr. Quintin Moore; vice-chairman, Prof. C. H. Desch; hon. secretary and treasurer, Dr. G. S. Cruikshanks; Committee—Dr. T. Ewan, Prof. T. Gray, Messrs. J. McLeod, L. Hislop, W. S. Herriot, J. Hope, S. H. B. Langlands, D. A. McCallum, J. McFarlane, J. McGregor, J. McWhirter, Jos. Robertson, Jas. Robertson, R. T. Thomson, J. H. Young, and W. W. Wilson. The report for the past year states that seven meetings have been held of which four were of an informal nature.

MEETINGS OF OTHER SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

On April 1, Mr. Wm. Thomson presiding, Lieut. W. A. Macfadyen read a paper on "Electrolytic Iron Deposition." The object of the work described was to obtain data upon which an industrial process could be founded for salving worn steel parts by electro-plating them with iron. With ferrous ammonium sulphate as electrolyte excellent results were obtained with dilute solutions at room temperature, but the deposition was very slow; with a concentrated solution the results were equally good but the rate of deposition was about 7 times faster; with a concentrated solution at 60° C. 50 times faster than with a cold dilute solution. Varying acidity had a great effect on the deposits, the best results being obtained with an electrolyte about ·005 N with respect to sulphuric acid. Iron can be deposited directly on to steel, and subsequent heat-treatment produces an adhesion of the deposit to the basis metal very much better than the best attainable by simple plating, and the deposited iron is much tougher than before treating, although it is considerably softer. Such deposits can also be case-hardened with good effect.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

Sir Boverton Redwood presided at the annual meeting held at the Royal Society of Arts on April 15, the retiring president Mr., now Sir, Charles Greenway being absent owing to illness. In a valedictory letter, the latter referred to the need for increasing the scope and activities of the Institution, and suggested that a special membership should be instituted for the large oil companies at a subscription of 250 guineas yearly.

The new president, Sir Frederick Black, then delivered an address on "Some War Problems of Petroleum Supply." The main problems were specified under three heads (1) The production of sufficient supplies for the needs of the war; (2) the adjustment of the processes of refining to the provision of increased quantities of heavy fuel and of petrol, particularly for aviation purposes; (3) the provision of sufficient tank steamers and tank cars for distribution by sea and land. In addition the oil industry was called upon to furnish certain products for use as high explosives. In this connexion the extraction of toluene from Borneo oil proved a great help; experiments were also undertaken to obtain similar results with petroleum from other sources. After referring to the "key" nature of the petroleum industry and to the enterprise shown by the great oil companies in opening up new sources of supply, erecting refineries, building pipe lines and tank steamers, the author alluded to the problem of home production of oil from shale and cannel coal, and stated his conviction that although such production will have special difficulties of cost and disposal of products to contend with, it will nevertheless become one of the sources of supply that the market will need. Sir F. Black then related his experiences during his visit to the United States with the British War Mission arranging for supplies of oil and tank steamers, both of these objects being eventually attained. In regard to ocean transport, the carriage of oil in double-bottom ships did more than any other single effort to relieve the situation; over one million tons of oil were conveyed overseas by this means. The inestimable services of the Navy may be realised from the fact that in the 4½ years of war about 250 million tons of British coal and about 30 million tons of oil from all sources to all ports

of the Allied countries in Europe were transported safely overseas. The remainder of the address was devoted to the main problem of the future, *viz.*, the adequacy of petroleum supplies. A leading American expert, Mr. M. Requa, has expressed somewhat pessimistic opinions concerning the future supply in the United States, but he is very hopeful in regard to production from shale. The U.S. Geological Survey estimates that about 40 per cent. of the entire known petroleum sources of the country has been exhausted. Assuming that new areas of equal productivity to those already known will be discovered and worked, American oil supplies, excluding Mexico, have a life of only 30 years. The world's demand for petroleum products will increase greatly; this demand will be met for some time by the development of new sources, including those of carboniferous and vegetable origin, but the conservation of supplies and the avoidance of waste are from all points of view imperative.

THE FARADAY SOCIETY AND THE RÖNTGEN SOCIETY.

The joint meeting held by the above Societies at the Royal Society on May 1 was of unusual interest. The past few years have shown the urgent need for the detailed examination of ferrous, non-ferrous and other products upon which human life depends, and it is thought that the method of examination by means of X-rays has a great future before it. Such a method might, as Sir Robert Hadfield pointed out, prove costly to the manufacturer at first, but the knowledge gained and the improvements acquired would more than compensate in the future. A great deal of work has been done on the subject of "Radio-metallography" during recent years in this country, America, France, Japan, and Germany, and the results obtained give every encouragement for future research. Summaries of the most important work were dealt with by the chairman, Sir Robert Hadfield, in opening the discussion.

Professor Bragg, in giving an introductory account of the subject, said that engineers and metallurgists must realise that they are using a new power which is denied them in the case of light, the difference being the shortness of wavelength which enables X-rays to penetrate substances of the most delicate nature and, equally well, several centimetres of steel. At present the work is being carried out on a relatively small scale, but Mr. Campbell Swinton hoped that in the near future the question would be attacked from the engineer's point of view, and that much larger powers would be used. This point was emphasised by Capt. Knox and Major Kaye and by Monsieur Plion and Mr. Geoffrey Pearce, who thought that future success with X-rays depends on improved equipment, and it is on those lines, rather than on application, that research should tend. At present the available equipment is satisfactory for the examination of aluminium and light alloys, though further progress might be looked for; but for iron and alloy steels different equipment is required to make X-ray examination practical. In X-ray photography, many practical details need attention according to the material to be examined, such as the kind of radiations used, plates and intensifying screens, time of exposure and development. Mr. Renwick and Dr. Slade both dealt with the subject and pointed out that the same contrast would be obtained with soft radiations through a thin layer as through a thick, provided a longer exposure is given; with harder radiations and the corresponding shorter exposure, less contrast is obtained.

X-ray examination has been used in the laboratories of Mons. Schneider at Le Creusot for determining segregations, blow-holes, foreign bodies, faulty welds, defects in gear cases of aircraft engines, hair cracks. Radiography might also be used for the rapid examination of steels containing varying amounts of tungsten and the examination of compound metals. For the examination of timber for aircraft, this method is of great value. Using soft radiations, defects, due to natural flaws in the wood, resin pockets, diseases, or to defective workmanship, which would possibly cause serious injury to the airmen, are easily revealed.

Several very beautiful photographs were exhibited by different workers, including Prof. Bragg, Capt. Knox and Major Kaye, also some striking radiographs of carbon electrodes by Sir Robert Hadfield. Other exhibits and demonstrations were given by various workers, including the apparatus used at the War Office X-ray Laboratory for testing definition of X-ray bulbs, exhibited by Major Phillips.

SOCIETY OF GLASS TECHNOLOGY.

The annual meeting was held in Sheffield on April 16, with Mr. W. F. J. Wood, the retiring president, in the chair. In a short presidential address, Mr. Wood spoke of the impending establishment of a Glass Research Association (this J., 1919, 133 R), stating that at an early date all glass manufacturers would be invited to join it, and that substantial subscriptions had already been promised. After a description of industrial research in the United States had been given by Mr. A. P. M. Fleming, of the British Westinghouse Co., Sir Frank Heath, Secretary of the Department of Scientific and Industrial Research, addressed the meeting. He pointed out that the glass industry has been engaging the anxious consideration of the Government, as much, if not more, than any industry in the country since the war began. During the war the Department had been enabled to help the industry in many ways, and would do so in future. He could not help feeling that too much dependence upon State aid indicated an unhealthy condition in industry. It ought not to be necessary for any industry to look outside itself for direct and immediate aid in the conduct of its work.

The Department of Glass Technology of the University of Sheffield was opened to inspection, and members had the opportunity of seeing the vacuum casting of a large glass pot of 38 in. diameter. The first annual dinner was held in the evening. The president for the ensuing year is Mr. S. N. Jenkinson.

SOCIETY OF PUBLIC ANALYSTS.

At the meeting held on May 7, Dr. S. Rideal presiding, Messrs. T. F. Harvey and F. Mackley read a paper on "The Analysis of Mercury and Zinc Cyanide and of Double Cyanide Gauze." Double cyanide gauze, so extensively used for field dressings during the war, is prepared by impregnating large rolls of gauze with a previously prepared paste containing about 50 per cent. of mercury and zinc cyanide. The authors described rapid methods of analysis for the control of both paste and finished gauze.

"The Estimation of Small Quantities of Antimony," by Dr. W. Beam and Mr. G. A. Freak, described a modification of the process proposed by Schidrowitz and Goldsbrough. The antimony is deposited on copper foil, dissolved in boiling alkaline permanganate solution, reduced with sulphur dioxide, and then converted into colloidal trisulphide in the presence of gum. Colorimetric comparison is then made with solutions prepared from a standard potassium antimonyl tartrate solution.

ROYAL SOCIETY OF ARTS.

A series of three Cantor lectures was delivered by Prof. W. A. Bone during March on "Coal and its Conservation."

Of all important raw materials produced in this country, coal is the only one of which the output is in excess of national requirements. There is, moreover, so far as Great Britain is concerned, no real alternative to coal as a source of heat and power on any large scale, the total available water power being capable of generating only about 8 per cent. of our present requirements, and amounting to about 1/30th of that available in the United States or Canada. The estimate of the world's coal supply in 1913 was 7,397,553 million tons, of which 69 per cent. is located in America, 17·3 per cent. in Asia, 10·6 per cent. in Europe, 2·4 per cent. in Oceania, and 0·6 per cent. in Africa. In 1905-07, the output of coal per person was, in the United States 589 tons, and in Great Britain 289 tons. In 1908-10 the figures were, respectively, 591 tons and 265 tons, and in 1911-13, 651 and 254 tons. The pithead price of coal in Great Britain has risen from 12*s.* 5½*d.* per ton in 1915 to 25*s.* in 1919. The consumption of coal in the United Kingdom in 1913 was distributed amongst the several industries as follows (the figure in each case denotes million tons):—Mines and factories 80, metallurgical industries (including iron and steel) 32, bricks, ceramic, glass, chemical manufacture 6, railways and coasting steamers 17, gas works 19, domestic purposes 35, making a total of 189 million tons.

The future policy of this country as regards power production should be to utilise low grade fuels for this purpose, and to export the better grades of steam coals. All coals intended for use in iron and steel smelting, and for domestic purposes, should be carbonised with by-product recovery before such use. By-product recovery—partial or complete—should likewise be applied to coal consumed for power purposes. The essential differences in the products yielded by high and low temperature carbonisation processes were briefly discussed, and it was pointed out that by gasifying the coke, 60 per cent. of the heat value of the coal can be obtained in the gas. Caution was urged in regard to the adoption of the suggestion of Dr. Carpenter that gas should be charged for on a basis of its potential heat units. It would not be good policy to send low grade gas through the mains. Moreover the chemical composition of the gas as influencing its safety and convenience in use, is of consequence.

The final lecture was devoted to the question of power supply as a problem in industrial reconstruction. The 1907 Census of Production accounted for 10 million h.p. in the factories of the kingdom, 26 per cent. of the prime movers being electrical. The total electrical power generated was 2388 million kilowatt years, of which about 62·5 per cent. was generated for public utility services. The load factor in co-operative generation was only 16 per cent. The average efficiency of the conversion of heat energy of coal into mechanical power *via* steam-turbine, dynamo, is about 4 per cent., representing a consumption of about 5 lb. of coal per B.H.P. hour. In the process of conversion, 96 per cent. of the heat of the coal is lost. Gaseous fuel is unchallenged as a medium for heat distribution, as is electricity, according to the lecturer, for power. There seems to be little to choose between steam and gas systems for the purpose of such power production. The efficiency of electric power production is expected to be slightly above 20 per cent. in one of the super-stations now being erected in this country, equivalent to 1 lb. of coal per kw. hour. Results of tests on the 35,000 h.p. Parsons' turbo-alternator at Chicago have indicated a production of 1 shaft h.p. per lb. of coal.

NEWS AND NOTES.

BRITISH INDIA.

Potash from Bitterns.—During recent months the attention of salt manufacturers has been drawn to the possibility of recovering potassium salts from the bitterns remaining after salt recovery. Recent experiments by salt producers have demonstrated the possibility of obtaining potassium salts on a commercial scale from this neglected source, and experiments on a larger scale are about to be undertaken.

Casein Industry in Bombay.—Before the war the Germans investigated the possibility of obtaining casein from India, and considerable quantities were exported to Germany in the years just preceding 1914. But the casein then made was under German direction. After the outbreak of war Indian manufacturers continued to make casein in fairly large quantities, but without technical guidance, and the quality produced was not very satisfactory. The Government helped the producers, and the material is now made at various places in the Presidency by up-to-date methods. This industry bids fair to assume large proportions in the near future.

Substitute for Barley Malt.—The Department of Agriculture in India has published recently a paper in the chemical series dealing with the investigations carried out with the object of finding a satisfactory substitute for barley in malting operations. A large number of cereals was examined, and it was found that "Cholam" or Juar, commonly known as great millet (*Andropogon sorghum*) is a good substitute for barley, although it contains less husk; but this difficulty can be remedied by admixture with malted paddy or bran. Cholam is very largely available in India, and at very cheap rates. Malted foods were prepared, and exhibited publicly, and the results were highly satisfactory. It is to be noted that the malt extract prepared from Cholam hydrolyses starch at a greater rate than barley malt extract, although under identical conditions the proportion of dextrine to sugar produced is greater than with barley.

Manganese Ore.—At a recent meeting of manganese mining companies, the position of manganese ore in India was described by Sir Thomas Birkett. During the past year the mining industry suffered all the disadvantages arising out of war conditions, and consequently production was considerably restricted. New ore formations have been found at the principal mines, but the cost of working has risen considerably owing to increased wages. India has now to be prepared for a serious contingency. The Caucasus mines will again reopen, and there are other mines in Egypt and Africa which threaten formidable competition. Egyptian and African deposits are more favourably situated than those in India for putting manganese ore on the European market, and unless the Government helps the industry by various concessions in regard to transport, the industry has a very gloomy future before it.

SOUTH AFRICA.

A South African Mint.—It is officially announced in the Senate that the Government intends to establish a mint in South Africa. A bill for that purpose will be introduced this session.—(*Reuter.*)

AUSTRALIA.

Copper Production.—Telegraphic advices state that all the copper mines and smelters in Australia, except the Mount Morgan and Mount Lyell, have now suspended operations.—(*The Times, May* 8, 1919.)

Petroleum Discovery in New Guinea.—The Melbourne *Age* reports the discovery of great petroleum wells of high commercial value in the portion of New Guinea captured from the Germans, and states that information obtained by a party of expert investigators from America has been confirmed and amplified since Australians occupied the territory.—(*Official, May* 1, 1919.)

CANADA.

Organisation of Canadian Chemists. — The "Chemists' Organisation Committee," appointed at the Convention of Canadian Chemists held in Ottawa, May, 1918, has issued a preliminary report, which is to be submitted to the second convention to be held at Montreal during May 1919. The main recommendations are, briefly, as follows:—The task of organising chemists in Canada should be carried out by an entirely new and separate organisation, for which the title "The Institute of Chemistry of Canada" is proposed. The membership to consist of Fellows and Associates. The qualifications for the Fellowship should be:—(A) Graduation at a university after a four-year course with chemistry as chief subject: or (B) graduation at a university after a three-year course with chemistry as main subject, followed either by a further year's university training in chemistry, or by two years' experience in an approved laboratory; or (C) five years' active experience with a responsible position—in either pure or applied chemistry, and the passing of an examination before a board appointed by the Institute. This examination may be waived in the case of chemists already practising at the date of incorporation of the Institute. The minimum age of Fellows to be 25 years, below that age the same qualifications to apply for the Associateship. An Associate to become Fellow on reaching 25 years of age on the recommendation of five Fellows, provided he has practised chemistry for at least two years. All candidates must satisfy the examiners that they have had a good general education.

The objects of the new organisation would be to raise the status of the profession and so attract the best intellects; to have available an organisation that could be consulted by the Government in times of crisis; to protect the public; and to assist chemists by establishing registration and employment bureaux, a library, and centres for social and scientific intercourse.—(*Canad. Chem. J., April,* 1919.)

Mineral Production in Canada.—The preliminary report of the Canadian Department of Mines gives the broad results of production, value, exports, etc. for 1918. The total value of metals and minerals won was $210,204,970, an increase of 10·8 per cent. over 1917, and of 44·3 per cent. over 1913. Out of 45 products listed, 18 reached their highest production in 1918 or 1917. The output of copper in 1918 amounted to 118,415,829 lb., an increase of 8·4 per cent., gold slightly declined to 710,526 fine oz., and silver decreased by 4·2 per cent. to 21,284,607 fine oz. The recorded output of platinum was 39 crude oz. against 57 for 1917, but no definite record of the total recovery of the metals of the platinum group has been obtained. Shipments are reported in 1918 of 8677 oz. platinum and 13,016 oz. palladium. The amount of nickel produced was 92,076,634 lb., an increase of 9·14 per cent.; exports were 1,710,800 lb. of fine nickel and 85,767,700 lb. of nickel in ore, etc. The lead production was 43,846,260 lb., an increase of 34 per cent.; the lead in ores etc. exported rose 70 and pig lead over 600 per cent. The total production of zinc was 33,663,690 lb., much of which was treated in Canada. Iron ores show a further falling off to 206,820 short tons. The ore charged to blast furnaces was 2,242,387 tons, Pig iron production slightly increased, the output being 116,520 tons from blast furnaces and 30,425 tons at electric furnaces. Steel ingots and castings are estimated at 1,893,000 tons, 120,000 tons being produced electrically. The total production of coal was 14,979,213 tons, or an increase of 6·6 per cent., but the Dominion still imports the greater part of the coal it consumes. The output of oven coke was 1,234,347 tons, averaging 0·634 ton per ton of coal. By-product recovery ovens dealt with 71·2 per cent. of the coke produced. There was a slight increase in petroleum output (304,741 barrels), the greater part of the consumption being still imported. Other metals and minerals reported on are molybdenite, arsenious oxide and arsenic, asbestos (output 143,456 tons), chromite (21,994 tons), fluorspar, graphite, magnesite (39,365 tons), pyrites (416,649 tons containing 38 per cent. of sulphur), and salt, the output of which declined by 5 per cent.—(*Bd. of Trade J., April* 17, 1919.)

JAPAN.

Mineral Production in 1917-18.—The reports of the Japanese Bureau of Mines give the following statistics:—

Mineral	Production 1917	Production Jan.-June 1918
	Tons	Tons
Antimony	6,572	—
Chromite	8,798	1,173
Copper	63,812	41,787
Gold (lode)	226,122*	122,632*
Lead	15,557	2,419
Manganese ore	50,552	12,219
Silver	7,111,720*	3,166,344*
Tungsten	721	291
Zinc	53,852	—
Asphalt	3,811	1,411
Coal	25,939,637	13,999,517
Lignite	150,450	76,023
Petroleum, crude	2,850,159†	1,220,968†
Phosphate rock	119,682	112,519
Pyrites	119,426	—
Sulphur	116,120	34,963

* Oz. troy. † Barrels of 42 galls.

The antimony production for 1917 was 30 per cent. less than in 1916, and it is expected to remain stationary for 1918. The reduction of chromite produced was largely due to the United States embargo on imports. The copper output for 1917 is considered to be erroneous, and a large firm of metal brokers corrects the figure to 89,756 tons. In any case there was a large increase during 1917 which may or may not be maintained during 1918. The 1917 lead production represented a 30 per cent. increase on 1916, and large amounts of Australian concentrates were imported during the year. The first half of 1918, for which a corrected figure of 4252 tons is given, shows a big decline which is largely due to the falling off of Australian imports owing to high freights.

The small rise in production of manganese ore in 1917 is expected to be followed in 1918 by a 50 per cent. decrease, also chiefly on account of shipping difficulties, and for a like reason the zinc output, which went up by 50 per cent. in 1917, will suffer a big drop in 1918. The small decline in tungsten output indicated by the 1918 figures must also be attributed to lack of tonnage.

The coal position shows promise of still higher prices as well as of increased outputs, while the petroleum production will be adversely affected by want of well-boring apparatus. The important increase of 75 per cent. in phosphate rock indicates the growth of the chemical industry and the demand for fertilisers. The sulphur markets, as the 1918 figures show, are quite inactive, again for want of shipping facilities.—(*U.S. Com. Rep., Feb.* 19, 1919.)

UNITED STATES.

The Government Nitrate Plants.—An announcement authorised by the Assistant Secretary for War states that much constructive and creative work is needed to adapt the Government nitrate plants to the requirements of peace and to the production of fertilisers. It has been decided to establish forthwith a civilian organisation, to be called the United States Fixed-Nitrogen Administration, which will be under the joint control of the Secretaries of War, Navy, Interior and Agriculture, and will take over the nitrate plants and other interests now administered by the Nitrate Division of the Ordnance Department. Mr. A. G. Glasgow has been appointed first administrator of the new organisation.

"Colloidal" Fuel.—The imperative need for increased supplies of liquid fuel, particularly for naval purposes, has prompted American engineers to investigate the problem of incorporating solid and liquid fuels in such manner that the resultant mixture can be handled and utilised as ordinary oil fuel. The work was carried out under the auspices of the Submarine Defence Association with the assistance of the United States Navy Department, and the results are of importance as they promise not only conservation of oil fuel but also utilisation of low-grade solid fuel.

The use of pulverised coal alone necessitates the adoption of special burning installations, and the difficulties connected with handling and storage render it impracticable as a naval fuel. Attempts made hitherto to blend any appreciable proportion of pulverised solid with liquid fuel have failed because of the sedimentation of the solid. The problem has, however, now been solved by the special incorporation of a "fixateur" whereby a liquid of colloidal nature is obtained. By this means 30—40 per cent. of coal (95 per cent. of which passes a 200-mesh screen) can be suspended in oil for several months without material sedimentation. The composition of the fixateur, which is used to the extent of 1 per cent., is not disclosed. Other substances (not specified) are incorporated, the properties of which have some particular influence upon the combustion and characteristics of the fuel, *e.g.*, dispersion of solid particles, miscibility, viscosity, flash point, melting point, ash and sulphur content, drying, fluxing, and enrichment with combustible elements. Some of these substances may remain in the final product, or, having fulfilled their function, may be distilled off for further use.

One grade of colloidal fuel was devised to utilise some poor quality "anthracite rice" containing 25·5 per cent. of ash and having a calorific value of 10,900 B.Th.U. per lb.: 38½ per cent. of this was incorporated with 61½ per cent. of Pressure Still Oil, wax tailings, petroleum pitch, and fixateur running 18,505 B.Th.U. per lb. The product contained 10·2 per cent. of ash and had a calorific value of 162,500 B.Th.U. per gallon. The calorific value of the fixated oil itself was only 151,750 B.Th.U. per gallon. This increased heating value has an important bearing upon transport costs and upon the steaming radius of ships. Further research was directed towards the blending of petroleum oils and coal tars with coke and asphaltic substances. A stable liquid fuel was made up of oil 45 per cent., tar 20 per cent. and pulverised coal 35 per cent., thereby replacing over one-half of the oil. Asphaltic and free carbon particles in Pressure Still Oil may also be stabilised, thereby rendering a low sulphur oil available for metallurgical uses.—(*"Colloidal Fuel: Composites of Oil, Tar and Carbon," issued by The Submarine Defense Association, 141, Broadway, New York.*)

GENERAL.

Suspension of Work at the Avonmouth Spelter Works.—Owing to the greatly increased cost of materials and labour, and the consequent impossibility of conducting operations so as to compete with foreign producers, the directors of the National Smelting Company have decided to close down the works at Avonmouth pending the advent of better conditions. We are informed that existing contracts will be carried out but no new work will be undertaken. The Avonmouth factory was planned on a very large scale primarily to treat Broken Hill concentrates (which in pre-war times were shipped to Belgium and Germany) for the production of zinc and sulphuric acid. (See also this J., 1919, 91 R.)

Chemical Industry and the Peace Treaty.—The official summary of the Treaty of Peace presented to Germany by the Associated Powers on May 7 at Versailles imposes certain obligations on that country in regard to the supply of various chemical products. "Germany accords option to the Inter-Allied Reparation Commission on dyestuffs and chemical drugs, including quinine, up to 50 per cent. of total stock in Germany at the time the Treaty comes into force, and similar option during each six months to end of 1924 up to 25 per cent. of previous month's output." "Germany is to deliver annually for 10 years to France coal equivalent to the difference between annual pre-war output of Nord and Pas de Calais mines and annual production during about 10 years." Germany is also to give options to France and Belgium for annual deliveries of 7 and 8 million tons of coal respectively. "Provision is also made for delivery to France over 3 years of benzol, coal tar and sulphate of ammonia. The Commission has powers to postpone or annul the above deliveries should they interfere unduly with industrial requirements of Germany."

The British Photographic Research Association.—This was the first Association to be founded under the scheme of the Department of Scientific and Industrial Research, having been incorporated in May 1918. Besides the president, Sir J. J. Thomson, and four vice-presidents it possesses a chairman and a council which, composed mainly of representatives of the twenty-three associated firms, includes also Dr. H. S. Allen, Prof. J. N. Collie and Sir Herbert Jackson. The director of research is Dr. R. E. Slade, and the laboratory is meanwhile at University College, London, but research work may be carried out elsewhere under his general direction.

Among the subjects proposed for purely scientific investigation (the results of which will be published from time to time) are: The fundamental properties of silver haloids; the physical and chemical properties of gelatin and other colloids; photochemical reactions; colloidal chemistry; the theory of colour photography. The subjects of applied research will include:—Desensitisation and reduction of sensitive materials, with particular reference to insensitive spots in plates and papers and to impurities in the raw materials; the causes of the specific effects produced by various samples of gelatin with a view to the improvement and ultimate standardisation of this product; apparatus and its material, including enamels, alloys, etc.; paper and cardboard; colour photography. The Association will maintain its active interest in any result achieved in technical research until this result has been adopted on a practical manufacturing scale. Under necessary restrictions and subject to the approval of the Council, specific researches may be undertaken for individual members.

A library has been founded, relevant scientific

literature will be collated and technical inquiries from members will be welcomed. The address of the Association is: Sicilian House, Southampton Row, London, W.C. 1. Secretary: Mr. A. C. Brookes.

Protection of Oil Tanks against Lightning.—The problem of the protection of petroleum products contained in tanks and reservoirs against lightning has been one on which the most divergent views have been held, and the Petroleum Executive is to be congratulated on its initiative in publishing a bulletin which enables those interested to obtain the views of experienced men on this subject. Although theory suggests that lightning conductors should prove of great service, practical men have decided that efficient theoretical protection not only adds to the expense of construction, but is a real source of danger owing to the liability of sparking taking place between the lightning rods and the steel structure of the tank or reservoir. The general opinion is that the tanks act as efficient lightning conductors, and in the majority of cases the view is expressed that the angular portions of the framework and of the handrailing round the top of the tank should be slightly lengthened and pointed in order to efficiently carry off brush discharge. Sir Oliver Lodge emphasises the fact that he could not recommend the attachment of any lightning conductors to tanks or reservoirs containing petroleum products, but in opposition to the major consensus of opinion he would prefer the steel structure not to convey electric current at all, and to obviate this he would avoid angular points on the top of the tanks and make no provision for efficient earthing of the tanks with the ground. As the result of many inquiries and considerations, it may be stated fairly definitely that in order to protect storage tanks from lightning to the best advantage, the tanks should be provided with a large number of points and edges along the top, capable of effectually dispersing an induced electric charge; that there should be no resistance between the tank and the earth, and if built on a concrete foundation or on dry soil provision should be made for efficient earthing by means of copper conductors and earth plates. The recommendation of Sir Oliver Lodge that vent pipes from which gases are likely to escape should be surrounded with a metal cage efficiently connected with the pipe is worthy of general introduction.—(*Inquiry into the Protection of Oil Storage Tanks against Lightning. With a memorandum by Sir O. Lodge. Bulletin No.* 1. *H.M. Petroleum Executive, H.M. Stationery Office*, 2*d.*)

Dutch Margarine and Butter Industry.—Before the war the annual production amounted to about 30,000 tons butter and 100,000 tons margarine; 30,000 tons of the latter was for home consumption, and 60,000 tons went to England. The margarine industry was able to develop to such a degree because cheap raw material was available from America and sufficient milk was produced at home. The adulteration of butter was practised, particularly in North Brabant. The butter from that quarter usually had a high Reichart-Meissl value, as the makers mixed margarine with it so as to be within the lowest R-M. value allowed and sold the mixture as pure butter. This adulteration proved detrimental to the farmers and Dutch butter no longer commanded a high price on the market. Besides margarine, the Dutch Board of Agriculture permitted mixtures containing 35 or 65 per cent. butter and 65 or 35 per cent. margarine to be supplied in Holland.—(*Chem. Umschau*, No. 12, 1919.)

New Kaolin Deposits in Norway.—New strata of kaolin have been discovered in the island of Bornholm. Preliminary investigations indicate that the deposits are rich and that the quality is of the very best.—(*Berlingske Tidende, Mar.* 20, 1919.)

Industrial Uses of Seaweed.—A factory has been built in Norway for the manufacture of "Norgin" and "Tangin" on a large scale from seaweed. The former substance is similar to size, and is used as dressings for cotton and linen fabrics and by painters for the preparation of inside walls and ceilings. It is soluble in cold water, and therefore more easily applied than ordinary size. It is also used in the manufacture of soap, buttons, india-rubber hose pipes, oil paper and imitation leather. "Tangin" is a powder with special medicinal properties for use in bath-water and is recommended by the medical faculty. The seaweed undergoes a special treatment immediately after collection to prevent premature decay. The thick stalks, which are especially valuable, are barked, sliced, pressed and subjected to various chemical processes before the products are complete.—(*Teknisk Ukeblad, Mar.* 21, 1919.)

Neutral Palm Oil.—At a meeting of the Academie d'Agriculture, M. Lindet gave a *résumé* of a paper on neutral palm oil by M. Paul Ammann, director of the laboratories at the Ecole Coloniale de Nogent. It is known that palm oils always show a marked rancidity, indicated by a high acidity and disagreeable odour; this rancidity is due to the splitting of the fat by enzymes present in the vegetable tissue during the period when the fruit is subjected to excessive ripening (in order that it may easily be detached from the cones), and during the prolonged treatment of the fruit in pits or in vessels so that they may more easily give up their oil when cooked. M. Paul Ammann explains that the cones can be detached before they are completely ripe and cooked immediately in water; by this means the fruit can be just as easily detached, and the acidity of the oil produced does not exceed 0·2 per cent. as compared with 14—15 per cent. frequently met with. These neutral oils can be used for edible purposes.—(*Depêche Col., Feb.* 18, 1919.)

Mining Situation in Granada, Spain.—The acting British Consul at Malaga reports that, with the following exceptions, mining operations have been nearly at a standstill:—During the past year a Belgian company raised 5000 tons of lead ore; three British firms mined about 565,000 tons of iron ore; the mercury and calamine outputs were only 1774 kilo. and 90 tons respectively; 400 tons of wolframite was extracted by a Parisian company. Quite recently (1919) a newly-formed company has been exploiting the wolfram deposit with considerable success.

The province contains some rich and extensive deposits of iron, lead, copper and zinc ores; also lignite and some asbestos, but in every case exploitation is left to foreigners, the Spanish, and especially the Andalusians, being very lacking in enterprise. It is reported that a company is about to commence the mining and distillation of lignite.—(*Bd. of Trade J., Mar.* 13, 1919.)

Mineral Wealth of Austria-Hungary.—The *Deutsche Allgemeine Zeitung* publishes an abstract from a book by Dr. Tertsch, of Vienna, on the mineral wealth of the former Austro-Hungarian Empire.

In German Bohemia the rich deposits of wolfram and radium, and the graphite mines in Southern Bohemia, would be invaluable to German industry. German Austria is rich in iron and does not lack graphite for the iron industry. The molybdenum and quicksilver mines will doubtless come into the possession of the Slovenes. Should the Czechs retain Slovakia and the Rumanians Transylvania, the future Magyar State will contain practically no mineral wealth, whereas Rumania

will become a rich land. Austria was completely independent of foreign supplies of iron, antimony, mercury and radium, and was practically independent of imported lead. The country depended to a considerable extent upon foreign sources of zinc and silver, and the home production of copper, tin, bismuth, arsenic and platinum was less than 10 per cent. of the total requirements. In the years 1910-13 the total consumption of metals in Austria-Hungary was 24,734,370 tons, valued at 339 million kroner.—(*Bd. of Trade J., April* 3, 1919.)

Metals Required for the German Steel Industry.—The supply of metals required for the German steel industry is the subject of a recent monograph by Beyschlag and Krusch (1918), who arrive at the conclusion that sufficient molybdenum and vanadium can be obtained from home sources, but nickel, chromium and tungsten must be imported from abroad.

In 1913 Germany consumed about 6000 tons of nickel and 100 tons of cobalt. About 500 tons of the former was obtained from the nickel-cobalt ores of Frankenstein, Schneeberg, St. Blasien and Sohland, and the remainder from New Caledonia and Canada, sources which must be tapped again after the war. All the chromium used has hitherto been imported. In 1913, 23,251 tons was obtained from New Caledonia, Rhodesia and Turkey. In the same year, 400—500 tons of tungsten was extracted from native ores, out of a total consumption of 4500 tons, the imported material coming from Spain, Portugal, Argentina, India, Australia, Malaya, and England. Prior to the war, molybdenum was used in Germany solely as a source of chemical preparations; only in the works at Teutschenthal was ferro-molybdenum produced for export to England. The best native source is the Mansfeld copper schists, which contain 5 per cent. of molybdenum ore; and the wulfenite deposit at Werdenfels in Höllental near Garmisch still awaits exploitation. The total home demand could be met by the vigorous working of the native copper schists.

The demand for vanadium was very small before 1914: to-day it is from 600—800 kilo. per month. German South-West Africa (Otavi) formerly supplied 60—150 tons of mottremite, containing 8—10 per cent. of vanadium. Iron ores and clays have a small vanadium content, and slags show 0·5—0·7 per cent. vanadium; the copper schists also contain this metal. Foreign sources of supply are Colorado, Utah, Pennsylvania, New Mexico (Siena de los Cabellos), and Peru (Mina Rapros). In 1911 the last-named produced 2151 tons of ore, equal to three-fourths of the world's production. The German demand will probably be about 18 tons, and this should be obtained by recovery from slags.

The authors advise the accumulation of a reserve of the above metals, sufficient to last 5 years, which could be used instead of gold for covering the issue of paper currency. The State should acquire (metric tons):—nickel 20,000, chrome ore 150,000, wolframite 10,000, molybdenum 750, and vanadium 45. These would have a total value of 341·75 million marks (about £17,000,000.)—(*Metall u. Erz, Feb.* 8, 1919.)

Future of the German Nitrogen Industry.—Negotiations have taken place between the German Imperial Economic Office (Reichswirtschaftsamt), the Imperial Treasury and the representatives of the nitrogen industry for the purpose of founding a State nitrogen monopoly. These have now been concluded, and as a result it is proposed to establish a State Syndicate of the Nitrogen Industry, similar to the potash syndicate, with a compulsory number of shares, but not interfering with the independence of the individual enterprises.—(*Bd. of Trade J., May* 8, 1919.)

German Potash Industry.—Conditions of production were discussed at a recent meeting of representatives of the German Potash Syndicate. It was pointed out that the restriction of output gravely prejudiced the immediate future of agriculture and that the effects would be specially marked in this year's potato crop. Spring manuring has been almost wholly omitted, and the autumn manuring was uncertain. Owing to the stoppage of sales from November 1918, the year's output of potash had been only 1,020,000 instead of the expected 1,200,000 metric tons as against 1,094,000 tons in the preceding year; and lack of coal consequent on the wagon position had made impossible the accumulation of reserves. The workers returning in large numbers from the front could therefore be employed only on unproductive work. The higher wages payable for a shorter working day with a reduced output, together with the enormous rise in the price of materials, had increased the cost of production so much that even with sales at the advanced prices fixed in July 1918 the works would have to close down. Orders for 140,000 wagon-loads of potash for German agriculture were already in arrear. A later review of the industry emphasises the necessity for a check in the race between the mounting prices of food and labour and expresses great satisfaction that negotiations have been entered into at Spa for the resumption of exports to America.—(*Z. angew. Chem., Feb.* 14, *Mar.* 18, 1919.)

The Linoleum Industry in Germany.—The German linoleum industry has been almost completely inactive during the war, and in trade circles the outlook is pessimistic, for although the demand for linoleum is very great neither makers nor dealers have stocks, and it is considered unlikely that the manufacture can be resumed before the end of the year. Jute and cork might, at need, be replaced, *e.g.*, by paper, but there is no substitute for linseed oil, and that will be required by the margarine factories for a long time to come. To import linseed oil for making linoleum, even if it were possible, is out of the question owing to the cost.—(*Z. angew. Chem., Feb.* 18, 1919.)

Union of German Technologists.—At a meeting held at Eisenach on February 8 and 9, 1919, the recently formed "Union of Technologists" (*cf.* this J., 1919, 126 R) adopted a constitution and rules. Reports from all parts of the country on the campaign for the more active participation of technical experts in administrative and political life indicated that the greatest success had been attained in Würtemberg, where all technical questions arising in the Chamber must be referred to a technical commission. The committee was empowered to arrange for the publication of a daily newspaper devoted to the interests of technologists. A resolution, addressed to the National Assembly at Weimar, stated that as technical workers were indispensable to the reconstruction of national and industrial life, they were entitled to participate in all decisions affecting the welfare of the State.—(*Z. angew. Chem., Feb.* 21, 1919.)

Mineral Wealth of the S.W. African Protectorate.—Diamonds constitute the most valuable mineral product of this former German colony. They were discovered in 1908, but are now nearing exhaustion. They occur in a coastal strip of gravel which does not extend more than 15 miles inland. The yield for 1913 was 1,284,727 carats, worth £2,698,500, which was over 20 per cent. of the world's output, whilst in 1914, up to August, 5,400,000 carats, valued at £9,250,000, had been gathered. In quality the diamonds resemble

Brazilian stones; they are small, but the size increases from north to south. The largest stone weighed 34½ carats, the average is from a fifth to a sixth of a carat. The diamantiferous gravel varies from 4 in. to 30 ft. in thickness, and the richest holdings have yielded 200 carats per cubic metre at a working cost of 2*s.* 2*d.* per carat. The industry has been Government controlled since 1900, and the Kolonlale Bergbau Gesellschaft distributed during 1910–1913 dividends amounting to 112 times its capital of £5025. The highest dividend was 3800 per cent. A recent development of the diamond industry is the formation of a powerful company to dredge the ocean bed along the coast and the diamantiferous deposits of the shore. The existence of a large diamond pipe has been known for some years. The Government takes 40 per cent. of the proceeds.

Copper appears to be an increasingly productive industry; the chief deposits are in the Otavi district; other areas are Khan and Ida in the Swakopmund, and Sinclair in the Luderitz Bay districts. Exports in 1913 were worth £396,000.

The internal trade has been insignificant; the towns and villages are few; only in Windhoek do the European residents exceed 2000. The Germans have discouraged foreign interests and immigrants; there are natural barriers to the Protectorate by land and by sea, as the ports are unfavourable. Exports were diamonds and copper, and profits were external; but development of the copper industry may now give rise to a population with local demands that will stimulate internal trade. German money was, however, being invested in South-West African farms. Little more than 1 per cent. of the trade crossed the land frontiers, but with present railway facilities land trade may be expected to develop. In spite of German exclusiveness the Protectorate has not been a financial success, and with the waning diamond industry the outlook was not promising.—(*Bd. of Trade J., April* 3, 1919.)

New Manganese Ore Deposits in Panama.—H.M. Consul at Colon reports that new "bedded" and outcropping deposits of manganese ore have been discovered near Boqueron in the valley of the Chagres River. Part of the ore is broken up in boulders weighing as much as 150 tons. At two mines already started 30—40,000 tons of surface ore is in sight. Finer ores, which are bedded in clay, can be concentrated at a very small cost. At present there are two routes by which these properties may be reached, and it is probable that a railway will be built to Nombre de Dios, 8 miles away. The Boqueron River can produce adequate water power for contemplated operations.—(*Bd. of Trade J., April* 24, 1919.)

Mineral Resources of Guatemala.—Prospecting presents unusual difficulties in Guatemala because of the thick vegetation in some places and the heavy capping of volcanic ash in others. It is believed, however, that with improved shipping facilities the exploitation of a number of minerals would be commercially feasible. There is a large area in Guatemala where gold is known to exist in small quantities. Two companies are at present working this field, but operations have been hampered by war conditions. There are no silver mines in operation in Guatemala, but some were formerly worked at Huehuetenango and Chiquimula, and there are several localities which could be exploited advantageously. Lead deposits are fairly numerous, principally in the north-western districts, the ore carrying a low silver value. One small company at present mines lead, chiefly for local consumption.

Zinc is found in several places, but chiefly in Chiquimula, where it is generally associated with lead and some copper. Some of the concentrates were exported during the war when high prices prevailed. Traces of copper are found in various districts, but there are no deposits of sufficient importance to warrant commercial development.

The iron ore deposits of Guatemala, though of high grade, are of little importance. The chrome ore fields are said to be quite promising, high grade deposits having been found in several districts. About 2000 tons of ore was exported during 1918. Limestone is found in large quantities and is used in conjunction with a siliceous volcanic ash for making cement. Coal deposits have been found but require further investigation. Graphite also occurs.

A large quantity of mica has been exported to the United States during the war, and efforts are being made to continue the working of the mines. A good grade marble is found in quantity. Nitre and sulphur are worked by the Indians to supply local needs.

Titanium, mercury, antimony, and molybdenum are all known to exist in Guatemala, but no efforts are being made to exploit them.—(*U.S. Com. Rep., Jan.* 31, 1919.)

Secondary Metals in 1917.—A report by J. P. Dunlop treats of the efforts made in the United States to utilise metalliferous waste of all descriptions in place of new or primary metal, and gives details of the classification and treatment of copper, lead, zinc, antimony, tin, aluminium and nickel. The author mentions that the value of the British Army salvage for three years was estimated at $500,000,000, out of material which formerly went into the scrap heap. The price of steel from the open-hearth furnaces remained practically the same on account of the use of cheap steel scrap. By the use of the naval gun factory of its own scrap, the U.S. Government was saved $308,775 in 1917. To use the scrap to the best advantage a series of specifications were drawn up whereby the materials were classified as regards size and purity. The Eastern Brass and Ingot Corporation established several plants for briquetting machine turnings for manufacturers, adopting enormous pressures with a sharp shock in such a manner as to expel the air before the shock is delivered, thus preventing the disintegration of the ingot when fed into a hot crucible, and also effecting a reduction of about 80 per cent. in losses by oxidation. Apart from tin, the methods used for the re-smelting of the non-ferrous metals are much the same as those adopted for new metal, except that the fluxes used have to be carefully chosen in order to avoid excessive losses by oxidation.

The secondary tin recovered in 1917 amounted to about one-fourth of that imported, and was valued at about $24,000,000. The tin-plate scrap is detinned by one of three processes—the electrolytic alkali, the chlorine, or the alkali saltpetre process. The first yields spongy tin for re-smelting, the second tin tetrachloride for the silk industry, and the third tin oxide. The total recovery from this source was 3330 tons (representing about 27 to 32 lb. of tin per ton), or about one-ninth of the amount used in 1917 for this purpose. The plants established have not been working to their full capacity, as beyond a certain radius the shipment costs render treatment unprofitable. A great economy in tin has been effected by the less extravagant use of the metal in solders and bearing metals, and some useful proved formulæ are given in which the percentage of tin is greatly curtailed without loss of efficiency.

The statistics quoted show fully that the secondary metals have as much claim to the manufacturer's attention as the primary metals, and upon their economical use depends much of the future prosperity of manufacturing organisations.—(*U.S. Geol. Surv., Feb.*, 1919.)

PERSONALIA.

Prof. F. Soddy, professor of chemistry in the University of Aberdeen, has been elected to the newly established second chair of chemistry in the University of Oxford.

The Poynting Chair of Physics in the University of Birmingham has been filled by the appointment of Dr. S. W. J. Smith, assistant professor at the Imperial College, South Kensington.

The death is announced of Prof. J. J. T. Schloesing, the well-known agricultural chemist, at the advanced age of ninety-four.

Dr. A. A. Boon, who has been on the teaching staff since 1898, has been appointed professor of chemistry at the Heriot-Watt College, Edinburgh. Dr. Briggs, head of the department of mining in the same College, has been promoted to the status of a professor.

Mr. W. A. Walmsley, manager of the Clayton Works of Messrs. Hardman and Holden, Manchester, has been appointed chemist to the Corporation of Glasgow to superintend the distillation of tar, ammoniacal liquors, etc.

The widow of the late Col. Bertram Hopkinson, professor of mechanism and applied mechanics at Cambridge University, has offered £2000 towards the endowment of a new chair in the same university to be called the Hopkinson Chair of Thermodynamics. Further sums amounting to £1750 have been promised by others.

The delayed list of "New Year's" Honours has now been published. A baronetcy of the United Kingdom has been conferred on Mr. Charles Greenway, chairman and managing director of the Anglo-Persian Oil Co., Ltd., and immediate past-president of the Institution of Petroleum Technologists. The honour of knighthood has been conferred upon Mr. W. S. Glyn-Jones, Secretary and Registrar of the Pharmaceutical Society; and upon Prof. R. A. Gregory, for many years acting-editor of *Nature* and organiser of the British Scientific Products Exhibition held last year.

REPORT.

THE PRODUCTION OF OIL FROM CANNEL COAL AND ALLIED MINERALS.

The special committee appointed by the Institution of Petroleum Technologists has now presented its final report. As the outcome of the interim report issued in August last (this J., 1918, 326 R), a company has been formed to produce oil from bituminous material, to manufacture domestic and industrial fuel, and cognate objects. The company is styled the Midland Coal Products Co., Ltd., and has a capital of £100,000, which has been fully subscribed. A site has been chosen in the centre of the Midland coalfield which is adjacent to three shafts now bringing up various grades of coal, served by three railways, and generally well adapted for carrying out the operations mentioned in the Memorandum of Association. Large works are to be erected, but the company is not to confine its activities to the district in which these are situated. The undertaking is not in receipt of Government assistance, nor is it interested in any particular type of retort or process. The development of this industry has resulted in the production of various designs for new types of retorts, some of which are technically unsound, and it is anticipated that the company will be able to fulfil a very useful function in investigating new types of retorts, and in determining the most profitable use and method of treatment of any particular material, thus helping to establish the industry on a sound commercial basis.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Export of Bleaching Powder.

Sir Kingsley Wood asked whether the President of the Board of Trade was aware that German and Austrian bleaching powder is offered in the market at £11 10*s.* per ton delivered in Sweden; and that British manufacturers have been unable to ship freely to Sweden because of the time lost in obtaining guarantees from Sweden and export licences on this side; and if he would give an undertaking that these licensing restrictions and guarantees from neutral countries shall be abolished.

Mr. Bridgeman in reply said he had no information to enable him to reply to the first part of the question. There has in a few cases been some delay in the issue of licences for the export of bleaching powder to Sweden, owing to the necessity for obtaining guarantees against re-export, but an arrangement has been made with the Inter-Allied Trade Committee in Sweden that as soon as guarantees have been issued the numbers of such guarantees, with certain other particulars, should be telegraphed to the Export Licence Department, which will promptly issue the necessary licence without waiting for the actual guarantee. By this arrangement the delays complained of should to a great extent be removed.—(April 29.)

The Budget Statement.

One of the chief proposals for the new financial year is the initiation of a scheme of Imperial Preference, under which existing duties on manufactured articles and on consumable commodities, other than alcohol, coming from the Dominions will be reduced by one-sixth. The loss of revenue thereby entailed in respect of sugar will be about £500,000, only 7 per cent. of the imports of this material coming from Empire sources. The excise duty on beet sugar in this country will be reduced accordingly. The reduction in revenue on motor spirit, 18 per cent. of which is supplied by the Empire, will be about £60,000. The rate of preference on spirits will be 2*s.* 6*d.* a gallon, charged as extra duty on foreign spirits, and this will involve a loss of over £3,000,000 in a normal year. The income tax is to be left unchanged pending the report of the Royal Commission, the death duties to be increased, but the excess profits duty to be reduced from 80 per cent. to 40 per cent. The duty on proof spirit to be increased from 30*s.* to 50*s.* a gallon, and that on beer from 50*s.* to 70*s.* a standard barrel; the average gravity of the latter not to exceed 1040 (existing limit 1032).—(April 30.)

Fertilisers.

In answer to Capt. Terrell, Mr. Kellaway stated that there is no shortage of nitrate for use on the land. The Ministry of Munitions is ready and willing to dispose of its stocks of nitrates, but there is at present no appreciable demand from farmers in this country. The price is fixed by the Board of Agriculture at £20 a ton.

The same member asked the Parliamentary Secretary to the Board of Agriculture what steps were being taken to lower the price and increase the supplies of fertilisers. Commander Eyres-Monsell replied that the prices of artificial fertilisers have been fixed by Orders issued by the Ministry of Munitions up to May 31, 1919. In the cases of sulphate of ammonia and superphosphate the prices fixed were less than the cost of production. Active steps have been taken to increase the quantity available for agriculture, and in consequence this has been larger than in any previous

year. It is not proposed to continue the fixing of prices by Order during the coming season, but the Board is endeavouring to arrange by voluntary agreements among the makers that fertilisers shall be sold at reasonable prices.—(May 1.)

German Munition Factories

Sir A. Steel-Maitland, in response to Sir K. Wood, intimated that the Ministry of Munitions arranged to send over at intervals representatives of various British industries. In all, four missions were to be sent, one of which was a Chemical Mission. This has already returned and reported with regard to poison gas manufacture, and has yet to furnish reports of other matters. It was felt, however, that a commission representing chemical manufacturers should also be sent with the object of studying German chemical manufactures from a commercial point of view, and arrangements for this were undertaken by the Department of Overseas Trade. Some delay has arisen because it was found difficult to make arrangements for parties of more than six or eight at a time, while the Association of British Chemical Manufacturers urged that the group of industries concerned could not be adequately represented by a party of less than twenty. A reply has, however, now been received from the Governor of Cologne that a commission not exceeding twenty members can be received at an early date, provided that not less than seven days' notice is given. The Association of British Chemical Manufacturers has been advised accordingly; arrangements are now being made, and the military authorities are anxious to co-operate in every way in their power.—(May 2.)

Benzol Supply.

Sir A. Geddes informed Mr. Joynson-Hicks that of the 1577 gas undertakings in the United Kingdom, 186 have installed oil-washing plants and 600 tar-washing plants for the production of benzol. The Board of Trade has no power to compel gas undertakings to provide themselves with such plant.—(May 5.)

British-America Nickel Corporation.

Replying to Mr. Hugh Edwards, Sir A. Geddes stated that H.M. Government is in a position, should occasion arise, to exercise complete control over the business of the British-America Nickel Corporation, but otherwise no conditions are imposed on the actual conduct of that business. The Government has appointed representatives to the directorate, and has advanced to the Corporation $3,000,000, which is secured by the issue of 6 per cent. mortgage 15-year gold bonds. The first repayment of $250,000 for the redemption of the bonds, due on February 1, 1919, has not been paid and the Corporation has been granted permission to postpone payment by H.M. Government, which has neither received nor asked for any compensation for this accommodation.—(May 5.)

LEGAL INTELLIGENCE.

Application for Use of Enemy Patents.—On April 23, before the Controller of Patents in the Patents Court, London, an application was made by Morton Sundour Fabrics, Ltd., of Carlisle, for licences to use certain patents of the German firm of Bayer & Co. for the manufacture of dyestuffs. The patents in question were Nos. 29138/09, 2373/09 and 25986/09. The firm had previously been granted licences in respect of other processes. The Controller intimated that the grant of the licences would be recommended.

TRADE NOTES.

BRITISH.

Mauritius in 1917.—The value of the total trade of the Colony in 1917 was 100,472,188 rupees (£6,698,145, with the rupee at 1*s.* 4*d.*), showing a decrease of about 21 per cent. below 1916, but a gain of 40 per cent. over 1913. The principal reductions in imports in 1917 were in respect of grain and flour, yarns and textiles, chemicals and drugs, and the chief increases, fertilisers, chemicals for local manufacture and tobacco. The exports included:—Sugar, 187,815 tons, valued at Rs. 54,539,232; aloe fibre, 1194 tons, at Rs. 411,600; coconut oil, 112,000 litres, at Rs. 62,500; molasses, Rs. 29,000; rum, Rs. 26,600; and vanilla, Rs. 4100.

The cost of production of sugar, in field and factory, has increased since 1914 by 55·4 per cent., while the increase in the average sale price is computed at 50 per cent. compared with the pre-war average. The total crop for 1916-17 was 209,035 tons, and that for 1917-18, 226,000 tons. The whole of the vesou crop of 1917 was sold to the Royal Sugar Commission on the basis of 17*s.* per cwt. f.o.b. for the first grade sugar, but subsequently arrangements were modified to allow of a portion of the vesou to be shipped to India, together with the whole of the first syrup sugar, for financing the export of foodstuffs and essential supplies to Mauritius. The cultivation of limes, for which the soil is well suited, is under consideration.—(*Col. Rep.—Ann., No.* 985, *Feb.*, 1919.)

The East Africa Protectorate in 1916-17.—The value of the goods exported from this Protectorate in 1917 was £587,044, and the values from the other territories serving the ports of Mombasa and Kilindini were: Uganda £699,824, German East Africa £47,118 (against £448,103 in 1914), Belgian Congo £279,670 (£26,127 in 1914), and the Sudan £197.

There was an increase of about 50 per cent. in the value of hides and skins exported from the Protectorate, 97 per cent. of the total exports going to the United Kingdom. Exports of sisal and "other sorts" increased by 38 per cent. in quantity and 69 per cent. in value over the previous year. The export of grain and oil seeds, while still only 27 per cent. of the quantity shipped five years ago, increased by 85 per cent. in quantity and 108 per cent. in value. The export of copra rose from 9774 cwt., valued at £8433, to 28,748 cwt., valued at £28,748; 23 per cent. of this export went to Britain, 31 per cent. to Italy, and 45 per cent. to France. The quantity of rubber exported increased from 500 to 1001 cwt. The export of sodium carbonate amounted to 2163 tons, valued at £45,056. Of this, 1771 tons was shipped to India, 212 tons to Egypt, 100 tons to Italy, and 51 tons to S. Africa.

Sisal cultivation is rapidly increasing as a result of the establishment of electric power stations, and the very high prices obtained for sisal fibre in England. The future of this industry is regarded as most promising, a number of factories being now established in various parts of the country, the local demand for the necessary machinery being very much in excess of the supply available.

The working of the soda deposits of Lake Magadi continues to be carried on successfully, and this industry will probably develop into one of the most important in the Protectorate.

The position as regards mica remains much as it was in the previous year, the effect of the war having been to cause good prices to obtain in the home-markets, but at the same time to cut off the supply of skilled European supervision necessary to the successful working of the concessions.—(*Col. Rep.—Ann., No.* 988, *Mar.*, 1919.)

FOREIGN.

The Spanish Olive Oil Crop.—The following figures, based upon general opinion rather than definite statistics, stand for the whole of Spain, but really represent the production of Andalusia, where practically all the oil is manufactured.

The estimate for 1917-18 is 460,000 metric tons, including the hold-over from the previous year. About 23,000 metric tons was exported in 1918, and 230,000 tons consumed, leaving a balance on hand of 207,000 tons. The 1918-19 crop will be only about 230,000 metric tons: this added to the stock on hand gives 437,000 tons; the annual Spanish consumption is 230,000 tons, consequently 207,000 metric tons remain for export. Probably the Government will authorise the export of only 115,500 tons during 1919. Large exports will necessitate large supplies of barrel staves and tinplate for containers.

Practically the whole of the oil is owned by Spanish subjects and a recently appointed royal committee regulates commerce. The committee will strive to harmonise the interests of the producers and consumers of olive oil including the utilisers of by-products, such as greases and fuel.

Olive oil is an important source of Spanish income, and owing to rise of price export has been restricted. The 1918 export was only one-third of that of the two previous years.—(*U.S. Com. Rep., Mar.* 3, 1919.)

Swedish Wood-Pulp Market.—Shipments of wood-pulp from Sweden to Germany have been resumed. Large shipments from Göteborg to France and England have nearly exhausted the stocks. Price: 300 to 315 kronor per metric ton (2*d.* per lb.) f.o.b. Göteborg (kronor=1*s.* 1½*d.*). Demand for sulphite pulp has been weakened owing to the British paper controller having taken over, as from January 1, 1919, all purchases and shipments, but the demand is expected to increase when English paper manufacturers are given new import licences. The present production of sulphite pulp is about two-thirds of the normal, and stocks are about 90,000 tons less than a year ago.

Increased manufacturing expenses have enhanced prices, which are now 425 to 430 kr. per metric ton f.o.b. Göteborg for bleachable sulphite, and 400 to 405 kr. for strong sulphite. F.o.b. prices at Gulf of Bothnia are 40 kr. lower owing to freight difference; and these are 20 to 30 kr. lower than Norwegian prices.

The sulphite cellulose market has been dull since the stoppage of the manufacture of spinning paper, export of which to the Central Powers has been prohibited. In spite of greatly increased manufacturing expenses, selling prices have not been increased, and are now 370 kr. per ton f.o.b. Göteborg, and 340 kr. per ton f.o.b. the Baltic. The above prices relate to December 1918.—(*U.S. Com. Rep., Mar.* 11, 1919.)

Position of the Soda Industry in Switzerland.—A recent decree of the Bundesrat runs: "Anyone wishing to manufacture or import into Switzerland products of soda, or mixtures of which it is the chief constituent, requires a permit from the Bund. The permits are limited as regards time and quantity and may be renewed or withdrawn. The Bundesrat will attach to these permits such conditions as may serve to secure home requirements at moderate prices." In a report to the Neutral Commission the Bundesrat points out that the restricted import of coal consequent on the armistice has completely altered the favourable position of the Swiss soda industry, which will have to be temporarily suspended. The Solvay company offers soda ash at 25—30 francs per 100 kilo. delivered in Switzerland, whilst the Swiss product now costs 66·2 francs. In order to preserve its industrial independence as regards raw materials and to protect the home soda industry, the Bundesrat has decided against a soda monopoly, and against dealing with the competition between the home and foreign industries either by tariffs or friendly agreements. The embargo on alkalis of November 19, 1917, will not be enforced and the manufacture and export are freed.—(*Z. angew. Chem., Mar.* 18, 1919.)

Impending Resumption of Trade Relations between Germany and Japan.—According to the Bâle *Anzeiger*, a Japanese Commission recently left Tokyo for Italy, charged with the duty of making a trade compact with Austria, Hungary and Germany. Reuter's correspondent states that Japan will send finished goods and raw materials, principally copper, to Germany, and that she expects to receive in return chemicals and electrical goods.—(*Oester. Chem.-Z., Mar.* 15, 1919.)

GOVERNMENT ORDERS AND NOTICES.

EXPORTS.

Existing export prohibitions have been further relaxed, as follows:—

Headings transferred from one list to another.

From List A to List C:—

Aceto-celluloses; glucose, liquid; wood and timber of all kinds, hewn, sawn or split (except lignum vitæ, mahogany and hardwoods, which are on List C.)—(April 24.)

Iron ingots, plates and sheets, and sectional and constructional material of iron; steel containing tungsten or molybdenum; steel containing chromium, cobalt, nickel, or vanadium; steel, sectional and constructional material.—(May 1.)

From List B to List C:—

Bauxite.—(April 24.) Milk powder.—(May 1.)

Altered headings.

(A) Oils and fats, edible, including blends of two or more edible oils and fats, except the following (which are on List C): Hempseed oil, kapok seed oil, maize oil, mowrah seed oil, niger seed oil, olive oil, poppy seed oil, rape seed oil, shea butter, sunflower oil, dripping, premier jus.—(April 24.)

Export Licences.—The Board of Trade announces that all licences will now be accepted by the Customs Department irrespective of any time limit which they may contain.

Salt of all kinds may now be exported to Norway without licence or guarantee.

An open general licence has been issued allowing of the exportation of lactol and lactogol to all destinations except those referred to in List C.

Exports to Occupied Areas.—The general licence issued by the Board of Trade authorising, on certain conditions, the supply of goods to the occupied territories on the left bank of the Rhine, has been extended to apply to the right bank also.

The Statutory List.—The Foreign Office has notified that as from midnight, April 28-29, all Black Lists were withdrawn; there are therefore no disabilities attaching to trade and communication with firms or persons on these lists.

IMPORTS.

The importation, except under licence, of the following articles is prohibited:—Potash salts, namely, potassium carbonate, bicarbonate, chlorate, perchlorate, chloride or muriate, chromate and bichromate, cyanide, ferrocyanide or yellow prussiate, hydrate or caustic, nitrate, permanganate,

sulphate, including potash alums and potash manurial salts and mixtures containing any of these substances; saccharin and mixtures containing saccharin and other substances of like nature and use.

Restrictions on the importation of the following articles, *inter alia*, have been removed:—Yeast; antimony, crude, regulus and sulphide; waste or scrap rubber.

The importation of the following is to be licensed only exceptionally, as and when required:—Methyl alcohol; scientific glassware (for full list of articles included under this heading *v. Bd. of Trade J.*, May 8, 1919).

The importation of the following is to be restricted:—Glassware (including bottles and jars) other than scientific glass and glassware, machinery glass and glassware, optical glass and manufactures thereof, miners' lamp glasses and miners' electric lamps, are to be admitted at the rate of 50 per cent. of 1913 imports.

Dyes.—The Trade and Licensing Committee has issued a general licence authorising the importation of dyestuffs and other products covered by the Prohibition of Import (No. 29) Proclamation (this J., 1919, 94 R), which are of *bonâ fide* Dominion origin.

Paper.—The Paper Control has been abolished as from April 30. On that date the Board of Trade issued a memorandum concerning the regulations now to be enforced with regard to the importation of paper and paper goods. Importations of paper manufactured within the British Empire are free of licence, but those from foreign countries are prohibited except under licence. The conditions under which licences will be issued are set out in the *Board of Trade Journal* of May 8.

NEW ORDERS.

The Gas Works Retort Carbon, etc., Control (Suspension) Order, 1919. Ministry of Munitions, April 18.

The Seeds, Oils and Fats (Suspension) Order, 1919. Ministry of Munitions, April 29.

The Steel and Iron Supplies Control (General Suspension) Order, 1919. Ministry of Munitions, April 29. [The Schedule to the Order contains a list of 14 Orders which are suspended as from May 1, until further notice.]

The Food Controller has issued a new Order fixing maximum prices for copra, ground nuts and palm kernels, and the resultant crude and refined oils obtained therefrom.

NOTICES.

The Food Controller has issued a Notice revoking the following Orders:—The Oil Splitting Order, 1917; The Oils, Oilcakes and Meals (Requisition) Order, 1917; The Hardened Fat (Requisition) Order, 1917; The Seeds, Nuts and Kernels (Requisition) Order, 1917; The Oils and Fats (Requisition) Order, 1917; The Home Tallow and Greases (Maximum Prices) Order, 1918; The Bones (Maximum Prices) Order, 1918; and The Edible Oils (Maximum Prices) Order, 1919.

Seeds, Nuts, Kernels, Oils and Fats.—The Minister of Munitions has given notice that he has issued a general licence authorising all persons to deal in any of the seeds, nuts and kernels, oils and fats scheduled to the Orders made by the Minister of Munitions on May 1 and 9, 1917. As the operation of the various Seeds, Oils and Fats Orders of 1917 has been suspended (*v.s.*), he will in future exercise no control whatever over any of the materials referred to in these Orders.

The Board of Trade has announced (April 26) that, with a few exceptions, all controls on the sale and distribution of commodities exercised under the Defence of the Realm Act have been, or will be, abolished by May 31 at latest.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for April 24 and May 1.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Numbers
Canada	Preserved foods, sugar, syrup, cocoa butter, gelatin	753
,, ...	Chemicals, medicines, soap	755
,, ...	Chemicals, laboratory equipment, scientific instruments	756
,, ...	Chemicals, perfumes ..	c
Mauritius ..	Linseed oil, paints, turpentine, putty, glass, paving tiles	726
New Zealand ..	Soap	757A
South Africa ..	Glass bottles, leather ..	764
,, ..	Superphosphates, fertilisers	766, 767
,, ..	Chemicals, drugs, perfumery	768
,, ..	Phosphate fertilisers ..	177/3/19†
Belgium ..	Chemicals, drugs, varnish, paints	777
,, ..	Soap	780
,, ..	Fertilisers (sulphates and nitrates)	781
,, ..	Oils and greases ..	782
,, ..	Metals, glass, enamel ..	784
,, ..	Dyes, varnish, spirits, driers	785
,, ..	Glass, earthenware ..	787
,, ..	Asphalt, fertilisers, colours, varnish ..	2587 T & R†
„Netherlands	Fruit essences and colours for confectionery and mineral waters ..	789
France	Glassware, fertilisers ..	733
,, ...	Chemicals for tanning and dyeing sheepskins ..	795
,, ...	Metallurgical products ..	796
,, (W. Africa)	Rice and maize starch ..	735
Copenhagen ..	Fats and oils for the margarine industry ..	740
,, ..	Writing and lithographic paper	741
,, ..	Iron, steel, metals ..	728
Italy	Pig iron, vulcanised fibre	800
,, ...	Heavy and fine chemicals	802
,, ...	Pottery, glass	804
Sicily	Sodium nitrate, ammonium sulphate	808
Greece	Boiled oil, paint ..	736
Scandinavia ..	Soap, perfumes	807
Jugo-Slavia ..	Chemicals	805
Spain	Iron, steel, copper sulphate, caustic soda ..	744
.. .. ..	Tin, tinplate, copper sulphate	745
,, ...	Chemicals, dyes ..	746
,, ...	Fertilisers	811
Switzerland ..	Chemicals and pharmaceutical products ..	749
,, ..	Skins, leather, glass, porcelain	750
Asia Minor ..	Metals, sheet copper, paints, oils, leather ..	773
Argentina ..	Galvanised iron and wire	772

* Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

† South African Government Trade Commissioner, 90, Cannon Street, E.C. 4.

‡ Belgian Section, Department of Overseas Trade, India House, Kingsway, W.C. 2.

TARIFF. CUSTOMS. EXCISE.

***Australia.*—The importation of goods from Belgium is permitted after April 30 only where the proportion of the value of enemy material or labour in such goods does not exceed 5 per cent.**

Drawback of the full amount of the duty paid is now allowed, under certain conditions, on paper (with some exceptions) and pipe or roll gamboge.

The importation of dry foodstuffs (with some exceptions), confectionery, soap, metal and linoleum polishes and dry pharmaceutical preparations, when put up in containers made from tinplate, is now permitted.

Belgium.—An export tax of 100 francs per hectolitre of 100 degrees strength (Gay-Lussac), at 15° C., has been levied on alcohol.

Canada.—Individual licences are still required for the export to all destinations of gold and silver coin, bullion and bars, cinchona bark and products, quinine and its compounds, cocaine, opium, syrups, molasses and sugar.

China.—The new import tariff will come into force on a date to be notified later. The published duties have been fixed to represent 5 per cent. of the average values of imported goods during the five years 1912–1916. Among the articles mentioned in the schedule of duties are chemicals, medicines, dyes, pigments, oils, soap, gum, wax, varnish, glass, china, earthenware, leather, paper, matches, sugar, starch and metals. The full list is given in the *Board of Trade Journal* of May 1.

France (Morocco).—The export of castor oil seeds is now allowed to France, French Colonies, Allied and neutral countries.

Italy.—The Ministry of the Treasury has been empowered to prohibit for such period as may be considered necessary the import of foreign currency.

New Zealand.—Butyric aldehyde and cattle-dip "Killic," are now admitted free of import duty.

Nigeria.—The import duty on kerosene and all other lamp oils and fuel oils not otherwise specified is fixed at 2*d.* per gallon, with an additional charge of 25 per cent. on the amount of duty so leviable.

Serbia.—British traders who desire to learn the rate of Customs duty on any particular class of goods should apply to the Dept. of Overseas Trade.

Sweden.—The export prohibition has been withdrawn, as from April 11, on timber, iron and iron alloys (with some exceptions), some classes of paper, glassware, earthenware and some chemicals and colours.

Switzerland.—The authorisation of the Federal Council is required for the manufacture and import of caustic soda and sodium carbonate, whether pure or as the principal constituent of a mixture.

Among the articles the export of which is covered by general licence are talc, emery stones, asbestos, glass, chemical apparatus, essential oils, nicotine, glycerin, resins, glue, gelatin, gluten, putty, grease for lubricating purposes, candles, soap, incandescent mantles and liquid gum.

United States.—Cinchona bark and its products, quinine and its derivatives, have been removed from the export conservation list.

THE GOVERNMENT SCHEME FOR ASSISTING THE DYE INDUSTRY.—The Board of Trade has given notice (May 10) that the Trade and Licensing Committee has nominated the following gentlemen as the Licensing Sub-Committee to deal with all questions relating to the administration of the Prohibition of Import (No. 29) Proclamation, 1919, in respect of dyes, etc:—Mr. W. E. Kay (Calico Printers' Association); Dr. A. Rée (Association of British Chemical Manufacturers); Mr. J. Turner (British Dyes); and Mr. Thorp Whitaker (Bradford Dyers' Association). The chairman is Lord Colwyn. The offices of the Licensing Sub-Committee are at Danlee Buildings, 53, Spring Gardens, Manchester.

REVIEWS.

OILS, FATS AND WAXES. *By* P. J. FRYER *and* F. E. WESTON. *Vol. II., Practical and Analytical. Pp.* 314. *(Cambridge: The University Press,* 1918.) *Price* 15*s. net.*

This volume is supplementary to and completes the earlier treatise on this subject by the same authors, and deals with the technique of the analytical processes on which the control and elucidation of technical problems connected with the manufacture and uses of oils, fats and waxes are largely based. It stands in good relationship to the earlier one in that the method of treatment has been kept to the same lines, so that reference is made easy.

The object of the work is, according to the authors, to present an account of the methods of analysis etc. employed in this field of work, in such a detailed and careful manner that these analyses may be conducted with that exactitude and care which in no field is more necessary. The words of the authors in the footnote to page 2 must be heartily endorsed, as by faulty technique and careless procedure not only can the most fallacious results be arrived at in dealing with fatty mixtures, but, as in the technical manufacture of edible products of this nature, the question of loss is of the highest moment, so also is the question of exactitude of determination of the nature of their products at all the various stages of their manufacture.

From the vast host of analytical methods available, the authors have made such a selection as is, in their judgment, necessary and sufficient to the end in view, and when the extraordinary multiplication of perfectly useless processes for the analysis of edible oils and fats etc. is considered, such an attempt at selection is of great value both to the analyst and also to the manufacturer who has to understand such analyses, if this selection be found to be the result of experience and judgment. The selection made is a thoroughly good one, and provides ample information and guidance to the worker in this field. No doubt the apparent appeal to the student which marks all the methods may jar somewhat on the more advanced worker, particularly those who, not having learnt under a careful teacher, are apt to consider themselves infallible, yet the cautions inculcated are by no means to be considered lightly and leave the impression that the authors themselves fully understand the paths in which they endeavour to lead others.

For this reason, there is the temptation to the reviewer to be ultra-critical, and attention may perhaps be drawn to one or two points which may possibly have been quite unintentionally left open to question.

For instance, it is not quite satisfactory to instruct the student to weigh out an exact weight of recently ignited sodium carbonate taken from a desiccator, on a clock glass, particularly when the standard solution to be prepared therewith is the basis of some of the most important determinations such as the saponification value.

Again (p. 118), the Polenske value is stated to have reference only to coconut and palm kernel fats and butterfat, but the advent of such a variety of palm fats in general from many different species renders this statement too narrow. In dealing with the question of "acidity," it would have been advisable to draw the attention of the student to the fact that with coconut and other palm fats the method of expression as percentages of lauric acid is more useful and correct in practice.

Further, the statement (p. 167) that the saponi-

fication value of fatty acids is to be performed in a similar manner to that employed in determining the "acid" value of fats is likely to lead to serious error in certain cases.

It is almost invidious to pick out such slight errors as the above when so much is excellent, but this very excellence, as has been said, calls for criticism.

The great mass of figures and data given are reliable and point to painstaking care in their compilation.

The work is divided into sections dealing with (1) The general methods of analysis and investigation, (2) The interpretation of the results obtained, and (3) A scheme for attacking the problem of identifying or characterising unknown oils or fats. The scope of the book covers not only edible oils and fats, but also deals with those generally used by the soapmaker, together with waxes, rosin, turpentine, etc.

Whilst intended primarily for the analyst, it must be taken in conjunction with the earlier volume, to which it forms a worthy addition, and therefore should be of interest also to those who are directly engaged with the more technical side of this subject.

CECIL REVIS.

A SYSTEM OF PHYSICAL CHEMISTRY. *By* W. C. McC. LEWIS. *Second Edition in three volumes. Vol. I., Kinetic Theory. Pp.* 494; *Vol. II., Thermodynamics. Pp.* 403; *Vol. III., Quantum Theory. Pp.* 209. (*London: Longmans, Green and Co.* 1918-19.) *Net prices:* 15*s.*, 15*s.*, 7*s.* 6*d. per vol., respectively.*

It is distinctly gratifying to find that a second edition of this work has been called for after a period which must be regarded as very brief when one considers that the attention of chemists during the last four years has been almost exclusively directed to problems of a severely practical kind. The author could not well desire a more striking manifestation of the appreciation with which his exposition of the general principles of physical chemistry has been received. It may be possible that the many new scientific enterprises which have been forced upon the chemist under war conditions are to some extent directly responsible for the recognition of the fact that an adequate knowledge of this branch of chemistry has become an absolutely essential part of the equipment of the modern chemist, whether his activities are academic or industrial.

Prof. Lewis's work, which is intended for use as a general text-book, covers a great deal more ground than is traversed in elementary treatises on the subject. The addition of a third volume to the two which served to confine the subject matter of the first edition obviates the division of the second volume into two parts, and is in the author's opinion justified by the rapid development of the new ideas which are associated with the quantum hypothesis, the claims of which to separate treatment are based on its successful application to problems which the kinetic theory and thermodynamics alone are incapable of solving.

The prefatory chart which indicates the mode of subdivision of the subject matter in the separate volumes might possible suggest that considerations of convenience and utility had been sacrificed to the rigours of a system, but in point of fact there is no evidence of this in the actual arrangement which has much to be said in its favour.

The detailed treatment of the subject matter is characterised by thoroughness, lucidity of exposition and suggestive criticism. The reader is brought into contact with the results of recent research, and with the memoirs which are usually regarded as physico-chemical "classics" by the inclusion of extracts from original papers. At every point, the book conveys the expression that the author has kept in very close touch with the recent advances which have been made in this rapidly expanding branch of physical science. It might possibly be urged that the illustrative experimental data are not always the best available, but this is a minor blemish in what can only be described as an excellent piece of work.

New additions to Volume I. comprise an account of crystal structure on the basis of *X*-ray measurement, of various aspects of the colloidal state, of the dual theory of catalysis and of Langmuir's investigations relative to the mechanism of surface effects in heterogeneous systems. In Volume II. the chief attraction is the addition of a new chapter on osmotic pressure. In Volume III., which is unique in many ways, the physico-chemical applications of the principles of statistical mechanics are dealt with, and the necessity for modifying the fundamental concepts thereof by the introduction of new ideas, such as are involved in the quantum hypothesis, is clearly indicated. The author is however under no illusion with respect to the position of the new ideas and recognises that the position of the quantum theory is not yet satisfactorily defined, although the sum total of evidence in its favour is considerable.

The new edition differs from the old in an increase in the size of the page and in the changed character of the letterpress. One of the least satisfactory features of the first edition has thus been remedied by the publishers in the issue of the second.

H. M. DAWSON.

PUBLICATIONS RECEIVED.

BOILER CHEMISTRY AND FEED WATER SUPPLIES. *By* J. H. PAUL. *Pp.* 242. (*London: Longmans, Green and Co.* 1919.) *Price* 14*s.*

CATALOGUE OF LEWIS'S MEDICAL AND SCIENTIFIC CIRCULATING LIBRARY. *Including a classified index of subjects with the names of those authors who have treated upon them. New Edition (revised to the end of* 1917). *Pp.* 492. (*London: H. K. Lewis and Co., Ltd.* 1918.) *Price* 12*s.* 6*d.*

AT A GLANCE. TWELVE CONVERSION TABLES FOR INTERNATIONAL VALUES OF BRITISH, METRIC, AND RUSSIAN WEIGHTS, MEASURES, TEMPERATURES, AND DATES. *By* J. E. SLACK *and* A. DOREY. *Pp.* 75. (*London: The Technical Publishing Company, Ltd.* 1918.) *Price* 7*s.* 6*d.*

DESIGN OF CONCRETE MIXTURES. *By* D. A. ABRAMS. *Bulletin* 1. *Pp.* 20. (*Chicago: Structural Materials Research Laboratory, Lewis Institute. April,* 1919.)

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. *Department of the Interior.* (*Washington: Government Printing Office.* 1919.)

QUICKSILVER IN 1917. *By* F. L. RANSOME. *With a Bibliography by* I. P. EVANS.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA IN 1917. *Mines Report. By* V. C. HEIKES.

SECOND REPORT ON COLLOID CHEMISTRY AND ITS GENERAL AND INDUSTRIAL APPLICATIONS. *British Association for the Advancement of Science.* 1918. *Pp.* 172. (*Published for the Department of Scientific and Industrial Research by H.M. Stationery Office.* 1919.) *Price* 1*s.* 6*d.*

A STUDY IN THE PERFORMANCE OF "NIGHT-GLASSES." *By* L. C. MARTIN. *Bulletin No.* 3. *Department of Scientific and Industrial Research. Pp.* 39. (*London: H.M. Stationery Office.* 1919.)

STATE *v.* PRIVATE ENTERPRISE IN CHEMICAL INDUSTRY.

There is a tendency in some quarters to assume that methods which have led to success in war-time will be equally successful in times of peace. The assumption by the State of the control of certain industries, such as food production and the manufacture of munitions of war, was undoubtedly rendered imperative by the extraordinary exigencies of the time, and the end attained bears witness to the efficacy of the means employed; but, *tempora mutantur*, and it does not follow that these means would be practicable, equitable or conducive to economic well-being under entirely different circumstances. The subject of State *v.* private management in its application to the explosives industry was treated in a lucid and convincing manner by Mr. R. G. Perry, chairman of the Association of British Chemical Manufacturers, in his evidence before the Coal Industry Commission on May 16 last. The advocates of State-ownership on that Commission, who were apparently pre-convinced that the solution of the problem of munitions supply was due solely to State enterprise, cannot have received his evidence with much gratification, but their dissatisfaction will not be shared by those who believe, with the witness, that State management, as we know it, fails in peace-time because it lacks foresight and initiative, and that its success in time of war depends very largely upon assistance received from private sources.

Mr. Perry stated that as chairman of Messrs. Chance and Hunt, Ltd., and as responsible manager of H.M. Factory, Oldbury, he had had practical experience of both private and State enterprise. Although TNT had been adopted by the War Office as a standard high explosive in case of war, when the time came it was found that no adequate provision had been made for its production in bulk, plant was non-existent, and there was apparently no War Office official able to specify the process or design the necessary plant. In December, 1914, the War Office entered into an agreement with Chance and Hunt, Ltd., by which that company placed the whole of its resources, material and personal, at the disposal of the Government for the erection and operation of a national factory to manufacture high explosives. The Government was not able to meet the agreed condition to provide specifications of the process to be employed, designs of plant, etc., until after the arrival of the American chemical engineer, Mr. K. B. Quinan, in January, 1915. The production of finished TNT was commenced at Oldbury 14 weeks after the cutting of the first sod, and before the end of 1915, 3000 tons had been produced. The *personnel* of the second national factory, Queensferry, was drawn mainly from scientific and business men and not from Government Departments; it was under Government control, and the producing stage was not reached until one year after constructional work was started. There are many reasons which may be urged to account for the greater length of time taken to secure production at Queensferry as against Oldbury, but the point is that the initial step taken to secure an adequate supply of high explosive was to utilise an existing firm of British manufacturers, which, with the full assistance of a Government Department, obtained results more quickly than were afterwards achieved.

Refuting evidence given by Sir L. Chiozza Money, the witness said that the initial work of building up an explosives industry commensurate with the vital needs of the forces was performed by the Department of Explosives Supply while it was under the ægis of the War Office. The success achieved was due as much to the private firms to which the Government Departments communicated their needs as to the co-ordinating work performed by the latter. The fact that the War Office was compelled to hand over to an entirely new Department—the Department of Explosives' Supplies—the responsibility of providing such a vital need of war as explosives was an argument against complete reliance upon the principle of placing productive operations solely in the charge of Public Departments not subject to periodic judgment by results, as is the case with private companies. Mr. Perry also controverted the evidence of Mr. Sidney Webb. There were no data to support the contention that sulphuric acid could be produced more cheaply at State factories than in private works. The best practice of British manufacturers was at least equal in efficiency and cost of production to the best results of competitors overseas. The sole reason of the small production before the war was lack of demand, due largely to the absence of a dye industry.

In the autumn of 1914 the War Office pursued the policy of purchasing sulphuric acid from America; no encouragement was given at that time to home producers to extend their plants or erect new ones; British producers and experts were not consulted; and in the result probably not more than 75 per cent. of the acid purchased reached its destination.

The early purchases of TNT in the United States were at the rate of over 4*s.* per lb.; the cost of production of the 50,000 tons supplied by the Oldbury factory was 14·4*d.* per lb., inclusive of all charges, capital and operating.

The State-owned factory at Langwith for the manufacture of ammonium perchlorate began production many months after the privately erected works of the United Alkali Co., although the latter was started three months later than the former. The increase in the production of ammonium nitrate from about 100 to 4000 tons per week was effected by the Department of Explosives Supply making known its needs to the manufacturers, who overcame the difficulties presented, devised new processes, and, by extending their own organisations, achieved results that at one time appeared impossible.

PRODUCTION OF GLYCERIN FROM MOLASSES.

ARTHUR R. LING.

In view of the apparent close structural relationship between the monohexoses, glucose, fructose, etc., and glycerin, the conclusion seems justified that it ought to be possible to obtain the latter compound by the fermentation of these sugars under certain conditions with one of the saccharomycetes or yeasts. Nor is this mere speculation, for be it remembered that Pasteur in 1858 observed that glycerin and succinic acid, albeit in traces only, are invariable products of the so-called alcoholic fermentation of the sugars, and this is now a well-established fact. Moreover, there is every reason to believe that the glycerin at all events formed in this way owes its origin directly to the sugars and not to the secondary constituents always present in those fermentable liquids, worts, musts etc. met with in commerce. In this connexion it may be pointed out that F. Ehrlich showed in 1907 that the higher alcohols and esters present in fermented worts and musts are derived from the amino acids and not from the sugars. In 1909 he brought forward evidence that succinic acid is formed in the same manner.

Despite numerous attempts to obtain glycerin in such quantity by the fermentation of sugars that its production in this way would become commercially profitable, no success has up to quite recently been met with.

A report from the Laboratory of the Internal Revenue Bureau, Washington, dated May 6, 1918, has within the past few days been placed in the hands of the writer. In it experiments are described indicating that the problem of the production of glycerin by the fermentation of sugars in such a yield as to be of commercial significance has been solved.

It seems that Dr. Alonzo Taylor, then Assistant Secretary of Agriculture, reported that when in Germany in the summer of 1917 the Germans were producing glycerin in large quantities by a fermentation process. Investigations were undertaken at four different laboratories in the United States with a view to elucidating the problem, and Mr. A. B. Adams, Chief Chemist of the Laboratory of the Internal Revenue Bureau, Washington, was able to report to the Hon. Daniel C. Roper, Commissioner of Internal Revenue, three months after the work had been assigned to the laboratory, that Mr. John R. Eoff had solved the problem in so far that he was able to produce glycerin in such quantities that if the actual cost of the recovery was not too high the process would be commercially profitable. Details of the process have been furnished to the British and French authorities, and to interested manufacturers in the United States.

The report in which the experiments are described in detail is signed by Messrs. John R. Eoff, W. V. Linder, and G. F. Beyer.

After numerous trials with pure cultures of different yeasts, *Saccharomyces Ellipsoideus (var. Steinberg)*, No. 657 of the collection of the American Museum of Natural History, New York, was selected as most suitable. Preliminary experiments were then instituted which ultimately led up to the following general conclusions:—

The best yields of glycerin were obtained by fermenting solutions of sugars containing 5 per cent. of sodium carbonate, which must not be added to the liquid all at once. A less quantity of the alkali diminishes the yield of glycerin, whilst a larger quantity stops fermentation. Other alkaline substances, sodium hydroxide, potassium hydroxide, and borax may be used, but sodium carbonate (soda ash) is preferable on account of its cheapness. Although no hard and fast rule can be laid down for the method of adding the sodium carbonate, which must be varied according to the nature of the sugar solution, it should be added as soon as the fermentation has well started, and in as large quantities and as frequently as is possible without stopping fermentation. The earlier the addition of the alkali, the higher the yield of glycerin will be. It is necessary that the yeast be "worked up" by making a "bub," and it has been observed that the presence of ammonium chloride in the fermenting liquid augments the yield of glycerin. The most favourable temperature for the fermentation is 30—32° C., and the fermenting liquid should not vary from these limits of temperature for any considerable period. Higher temperatures lead to a loss of alcohol and glycerin, and to the formation of objectionable substances, whilst smaller yields of glycerin are obtained at lower temperatures. The most favourable concentration for the sugar solutions lie between 17·5 and 20 grams of sugar per 100 c.c. It has been found that when fermentation is complete according to the method above outlined, 20—25 per cent. of the sugar originally present in the liquid is converted into glycerin, and practically all the remainder into alcohol and carbon dioxide. The nature of other substances which are formed has not yet been determined. It is mentioned that when the sodium carbonate has been added to the fermenting solution in sufficient quantity, a copious precipitate is formed, the evolution of gas ceases, and the yeast apparently lies dormant for a while. The precipitate eventually disappears and the fermentation again proceeds. It is essential that this precipitate should form, and that the fermenting liquid lie quiescent for a while. The addition of the sodium carbonate in solid form has been found to produce better results than if it be added in the form of a solution.

A description is next given of the process as carried out on a commercial scale, using inedible "black strap" Porto Rico molasses.

The yeast starter or "bub" is first prepared in the following manner. Yeast No. 657 (see above) was seeded with a platinum loop into 150 c.c. of sterile grape juice, and allowed to ferment to the final degree. Fifteen c.c. of this was then added to 150 c.c. of sterile grape juice, and when fermentation had finished 75 c.c. was added to 800 c.c. of a solution of sterilised "black strap" molasses at 21·2° Balling (about sp. gr. 1·085). As soon as brisk fermentation had set in, 3 grams of soda ash was added and the bottle shaken until solution was complete. After fermentation had resumed, and when it had reached its final point, the whole of the liquid was added to 2 gallons * of a similar "black strap" molasses solution, and this was treated at the proper time with soda ash in the same proportion as before. Fermentation being complete, the whole two gallons was added to 40 gallons of a solution made as follows:—

"Black strap" molasses was dissolved in sufficient water to make 425 gallons of wash at 21·2° Balling at 25° C. Eight pounds of ammonium chloride was added, and after the liquid had been sterilised sufficient sterile water was added to bring it back to the original density. This solution contained 16·85 per cent. of sugar. The following are the details of the main fermentation:—

17.11.17., 9 A.M.—40 gallons of wash (see above) seeded (see above).
3 P.M.—2 lb. soda ash added.
9.15 P.M.—The 40 gallons added to 385 gallons molasses wash.
18.11.17., 12.30 A.M.—Added 24 lb. soda ash (T. 30° C.).
3.30 A.M.—Added 36 lb. soda ash (T. 31·5° C.).
5.30 A.M.—Added 48 lb. soda ash (T. 33° C. Attemperated to 30° C.).
11 A.M.—Added 48 lb. soda ash (T. 32·5° C. Attemperated to 30° C.).
5.30 P.M.—Added 36 lb. soda ash (T. 32° C. Attemperated to 30° C.).

The fermentation was then allowed to proceed to completion, which took five days, the temperature being kept at about 30° C.

At the conclusion of fermentation the wash was analysed and the following results were obtained:—Glycerin, 3·1% by vol.; alcohol, 6·75% by vol.; sugar (apparent), 0·86% by vol.; alkalinity, 3·6 grms. Na_2CO_3 per 100 c.c.

The purification of the fermented wash was then carried out as follows:—3200 lb. of the wash was neutralised in a tank with sulphuric acid, and 12 gallons of a saturated solution of commercial ferrous sulphate (copperas) added. The wash having been brought to near the boiling point, milk of lime was added until there was an excess

* The gallon referred to in this article is the U.S. gallon. The factor for the conversion into the British gallon is 0·834.

of lime in solution, when the wash was boiled for half an hour by means of a steam coil. The liquid was next passed through a filter press, and the cake steamed. The copperas and lime treatment was then repeated, and after again being passed through a filter press the alkalinity was brought to 0·2 per cent. (Na_2CO_3) by the addition of soda ash. It was then filter pressed and steamed, and the filtrate evaporated in a vacuum evaporator to a thick syrup which contained between 30 and 35 per cent. of glycerin. It was then distilled in a still resembling that of Jobbin. About 50 lb. of dynamite glycerin was thus obtained, or roughly about *half that present in the fermented wash.*

The following is an analysis of a sample of the dynamite glycerin:—

Sp. gr. at 15·6° C., 1·2616; carbonaceous residue, 0·058%; ash, 0·009%.

The carbonaceous residue is high, but a redistillation of the glycerin gave a satisfactory product. The glycerin was found to nitrate normally.

It is noteworthy that it has been found that the second treatment of the fermented wash with copperas and lime is superfluous. Hitherto it has not been found possible to obtain a perfect crude glycerin from molasses.

Several additional experiments have, it is stated, been carried out on a much larger scale—2000 gallons—with the same results.

It will be remembered that in an earlier part of this report it was mentioned that from 20—25 per cent. of the sugar originally present in the mash is converted into glycerin. Taking the sugars actually fermented in "black strap" Porto Rico molasses as 50 per cent. of the molasses (and this is a very liberal estimate, for it may be computed from the figures given that nearly 3 per cent. of the sugar in the molasses is left unfermented), and remembering that only half the glycerin formed is recovered as crude glycerin, the yield of glycerin could not be expected to exceed 5½ to 6 lb. per cwt. of the molasses dealt with. It is only fair, however, to quote the following remarks of the signatories of the report. They say:—

"It must be borne in mind that there is considerable alcohol produced in these fermentations. At the present price of alcohol and raw materials it is safe to say that the value of the alcohol balances the cost of all material and overhead charges entering into the production of the fermented mash. This being true, then the slop from the alcohol distillation which contains the glycerin is had free of cost, so that the only cost to be considered for the glycerin would be that of purification and distillation. This should not be great. No attempt has been made as yet to recover the alcohol, it being deemed a matter offering no difficulty."

Experiments have also been carried out on a large scale using cane sugar and starch glucose as fermentable material. It was found, however, necessary in these cases to employ yeast foods in quantities that deleteriously influenced the purification of the glycerin. It was therefore concluded that these materials possess no superiority over molasses for the purpose.

Since the process of producing glycerin by fermentation is in its present state of development restricted to molasses, the writer would point out that in some parts of the world, notably in Australia and Fiji, molasses is a waste product which is run out to sea. The present process should, therefore, be of great significance in such countries. There are several details in this process, as outlined in the report, which in the writer's opinion are open to criticism. As, however, a year has elapsed since the report was officially handed in, further developments may have eliminated the applicability of these criticisms.

THE SMELTING OF ZINC ORES.*

The zinc industry has never been one of any substantial magnitude in Great Britain although, normally, this country is a heavy consumer of the metal. Nominally producing some 60,000 tons yearly, probably not more than half this quantity was primary spelter (*i.e.* produced direct from the ore), the remainder being recovered from galvanisers' residues, etc. The need for the establishment of a sound British industry was duly appreciated at an early stage in the war but, although additions have been made to our producing units, the position is still very far from satisfactory. The outbreak of war found the world's production of zinc substantially in the hands of three countries, the United States, Germany and Belgium. Germany and Belgium becoming impossible as sources of supply, we and our Allies were thrown almost entirely on the resources of the United States for our vitally pressing war needs. The result was an enormous inflation of prices, which soared until the quotation for ordinary brands of spelter reached about £115 per ton. More serious still was the case with the special brand of fine zinc with a guaranteed purity of 99·9 per cent. or thereabouts, so essential for the production of cartridge and spinning brasses, which rose at one time to about £180 per ton. The bulk of this, redistilled in retorts, was supplied to us by the United States, but a considerable quantity came from Norway and Sweden, where it was produced by distilling ordinary spelter in electric arc reverberatory furnaces. Our domestic industry did everything possible, with the limited instruments of production at its command, to maintain the maximum output until the incessant demands for men for the army and shortage of zinc ores caused by shipping restrictions had the inevitable result of bringing about a considerable drop in output. Even existing metallurgical works were not able to bring new additions to plant into use, or even to utilise more than a fraction of their original plant. A further limiting factor was the lower grade of zinc ore available, practically all imported ore coming from Spain and Northern Africa with small sporadic shipments from Italy and Sardinia. Coupled with these difficulties, grave enough in themselves, were the restrictions on all stores, iron, steel, refractory materials and fuel.

The demand upon the resources of the United States was so clamant and so enormous that, freed from practically all the disabilities of war, as also from the restrictions caused by Government control, munitions levy or excess profits duty, feverish haste was displayed by private enterprise in that country in not only augmenting output from existing plants to the utmost, but in bringing back into operation derelict plants long abandoned, and in building huge new ones at an unprecedented rate. It is said that at the new plant at Donora productive work with one section actually commenced 143 days after the cutting of the first sod, constructional work having been carried on without pause, night or day, with the assistance of a huge scheme of artificial illumination.

These facts are mentioned in order to emphasise the point that such an atmosphere of scramble on all sides—one where practically all normal considerations of commerce and economics were subordinated to the call for output at almost any cost—was one little conducive to substantial tech-

* From a lecture delivered by J. C. Moulden at the Royal School of Mines on May 1: being the first of a series arranged particularly for the benefit of men who have been away on war service, and dealing with subjects in which there have been recent developments.

nical progress along commercially economic lines. It cannot be said that no progress was made, but it was certainly a minimum in ratio to the work done and tonnage output. In the circumstances, what would under all normal conditions have been metallurgical crimes became virtues.

With the ending of the war we are faced with an entirely new set of circumstances upon which to base our industrial future—circumstances which do not correspond with those of pre-war times nor, of course, with those of the belligerent period, and an intelligent concept of them is a necessity if we are successfully to maintain and expand our domestic zinc smelting which our Government recognises as a key industry. As we now stand, the United States as a producer is so far in advance as to eclipse all others. Germany, previously occupying second place, is an unknown quantity, and Belgium, we are advised, has so far been crippled that two years must elapse before substantial rehabilitation of zinc smelting can take place. Britain has potential plant capable of producing, say, 100,000 tons per annum if in full operation, but adverse factors such as labour, delay in reconstruction, coal, refractories and others, prevent anything like a rapid realisation of this figure. The British Government has arranged to handle the output of the Broken Hill concentrates, formerly contracted for by the Germans. At the time of the armistice, over 500,000 tons of these concentrates had accumulated and they are now arriving in this country to the exclusion of all other ores, with the exception of a little calamine from Italy and Sardinia.

The treatment of Broken Hill concentrates presented, however, special difficulties. The average composition was zinc 47 per cent., lead 4 to 6 per cent. and 8 to 12 oz. silver. The zinc mineral is popularly referred to as blende, but there is practically no real blende in these mines; the mineral is actually marmatite in which the zinc is partly replaced by isomorphous iron and manganese. It is this mineral which causes so much of the trouble in roasting the Broken Hill concentrates, for while the oxides of iron and manganese probably exert a beneficial catalytic action in assisting the removal of the sulphur, they also tend to form a compound of zinc, manganese and iron oxides, practically free from silver and lead and similar in composition to the mineral franklinite, which accumulates on the hearth of the furnace and, if not removed, ultimately breaks the rabbles of the mechanical furnaces. Roasting is carried out in open and muffled furnaces and the latter are essential if the sulphurous gases are to be utilised for the production of sulphuric acid. Muffled furnaces are operated by hand and mechanically. Of the former, the Delplace is greatly superior and uses from 11 to 13 per cent. fuel compared with 18 to 25 per cent. consumed in the Rhenish type. Mechanical furnaces such as the Hegeler and Merton work well with the simpler and cleaner English and American blendes, but are not satisfactory for the complex Broken Hill concentrates. The Ridge furnace is now being successfully used in England on a mixture of English blende and Broken Hill concentrates. Mechanical furnaces are successfully employed at Anaconda, but there the problem is of a different nature. The roasted ores are leached for electrolytic treatment and the aim is to get the maximum amount of soluble zinc sulphate; it is found that if the temperature is not allowed to exceed 732° C. and the amount of air limited, the maximum amount of sulphate and the minimum amount of insoluble zinc ferrite are formed.

In roasting for retort distillation, the total sulphur as sulphide should not exceed from 0·85 to 1 per cent. The temperature necessary to decompose zinc sulphate is between 900° and 950° C. Much had been said of the evil effect of lead in retort distillation but it was not nearly so objectionable as the matte which was formed by residual sulphur and which, by its action on the retort, was probably the worst enemy of the distiller. Ores running so high as 25 per cent. of lead have been smelted without any difficulty. Blast roasting in Dwight-Lloyd machines has been carried out experimentally with some success by Rigg and Warner at Port Pirie, S. Australia, but losses of zinc occur from causes not yet traced.

With regard to retort practice, there is very little progress to report. Mechanical charging machines such as those of Simmons and Dorr-Delattre have been adopted in a few cases, and it is very desirable that they should become more general in Great Britain. The work of Roitzheim and Remy on the use of continuous vertical retorts appears to offer a promising field for research, but full details of the experiments, which were carried out in Germany, are lacking. There is also distinct promise in the idea, carried out at Bartlesville, U.S.A., to distil large tonnages of roasted ore in retorts for a recovery of only 60 per cent. of the zinc, and to treat the retort residues in Wetherill grates for the volatilisation and recovery of the remainder in the form of zinc oxide for use as pigment. The final yield would be high, and the high cost and heavy fuel consumption involved in recovering by distillation the extra 10 or 20 per cent. of zinc in the retort would be avoided. Two other lines of research suggest themselves as worthy of further attention, *viz.*, briquetting or "egging" the ore, and pre-reducing the charge. In retort practice, there were three stages: first, the moisture was driven off; second, the iron oxides were reduced with evolution of oxygen, and thirdly metallic zinc was reduced and volatilised. By the use of preheated ore, an economy would be effected because the retorts would contain more material and less oxygen would be evolved with the probability of a decrease in the amount of blue powder.

In addition to the usual difficulties regarding labour with which this country has to contend, there is a very strong prejudice against zinc smelting. It is admitted by Trade Union officials to be unjust and, although hot and dusty, conditions at the zinc works are no less favourable than in other industries. However, the prejudice exists, and in the economic interests of the industry labour-saving contrivances must be installed.

Troubles arising out of the use of refractories from home sources are not so much due to the lack of suitable material in this country as to the absence of systematic treatment and sorting of such refractories and clays as are available. Great care and judgment are necessary in the choice and preparation. Mixtures containing carborundum, zirconia, etc., have been tried. Zirconia up to 5 per cent. (the economic limit at present cost) showed no improvement in the lasting properties of the retort.

Flotation methods of concentration have not only been of incalculable value in the case of Broken Hill ores but have also rendered electrolytic treatment generally possible. When electrolysis of zinc sulphate solutions was first attempted at Cockle Creek, it was soon found that the acid treatment of the crude ore caused the formation of large quantities of gelatinous silica which prevented filtration with heavy losses of zinc. As flotation concentrates contain very little silica, this difficulty is now avoided. At Anaconda electro-deposition of zinc from sulphate solutions is carried out successfully on a large scale, and at Risdon, Tasmania, 100 tons of electrolytic zinc is being produced weekly. It is not possible to give costs or to prophesy whether the methods will be found

economical under normal conditions. The chief factors for successful working are purity of solution and cost of power. For example, so little as 0·03 per cent. of cobalt in ore is objectionable and must be removed from the solution before electrolysis.

COST ANALYSIS IN CHEMICAL MANUFACTURE.

PART I.

ORIGIN AND SCOPE OF THE GOVERNMENT METHOD.

Two valuable reports on the "Costs and Efficiencies for H.M. Factories controlled by Factories Branch, Department of Explosive Supply," have been issued from Storey's Gate, the headquarters of this branch of the Ministry of Munitions. These reports give very interesting and detailed information as to the costs of production of explosives, and of the acids etc. used in making them, at various Government factories during the war. But of even greater interest than the data contained in the reports is the method of cost analysis adopted in arriving at them, and the uses to which this analysis has been put. The reports illustrate a development in methods of controlling manufacture which chemical manufacturing firms, and especially big manufacturing combines, are likely to find of great service.

A foreword to the second report, written by Mr. K. B. Quinan, explains the origin of both reports by relating how the stimulating system of instructive administration of which they form the text came into operation. Incidentally, he throws light on the history of the development of our explosives manufacture during the war. In the earliest stages of the war the anticipated demand for explosive products was met by enlarging existing factories, a step which not only made possible a rapid increase in production but obviated the need to recruit and train new technical staffs. But the limits of this policy were soon reached, and early in 1915 the Committee on the Supply of High Explosives, of which Lord Moulton was chairman, inaugurated the policy of erecting new and national factories. The following year the scope of these Government Factories had increased to such an extent that a separate branch (the Factories Branch) of the Department of Explosives Supply was organised to administer them. Only when an attempt was made to collect the necessary technical data and assistance from existing factories did it become evident that owing to the extraordinary demands of war there was—practically throughout the entire country—a regrettable lack of available accurate technical data, and an even greater lack of trained technical men. The great explosives and chemical companies of the country were all doing their utmost to meet the call for explosives, and their technical staffs were already sorely overtaxed. It was necessary to rely almost entirely for the staffing of these proposed new factories upon the young and, usually, inexperienced chemists of the country; moreover, the scale upon which manufacture had to be faced was so enormous as to be unique, and it was frequently necessary to devise entirely new methods and plant suitable for bulk production.

Mr. Quinan met these difficulties as follows in the case of those factories of which the construction and operation was entrusted to him. First he arranged that it should be possible to take daily accurate stock of materials produced and in process on any plant, and he had drawn up in readiness, even before the larger factories came into operation, a set of daily, weekly, and monthly technical report forms and a more or less complete system of accounting, so that from the outset information concerning the efficiencies of the various processes and the costs of production could be obtained from those in charge, and could be rendered available for circulation. Further, he inaugurated a system of monthly meetings or technical conferences over which he presided. These were attended by representatives from the various Government factories. At these meetings the work of the various factories was compared—instruction being given as to the technology of the various processes and plants—and the relation between the cost of manufacture and efficiency of working was brought out. To do this the more clearly, a graphical system of costs representation was adopted. This appears throughout the two reports before us, which were prepared for the fourteenth and seventeenth costs meetings respectively—the latter meeting proving to be the last, owing to the sudden suspension of hostilities.

In order to collect and tabulate the technical and costs statistics for these technical meetings, a statistics branch was formed under Mr. S. I. Levy. The first report covers the working of Government TNT and propellant factories, as far as data are available, from June, 1916, to December, 1917. For TNT factories, costs are shown for three six-monthly periods, but for cordite factories data are available for two six-monthly periods only. The second report covers the working of the TNT and propellant factories for the months of May and June, 1918, and for various six-monthly periods up to and including January—June, 1918. In addition, costs are given for the manufacture of calcium nitrate, ammonium nitrate, picric acid, tetryl and ammonium perchlorate, and sections have been included on steam, gas producers and electric power.

It is interesting to note that in this report it has been possible to show costs for many manufactures at two Canadian factories, for American Grillo and chamber plants, for nitric acid manufacture and sulphuric acid concentration at a British trade factory, and for cordite at another trade factory. Evidently the recognition of the value of this comparative costing was becoming more widespread (possibly owing to the printing of the first report), and data from outside sources were being supplied to the Factories Branch, Statistical Section. Figures are also shown for the consumption of materials in tetryl manufacture at the Royal Gunpowder Factory, Waltham Abbey.

The graphs representing the costs have been drawn for comparative purposes. They provide the means of comparing, for any one product or process, the cost:—

(i) At any particular factory during successive periods.

(ii) At different factories during the same period.

(iii) In some cases, with different plant, during the same period—*e.g.*, in the case of sulphur trioxide production on Mannheim, Grillo and Tentelew plant, and, in the case of concentration, on Cascades, Gaillard Towers, Kesslers and Gilchrist.

Hence the graphs show at a glance what improvement a factory is making, how it compares with its fellows, and how the use of different plant affects the costs of working.

In order to make costs comparable, raw materials have been charged to all factories at a uniform flat rate for 100 per cent. materials, and factors have been noted which might operate favourably or otherwise against a factory. For example, in calculating the comparative cost of nitric acid production, although the cost of handling nitre cake has been included, no credit has been allowed to

any factory for sale of nitre cake as some factories were compelled, owing to local conditions, to dump the material; again, since all factories were not provided with nitre bag washing plant, the costs of running this plant, where it existed, have been excluded from the cost of nitric acid production. Similarly, pure glycerin has been charged at a flat rate even when a factory has purified its own glycerin, as in a factory where there is no glycerin distillery the pure material has to be purchased.

A careful analysis has been made of all costs. The cost of production is made up of two main items—cost of raw materials and service charges. On this comparative basis the cost of raw materials reflects directly in most cases, and is always largely influenced by, the efficiency of production. The service charges are divided under five main headings, shown separately on the graphs, but given as a total in the accompanying tables. They are:—(1) Labour, (2) fuel, (3) water, steam and power (denoted by W.S.P.), (4) maintenance, and (5) general. This allocation of costs makes it possible to see at once which are the heavy items of expenditure and where economy might be effected.

The heavier of the two main items in the cost of production is the cost of raw materials, so that economy in raw materials usage stands out at once as a goal to be aimed at. Further, the submarine campaign was making the necessity for this economy urgent from other than financial motives, so that it is not surprising to find from the graphs —*e.g.* Graphs 1A and 3A of the second report—that an improvement in plant efficiency seems to have been the first point to be tackled. There appears to have been rapid improvements here.

The second item in the cost of production, that of service charges, is apt at first sight to be overshadowed by the cost of raw materials, but as economy in the latter was gradually effected the question of services came more and more to the fore, and throughout the second costs report the necessity for economy in this direction is insisted upon. The growing shortage of labour throughout the country was emphasising this point. Again and again in dealing with successive products it is reiterated that service charges have become one of the most important factors in the costs, and in order to point out very clearly the great importance of this item in TNT manufacture, for instance, a special graph (Graph 5B) has been prepared showing the ultimate service charges per ton TNT, the "ultimate" service charges including not only those for the actual nitration process but also the service charges involved in the acid usage, *i.e.* on the denitration plant, the concentration plant and at the retorts.

(A further contribution on this subject will appear in a subsequent issue.)

REFRACTORIES.

Dr. J. W. Mellor delivered recently a course of five lectures on refractories under the joint auspices of the Newcastle Section of the Society of Chemical Industry and of the Armstrong College, Newcastle-on-Tyne. The following is a brief account of some of the more interesting points dealt with:—

The action of heat on clay first drives off hygroscopic moisture and dehydrates the colloidal silicic acid; at 500° C. the clay is decomposed into free silica, free alumina, and water; about 800° C. the alumina begins to polymerise, forming more complex molecules; above 1000° C. alumina and silica recombine to form sillimanite, $Al_2O_3.SiO_2$; at 1500° C. the clay sinters to a stone-like mass; at 1650° C. the clay softens and loses its shape; and at 1700° C. it forms a brown or grey viscid liquid. Some assume that the compound $Al_2O_3.2SiO_2$ is formed when the water is expelled from clay, but there is no evidence for this beyond the fact that the ratio $Al_2O_3 : SiO_2$ is the same before and after dehydration, and this would obviously be the case whether combination existed or not. However this may be, at about 500° C. the bricks or other goods being fired absorb heat without rise of temperature; at about 900° C. they become hotter than the kiln, and afterwards cool down to the temperature of the kiln. Clay expands during dehydration, the specific gravity falling from 2·61 to 2·47 at 600° C., and afterwards contracts, the specific gravity rising to 2·73 after calcination at 1200° C. The contraction results from the vitrification or the closing of the pores, and from the change of the products of decomposition to a mixture with a higher specific gravity. With many fireclays this fire contraction would be difficult to manage, but the percentage contraction is lessened by the use of previously fired fireclay called "grog." The grog acts as a kind of skeleton about which the fireclay vitrifies or sinters. The firebrick is fully matured when, during the firing, it has attained its minimum size. If the minimum size has not been attained during the firing, the brick will contract further when in use. To get the soundest and best possible brick of a given texture it is necessary to use grog which has attained its maximum shrinkage, and to take more than 99 per cent. of the possible fire shrinkage out of the bricks during the burning. A practical test for finding if a brick has been adequately fired is to heat one-half of it in a furnace in which such bricks are to be used, and to compare the result with the half which has not been re-fired.

When alumina is heated, its specific gravity increases from about 2·8 at 600° C. to about 3·9 at 1200° C., corresponding with a contraction of nearly 30 per cent., and such calcined alumina is less soluble in acids, less hygroscopic, etc. The change is exothermic, for heat is evolved at about 1000° C. The contraction of alumina or bauxite bricks is difficult for manufacturers to deal with, since the products are liable to become cracked and distorted, and it is also difficult to ensure that the reaction is completed. Under ordinary firing conditions the change is slow, and takes a very long time for completion. Hence serious difficulties have arisen through subsequent contraction, and makers and users alike have condemned alumina or bauxite bricks. These bricks have really not had a fair trial.

Several other oxides, such as ferric and chromic oxides, undergo analogous changes, but not in so pronounced a degree. Chemists know how these oxides become comparatively inert after calcination. With zirconia the changes are even more pronounced than with alumina. The evolution of heat is so great that the mass becomes momentarily incandescent. Magnesia also undergoes analogous changes during calcination at high temperature, its specific gravity changing from about 3·2 to 3·6, corresponding with more than 11 per cent. contraction. The conversion from A to B magnesite is accelerated by the presence of ferric oxide.

Magnesite bricks are made without the addition of any foreign binding agent. In the manufacture of silica bricks, it is usual to add about 2 per cent. of slaked lime, unless there is sufficient natural clay present to serve as the binding agent; the added lime, however, is very prone to cause the formation of silicates, thus rendering the bricks structurally weak and brittle. A small proportion of a plastic clay forms crystals of sillimanite, but even then the bond is stronger with the clay than

with the lime bond. Silica, as flint, is converted into a form of lower specific gravity much more rapidly than when present as quartz, and the evidence is almost conclusive that such conversion is accelerated by the presence of iron oxide in a certain form. This means that in the ordinary process of manufacturing the bricks, instead of getting a 30 per cent. conversion there may be a 60 per cent. conversion. Some bricks made in South Wales with silica rock containing 5 per cent. of ferric oxide were found to give excellent results, one furnace manager declaring that they were the best he had ever had. The presence of iron seems to toughen the lime bond. In Dr. Mellor's opinion, a highly plastic and tenacious clay bond is preferable to lime for silica bricks, the plasticity and tenacity being necessary in order that a reasonably low amount of clay may suffice. A high proportion of either lime or clay bond will lower the refractoriness. As a general rule, in passing from the crystalline to the vitreous condition there is an expansion, and conversely a contraction in passing from the vitreous to the crystalline form. With felspar there is a contraction of about 6 per cent. on crystallising, and if the fused material cools without crystallisation this contraction does not occur. Vitreous quartz also contracts as it crystallises, and vessels made of it shatter as crystallisation occurs.

Some curious results have been obtained in connexion with the penetration of firebricks by dust. With dusts consisting of oxide of iron, copper, or zinc, the penetration is fairly rapid and fairly deep, perhaps an inch in a couple of hours. As there is evidence of the volatilisation of the metals named at surprisingly low temperatures in reducing atmospheres, *e.g.*, copper at 600° C., and iron at 1100° C., Dr. Mellor believes that these metals penetrate the refractory as vapours. A fine-grained texture in bricks is favourable for resisting penetration by vapour or dust. Ferruginous dusts in reducing atmospheres are characterised by rapid slagging, silica bricks especially being readily attacked. With salty coals the salt vapour rapidly attacks silica and fireclay refractories, a very fusible slag being produced. The best results in resisting this action seem to be given by bricks in which the ratio of alumina to silica molecules is less than 1 : 3·5, as in the case of good resisting material containing 6·3 per cent. silica and 30 per cent. alumina.

For withstanding abrupt changes of temperature a porous open texture is most suitable, but there is a limit to the possibilities in this direction owing to the necessity of keeping the materials fairly tough, and in some cases permeability to gases would be too much favoured by porosity. The low thermal conductivity of highly porous materials also renders a porous structure undesirable for low temperature muffles and retorts. Contrary to what are, presumably, the views most generally held, Dr. Mellor believes that at high furnace temperatures a highly porous structure favours the conductivity of heat, and that only at low temperature are highly porous refractory goods of low thermal conductivity. He contends that the effect of radiation across the pore spaces is forgotten, as well as that of convection (*see* this J., 1919, 140 R).

Production of Portland Cement.—The annual production of Portland cement in Europe is as follows (in millions of barrels):—U.S.A. 92·8, Germany 30, Britain 17, France 8, Denmark 7, other European countries 10. Thus the output of the United States far exceeds that of the whole of Europe, a fact which is ascribed mainly to the successful development of the rotary kiln and to the progress of concrete construction on a very large scale in that country.—(*U.S. Geological Survey.*)

NEWS FROM THE SECTIONS.

NEW YORK.

A joint meeting was held on April 18 with the American Chemical Society and the American Electro-chemical Society, at the Chemists' Club, New York. Dr. P. C. McIlhiney, vice-chairman of the Section, presided over an attendance of about 150 members and guests. Dr. W. H. Nichols moved the following resolution which was carried unanimously. "The New York Section of the Society of Chemical Industry, having learned of the death of Sir William Crookes, past-president of the Society of Chemical Industry, desires to record its sense of the personal loss which the Society feels, and of the debt which science owes to him for his brilliant and painstaking researches which have contributed in a high degree to the practical development as well as to the theoretical understanding of the problems of chemistry and physics.

"The death of Sir William Crookes forces upon our attention the fundamental character of the work to which he devoted himself, a field in which the number of successful workers is small, and leads us to express a fervent hope that other men of genius may be stimulated to pursue related lines of endeavour."

Through the efforts of the Perkin Medal Committee two new portraits have recently been presented to the Chemists' Club. The portrait of Dr. J. B. F. Herreshoff, the recipient of the medal in 1908, was presented by Dr. W. H. Nichols on behalf of the General Chemical Company; and the second, that of E. G. Acheson, who received the medal in 1910, was given by Mrs. Acheson. Both Dr. Herreshoff and Mr. Acheson were present and were prevailed upon to give a short account of their careers.

MANCHESTER.

A paper on "The Production and Refining of Edible Oils" was read by Mr. B. P. Flockton at the meeting held on May 2, Mr. Wm. Thomson presiding. The author stated that until the end of 1914 the edible oil industry had received very little attention in this country: it was practically confined to Holland, Germany, Austria and Belgium, British manufacturers being chiefly concerned with the treatment of edible oil seeds to obtain oil for better quality soaps. Many up-to-date plants were now being installed in this country, and in the near future we should be quite independent of outside sources of supply. Further, since 90 per cent. of edible oil seeds were grown within the Empire, this very important industry should provide a field for export. Dealing with the question of extraction, Mr. Flockton said that ordinary rolling was quite inadequate; the reduction must be gradual so that the resulting meal was not granular but flaked. The meal should be heated to a high temperature and moistened to ensure the flow of the oil, otherwise a high percentage of the latter would be left behind, even though abnormally high pressure had been applied for an unnecessary length of time. In order to obtain the maximum yield of oil, the excess of moisture, present in many seeds, should first be eliminated as far as possible. The refining cost varied, but as a rule £5—£6 per ton should cover all overhead and manufacturing charges.

The report for the past session records the holding of seven meetings at which twelve papers or communications were read, the average attendance being about 70. Emphasis is laid upon the usefulness of inviting members of kindred societies to attend meetings, both from the point of view of stimulating local interest in the Society, and from that of inducing co-operation towards common

(local) ends. A generous tribute is paid to the efficient work of Mr. L. E. Vlies, the late Hon. Secretary. The personnel of the new committee is as follows:—Chairman, Mr. John Allan; Vice-chairman, Mr. Wm. Thomson; Hon. Secretary, Mr. L. Guy Radcliffe; Committee, Prof. A. Lapworth, Drs. E. Ardern, T. Callan, Capt. F. S. Sinnatt, and Messrs. W. Andrews, J. Baddiley, W. B. Hart, J. H. Hoseason, S. E. Melling, H. Moore, J. D. Paton, and L. E. Vlies.

LONDON.

At the meeting held on May 5, at Burlington House, W., three papers were read by Dr. P. E. Spielmann and his colleagues, Mr. F. Butler Jones, Dr. S. Schotz, and Mr. H. Wood, respectively.

The first consisted of a critical examination of the relative trustworthiness and accuracy of the several methods for the estimation of carbon disulphide. It has been found that the most accurate method is that of extraction as potassium xanthate, oxidation of this with bromine, and precipitation as barium sulphate. The most convenient method is that where advantage is taken of the diminution of specific gravity due to the removal of carbon disulphide by alcoholic potassium or sodium hydroxide. Estimations involving the formation of copper xanthate were found, on the whole, to be somewhat unsatisfactory. Quantitative estimation by means of phenyl hydrazine appears to be impossible owing to the appreciable solubility of the precipitate in benzene. The chairman, Dr. Charles A. Keane, at the conclusion of this paper, remarked that in estimating copper xanthate the difficulty was always that of obtaining a precipitate of constant composition.

In the second paper on the estimation of thiophene, the methods of Denigès (employing basic mercuric sulphate) and of Paolini and Silbermann (who used basic mercuric acetate) were examined, and in each case the authors claim to have improved and simplified the method of working. Dr. F. B. Thole in commenting on the satisfactory nature of the test, even in the presence of hexylene, questioned whether di-olefines would also be non-reactive, in view of the fact that they gave a precipitate with basic mercuric sulphate.

A particularly interesting discussion followed Dr. Spielmann's third paper on the "free carbon" in tar and pitch. He described the several modes of extraction and the liquids which were tried, from which it seems that the best method consists in the employment of carbon disulphide and benzene in an ordinary Soxhlet extractor. Pyridine is a more far-reaching solvent but requires an all-glass apparatus. In the discussion it was elicited that the commercial value of tar and pitch when used for road-making and as a binder for briquettes is appraised in part by the "free carbon" content.

The reading of the above papers was preceded by the annual meeting and the election of the Committee. The report for the session stated that in spite of the transference of some 58 members to the Bristol Section, the membership of the London Section had risen from 1139 to 1285. Seven meetings have been held, so far, at which 20 papers have been read, and the average attendance has been 122. Reference was made to the visit of M. Paul Kestner in November last, to the initiation of an Inter-Allied Conference of Pure and Applied Chemistry, and to the forthcoming annual meeting of the Society in London. The Sectional Committee on Empire Sugar Production has continued its inquiries and the report will be communicated at the Annual Meeting in July. As an outcome of the discussion on Refractometry, a committee has been formed to consider "Temperature Specification and Methods of Control in connexion with Refractometers." The following members of the Committee retire at the end of the session:—Messrs. W. C. Hancock, J. W. Hinchley, J. Macara, J. W. Macdonald, T. D. Morson, and F. I. Scard; and in their places have been elected:—Dr. M. O. Forster, Messrs. E. V. Evans, E. C. B. Wilbraham, E. R. Bolton, C. Doree, and Capt. G. S. Walpole. As previously announced, Mr. Julian L. Baker succeeds Dr. C. A. Keane as chairman, the latter remaining on the Committee.

BIRMINGHAM.

In the absence of Dr. Morrell, Dr. E. W. Smith presided at the meeting held on May 6 at the University. In the first paper, "Chlorination of Benzene. Analysis of Mixtures of Benzene, Chlorobenzene and Dichlorobenzene, etc.," Prof. P. F. Frankland, Mr. S. R. Carter and Miss D. Webster described a distillation method similar to that used by H. G. Colman for determining toluene in commercial toluol (this J., 1915, 168). From the amounts distilling below 122° and above 142° C. the percentages of benzene and chlorobenzene are obtained from a graph, and the dichlorobenzene is found by difference. The method is accurate and expeditious, distillation being complete in 30—45 min.

The second paper was on "The Application of Colloid Chemistry to the Problems of Physical Metallurgy," by Mr. F. C. A. H. Lantsberry.

MEETINGS OF OTHER SOCIETIES.

ROYAL SOCIETY OF ARTS.

The second "Trueman Wood" Lecture was given on April 30 by Sir Herbert Jackson on "Glass and Some of its Problems." The lecture was mainly of an experimental character; the complementary descriptive matter will appear in due course in the Society's *Journal*.

After a few explanatory remarks on glass and its constituents, the lecturer proceeded to discuss the question: Is glass a solid? He showed that the dictionary definition of a solid as a substance with a fixed form whose particles are not free to move, certainly did not apply to glass which possesses marked viscosity through a long range of temperatures. Dealing with the sealing in glass of metallic wires, Sir H. Jackson explained that thermal expansion is by no means the only factor to be considered. Thus a glass that will hold copper and platinum wires will not retain iron or nickel wires. The coefficient of expansion of copper is about double that of iron, and those of iron and nickel are intermediate between the two. The difference is due to the fact that copper and platinum are relatively soft and the other two metals hard: the glass as it cools pulls and deforms the former but not the latter. In regard to the problem of structure, the lecturer said that he had never seen perfectly vitreous glass except in small pieces; he inclined to the view that every substance has both a crystalline and an amorphous form. The vitreous form of white arsenic would be very valuable for use in optical glass if it could be preserved, and a method of stabilising it was wanted. Certain experimental data obtained by etching glass and by spreading on it very strong liquid glue did not prove its crystalline nature, but the phenomenon of fluorescence was truly indicative of that state; he knew no single instance of a truly vitreous substance showing phosphorescence. A crystal of zinc silicate was divided into two and each part powdered. One portion was vitrified by a very sudden cooling; it did not phosphoresce; when, however, it was heated it became crystalline and phosphorescent. Many of the constituents of glass exist

in both forms, *e.g.*, the borates, phosphates and silicates of calcium. Nearly all vitreous substances show a tendency to crystallise at some temperature. No change occurs when a super-saturated solution of sodium acetate is cooled with ice and salt or with solid carbon dioxide, but, as the lecturer demonstrated, at the temperature of liquid air, solid vitreous acetate separates out, and on warming suddenly becomes crystalline inducing momentary crystallisation of the whole mass. A similar experiment was performed with Rochelle salt, but in this case the vitreous solid does not change on being warmed, and consequently no crystallisation occurs.

The rest of the lecture was devoted to demonstrating the formation of opal and coloured glasses. Four transparent bulbs of the same glass showed different degrees of opacity on being heated to different temperatures, and a transparent bulb containing gold became successively pink, dark red and blue, the colours produced depending on the size of the particles liberated. Three clear glasses containing the same proportion of nickel but different alkalis (potash, soda and lithia) became violet, brown and yellow, respectively. Boro-silicate glass was changed by heat into violet or yellow according to the proportion of alkali present. The lecturer emphasised the analogy between the phenomena shown by glasses and by solutions, and exhibited on the screen some beautiful experiments showing the reduction of gold solutions with semicarbazide in the presence, and absence, of tannic acid as protective colloid.

THE IRON AND STEEL INSTITUTE.

The annual general meeting of the Iron and Steel Institute was held on May 8 and 9, at the Institute of Civil Engineers, when a large number of papers was presented.

M. L. Greiner presented a "Report on the Condition of the Belgian Iron and Steel Works after the German Occupation." He described in considerable detail the deplorable condition of the whole of the industry, and its effect on the future position of Belgium as a manufacturing nation; in particular he drew attention to the wanton manner in which whole establishments had been put completely out of action by the careful destruction of vital machines in a systematic manner. His report was amply confirmed by a number of the members present, particularly by Mr. Harbord and Mr. Mather, who were able to describe personal experiences in the devastated area.

Mr. L. C. Harvey read a paper on the "Use of Pulverised Coal." This was a supplement to a recent report submitted by the author to the Director of Fuel Research, and dealt, among other things, with the application of pulverised coal to steam raising, the generation of motive power, and as a source of heat in metallurgical works.

A contribution by Mr. C. H. F. Bagley on "Modern Steel Metallurgy" described a system worked out by himself some years ago, mainly in connexion with the basic open-hearth process, the object of which is to render more simple and reliable the methods of calculating the consumption of materials and the technical results in the manufacture of steel from any kind of pig iron by any standard process.

Mr. J. C. W. Humfrey, in a paper entitled "Macro-etching and Macro-printing," described a method for the development of the macro-structure of steel ingots and forgings. The etch produces on the surface of the specimen a relief structure which is simply the original cored structure of the ingot; the specimens can be used as blocks for the production of direct contact prints, and the paper is illustrated with a number of such contact prints from the steel specimens. A paper by Messrs. W. H. Whitely and A. F. Hallimond described the results of investigations into the microstructure of slags, the structure of the hearth in the acid open-hearth process, and the reactions occurring in the molten slag during the process. The paper is illustrated with many excellent micrographs. The "Manufacture of Files" formed the subject of a paper by Mr. Geo. Taylor. He gives much information with regard both to the mechanical and metallurgical processes of manufacture. His paper will form one of the most complete works of reference available on the subject at the present time. Dr. J. H. Andrew and Mr. G. W. Green described in considerable detail the manufacture and treatment of certain kinds of high speed tool steel. Four different ingots were followed through every stage in the process of manufacture. The treatment described represents the standard practice carried out in the works of Sir W. G. Armstrong, Whitworth and Co. Ltd. A paper by Mr. D. Hanson and Mr. J. E. Hurst gives an account of the method adopted to overcome certain difficulties in the case-hardening process. Various troubles, which were traced to the presence of films of free cementite in the case of the finished articles, were entirely overcome by the adoption of certain slight modifications of the process, which were described.

A considerable number of papers could not be read at the meeting on account of lack of time. Of these mention may particularly be made of one by M. A. M. Portevin and M. Garvin on the "Experimental Investigation of the Influence of the Rate of Cooling on the Hardening of Carbon Steels." The meeting also included a joint session with the Institution of Electrical Engineers, at which a selection of papers on electric furnaces was discussed. These included papers by W. K. Booth, R. G. Mercer, A. Sahlin, V. Stobie, J. Bibby, and H. A. Greaves.

INSTITUTION OF MECHANICAL ENGINEERS.

On May 2, Dr. W. H. Hatfield read a paper on "The Mechanical Properties of Steel, with some consideration of the question of Brittleness," in which he discussed generally the question of brittleness and the relationship of the results of various mechanical tests to the failures of parts in service. The various forms of mechanical tests in use and the data they provide were reviewed, and the opinion expressed that the tensile test and the data derived from it are the fundamental factors indicating the strength and condition of a steel, but that all the other tests give additional and distinct information not so revealed. No special reliance should be placed on any one form of test. The results obtained from different forms of mechanical tests on a variety of steels were discussed and several outstanding facts of much interest were brought forward. The conclusion was reached that real brittleness in service is distinct from notch brittleness, and whilst a really brittle steel will always give a low value under the notched impact-test, a low value under such test does not necessarily denote a really brittle steel. Real brittleness is readily distinguished by tests other than the notched-bar test.

THE CHEMICAL SOCIETY.

On May 15, with Sir J. J. Dobbie in the chair, Mr. B. Blount and Dr. J. H. Sequeira read a paper on "'Blue John' and other forms of Fluorite." The object the authors had in view was to determine the exact cause of the coloration of the mineral; in this they were unsuccessful, but a number of interesting observations were recorded.

Chemical analysis showed that specimens of the blue and green forms of fluorite had practically

identical composition, *viz.*, over 99·5 per cent. of calcium fluoride, traces of aluminium and/or iron, and of manganese, and a very minute trace of magnesium. The analytical figures led to the conclusion that the coloration was not due to mineral constituents. The hypothesis that it might be caused by an organic dye was tested by extracting with organic solvents; of these only two, chloroform and toluene, yielded an appreciable quantity of extract, and this was found to contain less than 0·05 per cent. of carbon. Numerous experiments with radium compounds led to the inference that the coloration was not of radio-active origin. When the crystals are heated to 350° C. in a sealed tube, a liquid (chiefly organic) is expelled, decrepitation occurs, and the mineral becomes white, and, when hot, fluorescent. On cooling the colour is not restored. The authors incline to the view that organic matter is the cause of the coloration.

The proposed alterations in certain of the Society's by-laws were carried at a special meeting held on May 8. Women will now be eligible for election to the Fellowship.

THE ROYAL SOCIETY.

Prof. W. A. Bone and Mr. R. J. Sarjant contributed a paper on "The Action of Pyridine upon the Coal Substance" at the meeting held on May 15. It was shown that the presence of oxygen has an important retarding action upon the extraction process (the extent of which varies considerably with the nature of the coal), and that in order to obtain consistent results in any such process, it is necessary not only to employ an anhydrous solvent, but also to exclude oxygen. A suitable apparatus and method were described for carrying out the process under standard conditions, such as will give consistent results of comparative value with various coals. The application of the method to two typical isomeric bituminous coals was fully described. When such extraction is carried out at ordinary pressures, with exclusion of oxygen, a practical limit is finally attained. In the case of the two coals in question, this limit considerably exceeded the amount of "volatiles" yielded by them on carbonisation at 950° C. At higher pressures this first limit was considerably passed, and when conducted in sealed tubes between 130° and 150° C. as much as two-thirds of the coal substance was rendered soluble.

The results as a whole indicate that neither pyridine alone nor even pyridine in conjunction with chloroform is capable of extracting in a pure condition the resinic constituents of the coal substance, and that in addition to any ordinary solvent action which pyridine may have upon such constituents, it also at the same time slowly attacks and resolves into simpler molecular aggregates the complex structure of the coal substance as a whole, for which it has a marked affinity.

Chemical Industry Club.—The monthly meeting of the Chemical Industry Club was held at the Club Premises, 2, Whitehall Court, S.W., on May 19, with Dr. Hodgkinson in the chair. During the evening the Honorary Secretary, Mr. H. Edwin Coley, gave a description of the Chemists' Club in New York, and referred to the arrangement that has been made between the English and American Clubs under which members of either Club can acquire temporary membership in the other, without payment. Mr. J. Lainson Wills, of St. Louis, U.S.A., was present and gave an address on "The Effect of Prohibition on the Brewing Industry in America." The membership of the Club now totals 584, inclusive of applications, and there is every sign of continued prosperity.

NEWS AND NOTES.

CANADA.

Potash from Cement Plants.—The Canada Cement Co. is planning to establish a potash recovery plant (spray system) at Port Colborne, Ont. This indicates confidence in the permanent success of such a project under any conditions which are likely to prevail in the Canadian potash market.

Recovery of Fish Scrap.—Partly as a result of Government action and partly as a result of previous trials, there has been recent growth in the interest taken by some companies in utilising the fish waste of the Eastern Provinces. The market for fish meal and oil is a large one, and plants for handling fish scrap are expected to increase rapidly in Nova Scotia and the East.

Copper in Northern Manitoba.—During the war much prospecting was done in districts along the new Hudson Bay Railway. Starting at The Pas a mining country is rapidly opening up. Payable quantities of copper, gold, and silver ores are already blocked out in many localities and the Government has decided to build a railway seventy-five miles from The Pas to the Flin Flon property. When this has been done the owners will proceed with their project of putting up a smelter capable of handling 2000 tons of sulphide ore per day. This Manitoba area is one of the newest and most promising in the Dominion, especially as a copper producing area.

The Protection of Canadian Chemical Industries.—The electrochemical industries at Niagara Falls, Ont., and Shawinigan Falls, Que., are in the main well situated to meet American and other foreign competition. There is some danger at Niagara Falls that in the course of time the multiplicity of users of electric power under public ownership may make it difficult for the electrochemical users to obtain sufficiently cheap rates. Other chemical industries, however, are looking for some special consideration on the part of the Government. Users of industrial alcohol have succeeded in getting legislation before Parliament this session, and it is expected that alcohol of a high grade of purity will be available for all industrial users at a price which will be quite satisfactory. A number of the smaller manufacturers who were able to make successfully a few chemicals during the war period are having difficulties in holding their business under the reduced prices, and if they are to continue their capital must be greatly increased. Companies engaged in pharmaceutical preparations have been able to extend and hold business, and are not in special need of attention. Companies engaged in chemical industries based on salt are not so well situated, and although Canada has all the raw materials and large plants established for the production of soda, chlorine, bleaching powder, and soda ash, the low prices at which American companies were able to obtain surplus war products has had a "dumping" effect on the Canadian market. Some measure of increased protection and limiting of importations of products already available here is likely to follow.

British Columbia.

British Columbia Department of Industries.—The Provincial Government has passed legislation to raise $2,000,000 to be administered by the new Department of Industries to promote industrial research, survey natural resources, co-ordinate industries, investigate and give financial assistance to new industries, and generally to further the economic development of the province.

Minerals, Metals, etc.—The Provincial Government intends to establish an ore-testing laboratory and mineral research station at the University of British Columbia.

The New Hazelton Gold-Cobalt Mines, Ltd., has received from the Dominion Government ore-testing laboratory the returns on a consignment of 26 tons sent to Ottawa last August. The contents comprised molybdenum, cobalt, nickel, arsenic and gold, and the gross value was $2399·5. Quite recently, 28 tons shipped to the Anyox smelter gave $1090 in gold, or $53 per ton net, after paying railway and smelter charges. This mine, which is situated on Rocher de Boule mountain, four miles from the Grand Trunk Pacific Railway, promises to develop into one of the richest in the province.

Copper.—The Canadian Government is being urged to establish a copper smelter on the Pacific Coast to avoid the necessity of exporting Canadian ore to smelters in the United States. The big Granby Smelter at Anyox, B.C., has resumed operations after being idle for a month, when stocks on hand amounted to over 8000 tons. On March 1 there was 400,000 tons of copper in the North American market, 50,000 tons of which was sold up to April 1 at 14 to 15⅛ cents per pound.

An improvement in the process of leaching roasted ores is being demonstrated in Vancouver by Mr. C. J. A. Dalziel. The ore particles are agitated in sulphuric acid solution by jets of air. The copper is dissolved out in 24 hours, and the clear solution is siphoned off directly into electrolytic cells.

The Canadian Geological Survey has reported on the important discovery of copper ore at the head of Gun Creek on Copper Mountain. The survey shows an ore body 800 by 2500 feet, with vertical exposure of 200 feet, giving 30,000,000 tons estimated in exposed portions. Samples assay 1·5—8 per cent. copper, with an average of about 3 per cent. Outlying deposits have yielded samples assaying $9 gold, 7 oz. silver, and up to 31 per cent. copper.

Mining Convention.—The International Mining Convention, held on March 17-19 (this J., 1919, 142 B), reflected the intense interest which is being taken in the mining developments of the province; over 500 delegates attended. The mineral resources are both large and varied; the fundamentals, iron and coal, are present, and upon these the growing shipbuilding industry mainly depends. The prospects of obtaining precious metals are hopeful, especially in regard to platinum. Over 200 delegates visited the Britannia copper mine on Howe Sound, which is said to be the largest copper mine in the Empire. The Convention passed a recommendation asking the British Government to abolish the present fixed price of silver, and a resolution was passed requesting the Canadian Government to re-establish old postal rates on United States mining and scientific journals. Among the numerous papers presented were: "Mineral Resources of British Columbia," by the Hon. W. Sloan, Minister of Mines; "Gold," by H. N. Lawrie; "Government Control of Smelters," by S. Norman; "The Better Preparation and Utilisation of Coal," by G. W. Evans, of the U.S. Bureau of Mines, and F. W. Glover; "Taxation of Mines," and "Industrial Welfare."

AUSTRALIA.

Mineral Deposits along the Trans-Australian Railway.—The Commonwealth Railway Commissioner has recently reported on the territory opened up by the Trans-Australian Railway. Besides gold discovered in Tarcoola in 1900 and worked under very great difficulties, the following minerals are found along the route. A valuable opal field was discovered in 1915 in the Stuart Range, N.E. of Tarcoola. It has an area of 10×2 miles, and, in the opinion of the South Australian Government geologist, constitutes a very important mineral discovery. Deposits of manganese ore are found upon the western fringe of the Permatti Lagoon, 4 miles N.E. of Woocalla, and quantities are now being carried by rail to Port Augusta for shipment. Deposits of high grade barytes also exist in the same district. Copper ore occurs near Woocalla and at Mount Gunson, and tin ore in the vicinity of 230 miles from Port Augusta. Gypsum is found in the neighbourhood of Hesso, 34 miles from the latter port, and deposits of chromite and ochre are reported in the same locality. Large deposits of valuable clay exist near Woocalla suitable for certain types of pottery not hitherto manufactured from Australian clays, and salt is found in abundance in Lake Hart and other lagoons. Consignments are dispatched regularly to the seaboard and a heavy traffic is anticipated. —(*Bd. of Trade J., April* 24, 1919.)

SOUTH AFRICA.

The Sulphuric Acid Industry.—Owing to its connexion with the manufacture of explosives, the sulphuric acid industry is one of the most highly developed in the Union. The five firms engaged in it produce about 53,000 tons of sulphur trioxide a year, most of which they consume themselves in the manufacture of explosives, so that in the year 1916—1917 only 2964 tons of sulphuric acid was available for disposal. The manufacture of ammonium sulphate requires about 2500 tons of commercial acid yearly and the cyanide process for gold about 1800 tons of arsenic-free acid. Minor quantities are employed for making superphosphate, for splitting fats, etc. Messrs. Kynoch, Ltd., advertise a chemically pure acid which conforms to the standard of the British Pharmacopœia.

Before the war the raw materials were almost wholly imported, the sulphur chiefly from Sicily (Sicily seconds), and as Spanish pyrites. The imports for recent years are:—

	1914 tons	1915 tons	1916 tons	1917 tons
Rock sulphur, including pyrites	3900	14,000	25,700	18,500
Flowers of sulphur	1120	1140	3500	900

The increasing difficulty in obtaining sufficient imported sulphur to supply the growing demand has directed attention to South African sources, and large quantities of local pyrites, mainly concentrates from the gold mines, are employed in the chamber process, but at a considerable expenditure for new furnaces. No information is available regarding the possible use of pyrites in the contact process.

Free sulphur, of no commercial value, occurs along the coast around Walvis Bay and Conception Bay, and deposits of unknown value have recently been found near the mouth of the St. John River, Griqualand East. Notwithstanding possible developments, as at Areachap in the Cape, no large deposits of massive pyrites are actually known. There are however many unopened gossan outcrops in the older formations, and practically all the gold ores of the country contain from 5 to 35 per cent. of pyrites. While the Main Reef is on the whole poor in pyrites the percentage in the Black Reef is comparatively high, with only a trace of arsenic.

The New Transvaal Chemical Co., Delmore, works up auriferous pyrites to refractory concentrates which are roasted in specially designed furnaces, a process in operation even before the war. Near Germiston, Pyrite Ltd. produced in 1916, 4300 tons of pyrites (50 per cent. sulphur) from accumulated tailings. At Sabie, in the Transvaal, there are said to be 40,000 tons of tailings and sands which would yield about 4000 tons of concentrates free from arsenic and antimony and containing about 40—50 per cent. of sulphur. The same quantity of concentrates could be produced yearly. The New Areachap Copper Mines Ltd., Gordonia, Cape Province, works marcasite (39—48 per cent. sulphur), of which 30,000 tons is estimated to be in sight. The Barberton district could produce 1000 tons of

concentrates a month containing over 40 per cent. of sulphur and appreciable quantities of gold.

Should the price of sodium nitrate continue to rise it might be possible to utilise local potassium nitrate, such as that found near Prieska, if the potassium were available as a fertiliser. Lead of high quality is produced at the Broken Hill mine in Northern Rhodesia, and the erection of plant for rolling sheet lead on the Rand is under consideration. Most of the necessary machinery could probably be built locally. A small quantity of the spent oxide from the pyrites burners is converted into basic ferric sulphate for use in the refining of glycerin, and some of the oxide is possibly made into paint. The shortage of drums is not acute, but glass and earthenware containers are very scarce.—(*S. Afr. J. Ind., Feb.*, 1919.)

The Barytes Industry.—Barytes is widely distributed in South Africa, the chief deposits occurring in Southern Rhodesia near Hunters Road and near Bulawayo, in the Cape Province near Riversdale, and in the Transvaal on the Magalaquen River. The principal consumers are the explosives factories and paint manufacturers, and a small quantity is used by rubber tyre manufacturers. Some of these are supplied from the deposits indicated above. The imports of barytes into the Union for the six months ended September 30, 1917, were 28,316 lb. It is doubtful whether the South African requirements amount to five tons per month.—(*S. Afr. J. Ind., Feb.*, 1919.)

UNITED STATES.

The American Chemical Society.—The 57th meeting of the American Chemical Society in April was called the Victory Meeting, and was one of the most successful in the history of the Society. Nearly eleven hundred members attended, and the programme was varied and interesting. Dr. Irving Langmuir's presentation of his newly developed theory of the arrangement of electrons in atoms and molecules evoked much discussion. The symposium on library service in industrial laboratories was unique and brought out many valuable points.

The Council of the Society enlarged its committee on reagents to deal with the standardisation of American-made scientific apparatus, took action urging the President to appoint a high commission to co-ordinate the work of developing the country's natural resources, elected the Italian scientist, Ciamician, to honorary membership, instructed the journals of the Society to avoid foreign language quotations, whenever possible using English translation instead, considered numerous other matters and discussed the reports of nearly forty committees. The Society now has more than 13,000 members.

A report by the Omnibus Committee was considered of such importance that it will be printed in the May issue of the *Journal of Industrial and Engineering Chemistry* in order that comments may be made by members and definite action taken at the September meeting. The committee dealt with 178 suggestions from 20 sections, 8 individuals, 2 outside and 5 unidentified sources.

The plan for co-operative work with English chemists in preparing compendia of scientific literature was received with enthusiasm.

Reinforced Lead Sheets.—A successful process for reinforcing sheet lead with lead-coated iron wire has been devised. This new material is well suited for lead chambers etc., and large pipes can be made from it. Such reinforced lead ¼ in. thick made into a pipe of 8 in. diameter withstood eight times as much pressure as the same sized pipe with ¼ in. walls of the usual lead without reinforcement.

The Optical Glass Industry.—The new optical glass industry is on a very satisfactory foundation. The three producers who made glass primarily for their *own use will continue to do so and are prepared to sell to others. The quality in some cases is superior* to German glass, and there is a determination to continue improvements regardless of cost. Important progress has been made in pots and the furnace cycle has been greatly reduced, as well as the time for annealing.

GENERAL.

Endowments for Chemistry and Metallurgy at Cambridge University.—A munificent gift of £210,000 has been made to Cambridge University for developing the chemical school under Sir W. J. Pope. The donors are connected with the petroleum industry and include: The Burmah Oil Co., £50,000; the Anglo-Persian Oil Co., £50,000; the Anglo-Saxon Petroleum Co., £50,000; Viscount Cowdray and the Hon. Clive Pearson, £50,000; and Mr. H. W. A. Deterding, £10,000.

The Goldsmiths' Company has offered a sum, not exceeding £5500, to the University for the purpose of extending and equipping the Department of Metallurgy. The Goldsmiths' Readership in Metallurgy was founded by the Company in 1908 and Mr. C. T. Heycock was appointed Reader. The metallurgical department was at first housed in two rooms in the Chemical Laboratory, but the number of students rapidly increased and, when the Department of Agriculture left the Chemical Laboratory in 1910, Sir William Pope assigned the rooms thus vacated to metallurgy, the Goldsmiths' Company contributing the sum of £800 for their alteration and equipment. The number of students working at metallurgy has now increased beyond the capacity of the present laboratory, and the generous gift of the Goldsmiths' Company will provide a new analytical laboratory with benches supplied with compressed air and high and low voltage direct current, a balance room, and also a room for general galvanometer and photographic work with eight gas furnaces round the walls. Accommodation for sixteen students working at assaying and general mineral analysis, and for ten research students, will thus become available.

Proposed Manufacture of Beet Sugar in Scotland.—War conditions are giving rise to new and diverse industrial enterprises. When we recollect that in peace time we bought something like £14,000,000 worth of beet sugar from Germany and Austria, and that our trade relations with Germany cannot revert immediately to their previous state, and when we further realise that our cane sugar producing colonies will barely be able to provide us with our annual pre-war consumption of 90 lb. per head of population, we may expect frequent proposals for developing the supply of home-grown beet sugar. One of the latest of these hails from Ayrshire, where a syndicate has been formed for growing sugar beet for the purpose of manufacturing sugar. The financial part of the scheme has not yet been agreed upon, except in so far as all idea of Government support has been abandoned, since the Development Commission has refused assistance on the ground that money is not available for companies trading for profit; moreover, the Treasury does not yet appear to have given its consent to the raising of the necessary capital privately. On the other hand, Sir R. B. Grieg, Commissioner for the Board of Agriculture, Scotland, writes confidently of the effect such an industry, when once profitably established, would have on that district, where the soil conditions are eminently suitable for the cultivation of beets which would take the place of turnips in the usual rotation. The deep and careful cultivation, he writes, would improve the capacity of the soil for other crops; it would employ additional labour; it would stimulate and increase the demand for fertilisers; in fact, it should produce an all-round

improvement in the farming of the area. It is proposed to erect a factory about 1 mile from Stranraer, the Wigtownshire harbour. From here a daily service runs to Ireland, which might possibly be employed for sugar export business to Ireland. In addition to supplying seed, fertilisers and labour to lift the crops when they are ready, the syndicate propose to make the experiment of paying the growers £8 an acre, to meet rent, cost of ploughing and so forth, and anticipate a substantial profit; it is, however, prepared to revert to the usual custom of paying the growers for the actual amount of roots delivered, according to sugar percentages, if they should prefer it.

Recovery of Wax from Waxed Paper.—In connexion with the note which appeared under this heading in the issue of April 30 (p. 143 B), Mr. M. S. Salamon writes that it may be of interest to our readers to know that in this particular case Britain is ahead of the United States. The initial experiments were carried out some eighteen months ago, and showed that the only commercially successful process involved the extraction of the wax by means of a volatile solvent. In the last nine months there has been in course of erection at Nutfield, Surrey, a plant capable of dealing with large quantities of waxed paper, and also special machinery for preparing the material for extraction and for handling the various products after extraction. This factory is practically ready to start operations. In addition to reclaiming the waste waxpaper, the plant will also deal with waxed paper or board containers, such as have been used so extensively for storing jam, margarine and other foodstuffs.

The Sensitiveness of Guncotton to Shock.—A report, by H.M. Chief Inspector of Explosives, has recently been issued concerning an explosion which occurred at an Edmonton munitions factory on February 5, 1919. The work being performed at the time was the breaking up of Russian trench mortar charges contained in boxes holding bags of guncotton in the form of yarn, and bags of flaked cordite. H.M. Inspector records the impossibility of ascertaining the exact cause of the accident, but holds that it was most probably due to the extreme sensitiveness to shock of a thin film of the guncotton fluff or dust. The evidence indicates that a fire started at the zinc-lined wooden box into which the guncotton was being discharged. This receptacle had a circular opening lined with tinplate, and the tin had probably worn off, leaving the iron beneath exposed. "In these circumstances the fall of even a bronze tool, such as the scissors with which the bags were opened, or a glancing blow from a ring on a worker's hand, might well give rise to sufficient local heat to fire the thin film of guncotton dust with which the rim of the opening would undoubtedly be covered."

An explosives expert writes that, in his opinion, guncotton is not so sensitive to shock as the above explanation would imply. After repeated trials, he failed completely to explode perfectly dry guncotton, dusted on to an iron sheet about 1/50 in. thick placed on a table, by striking it with a pair of steel scissors weighing about 4 oz.; or by a small iron ring slipped on to the end of a wooden rod, by which means a far more severe blow can be given than with a ring worn on the finger. Alternatively, he suggests that the guncotton fluff, which is extremely sensitive to flame, might have been fired by a very small spark produced by a stone in the ring. He points out, however, that explanations of the above kind are purely conjectural and there is a danger in giving premature publicity to them. Many accidents have occurred in munition works under more or less similar circumstances. Owing to lack of evidence, a very conjectural explanation is advanced to explain the first occurrence. After the second the same explanation is given, the former case being used as an added argument in its favour, and by the time the third accident has happened the original guess is taken as a proof that the accident actually happened in such a manner. This is entirely unwarranted, unless it is possible to show that the only circumstances common to all the accidents are those upon which the explanation is based. This point is particularly emphasised because the acceptance of an incorrect explanation leads to the omission of further search, may prevent the discovery of the true cause, and gives a false sense of future security.

Egyptian Phosphate Resources.—Large deposits of phosphate similar to that of Algeria and Tunis occur over large areas in Egypt. These deposits are being worked at Safaga and Kossier on the Red Sea and at Sebaia on the Nile, but there are other large areas which offer good opportunities to the prospector. The production during the past nine years has fluctuated widely:—

	Metric Tons		Metric Tons
1910	2,397	1915	82,998
1911	12,013	1916	125,008
1912	70,918	1917	115,732
1913	104,450	1918	31,147
1914	71,045		

The rock is either exported as such, or converted into "Tetra phosphate" (this J., 1918, 437 B). The greater part of the output prior to the war went to Japan, but of late large stocks have accumulated owing to want of shipping. The quality of the rock varies, the best grade contains calcium phosphate 70%, iron and alumina 1·5%, a middle grade 64 and 2·75%, and the lowest quality 60 and 3%, respectively. The better qualities come from the Red Sea districts. To meet the native demand, superphosphate has been imported into Egypt during the past few years:—In 1913, 13,148 metric tons; in 1914, 15,278 tons; in 1915, 7,056 tons; and in 1916, 3,250 tons.—(*Bd. of Trade J., April* 10, 1919.)

Resources of the British Occupied Territory in the Cameroons.—During the war the Cameroons has been cut off from the outside world, and the present position of trade is no indication of the resources of the country. One great drawback to trade is the lack of roads and railways, but there is an excellent but little-used harbour at Victoria. Both tropical and sub-tropical products can be grown, and a great part of the country is rich in palm tree forests, especially in the lower Chang, Rio del Rey and Ossidinge districts; in the last district the Germans erected a considerable plant for dealing with palm kernels. Ground nuts are being grown on an extensive scale and will probably form one of the chief exports. In the Chang division there is a large area of elevated land (about 4000 ft. above sea-level) which is eminently suited for European settlement and where cereals, fruit and vegetables can be grown successfully. A remarkable vegetable fat, which after a very simple refining process is converted into a product resembling beef marrow fat, is obtained at Buea from the fruit of the "Ngaby" tree. When rubber prices are high it may be profitable to tap the vine rubber which grows in quantity in Ossidinge. The volcanic soil of the mountains is specially suited to cocoa cultivation, while tea and quinine can also be grown.

There are large iron ore deposits at Bamenda and several native smelters are working in a very crude fashion. Chalk and a fair quality coal have been obtained in Chang. Numerous salt springs occur in Ossidinge, but the salt produced is not sufficient to meet the native demand. The popu-

lation, especially that of Chang, is intelligent and enterprising.—(*Bd. of Trade J., April* 10, 1919.)

Mexican Guano Deposits to be Exploited.—On December 6, 1918, the Mexican Government granted to General Lucio Blanco a concession for exploiting guano deposits on the islands Isabela and San Juanico in the Pacific. The contract is for five years, renewable for another five, and permits the removal of a minimum of 2000 tons of guano annually, the concessionaire paying the Government 1·50 pesos ($0·75 3*s.* 1*d.*) per metric ton.—(*U.S. Com. Rep., Mar.* 3, 1919.)

Mineral Production in Italy.—The following statistics have been compiled by the Inspectorate General of Mines:—

Mineral	Production 1916	Production 1917
	Tons	Tons
Anthracite	18,544	25,194
Triassic coal		20,250
Lignite	1,282,019	1,656,963
Bituminous shales	4,477	19,750
Antimony	6,509	5,789
Iron	942,244	993,825
Ferro-manganese	4,360	4,800
Manganese	18,147	24,532
Lead	39,160	38,076
Copper	88,475	86,842
Tungsten	7	1
Zinc	91,043	79,453
Boric acid	2,298	2,335
Mineral waters	35,900	35,900
Aluminite	3,370	4,855
Bauxite	8,887	7,789
Graphite	8,172	12,117
Mercury	1,093	1,071
Petroleum	7,035	5,668
Iron and cupreous pyrites	400,900	500,783
Asphalt rock	16,829	8,615
Salt from springs	16,943	12,733
Rock salt	67,227	55,775
Sulphur	287,965	230,074

There are now 18 companies engaged in the Italian mining industry, their combined capital standing at the end of 1916 at the equivalent of 6¾ millions sterling. The chief centres of the industry are in Sicily, Tuscany, Sardinia, and especially at Bergamo, Brescia and Turin.

The lignite figures for the early months of 1918 do not show great promise, and it is specially noticeable that the larger mines are falling off both in total output and in the output per worker. On the other hand some of the smaller mines have largely increased their production.

The problem of potash supply is now being investigated by the Office of Inventions and Research, which points out that although the size of the iron smelting industry does not allow of an output from flue dust recovery on the scale of the English plants, yet a considerable amount of potash can be obtained from this source as well as from the flue dust from cement kilns, from molasses and olive residues, from wool grease and from seaweed. There are two other possible sources, namely the mother liquors from the salt mines and the deposits of leucitic rocks (double silicate of aluminium and potassium). If a successful process can be evolved for treatment of the latter, it would provide an almost inexhaustible source of potash. Previous to the war about 23,000 tons of potash salts was imported from Germany annually. Geological investigators predict that, in Sicily there is a total possible sulphur bearing area of some 2,000,000 square miles, of which less than 1 per cent. has yet been explored.—(*U.S. Com. Rep., Feb.* 28, 1919.)

Future of the Italian Iron Industry.—A memorandum issued by the Italian Metallurgical Association points out that the needs of the metallurgical industry will exhaust the home iron ore reserves in a comparatively short time, and that it is therefore necessary to import raw and half-manufactured materials. The Elban deposits, which in the past have yielded the bulk of the home supply of iron ore, are now so far exhausted that it is necessary to exploit veins under the sea at greatly increased costs. The Italian reserves are estimated as follows (metric tons):—Traverselle, 1,000,000; Cogne, 5,000,000; Central Italy, 2,000,000; Sardinia, 6,000,000; Val Brembana, 20,000; making a total of about 14,000,000 tons. The present consumption of ore is about 700,000 tons per annum, and at this rate the whole of the iron ore will be exhausted within 20 years.—(*U.S. Com. Rep., Feb.* 20, 1919.)

Developments in the Peat Industry.—The working of peat as a substitute for coal is extending greatly in many countries, and notably in Austria, where a limited company with a capital of one million kroner has recently been formed to exploit the peat deposits at Salzburg and to work up the by-products. Peat from 2000 localities in Hungary has been investigated, and the calorific values were found to range from 1100 to 4800 calories. In Switzerland, where it is hoped that peat may be used for 18 per cent. of the yearly requirements of fuel, the Peat Association founded in 1917 has obtained a loan of 5 million francs from the Federal Council. English coal has been replaced in Sweden by wood and by peat, of which 120,000 tons was dug in 1916. The yearly output may be raised in the future to 400,000 tons, which would correspond in calorific value to 180,000 tons of coal. In Denmark the output of air-dried peat was 22,000 tons in 1916 and 56,000 tons in 1918. Trials in Denmark of mixtures containing peat as fuel for locomotives are said to have given favourable results. The investigation and development of the extensive Irish deposits is backward although the yearly consumption of peat in Ireland is at least 5¼ million tons.—(*Z. angew. Chem., Mar.* 18, 1919.)

Use of Molybdenum during the War.—The war had a marked effect in stimulating the production of molybdenum. On the outbreak of hostilities, the price of molybdenite suddenly rose, and in a remarkable degree, the reason apparently being that Germany, aware of the impossibility of laying up enough tungsten, was buying molybdenite to take its place. England and France also had recourse to molybdenum in the production of high-speed steels. The French used molybdenum in the breech-blocks of some of their field guns, but never, it appears, in shells, armour-plate or gun-linings. Later in the war, it was proposed to make armour-plate containing molybdenum, and contracts were entered into in America to produce such plate. Steel companies were parties to large contracts for molybdenum; but before the steel was actually put to use the war ended. One of the companies concerned used molybdenum, to the extent of less than 1 per cent., in making crank-shafts and connecting rods for Liberty motors. (*Eng. and Min. J., Mar.* 15, 1919.)

Ramie for Textile Manufacturers.—United States inventors have lately devised means by which ramie can be spun in ordinary cotton machinery, whereby a round, smooth and even yarn is obtained. Prof. J. Rossi, of Naples, has discovered and patented a method by which china grass or ramie fibre can be retted without the use of any chemical agents, which at times have a tendency to injure the natural strength. When chemically degummed ramie is manufactured in combination with cotton, and dyed and printed, the resulting goods possess a novel silky lustre, while the colours show up clearly and brightly on both fibres. The dyes which serve for cotton serve equally well for ramie.—(*Manchester Guardian,* May 7, 1919.)

Proposed Socialisation of the German Chemical Industry.—The socialisation of industry and its application to the chemical industries is a prominent demand of the German socialists, although the proposal cannot be said to have been clearly thought out in its ultimate effects by the mass of German workers. In these unsettled times it is difficult to subject this socialistic idea to calm and unbiassed criticism, but Prof. H. Grossmann, in an article published in the *Zeitschrift für Angewandte Chemie* (March 18, 1919), has pointed out some of the dangers to the workers themselves which would follow its immoderate application to the delicate organisation of industries which are affected by foreign competition. One of the socialist theorists, Karl Kautsky, has formulated a definite scheme for the carrying out of the proposal. He recognises that increased production is one of the most urgent of present day needs, and an essential condition of the success of any socialistic experiment. At the same time he regards the introduction of socialisation as the most important task of the new German State. The means by which this is to be realised involve the creation of "compulsory syndicates" for those branches of industry which are not yet ripe for immediate socialisation, among which it would appear that the chemical industries would be included. The syndicate would be concerned with the procuring of raw materials and the disposal of the products, as well as the regulation of the conditions of production. It would also have the right to close down superfluous or unfavourably situated factories. Its management would be composed of equal numbers of representatives of the employers, the workers council, the organised consumers, and State officials. Prof. Grossmann describes such an organisation as a debating society, and shows how doubtful would be its capacity for attracting and applying the best abilities to the technical and commercial problems of a large industry. Kautsky proposes in addition that in the individual factories committees of workers should be established side by side with the employers' management to supervise the carrying out of the decisions of the syndicate and watch the interests of labour. To such committees members would be eligible who are independent of the factory organisation, such as doctors and officials of trade unions. At the best the working of such a scheme would lead to a multiplicity of counsels which could not be favourable to the peaceful development of the industry, since all decisions would be the result of difficult compromises between conflicting points of view. At the worst it would give rise to intrigues and cabals resulting in unrest and disintegration. Independent investigation and invention, upon which the progress of the industry is based, would tend to be suppressed, and emigration of the best and freest German intellects would be stimulated as in the times following the crises of 1815 and 1848, when similar restrictions on liberty of thought and action were the rule. With regard to the fully nationalised industries, the proposal provides for a decentralised management of the State factories, each being self-controlled. The representation on the boards of management would be in equal thirds as between the State, the workers and the consumers. It is recognised that the interests of the workers and the consumers are opposed, and that such opposition can only be reconciled by increased productivity, this motive being established as a substitute for the profit-earning stimulus under existing capitalistic conditions. Although Kautsky contemplates the compensation of the expropriated owners, this would be effected on the basis of the present value of the material assets taken over and the profit-earning capacity of the undertakings, which has fallen to an extraordinarily low level as the result of the Revolution. No recognition is to be paid to the efforts of scientific and technical men, which have made the German industry what it is, and of which all chemists, engineers and business men are justifiably proud.

Nitrogen Fixation in Germany.—In an article on the development and future prospects of the German atmospheric nitrogen industry, it is stated that at the outbreak of war Germany had in stock 100,000 tons of Chilean nitrate and 430,000 tons of ammonium sulphate. After the battle of the Marne, the Government decided to expand greatly the production of synthetic ammonia and advanced 30,000,000 marks to the Badische Anilin u. Soda Fabrik for this purpose. This firm was able eventually to increase its output of ammonia to 300,000 tons, using the Haber process. Other firms were active developing the Frank-Caro (cyanamide) process, and by the end of 1915 the Berlin-Anhaltische-Maschinenanbau A.-G. had erected 30 plants with a total monthly output of 100,000 tons of nitric acid. In the spring of 1915, when there was only one Haber plant—at Oppau—in operation, the cyanamide producers, backed by the Deutsche Bank, tried to induce the Government to protect the new nitrogen industry by granting a trade monopoly. Objection was raised to this proposal, especially by the Badische company, it being urged that a monopoly would only bolster up the unprofitable cyanamide industry, and that this firm would in a short time be able to supply all the ammonia required without any State assistance. Although the idea of a trade monopoly was abandoned, the Government decided to undertake the manufacture itself by the Frank-Caro process, and hundreds of millions of marks were invested in plants at Wittenberg, Chorzow, and Piesterloh. The Badische firm, with State assistance, also erected a very large works at Leuna bei Merseberg, in which 50,000,000 marks was invested. It would undoubtedly have been better for Germany if the Government factories had installed the Haber instead of the Frank-Caro process. However, this fact is not likely to have any appreciable effect upon the prospects of the German nitrogen industry from the point of view of foreign competition, since the cyanamide process is used in most foreign factories, the Haber process having not yet been fully worked out.

The prospects of establishing an export trade are not unfavourable. Germany's consumption of nitrate before the war was 750,000—800,000 tons, and it is estimated that she can now produce considerably more than this, and will therefore probably be in a position to export: but the great question is whether the industry will be able to hold its own against Chilean nitrate in normal times. The American market will probably be lost, but so great will be the world's demand for fixed nitrogen that there will be no difficulty in finding other outlets for the German products. Meantime it is to be noted that the State works at Chorzow has had to close down for lack of coal, and that labour conditions are very unsettled. On the other hand, it is significant that the Badische plant at Leuna is being enlarged.—(*Z. angew. Chem., Mar.* 21, 1919.)

Foreign Dyes in Siam.—The following figures show the imports of foreign dyestuffs into Siam in recent years:—

	Metric tons		
	1914–15	1915–16	1916–17
Aniline dyes	48·1	19·9	46·5
Indigo	98·6	267·5	365·3
Other dyes	61·5	44·1	30·5

—(*Z. angew. Chem., Jan.* 24, 1919.)

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Scientific and Industrial Research.

In reply to Lieut.-Col. Malone, Mr. Shortt stated that certain decisions have been reached which provide for the extension of the functions of the Committee of the Privy Council for Scientific and Industrial Research, but no decision has yet been made with regard to the establishment of a separate Ministry of Research. This question is still under consideration.—(*May* 8.)

Spelter Production.

The Financial Secretary to the Ministry of Munitions (Mr. Hope), answering Mr. Holmes said that the Government has been buying the total British spelter output during the war. The purchase price was fixed at £56 per ton, but was raised to £60; the selling price was not increased because the average sale price of £57 per ton showed a clear average profit to the Ministry. Since February 3 last, the selling price has been falling and is now £38. This does not involve a loss to the Ministry, because it is supplying concentrates to the smelters at a price based on a £56 value for spelter. At the moment, the smelters are making no profits. By a decision of the Cabinet, the contracts have been continued until November 5 next.

The terms of the contract made in April, 1918, between the Government and the Zinc Producers Association Proprietary, Ltd., of Australia, provided for the purchase by the former of certain stocks of concentrates together with the whole Australian output (less certain reservations) controlled by the Association, for the period of the war and ten years thereafter, subject to maxima of 250,000 tons a year during the war and the ensuing twelve months, and 300,000 tons a year thereafter. The purchase is at a flat price for the war period and five years thereafter, with provision as to division of profits on resale of a part of the quantities taken; for the remaining period it is based on the average London market price of spelter, but with a guaranteed minimum.—(*May* 8.)

The sum of £510,000 debentures has been advanced by the Government to the National Smelting Co., Ltd. The shareholders have paid 1*s.* per share on 500,000 shares, leaving 19*s.* per share uncalled. The whole position is being considered by the various Government Departments.—(*May* 19.)

Electricity Supply.

The Government Bill to provide an abundant and cheap supply of electricity was moved by the Home Secretary and read a second time. The measure provides for the appointment of five Electricity Commissioners, appointed by the Board of Trade, to conduct the whole of the policy dealing with the electrical industry—"to make experiments, to stimulate, to encourage, and to guide"—and to be assisted by advisory boards. The country will be divided into districts, each of which will have an Electricity Board, representative of the local authority, electricity undertakers, consumers and labour. These boards will acquire the generating stations and main transmission lines within their areas, but the machinery of distribution will remain in the hands of existing undertakers; they will, further, provide revenue and expenditure, borrowing money, if need be, from the National Exchequer through the Commissioners, but not exceeding £25,000,000 in the aggregate. The Commissioners may also advance up to £20,000,000 during the period in which the district boards are being set up. The prices charged for electricity will be such as are sufficient to cover expenditure on income account (including interest and sinking fund charges), with such margin as the Commissioners may allow.—(*May* 14.)

Saccharin.

The Chancellor of the Exchequer informed Mr. D. Herbert that saccharin is included among the articles in respect of which Imperial preference will be granted.—(*May* 12.)

German Caustic Potash.

Sir R. Cooper asked if the Soapmakers' Federation is offering German caustic potash, 90—92 per cent., at £100—£105 per ton; if a price exceeding £40 a ton renders this material impracticable for general consumption; and what effect this policy of aiding Germany to dispose of her produce at inflated prices would have on the value of the indemnity to be paid by her.

Mr. Kellaway replied that a proposal on the lines suggested in the question is now under consideration by the Board of Trade in conjunction with the Ministry of Munitions, but no decision has been reached.—(*May* 22.)

REPORTS.

PULVERISED COAL.

PULVERISED COAL SYSTEMS IN AMERICA. *By* L. C. HARVEY. *Special Report No.* 1, *Fuel Research Board. Department of Scientific and Industrial Research. (H.M. Stationery Office. 2s. 6d. net.)*

In pulverised fuel plants, the fuel is injected into the furnace in a finely divided form and is mixed with the correct volume of heated air prior to combustion. In Great Britain the process has been developed principally in connexion with the Portland cement industry in which its use has largely superseded that of other forms of fuel. On a limited scale, pulverised coal has been employed by the Admiralty for steam raising in land boilers. In the United States the process is applied to over 10,000,000 tons of coal per annum, and the present report details the results of a personal investigation by L. C. Harvey into the use of such pulverised fuel in that country. Gasworks' coke and breeze are unsuitable for use in a pulverised form, but pitch can be satisfactorily pulverised and employed. A certain amount of bituminous coal may, if desired, be mixed with anthracite and pulverised. Bituminous coal containing up to 30 or 40 per cent. of ash may be satisfactorily burnt in the pulverised form. The water content of lignites and peat need not be reduced below 5 per cent. for efficient burning in powdered form. The average total cost of pulverising in plants of 50 tons capacity per 24 hours, expressed as cost in coal of the coal pulverised, is distributed as follows:—Equipment 13·25%, drying 5·75%, pulverising 20·00%, and conveyance 4·00%, making a total cost of 43·00% of the coal pulverised.

The general pulverising installation embraces (1) the preliminary crusher wherein the coal is broken down to ¾ in. mesh, (2) the first elevator, (3) the magnetic separator, (4) the crushed coal bin, (5) the driers wherein the coal is dried to within 1 per cent. moisture content, (6) second elevator, and (7) the pulverising mills, those most generally installed being the "Fuller," the "Raymond," and the "Bonnot." The standard fineness of pulverisation adopted is 85 per cent. through a 200 mesh screen (40,000 holes per sq. inch) and 95 per cent. through a 100 mesh screen. The coal dust is conveyed to the burners by means of mechanical conveyors, or by means of compressed

air systems. The risk of spontaneous combustion of the coal is negligible if the store of crushed or dried coal does not exceed that necessary for two-days working. The limit of storage of pulverised coal at the mill house should be a 24 hours' supply, and that at the furnace eight hours' supply. The limit of height of the coal pile should be 10 to 12 feet, and the pile should be isolated from all sources of heat. Various forms of burner, operated by air supplied at a pressure of from 2 to 8 oz. per square inch, are available. A low-pressure air supply is recommended. For open hearth work, however, the fuel is ejected from the supply bin by compressed air at 60 to 80 lb. per sq. inch, preheated low-pressure secondary air being subsequently introduced at the burner nozzle.

Details are given of the use of pulverised fuel in various industries. These embrace (1) Metallurgical processes. In copper smelting a fuel ratio equal to 7·24 tons of copper per ton of pulverised coal has been obtained for continuous work. The following table gives the consumption of powdered fuel in the various operations of steel production :—

Operation	Weight of powdered fuel per ton of steel
Open hearth melting ...	500 lb. per gross ton of ingots cast
Soaking pits	190 lb. per ton (3300 lb. ingots)
Continuous billet-heating	125–140 lb.
Heating steel to forging temperature	458 lb.
Bushelling	450 lb.
Rolling	500 lb.
Puddling	1200 lb.
Annealing (sheet etc.) ...	290 lb. per ton of finished plate

(2) Steam raising. Results obtained by the Missouri, Kansas and Texas Railway indicate an evaporation of from 6·38 to 9·06 lb. of water from and at 212° F. per lb. of powdered fuel. (3) Railway locomotives. A saving of fuel of from 20 to 40 per cent. appears to be possible by the use of pulverised fuel in place of the more usual form. The advantages are stated *in extenso*, and indicate this field as one rich in advantageous possibilities for the use of pulverised fuel. Hitherto, little application of pulverised fuel has been made to marine propulsion or domestic heating.

The author concludes that the advantages of burning fuel in pulverised form have been definitely established, an economy of from 20 to 30 per cent. being established in many cases. On the other hand no economy is to be effected by the introduction of pulverised coal burning apparatus in substitution for existing efficient mechanical stoker installations, but for initial installations the latter plant can be introduced at a lower cost and will show increased overall economies over mechanical stokers. It is also noteworthy that waste coal can be used to good purpose, and that the new system involves a reduced demand for labour, this being particularly marked in the firing of railway locomotives. Useful appendices enumerate (1) the systems investigated, (2) the installations visited, (3) pulverised fuel users, and (4) a comprehensive bibliography.

REPORT TO THE BOARD OF TRADE BY THE FUEL RESEARCH BOARD ON GAS STANDARDS. [*Cmd.* 108, 1*d.*]

The report embodies the recommendations of the Fuel Research Board in reply to a request by the Board of Trade and other Departments that they should advise as to "the most suitable composition and quality of gas, and the minimum pressure at which it should be generally supplied, having regard to the desirability of economy in the use of coal, the adequate recovery of by-products and the purposes for which gas is now used." It is recommended that gas undertakings should be in a position to select those coals which can be drawn from the nearest centres of population. The charge to the consumer is to be based on the actual thermal units contained in the gas passed through his meter. More than one quality of gas may be supplied by a gas undertaking, but the following stipulations refer to all such separate supplies. The gas undertaking is to declare the calorific value of the gas it intends to deliver, and is to adjust consumers' appliances so that the gas may be burnt with efficiency and safety. Should the gas undertaking desire to alter its declared calorific standard, due notice is to be given to the consumers, whose appliances are to be adjusted to ensure safety and efficiency in use of the new supply. The gas is to be free from sulphuretted hydrogen, and the percentage of inerts is not to exceed 12 per cent. The minimum pressure is to be 2 in. of water at the meter outlet. Some relaxation of these requirements may be permitted when the gas is supplied exclusively for industrial use, the products being discharged in the open air, 10 feet or more above the level of adjoining roofs. The more complete removal of sulphur compounds and cyanogen compounds is strongly urged. It is suggested that burners should be standardised for use with gas supplies of respective calorific values 400, 433, 466 and 500 B.Th.U., suitable aëration adjustment being provided whereby the burner may be employed with any quality of gas comprised within successive numbers of this scale of calorific values.

COMPANY NEWS.

BRITISH COTTON AND WOOL DYERS' ASSOCIATION, LTD.

The 19th annual meeting was held at Manchester on May 21. Mr. A. Hoegger, who presided, referred to the position of the dye industry. Statements in the Press and advertisements of certain colour manufacturers tend to give the impression that most colouring matters are now available to dyers; but this is far from being the case. Whilst acknowledging the immense efforts that have been made by the dye makers, it must be admitted that, on the whole, the results have been rather disappointing. Common colours are in ample supply, but more faster colours and a much greater variety of different classes of dyes are still needed. In the cotton section dyes of the indanthrene and algole types are still much wanted, and, amongst others, azoic colours, diazo and benzo fast colours may be mentioned. In wool dyeing the situation on the whole is more favourable, although blacks of the Diamond Black PV type are scarce and at a comparatively high price. Dyes such as patent blue, alizarine cyanine green, and alizarine irisole are also in request. Much success has been achieved in the laboratories, but there is not yet sufficient large-scale plant to meet the requirements of the trade.

The trading profit for the year ended March 31, 1919, is £149,159, and the net profit £85,154 (issued capital £387,083 and £620,000 4 per cent. debentures). A dividend of 10 per cent. is declared on the ordinary shares, £50,000 is allocated to reserve (bringing that fund to £250,000), and the carry

forward is £40,260. Liquid assets amount to £679,400, and creditors' claims £180,600. With regard to the present position, the slubbing and woollen branches are fairly well employed; the cotton branches are still moderately occupied and new business is gradually coming round. There has been considerable improvement in the Indian trade during the last few weeks, and, generally speaking, the outlook for the current year is distinctly favourable.

NEW REGISTRATIONS.—*Maguire, Paterson and Palmer, Ltd.*—The following firms engaged in the manufacture of matches have combined to form a new company:—Maguire, Miller and Co. (Liverpool), Ltd., Maguire, Miller and Co. (Leeds), Ltd., Paterson and Co., of Dublin, and J. Palmer and Sons, of London. The new company, to be known as Maguire, Paterson and Palmer, Ltd., is a private one with a capital of £500,000, with registered offices at Liverpool. Vickers, Ltd., and Tillotson and Son, Ltd., cardboard manufacturers, are financially interested in the new company; match-making machinery will be manufactured at the Erith works of the former. A new match factory is to be erected in Liverpool.—(*Fin. Times, May* 8, 1919.)

The Chemical and Metallurgical Corporation, Ltd., has been formed with a capital of £1,200,000 to acquire the rights of Mr. Frank E. Elmore in respect of inventions for the treatment of complex zinc, lead, and silver ores.

The United Premier Oil and Cake Co., Ltd., has been registered with a capital of £1,500,000 to acquire the shares and business of Wray, Sanderson & Co., Ltd., the Premier Oil Extracting Mills, Ltd., Sowerby & Co., Ltd., John L. Seaton & Co., Ltd., and Universal Oil Co., Ltd. The business to be carried on is that of seed and bone crushing, oil extracting, manufacture of oil, fatty acids, glycerin, soap, etc.

The British Cocoa and Chocolate Co., Ltd., has been registered with a capital of £2,500,000 in £1 shares. The new company will acquire all the ordinary shares of Cadbury Bros., Ltd., and all the "A" and "B" deferred ordinary shares of J. S. Fry & Sons, Ltd.

NEW ISSUES.—*Jurgens, Ltd.*—This company was formed in 1914 to take over the business in the United Kingdom of the Dutch undertaking, Anton Jurgens' Margarine Works. It possesses a large factory at Purfleet, on which over £500,000 has been expended, and which it is now proposed to enlarge and complete. The capital of the company is £4,000,000, half in 7 per cent. guaranteed cumulative participating preference shares and half in £1 ordinary shares. Of the latter, £1,000,000 has been issued to the parent company, and £1,000,000 preference shares have recently been offered to the public at par, and the issue has been fully subscribed.

William Gossage and Sons, Ltd., is offering for public subscription at par, £750,000 in 6½ per cent. cumulative preference shares at par, forming part of the £2,000,000 new capital recently created. The nominal capital is now £2,950,000.

THE directors of the Swiss Society of Chemical Industry in Basel have recommended a dividend of 27½ per cent. for 1918, and an increase in the capitalisation of from 12·5 to 15·6 million francs.

THE Metallgesellschaft of Frankfort is to raise its capital from 18 to 21 million marks by the issue of three million marks of 5 per cent. preference shares, to be taken up by the Metallbank. This transaction will effect a closer co-operation between these two bodies.—(*Z. angew. Chem., April* 22, 1919.)

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for May 8 and 15.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS	REFERENCE NUMBERS
British India ..	Iron or corrugated sheets	881
,, ..	Metals, soap	885
,, ..	Oils, varnish, paint, rubber	887
Canada	Pharmaceutical products including glassware ..	820
,, ...	Acetate of lime, aluminium sulphate	*
Egypt	Caustic soda	828
Austria (occupied)	Copper sulphate, tanning materials, oils and oil seeds	829
Alsace-Lorraine	Chemicals, drugs, oil ..	902
Argentina ..	Galvanised sheets, tinplate, cement, chemicals, drugs	903
Belgium ..	Linseed-oil cake ..	830
,, ..	Tin, aluminium, copper, brass, iron, steel ..	840
,, ..	Leather, dressed and undressed	912
,, ..	Oils, fertilisers	920
,, ..	Leather, soap, perfumery	921
,, ..	Cattle food, fertilisers, pharmaceutical accessories	†
Brazil	Chemicals, drugs, cement, glass, paints, varnishes	923
France	Asbestos	849
,, ...	Paper	853
,, ...	Chemicals, paper, sugar, alcohol	856
,, ...	Tinplate	858
,, ...	Chemicals, drugs ..	930
,, (Algeria)	Chemicals, drugs, paints, varnishes, leather ..	862
Italy	Scientific apparatus ..	865
Mexico	Chemicals, drugs, varnish	867
,, ...	Dyes, paints, varnishes	935
Morocco ..	Mineral oil, glass, soap ..	870
Scandinavia ..	Caustic soda, soda ash, bleaching powder ..	942
,,	Textiles, paints ..	943
South & Central America ..	Chemicals, paper, soap, perfumery	945
Spain	Dyes, tanning materials, fine tanned skins, fish oils, greases	878
Switzerland ..	Chemical and pharmaceutical products ..	948

* Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.
† Belgian Section, Department of Overseas Trade, India House, Kingsway, W.C. 2.

TARIFF. CUSTOMS. EXCISE.

Australia.—Cartons and zinc cups for use in the manufacture of dry electric cells may no longer be imported.

The proclamation of August 9, 1916, prohibiting the import of soap from all countries except the U.K. has been revoked as from December 18, 1918.

Canada.—The import duty on formaldehyde is fixed at 20 per cent. *ad val.* under the British Preferential Tariff, and at 25 per cent. under the Intermediate and General Tariffs. In addition there is leviable a war tax of 5 per cent. and 7½ per cent. *ad val.* respectively.

France.—Raw sugar of foreign origin may now be imported for refining on the express condition that re-exportation is guaranteed.

New Customs decisions affect dental pastes containing a minute amount of saccharin, and zinc sulphide.

France (West Africa).—The Customs duties on sugar, syrups, chocolate, alcohol, petroleum, salt and matches have been modified.

Japan (Corea).—The consumption tax on sugar, molasses and syrup has been modified.

Netherlands.—The Customs and Excise duties on spirits have been increased.

Panama.—The export duties on, *inter alia*, ores, coconuts, copra, balata, rubber, sarsaparilla, pecacuanha root and copaiba gum have been modified.

South West Africa.—The Customs and Excise duties on certain spirits have been increased.

Tunis.—The import duties on mineral oil and spices have been modified

GOVERNMENT ORDERS AND NOTICES.

EXPORTS.

The following relaxations on existing export prohibitions have been announced :—

Headings transferred from one list to another.

From List A to List B:—

Potassium permanganate.—(May 8.)

From List A to List C:—

Iron ore; malt extract and preparations containing; silk yarn, artificial.—(May 8.) Copper and alloys of copper; copper ore; regulus, matte, concentrate and precipitate; iron pyrites.—(May 22.)

From List B to List C:—

Henbane.—(May 8.) Barium sulphate.—(May 22.)

Altered Headings.

(A) Cocoa, raw, and manufactures thereof, except cocoa-butter and cocoa powder; (c) cocoa powder. —(May 8.)

Iron and Steel.—The Board of Trade announces that nearly all forms of iron and steel have now been transferred to the "free" list; but iron ore and steel containing tungsten or molybdenum are on List C.

Coal.—The Board of Trade proposes to terminate the system of limited prices at present in operation in the case of coal shipped to Allied countries.

Czecho Slovakia.—Goods may now be shipped to this country *vid* Hamburg and the Elbe, under certain conditions.

IMPORTS.

General licences have been issued permitting the importation of the following articles:—Cocoa butter; oleo stearin; olive oil; articles of food containing sugar; soap and soap stock; medicinal bulbs and herbs. Zinc oxide is to be admitted up to 50 per cent. of importations in 1913.

NEW ORDER.

The Nitrate of Soda (Suspension) Order, 1919. Ministry of Munitions, May 13.

The Flax (Irish Crop) Order, 1919. Ministry of Munitions, May 23.

The Machine Tool, Wood-working Machinery and Treadle Lathes (Suspension) Order, 1919. Ministry of Munitions, May 23.

NOTICES.

The Board of Trade has given notice revoking, as from May 7, the Motor Spirit and Lamp Oil (Maximum Retail Prices) Order, 1918, the Petroleum Products (Wholesale Prices) Order, 1919; and the Motor Spirit Delivery Order, 1918, together with the Orders of February 6, 1917, and July 13, 1917, as from May 17.

The Minister of Munitions has given notice cancelling the Imported Flax Seed (Control) Notice, 1918, as from May 23.

Notice is given by the Privy Council that it is proposed to exempt dinitrophenol from the provisions of the Explosives Act, 1875.

LEGAL INTELLIGENCE.

FIRE AND EXPLOSION AT A TNT FACTORY. CLAIM AGAINST INSURANCE COMPANIES. *Hooley Hill Rubber and Chemical Co., Ltd.* v. *Royal Insurance Co., Ltd. and Others.*

In the King's Bench Division on May 8, Mr. Justice Bailhache heard a special case arising out of an arbitrator's award in a claim by Hooley Hill Rubber and Chemical Co., Ltd. of Ashton-under-Lyne, against the Royal Insurance Co. and three other insurance companies.

The award of the arbitrator stated that on June 13, 1917, a fire broke out in the TNT works belonging to the assured at Ashton-under-Lyne which burned fiercely for some 20 minutes, doing great damage, after which an explosion took place which shattered the premises. The total loss sustained in consequence of fire and explosion amounted to a sum far in excess of the aggregate amount of the sums insured by the policies. The insurance companies admitted liability to indemnify the assured for the loss sustained in consequence of the fire, but disputed liability, under the policies, for the loss consequent upon the explosion. The assured claimed to be indemnified on both counts on the ground that the explosion was an incident in the course of the fire and that the fire was the proximate cause of the whole loss. The arbitrator held that the contention of the insurance companies was well founded. The assured contended further that the insurance companies were estopped from denying that they were liable under the policies to indemnify the assured against loss which arose from the explosion. Evidence was laid before him in support of this contention as against the Royal Insurance Co. only. The negotiations were conducted by correspondence with the Manchester agent of this company, who in answer to an inquiry as to the position in the case of an explosion following a fire, replied that in such a case damage would be duly covered by an ordinary fire policy, with the qualification "that the loss or damage as specified in the third condition of the policy would still be excepted." The company understood the letter as a notification that it was covered against loss caused by an explosion following a fire and therefore limited its insurance against loss caused by an explosion following a fire to the policies about to be issued by the Royal Insurance Co. Consequently the insured did not cover themselves by taking out further policies against such loss. Subject to the opinion of the Court, the arbitrator awarded that the insurance companies should pay the following sums:—Royal £5096, and the other three companies £2548 each; if in the opinion of the Court this construction of the policies was wrong and they did in law cover loss caused by explosion following fire he awarded:—Royal £10,400, and the other three £5200 each; if construction of policies was right but he wrongly directed himself on the

question of estoppel, the Royal should pay £10,400 and the other three £2548 each.

Mr. Justice Bailhache said that he was bound by the judgment given in the case of *Stanley* v. *Western Insurance Co.*, in 1868, and he therefore upheld the award of the arbitrator, *viz.*, that the insurance companies were right in saying that their policies did not cover loss caused by explosion under the circumstances obtaining in the present case. As regards the question of estoppel, the letters written by the insurance manager would convey to an ordinary business man of intelligence that such a loss as had happened in this case was in fact covered by the ordinary form of policy. If the statement was a statement of existing fact independently of any question of law, the Hooley Hill Co. would be perfectly right and there would be an estoppel. If it were not for the old case he thought there would be a great deal to be said for the view expressed by the manager. His Lordship agreed with the arbitrator that there was no estoppel. The result was that the award would stand.

TRADE NOTES.

BRITISH.

National Sulphuric Acid Association, Ltd.—This association has been registered as a company limited by guarantee, with an unlimited number of members, each liable for one guinea in the event of winding up. Its objects are to establish the sulphuric acid industry of the United Kingdom on a permanently prosperous basis, commercially and scientifically, having regard to the necessity of its maintenance as a key industry in relation to the needs of other industries (particularly in time of war); to promote the discussion of all questions affecting the interests of the said industry; to create new outlets for the consumption of sulphuric acid; to devise means of disposing of surplus sulphuric acid production; to give effect, so far as lawfully may be, to the recommendations contained in "the report of a Departmental Committee on the post-war position of the Sulphuric Acid and Fertiliser Trades," appointed by the Minister of Munitions in February, 1917; to promote excellence, economy, efficiency and co-operation in relation to the manufacture and distribution of sulphuric acid, etc. Messrs. S. Mount and J. K. Stewart are joint secretaries. The registered office is at 166, Piccadilly, W. 1.

Fertiliser Manufacturers' Association, Ltd.—The constitution of this company is similar to that of the above, and among its objects are to take over the assets and liabilities of the unincorporated association of similar name; to promote the discussion of all questions affecting the interests of acid and chemical fertiliser manufacturers; to promote excellence, efficiency, economy and co-operation in relation to the manufacture and distribution of chemical fertilisers; to suppress malpractices; to carry on the business of acid and fertiliser manufacturers; to act as a trade protection society, etc. Secretary: Mr. J. K. Stewart. Registered office, 70, Fenchurch Street, E.C. 3.

FOREIGN.

Resources of the Dominican Republic (Latin America).—The commercial report for 1918 shows diminished prosperity compared with 1917, although in view of the foreign trade restrictions and shortage of tonnage results are not considered unsatisfactory. Under United States administration the Republic is being systematically developed, and the financial position of the State has considerably improved. The two chief exports are sugar and cocoa, the crops of which were bad in 1918 owing to late rains and disease of the cocoa plant. The value of the sugar exported was £4,600,000, and the cocoa production was only 18,800 tons, the lowest return for many years. There are a number of openings for trade with Great Britain, but a direct steamship service is essential for any great development of British trade. Considerable progress has been made in the building of roads by the Public Works Department. Little is known of the mineral resources, but a company is prospecting and nickel is said to have been found. Oil-boring at Azua has been successful and a small output of 300 to 400 barrels per day is expected.—(*Bd. of Trade J., April* 10, 1919.)

Copra in New Caledonia.—Exports of copra have recently been as follows (tons):—1913, 3215; 1914, 3103; 1915, 2676; 1916, 2283; and 1917, 3661. The colony is very well suited for the cultivation of the palm, and the production of copra on a large scale ought to be organised at once in order to meet the growing demand.—(*Dépêche Col., Mar.* 25, 1919.)

The Japanese Dye Market.—Great depression has ruled in the Japanese dye market since November last. Except for a few local transactions, business is at a standstill; merchants are reported to be endeavouring to cancel contracts, and bankers are extremely cautious in trusting dye merchants. Yellow dyes have fallen in price from 4200 to 1200, and black dyes from 470 to 230 yen per 100 kin (yen=2*s.*, kin=1·3 lb.). In some quarters it is anticipated that American competition will be felt more in the South Seas and in China than in Japan itself.—(*U.S. Com. Rep., April* 9, 1919.)

The Perfumery and Essential Oil Trade of Switzerland.—The manufacture of perfumes was started in Switzerland in the 'nineties of the last century. Despite many natural disadvantages, such as lack of raw materials and cheap fuel, it has made rapid headway and a large number of artificial perfumes have originated in the country. The recent economic blockade of the Central Powers, together with the activities of the S.S.S. (Société de Surveillance Suisse), have had an adverse effect on the importation of natural oils and upon the exportation of finished products. Before the outbreak of war the quantity of ethereal oils imported from Germany was more than double that obtained from France, but by 1918 this proportion had become reversed. The exports of synthetic perfumes in recent years have been as follows (in centner = $\frac{1}{20}$ metric ton):—1905, 507; 1913, 2466; 1914, 1920; 1915, 2116; 1916, 2117; 1917, 1395; 1918, 686. Although quantities have declined, values have increased enormously. Thus the exported value of synthetic perfumes in 1913 was 6,181,000 francs, and in 1918 7,220,416 francs; in the latter year the value was ten times greater than in 1900. The following table gives, in centner and francs, the exports of perfumes and cosmetics during the years 1913—1918:—

Year	Exports Centner	Value Frs.	Destination % *E.C.	N.	C.P.
1913 ..	2639	6,936,276	87·7	4·4	7·7
1914 ..	2048	5,938,582	83·9	6·8	9·4
1915 ..	2275	8,375,190	76·6	10·4	12·9
1916 ..	2361	11,125,141	82·0	12·3	5·7
1917 ..	1567	7,842,053	66·8	15·5	17·7
1918 ..	856	7,458,829	82·2	17·5	0·2

*E.C.=Entente Countries, N.=Neutrals, C.P.=Central Powers.

The falling off in exports and production in 1917 was due to Customs' difficulties, lack of transport, the commandeering of nitric acid and benzene for the Swiss army, and to general diminution in trade. As regards the future, Switzerland will have to look more to the East and to the South, more particularly because many of the

countries which formerly took her imports have initiated or developed their own industry. The competition of the United States and Japan will probably be formidable. The Swiss industry must devote its attention more particularly to the manufacture of specialities, *i.e.*, to quality rather than quantity production.—(*Schweiz. Chem.-Zeit.*, 11—13, 1919.)

Chemical Industry in the Netherlands.—An official report, issued in connexion with the Second Annual Utrecht Fair, gives information concerning the development and present condition of many of the natural chemical industries.

Sulphuric acid is manufactured by the Maatschappij van Zwavelzuurbereiding, Amsterdam, and the N.V. Amsterdamsche Superfosfaatfabriek, which has been united with the Centrale Chemische Fabrieken. Both the lead chamber and contact processes are used, though platinum for the latter has had to be purchased at fabulous prices. These two factories and the Lym- & Gelatinefabriek, Delft, produce raw and pure muriatic acid; nitric acid is also made by these firms as well as by Ketjen, the Fabriek van Chemische Producten, Pernis, and Van der Elst & Matthes' Ammoniakfabriek at Weesp.

Little soda, soda crystals or potash is produced; ammonium sulphate is manufactured at gasworks and by distilling organic matter. The N.V. Ammoniakfabriek v.h. van der Elst & Matthes, Weesp, manufactures household ammonia as well as sulphate, carbonate and nitrate. Chloride and phosphate of ammonia are made by the Amsterdamsche Superfosfaatfabriek, Ketjen. The demand for sources of nitrogen is very great, and only 10 per cent. of the requirements of nitrogenous fertilisers are covered by home supplies. Some soda is made electrolytically, together with chlorate of lime.

Chlorate of potash is manufactured by the N.V. Chemische Fabrieken Paludan & Co., Haarlem, and by the N.V. Chemische Fabriek v.h. Dr. F. C. Stoop, Utrecht. The output of superphosphate has decreased owing to the war, and scarcity of sulphate of ammonia has stopped the supply of mixed manures. Fluosilicate of soda, phosphoric acid, potash and soda phosphate, red lead and chloride of sulphur have been produced as by-products. Silicate of soda, the manufacture of which for strawboard is now profitable, is made by the N.V. Chemische Fabriek "Gembo" of Winschoten and the Chemische Fabriek F. C. Stoop. Nitrates of potash and soda are made by the latter firm and bisulphate of soda by the Chemische Fabriek Naarden and Ketjen. The high price of silver prevents the manufacture of silver nitrate. Iodide of mercury from Dutch East Indies' raw material is made by Brocades and Stheeman, white and red lead by the Utrechtsche Loodwit & Menie-fabriek G. Greeve, and the Zuid Hollandsche Verffabrieken, and plumbago and sugar of lead by the latter firm. The Maastricht Zinkwitmaatschappij has built a third factory for zinc white and lithopone; ivory black is produced by Wed. P. Smits & Zoon, ultramarine by E. Guimet of Sas van Gent, chrome yellow, zinc yellow, Berlin blue, lime green, etc., by the N.V. Verstoffenfabriek Remmert & Co. of Apeldoorn.

Hydrogen, oxygen and nitrogen are produced by the N.V. Maatschappij Oxynium, Schiedam, the two latter elements also by the N.V. Electro-Zuur- & Waterstoffabriek, Amsterdam. Argon and wolfram wire from the ore are made by Philips & Pope's Electric Lamp Works.

The Nederlandsche Gist & Spiritusfabriek makes 96 per cent. alcohol, amyl alcohol from by-product fusel oil, ether, and ether pronarcose in 50-gram bottles. The Fabriek van Chemische Producten at Pernis makes ether, formic acid and sodium formate. Calcium acetate products are more difficult to manufacture. Lactic acid and calcium- and ferrolactate are made by the N.V. Chemische Industrie Rotterdam.

Government coke ovens will shortly distil much coal tar. The Maatschappij van Koolteerproducten at Krimpen a/d Ysel makes a number of coal tar products, and Pernis and Naarden a variety of intermediates; Naarden produces also saccharin and ethereal oils for perfumes and flavourings. The N.V. Polak & Schwartz make a variety of fragrant and other organic substances, and Polak's Frutal Works, Amersfoort, produce, in addition to other perfumes, solidified cedar oil and ethereal oils free from terpene.

The Societeit voor Chemische Industrie, Katwijk, makes theobromine, sodium salicylate, caffeine and methyl salicylate, the Amsterdam Superfosfaatfabrieken "superol" (orthooxyquinolinesulphate) and "anæsthesine," the Amsterdam Kininefabriek quinine and its salts. Brocades and Stheemann will make dermatol, airol, and cascara.—(*U.S. Com. Rep., Mar.* 13, 1919.)

German Oil Mills Trade Association.—At the annual general meeting of the Bremen-Besigheimer Oelfabriken it was announced that the three largest German oil mills, the Verein Deutscher Oelfabriken of Mannheim, F. Thorl's Vereinigte Harburger Oelfabriken and the Bremen-Besigheimer Oelfabriken had concluded an agreement to form a trade association for the purpose of facilitating sales and purchases. Other large oil mills are expected to join in the scheme.—(*Seifenfab., Mar.* 5, 1919.)

REVIEWS.

RECENT ADVANCES IN PHYSICAL AND INORGANIC CHEMISTRY. *By* A. W. STEWART, *with an introduction by* SIR WILLIAM RAMSAY. *Third edition. Pp. xv + 284. (London: Longmans, Green & Co., 1919.) Price* 12*s.* 6*d. net.*

The new edition of Dr. Stewart's well-known book is largely a new work, as is pointed out in the preface. Whilst the first and second editions each contained fourteen chapters, the new edition consists of twenty, of which twelve are quite new and the others, with one exception, have been very considerably revised.

Ten years have elapsed since the book made its first appearance, and comparison of the first and third editions is of considerable interest as indicating the trend of work during the past decade. Attention has been drawn so much to radioactive phenomena and the evolution of the elements that about one-half of Dr. Stewart's book deals with these and kindred subjects, whilst the remainder is devoted to various matters of more or less interest.

Each chapter of the book forms a nearly complete and independent essay, so that the order in which Dr. Stewart deals with the material does not greatly matter, though one is rather surprised at the arrangement. Thus after dealing with electric furnaces, the fixation of nitrogen, the permutites, peroxides and per-acids, active nitrogen and absorption spectra in the first six chapters, the next three chapters are concerned more or less directly with X-ray work, the tenth chapter is devoted to the rare earths, incandescent mantles not unnaturally follow in the next chapter, and then we encounter the pseudo-acids before getting on to the inactive gases. Since each essay is nearly independent, the position of the chapter on pseudo-acids does not much matter, though the reason for its place is not clear.

The phenomena of radio-activity might have been dealt with before presenting work on X-rays and on inactive gases, more especially as the historical method is employed in the chapter on radio-activity (Chapter XV.).

The subjects described in the book have been indicated above, their treatment is generally satisfactory. Scarcity of diagrams is a drawback; that the first two chapters which deal respectively with the electric furnace and the fixation of nitrogen should not contain a single sketch of plant is remarkable. The space given to the permutites is not great (four pages), but one may question whether their theoretical interest is sufficient to warrant their inclusion under the head of recent advances when phase rule, colloids, and co-ordination valency theory are untouched. All these matters received some attention in the first edition, and their present exclusion is to be regretted considering the great technical importance of clear views on the phase rule and of a sound knowledge of colloidal chemistry, whilst the discovery of optical activity associated with the co-ordination compounds of metals, such as cobalt, must certainly be regarded as a very real advance in chemical science.

The chapters on peroxides and per-acids and on active nitrogen are short and to the point, but the treatment of absorption spectra in Chapter VI. leaves something to be desired. The reviewer cannot help thinking that had the subject of pseudo-acids (and bases) been treated immediately afterwards, and attention drawn to the fact that our usual indicators for acidimetry are included amongst these compounds, distinct advantage would have accrued.

The chapters dealing with radio-active phenomena, X-ray analysis, positive ray analysis, disintegration of the elements and kindred subjects are clearly written. Of much that is good, perhaps the best is to be found in Chapters XVIII. and XIX., which deal with isotopes and the elements respectively.

Some of the remarks in the concluding chapter in disparagement of the Ostwald school are unnecessary and uncalled for. That some physical chemists are unfortunately rather deficient in their knowledge of organic chemistry is unfortunately true, equally lamentable is the fact that organic chemists do not always possess a very accurate knowledge of physical and physico-chemical facts and theories.

The reviewer has read Dr. Stewart's book with much enjoyment, and hopes that it will be widely read by others.

J. T. Hewitt.

The Physical Chemistry of the Proteins. *By* T. Brailsford Robertson. *Pp.* xv + 483. (*London: Longmans, Green & Co.*, 1918.) *Price* 25*s. net.*

It is to be regretted that in abandoning the usually accepted hypothesis of protein ionisation Dr. Robertson has given us no effective working substitute, with the result that the treatment of the subject tends to be superficial and even the voluminous bibliography, ill-balanced. The author's contributions to literature are referred to in over one hundred references, whereas only fifty instances cover the allusions to the work of Arrhenius, Bayliss, Mellanby, Michaelis, Sörensen, and Roaf collectively. A redeeming feature, however, in this connection, is the extensive quotation from the work of W. B. Hardy, though an apparent omission to quote or recognise the significance of his work on denaturation and its prevention by preliminary treatment with fat solvents in the cold, is difficult to understand.

Referring more particularly to the parts of the work of immediate interest to those who have protein materials to examine, or to study and control in manufacture, it is to be noted that in the chapter on the preparation of pure proteins only one method is given in each case and allusions to others are scanty. No mention is made of the preparation of pure blood albumin, nor of fibrinogen. The chapter on "Quantitative Estimation of the Proteins" consists of descriptions of a nephelometric method, and a description of how Dr. Robertson himself carries out refractometric determinations with a Pulfrich Refractometer and sodium light, but with no temperature regulation. After reading this chapter it is less difficult to understand the statement on page 60, "The refractometric method does not permit the extreme accuracy which may be attained with the nephelometric method under favourable conditions," which is in accord neither with anticipation nor with general experience. No allusion is made to the standard methods of measurement of protein concentration which have been so skilfully elaborated by Chick and Martin and others, and which must necessarily enter into any computations based on physical methods, except in a few lines on page 70, where they are dismissed with the words, "the direct method of demonstrating the existence of protein compounds cannot be trusted to yield accurate data, and results and conclusions based upon this method are to be accepted with the greatest caution." Under the heading of "The Compounds of Proteins with Oxygen" reference to the work of Barcroft is restricted to twenty lines, and neither in the chapter dealing with the precipitation of the proteins by inorganic salts, nor under the heading, "Compounds of the Proteins with Toxins, Antibodies, Ferments, etc.," is any allusion made to Bauzhaf, whose painstaking and persistent advances in this work are marred only by difficulty of access on this side of the Atlantic. The phenomena of the "protection" of hydrosols by protein are alluded to very briefly indeed, and the whole consideration of "isoelectric condition" is confined to one page. Dr. Robertson's own researches have been largely studies of caseinogen solutions, but his views on the explanations of the behaviour in the electric fields have not met with general acceptance.

From the point of view of the research worker in the Physical Chemistry of Proteins, the book should be of value in providing an extensive bibliography, and the touchstone of a different school of thought against which to try his own hypotheses and preliminary conclusions. To the technical chemist wishing to consult a carefully reasoned and accurate source of information it is not calculated to prove of assistance.

G. Stanley Walpole.

PUBLICATIONS RECEIVED.

Biochemical Catalysts in Life and Industry. Proteolytic Enzymes. *By* Jean Effront. *Translated by* S. C. Prescott, *assisted by* C. S. Venable. *Pp.* 752. (*London: Chapman and Hall.* 1917.) *Price* 23*s.*

Applied Optics. The Computation of Optical Systems. *In* 2 *Volumes. Being the "Handbuch der Angewandten Optik" of* Dr. A. Steinheil *and* Dr. E. Voit. *Translated and edited by* J. W. French. *Vol. I., pp.* 170; *Vol. II., pp.* 207. (*London: Blackie and Son, Ltd.* 1918.) *Price* 12*s.* 6*d. per volume.*

ENEMY CHEMICAL PATENTS IN THE UNITED STATES.

The Report of the Alien Property Custodian in the United States, issued last March, gives a circumstantial account of the machinations and ramifications of the German chemical "octopus" in that country, and of the means adopted to cut its tentacles, thus paving the way for future economic independence. The powerful, highly organised, and ubiquitous German chemical houses not only had under their thumb some $3,000,000,000 worth of American chemical trade chiefly of the "non-heavy" description—but used their agents as a means of espionage and propaganda on behalf of the German Government. The full report, in so far as it relates to the chemical industry, is given in the April issue of the *Journal of Industrial and Engineering Chemistry*, and those who run may there read a story of intense interest and one whose burthen should be laid to heart by all who are concerned with the welfare of chemical industry in non-German lands. The upshot of the revelations was the seizure, under an Executive Order of the President of the United States, by the Custodian of all the known enemy alien property in the country to a value of approximately £140,000,000 sterling. This property is divided into two classes. The first, consisting of what may be termed investments of a purely honourable business kind, is to be held in trust pending the action of Congress; the second class, covering investments held by powerful industrial corporations pursuing political as well as financial ends, has apparently been seized irrevocably; in the words of the Custodian, "No obligation is owed to their private owners to conserve or care for them with a view to ever returning them in kind."

Among the second class of investments are included the German patents taken over by the Custodian under an amendment to the Trading with the Enemy Act of November 4, 1918. They number about 4500 and cover a wide field, including metallurgy, nitrogen fixation, hydrogenation of oils, etc., but the majority and the most valuable relate to dyes. Many of them were taken out not with a view to manufacturing in the United States, but with the evident intent of blocking American enterprise and of stopping importations from other European countries; and the product patent proved very serviceable in this respect. The former owners are now prospectively to be hoist with their own petard, for it has been resolved to use these sequestrated patents as a means of protecting the nascent American dye industry by preventing the importation of German chemical wares after the war. The introduction of new classes of dyewares has almost invariably followed some years after the original patents covering their manufacture were taken out. As many of the seized patents were dated 1917 or 1918, it follows that the American owners should be able, for some years at least, to keep out any new dyes, etc., with which the Germans may attempt to recapture the American market.

A new corporation, called the Chemical Foundation, Incorporated, has been formed to purchase from the Alien Property Custodian, and hold for the chemical industries and the country at large, the whole of the German-owned United States chemical and allied patents. The company is capitalised at $500,000, of which $400,000 is preferred stock and $100,000 common stock, the dividend on each class being limited to 6 per cent. The preferred stock is subject to redemption as a whole at par on January 1, 1921, or on any first of January thereafter, when the accumulated profits shall have become equal to the total issued and outstanding stock of both classes. In order to prevent unfriendly or sectional interests acquiring control, no stock will be transferable except with the consent of the board of directors, and the underwriters are endeavouring to distribute the stock as widely as possible among the chemical and allied industries. It is the intention that, eventually, no single subscriber shall own more than $1000 worth of stock, $800 preferred, and $200 of common stock, which has the voting power.

One half of the capital is to be paid to the Custodian in purchase of, substantially, all the German dye and chemical patents seized by him. The Foundation will issue non-exclusive licences under them to all Americans whose patriotism and competence are beyond question, and it will take legal proceedings against all persons who attempt to import any infringing product; the second half of the capital, it is understood, will be set aside as a kind of reserve to defray the cost of any litigation. Enemy trademarks taken over by the Custodian are included in the sale, and a plan is being formulated to enable the Foundation to issue licences to American manufacturers to use them, the intention being to issue such licences only when the goods to which the mark is to be attached are proved to be equal or superior to those of the original owner. Further, it is intended to purchase new patents, and the German copyrights covering much of the indispensable literature of science. After the preferred stock has been redeemed, it is proposed to allocate the profits of the Corporation, which are expected to be considerable, to the promotion of research, not by initiating or aiding investigation on its own account, but by effecting close co-operation between existing academic and industrial organisations. To this end one of the first steps will be to take a census of all laboratories, governmental, industrial, and academic, in the country, and to establish a bureau of information which will be accessible to researchers, manufacturers, consumers, and all others genuinely interested. Finally, it has been resolved to press Congress to pass a law for the institution of a licence system governing all chemical importations for a period of ten years.

This practical method of utilising confiscated property to encourage home industry and discourage importations from unfriendly sources demands the serious consideration of interested parties in other Allied lands. Whether the ultimate policy involved – namely the taxation of the consumers of chemicals, chiefly dyes, to promote research that is to benefit chemical industry at large and to provide funds for law costs—is preferable to the alternative of annulling the patents and stopping importation by the existing Customs machinery, is matter for discussion. In the United Kingdom this class of enemy property is also in the hands of the Custodian (the Public Trustee) and licences are granted to British manufacturers practically for the asking. The reticence of the responsible authorities here stands in marked contrast to the refreshing candour with which the corresponding authorities in the United States have disclosed their knowledge and intentions. It would, perhaps, be too much to expect the veil of secrecy to be lifted entirely during the negotiations which are taking place at the Peace Conference; but it must be emphasised that undue official secrecy and procrastination are to be deprecated inasmuch as they tend to keep interested and expert opinion uninformed, thus preventing it from arriving at decisions which may be required promptly when the time for action arrives. By then, chemical industry should be in a definite position to speak with effect, authority, and, if possible, with unanimity.

THE PASSING OF THE AMERICAN POTASH FAMINE.

P. G. H. BOSWELL.

The statement made recently in the public Press that 30,000 tons of German potash is to be delivered to this country in exchange for food suggests that the "opportunist" methods of obtaining potash during the war did not yield supplies equal to the demand. A similar delivery of potash to America is also foreshadowed, so that, despite the statements of the newspapers during the war that the potash problem had been solved for all time, it would appear that the current is again setting in towards the use of natural potash salts. The situation as regards potash in America as well as in this country before and after the signing of the armistice presents many points of interest, a few of which are here considered.

The National Exposition of Chemical Industries held in New York in September last was a powerful vindication (if such were needed) of the claim that applied science played a great part in the successful prosecution of the war. The Exposition was in many respects similar to the British Scientific Products Exhibition which was held a little earlier in the year at King's College, London. To proceed from the one to the other was most instructive. The smaller British Exhibition showed more of the part played by the scientist and man of research; the huge American Exposition indicated less the resourcefulness of the individual and more of the wonderful development in the industrial application of science. It was, in short, a magnificent advertisement of the vast American enterprise in applied chemistry and chemical engineering evolved by the stress of war.

The difference in attitude of the two organisations was shown by the character of the lecturettes: in England these were given mainly by distinguished scientists and dealt with recent advances in applied knowledge; in America they were mostly delivered by works' superintendents, chemists, and others, who concerned themselves with corresponding progress in industrial methods and applications. It was but fitting that part of the Exposition and several of the lecturettes should be devoted to the difficult and important problem of potash-supply. The speakers contented themselves with a description of the respective sources of potash, such as kelp, cement-kiln dust, alunite, the Searles Lake and Nebraska liquors etc., and with pointing out that such sources would be only sufficient to supply the needs of certain individual industries like the manufacture of chemicals. The total production had been 50,000 tons for the year, as against 230,000 tons imported before the war. Nevertheless, certain of the speakers were credited in the Press on the following day with having declared that nevermore would it be necessary to obtain potash-salts from Europe!

During the period immediately preceding the Exposition, the glass industry, and in part, the chemical industry, in America had been using considerable quantities of Russian potash. Besides that imported by private merchants, 4000 tons of carbonate of potash from Russia was imported into America in 1917 by the Russian Government. It is said that the responsible authorities desired to dispose of the stock in one lot, the figure of $3,000,000 being mentioned. Supplies were also imported into America by enterprising merchants, who, after the closing of the Black Sea, succeeded with great difficulty in getting the potash transported to Archangel. The supply arose out of the fact that the peasants in southern Russia depended almost entirely upon the sunflowers for their fats for edible and other purposes. Large quantities, therefore, were grown, and the ashes, comparatively rich in potash, which resulted from the burning of the stems, flowers, and seeds, were collected at intervals and taken to a depôt. The potash was leached out, the liquor evaporated down, and the resulting white carbonate packed into barrels of rather over 1000 lb. each. In many cases the degree of purity of the product was noteworthy. Large quantities contained (excluding moisture) over 96 per cent. of carbonate; potassium chloride formed less than 2 per cent., the sulphate less than 1 per cent., and soda, alumina, and silica were practically absent.

Serious difficulties were experienced in transporting the barrels from southern Russia to the northern ports. The railways were often too congested to be available and recourse had to be made to road haulage, portage on rivers, etc., and even to hand labour. When, however, the potash eventually reached its destination in New York, the price it commanded was sufficient compensation for all the trouble and expense of its transport. In March 1916 the high-grade material of 96—98 per cent. carbonate was eagerly sought at 90 cents per lb. In March 1918, owing to the arrival of further consignments *via* Archangel, the price had fallen to 35 cents. Last autumn, before the armistice, it was selling at 30 cents, and to-day it goes begging in New York at 15 cents.

In 1917 and 1918 the importation of Russian potash was only about half the normal (about 10,000 tons). The 4000 tons imported by the representatives of the Russian Government did not relieve the situation to any great extent, for their attempt to sell the consignment entire was not successful. Much of it was second-grade material and some was damaged by sea-water. Eventually the highest-grade product was selected and bought by the private importers in New York, such a course being, presumably, dictated only by financial stress.

The 96—98 per cent. carbonate of potash was retailed almost solely to manufacturers of pharmaceutical chemicals. The glass industry took very little, partly no doubt, so far as the manufacturers of optical glass were concerned, on account of the moisture-content. The nitrate was in more general use, but at least one optical firm bought very pure carbonate which had been recrystallised by the importers to free it from sulphates and chlorides. This purified carbonate was accepted as being purer than any pre-war material used in the works. It may be noticed in passing that a claim was made before the armistice that formulæ had been devised which permitted the substitution of soda for potash in optical glasses: a similar claim was made in Britain over two years ago in the case of table and ornamental glass.

Up to a short time before the cessation of hostilities, the export of only a very small quantity of potash for medicinal purposes was permitted from the United States to Britain. But this restriction was ultimately removed through the efforts of Mr. C. Macdowall, who was responsible for potash-control in the Chemical Section of the War Industries Board at Washington. By the time, however, that the larger American supply was available, the situation in Britain had been slightly relieved, for the recovery of potash from blast-furnace flues had begun.

In this connexion it is interesting to observe that, whilst it has been decided on all hands that the recovery of potash from cement-kiln gases and dust in this country is not a paying proposition, the reverse is the case in America. Recovery of potash was already proceeding in Portland cement works across the Atlantic during last autumn, but grave doubt was expressed as to the feasibility of extracting it from blast-furnace gases and dust.

Turning to other American sources of potash, it

is only necessary to say that the activities of the American Trona Company at Searles Lake, California, have too frequently been noticed in this journal to call for repetition here. The salt lakes of Nebraska yielded about one-third of the total American production of potash.

A noteworthy feature of the exposition in New York was the exhibit by the Hercules Powder Co. of chemicals other than potash extracted from the giant kelps of the Pacific Coast. The company owns a huge plant near San Diego, California, and turns out, among a long list of chemical products, ketones (including acetone), ammonium sulphate, acetic acid, and many esters.

As bearing on the probable future demand, it has generally been stated over the East and Middle West of the United States that never again would the soil be so heavily treated with potash manures as previously. The fact that the greater part of the pre-war American import of potash was used for fertilising purposes was regarded as being entirely due to German propaganda work. It is said that crops of potato, sugar-beet, cotton, tobacco, etc. have suffered little, if at all, from the absence of fresh applications of potash. This may well be, but it is of course possible that at present the crops are living upon and exhausting the reserve potash in the soil. That the poor sandy glacial soils of northern Germany should need continual dressings of potash, or that our own soil, at one time probably rich but tilled for centuries until its potash content has been almost exhausted, should require renewal, will surprise nobody. But vast areas of virgin soil in America, much of it rich clay and loam of glacial origin, ought not for many years to require artificial fertilisation with potash.

Since the armistice was signed, the consumption of potash in America has fallen considerably. New York warehouses are full of it, and the Nebraska and Californian plants have suspended operations in the absence of buyers.

The conclusion of peace, settling as it presumably will the question of the future ownership of the Alsatian deposits, will necessarily lead to a reconsideration of the war-time methods evolved in the struggle for potash.

PRESENT-DAY FOOD PROBLEMS.

In his recent Cantor Lectures on "Problems of Food and their Connexion with our Economic Policy" Prof. H. E. Armstrong considered the processes of assimilation and digestion in plants and animals with reference to the special food requirements of man. Attention was particularly directed to the general failure to take into account *quality* as distinct from *quantity* of food; and emphasis was laid on the particular value of fresh and whole foods—on account of the presence in these of certain indispensable but altogether minor constituents (Advitants)—and to the consequent need of devoting our energies, as far as possible, to the production of those foods which it is most desirable to raise on the spot, as they lose value on keeping and when preserved, leaving those which are not subject to this disability—such as wheat—to others, at a distance, where the conditions are such as to favour their production.

Life, in the main, is a geometric process: only materials that will fit into the living structure can be utilised and the patterns followed are strictly limited in type. The peculiarities are to be regarded as the outcome of qualities inherent in the primary vital unit—the carbon atom—and the selection by Nature of a single geometric type of material for her purposes. A carbon atom in association with four distinct and different radicles constitutes a system of which, in the simplest case, two forms are possible: these are asymmetric and are related as an object to its image. Such compounds are always optically active, to equal extents but in opposite directions. We are built only of one of these types of material and can only use this type as food; we should starve on food of the optical sign opposite to that at our disposal. It is clear that Nature builds always with the aid of templates or moulds and that her primary activity is controlled and directed at every stage.

Solid models of the structure of glucose were exhibited which had been constructed by Mr. W. Barlow. Attention was called to the mechanism whereby such structures might operate in determining the assemblage of the separate units in the synthetic production of glucose in the plant from formaldehydrol. The processes of digestion were discussed with special reference to the part played by enzymes, the manner in which these act being illustrated by reference to Urease, Lipase and Invertase. Their nature can only be inferred, as they cannot be dealt with individually; they seem to be colloid materials. Their singular and unrivalled activity, as hydrolytic agents, can only be accounted for on the assumption that they not only fit exactly the molecules which they are able to influence—either wholly or in some particular section—but in some way serve to condition hydrolysis by bringing the elements or ions of water to bear on the particular region of the hydrolyte where scission takes place.

Diffusion phenomena through differential septa were then considered, chiefly with reference to the experiments carried out by Adrian Brown with the aid of barley grains. The nature of the clue these give to the behaviour of anæsthetics generally and of substances such as acetic acid, alcohol and ammonia, which pass readily through all septa which are permeable by water, was pointed out. Substances of this class (Hormones) probably play an important part in stimulating digestion and in inducing changes throughout the system during the period of assimilation. The effects produced by vinous beverages generally were discussed at some length in this connexion and exception taken to the report of Lord D'Abernon's Committee on "Alcohol: its action on the human organism," on the ground of its incompleteness, all reference to recent work on the influence of alcohol, etc., on the course of chemical change being omitted.

Oxidative changes were next considered and a possible mechanism suggested. Oxidation is effected through the agency of the oxygen carried forward in the blood stream in loose combination with haemoglobin but there is every reason to believe that the oxygen functions simply as a depolariser and is initially converted into hydrogen peroxide—which, however, is not an oxidising agent *per se*: it needs a catalyst to render it active. Attention was directed to the formation of an oxidising "perhydrol" from ferrous sulphate and the peroxide (see this J., 1913, 391; "Studies on Oxidation": Armstrong and Colgate) and the suggestion was made that a similar process might be at work in cases of selective oxidation in the body.

Assuming that the enzymes are active, in many cases, through the agency of an acid radicle (CO.OH), it is conceivable that they might be convertible into perhydrols (COO.OH) and thereby function as hydroxylating (oxidising) catalysts, at least at the early stage when compatibility of the agent with the substance attacked is a matter of importance. Such oxidising enzymoid catalysts might also indirectly condition reduction—if a sufficiently easily oxidisable substance were included in the circuit.

Hydrogen peroxide is the one agent by which oxidation products may be obtained in the laboratory in agreement with those formed in the animal system, other oxidising agents as a rule giving different products. As most oxidising agents destroy hydrogen peroxide the difference is in no way peculiar. It has been thought to be surprising that fatty acids are so oxidised by hydrogen peroxide and in the body that the attack always takes place at the carbon atom third in the chain, the acid being converted ultimately into one in which the number of carbon atoms is less by two. It was shown that this is the result to be expected, using solid models constructed on the plan followed in representing glucose.

If a sympathetic enzymic mechanism such as that pictured be in any way concerned in the oxidative degradation of glucose, diabetes might be the consequence of its more or less complete destruction; or just as the ferrous perhydrol mechanism is thrown out of action by an oxidising agent, such as permanganate, so some interfering process might come into play and negative its action.

Dealing next with the liberation for use of the enzymic mechanism, the case of *secretin* was considered: as Starling and Bayliss have shown, the enzyme in pancreatic juice is only set free from the intestinal mucous membrane when this is subjected to the action of very weak chlorhydric acid but by a secondary process, through the liberation of the substance they have termed "secretin." It was in connexion with this discovery that they coined the term "hormone." The lecturer wished to confine the use of this term to the large class of chemically active substances, including alcohol and anæsthetics, which act primarily as mechanical disturbing agents and, in virtue of their irresistible penetrative power, not selectively and functionally. He would term secretin and other substances which are the characteristic secretions of various glands *Functional Adjuvants*. A possible way in which one of the most remarkable of these adjuvants, *Adrenaline*, may exercise its regulative influence on the blood stream was discussed.

The food accessories were next brought under discussion and the proposal was made that the term *adritant* should be substituted for *vitamine*, to which exception has frequently been taken. After a discussion of scurvy and Eijkman's observations in Java on Beri-beri, an account was given of the pioneer inquiry of Gowland Hopkins, first published in 1912, and to later work on the subject.

After reference to the evidence that the units of which the proteins are composed are all necessary as structural materials, the various inquiries carried out within recent years were considered, from which it appears that, in addition to the protein educts, a variety of materials of an unknown nature, the *Adritants*, are indispensable contributories to the vital process: in their absence not only is growth halved but disease sets in and ultimately death. These substances are present in milk and whole foods generally but their distribution is irregular and the proportions in which they occur are subject to great variation. The tendency of modern practice is to favour the use of foods which, if not destitute of these agents, contain them in insufficient quantity; there is little doubt that, during the war, our dietary has not afforded a sufficiency of these constituents, especially during the period when there has been a shortage of milk, eggs, butter and fruit. It is far from improbable that such deficiency has been the unsuspected cause in the past of much disease (especially of faulty teeth) and of malnutrition among the masses. The investigations relating to this subject were fully summarised and their great practical importance emphasised, as well as their bearing on our economic policy.

THE BEARING OF CHEMICAL COMPOSITION AND ITS ACCURATE DETERMINATION ON THE IRON AND STEEL TRADES.

C. H. RIDSDALE.

In the article on Chemical Standards appearing in the issue of March 31 (p. 97 R) Mr. Brearley appears to argue that the value of specified composition and of analytical work for steel is overrated; and that properly trained chemists do not make mistakes; so, except for those "who are not sure of themselves," standards are of questionable value; and a man trained on a synthetic plan is not very respectful towards either statements or specimens issued under authority. The first two points are also treated in a recent paper read before the Institute of Metals by Col. F. N. Jenkins (this J., 1919, 123 R) who points out that chemical analysis as such is "of no interest to the engineer."

That wrong and exaggerated meanings have been attributed to small differences in composition is due to errors of *interpretation*, and these are no fault of the chemist. Exactly the same in turn occurs in respect to each new metallographic method and test devised of late years. Besides, the effects of composition on properties of material can only apply when it is in the same condition.

The intense desire to explain a difference often leads to a wrong sense of proportion. The present writer has frequently emphasised this. For example in one paper (Diseases of Steel—"Journal of the Iron and Steel Institute," Vol. II, 1903, p. 235) "When some unsatisfactory result is obtained with steel the only step usually taken is to analyse it and perhaps make 'tensile tests,' and if these do not show the cause of the trouble it becomes a mystery. . . . But analysis fails to explain most of the trouble met with. . . ." Again, under the head of Chemical Disease (p. 251), he stated "The fact of being different to specification, etc., may be an incident and not affect the question, for it cannot be too clearly understood that the specification of a particular composition is only a means to an end, *i.e.*, a roundabout way of expressing that steel of a certain nature is required, which nature is in many cases associated with that composition. But the possession of a certain composition is by no means in itself a guarantee that the steel has the required nature . . . similar chemical composition does not always secure similar mechanical results. The reason is, of course, that composition is only one of several factors affecting the result, and others may completely outweigh its influence." Chemical clauses in specifications should be taken rather as an ideal to aim at than a condition to be invariably enforced to the letter.

Whether or not chemical specifications are too rigid and the effects of phosphorus and sulphur in steel, for instance, overrated, engineers do include definite chemical limits in their specifications; and both for scientific and industrial ends, we may take it that:—(1) Analysis is to-day a necessity. (2) But it must be accurate. Yet however excellent the method or the individual work, it does break down occasionally. (3) Commercial necessities demand (*a*), methods which present the least possible opportunity for failure, (*b*), a ready means for detection when failure occurs whether of method or of working.

Analytical agreement between duplicates of a sample of unknown composition does not prove that an analysis is accurate, as faulty conditions may have affected both; whilst the figures in a complete analysis may add up to one hundred through compensation of errors. But a similar sample of known composition (analytically standardised) run

through side by side is almost certain at once to reveal error, and is the only ready means of checking work, and yet leaving the individual free to follow his own methods.

This raises an issue which must be clearly kept in mind, *viz.*, first the claims of purely scientific work essential to progress—which ultimately becomes commercially beneficial—and secondly those of commercial needs which are directly of service to mankind. The arguments advanced for or against a given course often show a great confusion of ideas. The first demands for the chemist the right of continual investigation and variation of method, and is primarily educational; whilst the second requires that, whether or not the result he gives is absolutely right, one may rely on a uniform result for the same sample, no matter who tests it; and that therefore he must sink his personality, and either work the methods of his own selection to give this for a standardised sample, or use a standard method. Under cover of the first claim objection is taken to standardised methods, and the more rigid adherence to detail is prescribed—and still more in the case of methods where it is automatically fixed—the greater is the dislike to "having one's hands tied."

Apart from the benefits to industry, the educative and moral effect of the thorough study of detail necessary to evolve standardised processes must be of still greater value. A young chemist may get into the habit of sending out work without knowing or caring whether or not it is correct so long as it gets through; but both the enforced attention to precise details when given in standard methods, and having his work continually checked by standards, must lead to his improvement. This cannot prevent him from investigating questions for himself if he has the chance otherwise.

Such means are the more necessary because, however good the repute of a firm of analysts, the most experienced seniors rarely make the analyses personally. They only organise.

Objection to these means is comprehensible if the practice of each chemist invariably gave good results. Manufacturers know that differences between buyers' and sellers' chemists are frequent and serious, and whoever thinks otherwise cannot realise or will not admit their extent.

In Table 3 of the writer's paper (this J., 1919, 24 T) differences between the results obtained by metallurgical chemists of repute and many years' experience, working on identical homogeneous samples, are given—see "first results." In another example, an alloy steel, the results reported showed the following astounding differences:—

	Lowest %	Highest %
Carbon	0·48	0·60
Silicon	0·065	0·19
Sulphur	0·027	0·068
Manganese ...	0·45	0·59
Alloy metal ...	0·20	0·35

The first step to overcome error is to admit it, then measures can be taken to detect and prevent it. No one using chemical standards regularly is likely to remain long in ignorance as to whether his methods or working are accurate.

Young chemists should be encouraged to investigate for themselves the influence of impurities; but often these, if added as reagents, have not the same effect as when they occur in steel—hence the advantage of standards of commercial material similar to the samples tested. The authoritative nature of these should not be autocratic, but derived from their acceptance for the common good by men representing the classes concerned; and the testing of any chemist's work against that of such men should strengthen his "sense of confidence in his work, and of responsibility for its actual accuracy."

THE DISCOVERY OF PETROLEUM OIL IN DERBYSHIRE.

The discovery of oil at Hardstoft, in Derbyshire, has a special significance for chemists, inasmuch as applied chemistry played an important part in the decision which led to the drilling enterprise.

In the past the discovery of an oil well was a matter of speculative drilling; as is well known, one of the first oil wells was obtained as the result of drilling for water. As time progressed geologists achieved remarkable success in predicting favourable spots and localities upon which to drill for oil, and at the present time no large company undertakes the exploration of a prospective oilfield before consulting a geologist.

In England there were many indications that oil should exist, and Dr. A. C. Veatch, chief geologist to Lord Cowdray, after a thorough study of these occurrences, became convinced that his views should be tested out by the drill. He was aided in his research work by Mr. E. L. Ickes, an American geologist who had assisted Lord Cowdray in Mexico. In England leading scientific opinion held that petroleum oil as such was not to be discovered, and that if any oil existed at all it would be found to have been derived from coal—possibly by a process of distillation.

The weight of such opinion could not be lightly ignored, although it is due to Sir John Cadman and some others to say that they entertained more optimistic views. Further evidence in support of the belief in the occurrence of petroleum was made available by the investigations undertaken by Mr. J. E. Hackford, chemist to Messrs. S. Pearson and Son, who advised that such seepages as had been found were the products of petroleum oil, and that, were wells drilled, any oil that would be found in them would be free petroleum, and would have no relationship whatever to those oils that might have been derived from coal beds by distillation or other processes. In December, 1915, he predicted that the oil when found would have the following characteristics:—Motor spirit, 5—10%; kerosene (lamp oil), 40—50%; gas oil (basis of fuel oils), 15%; lubricating oils, 14—32%; paraffin wax, 5%; sulphur, 0·3—0·5%; sp. gr., 0·860—0·890; setting point, below 0° F.; viscosity (at 100° F. Redwood), 55 secs.; chemical characteristics: paraffin base containing naphthenes.

The first well was spudded in at Hardstoft on October 15, 1918, and on May 27, 1919, oil was struck at a depth of 3077 ft. The analysis made by Mr. Hackford of a sample taken from it gave:—

Motor spirit 7½%.
Kerosene 39%.
Gas oil 20%.
Lubricating oils 30·5%.
Paraffin wax 3%.
Sulphur 0·26%.
Specific gravity 0·823.
Setting point 0° F.
Viscosity (at 100° F. Redwood) 48 secs.

Chemical characteristics: paraffin base containing naphthenes.

The good agreement between these results and the predicted figures is noteworthy, and opens up the prospect of the utilisation of chemistry in the work of oil exploration.

It is understood that the analysis made by Sir Boverton Redwood—his last official act as Director of Technical Investigations, H.M. Petroleum Executive—is in substantial agreement with the above figures, and that he was of the opinion that the oil was a true petroleum of excellent quality.

The oil is rising in the borehole at the rate of about 350 ft. per day, and there is evidence of gas pressure behind the oil.

NEWS FROM THE SECTIONS.

CANADIAN PACIFIC.

Mr. Noble W. Pirrie, recently Director of Explosives to the Imperial Munitions Board, gave an address on April 5, at the Board of Trade Rooms in Vancouver, on "Canadian Chemical War Industries," in which he described the very great contributions made by Canadian chemists and Canadian chemical industries towards the supply of vital war munitions.

Of the three new processes for manufacturing acetone developed during the war, namely, from acetylene, starch and kelp, the two former were the most successful and were worked out by Canadian chemists on an industrial scale. At Shawinigan Falls, Quebec, the acetylene process has been established as a permanent industry for the manufacture of acetic acid as well as for acetone. The acetone fermentation of starch was established industrially at the Toronto plant of the Gooderham and Worts Distillery Co., this plant being given rent free by the company to the Munitions Board. A second plant was subsequently established at Terre Haute, Indiana, in the United States. The problem of disposing of the butyl alcohol obtained in large proportion as a by-product of the acetone-starch process was successfully solved by converting it into methylethylketone, just before the armistice was signed. Statistics were quoted showing the large proportion of high explosives supplied by Canada for war purposes as compared with the total Allied production.

The sympathy and condolence of the members of the Section was extended to the family of the late Thomas H. Young who died recently at Glendora, Cal. Mr. Young was a native of Birmingham, England, and on coming to Canada acted as chief chemist to the Canadian Pacific Railway at Winnipeg, Man. During the war, he was engaged at the James Island, B.C. works of the Canadian Explosives Limited, as inspector of trinitrotoluol production.

A paper on "The Fermentation of Kelp" was read on April 29, by Mr. C. J. Berkeley, recently research chemist to the Hercules Powder Works at San Diego, California.

The industrial production of acetone by the fermentation of kelp was one of the new chemical processes resulting from the war. It was developed in a very large way by the Hercules Company, some fifteen hundred tons of kelp being treated per day. Owing to the cost of harvesting the kelp, namely about one dollar per ton of wet material, and the yield of acetone from the wet material being only about one half per cent., the industry has been discontinued, now that the abnormal demand for acetone has ceased.

Mr. Berkeley described the development of the process and the procedure eventually adopted at the plant. Many months of close research work by a number of chemists were needed before the process reached its final shape. In addition to acetone, a very large variety of by-products, including potash, iodine, acetic acid and anhydride, and a series of esters and ketones, was turned out. The processes for producing and purifying these substances had to be developed independently. At the time the process was discontinued, a complete knowledge had not yet been obtained of the chemistry and bacteriology underlying the fermentation process, which was fundamental to all the other operations involved. Considerable information, however, had been accumulated on the complex questions presented. The prospect of basing a permanent industry on the fermentation of kelp does not appear promising. The use of the crude material as a fertiliser will probably continue but will be conditioned by the price of potash from other sources. It is greatly to be desired that further study should be pursued of the points involved in the fermentation because of their bearing on other points of industrial interest. The fact that pentosans make up a large proportion of the kelp plant and that these may be converted into useful products by fermentation, suggests the possibility of utilisation of the process in treating residues from yeast fermentations as well as direct fermentation of waste straw and similar vegetable material.

Following Mr. Berkeley's paper, the subject of German patents registered in Canada was discussed and action was taken to co-operate with other sections of Canada in obtaining legislation for the future protection of Canadian industries.

CANADA.

The Canadian Section of the Society of Chemical Industry held its annual meeting in conjunction with the second Convention of Canadian Chemists at Montreal on May 16 and 17. There are now in Canada the following groups of chemists:—The Canadian Section of the Society of Chemical Industry, the Canadian Pacific Section of the Society of Chemical Industry, the Manitoba Chemical Society, the Maritime Chemical Association of Nova Scotia, and the new organisation, the Canadian Institute of Chemistry.

It had been felt for some time that a purely Canadian Institute for chemists was desirable, inasmuch as the qualifications for membership in the Society of Chemical Industry, in accordance with the terms of its charter, do not carry any professional status. With the Institute of Chemistry of Great Britain and Ireland as a model, the Chemists' Organisation Committee drafted a basis of procedure and qualifications for membership in the new Canadian Institute (see this J., 1919, 164 R). After full discussion of these proposals a representative group of original members was selected to form the nucleus of the new Institute. Representation by provinces was chosen, inasmuch as all charters of this kind must be obtained from provincial governments in Canada. Some twenty-eight prominent and representative chemists were selected to carry on the work, and to invite all eligible chemists in the Dominion to become either Fellows or Associates.

The new Canadian Institute of Chemistry is really a development of the Society of Chemical Industry in Canada, and should do much to unite all chemical organisations in the country under this Society. It is expected that during the coming year complete association of all industrial chemical societies will take place. The past year has shown remarkable growth in the Canadian Sections of the Society of Chemical Industry. The Toronto Branch is the strongest numerically, and has its membership fully organised. Every section and branch, however, has shown great strength and the Society is beginning to take the position it should hold, not only among chemists, but also in the eyes of the public generally.

Papers were given dealing with the war efforts of Canada along several lines. Mr. J. R. Donald gave a paper on the inspection of explosives and chemicals. Capt. E. T. Sterne and Prof. J. W. Bain presented papers on the war efforts of chemists in explosives and the work of the Canadian War Mission. Messrs. Speakman and Newman described the manufacture of acetone and methylethylketone by fermentation processes, which was carried on in a very large way in Toronto plants during the war. Mr. A. F. Cadenhead described the development of processes for preparing acetone from calcium carbide at Shawinigan

Falls, Quebec. This was, perhaps, the outstanding achievement of Canadian chemical research workers during the war, and the United Shawinigan Chemical Industries is now in a position to go forward very rapidly on a peace basis with the production of a number of new products depending on cheap electric power. Mr. J. A. Dawson, chairman of the Canadian Pacific Section, described recent developments in British Columbia, and expressed the hope that complete amalgamation of the societies' interests would follow shortly in Canada.

It was decided to hold the annual meeting of the Canadian Section at Toronto next year.

BIRMINGHAM.

At a meeting held on May 10, Dr. H. W. Brownsdon made a short communication relating to a recent application of colloidal platinum to the preparation of high resistances. By the process described it is possible to produce resistances of approximately 100,000 ohms carrying 5 to 10 milliampères on a piece of glass about 3 × 2¼ in. The process has been perfected by Lieut. Catterson-Smith at the City and Guilds Technical College, Finsbury, E.C. The colloidal platinum (produced by arcing under water) is mixed with essential oils, and after the glass plate has been coated with the mixture it is stoved at a suitable temperature, and a fine continuous line of colloidal platinum is produced by removing some of the metal by combing in opposite directions. In a similar manner the mixture can be applied to glass tubes when the resistance takes the form of a spiral of colloidal platinum. Leads can be soldered to the resistances by means of a solder of low melting point.

LONDON.

The last meeting of the session, an informal one, was held at the Chemical Society's Rooms on June 2. An exhibit of rare metals and their salts was shown by Messrs. Johnson Matthey and Co., which excited considerable interest, as did also the displays of chemical apparatus, particularly English-made blown laboratory glassware, by Messrs. Baird and Tatlock and by Messrs. Townson and Mercer.

Messrs. George Kent and Co. showed instruments for measuring flow of gases in pipes. One apparatus of particular interest was a flow-meter for steam, the action of which depended upon the difference in pressure obtained on two sides of an orifice. This difference of pressure was registered on a moving paper by a style, the movements of which were corrected for different pressures of steam, so that it gave a graph which recorded the actual flow of steam past the orifice at any given time, without further correction.

Among the exhibits of Messrs. Baird and Tatlock was the K.P. clip, designed by Dr. C. A. Keane and Mr. G. Patchin, to secure a satisfactory means of preventing rubber connexions from slipping off glass and metal tubing, thus replacing the use of wire for this purpose.

Perhaps the most striking exhibit was that of the Zirconium Syndicate, Ltd., which showed a number of products made from zirconia. These included white oxide, oxychloride, soluble sulphate and soluble nitrate, as well as crucibles of various sizes and shapes, special articles manufactured to pattern, bricks, furnace-linings, and zirconia-lined graphite crucibles. It is understood that white zirconium oxide can now be produced on a commercial scale at a reasonable price, and the exhibits proved that zirconia can be readily moulded or worked into various shapes such as are likely to be required in industry.

MEETINGS OF OTHER SOCIETIES.

ROYAL SOCIETY OF EDINBURGH.

At a meeting held on May 5, with Dr. J. Horne in the chair, two papers of chemical interest were read. Prof. C. R. Marshall discussed the mode of action of metal sols. An attempt was made to determine the way in which metal sols act therapeutically by investigating the action of an electrolyte-free silver colloidal solution on bacteria. The action could not be explained by Brownian movement, surface phenomena, electric charge, catalytic power, or the concentration of ions in the dispersal medium. It appeared to be associated with the amicrons, which, it is suggested, are taken up by bacilli and probably converted into a soluble product.

In a paper entitled "An Analysis of an Electron Transference Hypothesis of Chemical Valency and Combination," Mr. J. Marshall discussed the Electron Transference Hypothesis put forward by Kelvin in 1902 and by Sir J. J. Thomson in 1904.

INSTITUTE OF METALS.

In the ninth Annual May Lecture delivered on May 19, 1919, Prof. Soddy covered much the same ground as in his lecture before the Chemical Society in December last (see this J., 1919, 38, 19 R). The more familiar phenomena characterising radioactivity were briefly reviewed. Incidentally, the lecturer mentioned that he did not regard potassium and rubidium as radioactive in the full sense. Comparing the penetrative power of γ rays and that of ordinary sunlight, it was remarked that γ rays would be stopped by an atmosphere equivalent to 25 cm. of mercury, whereas sunlight was easily able to penetrate the atmospheric equivalent of 76 cm. of mercury. Discussing the transmutation theory, Prof. Soddy remarked that in a sample of uranium sealed up in 1909, he had recently detected the presence of 25×10^{-11} grms. of radium, and he concludes that Ionium, which is the immediate parent of radium, has a life period of 100,000 or 105,000 years, 1 part of uranium in 7,000,000,000 of uranium changing into ionium per annum. The theory of isotopes received its main support from the fact that the atomic weight of lead was found to be 206 when derived from uranium, 208 when derived from thorium, compared with 207·2 the atomic weight of ordinary lead. Further support is lent by the fact that the atomic weight of ionium —a metal identical with thorium in the general sense—is 230, compared with 232 for thorium.

The atomic model of Vegard—which embodies the results and views of J. J. Thomson, Rutherford, Bohr, Moseley, Debye, and others—contemplates a central nucleus surrounded by various miniature saturnine or planetary orbits in which revolve various electrons. The central nucleus carries a net positive charge represented by the atomic number of the element, and is responsible for the phenomena of mass and radioactivity. The succeeding closed orbits in order are responsible for the phenomena of X-rays, and the high frequency spectra of the element—the K, L and M series of lines. Chemical and physical changes affect only the outer variable unclosed orbit of valency electrons. Radioactive phenomena, originating in the very heart of the atomic system, have no temperature co-efficient, and hitherto have not been retarded or accelerated in any way. By atomic bombardment employing very much higher potentials than hitherto, the central nucleus might be affected and radioactive change accelerated. Only two ultimate disintegration products were known—lead and helium—but conceivably even these are not immutable.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

At a meeting on May 20 at the Royal Society of Arts, a paper by Dr. F. Mollwo Perkin and Mr. T. C. Palmer was read entitled "The Chemist and Engineer in Relation to the Petroleum Industry."

In the refining of oils the work of the chemist precedes that of the engineer, but it should not end when that of the engineer begins, for the happiest results are attained when both collaborate in designing the large-scale plant. A good example of successful collaboration by workers in the two professions is afforded by the shale-oil industry, but even here all the problems have not been solved—that of the elimination of sulphur, for example, still remains. It is probable that coal or other bituminous matter will prove to be most advantageously utilised when it is first carbonised at a low temperature and then burned in a producer, but for this procedure to be profitable the by-products must be utilised, for example the oils produced during carbonisation; these, however, contain unfortunately a large proportion of unsaturated hydrocarbons, of substances which tend to polymerise, and of phenolic substances. It is the task of the chemist to devise a satisfactory method of purification, and, since conditions easily attainable in the laboratory, such as high temperatures and pressures and the use of non-corrosive materials, are costly in large-scale working, the chemist and the engineer must consult each other both as regards any necessary modifications of the proposed process and in the design of a working plant. Essential features of the latter are:—Simplicity combined with the adoption of labour-saving devices, economy in heat and power, and efficient temperature control. Losses may be minimised by the use of automatic recorders of various kinds, by watching for leakages of steam and water, by careful attention to boiler-efficiency and by maintaining the fires evenly, the fuel (bought on its calorific value) being weighed or measured. The employment of superheaters and regenerative devices brings about great economies.

The extraction of gasoline from natural gases by compression, refrigeration and absorption illustrates the successful technical application by the engineer of physical principles.

SOCIETY OF GLASS TECHNOLOGY.

The May meeting was held at the Institute of Chemistry, London, on the 21st ult., Dr. M. W. Travers presiding. A lecture on "Some Phenomena of Pot Attack," delivered by Dr. W. Rosenhain, described work which he had carried out in collaboration with Messrs. E. H. Coad-Pryor, V. Stott and Miss A. B. Taylor. The first step in their investigation of improved methods for producing optical glass was to search for a material to arrest the attack of molten glass and to attempt the discovery of a container entirely insoluble in glass at high temperatures. The study of glass attack on clay was performed under novel and standardised conditions, *e.g.*, an electric furnace was used, so constructed that temperature and atmosphere could be kept constant. It was found in many cases that the attack was proportional to the depth of the clay beneath the glass surface. The bottom of the pot, which was most attacked, became drilled with holes of a roughly circular shape, owing, probably, to currents being set up in the liquid due to density changes. It was proved conclusively that holes could be drilled in a pot which was free from all defects to start with. The methods used in the research included the microscopic investigation of the glass and pot attack, and the application of *X*-rays to the examination of small pots.

THE CERAMIC SOCIETY.

The Spring Meeting of the Refractory Materials Section was held at Middlesbrough on May 22 and 23, Sir W. J. Jones (Deputy Controller of Iron and Steel Production, Ministry of Munitions) presiding over a large gathering of members. The Mayor of Middlesbrough, Sir Hugh Bell, Bart., and Mr. J. H. Amos—the two latter on behalf of the Tees Conservancy Commissioners—offered a hearty welcome to the visitors.

Prof. P. G. H. Boswell contributed a paper on "Mica Schist for Lining Cupolas and Steel Converters," in which he suggested the desirability of testing for the purpose Scottish and other material of similar character to that which has been used successfully in America. Dr. A. Scott mentioned that similar material was used in Sweden as early as 1740, and has also been used in several other countries.

In the paper on "The Corrosion of Coke Oven Walls, I.: The Salts Extracted from Coal by Washing," Mr. W. J. Rees stated that washing removed sodium sulphate as well as sodium chloride. By interaction with the hot coal, sodium carbonate would be formed from the sulphate and would have a strong corrosive action. Dr. J. W. Mellor suggested the possibility that the addition of one or more substances to the washing water might be more effective for washing the coal.

In "Some Criticisms by a Firebrick Manufacturer," Mr. G. R. L. Chance complained of the indifference of users in regard to the exact specification of their requirements, and to the general question of the quality of the finished product. The practice of ordering special firebricks with an inadequate time limit for delivery was also condemned. Another ground of complaint was the lack of facilities for fairly testing goods under service conditions. The great need for systematic testing of kilns for burning refractories, with a view to determining which are the best types, was alluded to.

Dr. A. Scott's paper, "Factors Influencing the Properties of Silica Bricks (Part I.)," dealt with the effects of various bonding materials (simple oxides and mixtures of them, with also carbon in a few instances where ferric oxide was used) on the properties of silica bricks, including specific gravities, porosity, after-expansion, and refractoriness, and also on the conversion of quartz into tridymite or cristobalite.

Dr. J. E. Stead's "Note on a Silica Brick from the Roof of an Open-Hearth Furnace" had references to the changes taking place during service. His results confirm those previously published by E. Rengade and C. S. Graham.

The paper by Dr. W. Rosenhain and Mr. E. A. Coad-Pryor on "A New Type of Recuperative Furnace" described a furnace, designed for use at high temperatures, which can be left for considerable periods (over night, for instance) without risk of serious deviation from the condition in which it is left by the operator. Mr. H. M. Ridge stated that a very similar furnace had been in use for some time.

"Specifications for Refractories for Glassworks' Use," communicated by Mr. W. J. Rees on behalf of a committee appointed by the Society of Glass Technology, relates to provisional specifications for tank blocks, raw clays, and grog. In recommendations and suggestions appended, the clays for pots are classed in three grades, of which grade 3 is the material in general use, and grades 2 and 1 are purer and more refractory. In each grade, the mechanical division and fusion test is prescribed for bind clay, base clay, and grog respectively, and the temperature of firing for grog. Two special points were raised in the discussion: firstly, as to cases where the same clay serves as both bind clay

and base clay, and secondly, as to grade 1 requirements, which were considered so severe that Dr. W. R. Ormandy said he doubted whether any material available would meet the stipulations.

The report of the Committee on "The Standardisation of Tests for Refractory Materials (Part III.)" was explained by Mr. Cosmo Johns. Three ways of conveniently examining the penetrative action of slags on fireclays and firebricks are described and illustrated. Mr. Johns added as a personal suggestion that it would be advisable to make use of slag of definite composition, prepared from pure materials, and not ordinary commercial slags or materials.

The report of the Committee on the British Refractories Research Association having been adopted by the Ceramic Society, the Association can be registered and start working. Members will consist of firms and companies, and also individuals, in any way interested in refractory materials and products. The affairs of the Association will be managed by a Council elected annually by the members, every branch of the industry and every locality concerned being represented on the Council as far as practicable. Dr. J. W. Mellor is to be technical director of the research work, and Mr. R. C. Rann has been appointed secretary. Members are to subscribe 5 to 50 guineas per annum for five years, and the only other liability is a guarantee of not more than five pounds per member in case of winding up during the period of membership or within one year afterwards. The scientific and industrial research department will contribute for five years a sum equal to that contributed by the members. It is intended to co-operate closely with similar research associations in other industries. Members will be entitled to the answering of technical questions, to the recommending of subjects of research, and to the use on favourable terms of any patents or secret processes resulting from the Association's research work. Subscriptions amounting to over 500 guineas per annum for five years have been promised already from a few members towards an estimated requirement of £3000 per annum.

A preliminary but comprehensive programme of research work has been formulated, and it is proposed to have refractories made to the Association's specifications, and to have such refractories tested under service conditions.

Sir William J. Jones was elected President of the Ceramic Society, and Messrs. W. Hamilton, D. Sillars, J. Whiteley, and Dr. A. McCance were added to the list of Vice-Presidents. New members of the Council elected were Messrs. G. V. Evers, Cosmo Johns, and Cyrus Jones.

It was announced that the Autumn Meeting would be held at Stoke-on-Trent, the Spring Meeting of 1920 in London, and the Autumn Meeting of 1920 in the United States, in conjunction with the American Ceramic Society.

ROYAL SOCIETY OF ARTS.

A paper entitled "Science and Industry in Australia" was read by Lieut.-Col. Hon. Sir John McCall, Agent-General for Tasmania, on May 27.

After discussing the general climatic and agricultural features of Australia, the author stated that science had worked wonders in developing the country. This was especially marked in recent years in connexion with the refrigeration and cold storage of perishable products, such as butter, cheese, frozen meat, and fruit. Sugar cultivation in Queensland has prospered under Protection, and the country is now practically self-supporting in this respect. Little sugar beet is grown, but it would be an excellent thing for the soil; it is now on trial in Victoria.

The various mineral industries were then reviewed, and the records of some of the famous mines enumerated. Platinum is being profitably produced in New South Wales, and osmiridium in Tasmania. It is proposed to utilise the enormous deposits of brown coal which occur near Melbourne to produce electric power, and to exploit the oil shales in New South Wales and Tasmania, the former yielding 150 galls. of crude oil per ton. The gold industry has suffered from the fact that the price of this metal is fixed, whereas the prices of all other commodities, including labour, used in its production have increased. Manufactures have developed rapidly, and the Commonwealth Treasury has recently authorised the expenditure of £2,500,000 on extensions to steel works, manufacture of white lead, zinc, cement, etc. The possibilities of an export trade to China, India, etc., are great.

With regard to chemicals, an important scheme is receiving attention for the manufacture of caustic soda; sulphuric acid, superphosphates, and eucalyptus oil are produced in large quantities. Arrangements are being made to manufacture tinplate in sufficient amount—about one million boxes per annum—to meet the country's requirements. Arsenical "dips" are being successfully manufactured, and the production of carbide has been started in Tasmania at a factory which will produce 5000 tons yearly. Works are also being built in Tasmania for the manufacture of electrolytic lead sulphate. In Victoria plants have been erected for paper manufacture and for the electrolytic production of bleaching material for use in the paper mills.

In addition to ferro-alloys and many other engineering requisites, the manufacture of chemical apparatus has been stimulated by the war. It has been found that balances, weights, retort stands, crucible tongs, blowpipes, Bunsen burners, etc., can be made and sold more cheaply than when they were imported from Germany. The imminent utilisation of the water-power resources of Tasmania offers great prospects; already extensive works have been erected at Hobart to smelt zinc concentrates from Broken Hill. The possibilities attached to the scientific development of industry have been realised by the Commonwealth Government, which has established an Institute of Science and Industry, as well as a Bureau of Commerce and a Board of Trade.

At a meeting held on May 28, Mr. H. J. Powell read a paper on "Glass-Making Before and During the War."

Although glass-making is an old-established English industry—there are records of its continuous existence in London for 300 years—it was, before the war, in a state of decadence attributed by men of science to the ignorance and lack of initiative of the manufacturers, and by the manufacturers to the divorce of academic and industrial chemistry and to unfair trading conditions. All but two of the glass works were small, and, although only scantily equipped for research, each had to work out its own problems. There was no institution from which scientific help could be obtained. The effect of free trade was disastrous. Foreign glass produced under conditions widely different from those in England was sold at prices below, or only slightly above, the cost of production here.

English manufacturers were driven from one expedient to another to keep their works alive. Thus one manufacturer whose staple was originally flint-glass table-ware and flint-glass tube turned to making glass for table-ware, lampshades, etc., then to processes of surface-decoration, and then to coloured glass for painted windows and enamels. Messrs. Chance fortunately kept alive, although

with difficulty, the manufacture of optical glass, their output of which has recently increased twenty-fold. English manufacturers were able on occasion to supply, for the purposes of special investigations, glass or glass apparatus which could not be obtained elsewhere.

English furnaces were constructed for making lead glasses which are not suitable for laboratory ware, although lead-potash glass is probably the most scientifically perfect glass extant. To meet requirements arising out of the war English manufacturers now to a large extent make lime-soda-alumina glass instead of lead glass, but their adapted and makeshift factories cannot be expected to compete on equal terms with those of Germany and Austria, which are fully organised and equipped for dealing with leadless glass.

Notwithstanding the shortage of materials (indicated by the enormous increase of prices) and of labour, special glass for the most varied purposes has been made during the war by British firms. Reports from a number of these indicate activity in the manufacture of optical glasses of all kinds, including coloured glasses and compositions containing the oxides of uranium, didymium or cerium, glass for thermometers, tubes for acid plants, laboratory ware, including vessels of zinc boro-silicate glass, and in the production on a very large scale of electric-light bulbs, tumblers, jars, etc.

While recognising the exacting labour of Sir Herbert Jackson's experiments and the patriotic intention of the Institute of Chemistry in publishing glass recipes, the author considers the acceptation of some of the formulæ as official standards as unfortunate. If they were regarded merely as helpful suggestions, the evolution of the best possible glass would be more likely to continue.

Glass blowing is an art which requires long training, and, notwithstanding the mechanical perfection of machine-made vessels, the passing of the handicraft cannot be regarded without regret. In designs for glass, attention should be paid to the nature of the material and more to form than to decoration.

INSTITUTION OF GAS ENGINEERS.

The fifty-sixth annual meeting was held in London on May 27, 28, and 29. In his inaugural address the President, Mr. Samuel Glover, remarked that the gas industry had supplied 21,800,000 gallons of benzol, 8,000,000 gallons of toluol, and 4,000,000 gallons of solvent naphtha to meet the country's needs in the prosecution of the war. The benzol represented 1,200,000 tons of picric acid, and the toluol about 65,300 tons of TNT. The efficiency of benzol extraction as practised by the industry varied from 0·3—0·8 gallon per ton of coal in South Wales to 2·0—3·0 gallons per ton of coal in Yorkshire. The President voiced a plea for efficient Government recognition of the industry as one of vital importance to the well-being of the country. In subsequent discussion, it was agreed to draw the attention of the Coal Controller and of the Board of Trade to the low stocks of coal at present carried by gas works—in general averaging 3 weeks' consumption in Greater London and 2½ weeks in outside areas—and to appeal against the suggested withdrawal of the Calorific Standards Order.

The report of the Gas Investigation Committee, which was presented to the meeting, is devoted principally to an examination of the utilisation of gas manufactured at the Uddington Gas Works, of calorific value 385—394 B.Th.U. gross per cubic foot, the make of gas being 30,000 cub. ft. of gas per ton of Lanarkshire coal. It appears from the report that in ordinary use, existing appliances for heating and lighting, designed primarily for the combustion of gas of a higher calorific value, can readily be adjusted for use with gas of a low calorific value by suitably enlarging the injector orifice, so that the effect of lower calorific value is counterbalanced by the increased hourly consumption of gas. Pressures lower than 20/10′ water column at the injector orifice secure efficient operation of the appliances, adjusted as above. A continuation of the work embodied in the first report (this J., 1918, 37, 681 A) on the efficiency in use of samples of gas of various calorific values confirmed the essential correctness of the proposal of the Fuel Research Board (this J., 1919, 191 R) to charge for gas on the heat units delivered in it, the appliances used for the combustion of the gas being suitably constructed and adjusted.

A discussion on the "Education of the Gas Engineer" was initiated by Prof. A. Smithells, who urged the prime importance of the accession to the ranks of the industry of men of high scientific attainment. The necessary scientific mastery was not to be achieved except by a continuous university education. He guardedly suggested that, on the whole, the desired end could be best achieved by a short period of works experience preceding such university course. The ensuing discussion revealed considerable diversity of opinion on this matter.

The report of the Refractory Materials Committee dealt with the "Crushing Strength of Firebricks" and "Heat Conductivity." The results included in the first part indicate that the crushing strength of a firebrick is diminished by reducing the grain size of the grog when the proportion of grog is constant, and also by increasing the proportion of grog when the grain size is constant. The crushing strength of a new brick is not necessarily at its maximum, but this appears to be influenced by the use and temperature to which the brick is afterwards subjected. The report on "Heat Conductivity" was devoted principally to a theoretical discussion of the effect of porosity of structure of the firebrick upon its heat insulating properties. A sample retort made by the slip process of casting was exhibited.

The report of the Life of Gas Meters Committee indicates that the dust deposits in gas mains do not originate in the oxide used for purification, but arise from corrosion of the mains by hydrocyanic acid in the presence of moisture. Spraying the mains by means of atomised paraffin oil is advocated as a remedy, otherwise precautions safeguarding against deposition of water in the main should be taken.

Dr. W. B. Davidson briefly reviewed the interrelation of the gas and dye industries. He pointed out that the consumption of gas per head of population is four times as great in Great Britain as in Germany. Reviewing the growth of the synthetic dye industry, he remarked that fifty years ago half a million acres in South Europe were devoted to the cultivation of the madder plant, the estimated value of the product being about £4,000,000. In 1913, over 3000 tons of alizarin and other anthracene dyes were imported into England. The distillation of coal with the recovery of by-products must be regarded as an indispensable industry, alike in peace and war. The main difficulty to be faced in the working up of by-products is concerned with plant. The various charges for the sulphuric acid contact process may be apportioned as follows:—Materials, 35%; amortisation, rents, rates, taxes, insurance, 45%; labour, 8%; repairs, 6%, and other charges 6%. He regarded the setting up of plants for the manufacture of intermediates as, in general, too risky a proposition for gas manufacturers. He did not anticipate any immediate improvement in tar prices through the demand for dyes, the value of the whole of the coal tar products employed by the German dye industry in any one year not exceeding £500,000.

Papers were submitted on the "Application of Reinforced Concrete to Purifier Construction" and "War Experiences of the British Gas Undertakings," the latter detailing the damage done to gas works by aerial and other attacks.

SOCIETY OF PUBLIC ANALYSTS.

Six papers were read at the meeting held on June 4, when Dr. S. Rideal presided.

In "The Examination of Commercial Samples of Nicotine," Mr. P. J. Fryer reviewed existing methods of estimating nicotine, and described the use of the refractive index as a means of determining the water content of nicotine solutions, whether the alkaloid be free or present as oxalate or sulphate. Mr. T. E. Wallis then gave an account of certain Mexican insects of the species *Notonecta* and *Corixa* used in certain poultry spices and foods, which form a regular article of commerce and have been sold under the name of "Mexican Cantharides." The descriptions given will enable analysts to identify the insects either whole or broken. The "Rapid Method for Determining Nickel and Cobalt in Ores and Alloys," Part III., described by Dr. W. R. Schoeller and Mr. A. R. Powell, consists in precipitating the metals by adding solid potassium iodide to a strongly ammoniacal tartrate solution. If present in small quantities, manganese is estimated colorimetrically in the precipitated cobalt, and if much be present it is eliminated by precipitating the nickel and cobalt as sulphides or xanthates.

Mr. E. R. Bolton's "Note on the Oil of *Ceratotheca sesamoides*" pointed out the great similarity between this plant and *Sesamum indicum*. With the exception of the Baudouin reaction, which is negative for the Ceratotheca oil, all the analytical results for the two oils were practically identical. The oil would be useful in edible products. With the aid of the "Improved Method for the Estimation of Nitrates in Water by means of the Phenolsulphonic Acid Reaction," of Mr. R. C. Frederick, nitrates associated with chlorides up to 100 parts chlorine per 100,000 c.c. can be very accurately estimated by using a special sulphonic-sulphuric acid mixture. The colour formed is compared with that produced by a standard ammonia solution. In the last paper, "Estimation of Morphine in Indian Opium," Messrs. J. N. Rakshit and F. J. D'Costa compared results obtained by the lime and polarimetric methods, and concluded that the latter offers certain advantages.

INSTITUTION OF MINING AND METALLURGY.

In his presidential address, delivered at the annual meeting on May 8, Mr. H. K. Pickard gave a valuable summary of recent developments in metallurgical practice.

Flotation methods have brought about greater progress than any other single invention, concentration practice having been revolutionised by their adoption. Progress in zinc metallurgy has been chiefly in matters of detail; the problem of mechanical roasting, especially of Broken Hill concentrates, still awaits solution; wet processes of extraction with subsequent electrolytic recovery have become firmly established.

In the metallurgy of copper, the use of reverberatory furnaces with increased throat-area has led to a largely increased output per furnace in America, where also leaching processes have come more into vogue. In this country, shortage of Spanish pyrites has led to the successful exploitation of pyrites in coal seams.

Crow's method of precipitating cyanide solution under reduced pressure has been the outstanding development in the metallurgy of gold.

NEWS AND NOTES.

NEW ZEALAND.

The Kauri Gum Industry.—A new factory for producing kauri oil is commencing operations at Redhill, Northern Wairoa. The company has 7500 tons of material ready for treatment, the yield is expected to be 75 galls. per ton, and an output of 100 barrels of kauri oil per week is anticipated. The crude oil yields the following fractions:—Motor spirit, 15%; solvent oil (used in rubber manufacture), 30%; paint oil, 30%; varnish oils, 30%; and the balance, pitch. The cost of production of the crude oil will not exceed 6*d.* per gallon f.o.b. (see also this J., 1918, 456 R).—(*Bd. of Trade J., May* 22, 1919.)

CANADA.

British Columbia.

Minerals, Metals, etc.—*Gold.*—A new strike of placer gold has been made on the Yukon River 45 miles above Marshall City, and a big rush has taken place towards the diggings.

The Forty Mile Power and Dredging Co., capitalised at $5,000,000, has acquired 96 miles of river claims and hydraulic benches near Dawson City, Yukon Territory.

Coal.—Many new foreshore locations for coal on Vancouver Island have been made east of the Comox area.

The Granby Consolidated Mining and Smelting Co. is building a 1000-ton washing plant at its new coal mine at Cassidy, Vancouver Island, at a cost of $150,000.

Iron.—The Hyatt Steel Products, Ltd., has taken over the Canadian Metals, Ltd., the Tudhope Electro-Metals, Ltd., and the rolling mills at Port Moody. Besides iron and steel, babbitt, solder and type metal will be manufactured.

The British Columbia Government has voted $50,000 to supply up to 10,000 tons of native magnetite ore for experimental purposes. The Tudhope Electro-Metals, Ltd., has applied for 5000 tons and the Vancouver Magnetite Iron and Steel Smelting Co., Ltd., for 5000 tons. The latter company proposes to instal auxiliary fuel oil burners in its blast furnace to obtain the temperature of 3000° F. necessary to flux the charge.

JAPAN.

The Salt Monopoly.—According to the *Japan Gazette*, the Salt Monopoly Administration has so far proved a failure. Since last summer complaints have been heard in all quarters as to a shortage in the supply of salt. The manufacture of salt by the monopoly authorities last year was reduced from about 607,000 to about 476,000 tons, and, as the consumption in Japan in recent years has been about 875,000 tons annually, there will be a deficit of 440,000 tons this year. Naturally the price is ruling high. The monopoly is said to have suffered a loss of over 400,000 yen (about £40,000) last year. The authorities are now trying to import salt from Tsingtau and China to make good the deficiency.—(*U.S. Com. Rep., April* 16, 1919.)

The Fertiliser Industry.—The small size of the average Japanese farm (2·64 acres) has rendered necessary such intensive cultivation that the consumption of fertilisers is, of necessity, extremely large. This has led to a large fertiliser industry, as may be seen from the total value of the production in 1916, *viz.*, over £6,000,000. Oilcake of various kinds is one of the most important fertilisers used, the annual yearly consumption, including imports of bean cake from Manchuria, being valued at over £7,000,000. Soya-bean cake meal is the standard oilcake of the Far East.

The use of chemical fertilisers, although of recent

growth, is increasing rapidly. The production in 1905 was valued at £370,000, and that in 1916 at £2,000,000. Superphosphate is manufactured in Tokio from phosphatic rock imported from the South Sea Islands. The local production of superphosphate is estimated at 500,000 tons and of sulphate of ammonia at 55,000 tons. Sulphate of ammonia is also produced, but the home supply is insufficient, 16,777 short tons being imported—chiefly from Great Britain—in 1917. Nitrate of soda is imported from Chile to the extent of 50,000—60,000 tons annually. Animal fertilisers are not used to any great extent; the most important is fish scrap obtained by drying and pressing herring, sardines, etc., valued at about £700,000 yearly. A peculiar fertiliser is made from dried silkworms and dried silkworm pupæ. The total consumption of chemical fertilisers in Japan amounts to 600,000 tons yearly. It is stated that Japanese capitalists are planning to erect a plant with a capital of 20,000,000 yen (about £2,000,000) for the fixation of atmospheric nitrogen under certain American patents.

The above facts indicate that Japan is moving rapidly towards a position in which she will supply all the fertilisers she needs, so that the prospects of increased foreign trade are not very bright. Even sodium nitrate is now brought direct from Chile in Japanese steamers, the middlemen being entirely cut out. There should however be a field for sulphate of ammonia, animal fertilisers and special mixed fertilisers designed for specific purposes. There is no customs duty on fertilisers in Japan.—(*U.S. Com. Rep., April* 8, 1919.)

GENERAL.

The Salters' Institute of Industrial Chemistry.—Following the announcement of appointments already made (this J., 1919, 105 R), post-graduate fellowships have been awarded to the undermentioned chemists, who will continue their studies at the university or college indicated: Capt. W. H. Hoffert, B.A. (Oxford), Capt. A. G. Pollard, B.Sc., A.R.C.S. (Rothamsted Experimental Station), Mr. L. A. Ravald, M.Sc. (Municipal College of Technology, Manchester), and Mr. M. L. Wilson, M.Sc. (University of Manchester).

Endowments for Science at London Colleges.—Mr. Otto Beit, a member of the governing body of the Imperial College, has placed at its disposal the sum of £10,000 to be applied to building and equipping such departments of the college as may need most urgently assistance for development. An old student of the Royal School of Mines has contributed £8000 towards the equipment of an intermediate-scale laboratory for organic chemistry in the new building which is now under construction. The Goldsmiths' Company has offered the sum of £15,000 for the endowment of a chair of bacteriology at the London Hospital.

Industry and Higher Education.—A meeting of representatives of British universities and of the Federation of British Industries was held on May 20 to consider the establishment of some organisation for facilitating the transfer of university graduates to industrial life. Prof. Ferrier, of Bristol University, said there had been no difficulties in placing really first-class men, but men of the second class certainly needed assistance. There had been a marked tendency for university-trained men to proceed overseas, and even in the United States the English university man was generally sure of finding employment. Prof. H. B. Baker, of the Imperial College, agreed that the real difficulty was in fixing the second-grade student. In chemical industry there was routine work which would be more ably carried out by the trained man. The value of a well-trained man in routine work was not appreciated at present. A further meeting is to be held to deal with practical proposals for initiating a scheme.

Standardisation of Aircraft Materials and Parts.—With reference to our previous note on this subject (this J., 1919, 144 R), the British Engineering Standards Association has recently issued an index of specifications which are now, or will shortly be, available. The specifications number well over 200, and are classified under the following headings:—Bolts, brasses and bronzes, cast iron, dope and ingredients, electrical, fabric, heat treatments, engine parts, alloys, Technical Department Instructions (materials), petrol, steels, standard details, tubes, timber, wires, paints and varnishes. The specifications are on sale at 1½*d.* each, and a list of them is obtainable from the offices of the Association at 28, Victoria Street, S.W. 1.

The German Dye Industry.—A managing director of the dye works, formerly F. Bayer and Co., in Leverkusen, has recently stated that the dye industry had lost 60 per cent. of its former foreign trade. Nevertheless it is to be expected that this industry will play an important part in the future, especially in export trade. The fast light silk colours cannot be imitated, and no effort will be spared to recover the lost footing in foreign countries.—(*Deutsch. Allgem. Z., April* 18, 1919.)

Present Condition of the German Chemical Industry.—In common with most other industries, the German chemical industry is suffering much from the shortage of fuel. In the Frankfort district several works are making experiments with coal-tar oil as a fuel. The soap factories are receiving quite inadequate quantities of potash and calcined soda. The rubber factories in the Hanover district are short of the necessary fabrics, as well as of raw rubber. The chemical-pharmaceutical works are not receiving enough hydrochloric acid, soda lye, or soda, and the lack of glycerin and the embargo on the use of casein hinders the preparation of several important medicines. Only small quantities, at very enhanced prices, of indispensable raw materials, *e.g.*, varnishes and lacquers, are reaching the oil and colour works, while linseed oil, resins, copal and asphalt are confiscated. It is barely possible to obtain bright-coloured aniline dyes, since most of the works producing them are in the occupied zone. It is reported that the situation in the glass and porcelain industry is very serious. The Lahr Chamber of Commerce announces that the works there have been closed for months, and that the coal shortage is the sole obstacle to their re-opening and giving employment to some 400 hands. The Dresden Chamber of Commerce sends a similar report with regard to the Saxon glass industry, which cannot possibly revive so long as the coal shortage continues. The Plauen porcelain industry has been at a complete standstill since November last. Similar reports are to hand concerning the Magdeburg glass industry, and from Altenburg, Rudolstadt, Sonneberg, Weimar and Hanover.—(*Deutsch. Allgem. Z., April* 24, 1919.)

The German Fine Chemical Industry.—As a consequence of Government decrees, alcohol is practically unavailable for technical purposes and some branches of the industry, *e.g.*, the manufacture of formic acid so important during the war, have been almost completely abandoned. The enormous price of some products is due to the lack of satisfactory raw material. Thus tannin must be made from the inferior and now highly priced German gall-nuts, since the Chinese and Japanese gall-nuts cannot be imported. Colour printers and others find gall-nuts too costly to use, prices in general having risen by 30 to 300 per cent.

Foreign countries have not yet succeeded in making the chemicals they require at costs even approaching those ruling now in Germany; and the export prospects for the German industry are therefore still to be regarded as favourable. For example benzoic acid costs in England 55—60*s.* a kilo. but in Germany only 18 marks. Potassium permanganate costs 60 mk. a kilo. in foreign countries as against 1.35 mk. in Germany. Many English firms therefore await the moment when they can resume former relations with the German industry, and this holds also for Russia and Poland. After the peace of Brest-Litovsk a brisk trade was established with the latter countries which was interrupted by the present disturbances. An extraordinary demand persisted however for silver nitrate, but not, as it appeared, for photographic purposes. The Poles offered more than twice the former price of 176 mk. with the object of preparing pure silver to augment their reserves, an intention which was soon discovered and frustrated.—(*Z. angew. Chem., April* 29, 1919.)

The Nitrogen Monopoly in Germany.—Speaking on the Nitrogen Monopoly Bill in the National Assembly, Herr Gotheim, a Minister of State, expressed doubt whether at the present time the price of nitrogen could be fixed relatively to the prices of agricultural products. The Government was itself greatly interested in a speedy supply of fertilisers to agriculture, but only 6000 tons of pure nitrogen was in stock. By the end of April 10,000 tons might be available, but transport difficulties might interfere with the distribution.—(*Z. angew. Chem., April* 25, 1919.)

German Potash Output.—On account of shortage of coal and transport, of strikes and reduced individual output, barely 120,000 metric tons of pure potash was produced in the first quarter of this year. This compares with 300,000 tons in the corresponding period of 1918. The value of the production has decreased from 77 to 35 million marks. Deliveries of potash in Saxony have increased considerably of late, six trainloads per week having been delivered instead of three.—(*Z. angew. Chem., April* 18, 1919.)

Socialisation of the German Potash Industry.—The Potash Syndicate, in a communication addressed to the President of the National Assembly, opposes the proposed scheme for socialising the potash industry. Before the war the potash trade was one-half as to quantity, and two-thirds as to value, an export one. In view of the severe competition already appearing from Alsace and that expected from Spain, and also because immediate decisions are necessary in the export trade, the projected Potash Council with 30 members is considered to be impracticable. Socialisation should be deferred until the conclusion of peace, and in any case should not extend to the export trade.—(*Z. angew. Chem., April* 29, 1919.)

Accumulators in Germany during the War.—The demand for accumulators in Germany was very great at the outbreak of war. The large types of submarines required batteries of 220 cells of 4500 amp.-hrs. capacity, weighing 80 tons and costing about 250,000 marks. In 1917, 86 submarines were launched, and in 1918 the monthly addition was from 10 to 14. The synthetic rubber produced by F. Bayer and Co. was of the greatest value in the manufacture of battery boxes. The output of this rubber reached 150 tons per month in 1918, at a price of 37 marks per kilo. For military purposes the transport of cells for charging necessitated the substitution of celluloid for glass to save weight. This material was at first defective, particularly in regard to cementing, but the quality improved later.—(*Elektrotech. Z., Feb.* 20, 1919.)

Sugar Production in Germany.—The following statistics, published by the Food Ministry, show the considerable decline in the production of sugar which took place in Germany during the war:—

Year	Cwts. of crude sugar
1913—14 ...	... 52,358,700
1914—15 ...	... 50,202,000
1916—17 ...	... 31,158,600
1917—18 ...	... 30,958,700
1918—19 ...	... 25,000,000

The figure given for the current year is only an estimate; as, however, all raw sugar factories have already finished the working up of roots, there can be no important alteration in this figure. —(*Deutsche Allgem. Z.: Bd. of Trade J., May* 22, 1919.)

Peace Possibilities of the Swiss Chemical Industry.—In the *Schweizer. Chem.-Zeit.* (1919, 25—28; 65—69) Prof. E. Flerz discusses the present condition of chemical industries in Switzerland, and suggests directions in which developments might be made. In 1913 the value of chemicals exported from Switzerland was 67 million francs, and by 1917 this had risen to 175 million francs, whilst the corresponding values of the chemical imports were 85 and 157 million francs. The weight of exports, however, had fallen from 79,000 tons in 1913 to 74,000 tons in 1917, whilst the imports had fallen from 230,000 tons to 145,000 tons. Only in the branch of electro-chemistry was any improvement shown during this period, and this was mainly due to the demand for ferrosilicon, which increased by about 70 per cent., and for carbide, which, on account of its use as a substitute for manganese in steel, showed an increase of about 300 per cent.

Some compensation for the lack of iron and coal in Switzerland is to be found in the relatively abundant supply of water power, of which it is calculated that throughout the whole country on the average about 1000 cub. metres per second is available, with a fall of about 1000 metres. This would correspond to 13,400,000 horse-power, or, say, 10 million kilowatts. Assuming that 30 per cent. of this available power were utilised, it would be approximately equal to the available energy of Niagara, and would represent a saving in coal of about 4 million tons. It is estimated that utilisation of this source of electric energy would enable the following quantities of chemical products to be manufactured:—Nitric acid, 350,000; calcium carbide, 1,344,000; hydrocyanic acid, 273,000; acetic acid (from acetylene), 648,000; sodium hydroxide solution, 3,600,000; hydrochloric acid (30%), 12,600,000; and aluminium 220,000 metric tons. To these may also be added chlorates, perchlorates, bichromates, carborundum, calcium cyanamide, etc. The production of nitric acid, however, could not compete with its manufacture at Nottodden, where electric energy costs 10 fr. per h.p. per annum, as against 80 fr. in Switzerland.

Stress is laid upon the importance of utilising the whole of the coal imported by coking and distillation, and for this purpose it is suggested that communal coke and gas works should be established.

A factor of great importance for the future development of Swiss chemical industries is that they should be entirely in the hands of the Swiss; otherwise there is a risk of boycotting by other nations.

The financial support given in other countries to chemical enterprises should be imitated in Switzerland. With financial aid from the Swiss banks, chemical associations should be formed to study the conditions in foreign countries and to secure raw materials from countries such as the South American Republics. Diplomatic support would also be necessary in this direction.

The future of Swiss chemical industries appears to lie not in competing with the whole world in manufacturing products on a huge scale, but in developing a smaller industry of products of very high quality, as has been done, for example, in the watch industry.

Cement in 1917.—The United States attained a record production of Portland cement in 1917 of 92,814,202 barrels, valued at $125,670,430, or $1·354 per barrel, the highest price since 1899. The 1916 figure was $1·103 per barrel, and the output 91,521,198 barrels.

There were 117 plants working in 1917, an increase of 3 on the previous year, but there was a decrease of 18 kilns as a result of the substitution of several 40—90 ft. kilns by kilns 125—150 ft. in length; 636 of the kilns burned powdered coal, 103 burned crude oil, 6 burned natural gas and one producer gas. An interesting by-product of the industry was potash recovered mainly by means of the Cottrell process, 1806 short tons of potash as K_2O being obtained. The United States has now become practically independent of foreign supplies, the 1896 import figure of 3 million barrels having fallen to 2009 in 1916 and 1917.

Concrete barges have been in successful use on English canals since 1912, and at the time of writing 140 were under construction and also 24 concrete tug boats of various sizes. In France, China, Spain and Norway the construction of barges and small vessels of this material is proceeding apace. America, however, was the pioneer of large concrete merchant vessel construction, the ship "Faith," of 5000 tons dead weight capacity, equipped with engines of 3500 horse-power, being built at San Francisco. On a trial trip she developed a speed of over ten knots and successfully encountered a 60-mile-an-hour gale. One of the most serious factors in the construction is the adequate protection of the steel reinforcement from corrosion, such as by galvanising, and it is also recommended that some form of waterproof coating should be applied to the hull below the deck to prevent erosion. Another point of importance is that a concrete ship of 3500 tons dead weight capacity would weigh about 1300 tons more than a steel ship of the same capacity, and consequently would be more expensive to run. The construction cost per ton dead weight carrying capacity is estimated at $100—125, against $180—220 for steel ships. Experiments are being conducted to obtain a concrete of less weight by using light volcanic rocks.—(*U.S. Geol. Surv., Feb.*, 1919.)

Sodium Salts in 1917.—The basis of most of the sodium salt production in the United States is sodium chloride, but in 1917 four firms marketed sodium carbonate refined from natural deposits and two firms offered natural sodium sulphate. The production of sodium salts derived from natural sources was 7,108,835 short tons in 1917, valued at $24,445,676, as compared with 6,479,662 tons in 1916, valued at $16,600,406. Sodium compounds are steadily replacing potassium compounds, one important point being that they are economical from the freight point of view owing to the difference in the atomic weights of the metals. The production of soda ash in the United States has been:—1899, 390,653 short tons; 1904, 518,954 tons; 1909, 646,057 tons; 1914, 935,305 tons; 1916, 1,324,208 tons; and 1917, 1,578,889 tons.—(*U.S. Geol. Surv., Jan.*, 1919.)

Coal Resources of the Netherlands.—The following are the estimated coal resources of the Netherlands:—The Peel district, 1,766,000,000 tons; Southern Limburg, 3,165,903,537 tons; Winterswijk district, 324,000,000 tons; total, 5,255,903,537 tons, which, at the pre-war rate of 10,000,000 tons per annum, will last 525 years. The coal, however, is not first-grade. The price of Limburg coal last year was 17 florins (florin=about 1*s.* 7*d.*) per ton, whilst German coal was 90 florins, and is now 50 florins per ton.—(*U.S. Com. Rep., April* 18, 1919.)

China Clay in Bornholm (Denmark).—According to *Börsen*, new china clay deposits have been discovered at Bornholm. Preliminary examination shows the clay to be of first-class quality.—(*Weltwirtschaftszeitung, April* 18, 1919.)

Vanadium in Swedish Coal.—According to the *Aftonblad*, a concession has been given to work the coal beds in Ostergötland. The coal is of good quality, but its special characteristic is a content of vanadium. Analysis shows 0·95 per cent. of ash, of which 25 per cent. is vanadium. The cost of raising the coal is said to be 11·50 kronor per ton.—(*Metall. u. Erz, Mar.* 8, 1919.)

End of the Copper Scarcity in Norway.—The shortage of copper, from which all Norway, but especially the electrical industry, has suffered through war conditions, no longer exists. America is now in a position to deliver the whole of the metal purchased long ago on Norwegian account. In consequence of this, the electrical works at Christiania have forbidden the continued use of zinc and iron as electrical material. From July 1, 1919, only copper is to be used for electrical purposes. The imports from America will include large quantities of line wire.—(*Metall u. Erz, Mar.* 22, 1919.)

Mineral Resources of Holland.—The chief source of the mineral wealth of Holland is Limburg. Considerable coal deposits have been found at Kerkerade. In South Limburg there are not only coal mines but in the extreme south, near Epen, there are large quantities of good quality iron ore, zinc and lead, which have not yet been exploited. The discovery of clay and chalk in South Limburg has led to the erection of a Portland cement factory, which will be enlarged when transport facilities improve. Limburg limestone is much used for building, and Limburg clay, at present little utilised, is pure and of good quality. A very valuable sand for the manufacture of crystal glass is also found in Limburg. Both this province and North Brabant are rich in coal lying near the surface, and these mines, together with the coal fields at Winterswijk (Overijssel), would yield sufficient coal to furnish Holland's requirements for four centuries. There are excellent supplies of sand and iron ore in Brabant. Besides its coal fields, Overijssel yields rock salt, iron ore and some excellent quality clay. North and West Holland abound in peat. The sand dunes in the west, in addition to their value as a fertile soil for bulb culture, provide material for lime kilns, and the mud of the IJ valley is used in the manufacture of red cement.—(*Handelsblad, Mar.* 23, 1919.)

Wolfram Mining in Bolivia.—Bolivia is well known as a tin-producing country, but only within recent years has wolfram mining been added to its important industries. About ten years ago wolfram became an article of export, when it appeared in the list as "barilla," a concentrate averaging about 60 per cent. wolfram. Of this concentrate 186 tons, valued at £6255, was exported in 1908; the quantity steadily increased until in 1917 it amounted to 3828 tons, valued at £585,201, the United States taking far the greater part. Great Britain took 873 tons in 1916. The principal wolfram-producing district is La Paz, followed closely by Oruro, and at greater distances by Potosi and Cochabamba. The industry is now obtaining its produce from a large number of mines worked from the surface. A few derelict tin mines have been revived as wolfram producers. A large proportion of the wolfram industry in Bolivia is now under American control, British

interests being practically non-existent. German activity, which before the war was paramount, is now probably to a large extent disguised under Chilean colours.—(*Eng. Min. J., April* 5, 1919.)

The Economic Condition of Bulgaria.—Reports issued in November, 1918, by order of the Austro-Hungarian consular service contain valuable information relating to the economic condition of Bulgaria. The chief concern of the Government has been in connexion with ensuring increased output from the mines, and to this end large credits have been voted in the budget for the current year. The output of the government coal mines in Pernik for 1916 was 609,000 tons, an increase of 107 per cent. compared with 1914. The Plakanitza and Bor copper mines have been worked by Germany, and their output has been greatly increased. In the period 1902–1910 the total output of mineral ores in Bulgaria was as follows (in metric tons):—Copper 63,017, lead 9290, zinc 2397, zinc-lead ores 12,089, lead-copper ores 1034, and manganese ores 1930 tons.

The salt mines at Atana Rïöj were conceded in 1906 to a Russian company. The annual outputs were (in metric tons):—4638·5 in 1911, 4265 in 1912, 4819·4 in 1913, and in 1914, 4800. The output of salt from Anchials was formerly about 9000 tons. The salt lakes of the Dedeagatch yielded in 1913 from 4000–5000 tons, in 1914 only 1500 tons of poor quality.

The total sugar production for 1916—17 was about 1000 waggons. The output of the Sofia sugar manufactory is normally about 1000 waggons. There was a general shortage of alcohol, beer and brewing materials, fats, soap and soda, surgical wadding and dressings. A syndicate of soap makers was founded in 1916 to take steps to remedy the shortage of fats and soda. The price of washing soap was fixed at 3, 2·20 and 150 lewa the kilo. according to quality (lewa = 9½d.). In 1914 the paper imports from Austria-Hungary totalled 3,276,001 kilo., and from Germany 783,718 kilo. The demand for plate glass was much less than in normal times. There was an appreciable scarcity of hollow glass ware.

In the matter of chemicals, only the smallest fraction of requirements could be met by Germany under special conditions of export. The prices of sulphuric acid, caustic soda, tartar, naphthalene, disinfecting materials, etc., were very high. Supplies of caustic soda, ammonia, ferrous sulphate, naphthalene, and sodium bicarbonate were derived from Austria Hungary. Owing to the shortage of petroleum there was a considerable import of carbide from Germany, Austria-Hungary, and Sweden, the price varying from 5 to 8 lewa per kilo. There was likewise a great shortage of medicinal supplies, and such necessary articles as quinine, aspirin, iodine, phenacetin and mercury were ultimately imported from Germany. Large quantities of indigo and washing blue were imported from Austria-Hungary, and aniline dyes were imported principally from Germany. Even should the chemical industry of Bulgaria be fostered by State assistance, it will not be in a position to cope with home demands. Hitherto supplies of ferrous and copper sulphate, naphthalene, paraffin, kerosene, sulphuric and tartaric acids, soda, phenol, sulphur, starch, glue etc. have been derived from Austria-Hungary. In the case of many articles, however, precedence was taken by England and France. After the war it can safely be assumed that the quota from Austria-Hungary can be considerably increased. The importation of artificial manures should be accompanied by propaganda, as the Bulgarian farmer is not enamoured of novelties. In drugs etc. the main supplies are derived from Germany. The French, however, are recognised as competitors not to be despised.—(*Z. angew. Chem., Feb.* 25, 1919.)

OBITUARY.

SIR BOVERTON REDWOOD, BART.

We regret to record the death of Sir Boverton Redwood, which took place suddenly, at the age of 73, on June 4 from heart failure after only two or three days' illness. Sir Boverton had just been engaged on the analyses of the oil from the Chesterfield boring in Derbyshire, an enterprise in which he had been keenly interested from its inception. Among his many activities in none had he been more keenly concerned than in the development of home supplies of oil, especially for fuel purposes. He had always kept an open mind on the possibilities of finding oil in this country, and speaking on this subject before the Institution of Petroleum Technologists in November 1917, he said "The nation would be blameworthy if it did not put that test (the drill) into effect." Sir Boverton was known to be a keen advocate of retorting processes for obtaining oil from cannel and other bituminous minerals, and considered that both the proposed borings and investigations of retorting should be carried on simultaneously.

His connexion with petroleum dated from its early days and he had for years been an expert of world-wide repute. He travelled widely and was personally acquainted with many of the important oil-fields. He was technical adviser on petroleum to most Government departments, to the Corporation of London, the Port of London Authority and other public bodies, and served on Lord Fisher's Royal Commission on Oil Fuel for the Navy (1912). He was also on the Home Office Committee on Acetylene Generators, was chairman of the Gas Traction Committee, and of the Committee on the use of Alcohol as Fuel.

Sir Boverton Redwood took an active interest in the Society of Chemical Industry, his first official connexion dating from 1884—92, when he served on the committee of the London Section, this being followed by two years as chairman. He served several periods on the Council, on three occasions was Vice-President, and filled the office of President in 1907—08, when he displayed great personal interest and activity in obtaining the Society's Charter.

Owing almost entirely to his initiative the Institution of Petroleum Technologists was founded in 1914 and he served as its first President, the new Institution rapidly developing under his support and guidance.

His activities during the war were many. On the formation of the Petroleum Supply Branch at the Ministry of Munitions he became Director of Petroleum Research. Later, when re-organisation took place, he became Director of Technical Investigations on the Petroleum Executive. He also served on several committees, including Trench Warfare, where his special knowledge was of great service in connexion with "liquid fire."

The unquestioned authority of Redwood throughout the world in matters relating to petroleum was ample testimony to his marked ability and wide knowledge. He was a man of keen insight, an able administrator and a clear expositor of any problem, however complex, with which he had to deal. Personally he was most kindly and took a great interest in many of the younger men who became associated with him, always lending his influence to further their interests and advancement.

The burial took place at Hampstead Cemetery on June 7. Among the many friends and relatives who attended the funeral were Dr. Charles Carpenter, Mr. W. F. Reid and Dr. C. A. Keane, representing the Society of Chemical Industry.

J. S. S. BRAME.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Awards to Inventors.

Mr. Baldwin, Secretary to the Treasury, in reply to Sir C. Kinloch-Cooke, outlined the duties of the new Royal Commission (Powers and Functions) on Awards to Inventors. The main objects of the Commission are :—(1) To decide what awards are to be made to patentees for the use by Government Departments of their patents, where such awards are bestowable by statutory right under the Patents Act; and (2) to pronounce on awards which may be made as an act of grace. It will not devolve upon the Commission to determine the ownership of any invention, but to decide the validity of a claim to be rewarded by the Crown. Rival claimants to an award will be heard successively. The three main conditions which claimants, under the second heading, should fulfil are :—(*a*) Suggested inventions must have been reduced to a definite workable form. (*b*) The claimant must have been the first to communicate his invention to the Government Department. (*c*) The invention must be one of exceptional utility. —(May 22.)

Steel Imports.

Replying to Sir F. Hall, Sir A. Geddes (President of the Board of Trade) said that American steel manufacturers are quoting prices for delivery in the United Kingdom lower than those quoted by British manufacturers, though not to the extent suggested (£4 10*s.* per ton and upwards). The Government is not prepared at present to impose any restrictions upon the importation of iron and steel, in view of the demand in the country.—(May 26.)

Tinplate Industry.

Asked by Mr. Seddon as to the steps the Government intended to take to protect the tinplate and galvanised iron industries against American competition, in view of the fact that production costs are lower in the United States than in this country, Sir A. Geddes said that the tinplate industry in this country is finding a ready market for all its products, and, in view of the vital importance of encouraging our export trade, he would not at present take any steps which might restrict the available supply of such goods as are required for other industries.—(May 28.)

Government Laboratory.

Answering Mr. Hirst, Mr. Baldwin stated that temporary chemical assistants in the Government Laboratory are compelled to retire at the age of thirty. The regulation is included in the conditions of appointment and there is no intention of altering it.—(May 29.)

Sale of Linseed Oil to Germany.

Mr. Roberts, in reply to Sir R. Cooper, said that under the arrangements made at the Brussels Conference for Germany to be supplied with 70,000 tons of edible fats, a sale of 25,000 tons of linseed oil was arranged at £78 a ton. At that time there was a surplus stock of linseed oil in this country, which was previously offered to the trade at a lower price. The rise in price of linseed oil has been caused by neutral and enemy purchases in the countries of origin.—(May 30.)

Sulphate of Ammonia.

Replying to Sir A. Richardson, Sir A. Boscawen, Parliamentary Secretary to the Board of Agriculture, admitted that the control price at which sulphate of ammonia is being supplied to home agriculturists is below the cost of production. In answer to the complaint of the South Metropolitan Gas Company, that licences for export are obtainable only through the agency of a combination of trade competitors, the Board has replied that it cannot make exceptional arrangements.—(*June* 2.)

Coal Output.

In answer to Mr. Mackinder, Sir A. Geddes stated that the coal position is serious. Since the reduced working hours have been in force, the output has been at the rate of between 214 and 217 million tons per annum, compared with an output of 287 million tons in 1913. Exports will have to be reduced from the rate of 34 to that of 23 million tons, and except in the case of very small consumers, the rationing allowance now in force will be continued for another year as from July 1 next. After providing for the guaranteed profit to owners of 1*s.* 2*d.* per ton, the estimated deficiency in the working of the industry for the ensuing 12 months is valued at £46,600,000, equivalent to 4*s.* 3*d.* per ton of output. This means either an increase in price to the consumer of 4*s.* 6*d.* per ton, or the deficit will have to be met by the taxpayer.—(*June* 4.)

LEGAL INTELLIGENCE.

EXCLUSION OF A FELLOW FROM THE CHARTERED INSTITUTE OF PATENT AGENTS. *Law* v. *Chartered Institute of Patent Agents.*

This case, which is reported in the issue of Reports of Patent Cases dated June 4, is of interest to professional institutions which occasionally sit in judgment, through their councils, on the actions of their members. It may be gathered from the case that in all such instances care should be taken that any member of the adjudicating council who may be regarded in any sense prejudiced against the member in question has no part in the adjudication.

It appears that the control of patent agents is vested in the Board of Trade. If, after due inquiry, the Board holds a registered patent agent to have been guilty of disgraceful professional conduct, the Board may order the Registrar to erase his name from the register. By the charter of the Chartered Institute of Patent Agents, any member of the Institute being held by the Council, on the complaint of any person aggrieved, to have been guilty of any act discreditable to a patent agent, shall be liable to exclusion from membership by resolution of the Council.

A complaint having been made that a patent agent who was a Fellow of the Institute had been guilty of misconduct, the Council of the Chartered Institute of Patent Agents referred the matter to the Board of Trade, postponing any action which it might think fit to take until the Board had decided whether an order should be made to erase the patent agent's name from the register. At the hearing before the Board of Trade, counsel appeared under instructions from the Council of the Chartered Institute to state the alleged misconduct and a member of Council gave evidence, the effect of which was against the patent agent.

Subsequently the Council of the Institute considered the alleged misconduct as affecting the desirability of retaining the patent agent as a Fellow of the Institute, and, having come to the conclusion that there was misconduct amounting to an act discreditable to a patent agent, passed a resolution excluding the Fellow from membership of the Institute. The Fellow brought an action in the High Court to restrain the Council from acting upon the said resolution, on the ground that the Council, so far as it was composed of members who had taken any active or substantial part in the proceedings before the Board of Trade, had no jurisdiction to adjudicate.

Mr. Justice Eve held in effect that the Fellow's contention was correct and granted the injunction sought.

PERSONALI A.

The honorary degree of Doctor of Science of the University of Durham has been conferred upon Sir E. Rutherford and Sir G. T. Beilby.

Sir J. J. Thomson has been appointed, by an Order in Council, to be a member of the Advisory Council for Scientific and Industrial Research.

The Albert Medal of the Royal Society of Arts for 1919 has been awarded to Sir Oliver Lodge, "in recognition of his work as the pioneer of wireless telegraphy."

The new Langworthy Professor of Physics in Manchester University is Mr. W. L. Bragg, now lecturer in natural science at Trinity College, Cambridge.

Prof. P. Phillips Bedson has been appointed President of Section B, Chemistry, at the forthcoming 87th annual meeting of the British Association at Bournemouth.

Sir Albert Stanley has resigned the office of President of the Board of Trade on account of ill-health, and Sir Auckland Geddes has been appointed to succeed him.

Dr. M. O. Forster has been appointed a member of the Senate of London University, and, by this Senate, a Governor of the Imperial College of Science and Technology.

The Medical Research Committee has appointed Mr. Harold King, of the Wellcome Chemical Research Laboratories, to the post of Organic Chemist in the Department of Biochemistry and Pharmacology.

Major A. J. Allmand has been appointed, as from September 1, to the University Chair of Chemistry at King's College, London. Dr. Allmand is an honours graduate of Liverpool University and an 1851 Exhibition Scholar; he has worked with Prof. Donnan at Liverpool, with Prof. Haber at Karlsruhe, as assistant lecturer in physical chemistry at Liverpool University, and recently as chemical adviser at Army Headquarters.

REPORT.

THE DEVELOPMENT OF WATER POWER.

SECOND REPORT OF THE WATER-POWER COMMITTEE OF THE CONJOINT BOARD OF SCIENTIFIC STUDIES.

The shortage of coal due to the war having rendered imperative a search for other available sources of energy, the development of hydro-electric power has received a world-wide impetus. It is estimated that at least 1,600,000 h.p. from water power will have been developed in France by the end of 1921 as compared with 750,000 before the war. In Italy concessions totalling over 250,000 h.p. is under development, and schemes are in hand for utilising up to two million h.p. in the near future. The National Economic Council in Russia is said to be establishing hydraulic stations to supply the whole of the power requirements of Petrograd; and in Scandinavia and Switzerland the already large installations are being still further increased. Attention is also being given to the question in Spain, Germany, and Austria. The electrification of railways is making progress, and in the United States one railway system alone, the Chicago, Milwaukee and St. Paul, will soon have about 860 miles of track electrified. In France much of the track in the region of the Pyrenees is already electrified, and further developments are pending in this and other countries.

The estimate of the water horse-power already developed in the United Kingdom given in the First Report of the Conjoint Board (this J., 1919, 320 R) has been found to be too low, and from the latest available statistics the figure for 1918 should be taken as approximately 210,000 h.p. In the majority of cases these powers are only utilised for a 10-hour day, and there is little doubt but that they could be made available for the full 24 hours at the same rate.

The Indian Government has arranged for official reports of the possibilities of sites in that country. Rain-gauge stations have been established and gauging observations on rivers have begun. In Ceylon little use has been made hitherto of the large powers available, while in the Federated Malay States the chief development has been in the direction of hydraulic mining. In British Guiana little official investigation of the very great possibilities has yet been made, but the recently proved extensive deposits of bauxite in the colony render it most probable that water-power will be developed on a large scale in the near future. In Canada matters are much more advanced. Government and Provincial departments dealing with water-power questions are in existence, as well as a Commission on Conservation. For the new developments at Niagara, turbines of 52,500 h.p. each at 305 ft. head and 187·5 r.p.w. are specified, and these will be by far the largest ever built. Proposals have been put forward for a joint scheme with the United States for the utilisation of the available power of the St. Lawrence river, which for a great part of its course forms the boundary between the two countries. A complete census of the hydro-electric developments throughout Canada has been published by the Dominion Water Power Branch of the Department of the Interior in co-operation with the Dominion Bureau of Statistics; this shows a total of 2,305,310 hydro-electric h.p. now developed. The increase in the last eight years works out at 126 per cent., and to-day Canada has 276 developed hydro electric h.p. per 1000 of population against 100 for the United States. Of the total of 2,305,310 h.p. central electric stations account for 1,727,471, pulp and paper mills for 352,214, and other industrial establishments for the remaining 225,625.

In Australia little additional information is available, and in Tasmania the Government Hydro-Electric Department is continuing its policy of investigation. Nearly ten million h.p. from water power is estimated to be available in Papua (British New Guinea), and nearly as much more in the occupied territory of German New Guinea. This island appears to be in the enviable position of possessing for its size the most extensive water-power in the Southern Hemisphere. Increased interest in the development of water-power is being shown in New Zealand, but little fresh information is forthcoming from South Africa and Rhodesia.

The Committee concludes its report with a very strong recommendation that facilities for training in hydro-electric engineering should be at once provided at one or more of our universities, so that, in the future world development of hydraulic power, the British engineering enterprise may not be left behind.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for May 22, 29, and June 5.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters

of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
British India ..	Tanning materials ..	968
,, ..	Chemicals, drugs, dyes, paints	1020
,, ..	Dyes, yellow metal sheets, glass	1021
,, ..	Trinidad bitumen, cement, compositions for preserving wood and stone	1077
,, ..	Iron and steel sheets and bars, copper, brass and lead sheets and tubes, calcium carbide, paints	1078
Canada	Chemicals, dyes, medicines	*
Egypt	Coal, gas tar and pitch (tender for)	
,, ..	Paper	1024
New Zealand ..	Chemicals, fertilisers ..	1025
,, ..	Tinplate	1081
South Africa ..	Chemicals	1027A
,, ..	Tinplate, fertilisers ..	1032
Belgium ..	Dyes	974
,, ...	Laboratory apparatus ..	977
,, ...	China, porcelain, glass, earthenware, paper ..	979, 1041
,, ...	Brewers chemicals ..	981
,, ...	Oils, grease, colours ..	984, 1042
,, ...	Leather, skins	985
,, ...	Chemicals, colours, dyes, varnish	1043
,, ...	Tinplate, etc.	1016
,, ...	Pig iron, etc.	1050
,, ...	Oils, grease, inks, paint, varnish, china, glass, metals, chemicals, essential oils, dyes, fertilisers	‡2587 T & R
,, ...	Brass, bronze, gun metal	1082
France	Paper	988
,, ...	Animal fats, gums, bitumen	991
Italy	Metals of all kinds, asbestos, ebonite, celluloid	998, 1057
,, ...	Coconut oil, palm oil ..	1000
,, ...	Chemicals	1001
,, ...	Chemicals, dyes, coconut oil, leather	1056
,, ...	Copper sulphate, oils, fats	1059
,, ...	Chemicals, dyes, oils, artificial silk	1060
,, ...	Chemical and pharmaceutical products ..	1061
Netherlands ..	Colours, paints, varnish, oils, fats, wax, paraffin	1063
Portugal ..	Chemicals, metals, pharceutical products ..	1064
,, ...	Heavy chemicals, metals	1066
,, ...	Tar, inks, type metal, paper	1093
Russia	Machine oil, naphtha, petroleum, vaseline ..	§
Spain	Chemicals, drugs, perfumes, essences ..	1003
,, ...	Tinplate, cocoa	1004
,, ...	Chemicals, drugs ..	1006
,, ...	Dyes, chemical manures	1009
,, ...	Fertilisers, oil seeds, tinplate	1010
,, ...	Drugs, paints, varnish ..	1011
Switzerland ..	Pig iron, tinplate ..	1013
,, ..	Chemicals	1101, 1105, 1108
,, ..	Steel, copper, tin, zinc ..	1103
,, ..	Varnish, paint, chemicals	1107
Algeria	Oils, paint, varnish, glass, china, porcelain, leather, paper	1112
,,	Chemicals	1072
Morocco ..	Soap, candles, perfumes	1019
Palestine ..	Natural oils for perfumes	E 1-9‖
,, ...	Chemicals, drugs ..	J2 ‖
,, ...	Glass	J3 ‖
,, ...	China, porcelain ..	J4 ‖
United States ..	China, crockery ..	1117
Argentina ..	Chemicals, cement, paper	1118

* Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.
† Sir Aston Webb, Queen Anne's Chambers, Broadway, Westminster, S.W. 1.
‡ Belgian Section, Department of Overseas Trade, India House, Kingsway, W.C. 2.
§ Lettish Legation, 115, Park Road, Regent's Park, N.W. 1.
‖ Headquarters, Economic Section, O.E.T.A., Jerusalem.

TARIFF. CUSTOMS. EXCISE.

Australia.—The export of condensed milk is prohibited, save with the consent of the Minister of Trade and Customs, as from March 5.

The import of sheep dips is prohibited, save with the consent of the same Minister, as from March 26.

Brazil.—It is proposed to amend the customs duties on faience and porcelain.

Canada.—The form of the certificate which must accompany all importations of oleo-margarine is given in the *Bd. of Trade J.* of May 29.

Colombia.—The export of gold coin, bullion or dust is prohibited as from May 8.

An export duty of 5 per cent. *ad valorem* has been levied on platinum, to take effect on June 15.

France.—Mineral oils of British Indian origin are entitled provisionally, as from Jan. 18, to the application of the French Minimum Tariff rates of duty on importation into France.

Among the articles the import of which is now permitted, as from May 20, are oil seeds, gums, wood, oil-cake, paper pulp, marble, alabaster, lime, cement, graphite, copper sulphate and certain metals.

France and Algeria.—Raw skins and hides may be imported without licence, as from May 14.

Among the articles the export of which is provisionally prohibited are bones, hoofs, natural phosphates, bauxite, gold, platinum, iron ore.

Grenada.—The war tax on exported cocoa has been removed as from April 1.

Guatemala.—The new rates of customs duty on petroleum and gasoline, which come into force on July 1, are 5 centavos (gold) per kilogram in each case.

Italy (North Africa).—Cement, lime, coal, coke, heavy mineral oil and manures may be imported free of duty.

Madagascar.—The text of the Decree, dated April 20, regulating the import of poisonous substances, especially opium, morphine and cocaine, may be seen at the Department of Overseas Trade.

Netherlands.—Compressed fibre boards are subject to an import duty of 5 per cent. *ad valorem.*

New Zealand.—The import and export of tungsten, its alloys and compounds, are prohibited save with the consent of the Minister of Customs, as from March 18.

Among the articles which have recently been classified for customs duty are aeroplane varnish, magnesium chloride, certain soap compounds, Aladdin dye, and spirit of pennyroyal.

Panama.—The stamp duties on food pastes and soap have been abrogated.

Portugal.—The surtax on the export of paper is withdrawn as from May 10.

St. Vincent.—With some exceptions the revised rates of import duties are reduced to those imposed by the Customs Duties Ordinance, 1913, as from April 4.

United States.—A new General Import Licence "P.R.F. No. 37" covers the import from all countries, except Germany, Luxemburg, Hungary and Bolshevist Russia, of all commodities with a few exceptions which include pig tin, tin ores, concentrates and alloys, nitrates of potash and soda, salvarsan and all substitutes and equivalents thereof.

Manufactures of gold, the bullion value of which does not exceed 65 per cent. of the total value, may be exported without individual licences under the special licences applicable to commodities not on the Export Conservation List.

GOVERNMENT ORDERS AND NOTICES.

EXPORTS.

A general licence has been issued by the Board of Trade authorising the opening of credits on behalf of persons or bodies of persons in enemy countries.

Exports of Leather.—An open general licence has been issued for the export of rough and waxed splits and of all upper leather produced from hides and kips to all destinations, except those specified in connexion with goods on List C.

Germany.—The Board of Trade has issued a licence under which articles intended solely for the manufacture of human food may be exported to Germany.

Switzerland.—Licences for the export of foodstuffs on Lists A and B will be issued providing for consignment direct to the purchaser; foodstuffs on List C may now be sent direct to the purchaser without application to the Export Licence Department. Goods not consignable to the Société Suisse de Surveillance Economique (S.S.S.) need no longer be consigned to the British Legation at Berne.

Norway.—With the exception of goods on Lists A and B, all restrictions on export to Norway have been removed.

Czecho-Slovakia.—Goods despatched to Czecho-Slovakia should in future be consigned to the Commission Commerciale Tchecko-Slovaque at Hamburg.

IMPORTS.

The President of the Board of Trade, after considering the recommendations of the Consultative Council on Imports, has given the following further directions in regard to the prohibition of imports:

The restrictions on the importation of the following articles are removed:—

Fine balances; spring balances; celluloid in sheets, rolls and rods; aluminium sheets, foil, circles, rods, bars, ingots, angles, wire, tubes and strip; all hardware not otherwise specifically mentioned; peat moss litter; salt.

The importation of the following articles is to be licensed only exceptionally as and when required:—

Electric incandescent lamps (*i.e.* complete lamp bulbs with filaments), filament supports, contacts and tubes; manufactures of celluloid except sheets, rolls and rods; manufactures of aluminium except sheets, foil, etc. (*n.s.*); perfumery and toilet preparations.

The importation of the following articles is to be restricted as shown:—

The present ration for the following painters' colours and pigments (50 per cent. of 1916 imports) is to be maintained:—Brilliant, bronze blue, chrome green and yellow, chromate of lead, copper oxide, minium, oxide of tin, steel blue, Parisian blue, powder colours, red lead, vermilion. Bulbs for electric lamps are to be admitted at the rate of 50 per cent. of 1913 imports. Gas mantles, gas mantle rings and supports (earthenware) are to be admitted at the rate of 100 per cent. of 1916 imports in quarterly amounts. Carbons for arc lamps, cinemas and searchlights are to be admitted at the rate of 20 per cent. of 1916 imports.

A Consolidated List of Import Relaxations and Restrictions is given in the *Board of Trade Journal* of June 5.

NEW ORDERS.

"The Acids and Fertilisers (Suspension) Order, 1919," issued by the Minister of Munitions on May 30, suspends as from June 1, the operation of the following Orders:—Fertiliser Prices Order, 1918; Compound Fertiliser Order, 1918; Sulphuric Acid Order, 1917; Sulphuric Acid (Amendment of Prices) Order, 1918; Sulphuric Acid (Amendment of Prices) No. 2 Order, 1918.

The Mica Control (Suspension) Order, 1919. Ministry of Munitions, May 30.

The Food Controller has revoked Orders, issued in 1918 and 1919, dealing with the maximum prices for shredded suet, vegetarian butter and lard, oils and fats (compound), margarine, seeds, nuts and kernels, oils and fats.

COMPANY NEWS.

NEW PACCHA AND JAZPAMPA NITRATE.

At the annual meeting held on May 23, the chairman announced that the net output of nitrate during the past year was 535,000 quintals (quintal = 101·5 lb.), and the trading profit nearly £30,000, as against 527,100 quintals and £14,634 in 1917. No sales have been effected since the armistice was signed; but it is believed that all Government stocks in Europe have now been disposed of. High freights and the high cost of coal and stores will continue to handicap the position for a time, but there is little doubt that the inquiry in respect of next year's cultivation will cause a revival of demand. The general production in Chile is now reduced to a basis of little more than two-thirds of the 1917-18 output. The company's oficinas have, in common with many others, been shut down, but the raw material is still being worked. The company has £54,000 locked up in nitrate and stores (capital £57,000 and debentures £6000). A dividend of 10 per cent. has been declared, £10,000 is placed to reserve, and £11,827 is carried forward.

SALAR DEL CARMEN NITRATE.

Speaking at the annual meeting on May 29, the chairman, Mr. H. W. Sillem, said that he did not anticipate the good results of 1918 being repeated in 1919. There is practically no shipping available for the carriage of nitrate, and, so far as British tonnage is concerned, licences to load nitrate are being refused, steamers in Chile being directed to leave in ballast to receive cargoes of foodstuffs and raw materials in other ports. In his opinion, Chilean nitrate has nothing to fear from the competition of the synthetic product. The cost of production of the latter is understood to be very high, and it does not possess the same fertilising properties as the natural article. The net earnings in the past year amounted to £70,680, or £18,128 more than in 1917. The dividend for the year is 20 per cent., £20,000 is set aside to reserve account, leaving £6995 to be carried forward. The production in 1918 was 789,930 quintals, as against 616,180 in 1917. In common with all nitrate producers, working costs were higher, but this item was more than offset by better market prices.

TARAPACA AND TOCOPILLA NITRATE.

Sir Robert Harvey, presiding at the annual meeting held on May 31, said that the directors had closed the oficina on January 1 last, and it is not intended to reopen it until the present large stocks on the coast have been disposed of: meanwhile raw nitrate is being extracted from the most difficult parts of the ground. No nitrate can now be sent from Chile to meet this season's needs. Excellent new ground has been located, and when it is worked the plan will be adopted of keeping men in the callcheras all the year round and manufacturing each alternate six months. Referring to the general situation, the chairman said that all nitrate has now to be sold through the Asociacion de Productores in Chile, the ordinary

grade at 10*s.* 1*d.*, and the refined at 10*s.* 4*d.* per quintal, f.o.b. Chile. The world's demand, exclusive of Germany and Austria, is computed at 2,000,000 tons, so that when these countries come into the market there should be no difficulty of disposing of a normal year's output, say, 3,000,000 tons. Stocks on the coast, on May 15, exceeded 28,000,000 quintals, compared with a normal quantity of 16—17,000,000.

The gross profit for 1917 was £81,675, compared with £75,470 in 1916; £40,000 is allocated to contingency account, and a dividend of 10 per cent. is declared, leaving £13,537 to be carried forward (capital £200,000).

SAN LORENZO NITRATE.

This company also shows improved results for the past year, the gross profit being £23,000 against £17,000 (capital £24,000), and the dividend is maintained at 25 per cent., tax free. The production is not given. Stores stand at £26,100, and there are large stocks of nitrate. The Company's oficina is being closed down.

NEW REGISTRATIONS.—*British Dyestuffs Corporation, Ltd.*, has been registered with a capital of £6,000,000 to acquire all the assets of British Dyes, Ltd., and Levinstein, Ltd. The first directors include Dr. Herbert Levinstein, Sir Harry D. McGowan, of Explosives Trades, Ltd., Mr. G. P. Norton, Mr. J. Turner, and two others to be appointed by the Board of Trade. As previously announced, Lord Moulton is to be chairman.

Abram Lyle and Sons, Ltd., sugar refiners, etc., has been registered as a private company with a capital of £2,250,000.

TRADE NOTES.

BRITISH.

Jamaica in 1917.—The island was again visited by a hurricane in 1917, and the crops were materially affected. The imports were maintained at the usual level largely owing to increased prices. Whereas in 1907, Great Britain provided 47·4% of the imports as against 43·6% by the U.S.A., in 1917, Great Britain only provided 19·5% and the United States 70·1%. On the other hand, the United Kingdom now takes 44·8% of the island's exports as against 21·5% in 1907, while the share of the United States has fallen from 57·2% to 28·1%. The sugar production for the year has been a record one, the exports amounting to 32,000 tons, or double the amount of 40 years ago when sugar was the chief staple of the colony. Three new sugar factories have been provided for in St. Catherine and many projects for sugar developments are being actively considered by planters and capitalists. Considerable interest is now being taken in the growing of improved canes. The copra industry was extended during the year and drying plants are being erected in increasing number. Allowing for nuts converted into copra, the total exports were 30 million nuts and would have been greater but for the hurricane. Very good prices were obtained for hides, orange oil and honey, and pimento made a good recovery. The substantial sum of £540,000 was obtained for logwood and its extracts. The sisal plantation is progressing and the prospects are most encouraging. The work of the Deputy Island Chemist shows a decided increase, 1198 samples having been dealt with as against 988 in the previous year.—(*Col. Rep.—Ann. No.* 980, *Feb.*, 1919.)

Gambia in 1917.—The total value of the imports into this colony was greater by £218,247 than in 1916. The United Kingdom continued to be the chief source of supply, accounting for 58% of the imports as compared with 41% in 1914. Importations from France have dropped from 22% to 12% in the same period, and those from the British Colonies from 20% to 19%. The value of exports increased by £410,063. The principal articles were ground nuts, hides and palm kernels. The ground nut crop was above the average, 74,300 tons being shipped as against 46,366 tons in 1916. Of the total crop, 75% went to Great Britain. Owing to the great mortality among cattle the export of hides constituted a record at 101,120, valued at £58,951; of these, Great Britain imported 97·9%. The export of palm kernels decreased from 669 tons to 532 tons. Of the total exports, 79% went to the United Kingdom and 18% to France.—(*Col. Rep.—Ann. No.* 979, *Feb.*, 1919.)

FOREIGN.

The Japanese Dye Market.—It appears probable that licences will shortly be issued for the importation of dyestuffs into Japan. Home production does not seem to have been nearly sufficient to meet the demands; thus it is estimated that while pre-war imports of dyestuffs were valued at £900,000 per annum, the total paid-up capital in the Japanese dye manufacturing firms is £640,000. The Committee of the Diet has been asked to consider a scheme for establishing factories on a large scale from which materials could be distributed to smaller factories who could produce finished dyes. Although it appears doubtful if Japan can compete with Europe and America except under the protection of a tariff, the agitation for increased import duties has apparently not attained its object.—(*Bd. of Trade J., May* 22, 1919.)

Market for Chemicals and Drugs in Puerto Cabello (Venezuela).—There is little demand for industrial chemicals in Puerto Cabello, but drugs and medicines are constantly required. The imports in metric tons during 1916 and 1917 were, respectively:—Acetic acid 24·3, 16·9; sulphuric acid 21·0, 121·0; anhydrous ammonia 56·7, 39·7; carbon dioxide 111·1 100·6; calcium carbide 979·4, 249·9; disinfectants 207·1, 151·3; drugs, medicines etc. 700·5, 1063·3 soda, caustic and ash 637·0, 767·8; soda silicate 237·9 356·4; quinine 6·5, 9·6.

The soap and candle industry alone depends considerably on imports, but a certain amount of caustic soda is used in oil refining. Liquid ammonia is employed for refrigeration and liquid carbon dioxide for carbonated drinks; calcium carbide is purchased in diminishing quantities on account of electric light installation. Cotton dyes came originally from Germany, but now the United States controls the market. There are small imports of tanning materials, native woods being chiefly employed. The drug trade is important and the consumer pays heavily; imported and local proprietary medicines find a ready sale. Quinine Epsom and Glauber's salts, bicarbonate of soda and disinfectants are largely sold.

Great Britain, France and Germany supplied most of the chemical imports before the war, but it is claimed that in 1916-1917 the United States supplied 73 per cent. Most of these imports are made through about six large drug houses.—(*U.S. Com. Rep., April* 12, 1919.)

Alcohol Production in Cuba.—Efforts are now being made to establish ten up-to-date plants for the manufacture of alcohol from molasses. About 40 gallons of molasses result from the production of a ton of sugar, and this quantity yields 16 gallons of good quality alcohol. The estimated sugar production in Cuba for this season is 4,000,000 tons. The following figures show the export of molasses during recent years (gallons):—1912, 55,765,635 1913, 60,952,741; 1914, 84,652,997; 1915, 101,215,679 1916, 128,596,459. The proportion of these export

going to the United States has gradually increased until in 1916 it amounted to 90 per cent. Alcohol has been exported from Cuba in small quantities for several years past; the amount increased greatly in 1916 when over 2½ million gallons was exported.—(*U.S. Com. Rep., April* 15, 1919.)

The Varnish Market in Italy.—The time is very opportune for the introduction of varnishes into Italy, the market being very bare. The trade was formerly in German hands. The following quantities were imported during the first nine months of 1918 (kilograms):—Alcoholic varnishes, all from the U.S.A., 438; non-alcoholic varnishes containing mineral oils: Great Britain 12,348, France 3746, U.S.A. 936, Australia 198, and Sweden 100. All other varnishes: France 4027, Great Britain 64, U.S.A. 687.—(*U.S. Com. Rep., April* 30, 1919.)

Italian Perfume and Essential Oil Industry.—This industry has of late years been a source of profit, and it is now receiving Governmental encouragement, a decree having just been passed exempting the land and machinery used by these trades from a number of taxes and duties. In 1917 the output was 30,000 kilo. of mint essence, 2500 kilo. of essence of lavender (Piedmont and Liguria), 400 kilo. of thyme essence and 200 of myrtle (Sardinia). The value of the exports in 1913 amounted to nearly £500,000, the chief essences in order of value being lemon, bergamot, orange and mandarin.—(*Bd. of Trade J., April* 10, 1919.)

REVIEWS.

COLLOID CHEMISTRY.

FIRST REPORT ON COLLOID CHEMISTRY AND ITS INDUSTRIAL APPLICATIONS, 1917. *Pp.* 86. (*London: British Association for the Advancement of Science*, 1918.) *Price* 2*s. net.* SECOND REPORT ON COLLOID CHEMISTRY AND ITS GENERAL AND INDUSTRIAL APPLICATIONS, 1918. *Published for the British Association for the Advancement of Science by the Department of Scientific and Industrial Research. Pp.* 172. (*London: H.M. Stationery Office*, 1919.) *Price* 1*s.* 6*d. net.*

When Graham, more than fifty years ago, carried out his classical researches on diffusion and dialysis, and directed attention thereby to the existence of apparently homogeneous mixtures which differed in their behaviour from ordinary solutions, he laid the foundations of a new branch of physical and chemical science. Although, for a considerable time, the study of these apparently homogeneous mixtures or colloidal sols, as Graham called them, attracted comparatively little attention, their importance, both for physical theory and for industrial practice, has, in recent years, become increasingly recognised, and the special literature which has grown up around the subject of colloids has already attained a very considerable volume. And the volume is rapidly increasing owing to the growing number of investigators, both in pure and applied science, who have taken up the study of the many problems which colloidal matter offers for solution. So rapidly are the experimental results accumulating, so widespread and varied is the *rôle* which colloids play, that it is already becoming difficult to master all the facts and to bring the widely diverse fields of investigation into due co-ordination. The difficulty also is increased by the fact that the soil is still largely virgin, and that, owing to the lack of guidance by well-established theory, the digging and delving have been carried out in a somewhat haphazard manner. The appointment, therefore, in 1916, of a Committee of the British Association "with the object of compiling information regarding the advances which have been made in capillary and colloid chemistry with special reference to industrial processes," was a step of really great scientific importance; and the two reports which that Committee has already issued will undoubtedly receive the welcome which their excellence deserves.

The subjects dealt with in these two reports are arranged on the twofold basis of colloid properties (*e.g.*, viscosity, adsorption, peptonisation, etc.) and technical processes, and this method of classification has much to commend it. Any overlapping which is thereby involved is really an advantage, for it has the merit that it becomes possible not only to write a connected account of the advances made in the investigation of certain properties but the close interconnection between scientific principles and technical practice is rendered more evident. Incidentally, the necessity of greatly strengthening the purely scientific basis of many industrial processes becomes apparent.

In the first report, the viscosity of colloids is discussed by E. Hatschek in a brief manner, but a comprehensive bibliography of literature published during and after 1912 is appended. In subsequent sections of the report the following technical processes and applications generally are treated:—Tanning; dyeing; fermentation industries; rubber; starch, gums, albumin, gelatin, and gluten; cements; nitro-cellulose explosives; celluloid; physiological and biochemical subjects. Of these reports, those on "Colloid Chemistry and Tanning," by H. R. Procter, and on "General Review and Bibliography of Dyeing," by C. E. King, will arouse special interest. In the treatment of hides the well-known property of the gelatin-like colloids of swelling in dilute acids and of becoming dehydrated by salts is made use of in the process of "pickling," whereas in vegetable tannage the fixation of the tannin appears to be due to an electrical attraction between the positively charged hide and the negatively charged colloidal tannin.

The second report is a document of still greater interest and value than its forerunner. Here are given excellent short accounts of the present position of our knowledge regarding peptisation and precipitation; emulsions; the Liesegang phenomenon; electric endosmose (kataphoresis), both in its scientific and technical aspects; colloid chemistry in the textile industries; colloids in agriculture; sewage purification; dairy chemistry; colloid chemistry in physiology; and administration of colloids in disease. The list of subjects dealt with will give a sufficiently impressive idea of the penetration of colloid chemistry into numerous and widely diverse branches of science and technology. Without exception, all the reviews are well done, and one's confidence in their reliability is strengthened by the fact that the authors are all recognised authorities, each in the special department with which he deals. It is, perhaps, the writer's own interests that prompt him to select for special mention the report on Peptisation, by W. D. Bancroft, and Colloid Chemistry in Physiology by W. M. Bayliss. Both reports are excellent, and place the relevant facts in due order and perspective. Neither is a mere impersonal summary of work done or theories advanced, but freshness and vitality are imparted to each by the general personality and views of the writer. The excellent account by T. R. Briggs of Electrical Endosmose and its various industrial applications will be read with much interest by many, who will also not fail to note the author's somewhat restrained appreciation of the alleged merits of "electro-osmosis" for the de-watering of peat and clay. This section is especially valuable owing to the list of patents appended to the report. At a time when the textile industries are setting up Research Institutes the review of "Colloid Chemistry in the Textile Industries" by W. Harrison is very opportune. On reading this review one is impressed

chiefly by the large field of investigation which still remains to be cultivated.

The two reports of the Committee on Colloid Chemistry, and more especially the second, deserve to be read by all students and workers whether in pure or applied chemistry. Industrial practice, it must be confessed, is at present considerably in advance of our knowledge of the underlying principles, and it is therefore greatly to be desired, in the interests of a more rapid and economical industrial development, that the theoretical foundations of colloid chemistry should be strengthened. The reports before us, and those which will doubtless appear in the future, will do much to stimulate activity in this direction, and the Committee of the British Association responsible for their publication deserves the warm gratitude of all students and workers in the domain of colloid chemistry for the valuable service they have rendered to science.

ALEXANDER FINDLAY.

ALSATIAN POTASH.

LES MINES EN ALSACE-LORRAINE. L'INDUSTRIE DE LA POTASSE DE LA HAUTE-ALSACE. *Rapport par* M. FÉLIX BINDER. *Dec.* 1917. *Pp.* 94 *and* 3 *maps.* (*Paris: Ministère de la Guerre.*)

Although it is difficult to regard this report as other than pure propaganda, it is nevertheless propaganda in a good cause, and scientists and industrialists everywhere (outside Germany) will be grateful to the author for compiling so readable a statement of the case.

In the autumn of last year M. Paul Kestner read before the London Section of the Society of Chemical Industry a highly important paper, which rightly attracted much attention, upon the significance of the Alsatian potash-deposits in relation to the terms of peace (this J., 1918, 291 T). Since then it may be said that the German monopoly of potash has been for all time broken. Most of the information put forward by M. Kestner is included in M. Binder's report, and it is therefore unnecessary to do more than summarise it. M. Binder is thorough in his treatment of the potash question. He describes the history of the deposits in both Stassfurt and Alsace, and in assessing the resources and value of the latter, he emphasises their freedom from salts of magnesium. A brief account of the remaining world-supplies is given, and the remarks upon the Abyssinian deposits will interest those who have been puzzled by the contradictory reports of the peculiar resources there. He states (or quotes) the view that they have arisen from the evaporation of hot solutions, presumably of "juvenile" or deep-seated origin.

Reverting to the industrial aspects of the question, the author proceeds to recount the work of the Kali-Syndikat, the growth of the use of potash in agriculture and industry, both inside and outside Germany, and the control and allocation of sales. It is noteworthy that, of the 155 mines participating in the output before the war, the Alsatian mine Amélie I had 11·882 thousandths of the total production allocated to it—a proportion almost equal to that of the largest of the North German mines. This bears witness to the importance and quality of the Alsatian contribution to the potash supply. The "Kux" system (=mine shares of 3000 to 5000 marks) is described by the author, and reference is made to the "potash war" of 1909, as well as to the difficulties experienced in the attempt to hold a balance between taxing the potash and increasing its adoption in agriculture.

M. Binder gives full economic details of the Alsatian mines, both those under Franco-Alsatian control, which formed only a small proportion of the total, and those worked by German capital. Following a short account of their exploitation by the enemy, M. Binder proceeds to what may perhaps be considered the crux of the report, namely, their exploitation in the future under the *régime* of France (written, it should be remembered, in 1917). The water and other communications of Alsace with France, Switzerland, Italy and Spain are considered, and the hope expressed that the last three countries will become clients. More difficulty, on economic grounds, may be experienced in displacing German potash from other European countries, but the author hopes (and his hope will certainly be realised) that preference will be given in Britain to Alsatian potash. The importance of the North American ever-growing market is emphasised, and is followed by details of American consumption of potash, and of American exports to France and Germany. A plea then follows for the retention of Alsace by France and for the support of American capital to assist in developing the Alsatian deposits. The first part of the plea may now be regarded as a *fait accompli*. Is it too much to ask that not only American, but British capital may be invested in the restored provinces?

The report is accompanied by an appendix by M. Eccard upon the financial arrangements to be established for the Alsatian mines, by a short bibliography, and by three useful maps. It is clearly, simply and yet concisely written, and the author may be cordially congratulated upon the results of his labours.

P. G. H. BOSWELL.

PUBLICATIONS RECEIVED.

THE CHEMISTS' YEAR BOOK, 1918-19. *Edited by* F. W. ATACK, *assisted by* L. WHINYATES. *In 2 volumes. Pp.* 1146. (*Manchester: Sherratt and Hughes.* 1919.) *Price* 15*s.* 6*d., post free.*

CALCULATIONS USED IN CANE-SUGAR FACTORIES. *By* I. H. MORSE. *Second Edition, Rewritten. Pp.* 189. (*New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1917.) *Price* 9*s.* 6*d.*

OUTLINES OF THEORETICAL CHEMISTRY. *By* F. H. GETMAN. *Second Edition. Pp.* 539. (*New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1918.) *Price* 16*s.* 6*d.*

ORGANIC CHEMISTRY. *By* V. VON RICHTER. *Edited by* R. ANSCHÜTZ *and* G. SHROETER. *Vol. I. Chemistry of the Aliphatic Series. Second (Revised) Edition. Newly translated and revised from the German edition (after Prof. E. F. Smith's third American edition) by* P. E. SPIELMANN. *Pp.* 719. (*London: Kegan Paul, Trench, Trübner and Co., Ltd.* 1919.) *Price* 25*s.*

REPORT OF THE FOOD INVESTIGATION BOARD FOR THE YEAR 1918. *Pp.* 20. *Department of Scientific and Industrial Research.* (*London: H.M. Stationery Office.* 1919.) *Price* 3*d.*

THE LITERATURE OF REFRIGERATION. *A list of English, American, French, Italian, and German Books, Journals and Proceedings, compiled by the Food Investigation Board. Department of Scientific and Industrial Research.* (*London: H.M. Stationery Office.* 1919.) *Price* 4*d.*

ANNUAL REPORT OF THE UNITED STATES NATIONAL MUSEUM, 1918. *Pp.* 175. (*Washington: Government Printing Office.* 1919.)

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. *Department of the Interior.* (*Washington: Government Printing Office.* 1919.)

MINERAL WATERS IN 1917. *By* A. J. ELLIS.

IRON ORE, PIG IRON AND STEEL IN 1917. *By* E. F. BURCHARD.

FUEL BRIQUETTING IN 1918. *By* C. E. LESHER.

GOLD AND SILVER IN 1917. (*General Report.*) *By* H. D. MCCASKEY *and* J. P. DUNLOP.

CADMIUM IN 1918. *By* C. E. SIEBENTHAL.

INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 31ST DECEMBER, 1918.

EXPENDITURE.

Corresponding figures for 1917. £ s. d.	£ s. d.		£ s. d.	£ s. d.
		To Journal—Editorial and Sundry Expenses—		
550 0 0		Editor's Salary	575 0 0	
20 0 0		Do. Expenses	85 0 0	
280 4 2		Do. Assistant's Salary	300 0 0	
449 13 11		Abstractors	486 17 11	
15 1 11		Foreign Journals	27 11 9	
82 18 11		Sundry do.	. . .	
6 12 6		Insurance of Stock	4 15 3	
353 14 11		Review—Editor's Salary	512 10 0	
		Do. do. Expenses	435 4 2	
45 0 0		Photo (Medallist)	. . .	
			2426 19 1	
		Publishing Expenses—		
9463 5 4		General.....10,147 10 4		
974 5 4		Postage on Copies 1567 10 4		
	5240 17 0		11,715 0 8	14,141 19 9
		„ Annual Reports on Applied Chemistry—		
490 0 2		Expenses	839 5 5	
Less 353 9 5		*Less* Sales	283 18 7	
	136 10 9			555 6 10
		„ Sectional Expenses—		
25 0 0		Bristol	25 0 0	
61 3 6		Boston	. . .	
40 0 0		Birmingham	20 0 0	
64 3 0		Canada	85 0 0	
. . .		Canadian Pacific	30 0 0	
. . .		Edinburgh	40 0 0	
50 0 0		Glasgow	30 0 0	
50 0 0		Liverpool	100 0 0	
209 12 4		London	178 14 11	
105 5 3		Manchester	106 13 8	
75 0 0		Newcastle-on-Tyne	40 0 0	
100 0 0		New York	150 0 0	
46 3 2		Nottingham	. . .	
15 18 0		Sydney	. . .	
50 0 0		Yorkshire	53 0 2	
	892 5 3			858 8 9
	100 0 0	„ Research Grant (Cellulose)		. . .
	. . .	„ Empire Sugar Committee Grant		50 0 0
	. . .	„ Prizes for Essays		8 8 0
	163 7 9	„ Annual Meeting Expenses		156 4 1
	615 0 0	„ Superannuation (late Editor and Secretary)		615 0 0
		„ Working Expenses—		
600 0 0		Secretary's Salary	650 0 0	
320 12 0		Clerks in Secretary's Office...	526 18 4	
231 5 1		Rent, Lighting and Cleaning	428 18 2	
185 17 5		Stationery, Binding and Library	199 4 2	
270 14 0		Postages, Bank Charges, Telephone and Sundry Expenses	751 15 6	
		Depreciation of Furniture...	172 10 8	
	1608 8 6			2728 6 10
	8756 8 8			
	556 4 7	„ Excess of Income over Expenditure		. . .
	£9312 13 3			£19,113 14 3

Corresponding figures for 1917. £ s. d.	£ s. d.		£ s. d.	£ s. d.
		By Entrance Fees		620 11 0
		„ Life Composition Fees		62 8 9
		„ Annual Subscriptions		6783 13 6
538 13 0		„ Journal—Advertisements	5604 13 8	
182 12 3		„ Sales	2278 2 6	
5264 0 4				7882 16 2
1362 15 5		„ Collective Index—Subscriptions		. . .
1163 19 8		„ Decennial Index—Sales		. . .
		„ Research Grant (Cellulose)		. . .
0 19 0		„ Prize for Essay		8 8 0
4 1 0		„ Dividends and Interest on Investments		610 16 1
166 13 4		„ Excess of Expenditure over Income for the year		3145 0 9
. . .				
628 19 3				
. . .				£19,113 14 3
£9312 13 3				

Journal of the Society of Chemical Industry
No. 12. Vol. XXXVIII. JUNE 30, 1919. No. 12. Vol. XXXVIII.

DR. **BALANCE SHEET, 31ST DECEMBER, 1918.**

	£ s. d.	£ s. d.
To Bank Overdraft Secured		3527 11 6
,, Sundry Creditors		3301 4 5
,, Subscriptions to Society and Journal received in advance		989 13 1
,, Research Prize Fund and Interest		330 0 0
,, Accumulated Fund—		
Balance 31st December, 1917	23,681 5 6	
Less: Net Additional Expenditure appertaining to the year to 31st December, 1917	481 0 11	
	23,203 4 7	
Deduct: Excess of Expenditure over Income, 1918 £3145 0 9		
Depreciation of Investments at this date written off... 5355 10 6	8500 11 3	
		14,702 13 4
		£22,851 2 4

Cost.		
	£ s. d.	
4163	2 1	
870	0 0	
1122	3 1	
1031	15 4	
507	2 0	
900	5 6	
1187	1 0	
1629	14 5	
747	0 7	
922	10 0	
166	0 0	
1762	10 0	
696	0 0	
495	0 0	
700	0 0	
700	0 0	
1372	4 0	
676	8 1	
698	3 0	
661	0 2	
1700	18 5	
£22,708	18 8	

(Depreciation = 23·6% on cost written off)

	£ s. d.	£ s. d.
By Sundry Debtors		4978 17 3
,, Subscriptions in Arrears		85 10 0
,, Cash in hand (Secretary and Review Editor)		33 6 11
,, Investments at market value, viz. :—		
£ s. d.		
4476 9 2 Metropolitan Consolidated 3% Stock	3245 8 7	
1000 0 0 New Zealand 3% Inscribed Stock 1945	680 0 0	
1277 4 8 New South Wales 3% Stock 1935	970 13 11	
820 13 10 War Loan 4½% Stock 1925-45	816 11 10	
600 0 0 Gas Light & Coke Co. 3% Consolidated Debenture Stock	336 0 0	
1084 13 4 North British Railway Co. 3% Consolidated Lien Stock	618 5 2	
960 0 0 Midland Railway Co. 2½% Perpetual Guaranteed Preferential Stock	480 0 0	
736 0 0 do. do. 2½% Perp. Guar. Preference Stock	345 18 5	
1509 0 0 Great Eastern Railway Co. Consolidated 4% Irredeemable Guaranteed Stock	1011 0 7	
673 0 0 South Eastern Railway Consolidated 4½% Preference Stock	498 0 4	
1000 0 0 Metropolitan Water Board 3% "B" Redeemable Deb. Stock	620 0 0	
200 0 0 Nottingham Joint Station 3% Stock	116 0 0	
1250 0 0 Great Western Railway Co. 5% Consolidated Guaranteed Stock	1250 0 0	
800 0 0 Great Northern Railway Co. 3% Debenture Stock	496 0 0	
450 0 0 Nottingham and Grantham Railway Co. 4½% Consolidated Stock	355 10 0	
724 8 0 India 3½% Stock	510 12 0	
834 9 2 India 3% Stock	504 16 11	
1400 0 0 Dominion of Canada C.P.R. 3½% Land Grant Stock 1938	1022 0 0	
700 0 0 Dominion of Canada 4% Registered Stock 1940-60	588 0 0	
703 8 5 Western Australia Government 4% Inscribed Stock 1942-62	569 15 5	
700 0 0 War Loan 3½% Stock (Inscribed)	617 15 0	
1800 0 0 War Loan 5% 1929-47 Bonds	1701 0 0	
		17,353 8 2
,, Office Furniture	572 10 8	
Less Depreciation	172 10 8	
		400 0 0
		£22,851 2 4

To the Members of the Society of Chemical Industry.

We have audited the above Balance Sheet, dated 31st December, 1918, with the Books and Vouchers of the Society, and have verified the investments. In accordance with the practice hitherto adopted, no value has been placed upon the Stock of the Society's Journals on hand. Subject to this remark we are of opinion that the above Balance Sheet correctly sets forth the financial position of the Society at 31st December, 1918.

3 Frederick's Place, Old Jewry, London, E.C. 2.
17th June, 1919

PRICE, WATERHOUSE & CO.,
Chartered Accountants.

PRODUCTION AND SUPPLY OF SUGAR WITHIN THE EMPIRE.

Early in 1917, a Committee was appointed by the London Section of the Society with the following terms of reference:—

"1. To prepare an account of the pre-war sugar position as regards (a) Production, its amount and nature; (b) Consumption, its amount and nature, and (c) The quantity, nature, and source of the sugar imported and exported, of each unit of the British Empire.
2. To ascertain the economic sugar producing possibilities of each unit of the British Empire.
3. To report on the most likely localities for increased supply, as well as on the kinds of sugar required by the various consumers throughout the British Empire.
4. To make such technical suggestions as may appear of use to the development of the industry."

The Committee, the formation of which subsequently received the assent of the Council, consists of members of the Society, and certain co-opted experts in different branches of technology, that is to say, those interested in the production and refining of sugar, as well as other trades employing sugar such as confectioners, preserve manufacturers, and brewers.

The members of the Committee now include the following:—

Sir George Beilby, Mr. R. F. Blair, Prof. M. J. R. Dunstan, Sir Richard Carton, Mr. T. H. P. Heriot, Dr. C. A. Keane (ex officio); Mr. Arthur R. Ling (Chairman of the Committee); Mr. J. W. Macdonald, Mr. G. Mathieson, Mr. C. Sandbach Parker, Mr. J. Pickering, Mr. R. Robertson, Mr. F. I. Scard, Mr. Louis Souchon, and Mr. A. J. Yorke.

A schedule of questions has been addressed to the various Dominions, Colonies, Dependencies, and Protectorates of the Empire, and the replies to these being now complete, it is proposed to bring a report before the annual general meeting of the Society next month. On this occasion, a congress on the supply and production of sugar within the Empire will be held at Clothworkers' Hall, Mincing Lane, E.C., on Wednesday, July 16, at 10.30 A.M.–1 P.M., and from 3 P.M.—5 P.M. The Earl of Denbigh has consented to preside over the meeting.

Probably no other article of dietary has shown such a marked increase in demand during recent decades as sugar. It is a significant fact that the British Empire exceeds all other countries in the production of sugar, whilst the United Kingdom, which holds the second place in the world as a consumer of sugar, imports more than 90 per cent. of this commodity from foreign countries. Before the war, the majority was derived from Europe, for the most part from Germany and Austria.

The possibilities of extending the production of sugar within the British Empire are enormous, and from the data obtained by the Committee there can be no doubt that with improved methods of cultivation and manufacture, the Empire can be made self-supporting as regards sugar, whilst the possibility is not excluded that it might also supply many more countries than it does at present.

The chief part of the Committee's work has been directed towards the problem of increasing and developing the supply of sugar in the British Empire beyond the seas. The bulk of this sugar is derived from cane. In addition to this however the possibility of producing sugar from beet in the United Kingdom has not been overlooked. The Committee is in possession of much data on this subject, and its collation should lead to a final answer on what has been hitherto a vexed question.

RECENT IRON-ORE DEVELOPMENTS IN THE UNITED KINGDOM.*

Whilst the basis of the prosperity of a country is admittedly agriculture, its industrial growth is founded on mineral resources, and its participation in the world's markets is chiefly dependent on the extent to which these raw materials can be applied to home manufactures.

It is true that the first historical reference to this country mentions the export of tin from Cornwall and that Great Britain's production and export of copper in the early part of the 19th century were the largest in the world; but for its modern industrial pre-eminence it is indebted to its *coal* and *ironstone*.

The cheap manufacture of iron and steel in this country was greatly aided by the providential dispensation that the ironstone was so closely associated in nature with the fuel required to smelt it that the factor of transportation was practically eliminated. But the gradual exhaustion of the richer blackbands and clay-ironstones of the Carboniferous formation, and the introduction of the Acid Bessemer process of steel manufacture, which requires a pure ore free from phosphorus and sulphur, made it necessary to find other sources of iron-ore supply. For many years the United Kingdom has been dependent, for 30% of the iron-ore used in its blast-furnaces, on foreign countries. Foreign ore plays even a bigger *rôle* than at first sight appears, since it averages 50% iron as against an average of 30% for home ores. The importation of hematite, rich in iron and low in phosphorus, from Spain and the Mediterranean, has built up the big iron industries that are engaged in the manufacture of steel by the acid process in South Wales, on the North-West Coast, on the North-East Coast, and in Scotland, where the ports of Cardiff, Port Talbot, Whitehaven, Barrow, Middlesbrough, Newcastle and the Clyde, situated in close proximity to an ample supply of labour, enable foreign ore and native coal to be easily assembled and cheaply handled.

Cheap water-transport is the basis of the success of the importation of foreign ore. Its importance may be illustrated by the development of the great iron and steel industry of the United States. In that country the ore is brought in 10,000-ton boats from the north end of Lake Superior, where it occurs in great abundance, to Chicago and Pittsburg, where there are ample supplies of fuel and labour. In 1916 as much as 64 million tons of iron-ore was conveyed in this manner.

In the case of the United Kingdom, ocean-transport was found to have its drawbacks when the war broke out; and the scarcity of ship-tonnage, which resulted from the activity of the enemy submarines, raised the cost of imported ore from about 20*s.* (at which Best Bilbao ore ruled in British ports in 1914) to an actual price of over £6 per ton, although, under the cloak of Government subsidies, it figured at a lower level. At one period of the war the supply from these sources threatened to be cut off altogether.

To meet this situation an increased development of the Jurassic ironstones of this country was decided on. These ironstones, although abundant and cheaply worked, are what the ironmasters term "lean," that is to say they are low in iron, averaging only 28% of that metal. Moreover, they have a high phosphorus and sulphur-content and, for the most part, are rather silliceous.

In this place it may be well to recall that there

* A lecture delivered by Dr. F. H. Hatch at the Royal School of Mines on May 27, 1919.

are two classes of steel, which are named "acid" and "basic" respectively, according to the process used in their manufacture. Acid steel is produced from hematite pig-iron, practically free from phosphorus and sulphur, in furnaces provided with a siliceous (or acid) lining. Basic steel, on the other hand, is produced from pig-iron containing both these injurious ingredients, which are removed in the course of manufacture by means of a basic lining to the furnaces. The large increase in the production of phosphoric ores was reflected in the increased output of basic steel.

This increased production raised many difficult problems. In the first place it necessitated a different metallurgical treatment, involving, as already explained, the substitution of basic-lined steel furnaces for those of the acid type, with consequent increased supplies of suitable refractory materials. It also involved large additional supplies of fuel for smelting and of limestone for fluxing the ore in the blast-furnaces. Difficulties arose with regard to the supply of magnesite and magnesite bricks. Prior to the outbreak of war the magnesite brick industry was almost wholly in the hands of the Austrians. The Austrians possess in their own country extensive deposits of magnesite peculiarly suited for brick-making, and they have devoted both skill and money to the perfecting of their products, with the result that before the war they commanded practically the entire custom of the steel trade of this country. To make up for the loss of this Austrian material, arrangements were made by the Ministry of Munitions for the manufacture in this country of magnesite bricks, and the raw material was obtained from Euboea in Greece and from Salem in Madras. To furnish the required dolomite and limestone new quarries were opened up in this country.

With regard to labour a new supply had to be found not only to work the new quarries of ironstone, limestone, dolomite, etc., but also to build railways required to open them up, to erect extensions to existing plant, to man the new works, to re-line furnaces, etc., and this in face of the incessant and urgent calls of the Army to fill the gaps in the fighting line. Considerable use was made of prisoner labour. The difficulty with prisoners was to induce them to work. On account of the Army regulations work could neither be compelled by force, nor by a reduction of rations. The difficulty was overcome by the introduction of piece-rates; but only to a limited extent, as there was no outlet for surplus earnings in the canteens, food-supplies having been cut down on account of the general food shortage. The lack of quarrymen led to active steps being taken in responsible quarters to supplement and to increase the efficiency of manual labour at the quarries by the provision of mechanical appliances for stripping, breaking and loading the ironstone. In these open-workings, the output per man employed varies with the thickness of the ironstone bed, the amount of cover to be removed, the use made of mechanical appliances, and the condition of the weather. The weather materially affects the output, especially where hand-labour is concerned. From returns made to the Ministry of Munitions in December, 1917, it appears that the average output in the Midlands per man employed was 5 tons per shift, and that it ranged from 3·8 tons, where hand-labour was alone employed, to over 15 tons where mechanical excavators were in use under favourable conditions. The actual saving of manual labour which resulted from the installation of mechanical plant in the ironstone quarries during the war is estimated to have been equivalent to over 3000 men.

The Jurassic ironstones have a wide distribution both in this country and on the continent. In 1913 Germany mined, in Lorraine and Luxemburg, 28 million tons of Minette ores of Jurassic age, out of a total production of 36 million tons of iron-ore, while she imported in addition 3,800,000 tons of the same ore from Briey. Without the Lorraine iron-ore basin, which she took from France in 1871, Germany would have been unable to go to war, and she took care to secure the remaining portion of the field (*i.e.* the Longwy and Briey basins) soon after the commencement of hostilities. One of the best guarantees for future peace is the provision in the Peace Treaty that no portion of this iron-ore field shall remain in German hands.

In England the Jurassic formation stretches as a broad band from the coast of Yorkshire to that of Dorset. The ironstones occur on four different horizons:—

THE JURASSIC IRONSTONES.

Name of Ironstone Bed	Position in Jurassic System	Where worked
Westbury and Dover	Corallian ...	Not yet worked for iron
Northampton Ironstone	Lower part of the Inferior Oolite	Rutlandshire and Northamptonshire
Marlstone	Upper part of the Middle Lias	Cleveland in Yorkshire, South Lincolnshire, Leicestershire and Oxfordshire
Frodingham Ironstone	Middle part of the Lower Lias	North Lincolnshire

The Corallian ironstones are at present not worked as a source of iron, although the Westbury bed is quarried for use in the purification of illuminating gas. In the Kent coalfield a bed of oolitic ironstone, 16 feet thick, has been cut in the shaft of the Dover Colliery, at a depth of 593 feet from the surface. This stone contains, as mined, 33% of iron, 15% of silica, 9% of lime, 0·45% phosphorus and 0·05% of sulphur. With regard to mechanical condition, it is rather friable and may have to be sintered or briquetted before use in the blast furnace. On account of its favourable situation in a coalfield and on the sea-board it is most probable that steps will be taken to work this deposit in the near future.

The other Jurassic ironstones are all worked: and in 1917 accounted for over 80% of the total output of iron-ore in the United Kingdom, the remaining 20% being made up of hematite mined in Cumberland and Lancashire (10½%), blackband and clay-ironstone mined in the English and Scotch coalfields (8%) and sundry ores mined in Wales, Forest of Dean, Devonshire, Weardale and Ireland (1½%).

Taking the Jurassic ironstones in descending order the proportion in which they were worked (in relation to the total production of the United Kingdom) in 1917, and their iron-content are as shown in the table:—

Table showing relative production and iron-content of the Jurassic Ironstones.

Ironstone	Ratio to total production Per cent.	Average iron-content (as mined) Per cent.
Inferior Oolite (Northampton and Rutland)	21	32
Middle Lias (Cleveland) ...	32	28
Middle Lias (South Lincolnshire, Leicestershire, and Oxfordshire)	9	25
Middle Lias (Raasay)	0·5	23
Lower Lias (North Lincolnshire)	18·0	23
	80·5	27·6

The average composition of the different Jurassic ironstones is shown in the following table:—

Table showing average analyses of Jurassic Ironstones as received at the works.

	Inferior Oolite (Northampton) Per cent.	Middle Lias (Cleveland Var) Per cent.	Middle Lias (Leicester Var) Per cent.
Fe ...	32·5	28·1	25·2
Mn ...	0·24	0·41	0·23
SiO_2 ...	11·7	11·8	10·9
Al_2O_3 ...	6·1	10·2	8·0
CaO ...	2·7	4·7	9·6
MgO ...	0·4	3·5	0·6
S ...	0·10	0·26	0·11
P ...	0·60	0·47	0·25
Water(combined) ...	15·2	6·8	16·4

	Middle Lias (Oxfordshire Var) Per cent.	Lower Lias (Frodingham Stone) Per cent.	Corallian (Dover Colliery) Per cent.
Fe ...	24·0	22·7	33
Mn ...	0·27	0·96	—
SiO_2 ...	10·2	8·1	15
Al_2O_3 ...	7·6	5·1	—
CaO ...	12·2	18·2	9
MgO ...	0·6	1·0	—
S ...	0·06	0·16	0·05
P ...	0·23	0·31	0·45
Water(combined) ...	15·6	10·7	—

The Northampton ironstone is, in general, high in silica and low in lime, and contains 0·1% of sulphur and 0·6% of phosphorus. In part, it is smelted locally with limestone or with limey ironstone, obtained in the district, to neutralise its siliceous character. Some is sent to Frodingham and some to Middlesbrough for smelting with the ironstones of those districts; but the greater proportion goes to furnaces in the coalfields of Staffordshire, Derby and Nottingham, South Yorkshire and South Wales to be smelted in admixture with the calcareous blackband and clay-ironstones of the coal-measures and with tap-cinder.

The Cleveland ironstone is also siliceous and requires lime to flux it. It is high in alumina and sulphur and this feature militates against its use for making basic pig-iron, since the alumina-content makes it difficult to carry sufficient lime in the slag to ensure the production of a basic pig low in silicon and sulphur. To produce a suitable pig a considerable proportion of ores low in alumina, mainly of foreign origin, has to be added to the furnace charge. But, by using molten metal direct from the blast furnace and desiliconising it in a mixer, basic open-hearth steel can be made from Cleveland ores without admixture with foreign ores.

The Frodingham ironstone almost invariably contains sufficient lime to be fluxed without the addition of limestone. It also carries about 1% of manganese and can therefore be smelted without the addition of manganese ore. These self-fluxing properties make it a most valuable ore, in spite of its low iron-content which averages only 22%. The sulphur-content is 0·16% and the phosphorus, 0·31%.

The Marlstone of South Lincolnshire, Leicestershire and Oxfordshire is on the whole a "limey" ironstone and is often self-fluxing. In places, however, where the surface waters have leached out the lime, it is siliceous. Its phosphorus-content averages 0·25%; sulphur, 0·1%.

The following are average analyses of the limey and siliceous varieties, respectively:—

	Limey Ironstone (Unweathered marlstone) Per cent.	Siliceous Ironstone (Weathered marlstone) Per cent.
Fe	22.43	27·91
Mn	0·24	0·28
SiO_2	9·39	13·28
Al_2O_3	7·36	8·03
CaO	14·89	3·79
MgO	0·61	0·42
S	·0·06	0·05
P	0·23	0·22
Moisture	13·85	20·56
Difference (combined water, CO_2 and O)	30·94	25·46
	100·00	1 0·00

It will be seen that chemically the change from the limey to the siliceous type, brought about by weathering, consists of a loss of lime and carbon dioxide and an increase of all the other constituents—iron, silica, alumina and moisture. Physically, the change is from a compact bluish-green ironstone, consisting of carbonate of iron and lime, to a porous brown hydrated oxide of iron, or limonite. In the quarries the horizontal line of demarcation between the two varieties is often clearly discernible. Where, however, the "cover" consists of clay, shale or other impermeable material of sufficient thickness to hinder the downward percolation of the surface water, hydration and oxidation of the ironstone is prevented, and the green limey variety in that case extends up to the junction of the ironstone with the cover.

Before charging into the blast furnaces, the ironstone of all the districts is usually calcined, although a certain proportion is fed raw into the furnaces. The object of calcining, in the case of the oxidised stone, is to eliminate the water; in the case of the green carbonate stone, the effect is to drive off the carbon dioxide and convert the iron to peroxide. The loss on calcination is roughly 25% of the weight. Consequently, calcination at the point of origin saves railway carriage. It has the disadvantage, however, on the one hand, that exposure to the weather may result in the calcined material absorbing a considerable amount of water on its journey to the furnaces, and, on the other, that the handling and transportation of the dry material may engender a considerable quantity of dust, which is objectionable to the men engaged in its discharging, and tends to choke up the furnaces.

Calcining raises the percentage of iron considerably. If the loss on calcination is 25%, the increase is one-third of the percentage of iron in the raw stone. Thus, the 32·5%, which is the average iron-content of the raw Northampton stone, becomes 43% in the calcined material; the 28% of the Cleveland stone becomes 37%; the 24% of the Oxfordshire stone 32%, and so on. It follows that the use of calcined stone increases the output of pig iron per furnace. Furthermore, there is a saving of fuel in the blast furnace.

The calcining is either effected in Gyers, or Davis Colby kilns, with or without forced draught, or in the open heaps, or "clamps," as they are termed in Northamptonshire. It is a slow roasting process, and the fuel required is about 1½ cwt. of coal to the ton of ironstone.

The Jurassic ironstones, although poor in iron, are valuable because of their considerable thickness and widespread occurrence at only a slight depth below the surface. With the exception of the Cleveland District of Yorkshire, where the ironstone is now mined underground, the workings are nearly everywhere at the surface, the ironstone being quarried after stripping off an overburden of soil, sand, or clay as the case may be. Since the angle of the dip is usually small, or, in other words, the

beds are practically horizontal, considerable areas can be worked before the overburden becomes too great for removal at a reasonable cost. As much as 60 feet of soft material (sand or clay) can be removed, and under favourable conditions probably 100 feet will be removed.

The different beds of ironstone vary considerably in thickness. The thickest is the Frodingham bed in North Lincolnshire. This ironstone is 25 to 30 feet in thickness, and consequently can be worked very cheaply by mechanical excavation. Before the war, the cost of the stone in wagons at the quarries (exclusive of royalty) was not more than 1*s.* per ton. Probably it is double that now.

The workable part of the Northampton ironstone varies from 6 to 13 feet, averaging about 8 feet. The lower portion of the bed is generally too poor in iron for economic extraction. During the early part of the war it was sold at 3*s.* 3*d.* per ton of raw stone. Subsequently, the price was fixed at 3*s.* 9*d.* per ton, plus ½*d.* for every 1*s.* 3*d.* rise in wages above the rate current on November 12, 1917.

The Cleveland Main Seam varies from 5½ to 12 feet. It is mined at depths ranging from 100 to 600 feet, the mines being worked on the bord and pillar system. The cost of the stone at the pit's mouth is now about 10*s.* per ton, as against 2*s.* to 4*s.* for the quarried stone. The output per man employed on surface and underground in the Cleveland mines averages 2·2 tons per shift as against 4 to 15 tons for the quarried stone. In addition to the Main Seam, other ironstone beds, both above and below it, have from time to time been worked on a small scale in the Cleveland District. Their geological relation to the Main Seam is shown in the following table:—

IRONSTONES OF THE CLEVELAND DISTRICT

Geological Formation	Name of seam	Thickness of seam, feet	Thickness of intervening strata, feet
Inferior Oolite	Top or Oolite seam ...	4—9	
Upper Lias ...	Strata ...		... 260
	Main seam...	5½—12	
Middle Lias ...	Shale ...		... 2—6
	Pecten seam	1½—6	
	Shale ...		... 3—7
	Two-foot seam ...	1½—2½	
	Shale ...		... 20—30
	Avicula seam	0—3	

As compared with 1916 figures, the production of the Jurassic ironstones as a whole was increased by 45,000 tons per week, equivalent to 2⅓ million tons per annum. The increase reached this maximum in the first half of the year 1918. But it was not possible to maintain production at that figure on account of the calls of the Army on labour. The increase was made mainly in Northampton, Rutlandshire and Leicestershire, the quarries in these counties accounting for 59% of the total increase; but Cleveland accounted for 26% and Oxfordshire for 9%.

The following table, showing the production of the Jurassic ironstone in relation to the total production of iron ore in the United Kingdom during 1918, is compiled from returns made to the Ministry of Munitions.

PRODUCTION OF IRON ORE IN THE UNITED KINGDOM DURING 1918.

	Tons	
Cleveland	4,570,892	
North Lincolnshire ...	2,639,712	
Midlands	4,954,087	
Raasay	88,047	
Total Jurassic Ironstones ...		12,252,738 (80%)
Coalfields	1,119,215	
Wales and Forest of Dean	85,419	
Miscellaneous (Iroland, County Durham and Devonshire)	37,039	
West Coast (Hematite) ...	1,549,962	
Total non-Jurassic ores ...		2,791,635 (20%)
Grand total ...		15,044,373

With regard to the non-Jurassic iron ores of this country, the most important are the hematite deposits of Cumberland and Lancashire. These ores are remarkable for their richness in iron and their freedom from both phosphorus and sulphur, and they therefore furnish a pig-iron very suitable for the Acid Bessemer process, and yield an exceptionally pure steel. They are consequently in great demand; and this demand was emphasised during the war by the difficulty at one time experienced in securing sufficient supplies of hematite ore from Spain. Every effort was therefore made to push production to the utmost, and many abandoned mines were re-opened in order to extract the pillars.

The deposits occur as masses of irregular shape in the Carboniferous Limestone, a formation which in this district rests uncomfortably on the old Skiddaw Slates, and is itself concealed in places by overlying Coal-measures and Red Sandstones, or by Boulder Clay. The existing mines are situated between Lamplugh in Cumberland and Ulverston in Lancashire, a distance, from north to south, of 35 miles.

No doubt, besides the known deposits, many undiscovered ore-bodies exist in the Carboniferous Limestone, that can only be found by systematic prospecting by boring. Already before the war, borings through the Red Sandstones had disclosed, south of Egremont, some of the largest ore-bodies that have been found in either county, with the possible exception of that worked by the Hodbarrow mine. The Beckermet, Ullcoats and Ullbank Companies are now engaged in developing and working these deposits.

Since the Carboniferous Limestone is of widespread occurrence in the United Kingdom, it might have been expected that valuable hematite deposits would have been discovered in other parts of the country. With the exception, however, of deposits of limited extent in South Wales and in the Forest of Dean, this has not proved to be the case. The South Wales hematite was worked fairly extensively to the north-west of Cardiff between the years 1840 and 1870, and yielded in the aggregate some 3 million tons of ore. But with the exception of the Llanharry mine, which still continues to produce about 60,000 tons of ore per annum, all work has stopped on these mines.

In the Forest of Dean the deposits, or "churns" as they are locally called, are chiefly characterised by their irregularity and small dimensions. The output of this field is quite unimportant, being less than 300 tons a week.

The only other important sources of iron ore in this country are the blackband and clay-ironstones, associated with the coal seams in the English and Scotch coalfields. These ores, which once played a big *rôle* in the British iron industry, are now of small importance owing to the exhaustion of the larger and more profitable seams.

The total output from Scotch and English coalfields amounts to 1,120,000 tons per annum, of which 357,000 tons come from Scotland and 695,000 tons from North Staffordshire. In Scotland the ore is derived from narrow seams of blackband and clayband and from "balls" of ironstone brought down in working the coal.

In North Staffordshire there are (1) small

VIEWS OF DEVASTATED FACTORIES AT CHAUNY, FRANCE



Fig. 1.
Approach to the chemical works of the St. Gobain Company at Chauny.



Fig. 2.
Wrecked factory where plate-glass was polished.



Fig. 3.
Remains of the caustic soda factory.

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Fig. 4.

Wreckage at a sugar refinery in Chauny.



Fig. 5.

Wrecked boilers and boiler house.

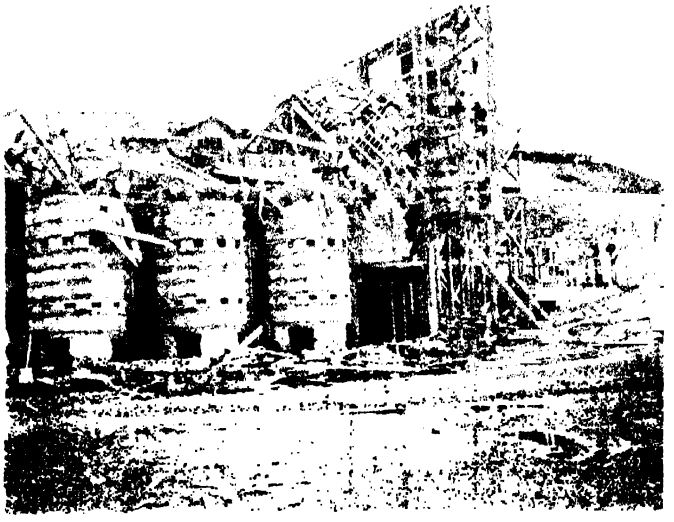


Fig. 6.

Ruins of pyrites kilns and Glover tower.

seams of blackband associated with sufficient combustible material to permit of calcination in the open without the addition of further fuel, and (2) seams of clay-ironstone which require the addition of fuel for calcination. By the calcination of these ironstones two products are obtained, (1) a high-grade material, containing over 60% iron, which is used for bottoming and fettling puddle-furnaces and for oxidising purposes in the steel furnaces; and (2) a slightly inferior quality containing 55% of iron which goes to the blast furnaces.

In the industrial recuperation of this country now that the war is over, the working of the low-grade Jurassic deposits which it is fortunate in possessing is destined to play a great part. This has been rendered possible by the great extensions to iron and steel works that have been initiated with Government assistance during the war. These works have been planned on the most modern lines, and possess on the same site by-product coke ovens, blast furnaces, steel works and rolling mills. They are designed for the basic process of steel-making and will be fed with home ores. In choosing the sites for these works regard has been paid to the situation of the raw materials—ore, fuel and flux—required to supply them. On the completion of these extensions there should be no necessity for this country to import a single ton of foreign steel. Before the war something like 2½ million tons of steel, in the form of slabs, blooms and billets, were imported into this country annually, mainly from Germany.

But for success in this great undertaking cheap ore and fuel are essential, and these can only be obtained, in face of the greatly augmented cost of labour and material, which is a legacy of the war, by an all-round increase in efficiency, embracing capital, engineering and labour—capital by the installation of up to date equipment, engineering by improved mining methods, and labour by an increased output per man per shift.

These are the problems of the immediate future that await solution.

SOME DEVASTATED FACTORIES OF FRANCE.

W. F. REID.

After the meeting of the Inter-allied Conference of Chemical Societies at Paris in April, a visit was paid by the delegates to the devastated regions of Chauny, Tergnier and St. Gobain (this J., 1919, 142 R). During this visit some interesting photographs were taken by Mr. Edwin Thompson, one of the delegates of the Society of Chemical Industry, which show in a graphic manner the deliberate and calculated destruction wrought by the Germans while they occupied this section of industrial France.

One of the chief factories destroyed was the celebrated chemical works of the St. Gobain Company, the approach to which is through the now ruined town of Chauny (fig. 1). The first plate-glass was made on the large scale at St. Gobain in 1693, the invention of the process being attributed to Abraham Thévart and Lucas de Nehou, who made their experiments at the rue de Reuilly, Paris. The ancient Romans, however, made rough plate-glass by casting; there are samples of glass sheets made in this way in the museums of Pompei and Reading. The plant destroyed by the Germans here was on a very extensive scale, being capable of turning out sheets of polished plate-glass 27 feet long and 12 feet 6 inches wide. The more portable parts of the machinery were stolen and the remainder wrecked by charges of explosive, as shown in fig. 2.

Wired plate-glass was made here by Appert's process, and the way in which this glass resisted the effects of the explosions bore eloquent testimony to its utility. Among the ruins lay tangled masses of fine steel wire upon which beads of various colours were threaded. In the manufacture of beads, as formerly carried on, pieces were cut off small glass tubes of diameters corresponding to the size of the beads. The pieces of tube thus obtained were rounded off by revolving them at a red heat in a mixture of powdered lime and charcoal. Apparently the St. Gobain beads were supported on steel wire during the heating, giving them a very brilliant surface.

Many of the buildings had been cleared of all machinery before they were destroyed, and so thoroughly were these depredations organised, that a railway was built into the factory by the Germans. Where the plant was not worth removing the whole factory was wrecked by a charge of explosive, as shown in fig. 3. In the case of power plants the boilers were rendered unfit for use either by explosive charges detonated inside them or by larger charges underneath them which destroyed both boilers and boiler house. The latter case is illustrated by fig. 5 where the boilers had just been inspected by our President, Prof. H. Louis, when the photograph was taken.

In the destruction of the chemical factories at Chauny German experts and manufacturers assisted, and pointed out the most valuable and least easily replaced portions of the plant belonging to their French competitors. It was at Chauny that the first commercially successful plant for working the Leblanc soda process was erected, and the factory continued working until destroyed by the Germans. Nicolas Leblanc obtained on September 25, 1791, a patent for working his process. The Duke of Orléans, better known as "Philippe Egalité," advanced sufficient money to build a small factory at St. Denis, Paris, which was called "La Franciade." In 1793 the Duke of Orleans lost his head and La Franciade was taken over by the State, but proved unsuccessful. Afterwards the process was started at Chauny, and the neighbouring factory of St. Gobain exhibited glass made with Leblanc soda in 1806, the same year in which poor Leblanc committed suicide in his ruined factory.

The caustic soda factory at Chauny appears to have aroused especially malevolent feelings in Teutonic breasts. Fig. 3 shows the present condition of what plant remains, and this photograph is interesting because the farthest to the right of the four persons in the background is M. Paul Kestner, President of the Société de Chimie Industrielle of France, and he is standing upon the shattered remains of a Kestner evaporating plant. The brick rubbish in the foreground has been broken up as a first step towards making concrete for reconstruction purposes. Portland cement for this purpose is, however, lacking, and hydraulic mortar is necessary for foundations, as the factory is situated on the low banks of the Oise. One of the British delegates was able to point out that the Romans, on their arrival in Britain, lacked the hydraulic materials to which they had been accustomed in Italy, and found a substitute in powdered brick. It would only be necessary to pulverise a portion of the bricks finely to render the lime mortar hydraulic.

Fig. 6 shows some ruins of sulphuric acid plant. There the Gay-Lussac towers were originally erected. Gay-Lussac was consulting chemist to the St. Gobain Co. at Chauny in 1827, when he invented his tower, and, at a later date, he became a director of the company. The first tower was erected at Chauny in 1842. Two years later the tower was introduced into a Glasgow factory. Those who have had an opportunity of witnessing

the wanton havoc wrought by people who call themselves civilised will feel no desire to co-operate with such people again, and the establishment of the Inter-allied Confederation will be welcomed by all who wish to prevent in future the prostitution of science to the will of barbarians.

COST ANALYSIS IN CHEMICAL MANUFACTURE.

PART II.

COSTS AND EFFICIENCIES OF NITRIC AND SULPHURIC ACID PRODUCTION.

Any attempt to summarise the great mass of data incorporated in the "Reports on Costs and Efficiencies for H.M. Factories" would be fruitless, for the information given therein does not admit of condensation. It must suffice, therefore, to indicate the principles and methods involved by selecting material from two of the more important sections of the Second Report.

Nitric Acid Production.

In calculating the comparative costs of nitric acid production, sodium nitrate is charged at £24 per ton $NaNO_3$, and sulphuric acid at £7 per ton H_2SO_4. The first graph presented shows the comparative costs per ton HNO_3 produced for nine Government plants, one British trade factory and two Canadian factories for the months of May and June, 1918. It makes possible an immediate comparison not only of the total costs, but also of the several items which go to make them up *i.e.* the raw materials usages, and the charges for labour, fuel, water, steam and power, maintenance and general services—so that it is clear where extravagance or economy occurs. The value of comparative cost analysis at once becomes plain. The results thus summarised graphically are commented on in the text. Here also tables of costs are given for each of the various factories for successive periods, so that it can be seen how each factory has been progressing. These results, again, are summarised in a graph (graph 1A), where three or in some cases four successive six-monthly periods are given for the several factories, together with the average working of all the factories for each period. For the most recent six-monthly period, January—June, 1918, data are given for nine Government factories. One of these factories, however—namely, Greetland—was producing nitric acid of only about 65 per cent. strength, so that, although its costs are most remarkable, this fact should be borne in mind when comparing them with those of the factories making stronger acid. Figures are tabulated below showing production, plant efficiencies, and raw materials usage, services and total cost per ton of product. The graphs (which are not reproduced here) further show the amounts of the total service charges assignable respectively to labour, fuel, water, steam and power, maintenance and general services, and these are discussed in the text. It is noticeable that in costs for a six-monthly period there are fewer striking variations than in monthly costs, where a charge such as, *e.g.*, maintenance, under which would come renewal of retorts, might be much heavier in some months than in others.

In the table below it is seen that for the period January—June, 1918, Gretna is cheaper than both Pembrey and Queen's Ferry, but the cost at Greetland is nearly £1 lower than at Gretna. The two highest costs given in this table appear to be for closing down periods, and this probably explains the high service charges. The best efficiency for the complete six months is 94·8 per cent. for Gretna, followed by Queen's Ferry TNT Retorts with 93·5 per cent. and Greetland with 93·3 per cent. The best H_2SO_4 usage is 1·348 tons at Greetland, whilst Gretna follows it very closely with 1·354 tons. (This points to economy in H_2SO_4 usage being compatible with high efficiency—a question which has been disputed. Nor would it appear, since service charges at Greetland and Gretna are also low, that this economy has affected the cracking of retorts.) Craigleith is very prominent as a heavy consumer of H_2SO_4. Necessity of avoiding any possible delay in discharging the retorts is cited as an excuse for this.

It is remarkable that the greatest difference between the best and worst factories in sodium nitrate usage amounts to only about £1.5, and in H_2SO_4 usage to only about £1.2 during this period, whilst the total service charges vary considerably. Attention is drawn to this, the most noticeable variations in the service charges allocated to maintenance, labour etc. being mentioned, and the fact emphasised that the average services for the six-monthly periods have been slowly but continually increasing, and so tending to counterbalance the improved usage in materials. Increased cost of labour must have been responsible in part for this increase, but nevertheless improvement is asked for here. Plant managers are thus given every opportunity of realising how they stand, and are put on their mettle both to improve on their own practice and to beat that of others.

It is interesting to note that the figures given in

COST OF PRODUCTION PER TON HNO_3.

January—June, 1918.

Factory	Production Tons NHO_3	Efficiency %	$NaNO$ Usage	H_2SO_4 Usage	Services	Total
Queen's Ferry, NC (Jan.—May)	1449·0	94·2	1·433 tons £34·392	1·368 tons £9·576	£11·643	£55·611
Litherland (Jan.—May) ..	1909·25	90·6	1·489 tons £35·742	1·472 tons £10·304	£8·982	£55·028
Oldbury	8726	91·8	1·470 tons £35·290	1·492 tons £10·446	£8·272	£54·008
Craigleith	1131·68	90·7	1·489 tons £35·736	1·520 tons £10·637	£7·393	£53·766
Penrhyndendraeth	1100·9	90·2	1·496 tons £35·893	1·389 tons £9·720	£7·192	£52·805
Queen's Ferry, TNT ..	14832·2	93·6	1·443 tons £34·632	1·385 tons £9·695	£5·394	£49·721
Pembrey	7217·8	91·4	1·477 tons £35·480	1·379 tons £9·653	£4·062	£49·195
Gretna	8787·32	94·8	1·123 tons £31·152	1·354 tons £9·471	£5·125	£48·748
Greetland	1701·66	93·3	1·447 tons £34·723	1·348 tons £9·454	£3·728	£47·905

the report for the various six-monthly periods show that during June—December, 1916, 29,258 tons HNO_3 was made, while during January—June, 1918, the production was 45,154 tons. The average efficiency on the nitrate used was 87·6 per cent. for the former period as compared with 92·9 per cent. for the latter, whilst the H_2SO_4 usage was 1·578 tons for the former period as compared with 1·405 tons for the latter period. The saving shown in cost of raw materials (charged at the flat rates) amounts to £3.3 per ton HNO_3 produced, which would represent a saving during January—June, 1918, of £149,000. An increase appears in service charges, but as the cost of labour and stores had increased so enormously between 1916 and 1918 this could hardly have been otherwise.

Sulphur Trioxide Production.

The pure sulphur content of pyrites and brimstone is charged at £13 per ton. The graphs marked 2 and 2A included in this section make it possible to compare at a glance Mannheim, Tentelew and Grillo working. It is explained in the text that during the period January to June, 1918, considerable changes were made in the explosives programme necessitating the closing down of the Queen's Ferry, Gretna and Oldbury Mannheim plants and also of the East Greenwich Grillo plant. Mannheim costs are high, but it is well to remember that the speedy erection of these plants in the early days of the war tided over a critical period. At this time too little was known in England of the design and working of Grillo plant to admit of it being put speedily into operation, and importing oleum from America was both a costly and an unpleasant business.

The first graph represents the May, June and January—June, 1918, figures for each factory together with the average and bogey figures for these periods. Canadian Chamber plant, American Chamber plant and American Grillo plant costs also appear. Comments are made on the results shown in the graph; for instance it is pointed out that on the whole the American and Canadian plants appear to be inferior in technical working to the English plants though as regards service charges they score heavily. Tables are also given showing the detailed costs month by month for each factory. The following is that given for the Gretna Grillo plant:

June, 1916—June, 1917, the efficiency was 78·8 per cent., whilst the efficiency for January—June, 1918, was 91 per cent. Since the production of sulphur trioxide for January—June, 1918, was 52,817 tons, this improvement in efficiency would represent a saving of approximately 3600 tons of sulphur. It is true that the closing down of the Mannheim plants, previously mentioned, may partly account for this increase in average efficiency, but the great improvements effected are clear from consideration of the individual factories. Thus the efficiency of the Gretna Grillo plant was 86 per cent. for January—June, 1917, but 94·1 per cent. for January—June, 1918, and comparison of the service charges at Gretna for these two periods shows a decrease of 5*s.* per ton net SO_3. At the Oldbury Mannheim plant the efficiency was 76·1 per cent. during June—December, 1916, but 83·7 per cent. for July—December, 1917, whilst the service charges have decreased by more than £2 per ton net SO_3. A decrease in service charges is not however apparent in all cases—at Pembrey, for instance, there was a slow but steady increase; but in service charges economy is masked by the rise of wages and the price of stores.

It is clear from the whole report that maximum efficiency has been aimed at throughout. The shipping difficulty naturally made this imperative, but ordinarily it might pay to run a plant at an efficiency lower than the maximum.

Other subjects dealt with in the second report are:—denitration, distillation, concentration of sulphuric acid, TNT production, nitrocellulose production, nitroglycerin production, cordite, ether, calcium nitrate tetrahydrate, ammonium nitrate (by calcium conversion process and by ammonia-soda process), picric acid, tetryl, ammonium perchlorate manufacture, comparative costs of raising steam, costs of electric power and gas producers, overhead charges, and labour usage. Those interested in these subjects should turn to the documents themselves for information.* Not only will manufacturers find there stores of useful data, but, further, many will be impressed by seeing the help which can be gained by keeping technical records for each separate process and by analysing costs. An appendix to the first report, which is also reproduced in the second, describes very briefly the methods of calculation employed, but it is understood that the Factories Branch of Explosives Supply is about to issue shortly a full description of

GRETNA GRILLO.

Period	Net SO_3 made. Tons	Efficiency %	Equivalent pure sulphur: Tons	Equivalent pure sulphur: Cost	Services	Total
				£	£	£
1917						
January—June	8174·0	86·0	0·465	6·045	2·679	8·724
July—December	13166·3	91·7	0·436	5·668	2·943	8·611
1918						
January, 4 weeks	1947·2	92·4	0·433	5·627	2·673	8·300
February, 5 weeks	2742·3	94·6	0·423	5·498	2·194	7·692
March, 4 weeks	2071·0	93·9	0·426	5·538	2·488	8·026
April, 4 weeks	1954·8	94·2	0·425	5·520	2·318	7·838
May, 5 weeks	2150·8	95·0	0·421	5·475	2·322	7·797
June, 4 weeks	1476·2	94·5	0·423	5·499	2·625	8·124
January—June	12342·3	94·1	0·425	5·524	2·412	7·936

From this it appears that the efficiency continues at a very high level, and that service charges have been continually decreasing except in June—the slight increase here being explained as being partly due to a small reduction in output.

The graph 2A, reproduced overleaf, shows the cost at the factories for the various six-monthly periods. What stands out clearly in comparing the successive periods shown in this is the improved plant efficiency at each factory and the consequent economy in raw material usage. Looking at the overall averages, it is seen that for the statistical methods employed, which will form a supplement to these reports.† In conclusion the

* The second Report on Costs and Efficiencies for H.M. Factories controlled by Factories Branch, Department of Explosives Supply, can be obtained (price 7*s.* 6*d.*) from H.M Stationery Office or the usual agents.

The first Report is out of print, but the data included in it for the six-monthly periods up to December 1917 are reproduced in the second Report.

† The Report on the Statistical work of the Factories Branch, Department of Explosives Supply, is now in the press, and will shortly be obtainable from H.M. Stationery Office or the usual agents (probable price 3*s.*)

closing words of the introduction to the second report may be quoted. "It is hoped that when it is seen what enormous improvements have been effected at H.M. Factories by the aid of detailed analysis of efficiencies and costs, a new impetus will be given to the chemical industry in Great Britain, which will help it in the future to hold its own with chemical industry throughout the world."

NEWS FROM THE SECTIONS.

CANADA.

Ottawa Branch.

The annual meeting of the Ottawa Branch of the Society of Chemical Industry was held in Ottawa on May 9, 1919. The principal item on the agenda was the election of officers for the ensuing year. By unanimous vote Dr. Frank T. Shutt, who has ably conducted the affairs of the Society during the past year, was re-elected chairman, and the secretary, Mr. S. J. Cook, was also returned. A committee of five was elected, and the officers for the year 1919—20 are therefore: Chairman, Dr. F. T. Shutt; Secretary, Mr. S. J. Cook; Committee: Messrs. A. E. MacRae, E. Stansfield, R. E. Gilmore, M. F. Connor, and F. J. Hambly.

After the election the members discussed the question of organisation among Canadian chemists, and made their plans in connexion with the Convention of Canadian Chemists held a week or two later. Delegates were appointed to represent the local branch at the Convention.

During the year 1918—19 the Ottawa Branch held seven meetings at which the total attendance was 249, the average being 36. Although the Branch has only completed its second year it now has on its roll 23 members of the Society, in and near Ottawa, and 21 associates of the local Branch, making a total of 44. It is hoped that the coming year will see this number augmented to about 65.

NEWCASTLE.

Prof. H. Louis was entertained at a dinner given by this Section on June 4, as an expression of appreciation for the good work he has done for the Society during his two years of office as President. The chair was taken by Dr. F. C. Garrett in the absence, through illness, of Prof. P. Phillips Bedson, the chairman of the Section.

MEETINGS OF OTHER SOCIETIES.

ROYAL SOCIETY OF EDINBURGH.

At the meeting held on June 2, Dr. John Horne in the chair, Dr. L. Dobbin read a paper "On the Presence of Formic Acid in the Stinging Hairs of the Nettle." The generally accepted view that formic acid is present in the stinging hairs of nettles is not convincingly established by previous investigations, in which nettles as a whole, and not exclusively the cell contents of the stinging hairs, were submitted to examination. The author has secured the collection of these cell-contents alone and the conversion of the free acid or acids which they contain into corresponding salts, by pressing the leaves of growing nettles between strips of the purest filter paper, previously impregnated with barium hydroxide or sodium carbonate and dried in air. The optical characters of the lead and barium salts prepared from the material so collected were examined by aid of the polarising microscope, and the various preparations were found to include crystals possessing the same characters as known specimens of lead formate and barium formate.

Samples of "Encysted Wood," presented by Colonel R. A. Marr, Norfolk, Virginia, U.S.A., were exhibited. This wood, obtained from the Balsa tree, is extremely light, its density being about half that of cork. Unfortunately it rotted easily in its natural state, but by a special process discovered by Colonel Marr a waterproofing mixture could be carried to the centre of any piece of timber coating the cells and ducts with an extremely thin permanent film. In this form the wood has been of great service in floating mines during the war.

THE ROYAL SOCIETY.

At the ordinary meeting held on June 5, Drs. E. F. Armstrong and T. P. Hilditch presented a paper on "A Study of the Catalytic Actions at Solid Surfaces." The authors have studied the rate of hydrogenation of a number of unsaturated fatty oils in presence of finely disseminated nickel, and expressed the results in the form of curves. These curves never approach the logarithmic type required for unimolecular action; in general they are very similar to those obtained in the case of enzymes, and they undoubtedly represent related phenomena. In each case the catalyst (enzyme or reduced nickel) unites primarily with the organic compound about to undergo change (hydrolyte or unsaturated glyceride), the complex so formed being decomposed by the other component of the interaction (water or hydrogen). In each case, moreover, action takes place entirely at the surface of colloid particles, and activity of the catalyst depends entirely on production of maximum surface and avoidance of impurities likely to destroy or dirty this surface.

It is considered that the interchanges take place in an electrolytic circuit in which the interacting substances are necessarily all comprised. Hydrogen and fatty oil are both to be thought of as coupled with nickel and interaction as brought about through inclusion in the system of the electrolyte required to establish a conducting circuit. Both hydrogen and fatty oil are to be regarded as having some affinity for the catalyst, and the rate of change is to be considered as determined by the rate at which the less active (hydrogen) enters into productive association with the catalyst.

The Bakerian Lecture was delivered by the Hon. R. J. Strutt on June 19 on "A Study of the Line Spectrum of Sodium as Excited by Fluorescence."

The lecturer described an improved form of sodium vapour lamp, in quartz, which gives an intensely bright sodium spectrum, admirably adapted for exciting sodium vapour to resonance.

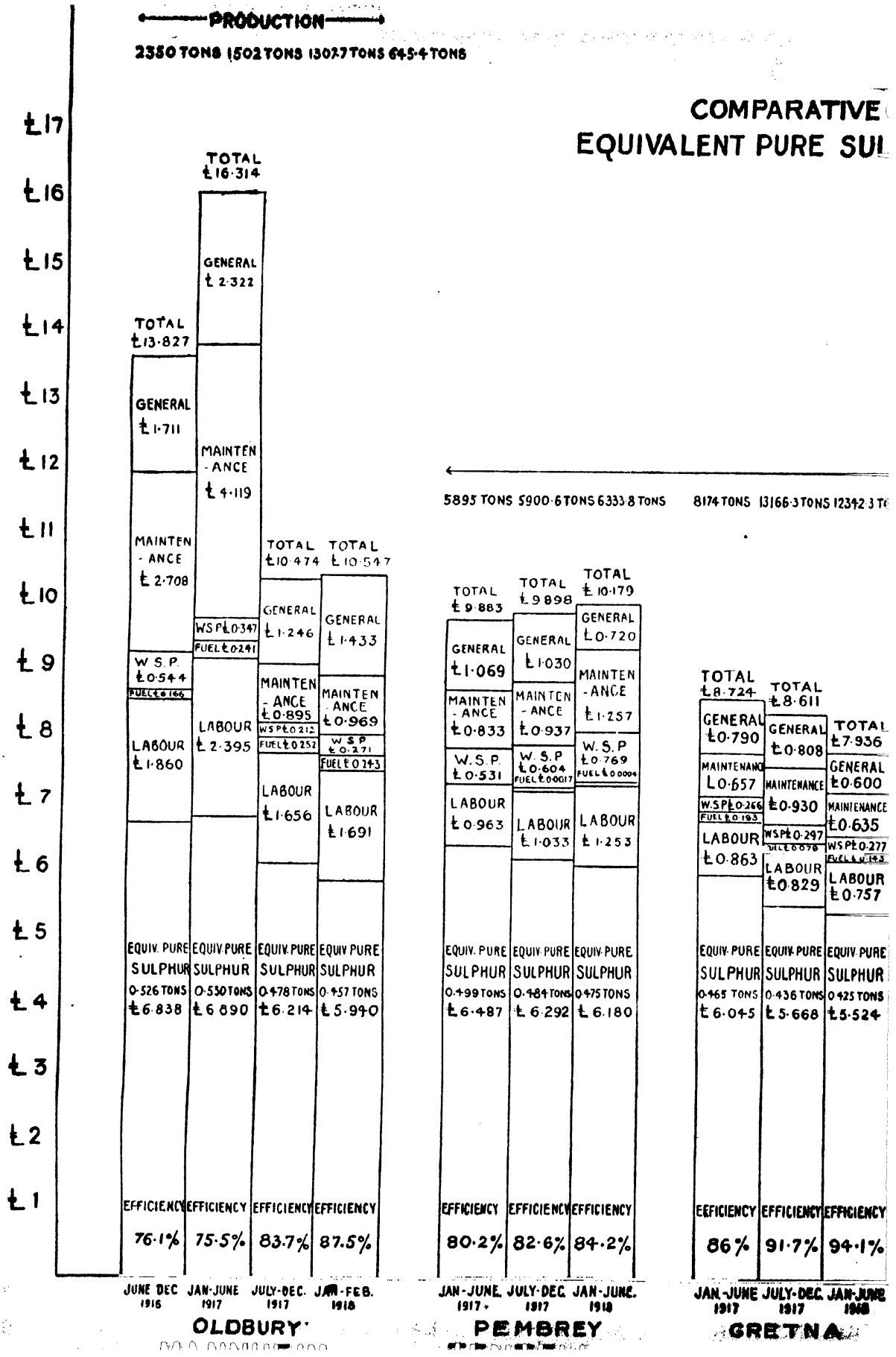
It is found that excitation of sodium vapour by the second line of the principal series leads to the emission of both λ3303 and the D line. On the other hand, as might be expected, excitation by the D line leads to the emission of the D line only, without 3303. If only one of the components of the doublet 3303 is stimulated, both the D lines are emitted.

When D light falls on sodium vapour, of appropriate density, it is known that an intense surface emission occurs from the front layer and a weaker one from succeeding layers. Analysis by absorption in an independent layer of sodium vapour shows that the superficial emission is more absorbable, and therefore nearer the centre of the D lines.

The breadth of the D lines in superficial resonance has been estimated by interferometer methods. It is found to correspond with the breadth conditioned by the Doppler effect, calculated on the assumption that the luminous centre is the sodium atom.

Polarisation could not be detected in the ultra-

COMPARATIVE
EQUIVALENT PURE SUL



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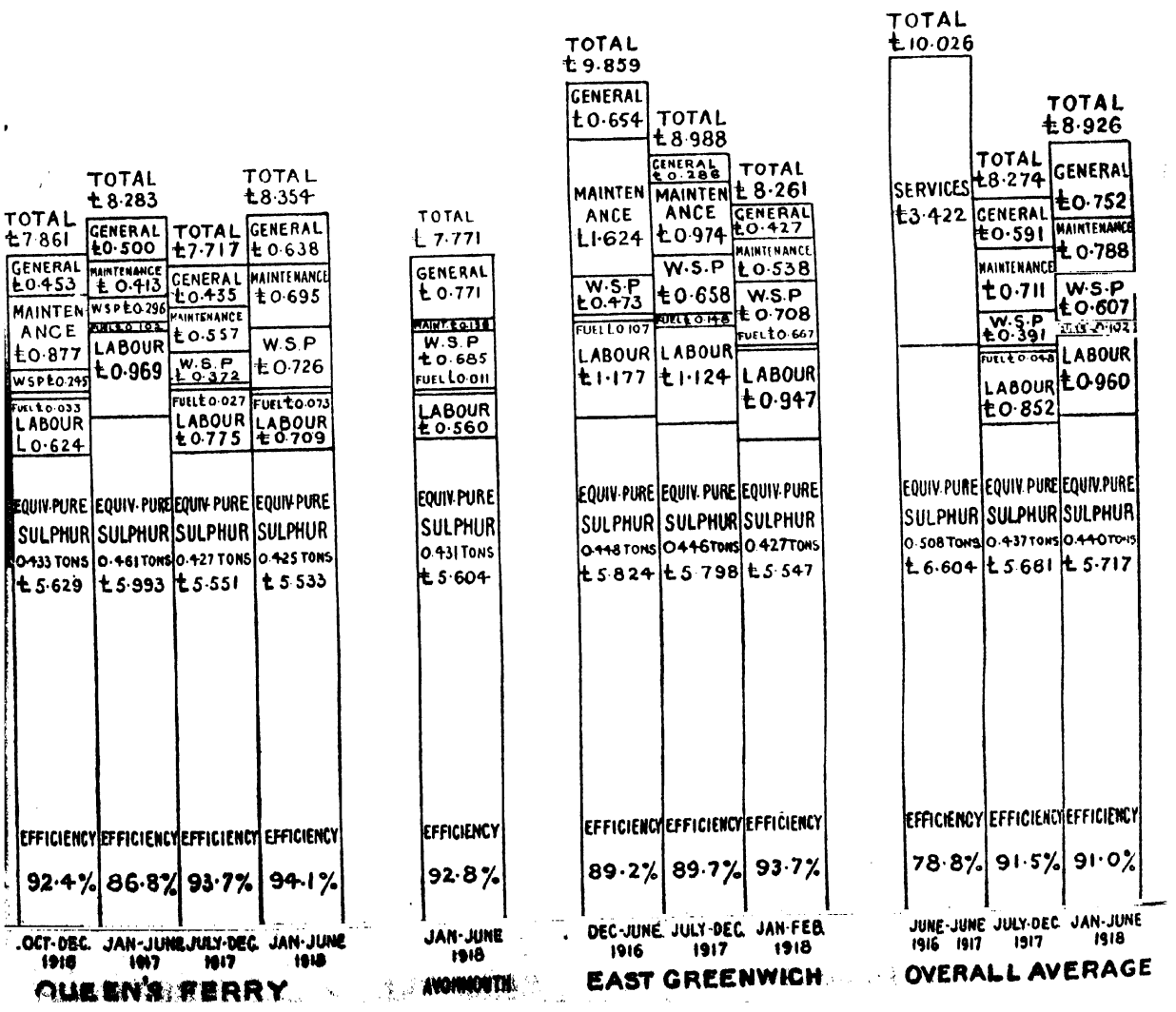
PER TON NET SO_3 PRODUCED

IS CHARGED AT £13 PER TON.

REPRODUCED BY PERMISSION
OF THE CONTROLLER
H.M STATIONERY OFFICE

PRODUCTION

98 TONS 25370 TONS 34276·5 TONS 25288·3 TONS 3797·8 TONS 3572 TONS 3130 TONS 1247·6 TONS 65058 TONS 57781 TONS 52816·5 TONS



violet resonance radiation, though, in accordance with previous observers, it was readily observed in D resonance.

THE CHEMICAL SOCIETY.

On June 5, with the President in the chair, Mr. P. Blackman read a paper on "An Isotonic (Isosmotic) Apparatus for comparing Molecular Weights." Two substances of known weights, w_1 and w_2, and of molecular weights, m_1 and m_2, are dissolved in the same solvent. One solution is placed in a porous, porcelain cell (test-tube shaped), the walls of which contain copper ferrocyanide as semi-permeable membrane. This cell is placed in the second solution contained in a wider and longer glass test-tube. After about 6 hours, osmotic flow between the solutions will have ceased, and the volumes, v_1 and v_2, of the two solutions are determined. The calculations are made from the formula $\frac{v_1}{v_2} = \frac{w_1}{w_2} \cdot \frac{m_2}{m_1}$. The porous cell is coated internally and externally, as to three-quarters of its length from the top, with paraffin wax to prevent the liquids creeping up. Good results were obtained with solutions of cane sugar.

The second paper was by Mr. V. Cofman on "The 'Active Substance' in the Iodination of Phenols." The author enumerated ten different methods of iodination and adduced evidence in favour of his claim that the halogen is conveyed to the phenol through the intermediation of hypoiodous acid, which in the course of the reactions decomposes into nascent iodine and iodate.

A brief summary by Prof. J. F. Thorpe of his investigations on the glutaconic acids, and on a new method of preparing glutaric acid, concluded the meeting.

THE BRITISH SCIENCE GUILD.

The annual general meeting was held at the Goldsmiths' Hall, E.C., on June 17. Sir Richard Gregory, in presenting the annual report, referred to the forthcoming second British Scientific Products Exhibition, which will be opened at the Central Hall, Westminster, on July 3, and for which the applications from exhibitors were sufficient to fill the allotted space four times over.

The presidential address was delivered by Lord Sydenham on "Science and Labour Unrest." The revolutions in the conditions of labour which the use of tools and the development of power to drive them had inevitably brought about, had led to widespread discontent, but science, which had unconsciously caused some of the evils, could now show the way to the restoration of national prosperity, viz., by greater economic use of power on a large scale and by more scientific management of industries. In increased production, and an excess of production over consumption, lay our only hope of recovering from the gigantic losses caused by the war and of securing higher standards of living and continuity of employment for manual workers.

Major-General Seely, the Under-Secretary of State for Air, said that the future development of aviation lay absolutely in the hands of scientific men, who were now called upon to devise means of securing greater safety in the air. He ventured to prophesy that within five years the two great difficulties of determining location and lateral and vertical declination would be solved.

Sir J. J. Thomson referred to the desirability of enabling the scientific men who had been working so successfully in the research departments connected with the Admiralty and the War Office, to continue work of a research nature. The spirit of research was now much more active in British industries, and the movement to form research institutes was full of promise, not only from the standpoints of science and of industry but also because of its ethical value. Alluding to the question of problems awaiting solution, Sir J. J. Thomson said that the discovery of the real cause determining the difference in behaviour between woollen and cotton goods when squeezed—the creases coming out from the former when the pressure is released, but not from cotton or calico—was of very great financial importance, although of singular complexity from a scientific point of view. According to an eminent scientist who had been associated with the fighting forces, the country had suffered greatly and unnecessarily during the war owing to ignorance of science among those in command. The cadets who passed well out of the Military Colleges constituted as a rule first-class material from a scientific standpoint, yet practically no subsequent use was made of their latent scientific ability. The Army, the Navy and the great Government departments generally stood in need of a strong infusion of men with true scientific training.

Major Sir E. H. Shackleton said that what struck him most on returning to civilisation was the great advance made by science during his absence. They left the cinematograph as a toy and came back to find it the fourth largest industry in the United States.

PERSONALIA.

Sir James Dewar has been awarded the Franklin medal of the Franklin Institute, Philadelphia.

Mr. S. H. Higgins has been appointed Head of the Research Department of the Bleachers' Association, Ltd.

Sir Henry Hadow has been appointed Vice-Chancellor of Sheffield University, and Prof. A. H. Trow Principal of South Wales University College, in succession to Prof. E. H. Griffiths.

Mr. J. E. Purvis has been appointed University Lecturer in Chemistry and Physics in their application to Hygiene and Preventive Medicine at the University of Cambridge.

Sir Frederick Black, President of the Institution of Petroleum Technologists, has resigned his office of Director of Navy Contracts, and has become a managing director of the Anglo-Persian Oil Co.

Mr. L. Guy Radcliffe, of the College of Technology and Hon. Sec. of the Manchester Section of the Society, has been awarded the Gold Medal of the Worshipful Company of Dyers for researches published in 1917-1918 on the sulphonation of fixed oils. He was assisted in this work by Mr. S. Medofski.

Among the members of the new committee recently appointed by the Government to inquire into the financial needs of university education in the United Kingdom are Sir J. J. Thomson, Sir J. J. Dobbie and Sir Dugald Clerk.

The Council of Liverpool University has appointed Dr. J. G. Adami as Vice-Chancellor in succession to Sir Albert Dale. Colonel Adami has occupied the Chair of Pathology and Bacteriology at the McGill University, Montreal, since 1892, and has recently been on active service with the Canadian Army Medical Corps.

The University of Manchester has bestowed the honorary degree of Doctor of Science upon Prof. J. C. McLellan of Toronto University, and upon M. Jean Perrin, professor of physical chemistry at the Sorbonne, Paris. The degree of M.Sc. Tech. has been conferred upon Mr. A. P. M. Fleming, Head of the Research Department of the British Westinghouse Co.

NEWS AND NOTES.

SOUTH AFRICA.

Salt.—At a recent conference of manufacturers, a representative of the South African Salt Owners' Association stated that the association had produced over 500,000 bags of coarse salt during last season, and that this quantity could be quadrupled if better means of transport were available. The country could be made self-supporting in regard to salt and its by-products if some system of light railways could be provided. The Association also considered it advisable to create an export trade in the southern hemisphere. It was thought that vessels returning to Australia, Japan, and East Africa might load salt at a low rate of freight or as ballast. The establishment of a central factory for the manufacture of by-products of salt was also considered necessary, and of scarcely less importance is the provision of storage at railway stations. The Association was further of opinion that the Government should impose an import duty on salt, and furnish such scientific assistance as would enable the industry to be run on the most up-to-date lines.—(*Official*).

Natural Soda on the Rand.—A rich discovery of natural sodium (and potassium) carbonate is reported from a property near Klerksdorp. A Johannesburg syndicate has acquired a large area of the deposits, and it is intended to begin development without delay.—(*Official.*)

Saldanha Bay Phosphate Deposits.—The extensive deposits of phosphatic rock occurring at Saldanha Bay are to be exploited. The mineral contains 14—16 per cent. of phosphoric oxide, 2 per cent. soluble in citric acid, and the price has been fixed at £8 15*s.* per ton, made up in bags of 200 lb. The material is to be worked up in a large factory at Johannesburg, where, it is anticipated, 2000—3000 tons per month of treated fertiliser will be turned out.—(*Bd. of Trade J., June* 5, 1919.)

Guano-Phosphate from Cape Cross.—The Government is receiving shipments of guano-phosphate from Cape Cross, which will be available for the forthcoming sowing season. The phosphate will be sold only to *bonâ-fide* farmers at £11 10*s.* per ton of 2000 lb., or 23*s.* per 200 lb. bag, delivery free on rail at Capetown, or on board ship at Table Bay Docks.—(*S. Afr. J. Ind., April*, 1919.)

Mica.—Shipments of South African mica to Great Britain have been so small that no regular market has yet been established. Care in production, and favourable shipping rates, would secure a regular market in the United Kingdom.—(*S. Afr. J. Ind., April*, 1919.)

Nitric Acid and Nitrates.—Nitric acid is used in South Africa chiefly for the production of nitroglycerin, gun-cotton and collodion cotton. This acid is also employed to dissolve copper from the gold-copper mixture precipitated by zinc from cyanide solutions in the treatment of the cupriferous gold ore from the Pilgrim's Rest district. The production of the three explosive works—Kynoch, Ltd., the Cape Explosives Works, Ltd., and the British South African Explosives Co., Ltd.—is about 18,000 tons. The total invested capital is not known, but the cost of the nitric acid plant of the Cape Explosives Works, Ltd., was about £37,000. Owing to lack of water power and to the fact that nitrates are imported duty free, there is little prospect of the successful manufacture of synthetic nitrates in South Africa. For explosives, however, nitric acid will continue to be manufactured locally from imported Chilean or synthetic nitrate, because importation of the acid is dangerous and expensive, and in addition there is a 20 per cent. *ad valorem* duty on the imported acid (with a rebate of 3 per cent. on that produced in the United Kingdom).

Barium nitrate, made from imported barium carbonate, forms an ingredient of the fuse-igniter composition used in the Transvaal mines. Lead nitrate is used to produce lead-zinc couples to facilitate precipitation of gold from cyanide solution, and is added to solutions or ore under treatment to precipitate soluble sulphides which interfere with the process. It is manufactured by the explosives works from lead derived from the Rhodesian Broken Hill mines.—(*S. Afr. J. Ind., April*, 1919.)

BRITISH INDIA.

Soil Surveys.—One of the important undertakings of the Board of Agriculture is the systematic surveys of soils in the different provinces. In Bengal considerable progress has been made with the provincial soil survey. Red soil shows a deficiency in phosphoric acid and lime in western Bengal and of potash in eastern Bengal. The soil survey is not limited merely to the analysis of soils, but the contents of ashes of the typical crops grown in each district are examined and recorded. Thus it is possible to determine the exhaustion of valuable soil constituents by the plants. As an instance, it is pointed out that in north Bihar the indigo soils have undergone deterioration owing to the depletion of phosphatic constituents (this J., 1919, 119 R).

Apatite.—Large deposits of apatite have been found in India, and it has been suggested to use it for enriching Indian basic slag which is of very low phosphatic content. Considerable work has been done by the Board of Agriculture in determining the solubility of the apatite and rendering it useful as a fertiliser. It has been shown that the large percentages of iron in Indian apatite restricts its use in the manufacture of superphosphate. It is suggested by the Board of Agriculture that cheap electric power, which will be available at the Tata Hydro-electric Works, particularly by its Koyna power project, would render it feasible to utilise these natural phosphate minerals as a source of soluble phosphate. The use of Palmer's patent has been suggested in this connexion.

CANADA.

A New Research Organisation.—The Shawinigan Water and Power Co., Montreal, is establishing a new research department to correlate the work being carried out in its various departments and to undertake new investigations on the manufacture of magnesium alloys, and on a number of other electro-chemical and metallurgical processes. Synthetic organic compounds based on calcium carbide manufacture and the production of acetic acid form the non-metallurgical field of this company. The development of Shawinigan industries has been of great value during the war and the above company is now opening a branch in England.

The Canadian Institute of Chemistry.—At the first meeting of the Council of the new Institute, Prof. J. W. Bain, at present on the Canadian War Mission at Washington, and head of the Chemical Engineering Department of the Faculty of Applied Science, University of Toronto, was elected chairman. Three Vice-Presidents were chosen, as follows:—Dr. G. Baril, M.D., Laval University, Montreal; Dr. A. McGill, Department of Trade and Commerce, Ottawa, and Dr. R. D. MacLaurin, of the University of Saskatchewan, Saskatoon. Mr. Harold J. Roast, of Montreal, is the acting Secretary-Treasurer of the Institute.

Ten members were chosen to form an Executive:—Prof. E. G. R. Ardagh, University of Toronto; Dr. J. S. Bates, Price Bros. Ltd., Kenogami, Que.; Dr. H. E. Bigelow, Mount Allison University, Sackville, N.B.; S. J. Cook, Trade and Commerce, Ottawa, Ont.; J. A. Dawson, Trade and Commerce,

Vancouver, B.C.; I. Grageroff, Canadian Explosives, Montreal, Que.; Dr. L. F. Goodwin, Queen's University, Kingston, Ont.; Prof. A. Lehman, University of Alberta, Edmonton; Prof. E. Mackay, Dalhousie University, Halifax, N.S.; Prof. M. A. Parker, University of Manitoba, Winnipeg, Man. The new Institute is finding ready support and the James Robertson Co. Ltd., of Montreal, has started with a subscription of $500 to a general fund for carrying on the work. Offices have been opened in the Kingdom Building, Beaver Hall Hill, Montreal, Quebec.

Maple Sugar.—Reports from various maple districts in Eastern Canada state that the maple products this year will beat all records for the last ten years. The makers of maple sugar and syrup in Canada exceed 45,000. About 550,000 acres of land is being reserved in its natural wooded state, of which two-thirds is situate in Quebec, and the Eastern Townships of this province constitute the centre of the world's supply of maple products. Maple syrup is not exported on a large scale.—(*Official.*)

British Columbia.

Natural Deposits of Salts of Magnesium and Soda in British Columbia.—Several companies are interested in developing certain lake deposits of magnesium and sodium salts in this province. These salts as they occur in British Columbia, present several novel geological features. In places, very pure magnesium sulphate separates out and may be loaded directly. In other places, both magnesium and sodium sulphate occur in various proportions. The series of deposits consist of calcium carbonate, hydrated magnesium carbonate, gypsum and epsomite. They all occur in very fine grains; the epsomite is the only product being worked so far. The lake deposits consist of numerous circular closely spaced areas of magnesium sulphate, overlain by a few inches of brine, and between them there is a dark mud mixed with the salt. The under surface appears convex, or cone-shaped. All these deposits offer a striking exercise for the application of physico-chemical principles to the solution of their cause. Freight rates and the fact that the pharmaceutical trade is accustomed to larger crystals is delaying the wide sale of these products, but eventually they must command the Western market.

UNITED STATES.

Future of the National Research Council.—The National Academy of Sciences having been requested to perpetuate the National Research Council has adopted a plan for a permanent foundation to replace the temporary war-time organisation. The purpose of the Council is to promote research in the mathematical, physical and biological sciences and in the application of these sciences to the useful arts such as engineering, agriculture and medicine. In order that the work may be carried on most effectively the Council is being organised in divisions of which there are two classes:—(A) Those dealing with the more general relations and activities of the Council, and (B) divisions concerned with related branches of science and technology. Under this classification the divisions under (A) are I. Government, II. Foreign Relations, III. State Relations, IV. Educational Relations, V. Industrial Relations, and VI. Research Information Service. Under (B) the divisions are those of VII. Physical Sciences, VIII. Engineering, IX. Chemistry and Chemical Technology, X. Geology and Geography, XI. Medical Sciences, XII. Biology and Agriculture, and XIII. Anthropology and Psychology. The organisation is being rapidly completed along these lines and the work is proceeding in accordance with the policies adopted. A number of National Research Fellowships have already been granted for chemistry and physics.

The Essential Oil Industry and the Projected Ban on Alcohol.—The prospect of being deprived of alcohol in the near future has caused some concern among manufacturers of flavouring extracts, especially as some States have already prohibited the sale of certain flavours which usually contain high percentages of it. Since the use of any solvent not known to have food value and to be readily assimilated by the human body may be barred in future, the possibilities are somewhat limited. Bakers have found purified and refined vegetable oils, such as coconut and cottonseed oils, satisfactory diluents for lemon, orange and such oils, and recent research indicates the possibility of using glycerin in one form or another for vanilla. This may, however, necessitate some revision in standards, since certain resins dissolved by alcohol are not soluble in glycerin or its derivatives, and hitherto the presence of such resins has been required in a true vanilla bean extract as distinguished from synthetic vanillin. The glycerin extract appears to be perfectly satisfactory in appearance and in use. The perfumers seem to be faced with a more difficult problem since the more delicate perfumes may be easily overcome or neutralised by the odour of the substitute solvent. The use of small drops of the undiluted extracts may come into vogue.

Benzyl Alcohol as Local Anæsthetic.—Benzyl alcohol is now available for use as a local anæsthetic. It is said to be very efficient, a 1 per cent. solution producing anæsthesia for 30 minutes.

Cost of Production of Nitric Acid.—In a paper read before the American Chemical Society on May 8, Dr. C. L. Parsons compared the cost of production of nitric acid from Chilean nitrate with that of acid made by the catalytic oxidation of ammonia. He stated that a 94 per cent. acid could be made by the latter process, in competition with acid from Chilean nitrate when this material cost 2 cents per lb. and the cost of ammonia was 11½ cts. per lb. The cost of 50 per cent. acid would be the same by the two processes when nitrate cost 2 cts. per lb. and ammonia 14 cts. per lb.—(*Chem. and Met. Eng., May* 15, 1919.)

Progress in Electro-Chemistry.—In his presidential address to the American Electro-Chemical Society on "Electro-Chemistry and its Human Relations," Mr. F. J. Tone dealt with recent applications of electro-chemistry to agriculture, sanitation and metallurgy. Referring to the use of chlorine for sterilising potable water, he stated that more than 20 millions of the population of the United States dwelling in cities are now safeguarded from disease by this means. During the recent influenza epidemic the number of cases in the cell rooms of two electrolytic chlorine plants, located in different States, was one-half of that in any other portion of the plants. The Carrel-Dakin solution for the treatment of wounds is perhaps the greatest surgical discovery of the war. A large field lies open for the use of chlorine in sterilising sewage. A million gallons of the latter can be sterilised with 120 lb. of hypochlorite, and the cost of treating the sewage of a city of 1 million inhabitants does not exceed $360 a day, or about 6*d.* per head per year. Chlorine should also be applied to the sanitary control of milk supply.

The electric furnace is used in the third stage of the triplex process for refining steel, whereby a product is obtained from which rails are made which do not break and plates which do not fracture. It is the task of the electro-chemist to produce alloy steels in such quantities that not only the vital parts of motor cars, farm tractor motors and aeroplane engines can be made of them, but the entire mechanisms. We seem to be on the eve of great advances in the manufacture and use of

ferro-uranium and ferro-zirconium; in fact, it is whispered that a zirconium-steel can be made of tensile strength 300,000 lb., with 30 per cent. elongation. The use of such material for the construction of ocean liners and railway trains would increase their carrying capacity by 25 per cent., or, with the same weight of metal, they could be made four times as strong. In a word, the task of the electro-metallurgist is to put super-steel on a big tonnage basis.—(*Chem. and Met. Eng., April* 15, 1919.)

JAPAN.

The Iron and Steel Problem.—The Tokio Chamber of Commerce proposes that relief be secured for the iron and steel industry by raising the Customs duty and by granting subsidies. The suggested increase of rate on pig-iron is from 10 sen (2½*d.*) to 50 sen (1*s.*) per 100 kin (133⅓ lb.), the latter figure being equivalent to an *ad valorem* duty of 21·5 per cent. It is further suggested that a subsidy be granted on pig-iron produced by Japanese firms in Manchuria, China, and Korea, sufficient to counterbalance the import duty. Shipbuilders oppose these tariff proposals. As late as last March the agitation for Government assistance of the iron and steel trades continued unsuccessfully, and a proposed combine of these trades remained uneffected. English pig-iron is on offer at a price considerably below the cost of production in Japan.—(*Bd. of Trade J., May* 29, 1919.)

GENERAL.

"The Chemical Age."—We are pleased to extend a welcome to this new weekly contemporary, of which the first issue appeared on June 21. The sphere of activity of the new journal will be the fertile field of industrial chemistry, and, as may be gathered from a perusal of the first number, the interests of engineering chemistry will receive particular attention. The publishers are Messrs. Benn Brothers, Ltd., of 8, Bouverie Street, E.C., who are the proprietors of the *Gas World* and other publications.

Report of the Alien Property Custodian of the United States.—The Association of British Chemical Manufacturers has had this report reprinted from, and by permission of, the *Journal of Industrial and Engineering Chemistry* (see this J., 1919, 197 R). Those who wish to obtain a copy may do so by applying to the Secretary of the Association, at 166, Piccadilly, London, W. 1, enclosing a postal order for 1*s.*

The Cane Sugar Industry in Cuba.—The sugar cane is said to have been introduced into Cuba in the year 1523. The climate is unsurpassed for the growth of abundant cane crops, and as, moreover, the soil is very fertile, little artificial manuring is done. A series of successful experiments with sulphate of potash, superphosphate and slaked lime has, however, proved the importance of their application. The plants are reproduced by cuttings, take 18 months to ripen, and are not infrequently grown for 25 years in the same field, during which period the yield gradually diminishes. The density and purity of the juices, however, increase. Fifty tons of cane per acre are often obtained. Cuba was a Spanish colony from 1492 to 1898, when it became an independent state under American suzerainty. To the abolition of Spanish rule and the subsequent introduction by the United States of the latest machinery and the most up-to-date scientific methods of culture and extraction, the marvellous growth of the Cuban cane industry must be ascribed. The annual production of 70,000 tons in 1817 had in 1850 advanced to 300,000 tons. In 1894, 1,054,000 tons represented the maximum production under Spanish rule, and the minimum production of 212,000 tons occurred in 1896, when war and rebellion raged throughout the island. When peace had been re-established the industry made a wonderful and steady recovery, producing 300,000 tons in 1900, 1,163,000 tons in 1905, 1,180,400 tons in 1910, and 2,593,000 tons or 14·14 per cent. of the total world's production in 1915. In 1918, Cuba furnished 19½ per cent. of the world's sugar production, or 3,350,000 tons, and for 1919 Willet and Gray estimate a probable crop of 3,600,000 tons. During the war Cuba has supplied a portion of the deficiencies caused by the failure of the European beet sugar crop, which dropped from 8,758,900 tons in 1914 to 5,050,000 tons in 1918.

Sugar Crop of the West Indies in 1918.—Last year's weather conditions in the West Indies were not favourable to sugar production. The sugar and molasses, in terms of sugar, exported both in 1916 and in 1917 amounted to 300,000 tons; last year the quantity was 50,000 tons less; prospects for 1919 are better, the total estimate being 291,225 tons. The exports of sugar and molasses in 1918 were:—Dark crystals 21,478 tons, Canada taking 79 per cent.; yellow crystals 240 tons (Newfoundland, 75 per cent.); white crystals 290 tons (Newfoundland, 55 per cent.); muscovado 11,190 tons (Great Britain, 76 per cent.); fancy molasses 9,113,614 galls. (Canada, 62 per cent.); choice molasses 1,283,268 galls. (Newfoundland, 67 per cent.); vacuum pan molasses 286,727 galls. (Great Britain, 99 per cent.).—(*U.S. Com. Rep., April* 18, 1919.)

Fermentation Glycerin.—In connexion with the production of glycerin by the alcoholic fermentation of sugar, a paper was recently read by K. Schweitzer before the Swiss Chemical Society on the effect of adding a reducing agent to the fermenting liquor. According to Oppenheimer, the glycerin is formed by reduction of glyceraldehyde or dihydroxyacetone, into which the hexoses are primarily broken up. The author found that acid reducing agents were unsuitable, but sodium sulphite produced a greatly augmented yield. Whereas Pasteur (1857) obtained from 100 grs. of sugar with yeast 3·6 grm. of glycerin, and Oppenheimer (1914) with yeast juice got 3—12 grm., Schweitzer with yeast and sodium sulphite obtained 21·3 grm. The yield obtained by Eoff, Linder and Beyer (this J., 1919, 175 R) using a yeast and sodium carbonate was 20—25 per cent.—(*Schweiz. Chem.-Zeit.*, 18—19, 1919.)

German Industry and the Peace Negotiations.—The "Reichsverband der deutschen Industrie" (Imperial Association of German Industries) has declared that the acceptance of the proposed terms of peace would be a death-blow to the economic life of Germany. The territories demanded by the Allies are indispensable for the supply of agricultural produce and raw materials, especially coal and ores; and the fulfilment of the condition that a considerable portion of the remaining coal supply shall be delivered to France, Belgium, Italy and Luxemburg would lead to industrial paralysis. The production of iron would be reduced to one-fourth; and the obligation to give the Associated Powers the benefits of the most-favoured-nation clauses without reciprocity would lead to the flooding of German markets with foreign goods. The power given to the Entente to determine the quantities of raw materials and foodstuffs to be imported into Germany shows a brutal will to destroy by causing unemployment and ruin to millions of German working-class families. The surrender of the merchant fleet and the enslaving of the shipbuilding yards to work for the Allies exposes Germany entirely to the arbitrary power of her competitors. The acceptance of the peace conditions would be worse, from an economic standpoint, than the continuation of the blockade

and the occupation of the coal districts. The Reichsverband therefore affirms that the proposed peace conditions are impossible to execute and therefore unacceptable.—(*Stahl u. Eisen, June* 5, 1919.)

Blast Furnaces in Belgium.—According to the *Moniteur des Intérêts Matériels*, the number of blast furnaces in Belgium on July 1, 1914, was 60, of which 49, having a total output capacity of 7057 metric tons per 24 hr.-day, were then in blast. The actual output for the first half of 1914 was 1,233,410 tons. To-day the output is *nil*. With the exception of four furnaces in Hainaut, which had been requisitioned and are in good condition, practically every furnace has been wholly or partly demolished. Before the war Belgium possessed 50 converters, 19 open-hearth furnaces and 96 rolling mills.—(*The Iron Age, May* 21, 1919.)

Condition of the Belgian Glass Industry.—All Belgian window-glass factories remain intact, raw materials are in hand, and labour available, but it will take time to train young workmen to make up for the deficiency caused by the war. The factories are not yet running, however, owing to disagreement with trade unions regarding labour contracts. In 1914 there were 30 furnaces; at present there is one hand-worked and one machine-worked furnace in operation, and the production is 20,000 boxes of 100 sq. ft. per month. Glass is six and a-half times as costly as in 1914; the price of hand-made glass is now 260 francs per box of 300 sq. ft. loaded on car at factory, that of machine-made glass 240 francs per box, free sizes 4c. 21 ounces, 200 sq. ft. Belgium and France greatly need window glass; the French Government has made a proposal for 40,000,000 square metres at 225 francs per box of 300 sq. ft. A co-operative association comprising the principal Belgian window-glass manufacturers has just been formed with head offices at Charleroi. The capital is 224,750 francs divided into 8990 shares of 25 francs each. The plate-glass factories have not suffered very much, and although the Germans deported copper and machinery, most of the factories will be running again in a few months' time. Charleroi "rolled glass" sells at 12 francs (9*s.* 6*d.*) per sq. metre. Most of the crystal-glass factories have continued to manufacture half-crystal glass during the war, but labour trouble exists at present. The only Belgian bottle factory—at Jumet—has continued to work during the war. A new factory to be worked on a French system is being built at Merxem near Antwerp. The furnaces will use tar fuel, which is giving good results in a glass factory in Holland.—(*U.S. Com. Rep., April* 12, *May* 12, 1919.)

Output of Alsatian Potash.—There are now five mines in operation, *viz.*, "Reichsland," "Theodor," "Max," "Marie," and "Luise," with a combined output of 2000 metric tons per day. It is hoped to double the production within about 3 months. In July next, "Amelia I and II," "Marie Josef," and "Else" will be ready to start operations, when the production should rise to 5000 tons. The "Prince Eugen" is expected to be ready by January 1920. "Anna I and II," "Ensisheim I and II," and "Rudolf" are expected to reach the producing stage in 1922, when the daily output should attain 9000 tons. All the mines are under French control.—(*Z. angew. Chem., May* 9, 1919.)

Reported New Oilfield in Western Mexico.—Recent investigations have revealed the existence of rich deposits of petroleum on the Pacific Coast. The Federal Government has conceded authority to explore and exploit an island (probably the island of Altamuro), which is stated to be extraordinarily rich in oil and in asphalt.—(*El Universal, March* 11. 1919.)

REPORTS.

REPORT ON THE INVESTIGATIONS CARRIED OUT BY THE CHEMICAL WASTE PRODUCTS COMMITTEE OF THE MUNITIONS INVENTIONS DEPARTMENT, MINISTRY OF MUNITIONS (*not printed*).

Considerations of economy and especially economy of freightage led to the formation in March 1918 of a special committee of the Munitions Inventions Department to investigate the possible utilisation of chemical waste products. A long list of waste products was compiled after circularising manufacturers, and from this the Committee selected certain subjects for investigation. It was ascertained that about 30,000 tons of mimosa bark is treated annually in the tanning industry, and a process was evolved for the conversion into paper of the residue after the extraction of tanning material. In connexion with the utilisation of scrap timber for paper making, proposals for the erection of special plant were rejected because of the expenditure involved and attention was directed to the caustic soda treatment in esparto plants of pine, birch and oak, after the waste timber had been shredded into a suitable size at the saw mills.

A successful process was devised for detanning scrap chrome-tanned leather (which is not considered suitable for use as a fertiliser) and utilising it in the manufacture of glue. Many sulphuric acid manufacturers asked for information as to the best method of treating sulphide or arsenic residues; the treatment suggested was to raise the sludge to a temperature of 200° C. when the sulphide of arsenic and other impurities assume a granular form and can be separated from the acid, washed and dried for arsenic smelting.

The residues left after the extraction of alumina from bauxite have accumulated in large quantities, and although they contain a high percentage of iron they have not as yet been successfully utilised in this country. The German process for alumina extraction, roasting bauxite with sodium carbonate, converts the oxide of iron into a compound which ultimately yields ferric hydrate on treatment with water. Before the war this material was imported as "Lux" and largely used for purification of coal gas. The English caustic soda extraction process leaves the iron oxide in its original condition in the bauxite ore. Various processes for the conversion of these residues into material suitable for gas purification were examined, but none was found to give material to pass the rigid tests adopted by the Committee. Various other residues containing oxide of iron were examined and some found suitable for gas purification. A residue resulting from the manufacture of cyanide, and containing a high percentage of ferric hydrate, was rendered available by the introduction of a special drying process to give the right physical texture. Iron was recovered from the waste hydrochloric acid liquors obtained in the pickling of iron by the addition of lime in order to obtain material for gas purification.

In view of the importance of selenium in the glass industry various residues from sulphuric acid works burning pyrites were examined. The selenium found in flue dust was not worthy of consideration, while the amount present in the sulphate of lead sludge from the Glover tower and sulphuric acid chambers varied between 0·3 and 0·7 per cent. and in exceptional cases 4 per cent. was found.

The conditions for converting the residues left after the oxidation of organic substances by sodium bichromate and sulphuric acid were determined.

Crude benzol was recovered from the tarry residue from the sulphuric acid purification of benzol by treatment with steam or water to obtain a separation of acid of about 40 per cent. and subsequent

distillation of the tar with an equal weight of lime. Many residues consisting mainly of calcium sulphate were submitted to the Committee and examined for nitrogen with a view to their admixture with fertilisers.

Other matters dealt with were:—The extraction of chemicals used in P.H. gas helmets, the utilisation as a fertiliser of maize residues from the manufacture of butyl alcohol, the investigation of residues from the manufacture of acetic anhydride and of brucine, of residues containing sulphur, of the watery liquid from the steam drying of wood, of waste salt, of peat tar residues, and of hydrofluosilicic acid from phosphate works, the derusting of metals, the low temperature crystallisation of salts such as nitre cake, the production of methyl alcohol from methane, the treatment of nitrogenous liquors such as urine with magnesium phosphate, the corrosion of acid resisting metals, and the use of peroxide of manganese electrodes in the manufacture of persulphates.

The researches in progress are:- Further investigations upon bauxite residues, chrome liquors and sulphate of lead residues from acid works; the examination of quartz and mica residues from the preparation of china clay, waste liquors from the ammonia plants of Scotch blast furnaces, silicol residues from the manufacture of hydrogen and residues from alizarin manufacture, and the removal of copper and nickel from steel scrap bound with copper-nickel alloy.

The Committee recommends that its unfinished work should be carried to completion, and that the existing organisation should be developed as a permanent Chemical Research Department on lines similar to those of the National Physical Laboratory. The Department would consist of an advisory committee in association with a director and chemical staff with its own laboratories, and its duty would be to consider and report upon both problems from manufacturers and proposals from inventors.

REPORT ON THE TRADE OF CANADA AND NEWFOUNDLAND, TOGETHER WITH A DETAILED REPORT ON THE TRADE OF THE PROVINCE OF ONTARIO FOR THE YEAR 1918. By F. W. Field, H.M. Trade Commissioner at Toronto. [Cmd. 163, 3*d*.] London: H.M. Stationery Office.

The following table, compiled by the Mines Department, Ottawa, contrasts the production of the principal metals in Canada during 1917 and 1918 (*cf.* this J., 1919, 164 B):—

Products	1917	1918
Pig iron (short tons) ..	1,170,480	1,182,000
Steel ingots and castings (short tons)	1,745,734	1,910,000
Copper (lb.)	109,227,332	115,000,000
Zinc (lb.)	29,668,764	36,000,000
Gold (dollars)	15,272,992	14,750,000
Silver (oz.)	22,221,276	20,780,000
Nickel (lb.)	82,330,280	90,000,000
Lead (lb.)	32,576,281	—
Coal (short tons)	14,046,759	15,180,000
Total mining production of Canada (dollars) ..	189,646,821	220,000,000

There was an increased output of asbestos, chromite, felspar, graphite, magnesite, fluorspar, pyrites, etc., and also of petroleum.

The annual production of pulp and paper is of the value of about $100,000,000 a year, and the exports were valued at $71,754,425 for the year ending March 31, 1918. The total value of Canadian imports from the United Kingdom declined from $107,000,000 in 1917 to $81,000,000 in 1918. During the same period, imports from the United States increased from $664,000,000 to $792,000,000. While in the period 1915—1918, Canadian imports from the United Kingdom showed a decrease of 10 per cent. during the same period, the imports from the United States increased by 160 per cent. The two countries which made most headway in trade with Canada during 1918 were the United States and Japan. The proximity of Canada to the U.S.A. necessitates that the Canadian market should be given special consideration even amongst markets of the Empire. Suggestions are made as to how trade with the Dominion may be fostered. Special attention should be given to developing the various sale departments in the country. First-class representation by agents is essential, and connexions should not be severed during periods of trade depression. The questions of the despatch of goods on consignment, invoices, etc., need attention. Designs peculiar to Canada must be adopted by British manufacturers, and the scale of advertising expenditure needs thorough revision. Loose-leaf catalogues and the cinema are means of advertisement to which special attention is drawn. Personal visits of the firms' representatives to Ontario are recommended. A reciprocal interchange of Canadian and British graduates in engineering is desirable in order to standardise current engineering practice in the two countries.

The mineral production of Ontario is about half that of the whole of Canada. It has increased in value from $6,000,000 in 1893 to $72,000,000 in 1917. The Copper Cliff and Coniston smelters during 1918 treated 1,141,089 tons of ore, producing 64,926 tons of matte containing 33,688 tons of nickel and 17,232 tons of copper. The International Nickel Co. commenced operations in July, and between July and September produced 358,205 lb. of nickel and 359,713 lb. of copper from nickel-copper matte.

The United States has established over 500 branch works or assembling plants in Canada, representing an investment up to October 1916 of $251,000,000, a decided impetus towards development in this direction having been evident in 1918. It is suggested that United Kingdom firms should consider the advisability of following this tendency.

Although an important linen industry has just been established in Ontario, importers contemplate a continuation of an excellent import trade in this material with Britain. In the matter of chemicals, there has just been considerable development in the production of glycerin, ethyl alcohol, toluol, benzol, methylethylketone, butyl alcohol, crude magnesite, calcined ferruginous magnesite, chrome, china clay, ochre, Epsom salts and alums. Sal-ammoniac is being manufactured for the first time, likewise aspirin, phenacetin, permanganate of potash, paramidophenol base and hydrochloride. Dyes are obtained principally from the United States. The domestic export trades in paints and varnishes are being extended. The dry colours employed are largely of domestic origin. There has been considerable progress in the manufacture of illuminating glassware. The opinion is general that the United Kingdom will regain its trade with Ontario in chinaware lost during the war, and now largely held by Japan.

Reports from Trade Correspondents in Nova Scotia, New Brunswick, Quebec, Manitoba, Saskatchewan, Victoria, Vancouver, and Newfoundland are also included. The minerals and mineral products of Nova Scotia were valued at $55,840,000 in 1918, and $50,109,000 in 1917. The gold bearing lands have an area of 3000 sq. miles. The present annual coal production is 6,000,000 tons. The annual output of gypsum is about 300,000 tons, and is exported largely to the United States, whence it is returned in the form of manufactured articles. The coal production of New Brunswick in 1918 totalled 265,000 short tons. The antimony deposits

are to be developed, and it is anticipated that the mines will be in operation early in 1919. The oil production amounted to 2800 barrels during the year. The iron mines in Newfoundland produced and exported over 800,000 tons in 1918. Appendices are devoted to statistics of the paper and pulp industry of Ontario 1917, and a comparison of the imports into Canada for consumption of dutiable and free goods for the fiscal years ending March 31, 1914 and 1918.

[Additional matter contained in the Report has been recorded in previous issues of this Journal (*cf.* Review, 1919, pp. 7, 25, 51, 63, 85, 105, 125, 143, 165).]

COMPANY NEWS.

BROKEN HILL PROPRIETARY CO., LTD.

The 39th ordinary general meeting was held in London on June 12, Mr. J. S. Smith-Winby presiding. After protesting against the injustice of being subject to double income-tax, and of the postponement by the Government of the settlement of this question by referring it to a Royal Commission, the Chairman reviewed the position of silver and lead. The situation of and the outlook for silver were satisfactory, particularly from the producers' point of view, but the lead position was serious. The action of the Government in raising the price of lead from £29 on November 11, 1918, to £40 per ton on November 26, at a time when there were large stocks on hand, resulted in increased production and in shaking the confidence of consumers. The price has since fallen to below £23, a level which at the present time renders production quite unprofitable in many countries. No complaint could be urged against the Government for not continuing the contract with the Broken Hill Associated Smelters Co. after March 31 last. This company is the largest exporter of lead in the world, having a yearly plant capacity of over 200,000 tons of lead for export, a quantity more than sufficient to supply the annual requirements of the United Kingdom.

The reserves of the Proprietary Co. were estimated in December last at 1,095,015 tons of ore of an average assay value of 6·7 oz. silver, 12·8 per cent. lead and 11·6 per cent. zinc. There is still a considerable quantity of carbonate ore in the mine. Mine expenses are increasing rapidly; the costs for ore-raising and for lead and zinc mill treatment before the war averaged 25*s.* 3*d.* per ton over three years; last year they were 34*s.* 3*d.* per ton. Prices of mining requisites are exceedingly high, and the demands of labour are insatiable. Considerable trouble has been experienced with labour, many of the miners being misled by professional agitators; at the present time all the principal mines are shut down as the result of a dispute between certain of the Labour Unions. The profit on last year's working, after providing for administration and depreciation, was £214,166 (capital £600,000), which was £80,000 in excess of the previous year.

BRITISH DYESTUFFS CORPORATION, LTD.

At an extraordinary general meeting held at Manchester on June 17, resolutions were unanimously agreed to authorising increases of capital from the original £6,000,000 to £8,000,000 by the creation of 2,000,000 additional preferred ordinary shares of £1 each, and to £10,000,000 by the creation of 2,000,000 additional preference shares of £1 each.

BRUNNER, MOND & CO., LTD.

In presiding at the annual meeting held in Liverpool on June 20, Mr. Roscoe Brunner stated that the issued capital of the company had been increased by £212,000 to purchase nearly the whole of the shares of the Buxton Lime Firms Co., Ltd. Profits had decreased by £99,000, and the dividend on the ordinary shares had accordingly been reduced from 11 to 10 per cent. It is now proposed to increase the nominal capital of the company from £10,000,000 to £15,000,000.

Dealing with the manufacture of high explosives, Mr. Brunner said that most of the TNT originally produced in this country, and also that sent from America and Canada, had been far too impure to be used with safety. The method of purification adopted was invented in the company's laboratories. The process of manufacturing synthetic phenol was so improved by the staff that the company was able to obtain the highest yield in the country. The second largest works, Lostock, was given up to the production of ammonium nitrate, at the sacrifice of a large output of soda ash. This substance was made by three different processes, the first comparatively simple, but the other two presented difficulties which at first appeared to be insoluble. Many new plants were erected, factories were built and old ones adapted; in all, there were nine different plants under the company's control from which more than 5000 tons a week of high explosive material was turned out; in addition plans were supplied for the construction of an ammonium nitrate factory in America with an output capacity of 4000 tons a week. The initial contracts with the Government were undertaken at 5 per cent. profit above cost, but as there had been no desire to make large sums out of war work, this was altered, at the company's suggestion, to a basis of fixed prices per ton of products supplied, thereby reducing the profits considerably. Trade is now apparently beginning to revive—a change which would have come earlier but for the ever-growing demands of labour. During the war, Government factories may have produced on as favourable terms as private works, but the point was debateable; and it must not be overlooked that during that period the State relied much upon the assistance rendered—often gratuitously—by many eminent technical men, which it would not have in time of peace. With regard to coal, the Controller had reckoned on a saving of 700,000,000 ton miles per annum by taking the whole of the distribution into his own hands. The result had not been published, but in the case of Brunner Mond and Co., calculation had shown that his intervention had led to a loss of more than 2,000,000 ton miles per annum.

The report and accounts were adopted and the proposed increase of capital carried unanimously.

BRITISH CYANIDES CO., LTD.

On June 20 the annual general meeting was held in London, Mr. C. F. Rowsell, chairman of the company, presiding. In moving the adoption of the report and accounts, Mr. Rowsell stated that the trading profit for the past year was £62,720, and the net profit, subject to excess profits duty (if any), £20,572, the corresponding figures for the previous year being £67,478 and £36,725, respectively. The decline in profits was more than accounted for by the sudden cessation of the manufacture of an important chemical compound for the Government when the armistice was signed. The issued capital now stands at £278,558, and the reserve account at £23,000. The past year had been a very difficult one, but the future is regarded hopefully, the demand for the company's products being now

again on the increase. With reference to the British Potash Co., negotiations are on foot which, when completed, will secure to the company large supplies of raw material, and place the large-scale production of muriate of potash on a competitive basis.

Mr. Kenneth M. Chance, managing director, referred to the shortage of cyanide in the first year of the war, and described how the company by doubling its output had helped to alleviate the situation. After much preparatory work, which had involved the erection and pulling down of three large-scale plants within three months, it had been able to meet the full requirements of the country for carbonate of potash for optical-glass. The best quality of this substance could only be manufactured from native raw material. Very large quantities of sodium permanganate had been produced for use in gas-masks. In general, the output of the company had increased greatly during the war; the number of articles manufactured increased from two to nine, the weight by 2½ times and the value by 5½ times. Mainly owing to want of confidence, the chemical trade of the country was doing badly at the moment, but he predicted a remarkable period of prosperity as soon as the tide turned. The company would be in a good position to meet demands owing to its large expenditure on new works, shortly to be completed. Amongst other activities, experimental work on a nitrogen fixation process is to be resumed in August next.

THE MOND NICKEL CO., LTD.

Mr. Robert Mond, chairman of the company, has intimated that owing to stagnation of trade and consequent accumulation of stocks, the directors of the company have with great regret been compelled to close down three-quarters of the works. It is hoped, however, that the situation will rapidly improve after the conclusion of peace, and that normal production will then be resumed. Meantime the suspension of work involves the temporary dismissal of a large number of workpeople, but in the matter of employment preferential treatment is being accorded to returned soldiers and others who have done work of immediate national importance.

MAYPOLE DAIRY COMPANY, LTD.

The profits of this company for 1918 amounted to £713,566, compared with £747,249 in the previous year. Since the partial lifting of the blockade there has been a great advance in the price of raw materials owing to competition from countries short of food. Hence there has been a considerable rise in the cost price of margarine. The capital of the company has been increased to £3,000,000 by the creation of 16,000,000 new shares (deferred ordinary) of 2*s.* each, which will be issued at par to holders of the old deferred ordinary shares as and when required.

NEW REGISTRATIONS.—*The British Empire Sugar Research Association* has been registered as a company limited by guarantee to promote, assist and conduct research and other work for the furtherance of the sugar trade or industry. Membership is restricted to British subjects or corporations.

Radiation, Ltd., has been registered to effect a combination of the interests of John Wright and Eagle Range, Ltd., the Richmond Gas Stove and Meter Co., Ltd., and the Davis Gas Stove Co., Ltd. The nominal capital of the new company is £2,750,000.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for June 12 and 19.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REFERENCE NUMBER.
British India ...	Dyes	1166
British W. Indies	Paints, oils, varnish ...	1167
Canada	Chemicals for rubber and paint trades, quinine, magnesium carbonate	1128
,, ...	Chemicals, dyes, textiles	1129
New Zealand ...	Chemicals, fertilisers ...	1131
,, ...	Heavy chemicals ...	1170
South Africa ...	Glycerin for manufacturing purposes	1171
Belgium ...	Chemicals for glass and pottery trades ...	1136
,, ...	Chemicals, dyes ...	1138
,, ...	Dyes, varnish	1139
,, ...	Oils, spirit	1141
,, ...	Perfumes, foodstuffs ...	1145
,, ...	Asbestos	1148
,, ...	Glass, soap, varnish, paint	1149
,, ...	Margarine	1153
,, ...	Ultramarine, soap ...	1154
,, ,,	Iron, steel, bronze, fire-bricks, chemicals ...	1175
,, ...	Chemical and pharmaceutical products, drugs, rubber	1182
,, ...	Steel, cast steel, high speed steel, forged steel	1187
,, ...	Tinplate, colours, paint, varnish, caustic soda, potassium, dyes ...	(3336 T&E)*
Greece	Paint, fertilisers, glass, perfumes, pharmaceuproducts	1188
Italy	Chemicals, copper sulphate, soap	1159
Rumania ...	Tinplate, chemicals, copper sulphate, caustic soda	1190
Spain	Ammonium sulphate, sodium nitrate ...	1194
,, ...	Celluloid, colours, paints	1163
,, ...	Tanning materials, indigo, cochineal, quinine, metallic filaments ...	1195
,, ...	Chemicals, dyes, drugs, perfumes, paint, varnish	1197
Morocco ...	Candles, soap, druggists' requisites	1200
Brazil	Asbestos, paints, chemicals, drugs	1202

* Belgian Section, Department of Overseas Trade, India House, Kingsway, W.C. 2.

TARIFF. CUSTOMS. EXCISE.

Australia.—The importation of all rubber-covered wire is prohibited as from July 1 unless labelled in accordance with certain specified conditions.

Canada.—The importation of cocaine, opium, opium alkaloids, their salts and derivatives is prohibited, except under licence, as from May 14.

The prohibition of the export of Canadian silver coin, bullion and bars has been cancelled as from May 14.

France and Algeria.—The *ad valorem* surtax on imported goods has been increased as from June 14. The rates vary from 10 to 40 per cent. for the "General" Tariff and from 5 to 20 per cent. for the "Minimum" Tariff.

The existing prohibitions on imports have been removed except in some cases which include coal tar products, dyes and perfumes, as from June 20.

French West Africa.—An internal consumption tax of 5 francs per 100 kilo. has been imposed, as from February 28, on salt of any origin whether marine, saline, crystalline or table salt, and whether imported into or produced within the Colonies of French West Africa.

Netherlands.—The prohibition of the export of cork has been cancelled as from May 21.

New Zealand.—The import of goods from Belgium finally manufactured in that country is allowed under certain conditions.

Nigeria.—An additional export duty of £2 per ton has been levied on palm kernels. It will come into operation on a date to be fixed by the Governor and will remain in force for 5 years.

Rumania.—Most of the existing restrictions on the import of goods have been removed as from May 15. Exporters should note that it is necessary for all invoices to be viséd at the Rumanian Legation in London and that firms must produce a certificate from a British Chamber of Commerce certifying that the goods are of British origin and that the prices set forth in the invoice are the current prices ruling in the U.K.

Salvador.—As from July 1, the rates of customs duty on petroleum and gasoline will be 5 centavos (gold) per kilo. in each case.

United States.—On and after July 1, nitrate of soda and potash may be imported without restriction under a General Import Licence when coming from countries with which general trade is authorised.

GOVERNMENT ORDERS AND NOTICES.

EXPORTS.

The Board of Trade has announced the following further relaxations of existing export prohibitions:—

Headings transferred from one list to another.

From List A to List C:

Copper sulphate.—(June 12.)

From List B to List C:—

Malt sugar and articles and preparations containing: coal tar pitch.—(June 12.)

Potash salts and mixtures containing such salts not otherwise prohibited.—(June 19.)

Altered headings.

(A) Aircraft, other than balloons, of all kinds and their component parts, together with accessories and articles suitable for use in connexion with aircraft; quinine sulphate. (C) Cinchona bark, its alkaloids and salts, and preparations of any of these substances, except quinine sulphate.

Exports without licence.—As a result of the removal from List A of preparations containing quinine, except quinine sulphate, the heading on the free list of exports relating to patent and proprietary medicines has been amended to read as follows:—"Medicines, proprietary and patent, except such as contain cocaine, santonin, cod liver oil, opium or opium alkaloids."

Exports of foodstuffs.—An open general licence has been issued permitting the export to unoccupied Germany, Finland, Esthonia, Poland, Lettland (Latavia) and Lithuania, of all foodstuffs except those included in Section A or B of the prohibited list.

Exports to Sweden and Denmark.—Except for goods on Lists A or B, all restrictions on export to these countries, whether by freight or by parcel post, have been removed.

IMPORTS.

General licences have been issued permitting the importation of upper leather and fibre flax seed for sowing.

Certificates of origin and interest are no longer required for goods imported into the United Kingdom from Belgian ports.

Importation of dyestuffs.—The following announcement was issued by the Board of Trade on June 19:—

Whilst the regulation of the import of dyestuffs was primarily necessitated in order to prevent the free access of German materials to this market, it was felt that some measure of control was desirable over all imports if the scheme was to be thoroughly effective. It was therefore decided that a Central Importing Agency should be established under the direct control of the Committee through which all imports of dyestuffs must pass at some stage. As soon as the Committee is in a position to consider applications for the import of German dyestuffs, which will not be until after the withdrawal of the Trading with the Enemy Regulations, the Central Importing Agency will be the medium through which supplies are made available to consumers. Except in the case of German dyes, the agency will now undertake if desired the purchase of dyestuffs abroad on behalf of consumers, but where it is desired to make purchases direct or through recognised merchants the goods will merely require to be consigned to the agency for the account of the particular consignee and the shipping documents made out accordingly. For its services the agency will charge a commission of 1% on the invoice value of the goods with a minimum charge of 5*s.*, but this charge will not include any incidental expenses such as freight insurance, storage, etc., which must naturally be additional and borne by the importer. The offices of the Central Importing Agency for the time being are at 21, Spring Gardens, Manchester. Any firm desiring further information on the subject or wishing to make application for an import licence are advised to communicate direct with the Secretary of the Licensing Sub-Committee at 53, Spring Gardens, Manchester.

TRADE NOTES.

BRITISH.

Sierra Leone in 1917.—The exports of palm kernels during the year 1917 increased by 12,704 tons and in value by £161,863 over those of 1916. The United Kingdom imported 97½% of the total exports of 58,020 tons. The Imperial Government fixed the price of palm kernels in May, 1917, at £26 per ton, but it was found necessary by shippers to lower the price paid to native producers, and this has had an adverse effect on the quantity brought to market. The exports of palm oil, amounting to 543,183 gallons, show a decrease of 2·6%. This is due to the increased consumption for the manufacture of native soap owing to the high cost of the imported article. Of the total quantity exported, 97% went to the United Kingdom. Only 471 tons of plassava was exported, as against 883 tons in 1916, although prices have risen from £44 per ton to £78 per ton. The number of hides exported amounted to 9167, as compared with 14,989 in 1916. The prohibition of the importation of hides into the United Kingdom naturally interfered with this trade. A promising industry in cocoa is being built up in the North Sherbro District. Practically all the cocoa is, however, sold in an unfermented state. A Government Cocoa Station has been established to afford assistance and advice. The groundnut crop suffered severely

from the heavy rains. Over 700 acres have now been planted with gum copal and the plants show great promise.—(*Col. Rep. Ann., No.* 990, *May*, 1919.)

FOREIGN.

Japanese Copper for Germany.—The Japanese Department of Commerce has given its consent to the resumption of the export of copper to Germany. The deliveries will afford immediate relief to the Rhenish-Westphalian and the Upper-Silesian industries; at the moment there is no shipping available.—(*Z. angew. Chem., Mar.* 28, 1919.)

Sulphuric Acid Prices in Germany.—The following new maximum prices for sulphuric acid and oleum were fixed by Government Order on April 24, 1919:—(*a*) Sulphuric acid, up to 78% monohydrate, 510 marks per metric ton. (*b*) Acid, 78 to 92% monohydrate, 1060 marks per ton. (*c*) Highly concentrated acid, over 92% monohydrate, and oleum up to 40% free anhydride, 684 marks per ton. (*d*) For acid for special purposes, *e.g.*, chemically pure acid and acid used for accumulators, the maximum prices will be as above plus an addition proportionate to the cost of production. The above prices are f.o.r. ex-works.—(*Z. angew. Chem., May* 9, 1919.)

Allocation of Potash Sales in Germany.—The Distribution Office for the Potash Industry has regulated the sales of potash during 1919 as follows:—

	Home sale. Double cwt. pure potash (K_2O)	Sale abroad. Double cwt. pure potash (K_2O)
Carnallite, containing not less than 9% and not more than 12% K_2O...	39,000	
Crude salts with 12—15% K_2O...	3,700,000	421,000
Fertiliser salts:		
20—22% K_2O	1,216,000	680,000
30—32% K_2O	49,000	6,600
40—42% K_2O (includ. fertiliser salt of 38% K_2O) ...	946,000	266,000
Chloride of potassium	3,015,000	56,500
Sulphate of potash—over 42% K_2O	72,200	230
Sulphate of potassium and magnesium	20,600	46,500
Totals ...	9,057,800	1,476,830
Grand Total	10,534,630	

—(*Z. angew. Chem., May* 6, 1919.)

Dutch Guiana in 1917.—This colony suffered severely from war conditions during 1917. The production of cacao amounted to 2,243,595 kilo., an increase of 20% over 1916, yet the total crop realised 8% less than in the latter year. The production of sugar for the year was 11,210,209 kilo., and of molasses 530,375 litres. Rubber production decreased about 50% and there seems little chance of increased production. The balata production amounted to 887,565 kilo. Much prospecting and development of the bauxite mines have taken place. Sisal hemp was exported for the first time to the extent of 2225 kilo. The imports included cement valued at £2350; paint and varnishes valued at £7300; and soaps valued at £10,000.—(*U.S. Com. Rep. Supp., Mar.* 13, 1919.)

The Swiss Chemical Industry.—Since the year 1917 when the Swiss chemical industry reached its greatest prosperity the activity of foreign competitors has become increasingly perceptible and the cost of raw materials and of coal, now about eight times its pre-war prices, causes some anxiety. Competition in the dye trade is mostly to be feared from England.

Extensive developments similar to those in the manufacture of sulphuric acid and dyes (this J., 1919, 113 R) have occurred in other chemical industries, such as the production of pharmaceutical substances, the prices of which have fluctuated more widely than those of dyestuffs and now tend downward, and the manufacture of soda, the whole Swiss demand for which formerly supplied by Germany can now be met by the Schweizerische Sodafabrik. Regular supplies of foreign phosphates are still required, but a mixed fertiliser composed of basic slag and potash from Germany and of calcium cyanamide produced in Switzerland, has been found useful.

The electro-chemical and electro-metallurgical industries, although independent of coal, have experienced the prevailing difficulties in obtaining raw materials, but nevertheless, contrary to anticipations at the beginning of the war when several factories ceased working in view of an expected failure of orders, their exports, and notwithstanding swollen costs, their profits, have increased greatly. The relatively small internal consumption of carbide has risen during the war from 3000 or 4000 metric tons yearly to about 15,000 tons; it is used for lighting and welding and for making calcium cyanamide, acetic acid and chlorine-containing solvents. The production of these and of alcohol, acetone and ammonia, for all of which there is a local demand, may grow, since several firms, faced with a withdrawal of foreign orders for ferro-silicon and similar alloys (the internal consumption of which is only about 1500 tons yearly) propose to turn their attention to the production of these substances. New uses for acetylene are as a substitute for motor spirit and for enriching illuminating gas from the distillation of wood. The cast steel produced in the electric furnace by two Swiss firms is approved by local machine-makers.

The following table gives the exports of the substances named during recent years, together with the percentage, to the chief importing countries:

EXPORTS.

Material	Year	Metric tons	Destination %
Pharmaceutical Products	1913	680	Germany, 29 U.K., 9 France, 9 Italy, 9
,, ..	1915	670	U.K., 21 Germany, 18 France, 16
,, ..	1917	800	Germany, 53 U.K., 10 France, 10
,, ..	1918 (9 months)	580	France, 21 Germany, 19 U.K., 16
Calcium Carbide ..	1913	31,800	Germany, 79
,, ..	1915	55,100	Germany, 88
,, ..	1917	59,500	Germany, 63 France, 29
,, ..	1918 (9 months)	57,800	Germany, 59 France, 39
Ferro silicon ..	1913	16,200	Germany, 75
Ferro chrome &c. ..	1915	19,300	Germany, 96
,, ..	1917	22,800	Germany, 99
,, ..	1918 (9 months)	12,200	Germany, 99
Aluminium	1913	7400	Germany, 77
,, ...	1915	9100	Germany, 94
,, ...	1917	11,000	Germany, 97
,, ...	1918 (9 months)	7300	Germany, 97

(" *Rückschau über Handel u. Industrie der Schweiz," Schweiz. Bankverein; Schweiz. Chem.-Z.*, 16—17, 1919.)

REVIEWS.

REPORT ON THE FOOD REQUIREMENTS OF MAN. *By the Food (War) Committee, Royal Society. Pp.* 19. *(London: Harrison and Sons.* 1919.) *Price* 1*s.* 6*d.*

Being the work of a Committee which is reputed to have influenced Government policy during the war, this Report is likely to be ranked as an authoritative document, but under so comprehensive a title a more meagre presentation of the problems of dietetics could not well be given. Nearly the whole of our food, we are told, is slowly burnt in the body, as it might be in a furnace: *therefore*, "the value of a food can be estimated by finding out how much heat it will produce when oxidised or burnt. If the total energy given off by a man in the course of a day is known, it is sufficient to give him a food yielding the same number of utilisable calories in order to cover entirely the requirements of the body. These are the net requirements."

Man, in fact, throughout the report, is treated as little more than a machine—to be stoked at intervals, like a steam engine boiler, with mere combustible matter.

The variations in the requirements, from this caloric point of view, according to age, size, work and environment, are considered at length—mainly with the object of pointing out how insufficient the data are and how difficult it is to appraise the values to be taken into account during the several periods of the day, particularly during work time. The most obvious method, it is argued, would be to define work by the number of kilogram-metres performed in the course of 8 hours. The essential factor, however, is not the mechanical value of the work done but the amount of energy which must be set free in the body—*i.e.* the amount of food or body substance which must be consumed in order to perform this amount of work; it is therefore necessary to know the output of energy in calories actually involved in every kind of occupation. Although the Committee has commenced a research on these lines, many thousands of observations must be made before it will be in a position to appraise correctly the energy requirements of the chief occupations. The greater part of the report is taken up by a discussion of the existing information on the subject, and is interesting reading. But would such data, if available, be of much practical value? Except under severe compulsion, such as war conditions involve, the masses are not likely to submit to academic limitations of the food supply: appetite and economic conditions are fairly certain to determine the public taste and demand. In the course of the account of his celebrated series of observations, dealing with the importance of accessory factors in normal dietaries, published in 1912, Gowland Hopkins makes the remark—

"Only those perhaps who have had the experience of feeding animals with excess of food and have noted the amount eaten for considerable periods, will realise how well adjusted, under normal circumstances, is the instinctive appetite to the physiological needs."

Taking into account the many personal and other factors that are operative, it is clear that a vast amount of labour would be spent to little purpose if an exhaustive experimental inquiry of the kind spoken of were carried into execution. We might almost equally well set to work to determine the amount of heat energy that should be expended "theoretically" in the various separate operations in the kitchen and in warming the house and allowance fuel accordingly—leaving out of account the fact that the heat usefully developed is a function of the stove and also of the operator, as well as of the fuel used.

The special requirements of children and adolescents are considered at considerable length but in somewhat naive terms, and the discussion does not carry us much, if at all, beyond the point at which we are left by ordinary common sense observation. Fortunately, it is recognised and insisted that the requirements of the young are high—at least equal to, if not greater than those of the adult, after childhood. Strangely enough, the schoolboy of the well-to-do classes is referred to as "well-fed and over-exercised"; over-exercised he may be, but as a rule he would scarcely describe himself as well fed at school; too often, it is to be feared, he is underfed, having regard both to the quality and variety of his food. Barlow's disease, an outcome of malnutrition, it is well known, was first met with in the homes of the rich.

The food requirements of brain workers form a separate section, but these again are considered mainly from the energy point of view—without taking into account the possibility that they may require an extra supply of reparative materials present in small proportions in many foods only; the use of a large proportion of protein food is recommended, but only on account of this being spontaneously oxidisable apart from the exercise of muscular activity.

The last chapter is devoted to the consideration of quality, under the headings of proteins, meat, carbohydrates, sugars, fats and accessory substances or "Vitamines." Although the accessory substances are referred to and stress is laid on their importance in the final section of this chapter, this is done in far too curt a way, only a third of a page out of nineteen being occupied by the discussion; taking into account how much has been learnt quite recently of their peculiar and essential value and of their limited distribution in foods in view particularly of the important contributions made by the English school to their study, it is surprising that so little is said on the subject. However inadequate our present knowledge of the science of nutrition may be, it is far from being so inadequate as the reader of the report might think. The Committee seems to have thought almost always in terms of calories; it may be suspected that the report was written only from this point of view, and that, in revising it, a wise editor inserted here and there a few lines which serve to give real guidance such as the following for example:—

"*As a general rule one may say that the protein in the diet of the average man should not fall below* 70—80 *grammes* (2½ *to* 3 *ozs.*) *a day. The protein should be derived from a mixed diet and should include, if possible, a certain amount of protein of animal origin.* The special value of animal proteins and especially those of milk, for building up the body, is one of the reasons why milk is of such supreme value in the feeding of infants and young children, and *no diet for such can be considered satisfactory which does not contain a considerable proportion of milk.*" K

THE PRINCIPLES OF BLEACHING AND FINISHING OF COTTON. *By* S. R. TROTMAN *and* E. L. THORP. *Second Edition, Revised. Pp.* 347. *(London: C. Griffin and Co.* 1918.) *Price* 21*s. net.*

It is to be regretted that the authors, owing to circumstances arising out of the international situation, have not had the time to re-write this book for the second edition, because since the publication of the first edition quite considerable progress has been made on the scientific side of the industry treated. This new knowledge reduces the first two chapters on the structure and constitution of cotton to little more than history, and the matter on bleaching and bleaching powder would require considerable alteration.

The chapter on cotton testing might have included an account of the accurate testing machines used for determining the breaking strain and elasticity of yarns and papers, for it is only by using accurate instruments and making a large number of breakages that reliable information regarding strength can be obtained. The carbohydrates are discussed at length; the manufacture of starch is fully described although finishers do not make their own starch. The subject of alkali boiling is treated in a scientific manner. The authors make out a case for the caustic soda boil in place of the lime boil, sour, ash boil, but, perhaps, if their experience was of the Lancashire instead of the Nottingham trade, they would have different views.

Presumably this is the first book which has touched on the scientific side of finishing, for hitherto scientific development has little affected this industry. The descriptions of machinery are of great interest, and this book should be read by all bleachers interested in the scientific side of their occupation. S. H. HIGGINS.

COAL TAR DYES AND INTERMEDIATES. *By* E. DE BARRY BARNETT. *Pp. xvi* + 213. (*London: Baillière, Tindall, and Cox.* 1919.) *Price* 10*s.* 6*d. net.*

The introductory section of this handy treatise on coal tar dyes and intermediates contains a very readable historical summary which *inter alia* serves to lay stress on the value of work often underestimated as being purely academic. The author states that the full importance of the introduction of the first azo-colour was recognised only twelve years after this discovery, when "Griess and Kekulé had published their work on the constitution of the diazo- and azo-compounds." It is, moreover, interesting to note that for nine years after the discovery of Perkin's mauveine, "aniline colours had only been obtained by purely empirical methods" until the publication of Kekulé's benzene theory, which "at once placed the whole chemistry of the aromatic compounds on a scientific basis." In the reviewer's opinion these quotations contain a warning to which the exigencies of the present transition period are blinding many would-be educational reformers.

Attention is drawn to the defective and often purposely misleading nomenclature of colours. Alizarin yellow has no chemical relationship to alizarin, and azo-carmine is not an azo-dye. Unfortunately, however, there are cogent trade reasons for this irrational terminology.

The main portion of the book is divided into two parts, of which the first gives a summary of the preparation of intermediates, the primary reactions of nitration, sulphonation, chlorination and oxidation being discussed together with the secondary processes of amidation and hydroxylation. A useful introduction is given to the complex chemistry of the sulphonic acids of the naphthylamines, naphthols and aminonaphthols.

The second and larger part of the treatise is divided into fourteen sections, each giving an outline of the chemistry of a group of colouring matters. The large section on the important azo-dyes includes also a reference to the allied stilbene, pyrazolone and thiazole dyes. The sections on indigoid and anthraquinoid dyes contain an up-to-date synopsis of these complicated and valuable dyewares.

Each section is furnished with references to original memoirs and to patent literature. In view of recent developments among British dye producers, the author's experienced views on the future prospects of the synthetic colour industry in this country will be read with special interest.

The book shows signs of haste in proof reading, and contains several orthographical errors. The following are unconventional spellings of well-known chemicals:—pyrolousite, crysoidine, chrysalliline, istaine and alkaly. The names of Nevile and Winther are invariably given incorrectly. There is perhaps sufficient reason for distinguishing between the commercial products "benzol" and "toluol" and the chemical substances "benzene" and "toluene," but the necessity for a third set of synonyms "benzole" and "toluole" is not apparent. The Teutonic "oxy" is too frequently used as the equivalent for "hydroxy." The constitution of "J" acid has proved a pitfall. On page 62 is a bewildering account of the preparation of this important intermediate, rendered almost incomprehensible by an erroneous substitution of α- for β- positions in both the given recipes. A similar confusion is noticeable on page 109 in the graphic formulæ for the aldehydic and thiazole condensations of this acid.

Apart from these blemishes, which will probably be absent from the next edition, the treatise may be warmly recommended as a useful and practical introduction to the chemistry of synthetic intermediates and dyes. G. T. MORGAN.

SEASONING OF WOOD. *A treatise on the natural and artificial processes employed in the preparation of lumber for manufacture, with detailed explanations of its uses, characteristics, and properties. By* JOSEPH B. WAGNER. *Pp. xiii* + 274, *with* 101 *illustrations.* (*New York: D. Van Nostrand Company,* 1917.) *Price* 16*s. net.*

The great world-shortage of seasoned timber from which we are now suffering compels the universal adoption of artificial seasoning whenever possible, and it is with pleasurable anticipation that we turn to any work on the subject. That now before us is well printed and bound and has excellent plates, but so far as they illustrate seasoning their value is greatly depreciated through lack of adequate explanation in the text. Both the text and the glossary are marred by many gross mistakes and popular misconceptions. Statements such as the following appear frequently: "Resin in its hardened state as produced by heat is only slowly soluble in water and contains a large proportion of carbon, the most stable form of matter" (p. 158). "Where these means are applied which rely on heat alone to accomplish this purpose, only that of the moisture which is volatile succumbs, while the albumen (*sic*) and resin becoming hardened under the treatment, close up the pores of the wood" (p. 159).

With reference to the artificial seasoning of timber the sole parts worthy of note are taken in detail, without acknowledgment, from Tiemann's writings or U.S. Forestry Service Bulletins.

The book is nearly worthless to technologist and practical man alike, and is a great contrast to Tiemann's excellent work on the same subject.

G. STANLEY WALPOLE.

PUBLICATIONS RECEIVED.

THE ANALYSIS OF MINERALS AND ORES OF THE RARER ELEMENTS. *By* W. R. SCHOELLER *and* A. R. POWELL. *Pp. x*+239. (*London: Charles Griffin and Co., Ltd.* 1919.) *Price* 16*s.*

THE MANUFACTURE OF VARNISHES AND KINDRED INDUSTRIES. *Vol. I. The Crushing, Refining and Boiling of Linseed Oil and other Varnish Oils. Based on and including the "Drying Oils and Varnishes" of Ach. Livache. By* J. G. MCINTOSH. *Third edition, revised and enlarged. With* 114 *illustrations and numerous tables. Pp. viii*+498. (*London: Scott, Greenwood and Son.* 1919.) *Price* 17*s.* 6*d.*

CHEMICAL COMPENDIA IN THE ENGLISH LANGUAGE.

W. P. WYNNE.

The need for collating chemical data, arising from the accumulation of an ever-growing mass of material, was met in the first instance by the publication of dictionaries such as those identified with the names of Gmelin, of Watts and of Muir and Morley. Then, towards the close of last century, dictionaries gave place to compilations like Beilstein's "Handbuch der organischen Chemie" and Richter's "Lexikon der Kohlenstoff-Verbindungen," by reference to which it was possible for research workers quickly to identify, or to recognise as new, any compound which might be produced in the course of an investigation. Before the end of 1910, each of these publications had run through three editions and the preparation of a fourth edition of Beilstein's Handbuch was projected by the German Chemical Society. This fourth edition may reach 15 volumes, towards the cost of which subscriptions amounting to a total of 2,500,000 marks (£125,000) had been obtained by the end of June 1918, including contributions of 300,000 marks each from the large German chemical firms. In addition, a new publication, replacing Richter's Lexikon, was promoted by the same Society under the title "Literatur-Register der organischen Chemie," of which one volume, covering the period 1909-11, appeared in 1913, its production being subsidised by one of the German chemical firms.

Dependent on these German publications, chemists in the Allied and Associated countries have been handicapped since the outbreak of war by the fact that, outside of Germany, no organisation existed by which summaries of the organic chemical literature could be continued and brought up to date. This dependence on German compendia, moreover, had the effect of fostering the illusion that chemistry is a branch of science in which Germany especially excelled and of stimulating that flow of trained chemical students to German laboratories, which, by denuding non-German Universities of their most promising men, contributed to the German research output, while making research work difficult to organise in this and other countries for lack of workers.

Moved by these considerations, and with a full experience of the difficulty encountered in the many organic chemical industries, set on foot or expanded during the war, owing to the inaccessibility of German compendia, a strong committee was formed in Manchester towards the close of 1917, with Mr. F. W. Atack as secretary, to promote the compilation of chemical compendia in the English language. One important point in the case made by this committee was the necessity of restoring the prestige of the English-speaking nations in the domain of chemistry, and another was the need for an impartial survey of the literature both of inorganic and organic chemistry. German compendia, it is well known, are incomplete in regard to other than German literature, and in the new Literatur-Register (probably also in the new Beilstein) the references to non-German literature are made, without mention of authors' names, to abstracts of the original papers published in the "Zentralblatt," thus preventing reference to any other index or series of abstracts except through the medium of that German publication.

Early in last year, when the committee's proposals had received a sufficient body of support from the academic and industrial sides of chemistry, application was made to the Department of Scientific and Industrial Research for a grant in aid of the scheme. This application having been referred by the Department to the Council of the Chemical Society, the question of the publication of chemical compendia in the English language was remitted to the General Committee of Chemical and Allied Societies. At a meeting of this body in March 1918, the following resolutions were adopted:

i. That in the opinion of this meeting it is expedient to publish an English work of reference completely covering scientific and industrial chemistry on lines similar to those of Beilstein;

ii. That this resolution be communicated to the corresponding American chemical societies and their co-operation invited.

At this meeting, an executive committee was appointed to draw up a report on the scope, organisation and cost of the proposed compendia. This report, submitted to the General Committee of Chemical and Allied Societies in November, was adopted in an amplified form as a Final Report on January 30, 1919. Copies of this Final Report, as also of the earlier one, were sent to the American Chemical Society, with which body as with American chemists generally the closest co-operation is desired; copies of the Final Report were also sent by the Chemical Society to the corresponding Societies of Paris and Rome with the view of eliciting support for the scheme from French and Italian chemists.

Briefly, what is proposed is the compilation and issue of two compendia in the first instance—one for organic and the other for inorganic chemistry. The former is projected on the model of Stelzner's Literatur-Register, but containing more detailed information than that book and with complete references to original sources; the latter, by following Gmelin-Kraut's or Abegg's mode of treatment of the material, is to be the more readable. Arrangements have been suggested for ensuring rapid publication of the volumes dealing with organic chemistry covering the period from 1909 to the present time and for the publication of supplements at regular intervals.

How far these plans, and others for the compilation of patent and other literature of the Allied countries can be placed on an inter-Allied basis, and effect given to them in the near future, is one of the problems to be discussed at the London meeting of the Inter-Allied Federal Council. It may be hoped that simultaneous publication in English and in French may solve the difficulty in which American, British, French and Italian chemists find themselves placed as one of the consequences of the war and, incidentally, serve to falsify yet one more German prediction (*v.* Le Blanc, "Zentralblatt," June 26, 1918) to the effect that, "as no other nation at the present time commands such organised information as is furnished by German handbooks and literature-registers, it is practically impossible for the initial German advantage to be made up."

An opportunity such as the present is not likely again to arise, and if it be seized with something of the energy which, in other directions, has won the war for the western nations, it will no longer be true—again to quote Le Blanc—that "every foreign student is compelled to fall back on German chemical literature and in this manner chemistry acts as a missionary of the German language." No longer is it tolerable to suffer this type of German penetration in the field of pure and applied chemistry, to the development of which the Inter-Allied nations have made so large and fertile a contribution.

CONDITIONS CONTROLLING THE SUCCESSFUL CULTIVATION OF THE SUGAR BEET.

J. P. OGILVIE.

In the United States the beet sugar industry is now firmly established. During the year 1917-18, the number of factories operating was 91, the area cultivated was 661,797 acres, and the total quantity of sugar manufactured was 765,207 tons. Practically all this production was "white granulated," that is a grade of sugar of sufficiently high quality to be directly consumed without passing through the refinery.

A considerable time elapsed, however, before it was possible to regard the position of beet cultivation in America as fully assured, and the history of its establishment provides the most instructive lesson possible to us who desire to see the industry founded in this country. Those who have studied the question must have been impressed with the fact that it is much more complicated than might at first sight appear. It has been demonstrated convincingly that crops of beet at least as large per acre, and at least as high in sucrose content, as on the Continent can be cultivated in the United Kingdom; while it is equally certain that the extraction of the juice from the roots and its conversion into commercial sugar in the factory could be carried out here as well as elsewhere. But this is by no means the whole question. On coming to consider the larger problem of the cultivation of the beet by farmers on an industrial scale for manufacture in competition with other sources of supply, one realises that there are many conditions that must receive careful attention.

Dr. Harris' recently published book* treats in the main of the practice of cultivating and harvesting the beet, and is written more particularly for the use of the farmer; but it also contains information dealing with the economic conditions which in America have been found to control the successful carrying on of the industry. Most of these conditions must be met also by us on this side if commercial success in this direction is to be achieved; and a brief review of them, therefore, would seem to be opportune at this time when at last the Government has introduced fiscal legislation definitely favourable to the foundation of the industry in the United Kingdom.

It is made very clear that the life of the industry depends upon the efficiency of the farmer, who must receive education in the special methods followed in this branch of cultivation. Every operation from the ploughing of the land to the delivery of the roots calls for skill and painstaking care, and none can be slighted without being reflected in the returns. Dr. Harris remarks (page 51) that "the farmer who would succeed must get down on his knees and use his fingers, almost fondling each plant, and if he is not willing to do this he will not make a good beet farmer." As the high sucrose content and purity of beets are artificial characters produced by years of special cultivation, selection, and breeding,† the quality of the crop is subject to modification by cultural methods. It not only responds readily to good treatment, but it quickly deteriorates under bad. In therefore considering the advisability of establishing a factory in a particular district, consideration should be given to the farmers who will raise the roots, the methods to which they have been accustomed, and their possible adaptability to the new practice.

Not only must the farmer be trained to be efficient in his methods, but he must be urged to show an attitude of enterprise in order to lower working costs. Beet sugar manufacture, it should always be borne in mind, operates more or less in competition with cane sugar produced on colonial plantations, where labour is cheap, and where moreover, methods of agriculture and manufacture are constantly being improved.* It is pointed out (page 232) that "if we are to produce sugar in competition (with that made from the cane), it is essential that our labour should be made as efficient as possible by the use of machinery, and the application of scientific methods to the farm. . . . It is on the farm that this greater efficiency must be sought, since the price paid for the roots is the chief item of expense involved in the cost." On the other hand, the cost of actually manufacturing the sugar from the roots is a fairly constant value, and is easily estimated and controlled. The success of this branch of the industry may safely be left in the hands of the experienced technologist.

There is the important question of labour of a suitable kind, of which a sufficiency at a reasonable rate must be assured. In America it has been found that the hand labour involved in the cultivation of the beet is more than ten times that required for wheat, five times that for corn, and twice that for potatoes; while the horse labour is three times that used for wheat, oats, and barley. Again it is insisted (page 48) that "since manual labour constitutes nearly half the total cost of growing beets, and since more than two-thirds of this comes at the time of thinning and harvesting, it is imperative that as many labour-saving devices as possible be used." It is pleasing to note that relief at the harvest season to some extent seems to be in sight, for a number of mechanical toppers are proving successful, though there still remains the labour expended in blocking and thinning. In these two operations, as well as in topping, children can be employed to advantage, finding in this way work that is at the same time remunerative and healthful.

Among the other conditions controlling the successful cultivation of the sugar beet discussed by Dr. Harris may be mentioned the question of capital, for beet raising requires more than most other crops. Special planters, cultivators, harvesters, and the like are required, upon which a certain amount of money must be expended before returns are obtained. It, therefore, frequently becomes necessary for advances to be made to the farmer; or, alternatively, for the sugar company to furnish implements, and also to render other financial aid during the growing season.

In America it is noticeable that in many districts beets are not grown, in spite of the fact that the soil may well be adapted for the purpose. This circumstance is due to the competition of other crops, and generally can be observed in parts near large towns, greater financial returns to the farmer being obtainable from market garden crops. Transport of the roots is an important factor in the States. If roots are cultivated more than a certain distance from the factory, the railway must be accessible, for ordinarily it is found that beet cannot be advantageously hauled more than two or three miles. Lastly, there is the obvious condition that a certain supply of roots from season to season must be assured from the farmers in the particular district in which the factory is to be located.

* "The Sugar Beet in America." By F. S. Harris, Ph.D., Director of the Utah Agricultural Experiment Station. (The Macmillan Company, New York.) 1919. Price $2.25.

† An outline of the manner in which selection and breeding are effected was recently given by F. V. Darbishire (this J., 1919, 21 R).

* Cane sugar imported from the insular possessions of the United States (Hawaii, Porto Rico and the Philippines) pays no duty, while that from Cuba is admitted at a reduction of 20 per cent. from the rate imposed upon sugar from other foreign countries. Home-produced beet sugar, therefore, is in direct competition with cane sugar from these sources, and also with that made in the Southern States, namely Louisiana and Texas.

These briefly are the more important conditions that have been found to obtain in America during the years taken to place the beet sugar industry in its present established position. They resolve themselves generally into the education of the farmer; the organisation of labour; and the provision of capital. In order to overcome the difficulties involved in carrying them into practice in this country, and thus to avoid discouraging failures at the outset, it would seem desirable, in fact necessary, that concerted action should be taken to meet them. Already the Government has guaranteed financial assistance in the erection of a factory at Kelham, Nottinghamshire,* but it is much to be hoped that State aid will be further extended in the way of directing and assisting the efforts that may soon be made to promote the British beet sugar industry.

At the present moment much might be learnt from a general examination of the methods of beet cultivation (and perhaps also of sugar manufacture) followed in other countries, and this is a matter that might be directed by the Government. On the Continent it has been the custom in the beet sugar industry for years past when it has become necessary to investigate technical matters that from time to time have arisen, such as the combating of plant diseases, or the adoption of improved devices in the field or factory, to appoint a small commission for the purpose of reporting upon the prevailing practice elsewhere. It is certain that a visit to other countries of two or three British agriculturists and technologists in order intimately to investigate the present conditions there would at this time be productive of information of the most useful kind.

In conclusion, some of the many benefits that have been found to accrue from the establishment of the beet sugar industry in America and elsewhere may be mentioned. Mr. Truman G. Palmer, a recognised authority on the subject, recently wrote† "For 15 years I have made a personal study of the sugar industry in the United States, Germany, Austria-Hungary, Russia, France, Belgium, Holland, Denmark, Sweden, and some portions of the tropics. In the above named countries of Europe, I have met or studied the writings of their leading agriculturists, economists, and other thinking men, and without exception they state that the culture of sugar-beets raises the standard of their agricultural methods as does no other crop, rids their fields of noxious growths, puts their soil in better condition, increases by 25 to 80 per cent. the average yield of all other crops grown in rotation. . . . In no beet country visited was there found a disposition to regret its establishment, or the money it cost to establish it."

Dr. Harris also has observed that in the States beet production has stabilised the industry of agriculture in different parts, affording farmers an assured market for a crop, the cost of producing which can be calculated with a fair degree of accuracy, whereas the profits from certain other kinds of produce are less secure. Beet cultivation demands deep ploughing, and the result is that the crop following in the rotation is benefited in a marked degree. It promotes efficient farming generally, since at every stage thoroughness is necessary, this being reflected in the raising of other crops. During the winter months employment is given in the sugar factory to many who might otherwise be idle. Increased business to a number of other industries not directly connected with the farmer is promoted, such as those concerned with transport, machinery and plant construction, and fertiliser manufacture. Cheap cattle foods made from the by-products of the farm and factory are provided, and several secondary industries arise from the use of sugar-house products. Finally, one of the most important contributions of the beet-sugar industry to the welfare of the general community is that it assists in ensuring national dependence in the supply of a most necessary article of food. After our experience in regard to the sugar supply of this country during the war, it is hardly necessary to elaborate this point. It is one which literally has been brought home to every one of us.

* This J., 1918, 77 R.

† *Journal of the National Institute of Social Sciences*, July, 1916.

SOME RECENT ADVANCES IN THE MEASUREMENT OF HARDNESS IN METALS.

F. C. THOMPSON.

As Le Chatelier has pointed out, the property of hardness, since it obeys neither the law of addition nor that of equivalence, cannot be measured in terms of any absolute unit. Two materials which appear equally hard on one scale generally appear unequal when referred to another. It is therefore only possible to refer this property to certain well-defined empirical scales which admit of comparative results being obtained. In these circumstances it is not surprising that a generally acceptable definition of hardness has not been formulated; but that due to Sir Robert Hadfield—"hardness is resistance to deformation"—is sufficient for practical needs.

The static hardness tests include the well-known Brinell test, in which a hardened steel ball commonly of 10 mm. diameter is forced into the sample under a given load of, for the harder metals, usually 3000 kilo., and for the softer ones 500 kilo. The hardness number is then defined as the ratio of the load in kilo. to the spherical area of the impression produced in sq. mm. In Ludwik's test a 90° cone is substituted for the ball, the hardness being as before taken as the ratio of the load to the conical area of the indent, *i.e.*,

$$\frac{P}{\pi a^2 \sqrt{2}}$$

where a is the radius of the impression.

The superiority of this test over Brinell's lies in the fact that the deformation produced is geometrically similar for all loads. A test suggested by Auerbach in 1891, which although it has not found much practical application might yet in certain cases be of value, is one in which two similar samples of the material under test, either in the form of cylindrical or square bars, are pressed into each other, the load per unit of flattened area being taken as a measure of the hardness.

The unsatisfactory nature of the Brinell test as a measure of hardness is shown by the fact that the value obtained, so far from being a constant for a given material, varies with the diameter of the ball used and the load applied. Thus for equal loads the smaller the ball, and for the same sized balls the higher the load, the greater is the hardness numeral obtained. The time during which the maximum load is applied is also a cause of variations, especially with very soft materials. Thomas has shown that, for a very soft steel, the Brinell number under otherwise constant conditions of test may change from 128 to 115, according as the load is applied and at once removed, or is left on for 10 minutes, respectively. For harder materials, the time factor becomes of much less importance except in the first few seconds of the test, the Brinell number for a tempered nickel-chrome steel changing only from 340 when the pressure was maintained for 10 seconds to 335 after 2 minutes.

The variations produced by altering the diameter of the ball or the load applied arise in part, at any rate, from the fact that the deformations produced under varying conditions are not geometrically similar. It has therefore been repeatedly suggested during recent years that the *modus operandi* of the test should be altered so that a definite degree of deformation should be produced and the load required be measured. This method, although undoubtedly superior to that in use in the standard test, is applicable chiefly to special purposes only, since it is possible to obtain a result in one operation only when the depth of the indentation is automatically recorded—a method which has not received a very cordial reception. When the diameter of the impression is measured at least two tests and a calculation are necessary. It must also be borne in mind that on account of the extrusion of metal around the indentation, hardness numbers calculated from the depth and diameter, respectively, do not coincide, the former being rather higher as is illustrated in Table I.

TABLE I.

Material	Hardness no. at 900 kilo. calculated from depth	Hardness no. at 900 kilo. calculated from diameter
Mild steel ...	126	111
Rail steel ...	197	174
Cast iron	235	190

As examples of the tendency to modify the Brinell test by working with a constant deformation, it may be mentioned that the U.S. Bureau of Standards has used as a measure of hardness the load in kilo. required to produce an impression one mm. deep, while Martens adopts a standard indent 0·05 mm. deep with a ball 5 mm. in diameter. The latter excessively small deformation is in line with the view now rapidly gaining ground that the impressions often used at the present time are far too large.

The influence of the load in determining the Brinell number has been investigated by a large number of workers. According to Benedicks, if Ho is the hardness number with a load Po and H the corresponding number under a pressure P, then $Ho = H\frac{\kappa + Po}{\kappa + P}$ where κ is a constant, which for steels is about 1000. A most interesting research by Greenwood on the hardness of copper-aluminium alloys leads to the following conclusion:—The hardness (Brinell) of any material measured with a standard 10 mm. ball and a load of P kilo. can be expressed by an equation of the general type $H = \kappa + P^x$, where κ and x are constants depending on the substance under test. For a copper alloy containing 10 per cent. of aluminium $H = 39 + P^{0·17}$, while for mild steel $H = 80 + \sqrt{P}$. It is of interest in this connexion to note that, as was pointed out by the present writer, the constant κ is a function of the elastic limit of the material, $0·3\kappa$ being a rough measure of the yield point. It may, therefore, be said that the Brinell number under any load is the sum of two factors, one of which is a function of the elastic limit while the other is dependent on the extent to which the material is hardened by cold work.

An empirical relationship has recently been pointed out by Russell, who has shown that for a very wide range of materials $P = aV^m$, V being the volume of the indentation produced by a pressure P, a and m being constants for each material. The value of m is almost 0·6 for most of the materials tested. For Greenwood's 10 per cent. copper-aluminium alloy, $P = 1000\ V^{·62}$, and for a 0·3 per cent. carbon steel $P = 1169\ V^{·577}$, the volume being measured in cu. mm. From the relationship $P = aV^m$ when V is unity $P = a$, and a new hardness number is therefore defined by Russell as the load in kilo. which will displace 1 cu. mm. of the metal. This formula is similar in type to that of Meyer, who showed that $P = ad^n$, n being a constant for a given material, d the diameter of the impression produced under a load P, and a a constant for a given material and given diameter of ball.

When the depth of impression is plotted against the corresponding load it has been shown by Bateson that the graph obtained consists of an initial curved portion which is succeeded by a straight line. From the slope of the latter, hardness numbers are obtained which are independent of the load. By this means, therefore, values can be obtained with lower loads on soft materials comparable with those obtained under standard conditions on steels—a conclusion of considerable importance.

Passing on to a consideration of the size of the ball used, Moore has shown that from two impressions under loads P and P_1, which produce indents of diameter d and d_1 with the same ball of diameter D, the hardness number corrected to standard conditions is given by $H = \frac{16PD^{n-2}}{\pi(2d)^n}$ where n is a constant, between 2 and 2·5, depending on the material and equal to $\frac{\log. P_1 - \log. P}{\log. d_1 - \log. d}$. Using this formula results have been obtained with a 4·76 mm. ball, which coincide with those from the standard test, and with those resulting from the Ludwik cone test.

This hardness figure is calculated from the *projected* area of the indentation, *i.e.*, $\frac{\pi d^2}{4}$, and not the spherical area. The corresponding Brinell number is obtained by multiplying this result by 0·933. The use of the plane projected area has also been advocated by Unwin, who pointed out that by its use in the Brinell and the Ludwik tests the hardness numbers should be the same in both cases. Experiments, however, have shown that, when calculated in this manner, the values are not the same, the Ludwik hardness being in general lower than the Brinell. The following table gives an idea of the relation of the numbers obtained in the standard Brinell test to those obtained by calculation from the projected area $\frac{\pi d^2}{4}$.

TABLE II.

Diameter of indentation	Brinell no.	Hardness no. calc. from $\frac{\pi}{4}d^2$
2·5 mm.	600	612
4·0 ,,	228	239
6·0 ,,	95	106

In the determination of the hardness of very small specimens a 10 mm. ball is inapplicable, and an ingenious modification of the test due to Dr. T. Baker allows of results being obtained with small balls, say 1 mm. in diameter, identical with those derived in the normal test. So long as the ratio of the load to the square of the diameter of the ball is maintained constant the diameter of the impression is directly proportional to that of the ball. The accuracy of the statement is shown by the following results:—

TABLE III.

Diameter of ball	Load in kilo.	Diameter of impression	Brinell no.
10 mm.	3000	4·75 mm.	159
7 ,,	1470	3·33 ,,	158
5 ,,	750	2·35 ,,	163
1·19 ,,	42·5	0·567 ,,	158

Considerable amount of attention has lately been paid to impact hardness tests. It was shown by Roos that, using a ten mm. ball as the indenting tool, the energy of the blow is proportional to the square of the spherical area of the impression. A more general relationship, due to Martel, which applies equally to ball or cone tools, defines the dynamic hardness number as the ratio of the energy of the blow in kilo. to the volume of the indentation in c.c. This definition has been adopted by Edwards and Willis in their recent work on this subject, in which a falling weight with an impact energy of 63 inch-lb. to which a 10 mm. ball is rigidly fixed produces the indentation. The relationship of this test to the standard Brinell is given by the formula $H = \frac{7582}{d^3}$, where d is the diameter of the impression produced by the impact.

It was also shown by these investigators that when the energy of the blow E was altered $\frac{d}{\sqrt[4]{E}}$ is a constant for each material. The technical value of the impact hardness test is evident in that the time factor is completely eliminated, and secondly that by its means hardness tests may be made on metals at high temperatures. The hardness of a given material, however, when measured under dynamic conditions according to Martel's formula is always appreciably higher than when determined under the standard static test. For most materials the ratio of the dynamic to static values is somewhere about 1·5, though for cast tin it is 4·3, for cast zinc 2·84, and for "Armco" iron 2·06.

Of the tests which are dynamic in character, the Shore scleroscopic method is by far the most important. A diamond-faced hammer weighing about 40 grains drops upon the specimen under test from a given height, the height of rebound being used as the hardness number. The area of the indenting point is stated to be $\frac{1}{2500}$ sq. in. A slight permanent indentation is produced, the height of rebound being diminished as the work spent in doing this is increased. The Shore and Brinell values for the same material bear no very constant relation to each other, the average value of the ratio of the Brinell to the scleroscopic hardness number being approximately shown in the following table:—

TABLE IV.

Brinell no.	Ratio of Brinell to scleroscope values.
150	5
300	5·7
450	6·3
550	6·6
700	7·2

CORRIGENDA.—"Recent Iron-Ore Developments in the United Kingdom." In the analyses of Jurassic ironstones on page 221 R (issue of June 30), insert "moisture" in lieu of "water (combined)"; and the average percentage of silica in Northamptonshire ironstone should read 14.7. instead of 11.7.

PROLONGATION OF PATENTS.

A patentee may present a petition to the Court praying that his patent may be extended for a further term, and in considering the petition the Court shall have regard to the nature and merits of the invention in relation to the public, to the profits made by the patentee as such, and to all the circumstances of the case.

The object of this provision of the existing law is apparent. The intention of the patent grant—that the inventor shall have opportunity of obtaining reward—frequently fails. Where this is due to circumstances over which the patentee has no control it is only fair that he should be given a further opportunity, always with due regard to his original merit and the degree of his want of success.

The petition to the Court involves a searching inquiry, it being of the utmost importance that accounts with reference to the working of the patent should have been kept and should be produced to the Court. Thus the expense of the proceedings is considerable.

The exigencies of war have prevented many patentees from working their patents, and those who think fit to petition the Court for an extension of the term will undoubtedly find this fact much in favour of the petition.

To patentees, however, this does not appear sufficient. In the majority of cases the circumstances over which the patentees had no control were the direct action of the Government in commandeering their works, in refusing to supply material, in conscripting the patentee himself and the like. Why should the patentee be put to the expense and trouble of an elaborate inquiry to show that had it not been for the war he might have been sufficiently remunerated?

Thus there has arisen a demand for some procedure simpler than the petition to the Court for obtaining an extension rather as a redress for a grievance than as an act of grace born of sympathy.

The demand seems rational. The patentee is not in the same position as the ordinary manufacturer or trader. The misfortunes of war have affected these also; but in making good they are not limited by man's decree.

It is not the principle at stake that creates difficulty, but the mode of applying it. There are those who advocate a simple plan; they would add automatically, or at all events on demand, to the life of the patent that portion of its life which was lived during the war. Unfortunately the problem is not so simple as the proposed solution.

As nearly as can be ascertained, in 1915, some 594 patents attained their fourteenth year and expired; in 1916, 596; in 1917, 653; in 1918, 804. If each of these is to be resuscitated for 3, 2 or 1 year, as the case may be, what is to be the position of those who have started manufacture during the lifeless period?

Again, the hardship which it is desired to alleviate is not universal, or uniform; there are patents which have been worked during the war even more profitably than previously; others have only partially suffered. In justice to the public some patents should be excluded from the proposed extension; others granted it in minor degree; but how is the Comptroller to differentiate?

It is to be feared that a judicial inquiry at which objectors may be heard cannot be avoided. What is certainly required is a less costly and exhaustive inquiry than the current procedure before the High Court; for this the reformers should press.

AN anonymous gift of 1½ million dollars has been presented to Cornell University, U.S.A., for the establishment of new chemical laboratories.

THE SECOND BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

The opening ceremony took place at the Central Hall, Westminster, on July 3. Lord Sydenham, president of the British Science Guild, under whose auspices the exhibition is being held, presided, and was supported by many distinguished representatives of pure and applied science. The speakers included the Rt. Hon. the Marquess of Crewe, the Rt. Hon. Lord Moulton, Sir Philip Magnus, and Sir Richard Gregory (chairman of the Organising Committee). Lord Crewe, in opening the exhibition, dealt, *inter alia*, with the means of preparing students to take an early part in industrial life. The pursuit of definite industrial courses during vacations had always seemed to him to be a particularly hopeful plan. The custom of taking small bodies of selected students on tours for terms of 6—8 weeks to works was also to be recommended; and thirdly, there was the system of industrial fellowships for post-graduate workers.

Lord Moulton referred to the methods by which Germany had attained her conspicuous position in trade and industry before the war. First, she was far more skilful than we were in forming trade combinations to monopolise the raw products of industry; secondly, she outwitted us in the art of salesmanship; and thirdly, Germans applied themselves with greater assiduity to the elaboration and perfection of details, so that they succeeded in producing articles of superior and more uniform quality. We were like an old-established house; they were like a young house that wanted to make business. The experience of the past five years had convinced him that there was no limit to the capabilities of our workers, provided they could be roused to action; there was nothing they need fear—except themselves.

The Exhibition catalogue—a bulky volume of over 300 pages—contains, in addition to a full list of exhibits, an excellent account of the war-work which has been done in the laboratories of the universities, technical colleges and research institutes, and by a few industrial firms. Another valuable feature is a full and up-to-date catalogue of scientific and technical books. In an introductory article, Sir R. Gregory explains the *raison d'être* of the exhibition. Whereas that held last year demonstrated this country's emancipation from dependence upon enemy countries in respect of many vital industries, this year's exhibition is designed to promote the further development of those industries, as well as to encourage the establishment of new ones founded on progressive science and invention. The Exhibition will be open daily at the Central Hall, Westminster, until August 5, from 11 A.M. to 7 P.M., and on Saturdays from 12 A.M. to 9 P.M.

MEETINGS OF OTHER SOCIETIES.

THE ROYAL INSTITUTION.

The last Friday discourse of the session was delivered by Prof. Sir E. Rutherford on June 6 on "Atomic Projectiles and their Collisions with Light Atoms."

The lecturer first directed attention to the enormous energy associated with the fast moving α and β particles ejected from radioactive sources. He had introduced a modification of the "nucleus atom" as the result of experiments concerned with the scattering phenomena produced by the impact of such swift moving α particles upon various surfaces. The atom he conceived as constituted of a positive charge concentrated in a minute nucleus, the size of which however increased with the atomic weight, and surrounded by one or more rings of electrons, the radii of the rings being very large compared with nuclear dimensions. The deflection of α-particles owing to impact upon substances such as gold had led to the conclusion that in such impacts the α-particles were unable to penetrate into the immediate neighbourhood of the nucleus of the target atoms. The distance of approach was of the order of 10^{-11} cm. and the inverse square law of attraction and repulsion had been abundantly verified at these minute distances.

The method of scintillations has been applied to determine the range to which atoms were ejected from various substances by "head-on" impact therewith of fast moving α-particles. Discussing more particularly the impact of such α-particles with lighter atoms, it was pointed out that after such impact, the α-particles and the ejected atom would move in the original direction of impact, the ejected atom moving the faster. An investigation of such impacts in the case of hydrogen led to the conclusion that the respective nuclei approached with 3×10^{-13} cm. of one another, resulting in the ejection of constituents of the nucleus itself from the hydrogen atom. A helium atom is composed of a nucleus of 4 hydrogen atoms together with 2 electrons. It survived whole after collision with other atoms. No evidence of helium débris after impact of α-particles had hitherto been obtained In the case of ejectment by impact upon atoms of oxygen or nitrogen curious results had been obtained. The number ejected from the atoms of nitrogen steadily decreased as the range of ejection increased from 7 to 9 cm. Thereafter, the number ejected to increasing ranges diminished very slowly as the range increased up to 28 cm. The only possible conclusion from the results obtained over this extended range (the calculated maximum range of ejection for the N atom is 9 cm. while that for H is 28 cm.) is that the particles so projected from nitrogen are constituted of atomic hydrogen, or H_2 or H_3. The hydrogen, the lecturer speculatively imagines to arise from the nitrogen atom, this being constituted of three helium atoms and two hydrogen atoms. This view does not necessarily mean that nitrogen was not an element but rather that it was an element in a particular condition. Advance in the study of atomic impacts would be materially assisted were α-particles discovered possessing a very much larger range than those hitherto available.

SOCIETY OF GLASS TECHNOLOGY.

The June meeting was held at the University, Sheffield, on the 18th inst., the President, Mr. S. N. Jenkinson, in the chair.

Mr. Jenkinson addressed the meeting on "Impressions of a Recent Tour of the German Glass Factories." During his tour in Germany he visited Silesia, Saxony, Saxe-Weimar, and other districts, investigating the conditions in the factories, and particularly in the glass works. The size of the ceramic industry in Germany in pre-war days can be judged from the fact that in 1913 it exported glass to the annual value of 123 million marks and pottery to the value of 94 million marks; 75 per cent. of the output was exported. Hence the outbreak of war caused the shutting down of many factories. The policy during 1915-16 was to re-open several of the glass factories, and allow one furnace in each works to be kept going, and a scheme was inaugurated whereby finance in the industry was pooled. At the present time there is very little production of glassware owing largely to the lack of coal and the state of transport. Stocks are very low. Throughout the visit he was very much impressed by the fact that all the plant in the works was kept at the highest pitch of efficiency, so that immediately opportunity came a high rate of pro-

duction would follow. This fact will have to be taken into account by British manufacturers. Out of some 132 furnaces, concerning which he made inquiries, only about eight were working.

Dr. M. W. Travers then gave a short account of "Some Experiments with a Gas Fired Pot Furnace." He described furnaces which had been used in producing chemical glassware, and advocated burning the gas from the producers in front of the pots, and taking the burnt gases out of the furnace at the back.

Dr. Turner followed with a paper on "The Properties of British Fireclays suitable for Glass Works Use. Part 1.—The Variation of Shrinkage, Density, and Porosity with Temperature." (Preliminary communication.) By E. M. Firth, F. W. Holden, and W. E. S. Turner. This paper was well illustrated by assemblies of fireclay blocks showing the behaviour of various fireclays under the tests outlined by the authors. The paper is the first communication of a research carried out under the auspices of the Refractories Research Committee of the Society.

A third paper entitled "The Examination of Optical Glass in Relation to Weathering Properties," by A. V. Elsden, O. Roberts, and H. S. Jones, was taken as read, and will be published in the Journal of the Society in due course.

The above meeting ended the session. The first meeting of the next session will be held in October.

NEWS AND NOTES.

CANADA.

Manufacture of Ferro-Molybdenum.—Since March, 1916, 100,000 lb. of 70 per cent. ferro-molybdenum has been produced for the Imperial Munitions Board by the direct smelting of molybdenite concentrate at the works of the Tivani Electric Steel Co., Belleville, Ont. Vertical cylindrical furnaces of the single-phase type are employed, requiring 3000—4500 amp. at 50 volts per furnace. Each consists of an iron shell, lined with red brick, firebrick, silica brick, and carbon in succession, and resting on a concrete foundation. The lower electrode consists of a water-cooled bronze or copper block from which iron rods project upwards into the furnace bottom, and the upper electrode of a graphite or carbon rod. For the production of 70 per cent. alloy from concentrate containing MoS_2 75 and Fe 9 per cent., the charge consists of concentrate 100, lime 120, coke 10, and scrap steel 5 lb. Each furnace is tapped every 4 hours, the output being 1050 lb. of alloy per 24 hours.—(*Trans. Canadian Mining Inst.*, 1918, *Vol.* 21, 154—160.)

Progress of Chemical Industries.—The Department of Trade and Commerce through its Bureau of Statistics has in course of preparation a booklet giving a summary of the chemical industries of Canada. Plants connected with chemical and allied industries are distributed as follows:—

Nova Scotia	30
Prince Edward Island ...	2
New Brunswick	20
Quebec	161
Ontario	293
Manitoba	38
Saskatchewan	8
Alberta	21
British Columbia	61
	634

The striking growth of chemical industries within the Dominion during the last six years is shown by the following tables:—

I.—*Exports of Canadian Drugs, Dyes and Chemicals for the fiscal years* 1912–1919.

Year	British Empire	Foreign	Total
	$	$	$
1912	827,500	849,716	1,677,216
1913	1,066,158	734,279	1,800,437
1914	841,566	888,637	1,730,203
1915	955,156	2,588,545	3,543,701
1916	1,398,832	5,050,313	6,449,145
1917	1,719,972	7,498,443	9,218,415
1918	2,765,292	11,442,317	14,207,609
1919	4,300,142	12,752,932	17,053,074

II.—*Imports of Drugs, Dyes and Chemicals from* 1912 *to* 1919.

Year	British Empire	Foreign	Total
	$	$	$
1912	2,806,555	9,789,296	12,595,851
1913	3,417,468	13,093,875	16,511,343
1914	3,201,277	11,437,012	14,638,289
1915	2,878,322	10,570,745	13,449,067
1916	3,034,277	14,060,648	17,094,925
1917	4,873,226	22,726,987	27,600,213
1918	3,636,024	22,886,148	26,522,172
1919	4,003,513	28,785,191	32,788,704

Oil Exploration in Alberta.—It is understood that many Canadian business men are actively supporting exploration work on the potential oilfields of Northern Alberta, where over twenty different parties are now operating. So far only heavy oils have been struck, but it is possible that lighter oils will be found in the lower levels. The Dominion Government is supporting development work by loaning a special drilling plant capable of testing formations down to 3000 ft. All duties on well-drilling outfits from the United States have been revoked, and these portable outfits are being taken to the Peace River country in large numbers.

AUSTRALIA.

New Chemical Enterprises in Western Australia.—The Portland Cement Company of Western Australia is now erecting works in that State for the manufacture of Portland cement, agricultural lime and allied products. The Company has a capital of £185,000 and has secured the rights of extensive limestone deposits in Western Australia.

Investigations of the resources of Western Australia have been recently carried out on behalf of Messrs. Brunner, Mond and Co. with a view to establishing alkali works in the State.—(*Official.*)

SOUTH AFRICA.

The Coal Industry.—The quantity of coal exported last year was 1,208,000 short tons, valued at £1,033,000, as compared with 856,000 tons, worth £337,000, in 1913. Many new markets have been found for South African coal during the war, considerable quantities having been sent last year to Argentina and Uruguay as well as to the British East Indies and Egypt, though consignments to Portuguese East Africa fell off considerably. On the other hand, less coal for bunkering purposes was shipped last year—*viz.*, 1,276,000 short tons, as against 1,452,000 tons in 1913, although increased prices caused the value to rise from £1,052,000 to £1,906,000.—(*Official.*)

Exports of Wool.—Nearly 116,000,000 lb. of sheep's wool, valued at £9,700,000, was shipped from the Union last year as against 177,000,000 lb. and £5,700,000 in 1913. The United States took one-third of the total, whilst the United Kingdom took a little more and Japan rather less than a fourth each. The exports of mohair at 19,600,000 lb. were about 12 per cent. more in quantity but nearly double the value of the 1913 exports. The United Kingdom received the main bulk, but

there was a large increase in the sales to the United States.—(*Official.*)

Candle Manufacture.—There are six candle factories in the Union producing 14,600 short tons, valued at £626,000. The imports are negligible. The kinds of candles produced are stearin, paraffin, and sperm, which consist of paraffin wax with 10 to 20 per cent. of stearin. Commercial stearin, a mixture of palmitic and stearic acids, is made in the Union, chiefly from synthetic tallow obtained by catalytic hydrogenation of whale oil, but some is produced from the oil of the Mafurra bean. The fat or oil is saponified in autoclaves under pressure, and the fatty acids being dark, are distilled in superheated steam. To prevent theft, candles used in the gold and diamond mines, and sometimes their wicks, are specially coloured. In addition to glycerin, "oleine," *i.e.* commercial oleic acid, is a by-product. Oleine is useful for lubricating wool in spinning, but is not in demand for this purpose in South Africa; it is therefore employed in soap-making. Hydrogen for hydrogenation is obtained by the electrolysis of water, and the accompanying oxygen of 99 per cent. purity is employed for acetylene welding. There is at present a shortage of calcium carbide, and of tools for cutting and welding, but when times become normal a large local demand for oxygen is to be expected.—(*S. Afr. J. Ind., Dec.*, 1918.)

UNITED STATES.

American Engineering Standards Committee.—This Committee has recently revised its constitution, and after ratification of the same by the various constituent societies, will be known as the American Engineering Standards Association. The Association is constituted of representatives of the American Institutes of Electrical, Mining and Metallurgical, Civil and Mechanical Engineers respectively, together with representatives of the American Society for Testing Materials, and the Government Departments of War, Navy and Commerce. The Association, amongst other objects, seeks to co-operate with similar organisations in other countries to secure an international status for approved American engineering standards. Formulated standards may be submitted to the Association for approval or otherwise by any organisation. Scientific standards and standards of a commercial character submitted for approval by any organisation will be considered by specially constituted sectional committees. The Association may call together all who would be interested in the formulation of a new standard, and will safeguard that sectional committees are balanced and representative. After approval, a standard is to be described as "Approved by the American Engineering Standards Association." The approval may be designated as either "Recommended Practice," "Tentative Standard" or "Standard," the last indicating general acceptability. The Association will also act as a bureau of information in standardisation, and function as an intermediary whereby any organisation intending to define a standard may get into touch with others similarly interested. The address of the Association is 29, West 39th Street, New York.

Durability Tests of Wearing Apparel.—Research chemists are now devising laboratory tests on wearing apparel which can be interpreted in terms of durability and which will be duly standardised. Enough data has been collected regarding fabrics of known history to justify the use of tensile strength, stretch, resistance to bursting, composition and similar tests. The relation of mechanical construction to wear is, of course, well known, especially in pile fabrics, and experiments leading to the discovery of a test for friction wear and "shine" on fabrics are well under way. Ultra-violet light is still widely used to determine fastness to light, but it leaves something to be desired since there is doubt if it adequately represents weather conditions.

Chrome Ore Statistics.—The U.S. Geological Survey reports that the total production and shipment of chrome ore in the United States in 1918 was equivalent to 63,000 (long) tons of ore of 50 per cent. grade; and unsold stocks at the end of the year were equivalent to 30,000 tons of the same grade. Imports of chrome ore in 1918 were nearly 28,000 tons more than in 1917, amounting to over 100,000 tons. The principal countries of origin were Rhodesia, New Caledonia and Brazil. The average cost per ton at the shipping port was $28.17, but the ore from Canada (20,949 tons), much of which was of low grade, averaged $31.56.

Recovery of Used Lubricating Oil.—The Midwest Engine Co. of Indianopolis has successfully utilised the following method of recovering spent lubricating oil. After the oil has been left to stand in barrels to deposit sediment, it is drawn off into reclaimer tanks which are heated by gas burners to expel the water and lighter oils. The heating also causes further sedimentation of suspended solids. When the oil is near the boiling point a gas flame from a torch is played upon it. Thousands of gallons of good oil have been recovered by this process. The recovered oil has practically the same composition as the original oil.—(*Amer. Gas Eng. J., May* 10, 1919.)

The Dye Industry of the United States.—The Norwegian Embassy at Washington reports that last year the American dye industry satisfied the immense civil and military requirements and produced an excess available for export of the value of more than 10 million dollars. Quantity having been the aim during the war it will now be sought to improve the quality; already 160 types of dyes—said to be equal to the German products—can now be produced, compared with 900 types sent out by Germany before the war.—(*Z. angew. Chem., May* 16, 1919.)

GENERAL.

The Inter-Allied Federal Council for Pure and Applied Chemistry.—Following the initial gathering of international delegates held in Paris in April last, the first meeting of the above Council is being held in London from July 14—18, by the invitation of the Society of Chemical Industry. The Court of the Worshipful Company of Salters has kindly offered the necessary accommodation for the five meetings of the Council. At the time of writing the exact number of delegates attending the Conference is not known with certainty, but it is understood that the following are among the principal representatives of the countries named:—France: Prof. C. Moureu and M. Paul Kestner; United States: Dr. F. G. Cottrell and Dr. C. L. Parsons; Great Britain; Sir William Pope and Prof. H. Louis; Italy: Prof. E. Paterno and Eng. L. Parodi-Delfino; Belgium: MM. Chavanne and Crismer. M. Gérard will act as secretary to the Conference. We take this opportunity of extending to the visitors a very hearty welcome in the name of the Society of Chemical Industry, and trust that the fullest measure of success will attend their labours on behalf of chemistry and chemists in the Allied lands.

British Cotton Industry Research Association.—This association was registered last month as a company limited by guarantee (not formed for the purpose of profit) and with objects similar to those of other research associations recently instituted. The first council will consist of 25 members, 13 of whom will be appointed by the subscribers to the memorandum of association, 5 by the Federation of Master Cotton Spinners' Association, Ltd., 3 by the Cotton Spinners and Manufacturers'

Association, 2 by the Employers' Federation of Dyers and Finishers, and 2 by the Federation of Calico Printers. Pending the nomination of the council, the management will be in the hands of a committee of eighteen. The registered office is at 102, Deansgate, Manchester.

German Coal Resources and the Peace Treaty.—In an article in *Nature* (July 3), Prof. H. Louis considers the losses sustained by Germany under the terms of the Peace Treaty signed at Versailles on June 28. The cession of the basin of the Sarre will deprive Germany of 5·7 per cent. of her coal reserves and of slightly more than 7 per cent. of her annual output of bituminous coal; on the other hand France will gain to the extent of about 33 per cent. of her yearly production. Before the war the coal output in France was about 42¼ million tons, of which nearly 22 million tons came from the Pas-de-Calais fields and nearly 8 millions from the Nord district. These fields have been so badly devastated that it will take at least five years to restore them. The maximum quantity of coal to be delivered by Germany to France, Italy and Luxembourg will not exceed about 32—35 million tons a year, or about one-fifth of her output exclusive of that from the Sarre basin. Added to this the defeated country may have to cede some of her Silesian coal to Poland, but in any event she will not lose more than one-third of her coal reserves; as these formerly amounted to more than half the total coal in Europe, she is not seriously weakened, although France is undoubtedly strengthened. The extent of the deposits of "minette" iron ore in Lorraine and of potash in Alsace now transferred to France is already familiar to readers of this Journal (see J., 1918, 227 R, 333 R, and 291 T).

Industrial Importance of Alsace-Lorraine.—The following comparative statistics relating to the pre-war period demonstrate the potential value to France of her recovered provinces:—

Production.	France.	Alsace-Lorraine.
Coal (metric tons) ...	40,500,000	3,200,000
Iron ores ,, ...	23,250,000	21,000,000
Salt ,, ...	1,150,000	75,000
Mineral oil ,, ...	—	35,000
Iron ,, ...	5,310,000	3,869,000
Steel ,, ...	4,635,000	2,305,013
Potash salts ,, ...	20,000	1,167,460
Potatoes ,, ...	13,590,000	1,266,460
Alcohol (hectolitres) ...	3,100,000	11,620
. . . . .	. . . . .	. . . . .
Area, sq. kilom. ...	536,408	14,512
Population ...	37,000,000	1,900,000
Industrial population ...	6,200,000	421,000
Employees in chemical works	33,650	2,693
Railways—kilom. ...	50,993	1,921
Steam power (h.p.) ...	3,551,000	425,000
Water power (h.p.) ...	600,000	40,000
Blast furnaces	112	58
Coal consumption ...	59,000,000	11,000,000
Cotton spindles	7,400,000	1,900,000
Wool spindles	2,000,000	568,000

—(*L'Industrie Chimique, June*, 1919.)

A New Chemical Institute for Italy.—The Italian Government has allocated the sum of one million lira for the foundation of an Institute of Experimental Chemistry in the University of Padua.—(*Z. angew. Chem., May* 16, 1919.)

Radio-active Minerals in Italy.—The Italian Minister of Agriculture has appointed a commission to determine if there are sufficient radio-active materials in the country to warrant exploitation. Investigations already carried out by Professors Millosevich and Rasini, of the University of Pisa, have raised hopes of success. Madame Curie has been visiting certain localities which are believed to contain radium.—(*U.S. Com. Rep., May* 12, 1919.)

Mineral Production in Sardinia.—Before the war Sardinia exported a yearly average of 187,383 tons of metalliferous minerals, the greater part of which went to foreign countries. The most important production was that of zinc, 140,000 tons; then silver-lead, 34,000 tons; also iron ore, antimony, copper and manganese. About 28,000 tons of brown coal and anthracite was also produced. In 1915 great efforts were made to increase the mineral production, and, besides increases in the output of copper, manganese and antimony, the fuel production was augmented to 55,000 tons. In 1916 the export of iron ore to Italy reached 20,000 tons, and it is hoped that in the future 150,000 to 200,000 tons will be obtained without opening up any new mines.—(*Economista d'Italia, April* 23, 1919.)

Improvement in the Manufacture of Carbide.—A patent has recently been taken out in Sweden (by C. Aberg of Helsingfors) for the utilisation of the waste carbon monoxide produced in the manufacture of calcium carbide. It is proposed to recover and utilise this gas for the burning of the lime, thereby saving 70 per cent. of the cost of fuel. The process should not involve much expense, and experts are said to regard its possibilities with much favour.—(*Z. angew. Chem., May* 16, 1919.)

Swedish Iron Industry.—Speaking against the introduction of an 8-hour day in the Swedish iron works, engineer H. V. Eckermann stated that owing to the enormous cost of ore and fuel the cost of production of pig iron was now 230—270 kronor (£10 5*s.*—£12) per metric ton. The introduction of an 8-hour day on the top of this would lead to a most serious crisis.—(*Z. angew. Chem., June* 3, 1919.)

Cement Manufacture in Finland.—Two cement factories, in Lojos and Pargas, were started during the war. It is stated that the native raw material used is satisfactory, the cement better than that formerly imported from Germany, and that the output capacity is 1,500,000 barrels per annum. The manufacture is much hindered by shortage of coal.—(*Z. angew. Chem., June* 3, 1919.)

Chemical Works at Knarrevik, Norway.—The factories of the Norske Superfosfatfabrik were completed in 1917. The products manufactured are superphosphate and sulphuric acid, together with various by-products such as sodium fluosilicate and copper. At the factory belonging to the "A/s Knarrevik," herring-fat and meal are prepared by an extraction process. The raw materials used are refuse from the canning factories and some fresh fish, but the meal is prepared from the fresh material only. The materials used in the superphosphate factory are apatite, Florida phosphate and pyrites. The last is obtained mainly from the Orka mines; although of low grade, it is used successfully. The copper extraction works, which started operations this year, contain two roasting furnaces which consume 75 tons of burnt cinder daily. The company possesses large limestone quarries, and from the residues air-slaked lime is prepared and sold to farmers. The daily output of the limekilns is 20 tons of quicklime. The superphosphate factory is to be enlarged to a capacity of 70,000 tons.—(*Z. angew, Chem., May* 30, 1919.)

Sugar Consumption in Norway.—No sugar is produced in Norway, and as the staple diet of the people is bread, fish, meat and potatoes, the consumption of sugar has been very low compared with that of other countries. Of recent years the import duty has been lowered, and the average consumption per person has greatly increased; thus the average for 1881—1885 was 11·7 lb. per person;

1906—1910, 34·9 lb.; 1912—1915, 44·5 lb. Even these increased figures are small compared with other countries; thus in the years just before the war Sweden consumed 56·5 lb. per head, Denmark 86·7 lb., United Kingdom 89·2 lb., and the United States 82·2 lb. Until 1916 the bulk of the sugar was obtained from Germany, but since then the United States has supplied the largest quantity. When conditions again become normal it is not expected that the United States will be able to compete in the Norwegian market against Germany and the East Indies.—(*U.S. Com. Rep., June* 3, 1919.)

Coal in Celebes (Dutch East Indies).—Coal was discovered in the island in 1913, but it was of poor quality and in very thin seams. A pure and workable seam of coal 1·5 m. thick and 1200 m. long exists in the north of the Tondong Koerah district. It contains pure brown coal analysing, ash 10%, sulphur 2%, water 8%, and giving 45% of coke. Refined coal from the same district showed, ash 15%, sulphur 2—3%, water 2%, coke 60—80%, and calorific value 6000—7300 calories. The Podo coalfield is the best in the Tanette district and contains a seam 0·75 m. thick covered mostly with limestone. Analysis gave, ash 11—18%, sulphur 3%, water 1·8%, coke 60—85%, and calorific value 7400 calories. —(*Bd. of Trade J., May* 29, 1919.)

Banana Fibre as a Substitute for Hemp.—A process has been patented for the use of banana fibre for textiles, yarns, cords and alpargata soles, as a substitute for hemp. Trials having proved satisfactory, a works is to be erected in Las Palmas, and the machinery is already on order from the United States.—(*U.S. Com. Rep., April* 12, 1919.)

The Pyrites Deposits in Huelva (Spain).—A study of the deposits of pyrites in the province of Huelva reveals equally the industrial potentialities of the country and its lack of industrial enterprise, especially on the part of capital, which leaves to foreigners the easy task of enriching themselves at Spain's expense. A report published before the war showed the world's production of iron and copper pyrites in 1912 to have been 5,880,000 tons, of which 3,700,000 tons came from Spain. Ninety per cent. of the sulphur consumed in industry is used in the form of pyrites, and Spain, its chief producer, is not even mentioned in the statistics of the production of sulphuric acid. Even Holland, which produces no pyrites at all, figures fifth in the list of manufacturers of sulphuric acid with an output of 500,000 tons. During recent years Spain has decided to manufacture superphosphates, and is said to occupy the eighth place in this industry with 180,000 tons; but this quantity is insufficient for her needs and much has to be imported.—(*Dia, Mar.* 14, 1919.)

German Sugar Prospects.—The next sugar output will probably be the smallest on record, the average decrease in the area under cultivation being 15 per cent. Germany is likely to have to import sugar during the next twelve months, probably from Bohemia.—(*Frankfurter Z., May* 28, 1919.)

Platinum Deposits in Germany.—The platinum deposits discovered before the war in the Olpe and Siegen districts are now to be exploited.—(*Weltwirtschaftszeitung, June* 3, 1919.)

Cultivation of Groundnuts in Mesopotamia.—According to the *Baghdad Times*, a successful experiment has been carried out at Fellujah, on the Euphrates, about 38 miles west of Baghdad, which shows that the cultivation of groundnuts offers possibilities. A small plot one-tenth of an acre in extent yielded nuts at the rate of 2550 lb. per acre, equivalent to 1800 lb. when dried. Demonstration plots at various centres are to be arranged for as soon as possible. Up to the present Mesopotamia has been practically destitute of oil-seed crops.—(*U.S. Com. Rep., May* 13, 1919.)

German Potash for the U.S.A.—The negotiations between the Potash Syndicate and the United States have led to nothing because the latter sent, instead of technical men as representatives, officials and military persons who were not in a position to make terms. The Syndicate had sent large quantities of potash to Hamburg in the hope of effecting early business, but the American representatives advised the Syndicate to dispose of them elsewhere.—(*Z. angew. Chem., May* 27, 1919.)

American Potash in 1917.—The potash industry of the United States began in 1914 when an American company made a small production from kelp, but in 1917 there were 95 producers of potash salts and a total of 126,961 short tons of potash-bearing material was won, valued at $13,980,577. Sixty-three per cent. of this, calculated as K_2O, was made from natural brines and the bulk of the rest from cement mill dust, kelp, molasses residues and alunite. The salts mainly marketed were crude carbonate and sulphate used for agricultural purposes. Only 8100 short tons of potash (K_2O) was imported in 1917, whereas the imports for the 4 years previous to the war had been over a quarter of a million short tons per annum. America has thus become almost self-producing as regards her needs in potash salts and independent of German supplies. It is difficult to estimate how many of the smaller producers will survive when the demand no longer exceeds the available supply.

The natural potash brines consist essentially of a mixture of the sulphates, carbonates and chlorides of sodium and potassium, a comparatively small amount of chlorides being present. The brine is concentrated first by a solar evaporator and then in multiple-effect evaporators to saturation point. This is then fed through a rotary kiln drier, dried completely, and afterwards pulverised. The potash content ranges from 20—30 per cent. Several processes, most of which have not yet been used commercially, have been devised for the extraction of potash and alumina from alunite which is a basic sulphate of potash and aluminium. On ignition the potash is rendered soluble in the form of potassium sulphate and the alumina remains insoluble. Many experimental plants have been installed for the extraction of potash salts from felspar, glauconite or greensand, mill tailings, leucite, sericite and slate. A substantial amount is being produced by the treatment of waste water in beet sugar manufacture, sheep washing and the leaching of wood ashes (*cf.* this J., 1918, 264 B).—(*U.S. Geol. Surv., Mar.*, 1919.)

Wolfram in South China.—Since the fall in price at the end of 1918, shipment of wolfram from Hong Kong has practically ceased, but the extraordinary activity previous to this when production reached 1200 tons per month, shows that the South China deposits will in future be one of the chief sources of the world's supply of tungsten. A large new field was located in July, 1918, on the borders of the Kwangsi and Kwangtung Provinces. The total exports in 1918 amounted to about 10,000 metric tons, the average price at Hong Kong being about £200 per short ton. The actual cost of the ore at the mine is about £50 per ton, but coolie transport, carriage by water and rail and various taxes greatly increase this figure. There is little doubt that the mines could be worked profitably at present prices, but until the mine owners are able to frame some estimate of the post-war level of prices, little mining work is likely to be done (*cf.* this J., 1918, 13 B, 154 B, 475 B).—(*U.S. Com. Rep., April* 11, 1919.)

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Munitions Supply during the War.

During the debate in Committee of Supply on the vote for the Ministry of Munitions, the Deputy-Minister of Munitions (Mr. Kellaway) stated that the total pre-war output of shells was about 55,000 per annum; between August 1914 and November 11, 1918, the total production was 200,000,000. The total production of guns in the same period was 26,430, plus 9170 which were repaired, and of machine guns, 250,000. The output of motor vehicles was 1910 in the September quarter of 1916, and the total output from that date to December 1918 was 100,626. At the outbreak of war, the British army possessed about 100 aeroplanes; in November 1911 the production was 4000 per month. In the ten months of 1918, 15,500 tons of lethal gases was sent to France. Although we did not succeed in improving on the effectiveness of the gases used by the Germans, we certainly equalled it, and as regards defence, our gas mask was the best of any used by the fighting forces. The saving which accrued from introducing a system of cost accounting, and basing upon these costs the prices which contractors were allowed to charge, was £300,000,000. The sale of surplus stores had realised £130,000,000 up to date.

We started the war with German fuses for our shells, with German sights for our guns, with German magnetos and plugs for our motor transport and aircraft, with German sulphuric acid and toluol for our high explosives, with German optical glass for our binoculars, with German electric bulbs for our ships, with German high-speed steel for our machine tools, and with German spelter for gun metals and other alloys. Thanks to British chemists, scientists, manufacturers and craftsmen, we have been able during the war to make ourselves independent of and superior to Germany in the production of every one of these essential materials.

Mr. Bigland referred to the action taken by the Minister of Munitions in acquiring glycerin from producers in England for the period of the war at £59 for the crude and £87 per ton for the dynamite quality. The price in the world's markets rose in some cases from £120 to £200 per ton. The Minister had, further, induced all British suppliers of oil seeds and nuts to refuse sales to buyers outside the Empire unless they contracted to deliver the glycerin-content at the British Government's price. The Norwegian and other fishermen also complied with the Government's demands, and in 1916 no fewer than 100,000 barrels of whale oil, with a glycerin-content of 10 per cent., was received from them.—(June 24.)

The Government's Trade Policy.

Sir A. Geddes, President of the Board of Trade, stated that the Government had worked out in detail a permanent trade policy which, in his opinion, should not be disclosed until conditions became more normal.—(June 24.)

Importation of American Coal.

In reply to Sir Henry Norman, Mr. Bridgeman said that contracts have been made for delivery of American coal to European ports at prices which, owing to the higher rate of freight from America, are higher than those at which British coal can be supplied. There is no restriction on the importation of coal, but American coal could only be delivered in this country at a very much higher price than that at which British coal is now obtainable.—(June 25.)

British Cellulose Company.

In answer to a question put by Mr. Raper, Mr. Bonar Law stated that it is hoped that the report of Lord Sumner's Committee regarding the British Cellulose & Chemical Manufacturing Co. will be issued before the end of July.—(July 1.)

Sulphuric Acid.

Sir A. Geddes, replying to Sir R. Cooper, gave the following approximate figures of production of sulphuric acid (100 per cent.) in the United Kingdom: 1913, 1,000,000 tons; 1918, 1,290,000 tons. The first figure includes 25,000 tons and the second 310,000 tons of fuming acid.—(July 1.)

Ministry of Ways and Communications.

In the debate on the Report stage of this Bill, Mr. Joynson Hicks proposed to remove from the scope of the Bill all provisions relating to matters other than railways and canals. Under the terms of an arrangement between the Government and a group of members, docks, harbours and roads were to be excluded, but the Ministry concerned could require improvements to be made in docks and harbours, subject to an appeal by the dock authorities to an arbitrator; and a special Roads Advisory Committee was to be constituted to advise the Ministry. Both proposals were carried.—(July 1.)

Income Tax (Learned Societies).

Asked by Mr. Marriott if he would introduce legislation to place learned societies in the same position in regard to income tax as societies registered under the Industrial and Provident Societies Act, 1893, Mr. Chamberlain referred to the exemption contained in Section 37 of the Income Tax Act, 1918, in favour of charitable societies, which includes societies for the promotion of science or other branches of learning.—(July 2.)

Levinstein, Ltd.

Replying to Mr. Macquisten on the subject of the acquisition by Levinstein, Ltd. of the Ellesmore Port Chemical Works, formerly belonging to Meister, Lucius and Brüning, and of the supposed manufacturing secrets in its possession and their sale to the Du Pont Powder Co., of America, Sir A. Geddes said that the works in question was sold for, approximately, £79,000 to a British-controlled company of which Dr. H. Levinstein, a British-born subject, is managing director. No secret processes for the manufacture of dyes were discovered there. The details of the agreement made between Levinstein, Ltd., and the Du Pont Co. are known to the Board of Trade, but would not be disclosed without the consent of the parties concerned. Dr. Levinstein and his company have rendered very great services to H.M. Government and to British dye-users during the war.—(July 2.)

Scientific Attaché.

Mr. Harmsworth informed Commander Bellairs that Major Mendenhall, professor of physics in the University of Wisconsin, has been appointed scientific attaché to the United States Embassy in this country; but no steps have been taken to make a similar appointment to the British Embassy at Washington.—(July 8.)

Price of Coal.

Sir A. Geddes announced the Government's intention to raise the price of coal by 6s. a ton in order to meet the increased expenses at the mines. The effects will probably be very serious.—(July 9.)

LEGAL INTELLIGENCE.

CLAIM TO DISSOLVE CONTRACTS WITH AN ENEMY FIRM.
The British Diamalt Co. v. *H. A. Taylor and Others.*

In the King's Bench Division on June 20, Mr. Justice Ballhache heard an action by H. A. Taylor, D. D. Taylor, H. D. Taylor and C. T. Taylor, trading as the British Diamalt Co., manufacturers of malt foods and extracts at Sawbridge, North Herts, against J. Hauser, M. Sabotka, H. Hauser, A. Hauser, H. Sabotka and F. Sabotka, trading as the Erste Wiener Export Malzfabrik Hauser and Sabotka, manufacturers of patented and proprietary malt foods and extracts at Vienna, for a declaration that certain contracts dated 1906, 1910 and 1913 were dissolved as from the date of the outbreak of war between Great Britain and Austria.

According to plaintiffs, the agreements provided that they should use certain of the Austrian company's trade marks and processes and any developments thereof for the production from wheat and malt of malt-extract preparations. During the war the plaintiffs had effected improvements in the processes and discovered certain preparations, which under the contract they could not have utilised or manufactured without the written consent of the defendants; but the obtaining of such consent would have involved intercourse with the enemy.

Counsel for the defendants maintained that they were entitled to rights which had accrued up to the date of the outbreak of war. The agreement should be either dissolved in its entirety or not at all.

His Lordship said he was satisfied that these contracts were, for certain purposes, dissolved, and he would make the declaration claimed, provided it could be put into proper form. At the same time the declaration would be without prejudice to any rights of the defendants at the date of war; and with liberty to apply if any question arises as to what those rights were. The question of costs was reserved.

PROHIBITION OF EXPORT OF PRUSSIATE OF SODA.
Klipstein and Co. v. *The Manchester Oxide Co., Ltd.*

In the King's Bench Division on June 27, Messrs. Klipstein and Co., of New York, sought to recover damages from the Manchester Oxide Co., Ltd., for breach of a contract, dated July 10, 1914, for the supply of 600 tons of yellow prussiate of soda. The contract price was 2¾*d.* per lb., delivery in equal and monthly quantities over 1915. The main defence was that delivery was prevented owing to prohibition of export to the United States being proclaimed in March 1915. The plaintiff company replied that it was entitled to delivery in Canada, and had instructed defendant company to that effect in March 1915.

Mr. Justice Ballhache delivered judgment on June 30. He said that defendant company was the only substantial manufacturer of prussiate of soda in this country, and that by the contract practically the entire output—about 50 tons per week—would have been shipped to America. In the autumn of 1914, a Mr. Chance and his company, manufacturers of cyanide for the S. African mines, offered to buy defendants' output at 4*d.* per lb., as against the market price of 6½*d.*, in the event of the Board of Trade issuing a prohibition of export. That prohibition was eventually issued after the Board had made its own independent inquiries; the proclamation was a valid one to which the defendants had to conform although it was greatly to their interest to do so. The request to ship to Montreal was not a business request which was intended to be acted upon, and he was not sure that such shipment would have been justifiable in view of the contingency that the material might have found its way to the United States.

The defence succeeded except as to the failure to ship the consignment for January 1915. Judgment would be for the plaintiff company for £1750 with costs.

APPLICATION FOR USE OF BAEKELAND PATENTS.

Before Sir Cornelius Dalton in the Patents Court on June 26 an application was made by Nicholsons (Newcastle-on-Tyne) Ltd., for licences in respect of certain of the well-known Baekeland chemical patents proposed to be used for making varnishes. The application related to Nos. 1921/1908, 1922/1908, 21,566/1908, 6293/1912, and 6294/1912. The applicants had been making aeroplanes and the standard dope during the war, and had a big plant which would be admirably suited for making materials such as were covered by the patents in question, *viz.*, condensation products of phenols and formaldehyde.

Sir George Marks, for the patentees, said he could not see that there was any evidence that the applicants were carrying on a business for which these patents were essential or that they were familiar with these patents. He suggested that the licences should not be granted until further evidence had been put forward. British Dyes Ltd. was concerned in these patents.

The Controller thought it premature at the present stage to grant the licences, and while not refusing the application, he adjourned it for further evidence. An order was made accordingly.

REPORTS.

POWER ALCOHOL.

REPORT OF THE INTER-DEPARTMENTAL COMMITTEE ON VARIOUS MATTERS CONCERNING THE PRODUCTION AND UTILISATION OF ALCOHOL FOR POWER AND TRACTION PURPOSES. H.M. Petroleum Executive. [Cmd. 218, 2*d.*] London: H.M. Stationery Office.

The above report has been presented to the Minister in charge of the Petroleum Executive by the special committee appointed in October, 1918, which included, among others, the late Sir Boverton Redwood, Bt. (chairman), Sir J. J. Dobbie, Prof. H. B. Dixon, and Dr. W. R. Ormandy.

The matters especially considered were (1) the production of alcohol from (*a*) waste sulphite lyes, (*b*) wood, (*c*) peat, (*d*) bracken etc., (*e*) the mahua and other trees, (*f*) potatoes, maize, beet, molasses and other alimentary substances, (*g*) seaweeds, and (*h*) by synthesis; (2) the utilisation of alcohol in internal combustion engines either alone, using adaptations of, or special devices on, existing engines, or admixed with other substances; and (3) denaturants and Excise arrangements.

Owing to the cessation of hostilities the Committee deemed it advisable to prepare this progress report, recording conclusions and recommendations the adoption of which they consider to be necessary if alcohol and mixtures of alcohol with ether or with hydrocarbons are to be brought into use for generating power.

The Departmental Committee on "Industrial Alcohol" reported in 1905 that the use of spirit for motors depended upon price, and that as the price of petrol was then about half that of methylated spirit further investigation might be delayed until the approximation between the two prices created a practical alternative of choice between the two fuels. It is clear that the conditions fulfilling this anticipation are in sight.

As the words "industrial alcohol" have been

taken by some to refer to an inferior potable spirit, it is recommended that all alcohol for power or traction purposes should be described as "power alcohol." All sales of power alcohol should be made on the basis of a certified percentage by volume of absolute ethyl alcohol with a minimum of 90% at 62° F.; alcohol mixtures should not contain water in excess of 10% by volume of the alcohol after mixture, and when benzol, ether, petrol or the like are mixed with alcohol in quantities in excess of those which may be required as partial denaturants, the nature and percentage of such components should be plainly stated on the containers, etc.

It is probable that in the near future the demand for petrol will cause the price to rise, indeed in America the sale price rose 200% between 1914 and 1918 when the consumption rose from 1200 to 2680 million gallons, and the investigation of alternative supplies of motor fuel should now proceed. Prof. Dixon is directing the compilation of experimental data concerning the behaviour of alcohol, alcohol-benzol, alcohol-ether and other alcohol-mixture vapours on their combustion with different volumes of air and with varying quantities of water and denaturants. A practical trial of alcohol-benzol and alcohol-benzol-petrol mixtures is being carried out in one complete fleet of motor omnibuses over a period of 26 weeks, together with incidental bench and other tests.

Records of work done on the extraction of ethylene from coal and coke-oven gases indicate that there is available a large potential source of power alcohol, but further investigations are necessary, particularly upon the conversion of ethylene into alcohol before definite figures as to quantities and price can be given.

The fundamental attraction of alcohol as a substitute for any fuel necessarily derived from coal or oil lies in the fact that its chief sources, which are to be found in the vegetable world, are being continuously renewed and are susceptible of great expansion without encroachment upon food supplies. Important vegetable substances from which power alcohol may be obtained are: (1) Sugar-containing products, such as molasses, mahua flowers, sugar beet, and mangolds; (2) starch or inulin-containing products, such as maize and other cereals, potatoes and artichokes; and (3) cellulose-containing products, such as peat, sulphite wood pulp lyes and wood. The world's production of molasses is not known, as large quantities are run to waste. Evidence was received concerning achieved costs and yields of power alcohol from the flowers of the mahua tree (*Bassia latifolia*), which flourishes in Hyderabad and the Central Provinces of India. The sun-dried flowers contain about 60% by weight of fermentable sugar and can be collected and delivered to the factory in the zone of growth at £1 10*s.* per ton. The yield on fermentation and distillation is about 90 gallons of 95% alcohol per ton. The flowers can be pressed, packed, exported and stored for long periods without deterioration. It may be possible to increase the production of flowers by cultural treatment, but so far cultivation of the mahua tree has not been attempted.

The prospective production of alcohol from maize and other cereals in various parts of the Empire is considered encouraging both as regards quantities and cost, but the production within the United Kingdom from potatoes, artichokes, sugar beet and mangolds cannot be placed on a commercial basis without some system of State subvention. Potatoes yield only 20 gallons of 95% alcohol per ton and artichokes little more. No satisfactory method for the utilisation of peat as a source of alcohol has been brought to notice, but its potential value should not be overlooked. The Committee considers that so far as vegetable sources of raw material are concerned we must rely mainly on increased production in tropical and sub-tropical countries.

It appears that as regards the United Kingdom new conditions affecting the denaturing of alcohol would arise if the market price of petrol were to remain permanently as high as that of denatured power alcohol. The high price of alcohol compared with petrol has prevented its commercial use for power purposes hitherto, and since the denaturing process now in use increases the cost (sometimes by as much as 6*d.* per gall.) the increase should be restricted by reducing the proportion of wood naphtha. In all cases of approved use for power purposes the proportion of wood naphtha might be substantially diminished or replaced by petrol, benzol, or other nauseous substance supplemented by methyl violet as colouring. It is recommended that every effort be made to provide a denaturant or alternative denaturants—*e.g.* formaldehyde, pyridine and tobacco oil, the employment of which will be effective in the smallest possible quantities and at the lowest possible cost. When denaturing operations are carried out at any transport depôt, the necessary volumetric mixings should be allowed in any suitable vessel although such vessel may contain power alcohol previously denatured. No impediment should be placed in the way of manufacturers or importers by the imposition of the usual bonded warehouse rules and regulations upon those who store and handle alcohol denatured to an approved specification, although special rules will have to be observed. The motor omnibus trial proved the desirability of users being allowed to convey power alcohol by rail or road in tank wagons and the use of an approved type should be allowed, under seal if the alcohol be undenatured.

It is recommended that having regard to the exemption of home-produced benzol and shale motor spirit from the motor-spirit tax (Excise), power alcohol when produced in the United Kingdom be correspondingly exempted, and that, having regard to the scope for earlier large production in the Empire overseas, importation of power alcohol be permitted free of duty.

It is considered that the State should foster the production and utilisation of alcohol for power purposes because, as has already been indicated, the chief raw materials for its production are susceptible of great expansion, while the materials from which benzol, petrol, etc. are derived are limited to deposits, definite in extent, that cannot be renewed. Furthermore as power alcohol is miscible with water in all proportions its use affords greater safety from fire.

The development of the alcohol industry is such a complex and far-reaching problem that it cannot be left entirely to the chances of private enterprise and the ordinary play of economic forces, but can only be handled adequately by concerted Government action. Consideration should be given to the education of the public concerning the merits of power alcohol and mixtures of that fuel.

An organisation should be established by the Government to initiate and supervise experimental and practical development work at home and overseas on the production and utilisation of power alcohol, and to report from time to time for public information on all scientific, technical, and economic problems connected therewith. This organisation should be permanent, be in close relation with the various Governments of the Empire, and be so constituted as to be able to deal with alcohol in conjunction with other fuels which are or may become available as a source of power.

Further investigations should include an examination into the necessity for revision of the statu-

tory regulations that the specific gravity of distillers' wort before fermentation must be ascertained by means of the saccharometer. It is equally essential that the necessity to allow fermentation and distillation to proceed simultaneously in the same building and to allow continuous distillation should receive early consideration.

REPORT OF THE FOOD INVESTIGATION BOARD FOR THE YEAR 1918. Department of Scientific and Industrial Research. (H.M. Stationery Office. 1919.) 3*d*. net.

The Board was first established as the Cold Storage Research Board but, owing to the wide scope of the work involved, the Advisory Council changed the title to the "Food Investigation Board" with the following terms of reference. "To organise and control research into the preparation and preservation of food." To cover so large a field as is offered by food, the Board decided to establish committees corresponding with the different classes of material dealt with, and an account of the investigations in progress is described conveniently by recording the work of each committee.

The Fish Preservation Committee has been occupied mainly with the investigation of a method known as brine freezing, in which the fish to be frozen are immersed in strong brine at 10° F. (−12° C.); this process is rapid and the separation of fluid and solid in the tissues which occurs during slow freezing is prevented. It seems possible that the wastage of food due to gluts of fish could be avoided by the installation of brine-freezing plants at suitable ports. Although the workers are at present widely scattered in different research laboratories, much preliminary work has been done; plans and estimates for the establishment of a permanent laboratory at Lowestoft are now being prepared. The work of the Engineering Committee has been concentrated, for the time being, on the problems presented by the development of cold storage in this country, namely, the type of wagon or barge best suited for the carriage of frozen produce, and upon problems of insulation. The Meat Committee has a large number of investigations in hand, including an inquiry into the cause of the peculiar sensitiveness of beef to freezing. A special experimental plant for investigations at low temperatures has been installed at University College, London. Other investigations in progress relate to the autolytic changes in meat, influence of blood on the rate of autolysis, isolation of hitherto unknown flesh constituents, moulds which infect cold stores, etc.

The Oils and Fats Committee was formed to make a survey of the sources of supply of edible oils and fats with the object of increasing the proportion available for human consumption. Research under the Fruit and Vegetable Committee is in progress at Cambridge and in London. The influence of the composition of the air in fruit stores is under investigation and interesting results in stopping the sprouting of store potatoes have been obtained. The oxidising enzymes which are responsible for the browning of the flesh of ripe fruit have been studied and new knowledge regarding the distribution of these oxidases has been secured. It is proposed to follow out the chemical changes occurring in fruit during maturation and storage, and methods have been devised for obtaining satisfactory samples of sap and for preserving it. The nitrogen content of apple sap was found to be extremely low, namely, 0·014 grm. per 100 c.c.; of this nitrogen, 40 per cent. was present as ammonium salts and the remainder as simple amino acids, whilst proteins could not be detected. Determinations of the quantities of starch, sucrose, and reducing sugars (maltose, dextrose, lævulose, pentoses) are being made in order to follow the changes taking place in the carbohydrates of fruit. The physical changes progressively occurring in stored apples will be studied by determining the depression of the freezing point, density, viscosity, electrical conductivity, and concentration of hydrogen ions of the expressed juice at regular intervals. An examination of the effect of external conditions on the growth of fungi producing the decay of stored fruit is proceeding. The various fungi are being isolated and the effect of low temperature and various concentrations of carbon dioxide on their germination and growth is being studied.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS.

The annual report for the year ending May 31, 1919, states that 145 firms, representing a capital of £70,000,000, are now members of the Association, and, in addition, seven other separate associations are affiliated thereto. The Association has appointed representatives on the committee set up by the Board of Trade for the purpose of reviewing and co-ordinating the needs of consumers and the producing powers of British manufacturers in the matter of dyes; and the claims of the fine chemical industry to be regarded as a key industry have been pressed upon the Board. Although the Government policy with regard to key industries will not be announced until the autumn, the Council welcomes the work of the Imports Restriction Committee upon which the Association is represented.

The Traffic Committee has considered various matters connected with railway and road transport of chemicals, and the Association has joined the Traders' Traffic Conference. In December the Association was invited by the then Minister of Reconstruction to advise on the utilisation of national factories after the war. The sub-committee appointed to consider this question recommended in April that the sale of national factories should be delayed for six months. A good response has attended the request to producers of pitch to supply to the Association particulars of all sales over 100 tons. Particulars of such sales (other than vendor's name) are now being supplied to other producers. At the request of the corporation which was formed by British buyers of quinine to enter into an agreement to purchase quinine from the Dutch manufacturers, the General Manager was appointed chairman of the corporation. An information and statistical bureau has been established and a directory will shortly be available which should assist British chemical manufacturers in extending their home and overseas trade. A memorandum suggesting amendments of the Patents and Designs Act Bill (1917) has been presented by the Association to the Comptroller-General of Patents.

The Chairman of the Association, Mr. R. G. Perry, has been appointed to act as arbitrator in disputes arising out of transactions in or relating to the chemical industry. Collaboration as occasion arises between the Paris Chamber of Commerce and the Association has been arranged for. A memorandum on the question of fuel shortage was presented to the Coal Controller. A National Sulphuric Acid Association to co-operate very closely with the Association has been established during the year. The Association has discussed with the Board of Trade the inadequacy of its published statistics, and it is hoped that import statistics of various chemicals will be available to its members even when not included in the published official returns. During the past year the

closest co-operation has been maintained with the Department of Overseas Trade. The Association has decided to support attempts being made to remove unfairness in the imposition of levies under the Munitions (Liability for Explosions) Act, 1916.

COMPANY NEWS.

ZINC CORPORATION, LTD.

At the eighth ordinary general meeting, held in London on June 23, Mr. F. A. Govett, chairman, reported upon the position of the company and reviewed the general industrial situation. The net profits of the Corporation for 1918 amounted to £226,470, compared with £225,150 for 1917, and the dividends for the year 6*s.* and 3*s.*, as against 5*s.* and 2*s.*, on the preference and ordinary shares, respectively. The ore reserves at the end of 1918, exclusive of the zinc lode, were estimated at 2,076,000 tons with an average value of 14·6 per cent. lead, 2·6 oz. silver, and 9·4 per cent. zinc, or 189,000 tons more than at the end of the previous year. The company has £100,000 invested in the Tasmanian Electrolytic Co., which is contemplating an extension of plant to increase its daily output of electrolytic zinc to 100 tons; it has a two-fifths interest in the large company which has been formed to work the Elmore process, and it is erecting a small plant on a commercial scale; it has also a share in the Ganelin process which is under trial by the Amalgamated Zinc Co.

The general outlook is not good; there are very large stocks of base metals and the actual consumption is small. The Australian industry will survive provided European labour conditions are reasonably quiet. The recent fall in the price of lead has curtailed sharply production in America, Spain and other countries, and although prices may not as yet have touched bottom there is no probability that they will fall below the company's cost of production. At the present time stocks of metal are accumulating, sales are very few; and the company's working expenses are at the rate of £5,000 per month. The present position is such as the world has never seen before, and the future is hopelessly obscure.

Appreciable rise in the cost of coal and labour would seem to be the final nail in the coffin of zinc smelting in this country, as witness the recent stoppage of work at Avonmouth. The amount of protection required by this key industry makes it impossible to establish it here. Such establishment is now, moreover, undesirable; there is no great profit in it; the submarine has altered the whole aspect of the problem for it requires more ships and longer voyages to bring concentrates than to import the metal. In war time we must be dependent on the importation of one or the other, and in peace it may pay us, as formerly, much better to import the spelter from countries where labour is cheaper and more productive. Unless labour conditions here are going to alter vastly, or unless the price of spelter is to be permanently far higher than before the war, there is no further question of the company joining in any scheme of zinc production in this country. Increased costs of production point to electrolytic extraction by cheap water power as the only solution. In the immediate future it looks as if spelter production will go back to Belgium, and that it will then be gradually transferred from there to Norway, as water power becomes harnessed.

Levers Brothers, Ltd.—At an extraordinary meeting held on June 26, it was resolved to increase the capital of the company from £60,000,000 to £100,000,000.

NATAL AMMONIUM, LTD.

The sixth annual general meeting was held in London on June 25. The Rt. Hon. the Earl of Selborne, who presided, said that the company's output of sulphate of ammonia increased by 60 per cent. during 1918. The material is of a high quality and finds a ready sale at high prices, 10 per cent. of the production being absorbed by the South African market and the remainder being exported mainly to Mauritius and the East. The full-gauge railway to neighbouring coalfields has now been completed. Of the ten additional producers, to be constructed of materials obtained locally, two are completely and two nearly finished. The net profit on the year's working was £18,529 (capital £325,000, and this has been set against the loss of £22,813 brought forward from the previous year. The property is a really valuable one, but the company is saddled with a war load of debt, unsecured loans amounting to £110,000 having been contracted. The chairman also stated that the stocks of sulphate of ammonia valued in the balance sheet at £44,000 were taken in at £40 a ton, and that all of it has since been realised at prices above £40 and up to £47 a ton.

NORTHERN EXPLORATION CO., LTD.

The ordinary general meeting was held on June 26, in London. The chairman of the company, Mr. F. L. Davis, presided and described in some detail the estimated mineral resources of the islands (this J., 1918, 239 B) and the efforts made to exploit them.

The output of coal in 1918 was over 100,000 tons, and working is so simple that even now, with limited appliances, the cost does not exceed 7*s.* per ton f.o.b. Spitsbergen. A Swedish and a Norwegian company are also successfully working coal seams. The extensive iron ore deposits can be quarried at under 3*s.* a ton and as there is an abundance of good limestone at hand, there should in time develop an important steel industry. A good quality asbestos occurs at Recherche Bay, and the marble deposits are of exceptional value. Conservative estimates put the cost of delivery of the marble in this country at £2 per ton, and the value here at £4—£16 per ton. Since 1914, 300,000—400,000 tons of coal has been shipped to Scandinavia and over £1,000,000 has been spent by Scandinavian companies which have nearly completed equipment to produce 1,500,000—2,000,000 tons of coal per annum.

LAUTARO NITRATE.

As the company's three oficinas were overhauled during 1918, the production was about 300,000 quintals less than in the previous year. The trading profit was consequently somewhat lower at £317,064. The gross profit, £399,835, included £10,262 from general investments and £72,000 from investments in steamers. After deducting income tax and excess profits duty, etc., there remains a net profit of £248,603 (capital £550,000). The dividend for the year is 18 per cent. free of tax, and large appropriations have been made to reserves. The company has £197,807 invested in steamers (all the original steamers were lost by enemy action), and £24,842 in enemy banks, derived from sale of nitrate stocks in Hamburg at the outbreak of war.

In his address to the thirty-first annual meeting on June 18, the chairman urged two reforms: the Chilean Government should reduce the export duty on nitrate, or better, it should revoke that duty and participate in the sale or in the profits of the producers; and a really effective central selling agency should be established.

SAN SEBASTIAN NITRATE.

The production of nitrate during 1918 was 289,284 quintals, of which 68,546 quintals, valued at £28,496, was in hand at the end of December. The gross profit was £2516 higher at £12,935, and the net profit £7726 as against £7012 (issued capital £143,750). The dividend is again passed. Addressing the annual meeting held on June 19, the chairman refuted the official view that as nitrate cannot be used on the land until early next year, therefore there is no need to ship it now. Neither the works, railways, nor ports in Chile are designed to meet a sudden demand, and transport facilities in Europe are not such as to allow of a postponement of delivery until actual consumption is due. The company's works have been closed down since January last.

TRADE NOTES.

BRITISH.

Canadian Tariff Changes.—In the annual Budget speech on June 5, the Minister of Finance, Sir Thomas White, announced some important changes in the tariff regulations regarding chemicals and metals. These are referred to on page B of this issue, and the full list is given in the *Board of Trade Journal* of July 3. The Government announces that changes made this year are of a temporary nature, and has requested the various industries of the Dominion working together in groups to prepare exhaustive statements in support of any action they wish the Government to take at any later date.

South African Wattle Bark.—The Report of the Acting Trade Commissioner for the South African Union in London, dated March 18 last, gives the following figures of consumption and stocks in hand:—

Consumption.	1917. tons.	1918. tons.
Bark and liquid extract converted into terms of bark	24,267	27,526
Solid extract	745	1,814
Stocks held at December 31.		
Bark and liquid extract in terms of bark	6,486	13,508
Solid extract	286	1,051

—(*S. Afr. J. Ind., May*, 1919.)

The Australian Portland Cement Market.—Most of the cement used in Australia is imported from Britain, Japan and Denmark, although recently a good-quality cement has been produced in Australia to meet the difficulties attending importation. The total quantity imported in 1915-16 amounted to 75,843 tons, of which the United Kingdom supplied about 33%, Hong Kong 10%, New Zealand 9%, Denmark 16%, and Japan 18%. During the same year 1367 tons was exported to the Pacific Islands. The general import duty on cement is 1*s.* 6*d.* per cwt., with a preferential tariff of 1*s.* per cwt. on cement produced in the United Kingdom.—(*U.S. Com. Rep., June* 31, 1919.)

FOREIGN.

Chemical Imports into the United States.—A bulletin entitled "Chemical and Allied Products Used in the United States" (Miscellaneous Series, No. 82) has just been issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce, with the co-operation of the American Chemical Society. The object of the publication is to reveal to manufacturers the extent of the domestic markets for the various chemical wares the manufacture of which has recently been undertaken in the United States, and those firms who are obtaining German patents from the Chemical Foundation expect to find in the statistics the facts they need to plan their operations intelligently. It is shown, *inter alia*, that of the $45,000,000 worth of manufactured chemicals, exclusive of dyes, paints, pigments and varnishes, imported in the year 1913—1914, more than 40 per cent. came from Germany. The bulk of the publication consists of classified lists of some 2500 materials by quantity and by value, together with the percentage derived from each country of origin. Commercial names are given in the first place and these are followed in some cases by the scientific names or by very brief descriptions. Following this is a list of 3000 other products imported in amounts less than $100 each. Summary tables comparing imports with exports and production are also included. The price of the bulletin is 25 cents, and it may be obtained from the Superintendent of Documents, Washington, D.C.—(*U.S. Com. Rep., May* 26, 1919.)

The German Nitrogen Syndicate.—On May 8 the "Stickstoff-Syndicat G.m.b.H." (Nitrogen Syndicate, Ltd.) was formed by the three great groups of producers of nitrogen compounds with the object of effecting combined sales of their products. The groups in question are the Badische Anilin u. Sodafabrik (works at Oppau and Bruna near Merseburg); the Ammoniak - Verkaufs - Vereinigung (Ammonia Sales Association) in Bochum, with the Oberschlesische Kokswerke u. Chemische Fabriken A.-G. (Upper Silesian Coke and Chemical Works, Ltd.) and the Wirtschaftliche Vereinigung der Gaswerke (Economic Association of Gas Works); and the Bayrische Stickstoff-Werke (Bavarian Nitrogen Works), representing the cyanamide industry.—(*Z. angew. Chem., June* 3, 1919.)

Ban on German Goods in Denmark.—The Copenhagen papers publish detailed lists of goods of which the importation from Germany to Denmark has been forbidden by the Entente. The list includes gold, silver, war material of all kinds, coal, coke, wood, paper, dyes, iron and steel, sugar, window glass, and machinery for industrial purposes. The Danish Foreign Office is to protest against this procedure, pointing out that it will have more serious consequences for Denmark than for Germany against which country the prohibition is directed.—(*Z. angew. Chem., May* 17, 1919.)

Reports of German Dye Companies for 1918.—The Badische Anilin u. Sodafabrik had a gross profit of 67,646,537 marks, general expenses 15,365,924 mk., and net profit 10,848,442 mk. (after writing off 40,604,423 mk.); the corresponding figures for 1917 were 58,245,342 mk., 7,973,036 mk., and 30,001,400 mk., respectively. Over 60 million marks was paid in wages, and nearly 22 millions in salaries and bonuses. The dividend for the year is 12 per cent., compared with 20 per cent. for 1917; 5 million mk. is placed to reserve, 2 million mk. to a fund for disabled soldiers and 1 million mk. for the workmen's relief fund.

After the signing of the armistice, many of the factories were closed down, and by the end of November the remaining factories at Ludwigshafen and Oppau also ceased operations. A few of the factories at Ludwigshafen have since resumed work. It is hoped that the factory at Oppau will be working at full pressure by the end of 1919, and the factory at Merseburg, which is being extended, by the beginning of 1921. In March 1919, a new loan of 50 million mk. at 6½ per cent. was contracted for the purpose of extending the nitrogen works and for the purchase of lignite mines.

The Höchst Dye Works (formerly Meister, Lucius and Brüning) reports a gross profit of 52,800,954 mk., and, after writing off 23,750,000 mk., a net

profit of 14,955,604 mk. The dividend has been reduced from 18 to 12 per cent. A loan of 30 million mk. is being raised to purchase a new plant and to reconstruct for peace trade.

The A.-G. für Anilin-Fabrikation, Berlin, has lso reduced its dividend from 18 to 12 per cent. ts net profit, including carrying forward, was ,972,770 mk. The expenditure on wages, salaries, nd bonuses was nearly 9 million mk. higher than n 1917. The results for the first quarter of 1919 re very unsatisfactory.

The report of the Chemische Fabriken vorm. Weiler-ter-Meer, of Uerdingen, Lower Rhine, states hat all departments of the works were closed lown after the Allied occupation. The net profit ud balance brought forward amount to £62,000, gainst £107,000 in 1917, and the dividend is educed from 12 to 10 per cent.

The Griesheim-Elektron Company of Frankfurt /Main made a net profit of 4,516,197 mk. 9,656,072 mk. in 1917), and declares a dividend of per cent. (against 16 per cent.). The future is onsidered very doubtful.

The Leverkusen Dye Works (formerly Fr. Bayer nd Co. in Leverkusen), reports a net profit of 3,088,188 mk. (against 31,084,370 mk. in 1917) and ays a dividend of 12 per cent. It is proposed to xtend the works in the neighbourhood of Cologne. —(*Kölnische u. Frankfurter Z., Z. angew. Chem., May*, 1919.)

Italian Company News.—A company with a capital of 300,000 lire (say £12,500) has been formed in Verona to manufacture "tetraphosphate" (this J., 1918, 437 R) and other products.

The "Societa Italiana Prodotti Esplodenti" in Milan (capital 30,000,000 lire) made a net profit of 2,203,038 lire in 1918, out of which the legally sanctioned 8 per cent. dividend will be paid.

The Match Industry in Italy.—The production of matches in Italy in 1914 amounted to 72 milliards, of which 57 per cent. was of wood and 45 per cent. of wax. Of these numbers, some 5 and 13 milliards respectively were exported, chiefly to the Mediterranean countries. The value of the production is estimated at 22 million lire, of which sum 15 millions was for the wax matches. In 1911, there were upwards of 100 factories employing 5500 workpeople; they were mostly small factories, the total power used being only 1000 h.p. The three largest, with one of the smaller, have formed a "trust," which comprises 70 per cent. of the total production. Some 70 tons of white and red phosphorus were used in the manufacture. The wood for the boxes, amounting to 800 tons, was imported, for the most part from Bavaria, and consisted principally of refuse from the toy-making industry.—(*Z. angew. Chemie, March* 28, 1919.)

Photographic Chemicals in Switzerland.—The Swiss Society of Chemical Industry in Basel is about to place on the market a number of photographic chemicals of its own manufacture. In addition to "metagol," diamidophenol "Ciba," and ready-made developers, such as metagol-hydroquinone and a metagol-glycine-paramidophenol, are to be marketed. The last-named and also a paramidophenol-hydroquinone mixture will be in a highly concentrated form to be diluted 0 times before use. The company is also facturing fixing salts and a dry plate, the to be marked "Ciba."—(*Z. angew. Chem.*, 16, 1919.)

e **Swiss Glass Bottle Industry.**—A trust is g formed in this industry. Simultaneously the institution of a six-hour day in all the ories it is proposed to introduce the Owen le machine, the patent rights alone of which 15 million francs. With this machine it is hoped to meet foreign competition, for it is much more efficient than the French machines hitherto used in Switzerland.—(*Z. angew. Chem., May 16, 1919.*)

Swiss-German Commercial Treaty.—By the new treaty covering the period June 1 to November 30, 1919, Germany undertakes to deliver to Switzerland 50,000 tons of coal per month, at 123 and 140 francs per ton delivered at the Swiss frontier. Germany also agrees to permit exports of iron and steel so far as possible; as no fixed quantities are specified both countries will be able to make use of free competition. During the treaty period Germany will also send 250 trucks of raw sugar—to enable the Aarberg sugar factory to continue operations—and 250 trucks of potash salts per month. Switzerland has agreed to send to Germany 50 trucks of milk products per month and, conditionally, 5000 head of cattle.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for June 26 and July 3.)

TARIFF. CUSTOMS. EXCISE.

Australia.—The prohibition of the import of tinplate has been revoked.

Canada.—The rates of import duties have been modified on, *inter alia*, many salts of sodium, crude petroleum, cement, iron ore, lead, tin, zinc, copper, brass, nickel, nickel silver and rolled iron.

China.—The revised Customs tariff will be enforced from August 1.

Czecho-Slovakia.—Export licences for goods to be exported to all destinations will be granted by the Import and Export Commission, Prague, subject to the condition that payments for such goods have been made through the Czecho-Slovak Clearing Bank, Prague.

France.—A translation of the "Bill for the Modification of the Customs Régime of Petroleum Products Imported into France" is given in the *Bd. of Trade J.* of July 3.

Greece.—The Greek Government has given notice of denunciation of several commercial conventions with the U.K. Failing 3 months' final notice, these will remain in force until September 3, 1920.

The consumption tax on imported alcohol has been increased, except in certain cases, with effect as from April 1—14. This tax is charged in addition to the ordinary import duty.

Johore.—The export duties have been revised on areca nuts, gambier, sugar, indigo, rubber latex, timber, gold, tin, tin ore, wolfram and scheelite, etc.

Netherlands East Indies.—Export licences are still required for kinabark, quinine and its salts, tin, tin ore, copra, groundnuts and mineral oils.

Newfoundland.—It is proposed to raise the rate of import duty on certain kinds of leather, when bark tanned, from 20 to 30 per cent. *ad valorem*.

Spain.—The temporary suspension of the export duty on lead ores has been prolonged until August 31 next.

United States.—The War Trade Board will consider applications for import licences for pig tin and alloys containing tin as from June 16, but shipments must not leave place of origin before June 30 or enter the United States before August 1.

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified, or in certain cases to buy goods on own account. British firms may obtain the names and addresses of the persons referred to by applying to the department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
Australia ...	Dyes for leather, woollen goods and hat straw ...	3
,, ...	Gelatin, safety matches	4
,, ...	Sheet glass and glassware	5
,, ...	Whale oil, cod oil, turpentine, industrial chemicals	10
British India ...	Dry distemper paint, belt composition	1205
,, ...	Leather, steel	1208
,, ...	Chemicals, pharmaceutical requisites	1215
,, ...	Heavy chemicals ...	1218
,, ...	Dyes, lubricants, greases	15
,, ...	Printing paper, fast dyes for cotton thread, oils, glass, cement ...	18
,, ...	Aniline dyes	20, 28
,, ...	Chemicals, paper ...	22
,, ...	Lubricating oils, greases, metals, boiler composition, cement, paints, disinfectants	24
,, ...	Earthenware, glassware	29
British W. Indies	Drugs, druggists' sundries	1221
,,	Fertilisers, cane sugar, molasses	33
Canada	Filter papers (13·15 in. diam.)	*
South Africa ...	Mining chemicals, dyes, paints, etc.	1230
Belgium ...	Ultramarine, white lead, linseed oil, tanning and dyeing extracts ...	1240
,, ...	Soft pig lead, antimony	1242
,, ...	Rubber, oils, greases ...	52
,, ...	Gas mantles	57
,, ...	Industrial oils	58
,, ...	Chemical and pharmaceutical products ...	60
Bulgaria ...	Paper, leather, gum arabic, tin, lead, antimony, petroleum, alcohol, turpentine, printing inks, dyes, paints, soda	1245
,, ...	Machinery and supplies for drug trade ...	63
France	Chemicals	71
,, ...	Light chemicals, pharmaceutical products ...	71a
,, ...	Paper, leather, turpentine	73
Italy	Pharmaceutical and chemical products ...	75
,, ...	Lubricating oils ...	76
,, ...	Chemical and pharmaceutical products ...	1670, 1676†
,, ...	Soap, perfumery ...	1696†
,, ...	Edible oil	1699†
,, ...	Wood pulp, mineral oils	1703†
,, ...	Leather, imitation and substitutes	1712†
,, ...	Chemicals, dyes, leather	1675†
Netherlands ...	Chemicals, drugs, soap, optical glass, leather	1251
Spain	Lamp filaments, quinine, tanning materials, natural or synthetic indigo, cochineal ...	81
Algeria	Paint, varnish, soap ...	87
,, ...	Edible oils, copper sulphate	89
,, ...	Oils, soap	94
Palestine, Syria	Corrugated iron sheets, chemicals, matches, candles, cement ...	101
Mexico	Heavy chemicals, chlorate of potash, tinplate ...	106
Brazil	Sheep and cattle dips, liniments, embrocations	1262
Chile	Paints, oils, varnishes ...	1203

* High Commissioner for Canada, 19, Victoria St., S.W.1.
† The Secretary, British Chamber of Commerce for Italy, 7, Via Carlo Felice, Genoa.

GOVERNMENT ORDERS AND NOTICES.

EXPORTS.

The following changes in existing export prohibitions have been notified by the Board of Trade:—

Heading transferred from one list to another.

From List A to List C:—Leather.—(July 3).

Altered heading.

(A) Hides, British and Irish cattle. (C) Hides, except British and Irish cattle.—(July 3.)

IMPORTS.

By a Proclamation—to be cited as the Prohibition of Import (No. 32) Proclamation, 1919—the importation of the following articles is prohibited:—

Chemicals of all descriptions; electrical goods and apparatus, including electrical plant and machinery of all kinds, and insulating materials of all descriptions; scientific, mathematical, and optical instruments; tungsten powder and ferro-tungsten.

With reference to the above Proclamation the Board of Trade has given notice that its terms have been widely drawn for convenience of administration, and that for the present it is not intended to do more than to control the entry into the United Kingdom of certain classes of chemicals of a high degree of purity. The Department of Import Restrictions will therefore almost immediately issue general licences for a large number of chemicals which are not of this description, and they will also issue licences in suitable cases and for limited quantities of the chemicals which are retained under control. For this purpose the Department will be assisted by a committee which is now in process of formation, and which will contain representatives of official, scientific, and trade bodies connected with the chemical industry.

Import Licences.—General licences have been issued in respect of:—Leather of all descriptions; leather board and cut leather stock; paints and enamels. The general licence for pyrites has been revoked, but applications for special licences may be made to the Department of Import Restrictions, 22, Carlisle Place, S.W. 1.

NEW ORDERS.

The Seeds, Oils, and Fats Order, 1919, Ministry of Food, June 23.—The Order restricts dealings in the following articles:—Copra, cotton seed, groundnuts, palm kernels, coconut oil, cottonseed oil, groundnut oil, palmkernel oil, soya oil, premier jus, oleo oil, neutral lard, linseed oil, and linseed.

The Household Fuel and Lighting Order, 1919. Board of Trade, June 23.—This Order appeared in the *London Gazette* of July 1, upon which date it came into force.

Storage of Acetylene.—A Home Office Order (Statutory Rules and Orders, 1919, No. 809, 1*d*.), has been issued prescribing the conditions under which acetylene, when contained in a homogeneous porous substance, with or without acetone or other solvent, shall not be deemed to be an explosive within the meaning of the Explosives Act of 1875. The Order, which is dated June 23, will come into force on August 1, 1919.

Payment of Patent and Trade-mark Fees in Enemy Countries or on Behalf of Enemies.—On July 7 the Board of Trade issued a general licence authorising the payment of fees in respect of the grant and renewal of patents, and of the registration, and renewal of the registration, of trade-marks and designs in enemy countries or on behalf of enemies.

PERSONALIA.

We regret to record the death of two distinguished members of the Society, Sir John Brunner, Bart., an original member, and Prof. Adrian J. Brown, of Birmingham University.

The Swedish Academy of Sciences has elected Prof. F. Soddy a foreign member, in succession to the late Sir William Crookes.

According to the *Zeitschrift der angewandten Chemie*, Dr. A. Werner has resigned his professorship of chemistry of Zurich.

Capt. H. J. Page has been appointed head of the chemical department in the Experimental Station and School of Horticulture of the Royal Horticultural Society at Wisley, Ripley, Surrey.

Dr. H. S. Allen, reader in physics at King's College, London, and secretary of the Physical Society of London, has been appointed lecturer in natural philosophy at the University of Edinburgh.

Mr. J. B. Robertson has been appointed lecturer in chemistry in the South African School of Mines, Johannesburg, and Mr. A. E. Walden, professor of chemistry in the Wilson College, Bombay. Both were previously on the staff of the chemical department of Edinburgh University.

OBITUARY.

LORD RAYLEIGH.

The death on July 2 of Lord Rayleigh in his seventy-seventh year has deprived British physical science of one of its most illustrious leaders. From the time when he graduated as Senior Wrangler and took the first Smith's Prize (1865) at Cambridge University until his memorable discovery of argon (1904) his life was crowded with scientific achievements of the first order. His collected papers, published by the Cambridge University Press in 1899-1903, testify alike to his power of work and wonderful versatility. These volumes included some 272 papers and covered a very wide range of subjects among which were acoustics, the measurement of fundamental electric units (including the electro-chemical equivalent of silver), optics, photography, thermodynamics and hydrodynamics, capillarity and viscosity. The achievement for which he will be best and longest remembered by chemists was his discovery of argon in the atmosphere, in the later stages of which he was associated with Sir William Ramsay, and which was the culminating point of a 10-years' research on the densities and other physical properties of gases.

Among the many posts of distinction filled by Lord Rayleigh were:—Cavendish Professor of Physics at Cambridge University, President of the British Association (1884), Professor of Natural Philosophy at the Royal Institution, and Chancellor of Cambridge University. He played an important part in the establishment of the National Physical Laboratory, and served as Chief Gas Examiner under the Metropolitan Gas Acts, with a seat on the Board of Trade Committee which reported on the testing of gas.

A full measure of honours and awards came to him. He was the recipient of honorary degrees from eight universities, was awarded the Royal and Copley medals of the Royal Society, received the Nobel prize for physics (1905), and the Order of Merit at its institution in 1902. Devotion to mathematical physics did not preclude an active interest in practical affairs, his farm of over 7000 acres in Essex being conducted with much success. His eldest son, the Hon. R. J. Strutt, professor of physics at the Imperial College of Science and Technology, succeeds him in the title.

REVIEWS.

BOILER CHEMISTRY AND FEED WATER SUPPLIES. *By* J. H. PAUL. *Pp. ix* + 242. (*London: Longmans, Green and Co.* 1919.) *Price* 14*s. net.*

The supply of feed water to boilers is a matter of vital importance to those responsible for the maintenance and safety of steam raising plant and is also a factor to be considered in connexion with the economy of fuel and of steam. The literature dealing with the two latter branches of this large subject, although perhaps rather diffused, is fairly comprehensive, but there is a distinct gap to be filled by an exposition of the chemical and physical properties of waters and of their behaviour at high temperatures and pressures. The author of "Boiler Chemistry" has accomplished this in a most lucid and interesting manner. He conceives the steam boiler as an autoclave in which solutions are concentrated and substances produced during the conversion of water into steam, and has succeeded in the difficult task of explaining chemical phenomena in non-technical language while incorporating a certain amount of hypothetical matter relating to the theory of corrosion which will be of interest to a wide circle of chemists.

The early chapters of the book trace the sources of the impurities found in natural waters due to intimate contact with the atmosphere, and the earth, and to biological action. Interesting information as to the variations in the composition from day to day is given and illustrated by means of graphs.

There is an excellent chapter upon the scales and deposits found in boilers, followed by an outline of softening processes. It is perhaps to this section that the industrial chemist will turn most eagerly, and although basic principles are clearly enunciated, one feels that the value of the book would have been enhanced had more been written about the actual operation and control of softening plants. Many plants are at times called upon to carry an overload, under which circumstances the chemist in charge needs to know rather more about the influence of the time factor upon the process than is given by the author.

The popular belief that water must not be softened below 5° of hardness if corrosion in the boiler is to be prevented is condemned as heresy, and a more rational explanation of corrosion by improperly softened water is offered. The next chapter describes the behaviour of soluble salts within the boiler and the considerations which should govern the use of the blow-off cock. Following this is a contribution to the theory of corrosion.

The author rejects the electrolytic theory and also considers that oxygen has been given more credit than it deserves in the formation of atmospheric rust. Emphasis is laid upon the part played by carbon dioxide within the boiler, and in logical sequence there is given the experimental evidence in support of the hypothesis that many instances of corrosion are due to a molecular rearrangement whereby oxide of iron is formed and the carbonic acid is converted into formic acid and then into aldehyde. In setting out this matter at some length the author does not neglect to deal with the diagnosis of corrosion due to other causes.

The concluding chapters deal with the properties of condensed water, the corrosion of superheaters, the prevention of priming and the formation of external deposits on the boiler shell. Every statement made in the book is supported by detailed analytical evidence for which the author assumes sole responsibility, and which will constitute a mine of information for those interested in steam raising.

H. HOLLINGS.

THE SPINNING AND TWISTING OF LONG VEGETABLE FIBRES (FLAX, HEMP, JUTE, TOW AND RAMIE). *By* H. R. CARTER. *Second Edition, revised and enlarged, with* 208 *illustrations. Pp. xvi* + 434. (*London: Charles Griffin and Co., Ltd.* 1919.) *Price* 24*s. net.*

The author of this book is ambitious when he endeavours to include in one volume the comprehensive and technical treatment of preparing, carding, spinning and twisting of flax, hemp, jute, tow and ramie yarns; of the manufacture of thread, twine, cords and ropes as well as chapters on mill construction, boilers, engines, steam, water power and power transmission. Any one of the subjects is worthy of fuller and more adequate technical and systematic treatment than is here given. The author claims that the same general principles underlie the preparing and spinning of all "long" vegetable fibres; he might have gone further and included worsted preparing and spinning.

It is certainly confusing when the continuity of the matter is broken by references to each contemporary subject in turn. The sequence of operations is interrupted when the treatment of waste, its preparation and spinning is introduced. It would have been better to have dealt with this section in a separate part of the book and as a distinct industry—which it is. The processes of reeling and bundling should naturally have followed wet spinning. The introduction and discussion of boilers, engines, steam, water power and power transmission are foreign to a book of this character.

The book contains a mass of valuable technical and practical information, but it is scrappy, and the description of machinery details is loose—similar parts being often described by several names which are known to only a few in the trade. A better way is to adopt the common name and adhere to it throughout.

Much of the descriptive matter is inadequate and most of the illustrations are of the machine maker's catalogue type. Many of these are photographs or pictures and occupy a full page or nearly so—they appear without numerals and letters of reference. Such illustrations from a technical point of view are practically useless to the reader or student unless supplemented by specially prepared line diagrams which illustrate the essential details and parts of the mechanism.

Reverting to a few of the points discussed, reference is made on page 27 to the Legrand system of artificial retting, which process can be conducted during 6½ months of the year. Figures are given to illustrate the cost of this process. A further reference on page 30 states that the process is possible all the year round. No explanation is offered for the shorter season on which the figures are based. In connexion with flax roughing (p. 50), 6 to 8 pieces per lb. are given as the usual "piecing" out size. On page 52 the range of pieces per lb. is given as from 2 to 8; such differences in a standard book are misleading and liable to confuse the reader and student alike. The reference to the setting of the sheets in the hackling machine is misleading (p. 60). The author's "recommendations" of setting point to point at the coarse end and slightly intersecting at the fine end are common practice. On page 90 the author rightly says that the weight of the levers should be considered when working out the total pressure on the drawing rollers, yet the solution supplied neglects these lever weights.

Speaking generally this volume is interesting for its historical survey and general description of the textile fibres and the preparation of the raw materials with which it treats.

The incidental comparisons of the subsequent descriptions of the operations and processes involved in the manipulation of the various materials into their respective yarns, threads, twine and ropes of the different industries is not only interesting but instructive and helpful, as comparisons always are. F. BRADBURY.

OSMOTIC PRESSURE. *By* ALEXANDER FINDLAY. *Monographs on Inorganic and Physical Chemistry. Second edition, with* 10 *figures. Pp.* 116. (*London: Longmans, Green and Co.* 1919.) *Price* 6*s. net.*

The second edition of Prof. Findlay's "Osmotic Pressure" retains all the essential features of the original work, but embodies also the most important of the developments that have taken place both on the experimental and on the theoretical side during the past six years. On the experimental side attention is directed to the wide alterations in the type of apparatus used by Morse and his colleagues in Baltimore, including the use of an electrical pressure gauge, whilst on the theoretical side the work of F. Tinker is of special interest. The book is a most valuable monograph and is likely to continue its career of usefulness with increased efficiency in the form in which it is now presented. T. M. LOWRY.

PUBLICATIONS RECEIVED.

GAS AND FUEL ANALYSIS FOR ENGINEERS. *By* A. H. GILL. *Eighth revised edition. Pp. vi*+145. (*New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.* 1917.) *Price* 6*s.*

THE CHEMISTRY AND MANUFACTURE OF HYDROGEN. *By* P. L. TEED. *Pp.* 152. (*London: Edward Arnold.* 1919.) *Price* 10*s.* 6*d.*

THE METALS OF THE RARE EARTHS. *By* J. F. SPENCER. MONOGRAPHS ON INORGANIC AND PHYSICAL CHEMISTRY, *edited by* ALEXANDER FINDLAY. *Pp. x* + 279. (*London: Longmans, Green and Co.* 1919.) *Price* 12*s.* 6*d.*

INDUSTRIAL HANDBOOK. *Indian Munitions Board. Revised edition* 1919. *Pp.* 417. (*Calcutta: Superintendent Government Printing, India.* 1919.)

ÉTUDES DE PHOTOCHIMIE. *By* V. HENRI. *Pp.* 218. (*Paris: Gauthier-Villars et Cie.* 1919.) *Price* 21 *fr.* 60 *c.*

THE ENERGY RESOURCES OF THE UNITED STATES: A FIELD FOR RECONSTRUCTION. *By* C. G. GILBERT *and* J. E. POGUE. *The Mineral Industries of the United States. Smithsonian Institution. Bulletin* 102, *Vol. I. Pp.* 165. (*Washington: Government Printing Office.* 1919.)

THE INTERNATIONAL MOVEMENT IN FERTILISERS AND CHEMICAL PRODUCTS USEFUL TO AGRICULTURE. (*9th Review.* 1918.) *Documentary Leaflets of the International Institute of Agriculture, Rome. Pp.* 44.

OPPORTUNITIES IN CHEMISTRY. *By* ELLWOOD HENDRICK. *Pp.* 102. (*New York and London: Harper and Brothers.* 1919.) *Price* 8*s.* 6*d.*

DIE HYGIENE DES WASSERS. *Gesundheitliche Bewertung, Schutz, Verbesserung und Untersuchung der Wässer. By* DR. AUG. GÄRTNER. *With* 93 *illustrations and* 11 *tables. Pp.* 952. (*Braunschweig: Friedr. Vieweg und Sohn.* 1915.)

APPARATE UND ARBEITSMETHODEN ZUR MIKROSKOPISCHEN UNTERSUCHUNG KRISTALLISIERTER KÖRPER. *By* C. LEISS *and* DR. H. SCHNEIDERHÖHN. *With* 94 *illustrations. Pp.* 94. (*Stuttgart: Franckh'sche Verlagshandlung.* 1914.)

THE ANNUAL MEETING.

The reasons which led the Council to accept the invitation of the London Section to hold the 38th annual meeting in London have been fully justified by the event. Its historic associations with industry and commerce, its possession of more scientific institutions than any other city in the world, its unique position as the capital of the Empire and its ready accessibility, make London an ideal locality for the meeting place of a Society whose membership includes manufacturers, scientists, and merchants in all parts of the British Commonwealth. The patronage accorded by H.M. the King and H.R.H. the Prince of Wales, combined with the hospitality extended by the Lord Mayor and the Worshipful Masters of the Salters', Goldsmiths' and Clothworkers' Companies, conferred exceptional prestige and importance on the meeting; and the presence of distinguished delegates of Allied Chemical Societies, together with the synchronising of the meetings with the peace celebrations in Paris and London, further contributed to make the occasion one of extraordinary significance for the Society of Chemical Industry, and, we may hope, one of no little moment to the cause of chemical science.

The Opening Meeting.

The address of welcome by the Lord Mayor at the Mansion House showed an appreciation of the value of chemistry to national life which is rare among our public men; were it otherwise, the President in his reply would not have had to lament the fact that the scientific technologist and the man who makes the goods rank lower in popular esteem than the man who barters them. A further advantage arising from the choice of London as the locality of the meetings was the chance it gave to the London press to report the proceedings. This opportunity was taken advantage of to an extent which could not have been anticipated, and we may hope that the precedent will be duly followed. The immense power for good or ill wielded by the ephemeral press must be harnessed to the service of science in the interests, not only of scientific men, but of national security and efficiency.

The President's address brought out some new facts and figures relative to the achievements of British chemists in the successful prosecution of the war, progress in the manufacture of explosives, drugs and aeroplane materials, developments in photography, dyes, glass, edible oils and ferro-alloys all receiving attention. The conclusions drawn were that our scientists had fully proved their ability during the war, and that it now remains to increase their number and opportunities; success in the coming industrial struggle can only be achieved by the same means which brought us victory in the war, namely, greatly increased production.

The Conferences.

Apart from the purely technical matters which were dealt with at the six conferences, there appeared to be an underlying current of opinion that great as the achievements of chemistry undoubtedly have been during the war, we are but on the threshold of making our position secure, and that at all costs—to use the words of Pasteur—"*il ne faut pas s'arrêter aux choses acquises.*" Further, that the industry generally stands in need of more and better organisation, based on the principle of co-operative effort, and of beneficent rather than benevolent neutrality on the part of the State.

As the papers and discussions are printed in detail in the current issue of the Transactions, only brief summaries are given in this place. An account of the conference on sugar production and consumption within the Empire is held over, pending the necessary revision of the statistical and other data which were presented to the conference in a preliminary form.

Conference on the Inter-Allied Chemical Federation.

Sir William Pope described the reasons which had led to the decision to form an international scientific organisation with the Central Powers excluded, and explained the somewhat intricate relationships between the various Inter-Allied and National scientific bodies which have been formed or are in process of formation. As an illustration of the utility of establishing co-operative effort in the sphere of chemistry, he instanced the question of the publication of chemical compendia and abstracts (see this J., 1919, 239 R). This subject has now been under discussion for some considerable time, and it is to be hoped that definite action will soon be taken, preferably on an international basis, but if not, upon a national one. While Allied chemists have been deliberating, German chemists have been acting, with the result that the first volume of the new "Beilstein" has been issued at a price equivalent to about 30*s.* when the low exchange value of the mark is taken into account (this J., 1919, 126 R). However willing Allied chemists may be to avoid using this and other similar German publications, it seems almost unavoidable that they will be forced to do so, and that a vested interest in them will accordingly be created.

With Prof. Armstrong's remarks on the need for good literary style in chemical publications, no one will feel inclined to cavil, but the extent to which the wants of chemists can be adequately met by the provision of well-written monographs is open to question. Handbooks and compendia have proved their indispensability as enlarged indexes and dictionaries of chemical literature: it would add greatly to their size and cost and nothing to their value as "business" documents, which they essentially are, if they were given a more literary dress; but monographs, text-books, annual reports and the like should undoubtedly be made as readable as possible. The main obstacle to immediate action in the publication of chemical compendia appears to be the difficulty of raising the necessary funds; here is a chance for the Government to pay back a little of what it owes to chemistry for services rendered during the war. In accordance with the desire expressed by Sir William Pope that this subject should now be freely discussed, we shall have pleasure in placing our correspondence column at the disposal of those who have opinions and suggestions to bring forward.

Conference on Power Plant in Chemical Works.

This conference was arranged by the Chemical Engineering Group, and, thanks to the efforts of its chairman and secretary, a series of papers was presented which fully deserved the close attention of the large audiences which were present throughout the two sessions.

In the forenoon, Prof. Louis, as chairman, dwelt on the grave situation confronting the nation through the alarming diminution of the coal output, which he considers to be primarily due to the adoption of a minimum wage. He insisted on the duty of the chemical engineer at this critical period to put forth every effort to find means of utilising our available fuel to the utmost. M. Paul Kestner, an honoured guest, speaking on behalf of his French colleagues, wished the newly-constituted Group

prosperity and success, and referred in sympathetic terms to the assistance he had received from British chemists in his early days.

The first paper was by Capt. C. J. Goodwin on "Waste-heat Boilers and Pulverised Fuel in Chemical Works." The subject is too vast a one to be covered *in extenso* within the limits of such a paper, but the material was deftly handled and well illustrated by lantern slides. In the ensuing discussion, Dr. Ormandy, Mr. L. C. Harvey, Capt. Sinnatt and Mr. Ridge brought out other interesting points bearing on the subject. A contribution by Prof. W. A. Bone and Mr. P. St. G. Kirke dealt with the Bonecourt system of incandescent surface combustion and of its application to the firing of multi-tubular boilers with coke-oven and producer gas. During the war the problem of superheat has been investigated and the Bonecourt boiler has been modified to provide for superheats up to the highest degree required in modern power-station practice. In the discussion Prof. Bone stated that low-grade blast-furnace gas could also be used for surface combustion boilers provided it were thoroughly cleaned, but in that case greater efficiency would be obtained by using it in an internal combustion engine.

In the afternoon, under the chairmanship of Dr. C. Carpenter, Mr. P. Parrish gave an excellent paper on "A Chemical Works Power Plant and the Production of Steam from Low-grade Fuel." He dealt with the "power load" of a chemical works, described a typical plant, and discussed the question of centralisation *v.* decentralisation of the power plant as affecting particular works' operations. The use of coke breeze for boiler firing was exhaustively treated and numerous results of continuous tests and comparative cost sheets were given. Prof. Hinchley followed with some useful notes on the economic management of small boiler plants. Mr. H. Martin's "Notes on Electrical Plant in Chemical Works" was not read owing to the absence through illness of the author. The paper urges the need for installing new and efficient electric plants, and discusses the measures to be taken for the introduction of electric power into chemical works.

A pleasing feature of the meetings was the business-like dispatch with which the discussions were conducted. No time was wasted in waiting for speakers, remarks were brief and to the point and the usual irrelevancies conspicuously absent. These results were attained by the previous circulation of abstracts of the papers read, of "discussion slips" for intending speakers to hand to the chairman, and of a few rules for the general conduct of the meetings. The Group is to be congratulated upon the success of its first conference.

Conference on Dyestuffs, Synthetic Drugs and Associated Products.

The large attendance attracted to this meeting was maintained throughout the day, and was duly rewarded by material of much interest. Dr. Herbert Levinstein opened the proceedings with an illuminating and skilfully balanced address on "The British Dyestuff Industry," in which he emphasised the paramount importance to the State which the successful manufacture of colouring-matters represents. Four principal arguments were selected in support of this claim, namely, (1) it is a key-industry, (2) its possession offers a guarantee of peace, (3) it gives an incentive to organised research and is thus related to the development of new industries, and (4) a flourishing dyestuffs industry has considerable political importance as an agent of peaceful penetration. He administered some wholesome and necessary correctives to those complacent spirits who would seem to suggest that it is the English-speaking chemists who have won the war, whereas the real war-work of our chemists lies yet before us. Trenchantly summarising his observations, he declared that it will be madness on our part not to render ourselves economically free in this particular province, that it will be folly to leave Germany in sole possession of the potential arsenals which dye-making factories constitute, and that it will be impossible for us to maintain our commercial supremacy if we neglect this great opportunity to train our research chemists.

Prof. G. T. Morgan described some "Colour-producing Intermediates," and exhibited patterns of chromium, copper, cobalt and vanadium lakes obtainable from hydroxyazo-dyes derived from 2:4-dinitroaniline. Mr. James Morton, discussing "Dyes and British Textiles," traced the probable effects of the three alternative policies which might be adopted in meeting the present situation, namely, (1) unrestricted admission of German dyes, (2) prohibition of entry by tariff and boycott, or (3) temporary control of imports supported by Government subsidy, and outlined the machinery by which the last of these could be operated.

At the afternoon session Mr. E. V. Evans, dealing with the "Manufacture of Intermediates," called for closer co-operation among the sporadic producers, Professor A. G. Green raised an important point in "Patent Laws and the Dyestuffs Industry," namely, the probable attitude of German producers in regard to future inventions, Mr. F. H. Carr dwelt on the part played by the "Manufacture of Synthetic Drugs" in establishing a coherent and interconnected chemical industry, Dr. W. R. Innes drew attention to the war-difficulties encountered by manufacturers of "Photographic Chemicals," and Dr. M. O. Forster pleaded for the "Organised Preparation of Laboratory Chemicals" on the lines developed by Kahlbaum and Schuchardt. Lively discussions occurred at intervals during the day, and to these interludes contributions were made by the chairman, Dr. Rée, the various authors of papers, Prof. H. E. Armstrong, Dr. J. C. Cain, Mr. W. H. Dawson, Mr. D. Lloyd Howard, Mr. L. M. Nash and Prof. W. H. Perkin.

Conference on the Chrome-Tanning Industry.

At the opening of this Conference, held at the Goldsmiths' Hall, the chairman, Mr. F. H. Briggs, referred to the backward condition of the industry in England and attributed this partly to the fact that a large amount of the trade in raw skins within the British Empire had fallen into German hands before the war. The chrome leather manufactured from these skins by the Germans was then largely sold in England. This deplorable condition had recently been remedied, and it seemed probable that in future the chrome tanning of East India kips in England would be carried out on a much larger scale than in the past. Tanners are now thoroughly aware of the advantages to be derived from scientific research, and it was unfortunate that this awakening had not taken place many years ago.

Prof. McCandlish outlined the development of the chrome-tanning industry in the United States. The first successful commercial method of chrome tanning, Schultz's two-bath process, was devised and developed in the United States. Large sums of money had been lost by the pioneers in the industry, but by the exercise of initiative and good business ability it had developed into an industry of enormous proportions. Some of the improvements made in the manufacturing process were described, which indicated that progress had been made by the development of existing methods rather

than by revolutionary changes. Reference was made to the very much larger scale on which tanneries operated in America as compared to England.

Mr. M. C. Lamb dealt with the chrome-tanning industry in Great Britain, and gave an interesting historical account of its development. Improvements in the component liquors of Schultz's original two-bath process were described, and it was shown how these effected economies in practice. However, the one-bath process appealed to tanners in this country, as, in its method of application, it more closely resembled the vegetable-tanning process. Chrome leather had been much used for the uppers of British army boots during the war, and had proved entirely satisfactory. A development of chrome tanning, carried out to a greater extent in England than in any other country, was the manufacture of chrome sole leather. Its waterproof qualities and durability will undoubtedly lead to an increasing demand for this class of leather. Tribute was paid to the debt owed to Prof. H. R. Procter for his valuable contributions to our knowledge of the scientific side of the industry.

In the discussion which followed, Mr. Grant Cooper expressed surprise that such large supplies of raw hides had been allowed to pass out of the British Empire into German hands, and trusted that with increased appreciation of the value of chemical assistance the condition referred to by the chairman would never return. Mr. R. Faraday Innes thought that the British tanner was too slow in realising the advantages accruing from chemical aid. Mr. D. Woodroffe pleaded for closer co-operation, not only between tanner, chemist and foreman, but also between the allied industries manufacturing tannery equipment. A discussion on the training of technical chemists followed, in which Dr. C. A. Keane, Prof. McCandlish, and Mr. Lamb participated.

Conference on Recent Developments in the Fermentation Industries.

After some introductory remarks of an historical nature by the chairman, Sir J. J. Dobbie, Col. Sir F. Nathan read a paper on the manufacture of acetone. When, during the war, Austria ceased to export this substance, the United States became the only source of supply, the quantity produced in this country being negligible. Catalytic processes involving the use of alcohol and of calcium carbide as raw materials had been successfully worked out. The Weizmann process was used in this country, but it attained the largest measure of success at Toronto, where, in 1918, an output of 200 long tons per month was reached. At Toronto, also, a successful catalytic process was devised for converting the by-product butyl alcohol into methylethylketone, which can satisfactorily replace acetone in the manufacture of cordite. Although it has been proved during the war that acetone can be manufactured by the fermentation of substances containing starch, this method is not likely to compete with its production by the destructive distillation of wood.

Mr. Amos Gill described in detail the morphological characteristics of the micro-organism used by C. Weizmann for the production of acetone and butyl alcohol from cereals, and discussed a number of interesting points in connexion with the application of the process. The procedure as carried out at King's Lynn factory was described in detail, also the various devices adopted to keep the plant and cultures aseptic.

In the ensuing discussion, Prof. A. Fernbach claimed priority for the discovery of the fermentation process for making acetone and butyl alcohol from starchy materials, and stated that he had shown it to Dr. Weizmann. The Fernbach and Weizmann processes were identical. Sir F. Nathan agreed to this claim and added that his Department had been using bacteria provided by Dr. Weizmann. The process had been used in this country, Canada and the United States, and in every case with some form of grain and not with potatoes. The Hon. F. R. Henley said he had used horse-chestnuts, but it was impossible to carry through fermentation unless all husk was removed, which in practice was impossible. By mixing chestnuts with maize or rice, fermentation could be effected.

Mr. Chaston Chapman directed attention to the inadequate provision made in this country for systematic instruction in industrial micro-biology. Although much work has been done on brewing and distilling the minor fermentation industries have been left largely to take their chance. Lactic acid was cited as an example and statistical information showed that in 1912 we were not able to supply our own requirements but were importing largely, in some cases from our former customers. Much of the lactic acid is made in a haphazard manner, the quality being poor and the cost of production high. The author also discussed the desirability of an institution being devoted to the systematic prosecution of original research in connexion with any industry in which micro-organisms or enzymes play an important part. Such an institute would also provide organisms in pure culture and in quantities sufficiently large for industrial purposes.

Mr. Brierly urged the extension of the pure culture laboratory at Rothamsted, and in drawing attention to the Association of Applied Biologists suggested that the Society of Chemical Industry might have joint meetings with that body. Mr. F. L. Lloyd discussed the great difficulties of obtaining and retaining pure cultures for technical purposes, and the chairman suggested that an association on the lines indicated by Mr. Chapman might be formed in connexion with the Department of Scientific and Industrial Research.

The Social Functions.

The social gatherings in connexion with the meeting were, fittingly, of a more numerous and elaborate character than those held during the past few years, and the revived experience of such functions emphasised their great value both from a social and a professional standpoint. In addition to the luncheon, to which 360 members and guests sat down at the Connaught Rooms, and the annual dinner at the Savoy Hotel attended by some 250, successful soirées were held at the Imperial College and the British Scientific Products Exhibition. The final day was devoted to a visit to Windsor Castle, including St. George's Chapel, the Albert Memorial Chapel and the State Apartments, a luncheon at the White Hart Hotel, Windsor, and to an enjoyable trip on the Thames from Windsor to above Maidenhead. About 200 people took part in this excursion. The pleasure of these entertainments was much enhanced by the company of colleagues from the Allied countries who were taking part in the Inter-Allied Conference, and not less by the presence of many lady guests. The hospitality offered by the Chemical Industry Club also materially assisted in giving members and their friends valuable opportunities to meet, fraternise, and exchange ideas. At the final function—the lunch at Windsor—Prof. Louis took the opportunity of expressing the gratitude of all to the London Section, and in particular to its chairman and secretary, for their hospitality and the immense amount of trouble which they had taken, and of congratulating them upon the complete success of their efforts.

THE INTER-ALLIED CHEMICAL CONFERENCE.

Meetings of the delegates appointed to represent the Allied countries were held at the Salters' Hall, London, E.C., from July 14—17, inclusive. Six sessions were held, and the various nations were represented as follows:—

Belgium. M. Lucion, past-president of the Société Chimique de Belgique; M. Timmermans, associate professor in the University of Brussels. *France.* M. Moureu, member of the Institute of France and professor at the Collège de France; M. Kestner, president of the Société de Chimie Industrielle; M. Béhal, member of the Académie de Médecine and professor at the Ecole Supérieure de Pharmacie de Paris; Dr. Marquis, chief editor of the Bulletin de la Société Chimique; Dr. Marie, general secretary of the Société de Chimie Physique; M. Voisin, member of council, Société de Chimie Industrielle; and M. Gérard, general secretary of the Société de Chimie Industrielle. *Italy.* Dr. O. Severini, director of the Società Generale per la Cianamide; Dr. G. Pirelli, representing the Società di Chimica Industriale of Milan. *United States.* Dr. F. G. Cottrell, chief metallurgist, U.S. Bureau of Mines; Dr. C. L. Parsons, chief chemist, U.S. Bureau of Mines, secretary of the American Chemical Society; Dr. E. W. Washburn, professor of ceramic chemistry at the University of Illinois, past-chairman of the Division of Chemistry and Chemical Technology of the National Research Council. *United Kingdom.* Sir William Pope, professor of chemistry at the University of Cambridge, chairman of the Federal Council for Pure and Applied Chemistry; Prof. H. Louis, professor of mining at Armstrong College, University of Durham, president of the Society of Chemical Industry, Prof. H. E. Armstrong, past-president of the Chemical Society; Dr. E. F. Armstrong, vice-chairman of the Association of British Chemical Manufacturers; Mr. A. C. Chaston Chapman, past-president of the Society of Public Analysts; Prof. W. P. Wynne, professor of chemistry in the University of Sheffield. The following also attended by invitation: Dr. R. F. Ruttan, director of the department of chemistry, McGill University, Montreal, president of the Royal Society of Canada, and Dr. H. Hibbert from the United States.

The proceedings of the Conference were conducted in French, M. Moureu acting as chairman, and M. Gérard as secretary. Almost the whole time of the Conference was taken up in framing the constitution of the new body (*v.i.*), which is to be known as the "International Confederation of Associations for Pure and Applied Chemistry" (Confédération Internationale des Associations de Chimie Pure et Appliquée), and in discussing the desirability of its inclusion in the scheme of organisation projected by the Conference of Scientific Academies. The following officers were elected for a term of three years:—President, M. Moureu; Vice-Presidents, M. Chavanne (Belgium), Signor L. Parodi Delfino, Dr. C. L. Parsons, and Sir William Pope; General Secretary, M. Jean Gérard (49, rue des Mathurins, Paris).

In addition to the five countries represented as above it was decided to admit neutral countries which have not bound themselves by association with any other international organisation having similar objects. It was also agreed that the British Dominions and the nations signatory to the Peace Treaty should each have separate representation on making application. In this connexion Canada and Poland have already signified their adhesion. After participating in the peace celebrations on July 19, many of the delegates journeyed to Brussels to take part in the proceedings of the International Research Council, July 22 being the date arranged for the consideration of affairs relating to chemistry. The relationships between the International Research Council, the International Chemical Federation and the constituent members of each are clearly set out in the address given by Sir William Pope at the Mansion House on July 15 (see this issue, p. 208T); it may be of interest, however, to add that with the exception of Belgium, each of the nations at present represented on the International Chemical Federation has formed a national organisation similar to our Federal Council for Pure and Applied Chemistry; thus the United States has instituted a Chemical Division of the National Research Council; France, the Fédération Nationale des Associations de Chimie Pure et Appliquée; Italy, the Associazone Italiana di Chimica Generale ed Applicata (see p. 270 R of this issue). Before adjourning, the Conference resolved to hold its next meeting in Italy, towards the middle of June, 1920. A translation of the rules adopted and of the resolutions passed is given below:—

RULES.

I. The National Federations or National Councils of the Chemical Associations of Belgium, the United States of America, France, the United Kingdom of Great Britain and Ireland, and Italy agree to form an international association to be known as the International Confederation of Associations for Pure and Applied Chemistry, and having as its objects:—

(i) To reinforce between the Allied peoples the bonds of esteem and friendship which have already been strengthened during the war.

(ii) To organise permanent co-operation between the chemical associations of the different countries.

(iii) To co-ordinate their scientific and technical activities.

(iv) To contribute to the advancement of chemistry in all its branches.

No limitation is set to the duration of the Confederation. Its provisional headquarters are to be in Paris.

II. The admission of a country to the Confederation is subject to the conditions laid down in the rules of the International Research Council.

Membership of a country in the Confederation to be effected through its National Federation or National Council, or in the absence of these, through a national association representing chemistry.

III. The Confederation shall act through a Council assisted by a permanent secretarial staff with a special office, the appointment of which will form the subject of an international agreement between the constituent countries.

IV. The annual subscription is fixed for each country at a rate proportional to the number of its inhabitants, in accordance with the following table:—

	Population in millions of inhabitants.	Minimum annual subscription.
Category A ...	less than 5	500 francs
,, B ...	from 5 to 10	1,000 ,,
,, C ...	from 10 to 15	1,500 ,,
,, D ...	from 15 to 20	2,500 ,,
,, E ...	from 20 to 30	3,500 ,,
,, F ...	more than 30	4,500 ,,

Members of the Confederation are only liable for expenses connected with the general administration. No further expenditure can be demanded unless their consent thereto has previously been obtained.

V. Withdrawal from the Confederation is subject to two years' previous notice and to all obligations being fulfilled.

Membership may be determined by a majority of two-thirds of the members of the Council, either present or represented, for non-payment of the minimum annual subscription or for a serious offence, the member having previously been called upon to furnish explanations.

VI. The Confederation to be administered by a Council consisting of delegates of each of the contracting countries, the number of whom is fixed according to their category as indicated below :—

	Delegates.
Category A	1
,, B	2
,, C	3
,, D	4
,, E	5
,, F	6

The delegates are appointed for three years by the Council of the National Federation or the National Council of their respective countries. One-third of the number shall retire annually but shall be eligible for re-election.

VII. The Executive Authority of the Council shall consist of a president, four vice-presidents and a general secretary.

The Council shall elect (by a majority) these officers from amongst its own number, every three years; they shall not be immediately eligible for re-election to the same office. The president to be chosen from among the vice-presidents.

VIII. The Council shall meet at least once a year on the day before the annual general meeting in the town where the latter is to be held, and, in addition, as often as it shall be convened by its president or upon the requisition of one-fourth of its members.

The Council shall fix the date and place of meeting, draw up the budget, and decide as to expenses.

Resolutions shall be adopted by a majority, each nation having the right to only one vote.

In matters appertaining to administration and finance, votes shall be given by countries, each nation having a number of votes equal to that of its delegates. Proxies may be appointed by the delegates of any nation to represent them and vote in their name. Postal votes are permissible, but only on matters appearing on the agenda. The chairman to have a casting vote.

IX. Minutes of the meetings shall be kept. Two copies of these minutes shall be signed by the chairman and the secretary of the meeting.

The permanent secretarial staff shall have the custody of the archives, and be entrusted with the execution of the resolutions adopted by the Council and the Executive, and in particular with the circulation of the agenda.

X. The functions of the Executive shall be :—

(1) To see that the rules are strictly observed; (2) to prepare the agenda for meetings of the Council; (3) to record and carry out the decisions of the Council; (4) to perform during the entire period elapsing between two meetings of the Council the necessary acts of administration and to report on the same in writing to the members of the Council; (5) to submit to the Council a draft yearly budget; (6) to represent the Confederation, or to appoint its representatives.

XI. There shall be instituted, in addition to the Council, a consultative committee, consisting of as many sections as shall be necessary to ensure the complete representation of pure and applied chemistry in conformity with the regulations of the Confederation.

XII. The annual meeting to be attended by members of Council and delegates of the various National Federations or National Councils.

An ordinary general meeting, to be called a Conference, shall be held at least once every year, preferably in the locality where the International Congress of Pure and Applied Chemistry is held and at the same time.

The Conference shall meet whenever it is called by the Council, or at the request of at least one-half of the members of the Confederation.

The Conference shall receive the reports on the administrative work of the Council, on the financial situation, and on the general position of the Confederation.

It shall adopt the accounts for the past financial year, as certified by an auditor elected from outside the body of the Council and appointed by the Conference of the previous year. It shall pass the estimates for the forthcoming financial year and discuss questions placed upon the agenda.

The annual report and the accounts shall be sent to all the members at least three months before the meeting of the Annual Conference.

The agenda of the Conference shall be drawn up by the Council and must include every question which shall have been transmitted to it by any of the members of the Confederation three months at least before the holding of the Conference.

The Conference shall be served by the same secretarial staff as the Council.

Votes on administrative and financial questions shall be cast by countries, each of which shall be entitled to the number of votes indicated in the categories specified in Rule VI.

The delegates of any country may appoint one or several proxies to represent them and vote in their name.

XIII. Expenditure shall be authorised by the president and disbursed by the permanent secretary.

The Confederation shall be represented in all civil and legal proceedings by the permanent secretary.

XIV. Resolutions of the Council relating to such purchases, exchanges, and transfer of real property as may be needed for the accomplishment of the objects of the Confederation, grant of mortgages on the said properties, leases for more than 9 years, transfers of properties and loans, must be submitted to the Conference for approval.

XV. Suggested alterations in the Rules may only be submitted to the Conference on the initiative of the Council of the Confederation, or on the application of one of the constituent National Federations or National Councils.

The proposals for alteration shall appear on the agenda of the Conference provided they have been received in writing at the office of the Confederation at least three months previously.

Votes shall be taken by countries.

Postal votes to be allowed in this case.

The Rules can only be altered by a majority of two-thirds of the votes cast.

XVI. In the event of the Conference being convened to decide upon the dissolution of the Confederation, special notices to that effect shall be sent three months in advance; and at least three-quarters of the members of the Confederation or their proxies must be present.

If this proportion is not reached, the Conference shall be adjourned for not less than six months, when the decision of the adjourned meeting shall be operative, irrespective of the number of members present.

In any case, dissolution can only be resolved upon by a majority of two-thirds of the votes cast.

XVII. In the event of dissolution the Conference shall appoint one or more trustees to liquidate the property of the Confederation: and any surplus assets shall be given to an international institution.

XVIII. In the interpretation of these Rules the French text shall be authoritative.

Resolutions.

The International Confederation of Associations for Pure and Applied Chemistry, meeting in conference in London from July 14 to 18, 1919, hereby records the following opinions:—

1. That the Confederation should be included in the scheme of organisation contemplated by the Conference of Scientific Academies, with autonomous powers, as the Chemical Section of the International Research Council.

2. That it shall constitute "The International Committee of Chemistry."

3. That the various national delegates representing chemistry at the meeting of the International Research Council shall be appointed by the same National Federation which appoints the delegates to the Confederation.

4. That the officers of the present Confederation be, *ex officio*, officers of the Chemical Section of the International Research Council.

* * *

M. Jean Gérard, writing from Brussels on July 24, states that, in order to satisfy the requirements of the International Organisation of Scientific Academies, slight alterations in the form of some of the Rules adopted by the London Conferences were made by the delegates appointed to represent it at the Brussels Conference; that the modified Rules (as given above) were approved by the Organisation; and that the Confederation has been admitted to the International Research Council as the Chemical Section, in accordance with Resolution 1 above.

POWER ALCOHOL.

The Report of the Inter-Departmental Committee on the production and utilisation of alcohol for power and traction purposes marks a far reaching and welcome advance in Government enterprise. Comparatively few of the public realise how important power alcohol will become in the future if rapid transport, whether by land, sea or air, is to be developed to the extent which recent achievements have made probable. The known oil supplies of the world are estimated to last only a limited period, and even if productive new fields are discovered there still remains the need of providing alternative supplies of motor fuels derived from new raw materials. The fundamental fact that the vegetable raw materials from which alcohol can be manufactured are being continually renewed and are capable of great expansion makes alcohol motor fuel the ideal for the future, and any State which neglects to encourage and to prepare for its application to these purposes is ignoring the best interests of its citizens.

The problem is far too big to be undertaken by private enterprise, and we therefore welcome the recommendation that the time has come for the Government to ensure close investigation of the questions of production and utilisation, in all their branches, of alcohol for power and traction purposes.

It is the question of production and the restrictions governing utilisation which are of greatest interest to the industrial chemist. The outlet for alcohol in the chemical and allied industries is very large were it not for the many restrictions governing its use. It is unthinkable that the use of alcohol for power purposes will be permitted on better terms than are allowed to the chemical industry. How onerous are the restrictions at present regulating the use of alcohol may be seen from the emphatic recommendations for their abolition contained in the Report.

Obviously, power alcohol must be made unfit for human consumption and proof against illicit purification to render it potable. The present denaturing process is very costly, adding as much as 6d. to the price per gallon, and it is suggested that the proportion of wood naphtha, the principal denaturant, should be reduced as much as possible. This was done during the war owing to the shortage of wood spirit without detriment to the State, and it is a source of great hardship to many industries, in particular the photographic, that a return has since been made to the pre-war practice.

The Committee suggests that petrol, benzol or other nauseous substances supplemented by a small quantity of methyl violet should be used, and that every effort should be made to provide alternative denaturants—for example formaldehyde, pyridine and tobacco oil—the employment of which will be effective in the smallest possible quantities. Power alcohol must be denatured at the lowest possible cost per gallon compatible with the protection of the revenue.

Greater facilities are required to permit the necessary volumetric mixings during denaturing; transportation by rail or road in tank wagons instead of in barrels or small containers must be allowed. It must be made possible to ship power alcohol in tank steamers and to handle and store it in bulk at the ports of arrival. Generally, the present restrictions concerning its manufacture, storage, transport and distribution will have to be largely removed if power alcohol is to be handled cheaply and expeditiously in large quantities.

Needless to say the Committee advocates the production and importation of power alcohol free of duty.

Alcohol may be produced from vegetable sources or by synthetic processes. Potable alcohol has in the past been produced from foodstuffs but with the prevailing world shortage these will be far too costly to serve as raw materials for power alcohol. As vegetable growth is dependent on ample sunshine and suitable temperature, its economical production can only be effected in tropical and sub-tropical regions from such materials as molasses and quickly grown sugar or starch-containing products. Special attention is directed to the flowers of the mahua tree (*Bassia latifolia*) in India as a source of alcohol.

Wood and wood pulp lyes and possibly peat may perhaps serve as sources of fermentable material after hydrolysis, and systematic research into these questions is desirable.

The only synthetic production considered by the Committee is that from ethylene derived from coal and coke-oven gases, and it is considered that a large potential source of power alcohol is thus available, but much further research is required, particularly as regards the catalytic conversion of the ethylene into alcohol before definite figures as to cost can be given. No mention is made of the production of alcohol from acetylene derived from

carbide; this is a well-established technical process and given cheap carbide should compete favourably as regards cost.

It is of course essential that the price of power alcohol must be such as to enable it to compete with petrol and to ensure cheap transport, which is more than ever necessary now that our railways under State control have failed to cope with the national traffic.

The Committee urges the Government to establish forthwith an organisation to initiate and supervise experimental and practical development work on the production and utilisation of power alcohol, and it is to be hoped that effect will be given to this recommendation without delay. The diminishing supply of coal in this country makes it urgent that steps shall be taken to supplement it by other fuel, and if the nation can applaud the expenditure of a million pounds to search for oil under Britain it should be eager to expend a like sum on the development of power alcohol.

A full abstract of the Report appeared in our last issue (July 15, p. 250 B).

LECTURES AT THE BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

On July 7, Sir William Tilden gave an address on "Chemistry in Reconstruction."

A visitor to the exhibition could not fail to experience the comforting conviction that British chemical manufacturers are now quite capable of holding their own in regard to variety and quality of products. They will undoubtedly be able to supply this country with drugs, dyes and other necessaries so long as they continue to exhibit the same skill, energy and resource which has been gradually developed during the last five years and provided they continue to receive for a time adequate protection from foreign imports. With regard to trade outside the United Kingdom it is too soon to indulge freely in optimism. In a recent speech the Prime Minister pointed to the condition of German territory, which has not been damaged or disturbed to any appreciable extent by the operations of the war, and which retains the famous chemical establishments with plant and machinery in working order, and even extended by material stolen from Belgian and French factories. Moreover, Germany has the services of a very large body of technical chemists of great skill and experience, and she will naturally make greater efforts than ever to penetrate into foreign markets. Then there is Switzerland with good schools of chemistry and an already established chemical industry. During recent years the United States has vastly extended the chemical departments of its universities and technical schools, and put up much new capital for the development of chemical manufactures. Japan, also with a well-equipped university, many natural products, and cheap labour will certainly appear in the field.

All these will undoubtedly prove very formidable competitors in the race in which the British chemist will have to enter. In this country also there is still a great deficiency in the number of well-qualified chemists available for the service of industry. The manufacturer has too long been satisfied with the services of the laboratory boy, who can be taught to perform routine testing without any knowledge of more than the most elementary chemical principles. We require a large number of well-educated men equipped with the fullest possible knowledge of modern chemistry in every branch. Referring to the problem of converting the academic into the industrial chemist, Sir W. Tilden said there can be little doubt that this is best accomplished in the works, and in the long run manufacturers will find it pay best to employ the academic chemist thoroughly drilled in the practice of analysis and well acquainted with all the methods of research, who must be assumed also to possess common sense, and give him time and facilities for becoming acquainted with constructive materials and that amount of elementary engineering which is requisite for his work.

One great feature of modern chemical manufacture is the production by synthetic processes of compounds which hitherto have been obtained from natural sources. Of these the most remarkable is the production of ammonia from hydrogen and atmospheric nitrogen, which notwithstanding physical difficulties is likely to proceed on a very large scale. Another case of a different kind is the production of rubber which has been going on in Germany during the war. There can be no doubt that in a few years this substance will appear on the market, provided the initial material, at present acetone, is available at a sufficiently cheap rate. Synthetic rubber now obtainable in the laboratory costs about twenty times as much as the natural article from the plantation.

In his lecture on "Coal Conservation," on July 11, Prof. H. E. Armstrong urged that the problems of coal should be treated comprehensively without further delay, so that the issues may be properly considered and a scheme worked out in which all interests are taken into account and the general requirements of the public fully met. The mere provision of a limited number of large central power stations foreshadowed in the Electricity Supply Bill will not alone suffice, he considers.

Two main objects should be kept in view:—(1) The due utilisation of every product that can be economically extracted from coal; (2) The provision of a smokeless solid fuel for public use, so as to abolish the smoke nuisance. In the not distant future gas should be all but entirely supplanted as a lighting agent by electricity; and the gas that is required for heating purposes should be obtainable as a by-product: the production of gaseous fuel, that is to say, should no longer be in the hands of a separate industry.

The carbonisation of coal cannot be treated merely from the economic standpoint. In view of the prospective world-shortage of petroleum, it will be criminal folly if we fail to produce all the oil fuel that can be obtained by subjecting our supplies of bituminous coal to a preliminary distillation at a relatively low temperature.

In the scheme laid down in the lecture, it is contemplated that the supply of raw coal would be confined to certain centres governing selected areas; as soon as such centres were brought into effective action, the use of raw bituminous coal in their areas should be forbidden. The coal would first be carbonised at the centre in such manner that the maximum yield of by-products, gaseous and liquid, would be secured, together with a residue which could be in part supplied for domestic or manufacturers' use and in part used at the centre in generating electric power, preferably after gasification in a producer in order to recover the nitrogen as ammonia. Domestic needs would be best met by carbonising a certain proportion of coal of special quality, so as to produce a standard smokeless fuel containing a minimum proportion of ash; coal of lower grade would be used for power purposes. Each centre would be the local source of supply for every kind of fuel, as well as of electric power. That great economy must be effected in our use of coal has long been clear, if only on the grounds of the prospective exhaustion of our supplies. The sudden rise in price has

ow created a situation so full of peril that action annot any longer be stayed. A fusion of the nterests must therefore be enforced, so as to get id of all unnecessary charges; and efficiency must e aimed at in every direction.

It is recognised that the position in which the as industry is placed is one of peculiar difficulty. The gas companies can no longer afford to pursue heir antiquated methods and continue to manu- acture gas by merely heating coal; the quantity f coal required for the purpose would be too great nd the coke produced would not be suitable for omestic use. The change foreshadowed in the echnical press would involve the production of very weak gas which, in the opinion of the ecturer, would be unsuitable for domestic use. But if the rich gas obtained in carbonising the arge quantities of coal dealt with at each of the entres advocated were to form the basis of the upply, it would be possible to dilute this to no nconsiderable extent and yet supply a gaseous fuel f superior calorific power really suitable for use n gas stoves.

In this connexion, reference was made to the ecent report to the Board of Trade by the Fuel esearch Board on Gas Standards; this is mis- eading, as no account is paid in it to quality, xcept as defined by calorific power. It may be uestioned whether the Committee were a compe- ent body to deal with so complex a problem.

Reference was also made to the indubitable uperiority of the open fire of solid fuel to the gas ire. Prof. Bone, in the subsequent discussion, lso laid emphasis on this point.

THE ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS.

The third annual meeting of the Association was eld in the rooms of the Chemical Society at Burlington House on July 10, and was followed in he evening by a dinner at Princes' Hotel.

In his speech at the annual meeting, the chair- man, Mr. R. G. Perry, described at length the useful work which had been done by the Association during the past year in consolidating the industry and strengthening the position of its various branches (see this J., 1919, 252 R). He pointed out that we are only on the threshold of a great dye industry in this country, and this question had engaged the close attention of the Council. The Association has been recognised by the Board of Trade, and Dr. A. Rée and the General Manager, Mr. Woolcock, have acted as members of the Trade and Licensing Committee. In addition Lord Moulton, who is honorary president of the Asso- ciation, has accepted the chairmanship of British Dyestuffs Corporation. Close attention has been given to parliamentary legislation in so far as it affects chemical industry, and especial considera- tion has been devoted to patent law and traffic problems. A strong Commission of the Association, representative of all branches of the industry, has recently made a comprehensive report on its visit, under Government auspices, to the chemical fac- tories in the occupied area of Germany. It is worthy of note that during the year an "*Entente cordiale*" has been established between the British and French chemical industries, and collaboration between the two should be to their mutual advan- tage. After touching on many matters of domestic interest the chairman stated that he was called upon to give evidence before the recent Coal Com- mission and to give his views on the control of productive operations by Public Departments (this J., 1919, 175 R).

In the discussion which followed appreciation was expressed of the work done by the Council, and it is evident that the chemical industry has derived great benefit from the activities of the Association since its formation in 1916.

In the evening a distinguished and representative gathering dined at Princes' Hotel, and among the guests of the Association were:—Gen. Sir Wm. Birdwood, Sir J. J. Dobbie, the Earl of Dunmore, Mr. T. G. Feasey, Lord Glenconner, General Hartley, Mr. J. Fitzallan Hope, Sir Herbert Jack- son, Sir Evan Jones, Mr. F. G. Kellaway, Sir A. Steel Maitland, the Rt. Hon. Sir Alfred Mond, the Rt. Hon. Lord Moulton, and Mr. R. T. Nugent. The toast of "H.M. Ministers" was proposed by Lord Moulton and responded to by Sir Alfred Mond. Lord Moulton expressed the great anxiety he had experienced in the early days of the war at the lack of important chemical industries vitally necessary to save this country from defeat and wondered to what extent the nation realised the importance of chemical industry. In proposing the toast of "The Association," Mr. F. G. Kellaway enlarged upon the remarkable achievements of British chemists and the great part played by the industry as a whole. The toast was responded to by Mr. Max Muspratt. Dr. C. Carpenter, vice-president of the Association, gave the toast of "Our Guests," which was replied to by the Earl of Dunmore and General Birdwood. The toast of "The Chairman" was proposed by Sir William Pearce and briefly acknowledged.

CHEMICAL STANDARDS.

By invitation of the Council of the Institute of Chemistry, a Conference was held on June 26 to consider the advisability of making provision for the preparation and issue of authoritative samples of chemical substances, metals, etc., of ascertained composition. The Conference was attended by re- presentatives of the following public bodies:—The Federal Council for Pure and Applied Chemistry, the Chemical Society, the Society of Chemical In- dustry, the Society of Public Analysts, the Institute of Metals, with the Standards Committee of the Institute of Chemistry. The conclusions arrived at were:—

That the provision of standard chemical sub- stances was desirable, for the general use of both chemists in practice and students.

That having regard to the fact that such standards could not be provided without reference to methods of analysis, the scheme should not aim at restricting the choice of methods, but always to their revision and improvement, thereby diminishing the chances of discrepancy in results. Incidentally, by this means, science will be advanced and accuracy more generally attained.

That, in view of the importance of analysis in carrying out the scheme, the whole matter should be referred in the first place to the Society of Public Analysts, with a suggestion that the Society should form a Special Committee on which representatives of the allied Bodies should be co-opted.

That the Society be asked to frame a scheme for the consideration of the Federal Council for Pure and Applied Chemistry, reporting on its practic- ability, the cost of the investigations involved and the organisation generally.

That ultimately the scheme be submitted to the Department of Scientific and Industrial Research and, if necessary, the support of the Conjoint Board of Scientific Societies should be asked to secure the co-operation of the Government in its fulfilment.

That, in the event of the Government placing the matter under official control, provision should be made for the co-operation in the scheme of the re- cognised Bodies concerned with chemistry and their respective members.

MEETINGS OF OTHER SOCIETIES.

THE FARADAY SOCIETY.

The first paper presented at the meeting held on July 14 (Professor A. W. Porter in the chair) dealt with the application of magnetic tests to determine hardness in steels, and described a method of measuring the so-called "magnetic hardness." The author—Mr. L. A. Wild—claims that while the method will not measure "every sort of hardness, ... it is of very great utility for the investigation of heat treatment problems." In the discussion which followed several speakers, including Dr. J. A. Harker, criticised the definitions which the author had given of certain already well-defined processes, such as normalising, annealing, etc.

A paper on "The Disappearing Filament Type of Optical Pyrometer," by Mr. Forsythe, was communicated by Dr. Ezer Griffiths. In this type of instrument a small tungsten- or carbon-filament lamp is mounted in the focus of the eyepiece of a telescope which is sighted on to the object whose temperature is required. The current through this lamp is varied until the filament just disappears against the background. The current is a function of the temperature required. The paper goes very thoroughly into the theory of the instrument and its adjuncts, the methods of calibration, the various errors which may arise and the accuracy attainable.

Prof. K. Honda and Mr. H. Takagi contributed a paper "On a Theory of Invar." The fact that Invar has no thermal expansion at ordinary temperatures is explained on the ground that the addition of 35·4 per cent. of nickel lowers the temperature of the A3 transformation to the vicinity of room temperature. It is known that at this point the slope of the volume change curve is at a minimum, the metal expanding with rise of temperature up to this point and then contracting.

Mr. E. A. Ashcroft described certain alloys of lead and magnesium which have the property of absorbing oxygen in the presence of water vapour. The alloys possessing this property contain between 50 per cent. and 95 per cent. of lead. In the discussion it was suggested that the effect was probably an electrolytic one. Various speakers suggested different uses for the alloy, one being the manufacture of argon by the absorption of oxygen prepared from air and another was to keep a certain amount of the alloy in the gas bags of airships in order to prevent the hydrogen from becoming seriously contaminated with oxygen.

Other papers were (1) "The Mechanism of the Surface Phenomena of Flotation," by I. Langmuir; (2) "The Electrolysis of Solutions of Sodium Nitrate using a Silver Anode," by F. H. Jefferey; and (3) "On the Equation for the Chemical Equilibrium of Homogeneous Mixtures, Part I.," by Prof. Porter. A good discussion followed the reading of the first of these papers, reference being made, amongst other things, to the amazingly small quantity of oil—tablespoons in tons of water—required to produce flotation. Prof. Porter's paper was taken as read.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

A paper on "The Measurement of Temperature," with special reference to the needs of manufacturers of paints and varnishes, was read by Mr. R. S. Whipple before this Association on July 10. After dealing with the general subject of thermometry and pyrometry, the author summarised the practical considerations underlying temperature measurement in oil and colour works as follows:—

In the laboratory nothing can exceed the convenience of the mercury-in-glass thermometer for temperatures up to 300° or even 400° C., but in the works, for temperatures up to 300° C., the mercury-in-steel thermometer is to be preferred. For this purpose the steel tube must be protected by means of lead covering. As comparatively long capillaries may be used with these instruments, there is no difficulty in fixing the bulb into a vat, and the reading part of the instrument several feet away from it.

In many processes, such as the manufacture of varnishes and in the preliminary preparation of linseed and other oils, the reading of temperatures up to 300° or 400° C. is best performed with either resistance or thermo-electric thermometers. For taking the temperature of a group of pans or vats it is generally advisable to instal a switchboard so that any one of several thermometers can be read on the one galvanometer. If an open temperature scale is required, then a resistance thermometer should be employed, but if the thermometer is to be taken in and out of the vessels continually it is preferable to use a thermo-couple. A couple is more robust than a resistance thermometer and is more easily renewed. Thermo-couples should be employed for temperatures between 800° and 1000° C., *e.g.*, in the manufacture of litharge. For temperatures not exceeding 900° C. some of the protected base metal thermo-couples, such as Hoskins nickel-chrome, or the Titan couple may be used. For temperatures above 1000° C. it is advisable to employ platinum-rhodium couples. In the frit furnaces either radiation or optical pyrometers should be used. The decision as to which type of pyrometer should be used depends very much on the class of labour working with the pyrometer. If the temperatures are to be read and not recorded, and if a fairly skilled observer is to use the instrument, then an optical pyrometer should be employed. If, on the other hand, an untrained observer is to take the temperatures, a Féry radiation pyrometer should be used. The Féry instrument has also the advantage that a record of the temperatures can be taken without serious difficulty.

LEGAL INTELLIGENCE.

APPLICATION FOR LICENCE TO USE ENEMY PATENT.

In the Patents Court on July 10 an application was made by the Citex Fire Extinguishing Co., Ltd., of London, for a licence to use German patent 10086/1908, in the name of Roemer, for the production of carbon dioxide for use in fire-extinguishing apparatus. The patent claimed the use of a solution of potassium carbonate (96—98 per cent. purity) for the production of the carbon dioxide required.

The secretary of the applicant company said that it had been manufacturing the chemical charge continuously for several years; originally it had an arrangement with the patentee, although this had not been registered, and the company had to pay the patent renewal fees and a royalty of 1*s.* on each cartridge, which sold at about 8*s.*

The Comptroller of Patents said that application should have been made previously. It was debatable whether the arrangement specified was a valid one. The secretary said that the royalties were credited to the patentee, and that the company did not want to pay anything unnecessarily. The Comptroller said this might be a question under the Peace Treaty, and would be raised afterwards. He would recommend the grant of the licence by the Board of Trade.

CORRIGENDA.—**In the issue of June 16, p. 202 R, col. 1, line 35, read "eventually became," in lieu of "on coming to Canada acted as"; in the issue of July 15, p. 256 R, under "Import Licences," line 4, read "barytes" in lieu of "pyrites."**

NEWS AND NOTES.

CANADA.

Production of Helium in Alberta.—After several years' experimental work at Calgary, a plant has been erected in that city for the separation of helium from the natural gas of the Alberta fields; its capacity is 15,000 cub. ft. per 24 hours and the cost of production is estimated at 24 cents per cub. ft.—(*Oil, Paint and Drug Rep., June* 30, 1919.)

SOUTH AFRICA.

The Natal Cane Sugar Industry.—The Natal sugar industry made a poor start owing to lack of sufficient capital and adequate technical experience. At the present time, however, the majority of the 35 central factories is furnished with up-to-date machinery and many are capable of crushing 200–300 tons of cane per half-shift of 12 hours. The cane ripens about 21 months after planting, which takes place between September and November. Three crops are generally taken. On fertile land the first crop is calculated to give at least 3¼ tons of sugar per acre, and succeeding crops not less than 1¼ tons. Natal is now able to meet almost entirely the sugar requirements of the South African Union. The total production has, in recent years, been (tons):—1908, 35,000; 1913, 96,000; 1917, 114,000; and 1918, 115,000. Owing to more stringent immigration laws Indian labourers are being replaced by the less reliable Kaffirs. Although the production of sugar is increasing and prices are rising, there has been a feeling of unrest on the South African sugar market owing to the possibility of Mauritius making an attempt to flood the South African market with 60,000 tons of sugar which has been left on hand owing to want of shipping for export.

AUSTRALIA.

Mining in South Australia.—Marked activity is being shown in mining operations in South Australia; the production for 1918, valued at £1,451,498, nearly equals that of 1917 and compares with an output 10 years ago valued at £413,390. The value of the manganese ore raised in 1918 (£17,000) was ten times that of 1917. Other values for 1918 are: Copper, £828,556; ironstone, £277,279; salt, £177,038; limestone, £34,813; gypsum, £28,012; flint, £11,849; phosphate, £10,773; silver-lead ore, £10,161. Some rich copper ore discovered near Broken Hill yielded copper valued at £859 from 33¾ tons, after deducting 20*s.* a unit for freight and smelting charges.—(*Bd. of Trade J., July* 3, 1919.)

Queensland.

Manufacture of Roofing Tiles.—The manufacture of roofing tiles, a comparatively new industry to Australia, has been extended to Queensland, a works having recently been established at Riverview by the Terra Cotta Roofing Co. Ltd. The texture of the tiles, now being made in small quantities, is considered to be equal to, and the manufacture in one respect (harder burnt) superior to, the previously imported article; they are considered to be especially adapted to Queensland, *i.e.*, they are hard, medium coloured, strong, and provided with the standard grooves and lips that have proved so efficient in the past. Tests warrant the belief that the Queensland tile will keep its original colour. With the delivery of modern machinery it is expected that employment will be found for a considerable number of hands.—(*Industrial Australian, Feb.* 13, 1919.)

Flax Cultivation.—The Queensland Department of Agriculture is making inquiries with a view to securing supplies of flax seed (linseed) for prospective Queensland growers. The Commonwealth Flax Industry Committee emphasises the fact that the production of fibre flax requires a rainfall of at least 30 in. per annum, with regular incidence, a moist spring, and preferably cloudy skies—conditions which are met with in parts of Tasmania, Victoria, and New South Wales. For the present the supplies of seed will be required for these States. The Committee has recommended that experimental plots be established in districts in Queensland, where the above climatic conditions prevail, and that, should the result of the experiments be satisfactory, it may warrant the cultivation next year of fibre flax in Queensland on a commercial basis. Consideration is being given by the Committee to the supply of seed.—(*Industrial Australian, Feb.* 20, 1919.)

NEW ZEALAND.

State Forestry.—The report on State Forestry in New Zealand for the year 1917—1918 deals with the forest situation in the Dominion under Part I.—"State Nurseries and Plantations" and Part II.—"Native Forests."

In Part I. it is shown that during the year 6,822,700 trees were raised at State nurseries, 4,725,547 were sent out to plantations, and 530,458 to outside lands. The total area planted during the year was 2653 acres, making the total area under plantation 32,645 acres.

In Part II. the output of native timber from the Dominion sawmills is given as approximately 247,980,000 super. feet, or 104,520,000 super. feet less than for the preceding year. This output includes 20,890,359 super. feet of native kauri and 1,000,000 super. feet of *Pinus insignis* and eucalyptus timber grown by planting. The export of native timber amounted to 70,747,737 super. feet and the import of exotic timber to 12,864,363 super. feet.—(*Australian Forestry Journal, Jan.*, 1919.)

UNITED STATES.

Standardisation of Dyes, etc.—One of the New York laboratories is initiating extensive work in standard dye tests, the service being particularly useful in export trade. The yarn dyed with the sample is sent to the purchaser with a certificate on which the method of dyeing is described, and the dye is shipped direct from the testing laboratory after sampling. It seems evident that under such conditions the export of American dyes should be greatly facilitated.

A fellowship has just been established at an American university by a large paint manufacturer for the investigation of the measurement and standardisation of colour. The same problems are being studied in the research laboratories of a maker of photographic materials, who is installing a colour-measuring apparatus at a cost of $2500.

New Method of Investigating Metal Stresses.—The use of the motion-picture camera in conjunction with the microscope has recently given most interesting data in a series of tests on metal stresses. The change produced by repeated bending of iron in a bending machine up to the breaking point was successfully recorded and each change in structure faithfully reproduced upon the film and screen. Ultimately it will be possible to tell how far a given specimen has progressed toward its breaking point by comparing its crystalline structure with a film of the same material, and thus know in advance what replacements must be made for the sake of safety. Such records will also be helpful in heat-treating practice.

Report on European Dyestuff Situation.—An oral report on the dyestuff situation in Europe has been presented to the U.S. Secretary of Commerce and to the President of the Chemical Foundation by

Mr. Wigglesworth, who, as trade commissioner to the Department of Commerce, recently spent three months on a survey of conditions in England, France and Italy. He recommends the adoption in the United States of the English licensing system, now being favourably considered by France and Italy, as it appears to be adequate to meet any unforeseen conditions which may arise.—(*U.S. Com. Rep., June* 11, 1919.)

Sulphur Deposits in Texas.—The Acting British Consul reports that the Texas Gulf Sulphur Co., which is developing the sulphur bed at Gulf, Texas, has attained a production of 1200 tons a day and has signed contracts to export up to 200,000 tons a year from Texas City, where the wharfage rate on sulphur is only 20 cents per gross ton. Electrically-operated shovel cranes will unload the cars into bins and thence into the ships, of which three, each of 5000 tons, will be in service every month.—(*Bd. of Trade J., July* 3, 1919.)

JAPAN.

A Chemical Investigation Society.—Japanese chemical industries experienced a wonderful development during the war, but the restoration of peace has shown that the position of many of them is by no means stable. With the object of helping those branches which are in a bad position and of stabilising others which need support in view of prospective foreign competition, Prof. T. Takamatsu and others have founded the Chemical Industry Investigation Society under the auspices of the Chemical Industry Association. The Society has undertaken, in the first place, an immediate investigation of the position of the following groups of substances: I. Heavy chemicals and electro-chemical products; II. Coal-tar products, distillation products and drugs; III. Paints and pigments; IV. Glass; V. Rubber; VI. Fats, oils, soaps and waxes; VII. Celluloid. Each group has its own special committee which is charged with devising means of relief. The following is a summary of the recommendations arrived at up to June, 1919:—

I. (a) The rate of import duty on potassium carbonate should be 5 yen per 100 kin (=0·9*d.* per lb.); potassium chloride should be duty free. (b) The import duty on caustic soda should be raised to 25 per cent.; the price of salt sold by the Salt Monopoly Bureau should be reduced to 40 sen; and the Government should encourage the exportation of bleaching powder by granting a bounty of 1 yen per 100 lb. (c) The cost of manufacture of soda ash in Japan will be 115·77 yen per ton (£11 16*s.* 4*d.*); its future should be assured provided adequate help is received from the Government.

II. (a) The import duty on dyes, drugs and their intermediate products should be 50 per cent. *ad valorem*; and on raw materials, *e.g.*, benzene, methyl alcohol, 25 per cent. (b) Factories owned or controlled by Government should not manufacture any products which are being produced by private firms. (c) The Government should grant special facilities in regard to exportation and freight.

III. If import duty is to be levied on lead and zinc, it should be refunded when these are used for paint and pigment manufacture.

IV. (a) Freights to India should be so lowered as to enable Japanese glassware to compete with European in that country. (b) Importation of soda ash should be duty free. (c) Import duty on sheet glass should be doubled, at least, and firebricks should be admitted free. (d) Freights on exported window glass should be greatly reduced.

V. No definite conclusions have yet been reached, but the committee agrees that raw materials and perfumery should be free of import duty, but fatty acids, paraffin wax, glycerin and dynamite should be highly taxed.

The Chemical Industry Association is extending its activities by arranging for popular lectures on the chemical industries to be given in twenty-three different towns during the next five months. (kin=1⅓ lb.; yen=2*s.* 0¼*d.*; sen=·01 yen.)

GENERAL.

The Character of Derbyshire Oil.—Further and more detailed analyses of the oil obtained at the Hardstoft boring have been made by Mr. J. E. Hackford. In addition to the data already published (this J., 1919, 201 R), the viscosity has been determined at various temperatures, the flash point (Abel closed) is 35°F., the ash content 0·036%, and the calorific value 20,290 B.Th.U. Distillation tests show that the crude oil will yield 4·5% aviation spirit, or 7·2% first grade commercial spirit, or 10% commercial motor spirit. The kerosene fraction varies from 30—40%. A sample representing 33% of the crude oil had:—Sp. gr. 0·783, flash point (Abel closed) 135° F., colour-water white, and sulphur 0·08%. The quality of the gas oil was also very good. The percentage of lubricating oils obtained was 30, the sp. gr. 0·893, ash 0·01%, and viscosity, R.I., 3736 secs. at 140° F., 328 secs. at 180° F., and 172 secs. at 212° F.

Patents, Trade Marks and Designs in Relation to the Terms of Peace.—During the period of the war numerous patents have gone void in the countries of the high contracting parties through the non-payment of fees, or non-working, or non-fulfilment of various formalities. All these can be revived within one year of the Treaty coming into force on payment of the regular fees due in the interim, and without extra fines or payment, but always without prejudice to the rights of third parties acquired in the meantime. Any patent which could have been filed during the war to claim rights under the International Convention, but which for any reason whatsoever was not so filed, can now be filed during the six months after the Treaty coming into force, but again without prejudice to the rights of third parties acquired in the meantime, so that apparently any person having got to work on such defaulted patent during the interim can continue to infringe even though the patent be renewed to the original inventor.

In Continental European countries these patents will date from the day of application in those countries, but with priority date as of the date of the original application in the country of origin. In the United States and Canada they will date from the day of grant of the application after allowance, while in Great Britain, Australia, New Zealand and South Africa, they will date from the day of application in the country of origin, unless a new legislation changes this.

Each of the Allied Associated Powers reserves to itself the right of imposing such limitations, conditions or restrictions on rights thus granted (except in the case of trade marks), or which may subsequently be acquired, in accordance with its legislation, by German Nationalists, "whether by granting licences or by the working, or by preserving control over their exploitation, or in any other way as may be considered necessary for national defence or in the public interest, or for assuring the fair treatment by Germany of the rights of industrial and literary property held in German territory by its Nationalists, or for securing the due fulfilment of all the obligations undertaken by Germany in the present Treaty, but the rights thus reserved by the Allied and Associated Powers shall only be exercised in cases considered necessary for national defence of the public interest." The pro-

visions of this article shall not apply in the case of businesses or companies liquidated under war legislation by the Allied or Associated Powers.

From this it would appear that even those patents which have been deliberately allowed to go void by their owners during the war can now be resuscitated for the remainder of the period of grant. This at first may seem unfair, but on the other hand it would be still more unfair to natives of a country if foreigners could renew their rights while they themselves could not.

The Treaty is reciprocal as regards patents and trade marks with the exception above stated, and we are able now to obtain patents and pay the fees on them in the enemy countries.

Explosives and Poisons in Relation to the Peace Treaty.—Article 172 of the Peace Treaty enacts that within three months of the treaty coming into force the German Government shall disclose to the Allied Governments the nature and mode of manufacture of all explosives, toxic substances or like chemical preparations used, or prepared for use, by Germany during the war.

Italian Chemical Federal Council.—An Italian Association for General and Applied Chemistry (Associazione Italiana di Chimica Generale ed Applicata) has been recently established with temporary offices at 89B, Via Panisperna, Rome. The officers for the current year are:—President, Prof. G. Ciamician; Vice-Presidents: L. Parodi Delfino, A. Menozzi; Council: Prof. F. Garelli, P. Ginori Conti, Prof. R. Nasini, Prof. A. Piutti, U. Pomilio, F. Quartieri, Dr. A. Ricevuto, Prof. R. Salvadori, Dr. O. Severini, Prof. V. Villavecchia. Finance Committee: Prof. P. Biginelli, G. Bracchi, Prof. G. Fabris. Prof. Domenico Marotta is the acting general secretary. The Association is to publish a journal dealing with industrial chemistry, trade matters, education, etc.

An Iron Industry for Holland.—It has now been definitely decided to erect two or three blast furnaces near Ymuiden on a site connected by rail and canals with the main lines of communication, and it is intended at a later date to increase the number to six and, possibly, to instal electric furnaces also. The output of the blast furnaces will be 250 tons each per day. There is to be a Martin furnace with a daily output of 600 tons, rolling mills with an output of 500 tons per day, and two batteries of coke ovens with 60 ovens per battery. The necessary arrangements are being made for the utilisation of the by-products. Slag will either be converted into cement or utilised in the manufacture of bricks, for both of which there is a great demand in Holland. It is expected that the sale of these by-products will reduce the cost of production to such an extent that German competition need not be feared. Meantime, temporary works will be established containing two or three Martin furnaces with a total production of 60 to 80 tons per day. There will also be a small rolling mill producing bars and angles, with a calculated output of 150 to 200 tons per day. It is stated that the necessary arrangements have been made with the Netherlands Government for the supply of coal from the State mines.—(*Board of Trade J., June* 26, 1919.)

War Damage in Belgium.—The *Information Belge* states that the Central Industrial Committee of Belgian Manufacturers has assessed the total value of industrial damage done during the war at 9,287,000,000 francs (about £371,500,000). Among the items specified and the value of damage done, in millions of francs, are:—Mining and quarries 993, zinc and copper 496, iron and steel 1107·5, ceramic 229·5, glass 154, chemicals 229·5, textiles 2198·5, hides and skins 718, and paper, pulp, etc. 69·5. Values are assessed on prices as at end of April 1919.—(*Bd. of Trade J., July* 10, 1919.)

Resources and Industries of the Christiansand District (Norway).—Mineral deposits of nickel, molybdenum, and felspar have been prospected and feverishly worked during the war. The output of refined nickel at Saetersdal now amounts to 75—100 tons per month, while the refining plant at Vennesla, owned and operated by British capital, shipped over 2500 tons of aluminium to England during 1917. Six tons of molybdenum glance was exported in 1917, probably to England. Deposits of this mineral near Mandal were worked during 1917 and the concentrates shipped to England, but the official figures are not available. The district contains a number of large tobacco factories which in 1917 imported over 260,000 lb. of leaf, 96 coming from America. There is abundant water-power awaiting development, recent estimates placing the total available quantity at 1,000,000 h.p. The chief exports from the port of Christiansand in 1917 were (metric tons):—Aluminium 2540, felspar 635 (to Germany); nickel 311, sodium nitrite 300, paper 1741; also 7327 standards of timber, and 64,330 cub. ft. of wood pulp.—(*U.S. Com. Rep. Suppl., May* 15, 1919.)

Use of Fertilisers in Denmark.—Danish agriculture is carried on with a very high degree of efficiency. The farmers are well versed in the scientific use of fertilisers, and take a special interest in obtaining the largest possible return from their land. The following table shows the yields (in bushels per acre) compared with the corresponding yields obtained in America:—

		Average 1909—1913	1917	1918
Wheat ...	Denmark...	44·5	32·8	45·0
	U.S.A. ...	14·7	14·2	15·6
Rye	Denmark...	28·6	20·5	23·5
	U.S.A. ...	16·1	14·7	14·1
Barley ...	Denmark...	42·4	27·7	39·0
	U.S.A. ...	24·3	23·7	28·9
Oats	Denmark...	48·4	30·8	44·4
	U.S.A. ...	30·6	36·4	34·5
Potatoes ...	Denmark...	210·0	225·0	214·0
	U.S.A. ...	97·0	100·8	not stated

There was a decline in yields during 1916 and 1917 owing to the shortage of fertilisers, and the recovery in 1918 is attributed to the unusually favourable weather.

All manures are applied in the elementary forms of superphosphate, nitrates and potash, and there is no market for mixed or special compound manures. During the war supplies became so short that the Government took over the distribution. The import returns show that phosphates fell from over 200,000 tons in 1914 to 19,000 tons in 1917, and to zero in 1918. Chilean nitrate similarly dropped from 42,000 tons in 1914 to 116 tons in 1918, but synthetic nitrate from Norway increased from 11,000 tons in 1914 to 19,000 tons in 1918. Potash supplies (from Germany) increased from 23,000 tons in 1914 to 33,000 tons in 1918. If prices are not prohibitive, it is expected that greatly increased quantities of fertilisers will be used in the next few seasons to make up the deficiencies of recent years.

The home manufacture of superphosphate, as well as a large part of the dealings in nitrates and potash, is in the hands of the Danish Fertiliser Co. (generally known as the Fertiliser Trust), which has practically a monopoly. The Trust has several superphosphate plants, the total annual capacity of which is nearly 200,000 tons. The farmers' associations have recently formed a co-

operative society for the purpose of buying and distributing fertiliser supplies, and this association is expected to import over 150,000 tons of superphosphate and to become a formidable rival to the Trust. Importers are very anxious to get quotations for early delivery of superphosphate.—(*U.S. Com. Rep., May* 23, 1919.)

Cadmium in the U.S.A. in 1918.—The United States produced, in 1918, 127,164 lb. of metallic cadmium and 51,702 lb. of cadmium sulphide, the average prices per lb. being $1·48 and $1·36 respectively.

The cadmium of commerce is derived from zinc minerals and ores, the average content being in the ratio of about 1 of cadmium to 200 of zinc. A separation is effected by the higher volatility of cadmium in the distillation of zinc, the first fractions containing a greater proportion. Another important source is the fumes from lead blast furnaces. It is hoped that electrolytic zinc-plant residues will soon be supplying about one-third of the production.

Cadmium is used in easily fusible alloys and some aluminium solders. The addition of 1 per cent. of cadmium to lead improves the coating property of lead on iron.

Owing to the scarcity of tin an investigation was made on the possibility of substituting cadmium, and a satisfactory solder was made consisting of 80 parts of lead, 10 parts of tin and 10 parts of cadmium. An investigation of its toxic properties is proceeding with a view to its use on food containers. The use of lead-cadmium solders is complicated by the ease with which cadmium oxidises, but the addition of tin or zinc appears to reduce the tendency. The higher price of cadmium is offset by the smaller quantity required in the alloys.

The use of cadmium sulphide as a permanent pigment is well known; it is also used to give colour and lustre to glass and porcelain. There appears to be some possibility of using cadmium, as a primary coat, for rust prevention in electro-plating. —(*U.S. Geol. Survey, May* 1919.)

Raw Materials of the German Printing Industry during the War.—After the outbreak of war the necessity of finding substitutes for resin, turpentine, linseed and other oils, soot and lamp black, products mainly obtained from America, soon became apparent. Existing supplies of resin and oils were commandeered for military purposes, and all linseed oil was earmarked for edible purposes. The good results expected from the winning of resin from Russian Poland did not materialise, as the pine resin obtained was not suitable for the printing industry. The substitution of a suitable product for resin was partly overcome by means of coumarone resin ("acid tar"), which was obtained from the heavy benzol fraction by treatment with concentrated sulphuric acid. The production of coumarone resin was carried out with good results at practically all the coke-ovens and benzol works in the country. There are about thirty sorts of this resin prepared, from pale elastic to liquid black varieties, and, although they are not complete substitutes for resin, they have greatly helped in the printing trade and will doubtless be used in the future. The large number of artificial resins obtained by the condensation of phenols and aldehydes found little application, mainly on account of their sparing solubility in the solvents used in the printing pastes. Petroleum pitch, of Austro-Hungarian source, has been used as a substitute for resin. It has been still more difficult to find substitutes for linseed and wood oils, etc. Blown or oxidised marine oils were only available in the early days of the war. The printer had to be content with light-coloured coumarone resin and suitable solvents, *e.g.*, a petroleum distillate was used in place of turpentine. Great difficulty was experienced in finding a substitute for glycerin for making book printing paste; glycol was found to be satisfactory, but little was obtainable. The finest qualities of soot and lamp black, particularly of "flying soot," could not be replaced, and good lamp black could not be prepared for lack of suitable oils. Mineral oils, previously obtained from America, were soon exhausted, the supply from Galicia and Rumania failed temporarily, and the home production was scarcely worth consideration. Only small quantities of spindle oils were procurable, and the refined sorts have long since been unobtainable. As substitute for these oils, a coumarone resin of liquid consistency was used, generally along with tar oils, the latter always being obtainable in sufficient quantities. The use of such products for printing purposes gave the newspapers an unpleasant odour. Although the greatest efforts were made to keep the printing trade in full activity owing to its extraordinary value from a political point of view, coumarone resin was practically the only thoroughly satisfactory substitute evolved.—(*Z. angew. Chem., Feb.* 28, 1919.)

The Institute of Chemistry.—In the July examinations for the Associateship of the Institute one candidate passed in mineral chemistry: Lieut. C. W. Wood, King's College, London; two candidates passed in organic chemistry: L. G. Peirson, B.A.(Cantab.), and J. E. Pollock, B.Sc.(Lond.), University College, Reading; and one in chemical technology, with textile chemistry as special subject: P. E. Stanhope, Royal Technical Institute, Salford.

WORLD'S PRODUCTION OF CALCIUM CYANAMIDE.

	1918						
	Productive capacity of works completed or under construction	Actual production	1917	1916	1915	1914	1913
	metric tons						
Germany	600,000	300,000	400,000	500,000	500,000	36,000	24,000
Austria-Hungary ...	30,000	24,000	24,000	24,000	24,000	24,000	7,500
France	300,000	100,000	100,000	100,000	80,000	7,500	7,500
Italy	80,000	15,000	12,300	25,105	25,292	15,556	14,982
Norway	200,000	200,000	200,000	26,409	25,000	14,670	22,110
Sweden				18,000	16,363	18,000	18,352
Switzerland	65,000	40,000	40,000	29,500	12,500	7,500	7,500
Canada	58,000	58,000	58,000	58,000	58,000	58,000	48,000
United States ...							
Japan	101,605	50,000	50,802	33,462	30,278	11,171	7,000
Total production	1,434,605	787,802	885,102	814,476	771,433	192,397	156,944

(*Internat. Inst. Agric., May,* 1919.)

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Sale of Linseed Oil to Germany.

Captain Brown asked if the President of the Board of Trade was aware of the allegation that while Belgium is paying £120 per ton for linseed oil, the British Government is selling it at £75 per ton to Germany.

Mr. McCurdy, in reply, stated that in accordance with the arrangements made at the Brussels Conference, 25,000 tons of linseed oil were sold to Germany at £78 per ton. When this price was fixed the oil could be bought in this country at £58 per ton, and Belgium had declined to purchase any part of the British surplus.—(July 8.)

Answering another question by the same member, Mr. Roberts said that the quantity of linseed oil delivered to Germany under the agreement of March 31, 1919, was approximately 12,000 tons, and that no further agreements have been entered into. —(July 11.)

Importation of Silica.

Mr. Seddon inquired whether the decision to allow unrestricted importation of silica ground and silica sand would be permanent, and if the President of the Board of Trade were aware that many members of the Flint and Silica Flour Manufacturers' Association laid down expensive plant during the war in order to make the country self-supporting. Mr. Bridgeman replied that the Board of Trade was not prepared to prohibit the importation of these important materials. —(July 14.)

Pithead Prices of Coal.

In answer to Sir W. Davison, Mr. Bridgeman gave the following average prices per ton of coal at the pithead for the latest periods for which particulars are available:—Scotland (including 6*s.* increase), 28*s.* 11*d.*; rest of Great Britain, 29*s.* 4*d.*; Transvaal, 1918, 5*s.* 6*d.*; Natal, 1918, 10*s.* 7*d.*; India, 1918, 5*s.* 10*d.*; U.S.A., June 1919, 11*s.* 2*d.*; France, June 1919, 36*s.*; Belgium, 1917, 18*s.*; Spain, 1917, 39*s.* The average price of pithead coal in the United Kingdom in 1913 was 10*s.* 1½*d.* per ton.—(July 14.)

Patents and Trade Marks Bills.

Bills to amend the Patents and Designs Acts and the Trade Marks Act, 1905, were introduced by the President of the Board of Trade, and read a first time. The former proposes, *inter alia*, to extend the life of patents, including those expiring before January 1, 1920, and of licences granted under them, from 14 to 16 years; any loss or liability in respect of contracts made with the patentee before November 19, 1917, to be adjudicated upon by the Court. Product patents of a chemical, medicinal or dietetic nature are to be abolished as from the passing of the Act.—(July 15.)

The Coal Mines Bill.

Major Baird, Under-Secretary to the Home Office, moved the second reading of this Bill, which gives effect to the promise made by the Government to adopt the recommendations of the Sankey Commission in regard to the substitution of a seven-hours day for an eight-hours day. The Bill was read a second time.—(July 17.)

Coal Production.

Sir A. Geddes informed Mr. Houston that in 1916, the latest year for which a complete comparison is available, the output of coal per person employed per year was for the United Kingdom 265 long tons, and for the United States 800 long tons. In reply to Captain Bowyer he gave the following figures of production for the United Kingdom during the 24 weeks ended June 22, 1918, and ended June 21, 1919:—Outputs, 109,046,000 and 110,652,000 tons; average numbers of workers employed, 972,000 and 1,112,000, respectively.—(July 21.)

Beet Sugar Factory.

In answer to Sir J. D. Rees, Sir Arthur Boscawen stated that the Government had decided in principle to give assistance to the British Sugar Beet Growers' Society by means of an advance of part of the capital required, and a guarantee of interest for a certain number of years on the remainder of the capital, up to a fixed amount. The exact terms and conditions of the assistance to be given are now under consideration.—(July 21.)

Japanese Imports into India.

Mr. Montagu, replying to Captain Ormsby-Gore, said the total value of imports into India from Japan was £3,187,000 in 1913-14, £2,966,000 in 1914-15, and £22,404,000 in 1918-19. Only a small proportion of these imports were not manufactured goods. —(July 21.)

REPORT.

REPORTS BY THE COAL INDUSTRY COMMISSION. *Second Stage.* (*Cmd.* 210, 4*d.*) *London: H.M. Stationery Office.*

1. The Chairman (Mr. Justice Sankey) recommends the immediate purchase of coal royalties by the State; at present there are difficulties in working and waste of coal due to the multiplicity of owners, irregularity of boundaries, barriers left between different properties and lack of co-operation in drainage. The value of each property should be assessed by Government valuers, and Parliament should consider the fixing of a maximum sum to form a pool to be allocated between the various royalty owners. He further recommends that the principle of State ownership of the coal mines be accepted, so that co-ordination of effort in respect of production, export, and inland supply may be attained; this is necessary owing to the unique position of the industry. Consumers are entitled to have a voice in the production and selling of coal; at present there is underselling in the export trade and overlapping in the inland trade. Under State ownership the waste due to lack of capital in some mines and improper management in others would be obviated, and standardisation of materials and appliances would be possible. In view of the attitude of the workers and of the colliery owners, nothing short of State ownership will achieve the desired results. In addition to collieries and accessory plant, composite undertakings should be purchased unless the severance of the undertaking can be commercially effected; the question of leaving the coke and by-product industry in private hands remains to be considered. It would always be possible to lease a mine or group of mines or a composite undertaking. A scheme for local administration is outlined which it is recommended should be immediately set up and worked for three years, after which the mines should be purchased.

2. Sir L. C. Money and Messrs. Hodges, Smillie, Smith, Tawney and Webb are in substantial agreement with the above report but recommend a greater share in administration for the workers, and State ownership of coke and by-product plant attached to collieries. Messrs. Hodges, Smillie and Smith do not agree to compensation for mineral owners (except for small owners).

3. Sir A. Nimmo, Sir A. M. Smith and Messrs. Balfour, Cooper and Williams recommend the acquisition by the State of all coal seams subject

to existing leases, but strongly oppose the nationalisation of the coal mining industry owing to the ineptitude of Government Departments for managing an industry and to the danger due to political influence. They do not consider it proved that nationalisation would cheapen coal or prevent strikes, but conclude that it would be detrimental to the development of the industry and to the economic life of the country. The fall in output should be immediately investigated and any proposal affecting the nation as a whole or giving preference to any class be referred to the community. Suggestions are made for improvements in safety, housing, etc., and a scheme of administration providing for the representation of workers on Pit Committees is outlined. Local authorities should be given power to deal in household coal in open competition, and consolidation of distributing agencies should be effected without forming harmful trusts. A committee of owners, miners, consumers and distributors should meet to consider points of common interest.

4. Sir A. Duckham recommends the acquisition of mineral rights and the granting of leases to amalgamated mining interests in definite areas to be defined. Such amalgamations (District Control Boards) should issue shares to the value of the various interests based on 1914 prices, and carrying a guaranteed 4 per cent. dividend with a further 2 per cent. if earned; two-thirds of any further profits must be used to reduce the price of coal. Provision is made for a bonus on output for workers and a bonus on profits for staff. Each Board of Directors would contain at least four elected by shareholders, one staff and two workers' representatives. Composite undertakings would work their own collieries under lease, but would only sell coal as such through the District Board

GOVERNMENT ORDERS AND NOTICES.

NEW ORDERS.

THE COAL (PIT'S MOUTH) PRICES ORDER, 1919.

BOARD OF TRADE, JULY 12.

This Order makes provision for an increase of 6s. per ton in the pithead price of all coal despatched from collieries on or after July 16 for consumption in the United Kingdom, and for an automatic increase of the same amount in the retail prices of house coal. The minimum prices of coal, coke-oven coke and patent fuel for export and for ships' bunkers have also been increased by 6s. per ton. This increase in the minimum prices applies to all cargoes and bunkers, the loading of which is commenced on or after July 16, 1919, and involves increases of all prices of coal, coke-oven coke and patent fuel for export and bunkers which are at present less than 6s. above the existing schedule price.

The Coal (Pit's Mouth) Prices No. 2 Order, 1919, issued by the Board of Trade on July 15, postponed the coming into operation of the above Order until a later date to be determined.

The Coal (Pit's Mouth) Prices No. 3 Order, 1919 (Board of Trade, July 18), enacts that the original Order shall come into force on July 21.

A White Paper issued by the Board of Trade on July 11, shows the basis upon which the increase of 6s. per ton is calculated. The estimated deficiency on the working of the coal industry for a period of twelve months from July 16 last is £46,600,000.

The Controller of Coal Mines has issued an Order for the substitution of sea-borne coal from Durham and Northumberland for rail-borne coal which has been supplied during past years from Yorkshire and the Midlands. This Order applies to gas companies, power stations, and users generally of manufacturing coal as from August 1.

ORDERS CANCELLED.

The Army Council has issued a schedule of Orders, dating from 1917, and relating to leather, etc., which are cancelled as from June 30, 1919.

EXPORTS.

The Board of Trade (Export Licence Department) has issued, in the *Board of Trade Journal* of July 10, a number of special export regulations applicable to countries in Europe and on the Mediterranean Sea.

Trade with Germany etc.—General licences are now issued authorising, with certain reservations, the resumption of trade with Germany and German-Austria. No licences are required for the export of goods included in list C.

Re-exportation of Imported Chemicals.—We are officially informed by the Board of Trade, Department of Import Restrictions, that firms desiring to import chemicals on the 'prohibited list in transit, pending re-export, should make application to that Department giving full particulars of the transaction, together with country of origin and destination. Such firms will then be sent a form of bond, on completion of which the import will be authorised. The bond will be discharged on proof of export, by means of, for example, either a bill of lading or a certificate issued by the Customs containing sufficient particulars to identify the exported goods covered by the bond.

IMPORTS.

The Department of Import Restrictions has issued general licences allowing importation of the following materials:—

Acetate of iron; acetate of lime; acetone; adalin; alum; aluminium acetate; aluminium sulphate; ammonia (hydrate), carbonate, chloride, chlorate, nitrate, phosphate, sulphate; baryta; bleaching powder; boracite, borate of lime; borate of manganese; borax; boric acid; brimstone; calcium carbide; carbon bisulphide; carbonic acid; chloroform; chromic acid; cinchonic salts; cinchonidine salts; citrate of lime; citric acid; copper sulphate; cream of tartar; Epsom salts; ether; ferrous sulphate; formaldehyde; fusel oil; gelatin, photographic; glycerin; hydrochloric acid; hydrofluoric acid; iodine; lactic acid; lead acetate; lead nitrate; lithia carbonate; magnesia; magnesium chloride; magnesium sulphate; manganese dioxide; menthol crystals; mercurial salts; methylethylketone; nitric acid; oxalic acid; phosphoric acid; picric acid; quinidine salts; quinine salts, other than sulphate; quinoidine; sal acetos; soda ash; soda, aluminate, bicarbonate, caustic, chloride, crystals, nitrate, nitrite, silicate, sulphate, sulphide; Stovaine; sulphuric acid; tartar emetic; tartaric acid.

The Board of Trade announces that Consular certificates of origin and interest will no longer be required to be produced in respect of goods imported into the United Kingdom.

Sir Evan Jones has resigned his position as Commissioner of Dyes. All communications referring to dyes should now be addressed to the Assistant Secretary, Industries and Manufactures Department, Board of Trade, Gwydyr House, Whitehall, London, S.W. 1.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for July 10 and 17.)

TARIFF. CUSTOMS. EXCISE.

Argentina.—A decree dated May 17 controls the import and sale of opium and its preparations, morphine and its salts, cocaine and its salts and Indian hemp. Importation by druggists is only permitted with the concurrence of the Department of National Health. The Department may cause an analysis of the goods to be made before importation is allowed.

Australia.—The application of the new regulations affecting the import of rubber-covered wire has been postponed until January 1, 1920.

French Colonies.—The prohibition of the import of sugar and alcohol is extended to all French possessions except India, Tunis and Morocco, as from July 8.

Japan.—The restriction on the export of the following articles was removed on May 23:—Caustic soda, soda ash, borax, rubber, copra, coconut oil, chrome, ferro-chrome, chrome steel, tungsten, tin, molybdenum, nickel manganese cobalt and their ores, tin chloride, tin plate, ferro-nickel, ferro-cobalt, spiegeleisen, ferro-manganese, ferro-tungsten, antimony, Chile nitrate, cyanides of soda and potash, mica and plumbago.

Luxemburg.—The new provisional customs tariff affects, *inter alia*, sodium chloride, sugar, vinegar, acetic acid, wines, spirits and tanning extracts.

Netherlands.—The prohibition of the export of potable spirits and odoriferous substances has been withdrawn as from July 2.

New Zealand.—Certificates of origin and interest are now required in respect of goods imported from Belgium.

Portugal.—The surtax on imported "articles of luxury" affects skins, ivory, camphor, malt, yeast, essential oils, alabaster, marble, salt, chemicals, medicines, rubber, gutta-percha, alcoholic beverages, chocolate, preserves, glass, porcelain, toilet soap, gold, silver and platinum.

Rumania.—Invoices for goods shipped to Rumania do not require to be visé by the Rumanian Government representatives in the country of export.

Russia (Northern Territory).—The temporary alterations in the rates of customs duties are set out in the *Board of Trade Journal* of July 17.

Sweden.—Export restrictions are now withdrawn on emery, polishing stones, unwrought lumber, iron sheets coated with tin, lead, etc., certain scientific instruments and mounted optical glasses.

Switzerland.—Exportation of the following substances is now permitted by general licence:—Gentian root, saltpetre, kaolin, calcium phosphate, fluorspar, quartz in powder, kieselguhr, silicate of alumina, emery, carborundum, ferro-alumino-silicon, saccharin, essential oils, perfumery, matches, colours, varnish, asphalt, firebrick, optical glass, aluminium, dye woods, tannin and many other chemicals.

Tunis.—Among the articles the export of which is still prohibited except under licence are oil seeds, vegetable oils, phosphate of lime, bauxite, petroleum, iron ore, gold, silver, platinum and pimento.

United States.—It is proposed to amend the customs duty on imported magnesite, ore, calcined and brick.

The Revenue Act of 1918 may be seen at the Department of Overseas Trade.

Venezuela.—Recent customs decisions affect linseed oil and sheet glass.

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Numbers
British E. Africa	Roofing material, paint, varnish	*
British India (Bombay)	Iron and steel products, galvanised sheets, lead, zinc, aluminium, copper and brass sheets and tubes, asbestos ...	—
,,	Corrugated sheeting, galvanised iron	108
British W. Indies	Paints, oils, varnishes ...	1091
Canada	Drugs	112, 113
,, ...	High-speed steel, etc. ...	152
,, ...	Sanitary earthenware ...	†‡
New Zealand ...	Preserved food, fertilisers	117
South Africa ...	Galvanised iron, steel plates	156
,, ...	Paints, colours	157
Austria (Trieste)	Fertilisers, paraffin ...	158
Belgium ...	Caramel, brewers' sundries	163
Czecho-Slovakia	Drugs	167
France	Vegetable and animal fibres, kapok	170
Greece	Soda, copper sulphate, paint, metals ...	172
,, ...	Metals, glass, pottery ...	174
,, ...	Soap	175
,, ...	Chemicals, paper ...	176
,, ...	Metals, glass, leather, paint	178
Italy	Chemicals, metals, minerals, fire-bricks ...	127
,, ...	Chemicals, lubricants, paraffin, steel ...	‖1679
,, ...	Chemicals, pharmaceutical products	‖1682
,, ...	Metals	‖1685
,, ...	Plateglass	‖1686
,, ...	Metals, fertilisers ...	‖1688
,, ...	Scrap metals	‖1689
,, ...	Chemicals, dyes, paints	‖1693
,, ...	Heavy chemicals, drugs, dyes, oils, gums, waxes	‖1700
,, ...	Caustic soda, drugs, oil, paint, varnish, fertilisers	‖1701
,, ...	Chemicals, dyes ...	‖1707, 1716
,, ...	Chemicals, dyes, mineral oil, castor oil	‖1718
,, ...	Fire-bricks, refractories	‖1723
Rumania ...	Iron, metals	131
,, ...	Chemicals, drugs ...	184
Spain	Hides, oil seeds, jute ...	133
,, ...	Drugs, lubricants ...	186
Spain, Portugal and N. Africa	Heavy chemicals, dyes, iron, steel, tinplate ...	136
Sweden	Chemicals, pig iron, tinplate	187
Argentina ...	Chemicals, cement ...	143
,, ...	Ammonia, aniline, arsenic, carbide, caustic soda, tar oil, carbolic acid, cream of tartar, stannous chloride, ferro-manganese, ferro-silicon, pig iron, gum lac, pure tin ingots, steel, sulphur, sulphate of alumina, tinplate ...	§
Chile	Paint, oil, cement ...	144
Netherlands, West Indies	Varnish, beeswax, turpentine, leather, leather cloth, glass, marble ...	146

* The Secretary, Statistical and Information Department, London Chamber of Commerce, 97, Cannon Street, E.C. 4.

† High Commissioner for Canada, 19, Victoria Street, S.W. 1.

‡ Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

‖ The Secretary, British Chamber of Commerce for Italy, 7, Via Carlo Felice, Genoa.

§ The Argentine Legation, 2, Palace Gate, W. 8.

TRADE NOTES.

BRITISH.

Jamaica in 1917—18.—The Jamaica sugar industry has been greatly stimulated by the high prices prevailing and the favourable conditions for crop production. The sugar exported in 1917 was a record for the island, amounting to 32,000 tons. This is estimated to have realised £672,000. Important developments are anticipated in the industry, and immediate arrangements include the erection of three new sugar factories in St. Catherine. Improvements in growing are also receiving attention, and heavy demands are being made on the nurseries at Hope and Montpelier for supplies of improved varieties of canes.

The copra industry is being extended, and numerous drying plants are being erected in the coconut districts. The total production was adversely affected by the hurricane, but large numbers of young trees are now coming into bearing and a progressive increase is looked for in the exports of coconuts during the next ten years. The exports for 1917 amounted to 30 million nuts.

Very good prices were obtained for hides, orange oil, and honey. Logwood and its extracts were exported to the value of £540,000.

The values of the total imports and exports of Jamaica in 1917 are compared in the table with those in 1907. The source and destination of the imports and exports respectively are also given for these two years.

	Imports.		Exports.	
		per cent.		
Source or Destination.	1907	1917	1907	1917
United Kingdom ...	47·4	19·5	21·5	44·8
United States	43·6	70·1	57·2	28·1
Canada	5·5	6·7	7·6	15·1
Other Countries ...	3·5	3·7	13·7	12·0

Total values:—Imports: 1907, £2,914,013; 1917, £3,323,942; Exports: 1907, £1,992,007; 1917, £2,479,107.

The Deputy Island Chemist dealt with 1198 samples in 1917, being 210 more than in the previous year.

The present prospects for sisal hemp are most encouraging, high prices being obtained for small parcels of the fibre. About one million plants are now being established at the Lititz plantation to supply the requirements of the 900 acres available for cultivation of sisal on the island.—(*Col. Rep. Ann.*, No. 980, *Feb.*, 1919.)

FOREIGN.

The Foreign Trade of Hongkong in 1918.—The Hongkong trade and shipping returns for 1918, the first attempt by the Colonial authorities to furnish complete records of the trade of the port, although based merely on merchants' declarations and to be regarded therefore only as approximate estimates, contribute undoubtedly towards a better knowledge of Chinese trade.

The total value of the trade of Hongkong amounted in 1918 to £127,990,977, the main distribution of which is indicated in the following table:—

Source or Destination	Imports (£60,938,490)	Exports (£67,057,487)
	Per cent.	
French Indo-China	25	8·7
Japan and Corea	16·1	6·7
China and Formosa	15·4	55·2
U.S.A.	13·7	8·1
British Dominions, Colonies, &c.	13·3	11·3
United Kingdom	7·3	1·7

The 1918 returns do not give a correct idea of British trade with Hongkong and South China under normal conditions. The British cotton piece-goods manufacturer has held his own in spite of the increasing pressure of Japanese competition, and 73 per cent. of the machinery imported (£491,788, excluding electrical machinery) was British, but war conditions diverted the bulk of the trade in metals and hardware to America, and the Japanese have secured by far the largest part of the trade in "sundries." With the hold thus secured by American and Japanese products in the South China market the utmost energy and enterprise will be demanded of the British manufacturers and merchants if they are to enjoy their full share of the trade.

Glass.—Of the imports of sheet and plate glass, valued at £69,817, two-thirds came from Japan and the balance mainly from the United States. Goods of better quality than those supplied by the Japanese are in demand. Japan sent almost all the bottles (£59,286) and four-fifths of the glassware (£47,556) imported during 1918.

Chemicals and Drugs.—The principal imports were calcium carbide (£53,735), caustic soda (£44,297), and sulphuric acid (£30,969). About half the total imports came from Japan.

Dyeing and Tanning Materials.—Total imports: £350,104. The smallness of the import of aniline dyes (£6811, mostly from the United States) is ascribed to the unfamiliar British, American and Swiss packages and to real or supposed defects in quality, but nevertheless there is a great demand in China for good aniline dyes, especially for a fast indigo blue.

Metals.—Total imports £8,233,600.

	Per cent of Total Value.	Sources. Per cent.
Brass ...	2·0	Japan 50; U.S.A. 28·6; U.K. 7·2.
Copper ...	1·2	Japan 56·2; U.S.A. 18·1.
Iron and Steel ...	57·3	U.S.A. 80·5; Japan 5·8; U.K. 5·2.
Lead ...	2·4	Australia 60·3.
Tin ...	34·0	French Indo-China 91·1; Netherland Indies 6·0.
Zinc ...	0·3	
Sundries ...	3·0	

Minerals and Oils.—Imports: £893,518. Exports: £1,385,395, of which wolframite accounts for £1,267,789.

Nuts and Seeds.—Chiefly groundnuts were exported, of which America took shipments to the value of £329,596.

Oils and Fats.—Imports of kerosene: £1,606,452, three-fifths of which came from America and the balance from Sumatra, the Netherland Indies and the Straits Settlements. Four-fifths of the imported lubricating oil was of American origin. The largest export of vegetable oil was wood oil (£421,582), of which America took 62 per cent. and the United Kingdom 13 per cent.

Paints.—Total imports: £200,350, of which 30 per cent. came from the United Kingdom, 18 per cent. from the United States and 13·6 per cent. from Japan. Chinese merchants frequently prefer paints in liquid form ready for immediate use.

Some further information is summarised below:—

	Total Imports	Country of Origin.
Chinaware	£170,669	Japan 76%.
Leather ...	894,381	Straits Settlements (sole leather); Japan (manufactured articles).
Matches ...	700,622	Japan 98%.
Paper ...	580,237	Japan 67%.
Soaps ...	163,916	U.K. 42%; Japan 37%.
	Total Exports.	Importing Country.
Hides ...	£846,081	Straits Settlements 33%.
		U.K. 25%.
		Japan 25%.
		U.S.A. 3%.

(*Bd. of Trade J., July* 10, 1919.)

COMPANY NEWS.

BRITISH DYESTUFFS CORPORATION, LTD.

A prospectus has been issued by this company offering for subscription at par 2,500,000 seven per cent. £1 preference shares and 2,500,000 preferred ordinary shares of £1. The authorised share capital is £10,000,000, of which £1,000,000 is in deferred ordinary shares, and the remainder divided equally between preference and preferred ordinary shares. It is worthy of note that the Government has subscribed for £850,000 in preference and a like amount in preferred ordinary shares. Of the proceeds of the present issue, approximately £1,700,000 will be paid to the amalgamating companies (British Dyes and Levinstein) to enable them to pay off outstanding liabilities. The prospectus states further that the total consumption of dyes in the United Kingdom in 1913 was 45,000,000 lb., of which more than 38,000,000 lb. was obtained from Germany. The production of dyes by the amalgamating companies is now more than four times their pre-war production, and is increasing rapidly. The total share capital and reserves of the four largest German dye companies in 1913 was £9,886,318, and the total profits £2,499,592. The combined profits of Levinstein Ltd. and British Dyes Ltd. were, in 1915—16, £852,350; in 1916—17, £1,295,862; and in 1917—18, £1,307,512. The amalgamating companies have works at Tunbridge and Dalton (Huddersfield), Blackley and Clayton (Manchester), and Ellesmere Port, and at the present time employ nearly 300 trained chemists and over 6000 workpeople. It is proposed to add to the extensive plants now in operation and under construction, and to increase the output of dyestuffs.

"SHELL" TRANSPORT AND TRADING CO., LTD.

Sir Marcus Samuel, presiding at the annual general meeting on July 1, referred to the growing importance of the use of liquid fuel, particularly in view of the diminished output of coal. The world's production of liquid fuel is at present about 40,000,000 tons per annum, but a very large proportion of it was already placed before the shortage of coal became apparent. Hence the substitution of liquid fuel for coal is strictly limited and the call for economy is urgent. The position might be considerably alleviated by using oil in internal combustion engines instead of burning it directly. "Shell" motor spirit is now everywhere available and there is no likelihood of demand exceeding supply. When the experiments now being undertaken are completed, this motor spirit will be found to have a 15-20 per cent. greater mileage efficiency than any other on the market. In spite of a big increase in capital, the dividend is maintained at the rate of 35 per cent. free of tax, and £41,172 is placed to the reserve fund, which now stands at £1,000,000. These satisfactory figures reflect a successful year's trading, due mainly to selling in Eastern currency and increased output of crude oil. Two subsidiary companies—the Egyptian Oilfields Ltd. and the "Shell" Company of California have paid substantial maiden dividends. Notwithstanding the success of the former, a long time must elapse before Egypt can produce sufficient oil to cover its own requirements. The total cash reserves of the associated companies amount to £24,000,000, and the total sum written off by them for depreciation since 1907 exceeds £12,000,000.

BURMAH OIL CO., LTD.

In his review of the company's operations during 1918 at the annual meeting held on June 26, Mr. J. T. Cargill, chairman, referred to the great progress made by the Anglo-Persian Oil Co., in which the Burmah Company has an interest of 949,864 ordinary £1 shares, the remaining 2,000,000 shares being held by the Government. These shares, states the *Financial Times*, are valued in the market at £15 per share, but are understood to figure in the Burmah Company's balance-sheet at 2*s.* 6*d.*

Work in 1918 was chiefly directed by the exploitation of the Yenangyoung field in the Beme district, where a very rich sand was struck; but production is falling off rapidly—a common experience in this field. Nevertheless, there are ample reserves of oil on the company's lands. Results obtained outside Burmah have been less satisfactory. In India, one district has been abandoned after drilling to 2660 ft. at a cost of £40,000 without finding oil; in another, drilling was abandoned after sinking to 1300 ft., and in Assam operations have been abandoned owing to the poor quality of the oil, small production and the presence of much water. Operations in Trinidad have also proved disappointing, production having been hindered by difficulties connected with plant and labour. With regard to the finances, the capital has been increased from £1,905,500 by the capitalisation of reserves, and the dividend for the year is 30 per cent., free of tax, equivalent to 45 per cent. on the capital as it stood in 1917, when 32½ per cent. was distributed. During the past four years the company has paid over £4,000,000 in income tax and excess profits duty, and distributed £2,758,000 in dividends.

LAGUNAS NITRATE.

The report for the year 1918 shows a net profit of £32,900, compared with £51,400 for the previous year (capital, £900,000). The dividend is maintained at 2*s.* per share free of tax. No appropriation is made to reserve, which stands at £100,000, but the balance forward is increased from £894 to £14,924. The stock of nitrate at the end of the year was 136,000 quintals, of which over 80,000 quintals had been sold but not delivered. The production of iodine was discontinued early last year owing to the accumulation of stocks; nitrate is being extracted on a reduced scale but the oficina was shut down in December last.

At the annual meeting held on June 23, the chairman, Mr. R. E. Morris, referred to the Association of Producers formed last year, which fixes prices, controls sales and has agencies in many centres. Some 83 per cent. of the producers belong to this organisation, but remaining outside it are the very important Antofagasta Oficinas, controlled by the Antofagasta Company, the German and the American companies, the last named being deterred from joining by the Sherman law.

The Chilean Government, which has not recognised the Association, has already sold nitrate through the Antofagasta Co. to Holland and Spain, and it is reported that negotiations are taking place for a consignment of one million tons to a firm established in Belgium, on the basis of a selling commission of ½ per cent., the profit to be shared equally between the producers and the consignees, but the loss, if any, to be borne by the producers alone. Such interference is greatly to be deprecated.

AGUAS BLANCAS NITRATE.

In common with other nitrate undertakings, this company did less well in 1918 than in the previous year. The trading profits, including £13,824 from iodine, was £8500 less at £56,900, and the net profit £24,100 lower at £38,155. The remainder of the outstanding debentures has been redeemed, the reserve fund increased to £40,615, and the dividend on the ordinary shares is 10 per cent., as against

13 per cent. The division of the proceeds of the sale of land amounting to 15*s.* per share was not sanctioned until February 1919, so that this distribution does not appear in the accounts. It has now been paid and the issued capital reduced to £67,500. The nitrate sold amounted to 720,000 quintals, compared with 685,000 last year; the cost averaged 10*s.* 9*d.*, as against 8*s.* 5·89*d.*, and the sales 12*s.* 4·89*d.*, against 9*s.* 8·13*d.* Extraction is proceeding, but manufacture has been suspended.

PROPOSED AMALGAMATION BETWEEN THE SCOTTISH OIL COMPANIES AND THE ANGLO-PERSIAN OIL CO. LTD.—The Anglo-Persian Oil Co. Ltd. has made proposals to the Scottish oil companies offering to purchase the whole of their issued ordinary shares, and to form a new company, to be called "The Scottish Oil Company Ltd.," with a capital of £4,000,000, of which £3,000,000 would be in 7 per cent. £1 non-cumulative participating preference shares and £1,000,000 in ordinary £1 shares. The preference shares to be issued in payment of the shares in the existing Scottish oil companies and the ordinary shares to be subscribed for in cash by the Anglo-Persian Co. On the formation of the new company, the Anglo-Persian Co. would agree to supply to it, as from January 1, 1923, such quantities of crude oil as may, with the supplies of crude oil from shale, be necessary to keep the present refineries running at full capacity, and at a price sufficient to enable the new company to pay the dividend on the new preference and ordinary shares and to leave a surplus for division between both classes.

PERSONALIA.

Sir A. D. Steel Maitland has resigned his post of head of the Department of Overseas Trade at the Board of Trade.

The death is announced from Berlin of Prof. Emil Fischer at the age of 67.

Dr. Paul Haas has been appointed lecturer in plant chemistry and Dr. F. W. Goodbody lecturer in medical chemistry, at University College, London.

The post of Professor of Mines at the Royal School of Mines, vacant by the resignation of Prof. W. Frecheville, has been filled by the appointment of Mr. S. J. Truscott, who has been assistant professor for the last seven years.

Mr. T. Crook, an assistant superintendent of the Scientific and Technical Research Department and Technical Information Bureau at the Imperial Institute, has been appointed head of the Intelligence and Publications Section of the Imperial Mineral Resources Bureau.

Dr. A. J. Clark has been appointed to the University chair of pharmacology at University College, London, in succession to Prof. A. R. Cushny. He previously held the chair of pharmacology in the University of Cape Town.

Prof. A. Findlay, professor of chemistry at the University College of Wales, Aberystwyth, has been appointed to succeed Prof. F. Soddy as professor of chemistry at the University of Aberdeen.

Mr. E. Grant Hooper, Deputy Chief of the Government Laboratory, retired at the beginning of this month, under the age regulations, after more than forty years' service. He had held the above post since 1912, prior to which he was in charge of the Crown Contracts branch of the Government Laboratory. Mr. Grant Hooper's successor as Deputy Chief Chemist is Mr. J. Connah, who has hitherto been in charge of the branch laboratory at the Custom House.

At Manchester University, Mr. D. H. Bangham has been appointed lecturer in chemistry, and Dr. J. K. Wood, of Dundee, lecturer in physical chemistry in the faculty of technology.

It is announced that Prof. W. M. Gardner, Principal of the Bradford Technical College since 1906, and head of the Chemistry and Dyeing Department since 1895, is retiring on account of ill-health.

Prof. T. Brailsford Robertson has been appointed to succeed the late Sir E. C. Stirling as professor of physiology in the University of Adelaide. Prof. Robertson was formerly professor of biochemistry at Toronto University.

Sir J. J. Thomson has been elected to a newly-established chair of experimental physics at Cambridge University, which will terminate when he resigns office unless the University determines otherwise. Other appointments at Cambridge University include:—Mr. F. W. Dootson to a lectureship in chemistry, and Mr. W. H. Miller to a lectureship in organic chemistry.

OBITUARY.

SIR JOHN BRUNNER, BART.

John Tomlinson Brunner, one of the founders of the firm of Brunner, Mond and Co., was born at Everton, near Liverpool, in 1842, where his father, the Rev. John Brunner, of Zürich, kept a school. He was educated at this school until the age of 15, when he entered upon a commercial career with a Liverpool firm, subsequently obtaining an appointment at the chemical works of Messrs. J. Hutchinson and Co., alkali manufacturers, of Widnes, where he remained eleven years. It was there that he first met the late Dr. Ludwig Mond who had come to the same works to elaborate a process for the recovery of sulphur from alkali waste. The friendship which grew up between the two men ripened ultimately into a business partnership which was destined to play a very important part in the development of the heavy chemical industry of Great Britain. This partnership of commerce and science was formed to work and develop the Solvay ammonia-soda process in this country. The difficulties encountered in the early days of the firm were many—in fact, as Sir J. Brunner was wont to relate, nearly everything exploded or broke, except the firm's credit. Starting with a small capital, a single factory with 40 workers and a yearly output of 800 tons of soda, the business steadily progressed until to-day it has a nominal capital of £15,000,000, numerous works, many thousands of employees and a normal annual output approaching 1,000,000 tons. Combined with those indispensable attributes of a successful business man, foresight and initiative, Sir John Brunner possessed that humanising touch which kept him on the best of terms with his employees and enabled his firm to secure the pick of the local labour market. He introduced profit-sharing in 1907, a sick-benefit scheme, at the cost of the company, developed first-aid and ambulance work, and originated the system of granting an annual holiday of one week with two weeks' pay to every worker who had not absented himself without permission for more than two days in the previous year. His generosity and welfare work were not confined to his own business; he took an active interest in and promoted many local movements, erected and assisted schools and public libraries, and founded a chair of Economics (by a gift of £10,000) and a chair of Egyptology at Liverpool University. He also gave £5000 for the National Physical Laboratory and a like sum to a hospital in Bulach,

Switzerland, of which town his ancestors had been burgesses since the 14th century.

The deceased baronet had a long and useful career as a member of Parliament, where he worked as an advanced Liberal with a tendency towards independence. He was a pronounced democrat, a free-trader and a Home-Ruler. Among the Royal Commissions he served upon was that on Canals and Waterways in 1906, where he was able to give point to the agitation he had started 21 years previously in favour of Government control to secure the development of this neglected means of transport.

He was created a baronet in 1895 and appointed a Privy Councillor in 1906. His death on July 2, after a brief illness, removes yet another original member of this Society and a figure everywhere known and respected in the world of chemical industry. He leaves two sons and three daughters; the eldest son, Mr. J. F. L. Brunner, succeeds to the title, and the second, Mr. Roscoe Brunner, is chairman of Messrs. Brunner, Mond and Co., a position held by his father for over 40 years.

PROF. ADRIAN J. BROWN.

By the passing away of Adrian J. Brown, F.R.S., M.Sc. (Birmingham), Director of the British School of Malting and Brewing, and Professor of the Chemistry and Biology of Fermentation at Birmingham University, on July 2, three days after the death of his wife, the world loses one of its foremost scientific workers in the domain of fermentation, and a man held in esteem and affection by all privileged to know him.

Born in 1852 at Burton-on-Trent, and educated first at the Grammar School of his native town and later at the Royal School of Mines, Adrian Brown acted for some time as assistant to the late Dr. Russell at St. Bartholomew's Hospital, and afterwards accepted the position of chemist at the brewery of Messrs. Salt and Co., of Burton-on-Trent. His duties in the brewery did not prevent him from investigating problems more purely scientific in character, and to this period belong some of his more important investigations on yeast growth, the mechanism of enzyme action, the heat of fermentation, etc., now ranking as classics, as well as the discovery and study of *Bacterium xylinum*. His work on semi-permeable membranes, in particular of the barley-corn, and that on the organism known as *Bacterium X*, were carried out during his occupancy of the Birmingham chair, which he filled with conspicuous success from the inauguration of the School of Malting and Brewing in 1899 to the day of his death.

Essentially fair-minded, a sportsman in the best sense of the term, and possessed of an intimate first-hand knowledge of natural history in all its branches, he was as far removed from the dry pedant as day from night, and no student who came under his influence could fail to derive profit therefrom.

His published work bears the stamp of the man and, what is indeed rare nowadays, when speech and action so often precede the taking of thought, none of it has ever required subsequent defence or modification.

Professor Brown served for some years as Examiner in Biological Chemistry to the Institute of Chemistry, as President of the Institute of Brewing, and as a member of the Council of the Chemical Society. He was elected a Fellow of the Royal Society in 1911.

He is survived by two sons and two daughters.

THOMAS H. POPE.

REVIEW.

BIOCHEMICAL CATALYSTS IN LIFE AND INDUSTRY. PROTEOLYTIC ENZYMES. *By* JEAN EFFRONT. *Translated by* S. C. PRESCOTT. *Pp. xi* + 752. (*New York: J. Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1917.) *Price 23s. net.*

Effront's earlier work on "Enzymes and their Applications" was a classic in its day and by far the most readable book on the subject for the general student. The present volume hardly maintains this standard, though it must be admitted that the author has set himself a task of the highest magnitude. The treatment is unequal and much work of fundamental importance, particularly that published in English journals, is ignored or only very scantily quoted, thereby detracting greatly, if not entirely, from any claim of the work to be authoritative. The work of Emil Fischer, of Abderhalden and of Van Slyke in their respective fields, to mention three names only, has carried the knowledge of the protein molecule far beyond the days of Schützenberger.

After a preliminary section, Part I deals with the coagulating catalysts—thrombin, myrosinase and rennet. Successive parts are devoted to pepsin, trypsin, erepsin, and amidases and a final section deals with the applications of the enzymes in industry. The nomenclature is hardly all that can be desired, probably because the French have not yet followed international custom in this respect and the translator has been content to paraphrase the French names: galactase, for example, should be an enzyme splitting galactosides and not a trypsin.

From the point of view of our readers the most important section is that devoted to the application of the enzymes, which occupies a quarter of the book. Officinal pepsin is carefully described with special reference to the exacting requirements of the French codex. A section on the chemical and enzymic exploration of the stomach is very complete and suggestive. The *rôle* of proteolytic enzymes in breadmaking is discussed, but the references are very incomplete and the statements made, as well as the theory based on them, are of doubtful accuracy. The part played by proteolytic enzymes in brewing has been the subject of many British researches culminating in those of Horace Brown: as this work receives anything but adequate treatment the section must be regarded as unsatisfactory. Similar sections are devoted to the activity of proteolytic enzymes in yeast manufacture, cheese making and tanning.

The catalysis of the soil are somewhat fully dealt with, the author throughout writing of bacteria as if they were catalysts: this seems a bold extension of the accepted definition of an enzyme.

Some useful notes on the recovery of nitrogenous wastes contain the practical experience of the author. A final section deals with the work of Pechère in Belgium, subsequently taken up by Abderhalden, on the nutritive value of products of advanced hydrolysis of protein substances.

As already stated the book is unequal in treatment and must be read very critically by those using it. None the less it is written with much grace and charm, and the perusal of its pages cannot fail to be of value to all workers in this difficult subject.

E. F. ARMSTRONG.

PUBLICATION RECEIVED.

EXPLOSIVES. *By* E. DE BARRY BARNETT. *Industrial Chemistry, edited by* S. RIDEAL. *Pp.* 241. (*London: Baillière, Tindall and Cox.* 1919.) *Price 12s. 6d.*

EMPIRE SUGAR.

No feature of the recent annual meeting of the Society attracted more general interest than the Preliminary Report of the Empire Sugar Supply (Technical) Committee, which was presented at Clothworkers' Hall, Mincing Lane, E.C., where a conference on the subject was held on July 16, the Earl of Denbigh presiding. Nor is the interest evinced in the Committee's work at all surprising, when we bear in mind the important place sugar now holds in our daily life. As the report (*v* p. 287 T) points out, sugar in days of yore was consumed as a condiment or even as a medicine, but it has become during the last few centuries one of the most important articles of dietary among civilised nations. As regards our own country, let it be remembered that the United Kingdom consumes sugar in different forms at the rate of more than 90 lb. *per capita* per annum.

There are many interesting facts connected with the production and consumption of sugar within the Empire. First and foremost it may be pointed out that we produce more sugar than any other State in the world, which, however, is by no means consistent with another fact—*viz.* that, prior to the war, more than 96 per cent. of the sugar imported into the United Kingdom came from foreign countries, the greater part—80 per cent. of the total—being European beet sugar.

The sugar produced within the British Empire is principally derived from sugar cane, and the problem which the Committee set itself to solve was whether the Empire can be rendered self-supporting as regards its sugar supply. The first question is: How do we stand at the present time? In this connexion we cannot do better than refer to the report, and more especially to the explanation given by Mr. J. W. Macdonald of the statistical tables compiled by the Committee from the data they have collected. From these it appears that the Empire is consuming about 6,250,000 tons of sugar annually, whilst it produces normally about 3,350,000 tons per annum, so that there is a shortage of more than 2,500,000 tons in the annual production of sugar if the Empire is to become self-supporting. The question is: Can we make up this deficiency; and, if so, how can it be done?

The report deals at some length with the question of the establishment of a beet sugar industry in the United Kingdom, a project with which it will be remembered Lord Denbigh has been associated for some years. That we can grow beets of sugar content and purity equal to those produced on the continent of Europe has been abundantly proved. On the other hand our farmers have much to learn as regards the cultivation of this particular crop, and until the enterprise is placed on co-operative lines, the farmer getting an interest in the factory and the sugar maker in the farm, no regular supply of roots—a factor essential to success—can be assured. Doubt has often been expressed as to whether we have sufficient land in this country to warrant the establishment of a new agricultural industry; but here it may be pointed out that there are thousands of acres available, and there need be no fear that the land put under beet would reduce the acreage now under wheat and other cereals. Far from it, with the establishment of a sugar industry much land now practically lying idle could be utilised for the purpose, and since beet is such an excellent rotation crop, opening up the soil better than any other, this land would also be available in some years for cereals. It has been stated that the present high efficiency of agriculture in Germany would not have been attained without the beet industry.

As an imperial question, however, the problem of increasing the production of sugar in our Empire beyond the seas is the most weighty. Many of the speakers at the conference pointed to India, with which country the report deals at length, as the portion of the Empire in which the sugar shortage could be made up. India until recently produced more sugar than any country in the world. The latest returns show that Cuba now holds the premier position. But practically the whole of the Indian sugar is that known as gur, a soft variety produced by the natives for their own consumption by primitive methods, involving much waste. This gur is unfit for refining, and over and above the 2,500,000 tons normally produced of it per annum, some 800,000 tons of ordinary raw and refined sugar are imported annually. Prior to the war some of this was German and Austrian beet sugar. It is understood that a Commission is about to be appointed to investigate the sugar problem in India. Many reforms will be required. The present small holdings must be converted into estates to supply central factories with cane, and sugar must be produced by modern methods. There is one respect in which India occupies a unique position in comparison with the rest of the Empire. There is an abundance of labour. Most valuable work is now being carried out in the selection of seedling canes by cross fertilisation, and for much of this we are indebted to Dr. C. A. Barber.

Sir Alfred Chatterton said that the exportation of sugar from India to this country had fallen off about sixty years ago, and the demand in India for sugar was likely to continue to increase, so that no surplus of sugar could be expected for many years. Any increase in sugar production must be accompanied by the introduction of modern machinery and methods. The replacement of sugar by other crops had also to be borne in mind. One great aim would be to produce a sugar which would keep for a longer period than the native gur. Small power-driven mills worked with oil engines and suction gas had been installed by the Government, and these extracted 25 per cent. more juice than the country mills.

Sir Francis Watts, the Imperial Commissioner of Agriculture for the West Indies, made a most illuminating speech at the meeting. He expressed the opinion that there remained but few British tropical colonies in which the condition of the sugar industry was such as to encourage capitalists to come forward to its extension. As regarded the West Indies, Sir Francis thought that much could be done, and Jamaica with an effort could raise its sugar production to 200,000 tons per annum. He was of opinion, however, that unless some measure of assurance were given to those who desired to produce British sugar, they would be ousted by foreign producers who were already equipped for the purpose.

Taking a broad view of the possible outcome of this important work, it must not be thought that the Committee's objects will be consummated all at once. There are parts of the Empire besides those mentioned which could be put under cane cultivation; to cite one, there is the West Coast of Africa. As a matter of fact the work can only bear fruit after a number of years, and then not unless it receives encouragement from the Imperial Government. In the meantime, Mr. Arthur R. Ling and his Committee are undoubtedly to be complimented upon the valuable and arduous work which they have accomplished, work which not only adds testimony to the public utility of the Society of Chemical Industry, but which also marks a step forward towards the attainment of economic independence within the Empire.

REPORT OF THE COMMITTEE ON THE STANDARDISATION OF LABORATORY GLASSWARE.

The suggestion that the Society of Chemical Industry should take up the question of the standardisation of laboratory glassware was made on the occasion of the reading of a paper on "Scientific Glassware" by Dr. Morris Travers at the Annual General Meeting of the Society at Bristol in July 1918 (see Journal of the Society of Chemical Industry, vol. 37, p. 235 T). Dr. Travers subsequently brought the matter before the British Chemical Ware Manufacturers' Association, which approved of the suggestion that the Society should take the initiative in the matter and assured Dr. Travers of its heartiest co-operation. A letter was received later from the Controller of Optical Munitions and Glassware Supply of the Ministry of Munitions, supporting the suggestion that standardisation should be effected as early as possible, and offering the services of a member of his technical staff to discuss the best methods of procedure to be adopted. On October 21, 1918, Mr. F. W. Branson, of Messrs. Reynolds & Branson, Ltd., of Leeds, read a paper on "Some Aspects of the Chemical Glassware Industry" (including Standardisation), before the Yorkshire Section of the Society. (See J.S.C.I., vol. 37, p. 337 T.)

At the meeting of Council of the Society held on October 24, the President proposed that a committee should be appointed to confer with other interested bodies on the subject, with a view to cutting down the supply of various classes of apparatus to a certain number of standard sizes, and he intimated that the Société de Chimie Industrielle was prepared to co-operate in the matter. This proposal was agreed to, and the following were appointed to serve on the Committee:—Sir Robert Hadfield, Mr. K. Chance, Sir Herbert Jackson, Dr. C. Carpenter, Mr. W. F. Reid, Dr. Travers (Convener), with the President (Prof. Louis) and the Hon. Treasurer (Mr. D. Lloyd Howard) *ex officio*.

At the first meeting of the Committee, held on November 20, the subject was discussed in a preliminary manner, and it was strongly felt by the members present that it was necessary in the first instance to obtain the views of manufacturers, users, and the retail trade. The Committee therefore asked the Council to authorise it to obtain the co-operation of representatives of these bodies, and the Council at its meeting in November authorised the Committee to co-opt other members and to call in the assistance of associations or individuals at its discretion. The Committee acting on this authority has since co-opted the following members:—Mr. Arnold Stevenson (Glassware Supply, Ministry of Munitions), Mr. V. Stott (National Physical Laboratory), Dr. J. J. Fox (Government Laboratory), Mr. J. R. Griffin (British Laboratory Ware Association), Mr. F. W. Branson of Leeds, Mr. D. P. Berridge and Mr. F. A. Beesley (Science Masters' Association), Mr. G. F. Baker (British Lamp-blown Scientific Glassware Manufacturers' Association), Dr. S. Rideal (Society of Public Analysts), Mr. T. A. Moore (India Office), Mr. G. A. Mallinson, interim (Pharmaceutical Society), Dr. W. E. S. Turner (Society of Glass Technology), Lt.-Col. D. Harvey (War Office). Mr. Kenneth M. Chance, owing to business engagements, has had to resign his membership of the Committee.

In dealing with each class of apparatus the Committee in the first instance set to work to collect information as to the varieties and sizes manufactured before and during the war, and statistics of sales by the distributing firms, which gave the only definite indication of the relative demand for different articles. In the case of beakers the Committee also endeavoured to obtain the views of users as to the forms and sizes which should be manufactured, by addressing an inquiry to certain of the more important professional bodies, but the answers which they received were so indefinite that the method was not followed up. As it frequently happened that important information with regard to a particular kind of glassware was received when the inquiry relating to it appeared to have almost reached a conclusion, the work of the Committee has been somewhat prolonged.

In making its recommendations the Committee has had due regard for the fact that much money had already been spent on moulds, and that it would be quite useless to advise the manufacturers to replace existing moulds by new ones, without very strong reasons for doing so.

All dimensions and capacities are given in metric measure, which the Committee considers should be more uniformly adopted. This point is important, if an export trade in scientific glassware is to develop in connexion with such countries as South America.

CYLINDRICAL BEAKERS.

The study of the problems connected with this section of the subject occupied a considerable amount of time. Detailed information as to the sizes manufactured by British, German and Austrian houses was laid before the Committee, and also statistics as to the relative numbers of the various sizes of beakers sold by the principal dealers in this country. Every endeavour was made to ascertain the views of users as to the forms and sizes of beakers most commonly employed in scientific and analytical laboratories. Suggestions made by both manufacturers and dealers with a view to cheapening production and distribution had also to be considered.

So extensive was the information which was ultimately collected, that it was necessary to appoint a Sub-Committee to deal with it. On the report of the Sub-Committee the Committee decided to make certain definite recommendations which are detailed below:—

It appeared that three kinds of beakers were on the market:—(*a*) A squat form with or without spout, (*b*) a medium form, (*c*) a tall form. It was generally agreed that two forms would meet all requirements.

The thicknesses of the walls of beakers should approximate to those set down in the table. It was decided that no advantage is to be gained by specifying as the nominal capacity of a beaker the approximate content when filled to a definite distance from the top, because in analytical practice a beaker is usually half filled with liquid, but that the capacity of a beaker should be specified as the approximate content when filled to the brim with liquid. The total height, and the external diameter immediately above the curve at the base should also be catalogued. From the point of view of the user the taper in beakers should be slight, otherwise precipitates tend to settle on the walls; a slight taper is also desirable from the manufacturing point of view, so that the article when blown may be easily freed from the mould. For storage purposes the tapering of beakers is an advantage, for the greater the taper, the greater is the number of beakers of a single size which can be stored in a bin. It was decided that a taper of 1 in 20 on the diameter should be adopted.

From the manufacturing point of view it is important that the series of beakers should be so designed that corresponding numbers of the squat and tall beaker series should have identical diameters at the base, so that a tall beaker spoiled in the process of manufacture could be cut down to

the height of the squat beaker. This principle, which had been employed by Bohemian manufacturers and by one English firm, was adopted by the Committee.

While it was of equal advantage to manufacturers, dealers, and users, to reduce the number of beakers in the series, in arriving at a decision as to the series which should be adopted, close attention had to be paid to the following points:—

(*a*) The series must contain those sizes which are in most common use. (*b*) The space between the beakers must be such as to allow of packing material being placed between adjacent members when the beakers are nested. The space between the beakers must increase with increase in diameters of the beakers. (*c*) When the beakers are nested the rim of each beaker must rest on the rim of the next in series. (*d*) The general appearance of the beakers when nested in series must not be left out of account.

It was finally decided to adopt the following series of diameters:—26, 30, 35, 41, 48, 56, 65, 75, 86, 98, 111, 125, 140, 156, 173 mm.

Finally, the ratio of the height to the diameter of the beakers in the two series was considered, and after reviewing the information which had been collected with regard to existing series, it was decided to adopt the values 1·37 and 2·0 as the values of the ratio, overall height to diameter near base, for squat and tall series respectively.

TALL SERIES.

Ratio $\frac{\text{Height}}{\text{Diam.}} = \frac{2}{1}$ Taper = 1 in 20.

A No.	B External diam. near base	C Thickness of walls	D Overall height	E Approximate capacity to level of brim	No.
	mm.	mm.	mm.	c.c.	
0	26	0·5	52	25	0
1	30	0·5	60	40	1
2	35	0·5	70	60	2
3	41	0·5	82	100	3
4	48	0·75	96	160	4
5	56	0·75	112	250	5
6	65	0·75	130	400	6
7	75	0·75	150	600	7
8	86	1·00	172	1000	8
9	98	1·00	196	1500	9
10	111	1·00	222	2000	10
11	125	1·00	250	3000	11
12	140	1·25	280	4000	12
13	156	1·25	312	6000	13

SQUAT SERIES.

Ratio $\frac{\text{Height}}{\text{Diam.}}$ = 1.37 to 1. Taper = 1 in 20.

A No.	B External diam. near base	C Thickness of walls	D Overall height	E Approximate capacity to level of spout	No.
	mm.	mm.	mm.	c.c.	
1	30	0·5	41	25	1
2	35	0·5	48	40	2
3	41	0·5	56	60	3
4	48	0·75	66	100	4
5	56	0·75	77	160	5
6	65	0·75	89	250	6
7	75	0·75	103	400	7
8	86	1·0	118	600	8
9	98	1·0	134	900	9
10	111	1·0	152	1300	10
11	125	1·0	171	2000	11
12	140	1·25	192	2750	12
13	156	1·25	214	4000	13
14	173	1·25	237	5000	14

The preceding tables give the dimensions of two series of beakers recommended for adoption by the Committee. It is also recommended that the data set down in columns A. B. D. and E, be given in price lists and catalogues.

Beaker Flasks and Conical Beakers.

It appeared to the Committee that no advantage would be gained by suggesting that manufacturers should make new moulds for beaker flasks and conical beakers. It recommends, however, that the greatest diameters, the heights, and the total capacities of these articles should be catalogued.

FLASKS.

The Committee considers that a flask should hold at least the nominal capacity when filled with liquid to the level of the base of the neck. The nominal capacity and the external diameter of the neck should be catalogued.

The flange of a flask should be turned over sharply, the mouth should not be belled.

It did not appear to the Committee that any material advantage was to be gained by reducing the number of round and flat-bottomed flasks manufactured, except in so far as it might be possible to eliminate one or the other of almost identical sizes such as those corresponding to 100 and 125 c.c., 350 and 400 c.c., 700 and 750 c.c., 1250 and 1300 c.c. The sizes of flasks between 50 and 10,000 c.c., which it considers to be sufficient to meet all requirements, are set down in the following table. Of these flasks, those corresponding to 600, 1250, and 2500 c.c. are retained, as they correspond to the pint, quart, and the 2 quart sizes, and are therefore in demand for certain purposes.

It was suggested to the Committee that if flasks, over a considerable range, had necks of the same diameter, the number of sizes of rubber stoppers which it would be necessary to stock in the laboratory, might be considerably reduced. The Committee decided not to adopt the suggestion.

The Committee recommends that as new moulds come to be made, the necks should conform to the following dimensions:—

(*a*) FLAT, ROUND-BOTTOMED AND CONICAL FLASKS.

Capacity of flask cc.	External diameter of neck mm.	Capacity of flask cc.	External diameter of neck mm.
50	17	(1250)*	33
100	18	1500	35
150	18	2000	40
200	21	(2500)*	40
250	25	3000	45
350	25	4000*	45
500	27	5000	55
(600)*	27	7500	60
750	29	10,000	65
1000	33		

* Flat and round-bottomed only.

It appears that there is still a demand for the pear-shaped as well as the globular form of flask.

(*b*) WIDE-MOUTHED FLASKS WITH SHORT NECKS.

i. Flat-bottomed flasks, known as CO_2 flasks or extraction flasks.

ii. Round-bottomed flasks, known as bolt heads.

Capacity cc.	Diameter of neck mm.	Capacity cc.	Diameter of neck mm.
50	30	750	50
100	35	1000	55
150	35	1500	55
250	40	2000	60
350	40	3000	60
500	45	5000	65

Flat-bottomed flasks to 500 cc. capacity only.

In view of the fact that a very considerable number of moulds for the short, wide-mouthed flasks, with flat and round bottoms (known as extraction or CO_2-flasks, and bolt-head flasks respectively), are already in the hands of various manufacturers, the Committee suggests that the manufacturers should confer amongst themselves with a view to eliminating unnecessary sizes at once.

(c) Distillation flasks.

Capacity cc.	Diameter of neck mm.	Length of neck mm.
50	12	135
100	15	145
150	17	155
250	20	170
350	20	185
500	23	200

Larger sizes as round-bottomed flasks.

(d) Kjeldahl flasks.

Capacity c.c.	Diameter of neck mm.	Capacity c.c.	Diameter of neck mm.
100	22	300	28
200	25	500	30

(e) Conical filtering flasks.

The flasks must be well annealed, evenly blown, and thick in the walls, so as to be able to stand exhaustion, and filling with boiling liquid without cracking. The neck of filtering flasks to take rubber stoppers should be turned out sharply and not belled. The tubulure should be so drawn out as to take thick walled rubber tube 3/16 in. internal diameter. The internal diameter of the neck should be at least:—

Capacity c.c.	Diameter mm.	Capacity cc.	Diameter mm.
100	25	1500	40
250 or 300	33	2000	45
500	35	3000	45
750	40	5000	50
1000	40		

Kipp's Apparatus.

The overall height and the diameter of the middle bulb should be listed.

The Committee considers that four sizes corresponding to 85 mm., 105 mm., 125 mm., and 180 mm.; or 250, 500, 1000, and 2000 c.c. should meet all requirements.

FUNNELS.

(a) Plain or fluted funnels of thin glass.

It is of very great importance that funnels should be made so that, in the case of plain funnels, a hardwood cone accurately turned to an angle of 60° will fit into the inside without side play. In the case of ribbed funnels the ribs should be pronounced on the inside.

Funnels should be ground flat on the top.

The stems should either be of parallel bore, or should taper slightly to the point; taper in the reverse direction is objectionable. The point should be ground off at an angle of about 30°.

Though the sizes of funnels are generally catalogued in inches, the Committee suggests that the dimensions should in future be given in millimetres. The series 1, 1¼, 2, 2½, 3, 3½, 4, 4½, 5, 6, 8, 10, 12 inches, should be replaced by the series 30, 45, 60, 75, 90, 105, 125, 150, 200, 250, and 300 mm., the number in the series being reduced from 13 to 11, the sizes 3, 3½ and 4 in., which are important, corresponding almost exactly with the sizes 75, 90, and 105 mm.

The following is a summary of the suggested dimensions of funnels:—

Outside diameter across top mm.	Approximate length of stem mm.	Approximate external diameter of stem mm.
30	45	5
45	60	5 to 6
60	75	6 to 8
75	90	8 to 10
90	105	8 to 10
105	120	10 to 12
125	130	10 to 12
150	150	12 to 15
200	165	15 to 20
250	180	20 to 23
300	200	22 to 25

(b) Deeply ribbed funnels, pressed.

The following sizes, for which press moulds already exist, were adopted by the Committee:—

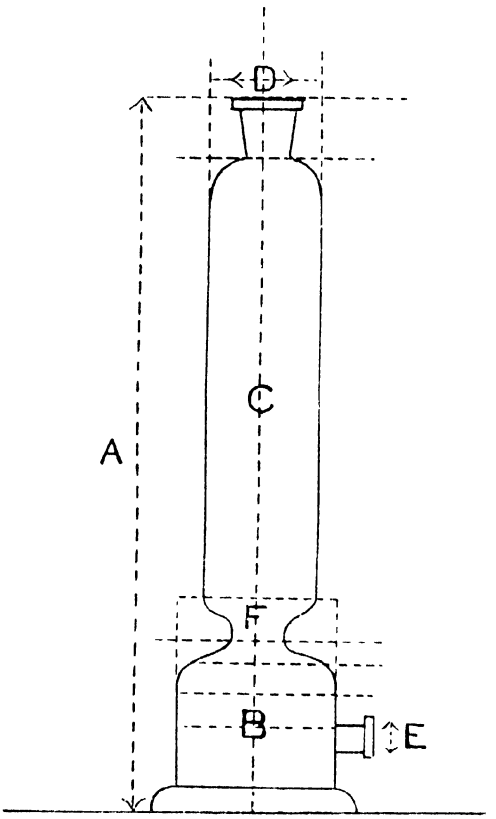
7, 9, 11, and 16 cm.

DRYING TOWERS.

The total height and the diameter of the cylindrical portion should be catalogued. The tubulure at the base should not be less than 15 mm. in diameter at the outer end. The following dimensions of drying towers—from moulds which already exist—are recommended for adoption:—

No.	A	B	C	D	E	F
1	200	45	40	25	15	15
2	250	55	45	30	15	18
3	300	65	50	30	15	18
4	400	90	65	30	15	22

It is important that the internal diameter of the constriction should be less than the minimum internal diameter of the neck.



DESICCATORS.

The catalogued dimension of a desiccator should be the internal diameter of the opening of the container portion of the apparatus.

The dimensions of a desiccator should be such that the depth of the part of the apparatus in which the article or material to be dried is placed should be at least two-thirds of the diameter of the opening

The ground contact surface between the body of the apparatus and the lid or cover should be at least 15 mm. for 100, 125, and 150 mm. sizes, and 20 mm. for 200 and 250 mm. sizes. In the case of vacuum desiccators, the ground contact surface should not be less than 20 mm. in any case.

The Committee considers that the following

variety and sizes of desiccators will meet all requirements:—

Scheibler form (plain, with tubulure in lid, and with tubulure in side), 100, 125, 150, 200, and 250 mm.; Fresenius form, 125 mm.; Hempel form, 150 mm.

ASPIRATORS AND WOULFF'S BOTTLES.

The Committee recommends that the diameter and height overall be listed. The vessel should contain at least its nominal volume when filled with liquid to the base of the neck.

The ratio of the diameter to the height to the base of the neck should not be less than 3 to 5.

The taper of the necks and tubulures should be such as to correspond to change in diameter at a rate corresponding to about 1 in 7, so as to allow of stoppering, and to fit corks and rubber stoppers.

In the case of Woulff's bottles, it is important that the side necks be so placed that a glass tube can pass through the centre of a cork in the neck vertically to the bottom of the bottle.

It is considered that the following sizes will meet all requirements:—

Nominal capacity cc.	Minimum internal diameter of necks mm.	Minimum internal diameter of tubulures mm.
125[a]	15	15
250	15	15
500	20	15
1000	25	20
2500	32	20
5000	40	25
7500	40	25
10,000	40	25
15,000	45	25

[a] Woulff's bottle only.

GRADUATED APPARATUS.

The Committee desires to call attention to the facilities offered by the National Physical Laboratory for the testing of graduated glassware. The Committee has had before it copies of a pamphlet dealing with "Volumetric Tests on Scientific Glassware" issued by the National Physical Laboratory in July, 1918, in which full information relating to the details of these tests is given. Copies of this publication may be obtained free of charge on application to The Director, The National Physical Laboratory, Teddington, Middlesex. The pamphlet deals with Class A Tests, that is, the examination of apparatus in which the highest degree of accuracy is required, and vessels which pass the tests have the Laboratory mark, which is a combination of the Laboratory monogram and the date of test, etched on them. Apparatus submitted for Class A Tests and found to be outside the limits of acceptance for standard apparatus is, if considered of reasonable accuracy for commercial purposes, given the Class B mark. In addition to the Class A tests the Laboratory has now under consideration Class B tests, that is, the examination of apparatus primarily intended to possess only commercial accuracy. It is hoped that it may be possible to complete the final arrangement for these tests in the near future.

(a) Pipettes.

The dimensions recommended for single-mark bulb pipettes are given at bottom of page.

In view of the great divergence in opinion and practice amongst chemists in their methods of using pipettes and burettes it was thought desirable to include in this report brief notes on this subject.

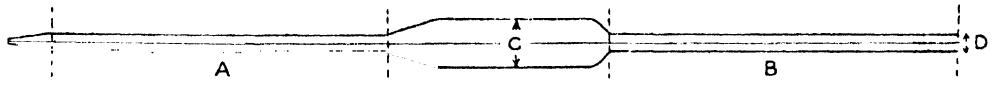
With regard to pipettes, numerous methods of using one mark delivery pipettes have been proposed from time to time; but all may be included in one or other of the two following classes:—

(*a*) Those in which the small quantity of liquid which remains in the jet is allowed to stay there, and

(*b*) Those in which this liquid is ejected, *e.g.*, by blowing down the pipette, or by closing the top of the pipette with one finger and warming the bulb by clasping it with the other hand.

Methods in which the small quantity of liquid which collects in the jet of a pipette when outflow has ceased is allowed to remain there are more reliable than those involving the ejection of this liquid. The latter methods are, therefore, not to be recommended. With regard to the former methods it is essential in order to obtain the best results to have a perfectly definite order of procedure. Recommendations as to the procedure to be followed are given below. In order to obtain results with pipettes tested at the National Physical Laboratory which shall be in agreement with the values certified, the pipette should be used in accordance with the conditions of test printed on the certificate of corrections. In cases, however, where one is prepared to accept the nominal value of a pipette provided that it is correct within reasonable limits the following method may be used, with pipettes calibrated in accordance with the National Physical Laboratory methods of test, without introducing appreciable errors.

The pipette is filled with liquid to a short distance above the mark. Liquid is then run out until the meniscus is on the mark and the outflow is then stopped. The drop adhering to the tip is removed by bringing the tip of the pipette into contact with the surface of the liquid from which it has been filled and then removing it without jerking. The pipette is then held vertically and allowed to deliver with the jet touching the side of the receiving vessel, the vessel being slightly inclined. The pipette is allowed to drain for 15 seconds after outflow has ceased, with the tip still in contact with the side of the vessel, and the pipette itself vertical. On completion of the draining time the vessel is removed from contact with the tip of the pipette, thus removing any drop adhering to the outside



Capacity .. c.c.	1	2	4	5	10	25	50	75	100
A .. .. mm.	95	100	120	120	190	200	200	200	165
B .. .. mm.	110	115	120	120	160	200	200	200	200
C (int.) .. mm.	5·5 to 6·5	7 to 7·5	10 to 10·5	11·5 to 12	13·5 to 14	17 to 18	27 to 28	30 to 31	35 to 36
D (int.) .. mm.	2	2	3	3	4	5	5	5	7
Distance of mark above bulb, about .. mm.	25	35	35	35	40	50	50	50	50

of the pipette. To determine the instant at which outflow ceases, the motion of the liquid surface down the delivery tube of the pipette is observed, and the delivery time is considered to be complete when the meniscus comes to rest slightly above the end of the delivery tube. The one-fourth minute draining time is counted from this moment.

The method just described in detail differs from the method of test at present employed at the National Physical Laboratory only in the following particulars:—

(*a*) The pipette is allowed to deliver with the jet continuously in contact with the walls of the receiving vessel instead of using free delivery.

(*b*) At the end of the one-fourth minute drainage time the drop adhering to the pipette is detached against the side of the receiving vessel instead of on the surface of the liquid already delivered.

As stated previously, when a pipette is being used for work in which, if the pipette is accurate within reasonable limits, it is sufficient to accept its nominal volume for delivery as the correct volume delivered, then it is immaterial whether the National Physical Laboratory method is adhered to strictly or the alternative method given above be used. The difference between the results obtained by the two methods is appreciably less than other possible incidental errors. This is assuming of course that the pipette was initially calibrated for the above methods of use. If, however, such a pipette is used by methods involving the ejection of the drop of liquid, which in the above methods is allowed to remain in the pipette the results obtained may differ very appreciably from the volume delivered by the method for which it was calibrated. In view of the fact that more reliable results are obtainable by the methods of using pipettes described above than by injection methods, it is recommended that manufacturers should continue to calibrate pipettes in accordance with the conditions of test specified in the National Physical Laboratory test pamphlet previously referred to. Further, in order to secure uniformity of results it is desirable that users of pipettes should follow the above recommendations as to method of use. In arriving at the conclusions set out above the results of a recent investigation on different methods of using pipettes carried out at the National Physical Laboratory were available to the Committee, and will be published in the Society's Journal in the near future.

Burettes.

Two of the main sources of error in the use of burettes are:—

(*a*) Change in rate of delivery arising from different manipulation of the tap on different occasions. This causes a variation in the volume of liquid delivered corresponding to a given interval on the burette. (*b*) Change in reading due to drainage of liquid down the walls of the burette.

Quite large errors may arise from these causes and often escape detection in ordinary analytical work, particularly if burettes with quick delivery times are used. By delivery time is meant the time occupied by the outflow of water from the zero graduation mark to the lowest graduation mark when the tap is fully open. The possibility of errors arising from the above causes is reduced to a very considerable extent by using burettes with comparatively long delivery times.

The times of delivery specified by the National Physical Laboratory for burettes submitted for Class A tests are given in Table A.

The minimum times of delivery have been so chosen that for tubes of the diameters ordinarily employed for burettes, the rise in the meniscus due to drainage shall not exceed approximately 0·05 mm. in the first two minutes after closing the tap. The maximum times have no physical significance but merely fix an upper limit in order to avoid the rate of delivery being made intolerably slow.

Table A.

Length graduated, cm.	Minimum time of outflow, sec.	Maximum time of outflow, sec.
15	30	60
20	40	80
25	50	100
30	60	120
35	70	140
40	80	160
45	90	180
50	100	200
55	110	220
60	120	240
65	130	260
70	140	280
75	150	300

With burettes conforming with the above limits as to delivery time, the second cause of error mentioned at the outset, *viz.*, change in reading due to drainage, is practically eliminated. The errors introduced by increasing the time of delivery above the natural time of delivery of the burette are also very much smaller than would be the case with burettes calibrated for a quick delivery.

With burettes calibrated for the above delivery times the only demands made upon the user in order to obtain results in agreement with those obtained in testing the burette are:—

(1) The burette should be allowed to deliver with the tap fully open. (2) The reading should be taken immediately after the required amount of liquid has been run from the burette. (3) The 0 c.c. mark of the burette should be taken as the starting point.

The mode of manipulation is thus extremely simple and makes a minimum demand on the user's time and attention.

It is worth while to consider the above details of manipulation more fully, with a view to possible variations in the course of analytical work.

The first condition should be adhered to as strictly as possible. If, however, the liquid is delivered more slowly, the errors introduced will be much smaller for burettes of the specified times of outflow than for burettes of short delivery time. Moreover, the times of delivery fixed are quite long enough for almost all purposes, and it will rarely be desired to lengthen them still further. It is of course not feasible to keep the tap fully open when the end point of a titration is being approached. The fact that the last cubic centimetre or so is delivered quite slowly is in effect, however, simply an introduction of a short drainage time, and it has been pointed out previously that the delivery times have been so chosen that the rate of drainage is almost negligibly small. Also, in testing burettes the last cubic centimetre is necessarily run out slowly thus approximating to the conditions of an actual titration. It may also be desirable at times to add the reagent from the burette in small quantities at a time. If this is done by smartly turning the tap fully open and smartly closing it when the required fraction has been added, the total volume thus added, as indicated by the initial and final burette readings, will be in close agreement with the volume delivered by emptying the burette continuously from the initial to the final reading. This again is in virtue of the fact that the delivery times have been chosen sufficiently long. With quick delivery times very different results would be obtained in the two cases. It should further be pointed out that although the proposed delivery times are appreciably longer than those which it is customary to employ, yet by eliminating the necessity of waiting for drainage, the time occupied by a

titration is actually shortened in spite of the increased delivery time.

The second condition, given previously, that the reading should be taken immediately after the required amount of liquid has been taken from the burette, may be departed from within reasonable limits (say, 2 or even 5 minutes), to suit the convenience of the user. If the third condition is departed from and a reading other than the 0 c.c. mark is taken as the initial reading, only quite small errors will be introduced.

The Committee recommends that burettes should be made with delivery times in accordance with the National Physical Laboratory specifications and used in the manner described above.

The Committee recommends that a detailed account of the work of Mr. V. Stott on the use of pipettes and burettes shall be published in the Society's Journal.

Measuring Flasks.

The Committee calls attention to the dimensions of necks of graduated flasks set down in the pamphlet issued by the National Physical Laboratory.

Measuring Cylinders.

The Committee calls attention to the fact that only in the case in which the body of a measuring cylinder is made from tube is it possible to obtain anything approaching perfect uniformity of internal diameter. In cylinders blown in the mould the internal diameter invariably diminishes more or less sharply towards the bottom, and the walls are often irregular. The length of the bottom of a cylinder blown in a mould corresponding to 1/10 of the nominal capacity should not be graduated, as the readings over this range are likely to be inaccurate.

In reading the level of liquid in measuring cylinders attention is called to the method of observation described by the National Physical Laboratory. Unless proper precautions are taken widely different results can be obtained.

The following dimensions of cylinders are recommended for general use:—

Capacity, c.c.	Diameter, mm.	Height overall, stoppered, mm.	Height overall, unstoppered, mm.	Diameter of foot mm.
5	13	—	110	35
10	15	—	125	35
25	20	200	200	45
50	24	240	200	50
100	31	290	240	60
250	41	380	330	75
500	52	480	380	95
1000	67	510	440	115
2000	82	610	500	130

Lamp-blown Apparatus.

The Committee considered the possibility of standardising lamp-blown apparatus. It was represented to it that if such pieces of apparatus as the Orsat gas-analysis apparatus were standardised, chemists would not experience the difficulty of replacing broken parts which existed at the moment. The Committee, however, was not in a position to undertake the enormous amount of detailed work which the fixing of standards would entail, but suggests that the matter might be taken up by the British Lamp-Blown Scientific Apparatus Manufacturers' Association. As no moulds are required in this work the case is somewhat different from that of the mould-blown hollow ware.

[Signed]
Morris Travers, *Chairman.*
J. P. Longstaff, *Secretary.*

July 12, 1919.

SOME CHEMICAL PLANTS IN THE COLOGNE AREA.

Part I.

A. J. Allmand and E. R. Williams.

Last January and February we had occasion to visit certain chemical works near Cologne with a view to inquiring into their economic situation. During our visits we acquired the information and made the notes which form the basis of the present articles. It should be clearly understood in reading what follows that we had no authority to demand that the firms should disclose to us any secrets, or, indeed, any working details beyond those directly concerned with the matter in hand. Further, we only examined inorganic chemical manufacturing processes.

Leverkusen Works of the Firm Farbenwerke (vorm. Friedrich Bayer) Elberfeld.

This well-known factory is situated hard on the east bank of the Rhine, a few miles north of Cologne. It is well over a square kilometre in area. Its lay-out has been planned on logical lines and everything is done on a lavish, not to say unduly expensive and elaborate, scale. Broad roads running N. to S. and E. to W. intersect it at frequent intervals. Water transport communications are excellent, as are railway facilities both inside and outside the works. The row of blocks of buildings next the river is devoted to the manufacture of so-called initial products or raw materials, comprising plants for sulphuric acid, hydrochloric acid and sodium sulphate, nitric acid, caustic soda (from sodium carbonate), caustic soda and chlorine (electrolytic), sodium sulphide, barium sulphide, sodium chromate, etc. Next comes a row of buildings for the manufacture of "intermediates," including derivatives of acetic acid, acetone, mercaptan, benzene, naphthalene and anthracene. Finally come the "end-products," comprising all kinds of coal-tar dyes, salicylic acid, sodium salicylate, phenacetin, lithopone, superphosphates, artificial rubber, photographic chemicals, papers and films and artificial sodium nitrate. The power-house contains four 2500 h.p. turbo-generators used for mechanical power and lighting, and five machines for the electrolytic alkali plant, each generating 4000 ampères at 220 volts. Before the war, they employed about 7500 workpeople (including 3000 mechanics) and 1500 salaried personnel (engineers, clerks, chemists, foremen, selling branch, etc.). A far larger number of workmen was employed during the greater part of the war, owing to extensive munition work (including poison gases).

Space will only permit us to describe a few of the more interesting plants.

Sulphuric acid and cement from waste calcium sulphate.

This plant is still in the experimental stage, though in one month as much as 1000 tons of sulphur trioxide has been produced. It originated in an attempt to dispose of the calcium sulphate press-cake resulting from neutralising the excess of sulphuric acid used in many organic sulphonation processes. All available dumping grounds in the neighbourhood had already been filled up. The process consists essentially of mixing the press-cake with coal and a slagging material and feeding it in at the upper end of a cylindrical revolving furnace, slightly inclined from the horizontal, and lined with a suitable refractory material. The two furnaces at present installed are about 50 metres long and 3 metres in diameter. They are coal-dust fired. The charge was stated to take about

ree hours to reach the bottom end of the furnace. From there it drops into a second similar furnace of smaller diameter which acts as a cooler (air for combustion of coal drawn up through this?). The gases pass through dust chambers and an electrostatic dust collector (unsatisfactory) and are led to the sulphur trioxide converters. Practically all sulphur trioxide is produced in the furnaces. The slag is sent elsewhere to be ground. It was stated that the resulting cement was of good quality. Also that natural calcium sulphate had not been used. Gypsum had been tried, but the (briquetted?) charge broke up owing to water evolution. Anhydrite would probably prove suitable. The method had not been fully worked out, and trouble was sometimes experienced owing to the charge fusing and destroying the lining.

Synthetic nitric acid and sodium nitrate.

In this plant ammonia gas mixed with an excess of air is passed over a catalyst at a suitable temperature, and the resulting oxides of nitrogen absorbed either in soda solution or in water.

The ammonia was obtained in the form of a 20—25 per cent. aqueous solution from the cyanamide works at Knapsack, or from gas works, and the gas distilled off by steam in plant of normal design. At times ammonia liquor was not available, and the gas was generated by interaction of ammonium sulphate solution and lime water, driving off the ammonia by blowing in steam. The gas is then passed to the furnace house, where it is mixed with air before entering the furnaces. This air had previously passed through a regenerator (10 ft. diameter by 18 ft. high), heated by the furnace gases, and the mixture entered the oxidiser at a temperature of 250° C. The oxidisers were more or less still in the experimental stage. Those in use were about 14 ft. in diameter and 18 ft. high and contained the contact mass—granular iron oxide plus some heavy metal oxide, all sieved through a 6-mesh sieve, in successive layers of 0·5 in. thick spread out on perforated tiles. The gases, containing 7—10 per cent. ammonia, entered tangentially at the top of the furnace and were finely baffled through the catalyst, which was kept at a temperature of 700—800° C. A conversion of 80—85 per cent. to oxides of nitrogen took place, the losses being due to dissociation and combustion of ammonia, its interaction with nitrogen oxides, &c.

The nitrous gases passed through a cooler and then through one of several series of six absorption towers, down which passed saturated (usually filtered) sodium carbonate solution. The first of these was of granite, the remainder of wrought iron, and they were about 40 ft. high and 5 ft. in diameter. Great trouble was experienced owing to air corrosion and breaking down. The exact cause of this was never discovered nor where it was likely to break out. The plant could either be worked by passing gases through until the sodium nitrite formed was all converted into nitrate, or else by bringing about this conversion through subsequent addition of nitric acid. A solution containing about 350 grms. $NaNO_3$ per litre resulted, and this was concentrated in hot-jacketed shakers and crystallised out. The plant was capable of producing about 6000—7000 tons per month, which in its turn could supply the firm's entire pots when working at full capacity.

Later in the war, nitric acid (40 per cent.) was made from these oxidiser gases, the capacity of the plant being some 1000—1500 tons monohydrate per month. For this purpose they were passed through massive granite towers, each some 60 ft. high and 18 ft. in external diameter, arranged in two parallel series of six. Water or dilute acid from later towers passed down through the first five pairs and sodium carbonate solution down the last pair. The strong acid was drawn off from the third or fourth sets—it could not be predicted from which in practice. Acid of 47 per cent. strength was said to be the maximum possible. The towers were stated to be too wide—their absorbing area was not fully used. The weak nitric acid was concentrated by vitriol, steam and a proportion of hot burner gases being blown in. This plant was said to be unsatisfactory and to cause endless trouble with repairs. The vitriol was reconcentrated in a Kessler plant (about 20 small units).

Silico-ferron centrifugal pumps and pipes were largely used, though not too satisfactory.

The whole process is stated to be at present too costly (though it has a future). This plant in particular is in bad repair and will be shut down when ammonia stocks are worked off. In the meantime experimental work is being constantly done on it with a view to future improvements.

Electrolytic alkali and chlorine plant.

The cell room contained five lines, each of 60 Billiter-Siemens cells. There were also some Griesheim cells which had been installed about 18 years ago and which now are only of historical interest, though sometimes still used in consequence of the large number of Billiter cells that may be out of action at any moment. They take the same current as the Billiter cells, work at 3·8 volts, and the contents of the cathode compartments are drawn off every, 30—36 hours.

Originally, the Billiter cells had been designed for 2000 amp., but it had been found that there were certain advantages in making three 6-inch holes in the brick partition wall between each pair of units in parallel, thus making a 4000 amp. unit. This consisted of a cast iron vessel about 10 ft. × 14 ft. × 12 in. deep. The sides of this casing were lined with a chlorine resisting brick. A central brick bridge wall extended from end to end and served to support the covering slabs which were of Portland cement. Holes were cast in each slab to permit the passage of the graphite rods supporting the anodes. These slabs were luted into place with a mixture of tar and pitch. During the war, owing to the shortage of both tar and pitch, the luting was done with Portland cement.

The cathode consisted of a horizontal sheet of heavy iron wire gauze, supported about 4 in. above the cast iron shell and electrically connected to it. Upon the gauze was spread the diaphragm, which consisted of a paste of long-fibred asbestos and barium sulphate. Above this diaphragm and supported by graphite rods passing through the covering slabs, were the anodes. These anodes consisted of artificial graphite slabs about 26 in. × 7 in. × 1¼ in. These were drilled and tapped, and made a screw joint with the supporting rods (section 1 × 2 in.). Each unit was equipped with 80 such anodes.

Contact from the positive bus was made by a short length of flexible copper cable terminating in a lead cap which was cast over the projecting head of each graphite supporting rod. Contact to the negative bus was made directly through the iron casing.

An opening in the cover of each half-unit served for the inflow of brine. A central opening in the bottom of the casing, *i.e.*, in the cathode compartment, was connected by means of an iron pipe to an overflow syphon. At the end of the cathode compartment a glass level gauge was fitted, also an opening for the hydrogen outlet pipe. The chlorine left the cell by means of an earthenware pipe leading to a lead-lined chlorine main.

Below each line of cells was a channel having sufficient headroom for workmen, and the cells were supported over these pits by means of steel "I"

beams, from which they were insulated by porcelain knobs.

The cells were operated with a positive pressure of about 2 cm. of water on the cathode side, and a few mm. of water on the anode side. This positive pressure on the mains served to prevent any leakage of oxygen and also to show up any leakage, especially in the chlorine main and anode compartment covers.

The hydrogen produced was compressed into cylinders, and in this form some of it was sold. The greater portion however was used in the works for purposes of oxy-hydrogen welding or cutting.

In order to produce a chlorine of the purity required for many organic preparations most of the gas from the electrolytic plant was liquefied. It was first led into earthenware absorbers filled with strong sulphuric acid. The dry gas was then compressed in lead-lined gear-driven pumps, using a concentrated sulphuric acid in the compression cylinder. The compressed gas, at about 3 atmospheres, was condensed at a low temperature by means of an ammonia refrigerating plant. From the condensers the liquid chlorine passed into large steel receivers from where it was filled into smaller cylinders or piped directly to any required point in the works.

The catholyte contained 120 grms. caustic soda per litre about three days after setting the cell going, and this gradually rose to a figure of 160 grms. per litre at the end of three months as the diaphragm resistance increased. The voltage rose correspondingly, a figure of 4·3 volts being reached. The cells were cleaned out after four months.

The evaporator plant was originally designed to operate as four triple-effect vertical evaporators producing a liquor containing about 40 per cent. of caustic soda. Originally steam from the low pressure cylinder of the generator engines was used in the first effect. Better practice was later attained by using steam from the high pressure cylinder and two evaporators as a double effect. All the vertical type evaporators were fitted with salt filters. Owing to the corrosive effect of caustic stronger than 40 per cent., a smaller horizontal type evaporator without salt filter was used to complete the evaporation and to produce a 50 per cent. solution which was strong enough for the general purposes of the plant of the works.

The whole plant was working under a disadvantage owing to shortage and bad quality of materials. Much zinc and aluminium were being used instead of copper and the quality of the asbestos and of the graphitised anodes was poor. As a consequence, instead of producing 10,000 tons of chlorine per annum, for which it was designed, the output did not exceed two-thirds of this figure.

(To be continued.)

The Institute of Metals.—The autumn meeting of the Institute of Metals, to be held in Sheffield on September 24 and 25, will be the first occasion since 1913 that a gathering has been held outside of London. The attendance of many metallurgists and engineers from all parts of the world is expected, and in addition to the communication of papers there will be visits to works and a number of social entertainments. The papers will include: "Moulding Sands for Non-Ferrous Foundry Work," Prof. P. G. H. Boswell; Second Beilby Report on "The Solidification of Metals from the Liquid State," Prof C. H. Desch; "Observations on a Typical Bearing Metal," Miss H. E. Fry and Dr. W. Rosenhain; "Season Cracking of Brass," Dr. W. H. Hatfield and Capt. G. L. Thirkell; "The Ternary Alloys of Tin-Antimony-Arsenic," Dr. J. E. Stead; "Graphite and Oxide Inclusions in Nickel Silver," Dr. F. C. Thompson, and others.

THE MANUFACTURE OF FERMENTATION GLYCERIN IN GERMANY DURING THE WAR.

The investigations initiated by Lüdecke with the object of obtaining glycerin on an industrial scale by means of the fermentation of sugar assumed supreme importance in Germany after the outbreak of war, when the supplies of fat became enormously curtailed as a result of the imposition of the blockade. The extension of these researches and the conversion of the results obtained into the practical process of Connstein and Lüdecke were kept a close secret during the war, but were recently made known by Connstein at a meeting of the German Chemical Society, a report of which has appeared in the *Wochenschrift für Brauerei* (May 10, 1919).

The process is based on the observation that the percentage of glycerin formed from sugar is increased if the fermentation is allowed to proceed in presence of alkaline substances. Among the latter a special position is occupied by sodium sulphite, which yeast is able to withstand in very large proportions. Thus, a solution prepared from 10 litres of water, 1 kilo. of sugar, and 400 grams of the sulphite, together with ammonium sulphate, sodium phosphate and potassium salts, is completely fermented in a few days by 100 grams of yeast.

The process was worked by the Protol Company, and as many as 63 factories were at first pressed into the service, although only the few largest were finally retained, the monthly output of glycerin being about 1000 tons. Very serious practical and administrative difficulties were encountered at the outset, but these were ultimately overcome, and it was found possible to obtain 20 parts of purified glycerin, 27 parts of alcohol, and 3 parts of aldehyde from 100 parts of sugar. After removal of the yeast by filtration and of the alcohol and aldehyde by distillation, the bulk of the salts present are precipitated by calcium chloride and then by sodium carbonate, the liquid being afterwards neutralised with hydrochloric acid and filtered from the sludge formed; concentration and subsequent distillation yield a glycerin suitable for all technical purposes. As is the case with soapworks glycerin, the distillation of fermentation glycerin is sometimes complicated by the presence of trimethyleneglycol.

Neither the race of yeast, nor the nature of the sugar, nor the temperature prevailing during fermentation influences the yield of glycerin; raw sugar or even molasses is utilisable. At the termination of the fermentation the yeast exhibits certain changes in its morphological character, but still retains its fermentative capabilities; the worts used are, however, fatal to lactic and acetic bacteria.

With increase in the amount of sodium sulphite employed, the proportions of glycerol and aldehyde produced gradually increase, whilst those of alcohol and carbon dioxide continuously diminish; this is illustrated by the following experimental figures:

Sulphite employed	25	50	100
Glycerin formed ..	11.3	19.6	27.1
Alcohol ,, ...	40	28.7	23 3
Aldehyde ,, ...	2·4	5·8	8.6
Carbon dioxide ,, ...	37.6	35.8	29.4

No information is available as to the cost of fermentation glycerin, and its economic manufacture in normal times would naturally depend on such questions as prices, supply of fats, etc. (See also this J., 1919, 175B, 230B.)

NEWS FROM THE SECTIONS.

CANADA.

The Ottawa Branch of the Canadian Section has recently drawn the attention of the Dominion Government to the extremely unsatisfactory nature of the proposed classification of chemists in the Civil Service now before Parliament; and at a meeting held on June 20 in Ottawa, which was attended by every chemical branch of the Civil Service, it was decided to prepare and present to the Government a statement in support of the above contention, pointing out the dangers attendant upon and the need for revising the suggested classification.

This statement has now been drawn up. It includes a table containing a number of cases where the chemical profession has been discriminated against in comparison with other professions, and it points out that such discrimination not only affects Civil Servants, but tends to set a low standard for the whole country by discouraging the best men from entering the profession, thus militating against the advancement of Canadian chemical industry in competition with other countries. A second table sets out anomalies in the classification within the chemical service, and the opinion is expressed that no measure of revision would make the classification satisfactory. Hence an entirely new scheme of classification was found to be necessary, and this has been drawn up and submitted for consideration. In each of the classes specified the duties, the qualifications and the rates of remuneration are set out. (*a*) Laboratory Assistants must possess a primary school education, and their salary scale should be £180, rising to £300 per annum. (*b*) Junior Chemists should have had a training equal to that obtained by a University graduate, with special training in chemistry; salary scale £370 to £420. (*c*) Assistant Chemists should have the same qualifications as (*b*) with the addition of three years' specialisation in advanced chemical practice; salary scale £450 to £540. (*d*) Associate Chemists should have the further qualifications of 5 years' experience as assistant chemist, familiarity with chemical literature, and ability to supervise and carry out original investigations; salary scale £550 to £650. (*e*) Chemists, who must also possess administrative ability; salary scale £660 to £840. (*f*) Chief Chemists, who should be able to direct and control a division of chemical work under the administrative head of a Department; salary scale £720 to £1000.

CHEMICAL ENGINEERING GROUP.

The first report traces the history of the group from the preliminary meeting in July 1918 down to the end of April last. The members of the provisional committee were elected to the first committee of the group in March 1919, and four new members and honorary correspondents from eight Local Sections were subsequently added. Sub-committees have been appointed to deal with finance, information bureau, standardisation of materials and fittings, and chemical engineering data sheets. The Rules, adopted at the inaugural meeting in March, were formally approved by the Council on April 30. The Council Sub-committee has recommended that the group be given direct representation on the Council, provided this would not conflict with the terms of the Charter. The number of members enrolled up to April 30 was 465, distributed as follows:—London 172, Manchester 46, Yorkshire 44, Glasgow 31, Liverpool 29, Bristol 24, Birmingham 19, Newcastle 17, Nottingham 13, Ireland 8, United States 6, India 6, S. Africa 4, Australia 3, Edinburgh 3, other countries, etc., 40.

PATENTS IN RELATION TO INDUSTRY.

At the invitation of the British Science Guild some couple of hundred of those interested in patents for inventions attended a conference at the Central Hall, Westminster, on July 31, to discuss this subject under the chairmanship of Lord Moulton. Little, however, was heard of the relationship in question, those who spoke being chiefly representatives of the several professional bodies who have lately been making representations to the Board of Trade on the subject of patent law reform.

Sir Robert Hadfield stated that the Federation of British Industries had that morning agreed to press the following views:—A longer term for the patent; access of the public to the file of correspondence between the examiner and the applicant which precedes the grant of the patent; an expert judge for trying patent actions; two years for prosecuting a patent application; dating the patent as of the day of issue; 50 per cent. reduction of fees. Several of these points are more or less conceded in the Bill now before Parliament, but Sir Robert did not say whether the concessions are satisfactory. He stated that the subject of an Empire patent is not to be pressed at present.

Mr. Walter F. Reid pointed out that in neglecting inventors the State was disregarding one of its most valuable assets. The poor inventor did not have sufficient opportunity; he was taxed at the time when all his resources were needed for the development of his invention. Cheap protection was the key to progress.

Mr. Hunter Gray followed on the side of the inventor. It was lamentable that the debate on the second reading of the Patent Bill in the House of Commons within the past few days should have been occupied almost solely with a discussion of the attempt of a certain Trust to capture an industry, without a word being said as to the deserts of inventors or the benefit of inventions. He advocated the appointment of a committee by the Government to take evidence from all parties interested, for the purpose of evolving a live Patent Law.

Mr. Douglas Leechman objected strongly to the scheme of "licences of right" which had been transferred to the new Bill from the old almost without alteration. The interest of industry should be the first consideration of patent law. The main burden of his song, however, was a moratorium for patents; extension of the term by two years was quite insufficient. He computed that 100,000 patents were in force on August 4, 1914; let them all have another five years' life on application made by the patentee. To say that some of them had been worked during the war so that it would not be fair to give them a further term, was absurd.

Mr. W. M. Morley supported Mr. Reid in his demand for a cheaper patent. The £100 spread over 14 years was a tax which the inventor ought not to be called upon to bear. The United States Patent cost £7 for 17 years. With Sir Robert Hadfield he would reduce the cost of the British patent by one-half. He approved the system of annual taxation after the first four years and would not like our Patent Office to be choked, as was that of the United States, with the corpses of patents alive in theory but dead in fact. He made out that of the average £300,000 per annum income of the Patent Office £173,000 was due to renewal fees, and if these were halved the £120,000 annual surplus would sink to £30,000, which he deemed sufficient.

Mr. James Swinburne lamented public indifference to this question, which had fifty times the importance of the Irish question. He would like to see the surplus of the Patent Office income and more swallowed up in the maintenance in each important town of a technical library as good as that at the Patent Office.

Sir G. Croydon Marks was primed with a piece of information which appeared to surprise some of the previous speakers. It was that the initial £5 paid for a patent will in future keep it in force for six years instead of four. This, he claimed, would make the British patent the cheapest in the world. He lauded the new Bill and urged that it should be thoroughly examined before Committee stage was reached at the end of October. He admitted that he would have liked the Bill to have contained a more generous treatment of war-bound patents.

Lord Moulton expressed surprise that so little had been said on the subject under debate. The apparent ill-success which had met, according to the speakers, the attempts of deputations to convince the Board of Trade of need for the advocated reforms, he attributed to the point of view of the deputations not being that of public interest. They must convince the public that Patent Law is in the interest of the public. It was well known that 50 per cent. of the patents granted was mere rubbish and had better be swept away. Indeed the worthless patent was a restraint on invention. This accumulation of rubbish made the public suspicious of patents. The system of renewal fees was good as having a certain purgative effect. Dealing with the legal definition of "inventor" he regretted that a party to whom the invention was communicated from abroad could be the patentee. A patent must not have too long a term, it must be at the public disposal at an early period, for the public would insist that patents must help trade, and not strangle it.

CORRESPONDENCE.

CHEMICAL COMPENDIA AND ABSTRACTS.

Sir,—In your last issue (p. 259 R) you kindly offered to place your correspondence column at the disposal of those who had opinions to bring forward on the now much-discussed question of English, or better still, Anglo-French chemical compendia. Answering Dr. Wynne's remarks at the Conference on the Inter-allied Chemical Federation—must we really again copy the Germans, and must we have an English Beilstein or Richter? Not if we can do better. And better will be the always-up-to-date lexicon, in the form of an adaptation of the well-known card-index system, as suggested to me about six years ago by a French chemist, Dr. R. Padova, of Marseilles.

A card index is indeed eminently suitable both for an organic and for an inorganic lexicon. Subscribers all over the world would receive every month new cards to keep it up to date by the insertion of new compounds or new cards to replace old ones, when the information conveyed by them had become obsolete. No new edition would be needed, but a standing committee of the Inter-allied Chemical Federation would be constantly revising the work, sending out new cards or simply gummed slips for correction purposes. An hour monthly is the maximum amount of time each librarian would have to spend to keep the index up to date. Such a work would be invaluable for research, as the student could always be sure to find even the latest information. The only objection to this scheme is that it would require a special piece of furniture in each library; a trifle for a reference compendium, and if the cards would take up more room than an edition of Richter, they would occupy less than two editions or more.

The cards could be printed in English, French, Italian, and even German, the chemical formulae used for the classification being international; and the method could be used for an index of literature, giving only the chemical and physical properties of the compounds, where and when described, etc., and also for a more readable compendium of literature selected by the most eminent Inter-allied chemists and according to the latest accepted opinions. There would also be room for a compendium of patent literature made on similar lines, for organic and inorganic chemistry, which, if classified by subjects and properly commented upon, should prove a more valuable work even than Friedländer.

—I am, Sir, etc.,

August 5, 1919. J. J. Bloch.

Sir,—The necessity for complete compendia of the Beilstein type and of sets of abstracts for rapid reference is obvious to anyone who has been engaged on any kind of chemical investigation. The question resolves itself into (1) the nature of the references, (2) the most economical method of production, and (3) deciding on the languages in which the references should appear.

In my opinion the original papers and consequently complete sets of journals cannot be dispensed with. It is a misfortune that they are so numerous and so costly; but I cannot agree with Sir W. Pope's suggestion, if I understand it rightly, that an "Alembic Club" selection should be made of the more valuable contributions to replace them. Who is to judge of the value of a paper, for one that appears worthless to one reader may contain the germ of an important idea to another? It is only through the perspective of Time that the intrinsic worth of papers can be judged and a selection made.

Granted then that all original papers are available, there is no more rapid method of reference than through a Beilstein's Handbook and Richter's Lexikon, and these should be compiled for both organic and inorganic chemistry and possibly for other branches of the science as necessity arises.

The arrangement of Beilstein and Richter so far as organic chemistry is concerned could not, I think, be improved upon. Conciseness makes for clearness, ease of reference and economy. The work could be done in co-operation, say through representatives of the participating countries acting as editors with their staffs of assistants working under one roof.

The building might be the one projected for a central library and reading room.

In regard to abstracts, the most economical method of dealing with them would be for contributors of papers to the Inter-allied Journals to be obliged to furnish their own abstracts, which, together with other abstracts, should be edited and published from the central bureau at stated intervals after the manner of the Zentralblatt.

This Zentralblatt would, like its German prototype, contain abstracts of every paper, including patent literature. The patent literature might be classified and republished *in extenso* in the form of Friedländer publications, not only for one, but possibly for different industries.

The question of language would, I think, be fully met by Sir W. Pope's suggestion of limiting publication to French and English. Every educated person of any nation can read one or other or both languages, and the cost would be greatly reduced by not extending the number.

Prof. Wynne's suggestion that the Allied Govern-

ments might contribute substantially to the cost of these publications as a graceful acknowledgment of the gratuitous services rendered by the chemists of the Allied countries is one deserving of serious consideration.—I am, Sir, etc.,

August 7, 1919. J. B. COHEN.

NEWS AND NOTES.

AUSTRALIA.

Queensland Mining Industry in 1918.—The annual report of the Under-Secretary for Mines states that the value of the mineral output for 1918 was £3,740,925, or £272,052 less than in 1917, a decrease chiefly due to the drop of the gold yield from £567,371 to £194,268. Older goldfields such as the Charters Towers persist in their decline but fair development results were obtained in Clark's Gold Mines. Mount Morgan sent 232,592 tons of siliceous ore to the concentrating plant and produced £335,431 worth of gold from 115,715 tons of copper ore, besides 6638 tons of copper—now its chief product. Throughout the Commonwealth copper fetched an average price of £110 per ton. The most important copper-producing centre, Cloncurry, gave an increased yield of 1814 tons over 1917, notwithstanding labour troubles, and contributed 12,003 to the total 18,979 tons of copper produced by the State. In the Herberton district the development of the Empress and Rio Tinto mines is proceeding.

At the height of the market in 1918 record prices of £280 16*s.* and £276 per ton were secured for tin concentrates with metallic contents of 71 and 73 per cent. respectively, but in December only £140 was offered for concentrates of 70 per cent. and over. Stimulated by the high prices the output of lode tin in the Herberton district substantially exceeded that of 1917.

The State produced 983,193 tons of coal of an average value at the pit's mouth of 11*s.* 7·7*d.* per ton, or 2·96*d.* more than in 1917; a lessened demand and the enforced stoppage of one of the collieries accounting for the decrease in output of 65,280 tons. A revival towards the end of the year improves the outlook for coal in 1918, but not for coke of which three-quarters of the quantity required in Queensland for smelting is supplied from New South Wales.

Investigations have been made during the year into deposits of marble, salt, terra-cotta, clays, pigments, and manganese, and an extensive area of coal of good quality has been proved. Numerous minerals have been examined in connexion with the proposed State iron-smelting works, and the Jibbinbar deposits near Stanthorpe have been selected for a State arsenic mine.—(*Bd. of Trade J., July* 3, 1919.)

SOUTH AFRICA.

The Alcohol Industry in Natal.—The production of spirits in Natal increased from 1,004,310 galls. in 1917 to 1,934,040 galls. in 1918, owing to the increased demand by the Imperial Government and the production of motor fuel. During August—December, 1918, vinegar makers purchased 4791 galls. of Natal spirits for conversion into vinegar. Exports during 1918 were 1,009,957 galls., against 432,665 galls. in 1917. The countries importing this spirit in increased quantities were: Argentina, Australia, East Africa and Madagascar.

The newly-established Union motor fuel industry at Durban consumed 476,939 galls. of spirits in 1918. The motor-fuel factory started operations in February, 1918, and by the end of the year had manufactured 255,158 galls., of which 4319 galls. was exported. All the ether manufactured by the firm was used for motor spirit, with the exception of 1300 galls. sold to chemists for anæsthetic purposes, and 1950 galls. exported.

The fuel industry is handicapped by the present high cost of denaturants abroad, and by the import duties of 20 per cent. *ad valorem* on pyridine and wood naphtha, which are used solely for manufacturing purposes. Unless the cost of these denaturants substantially decreases with the expected fall in the price of petrol, the future outlook in regard to the manufacture of Natallte is unpromising. The fact that it takes 5 galls. of 96 per cent. alcohol to manufacture 4 galls. of ether may lead to the consideration as to whether a new fuel containing less ether can be manufactured instead of Natalite (this J., 1918, 95 B, 177 B).

The quantity of industrial spirit used under rebate of duty down to 2*s.* per gallon in the manufacture of medicinal and toilet preparations, perfumery and flavouring essences, increased from 64,114 galls. in 1916 to 83,980 galls. in 1918.—(*Bd. of Trade J., July* 24, 1919.)

UNITED STATES.

Autumn Meeting of the American Chemical Society.—The 58th meeting of the American Chemical Society will be held in Philadelphia from September 2—6 inclusive. The membership of the Society has increased nearly twofold since 1914, and is now 13,600.

The sessions, which are to be held at the Bellevue-Stratford, will relate to problems of reconstruction growing out of developments which placed the American chemist so much on his own resources both for materials and apparatus with the closing of foreign markets. One of the features of the meeting will be the first session of the newly organised dye section. There will be a joint session of this section with the Division of Industrial Chemists and Industrial Engineers to consider a proposal to revise the patent law. It has been suggested that the charging of a nominal annual renewal fee would compel many patentees to work their patents, rather than to permit them to be idle for many years.

Special arrangements have been made to give to all delegates access to the chemical plants of Philadelphia, including the munition works on the Delaware River. The conversion of such establishments to the ways of peaceful industry will come up in various aspects before divisions of the Society.

The provisional programme is as follows:—September 2: Council meeting and dinner to Council by invitation of the Philadelphia Section. September 3: General meeting, with addresses by Mr. Newton D. Baker, Secretary of War, and others. September 4: Divisional meetings and President's address, by Dr. W. H. Nichols, at the Museum of the University of Pennsylvania. September 5: Divisional meetings and banquet in the evening at the Bellevue-Stratford. September 6: Excursions and automobile trip to Valley Forge.

Use of Lead Oleate in Rubber Manufacture.—In a certain rubber works an employee, trained in a linoleum factory, decided to use lead oleate to overcome stickiness just as he would if he were making linoleum or oilcloth. The result was very satisfactory and now one company contemplates using a million pounds of the oleate during the next twelve months.

Alcohol.—A bill has been introduced into Congress for the purpose of relieving distillers of industrial alcohol of the restrictions which have made production costs so high. Alcohol distilleries will be licensed and bonded under an approved plan and denatured alcohol sold tax free for domestic and foreign use. Alcohol without denaturants may be withdrawn tax free for the use of University and research laboratories and for hospitals

conducted without profit. It is intended that there shall be an ample supply of suitable alcohol for the development of dyes, pharmaceuticals, new fuels and for scientific work generally.

Electric Furnaces.—At the meeting of the American Institute of Chemical Engineers, held at Boston in June, most of the programme was devoted to a symposium on electric furnaces, with special reference to their use with brass. Five types came in for discussion, namely, the direct arc type, the vertical ring induction furnace, the granular resistor, reflected heat type, the stationary indirect arc and the indirect arc type with stirring of the melt. Elaborate data as to the performance of these electric brass furnaces were produced, and records with brasses of different composition submitted. Four years ago there were no electric brass furnaces in commercial operation, while to-day more than one hundred are either in use or being installed by some forty firms. The capacity of these furnaces ranges from 300 lb. to one ton.

By-product Coke-ovens Fired with Producer Gas.—A new coke plant has recently been put into operation at the Providence Gas-Light Company's works at Providence, R.I., where the ovens, 40 in number, are fired with producer gas in order to release the entire output of gas for other purposes. By this means a yield of more than 11,000 cub. ft. of coal gas per ton of coal carbonised is secured. The installation is interesting as suggesting to the iron and steel industry the substitution of blast-furnace gas for coke-oven gas in heating the coke ovens. Such a change would release the whole output of oven-gas for use in heating furnaces, soaking pits, and open-hearth furnaces. The Providence plant has demonstrated that as low a coking time can be secured with producer gas as with coke-oven gas.—(*Iron Age*, *May* 22, 1919.)

JAPAN.

The Future of the Wood Pulp Industry.—The production of wood pulp has increased very greatly since the wood from Karafuto (Saghalin Island) has been used in Japanese paper mills. In the first year, 1915, the output of pulp from this source was 4676 tons; in 1917 it reached 38,448 tons. The Government Forest Bureau has recently given the following estimates of wood pulp production in the immediate future (tons):—Saghalin, 143,500; Hokkaido, 151,042; Hondo (Central Japan), 102,522; Chusan (Korea), 15,000. Total, 412,046 tons. The following table gives more detailed information:—

District.	Species.	Present output. Tons.	Future production. Tons.
Saghalin	Sulphite pulp	38,448	143,500
Hokkaido	Sulphite ,,	22,048	47,115
	Ground ,,	48,777	103,909
Hondo	Sulphite ,,	19,037	20,623
	Ground ,,	40,729	81,999
Chusan (Korea)	Sulphite ,,	—	15,000
Total	Sulphite ,,	79,533	226,238
	Ground ,,	89,506	185,808
	Grand total ..	169,039	412,046

No mechanical pulp, soda or sulphate pulp are produced in Japan.

The war has had a profound effect on the paper industry, and exports have increased enormously. In 1917, 66,095,952 kin of paper, valued at 16,095,316 yen, was exported; in the same year 8,336,655 lb. of wood pulp, valued at 875,492 yen, was shipped abroad. On the other hand, the home demand for pulp—chiefly for use in Japanese hand-made paper—has increased but very little. The total domestic consumption of pulp in 1917 was 181,436 tons. Deducting this figure from the total estimated production in the near future, there results a probable surplus of 230,610 tons. There should be no difficulty in marketing this surplus, but at the moment the home paper market continues to droop. The continual arrivals of American paper, bought by Japanese importers before the armistice, is also disturbing the market. American newsprint is quoted at 8 yen per ream, and imported art paper at 29 yen per 100 lb.; the price of Japanese newsprint is 7·80 yen per ream, and printing paper even higher. Prices are expected to decline still further in view of the American shipments and the increasing home production. (Kin=1·33 lb., yen=2*s*. 0½*d*.)

GENERAL.

Patents and the Peace Treaty.—The Council of the Institute of Patent Agents draws attention to Articles 306—311 of the Peace Treaty, which allow extensions of time for the maintenance or obtaining of such patents, designs, trade marks, etc., in enemy and in Allied countries, which should have been accomplished during the war (see this J., 1919, 269 R).

The Institute of Chemistry.—At a meeting of Council held on July 25 a letter was read from the Department of Scientific and Industrial Research stating that the researches undertaken by the Vitreous Compounds Research Committee had now been transferred to the British Scientific Instruments Association. The Nominations and Examinations Committee reported the admission of 18 students and the election of 57 Associates, 5 Associates to Fellowships, and 17 Fellows. This Committee was empowered to accept applications from candidates for an examination in Biological Chemistry to be held in October next. On the recommendation of the Institutions Committee, the Hartley University College, Southampton, and the Sir John Cass Technical Institute were added to the list of recognised institutions. Sir William Tilden and Mr. A. Chaston Chapman were nominated to serve on the Consultative Council on Medical and Allied Services of the Ministry of Health. It was decided that the Proceedings of the Institute be issued six times in 1920, and that the tariff for advertisements be increased by 50 per cent. in view of the corresponding increase in circulation. It was also agreed to consider the advisability of adding a branch of agricultural chemistry and microbiology to the branches of examination for the associateship.

The British Photographic Research Association.—A report by the director of research, Dr. R. E. Slade, states that a wide programme of research has been drawn up and preliminary experiments have been made on a large number of the subjects mentioned in the programme (this J., 1919, 165 R). The history of photographic science and industrial development shows that, since the publication in 1891 of the researches of Hurter and Driffield, practically no new methods of attacking the problems of photography have been introduced. Many workers have improved and worked out further details of the old-established methods, and very considerable advances have been made, but the time now seems ripe for entirely new methods of photographic research. The Association is using all the means at its disposal to initiate such new methods, and is making progress in this direction.

Some experiments have been made on gelatin, which though not suitable for publication will be of great use in future work. Progress has been made in investigation of photographic emulsions and a communication on this subject will be available shortly. Success has been attained in staining wood black or grey right through. This black wood, which was made in Germany before the war,

is used by manufacturers of cameras and optical instruments, and the grey wood is used for picture frames and furniture. The process, for which an application for a patent has been filed, should be quite suitable for use on a large scale and quite economical. Two communications from the laboratory have already been published ("Contrast and Exposure in X-rays Photographs Through Screens," by R. E. Slade, and "The Fundamental Law for the True Photographic Rendering of Contrast," by A. W. Porter and R. E. Slade) and it is intended to publish without delay any results of research which are of general interest and not of immediate use for application to specific problems of the photographic industry.

Revised Atomic Weights.—The report of the International Committee on Atomic Weights for 1919–1920, the first regular report since 1916, is given in the July issue of the *Journal of the Chemical Society*. It records the results of comparatively recent work on the atomic weights of hydrogen, carbon, bromine, boron, fluorine, gallium, zirconium, tin, tellurium, yttrium, samarium, dysprosium, erbium, thorium, uranium, helium and argon. The only changes recommended for adoption are:—Argon 39·9, boron 10·9, gallium 70·1, thorium 232·15, and yttrium 89·33. It is further proposed that the figure hitherto adopted for nitrogen, 14·01, should be altered to 14·008, which is probably correct to within ± ·001.

A New Process of Carbonising Coal at a Low Temperature.—In a letter appearing in the *Times* of July 29, Lieut.-Col. H. Clarke directs attention to the Summers system of low temperature carbonisation of coking coals. He remarks that a process for the low temperature carbonisation of non-coking coals, with by-product recovery, is in successful operation in the United States. Recently, in conjunction with Dr. H. G. Colman, he has made a thorough investigation into the operation of a continuous horizontal coke oven whereby coking coal, rich in volatile constituents, is subjected to low temperature carbonisation, resulting in the production of fuel possessing a hard, dense and uniform structure. The basic principle of the oven is its continuous operation, brought about by the action of a reciprocating floor, which by its movement longitudinally in the oven automatically discharges the coke from one end and draws the coal from the bunker at the other. Owing to the pressure set up within the oven by the action of the floor, a heavy compression of the plastic coal takes place, the resulting coke possessing the before-mentioned qualities, which render the coke sufficiently hard to withstand without breakage its subsequent subjection to the process of screening, and to meet the requirements of transportation. The coke produced by other systems of low temperature carbonisation is soft and friable in character. Amongst other features of the continuous process are, the more rapid carbonisation than is the case in any intermittent process, the low labour charges incidental thereto and the high yield of by-products, more especially of light hydrocarbons suitable for motor spirit, and of heavy fuel oils. The oven is patented in Great Britain by L. L. Summers, and a plant for demonstration purposes is being erected in the United Kingdom.

Drugs During the War.—The National Health Insurance Commission (England) has recently issued a memorandum (Cmd. 183, 2*d*.) on the special measures taken by it in relation to the supply of drugs and other medical stores during the war. The former dependence of the British drug industry on imported chemicals and the alarming shortage experienced during the early days of the war are now matters of common knowledge, but the memorandum constitutes a useful summary and an ever-necessary reminder of the essential facts of that deplorable situation. It is interesting to note that 40 University and College laboratories which undertook the preparation of novocain and beta-eucaine succeeded in producing 350 lb. (7,000,000 doses) and 216 lb. (3,000,000 doses), respectively, of these local anæsthetics. At the present time, it is stated, there is hardly any medicinal chemical of importance which is not being made on a large scale in this country, and the following list is given of substances in which Germany formerly possessed a monopoly but which are now produced commercially in the United Kingdom:—Acetylsalicylic acid, salicylic acid, sodium salicylate, methyl salicylate, salol, medicinal liquid paraffin, potassium permanganate, thymol, phenacetin, novocain, eucaine, salvarsan, neo-salvarsan, paraldehyde, resorcin and lanolin.

The Royal Ordnance Factories, Woolwich.—The final report of the Committee of Inquiry on Woolwich Arsenal has recently been published, together with the first, second, and third interim reports, in the form of a White Paper (Cmd. 229, 3*d*.). The Committee reiterates its opinion that the administration of the Arsenal is in need of thorough re-organisation and the appointment of a board of management, together with reforms in the system of costing. In the first interim report (Nov. 6, 1918), the Committee recorded its opinion that "the present storage of explosives at Woolwich constitutes in a high degree a real and grave source of public danger." Over 10,000 tons of explosives was accumulated within an area of 1284 acres, and very large quantities of high explosives and cordite were stored in unprotected brick buildings with slate or corrugated iron roofs, under 10 per cent. of the buildings complying with the Home Office regulations. The second interim report (Nov. 22, 1918) recorded the finding of the Committee that Woolwich Arsenal should be retained as a Government arsenal for munition manufacture in peace-time, together with a dissenting report by Lord Marchamley who adduced strong arguments in favour of removing it elsewhere.

The Sugar Industry in Java.—Much capital has in recent years been invested in rubber plantations in Java, so that the cane industry has perhaps hardly developed to the extent anticipated. Still, the industry has certainly expanded considerably, especially when it is remembered that only a small proportion of the exceptionally fertile soil is under cultivation for cane. The total production of 218,000 tons in 1880 had advanced to 710,000 tons in 1900, and in 1918 it had reached 1,791,000 tons manufactured in 186 factories. This growth must be ascribed not only to the naturally favourable conditions and good cheap labour, but also to the scientific assistance given by excellently trained technical experts, who by introducing economic methods of extraction have increased the yield to such an extent that in 1918 it was no less than 4·36 tons of first quality sugar per acre. Since the home consumption is small most of the sugar is exported. The acreage under cane cultivation has been considerably reduced for the 1919 season.

Superphosphate Industry in Holland.—The shareholders of the Zeeuwsche Cooperatieve Kunstmestfabriek have resolved to build a superphosphate factory at a cost of about 1½ million gulden (£125,000).—(*Z. angew. Chem., June* 6, 1919.)

Phosphatic Deposits in Holland.—Scarcity of phosphatic fertilisers during the war led to searches being made at home. Deposits containing 25—30 per cent. of phosphate were found in the provinces of Drenthe and Overyssel, in north-eastern Holland. A large factory has been erected to wash and pulverise the mineral, and production was promised this spring.—(*U.S. Com. Rep., May* 12, 1919.)

British Zinc Ore for Belgium.—The Belgium Union of Zinc Smelters (Zinkhüttenverband) has entered into an agreement with English producers to obtain from them 100,000 to 150,000 tons of zinc ore during the next five years. Before the war Belgium imported 480,000 tons of zinc ore, from which 200,000 tons of zinc was produced.—(*Rotterdamsche Courant, June* 11, 1919; *Z. angew. Chem., July* 8, 1919.)

Sulphur Production in Italy.—American sulphur has not only expelled the Italian product from the American markets, but is competing now in those of Europe. The legal regulations designed for the protection of the sulphur industry have to a great extent failed in their purpose. The fall in output is shown in the following table:—

Production of Sulphur (metric tons).

Year	Crude	Refined	Ground
1910	430,360	169,093	171,570
1914	337,843	149,100	165,362
1915	358,107	116,358	140,414
1916	269,374	50,900	12,200
1917	211,847	71,585	44,320

(*La Finanza Ital.*; *Z. angew. Chem., June* 20, 1919.)

Phosphate Production in Tunis.—The output of the Phosphates de Gafsa Company fell last year to 572,696 metric tons (150,938 tons less than in 1917) in consequence of the lack of native labourers, whose number fell from 4550 in July 1914 to 1860 at the end of 1918. Exports, which have been facilitated by the increased tonnage arranged for by the Allied Governments, rose, however, by 245,761 tons to 720,193 tons, and a still larger export, involving further depletion of stocks, is expected for 1919.—(*Z. angew. Chem., June* 20, 1919.)

Nigerian Indigo.—The last issue of the *Bulletin of the Imperial Institute* (Vol. 17, No. 1) contains an account of experiments made on the native indigo plant of West Africa (*Lonchocarpus cyanescens*, Benth.), which is cultivated in plantations extending to several hundred acres in the southern provinces of Nigeria. In its natural state the plant is a climber, reaching a height of 30 ft., but under cultivation it becomes a bush 7 or 8 ft. high, owing to regular cutting. The results of the tests made at the Institute show that the method of treatment usually employed in India yields indigo containing the largest proportion of indigotin, *viz.*, 43·2—56·3 per cent., compared with 60 per cent. from good Bengal indigo. Ammoniacal treatment gave much less indigotin, *viz.*, 31·9—45·0 per cent., but double the amount of indigo paste. The ash content varied from 4·7 to 13·8 per cent. Two of the five samples tested contained no indigotin and the rest were insufficient in quantity to permit of dyeing trials or commercial valuation. The yield of indigo obtained from the leaves of the Nigerian plant was much less than that obtained in India from green plants of *Indigofera* spp.

A New Elmore Process.—The new Elmore process for separating mixed mineral sulphides consists of treating the ore or concentrate with hot strong sulphuric acid, which converts lead sulphide into lead sulphate, but has no substantial effect on zinc sulphide. The sulphate of lead is dissolved by means of hot concentrated brine.—(*Mining Magazine, July* 1919.)

Standardisation of Laboratory Glassware in Germany.—The Verein Deutscher Chemiker has formed a joint committee with manufacturers of glass, porcelain, and scientific instruments to investigate the possibilities of introducing standardisation into the construction of laboratory ware. Eight separate sub-committees have been appointed to deal with different branches of the subject. Attention is directed to the need of standardising laboratory apparatus, both from the point of view of economy in manufacture and the convenience of the user. The present high cost of raw materials, high wages, etc., make co-operation in manufacture imperative. Standardisation would mean fewer moulds for glassware, etc., uniform screw threads, fewer and smaller catalogues, less storage room, apparatus which could be readily interchanged, and, generally, manufacture of fewer items on a larger scale, and therefore at reduced cost.—(*Chem.-Z., June* 5, 1919.)

Development of the Polish Lead, Zinc and Copper Mines.—It is the intention of the French to further the development of important Polish mines, and for this purpose French engineers are at present stationed in the industrial regions of Poland. Lead and copper ores occur in the palæozoic rocks in the region of Kielce, where copper is found in the form of azurite, copper green, malachite, copper pyrites, etc. Lead ores are found over an extended region and occur throughout a great part of the Lysagora range. During the war, the lead mines of Kielce and the copper mines in the region of Miedziana were restarted by order of the Austrian military authorities. The zinc and copper ores occurring in the Trias limestones in the region of Olkusz have for many years been the sources of supply to the zinc smelting works at Bendzin and Dombrowa, and the copper smelting works at Friedrichshütte near Tarnowitz, respectively.—(*Z. angew. Chem., June* 27, 1919.)

French Control at Ludwigshafen.—The Allied authorities at Ludwigshafen demand the recommencement of work at the dye factories under threat of penalties. This has not been possible until now owing to the need of repairs and to insufficient supplies of raw materials. Another obstacle is the control exercised by the French officers and civilians (almost exclusively chemists) which, if continued when the works are restarted, will mean the surrender of all secret processes, for it extends to the taking of photographs and to the eliciting of trade secrets from the workmen. Herr Erzberger has made a strong protest to the Allied authorities against the attempt to exercise constraint on the dye industry and against the procedure adopted by the French.—(*Z. angew. Chem., June* 17, 1919.)

The German Potash Industry.—The position of the German potash industry was reviewed at a general meeting of the A.-G. Deutsche Kaliwerke. It was remarked that the cession of Alsace-Lorraine subjects the industry to keen foreign competition which must be neither overestimated nor undervalued. While France lacks the large organisation necessary for the exploitation of the Alsatian deposits, it must be realised that they are extremely valuable, and that France has the support of her Allies. During the war America has built up a potash industry at considerable cost, and it has been decided that every American purchaser of imported potash must at the same time purchase a corresponding amount of the home product. Competition is also to be anticipated from Spain, and in all probability from other countries. To meet such competition the German potash industry must enter into agreements with foreign purchasers, and the industry must be united in its efforts. The German industry should be capable of producing and marketing 20 million double hundredweights yearly, compared with 12 million before the war. Production must be increased and cheapened in all ways—by scientific investigation, by combination throughout the trade, and various other means. Despite the fact that Germany no longer possesses a monopoly, the outlook in the potash industry is therefore not without hope. A dividend of 7 per cent. was confirmed.—(*Z. angew. Chem., July* 8, 1919.)

PERSONALIA.

Sir William H. Beveridge has been appointed Director of the London School of Economics.

The death is announced of Prof. H. W. Ward, in his 61st year, professor of physics at the Canning College, Lucknow, since 1889.

Prof. A. K. Huntington, who recently resigned the chair of metallurgy at King's College, London, has been granted the title of Emeritus professor.

Dr. E. Knecht has been appointed associate professor in technological chemistry, and Mr. D. J. Wood lecturer in physical chemistry in the faculty of technology at Manchester University.

The Council of Armstrong College, Newcastle-on-Tyne, has appointed Lieut.-Col. Sir Theodore Morison principal of the college in succession to Sir Henry Hadow.

Dr. Samuel Smiles, assistant professor of organic chemistry at University College, London, and co-secretary of the Chemical Society, has been appointed to the new chair of organic chemistry at Armstrong College, Newcastle-on-Tyne.

The chair of chemistry at Queen's University, Belfast, vacant through the death of Prof. E. A. Letts, has been filled by the appointment of Dr. A. W. Stewart, lecturer on physical chemistry in the University of Glasgow.

H.M. the King has been pleased to approve of the appointment of Prof. G. G. Henderson, professor of chemistry in the Royal Technical College, Glasgow, to the Regius chair of chemistry in the University of Glasgow. At the same university, Dr. T. S. Patterson has been appointed to the Gardiner chair of organic chemistry, and Dr. E. P. Catheart, professor of physiology in the London Hospital Medical School, to the Gardiner chair of physiological chemistry.

Mr. Andrew Carnegie died on August 11 at Lenox, Massachusetts, in his eighty-fourth year. He will be remembered by chemists for the part he took in the commercial development of the iron and steel industry of the United States, and for his large benefactions to public libraries and education. The total amount of his benefactions was estimated at over £65,000,000 in 1908.

LEGAL INTELLIGENCE.

LIABILITY FOR DAMAGES DUE TO AN EXPLOSION. *Belvedere Fish Guano Co., Ltd.*, v. *Rainham Chemical Works, Ltd*, *Ind, Coope and Co.* v. *Same.*

On July 24, before Lord Justice Scrutton in the King's Bench Division, the Belvedere Fish Guano Co., Ltd., brought an action against the Rainham Chemical Works, Ltd., for damages to its works arising from an explosion at the latter's factory in September 1916. Defendant company denied liability on the ground that it was acting as an agent for the Ministry of Munitions. Further, there was no danger involved in the manufacture and no evidence to show negligence.

The hearing was continued on July 25 and 28, and on July 30 his Lordship gave judgment. The substance which actually exploded was dinitrophenol which was being used for the manufacture of picric acid by a new process. The substance was by itself comparatively safe and stable, but under the influence of fierce heat it became a powerful explosive. There was no evidence before him as to what was the cause of the fire which broke out, but it may have been due to a workman smoking. Near the dinitrophenol was stored some nitrate of soda, boxes of which would burn fiercely if ignited. The fire originated in the room where these articles were stored, and it was clear that enough was known of the dangerous character of dinitrophenol for the works manager to warn the men to run for their lives, and the explosion followed almost immediately. In his opinion this came under the head of a dangerous trade involving the use of dangerous ingredients. He thought it was being carried on by Messrs. Feltman and Partridge as principals, the defendant company being its agent, and he decided that plaintiffs were entitled to recover against these three defendants.

In the second action by Ind, Coope and Co., a similar judgment was given against the same defendants but in favour of the other defendants on the record.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Alcohol Motor Fuel.

Mr. Bonar Law informed Mr. Manville that the Report on Alcohol Motor Fuel has been referred to the Department of Scientific and Industrial Research, with special reference to Recommendation No. 17 dealing with the suggested permanent organisation for encouraging and developing the production and utilisation of power alcohol within the Empire.—(July 23.)

Nitrogen Products Committee.

Replying to Capt. W. Benn, Mr. Hope stated that the report of this Committee has been received and was under consideration, as also was the question of publication. He was not aware that other countries are already establishing factories and availing themselves of the investigations made by this Committee.—(July 23.)

Patents and Designs Bill.

In the Patents and Designs Bill, 1919, the second reading of which was moved by Sir A. Geddes, it is proposed (in clause 1) that a British patent shall be deemed to have been abused (1) if it is not worked on a commercial scale within four years of the grant; or (2) if the working is hindered by importation from abroad; or (3) if the British demand is not being met; or (4) if the refusal of the patentee to grant licences is prejudicial to trade; or (5) if trade is prejudiced by the conditions imposed by the patentee. If abuse of a patent has been established the comptroller may grant a "licence of right" to applicants desirous of using it. A licensee may call upon the patentee to prevent infringement; if the invention is not being worked on a commercial scale and the patentee does not provide the capital necessary to work it, an exclusive licence may be granted to an applicant who can furnish the capital; if the powers specified prove to be ineffective the patent may be revoked. Clause 2 proposes that any patentee may declare his patent to be a "licence patent" and have it endorsed "licence of right"; and that the terms of such licence should be based upon benefit to the country and encouragement to the inventor. Clause 6 proposes to extend the duration of patents, and of licences under the patents, from 14 to 16 years; and under clause 7 the term of prolongation is not to exceed 5 years, or in exceptional cases 10 years, instead of 7 and 14 years as heretofore. Clause 11 reads:—

"(1) In the case of inventions relating to substances prepared or produced by chemical pro-

cesses or intended for food or medicine, the specification shall not include claims for the substance itself, except when prepared or produced by the special methods or processes of manufacture described and claimed or by their obvious chemical equivalents: Provided that in an action for infringement of a patent where the invention relates to the production of a new substance, any substance of the same chemical composition and constitution shall in the absence of proof to the contrary be deemed to have been produced by the patented process.

"(2) In the case of any patent for an invention intended for or capable of being used for the preparation or production of food or medicine, the comptroller shall, unless he sees good reason to the contrary, grant to any person applying for the same, a licence limited to the use of the invention for the purposes of the preparation or production of food or medicine but not otherwise; and in settling the terms for such licence and fixing the amount of royalty or other consideration payable, the comptroller shall have regard to the desirability of making the food or medicine available to the public at the lowest possible price.

"Any decision of the comptroller under this subsection shall be subject to the appeal of the court."

This section shall apply only to patents applied for after the passing of the Act.

Clause 18 prescribes regulations for the registration of patent agents, who hereafter must be British subjects.

The debate, which was attended by 35 members, was largely devoted to discussing the monopoly possessed by a firm of boot and shoe machinery makers which, it was stated, was controlled by an American company. Sir W. Pearce expressed the opinion that Clause 11 was a great improvement from the point of view of chemical industry. The Bill was read a second time and committed to a Standing Committee.—(July 28.)

The Trade Marks Bill.

In moving the second reading of this Bill, Sir A. Geddes explained that it provided for the registration of two classes of trade marks. Part A will include all existing trade marks and such as may in future be registered under the provisions of the principal Act. Part B is intended to include trade marks which are good property and in common use but which cannot be registered under the principal Act, and also marks removed from Part A under the provisions of the Bill. Registration in Part B shall be *primâ facie* evidence that the owner has the exclusive right to the trade mark, but no relief will be granted to its owner if the defendant establishes to the satisfaction of the Court that he (the defendant) does not deceive. Clause 6 is designed to deal with the abuse of the words "trade mark." In the past the registration of the name of a substance, *e.g.*, a drug, as a trade mark has secured a permanent continuation of the patent protection. To prevent this, it is proposed that if any substance manufactured under a patent be registered as a trade mark by the name or only practicable name for it, all rights to the exclusive use of the mark shall cease when the patent expires or is revoked. The Bill was read a second time.—(July 28.)

Sugar Imports.

The President of the Board of Trade informed Sir A. Fell that the imports of sugar into the United Kingdom in 1918 had been as follows (cwts.):—Refined, 431,027; unrefined: beets 153,836, cane and other sorts (mainly maple sugar) 25,528,146. Total, 26,113,009. Glucose: solid 208,038; liquid 169,583. Invert sugar is recorded as glucose.—(July 28.)

The Peace Treaty.

The Royal Assent was given to the Treaty of Peace Act and to the Anglo-French Treaty (Defence of France) Act.—(July 31.)

Import Restrictions.

Mr. Bridgeman, in answer to Mr. Cautley, said that the Committee appointed to represent the chemical industry to advise the Department of Import Restrictions of the Board of Trade consists of official representatives of that Board and of the Ministry of Health, together with: Mr. T. D. Morson and Mr. R. H. Bewick, of the Association of British Chemical Manufacturers; Mr. W. F. Reid, of the Society of Chemical Industry; Mr. E. White, of the Pharmaceutical Society; Mr. T. E. Lescher, of the Drug Club; and Mr. W. Mann, of the British Chemical Trades Association.—(July 31.)

Peat and Oil in Ireland.

Mr. Macpherson, replying to Sir M. Dockrell, said that the Irish Peat Inquiry Committee appointed by the Fuel Research Board has presented its report, which is now under consideration by the Government. There is no evidence of the existence of natural oil in Ireland in paying quantity.—(Aug. 1.)

Exports.

In reply to a question by Col. Burdon, the President of the Board of Trade specified the countries which are now importing British coal and the chief exports which are being obtained from them, as follows:—

France.—Wines and spirits, silk manufactures, wood, leather, chemical manufactures, fancy goods. *Italy.*—Hemp, silk fabrics, fruits and vegetables. *Spain.*—Iron ore, lead, copper, fruit and vegetables. *Sweden.*—Timber, wood pulp, iron, paper, iron ore. *Norway.*—Wood pulp, timber, paper, fish. *Denmark.*—Eggs, butter, bacon. *Egypt.*—Cotton, cotton seed, onions, eggs. *Algeria.*—Iron ore, zinc ore, vegetable fibres for paper making. *Argentine.*—Grain, meat, hides, butter, linseed, dyeing and tanning materials and extracts.—(Aug. 4.)

Munition Chemists' Salaries.

In reply to Mr. Sitch, Mr. J. Hope said that an increase in salary was refused to the chemists employed at H.M. Factory, Oldbury, because they were at least as well paid as chemists employed at other Government factories, and that it was impossible to discriminate; and in answer to Mr. R. Young, he said that he had no reason to doubt that the memorialists for an increase in salary included at least 100 Associates and Fellows of the Institute of Chemistry; that he fully realised the admirable work done by munition chemists; that the statements made by a Departmental officer to the effect that the question of principle raised in the memorial could not be admitted by the Ministry of Munitions, and that the latter objected to the holding of meetings by the staff to consider such matters, must not be taken to be the considered view of the Ministry.—(Aug. 5.)

British Dyestuffs Corporation.

Sir Philip Magnus asked the President of the Board of Trade if the shares in this company subscribed for by H.M. Government represented new money, or whether they were allocated in consideration of the £1,142,000 loaned by the Government at 4 per cent. to British Dyes Ltd.

Sir A. Geddes replied that the sum advanced to this company had been repaid, and that H.M. Government had subscribed for the shares in the amalgamated company instead.—(Aug. 6.)

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for July 24 and 31.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
British India (Bombay)	Iron and steel, galvanised sheets and tubes, pig lead, zinc slabs, tinplate, copper, brass, tin, aluminium, asbestos	200
Trinidad	Glass, earthenware, tin	204
British Malaya	Iron and steel, pharmaceutical preparations	272*a*
Canada	Galvanised iron, copper, brass and zinc sheets, tinplate, tin oxide, ceramic chemicals	269
New Zealand	Paper, leather	270
South Africa	Asphalt mastic, bituminous paint	209
"	Mining chemicals, dyes, paints, bottles, rubber	272
Belgium	Industrial and pharmaceutical chemicals	212
"	Pharmaceutical products	221
"	Chemicals, scientific instruments	229
"	Chemicals, drugs, mantles, glue, non-ferrous metals	231
"	Chemicals, starch, dextrin, oils, paint, varnish drugs, perfumery, fertilisers, metals, cement, plaster, soap, margarine, ultramarine	*3742, 4107, T & R
Bulgaria	Chemicals	275
"	Metals	278
"	Oils for soap manufacture, caustic soda, bottles, paper	280, 285
"	Gelatin, glue, shellac, varnish, iron wire, tinplate, soap	281
"	Copper sheets	282
"	Caustic soda, glycerin, vaseline, castor oil, palm oil	283
"	Fertilisers, machine oils, sulphur, copper sulphate, iron wire	284
France	Calf, box-calf, kid leathers	287
"	Oils, essences	288
"	Chemicals, dyes, aniline oil	289
France and Colonies	Cottonseed oil	242
Italy	Chemicals, electrical material	291
Netherlands	Non-ferrous metals, tinplate, galvanised sheets	246
Spain	Pharmaceutical products	248
Spain and Morocco	Drugs	249
Switzerland	Chemicals, drugs	252
"	Edible oil, lard, starch	298
"	Chemicals	299
Tripoli	Dyes, pigments, drugs	301
Japan	Chemicals, drugs, dyes, gelatin, glue, paper, rubber, asbestos, tinplate	302
United States	Drugs	260
" "	Chemicals, drugs, dyes	262
Argentina	Aniline dyes	304
Brazil	Cement	265
"	Chemicals, glass, crockery	266
Peru	Chemicals, china, earthenware	268

* Belgian Trade and Reconstruction, Department of Overseas Trade, Regent House, Kingsway, W.C. 2.

TARIFF. CUSTOMS. EXCISE.

Australia.—The import of foreign dyes to the extent of six months' supply will be permitted in cases where the same dye of British manufacture or an effective British substitute is non-existent or produced to an inadequate extent.

British West Indies.—It is proposed to unify the customs laws and duties in the whole of the British West Indies including British Guiana. The minutes of the proceedings of the conference may be inspected at the Department of Overseas Trade.

Canada.—The new rates of customs duty on rolled iron and steel, and cast steel when of greater value than 3½ cts. per lb., are 7½% *ad. val.* under the British Preferential Tariff and 12½% *ad. val.* under the Intermediate and General Tariffs.

China.—Goods shipped from the country of export after August 1 will be subject to the revised tariff.

France and Algeria.—Among the articles the export and re-export of which are again prohibited, except under licence, are condensed milk, margarine, oleaginous fruits and seeds, fixed vegetable oils and fats, soap, and sugar.

The prohibition of importation has been abolished in respect of potash, coal-tar dyes and intermediates, perfumery, etc.

The customs surtaxes have been abolished and a system has been substituted whereby the tariff rates of duty are to be multiplied by a figure known as "co-efficient of increase" which represents the relation which the official valuation of the goods in question made in 1918 bears to that of 1913. The co-efficient varies from 1·1 to 3; certain articles, including some iron alloys, certain chemicals, and optical instruments, are exempt from increase of duty.

Guatemala.—The new customs tariff is set out in the *Bd. of Trade J.* of July 24.

Italy.—Goods exported from the U.K. should be accompanied by a certificate that they are of British origin, as the special arrangement between the U.K. and Italy does not apply to articles shipped from the U.K. which are not the produce or manufacture of the U.K. It is advisable for U.K. exporters to obtain from the Italian importer before despatch of the goods an assurance that the import regulations have been complied with.

Morocco.—The new tariff valuations may be seen at the Department of Overseas Trade.

Netherlands.—The import duties on chloral-hydrate, chloroform, sulphuric ether, acetic ether and collodion have been increased as from May 23.

Portugal.—A surtax of 30 centavos per kilo. has been levied on imports of tin and its alloys, and one of 20 centavos per kilo. on exports of tin ore, as from June 28.

Russia (Northern Territory).—Import licences are again required for goods shipped after July 7.

Sierra Leone.—The revised export duties on palm kernels, palm oil, and kola nuts are: Palm kernels, £1 2*s.* 6*d.* per long ton; palm oil, £2 1*s.* 8*d.* per long ton; kola nuts, 4*s.* 8*d.* per cwt.

Spain.—Recent customs decisions affect cotton-wool, cotton yarn, wool waste, millet, manufactures of rubber and of buffalo skins.

Sweden.—The Government proposes to establish a sugar import monopoly.

United States.—On and after September 1, licences will be issued for the import of pig tin, alloys of tin, tin oxides, type metals, antifriction metals, waste metals, and other metals containing tin, from points other than points of origin and without reference to the date of shipment.

GOVERNMENT ORDERS AND NOTICES.

FOREIGN TRADE.

The Board of Trade has issued a Memorandum (Cmd. 274, 1*d.*) on trading conditions since the raising of the blockade. It is no part of the policy of H.M. Government to discourage British traders from competing in the German market, and it is very desirable that they should at once make every effort to secure a proper footing in Central Europe.

Exports.—Any goods may be sent to Germany without licence except such as are on Lists A and B of Prohibited Exports; export licences for the latter are to be obtained at the Export Licence Department, 1, Queen Anne's Gate Buildings, Westminster, S.W. 1. Goods sent to the occupied Rhineland through Holland need no longer be consigned to the Standard Bank of S. Africa at Rotterdam.

Imports.—Importation of goods from Germany is placed on the same footing as importation from all other foreign countries, but individual licences issued under the Prohibition of Import Proclamations are not available for goods of German origin.

Other transactions.—Other transactions of a commercial or financial nature with firms in Germany are permissible without further licence, provided they do not involve:—(*a*) the payment of money arising out of pre-war transactions; (*b*) the delivery of or dealing with property held in this country for persons in Germany since before the outbreak of war; (*c*) the transfer of securities by or on behalf of a person in Germany; (*d*) the allotment or transfer of securities issued by a company to or for the benefit of a German subject; (*e*) the transfer of any debt or other obligations due to a person in Germany.

The Memorandum also contains regulations and directions concerning trade with the territories formerly included in the Austro-Hungarian Dominions, Turkey and Bulgaria, Norway, Sweden, Denmark, Holland and Switzerland, Poland, Finland, Esthonia, Lettland and Lithuania.

EXPORTS.

Export restrictions.—Rennet powder, rennet extract and other preparations of rennet have been transferred from List A to List C.

Exports to Poland.—The Board of Trade learns from a semi-official source that permission is not required from the Polish Government for the import of printing and lithographic dyes, aniline dyes, borax, raw celluloid, chalk, kaolin, sand, potash, photographic materials, emery and carborundum in powder, graphite crucibles, laboratory and apothecary glassware.

IMPORTS.

Import restrictions.—General licences for formic acid and lithopone have been revoked.

Consolidated List.—A revised consolidated list of import restrictions was issued with the *Board of Trade Journal* of July 31.

Paper.—Rules have been issued by the Paper Imports Registration Department (23, Buckingham Gate, S.W. 1) which are to be observed by applicants for proportionate licences to import foreign paper and board in respect of British purchases.

NEW ORDERS.

The Minister of Munitions has issued the following Orders suspending the pre-existing Orders:—

The Iron Ore Mines, Cumberland and Lancashire (Suspension) Order, 1919. (July 24.)

The Potassium Compounds (Complete Suspension) Order, 1919. (Aug. 1.)

The Glass Control (Consolidated Suspension) Order, 1919. (Aug. 1.)

The Optical Munitions (Suspension) Order, 1919. (Aug. 1.)

REPORT.

REPORT OF THE INTER-DEPARTMENTAL COMMITTEE ON THE EMPLOYMENT OF GAS AS A SOURCE OF POWER, ESPECIALLY IN MOTOR VEHICLES, IN SUBSTITUTION FOR PETROL AND PETROLEUM PRODUCTS. *Petroleum Executive.* [*Cmd.* 263. 1*s.*] (*London: H.M. Stationery Office.*)

An inter-departmental committee was appointed in November 1917 to report upon (1) the employment of gas in substitution for petrol and petroleum spirits as a source of power, especially in motor vehicles, and the manner in which such gas may be supplied, stored, carried and used, with due regard to the safety of the public, and (2) the action, if any, which should be taken by H.M. Government to encourage and safeguard the use of gas for this purpose. After the publication of the interim report last year (this J., 1918, 186 R), an expert subcommittee was set up to investigate questions connected with the commercial use of gas for traction purposes in containers at high pressures, and with portable gas generating plants.

The Committee reports that gas traction is as safe as any other system of mechanical traction, even when flexible containers are used. Semi-rigid containers made of rubber and canvas are unsatisfactory. Metal cylinders composed of high carbon or certain alloy steels may be safely employed for working pressures up to 2250 lb. per sq. in. and their use should be encouraged. The average traction equivalent of 1 gallon of petrol is 250 cub. ft. of ordinary town gas. The total cost of compression into cylinders will vary between 1*s.* 8*d.* and 3*s.* per thousand cub. ft. of free gas, and will involve an average expenditure of 7*d.* per gall. on any petrol replaced. Model regulations for any gas-compressing or cylinder-charging establishments are appended to the report. With regard to admixture and control of the gas and air, the opinion is expressed that the closest approach to uniformity of mixture is secured with a non-variable area for air admission, the volume of air admitted after initial setting being determined by piston-speed. The gas supply should be positively controlled. Under these conditions, the following numbers indicate the relative power yields obtainable, after proper initial adjustment, from a motor vehicle engine unaltered structurally as regards the compression space:—Working on petrol, 100; on town's gas (450 B.Th.U. gross per cub. ft.), 91; on suction producer gas, partly hydrogenated with water gas (210 B.Th.U. gross), 87; on suction producer gas (140 B.Th.U. gross), 82.

The report points out that in the event of an attempt to establish a monopoly of motor spirit, any consumer for traction purposes of not less than 80,000 galls. a year has the commercial alternative, where supplies of town's gas are not available at a moderate price, of making his own gas. Details of a fully automatic system for this purpose are given. The risk of escape of unburnt carbon monoxide from a suction gas producer on a motor vehicle calls for no special precautions except when the vehicle is at rest within a closed structure, with the fire in the producer still burning. The weight of generator and accessories for a 30 b.h.p. engine is about 220 lb. The fuel cost of such generators with coke at 45*s.* per ton or anthracite at 55*s.* per ton is equivalent to petrol at 5.4*d.* per gall., one cwt. of coke or anthracite being on the average equivalent to 5·6 galls. of petrol for road traction purposes. With petrol, an efficiency of 1·33 ton-miles per penny is secured; the corresponding figure for coke employed in a suction gas producer is 7·5 ton-miles per penny. Suction gas, either alone or hydrogenated with water gas, should prove a suitable alternative

fuel for use in internal combustion engines designed primarily to run on alcohol. The use of liquefied hydrogen, methane, carbon monoxide or ethylene for traction purposes is commercially impracticable. Provided calcium carbide is available at a price not exceeding £5 per ton, there are commercial possibilities for the use of acetylene for purposes of enriching suction gas employed for traction purposes. The Committee considers that the employment of naphthalene for a similar purpose should receive attention. A reprint of the interim report accompanies the present report.

TRADE NOTES.

BRITISH.

Gambia.—The principal articles of export from Gambia in 1917 were groundnuts, hides and palm kernels. The groundnut crop was above the average, 74,300 tons, valued at £869,790, being shipped in 1917, as compared with 46,366 tons, valued at £506,098, in 1916. The good prices obtained resulted in an increase in the acreage planted. Of the total crop 56,839 tons, or 76 per cent., went to the United Kingdom and 15,892 tons, or 21 per cent., to France. The export of hides constituted a record, being 101,120 tons, valued at £58,591, as compared with 26,946 tons in 1916 valued at £10,019, and of this the United Kingdom took about 98 per cent. The export of palm kernels decreased from 669 tons, valued at £14,671, in 1916, to 532 tons, valued at £7994, in 1917. With the exception of 4 tons shipped to France, all the kernels went to the United Kingdom. Exports of wax, ivory and rubber from Gambia are now negligible.—(*Col. Rep. Ann. No.* 979, *Feb.* 1919.)

Gilbert and Ellice Islands.—The tonnage and value of the exports of phosphates from the Gilbert and Ellice Islands are given in the following table:—

1913–14	1914–15	1915–16	1916–17	1917–18
203,493 tons	153,366 tons	128,440 tons	95,688 tons	82,845 tons
£305,600	£229,960	£128,440	£95,688	£82,845

Experiments carried out at the Ocean Island Experimental Station have shown that the phosphate deposits which lie below the top soil are not only useless but may be detrimental to cultivation in the crude (fossilised) state.

The exports of copra from the islands show an increase from 4,500 tons in 1913-14, valued at £45,000, to 5,485 tons in 1917-18, valued at £63,465.—(*Col. Rep. Ann. No.* 995, *May*, 1919.)

Bahamas.—The imports into the Bahamas in 1917 were valued at £493,584, made up as follows:—United Kingdom 8·7 per cent., Canada 0·6, British Possessions 5·7, America 84·2, and other countries 0·8 per cent. The exports were valued at £402,477, of which 11·9 per cent. went to the United Kingdom, 72·1 to America, 2·9 to Canada, 10·2 to France, and 2·9 per cent. to other countries.

The unprecedented high prices paid for sisal and its drought-resisting properties have encouraged many farmers to extend its cultivation. Owing to political conditions exports showed a falling off in 1917, but it is expected that the situation will show marked improvement in the near future. In 1917, 7,501,346 lb. of sisal was exported of a value of £181,695, compared with 8,369,245 lb., valued at £114,465, in 1916. Increased cultivation of sisal is reported from many of the islands, including Abaco (225 acres), Andros (400 acres), Biminis, Savannah Sound, James's Cistern, Long Island, Ragged Island (35 acres) and Watlings (100 acres). Sisal is largely used in the islands as a means of exchange.

The output of cane syrup at Abaco was 2,970 galls., valued at £487. Two sugar mills are in operation at Harbour Island which produced about 1,300 galls. of syrup in 1917.

Salt-making was formerly an important industry at Inagua and brought in considerable revenue to the Crown in the form of royalties; in one year three million bushels of salt was exported. It is thought desirable to attract the attention of capital and energy with a view to reopening the trade. There are also salt pans in other islands—Rum Cay, Long Cay, Long Island, Ragged Island and Exuma. —(*Col. Rep. Ann. No.* 978, *Feb.* 1919.)

FOREIGN.

Trade of Foochow (China) in 1918.—H.M. Consul in Foochow reports that lead, tin slabs and tinned plates were the only metallic substances of any value imported into Foochow in 1918, each showing a slight decrease compared with 1917. The total value was £103,000. There was a large increase in the quantity of sugar imported, from 65,028 piculs in 1917 to 110,847 piculs, valued at £182,750 (picul 133·33 lb.). Imports of kerosene oil increased from 1,322,260 galls. in 1917 to 2,026,746 galls., valued at £131,450, a figure still very much below the average. As usual, Japan supplied all the matches (£36,650) and coal (£30,500) obtained from abroad.

The mineral resources of the Province are believed to be considerable, but development has been retarded owing to the disturbed state of the interior. The molybdenum mines alone have been able to continue working, but the output was insignificant. Applications have been made for permission to work several new molybdenum mines, and work has been started on two lead mines, a copper, a coal and a zinc mine, but only by native companies which possess insufficient capital to provide adequate machinery. The iron deposits in the Anchi and Yungchun districts are believed to be very valuable, although no suitable coal is found in the neighbourhood. A Chinese company, with a nominal capital of 5,000,000 dollars, has been formed to work them.

Owing to the war, British trade has naturally lost the position it held five years ago, and Japan has taken full advantage of the opportunity offered, not only to replace British goods but enemy goods also. As it is unlikely that the cost of British goods will return to the old level, some of the trade may be regarded as permanently lost. It is on maintaining and improving the general superiority of their wares that British manufacturers will have to rely in future for the extension of their trade, rather than on any hope of competing in price with Japanese or native goods. The Japanese import trade is being very energetically handled. Local British firms are not prepared to grant the long credits required by the native retailer, the result being advantageous to the Japanese merchants who readily take the risk these credits involve.—(*B. of Trade J., July* 3, 1919.)

The Casein Industry in France.—For some time past France has been the largest producer of casein. The imports and exports during recent years have been as follows:—

	Imports in metric tons				Exports in metric tons			
—	Hard	Raw	Total	Value	Hard	Raw	Total	Value
				£				£
1913	14·5	25·2	39·7	4,131	502	7,706	8,208	378,983
1914	6·0	24·1	30·1	2,417	379	5,598	5,977	278,602
1916	40·1	5·6	45·7	11,731	140	3,936	4,076	309,434
1918	98·5	·5	90·0	33,210	188	1,470	1,658	222,008

The French production of casein not only supplies the home demand but furnishes a surplus for exportation. Recent exports to Germany have been: 1913, 3587 tons, and 1914, 1949 tons. Declared

exports to United States have been: 1915, 1,772,743 lb.; 1916, 2,150,762 lb.; 1917, 1,627,121 lb.; and 1918, 198,424 lb.—(*U.S. Com. Rep., May* 21, 1919.)

Demand for Chemicals in Greece.—Rapid developments in the textile industry have occasioned a great demand for bleaching powder; sodium nitrite and sulphonated castor oil for the production of Turkey red; potassium bichromate and considerable quantities of aniline oil and salts of aniline for making aniline black; sodium sulphide; and of ferrous sulphate for the reduction of indigo. Diamine dyes (Congo red etc.) and sulphur black are also in demand.—(*Z. angew. Chem., June* 17, 1919.)

Increase in the Price of Aniline Dyes in Germany.—Owing to the exceedingly difficult conditions under which chemical manufacture is carried on at present in Germany, the various firms connected with the Interessengemeinschaft have decided upon raising the prices of their chemical products. A still further rise is contemplated as being necessary owing to the stagnation of the dye industry and the mounting costs of raw materials and wages. These increased charges will have the effect of rendering more equal the prices charged for the products in the home and foreign markets. —(*Z. angew. Chem., July* 8, 1919.)

Effect of the Socialisation of the German Potash Industry.—For some years the large Dutch consumers have made payments in advance up to 10 million gulden to the Potash Syndicate for future deliveries. These credits are now withdrawn and will not be renewed by the Dutch consumers who state that they have no confidence in the solvency of a socialised syndicate.—(*Z. angew. Chem., June* 17, 1919.)

French and German Competition in the Potash Industry.—The provisional Potash Exchange at Mülhausen has offered to supply the Rotterdam dealers with 20,000 tons of kainite during 1919. The dealers, however, require a guarantee that the Exchange will supply them with the same quantity at a fixed price during 1920 and 1921, and should this condition not be accepted, they threaten to boycott French kainite and to turn to the German Potash Syndicate.—(*Z. angew. Zeit., July* 8, 1919.)

Quebracho Output for 1919.—The River Plate districts of Argentine and Paraguay form the chief source of the world's output of quebracho extract. The production for 1919 is estimated at about 170,000 tons, of which nearly 90 per cent. is credited to La Forestal Combination. The distribution of the extract is difficult to forecast, and will depend largely on the terms of peace, on freight rates, and the competing prices of chestnut extract.—(*U.S. Com. Rep., June* 7, 1919.)

Exports of Copra, Coconut Oil and Quinine from the Netherland East Indies.—The following figures give the exports from Java and Madura during the last three years, compared with those for 1913.

	Copra. Metric tons.	Quinine.	Coconut Oil. Hectolitres.
1913	79,154	72	660
1916	38,492	114	108,680
1917	24,931	129	277,270
1918	3,493	251	277,770

The marked falling off in the exports of copra was due chiefly to the erection of local factories for extracting the coconut oil from the copra, the decrease taking place in exports to the Netherlands. The large increase in the exports of quinine is attributed to the growing demands of Great Britain and India, the United States and Japan.—(*Bd. of Trade J., July* 8, 1919.)

Economic Possibilities of East Africa.—The possibilities of agricultural development in the province of Mozambique are practically unlimited, as not only tropical but many sub-tropical and temperate crops can be grown. The chief products are sugar, cotton, coconuts, maize, beans and various oilseeds. Sugar cultivation is entirely in the hands of large land-holding companies, some 250,000 acres being under cultivation; the prospects are very hopeful and there is still much scope for future development. The cultivation of cotton is also making progress; it is grown in the Zambesi district by natives under the supervision of the Mozambique Company. The production of copra and sisal is increasing, cattle raising is being established on scientific lines, and there are cold-storage plants at Port Matola. The exploitation of the large forests of timber, mostly hardwood, is hindered by lack of good transport. The chief kinds of wood are cedar and "mucrusse"; the latter is similar to teak and has proved very suitable for railway sleepers, being unattacked by white ants.

Manufacturing industries are only in their infancy; soap, oil, and oilcake are being made, also bricks, tiles, and pottery. Plans are under consideration for starting a tanning industry and for the manufacture of cement, paper, glass, iron and steel. The future development of the province depends largely on transport facilities, and the Government has a project in hand for extending the railways. Lorenzo Marques is rapidly becoming an important port and coaling station. An excellent harbour costing upwards of £500,000 has been built and a large up-to-date coaling plant installed.—(*U.S. Com. Rep., May* 27, 1919.)

COMPANY NEWS.

MOND NICKEL CO., LTD.

Mr. Robert Mond, presiding at the annual general meeting on July 24, gave an account of some of the company's activities during the war period. The Board had placed the whole of the output at the disposal of the Government, and this had been doubled between 1914 and 1917. But for the difficulties met with, the plant for trebling the pre-war output would have been completed. The production of copper-sulphate had been doubled, and a new spraying mixture "Blighty" had been put on the market. The comparatively low prices obtained for the nickel sold to the Government had been offset by the much higher prices at which copper sulphate had been sold in the export markets. The platinum and palladium from the residues of the refining process had helped to supply the enormous war demand for these precious metals. With regard to costs of production, those of mining and treatment in Canada had nearly doubled, the cost of coal had more than doubled, and that of sulphuric acid had increased by 170 per cent.; timber had risen 400 per cent., steel work 180 per cent., bags 190 per cent., and casks 170 per cent. The wages of the process men in South Wales had risen by about 200 per cent., of men on shift work 187 per cent., and of day labourers 142 per cent.

Including the sum of £118,251 brought forward, the amount to the credit of profit and loss for the year ending April 30, 1919, is £422,679 (capital £3,400,000, debentures and interest accrued £899,375). The total distribution on the 7 per cent. preference shares and on the ordinary shares (17½ per cent. free of tax) amounts to £254,600, leaving £168,058 to be carried forward. Stocks on hand, valued at £2,200,741, show a large increase, owing to cessation of the

war demand for nickel, and this, together with the fact that the British and Allied Governments have also accumulated large stocks, has necessitated a temporary reduction of output, both in this country and in Canada.

ELECTRO BLEACH AND BY-PRODUCTS, LTD.

The gross profit for the year 1918, after deducting cost of repairs and standing charges, was £60,750, and the net profit £24,498 (issued capital £180,000). Of the latter sum, debenture interest and sinking fund call for £7,874, £4,000 goes to reserve, 7 per cent. and 12½ per cent. dividends are paid on the preference and ordinary shares respectively, leaving £391 to be carried forward, as against £1,670 brought in. During the year £70,468 was spent on additions to plant, and a loan of £35,890 was contracted from the Ministry of Munitions. The Inland Revenue Department has allowed the appropriation from revenue of £10,000 for deferred repairs

PACIFIC PHOSPHATE CO., LTD.

Owing to lack of tonnage and the prohibition of shipments of phosphate from Ocean Island and Nauru to neutral countries, the company's business has been seriously dislocated during the war. The island of Nauru, which contains the largest phosphate deposit in the Pacific Ocean, is no longer a German possession, having passed under British control. Shipments to Europe have not been possible during the past year, and trade to the Dominions and the Far East has been very restricted; hence the profit has been smaller than in 1917. Half of the sum of £50,000 placed to a "War Contingency Reserve" has been restored to the profit and loss account, and this sum, together with £20,460 brought forward and the net profit for the year of £44,882 (issued capital, £787,500), allows of a dividend for the year of 10 per cent. on the ordinary shares, leaving £13,830 to be carried forward.

BRIMSDOWN LEAD CO., LTD.

Many difficulties were encountered during 1918 owing to circumstances arising out of the war, but since the conclusion of hostilities, the output of white lead and other lead products has materially increased, and at the present time the demand is very great. After allocating £4620 to depreciation, there is a net profit of £5598 which compares with £6118 in 1917 (issued capital £130,925).

The directors have put forward a scheme of reconstruction which should place the company on a dividend-paying basis in the near future. The preference shareholders are asked to take one 7 per cent. non-cumulative preference share of 10*s.* and two ordinary shares of 5*s.* each in exchange for one existing 7 per cent. cumulative preference share of 15*s.* It is anticipated that the proposals will be adopted, a large majority of preference shareholders having signified its assent.

W. J. BUSH AND CO., LTD.

The 22nd annual general meeting was held in London on July 17. Mr. J. M. Bush, who presided, said that the recent increase in the spirit duty up to a total of 51*s.* 6*d.* per proof gallon will put essence manufacturers in this country in a most disadvantageous position as compared with their foreign competitors. As soon as freight facilities are restored British manufacturers are almost certain to find that much of their export trade is lost, and the high prices are also likely to cause a smaller demand in the home market. Especially will this be the case in essences in which ethyl compounds are used, which have to be made with duty-paid spirits and on which no drawback is allowed. For example, ethyl acetate and ethyl butyrate sell in the United States at one-eighth the price they cost to manufacture in this country at the present rate of duty. Obviously, the remedy is to pay drawback on these compounds, and it is difficult to see the point of view of the Government in refusing so reasonable a request. This situation has been pointed out to the Government by the British Essence Manufacturers' Association, and the suggestion put forward that some differentiation of duty should be made between spirit used for potable purposes and that used in other food industries. These representations, however, have so far been in vain. The whole of the company's investments in Russia have been written off without drawing on the reserve fund or reducing dividends. All other foreign branches and subsidiary companies have done well. The gross profit for 1918 is £271,278, and the net profit £65,903 (capital £250,000). The available balance amounts to £90,258, of which £20,000 is put to reserve and £10,000 applied to writing down goodwill. The dividend on the ordinary shares is 20 per cent. for the year.

EVANS, SON, LESCHER, & WEBB, LTD.

At an extraordinary general meeting held in Liverpool on July 16, it was unanimously resolved to increase the capital of the company to £750,000, by the issue of an additional £150,000 in ordinary shares. The chairman, Mr. W. P. Evans, said the new capital was required to increase manufacture and to develop the business at home and abroad. Increased capital was also required in view of the enhanced value of the company's products. Trade had been developing satisfactorily of late, and for the first four months of the current year sales showed an increase of 20 per cent. in value over the corresponding period last year. The new shares will be issued in the autumn.

FORTUNA NITRATE.

Speaking at the annual general meeting held on July 7, the chairman, Mr. H. C. Gibbs, said that two of the company's three oficinas were closed down, but at the third a new process for the treatment of low grade material was being tested. This process would undoubtedly lead to reduction in costs, and during May the experimental plant had produced 45,000 quintals at a cost of 8*s.* 7*d.* per quintal f.o.b. The net earnings for 1918 amounted to £36,406, or 23½ per cent. on the issued capital (£154,000), but in view of the adverse situation only 7½ per cent. had been declared, leaving £32,065 to be carried forward. In 1917 there was a loss of £9928 and no dividend was paid. The production of nitrate in 1918 amounted to 1,207,788 quintals, of which about 415,000 remained unsold; total stocks in Chile awaiting shipment amount to about 1,500,000 tons. The quantity of exploitable nitrate, above 12 per cent. grade, in the company's grounds was estimated at 9,500,000 quintals on December 31 last. In addition there is much material of lower grade, which, it is hoped, but not proved, may be worked at a profit by the new process.

ALIANZA NITRATE.

The report for the year ended December 1918 shows a satisfactory financial position. The trading profit was £467,213 and the output 2,010,798 quintals, equivalent to a profit of about 4*s.* 7*d.* per quintal, compared with 2*s.* 7*d.* in the previous year. The net profit was £363,961. The dividend was maintained at 40 per cent. free of tax, and the carry-forward is more than doubled at £299,889 (capital £500,000). There is a surplus of cash assets over liabilities of £422,755, as against £207,458 a year ago. Unsold stock amounts to 292,943 quintals, and production is being restricted.

SANTA RITA NITRATE.

The gross trading profit, including interest, amounted to £12,881 in 1918, and the net profit £8970, which with £1231 brought in allows of a dividend of 5 per cent., leaving £5201 to be carried forward. The oficina is closed down and manufacture will be suspended until the large stocks in the country have been materially reduced. Extraction of raw material is being continued.

NEW CAPITAL ISSUES.—*Oilfields of England, Ltd.* invites subscriptions for 170,000 ordinary shares of £1 each at par. The authorised capital is £250,000 and the main object of the company is to acquire petroleum rights over oil-bearing lands in England, and to bore for and produce oil on a commercial scale. A licence has been obtained from the Government to bore on the Kelham Estate, Nottinghamshire, where, it is stated, oil has been struck at a depth of 2440 ft. The sinking of wells is now to be undertaken, the site of the first three of which has been sanctioned by the Government.

Van den Berghs, Ltd. invites offers for 1,000,000 seven per cent. "C" cumulative preference shares of £1 each at 21*s.* per share, thereby increasing the capital to £3,675,000. The new shares will rank in front of the £625,000 ordinary shares which have received an average dividend of 22 per cent. during the past five years.

British Window Glass Co., Ltd. has been formed with a capital of £450,000 to acquire certain secret processes and inventions of M. E. Fourcault, of Charleroi, Belgium, to erect works at Queenborough, Kent, and to manufacture window glass. The share capital is divided into £400,000 eight per cent. cumulative participating preference shares of £1, and 1,000,000 ordinary shares of 1*s.* each. The preference shares were offered for subscription at par, and the issue was largely oversubscribed.

Borax Consolidated, Ltd.—The capital of this company has been increased from £2,300,000 to £2,900,000, by the creation of 600,000 new deferred ordinary shares of £1 each, of which 250,000 are now offered at 37*s.* 6*d.* per share. The net profit for 1918 was £423,971 after payment of excess profits duty, and the dividend on the deferred ordinary shares was 15 per cent.

United Glass Bottle Manufacturers, Ltd.—This company has made an issue of 100,000 £1 ordinary shares at 21*s.* and £75,000 first mortgage debenture stock at 95 per cent.

AMALGAMATIONS, ETC.—The Manbre Saccharine Co., Ltd., and the Sugar and Malt Products, Ltd., have agreed to amalgamate and to establish a new company, to be called "Manbre Sugar and Malt, Ltd.," with a capital of £400,000, to take over the assets and business of both.

The directors of the Associated Portland Cement Manufacturers (1900), Ltd., and of the British Portland Cement Manufacturers have agreed to the establishment of a scheme of joint management for the two companies which will permit of substantial economies being effected.

The four English oil companies operating at Baku, Russia—the Baku Russian Petroleum (1909), Bibi Eibat Oil Co., European Oilfields Corporation, and the Russian Petroleum Co.—have united their interests and formed a new company, the Baku Consolidated Oilfields, Ltd., to acquire and exploit oilfields in Baku and elsewhere.

An amalgamation has been effected between British Coalite, Ltd., Coalite, Ltd., and Low Temperature Carbonisation, Ltd.; the new company will bear the title of the last-named, which will acquire a controlling interest in the Barnsley Smokeless Fuel Co. The new capital will be £1,200,000.

REVIEWS.

APPLIED OPTICS. THE COMPUTATION OF OPTICAL SYSTEMS, BEING THE "HANDBUCH DER ANGEWANDTEN OPTIK" OF A. STEINHEIL AND E. VOIT. *Translated and edited by* J. W. FRENCH. *In two volumes. Vol.* 1, *pp. xiii* + 170. *Vol.* 2, *pp.* 207. (*London, Glasgow and Bombay: Blackie and Son, Ltd.* 1918 *and* 1919 *respectively.*) *Price* 12*s.* 6*d. net each volume*

The history of applied optics in Britain is the exact parallel of the more familiar history of the dye industry in this country. The growth of optical science here may have been hindered by Newton's espousal of the corpuscular theory of light, and his failure to realise an achromatic refracting system. Be that as it may, the foundations of applied optics were well and truly laid by Sir George Airy in papers appearing in the Transactions of the Cambridge Philosophical Society for 1827, some 30 years before the appearance of the work of von Seidel, to whose well-known conditions all well-designed optical systems must conform. Airy's results were extended and simplified by Coddington in his book, "A Treatise on the Reflection and Refraction of Light," appearing in 1829. The contributions of Herschel are enshrined in the Encyclopædia Metropolitana along with many other treasures which have there been buried and forgotten. The successful production by Schott and Abbe, subsequently to 1881, of varieties of optical glass followed upon their extension of the pioneering work of Vernon Harcourt and Stokes carried out during the first half of the nineteenth century. Czapski was of the opinion that success would have crowned the efforts of the English investigators if they had had at their disposal the services of a sympathetic glass maker. It is not without interest to note, as Cheshire has recently pointed out, that in 1881, Zeiss was entirely dependent upon Chance Bros. of Birmingham and Feil of Paris for his supplies of optical glass. Dollond was the first to achieve the construction of an achromatic combination of lenses. In 1886 the first catalogue of Jena glasses appeared, and thereafter the optical trade passed more and more into the hands of Germany. The optical fortune bequeathed us has not been utilised to our advantage, and belated attempts are now being made to recover our goodly heritage.

The book under review embodies the trigonometrical method developed by von Seidel for the rigid computation of optical systems. The formulæ have been employed for this purpose in the workshops of C. A. Steinheil and Sons for at least 30 years. The presentation of optical theory is condensed and does not conform with the traditional teaching of most English text-books—where the subject is developed algebraically. The algebraic method is well expounded in Dennis Taylor's "System of Applied Optics," 1906, and a cursory examination of the formulæ developed in the two modes of presentation leaves the reviewer undecided as to which system facilitates computation the more. Efficiency in the application of the trigonometrical method can only be achieved by bringing the teaching of optics in our schools and colleges into line with that method. Otherwise optical firms would be well advised to develop the algebraic method.

The work appears to be a translation of the original treatise of 1890. Some 12 pages of Vol. 1 are devoted to the discussion of symbols and sign convention. The recent paper shortage is not reflected in the fact that this discussion is repeated verbatim in Vol. 2 together with considerable other matter from Vol. 1. No attempt has been made to bring the signs and symbols employed into con-

formity with English practice. Thus (Vol. 1, p. 10) "x is measured upwards and the value of y is measured towards the side." Again (Vol. 1, p. 11) π denotes "the angle which etc." and is not used to represent the constant 3·141 . . . . The meaning of succeeding sentences (Vol. 1, p. 12) "A radius vector is always positive. Radii of curvature may be positive or negative" is a little obscure. The sign convention enables one to write apparently (Vol. 2, p. 27) $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$ or $\frac{1}{f}=\frac{1}{u}-\frac{1}{v}$, indifferently.

Any advantage accruing from the use of coloured optical diagrams is largely discounted by the fact that "it has not been found practicable to make the colours in all cases correspond with the colours of particular rays of light." There is no apparent need for a coloured illustration of a spectroscope of fairly old German design. The chapter on the determination of refractive indexes suffers from the defect inherent to a translation of a fairly old work—it is not up to date. Mercury and even cadmium lamps are now commonly employed as sources of spectroscope illumination in optical works. Such adverse criticisms as have been advanced do not detract from the value of the main purpose of the work—to facilitate optical computation. This purpose the work will undoubtedly fulfil for some time. In the meantime, there is still place for a native work dealing with the current practice of optical measurement, and in addition the trigonometrical computation of optical systems—if the algebraic method has been tried and found wanting.

J. S. G. THOMAS.

THE METALS OF THE RARE EARTHS. *By* J. F. SPENCER. *Monographs on Inorganic and Physical Chemistry. With diagrams. Pp.* x + 279. (*London: Longmans, Green and Co.* 1919.) *Price* 12*s.* 6*d. net.*

The book commences with an interesting historical summary of the discovery of the various members of the rare earths, which is followed by an account of their occurrence in nature. Chapter III gives a useful general account of the various methods which are employed for separating the rare earths, whilst the methods of controlling the separations are described in the succeeding chapter. Three long chapters deal with the preparation and properties of the compounds formed by members of the cerium group of earths, by members of the ythium group and by thorium, and these chapters contain various physical data, so far as they are available, of the metals and compounds. Atomic weight determinations, the position of the rare earth elements in the Periodic System and uses of the rare earths are dealt with in other chapters. The consideration of thorium along with the rare earths in the narrower sense is eminently justifiable and expedient. The whole treatment of the subject is logical and thorough and the book gives a very readable account of a difficult branch of inorganic chemistry. It can be strongly recommended to all interested in the rare earths. Reference, name and subject indexes, which seem to have been carefully compiled, greatly add to the value of the book.

The various compounds of the rare earth metals which have been singled out for detailed description have been selected judiciously, though it would have been interesting if some information had been given as to the reliance that can be placed on the formulæ attributed to many of the compounds.

The [illegible] practically free from errors, though are restored Brit[illegible]ly stated that the pentahydrate The book is pra[illegible] stable in contact with solu- on page 83 it is wr[illegible] 100·5°, whereas the solubility of cerous sulphat[illegible] diagram both show that it is tions between 56° and [illegible] to the tetrahydrate over the data given and the [illegible] of temperature. This error is unstable with respe[illegible] whole of this range

however to be attributed to a misleading statement made on the diagram which has been borrowed from another book. The proof reading has been very carefully done and the only misprint of any consequence which has been noticed is on page 138, line 9 from bottom, where gadolinium should be substituted for terbium.

Like other volumes of the series the book is well printed.

H. BASSETT.

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VOLUMETRIC ANALYSIS. *For Students of Pharmaceutical and General Chemistry. By* C. H. HAMPSHIRE. *Second Edition. Pp.* 127. (*London: J. and A. Churchill.* 1919.) *Price* 5*s.*

RAPPORT SUR LE COMMERCE ET L'INDUSTRIE DE LA SUISSE EN 1917. *Pp.* 476. (*Zürich: L'Union du Commerce et de l'Industrie.*)

ETUDE DE L'ORGANISATION DE LA PRODUCTION FRANÇAISE APRES LA GUERRE. MÉTALLURGIE. CONSTRUCTIONS MÉCANIQUES ET MÉTALLIQUES. *La Sidérurgie: Produits ordinaires. By* M. G. CARLIOZ. *Pp.* 112. (*Paris: Revue de Métallurgie. December* 1917.) *La Sidérurgie: Produits de la Métallurgie du Fer. By* M. G. CHARPY. *Pp.* 42. (*Paris: Revue de Métallurgie. March* 1918.)

MÉMOIRE SUR LE TRAITEMENT THERMIQUE DES OBUS (*Application de la méthode Taylor*). *By* L. GUILLET. *Pp.* 154. (*Paris: Revue de Métallurgie. January* 1916.)

BULLETIN OF THE RUBBER GROWERS' ASSOCIATION (INCORPORATED). *Vol.* 1. *No.* 1. *July* 1919. *Pp.* 55. (*Registered Office:* 38, *Eastcheap, London, E.C.* 3.)

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MINING AND MILLING OF LEAD AND ZINC ORES IN THE MISSOURI-KANSAS-OKLAHOMA ZINC DISTRICT. *By* C. A. WRIGHT. *Bulletin* 154. *Pp.* 134.

EXTINGUISHING AND PREVENTING OIL AND GAS FIRES. *By* C. P. BOWIE. *Bulletin* 170. *Pp.* 50.

METHODS OF SHUTTING OFF WATER IN OIL AND GAS WELLS. *By* E. B. TOUGH. *Bulletin* 163. *Pp.* 122.

INNOVATIONS IN THE METALLURGY OF LEAD. *By* D. A. LAON *and* O. R. RALSTON. *Bulletin* 157. *Pp.* 176.

NOTES ON THE BLACK SAND DEPOSITS OF SOUTHERN OREGON AND NORTHERN CALIFORNIA. *By* R. R. HORNOR.

CENTRAL STATION HEATING (ITS ECONOMIC FEATURES WITH REFERENCE TO COMMUNITY SERVICE). *By* J. C. WHITE. *Technical Paper* 191.

EIGHTH ANNUAL REPORT BY THE DIRECTOR OF THE BUREAU OF MINES TO THE SECRETARY OF THE INTERIOR FOR THE FISCAL YEAR ENDED JUNE 30, 1918. *Pp.* 124.

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. DEPARTMENT OF THE INTERIOR. (*Washington: Government Printing Office.* 1919.)

SAND-LIME BRICK IN 1918. *By* J. MIDDLETON.

GEMS AND PRECIOUS STONES IN 1918. *By* W. T. SCHALLER.

SOME CHEMICAL PLANTS IN THE COLOGNE AREA.

PART II.

BY A. J. ALLMAND AND E. R. WILLIAMS.

ELEKTROMETALLURGISCHE WERKE, HORREM.

This factory is situated a few miles west of Cologne in the "braunkohle" district and adjoining the large "Fortuna" generating station, from which it draws its power. It manufactures aluminium and zinc, using about 8500—9500 k.w. for the former and 2500 k.w. for the latter when working at full pressure. This includes expenditure on lighting and mechanical power. A total of up to 350 workpeople can be employed. The manufacture of zinc commenced in September 1913, and the production of aluminium has been taken up since the beginning of the war.

Aluminium Plant.

Three-phase 25,000-volt current from Fortuna was stepped down in a rotary converter station to 200-volt direct current. This was led to the furnace room, containing 78 cells in three parallel rows of 26 each. These cells were of steel plate, reinforced by channel irons outside and along the bottom and about 8 ft. × 4½ ft. × 2½ ft. deep. A casting through the base made contact between the carbon lining and the cathode electrical contact. The lining consisted of a mixture of fine coke and pitch, rammed into the steel shell, the whole being subsequently baked in oil-fired brick ovens. The dimensions of the furnace inside the lining were about 6 ft. × 3 ft. and 6 in. deep at the sides. The bottom of the lining sloped towards the centre, forming a well where the molten aluminium collected. A cast-iron form was used when lining the cell to ensure its right dimensions.

Above the furnace ran two copper bus-bars, supported on wooden posts and each carrying four anodes. The latter were about 2 ft. long and 1 ft. × 1 ft. in cross-section, and were furnished at the top with a cast-iron plug. A flat copper bar bolted into this made connexion with the bus-bar, and a thumb-screwed clamp permitted easy lateral or vertical adjustment. The bath appeared to be of normal composition, and was worked in the usual way, the solidified crust on the top being occasionally broken and the hot alumina resting on it pushed down and stirred in. Every 24 hours, one of the anodes in the centre was removed and the metal which had collected in the crucible ladled out by an iron spoon and cast in iron moulds. It was subsequently remelted to free it from inclusions of the bath.

The current per cell is 14,000—16,000 ampères—normally 14,500. The voltage, read by separate meters on each cell, varies between 6·5 and 7·5 volts. Each furnace therefore absorbs 100—110 k.w. The production of metal was stated to be 70—90 kilo. per furnace per 24 hours. An output of 80 kilo. (using 14,500 amps. and 7 volts) corresponds to 30·5 k.w.-hrs. per kilo. of metal and to a current efficiency of 68 per cent. The average efficiency may, however, well exceed this figure, as it was stated that 1200 tons of metal had been produced during the last six months of 1918, corresponding to at least 84 kilo. per furnace day.

The anodes, obtained from Rauxel (Westphalia), Plania (Ratibor, Silesia), Conrady (Nürnberg) and Siemens (Berlin-Lichtenberg) burnt very evenly and squarely at the ends. On an average they lasted two days, and if of good quality four to five days. If of bad quality they cracked and fell to pieces in an hour or two. The cell lining had a somewhat indefinite life, but normally did not need renewal more than once a year.

Zinc Plant.

In this plant zinc is obtained electro-thermally from a crude zinc oxide by reduction with coke. The ore used comes from the Harz, Ludwigshafen, etc., and contains about 70 per cent. zinc with small quantities of lead, copper, silver, antimony and cadmium. It is first mixed, slightly damp, with finely divided coke, and preheated to a dull red heat in a revolving roasting furnace (Bruchner type) by means of an oil and tar jet burner. This operation was said to take 8—10 hours. The charge, weighing about 5—5½ tons, and consisting of 70 per cent. ore and 30 per cent. coke, is then transferred to the electric furnace, hot from a previous operation, and smelted, this process taking anything from 24—36 hours. The zinc distils off, and is for the most part condensed and tapped as liquid, the remainder being burnt to zinc white.

The electric furnaces consisted of steel cylinders, 15 ft. in length and 15 ft. in diameter, mounted on trunnions, and rotated on a horizontal axis by means of a gear and pinion. The shell was lined throughout by 18 in. of refractory chamotte material. Three charging doors were disposed symmetrically round the middle of the casing. Through each end of the latter passed four sets of electrodes, and copper rings and brushes made it possible to supply current in all positions of the furnace. The electrodes were of amorphous carbon rod about 5 in. in diameter and 3 ft. long. From statements made, it would appear that they simply carry current to the charge, which is sufficiently conducting to allow the heating currents to pass through it (high proportion of coke, preheating).

Three-phase current is employed, and with a current of 2000—3000 amps., a voltage of 160—170 volts and a power factor of 0·8, each furnace consumes about 500—600 k.w. The exact figures, as also the time taken for the complete process, depend very much on the nature of the ore, skill of the workmen, etc.

The condenser, which abutted directly on to the furnace, consisted of a brick-lined cylinder, also capable of rotation on a horizontal axis. The end of the furnace was pierced by three holes about 8 in. in diameter, placed symmetrically about 18 in. from the axis of the cylinder. To these corresponded three holes in the condenser, and the zinc vapours passed directly through and for the most part condensed to liquid. Uncondensed vapours were burnt at the open end of the condenser, and passed into a stack, along a series of cooling flues and so to bag filters, connected with a suction fan. The metallic zinc was tapped off every 5—6 hours, and run into iron moulds.

The total zinc recovery, as stated to us, was low —only 75—77 per cent. Of this a certain amount is collected as zinc white (80 per cent. zinc), each charge giving about 150 kilo. of this product. The metal itself is 98 per cent. pure, the chief impurity being lead. The slags from a single operation weigh at least 1600—1700 kilo., and consist very largely of coke. At no time are they molten.

The plant when seen contained two preheaters and five electric furnaces. Four of the latter are constantly in action when working under full pressure, under which conditions a total of 300 tons of coke (for all purposes) and 10 tons of electrodes were stated to be required per month. Three hundred tons of zinc was made during the last

half of 1918. Practically no work was done in November and December.

A.G. für Stickstoffdünger, Knapsack.

This factory, which commenced work in 1906, adjoins the "braunkohle" deposits, a few miles S.W. of Cologne. It generates its own power, and makes calcium carbide and cyanamide. For a time during the war, ammonia was manufactured and sent to Leverkusen (see Part I), but this was discontinued later. The number of hands normally employed before the war was 2000.

Calcium Carbide.

The power plant consists of one turbo-generator of 4500 k.w., two of 5000 k.w., and five of 11,250 k.w. The last named generate three-phase current at 6000 volts, stepped down to 160 volts for the furnaces. One of these machines is kept as a stand-by when working at full pressure. There are seven furnaces of full capacity, 5000–6000 k.w., which can produce 200 tons of carbide per 24 hours. When visited two of the large generators were in use, giving 22,000 k.w. Of this quantity, 3000 k.w. was consumed for lighting and mechanical power. The balance of 19,000 k.w. was feeding four furnaces, which were turning out about 100 tons of carbide in the 24 hours.

The carbide furnaces consisted of steel plate shells about 30 ft. × 14 ft. × 10 ft. deep, and were lined with 18 in. of firebrick. It was stated that a carbon concrete crucible was rammed in on top of this lining up to the tap-holes. This would correspond to a minimum thickness of about 2 ft. There were three tap-holes, one under each electrode, with openings in the shell of about 2 ft. 6 in. by 4 ft.

The electrodes, which were in line and about 8 ft. apart from centre to centre, were of amorphous carbon (Siemens, Berlin-Lichtenberg, and a local factory), and built up of two sections 20 × 20 in. with one section 20 × 10 in. between them, giving a total cross-section of 50 × 20 in. Their length was 7 ft. 6 in. to 8 ft. There was no covering of any kind to prevent oxidation. The U-shaped water-cooled boss of the electrode head was recessed about 10 in. into the carbons, which were supported by bolts passing through the carbon shoulders into this boss. The latter extended over the whole of the top of the electrodes in the shape of an 8 in.-thick water-cooled flange. Flange, boss, and the actual electrical contact head were water-cooled by separate systems, employing flexible metal hose. Groups of flexible copper cables carried the power to the electrodes, which were suspended by chains passing over large sheaves down to the hoists set on the charging floor 30 ft. from the furnace. The hoists were worm-geared and engaged with a common non-reversing motor-shaft by hand levers and friction-clutch bevel-gears, thus allowing independent or simultaneous adjustment of the electrodes by a single motor. A meter board was set in front of the hoists. There was no simple means provided of lateral adjustment of the electrodes, though suspensions and power and water connexions would have permitted it. Electrodes were changed on the charging floor, 45—60 minutes being required.

Four openings in the back wall of the furnace were connected to a main exhauster flue, and by the use of curtain walls and an artificial draught, dust and smoke were reduced to a minimum. The charge consisted of lime and a very hard gas coke in approximately equal proportions. The lime passed through a 4 in. ring. It appeared to contain much small material. The daily requirements were stated to be 260 tons working at full pressure. The coke varied from 1 to 3 in. in diameter. Maximum daily requirements were said to be 185 tons. Lime and anthracite were present on the charging floor, to correct the grade of the carbide or the operation of the furnace.

Under normal operating conditions, the charge seemed to be 3—4 ft. below the feed floor, with the electrodes immersed to a depth of about 1 ft. No attempt was made to close in the top and the furnaces appeared to be in a perpetual state of "boiling down." It was said that there were no difficulties due to "bottoms building up," which seems very probable. The furnaces appeared to run with "flat tops." Wooden pokers were used for loosening the charge.

Electrodes were red-hot half-way up after service for a few hours. Half-consumed electrodes were red-hot up to the head. Nevertheless the different carbons of the built-up electrode burnt away very evenly. The electrode consumption was given as five kilo. per ton of carbide, a somewhat high figure. The power factor was given as 0·85—0·9. With a furnace power consumption of 5000 k.w. at 160 volts, this works out at a current of about 20,000 amps. per phase and an electrode current density of 20 amps. per sq. in.

The furnace was completely tapped every 2½ hours, *i.e.* one tap-hole every 45 minutes. An ordinary type of arc tapper, fitted with a 4 ft. × 4 in. × 4 in. amorphous carbon electrode, was suspended before each tap-hole. The carbide flowed into semi-cylindrical cast-iron chills over an air-cooled lip of cast iron, protected by a coating of solid carbide. It was stated that 1 kilo. produced 270 litres of acetylene. If this were an N.T.P. figure, it would correspond to a 77 per cent. carbide.

Cyanamide.

The carbide from the furnaces was cooled, crushed in jaw crushers, ground in tubular bar mills and conveyed to the nitrification plant. The nitrogen was furnished by a Linde liquid air installation.

The ovens consisted of horizontal cast-iron cylinders about 150 × 6 ft., enclosed for half their length in a brick setting. A track throughout the length of the ovens was used for the passage of the loaded cars of carbide. Gas, air and nitrogen ports were provided in the lower portion of the ovens at the end in the brick setting. The ends of the cylinders were closed by gas-tight cast-iron doors.

Carbide was placed in loosely made sheet-iron boxes 30 × 20 × 13 in., lined with newspaper. Fourteen boxes were piled on each truck and the loaded trucks were pushed into the ovens by means of a mechanical pusher. Twenty-eight such trucks were put into each oven. The oven being filled, the doors were closed and gas flames started. When the carbide had reached a sufficiently high temperature the gas supply was cut off and the nitrogen admitted. Absorption takes place immediately and the temperature of the carbide rises very rapidly. The complete cycle of heating and nitrifying occupies 28 hours. The nitrogen mains were not arranged for the series flow of gas.

When nitrification was completed the ovens were opened and the finished trucks were pushed out on to cooling tracks as the fresh charges of carbide were pushed into the oven. The blocks of hard crude "lime nitrogen" after cooling were broken, crushed and ground. The nitrogen content was said to average 20 per cent. The method of preliminary heating caused a loss of carbide due to oxidation, but the coating of lime resulting was removed before crushing and finishing the cyanamide.

In commenting on the dearth of nitrogenous fertilisers in Germany, Prof. Neubauer estimates the present requirements at 360,000 metric tons of combined nitrogen per annum. About 100,000 tons yearly was available during the war.

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This factory is situated a few miles west of Cologne in the "braunkohle" district and adjoining the large "Fortuna" generating station, from which it draws its power. It manufactures aluminium and zinc, using about 8500—9500 k.w. for the former and 2500 k.w. for the latter when working at full pressure. This includes expenditure on lighting and mechanical power. A total of up to 350 workpeople can be employed. The manufacture of zinc commenced in September 1913, and the production of aluminium has been taken up since the beginning of the war.

Aluminium Plant.

Three-phase 25,000-volt current from Fortuna was stepped down in a rotary converter station to 200-volt direct current. This was led to the furnace room, containing 78 cells in three parallel rows of 26 each. These cells were of steel plate, reinforced by channel irons outside and along the bottom and about 8 ft. × 4½ ft. × 2½ ft. deep. A casting through the base made contact between the carbon lining and the cathode electrical contact. The lining consisted of a mixture of fine coke and pitch, rammed into the steel shell, the whole being subsequently baked in oil-fired brick ovens. The dimensions of the furnace inside the lining were about 6 ft. × 3 ft. and 6 in. deep at the sides. The bottom of the lining sloped towards the centre, forming a well where the molten aluminium collected. A cast-iron form was used when lining the cell to ensure its right dimensions.

Above the furnace ran two copper bus-bars, supported on wooden posts and each carrying four anodes. The latter were about 2 ft. long and 1 ft. × 1 ft. in cross-section, and were furnished at the top with a cast-iron plug. A flat copper bar bolted into this made connexion with the bus-bar, and a thumb-screwed clamp permitted easy lateral or vertical adjustment. The bath appeared to be of normal composition, and was worked in the usual way, the solidified crust on the top being occasionally broken and the hot alumina resting on it pushed down and stirred in. Every 24 hours, one of the anodes in the centre was removed and the metal which had collected in the crucible ladled out by an iron spoon and cast in iron moulds. It was subsequently remelted to free it from inclusions of the bath.

The current per cell is 14,000—16,000 ampères—normally 14,500. The voltage, read by separate meters on each cell, varies between 6·5 and 7·5 volts. Each furnace therefore absorbs 100—110 k.w. The production of metal was stated to be 70—90 kilo. per furnace per 24 hours. An output of 80 kilo. (using 14,500 amps. and 7 volts) corresponds to 30·5 k.w.-hrs. per kilo. of metal and to a current efficiency of 68 per cent. The average efficiency may, however, well exceed this figure, as it was stated that 1200 tons of metal had been produced during the last six months of 1918, corresponding to at least 84 kilo. per furnace day.

The anodes, obtained from Rauxel (Westphalia), Plania (Ratibor, Silesia), Conrady (Nürnberg) and Siemens (Berlin-Lichtenberg) burnt very evenly and squarely at the ends. On an average they lasted two days, and if of good quality four to five days. If of bad quality they cracked and fell to pieces in an hour or two. The cell lining had a somewhat indefinite life, but normally did not need renewal more than once a year.

Zinc Plant.

In this plant zinc is obtained electro-thermally from a crude zinc oxide by reduction with coke. The ore used comes from the Harz, Ludwigshafen, etc., and contains about 70 per cent. zinc with small quantities of lead, copper, silver, antimony and cadmium. It is first mixed, slightly damp, with finely divided coke, and preheated to a dull red heat in a revolving roasting furnace (Bruchner type) by means of an oil and tar jet burner. This operation was said to take 8—10 hours. The charge, weighing about 5—5½ tons, and consisting of 70 per cent. ore and 30 per cent. coke, is then transferred to the electric furnace, hot from a previous operation, and smelted, this process taking anything from 24—36 hours. The zinc distils off, and is for the most part condensed and tapped as liquid, the remainder being burnt to zinc white.

The electric furnaces consisted of steel cylinders, 15 ft. in length and 15 ft. in diameter, mounted on trunnions, and rotated on a horizontal axis by means of a gear and pinion. The shell was lined throughout by 18 in. of refractory chamotte material. Three charging doors were disposed symmetrically round the middle of the casing. Through each end of the latter passed four sets of electrodes, and copper rings and brushes made it possible to supply current in all positions of the furnace. The electrodes were of amorphous carbon rod about 5 in. in diameter and 3 ft. long. From statements made, it would appear that they simply carry current to the charge, which is sufficiently conducting to allow the heating currents to pass through it (high proportion of coke, preheating).

Three-phase current is employed, and with a current of 2000—3000 amps., a voltage of 160—170 volts and a power factor of 0·8, each furnace consumes about 500—600 k.w. The exact figures, as also the time taken for the complete process, depend very much on the nature of the ore, skill of the workmen, etc.

The condenser, which abutted directly on to the furnace, consisted of a brick-lined cylinder, also capable of rotation on a horizontal axis. The end of the furnace was pierced by three holes about 8 in. in diameter, placed symmetrically about 18 in. from the axis of the cylinder. To these corresponded three holes in the condenser, and the zinc vapours passed directly through and for the most part condensed to liquid. Uncondensed vapours were burnt at the open end of the condenser, and passed into a stack, along a series of cooling flues and so to bag filters, connected with a suction fan. The metallic zinc was tapped off every 5—6 hours, and run into iron moulds.

The total zinc recovery, as stated to us, was low —only 75—77 per cent. Of this a certain amount is collected as zinc white (80 per cent. zinc), each charge giving about 150 kilo. of this product. The metal itself is 98 per cent. pure, the chief impurity being lead. The slags from a single operation weigh at least 1600—1700 kilo., and consist very largely of coke. At no time are they molten.

The plant when seen contained two preheaters and five electric furnaces. Four of the latter are constantly in action when working under full pressure, under which conditions a total of 300 tons of coke (for all purposes) and 10 tons of electrodes were stated to be required per month. Three hundred tons of zinc was made during the last

tain about 44 per cent. of oil. Arachis (groundnut) oil is grown chiefly in Madras, Bombay and Burma. India is the main source of the world's supply of castor oil; this oil is converted into "Turkey red oil" by means of sulphuric acid, an industry dependent on the price of the acid. Coconut oil is produced mainly on the West Coast; the export of mowhra has latterly greatly diminished. There are numerous other oils, trade in which might be developed.

Exports during recent years have been :—

Year	Oil Seeds		Oils		Oil cakes	
	Quantity Tons	Value £	Quantity Gallons	Value £	Quantity Tons	Value £
1912–13 ...	1,217,089	15,022,009	24,489,692	571,945	161,785	821,387
1913–14 ...	1,572,792	17,000,385	25,991,315	657,085	175,313	920,249
1914–15 ...	946,727	9,669,897	30,245,651	701,357	136,932	709,219
1915–16 ...	641,983	6,582,017	33,081,357	812,571	150,286	757,501
1916–17 ...	919,853	10,772,618	30,904,841	1,007,151	124,996	660,697
1917–18 ...	431,737	5,052,062	26,755,953	1,326,441	86,159	471,665

Alkaloids.—On account of its variety of climates, India is suitable for the extended cultivation of alkaloidal plants. The production of cinchona and opium products has been undertaken by Government. Supply, however, is unequal to demand, and in 1917—18, 29 tons of quinine and its salts, worth £105,660, was imported. Morphine is now being manufactured at the Opium Factory, Ghazipur. Hitherto seeds of *Strychnos nux vomica* have been exported; now the extraction of strychnine and brucine is being attempted. The export of nux vomica in 1917—18 amounted to 1962 tons, worth £25,329. It is proposed to form a Drugs Manufacturing Committee to stimulate the cultivation of alkaloids in India.

Natural Dyes.—India is very rich in natural dyes, of which the following are exported: Indigo, cutch, safflower, turmeric, annatto, red sandalwood. Heavier crops of indigo are being obtained by the use of phosphatic manures; the following figures show that the cultivation of this dye has considerably increased during the war (see this J., 1919, 119R) :—

Indigo.

Year	Acreage	Exports Tons	Value £
1912–13 ...	227,046	593	146,755
1913–14 ...	169,221	547	141,938
1914–15 ...	145,792	857	599,691
1915–16 ...	351,265	2096	1,385,795
1916–17 ...	770,000	1677	1,382,951
1917–18 ...	710,600	1456	957,985

Disinfectants and Antiseptics.—Much bleaching powder is imported into India for sterilising and bleaching purposes, the figures for 1917—18 being: Bleaching powder, 1510 tons, worth £51,531; bleaching materials, 5012 tons, worth £139,398. Other disinfectants imported in 1917-18 amounted to 1571 tons, worth £67,415. Small quantities of carbolic acid disinfectants have been made in India since the outbreak of war.

Fertilisers.—Although essentially an agricultural country, India uses few fertilisers. Bones are exported from India in steadily diminishing quantities. Thus in 1914—15 63,975 tons, worth £319,553, and in 1917—18 26,679 tons, worth £102,389, were exported.

Minor Products.—Considerable quantities of sodium sulphate are produced in India, and used in cotton mills, in the manufacture of glass, and for dehydrating oils; little is imported. Appreciable amounts of potassium nitrate are recovered from old village sites in Bihar and the Punjab; but Indian potash is unlikely to compete with that from other sources. The manufacture of zinc salts in India could be developed. The manufacture of aluminium sulphate and alums from pyritic shale has long been an Indian industry. Alum cake is also made from bauxite. Considerable quantities of aluminium sulphate and alum are imported. Litharge and red lead are made on a considerable scale, and the manufacture of white lead is likely to be started. Deposits of chrome iron ore in Mysore, Baluchistan and Singhbhum are being opened up, and attempts have been made on a small scale to manufacture chromium compounds. Ferrous sulphate has been made in India since the outbreak of war, as well as oxalic acid on a small scale. Citric acid could be made from limes, and tartaric acid from the pulp of tamarind fruit.

THE INTERNATIONAL RESEARCH COUNCIL.

At the meeting of Inter-Allied scientific delegates held in Brussels on July 18-28 last, the International Research Council was declared duly constituted for the purposes of co-ordinating international efforts in pure and applied science, of initiating the formation of international associations or unions, of directing international scientific action in subjects which lie outside the scope of existing associations, and of entering into relations with the Governments of the participating countries on matters falling within its competence. The following nations are now represented on the Council :—Australia, Belgium, Brazil, Canada, France, Greece, Italy, Japan, New Zealand, Poland, Portugal, Rumania, Serbia, South Africa, the United Kingdom, and the United States. The adherence of nations, other than the Central Powers, may follow at their own request or, on the proposal of a constituent nation, by a three-fourths majority vote of the Council. The nations which remained neutral during the war are invited to join the Council and the international unions represented upon it. A General Assembly will be held every three years, and the affairs of the Council will be managed by an Executive Committee during the intervening periods. The first Executive Committee consists of Prof. E. Picard, Dr. A. Schuster, Profs. Hale, Volterra and Lecointe. The permanent seat of the Council is to be at Brussels and the secretariat will reside in London, where a room has been placed at its disposal by the Royal Society.

The meetings of the delegates appointed by the Inter-Allied Chemical Conference in London (this J., 1919, 262 R) were held in the Palais des Academies de Belgique. Prof. A. Haller, who presided, announced that the referendum taken among the members of the Council of the pre-existing International Association of Chemical Societies showed a large majority in favour of dissolving that body. It was accordingly declared to be dissolved; and it was decided to return the endowment fund

presented to it by M. Ernest Solvay to the donor. A report on the proceedings of the London Conference was presented by M. Moureu, and the recommendations therein approved. The Rules were first adopted in principle only, as it was found necessary to modify some of them in certain minor respects in order to render them conformable to the requirements of the International Research Council and to make them fit into the framework of the associated international unions. A special committee, composed of one delegate from each of the nations represented, having effected these changes, the Rules were formally adopted. At the subsequent General Assembly the appointment of the officers ("Bureau") nominated by the London Conference was confirmed, and this Bureau then submitted the Rules successively to the Executive Committee of the Council and to the International Council at a plenary sitting, by whom they were approved

The official title of the international chemical federation is now *L'Union Internationale de la Chimie pure et appliquée*—the International Union of Pure and Applied Chemistry.

The general idea is that each adhering country will have its own national union, association or federal council for each distinctive branch of science (*e.g.*, the Federal Council for Pure and Applied Chemistry in the United Kingdom); that the international unions will be composed of representatives of the national unions; and that the International Research Council will be constituted of representatives from the international unions.

CONFERENCE ON RESEARCH ORGANISATIONS.

A well-attended conference was held at the Board of Education on July 29 to discuss certain difficulties connected with the organisation of Research Associations formed under the scheme of the Department of Scientific and Industrial Research. Sir William McCormick, who presided in the absence of the Rt. Hon. H. A. L. Fisher, remarked, in his opening statement, that nine research associations are now in being, eight have been approved by the Board of Trade and only await a licence, and twelve are in process of formation.

The vexed question as to ownership of results of research evoked considerable discussion. Sir Frank Heath stated that such results have been officially declared to be the property of the associations: they will be communicated to the projected Records Bureau connected with the Department, which will classify them, according to the wish of the Association, as confidential or non-confidential. Confidential results will not be communicated to anyone except with the consent of the body which transmitted them, but in cases where disclosure would be obviously desirable, the Bureau would endeavour to effect the transference of information. The Bureau will assist research associations in obtaining rare publications, but each association must have its own bureau as well as a library. The central bureau could not supply abstracts of literature, but it would draw attention to original sources of information. It is hoped that the expenses of the Records Bureau will be defrayed out of the annual Parliamentary grant.

A discussion then ensued on the question of rewards for individual research workers. The feeling of the meeting was strongly against such rewards, but it was suggested that a bonus on results might be given to a team of workers, and that individuals might be compensated by increase of salary. The allied problem of the desirability of allowing a worker to patent a discovery if his association declined to do so, also raised considerable discussion. Col. O'Gorman said that in his experience the proof of good organisation is team work, and the latter is killed by individual secrecy and working with the intent of making money from a patent. Mr. W. Dixon suggested that an employee might be allowed to take out a patent on the condition that his employer had a free use of it for all time. Sir Charles Parsons said that legal decisions in such cases were always against the employee: a man might patent the product of his own work in his own time, but not if it were the result of work done in his employer's time.

On the subject of co-operation among research associations in respect of matters of common interest, Sir F. Heath advised the appointment of joint committees *ad hoc* with strict terms of reference; and Mr. J. P. Hinchliffe suggested that two or three members of an association might be elected on to a kindred association, and *vice versa*.

The last topic of discussion was on methods of levying subscription rates. The Departmental memorandum on the subject suggests methods based on capital employed, average annual profits, annual wages bill, number of employees, volume or value of output, and amount of plant. None of these appears to be entirely satisfactory, and Sir William Jones stated that the Refractories Research Association had discarded all of them, and had come to the conclusion that a voluntary basis would be best as it would obviate the disclosure by manufacturers of information regarding their business. It was not suggested, however, that this plan was feasible for other associations.

PERSONALIA.

Madame Curie has been elected to the chair of radiology at the University of Warsaw.

Professor F. Giolitti, of Turin, has been awarded the Bessemer Medal of the Iron and Steel Institute.

Prof. Ernst Haeckel, the well known German biologist, died at Jena on August 8 at the age of 85.

The Henry Overton Wills chair of physics at Bristol University has been filled by the appointment of Prof. A. M. Tyndall.

Dr. J. C. Meakins, of McGill University, Montreal, has been appointed professor of therapeutics in the University of Edinburgh.

Lord Lee of Fareham has been appointed President of the Board of Agriculture and Fisheries, and Sir Eric Geddes Minister of Transport.

Prof. A. G. Vernon Harcourt, formerly professor of chemistry in the University of Oxford and past-president of the Chemical Society, died on August 23, in his 85th year.

Capt. B. J. Eaton has received the Order of the British Empire (O.B.E., Military Division) for war services. He has also received the thanks of the Secretary of State for the Colonies and the Federated Malay States Government for researches on rubber.

H.M. the King, on the occasion of the celebration of his birthday, signified his intention to confer a baronetcy of the United Kingdom on Colonel H. G. Barling, M.B., F.R.C.S., Vice-Chancellor of Birmingham University; and the honour of knighthood upon Prof. W. Boyd Dawkins, professor of geology and palæontology in Victoria University, Manchester, and Mr. J. W. Y. MacAlister, secretary of the Royal Society of Medicine.

NEWS AND NOTES.

BRITISH INDIA.

Industrial Scholarships.—A press note issued by the Director of Industries, United Provinces, states that at the seventh meeting of the Industries Section of the Board of Industries held at Naini Tal on June 14, 1919, the following among other matters were dealt with:—It was decided to recommend to Government that State Technical Scholarships in the following subjects be awarded during the year 1920: (1) Glassmaking, (2) the Dyeing of Textile Fabrics, (3) Electrical Engineering. On a previous occasion a scholarship in glass-making had been suggested by this Board, but as it was subsequently explained that facilities did not exist in England for giving a really first-class training, the matter was not proceeded with. The Board expressed the opinion that it was possible for conditions in this industry in England to have altered considerably since then, but if such should not be the case, arrangements might be made for the students to be trained in America or Japan, preferably in the former country. For the purpose of carrying out experiments in the manufacture of glass using the sodium carbonate which is manufactured locally from Reh deposits, the Board recommended that a grant of Rs. 5000 be set aside.—*(Official.)*

CANADA.

New Cyanide Plant.—It is now officially reported that the Cassel Cyanide Company will undertake the erection of a plant in Canada for the production of cyanide suitable for the use of the mining industries of the country, more particularly for those situated in Northern Ontario.

Canadian Chemical Industries.—The Dominion Government has, through its Department of Statistics, prepared a Directory of Canadian Chemical Industries. The information is complete to January 1919, and will be the first publication of this kind to be issued in the Dominion. It is the result of urging on the part of the Society of Chemical Industry, and action on the part of the Honorary Advisory Research Council. Some 634 firms are listed, and their names and products are given alphabetically. The directory also gives a very complete summary of the chemical industries of the Dominion and of the business done during the last six years.

Research in Alberta.—The Provincial Government of Alberta is seriously considering the question of establishing a research department to assist in guiding and co-ordinating the development work in connexion with the natural resources of the province. Coal, oil, natural gas, and salt are among the resources upon which the province hopes to build up industries of great magnitude. The Hon. A. G. McKay, Minister of Industries, and Prof. R. D. MacLaurin, of Saskatoon, are leading in the matter of bringing these problems before the public. The Industrial Convention in Medicine Hat in August should result in the announcement of a definite policy regarding the establishment of a provincial fund for research work.

Meeting of Maritime Chemists.—Chemists in the Provinces of New Brunswick and Nova Scotia are organised under the Maritime Chemists' Association. On July 15 they held their annual meeting at Sydney, N.S., which is an important centre of the steel and coal industries in Eastern Canada. A paper was read on "The Use of Benzol and Benzol Mixtures as Motor Fuel," by Mr. I. C. Mackie, who is chief chemist to the Dominion Iron and Steel Corporation of Canada, and during the war period was closely associated with the development of the large new benzol plant of that company. In the district the use of benzol and solvent naphtha for motor fuel has been steadily increasing. The difficulties of overcoming prejudice in the introduction of this fuel were dealt with, and in particular the effect of benzol on cork floats in carburettors and the question of the strength of the mixture necessary for complete combustion.

Mr. A. Blake, Chief Chemist of the Atlantic Sugar Refineries, St. John, N.B., gave a paper on "The Examination of Coals," and another was read by Dr. A. McGill, of Ottawa, on "The Chemists' War."

At the regular business meeting committees were appointed to consider the question of establishing a Section of the Society of Chemical Industry in Eastern Canada, and to urge the Provincial Governments to have Canada represented at the Exposition of Chemical Industries to be held at Chicago in September. Mr. H. B. Vickery, of the Imperial Oil Co., Halifax, is secretary of this organisation.

AUSTRALIA.

Mineral Production in New South Wales in 1918.—Owing to the high price of metals in 1918, the value of the mineral output of New South Wales attained the record figure of £14,391,981. Gold, which is now obtained principally from copper ores, showed a small recovery at 87,145 oz., valued at £369,473. The copper output was worth £696,580, of which £501,685 was extracted from the Great Cobar mine. The value of the tin produced was £548,876, compared with £373,696 in 1917; the output of the silver-lead mines was worth £5,712,138.

The aggregate mineral production of the State now amounts to £300,499,184, of which coal accounts for £92,721,420, silver-lead £86,235,094, gold £62,368,521, copper £14,988,804, zinc £13,000,000, and tin £11,511,880.

The coal production and coal trade of the State have been much interrupted by labour troubles, etc., and the Commonwealth Government has announced its intention of taking over the mines. Owing to the closing down of the metalliferous industry, the demand for coke has much diminished. The value of last year's output was £387,000, of which more than half was produced in the Illawarra District.

The State Department of Mines has recently issued a report on the limestone industry. The value of the annual production is now above £500,000 and its rapid growth is due primarily to the marked increase in the manufacture of Portland cement. The methods used in lime-burning are essentially the same as those employed twenty-five years ago, and the average output of lime is valued at £27,500. The production of marble is increasing. The report gives detailed information concerning the occurrences of limestone and dolomite with analyses.—*(Bd. of Trade J., July 17, 1919.)*

SOUTH AFRICA.

The Transvaal Gold Mines in 1918.—The Transvaal gold mines made profits in 1918 totalling £7,078,129 as against £10,486,283 for the previous year, a decrease of £2,725,368. The dividends declared in 1918 amounted to £5,273,633, which total is £1,444,971 less than that for 1917. Particulars given in the Chamber of Mines' progressive statement of gold production are as follows:—

	1918	1917
Tons milled	25,267,302	27,862,851
Stamps	8,878	9,470
Tube mills	338	332
Value of output	£35,768,688	£38,323,921
Total per ton milled ...	28/1	27/3
Total working costs ...	£27,318,600	£26,857,837
Costs per ton	21/8	19/4
Profit per ton	6/1	7/6

—*(Official.)*

UNITED STATES.

Engineering Chemistry.—A movement is on foot to establish a school of chemical engineering at the University of Michigan, the funds for which will be furnished by the State Manufacturers Association. The manufacturers are favourable to the plan and it only remains to work out certain details with the University authorities.

Zinc as a Structural Material.—Following the greatly stimulated production of zinc during the war, the American producers are now taking a renewed interest in extending the use of zinc, especially as a structural material. Zinc has many qualities of value in this direction, but its limiting characteristics are low strength, high thermal expansion, the tendency of wrought zinc to recrystallise and become brittle at low temperatures, its relatively low ignition point, and the ease with which acids and alkalis attack it. A campaign of education among builders is to be initiated.

Malleable Castings.—After four years of research the American Malleable Castings Association reports progress of the most practical kind. Whereas the ultimate strength of the casting formerly averaged 39,882 lb. and the elongation less than 5 per cent., the average from January, 1917, to March 31, 1919, was 51,000 lb. ultimate strength and 12.5 per cent. elongation. During March, 44 per cent. of the bars submitted from some one heat of each day's run by each member showed 52,000 lb. and 14.67 per cent. elongation. The real purpose of the research is to secure uniformity of product upon which an engineer can rely and without which malleable iron castings cannot hold their place. The research is exhaustive in nature and several generally accepted theories are being overthrown.

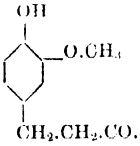
The Chlorine Plant at Edgewood, Maryland.—The largest chlorine plant in the world has been practically embalmed in such a way that should it become necessary to again put it into operation no time would be lost in doing so. This plant is a part of the Edgewood Arsenal at Edgewood, Maryland, and has a capacity of 100 tons of chlorine per twenty-four hours. The contract for the plant was signed on March 3, 1918, the location was decided on March 27, the necessary railroad was ready May 8, the shop building was begun May 10, and on August 1, 1918, the first circuit of cells was ready to operate. Nelson cells were employed and the plant was started and operated without any change in original designs and without any difficulty. The quality of the gas was such that liquefaction for use in manufacturing phosgene was not needed, but the installation included a liquefying plant as liquid chlorine was required for other purposes.

Copper Production in 1918.—The smelter production of primary copper in the United States during 1918 was 1,908,500,000 lb., valued at $471,408,000, showing an increase of 1·17 per cent. in quality and a decrease of 8·45 per cent. in value compared with 1917. The total production of new refined copper was 2,432,000,000 lb., or 4,000,000 lb. more than in 1917; and the regular refining companies also produced copper sulphate having a copper content of 7,917,696 lb. Stocks at January 1, 1919, were 180,000,000 lb., or 66,000,000 lb. more than at January 1, 1918; and 562,600,000 lb. of blister copper and material in process of refining was reported at smelters, in transit or at refineries, against 411,000,000 lb. in the previous year. The apparent consumption of refined new copper in 1918 showed an increase of 346,000,000 lb. over 1917 at 1,662,000,000 lb.

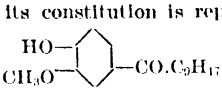
Cane Sugar in Porto Rico.—The cession of Porto Rico to the United States by Spain in 1898 was followed by a marked increase in the production of sugar, due not only to the establishment of new plantations, but more especially to the introduction of more up-to-date machinery. The establishment of Free Trade between the United States and Porto Rico in 1901 beneficially affected the sugar industry. The individual cane plants are propagated by cuttings; seeds are only employed by experimental stations for the purpose of creating new varieties. The plants ripen after 12—18 months and give an average yield of 40 tons of cane per acre and about 4 tons of sugar per acre. Although the soil of Porto Rico is very fertile it must be well prepared by deep ploughing and proper surface cultivation since the plants remain on the same field for at least four years. In recent years artificial manuring has been taken up, in the form of sulphate of ammonia, superphosphate and sulphate of potash. Chlorine manures are avoided since they act unfavourably on the formation of sugar in the cane and subsequently on the purity of the juices.

JAPAN.

The Hot Constituent of Ginger.—Thresh gave the name "gingerol" to the hot constituent of ginger, which was isolated by Gärnet and Grier who did not, however, determine its molecular formula. Recently H. Nomura, an assistant professor of Sendai University, has completed his researches on the subject, and published the results. He has found that the hot constituent consists of at least two different compounds, one of which called "Zingerone" is a crystalline solid having m.pt. 40°—41° C., molecular formula $C_{11}H_{14}O_3$, and the constitutional formula



The second constituent, named "Shogaol" ("Shoga" being the Japanese name for ginger), was also separated. Its molecular formula is $C_{17}H_{24}O_3$, and its constitution is represented by



being an $\alpha\ \beta$ unsaturated ketone.

Manufacturing Cost of Phenolphthalein.—The Research Institute for Hygiene at Osaka has recently published the result of an investigation on the manufacture of phenolphthalein. The present cost in Japan is stated to be:—

(1) *Phthalic anhydride.*

	Grms.	Yen.
Naphthalene	1,125	0·350
Sulphuric acid	12,562	1·954
Mercury	281	2·498
Commercial caustic soda	344	0·191
Commercial hydrochloric acid ...	640·5	0·068
Total for 271·1 grms. of the product ...		5·061

That is, Y.8·40 per pound of the product (approx. 17*s.* 3*d.* per lb.).

(2) *Phenolphthalein.*

	Grms.	Yen.
Phthalic anhydride	250	4·667
Phenol	500	0·867
Sulphuric acid	200	0·156
Caustic soda	80	0·356
Acetic acid	333	0·222
Absolute alcohol	533	1·776
Bone charcoal	50	0·256
Total for 182·9 grms. of the product ...		8·39

That is, Y.20·421 per pound of the product (approx £2 13*s.* per lb.). (Yen—2*s.* 0½*d.*)

Mineral Oil Industry.—With increased supplies of necessary plant and material, increased activity in the Japanese oil industry is anticipated during the current year. Several fresh schemes have already been taken in hand. Drilling is expected to be soon under way in the naval oil reserve fields of Formosa as well as in Nairyo and Kosempo. The Akita Mining College is to open a course in petroleum engineering, the first of its kind in Japan. The Nippon Oil Co. has built new plant at its Echigo refinery at a cost of $100,000. Owing to the prohibition of the exports of drill pipe from the United States development was held back during 1917—18 and production showed a decline. On the other hand, increased prices for oil, improved refining methods, and the increased utilisation of casing-head gasoline brought increased profits.—(*Indian and Eastern Engineer, July* 1919.)

GENERAL.

The Non-Ferrous Mining Industry.—The President of the Board of Trade has appointed a Departmental Committee to investigate and report upon the present position and economic possibilities of non-ferrous mining in the United Kingdom, and to make recommendations as to such Government action as may be expedient in regard thereto. The members of the Committee are Mr. H. B. Betterton, M.P. (chairman), Mr. H. F. Collins, Mr. J. Harris, Dr. F. H. Hatch, Sir Lionel Phillips, Bart., Mr. R. A. Thomas, and Mr. James Wignall, M.P. All communications should be addressed to the secretary, Mr. W. Palmer, Gwydyr House, Whitehall, S.W. 1.

The British Non-Ferrous Metals Research Association.—About a year ago a meeting was held of representatives of the non-ferrous metals industries and a provisional committee was appointed to take steps to form an association under the scheme of the Department of Scientific and Industrial Research. A memorandum and articles of association have since been drawn up and approved by the Department, and as soon as a licence has been received it is proposed to establish the Association upon a permanent basis. In addition to promoting technical efficiency in the production, treatment and utilisation of non-ferrous metals and alloys by the establishment of a research institute and experimental workshop, it is intended to institute an information bureau with branches in various centres. The method of assessing a firm's annual subscription will be decided by the Association in general meeting, but in the meantime the levy will be based upon the capital employed in the business, with a minimum subscription of £25. The officers of the provisional committee are: Mr. Thomas Bolton (chairman), Mr. F. Tomlinson (vice-chairman), and Mr. E. A. Smith (secretary), of 30, Paradise Street, Birmingham.

The Position of Chemists in the Special Brigade, R.E.—A correspondent wishes to draw attention o the hard case of chemists who were enrolled as such in the Special Brigade of the Royal Engineers early in the war. During the early days, from May 1915, the work of the Brigade, he states, was suitable for plumbers and navvies, and in the later stages the only technical knowledge required was that of joining electric wires and testing for "breaks," digging and carrying being the principal tasks. This contention, he continues, is borne out by the fact that beyond the original "Chemist Corporals" very few of the N.C.O.s in the Brigade have been professional men. The plea of "national necessity" which might be advanced to excuse their treatment during the war is certainly not applicable at the present time, when they are being transferred to fill the positions of clerks, storekeepers or checkers.

The German Nitrogen Industry.—In a statement made to *The Times* (August 19), Dr. E. C. Worden, of the United States Bureau of Aircraft Production, describes the nitrogen works of the Badische Anilin und Soda Fabrik at Oppau, near Ludwigshafen. Aided by a Government loan of nearly 200 million marks, this factory, he states, has been started since the armistice and when completed will have a storage capacity of 350,000 tons of ammonium fertiliser and a daily capacity of 2800 tons. Between 8000 and 9000 men are being employed. This building, which is only one of seven under construction, possesses a storage shed equal in area to the site of St. Pancras Station and is well furnished with automatic machinery, plant in duplicate and some 3500 telephones. Its cost to date is about £150,000. Dr. Worden also states that the firm of Fr. Bayer at Leverkusen has substantially 3000 tons of dyes, chemicals and pharmaceutical products, either finished or in process of manufacture, ready for exportation.

Low Temperature Carbonisation.—Further particulars have been supplied by T. C. Clarke of the low temperature coal-carbonisation process referred to in this J., 1919, 292 R. The process comprises three stages: (1) low-temperature distillation at about 800° F. (=427° C.), (2) briquetting the resulting soft friable semi-coke, and (3) submitting the briquettes to high-temperature distillation. In the first stage the coal is carbonised in heart-shaped retorts containing two shafts to which are fixed paddles rotating at the rate of one revolution in eight minutes, the coal being carried forward at the rate of one ton per hour. The coal is preheated to 300° F. (=149° C.) in a rotary heater. In the briquetting stage, pitch recovered during the carbonisation stage is restored to the coke and is thoroughly mixed therewith in either the solid or liquid form. The mixture is briquetted, and the briquettes exposed to the air for 10 minutes. In the third stage, the air-dried briquettes are exposed to a temperature of about 1800° F. (=982° C.) in a secondary retort, the floor of which is inclined at an angle, so that the briquettes do not crush one another while in a comparatively soft state, and roll down when the discharge doors are opened. The briquettes are quenched in the usual manner. The yields anticipated from an English coal containing 30 per cent. volatile matter in a plant carbonising 100 tons per day are: coke briquettes, 75 tons; motor spirits, 250 galls.; light naphtha, 100 galls.; heavy naphtha, 200 galls.; tar acids, 425 galls.; fuel oil, 625 galls.; sulphate of ammonia, 1·56 tons. Results are given of the yields obtained by the carbonisation of Clinchfield coals and Japanese lignite. To the coke briquettes the term "carbocoal" is applied. The percentage of ash therein is necessarily higher than that of the coal whence it is derived. Steam-raising tests conducted by the Pennsylvania Railroad Company gave an evaporation of 11·1 lb. of water from and at 212° F. per lb. of dry carbocoal (cal. value 12,438 B.Th.U. per lb.), corresponding to a boiler efficiency of 86·2 per cent. Raw coal (cal. value 13,009 B.Th.U. per lb.) from the same source gave an evaporation of 10·87 lb. of water and an efficiency of 81·1 per cent. In the tests the carbocoal was burnt without smoke at a rate of 165 lb. per hour per sq. ft. of grate. Tests made by the United States Navy Department indicated that Pocahontas coal with 11·5 per cent. higher calorific value gave only 5·3 per cent. higher evaporation duty. The United States Fuel Administration has co-operated with the Ordnance Bureau in the construction and operation of a plant possessing an eventual capacity of treating 1,500,000 tons of bituminous coal annually. The plant was to be in operation early in 1919.

With regard to the friability of coke derived

from low-temperature carbonisation processes, F. Mollwo Perkin instances the recent despatch of 50 tons of coke under adverse weather conditions in this country. After being handled twice, the coke arrived in almost the same condition as it was sent.—(*Times Engineering Supplement, Aug.* 1919.)

Manufacture of "Natalite" in British East Africa.—Owing to the shortage of petrol in East Africa, the Natalite Motor Fuel Co., Ltd., of Natal, has extended its operations to that colony, where the spirit is being made by a new company. Machinery to the value of £17,000 has been installed; it was purchased in France (£10,000) and in the Cape Province. As sugar and other products from which "Natalite" is made exist in abundance in East Africa, the future of the industry in that country is assured, the more so owing to the increased imports of motor cars and the shortage of petrol in the country. The fuel is also expected to be of value for aeroplanes, as it does not readily freeze.—(*Times Trade Suppl., Aug.* 16, 1919.)

Vegetable Oil Production in Southern France.—Olive oil from the Bordeaux district has acquired a world-wide reputation for quality and delicate flavour, and especially popular is a grade of oil obtained in the Bordeaux refineries from a crude oil which comes from Nice. During the war little oil has been exported, the bulk of the production being consumed in France. With the olive crop, abundant production occurs only in alternate years, and, as last year was the good one, the present harvest will not be very large.

The extraction of groundnut oil was established in Bordeaux in 1867, and the industry is now in the hands of one firm with a number of branches at Bordeaux and Marseilles. This firm has 150 collecting depôts in West Africa and imports the nuts in its own steamers. The Bordeaux plants can deal with about 96,000 tons of nuts (in shells) per annum, while the Marseilles refineries have a daily output of nearly 80 tons of superior oil.—(*U.S. Com. Rep., June* 7, 1919.)

Oil and Fat Industries at Esbjerg (Denmark).—A small company was formed in 1916, with a capital of about £2500, for the production of edible bone fat, meat extract and bone meal. About 50 tons of fresh bones is treated per month. The process consists in steaming the bones to remove the fat, and then grinding them to meal suitable for manure and cattle food. A certain amount of meat juice settles from the fat and is collected and concentrated to a bouillon. The latter product was formerly sold to Germany, but recently the demand has dropped and a stock of 50,000 kilo. has accumulated. The bone fat is used locally and sells at about 1s. per lb. A Copenhagen firm (Danske Ollemoller Saebe Fabrikken) has recently erected a plant for the manufacture of oils from copra, soya beans, groundnuts and cotton seed. The present plant cost about £200,000, and a refinery for the production of edible fats is projected. The benzine extraction process has been adopted, owing to the higher yields obtained, but in allowing for extensions provision has been made for installing oil presses if needed. The company is purchasing copra and soya from Asiatic Russia and cotton seed from Egypt. The plant at present consumes about 20 tons of coal and ½ ton of benzine per day.—(*U.S. Com. Rep., June* 5 *and* 7, 1919.)

Chemical Information Bureau in Jugo-Slavia.—Engineer M. Rojan has opened a technical bureau for chemical industry in Zagreb, more particularly in connexion with the sulphuric acid, superphosphate and tar distillation industries.—(*Z. angew. Chem., June* 6, 1919.)

Production of Iron Ore in the U.S.A. in 1917.—The iron ore mined in the United States during 1917, exclusive of that containing 5 per cent. or more of manganese, amounted to 75,288,851 gross tons. Of the iron ore mined, 94 per cent. was hematite; brown ore and magnetite furnished little more than 6 per cent. of the total production. The Lake Superior district produced nearly 85 per cent. of the total ore mined.

The average price per gross ton was, hematite $3·12, brown ore $2·95, and magnetite $4·29, representing a general average price of $3·15 per gross ton in 1917 which, compared with $2·34 in 1916, shows an increase of nearly 35 per cent.—(*U.S. Geol. Survey, April* 1919.)

Quicksilver in 1917.—The production of quicksilver in 1917 in the United States rose to 36,159 flasks (of 75 lb. net) and was the highest since 1883. It was obtained almost wholly from previously productive deposits. The demand for quicksilver is increasing in greater proportion than the supply, hence a fall in price is unlikely.

The cost of production is very variable, low grade Californian ores containing about 0·38 per cent. recoverable quicksilver costing from $65 to $70 per flask to produce and sell. The Government purchase price was $105 per flask and the San Francisco market price varied from $80 to $140.

The richest ores in the world are those of Almaden, Spain, where the average yield for 1917 was nearly 7 per cent. of metal. The Californian average yield was 0·38 per cent. and that of Texas 1·42 per cent. Wet gravity concentration of ore has not proved successful, but an experimental oil flotation plant gave promising results. The substitution of wooden for brick condensers constitutes a great economical advance due to the retention of mercury by the brick structures; 335 flasks of quicksilver were obtained directly by passing about 8000 tons of "earth" from the sites of old furnaces through a washer. The Scott shaft furnace is the standard type used, but retorts can be successfully used on rich ores, although their use is attended with the danger of mercurial poisoning.—(*U.S. Geol. Survey, March* 1919.)

The American Lime Industries.—In 1917 3,440,000 tons of lime was produced by 595 plants in the United States at an average price of 26*s.* per ton, being a decrease of 7 per cent. in output and an increase of 28 per cent. over the price in the previous year. Prior to the war over 1000 plants were employed, but the output has remained the same though the number of plants has been so greatly reduced. It is reported that the increase in cost of production is greater than the increase in the selling price. The State of Pennsylvania produced about one-quarter of the whole output, the remainder being produced by most of the States in relatively small percentages. Ohio, however, produces one-eighth.

The quantity of lime used for building and agriculture decreased notably in 1917, but that used in paper-making, tanning, blast furnaces, chemical works and sugar factories all increased, the most notable increase being in the sugar factories, which used double the normal amount of lime, though this is only about 1 per cent. of the total lime produced. Pennsylvania produced 42 per cent. of the lime used as a flux in the iron and steel industries, and the average price of lime for this purpose rose from 16*s.* 8*d.* per ton in 1916 to 22*s.* 8*d.* in 1917. The quantity of lime used for chemical purposes passed all previous records, amounting to 700,000 tons—an increase of 24 per cent.

Hydrated lime, chiefly used for building and agriculture, after increasing annually for several years declined about 1 per cent. in quantity but

increased 28 per cent. in value. The amount produced is nearly 19 per cent. of the total lime burned in 1917; this is practically the same percentage as in 1916.

About 7000 tons of lime was imported into the United States in 1917, about the same amount as in 1916, almost the whole of which came from Canada. The total quantity exported was 17,000 tons, chiefly to Canada, Mexico, and Central America.

The fuels used for burning lime in the United States are coal, wood, oil, natural gas, producer gas, coke and shavings. Of the kilns used for burning lime 32 per cent. consists of continuous vertical runner kilns in which the fuel and limestone are fed in alternate layers, 61 per cent. of continuous shaft kilns in which the fuel is kept separate from the stone, 1 per cent. of rotary kilns, and 20 per cent. of intermittent or unspecified types.—(*U.S. Geol. Survey, May* 1919.)

The Cohune Nut Industry in Honduras.—The carbonised shell of the cohune nut was found to be one of the best forms of charcoal for use in gas masks, and during the war the United States Government organised a large industry in this material. Although the need for gas-mask carbon has ceased, a permanent industry may yet be established for the extraction of oil from the kernels. The nuts grow in large clusters on the Manaca palm, one tree yielding about 300 lb. per annum. The nuts are from 1¼ to 3 inches long and from 1 to 2 inches in diameter. The shells are over ¼ inch thick, very dense and hard, and special machinery is used to crack them in order to free the kernels for oil extraction. The oil is stated to be superior to coconut oil for edible and cooking purposes. Honduras is the chief source of the cohune nut; in one district alone, in the Aguan Valley, a monthly yield of 10,000 tons could be collected. This district will shortly be opened up by railways.—(*U.S. Com. Rep., June* 6, 1919.)

The Platinum Output of Columbia.—Now that the Russian market is closed, the platinum output of Columbia is of very considerable importance. Outside the Russian Urals, platinum in appreciable amount occurs only in the region of the River Choco, a river of Columbia rising in the Andes. It is anticipated that supplies of platinum from Russia will fail in from 30 to 40 years. The supplies from the region of the Choco river however increase steadily every year. The following table shows the annual output from the respective regions:—

PLATINUM PRODUCTION.

Year	Russia (oz. troy)	Columbia (oz.)
1911	300,000	12,000
1912	185,381	15,000
1913	173,642	15,000
1914	156,775	17,500
1915	107,774	18,000
1916	78,674	25,000
1917	—	50,000

—(*Z. angew. Chem., July* 8, 1919.)

Mineral Oil in Venezuela.—The "Bermudez" Asphalt Lake with an area of 1100 acres is stated to contain asphalt of much better quality than that of Trinidad Asphalt Lake; well-sinking for oil is now proceeding in the vicinity. Asphalt and oil also appear to occur in the Delta Island of Pedernales; and in the west, particularly around Lake Maracaibo, the existence of these minerals appears to be definitely established. There is believed to be a great future for the mineral oil industry in Venezuela, the present production being regarded as a mere fraction of that which will be secured within a few years. Tank reservoirs have been built at La Guaira and Puerto Cabello, and oil fuel is in use on the railways. A refinery is in operation at San Lorenzo, 60 miles south of Lake Maracaibo; and a second one, with a capacity of 6000 barrels a day, is under construction on Curacao Island.—(*Bd. of Trade J., July* 10, 1919.)

The Nipah Palm Industry in British North Borneo.—The Bureau of Science, Manila, estimates that there is 12 per cent. of recoverable sugar in the sap of the Nipah palm (*Nipa fructicans*), which grows extensively in Borneo; and, reckoning on a yield of 4000 galls. of sap per acre annually, calculates that the resultant 4000 lb. of sugar would make the production a commercial success.

The manufacture of alcohol from Nipah sap is a well-established industry, the natives of the Philippines having for many years produced a beverage averaging about 25 per cent. alcohol. In 1913, 75 modern distilleries produced 2,500,000 galls. of distilled spirits of which over 98 per cent. is diluted for beverages, the remainder being utilised as fuel. The average cost of collection is about 4*s.* per 100 galls., but in a well-managed area it can be collected and delivered at a cost of two or three shillings. Between 6 and 7 galls. of alcohol can be produced from 100 gallons of sap. Thus the cost of raw material should be between 4*d.* and 6*d.* per gall., while the distillation plant should not cost more than £3000 for a 500 galls. per day unit. The total cost of production, allowing for wages, fuel and interest on investment, should not exceed 10*d.* per gallon. Experts who have operated in the Philippines put the cost of production under favourable conditions as low as 7*d.* per gallon.

The British North Borneo Government estimates that at least 300,000 acres of the Nipah palm exist at very accessible points in their territory, and their Department of Forestry discusses in Bulletin No. 3 the possibilities of establishing this industry. Further information can be obtained from the Secretary, British North Borneo (Chartered) Company, 37, Threadneedle Street, E.C. 3.—(*Bd. of Trade J., Aug.* 7, 1919.)

The Chemical Pulp Industry in Russia.—According to the *Paperjournalen* about 10,000,000 poods (161,000 long tons) of sulphite pulp was manufactured annually in Russia before the war, but owing to the low cost of labour, the factories were operated very inefficiently with old-fashioned machinery. Germany furnished nearly all the machinery, but few German firms were willing to grant the long credit required: this fact accounts for the scarcity of pulp factories in Russia.

During the war a new factory capable of an output of 20,000 tons of dry pulp per annum was built, but many existing ones were destroyed by artillery fire. Notwithstanding disadvantages, the Russian pulp industry has been very profitable because of cheap labour, high prices and the heavy duty preventing importation from countries other than Finland. The consumption of paper increases every year, and in the future competition will be free to all countries without distinction.—(*Bd. of Trade J., Aug.* 7, 1919.)

Re-use of Perished Rubber Bungs.—A simple method for rendering hard perished rubber stoppers again serviceable for use is given in a recent issue of the *Zeitschrift für öffentliche Chemie.* If the rubber stopper is not entirely perished, it can be restored to a usable condition by turning off the hardened external portion in a lathe, the turned surface being finally smoothed with sand paper. The softer the stopper, the greater must be the speed of rotation of the lathe. The hardened surface of a boring in the rubber stopper is similarly removed by means of a round file, the stopper being rotated in a lathe.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Spirit Duty.

In reply to Sir F. Hall who stated that British manufacturers of certain articles cannot compete with Germany on account of the high spirit duty in this country, and asked if such duty could be modified, Mr. Baldwin said that methylated spirit was duty free, and Section 8 of the Finance Act, 1902, allowed the use of pure spirit under certain conditions; no alteration in the law was called for, but he was willing to consider any particular case. —(Aug. 6.)

Gretna Green Munition Factory.

Answering Mr. Rose and Mr. Young, Mr. Kellaway said that the total capital cost of the above factory was about £9,184,000, and the cost of working from September 1916—September 1918 about £12,769,000. The value of the cordite manufactured was about £15,000,000, or £8,600,000 less than would have been required to purchase it from America at 1916 prices. A report on the future use of the factory is now under consideration.

The memorial from the chemists at this factory on the subject of revision of salaries, and a memorandum from the Institute of Chemistry, led to the appointment of a committee of the Treasury to examine the question, which is still sitting. He sincerely regretted that no reply was sent to the memorial. The Department of Explosives Supply had done much to improve the status of chemists employed in industry, and salaries paid by it compared favourably with those paid by private firms before the war, after making full allowance for increased cost of living. The Department is now employing thirty-five chemists and the number is being rapidly reduced.—(Aug. 7.)

The Zinc Industry.

Asked by Mr. Holmes if the National Smelting Co., Ltd., had resumed building operations at Avonmouth, if new arrangements had been made with the Government, and whether the Board of Trade proposes to carry out the recommendations of the Committee on the Sulphuric Act and Fertiliser Trades, Mr. Bridgeman replied that the arrangements made between the Government and the company in 1917 have not so far been modified in any respect. The whole question of the future of the home spelter industry is being considered.—(Aug. 11.)

Coal Consumption.

Mr. Bridgeman, answering Col. Burdon, gave the following figures of coal distribution for the year 1917 (millions of tons):—Total, 183; chemical and allied trades, 5; paper, printing, etc., 2; building, clay and stone, 6½; textiles, 9; blast furnaces, 19½; electricity works, 7; gas works, 18½; railways (locomotives), 13; and mines (other than coal mines) and quarries, 2½.—(Aug. 11.)

Import Restrictions on Chemicals.

Several questions on this subject were put by Mr. Raffan to the President of the Board of Trade, and were answered by Mr. Bridgeman.

(1) *Q.* If the Licensing Sub-Committee (Dyes Department) of the Import Restrictions Department has the power, before granting permission for the importation of medicinal chemicals, to demand the name of the actual manufacturers as well as that of the consignors and to demand the original invoice and to levy a charge of 1 per cent. on it, estimated at the rate of exchange at the time of granting permission to import?

A. Dye intermediates can be imported only under licence and must be consigned to the Central Importing Agency, which is entitled to levy a charge of 1 per cent. to meet expenses incurred. This arrangement has been made by the Licensing Sub-Committee of the Trade and Licensing Committee, and has met with the general approval of all the interests concerned. The name of the actual manufacturer is necessary in order to prevent the indirect importation of German dyes and materials, and the invoice value for the purpose of calculating the agency fee. Chemicals suitable only for medicinal purposes are not included within the scope of the arrangement. The Licensing Sub-Committee of the Dyes Department is distinct from the Import Restrictions Department. No fees are charged by the latter.

(2) *Q.* If the Department of Import Restrictions is inquiring why the requirements of such substances as diethylbarbituric acid, methylsulphonal and santoine cannot be satisfied in this country, notwithstanding the fact that these chemicals are not manufactured in Great Britain to any appreciable extent?

A. No inquiry as to the chemicals named can at present be traced, but it is a matter of routine to inquire of applicants for licences whether their wants cannot be satisfied from home sources. When it is agreed that chemicals which are needed are not manufactured in this country to any appreciable extent licences to import them are freely issued.

(3) *Q.* Whether the Licensing Sub-Committee (Dyes Department) of the Import Restrictions Department has the power to prohibit the importation of such chemicals as antipyrin, amidopyrin and phenacetin, notwithstanding the fact that these chemicals are used entirely for medicinal purposes, and are not in any sense intermediary dye products?

A. The three products named are undoubtedly intermediate coal-tar products, but for the reason stated in the question the duty of issuing licences for them has, by interdepartmental arrangement, been transferred from the Licensing Sub-Committee of the Dyes Department to the Department of Import Restrictions.

(4) *Q.* If the importation of vanillin into this country has been entirely prohibited in spite of the fact that the entire output of British manufacturers has been sold up to the end of September; and whether the effect of this prohibition has been to increase its market price from 45*s.* to 80*s.* per lb.?

A. The importation of vanillin is not prohibited entirely; it is restricted to 50 per cent. of 1915 imports. The suggestion in the latter part of the question is not acceptable.—(Aug. 14.)

Muriate of Potash.

Mr. John Dennis addressed questions to the President of the Board of Trade, to the Parliamentary Secretary of the Board of Agriculture, and to the Minister of Labour concerning the application of a farmers' co-operative society in Norfolk to import 200 tons of muriate of potash. Sir A. Geddes replied that the application, received August 11, had not yet been replied to. The requirements of the company will be filled by the British Potash Company, who hold a licence for the higher grade of potash salt referred to. The Alsace-Lorraine Trading Company does not import the higher grade salts, and if the West Norfolk Farmers' Manure Company, Ltd., has contracted to buy an import-prohibited article it should have first assured itself that a licence would be issued. It is probable that the muriate, which will arrive in the course of the next day or two, will be delivered at a price at least as favourable as that

at which it could be obtained from the Alsace Company. That price will be the f.a.s. price at Rotterdam, as fixed by international agreement, plus incidental expenses.—(Aug. 18.)

H.M. Factory, Queensferry.

Mr. Kellaway informed Mr. Rose that the capital expenditure on building and equipment of the factory had been £4,150,000; the expenditure on wages, approximately, £1,673,000; and the average number of employees from 1915–18 about 2500 men and 2500 women. The value of the total output of the factory is estimated at £19,800,000, and at £33,000,000 at American contract prices. The future of the factory is still under consideration.—(Aug. 18.)

The late Colonel Harrison.

In answer to Brig.-Gen. Croft, Mr. Hope stated that the late Col. H. F. Harrison died in November last of pneumonia, death being accelerated by the effects of the gases to which he had constantly exposed himself since July 1915 in testing gas masks. He left a widow and one son. The original pension of £135 per annum granted to the widow has recently been raised to £300 per annum, with effect from November 1, 1918. He was glad to take the opportunity of acknowledging the distinguished and devoted services of this officer.—(Aug. 18.)

Government Policy.

The Prime Minister, in the course of a three-hours' speech, stated that the Government had decided against the principle of State purchase of the coal mines, but Bills were being prepared for the purchase of mineral rights, for the raising of a fund to secure improvements in housing and social conditions of miners, to amalgamate mines in certain defined areas, and to secure the appointment of workers' representatives on the committees appointed to direct and control the mines in these areas.

The present trade policy would be terminated on September 1. The Government would submit proposals to prevent "dumping" and to protect "key" industries by an import licence system. These industries will probably need financial support for some time, but care would be taken to prevent undue profits. Assistance would be given to invention and industrial research. An Imperial Trade Investigation Board has been constituted to develop trade within the Empire; and a sum of £26,000,000 will be allocated as a banking trade account to enable Serbia, Rumania, Poland, etc., to resume trade relations with this country.

Two Bills introduced that day by the Minister of Labour were intended to introduce a 48-hour week and a minimum wage for all industries.

A Bill was to be introduced to control and develop canals and waterways for industrial purposes.—(Aug. 18.)

Fuel Research.

Mr. H. Fisher, replying for the Prime Minister to Lieut.-Col. Burgoyne, said that the laboratories of the Fuel Research Station at Greenwich are completed and have begun work. The main building will, it is hoped, be finished next month. The estimated total cost of buildings and equipment is £193,588. Experiments on the utilisation of inferior coal and colliery waste will be undertaken after the station is complete.—(Aug. 19.)

HOUSE OF LORDS.

The Patents and Trade Marks Bills.

In view of the lateness of the Session and of the important nature of the Bills, their second reading was postponed until after the recess.—(Aug. 14.)

GOVERNMENT ORDERS AND NOTICES.

IMPORT RESTRICTIONS.

With reference to the Prime Minister's statement in Parliament on August 18 (see previous column), on the subject of trade policy, the Board of Trade makes the following announcement as to the steps which are proposed in connexion with imports of goods from abroad.

Legislation will be introduced when Parliament reassembles in the autumn:—

(*a*) For the protection of goods manufactured in Great Britain and Ireland against "dumping," by taking power to prevent the sale in this country of similar goods beneath their price in the country of origin.

(*b*) To enable the Board of Trade to check any flood of imports (for instance from Germany) that might arise from a collapse of exchange so disproportionate to costs of production in the country of origin as to enable sales to take place in this country at prices altogether below costs of production here.

(*c*) To deal with unstable "key" industries in the following way:—

A limited number of unstable "key" industries will be scheduled, the products of which will be prohibited from importation into this country except on licence.

Pending legislation, a general licence under the Prohibition of Import Proclamations will be issued by the Board of Trade having effect as from September 1, 1919, and authorising the importation into the United Kingdom of all goods with the exception of the following, which will be treated as products of unstable "key" industries:—

(1) All derivatives of coal tar generally known as intermediate products capable of being used or adapted for use as dyestuffs or of being modified or further manufactured into dyestuffs. All direct cotton colours, all union colours, all acid colours, all chrome and mordant colours, all alizarine colours, all basic colours, all sulphide colours, all vat colours (including synthetic indigo), all oil, spirit and wax colours, all lake colours, and any other synthetic colour, dyes, stains, colour acids, colour lakes, leuco acids, leuco bases whether in paste, powder, solution or any other form.

(2) (i) Synthetic drugs (including antiseptics)

(ii) Synthetic perfumes and flavourings; synthetic photographic chemicals; synthetic tannins; esters and acid derivatives of aromatic hydrocarbons; alkaloids and their salts (except quinine); and the following organic chemicals:—Acetamide; acetic acid; acetic anhydride; acetyl chloride; camphor bromide; cinnamic acid and its salts; ethylene bromide; formamide; formic acid and its salts; gallic acid; lactic acid and its salts; nuclein; paraldehyde; pyrogallic acid; saccharin or other substances of like nature or use; salicin; thymol.

(iii) Analytical reagents; and the following fine chemicals:—Barium compounds; cerium fluoride and fluorides of other rare earth metals; hydrosulphites and allied bleaching compounds; hypophosphorous acid; iron and ammonium citrate; iron tartrate; molybdic acid and its salts; phosphorus oxides and halogen compounds; salts of per-acids and artificial peroxides; silver nucleinate and protelnate; tungstic acid and its salts.

(3) Optical glass including lenses, prisms and like optical devices; (4) scientific glassware; (5) illuminating glassware; (6) laboratory porcelain; (7) scientific and optical instruments; (8) potassium compounds; (9) tungsten powder and ferro-tungsten; (10) zinc oxide; (11) lithopone; (12)

thorium nitrate; (13) gas mantles and mantle rings; (14) magnetos.

In addition to the above, in pursuance of the undertaking given by the President of the Board of Agriculture in the House of Lords on March 19, 1919, the prohibition on the importation of hops will be continued for the present.

It is not proposed to make any additions to the above list unless and until Parliament so determines, with the possible exception that in the event of the contingency foreshadowed in paragraph (*b*) above arising, it might be necessary to suspend temporarily all or any of the imports from the country affected by the collapse of exchange.

GOVERNMENT TRADE POLICY.

The Prime Minister has addressed an open letter to the press in which he summarises and gives further particulars in regard to the proposals made by him in the House of Commons on August 18.

Key Industries.—Only such industries which fulfil the following tests will be regarded as "unstable key" industries:—

(*a*) That the product is essential for war, or for the maintenance of the country during war.

(*b*) That the industry had been so neglected before the war that there was an inadequate supply of the product.

(*c*) That the industry is one for the fostering and promotion of which the Government found it necessary to take special steps during the war.

(*d*) That if special Government support were withdrawn, the industry could not maintain itself at the level of production essential to the national life.

It is proposed that the fees charged for the issue of licences to import goods produced by such "unstable key" industries will be fixed in each case with regard to the difference between the price at which the article can be imported and the price at which similar articles can be sold in the United Kingdom. It may be necessary for some years for the Government to continue to assist these industries. Care will be taken that no undue profits shall be made at the expense of the community. Pending the grant by Parliament of the necessary powers to give full effect to this policy, the Government intends to continue the existing import restrictions which affect industries qualified to be regarded as unstable key industries. These will be scheduled and the schedule published at an early date.

Exports.—The Government will endeavour, through the Consular and Commercial Attaché Services, to stimulate the export trade in every direction.

Statistics and Information.—The Government will collect fuller information about production, trade, prices, costs and profits than has hitherto been obtained, and seek any powers that may be requisite.

Standardisation.—It is proposed to set up at the Board of Trade a Department of Standards (1) to promote and co-ordinate standardisation generally, and (2) to establish and administer such testing institutions as may be found necessary, and authorise and, so far as may be required, supervise the testing work carried out by technical institutions, trade organisations or private concerns.

FOREIGN TRADE.

Arabia, Hungary.—The Board of Trade has issued general licences authorising, with certain reservations, the resumption of trade with Arabia and Hungary.

"Occupied" Germany, etc.—Goods intended for "occupied" Germany, Luxemburg, Alsace-Lorraine, or Switzerland may be shipped at the exporter's option by any of the several routes now available.

Poland.—The Polish Commercial and Financial Agency, 88, Kingsway, W.C. 2, has been authorised to issue import permits, from whom the necessary forms may be obtained. The charges for an import permit are 5*s*. stamp duty, and one-tenth per cent. of the total value of the goods.

Long Term Credits for Export.—The Board of Trade has notified that an office will be opened shortly for furnishing sterling credits for assisting the exportation of goods to certain disorganised parts of Europe. Credits will not be furnished for the export of raw material or for the sale of stocks held by Government Departments.

REPORTS.

FIFTY-FIFTH ANNUAL REPORT ON ALKALI, ETC., WORKS BY THE CHIEF INSPECTOR, 1918. *Pp.* 81. (*London: H.M. Stationery Office.*) *Price* 2*s*.

The aggregate number of registered works in the United Kingdom in 1918 was 1580, a decrease of 2 on the previous year; this includes 166 works in Scotland. War conditions continued to exert their adverse influences on production and also militated against a full degree of inspection, but in spite of difficulties in maintaining output and effecting repairs, those responsible continued to meet the situation effectively, expending effort even on the extension and erection of plant and the consideration of fresh channels for activity in anticipation of possible post-war changes. From many districts an inferior quality and restricted supply of male labour are reported, but associated with this is the increasing efficiency of female labour. The tendency towards closer co-operation by firms engaged in the same departments of manufacture is again noted, and particular reference is made to a movement for forming a central laboratory for the consideration of questions and problems connected with the tinplate industry in South Wales, whilst the more extended employment of trained chemists in chemical works generally is mentioned with satisfaction as indicative of a more progressive policy.

Alkali Works.—The development of electrolytic methods for producing alkali and chlorine was very considerable, and towards the close of the year the operation of the Leblanc process was materially curtailed through its influence and that of the ammonia-soda process. In the future it is thought that the Leblanc process must yield, as regards the manufacture of alkali, to a combination of the two newer methods, and that the demand for hydrochloric acid and salt-cake, though still necessitating the decomposition of common salt with sulphuric acid, is likely to be met by the output of smaller works distributed more widely throughout the country. In Scotland the use of mechanical furnaces continued to give satisfaction, alike as regards costs and the maintenance of minimum escapes of acid gases. An unusual and fatal accident is reported through the sudden breaking of a salt-cake pot, the contents of which, falling into the fire-flue, caused a blow-back through stoppage of the draught.

Cement Works.—The output was much below the full capacity of the available plant, and it is considered that a great deal has to be done in repairs before normal working conditions can be restored. Little definite progress of a practical character was made towards the recovery of potash from kiln fume, although considerable quantities of the

heavier particles were deposited in flues and utilised for agricultural purposes.

Smelting Works.—In the South Wales district excessive amounts of sulphurous gases were discharged into the air from furnaces which prepare sulphide ores for zinc extraction but do not allow of utilisation of the sulphur acids produced, and it is urged that the use of such furnaces be discontinued as soon as possible. There was a more limited supply of sulphide ores other than those of zinc, partly owing to the development of methods for treating such ores at the mines in other countries. The deposition of fumes by mechanical methods continued in successful operation, whilst electrical methods extended, both as regards the scale of operations and the number of works in which they were adopted.

Sulphuric Acid.—The large increase in productive capacity in works specially erected to meet the abnormal war requirements eased the heavy pressure which was previously in evidence, but the conclusion of the armistice led to new plants erected on modern lines not being put into operation, while several plants already in operation were stopped. The easing of pressure allowed of necessary repairs, but shortage of labour and materials prevented rapid progress in this direction, although the general condition of working plant throughout the country was materially improved. Those of the newer designs of plant calculated to work with limited chamber space continued to give satisfaction, and instances are also noted in which a combination of the newer with the older type is in use, but as regards the latter it is considered open to question whether it is wise to combine two systems which differ in fundamental characteristics. It would seem that if the gas composition is adjusted to suit the small chamber space section of such a compound unit it will be too nitrous for the other section, and *vice versâ*, whilst an intermediate gas mixture is not calculated to elicit the best results from either section. The use of nitrous gases produced by the catalytic oxidation of ammonia continued to give much satisfaction, and the operation of this method was considerably extended; as experience is acquired, its facility of control and uniformity of operation are more recognised, and it is stated to be less costly than the old method, but it is pointed out that this aspect must depend on the relative cost of raw materials at the works. Oxide of iron contact towers, erected between the burners and the Glover tower, were under trial in several works, but did not give such good results as were anticipated, although in one instance such a tower led to a reduction by one-third of the nitre required to work the process. It is thought that the difficulties encountered are not fundamental, but that they are to be overcome by persevering effort. Trouble due to dust carried forward with the burner gases continued to receive much attention, and a modification of the usual chamber practice which has given satisfaction consists in removing part of the dust in depositing flues, and then cooling, washing, and filtering, and finally re-heating the purified gases before entering the Glover tower. This system entails more elaborate plant and increased fuel consumption, but is said to offer distinct advantages in yielding a high-grade acid and ensuring more regular working. Sulphide ores of zinc have proved satisfactory for use in the contact process and the calcined ore suitable for the extraction of zinc, but much difficulty has arisen in some cases in sufficiently purifying gases derived from the burning of pyrites, which has led to inefficient conversion of sulphur dioxide into sulphur trioxide and consequent high escape of acid gases, along with low production of "oleum." Gaillard towers continued in use for the concentration of sulphuric acid, but to a more limited extent, and these are still characterised by emitting the discharged waste gases higher in acidity than other types of plant. A modified form of Kessler concentrator did highly satisfactory work and the Davis concentrator proved efficient in bringing chamber acid up to about Glover tower strength. The Calder-Fox scrubber in its improved form is considered an efficient remover of suspended liquid particles. A man was fatally gassed by arsenuretted hydrogen whilst cleaning out a tank used for storing concentrated sulphuric acid, and attention is again called to the dangers of working in such tanks without proper ventilation both prior to anyone entering and also throughout the period of working, and to the necessity for taking precautions against the existence or formation of arsenuretted hydrogen.

Chemical Manure Works.—Greater activity characterised this industry; there was an increase both in the number of registered works and in their power of production. Indeed, in Scotland the quantity of phosphates and bones dissolved (76,800 tons) is the largest on record. The use of nitre cake is likely to become permanent as offering certain advantages apart from the question of producing superphosphates during a period of limited acid supply. The adoption of mechanical dens extended considerably, to the advantage of the industry, and many new types have been introduced.

Sulphate and Muriate of Ammonia and Gas Liquor Works.—Towards the close of the year there was a reversion towards the manufacture of sulphate of ammonia in several works where plant for production of concentrated ammoniacal liquor had been erected to meet the extensive but temporary demand for that product for munition purposes. The total quantity of ammonia products produced was less than in 1917 by the equivalent of 26,066 tons of sulphate of ammonia; thus, the first and the last year of the war were both associated with a reduced recovery of ammonia products. The shrinkage in 1918 was large when the expanding character of ammonia recovery for many years past is considered. Amongst influences tending towards a smaller production are mentioned the inferior quality of coal used, the use of water-gas, the large production of gas per ton of coal carbonised, the use of steam in vertical retorts, the production of concentrated ammoniacal liquor, accompanied too frequently by a high working loss of ammonia, and a reduction in the quantity of gas consumed. It is pointed out that a large production of gas per ton of coal carbonised and the use of steam in vertical retorts may lead to an increased recovery of ammonia per ton of coal, but that if the weight of coal used per volume of gas distributed is more than correspondingly less, an increased recovery per ton of coal carbonised is associated, on a similar gas consumption, with a decrease in the actual quantity recovered. In commenting on the foreign (largely German) control under which recovery coke-oven plant was erected before the war, it is observed that during the war important additions were made to works of this class by British effort and with British material, so that the future erection of such plant need not return under the former control. A fatal case of gassing occurred in a works where the proper procedure was not followed in attempting to remove a blockage in the exit pipe from the decomposer in a plant for producing concentrated ammoniacal liquor in a coke-oven works. Another fatality is reported from a sulphate of ammonia works where a female worker was gassed while endeavouring to replace a plug in a vent-hole in the pipe leading from the still to the saturator. Death in the second case was stated

to be due to carbonic acid poisoning, but it is thought probable that other gases were partly responsible. New installations of the "direct" process of sulphate making in gas works were put into operation during the year, but in two cases this process was discarded in favour of the ordinary distillation process, and in other works recovery by the direct process was disappointingly low. It is pointed out that it is only by careful attention to working conditions at the "bubbler," ammonia still, and gas purifiers that the best results can be obtained, and that where the process has been specially studied improved production has resulted. A memorandum on the analysis of ammoniacal liquor is attached as an appendix to the Report.

Nitric Acid Works.—There was a marked reduction in the output of nitric acid. An appreciable proportion was obtained from oxides of nitrogen resulting from the oxidation of ammonia and from the use of nitric acid in various processes. In most works, however, it was still manufactured by the decomposition of nitrate of soda, and for this purpose use was found for all the nitre-cake available.

Miscellaneous.—There was much activity in wool-carbonising works, and carbonising machines of improved type were brought into more extended use. Tinplate works were restricted in their operations by limited supplies both of labour and material. The use of nitre-cake for pickling the steel plates prior to tinning continued to be widely and successfully practised. The extent of operations was greatly reduced at alkali waste works, less waste being available for treatment in consequence of the increased production of alkali by electrolytic methods. The attractive prices for white arsenic led to the starting of several new works of this class, and, as in previous years, dry filters proved more efficient than wash towers for arresting arsenious oxide. There was active manufacture at bisulphide of carbon works, and in gas works the erection of tar dehydrating plant continued to extend, and there was also an increase in plant for the full distillation of tar. At picric acid works a great falling off in operations following the completion of the armistice is reported.

[Technical details contained in the Report will appear in the Abstracts.]

REPORT OF THE BRITISH CELLULOSE INQUIRY COMMITTEE. [*Cmd.* 306, 3*d*.] (*London: H.M. Stationery Office.*)

The committee appointed by the Government in August 1918 to inquire into the formation and financial arrangements of the British Cellulose and Chemical Manufacturing Co., Ltd., and associated companies, and upon their relations to Government Departments, presented its report to Parliament a few days before the adjournment. Although the terms of reference did not, apparently, cover all the questions raised in the Fifth Report of the Select Committee on National Expenditure (this J., 1918, 300 R), most of the criticisms contained therein receive reference, if not full treatment. Speaking generally, it may be said that the effect of the Report is to exonerate all the parties concerned. The issue of the Report was delayed largely through the continued absence in America of Dr. Camille Dreyfus, one of the principal witnesses, "and the explanations which he has given to us seem to us very unsatisfactory." The history of the inception of the British Cellulose Co. and of its multifarious financial arrangements are described in considerable detail, and lists of shareholders and debenture-holders, with their holdings, are appended. The debentures were issued without Treasury sanction. The oral evidence and the accountants' reports, which are stated to accompany the Report, are not issued with it.

The original company formed to manufacture cellulose acetate and to acquire the Dreyfus British patent rights was promoted by a Canadian staff officer and two others "who had previously essayed without success the manufacture of cellulose acetate in this country." The share capital was £4000, divided into 6*d*. shares, of which approximately one-fourth ultimately went to the subscribers for debentures, 79,998 shares to the Swiss interests, and 41,079 shares to the promoters as their promotion profit. Two years later the second company—the British Cellulose and Chemical Manufacturing (Parent) Co., Ltd.—was formed, with a capital of £3,500,000 in £1 shares, shareholders in the original company receiving £14 10*s*. new shares for one old. Why 6*d*. shares should have been the denomination selected the Committee was unable to ascertain, but no evidence was obtained to show that the capitalisation of either company was used to procure undue influence or that such influence was obtained, nor could any material inference be drawn from the great contrast between the nominal amounts of the shares of either company and the prices at which they were dealt in. The original company's 6*d*. shares changed hands at prices ranging from £1 to £10 10*s*. per share. "The contrast between the nominal capital of the original company and that of the parent company is so glaring that, for much of the criticism to which they have been exposed, we think that the promoters and others connected with the company's financial arrangements have only themselves to thank."

The account of the relations between the companies and Government Departments is too lengthy to admit of a satisfactory summary, but the following points may be selected: The delay in the completion of the company's works at Spondon, near Derby, ceased after Government assistance was forthcoming in respect of granting priorities for materials, etc. The supply of cellulose acetate from France broke down in June 1917, and the ever-expanding aeronautical programme caused additional anxiety. Brig.-General W. Alexander, of H.M. Factory, Gretna, was then appointed Director of Supply, and Mr. J. Radcliffe head of the section dealing with "dope chemicals." The former investigated the possibility of manufacturing at Gretna a "nitro-dope" as an alternative to cellulose acetate. Nitro-dope manufacture is independent of the latter material, but, it is stated, its inflammability is greater. On the report of Mr. Radcliffe that the company had arranged to enlarge its plant to meet the increased programme, instructions were given to proceed with the work at Spondon, all necessary priorities were granted, and a loan of £200,000 was advanced on the power plant. The company started to erect works for the extended production of cellulose acetate, for an acetone plant and for a carbide factory, without waiting for formal sanction.

In November 1916 H.M. Treasury agreed to refund the company its capital expenditure on plant up to a maximum equivalent to the excess profits duty for which it would be liable, subject to the company agreeing to quote reasonable prices and to take orders only for Government purposes during the war. The Committee does not feel itself called upon to discuss this arrangement; and, moreover, while the concession was in force no profits at all were made. Nor does the Committee consider itself competent to pass any opinion on the quality of the company's cellulose acetate; the Technical and the Inspection Departments, however, give preference to the French product as being more uniform.

A considerable part of the inquiry related to complaints of the British chemical trade that prefer-

ence had been shown to foreign interests. The gist of the reply thereto is that the Government policy was to discourage duplication of plant, and that if contracts had been placed with new manufacturers much delay in obtaining deliveries would have resulted.

With regard to the complaint that the Government was made exclusively dependent upon one source of supply, the production from which had been previously criticised, the Committee finds that no ill effect appears to have resulted from the policy adopted; it is also of the opinion that nothing amounting to favouritism to the Company was shown by the Aircraft Department. Attention is drawn to an arrangement whereby each of the managing directors, Drs. Camille and Henri Dreyfus, was allowed £4500 per annum for living and entertainment expenses, and to the chairman, Col. Grant Morden, £5000 for similar purposes; and to the fact that in 1917 Dr. C. Dreyfus had offered to employ a subordinate officer in the Aeronautical Inspection Department at an enhanced salary. "If all the facts," the Report concludes, "which we have sifted with so negative a result, had been available last year to the critics of the company and its proceedings, we think that their conclusions would, to say the least, have undergone large modification. It is satisfactory to be able to report that, in our opinion, there has been neither favouritism nor corruption, and that the official action taken has been throughout such as appeared to the Departments concerned the best that was open to them under the circumstances."

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for August 7, 14 and 21.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials.	Reference Number
Australia ...	Druggists' requisites ...	411
,, ...	Iron, steel, heavy chemicals	412
,, ...	Drugs, dyes	*
British India ...	Druggists' requisites ...	360
,,	Scientific instruments ...	366
,, ...	Drugs, soap, stains, etc.	367
,, ...	Metals	369
,, ...	Dyes, antifriction metals, wall and floor tiles	370
,, ...	Drugs, glass, crockery ...	373
,, ...	Glass, milk food ...	418
British West Indies	China, earthenware, glass	318
,,	Pharmaceutical goods ...	320
,,	Fungicides, insecticides	321
,,	Chemicals, drugs, soap, druggists' requisites	375
,,	Laundry soap	433
Canada	Rubber	314
,, ...	Glass, china	377, 378, 379
,, ...	Chemicals, druggists' goods	420
,, ...	Plate glass for automobiles, etc.	†
Egypt	Chemicals, paints, perfumes	383

*. The Agent General for New South Wales, 28, Cockspur Street, S.W. 1.

† The Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

Locality of Firm or Agent.	Materials	Reference Number.
South Africa ...	Petroleum	387
,, ...	Galvanised sheets ...	429
,, ...	Hides, leather, etc. ...	430
,, ...	Dyes, glass, pottery, paper	431
,, ...	Copper sulphate, caustic soda, saltpetre, linseed oil, grease	432
Austria (Trieste)	Fats, oils, oilseeds, rosin, fertilisers, etc.	434
Belgium ...	Paint, varnish	335
,, ...	Iron, steel, pitch ...	435
,, ...	Steel, metals	437
,, ...	Cretonne paper, cardboard, glue	439
,, ...	Sulphuric acid, sodium sulphate, pitch, calcium chloride, china clay, aniline dyes, pulp. (Goods in demand.)	—
Bulgaria ...	Petroleum, drugs, soap ...	440
,, ...	Copper, tin, galvanised sheets, caustic soda, soap	443
Czecho-Slovakia	Steel	390
Denmark ...	Leather	450
,, ...	Preserved foods ...	453
France	Soap	339
,, ...	Chemicals	391
,, ...	Haematite, Cleveland pig iron, etc.	393
,, ...	Ipecacuanha root ...	395
Italy	Lubricating oils ...	‡
,, ...	Refractory brick, crucibles	461
Netherlands ...	Druggists' sundries ...	463
Poland	Leather, tanning materials	399
,, ...	Chemicals	342
,, ...	Iron, steel, rubber, ceramics, chemicals, soap	§
Russia	Metals	345
Scandinavia ...	Soda ash	400
Serbia	Tinplate, asbestos, machine oils, paraffin, ceresine	466
Spain	Chemicals	351
,, ...	Chemicals, iron, steel, tinplate	352
,, ...	Metals	467
,, ...	Fertilisers	468
Switzerland ...	High-speed steel, chrome and nickel steel, etc.	353
,, ...	Oils, varnish, paint, soap, perfumes	473
,, ...	Chemicals, rubber ...	475
,, ...	Galvanised sheets ...	477
,, ...	Chemicals, drugs, disinfectants, perfumery	482
United States ...	Rubber, oils, chemicals, ores, metals, cattle food	356
Cuba	Chemicals, drugs ...	495
Chile	Iron, steel, glass, chemicals, dyes	357
,, ...	Tanning materials ...	490
,, ...	Glass, china	493

‡ The Secretary, British Chamber of Commerce for Italy, Via Silvio Pellico, 12, Milan.

§ The Secretary, Polish Commercial and Financial Agency, Commission International de Ravitaillement, 88, Kingsway, W.C. 2.

TARIFF. CUSTOMS. EXCISE.

Australia.—Recent customs decisions affect potato flour and condensed milk.

Belgium.—Except in certain cases export licences are no longer required for goods in transit through Belgium.

Export licences are still necessary in the case of, *inter alia*, ammonia, aniline, bones, brass, brick, cement, colours, certain metals, fats, oils, glycerin, gums, hides, lime, manganese dioxide, mineral pitch, nitric acid, phosphates, plaster, potash, resins, rubber, certain sulphates and sulphides, sulphuric acid, tar, tallow, turpentine, varnish and window glass.

Canada.—The Order in Council requiring all goods imported from Belgium to be accompanied

by a certificate of origin and interest has been rescinded as from July 1.

Colombia.—An additional duty of 3 centavos per kilo. has been levied on foreign salt imported at Buenaventura and Tumaco with effect from June 5.

France and Algeria.—Further particulars of the application of the new customs duties are given in the *Bd. of Trade J.* of August 7.

The law for the modification of the customs *régime* of petroleum products came into force on August 5.

French Indo-China.—The regulations governing the import and sale of cocaine, morphine and similar drugs may be seen at the Department of Overseas Trade.

Italy.—Among the articles for which import licences will be required after August 1 are, alcohol and alcoholic beverages, essences and essential oils, fruit syrup, chocolate, copper sulphate, sulphites of soda potash and lime, acetone, soaps, perfumery, vegetable fibres, artificial silk, cement, many metals, sulphur, copra, linseed, horn, benzine, mineral oil, sugar, matches, oilseeds and condensed milk.

A list of articles the import of which is prohibited except when destined direct to State Departments or "consortia" for supplies is given in the *Bd. of Trade J.* of August 14.

Luxemburg.—The provisional customs tariff is set out in the *Bd. of Trade J.* of August 21.

Morocco.—Export licences are no longer required for certain seeds, oleaginous seeds, locust beans, gums, resins, hides, vegetable hair and crude wax.

Netherlands.—The prohibition of the export of peat litter and sulphuric acid has been withdrawn as from July 25.

Recent customs decisions affect amyl salicylate, "pertinax" paper and magnesium perhydrol.

New Zealand.—Among the articles that have recently been classified for customs tariff purposes are metal cylinders to hold liquefied gases, welding rods of steel or aluminium, and certain kinds of paper.

Poland.—A copy of the provisional customs tariff may be seen at the Department of Overseas Trade.

Rumania.—A tax of 20 per cent. *ad val.* has been imposed on all exports except oil.

South Africa.—It is proposed to amend the customs duties on alcoholic beverages, medicinal preparations, ammonia and certain salts, barium peroxide, some preparations of phosphoric acid, borax glass, oil seeds and nuts, etc.

Southern Rhodesia.—The present customs and excise duties are to remain in force until July 31, 1920.

It is prohibited to import bones, bone meal, bone flour, bone dust, bone compound, dissolved bones or the like unless the bones have been sterilised by one of two processes mentioned. A declaration to this effect must be furnished by the importer.

Switzerland.—Export licences are no longer required for cork, artificial silk, lime, clay, sheets of imitation gold and silver, ammoniacal liquor, pure nitrate and Chilean nitre, etc.

Certain goods, amongst which are some chemicals, may only be exported over the Italo-Swiss and Franco-Swiss frontiers.

United States.—Recent rulings of the War Trade Board affect sugar, pig tin, tin oxides, alloys of tin, type metals, salvarsan and all substitutes and equivalents thereof, dyes, drugs, potash and chemicals.

COMPANY NEWS.

FANTI CONSOLIDATED MINES, LTD.

The ordinary general meeting was held in London on August 6, Mr. Edmund Davis (joint managing director) presiding.

After reviewing the financial situation, Mr. Davis described the developments which had taken place in connexion with the company's manganese deposits at Dagwin, near Taquah, in West Africa (this J., 1918, 57 R, 458 R). Shipments of ore during 1918 were 29,124 tons, and for the first six months of 1919, 14,907 tons. The concessions are, however, capable of being exploited to a far larger extent, one property alone, the Dagwin Extension, which has been proved along 2¾ miles, and upon which developments are being actively carried out, being capable of producing 90,000 tons a year. The detrital ore lying on the surface and down to a shallow depth is estimated to amount to nearly 3,000,000 tons. A large tonnage of ore has been sold over a term of years, the only outstanding difficulty being the high railway rate (8*s.* 6*d.* per ton, plus lighterage at Seccondee). Arrangements have been practically completed for the sale of the major part of the company's manganese interests to a new company with a share capital of £630,000, of which £50,000 will be subscribed for by a firm in the United States, which will also contract for 100,000 tons of ore per annum for five years. Steps are being taken to place the ocean transport of the ore in the hands of British shipping companies. As the United States has practically ceased to import ferro-manganese from Great Britain, it will probably need to import from 200,000 to 250,000 tons of manganese ore yearly, and even more if the steel capacity of that country continues to rise as it has done of late years (50 per cent. above pre-war capacity, against 43 per cent. increase for this country).

The balance of profit obtained in 1918 was £72,365 on an issued share capital of £448,448 in 8*s.* shares, and a dividend of 10*d.* per share for the year has been paid.

SOUTH METROPOLITAN GAS CO.

At the ordinary half-yearly general meeting held on August 13, Dr. C. Carpenter, chairman, dealt principally with financial considerations, export restrictions, and the "Beilby" Report on Gas Standards (this J., 1919, 191 R).

After successfully supplying public and private needs in South London for nearly thirty years, and performing work of more national than local importance during the war, the Company found itself in the unenviable position of being compelled by law to limit its half-yearly dividend to 1¼ per cent. less tax (six-elevenths of the pre-war dividend). Business had been quite satisfactory, especially in view of the drastic regulations laid down by the Fuel and Lighting Order. In spite of these and of an increase of 100 per cent. in the price of gas, sales of the latter had only diminished by 2¼ per cent. The principle of the sliding scale had not broken down but its present mode of application had become obsolete. Temporary hardships during the war were inevitable, but the present restrictions on the exportation of one of the company's products were unjustifiable. There should be no difficulty in basing the grant of export licences to individual undertakings upon the difference between home requirements and total production, the intermediation of a "pool" or "trust" being both unnecessary and dangerous. As a result of the present regulations, the company was left with a stock of by-products valued at nearly £250,000.

Dr. Carpenter expressed himself as in general agreement with the recommendations of the "Beilby" report, the chief of which was that in regard to gas no rigid standard of quality, other than calorific power, should be applied. The company proposes to adopt the procedure laid down in this report.

It was to be hoped that no more would be heard of the nationalisation of the coal industry, but mining rights might well be transferred to the State and leased by it to statutory undertakings. Workers in and on the mines should be taken into partnership with the capitalist, and with him have a voice in the management.

NITRATE COMPANIES.

The records of the principal nitrate companies during 1918 are given in the following table (*South American J., Aug.* 2, 1919):—

—	Production		Trading profits		Estimated profit per quintal		Div.	Inc. or Dec.
	1917	1918	1917	1918	1917	1918		
	quintals	quintals	£	£	*d.*	*d.*	%	%
Aguas Blancas	767,000	726,000	65,413	56,924	14	19	10	−3½
Alianza	2,993,857	2,010,798	389,489	467,213	31	55	40	...
Angela	427,777	372,220	34,912	49,069	19	31	30	+5
Anglo-Chilean	2,589,650	2,275,700	435,719	169,494	...	...	15	−10
Fortuna	1,409,668	1,165,613	11,457	61,492	2	13	7½	+7½
Lagunas Nitrate	518,000*	494,000*	60,625	40,653	28	20	2	...
Lautaro	2,287,000*	2,000,000*	333,010	317,064	34	38	18	−6
New Paccha	527,100	535,000	14,634	29,809	6	13	10	−5
Salar del Carmen...	616,180	676,081	63,356	82,812	14	28	20	−15
San Lorenzo	349,000*	303,000*	16,903	23,192	12	18	25	...
San Patricio	217,000*	285,000*	7,180†	10,874	...	9	nil	...
Santa Rita	431,000*	430,000*	9,902	12,372	5	7	5	+5
San Sebastian	366,929	289,254	10,419	12,935	7	10	nil	...
Tarapaca	660,000*	674,000*	75,470	81,675	27	29	10	−5
Total	14,160,161	12,236,666	1,514,129	1,415,578	25	27	...	...

* Estimated. † Loss.

Although dividends have been reduced—by an average of about 3½ per cent.—profits per quintal have been greater on a smaller output. The excellent price obtained of 13*s.* per quintal more than neutralised the increase in production costs in the case of the cheap producers. Since the cessation of hostilities the outlook has been darkening, and the situation will not improve until shipping facilities become available. Even then the market must to some extent be restricted owing to high freights, although the demand for agricultural purposes will be great. Owing to these circumstances the production of synthetic nitrogenous fertilisers is likely to be stimulated, and countries like Germany which possess a developed nitrogen industry will be in a strong position. It is the considered opinion of a chemist, of more than national repute, who has recently inspected the great Haber plants in Germany, that synthetic nitrate will be able to compete with Chilean nitrate at no very distant date. At the present time the German chemical industry as a whole is in a state of suspended animation owing to the dearth of coal.

BRITISH GLASS INDUSTRIES, LTD.

At an extraordinary general meeting held on August 7, Mr. C. W. Milne, the chairman, said the object of the meeting was to obtain authority to increase the company's capital by a further £750,000, and to issue 300,000 new £1 shares at 30*s.* premium. The whole of the shares of the Queenborough Glass Bottle Works, Ltd., and the business of the British and Foreign Bottle Co. have been acquired; and also 300,000 8 per cent. cumulative participating preference shares in the British Window Glass Co., Ltd., whose recent issue was over-subscribed six or seven times. At the company's factory at Canning Town, furnaces with a weekly capacity of 100—120 tons each are being installed; one of them is complete, five are nearing completion, and there are practically another ten in course of erection. There are four furnaces in active operation at the Queenborough works and two additional furnaces ready to start. In addition to the automatic glass bottle-making machines, the company has acquired the sole rights for machines for automatic grinding of stoppers and bottles. An output of 1750 tons per week is anticipated for the factory at Canning Town, where eventually only coloured bottles will be made, the manufacture of the pure white bottles being confined to the Queenborough works. The resolution to increase the capital was passed unanimously.

REVIEWS.

THE CHEMISTS' YEAR BOOK. *Edited by* F. W. ATACK, *assisted by* L. WHINYATES. *Fourth edition, 2 vols. Pp.* 1146. (*Manchester: Sherratt and Hughes,* 1918—19.) *Price* 15*s.* 6*d. net, post free.*

The first edition of the Chemists' Year Book, published at a time when the supply of the well-known German publications of similar scope had ceased, bore signs of hasty preparation, but met a distinct want and secured a considerable circulation. With successive editions the scope and value of the book have increased, and the present edition, though still capable of considerable improvement, is a very useful and on the whole trustworthy work of reference. One of the most commendable features of the Year Book is that the Editor is depending more and more for his material on authorities in the different branches of the subject. New sections have been provided by Dr. J. W. Mellor on "Analysis of Clays, Firebricks and Silica Materials"; Dr. E. J. Russell on "Agricultural Chemistry"; Dr. E. H. Rodd on "Crystallography," and others. Many sections

have been revised including the organic section which is greatly improved. Among the useful contributions to this part of the subject may be mentioned that of Dr. E. Hope on alkaloids.

The scope of the work has been referred to in former reviews, and need not be described in detail. The number of topics touched on is now so great as to raise a doubt whether the Editor is not attempting too much. He will be well advised to devote attention to the improvement of the present sections rather than to further extension of the scope of the book. In this connexion the sections with a physico-chemical bearing deserve special mention. The quotation (p. 436) of the densities of certain alloys to three places of decimals without mention of the temperature is absurd. In many of the solubility tables old and incorrect figures are given and as regards aqueous solutions the composition of the solid (hydrate or anhydrous salt) in equilibrium with the solution is not clearly stated. In these and some other sections much labour must be expended in order to make them an accurate reflexion of the present state of our knowledge, and the revision must be thoroughly done if the work is to hold its own with the German publications which will soon be available.

GEORGE SENTER.

ORGANIC CHEMISTRY OR CHEMISTRY OF THE CARBON COMPOUNDS. *By* VICTOR VON RICHTER *(Edited by Prof. R. Anschütz and Prof. G. Schroeter). Volume I.* CHEMISTRY OF THE ALIPHATIC SERIES. *Newly translated and revised from the German Edition (after Prof. F. Smith's third American Edition) by* PERCY E. SPIELMANN. *Second (Revised) Edition. Pp. viii + 719. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1919.) Price 25s. net.*

Even in these days of specialisation there is doubtless a certain number of people who obtain their knowledge of some particular science by studying an orthodox text-book, but there are probably few who would attempt to obtain a knowledge of advanced organic chemistry in this way, and who would not, in the ordinary course, attend lectures on the subject in one or other of the many recognised institutions. The books required may, therefore, be regarded as being supplementary to the lectures and can be placed in three classes: (*a*) the elementary text-book, (*b*) the advanced handbook, and (*c*) the research and reference literature.

We are well supplied with a number of excellent text-books which fall within class (*a*) and there is little need for criticism in connexion with them, unless, indeed, it were that their number embarrasses choice; regarding (*b*) and (*c*), however, the conditions are quite different.

It will be recognised by every teacher of advanced organic chemistry that a handbook of some kind is essential, because it is impossible in an ordinary course of advanced lectures to deal with any but the more important details, and the lecturer must confine himself mainly to the treatment of particular groups of compounds and make his points chiefly by the comparison of one group with another. In other words a course of advanced lectures in organic chemistry cannot, strictly speaking, be systematic, and the student must necessarily rely on his handbook for his knowledge of the system of the science and for the filling in of gaps.

There are, then, two essential features of the ideal handbook, namely, that it should be systematic and should give without excessive detail the main principles underlying each subdivision of the science. For these reasons those handbooks which are merely a collection of lecture notes, although valuable as representing another point of view, do not supply the want, as it is understood by the present writer, since they suffer under the same disadvantages as the lectures themselves.

Two outstanding attempts have been made to meet the need outlined above—both are German. One was initiated by the late Victor Meyer but left incomplete at his death. It was finished at a later date by Jacobson, and few organic chemists will deny that this treatise, which has never been translated, represents in many ways the ideal method of treatment. The other is V. v. Richter's handbook, a translation of the first volume of which, from the eleventh German edition, has now appeared.

Now, although opinions may differ as to the desirability or otherwise of having books of class (*c*), that is research and reference literature, written by our own people and in our own language, there can hardly be two opinions, apart from any question of the method of treatment, as to the undesirability of having handbooks of class (*b*) translated from other languages. A brief consideration of the book under review will clearly show one reason for this, because, owing doubtless to the complexity of the subject, the first volume of this edition was published at Bonn in 1909, whereas the second volume of the same edition did not appear until 1913. When one contemplates the amount of literature which has passed through the different publishing bodies since this first volume was written, it is clear that a handbook published at that time cannot be now up-to-date. It is true that the translated edition in the present instance is described as revised, but if this revision means correction of the text in accordance with recent discoveries, its effect has been negligible; indeed, the chemistry of this book is the organic chemistry of 1909, that is to say the book is ten years out of date.

Again, there is another great objection to the use of a translation, because it is apt to give a false sense of perspective to the advanced student. This objection is, moreover, enhanced in the present instance, because the Germans have, for a long time past, constituted themselves the recorders and publishers of organic chemical literature, a position which they have often abused by their policy of giving prominence to their own discoveries and deliberately leaving out, wherever possible, all reference to the discoveries made in other countries. It is greatly to be regretted, therefore, that the translator should have retained the original German references in their entirety, because a student reading this book could hardly fail to arrive at the conclusion that organic chemistry was a German science and that the discoveries made by other nationalities were negligible.

Every student of advanced organic chemistry knows "Richter," and probably every student realises, sooner or later, its limitations. The writer can well remember the effect produced on him by his first perusal of it in 1891, and the opinion formed by him then has not changed since. The greater portion of the book is wasted by the inclusion of too much detail which could easily have been placed in tabular form, if indeed it is necessary to include it at all, since such details are mainly of interest to research students and are given in full in the research and reference literature. On the other hand the main principles of the science, represented by the larger type, are given in too fragmentary a manner and a great deal that is essential is omitted.

This criticism is written in no carping spirit, but chiefly in the hope that the right handbook on organic chemistry will be taken in hand ere long. For the present we have nothing but "Richter" and must perforce put up with its many imperfections.

J. F. THORPE.

OBITUARY.

EMIL FISCHER.

The death of Emil Fischer deprives organic chemistry of its greatest leader. We, his contemporaries, can hardly estimate the place his work will take in the future, but it is probable that he will be regarded as one of the greatest organic chemists. Fischer was essentially a worker, he lived for nothing else and, though to work under him was the finest inspiration a young man could have, his pupils in the main have gone into industry. Fischer never founded a school in the sense that Von Bayer has done at Munich and he has not been responsible for any great new theories. His work was typically German, of the very best type, painstaking and thorough to the last degree. As a manipulator he was one of the best in the days when the standard of perfection was far higher than it is to-day, and though of later years he only very occasionally performed experiments himself his powers of observation and criticism remained unimpaired. His personality will remain in the memory of all who met him: tall and handsome in appearance, his voice had a singular charm. His tastes were of the simplest and his life a very retired and regular one solely devoted to his work. He systematically overworked, and regarded himself as more or less an invalid owing to phenylhydrazine poisoning. With his German students he was inclined to be autocratic, but treated the many foreigners who worked under him in a most friendly manner, particularly the English to whom he was very partial.

Fischer was born at Euskirchen in the Rhine province on October 9, 1852, and was nearly 67 when he died. He avoided official functions as much as possible and took but little part in chemical politics. A keen critic himself he was somewhat intolerant of criticism of his own work.

His influence on German chemical industry was very great. He frequently had some technical work in hand though this was always made subordinate to the academic research work. He placed his men in good positions in industry without difficulty, and many of them have since done well. Naturally he attracted the pick of the students from all countries and therefore was particularly fortunate in his collaborators: hence also the "atmosphere" of his laboratory was most enthusiastic and fertile of ideas.

He was a brilliant lecturer, though in later years he lectured to the first year students only: in the weekly colloquium attended by the research staff and students he was at his best as a teacher.

Fischer took his degree at Strassburg in 1874, and eight years later became ordinary professor at Erlangen, moving to Würzburg in 1885 and to Berlin, where he followed Hofmann, in 1892. The old laboratory in the Dorotheenstrasse was quite inadequate, and in 1900 a move was made to the new quarters in the Hannoverstrasse, where every conceivable facility was available and where he began his investigation of the proteins.

Fischer's researches were in the main in connexion with the three groups of natural products: the sugars, the proteins and the purines; he has reprinted his papers in three volumes so that they are easily accessible to the student.

The purine work dates from 1882 and was summarised in 1899—in its course the complex formulæ of uric acid, xanthine, guanine, etc. were established and their synthesis effected. The behaviour of the parent substance of the group, purine, and its derivatives was fully established, and technical methods for the synthesis of many of them have been subsequently elaborated.

Fischer's real love was for the sugars and he continued to work in this field until his death. His ultimate aim, the synthesis of cane sugar, was never realised, though he achieved the first synthesis of a natural disaccharide—melibiose. Probably no other field of work has been so difficult experimentally, and his papers on the synthesis, and still more the proof of the structural and stereochemical formulæ of glucose and its isomerides, are among the classics of chemical literature. In the simplest of language he develops a story which will have power to enthrall the student for many years to come. His talisman proved to be phenylhydrazine, and the first paper describing the interaction of this with the sugars bears the date 1884.

The protein work was begun in the new laboratory in Berlin: it involved first the study of the amino acids, then the application of the knowledge so gained to the analytical study of the products of hydrolysis of the proteins, and finally the coupling of the various amino acids to polypeptides approaching the proteins in complexity.

E. F. Armstrong.

PUBLICATIONS RECEIVED.

Boiler Feed Water. A Concise Handbook of Water for Boiler Feeding Purposes. (*Its Effects, Treatment, and Analysis.*) *By* P. G. Jackson. *Pp.* 102. (*London: Charles Griffin and Co., Ltd.* 1919.) *Price* 4*s.* 6*d.*

Report on Trade Conditions in British East Africa, Uganda and Zanzibar. *Union of South Africa. Department of Mines and Industries. By* T. Sleith. *Pp.* 64. (*Cape Town: Cape Times, Ltd.* 1919.)

Recherches sur Différents Points de la Fabrication des Obus. *By* L. Guillet. *Pp.* 34. (*Paris: La Revue de Métallurgie.* 1917.)

Publications of the United States Bureau of Mines. *Department of the Interior.* (*Washington: Government Printing Office.* 1919.)

A Preliminary Report on the Mining Districts of Idaho. *By* T. Varley, C. A. Wright, E. K. Soper, *and* D. C. Livington. *Bulletin* 166. *Pp.* 113. *Price* 20 *cents.*

Combustion and Flue Gas Analysis. *Reprint of Engineering Bulletin No.* 4. *Prepared by the United States Fuel Administration in Collaboration with the Bureau of Mines. Technical Paper* 219. *Price* 5 *cents.*

Saving Steam in Industrial Heating Systems. *Reprint of Engineering Bulletin No.* 6. *Prepared by the United States Fuel Administration in Collaboration with the Bureau of Mines. Technical Paper* 221. *Price* 5 *cents.*

Boiler Water Treatment. *Reprint of Engineering Bulletin No.* 3. *Prepared by the United States Fuel Administration in Collaboration with the Bureau of Mines. Technical Paper* 218. *Price* 5 *cents.*

Combustion Experiments with North Dakota Lignites. *Technical Paper* 207. *By* H. Kreisinger, C. E. Augustine, *and* W. C. Harrster. *Pp.* 44. *Price* 10 *cents.*

Publications of the United States Geological Survey. *Department of the Interior.* (*Washington: Government Printing Office.* 1919.)

Stone in 1917. *By* G. F. Loughlin *and* A. T. Coons.

Mineral Production of the United States in 1916. *Introduction by* H. D. McCaskey. *Summary by* M. R. Clark.

THE PATENTS AND DESIGNS BILL, 1919.

I. From the Point of View of the Chemical Manufacturer.

ROBERT L. MOND.

The manufacturer stands in a complex relation to patents. He is the principal user of them. As such he acquires those of use to him and owing to the continuous survey of the problems he encounters, and the researches necessary to elucidate them, he himself becomes an inventor and where possible covers his inventions with his own patents. As a patent is a monopoly granted for a limited number of years, in certain cases he desires for his own protection to benefit by this monopoly; in other cases he feels himself hampered by it.

New inventions covered by patents are rarely sufficiently worked out to enable a manufacturer to apply them without considerable further research and expenditure of capital, and many inventions —especially those affecting the large fundamental processes—require large means and many years to establish them on a fully commercial basis.

As these propositions contain an element of self-contradiction, it follows that any patent law must be of the nature of a compromise, and the new Patents Bill must be criticised from this point of view.

The first paragraph attempts to solve the difficulty created by the monopoly value of a patent in so far as it restricts manufacturing in this country, and the machinery adopted is to give very wide powers to the Comptroller of Patents which in certain cases he can delegate to an arbitrator, subject to an appeal to the High Court of Justice. It may be assumed that in all important cases such an appeal would be made, and the question arises whether a special Court with suitable assessors would not prove a more satisfactory tribunal than putting this additional duty on to the back of an already overburdened official.

Compulsory working of patents has been an essential part of the patent laws of most countries, and up to now has invariably proved a dead letter. One of the principal reasons for this is that without cordial co-operation between the inventor and the manufacturer it is only rarely that the printed description of a patent—however carefully drawn—conveys sufficient information to enable a new process to be successfully worked, and this successful co-operation cannot be obtained by compulsion. As a matter of fact a patent is only granted for a demonstrably new idea, whereas some of the fundamental conditions which allow this new idea to fructify may not in themselves be patentable and consequently are automatically excluded.

Paragraph 2 enables a patentee to make the Comptroller the business agent for the disposal of his patent on terms which the Comptroller will settle. Whether many patentees will avail themselves of this privilege will remain to be seen.

Paragraph 4, limiting the right of research to "any complete specification or any provisional specification followed by a complete specification" published during the last fifty years, treads on dangerous ground. Anyone conversant with the patent literature of 50 years ago will be struck by the number of valuable inventions which were then made and which might be re-patented as novelties to-day under this clause. The confinement of research within these narrow limits also gravely restricts the rights of the public to the benefit of former achievements of the human mind. As similar restrictions do not exist in other countries the search made by our patent office is placed on a much inferior level to that in other countries, and the fact that a patent is granted in this country would be no guide to its prospects of being accepted elsewhere.

Paragraph 6. The proper length of life of a patent has been the subject of various practice and much discussion. The United States, by including the two years provisional term, gives an effective life of 19 years. Ours used to be 14. This is now raised to 16.

The profound dislocation of industry due to the many new requirements arising from the war has in many cases not only prevented the full benefit being obtained from expiring patents but has precluded the full development of new patents not directly connected with war work. The claim of many inventors that existing patents or those which have expired during this period should be automatically prolonged for a term equal to the duration of the war, must commend itself to our sense of justice, especially as patent fees have been demanded during this period. At the same time new industries may have been started partly based on the assumption of the pre-existing normal life of a patent. The proposed term of sixteen years is of the nature of a compromise. It would have been fairer to have prolonged the life of patents for the whole period with provision for the grant of free licences to the above-mentioned industries. The inventors have been partially recompensed by additional dues being demanded for the two years. It is also provided (paragraph 7) that a patent may be prolonged from five to ten years by an appeal to the Court. This provision has always been a constituent part of English Patent Law, but the machinery has been so cumbersome and expensive and the decisions so erratic that very few have availed themselves of it. One of the greatest difficulties in judging the reasonable life of a patent lies in the fact that some inventions can be applied and tested with very little expenditure and effort in the course of a few hours, while others require very large means and many years of strenuous endeavour for their useful application. As a matter of fact it may be considered doubtful whether any of the inventions which have revolutionised great processes have been sufficiently advanced to allow of adequate working during the life of the original patent, and when the inventor has benefited it has been through subsequent patents obtained for improvements on the original idea.

Paragraph 9. The relief from the anomaly which made the validity of a patent depend on the validity of each claim is a distinct improvement and will facilitate correct findings in actions for infringement.

Paragraph 11. This paragraph provides for exceptional treatment of inventions for a certain class of materials, *viz.*, chemical substances for use in food and medicine and which are on the borderline between patents and trade-marks. As a matter of principle it is inadvisable that inventions should be differentially treated. Whether the power given to the Comptroller and the Court to deal with these will prove an advantage or disadvantage to the public, time alone will show. In so far as this clause makes the process of production of a chemical substance and not the substance itself the subject matter of a patent, it is a distinct improvement, and the inventor is safeguarded by the presumption of infringement by other producers who cannot demonstrate an alternative method of production.

II. From the Standpoint of the Chartered Patent Agent.

A. G. BLOXAM.

This new edition of the Bill that was before Parliament in the fall of 1917 stirs the present writer with melancholy. Two of the small committee who invented the Bill have already passed away. Splendid lawyers, both; but there is some doubt whether this, almost their expiring effort, may not come to be regarded as one of those deeds which live after men rather than as something worthy to have been interred with their bones.

There must be a reason why, for fifty years past, the manufacture of dyestuffs has been the Chemical Industry in the public mind. Possibly the cause is to be found on the north side of Oxford Street (curiously, there are no drapers on the south side); another case of *cherchez la femme*. Whatever the cause, no public pronouncement by politician, professor or patent agent has dealt with the chemical industry of this country as other than a struggling competitor of Germany's speciality.

Yet there is not much exaggeration in the remark that a maker of alkali made to the present writer—that the dyestuff industry is little more than the crumbs that have fallen from our table.

So long as the public interest in chemistry was aroused at all, it seemed of little importance in what particular branch of the science interest was awakened. When, however, agitation initiated by this particular section of the industry ends in a Bill of so remarkable a character as that now before us, the matter assumes a more important aspect.

The provisions of the Bill dealing with "abuse of monopoly rights" remain almost identical with those of the previous measure of 1917 (this J., 1918, 2 R).

The proper policy for the patent agent is, no doubt, to sit tight and say nothing; for if ever there were any truth in the popular belief that Acts of Parliament are drafted *by* lawyers *for* lawyers, that truth is illustrated here. Particularly should he let the matter rest, seeing that the patent agent—who had begun to think himself a patient agent—has at length received some further acknowledgment that he is a help, not a hindrance; indeed, in the new edition the inventor's pilot is to share with the sailor's pilot the honour of being the only professional man who must be a British subject.

But does the industry realise that the Bill enables any person interested to start an inquiry as to what particular process is being used in the works, and to what extent—whether patent A or patent B has proved the more profitable? Nor is such an inquiry to be conducted merely as between the patentee and the person interested, since any other person may take a hand in the game when it has once been started and must, of course, have access to all the evidence. If competition for trade is to be at an end this matters little; and so does a patent law.

The clauses relating to "licences of right" also remain with little alteration. One would like to learn the *motif* of these provisions; by accepting them the poor inventor will save in renewal fees, but become involved in certain legal formalities of which he may be heartily sick before he is quit of them. Will those desirous of using the patent be more eager to take a licence because the patent is endorsed? The patent agent's experience is that the patentee who is not himself a manufacturer is only too willing to negotiate the grant of a licence and is generally well satisfied with the result.

The term of the patent is to be increased by two years; on the other hand there is no moratorium for patents which have existed during the war.

The period of provisional protection is to be nine months instead of six. No one is likely to object to the additional three months for settling that curious jumble of technics, law and the word "substantially," called the complete specification.

It is to be regretted that the dyestuff industry should have prevailed in retaining the clause that prohibits claims for "substances prepared or produced by chemical processes." If we are to imitate the German law in the illogical manner in which it allows the mechanic to claim his product while forbidding the chemist, let us do so; but the words quoted have a meaning far more widely reaching than the prohibition of the German law. Why not acknowledge the real purport of the clause by limiting it to "dyestuffs and synthetic drugs"?

III. From the Viewpoint of the Inventor.

DOUGLAS LEECHMAN.

The granting of letters patent for inventions and the registration of new and original designs are based on a recognition of the fact that trade is benefited materially by the introduction of new and improved manufactures. The aim of any legislation on these subjects must therefore be regarded primarily and principally as to its effect on our industries; but, very much as there can be no eggs without hens, so there will be no inventions introduced unless our engineers and chemists are induced to become patentees and proprietors of registered designs. It will be useful, therefore, to consider how far the Patents and Designs Bill of 1919 would be likely, if it became an Act, to encourage or discourage inventors as such.

The Bill offers direct encouragement to inventors by extending the term of patents from fourteen to sixteen years from the date of application. Hitherto the possible life of a British patent has compared unfavourably with that of a number of other important countries, notably that of the United States of America where the term is seventeen years *from the date of grant*, and no renewal fees are demanded. While appreciating the additional two years, inventors must not be thought ungrateful if they continue to press for a term more equal to that enjoyed by our American cousins.

Another good proposal in the new Bill is found in Clause 8. It provides that if an alleged infringer is found to contravene any valid claim of the patent in question, the patentee shall be entitled to relief. This is much fairer than the present law, according to which if the defendant can upset any one claim in the specification he is held guiltless, even if he was never accused of infringing that claim.

Section 18 deals with patent agents, and by prescribing that any unauthorised person who either describes himself as a patent agent or practises as such, shall render himself liable to a penalty, will do much to protect the unwary inventor against unscrupulous and incompetent sharks.

An important improvement of the present law is hidden away among the schedule of minor amendments of the 1907 Act. It consists in a reversion to the old period of nine months for filing the complete specification, reckoning from the date of application with a provisional specification. Many important inventions cannot be worked out in the six months at present allowed for the purpose, and the extra three months will result in inventions being both more perfectly developed and more securely protected. The proposal to empower the Comptroller to proceed with a complete specification filed by one applicant only where the other turns obstructive, is another good practical idea.

Probably the promoters of the Bill would say that other clauses are very much to the advantage of the inventor, but I fear the contention only shows their lack of appreciation of the inventor's

position. Thus, Clause 2 offers to reduce to one-half the renewal fees on any patent if the patentee will agree to have it endorsed "licences of right." If an inventor is a manufacturer he will not want to license anybody and the half price renewals will be no sort of temptation to him; if he is not a manufacturer, licensing is practically the only way he can make money by his patent and he does not need the inducement offered. And no patentee in his senses is going to grant licences, where every licensee is to have the right to force him into an action for infringement, which is one of the preposterous provisions of both Clauses 1 and 2.

Clause 7 is good in so far as it gives the Court a general discretion to extend the period within which a petition for prolongation of a patent may be presented; but the provision for loss and damage to patentees by reason of the war is hopelessly inadequate; while proposed reduction of the term for which patents may be prolonged is, of course, distinctly prejudicial to inventors.

Clause 11, which deals with chemical products and substances intended for food or medicine, deserves more attention and space than can be given to it in a general article such as this; but it may be said that this clause is less objectionable than the corresponding one in the Bill of 1917. It is still far too wide in that the first part extends to all substances produced or prepared by chemical processes, not being confined to foods and medicines, and the second part is aimed against any invention *capable of* being used for the preparation or production of food or medicine. Licences are still to be granted to practically anybody and at a minimum of recompense to the patentee, though the fact is expressed a little less brutally than before. When will the authorities learn that the best inventors are still human beings and will not invent, and patent, and exploit for the fun of the thing (if any)?

The provisions for extending the grounds of opposition to prior publication in any document in the United Kingdom, and for disclosing the results of the official searches, though not directly favouring inventors, are so excellent on general grounds that one can hardly object to them as prejudicial to the interests of inventors.

The Bill seeks still further to negative the present enactment that a patent shall have to all intents the like effect against H.M. the King as it has against a subject. Perhaps the idea is to give a colour of regularisation to some of the acts committed in the name of the Crown during the war. These matters should be settled entirely by the Courts and so be cleared of any savour of suspicion and discredit.

It is deeply to be regretted that the Bill contains no provision for restoring to patentees the period of protection which they have lost during the war. They have complied with every requirement of the Acts and Rules and have even in many cases continued to pay renewal fees, and there has been a wholesale failure on the part of the Crown to carry out its part of the bargain. This is a gross injustice to patentees, and worse, it is a gross injury to the industries of the country which are being deprived of the use of many hundreds of inventions of proved commercial value.

It is also to be deplored that the other recommendations of the Federation of British Industries and the Conference of Technical Societies, especially in the matter of renewal fees, have been so studiously ignored by those responsible for the contents of the Bill. Fortunately the House of Lords was apprised of the true position and refused to be rushed into passing the Bill before the recess and will subject it to close scrutiny and criticism when it is brought up in the autumn.

PERMEABILITY OF CONCRETE.

S. BOWMAN.

The following notes describe in outline a method of investigating:—

1. The comparative merits of various concrete waterproofing agents.

2. The effect of such compounds on the chemical and physical properties of Portland cement and reinforced concrete.

3. The economic aspect of the use of such compounds.

Concrete waterproofing compounds are sold under various trade names and in most cases are patented proprietary articles. They may be divided into two classes:—(1) integral compounds, *i.e.* those that are intimately mixed with the Portland cement, and (2) compounds to be applied externally to the finished surface of the hardened concrete. Both classes may be further divided according as their action is chemical, *i.e.* those entering into chemical combination with the constituents of Portland cement, or physical, such as water repellents.

In order that an examination of the utility and effect of such compounds may be made, it is desirable that exhaustive tests be carried out with various Portland cement mixtures treated with the respective compounds and that the method of treatment be strictly in accordance with the instructions issued by the vendors of such articles.

With these objects in view, the following tests are to be recommended:—(*a*) Porosity, (*b*) tensile strength, (*c*) compressive strength, (*d*) setting time and soundness, (*e*) chemical constitution, (*f*) corrosion of reinforcement, (*g*) adhesion of reinforcement, and for purposes of comparison, it is necessary that the same cement and sand should be used throughout the various tests.

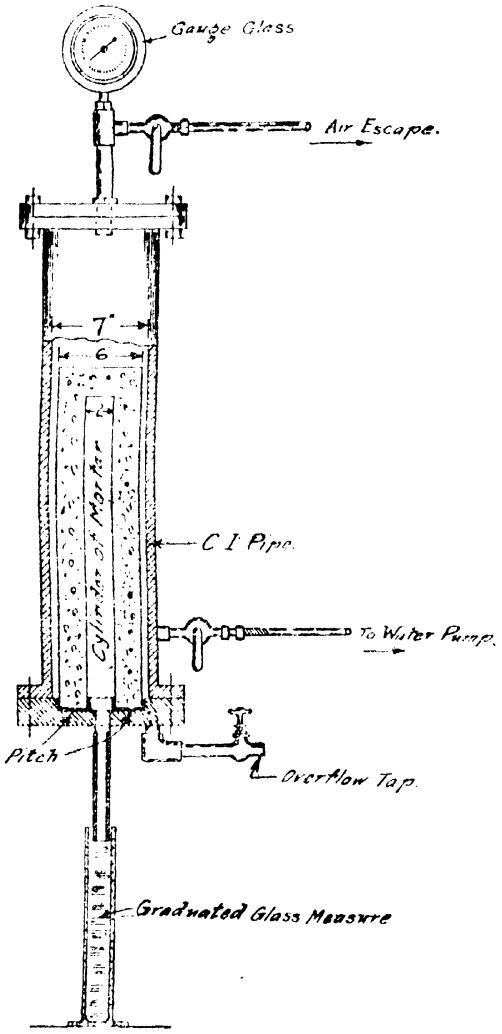
(*a*) *Porosity.*—In determining the porosity or permeability of a material like concrete it is desirable that the conditions of the test adopted should resemble as far as possible those obtaining in actual practice in the field. On reviewing the various methods of testing porosity it is considered that some form of percolation test is to be preferred to an absorption test as the latter has been found to give no criterion of the resistance of a material like concrete to the percolation of a liquid under pressure. Further, in connexion with a percolation test, it is considered that the usual disc form of test specimen is not satisfactory owing to the small area at the most a few square inches—which can be exposed to liquid under pressure on account of the comparative weakness of the material. If, however, a test specimen be made in the form of a hollow cylinder closed at one end, a vessel is obtained having a large surface area and being cast in a mould is free from that skin surface unavoidable where a hand tool such as a trowel is used.

Such vessels may be conveniently made by filling a cylindrical mould (made in two sections and bolted together), say 24 in. in depth and 6 in. internal diameter, with the cement mixture and embedding a round bar of 2 in. diameter to the required depth of 22 in. by means of a central guide. After the material has set and allowed to harden for a short time it is possible to remove the mould and bar and a vessel is obtained with walls 2 in. thickness and a superficial area of 480 sq. in. A series of such vessels may be made for each waterproofing agent, the proportion of cement to sand varying from 1:1 to 1:5 in each series, and also a similar series of vessels composed of the same cement mortar without waterproofing treatment.

The mixing of the mortar should be carried out with shovels on a non-absorbent surface for a definite period of time and with a definite percentage of water for each strength of mix.

After removal of the mould the vessels are completely immersed in water and allowed to mature for a period of, say, 21 days in order to accelerate the hardening of the mass, after which they are allowed to dry out in air before being fitted into the testing apparatus, the age of each vessel being similar.

The apparatus for testing such vessels (see sketch) consists essentially of a convenient length of C.I. piping with an internal diameter slightly greater than that of the vessel, say 7 in., the upper



APPARATUS FOR TESTING POROSITY OF CYLINDERS.

end being closed with a blank flange and the lower end with a circular base plate to which the vessel is fitted. The latter is made with a circular groove 2½ in. wide and 1 in. deep, and a small central hole into which the drip pipe is screwed.

A satisfactory method of fixing the vessel is to warm the base plate and half fill the groove with melted pitch, into which the open end of the vessel is carefully lowered. The surplus pitch overflows and with the aid of a hot poker a perfectly tight joint is finished off. When cool, the base plate with fitted vessel is securely bolted to the bottom flange of C.I. pipe, rubber washers being used to obtain a tight joint.

A side pipe is connected to the water pump and the apparatus filled up until the gauge shows 50 lb. pressure per sq. in. To test the permeability of the vessel this pressure is maintained until the amount of water percolating through the walls remains constant for any period, say 1 hour, at which stage readings are taken every hour for 6 hours, and the average taken to represent the permeability at this pressure.

Following this the pressure may be increased in gradual stages to 100 to 200 lb. per sq. in., allowing in each stage a time until constancy of percolation is obtained before taking readings as before.

In the event of there being no signs of percolation at the lower pressure after, say, 6 hours, the pressure may be raised to higher stages for similar periods, and if no percolation takes place at 200 lb. during a period of 48 hours the vessel may be said to be reasonably impermeable for the purpose of this test. In this manner all the vessels of each series may be tested, and the amount of percolation plotted against the percentage of cement in each mixture will give a curve showing the resistance of varying mixtures to percolation at various pressures, with and without waterproofing treatment.

Similarly, if desired, this test could be carried out using fuel oil or other mineral oil instead of water.

(*b*) *Tensile strength.*—In order to ascertain the effect of waterproofing compounds on the tensile strength of Portland cement, a series of briquettes should be made under B.S.S. conditions, composed of neat cement and also a mixture of standard sand and cement in the proportions of 3 : 1. Each series to be treated with a waterproofing compound under examination in addition to a series made without treatment.

Further in connexion with this test it would be desirable to ascertain the relationship of strength to age, therefore each series should consist of briquettes to be tested after maturing in water for periods of 7, 14, 28, 56, 90, 180, 365 days, the average breaking strains of 6 neats and 6 sands to represent the strength of each of these periods.

The results in lb. per sq. in. may then be plotted against the age and a curve obtained showing the effect in each particular case as compared with untreated cement.

(*c*) *Compressive strength.*—In this test 3 in. cubes composed of standard sand and cement in proportions of 3 : 1 and treated as in the previous test, should be made and crushed to destruction after maturing in water for similar periods. The results in lb. per sq. in., representing the average of 6 cubes at each period, could similarly be plotted showing the effect of such compounds on the compressive strength of Portland cement mortar at various ages.

(*d*) *Setting time and soundness.*—With regard to those waterproofing compounds which require mixing with the cement before use, it would be desirable to ascertain their effect on the original setting time and soundness of the cement used.

For these tests a quantity of cement, intimately mixed with the compound, should be spread out in a layer of 3 in. thickness and allowed to aerate for periods similar to those in test (*b*). At each period the whole should be thoroughly mixed up and a quantity withdrawn for the determination of setting time and soundness on the lines laid down in the B.S.S.

(*e*) *Chemical constitution.*—A complete analysis

of each waterproofing compound should be made in order as far as possible to determine its constitution, its probable action having regard to the constituents of Portland cement, and also the possibility of the equilibrium of the latter being so disturbed as to threaten disintegration.

(*f*) *Corrosion of reinforcement.*—The object of this test is to determine whether the rusting of steel embedded in cement mortar treated with integral waterproofing compounds is more or less rapid than when embedded in an untreated mortar of similar proportions.

For this purpose a series of cylindrical blocks 6 in. × 3 in. of 3 : 1 sand and cement may be made in suitable moulds and, while still in a plastic state, each block to have a ⅜ in. round mild steel rod of known weight partially embedded along the axis of the block in such a manner that that part of the rod is protected with an equal thickness of mortar. After maturing for a period of, say, 14 days in water and 7 days in air, the blocks are placed in a bath of sea water so that the surface of the water is 1 in. below the top of each block.

In order to accelerate corrosion the projecting ends of the rods are connected up in parallel to the positive plate of a 4 volt cell, the cathode being a sheet iron plate placed equidistant from all the blocks.

After remaining, say, 28 days under these conditions the blocks may be broken and the rods extracted. These are immediately immersed together for 1 or 2 minutes in a dilute solution of hydrochloric acid, which has the effect of dissolving the hydrated oxides of iron without appreciably attacking the metal. After careful washing and drying, the rods are reweighed and the loss may be taken to represent approximately the loss of metal due to corrosive action under the conditions stated. Although it is realised that the results are not quantitatively accurate, they are considered to be sufficiently so for a comparison to be made and for the effect of such waterproofing compounds in preventing corrosion to be ascertained.

(*g*) *Adhesion of reinforcement.*—The object of this test is to determine whether the adhesion of cement mortar to embedded steel is affected by the use of integral waterproofing compounds.

For this purpose a series of 6 in. cubes of 3 : 1 sand and cement should be made, each cube having a ⅜ in. round steel rod embedded the full depth of 6 in. along the axis of the cube. The rods should be of mild steel previously pickled to remove mill scale and a thin film of rust allowed to form before embedding. After maturing in water for a period of, say, 28 days, the cubes may be tested by being fixed and by suspending a tank from the projecting end of the rod and allowing the tank to gradually fill with water until the load overcomes the adhesion of the mortar to the rod. The weight of the tank plus water will represent the shearing stress between the mortar and steel, the average of the results of 3 cubes being taken in each case.

Providing that such waterproofing compounds have been found to have no deleterious action on the physical and chemical properties of Portland cement and reinforcement, the data obtained from the porosity test should enable an accurate estimation of the value of such compounds to be made. From these results it will be possible to ascertain the minimum quantity of cement required to produce an impervious mortar or concrete when treated with each of the respective compounds, and comparison can be made of the cost of such mixtures with an impervious mortar containing perhaps a greater percentage of cement but without the addition of a concrete waterproofing compound.

OIL AND GAS FIRES.

A monograph on "Extinguishing and Controlling Oil and Gas Fires," by C. P. Bowie, has recently been issued by the U.S. Bureau of Mines (Bulletin 170, Petroleum Technology 48, 20 cents). In the introduction it is stated that during the ten years 1908—18, approximately 12,850,000 barrels of oil and 5,024,506,000 cub. ft. of gas were destroyed by fire in the United States, involving an estimated property loss of $25,252,200. During this period 503 oil and gas fires were reported, of which 310 were caused by lightning and 193 by other causes, chief amongst which was frictional electricity.

Water being immiscible with oil, is rather unsatisfactory for extinguishing most oil fires, particularly if the volume of oil be large. In the case of an outbreak of fire in an oil tank, a common practice is to feed steam into the top of the tank and so exclude air from the space above the burning oil. This method is not entirely satisfactory, and the frothy-mixture system of fire fighting has been recently devised as a more satisfactory procedure. Essentially this system provides for bringing together two suitable chemical solutions and for spreading over the surface of the burning oil the thick tenacious foam resulting from their admixture. The solutions should be such that on mixture, an abundance of relatively tough bubbles inflated with a non-inflammable gas is produced. The mixture of 50 c.c. of each solution should produce from 600 to 800 c.c. of foam. The following pair of solutions has been employed for this purpose:—Solution A, water 100, aluminium sulphate 10, sulphuric acid 66° B. ½; solution B, water 100, ground glue 1¼, sodium bicarbonate 7½, arsenious oxide $\frac{1}{32}$. The relative proportions of the constituents as stated are by weight. The compositions of two other pairs of solutions frequently employed are also given. The solutions are stored in separate tanks and are delivered therefrom to foam-mixing boxes. The foam resulting on mixture is poured from the mixing box on to a number of baffle-plates arranged above the surface of the oil, so that the constituent bubbles of the foam are not destroyed by impact with the oil surface. In the more recent installations, foam slides are omitted, and the bubbles remain intact after a sheer drop of 20 feet or more. The system requires thorough inspection, and the complete cost including turbine, pumps, piping, tanks, labour, etc., is about 3 cents per barrel capacity of all the tanks protected.

Frothy mixture systems may be operated either manually or automatically, the action of the latter type depending upon the fusion of a plug of fusible material. The flow, having commenced, is maintained either by gravity or gas pressure.

Gas well fires can usually be readily extinguished by means of steam. The usual practice for purposes of safeguard is to set up portable field boilers in the vicinity of the wells and to surround the burning well with steam pipes. A portable extinguisher operating on the snuffer principle has been successfully used on small gas fires.

To prevent the starting of fires by frictional electricity in filtering gasoline, fine wire gauze should be used for straining purposes, the use of chamois skin for this purpose being entirely prohibited. Wooden buckets should not be used for drawing gasoline from pumps. Moreover, the metal of the funnel employed during the delivery should invariably be in contact with the metal of the tank. The tank trucks of the Shell Co., California, are grounded when in the garage for filling purposes. Copper chains are soldered to the spouts wherefrom the oil is delivered, the chain making

contact with the bottom of the tank into which the oil is being supplied.

Small gasoline fires are readily extinguished by means of sawdust, the efficacy of the method being improved by mixing sodium bicarbonate with the sawdust in the proportion of about 8 lb. of bicarbonate to 1 cub. ft. of sawdust. Frothy mixtures made up as already described and put up in portable containers are also useful for the same purpose. In order to obtain the best result with carbon tetrachloride as a fire extinguisher, it should be sprayed on the edges of the fire and not into the body of it.

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NEWS AND NOTES.

CANADA.

A New Goldfield in Quebec.—According to a *Reuter* message, a new goldfield has been discovered on the shores of Lake Kienawieeh, Quebec, where a Polish settler has sold his rights for £170,000.—(*Official.*)

UNITED STATES.

Bibliography on Helium.—Mr. E. R. Weaver, of the Bureau of Standards, has compiled a valuable classified bibliography of the literature on helium.

Thermit Welding.—Fourteen hundred pounds of thermit was used to weld a casting on the s.s. *Northern Pacific*, thus constituting the largest marine weld on record. The weld was entirely successful and was accomplished without removing the casting from the ship.

"**Chemical Age.**"—A new magazine, *Chemical Age*, has been established for the benefit of the business man in chemical industry. This publication, which has no connexion with *The Chemical Age* published in London, places special stress upon the economic side of the problems which confront chemists and engineers. *Chemical Age*, of which two numbers have appeared, is published monthly in New York City.

The Chemical Foundation, Inc.—This corporation (see this Journal, 1919, 197 B) has opened offices in New York and is now ready to take up the licensing of various chemical and metallurgical patents. Those applying for licences must be entirely American and have both the skill and facilities to manufacture under the licences sought.

High-grade Filter Paper.—Extensive experiments are being undertaken with the object of initiating the manufacture of the highest grades of analytical filter paper in the United States. Exhaustive work has been done in critically examining the leading papers now on the market with a view to determining the cause of any defect. The information thus gained has been very valuable in devising novel methods in regard to water supply, choice of raw materials and processes.

A New Source of Tannin.—The easily accessible supply of tanbark oak is rapidly becoming depleted on the Western Coast and experiments with other native barks for tanning are already under way. The sequoia, or Californian redwood, is being investigated as a source of tannin, as is also a variety of shrub available in large quantities. The heartwood of the sequoia contains about 12 per cent. tannin and would be available principally as sawdust. Laboratory experiments indicate good results with this tannin, but owing to the development of a colour its use might have to be restricted to the manufacture of sole leather.

Chlorinated Hydrocarbons from Natural Gas.—The existence of large quantities of natural gas, composed almost entirely of methane and free from the higher saturated hydrocarbons, ethane, propane, etc., far removed from industrial centres, and of chlorine in excess of peace requirements at once suggests experiments in chlorination. A preliminary report on the work of the Bureau of Mines indicates that the commercial production of carbon tetrachloride, chloroform and carbon hexachloride (from which ethane tetrachloride may be made) are possibilities. In the laboratory the gas has been completely chlorinated in one operation, the rate of flow largely determining the nature of the products. A catalyst having a high absorption value for chlorine is essential. Besides carefully controlled conditions for the reaction, efficient means for removing the products must be employed. Experiments on a semi-commercial scale are now to be undertaken.

JAPAN.

Researches on the Mucilage contained in certain Florideæ.—In an investigation on the mucilages of several varieties of marine algæ belonging to the natural order *floridcæ* found in the Sea of Japan, which are widely used for cloth finishing as well as for wall stiffening material, Mr. E. Takahashi has found that one variety, *Tsunomata*, yields galactose, arabinose, mannose, dextrose, lævulose, and another sugar resembling galactose which crystallises in rectangular plates, has a specific rotatory power $[\alpha]_{D20°} = 80{\cdot}75°$, and a melting point of 152°—153° C.; it does not yield an acid on oxidation with nitric acid. This hitherto unknown sugar, named by the author "floridose," has been found to be a hexaldose which on reduction yields a hexahydric alcohol—floriditol. The mucilage of *Funori* has been shown by the same author to yield galactose, arabinose, fucose, dextrose, and lævulose, but not "floridose." Mr. Takahashi draws the conclusion that the chief constituents of these mucilages are galactan, araban, and a new compound "floridosan" which on hydrolysis yield the sugars galactose, arabinose, and floridose, respectively.

Sulphur Production.—The chief deposits of sulphur in Japan occur on the island of Hokkaido, those on the Islands of Hondo and Kyushyu being less extensive. The output of sulphur diminished considerably in 1918 owing to the sudden cessation of demand subsequent on the conclusion of the armistice; the total production for that year was 64,711 tons, valued at 2,532,425 yen, representing a decrease of 45·2 per cent. in weight and 46·9 per cent. in value compared with 1917.

The geological formation of the sulphur districts is not uniform. In some localities large masses of sulphur are found covered with volcanic lava, in others the mineral occurs mixed with clay. At Iwaoto there is a deposit of precipitated sulphur, and another consisting of intrusions of fused sulphur in a sandy bed. The deposit at Horobetsu shows a continuous vein of pure sulphur in the form of irregular granules. Speaking generally, the crude material contains 30—60 per cent. of sulphur, and this is refined up to 99–100 per cent. quality by the operations of sorting, crushing, drying, distilling and moulding. The distillation is carried out in cast-iron stills of 3 ft. diameter connected with a condensing chamber measuring 20 ft. long and 2 ft. 5 in. diameter. In the past the stills have been heated by direct firing, but recently steam heating has been introduced with successful results. The following table gives the chief deposits of sulphur together with the monthly outputs in March 1918 and 1919:—

Locality.	Monthly Output. Metric Tons. March 1919	March 1918
Hokkaido.		
Shikabe (Oshima) ...	108	235·8
Kumadomari (Oshima)	153	436
Iwaoto (Shiribeshi) ..	242·8	483·5
Okujiri (Shiribeshi) ...	1207	1145·8
Tsurikake (Shiribeshi)	307	—
Horobetsu (Iburi) ...	279	859·6
Hondo and Kyushyu.		
Zo-o-zan (Yamagata)	119·8	124·5
Numajiri (Fukushima)	148·6	798·6
Matsuo (Iwate) ...	611	584·5
Akakura (Akita) ...	128·8	77
Nasu (Tochigi) ...	30	629
Hirayama (Tochigi) ...	94	145·6
Yonogo (Nagano) ...	90	106·8
Konoyeyama (Oita) ...	80	135
Iwojima (Kagoshima) ...	35·4	40

Work has recently been stopped at the Katsutani and Araodake deposits; each of these produced over 100 tons monthly until last year.

contact with the bottom of the tank into which the oil is being supplied.

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In his presidential address to the Chemical Section of the British Association at Bournemouth on September 9, Prof. P. Phillips Bedson, in his introductory remarks, paid tribute to the memory and life-work of Sir William Crookes and Professors Baeyer and Fischer. He then dealt with the history and development of the Periodic Law. The pioneering work of Newlands, Mendeléeff and Lothar Meyer was briefly reviewed, and attention directed to the work of Carnelley whose experimental investigations added materially to our knowledge of the physical properties of elements and compounds. Referring to anomalies of position in the Periodic Table, it was remarked that tellurium has resisted all attempts to bring it into order. The discovery of the rare gases necessitated the creation of a zero group as a constituent of the Table. Mendeléeff suggested that this zero group should contain a member lighter than hydrogen in Series I, and in a zero series a still lighter representative, which he has postulated as the "ether" of the physicist. Provision is still to be made in the Table for the accommodation of the rare earths. The contributions of Carnelley, Crookes and J. J. Thomson were briefly alluded to and reference was made to the phenomena of radioactivity as affording a method for the detection of new classes of elements. The phenomena in question indicate that the elements are to be regarded as divisible into three classes termed isotopic, isobaric, and normal, respectively, according as they differ in atomic weight, chemical properties or in both. The work of Moseley directed attention to the importance of the atomic numbers of the respective elements as affording evidence of the position of the elements in the periodic sequence. The evidence derived from this source supports the positions attributed to tellurium and iodine, potassium and argon in the Table. The concluding section of the address was devoted to remarks concerning the pre-war apathy of the public and of the Government concerning the national value of the chemical industries. The well known cases of the manufacture of dyes and of explosives were instanced and the lecturer regretted that even now there exists, and not only in the minds of the ignorant, a lack of information as to how chemical research has ministered to the amenities of everyday life.

The German Iron Industry.—The dearth of raw materials is still affecting production, which is now only about 30 per cent. of the peace time output, but the most serious factor is the refusal of the men to work. There is little hope of improvement for some time to come. Export trade is suffering and a great deal of business has been lost through the impossibility of prompt delivery. In prices American products hold the field, for instance American bar iron is being offered at Rotterdam at 180 florins per ton while the German price is 500 florins. The prospects of the Germans being able to recover their export markets in the future are somewhat doubtful. The importation of foreign ores, with the unfavourable state of exchange, will be a heavy burden on production costs. French competition will be keen, and will be backed by the ore productions of the conquered territory, and the German manufacturers are afraid of a strong invasion of the united Franco-Luxemburg-Belgian iron and steel mills.—(*U.S. Com. Rep., July* 26, 1919.)

"Tar Oils" in Germany.—Prof. H. Grossmann of Berlin states that successful attempts have been made during the war to render Germany independent of foreign sources of substances hitherto derived from imported petroleum oil. Large quantities of "tar oils" have been obtained from coal. This oil is a portion of the anthracene oil which distils over between 300° and 360° C. Crude anthracene and phenanthrene are removed therefrom by cooling, crystallisation and filtration. The more easily vaporised constituents are removed from the filtered anthracene oil which is once more cooled, and the last solid constituents precipitated. The oil so obtained serves for the preparation of various lubricating oils. By long continued heating at a high temperature a very viscous oil is obtained which was much used during the war. The tar oils can be mixed with mineral oils, and can be used for the manufacture of lubricating greases. It is computed that from the annual production of 1,500,000 tons of gas and coke-oven tars some 150,000 tons of such tar oils could be obtained.

The production of tar by the low temperature distillation of coal and lignites was also undertaken during the war, but no accurate returns as to the quantity produced are yet available. The tar oils resemble petroleum very closely in chemical character, and can be utilised for the production of benzene, illuminating oil, lubricating oil and paraffin. The yield of low temperature tar from brown coal averages from 10 to 20 per cent. of the dry substance, the yield from types of gas coal being about 8 to 12 per cent. Two principal methods of procedure are employed for obtaining the low temperature tars. In the one, the distillation of the coal is effected at a temperature not exceeding 500° C., much tar, little gas and ammonia being obtained. In the other method, which has hitherto been most generally employed, the coal is distilled in generators of various forms, the low temperature distillates being removed without further subjection to a higher temperature than that of their production. In working up these tars large quantities of phenolic substances are obtained, and the utilisation in peace time of these products and of the coke produced is a pressing problem. Possibly Germany may be made entirely independent of imported tar oils by the use of the Bergin process which renders possible the working up of tar and tar products, including pitch, into very valuable materials, by subjecting them to the action of hydrogen. It may also be found possible to submit the raw coal or lignite to the action of hydrogen in such manner that oil and benzene are obtained directly. The solution of this problem will put Germany on an entirely new footing as regards its supplies of combustible material and of power.—(*Schweiz-Chem. Z.*, 24—26, 1919.)

Increasing the Yield of Ammonia from Coal.—The yield of ammonium sulphate by the carbonisation of bituminous coal containing about 1·5 per cent. of nitrogen, amounts, in the case of even the largest gas undertakings, to only about 26 lb. of sulphate per ton of coal, compared with a possible yield of 160 lb., on the assumption that the whole of the nitrogen content of the coal is recoverable in the form of ammonia. The recovery in the Mond system is approximately 96 lb. of ammonium sulphate per ton of coal. By the steaming of continuously operated vertical retorts the normal yield, without steaming, of 35 galls. of 8 oz. ammoniacal liquor per ton of coal is increased to from 50 to 60 galls. These results are at least partly explained by the work of Tervet and that of Beilby, who obtained increased ammonia yields by passing respectively hydrogen and a mixture of air and steam over the incandescent coke. The recent process of Perkin and West (this J., 1918, 295 A. Eng. Pat. 114,937) employs a stream of low quality gas introduced at the base of a vertical retort for the same purpose. Salmang (this J., 1919, 452 A), by passing a mixture of steam and air through the fuel bed to which chalk or oxide of iron was added, obtained, under the most favourable conditions, a recovery of 96·3 per cent. of the nitrogen as ammonia, a recovery of 59 per cent. being obtained without the addition of chalk or oxide of iron. With the exclusion of air, the maximum recovery obtained by Salmang was 20 per cent. less than with a steam-air mixture. Sommer has shown that the maximum yield of ammonia with typical German coals occurs when distillation temperatures between 800° C. and 900° C. are employed. He maintains that 79 per cent. of the total nitrogen of the coal is retained in the coke, contrary to the results of other workers who have shown that with high temperature carbonisation, 50 per cent. of the total nitrogen remains in the coke. Sommer finds that the presence of steam tends to conserve ammonia. He expresses the opinion that the inclined chamber oven is productive of better results than can be obtained with the vertical retort. A similar advantage is obtained by increasing the size of coke ovens and by lowering the level of the upper collecting flue, benzol being likewise thereby conserved. The moisture content of coal certainly augments the amount of ammonia derived therefrom. Oxygen evolved during the process of carbonisation tends to lower the yields of ammonia and benzol. Hydrogen sulphide is oxidised very much more readily than ammonia, and its oxidation is considerably accentuated in the presence of water vapour. The presence of sulphuretted hydrogen in the gas evolved, therefore, serves to conserve ammonia. In high temperature carbonisation, hydrogen is freely evolved during the later stages, and ammonia is produced therefrom in accordance with the Tervet reaction, while some of the ammonia so produced is doubtless subsequently decomposed. Further research in the direction of admitting "stripped" coal-gas or blue water gas to the charge is desirable, with a view to obtaining an increased yield of ammonia.—(*Times Engineering Supplement, Aug.* 1919.)

Zinc Industry in Belgium.—A short report bearing this title has been written by M. F. Chase and issued by the United States Bureau of Mines in the "Minerals Investigations Series." In 1913 there were 14 plants in operation with 43,253 retorts; the number of workers was 8444 and 998,655 tons of coal were consumed; 488,730 tons of ore were treated and 204,220 tons of spelter were produced, or approximately 20 per cent. of the world's production. There were 10 rolling mills, with 34 rolls

and 742 workers, producing 49,120 tons. The actual value of all the products from treating zinc ore was 225 million francs. Of the ore, 840 tons came from Belgium, 175,000 tons from Australia and the remainder chiefly from Sweden and Sardinia.

The general custom in Belgium has been to roast zinc ores at chemical works and then transport the roasted ore to the smelting plants. Only 4 out of the 14 smelting plants have roasting plants attached. The total capacity of these 4 smelter roasting plants was 100,000 tons of ore per year. There were 10 chemical works having a zinc ore roasting capacity capable of treating somewhat over 300,000 tons a year. Owing to the large amount of Australian ore, smelting practice has developed the recovery of lead and silver values from the furnace residues.

The location and capacity of the 14 smelting plants are:—

Name of Company	Location	Retorts
Austro-Belge ...	Corphalie	2200
Biache-St. Vaast...	Ougrée	1000
Boom	Boom	1600
Dumont Frères ...	Sclaigneaux ...	6000
de Lamine ...	Antheit	2304
Nouvelle Montagne	Engis	3200
Overpelt-Lommel	Overpelt	2684
,, ,,	Lommel	2568
Pennarroya ...	Bleyberg	1700
Prayon	Foret	3840
Rothem	Rothem	3360
Vieille Montagne	Angleur	5440
,, ,, ...	Flone	4000
,, ,, ...	Valentin-Cocq ...	10,800
		50,696

Two plants were equipped to treat the residues producing lead, and also refined silver. About 60 per cent. of the smelting capacity can be said to be of modern construction, and in the newer works the tendency has been to increase the mechanical handling and also the mechanical charging and discharging of the furnaces. In roasting practice, hand-raked furnaces are general, and, although the mechanical or semi-mechanical roasters are not entirely successful, they require less labour per ton of roasted ore, and the Belgian plants will be thus at a serious disadvantage.

The general conclusion arrived at is that the future of Belgium as a zinc-producing country is not particularly bright, but that the relative position it will occupy from now on is not easily predicted. The opinion is expressed that for some years to come production will be far below the pre-war figures, and may never reach the 1913 level. During the last two years the idle plants suffered largely from lack of maintenance and from equipment being removed. To obtain lead, the towers and chambers of the sulphuric acid plant were dismantled. The smelting plants that were German-owned operated to a limited extent during the entire period of the occupation, and are in a fair way to resume work on an extensive scale. In others, much property was destroyed to get cast iron, copper and steel scrap. Rolling stock, machinery, belting, and practically all of the copper transmission lines were removed. The rehabilitation of the industry, even to a limited extent, will depend upon obtaining prompt and reasonable supplies of ore. If these are not provided promptly, the greatest asset that Belgium had, that is the skilled workman, will be lost, as these men undoubtedly will seek employment either in other countries or in other industries. The smelting capacity outside of Belgium has been so vastly increased that only the plants operating on low cost and high recovery can hope to compete successfully. Even before the war it was becoming evident that further reductions in smelting cost must be made. The Belgian engineers have contributed largely to the metallurgy of zinc, and, while they are now handicapped in so many ways, it is entirely within the realm of possibility that they can meet the situation and restore the industry to a fair percentage of what it was before the war. The longer this restoration is delayed the more difficult the problem becomes.

We understand that recent negotiations respecting contracts for the supply of Australian concentrates to Belgium have received a check owing to difficulties arising particularly in regard to freight. It is hoped that the difficulties will be overcome and that the contract for the supply of 100,000 tons yearly with buyer's option to increase to 150,000 tons, will be arranged. Meanwhile, it is stated that several works, including the Vieille Montagne and Nouvelle Montagne, have already secured a certain supply of ore and have relighted some of their furnaces.

Fuel from Sulphite Waste Lyes.—The Commercial Agent of the Canadian Government in Norway reports the discovery of a new method of producing fuel from sulphite cellulose waste, which has recently been tested with very satisfactory results at the Graeker factory near Fredrikstad. It is estimated that 22,000 tons of fuel could be produced yearly from 25,000 tons of cellulose waste. The fuel is obtained as a brownish coloured powder and is burnt in a special kind of grate.—(*Canad. Dept. Trade and Commerce, June* 30, 1919.)

Gold and Silver in 1917.—The United States produced, in 1917, 1,051,440 oz. of gold valued at $83,750,700 and 71,740,362 oz. of silver worth $59,078,100. The supply of new gold in that country is chiefly derived from dry or siliceous gold ores, treated in gold mills by amalgamation or cyanidation, or both, and from placer gravels, largely by dredging. A considerable output of gold is also now recovered from the refining of copper bullion from copper ores. The supply of new silver is derived from dry or siliceous silver and silver-gold ores, and from copper, lead and lead-zinc ores. The bulk of the ores of the former class are milled and cyanided at or near the mines, and that from the latter by the refining of copper and lead bullion produced in smelting.

The present tendency, in the absence of discovery and development of new gold fields on a large scale, is towards a declining world's output of new gold, and this tendency is accentuated by the high cost of labour and supplies, which makes the operations of many gold mines unprofitable.

In 1917, North and South America produced no less than 87 per cent. of the world's total production of silver.

The average value of precious metal extracted from U.S. minerals was, in dollars per ton of ore:—Siliceous ores 5·56, copper ores 0·49, lead ores, 6·88, zinc ores 0·90, copper-lead and copper-zinc ores 14·58, and from lead-zinc ores 2·82.—(*U.S. Geol. Survey, May* 1919.)

The Newcastle Chemical Industry Club.—This club, which at the date of opening in May last had 84 members on its roll, has now a membership of 109. In response to an appeal for funds to establish a library, over £300 has already been received. The first item in the list of fixtures for the coming months is a "field day" to be held at Durham City on September 27.

REPORTS.

REPORT OF THE COMMITTEE OF THE PRIVY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH. 1918-19. Pp. 94. [Cmd. 320, 6d.] (London: H.M. Stationery Office.)*

The fourth annual report covers the period from August 1, 1918, to July 31, 1919, and like its predecessors contains a short report by the Privy Council Committee and a long report by the Advisory Council. The former refers to successful researches undertaken in connexion with enemy mines and submarines, condensers in fast ships of war, flying at high altitudes and mining operations in the field, and to the pre-eminent services rendered by the National Physical Laboratory to all the military Departments of State. Other Government Departments have made increasing use of the organisation, and experience has shown the advantage of entrusting long, complicated and fundamental researches to a central department which is free from the daily embarrassments of administration. Stress is laid once again upon the urgent need of increasing the number of trained research workers; all plans for research must make the best use of existing institutions and personnel, and ambitious schemes for self-contained and independent organisations can have no ultimate success.

The administration of the Geological Survey and Museum is to be transferred to the Department for Scientific and Industrial Research on November 1 next, and the custody of the primary electrical standards and the testing of electrical instruments for use as secondary standards have already been moved from the Board of Trade to the National Physical Laboratory. The expenditure on the Laboratory was £116,038, and the estimated expenditure for the current year is £154,650. A grant of £10,000 has been approved, subject to Treasury sanction, to the Medical Research Committee for the work of the Industrial Fatigue Research Board. The sum standing to the credit of the Imperial Trust for the Encouragement of Scientific and Industrial Research at June 30 was £1,061,183, and the expenditure to that date had been £17,506. The trustees of this fund are committed to a further expenditure of £198,000 on eight Research Associations, and it is estimated that at least £175,000 more will be required for Associations now being formed. The number of Associations will probably eventually be between 40 and 50. Allowances or grants to 35 students under training in research and to 68 workers either working independently or as assistants amounted to £14,170, compared with £7,500 for 1917-18. Aid will now be given for 28 scientific investigations conducted by other bodies. The total expenditure of the Department for 1918-19 was £177,201, of which £8,722 was provided by the million fund.

The report of the Advisory Committee lays down, in the Introduction, a number of postulates concerning the functions of the State in regard to research. (*a*) The State should encourage research in pure science but not attempt to organise it; it should, however, organise research into problems directly affecting the welfare of large sections of the community. (*b*) The State research department should act as a central clearing house. (*c*) No investigations for the immediate benefit of industries not under State management should be conducted by the State department. (*d*) The exploitation or commercial development or administrative application of the results of research does not come within the sphere of action of a State research department.

Industrial Research Associations.—Up to July 31 last licences had been issued to research associations for:—Photography, scientific instruments, woollen and worsted industries, Portland cement, boot, shoe and allied trades, motor and allied manufactures, Empire sugar, cotton industry, and iron manufacture; and the list of associations "approved" at the same date included:—Rubber and tyre manufacture, music industries, linen industry, glass, chocolate, cocoa, sugar confectionery and jam manufacture, Scottish shale oil trade, non-ferrous metals, and refractories.

The original guarantee for a total expenditure of £40,000 during 5 years by the British Scientific Instrument Research Association, subject to the members contributing £4,000 out of revenue, has been increased by an additional sum of £24,000—£30,000. This very exceptional treatment has been accorded owing to the "key" nature of this industry, and a similar concession has been granted to the Glass Research Association for a similar reason. Claims for exceptional treatment can only be considered when the cost of the necessary research is great in relation to the means of the association, and payment on a higher scale than the normal can only be given if the industry concerned is essential to the existence of larger industries and to the defence of the realm, and if proof is forthcoming that any special advantages accruing from Government policy are in themselves insufficient.

The British Research Association for the Woollen and Worsted Industries has already achieved results in investigating the action of acids, alkalis and soaps on wool, the effect of manufacturing processes on textile fibres, the milling of wool, and the electrification of fibres. The establishment of the Scottish Oil Trade Research Association has been suspended owing to the serious outlook caused by the increased cost of labour, and the projected association for engineers and shipbuilders of Scotland and of the North-east Coast of England has not yet been realised. There is only one association connected with the engineering group of industries.

Ownership of Results.—In January last a very important modification was made in the conditions of grant, whereby all results of investigation are to belong to the associations, which are to hold them in trust for the benefit of their members. This ownership is subject to two conditions:—The Department may (*a*) effect the communication of results to other industries, co-operating bodies and persons, on certain terms and conditions, (*b*) veto the communication of results to foreign interests.

Limits of Co-operation.—Difficulty has been experienced in combining within the same association the makers and users of goods, and both the Cotton and Wool Associations have refused to take common action with the merchants.

"It is probable that certain industries will never form Research Associations—either because their commercial unit or factory unit is so large that they are able to conduct their own research without joining their competitors in a co-operative scheme, or because the sharing of results obtained by research does not suit the conditions of the industry. The explosives industry and the dye industry, which are now in the hands of practically single combines, are examples of the first, and the heavy chemical industry is a case of the second class."

The Position of Consultants and Analysts.—It is very important that research associations should define clearly their attitude to consultants or

* To be purchased through any bookseller, or directly from H.M. Stationery Office at the following addresses: Imperial House, Kingsway, London, W.C.2, and 28, Abingdon Street, London, S.W.1.; 37, Peter Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 23, Forth Street, Edinburgh; or from E. Ponsonby, Ltd., 116, Grafton Street, Dublin.

analysts, and it is hoped that they will agree not to undertake for their members any routine work of the kind hitherto undertaken by the professional analyst or consulting engineer. One association has agreed to make a panel of consultants and analysts to whom its members can apply for technical assistance, which it is not the proper function of a research association to supply. Although the higher kind of consulting work is not susceptible of this treatment, there is no reason to believe that original workers among consultants will find their services neglected as a consequence of the establishment of these associations; the reverse is the more probable effect.

Part II. of the Report deals with researches which the Department is undertaking for national purposes. Under this heading is included the work of the National Physical Laboratory, of the Fuel Research Board (pulverised fuel, gas standards, and work for the Dominions), the Peat Inquiry Committee, the work of the Power Alcohol Interdepartmental Committee, of the Mine Rescue Apparatus Research Committee, the Food Investigation Board, the Tin and Tungsten Research Board, the Oxygen Uses Co-ordination Committee, the Gas Cylinders Committee, the Committee on Lubricants and Lubrication, the Abrasives and Polishing Powders Research Committee, the Industrial Fatigue Research Board; and investigations on timber, building, metal struts and spars for aircraft, brass and copper castings, copper and zinc, and certain researches on the preservation and restoration of antique objects in the British Museum undertaken by Dr. Alexander Scott.

Then follows an account of the activities of kindred Government organisations in the Overseas Dominions and in the United States, France, and Italy. The Secretary of State for the Colonies has appointed a Research Committee to administer a fund of £100,000 for the encouragement of research in the non-self-governing Dominions of the Crown during a period of five years.

Part III. describes the more important developments that have taken place in researches initiated by other bodies and aided by grants from the Department, such as investigations on hard porcelain by the Joint Research Committee of the Stoke Central School of Science and Technology and the Staffordshire Potteries Manufacturers' Association, and the Institute of Glass Technology in Sheffield University. A complete list of aided researches undertaken by scientific and technical societies is given in an appendix.

Publication of Results.—Certain modifications have been made in the conditions under which grants for pure science are made to research workers and students in training. After careful consideration of the objects of such grants, *viz.*, to prevent exploitation of results by individual firms and to secure an adequate share of rewards to the discoverer or inventor, the Council has come to the conclusion that these objects can be sufficiently secured without requiring the submission of all results to the Department before they are published. Only in exceptional cases in which results of commercial value are obtained is it desirable to limit the freedom of publication. Hence it has been decided that an aided research worker shall be free to publish his results where and when he thinks best, provided that, in the opinion of the Council, the subject of investigation is one which is unlikely from the outset to lead to results of commercial value; but the research worker may not take out a patent or make other commercial use of any results without previous consultation with the Department.

The total number of grants made to individual workers has increased from 67 to 103; of these, 72 were new grants, and 66 were grants made to workers in pure science as compared with 28 to workers in applied science.

Inventions and Patents.—The Report concludes with a discussion of certain questions connected with the administration of patents. No worker under the Department may take out a patent without the consent of the Committee of Council, and where leave is given it must be taken out in the joint name of the inventor and of the Imperial Trust. The Department reserves to itself complete discretion in the administration of patent rights after consultation with the inventor; and the Trust reserves the right to refuse to be a party to a patent covering a discovery made under a Committee or Board of the Department or by a worker in receipt of a grant. Among the problems awaiting solution is the administration of foreign patents based on State-aided inventions; but on the general question of patentability it has been provisionally decided that patents should not be taken out for (*a*) inventions of value for the preservation of health or of life, or (*b*) inventions the use of which can be enforced by a Government Department. In these cases steps are taken to secure full and complete publication with a view to preventing others from securing a patent for the invention.

In view of the fact that the Department is not concerned with the commercial exploitation of inventions, it cannot undertake to bring inventors into touch with manufacturers.

INTERIM REPORT TO THE BOARD OF TRADE OF THE EMPIRE FLAX GROWING COMMITTEE. [*Cmd.* 281. 2*d.*] (London: H.M. Stationery Office.)

Before the war the world's production of flax was estimated at about 506,000 tons, of which about 400,000 tons was derived from Russia. The United Kingdom produced about 12,000 tons and consumed about 100,000. Of the home-grown crop, Ireland contributed 10,000 tons, and the causes for the almost total extinction of the cultivation of flax in Great Britain were partly the difficulty of procuring rural labour for the special attention which the crop requires at the harvest season, and partly the low price at which the fibre could be imported from Russia. The greatest permanent obstacle to the production of flax in this country is the labour difficulty. Flax should be pulled and not cut, and this entails a large supply of temporary labour. Pulling machines have been invented, but are in an experimental stage. One of the chief essentials for the revival of flax growing is the organisation of centralised retting and scutching factories where these operations could be performed on a large scale and extended over a longer period. As the result of special efforts during the war the production in the north of Ireland was increased from about 8000 tons in 1914 to 15,700 tons in 1918, but it was over 12,000 tons in 1912 and 1913. In the north of Ireland the industry is of the nature of a small home industry, in which all the operations are carried out by the farmer and his staff, whereas if it is to be established in other parts of the country it would be necessary, on account of labour scarcity, to organise it on the large scale, utilising the factory system for preparing the fibre from the crop. This is the policy which is being pushed in Great Britain, where, under the auspices of the Flax Production Branch of the Board of Agriculture, the acreage for 1919 has been increased to 20,000, as against 13,537 for 1918.

The development of the industry in the United Kingdom has been seriously threatened by the scarcity of seed, and the position will not be secure until a certain and satisfactory supply can be drawn from within the British Empire. The Committee regards this as a commercial possibility.

In Canada the variety grown almost exclusively is adapted only for the production of linseed, and the production of flax fibre is relatively small. Efforts have been made to induce the Canadian farmers to grow imported Japanese seed of the fibre variety of flax in order to establish a British source from which fibre seed could be drawn.

British East Africa is probably one of the most promising fields in the Empire for the establishment of a large flax-growing industry, which, however, can only be done by an increase in the transport facilities. In India, Australasia and Africa generally, experimental work has shown that flax can be grown successfully, and it is only a matter of economic and technical development. The Committee concludes that the efforts put forward with considerable success during the war period to encourage and extend the cultivation of flax in the United Kingdom and the Empire should be continued until their full value has been determined. These efforts in Great Britain have been experimental in character with a view to ascertain whether the use of machinery and a central retting system can re-establish the industry on a large scale and on an economic basis. Even if this be found impracticable, the scheme should be continued on a limited scale for purposes of scientific and industrial research. In Ireland the existing schemes should be further developed for the purpose of expanding the present industry, providing instruction in the cultivation and handling of the crop, improving the quality and yield by selection and supply of suitable seed, setting up training centres for instructors and scutchers, and supporting financially the establishment of new scutching mills. The Irish Flax Society should also continue its experimental and research work on the lines suggested for the English and Scotch schemes. In the south of Ireland efforts should be made to establish the industry on factory lines by creating at least two units of 1000 acres each. In Canada the cultivation of suitable fibre seed should be continued in order to establish a permanent source from which seed for the United Kingdom could be drawn. As regards East Africa, the success already achieved supports the hope that this Colony may become in a comparatively short time a main source of flax production within the Empire. The requirements are: (1) Establishment of machinery at central points; (2) development of agricultural research and experiments in flax production; (3) provision of expert assistance in the preparation and grading of flax for the market. The settlement of slightly disabled soldiers in East Africa should be encouraged with a view to the production of flax in those districts proved to be suitable.

FORTY-THIRD ANNUAL REPORT OF H.M. INSPECTORS OF EXPLOSIVES. 1918. [Cmd. 278, 3*d.*] (London: H.M. Stationery Office.)

During the year 1918, 8 new factories were licensed and 8 became extinct, leaving the total number unchanged at 183. The number of magazines inspected was 460, stores 184 and registered premises 158; 155 amending licences were granted for factories and 8 for magazines. Only one case of illegal conveyance was detected. No modification was made in the law.

Messrs. F. H. and P. V. Dupré, chemical advisers, examined 347 samples, of which 62 were rejected. The majority of these were again for excessive moisture, and attention is drawn to the need for careful waterproofing and to the extreme hygroscopic character of explosives containing both ammonium nitrate and chloride of sodium. Only 17 new explosives were examined and the number of testing station samples amounted to 4 only.

The total number of accidents reported during 1918 was 526, as against 701 in 1917, from which 44 deaths and 194 injuries resulted. Of the 44 fatalities, 20 were due to two accidents in which explosive substances were not involved. One, causing 7 deaths and 2 injuries, occurred during the mixing of "deck flare" composition, and the other during the manufacture of incendiary bombs containing a mixture of aluminium, oxide of iron and sulphur known as "thermalloy." In both accidents the material which ignited contained aluminium, and although under test these compositions are by no means hyper-sensitive, accidents with them have been somewhat frequent, the causes of ignition being very obscure.

In addition to accidents investigated under Section 66 of the Act a considerable number of others were investigated (of these a number are specially mentioned).

The following tabulation gives the number of accidents reported from August 4, 1914, to November 11, 1918, and the casualties involved:—

Accidents causing death or injury	Men		Women		Accidents not causing death or injury
	Killed	Injured	Killed	Injured	
733	271	745	54	571	544

Giving the following totals:—

Accidents	Killed	Injured
1,277	325	1,316

During the same period the maximum number of workpeople employed amounted to 86,555, the average number being 61,898.

These figures show a net result of 1·25 persons killed and 5 injured per 1000 per annum. Points of interest in this connexion are (1) the proportion of accidents causing no personal injury to the total number, *viz.*, 544 to 1277, especially remarkable in the case of accidents with detonators of which less than half caused personal injury; (2) of the 325 deaths 177 were due to TNT, picric acid and dinitrophenol, which prior to the war were regarded as comparatively free from danger; (3) the small number of deaths in gunpowder manufacture, *viz.*, 7; (4) the absence of any fatal accident in filling over 8000 millions of small arms cartridges; (5) the danger of incendiary and firework compositions containing aluminium powder.

THE TRADE OF WESTERN SAMOA, THE TONGAN ISLANDS, AND THE FIJI ISLANDS. *By* MR. R. W. DALTON, *H.M. Trade Commissioner in New Zealand.* [Cmd. 200—4*d.*, and Cmd. 201—3*d.*]

Western Samoa consists of a group of islands about 600 miles from Fiji, which were formerly under German influence but are now under Allied control. The soil is very fertile, the chief production being copra; but cacao and rubber have been grown with some success. There is still a very large area of uncultivated land and if this is developed a very prosperous future lies before the islands, although the natives are not inclined to work continuously either for themselves or an employer.

Before the war the major part of the Samoan trade was in the hands of the Deutsche Handels und Plantagen Gesellschaft, a large Hamburg firm operating in the South Seas. Since the military occupation the firm's trading operations have been suspended but the plantations have been carried on by a liquidator. Of the other white firms there are four British, and two each of American and Danish origin. The import trade in recent years has

been: 1912, £249,720; 1914, £236,239; 1915, £267,091; 1916, £178,840. From the published returns the 1916 trade appears to have been divided as follows:—New Zealand, 39%; Australia, 34%; United States, 19%; United Kingdom, 3%; but these figures are somewhat misleading as New Zealand and Australia ship a lot of goods which originate in Britain. The chief imports are provisions, cloth piece goods and hardware. Samoan merchants have recently established buying agents in San Francisco and so brought American competition into these markets, while the Japanese have begun to compete in cheap goods formerly supplied by Germany.

The export trade for 1916 amounted to £235,415, made up of copra £143,245, cocoa £63,970, rubber £20,228, hides £690, and papain £608. During the war the copra has nearly all gone to the United States owing to difficulties of shipping elsewhere, and the continuation of this business is likely to be a serious handicap to British trade interests. Much British trade is done through Sydney and Auckland, but it seems quite clear that British firms have not taken the direct interest in the Islands which they might have done. The future development of Samoa depends largely on a satisfactory solution of the labour problem. The German firm above-mentioned used labour from the Solomon Islands. The importation of Chinese is at present handicapped by the high cost of repatriation. With sufficient labour, it is estimated that some 80,000 acres of fresh land could be cultivated. The coconut and cacao crops have suffered from the attack of the rhinoceros beetle and canker, and scientific investigation of these two pests is greatly needed.

The Tongan Islands are about 409 miles from Fiji and 360 miles from Samoa and form a British Protectorate. The conditions of the natives and of trade generally are very similar to those already described for Samoa, but the trade, both import and export, depends almost entirely on the copra crop. The islands are very low lying and are frequently visited by hurricanes which do great damage to the coconut palms. The trade for the last six years has been as follows:—

Year		Exports		Imports
		Copra	Total	
1912	...	£209,567	£216,511	£169,473
1913	...	72,480	82,320	81,044
1914	...	67,304	73,036	87,702
1915	...	102,900	103,950	100,075
1916	...	26,360	32,520	48,428
1917	...	122,333	125,442	114,290

Messrs. Lever Bros. and Messrs. Burns, Philp & Co. now do most of the outward trade in copra, and a great deal of the trade is apparently already British, but our manufacturers could get a larger share by studying local requirements. The chief points in considering the future of the Tongan Islands are (*a*) the attitude of native labour, and (*b*) the need for some alternative products which will form a means of sustenance during the bad copra seasons.

The Fiji Islands include over 250 islands about one-third of which is inhabited. The total trade in 1917 amounted to £3,079,809 (imports £1,011,408 and exports £2,068,401). By far the most important product is sugar which forms over 70 per cent. of the exports, but copra is also important. The use of cattle as weeders in the coconut plantations has been successfully adopted and cattle raising is likely to form a considerable industry. The natives are of a similar type to the other South Sea Islanders, and in the past labour has been obtained by the importation of indentured Indians. The indenture system has now been abolished and the future position as regards labour is obscure. The import trade of 1917 was distributed between:—Australia, 52%; New Zealand, 17%; United Kingdom, 12¼%; United States, 6¼%; Japan, 2%; a large amount of the Australian and New Zealand trade consists of transhipments from Britain. Leaving Australasia to supply provisions, and United States to send oils etc., it is estimated that the United Kingdom can compete in the import trade up to £560,000 annually, in such goods as hardware, sugar machinery and cloth piece goods. The British share of the trade before the war was very large and a good deal of that which has been lost during the war will revert to Great Britain automatically when conditions again become normal. The future extension of trade, however, depends entirely on the labour problem; and if this is not satisfactorily solved it will not be necessary to attach any particular importance to trade with Fiji.

COMPANY NEWS.

BRITISH DYESTUFFS CORPORATION, LTD.

The statutory report states that in addition to the shares allotted to the amalgamating companies, there have been issued for cash 850,000 preference shares and 850,000 preferred ordinary shares (registered in the names of the nominees of H.M. Government). Receipts amount to £3,679,186, and disbursements include £125,000 underwriting commission and £1,710,125 paid to the amalgamating companies to enable them to discharge outstanding liabilities, etc., leaving a balance of £1,837,497.

At the statutory meeting held in London on August 26, Sir Henry Birchenough, who presided, said that 3,276,000 shares, or approximately two-thirds of the total issue, had been applied for by the public. There were now about 12,000 shareholders on the register. The item of £225,000 for preliminary expenses was largely made up of registration fees and stamp duty (£130,000), and brokerage (£60,000); the underwriting commission was 2½ per cent. There was every reason to believe that with the loyal co-operation of the textile industry, the corporation would be able to satisfy the requirements of this country, those of important consumers throughout the Empire, more particularly in India, and make a successful fight against German competition in China and other markets.

Lord Moulton stated that small quantities of dyes were being imported from Switzerland. The board had no positive knowledge, but believed that no German dyes were coming into this country by way of America.

RUBBER PLANTATIONS INVESTMENT TRUST, LTD.

At the tenth ordinary general meeting held on August 29, Mr. G. Croll, who presided, said that the total area under plantation rubber was estimated to be 2,750,000 acres at December 31, 1918. When this acreage is in full bearing seven years hence, the output would be approximately 500,000 tons, which is about double the quantity produced in 1918. There should be no fear of supply overrunning demand. In the United States there were over 1,000,000 registered motor cars in 1913, 2,250,000 in 1916, and approximately 6,000,000 at the beginning of the current year. It was difficult to understand why the manufacture of rubber goods in this country had not developed to any great extent; there is a growing demand for such goods at the present time, and the immediate need is for British manufacturers to augment their plant. The Rubber Growers' Association is inviting suggestions for new uses to which rubber might be put.

During the past financial year there was a net loss of £114,075, of which £45,000 was due to loss on exchange. The issued capital of the trust is £1,494,809.

ENGLISH OILFIELDS, LTD.

An extraordinary general meeting was held on September 1 to consider the question of raising the capital to £1,500,000 by the creation of 1,200,000 new shares of £1 each, to rank equally with the existing 300,000 shares. Sir James Heath presided.

Dr. W. Forbes-Leslie, dealing with the technical aspect of the undertaking, said that the company was founded in 1918 to acquire the interests of the English and Foreign Oil Finance, Ltd., including 20 square miles of land which had been especially marked out by geological investigation. Nineteen bore-holes had been sunk and evidence obtained of the existence over the whole area of oil shale seams having a thickness of retortable material of not less than 150 ft. and being remarkably uniform both in thickness and in oil content. Several of the borings had passed through some 70 ft. of a substance which yields a large percentage of wax—the so-called ozokerite of Norfolk.

Mining operations were started six months ago, and No. 1 Mine West Winch is capable of giving an output of 500 tons per day. Mining in the shale series is economical and samples from the mine faces show a 50 per cent. greater yield of volatile matter than was given by the bore-hole samples. The oil obtained from the middle shales is of remarkable quality, practically free from sulphur and gives high yields of motor spirit and wax. Dr. Forbes-Leslie estimates that these shales contain more than 2,000 million tons of practically sulphur-free material, which would yield 45–50 galls. of oil, at least 60 lb. of ammonium sulphate, and 60 lb. of wax, per ton. A long series of tests on the best form of retort had led to the selection of a new type which, subject to certain minor alterations, should give satisfactory results. Adjoining the mines is a 40 ft. deposit of blue clay extending over 161 acres, from which bricks, second to none in England, can be manufactured. The shale residues have been found to be suitable for cement manufacture. The chalk required for this purpose occurs abundantly on the property and the waste gas from the retorts will be available for fuel. It should be possible to produce 600 tons of cement daily when the projected 1000-ton shale plant is in operation. The property owned by the company is capable of supplying 18 works each dealing with 4000 tons of shale per day.

The resolution to increase the capital was carried unanimously.

AMMONIA SODA CO., LTD.

The report and accounts for the year ended January 31, 1919, show a trading profit of £43,139, and, after deducting excess profits duty, etc., a credit to profit and loss of £35,194. Out of this sum it is proposed to pay the preference dividend of 6 per cent. for the year, to write off the suspense account of £15,000, and to carry forward £15,036. The subscribed capital is £217,978.

Soon after the termination of hostilities it was found to be impossible to manufacture without incurring heavy loss, owing to increased costs, decline in the market price of the material manufactured, decreased demand, and to the bad state of the plant. In March last it was decided to suspend work and to overhaul the plant. **In the result the directors, in consultation with the chief shareholders, resolved upon voluntary liquidation. This course has been agreed to by the shareholders.**

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for August 28 and September 4.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
Australia ...	Glassware, stoneware ...	502
,, ...	Colours, earthenware, tiles	551
British India ...	Galvanised sheets, pitch	504
Canada ...	Carbon paper, inks ...	558
,, ...	Superphosphates*, basic slag, Paris green, lead arsenate, calcium arsenate, potash, vinegar, matches, polishes ...	—
Egypt	Galvanised sheet, asbestos roofing, bituminous paints ...	515
,, ...	Dyes, soap, glass, earthenware, paper	559
Austria	Drugs, medicines ...	516
Belgium	Cast steel, cast iron chilled rolls	517
,, ...	Chemicals, dyes and acids for textile industry ...	521
,, ...	Tinplate	525
,, ...	Chemicals, drugs, laboratory requisites ...	565
,, ...	Chemicals for dyeing, glue	566
Czecho-Slovakia	Chemicals, paints (catalogues oil)	†
Denmark ...	Pig iron	531
Esthonia	Petroleum, chemicals, medicines, caustic soda, iron, glue, quebracho, lubricating oils (goods in demand)	—
France	Drugs, fine glassware ...	533
,, ...	Hides, leather	570
Germany (Occupied Territory)	Iron, steel	574
,, ...	Oils	575
Italy	Zinc	‡
Rumania ...	Chemical and pharmaceutical products ...	577
Turkey	Glass, soap, perfumery, chemicals	540
,, ...	Glass, china, paint, etc. ...	541
Argentina ...	Dyes	544
Brazil	Cement, paint, varnish, glass, earthenware, chemicals, drugs, perfumery	585
,, ...	"Granite" earthenware	586
Chile	Aniline dyes	587
Peru	Glass, earthenware, paper, perfumery ...	549

* High Commissioner for Canada, 19, Victoria Street, S.W. 1.

† Chambers of Commerce (Export Department) at Prague, Budweis, Olomouc, Brno, Opava, Eger, Reichenberg, Pizen, Bradec-Kralove, Bratislava, Kosice, or Troppau in Silesia.

‡ British Chamber of Commerce for Italy, via Silvio Pellico, 12, Milan.

MARKETS SOUGHT. *Ceylon.*—Requirements of rubber manufacturers, of consumers of copra, cinnamon, citronella oil and desiccated coconut, and of buyers of plumbago.

Canada.—High grade felspar, phosphate and pyrites.

TARIFF. CUSTOMS. EXCISE.

United Kingdom.—**The preferential duties on certain articles, including sugar, glucose, syrup and saccharin, came into force on September 1. The regulations are set out in the issues of the *Bd. of Trade J.* for Aug. 28 and Sept. 4.**

Australia.—The import duties on certain dry colours have been amended.

Canada.—Recent customs decisions affect benzol, xylol, solvent naphtha and salt. The export of raw hides, skins and leather for boot manufacture has been prohibited, except under licence, as from August 2.

Chile.—Particulars of a recent decree regarding the payment of customs duties are given in the *Bd. of Trade J.* of Aug. 28.

Federated Malay States.—The rates of import duties on alcoholic liquors have been revised as from July 4.

France and Algeria.—The production, importation and sale of alcohol is reserved to the State until a law establishing a temporary or permanent régime for alcohol is passed, or at the latest until six months after the conclusion of hostilities.

French Guiana.—A statistical tax has been imposed on all goods, with some exceptions, imported from or exported to, all countries as from August 11.

Hayti.—A statistical tax has been imposed on, *inter alia*, hides, sugar, wax, alcohol and guano.

Italy.—For the present the new import restrictions do not apply to goods sent by parcel post except in certain cases. Goods so imported are still subject to import licence.

Jugo-Slavia.—Certificates of origin are required for goods imported, but it is not necessary that they should be *visé'd* by a Serbian consul.

Rumania.—The articles the importation of which is prohibited except with the consent of the Minister of Commerce and Industry includes certain kinds of glass and porcelain, fine skins, toilet soap, cocoa, chocolate and paper.

Sierra Leone.—The import duties on alcoholic beverages have been increased as from July 16.

South Africa.—The customs duty on medicinal and toilet preparations, essences, tinctures and syrups containing more than 3 per cent. of proof spirit has been fixed at £1 11*s.* per imperial gallon or 25 per cent. *ad val.*, whichever shall be the greater.

South Russia.—A customs duty of 10 per cent. *ad. val.* has been imposed on all goods, with some exceptions, including starch, salt, vinegar, fats and oils, glycerin, many chemicals, minerals and ores, certain metals, asbestos, rubber, clay, lime, and tanning materials.

Sweden.—Amongst the articles the export of which is still forbidden are minerals, colours, bitumen, asbestos, asphalt, animal fats, starch, oil cake, many articles of food, hides, skins, bones, hair, vegetable fibres, rubber, metals, mineral oils, vegetable oils, wax, glycerin, candles, soap, and many chemicals.

United States.—It is proposed to amend the customs duties on laboratory and optical glass, and on scientific instruments.

GOVERNMENT ORDERS AND NOTICES

SULPHATE OF AMMONIA.

New Maximum Prices.

The Board of Agriculture has come to an agreement with the makers of sulphate of ammonia in regard to the maximum prices to be charged for this fertiliser for home agricultural use for delivery in the eight months October 1919—May 1920. These prices are appreciably higher than those ruling during last season, owing to the fact that the Government subsidy given to makers during the war has now been withdrawn. The agreed maximum prices are fixed on a commercial basis which has to cover the substantial increases that have occurred since last year in the cost of coal, wages, and raw materials. The Board considers that these prices are not more than are necessary to secure to the manufacturers a reasonable trade profit.

For sale in lots of not less than 2 tons for delivery by rail or water to purchaser's nearest railway station or wharf in Great Britain, less a trade discount to agricultural merchants, dealers and co-operative societies, the agreed maximum prices are:—

Month of delivery	Price per ton, in bags, net cash
October, 1919	£20 10 0
November	20 15 0
December	21 0 0
January, 1920	21 7 6
February	21 15 0
March, April and May	22 0 0

In the case of deliveries to Ireland, Isle of Man or Channel Islands, the prices include delivery f.o.b. port in Great Britain.

The above prices are for 24·5 per cent. ammonia, and will be increased by 4*s.* per ton for each complete 0·25 per cent. ammonia over 24·5 per cent., and by a further 5*s.* per ton if sellers guarantee the free acid not to exceed 0·25 per cent.; and should be reduced by 4*s.* per ton for every 0·25 per cent. ammonia below 24·5 per cent. The qualitative increases and reductions apply only to deliveries of 2 cwt. and over. If the sulphate is specially ground or pulverised at buyer's request, an additional charge not exceeding 5*s.* per ton may be made.

Certain extra charges are allowed for deliveries of less than 2 tons.

SUPPLY OF HIGH GRADE POTASH FOR AGRICULTURAL PURPOSES.

The Government has recently acquired from Germany a quantity of potash salts in exchange for food, and arrangements have been made for the distribution of about 40,000 tons for agricultural purposes. The sale of the material will be undertaken by the British Potash Co., Ltd., 49, Queen Victoria Street, London, E.C. 4, under the direction of an Official Committee, to be called the Potash Distribution Committee, on which the Board of Trade and the Departments of Agriculture for England, Scotland and Ireland will be represented, together with representatives of trade interests.

The following maximum selling prices have been agreed for sales to farmers, delivered to nearest railway station in Great Britain or Ireland in lots of not less than 4 tons: Potash salts 30% K_2O, muriate of potash 80% KCl, £20 12*s.* 6*d.*; sulphate of potash 90% K_2SO_4, £23 2*s.* 6*d.*

Manure mixers, merchants, dealers and co-operative societies will be allowed a discount on these prices of 7*s.* 6*d.* per ton on potash salts, and 10*s.* per ton on the muriate and sulphate of potash.

The potash will be sold at the above basis prices, and a proportionate increase or decrease will be made for higher or lower quality as shown by analysis of a representative sample of each consignment.

For sales of small quantities *ex* merchants' store certain maximum additions to the above prices are allowed by the Board.

No potash of a lower grade than 30% Salts is available under the above arrangement, but licences are being granted to the Alsace-Lorraine Trading and Development Company, 54, Gresham Street, London, E.C. 2, for the importation of 20,000 tons in all of kainit (14% K_2O) and sylvinite (20% K_2O), to whom purchasers should apply.

EXPORTS.

Export credits.—The Government is prepared to consider applications for advances up to 80 per cent. of the cost (plus freight and insurance) of goods sold to:—Finland, the Baltic Provinces, Poland, Czecho-Slovakia, Jugo-Slavia, and certain areas in Russia. Applications to the Export Credits Department, 10 Basinghall Street, E.C. 2.

IMPORTS.

Mineral oils.—The general licence covering kerosene and benzine (including white spirit) gas oil and fuel oil refers to total quantity of import, and does not affect the arrangement with the Pool Board whereby the number of importing firms is limited. This arrangement ceases on October 31, after which date other firms will be allowed to import.

Opium and cocaine.—The importation of these drugs remains prohibited, except under Home Office licence, in accordance with the provisions of Article 295 of the Peace Treaty.

Paper.—All articles covered by the Regulation as to the importation of paper are to be admitted into this country as from August 29.

Transport of coal.—The Board of Trade has notified that the restrictions on the transport of coal by rail imposed under the Coal Transport Reorganisation Scheme are suspended as from September 1.

TRADE NOTES.

BRITISH.

Leeward Islands in 1917-18.—Owing to difficulties in obtaining sufficient supplies of Sea Island cotton for aeronautical purposes the British Government decided in October 1917 to acquire the whole of the production of these islands at the following prices:—Ordinary, 3*s.* per lb.; good ordinary, 3*s.* 4*d.* per lb.; superfine, 3*s.* 9*d.* to 4*s.* 7*d.* per lb.

The principal exports of the colony in 1917 were:—

	£	Percentage of total exports
Vacuum pan sugar ...	£477,031	43·6
Muscovado sugar ...	121,559	11·1
Molasses and syrup ...	58,413	5·3
Cotton, raw	78,460	7·1
Limes, citrate	6,930	0·6
,, concentrated ...	58,554	5·3
,, raw juice ...	84,528	7·7
,, cordial	103	—
,, fresh	48,454	4·4
,, pickled	403	—
Cocoa	8,239	0·8
	£942,674	85·9

Antigua.—A little more than half of the sugar exported from the colony came from Antigua, where the total quantity of canes dealt with during 1917 was 102,593 tons. The work of the factories was even more satisfactory than in the previous year. The sucrose left in megass was 3·01% in 1916 and 2·66% in 1917, the purity of the juice 83·95% and 84·78%, and the yield of sugar was increased from 11·01 to 11·42%. This improvement in the recovery of sucrose in the factory, as compared with the average of the five years immediately preceding the war, is calculated to be equivalent to an increase of 2¼ tons of cane per acre.

Dominica.—This island is the chief producer of lime products. The crop in 1917 was 396,000 barrels (of 4·55 cub. ft.) of fruit, compared with 384,000 barrels in 1917. The disposal of the crops is shown in the following table:—

Product	Barrels of fruit	Percentage of total crop
Concentrated juice ...	224,662	56·7
Raw juice	103,751	26·1
Fresh limes	41,243	10·4
Citrate of lime ...	26,068	6·6

The lime crop has been practically the same during each of the last five years. This lack of progress is largely due to the effect of the hurricanes of 1915 and 1916, and also to the increased cost of labour and the difficulty of obtaining supplies of concentrated manures.

Montserrat.—The export of lime products in 1917 was 200,000 galls. of raw juice, compared with an average of 134,384 galls. in the four previous years. Exports of muscovado sugar decreased from 417 tons in 1916 to 294 tons in 1917 owing to the shortage of labour caused by the boom in cotton cultivation.

The area under cotton cultivation was 2,608 acres, and the average production at the rate of 157 lb. of lint per acre, or 11 lb. per acre above the average for the past 14 years. High prices were maintained, and the outlook for the future is very hopeful.

The experimental work of the Agricultural Department has shown that the ajowan plant can be cultivated as a source of thymol, and some interest has been aroused in the cultivation of a local plant, *Datura Metel*, as a source of the alkaloid scopolamine.—(*Col. Rep. Ann.*, *No.* 992, *May* 1919.)

FOREIGN.

Japanese Foreign Chemical Trade.—The values of the chemicals, including explosives, imported into Japan have undergone continuous expansion in recent years. Thus the value imported increased from 20,012,802 yen in 1910 to 55,129,809 yen in 1916, representing an increase of from 5·9 to 7·3 per cent. of the total imports of all kinds into the country.

The relative positions of Germany, the United Kingdom and the United States in regard to the supply of chemicals to Japan during the period 1912–1916 may be gauged from the following statistics (yen = 2*s.* 0½*d.*):—

Value of Imports into Japan (in thousands of yen).

Substance	Year	Germany	U.K.	U.S.A.
Boracic acid	1912	92·6	24·4	1·3
,, ,, ...	1914	59·4	23·6	9·8
,, ,, ...	1916	10·0	242·5	129·7
Tartaric acid	1916	—	45·3	57·1
Salicylic acid	1914	170·2	—	5·2
,, ,, ...	1916	12·7	—	209·0
Carbolic acid	1914	139·4	37·4	65·0
,, ,, ...	1916	28·2	1·5	3665·6
Citric acid	1914	28·9	25·7	64·0
,, ,, ...	1916	·9	49·6	66·1
Caustic soda	1912	—	1162·8	3·7
,, ,, ...	1914	—	1291·8	116·9
,, ,, ...	1916	—	435·5	2489·3
Soda ash	1912	—	1388·0	0·2
,, ,, ...	1914	—	1485·2	45·2
,, ,, ...	1916	—	2936·9	70·7
Bicarbonate of soda* ...	1914	—	290·0	0·03
,, ,, ...	1916	—	330·2	36·5
Borax	1912	55·8	51·7	33·7
,, ...	1914	16·8	94·7	24·1
,, ...	1916	2·6	429·9	209·5
Potassium chlorate† ...	1912	412·8	234·7	0·8
,, ,, ...	1914	277·2	178·1	10·0
,, ,, ...	1916	14·2	397·8	856·3
Ammonium sulphate* ...	1912	—	12,011·7	—
,, ,, ...	1914	—	14,992·1	—
,, ,, ...	1916	—	511·3	—

* Increasing quantities of these materials have been imported from Manchuria (in 1916, bicarbonate 27·4, ammonium sulphate 284·4).

† The values of chlorate imported from France were 501·3 in 1912 and 312·3 in 1916.

Prospects of American Dye Trade in the Far East.—The dyestuff market in the United States is likely to remain firm for at least a year and German competition is not to be feared for another two years. Germany's stock of dyes is probably very much less than has been stated, and her difficulties in regard to labour costs, taxes and overhead standing charges (due to restricted production) will all be higher than in other countries.

With regard to the market in China, the chief difficulty manufacturers have to contend with is the conservatism of Chinese merchants. The unfounded rumour, current after the armistice, that large quantities of German dyes would be available at pre-war prices proved all but disastrous to American trade. Germany has almost insuperable difficulties to contend with in regard to transportation as well as production, and under these circumstances America will be able to compete both in quality and price. The question of credits is important, but American banks in China are giving great assistance. The pre-war German selling organisations are still intact, and what is now needed is American control of one or more large native dealers.

The Dutch East Indies offer great possibilities. Germany maintained experts in Java to give instruction in the use of German colours, and as these men have been unable to leave, she has an organisation ready for her post-war trade. German agents allowed long credits and were permitted to make their own arrangements as to payment. Prospects in Japan are also bright. German agencies are now in the hands of Japanese dealers. Little Government protection is offered to the dye-making industry, probably on account of fear to inflict injury on the established piece-goods industry. Direct sales are unfavourable in Japan where it is customary for small dealers to buy through the larger houses.—(*U.S. Com. Rep., July* 21, 1919.)

The Tin Mining Industry in Yunnan.—The production of tin in Yunnan province, China, has almost collapsed, the production having fallen to 2500–6000 tons this year against 12,000 tons for last year. Although more transport has been available than usual, the prices have been constantly falling, 99% metal being quoted at $84 per picul of 133 lb., 98% at $82, and 96% at $77 in local currency against normal prices of $95 to $105. There is little chance of recovery and many miners have gone to other work.

Exports of the metal from Hong Kong this year amount to 2111 short tons of value $2,353,640, practically all of which has gone to China itself. Stores of approximately 3000 tons are in hand in Hong Kong. The serious factor is exchange, the high price of silver preventing Yunnan tin competing with tin from the Straits Settlements.—(*U.S. Com. Rep., July* 9, 1919.)

The Sulphur Situation in Sweden and Norway.—The pre-war consumption of sulphur in Sweden amounted to 40,000 tons yearly, all of which was imported. The bulk was used in the sulphite wood pulp industry and was obtained from Great Britain and Sicily. At present there are prospects of America and Japan entering this market. During the war the majority of the pulp mills has been re-adjusted so as to utilise Norwegian pyrites in place of sulphur and this introduces further competition. Consumers are not likely to consider any price above about £9 per ton c.i.f. Sweden.

Before the war the requirements of the sulphite wood pulp industry in Norway were largely met by imported sulphur and the native pyrites was mostly exported. During the war this state of affairs has been altered and the majority of the pulp factories has been adapted to use pyrites. This change is reflected in the statistics. There has been an increase in the production of pyrites from 369,055 tons in 1911 to 513,335 tons in 1915 (the latest record available) but a decrease in exports from 360,228 tons in 1914 to 240,774 tons in 1918, the differences being accounted for by the increased home consumption. The sulphur imports have during the same period fallen from 15,411 tons in 1913 to 3,036 tons in 1918. The bulk of the sulphur imported previously came from Great Britain, Italy and Spain, but latterly Spain has been shipping far less than formerly, and in 1918 the United States furnished more than half the total imports imported.

The price of sulphur up to 1914 was fairly constant at 90 to 95 kroner (£5—£5 5s.) per ton, but since then it has increased by stages up to 300 kroner (krone = 1*s.* 1½*d.*). It is estimated that the normal demand for sulphur is about 7000 tons per annum (about 5000 to wood pulp works and 2000 to match factories and minor industries), but the present situation is very unsettled largely owing to the difficulties experienced by the sulphite mills in disposing of their products.—(*U.S. Com. Rep., July* 14, 26, 1919.)

Prices of Sulphuric Acid and Nitrogenous Fertilisers in Germany.—The price of sulphuric acid, as authorised on April 1, has been further increased as from July 1. The price of sulphuric acid containing up to 78% of the monohydrate is increased from 510 to 578 marks per 1000 kilo. sulphur content. For acid containing between 78% and 92% monohydrate the price is advanced from 1000 to 1069 marks, a deduction up to 125 marks per 1000 kilo. being allowed according to the quality delivered. The price of sulphuric acid of strength above 92% and of oleum containing up to 40% free SO_3 is advanced from 684 to 753 marks. The price of acid of unspecified strength is fixed by the addition of a suitable increment to the cost of production.

An increase in the price of nitrogenous fertilisers has been authorised by a decree of the Reichwirtschaftminister, the operation of the decree to be retrospective as from July 1, 1919. The current prices thus established show considerable advances on those ruling on March 16 of this year, the respective prices being as given in the following table:—

Price per kilogram % nitrogen.

	Present Price Pfg.	Former Price Pfg.
Ammonium Sulphate:		
(a) Ordinary manufacture ..	290	180
(b) ditto, dried and ground ..	296	186
Sodium ammonium sulphate ..	290	180
Ammonium nitrate	340	200
Potassium ammonium nitrate ..	340	220
ditto, per kilo. potash content ..	+48	+41
Sodium nitrate	310	275
Calcium cyanamide	140	140
Blood meal	260	260
Phosphate meal	220	220

The following prices per kilo. are likewise authorised: ammonium chloride 2·90 marks, sodium, ammonium nitrate mixed with from 40% to 48% of rock salt, 3·40 marks, ammonium nitrate containing a minimum of 3% bone meal 3·40 marks, ammonium nitrate mixed with either calcium sulphate or lime (containing about 40% gypsum or lime) 3·40 marks. Another decree places the prices of nitrogenous fertilisers on a uniform basis by increasing the prices of 9 nitrogenous fertilisers (compared with 5 formerly) by 1·00 mark per kilo. of nitrogen (formerly 0·80 mark) and the price of calcium cyanamide by 2·00 marks (previously 1·00 mark).—(*Z. angew. Chem., July* 15, *Aug.* 1, 1919.)

Water Power in German-Austria: Proposed Carbide Monopoly.—Until now water-power installations have been adapted to the supply of water available with certainty during nine months of the year; but it would be better if they were enlarged so that the greatest quantity of water available at any time could be utilised. A steady supply of energy should then be delivered at a high price during the whole year to the consumers of light and power, whilst the excess, available only from time to time, would serve for selected chemical factories using only cheap current and making a product easy to be stored and not requiring further treatment. The manufacture of calcium carbide, which could be carried on intermittently, fulfils these conditions, and it would be possible to make 6,500,000 tons of this material from the 500,000 metric tons of gas-coke annually produced in German-Austria. The necessary electrical energy (5·76 million kilowatt-hours) could be provided by the excess energy of the enlarged water-power stations, and the cost of electrical power would be reduced to all consumers. Carbide, to the value of 910 million kroner per year, could be produced and at a much lower cost than obtains in most other countries. This industry is well suited to be a State monopoly.—(*Z. angew. Chem., June* 17, 1919.)

Foreign Company News.—*France.*—The "Société Française de Radio Chimie" was established early in 1914 with a capital of 1,700,000 francs. Its operations were devoted to the working up of monazites and other radioactive earths with a view to the production of mesothorium, radium and its various transformation products. It devoted particular attention to the production of luminous and pharmaceutical radium products and has succeeded in introducing its products into several markets formerly supplied by Germany. A net profit of 251,817 francs enables a dividend of 10 per cent. to be declared.—(*L'Information, June* 12, 1919.)

Dutch Indies.—A firm of chemical manufacturers about to be established in Soerabaja will be primarily concerned with the production of carbon bisulphide, which is indispensable to the tobacco industry; the output will at first be 1,000 kilo. per 24 hours, so that Java will be in an independent position as regards uncertain import conditions.—(*Z. angew. Chem., July* 18, 1919.)

OBITUARY.

Dr. A. G. VERNON HARCOURT.

Dr. Augustus George Vernon Harcourt, who was born in London on December 24, 1834, died at St. Clare, Ryde, on August 25 last. As an undergraduate he studied under Dr. Daubeny and Henry Smith (Oxford's earliest teachers of chemistry), and in 1858 became lecture assistant to Sir Benjamin Brodie, who in October of that year delivered his first course of lectures as professor of chemistry in the new Science Museum which heralded the recognition by Oxford University of the educative value of natural science. Associated thus with the inception of the teaching of chemistry at Oxford, Harcourt was appointed in 1860 Lee's reader in that subject at Christ Church, and in the small laboratory of that college he continued until 1902 to initiate successive half-scores of undergraduates in the principles of chemistry. Himself a classical scholar of no mean standing, he nevertheless very actively supported the movement to abolish compulsory Greek in the curriculum of students of natural science at Oxford University.

Harcourt's early researches were on the rate of chemical change, for which his exceptional skill as an analyst stood him in good stead. His technical work was largely in connexion with gas supply, and he laid the foundations of the Carpenter-Evans heating process for the purification of coal gas from carbon bisulphide. He studied other gas purification problems, and devised a useful works' method for estimating the sulphur compounds in gas. He worked for over 20 years at the production of a standard of light which should be more trustworthy than the parliamentary standard candle, and in 1897 produced the 10-candle pentane lamp which goes by his name, and is now the accepted international standard of light. He invented a chloroform inhaler which reduces to a minimum the risks inseparable from the administration of that anaesthetic. He strongly advocated the use of coke in place of coal as a household fuel, and devised special labour-saving grates for its consumption. Harcourt was, with Arrhenius, the first to receive a science degree (in 1908, *honoris causa*) from Oxford University. He also received honorary degrees from Durham and McGill Universities. Elected to the Chemical Society in 1859, he was one of its secretaries from 1865 to 1873, and, after three terms of years as vice-president, became president for three years—1895-7. He gained his F.R.S. in 1868. For a period of 45 years—1872 to 1917—he was appointed and re-appointed by the Board of Trade one of the Gas Referees for the Metropolis.

REVIEWS.

The Chemistry and Manufacture of Hydrogen. *By* P. Litherland Teed. *Pp.* 152, *with* 22 *illustrations.* (*London: Edward Arnold,* 1919.) *Price* 10*s.* 6*d. net.*

Although the manufacture of hydrogen has long been carried out on a relatively small scale, it is only during the present century that plants for its extensive production have been developed, to comply with the demand for the gas, more especially for use in the hardening of fats, for use in airships, and for the synthetic production of ammonia by the Haber process. While much information on the subject is to be found in Patent Specifications, and scattered through the technical journals, there has hitherto been no book of recent date dealing with the subject available for those interested in chemical technology generally desiring information on the subject. The lecture given early in 1914 by Prof. A. W. Crossley (this J., 1914, **33**, 1135) and C. Ellis's book on the "Hydrogenation of Oils, Catalysers and Catalysis, and the Generation of Hydrogen" (Constable, 1914) are, so far as the writer knows, the only general sources of information on the subject, but since the year 1914 a very great development of the manufacture has taken place, owing to the largely increased demand for hydrogen for the above purposes arising from the war.

This gap in the literature Major Teed has endeavoured to fulfil in the book under review, and he has succeeded in writing a very readable description of the various processes in use and of suggested possible technical processes. These include not only the processes directly devised for production of hydrogen as the primary product, such as the silicol, the water-gas, and Bergius processes, but also those in which hydrogen is obtained as a by-product, such as the production of caustic soda by electrolysis. In addition to being readable the accounts given are also clear and generally accurate, and the illustrations are not too small or too overloaded with detail to enable them to be followed, as is too frequently the case in books

of this class. It is true that definite statements occasionally occur with regard to matters of detail which would not meet with anything like universal agreement from those engaged in the industry, but this is almost impossible to avoid in a short work dealing with the matter generally, and not intended to be an exhaustive handbook.

Very few typographical errors occur, those noticed being confined to misspellings of proper names—for example, "Neuman & Strienz" for "Neumann & Streintz" (p. 15) and "Moisson" for "Moissan" (p. 19). H. G. COLMAN.

THE MANUFACTURE OF VARNISHES AND KINDRED INDUSTRIES. *Vol. I. The Crushing, Refining and Boiling of Linseed and other Varnish Oils.* A. LIVACHE *and* J. G. MCINTOSH. *Third edition, revised by* C. HARRISON. *Pp. viii + 498. (London: Scott, Greenwood & Son,* 1919.) *Price* 17*s.* 6*d. net.*

This book affords yet another instance of the minute specialisation which is now to be found in every branch of chemical industry. It is the first volume of the third edition of Livache and McIntosh's "Drying Oils and Varnishes," and devotes nearly 500 pages mainly to linseed oil, without by any means exhausting the subject. In its present form the work has been so developed and adapted to English conditions as to be essentially a new book.

The English author, whose death occurred prior to the publication of this volume, was not only a practical expert in his subject, but was also a man of strong personality, which he has impressed upon his pages. It has therefore been no easy matter for the reviser who has completed the unfinished work to fill up the gaps in the subject matter in such a way as to harmonise with what had been written. On the whole it will be admitted that he has succeeded in his task. He has also adopted the plan, which is a wise one for this edition, at all events, of not interfering with the English author's mode of expression. For the same reason it is necessary to refrain from criticising some of the author's views on subsidiary points, such as his dislike for the metric system, and only to call attention to some of the minor errors connected with the main subject. In a future edition, however, it would be advisable for the editor to bring the nomenclature of such terms as "lezithin," "hydrocarbides" and "oxy" (for "hydroxy) acids," into harmony with the terms in common use.

The first fifteen chapters deal with the general properties of drying oils, and the production, composition, refining, and physical and chemical properties of linseed oil; its adulteration; the manufacture of technical products such as printing inks, blown oils, linoleum and rubber substitutes; the chemistry of the drying process, boiled oils, and paints; whilst the final chapter is concerned with oils other than linseed oil.

The information throughout is of a thoroughly practical character, and the book is one which every technical oil chemist will find of the greatest help in his work. It was perhaps inevitable that the chemistry of oils in general should have been compressed to such an extent as to necessitate frequent reference to general treatises on the subject; but a slight expansion in a few places would have obviated this drawback to a considerable extent, without increasing very materially the size of the book.

Several statements require correction or modification. For example, the statement that "the Maumené number gives parallel results with the iodine absorption results" is only relatively correct. Again, the term "linoleic" acid is very loosely used, being sometimes applied to the mixed liquid fatty acids of linseed oil, in other places (pp. 89, 239) to linolic acid, and in others (p. 86) to linolenic acid.

The subject matter has been brought up to date and the recent work of other chemists is critically considered, but it detracts greatly from the value of the book that no references are given to the original publications, and it is difficult to discover from the text whether the results discussed are old or recent. C. A. MITCHELL.

TABLES OF REFRACTIVE INDICES. *Vol. I. Essential Oils. Compiled by* R. KANTHACK, *and edited by* J. N. GOLDSMITH. *Pp. vi + 148. (London: Adam Hilger, Ltd.* 1918.) *Price* 15*s. net.*

This compilation contains records of the measurements of refractive indices of some 500 essential oils, together with references to the original literature in every case. Thus it is not only a list of essential oils obtained from various sources, both geographical and botanical, but also a useful bibliography of the subject.

In the introduction and preface, the author and editor have disarmed criticism by fairly stating the advantages and limitations of the refractometer as applied to the examination of such complex mixtures as natural essential oils, which, unlike simple bodies such as sugar or alcohol in aqueous solution, cannot be quantitatively estimated by any physical method. In the chemical examination of essential oils it is rarely possible to isolate and weigh the valuable constituents; and therefore indirect methods must be employed for the estimation of phenols, esters, alcohols etc., and all evidence, including specific gravity, optical rotation, refractive index, solubility and even odour, must be taken into consideration when deciding whether the sample under examination is to be classed as normal or abnormal. The utility of the "List of References" in these tables is here demonstrated, for it enables the analyst to find out quickly from original papers whether the figures quoted were observed on pure oils of commerce or on oils which could not be described as normal, owing to faulty methods of distillation or unusual sources of raw material used.

The compiler wisely insists upon the importance of quoting the temperature at which an observation is made and indirectly advocates the adoption of some standard temperature or temperatures when making determinations of refractive indices. Alternate pages are left blank for notes. Future editions might with advantage contain an illustrated description of the refractometer and the best methods of using, cleaning and adjusting might be added. The writer can recommend the book to all interested in the examination of essential oils, and at the risk of going beyond his present mandate he would add that a recent examination of Hilger's refractometer side by side with a standard German instrument, using various essential oils as test liquids, has shown it to be much the better instrument, giving sharper definition, more especially from 1·500 and upwards. E. T. BREWIS.

PUBLICATIONS RECEIVED.

THE SIMPLE CARBOHYDRATES AND THE GLUCOSIDES. *By* E. F. ARMSTRONG. *Third edition. Monographs on Biochemistry. Pp.* 239. *(London: Longmans, Green and Co.,* 1919.) *Price* 12*s.*

LECTURE DEMONSTRATIONS IN PHYSICAL CHEMISTRY. *By* H. S. VAN KLOOSTER. *Pp.* 196. *(Easton, Pa.: The Chemical Publishing Co.* 1919. *London: Williams and Norgate.) Price* $2.00.

GRUNDLEGENDE OPERATIONEN DER FARBENCHEMIE. *By* H. E. FIERZ. *With* 45 *illustrations and* 19 *tables. Pp.* 322. *(Zürich: Schulthess and Co.* 1920.)

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The excellent attendance of nearly 1500 members at the Bournemouth meeting provided satisfactory evidence that, despite the vicissitudes of war, the British Association has lost none of its hold on scientific men or on those who follow in their wake, "faint yet pursuing." Few will deny that this year's congress was an eminently successful one, scientifically, socially and financially; and in the case of several Sections experienced judges declared that the meetings were the most successful in their recollection.

The work of Section B (Chemistry) was from the point of view of interest at least equal to that of any pre-war meeting of the last decade. Doubtless this was the direct result of the war, since the great majority of the papers dealt specifically with aspects of the science which have risen into prominence during the last four years. But this in itself cannot be considered as the only cause of the large audiences and the marked enthusiasm. It is being gradually realised that if chemistry did not "win the war," it at least contributed very largely to that end, and the importance of science in general, and of chemistry in particular, is now securing public recognition. The interest taken in Section B at Bournemouth certainly shows that the Association is carrying out one of its fundamental objects, to wit, the advancement of knowledge, by inducing those versed in the spirit and letter of science to describe their observations and methods to people who seek knowledge without specialisation; and it was with this express purpose that the organising committee of the Chemical Section arranged a programme which should bring home some of the many activities of chemists during the war. As most of the papers read will appear in due course in the "Review," it is unnecessary here to do more than summarise the subjects with which they dealt. The different aspects of war chemistry referred to were chemical warfare, high explosives, glass, progress in metallurgy, raw materials (Geo-chemistry), and the recovery of spoiled ammunition, while closely related thereto were papers on industrial bacteriology and the preparation of acetone and industrial alcohol. The paper on chemical warfare is to be accorded the honour—shared by only one other paper—of being inserted *in extenso* in the forthcoming Annual Report of the Association; and in connexion with this subject the Committee of the Section passed a resolution urging the Government to make provision for a definitely organised scheme of research on explosives, chemical warfare, and allied physical and engineering problems begun during the war. The report of the Fuel Economy Committee was fully discussed, and excellent papers on pure chemistry were read by Professors Baly, Lapworth and Robinson, and by Dr. Lowry, on chemical reactivity and the mechanism of chemical reactions. By the courtesy of the superintendent, Capt. Desborough, the Section paid a most interesting visit to the Naval Cordite Factory at Holton Heath, Dorset. The inspection of this factory afforded an excellent object lesson in the construction of a chemical works from the point of view of completeness of detail in regard to manufacturing processes and the welfare of the workers.

The Presidential Address of Sir Charles Parsons, and also the address of Prof. Petavel to Section G, should be read by all who are interested in the subject of engineering applied to warfare; and of other sectional presidential addresses, that of Prof. Gray (Section A) dealing with the neglect of science by Government Departments, and that of Sir Daniel Morris to the Botanical Section on tropical agriculture in the Overseas Dominions, are worthy of the attention of chemists. Biochemists will read with interest the remarkable address of Prof. Keith to the Anthropological Section, in which he outlined a new hypothesis to account for the differentiation of mankind into racial types, based on the theory of hormones.

Reverting to the general subject, it may be of interest to recall that the British Association was founded in 1831 under the precidency of Viscount Milton, and that the Rev. W. Vernon Harcourt (president in 1839) was in a large measure responsible for its initiation. The Association can thus look back upon 88 years of active and fertile work in a cause whose importance grows daily more manifest, and whose prosecution still needs all the energy and devotion of its adherents. There are still some who are inclined to look with disdain upon the annual meetings, and to regard them merely as occasions for platform oratory, social entertainments and pseudo-scientific "junkettings"; but the better informed know that the more solid work is done by the Association through the many research committees which are formed under its auspices, and they realise the value of social gatherings for the interchange of ideas. As the reading and discussion of papers dealing with specialised research are now appropriately undertaken by the various individual scientific societies, so the meetings held in connexion with the Association have come to be devoted more especially to the description and elucidation of the broad general lines of scientific advance, and to the discussion of the results, reports and recommendations of the sectional research committees. The valuable work performed by the latter is as little realised by the outside world as is the fact that on account of the small sums available as grants-in-aid (aggregating about £1000 yearly) much of the expense of the investigations falls upon individual members.

Another valuable phase of the work of the Association is the popularising of the achievements and methods of science—an object of perennial importance. Although the annual meetings afford excellent opportunities for the dissemination of such knowledge and for the stimulation of interest, it cannot be denied that considerably more might be done in the direction of publicity. The annual volume issued by the Association is not only expensive but its publication is so belated that its value is reduced to small proportions, and, owing to financial stress brought about by war conditions, many valuable papers and discussions have of late been omitted from its pages. The matter of prompt publication could be remedied immediately, and when the financial position has improved it should be possible to reduce the price of the Annual Reports and to arrange for the issue of cheap reprints of papers and of sectional proceedings. The subject of public lectures, too, upon which Section L (Education) issued a valuable report in 1916, might well be taken up without further delay.

The question of grants in aid of research aroused considerable discussion during the meeting. The lack of sufficient funds for this purpose has been accentuated during the past few years, and the proposal to invite State assistance in respect of grants made by the Association has not met with unanimous approval. However, it is now reported that the principle of accepting grants from the Department of Scientific and Industrial Research has been agreed to; and if no hampering restrictions be imposed, and the Association is allowed to retain the sole right of adjudication, no serious impairment of its freedom should follow the acceptance of such assistance.

Another possible function of the Association is worthy of consideration. At the first meeting in

1831, the Rev. W. Vernon Harcourt proposed that it should "employ a short period of every year in pointing out the lines of direction in which the researches of science should move; in indicating the particulars which most immediately demand investigation; in stating problems to be solved and data to be fixed; in assigning to every class of mind a definite task; and suggesting to its members that here is a shore of which the soundings should be more accurately taken, and there a line of coast along which a voyage of discovery should be made." This suggestion, which apparently was never seriously followed, is of interest and importance at the present time, when the need for inspiring, guiding and co-ordinating research is everywhere apparent. The day has probably gone by when the Association could conveniently and adequately fulfil such functions: so great has been the development in all branches of science that their successful execution can now only be entrusted to the individual scientific societies, or to bodies like the Federal Council for Pure and Applied Chemistry, acting through special research committees. Work of this kind has hitherto fallen to University professors whose spheres of action are necessarily limited; is there not scope for a development of such activities on much wider lines? Material assistance for research has long been a crying need; now that there is some prospect of its realisation, let us not forget that equally necessary, if more subtle, form of assistance which is born of contact with other minds. For in science also, the life is more than meat and the body than raiment.

"MUSTARD GAS."

SIR WM. J. POPE.

$\beta\beta$—Dichlordiethyl sulphide $(CH_2Cl.CH_2)_2S$, was first obtained by Frederick Guthrie (Quart. Journ. Chem. Soc., 1860, **12**, 116), who recognised its powerful physiological effects, and was more thoroughly investigated by Victor Meyer (Berichte, 1886, **19**, 3260) and Clarke (Trans. Chem. Soc., 1912, **101**, 1583). Little importance apparently was attributed to the substance, but our scientific literature recorded that $\beta\beta$—dichlordiethyl sulphide can be prepared by the following series of reactions:

(a) $CH_2:CH_2+HClO=CH_2Cl.CH_2.OH.$

(b) $2CH_2Cl.CH_2.OH+Na_2S = (HO.CH_2.CH_2)_2S+2NaCl.$

(c) $(HO.CH_2.CH_2)_2S+2HCl = (CH_2Cl.CH_2)_2S + 2H_2O.$

The above, by order of seniority, may be termed Method 1 for the preparation of this simple organic compound.

Dichlorethyl sulphide was first used as an offensive agent by the Germans during an attack on Ypres in June, 1917; it was immediately identified by the Allies, and became known to the French as "Yperit" and to the British as "mustard gas." The Germans have recently stated that the English diagnosed this offensive material as diethyl sulphide (Chem.-Zeit., 1919, **43**, 366), but this statement is doubtless made merely for purposes of propaganda.

We have been told (Zanetti, J. Ind. Eng. Chem., 1919, **11**, 721) that the British gas casualties during July 1917, immediately after the introduction of mustard gas, were almost as numerous as those incurred during the previous years of war. The effects of mustard gas as a military weapon were indeed so devastating that by the early autumn of 1917 the technical advisers to the British, French and American Governments were occupied upon large-scale installations for the manufacture of this material by a process essentially identical with the Method 1 briefly described above. Our technical advisers were, to a certain extent, justified in their adoption of Method 1, because the examination of the German material showed fairly conclusively that Germany was manufacturing its mustard gas by this method.

So much secrecy was preserved in connexion with the project for the manufacture of mustard gas that very few chemists had any knowledge of the scheme of preparation adopted. About the middle of October, 1917, I learnt something of the project, and towards the middle of November, but only upon the urgent insistence of myself and others, our technical advisers consented to my undertaking the task of examining experimentally the preparation of mustard gas.

At the end of January, 1918, the laboratory details of a new method for preparing mustard gas were placed in the hands of the authorities; this, which may be termed Method 2, was worked out by me in conjunction with Mr. C. S. Gibson, and consists in the following reaction:—

$$2CH_2:CH_2 + S_2Cl_2 = (CH_2Cl.CH_2)_2S + S.$$

This method was entirely novel; no suggestion had been previously made that any such process was possible. Whilst the over-all yield to be obtained from the three-stage process of Method 1 could hardly amount to 60 per cent. of that theoretically possible, the new method gave practically a theoretical yield under the simple conditions laid down in our report. Method 2 was in the hands of our technical advisers—technical chemists, chemical engineers and large chemical manufacturers—early in February, 1918. The purely scientific work practically ended with the discovery of the method and the working out of the optimum conditions for yield, etc., and it was naturally recognised that all further work should be under the direction of the technical men who would be responsible for mass production; after February, 1918, neither I nor any other purely scientific chemist played any part save that of stimulating technical effort and of experimenting on points of minor detail connected with the process. Method 2 was first adapted to emergency mass production by Messrs. Levinstein, Ltd., and this firm was producing within six weeks from the time when it undertook the large-scale installation.

I put forward the above short history with some insistence on dates, because of the criticism advanced by Dr. Herbert Levinstein concerning certain conclusions which I drew in a recent address to the Chemical Society; I do this not from delight in controversy, but because I agree with my friend that "it is important that the facts should be correctly appreciated, as they have a bearing on policy" (this J., 1919, 248T).

Dr. Levinstein tell us (p. 249T) that "there is nothing technically cumbrous in the German process, nor is there any difficulty about it. . . . Our scientific advisers found this process difficult. If they had come straight to the dye industry we could have shown them how to carry out the reaction on the large scale without any difficulty whatever, exactly in the way the German dye industry carried it out. The fact is that the production of mustard gas in England on the other hand remained for too long a prerogative of our scientific advisers." These are remarkable statements. The task of installing on a works scale the German or Victor Meyer process for mustard gas was from the very start in the hands of several of our best known chemical manufacturers. It was never a prerogative of "scientific advisers," and no "scientific adviser" could have found difficulty in the process; the difficulties begin in the works. No dyestuff factory in

Great Britain had had any large-scale experience of either of the three reactions comprised in the German process; further, the most important stage in installing the German method here was entrusted to a great firm of organic chemical manufacturers which is largely interested financially in Messrs. Levinstein, Ltd. Why did not Dr. Levinstein tell his intimate business associates "how to carry out the reaction on the large scale without any difficulty whatever, exactly in the way the German dye industry carried it out"?

Dr. Levinstein's enthusiasm for his life-work is carrying him a little far; surely all is not vanity which does not end in the dye factory. Immediately it was realised that Method 2 had been correctly stated by Mr. Gibson and myself all work on the installation of the German method was stopped in Great Britain, France and America. It is impossible to suppose that the German process could have been put into large-scale operation among the Allies in any reasonable time, and the statement by the American technical chemist Dorsey (J. Ind. Eng. Chem., 1919, **11**, 288) that "the procedure used by Meyer, namely, the chlorhydrin procedure, proved to be unsuitable for large-scale production" must be accepted as correct. The German view on this subject is clear; when the chemical examination of our dud shell put them on to the track of the British process of manufacture they abandoned their own Method 1 and adopted our Method 2 (J. Ind. Eng. Chem., 1919, **11**, 675).

Dr. Levinstein tells us further (p. 248 T) that he disagrees with my deduction (Trans. Chem. Soc., 1919, **115**, 492) that "the German chemical service was inefficient; the scientific chemists under its control were incompetent." He states, however, that "we now know that the German method of making mustard gas had nothing whatever to do with the scientific chemists under the control of the German chemical service." This was precisely my point. The German chemical service was inefficient because it was not doing the work for which it existed; the scientific chemists under its control were incompetent because, whoever they were, they did not protest against the installation of an elaborate and costly process (Method 1) when a little work in the laboratory would have given them the ridiculously simpler and cheaper British process (Method 2). I venture to think that few chemists who reflect upon the meaning of the three reactions involved in the German method will disagree with my further conclusion, from which Dr. Levinstein dissents, that "it would be difficult to overrate the effects of the skill and perseverance exhibited by the German chemical manufacturer" (*l.c.* p. 402). That he should have been able to produce three hundred tons of mustard gas per month by the large-scale installation of the purely academic Method 1 constitutes indeed "a significant tribute to the potentialities represented by the large German fine chemical factories."

I have insisted above that Dr. Levinstein is under a misapprehension in supposing that the "scientific adviser" has exerted a paramount influence in connexion with chemical warfare in this country: if he is applying this term to people like myself I can assure him that our function has been strictly confined to telling what we knew or what we had discovered to men like himself—technical and industrial leaders. So soon as it became clear that our scientific investigators had obtained the information required by the manufacturer in connexion with mustard gas they proceeded to the study of another very interesting problem in organic preparation work; this in due course went through Dr. Levinstein's hands, and, as he is well aware, another important advance on German methods of manufacture was achieved.

The complaint is laid by Dr. Levinstein that in my Presidential Address to the Chemical Society I did not specifically "recognise that the success of our mustard gas work was due to the co-operation of the dye industry" (p. 249 T). It should be remembered, however, that I was addressing an intelligent audience well acquainted with those excellent articles from the pen of the professional advertisement writer with which the daily press has been deluged in loud proclamation of the invaluable services rendered to British chemical warfare by this great British industry. My time was limited, and I regarded this knowledge as common property.

For the further satisfaction of Dr. Levinstein's desire that the facts should be correctly appreciated, the addition of a few more details is necessary.

Mr. Gibson and I showed in January, 1918, that the reaction given as Method 2 proceeds practically quantitatively; absorption is slow at ordinary temperatures, attains a maximum at about 60° C., and is hastened by the initial presence of mustard gas. Messrs. Levinstein, Ltd., converted our laboratory method into a successful works process, and performed the absorption at between 30° and 40° C. in order to retain the liberated sulphur in some sort of pseudo-solution. During the transition from the laboratory to the works scale, however, nothing fresh was introduced which was of patentable novelty. The method emerged from the works as what Dr. Levinstein describes as the "Levinstein process" carried out in the "Levinstein reactor," both of which, as Dr. Levinstein truly observes, proved a great success in the United States. My colleague and I used only glass vessels for the absorption of ethylene by the sulphur monochloride, but the "Levinstein reactor" has proved in the past, and will prove in the future, a most valuable adjunct to the resources of the technical chemist. It consists of a cast-iron pot, rather deeper than the ordinary lavatory basin. When the ethylene is blown into a charge of sulphur monochloride contained in the "reactor" absorption occurs with the production of mustard gas. The inventive genius exhibited in the design of the "Levinstein reactor" is in keeping with the great traditions of the British dye industry.

The "Levinstein process" and the "Levinstein reactor" were, of course, handed over to the United States. The Americans were pressed for time, and did not succeed in contributing any new fact to our knowledge of the preparation of mustard gas. They adopted the British method for their large-scale installations, and the Head of the United States Chemical Warfare Service now describes this as the "American method" (Maj. Gen. Sibert, J. Ind. Eng. Chem., 1919, **11**, 673). So rapid is progress in technical chemistry that the process devised by Mr. Gibson and myself is probably by this time known in Central Europe as the "German method."

It may be of interest, in view of Dr. Levinstein's indictment of British procedure in the connexion under discussion, to point out that "mustard gas" was discovered by a British chemist, that the best method for its preparation was discovered by British chemists, and very rapidly put into large-scale production by a British firm. Further, that the best technical method for the preparation of the necessary ethylene has proved to be that described by a British chemist, Newth, which consists in acting upon alcohol vapour with heated phosphoric acid (Trans. Chem. Soc., 1901, **79**, 915). The only distinction which our country allows to pass to Germany in this matter is that of having treacherously introduced one of the most appallingly toxic substances known as a weapon of civilised warfare.

DETERIORATION IN THE HEATING VALUE OF COAL DURING STORAGE.

HORACE C. PORTER.

In the issue of the *Journal of the Society of Chemical Industry* of February 28, 1919 (page 58R), Mr. G. Cecil Jones calls attention to Bulletin 136 of the Bureau of Mines, by the present writer and F. K. Ovitz, on the above-named subject, and suggests "that the authors have overlooked a form of loss which may be several times as great as the small loss they have measured with such care." He cites from the Bulletin and compiles averages of percentages of ash found in several lots of coal at successive stages in their storage, and points to the trend of these towards an increase during the storage of the coal. This trend, he says, "points almost irrosistibly to the conclusion that there was a steady and far from insignificant loss of coal substance on storage." "The bulks were not weighed, and the deterioration measured was only that resulting from the fixation of oxygen, no account being taken of possible loss of coal substance in volatile form."

The possibility of change in weight of coal during exposure and weathering has been recognised by many of the investigators of coal deterioration, and the importance of the *rôle* that such change might assume in the net losses incurred has not been overlooked. In the very Bulletin quoted from there are reported (pages 24—25) certain tests on the Pittsburgh type of coal, throughout a period of five years, to determine this very matter, namely, the change in weight of the coal, calculated to the dry basis, and to show its bearing on the apparent loss in heating value. The results of two tests, each on 200lb. of coal over a period of five years, showed a change of plus 0.4 per cent. and plus 0.3 per cent. respectively in the dry weight of the test portions. This result conforms in general with the findings of other investigators, which show a slight increase in weight of the coal substance during exposure.

This result shows that with the Pittsburgh coal used in this experiment the change in weight was not sufficient to make it a material factor in the deterioration; in other words the determination, after storage, of the heating value *per pound* showed approximately the net loss of heat units in the total bulk of coal. The New River type of coal, which was used in the tests under discussion in the article quoted, is a coal of considerably less volatile matter than the Pittsburgh, and has certainly no greater tendency to undergo oxidation or other alteration during exposure.

If, in general, by weathering, coal may lose a part of its "substance in volatile form," or may oxidise at ordinary temperatures so as to have a part of its combustible substance carried away in oxides of carbon and water, there can be no question that any loss of weight so incurred must be added to the loss involved in the decrease of heating value per pound. This consideration has led to careful investigations of the nature of this change in the coal substance caused by exposure and by oxidation.

Richters*, Fayol†, Dennstedt‡, Bondouard§, Taffanel¶, Porter and Ralston||, and in England more recently Winmill** have studied the nature of the reaction of coal with oxygen at ordinary temperatures. They have shown that while a relatively small amount of oxides of carbon and of water is formed, the principal reaction is an addition of oxygen to the coal substance, and the net result is an increase in weight.

While there remains the possibility that water might be formed by oxidation of the hydrogen of the coal, and remain intimately bound in the coal substance so as to be removed only by heat in the course of analysis for moisture, this possibility is largely precluded by the fact that in the case in hand the coal analyses (see tables 4, 7, and 10, Bull. 136) do not show a material increase in moisture during dry storage.

The escape of volatile combustible matter from coal during exposure has been shown by Porter and Ovitz in a previous publication* to be inconsiderable in point of weight and calorific value. Of a number of coals investigated, including one similar to the New River type, the one showing the greatest loss of combustible gas during more than one year's exposure in air lost in this way only 0·16 per cent. of its calorific value and less than 0·1 per cent. by weight.

The experimental evidence above outlined shows that coal tends to increase slightly in weight during storage, and does not lose any appreciable amount of its combustible substance either by volatilisation or by oxidation. While in the experiments on New River coal, described in Bulletin 136 by Mr G. Cecil Jones, there was no actual measurement of change in weight, the burden of experimental evidence in similar tests and in the studies of the process of coal alteration just cited, is against the assignment of any important part in the deterioration to such a change.

It is impracticable to draw any definite meaning from the variation in content of ash apparently found in these tests in the successive samples of coal. The variations in ash were so irregular that averages are nearly worthless. Furthermore, if it were justifiable to draw a conclusion from such apparent increase of ash, there is found nearly as marked an indication of increase in the samples submerged in water (tables 3, 6 and 9), where no oxidation or volatilisation is likely to have occurred, as in those weathered by exposure. These irregularities are to be ascribed rather to the personal equation in sampling, to the accidental inclusion of foreign inorganic material in the test coal during repeated re-handlings and exposure, and to the possibility that the lighter and purer parts of the test lots of coal may have been washed or blown away during the long period of exposure to the elements.

Since deterioration can properly be determined only on the basis of ash-free, dry coal substance, and has been so determined in these tests, the irregularities in ash content of the successive samples are not of serious moment as affecting the accuracy of the results on deterioration. They certainly cannot, in themselves, without further corroborative evidence, be applied as an indication of proportionate change in weight of the material under test.

Referring to the subject of the world's fuel resources in his presidential address to the British Association at Bournemouth, Sir Charles Parsons said that it had been estimated that the United Kingdom possesses 2½ per cent. of the total coal but less than 1 per cent. of the total water power in the world. To investigate the possibility of tapping the earth's internal heat energy, a shaft might be sunk 12 miles down in 85 years at a cost of £5,000,000.

* Dingler's Polytech. Jour. 195 (1870), 375-331 and 449-458.
† Bull. Soc. Ind. Min. 8, ser. 2 (1879), 487.
‡ Zeit. angew. Chem. 21 (1908), 1060, 1825.
§ Bull. Soc. Chim. France, Ser. 4, Vol. 5 (1909), 377,380.
¶ Orig. Communications, 8th Internat. Cong. Appl. Chem. 1912), 10,277.
|| Tech. Pap. 65, Bureau of Mines (1914), 21-24.
** Iron and Coal Trades Rev. 87 (1913), 485, 92 (1916), 660.

* Tech. Pap. 2, Bureau of Mines, 1911.

THE JAPANESE DYESTUFF INDUSTRY.

Until the war cut off imports from abroad there were no colour-producing factories in Japan with the exception of certain works making pigments; the total of imports therefore represented exactly the total Japanese demand. The imports of dyestuffs were as follow:—

	1913.	1912.	1911.	1910.
Natural indigo	20,738 kin.	45,225 kin.	15,015 kin.	78,431 kin.
	Y.34,707	81,473	30,008	153,490
Synthetic indigo	1,652,977 kin.	897,688 kin.	1,769,962 kin.	1,523,121 kin.
	Y.3,277,205	1,879,739	3,724,313	3,238,460
Aniline dyestuffs	7,362,460 kin.	7,291,840 kin.	8,023,420 kin.	6,576,076 kin.
	Y.4,213,149	3,927,067	3,478,551	2,885,136
Alizarine dyestuffs	159,496 kin.	149,347 kin.	190,684 kin.	140,876 kin.
	Y.267,963	219,850	255,310	216,850
Aniline salt	490,432 kin.	519,055 kin.	179,299 kin.	180,585 kin.
	Y.143,761	143,142	50,246	56,382
Logwood extract	722,718 kin.	585,777 kin.	684,947 kin.	683,279 kin.
	Y.135,410	105,909	116,958	118,110
Total	10,408,821 kin.	9,488,932 kin.	10,863,327 kin.	9,001,783 kin
	Y. 8,072,195	6,357,270	7,655,386	6,668,428

The entire withdrawal of these imports naturally caused a great disturbance of the dyestuff market and an extraordinary rise in prices. As a consequence several colour-making plants were erected, the largest being that of the Nippon Senryo Seizo Kabushiki Kwaisha (Japan Dyestuff Manufacturing Co.), a firm which has received Government assistance. Several of the other firms, owing to shortage of capital and the lack of expert chemists, have been obliged to close their works.

The Yura Dyestuff Manufacturing Co. and the Mitsui Mining Co. are among the more successful companies. The Japan Colour Co. has also produced good Sulphur Blacks, which are now chiefly exported to China. Aniline oil and salt, the most easily made intermediates, were produced by every colour-making firm, and this soon brought about an over-production for the home market. The pre-war price of aniline salt was Y. 0·30; this rose soon after the outbreak of war to Y. 1·20, and has now fallen to Y. 0·60.

Among dyestuffs the sulphur colours at first attracted much attention, probably because of the comparative simplicity of their manufacture. Some makers utilised organic waste of all kinds for the raw material, going back in this respect to the original method of making "Cachou de Laval," the first of the Sulphur dyestuffs. Only a few makers have employed aromatic compounds as the starting point; these have naturally been the most successful, and are still making Sulphur Yellows, Browns, and Blacks, though they do not appear to give much attention to the purification of their commerical products.

The Nippon Senryo Seizo K.K. (Capital, 1,000,000 yen) and the Jura Senryo Seizo K.K. (Capital, 1,000,000 yen) have erected complete plants, and have succeeded in producing a range of marketable products. The Mitsui Mining Co. is making various anthracene colours and synthetic indigo. The most important dyestuffs manufactured in Japan at present are given in the following list:—

1. *Direct Cotton Colours:* Congo Red, Chrysamine G, Direct Orange, Cotton Blue R, BR, Heliotrope, Cotton Violet, Cotton Brown 2BR, Benzopurpurine 4B, Chrysophenine, Benzo Orange, Direct Yellow, Cotton Red, Diamine Scarlet.

2. *Basic Colours:* Rhodamine B, extra conc., Malachite Green, Methylene Blue, Methyl Violet, Magenta, Chrysoidine, Bismark Brown, Basic Rose, Cerise.

3. *Acid Colours:* Fast Pink B, Fast Red A.B, Fast Scarlet, Orange II. Naphthol Yellow S, Induline, Nigrosine, Acid Brown R, 3R, Metanil Yellow, Acid Yellow, Ponceau R, Azo-flavine, Citronine, Naphtylamine Brown, Golden Yellow, Brilliant Acid Blue, Acid Violet, Acid Green, Acid Red, Acid Blue B.BR, Fast Blue, Quinoline Yellow, Acid Brown AR.

4. *Mordant Colours:* Alizarines (Mitsui Mining Co.), Alizarine Blue, Alizarine Orange, Alizarine Maroon (Mitsui), Alizarine Brown (Nissen Co.), Anthracene Brown, Mordant Yellow, Chrome Brown, Chrome Yellow, Fast Chrome Violet, Steam Cosmos G (Ikeda Dye Co.).

5. *For Oxidised Colours:* Aniline Oil, Aniline Salt, Paramine, Fuscamine.

6. *For Insoluble Azo Colour:* Paranitraniline.

7. *Sulphur Colours:* A full range of blacks, browns, and yellows. Among them Kompira sulphur colours are the best known. The output of these dyes is not very certain; the following figures only are published:—

Sulphur colours	.. ..	1,242,885 lb. (March, 1919).
Aniline colours	.. ..	549,290 ,, ,,
Paramine	.. ..	8,400 ,, (1918)
Paranitraniline	.. ..	3,600 ,, ,,
Aniline oil	.. ..	860,000 ,, ,,
Aniline salt	.. ..	459,000 ,, ,,

Throughout Japan there were formerly 200 dye-works with a total capital of 17,000,000 yen and employing about 20,000 persons. Since the armistice, however, both dye works and dyestuff merchants have been badly hit by the slump in dyestuffs, raw materials, and chemicals. The Sulphur dyestuffs were most seriously affected on account of accumulation of cargoes and depreciation in the value of the stocks of carbolic acid which were held as raw material for Sulphur Blacks. Attempts have been made to relieve the industry by increasing the tariff on imports and by strengthening the manufacturers' position through combination and amalgamation. A bill for the protection of the home dyestuff industry was introduced by Seiyukai in the House of Representatives, the main feature being an increase of import duty on foreign dyestuffs (with the exception of artificial indigo) to 50 per cent. *ad valorem* for the next five years. A decision is expected in the near future.

The production of coal-tar in Japan is insufficient to provide raw material for all the dyestuffs required by the country. Three of the most important gas works have published figures of their annual output of coal tar and distillation products as follows:—

	Coal tar output. Koku.	Coal tar distilled. Koku.	Naphthalene produced. Tons.	Benzol. Tons.	Pitch. Tons.
Tokyo Gas Works ..	72,845	95,454	309·86	202	9,391
Osaka Gas Works ..	14,027	25,855	329·77	—	3,168
Nagoya Gas Works ..	12,466	11,084	23·95	53	1,106

In 1917 the total amount was reported as—Coal tar 341,000 koku. naphthelene 943 tons, crude-benzol 410 tons, pitch 20,556 tons. (Koku = approx. 3 cwts.)

No later information is to hand, but it is known that many gas works have been shut down in the last few years. We may conclude that Japan is certainly short of the raw materials and intermediates required for dyestuff manufacture. The necessary chemicals have also been lacking, but their manufacture has recently commenced, and some of the home products are already on the market.

The Government Iron Works and the Manchurian Railway Co.'s Iron Works are also extending their coke plants, and will produce coal tar. Within a few years Japan will be able to supply her own requirements in dyestuffs, with the exception of special products such as vat colours and certain complex direct cotton colours.

At the moment the dyestuff market is stronger on the improving demand from the home weaving industry and the growing trade with China. (Yen = 2s. 0½d., kin = 1·33lb., koku = 3·97galls.)

MEETINGS OF OTHER SOCIETIES.

INSTITUTION OF MINING ENGINEERS.

The thirtieth annual general meeting was held at the University of Birmingham on September 10, when Mr. G. B. Walker presided over a gathering of some 200 members. The Institution was welcomed to the University by the Vice-principal, Sir William Ashley, who stated that during the war the University buildings had been used as a military hospital, and that the Mining Department had been suspended, but it was hoped to re-start it within a few weeks. The application of electricity might mark the beginning of a new epoch, as did the application of steam many years ago, so that the whole problem of mining education required to be considered afresh.

After the annual report had been adopted Colonel Blackett was elected the new president and took the chair.

Prof. Sir John Cadman then read the first report of the committee on "The Control of Atmospheric Conditions in Hot and Deep Mines." The conclusions were summarised thus:—(1) The hindering effects on men of the heat in deep mines depended not on the temperature of the air, but on the wet-bulb temperature and the degree of stagnation of the air. (2) In the downcast shaft and main intakes of a well-ventilated coal mine the natural temperature of the strata had no appreciable influence either on the temperature of the air or on the wet-bulb temperature. (3) The data as yet available indicated that by properly designed ventilation and avoidance of leakage the hindering effects of the heat in deep mines could be obviated up to any depths at present contemplated in the working of coal or other minerals in this country. During the discussion which followed Mr. Davies, a South African mining engineer, described the conditions in a hot and deep mine, where to make work possible the air was put through a refrigerator until a wet-bulb temperature of 43° F. was obtained.

Mr. D. S. Newey read a paper on a new method of working thick seams of coal at the Baggeridge Colliery. The system had been successful, the men being able to stand upright to their work and efficient ventilation being easily maintained.

The next contribution was by Mr. C. F. F. Eagar on the training of officers and men of the tunnelling companies of the Royal Engineers in mine rescue work on active service in France, which described in outline the scheme in operation on the Western Front for training officers and men in the use of portable breathing apparatus, artificial respiration, and the general work of mine rescue. The deadly nature of the gases given off by the use of large quantities of explosives was early realised, and under the supervision of Lt.-Col. D. Dale Logan a number of sets of Proto apparatus was sent out to France. Three types of apparatus were used—"Proto" and "Salvus," worn by the rescuers, and the "Novita" oxygen apparatus for use in connexion with artificial respiration. The method adopted in testing for carbon monoxide was to use a bird or a mouse, and to observe the rapidity with which the animal was affected. When these are confined in a cage the bird is undoubtedly the better gas-detector. The best method of using mice is to have them thoroughly tamed and accustomed to handling. They can then be carried in a button-up pocket or a little pouch and pulled out in the air to be tested. If a mouse is made to exercise by making it crawl from hand to hand it inhales much more of the tainted air, and it will usually collapse more rapidly than a bird sitting on a perch. All ranks were taught this method of testing, one of the real advantages of which was that it obviated the nuisance of having to carry a cage. Mr. Eagar also stated that palladium chloride had been tried as a test for carbon monoxide, but it was found to be almost too sensitive, and other gases also gave a darkening of the ring with palladium chloride, notably sulphuretted hydrogen. In the apparatus for absorbing carbon dioxide coke absorbent had been used, but there was a tendency for a crust of carbonate to form on the outside, leaving the caustic alkali inside unacted upon.

The annual dinner was held in the evening at the Grand Hotel, and the two following days were given up to excursions in the district.

THE IRON AND STEEL INSTITUTE.

The autumn meeting of the Iron and Steel Institute was held, on September 18 and 19, in the rooms of the Institution of Civil Engineers.

The first day was given up to contributions on the subject of fuel conservation based upon reports presented by the British Association Fuel Economy Committee, and by Messrs. Cosmo Johns and L. Ennis on fuel economy in the German iron and steel industry. (See this issue, p. 355 R.)

On the second day, Mr. C. A. Keller described a new process for the manufacture of "synthetic cast iron," which consists in the recarburisation of iron and steel scrap, and is designed to give an iron the composition of which can be readily controlled. An electric furnace is used, into which are charged the scrap and sufficient carbon to give the required composition. By the addition of an adequate quantity of a sufficiently basic slag the sulphur content can also be regulated. The method is specially applicable to the manufacture of low silicon cast iron for the purpose of making malleable castings; it has been found useful during the war in dealing with the large quantities of steel turnings produced in the manufacture of shells.

A number of papers was presented dealing with different aspects of the manufacture and applications of nickel chrome steel. In particular a paper by Messrs. J. H. Andrew, J. N. Greenwood, and G. W. Green described the complete treatment of forgings in this material during the whole course of manufacture, as carried out at the works of Sir W. G. Armstrong, Whitworth and Co., Ltd. Among other things the authors recommend the use of a low casting temperature, though a high ladle temperature is considered to be advantageous. Their paper is the most complete work of reference on the subject which has yet been published.

Papers by Messrs. R. H. Greaves, Miss M. Fell, and Sir R. Hadfield dealt with the phenomenon of "Krupp Krankheit," or temper brittleness, especially in nickel chrome steels, and reviewed the conditions under which this form of brittleness is met with in certain steels, while Dr. Rogers described methods by which he is studying the same problem. The discussion on these papers was well sustained, and a number of interesting facts concerning the phenomenon were disclosed, especially by Mr. Dickenson, whose work on this subject, which was circulated as a secret document in 1917, has not previously been published. The methods which must be adopted to avoid temper brittleness appear to be well known, but the discussion indicated very clearly that the causes of this weakness in nickel chrome or other steels are quite unknown.

Papers by Messieurs Cohade and Portevin dealt with the "woody" fracture of nickel chrome steels. This type of fracture is generally associated with the presence of non-metallic enclosures in the steel, and is noticed when the metal is broken in a direction transverse to the direction of working. M. Cohade suggests that, while other factors are undoubtedly important, chemical composition of the steel has an effect which has not yet been realised. In the ensuing discussion a number of

other theories were advanced. There seemed to be a consensus of opinion among practical steel manufacturers that this form of fracture could best be avoided by the use of a high casting temperature.

Messrs. J. H. Whitley and A. F. Hallimond discussed the action of iron oxides on the structure of the acid open hearth furnace. The sources of the oxides were considered, and also their action on different portions of the furnace structure. Microstructures of various materials after service in the furnace were shown, and methods suggested by which the deleterious effects may be avoided.

Finally, a paper by Messrs. K. Honda and H. Takagi on the irreversibility of the nickel steels was discussed. Dr. Benedicks drew attention to the theory of Osmond and to his own work on the subject, and suggested that the irreversibility had already been explained without the necessity for the complicated theory of the authors.

A number of other papers, for which time could not be found at the meeting, are to be discussed by correspondence.

CHEMICAL INDUSTRY CLUB.

A meeting of the members of this club was held at Whitehall Court on September 22. There was a good attendance, and Mr. Richard B. Pilcher occupied the chair. The meeting was convened in order to discuss various matters relating to the forthcoming Annual Dinner and Annual General Meeting and to the improvement of the club generally. The Honorary Secretary reported that the membership now numbered 650.

CORRESPONDENCE.

CHEMICAL COMPENDIA AND ABSTRACTS.

Sir,—The question of the publication of chemical compendia and chemical abstracts has been discussed in your columns from various sides. I should like to consider it mainly from the scientific point of view, but do so with diffidence, as there is little I can say on the matter which will not be obvious and therefore commonplace.

The utility and the indispensability of compendia and abstracts have been admitted by all. Differences of opinion exist, however, with regard to the form the publications should take. Sir William Pope has suggested that there should be three types—reprints in English of the more important of the older chemical papers, a complete series of abstracts, and compendia, similar to Beilstein's Handbook of Organic Chemistry, covering the chief divisions of pure and applied chemistry.

Reprints of the more important of the older papers would undoubtedly form a useful publication, but it would not relieve the research chemist from the necessity of keeping complete sets of the better known journals at hand in his library. As Prof. J. B. Cohen has pointed out, an organic chemist refers to the little known papers of some Hans Schmidt much more frequently than he does to the classical memoirs of a Justus von Liebig. The reprinting of these papers would probably prove of less advantage to a research worker than it would to an advanced student. In connexion with the latter, I may perhaps be pardoned if I here express the opinion that we do not provide sufficiently for the wants of the advanced student of *systematic* organic chemistry. The translations, such as that of Richter's Organic Chemistry, which are in his hands to-day, are as dry as dust in comparison with the organic portion of the treatise which was written about thirty years ago by Roscoe and Schorlemmer. It seems a pity that this work, which is more readable and more interesting than any treatise on systematic organic chemistry hitherto published in any language, is not kept up to date.

Of the remaining two types of publications, compendia and abstracts, the latter are the more important. It is much to be regretted that most of the chemical societies deem it necessary to publish abstracts and to insist on their members subscribing for these abstracts as well as for their transactions. One would have thought that the course adopted by the German Chemical Society, twenty-two years ago, would have commended itself to other societies in the interval. A chemist who may feel it necessary to subscribe for the transactions of each of the larger chemical societies would be obliged to acquire at the same time duplicate, triplicate or, in general, multiplicate abstracts of little, if any, use to him in his work. I am quite in agreement, therefore, with Sir William Pope in recommending, if I understand him aright, that England, America, France and Italy should cease from issuing national abstracts and should combine for the publication in the English and French languages of one series of abstracts dealing, so far as possible, with every published paper and patent in pure and applied chemistry. If this were done any chemist could, if he so desired, have one complete series of abstracts and the original papers of three or four of the leading chemical societies at a price less than one-half of what he must now pay for them.

Provided we had a good series of abstracts covering pure and applied chemistry the writing of compendia would be a relatively simple, although a somewhat laborious, matter. Beilstein's Handbook of Organic Chemistry has been of such great use to chemists in the past that it is quite unnecessary to discuss the desirability of compiling similar handbooks dealing with other branches of chemistry. It is possible that owing to the financial condition of Germany, resulting from the late war, other editions of Beilstein's Handbook will not reach the high standard of the present issue, and that the chemical world will, in the future, look to England and America for a compendium to take its place. As Sir William Pope has suggested, it would be of great advantage to have similar compendia of technical, physical and inorganic chemistry. Thorpe's Dictionary could serve as a basis for a technical, and Moissan's for an inorganic, handbook, unless it should be considered advisable to regard physical and inorganic chemistry as a single subject—general chemistry—when a handbook such as Abegg's would rather commend itself.

Biennial registers of literature, such as Stelzner's, would be of little use to a research chemist who had a good quinquennial index of first-class abstracts at his disposal. A lexicon of the Richter type is more useful, but its advantages are rather overestimated. An organic chemist, in active research work, who has an up-to-date Beilstein in his laboratory can readily dispense with the lexicon.—I am, Sir, etc.,

HUGH RYAN.

Dublin, Sept. 8, 1919.

RESEARCH ASSOCIATIONS FOR THE GLASS AND REFRACTORIES INDUSTRIES.—The Glass Research Association, established in accordance with the Government's scheme for encouraging industrial research, has been licensed by the Board of Trade as a company not trading for profit. The secretary is Mr. E. Meigh, 7, Seamore Place, W. 1.

The Department of Scientific and Industrial Research has approved the Memorandum and Articles of the British Refractories Research Association, which are now under consideration by the Board of Trade. Mr. A. C. Rann, 14, Great George Street, Westminster, S.W.1, will act as secretary of the Association.

NEWS AND NOTES.

AUSTRALIA.

Exploitation of Victoria Brown Coal.—The Victorian Government contemplates the development of the brown coal deposits occurring at Morwell, about 80 miles east of Melbourne. The first cost is estimated at about £1,855,000. The available coal amounts to at least 20 thousand million tons. It is proposed to erect at Morwell an electric generating station with an initial capacity of 50,000 KW, to be increased to 100,000 KW by 1925. The estimated cost of current delivered therefrom to Melbourne is 0·326d. per unit. The production of briquettes on the low temperature carbonisation system is an essential part of the scheme. The output of the briquetting plant will probably be 200 tons per day initially.—(*Bd. of Trade J., Sept.* 4, 1919.)

Tungsten Minerals.—The attention of the Australian House of Representatives was recently directed to Governmental lack of enterprise as regards Australia's resources in wolfram, scheelite and molybdenite. Prior to the war Australia's whole output of these minerals was exported to Magdeburg, in Germany, but now the control of the minerals is vested in the Commonwealth Government. The contract with the British Government for the sale of molybdenite at 100s. per unit and of wolfram at 52s. per unit will probably continue until the end of the current year. The whole of the mines and works in the north of New South Wales, and the works in Sydney, are closed down consequent upon notification received from the authorised buyers that tungsten ores would not be accepted unless of a certain standard. To this standard the various works are unable to conform. The world's consumption of tungsten ores advanced from 4000 tons in 1906 to 10,000 tons in 1913. The United States output of tungsten ores was increased to 7000 tons in 1916, while the Empire production in 1916 was under 6000 tons. The British Government secured supplies of tungsten from Australia during the war at £400—£500 per ton, compared with £2000 per ton paid for the Norwegian and Swedish products. The Bureau of Science and Industry should carry out large-scale researches in the production of tungsten steels. The industry should be protected and the sales markets opened up so that the best price might be realised for the product. —(*Industrial Australian and Mining Standard, July* 31, 1919.)

Gold Discovery in Western Australia.—The Premier of Western Australia has announced that a large ore formation was discovered in June last on land held by Hampton Properties, Ltd., situated twenty-three miles south of Kalgoorlie. Shaft sinking has disclosed a lode formation 25ft. wide, with the ore channel traceable north and south for a considerable distance. The country rock is oxidised to a depth of 60ft., and is comprised of ferruginous quartz and soft lode formation giving high assay values. The discovery is considered to be of very great promise. There is also another ore formation about half a mile eastward showing visible gold.—(*Official, Sept.* 20, 1919.)

UNITED STATES.

Coal Tar Industry.—In 1918 one hundred and eighty firms were actively engaged in the production of coal tar derivatives in the United States, employing 26,217 employees of all grades. Of this number 2233 were technically trained men.

Tanning Industry.—The tanners in the United States have, though their council, under serious consideration the question of establishing a school to teach the tanning industry in a thorough manner. Whether a separate school shall be created or a separate college established at one of the universities has not been decided.

Petroleum Industry.—Since the petroleum industry is one of the most prominent of the chemical industries, it is interesting to note that the greatest unit of the Standard Oil group is equipped to handle about 200,000 barrels of crude oil daily, and it also operates nearly fifty large tank steamers. In its main engineering and research laboratory a staff of about ninety is employed on many phases of the petroleum problem, including the standardisation of tests and the perfection of testing apparatus.

The Alcohol Problem.—Gradually the breweries are finding new uses, the last to report having become a modern macaroni factory. Meanwhile a fight is being waged to secure regulations permitting alcohol used in the industries to be made tax free. Alcohol is quite important, if indeed not essential, in the production or refining of some 150 materials in industrial chemistry and pharmacy, to say nothing of its use in producing light, heat and power. Several recent experiments with alcohol as a motor fuel even in aeroplanes have yielded results encouraging to those interested in its use.

Coke Industry.—A by-product coke plant in Pennsylvania is operating 768 ovens divided into 12 batteries and consuming 12,500 net tons of coal every 24 hours. The plan contemplates eventually 24 batteries of 64 ovens each. From 12,500 tons of coal the products are approximately as follows:—8000 tons of screened furnace coke containing 2½ per cent. moisture, 520 tons of small domestic coke, 900 tons coke dust, 150,000 gallons of coal tar, 162 tons sulphate of ammonia, 29,000 galls. pure benzine, 7400 galls. pure toluene ,2800 galls. crude light solvents, 1400 galls. crude heavy solvents, and 75,000,000 cubic feet of gas in excess of requirements for the plant itself. This gas is of 575 B.T.U. The plant is said to represent the very acme of by-product oven installation and efficient operation.

SOUTH AFRICA.

Natal Sugar Industry.—H.M. Senior Trade Commissioner reports the receipt of the following statistics of the Natal sugar industry (crop 1917-18) from a reliable local source:—

Area under cultivation: Between 130,000 and 140,000 acres.
Area from which cane was cut last season: Say 60,000 acres.
Total output of cane: Say 1,320,000 tons.
Output of cane per acre: Average 20—24 tons.
Total output of sugar: 108,000 tons.
Output of sugar per acre: Say 1¾ tons.
Average weight of sugar per ton of cane: Say 1·8 cwt.
Price realised per ton of sugar: £25 average.
Value of season's output: £2,700,000.
Number of factories: 27.
Total capacity of factories: Say 150,000 tons per season.
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Derbyshire Oil.—It is stated on the authority of Sir John Cadman, Chairman of the Petroleum Executive of the Ministry of Munitions, that the daily yield of oil from the Hardstoft boring has averaged a ton a day for the past two or three months. No oil has been struck in the six other bore holes put down in Derbyshire.

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An important feature of this nutritional research has been the introduction of the quantitative factor, the neglect of which in the past has led to conclusions which may be quite erroneous. For example: in studying the changes in anti-scorbutic content during cooking, it is evident that if the foodstuff in the amount given contains, when raw, a large excess over the minimum required, any loss sustained will not be assessed or even detected if the residual amount in the cooked ration is still in excess of that minimum. In estimating the relative anti-scorbutic value of any given series of foodstuffs, the first step necessary is to determine experimentally for each substance the minimum daily ration which will protect the experimental animal from scurvy under the conditions of the experiment. An accurate estimate of the loss sustained by heating, drying or other methods of preservation can then be obtained by a comparison between the minimum rations required before, and after, the operation in question. The determination of these minima involves a large number of experiments, but these are necessary if the results obtained are to be other than misleading.

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(*a*) This cost varies from 3s. 3d. to 6s. 10d. per short ton, of which labour accounts for 70 per cent. It might be reduced by improved mining methods, by part substitution of mechanical for hand labour, and of trucks for mule waggons. (*b*) The cost of extraction is now 3s. 9d. to 5s. 8d. per short ton, of which labour accounts for 30 per cent., fuel 60 per cent., and technical control less than 1 per cent. There is great scope for technical control, particularly in regard to fuel consumption. By the present method of heating over 65 per cent. of the fuel is not utilised; and methods of extraction could be improved so as to yield 75 per cent. even with low-grade caliche. (*c*) Transportation from the oficinas to the ship costs about £3 15s. per short ton of commercial nitrate, 65 per cent. of which goes to the Chilean Government as export tax (2s. 4d. per quintal of 101·6 lb.). (*d*) Administration costs amount to approximately 1s. 7d. to 2s. 6d. per short ton of caliche. The above items of costs work out to about £4 6s. 8d. per short, or £4 16s. per long ton.—(*J. Ind. Eng. Chem., Aug.*, 1919.)

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Oppau Plant.	Tons per annum	Tons combined nitrogen per annum.
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Sodium nitrate	130,000 ..	21,410
Nitric acid (100%)	40,000 ..	8,890
Ammonia (liquid)	40,000 ..	32,900
Total		.. 66,700

The cost of the plant is stated to have been between 5 and 10 millions sterling; to-day a similar plant in the United States would cost at least £13,000,000. The personnel of the factory comprises 1500 labourers, 3000 mechanics, 350 clerks and 300 chemists. The daily consumption of fuel is 1750 tons of lignite and 500 tons of coke, and the total cost per diem is about £11,000, including allowances for depreciation, etc. Assuming that in normal times the plant would be shut down for repairs, etc., during one-tenth of the year, the total cost would be £11,600, and the output 553,000 lb. of combined nitrogen, *i.e.*, the production cost would be about 5¼d. per lb., equivalent to Chilean nitrate at 0·87d. per lb. (The latest reported price of the latter is 9s. per quintal, say 1d. per lb., in Chile.) If all the ammonia produced were converted into 100% nitric acid, the author concludes that the plant could produce acid at a cost not exceeding 3 cents (1½d.) per lb. The pre-war cost in the United States of this acid made from Chilean nitrate was 5-6 cents per lb. (2½d.—3d.), and to-day it will be considerably higher. Finally, the author indicates the serious consequences which would result from Germany acquiring a monopoly of these nitrogen compounds.—(*J. Ind. Eng. Chem., Sept.*, 1919.)

The German Bromine Industry.—The report of the Bromine Selling Association for 1918 states that

NEWS AND NOTES.

AUSTRALIA.

Exploitation of Victoria Brown Coal.—The Victorian Government contemplates the development of the brown coal deposits occurring at Morwell, about 80 miles east of Melbourne. The first cost is estimated at about £1,855,000. The available coal amounts to at least 20 thousand million tons. It is proposed to erect at Morwell an electric generating station with an initial capacity of 50,000 KW, to be increased to 100,000 KW by 1925. The estimated cost of current delivered therefrom to Melbourne is 0·326d. per unit. The production of briquettes on the low temperature carbonisation system is an essential part of the scheme. The output of the briquetting plant will probably be 200 tons per day initially.—(*Bd. of Trade J., Sept.* 4, 1919.)

Tungsten Minerals.—The attention of the Australian House of Representatives was recently directed to Governmental lack of enterprise as regards Australia's resources in wolfram, scheelite and molybdenite. Prior to the war Australia's whole output of these minerals was exported to Magdeburg, in Germany, but now the control of the minerals is vested in the Commonwealth Government. The contract with the British Government for the sale of molybdenite at 100s. per unit and of wolfram at 52s. per unit will probably continue until the end of the current year. The whole of the mines and works in the north of New South Wales, and the works in Sydney, are closed down consequent upon notification received from the authorised buyers that tungsten ores would not be accepted unless of a certain standard. To this standard the various works are unable to conform. The world's consumption of tungsten ores advanced from 4000 tons in 1906 to 10,000 tons in 1913. The United States output of tungsten ores was increased to 7000 tons in 1916, while the Empire production in 1916 was under 6000 tons. The British Government secured supplies of tungsten from Australia during the war at £400—£500 per ton, compared with £2000 per ton paid for the Norwegian and Swedish products. The Bureau of Science and Industry should carry out large-scale researches in the production of tungsten steels. The industry should be protected and the sales markets opened up so that the best price might be realised for the product.—(*Industrial Australian and Mining Standard, July* 31, 1919.)

Gold Discovery in Western Australia.—The Premier of Western Australia has announced that a large ore formation was discovered in June last on land held by Hampton Properties, Ltd., situated twenty-three miles south of Kalgoorlie. Shaft sinking has disclosed a lode formation 25ft. wide, with the ore channel traceable north and south for a considerable distance. The country rock is oxidised to a depth of 60ft., and is comprised of ferruginous quartz and soft lode formation giving high assay values. The discovery is considered to be of very great promise. There is also another ore formation about half a mile eastward showing visible gold.—(*Official, Sept.* 20, 1919.)

UNITED STATES.

Coal Tar Industry.—In 1918 one hundred and eighty firms were actively engaged in the production of coal tar derivatives in the United States, employing 26,217 employees of all grades. Of this number 2233 were technically trained men.

Tanning Industry.—The tanners in the United States have, though their council, under serious consideration the question of establishing a school to teach the tanning industry in a thorough manner. Whether a separate school shall be created or a separate college established at one of the universities has not been decided.

Petroleum Industry.—Since the petroleum industry is one of the most prominent of the chemical industries, it is interesting to note that the greatest unit of the Standard Oil group is equipped to handle about 200,000 barrels of crude oil daily, and it also operates nearly fifty large tank steamers. In its main engineering and research laboratory a staff of about ninety is employed on many phases of the petroleum problem, including the standardisation of tests and the perfection of testing apparatus.

The Alcohol Problem.—Gradually the breweries are finding new uses, the last to report having become a modern macaroni factory. Meanwhile a fight is being waged to secure regulations permitting alcohol used in the industries to be made tax free. Alcohol is quite important, if indeed not essential, in the production or refining of some 150 materials in industrial chemistry and pharmacy, to say nothing of its use in producing light, heat and power. Several recent experiments with alcohol as a motor fuel even in aeroplanes have yielded results encouraging to those interested in its use.

Coke Industry.—A by-product coke plant in Pennsylvania is operating 768 ovens divided into 12 batteries and consuming 12,500 net tons of coal every 24 hours. The plan contemplates eventually 24 batteries of 64 ovens each. From 12,500 tons of coal the products are approximately as follows:—8000 tons of screened furnace coke containing 2¼ per cent. moisture, 520 tons of small domestic coke, 900 tons coke dust, 150,000 gallons of coal tar, 162 tons sulphate of ammonia, 29,000 galls. pure benzine, 7400 galls. pure toluene ,2800 galls. crude light solvents, 1400 galls. crude heavy solvents, and 75,000,000 cubic feet of gas in excess of requirements for the plant itself. This gas is of 575 B.T.U. The plant is said to represent the very acme of by-product oven installation and efficient operation.

SOUTH AFRICA.

Natal Sugar Industry.—H.M. Senior Trade Commissioner reports the receipt of the following statistics of the Natal sugar industry (crop 1917-18) from a reliable local source:—

Area under cultivation: Between 130,000 and 140,000 acres.
Area from which cane was cut last season: Say 60,000 acres.
Total output of cane: Say 1,320,000 tons.
Output of cane per acre: Average 20—24 tons.
Total output of sugar: 108,000 tons.
Output of sugar per acre: Say 1¾ tons.
Average weight of sugar per ton of cane: Say 1·8 cwt.
Price realised per ton of sugar: £25 average.
Value of season's output: £2,700,000.
Number of factories: 27.
Total capacity of factories: Say 150,000 tons per season.
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the average price of bromine was somewhat better than in the previous year, but the cost of production was much higher. During the first three quarters of the year business was buoyant notwithstanding many difficulties, but it received a sudden check at the time of the armistice. The usual peace-time customers held back on account of lack of other materials and of the uncertain outlook, but more serious was, and is, the closing of former markets. The enemies of Germany are not likely to forsake their bromine industries which they have initiated or resuscitated during the war. The outlook for this industry is the worst imaginable.—(*Z. angew. Chem., July* 11, 1919.)

Iron and Manganese Ore Deposits in the Idarwald, Germany.—The British Military Governor reports that during the past few months prospecting for iron and manganese has been taking place in the Idarwald, about 50 kilom. south of Coblentz. The existence of these deposits was known before the war, but with the Lorraine ironfields in their possession, the Germans did not consider their exploitation sufficiently profitable. The work of the last few months, however, has given very satisfactory results, and it appears that the whole of the Idarwald is rich in these minerals. Deposits have already been discovered in the regions of Rhaunen-Sulzbach, Weitersbach, and Hornbruch (about 20 kilom. W. by S. of Berncastel). The ore is found at a depth of from 6 to 10 ft., but in several places also just below the surface. Analysis shows that it contains from 55 to 60 per cent. iron, and up to 30 per cent. manganese. Its transport could be effected at a small cost by means of the Hunsrück railway.—(*Bd. of Trade J., Sept.* 11, 1919.)

The German Sulphuric Acid Industry.—Before the war copper pyrites and zinc blende were by far the most important sources of sulphur for the manufacture of sulphuric acid. In 1912, 262,700 metric tons of copper pyrites was produced in Germany and 1,073,235 tons was imported, 81 per cent. of which came from Spain and the remainder from Portugal, Turkey, Norway and France. In the same year 982,000 tons of copper pyrites (109,000 from Germany), 550,000 tons of zinc blende (410,000 from Germany), 44,500 tons of sulphur-containing copper and lead ores, and 35,500 tons of material from the purification of coal gas were used in the production of 1,650,000 tons of 100 per cent. sulphuric acid and 170,000 tons of zinc oxide were obtained, among other products, from the above amount of sulphuric acid. In 1890 the production of sulphuric acid in Germany was 1,150,000 tons. At the present time Germany, having had to fall back upon her unlimited deposits of kieserite and gypsum as sources of sulphur, is, like America, independent of foreign countries as regards the production of sulphuric acid. Hardly any free sulphur is now used in making vitriol or black gunpowder, but an increasing quantity is employed in the treatment of vines, wine casks, and hops, for the manufacture of ultramarine, and for vulcanising rubber. In 1913 Germany imported 46,636 tons of sulphur, of which 85 per cent. came from Italy.—(*Z. angew. Chem., July* 11, 1919.)

Magnesite in Italy.—Owing to diminished importation of magnesite from Austria and Greece, deposits of magnesite have been worked near Leghorn and in Tuscany, and the bricks and cement produced there have met with considerable success. The mineral contains up to 95 per cent. of magnesium carbonate and is comparatively low in silica 2·06—3·50 per cent.) Whereas the imports fell from 1316 metric tons in 1913 to zero in 1918, the production of magnesite rose from 400 tons in 1912 to 24,000 tons in 1918, and it is considered that the Italian deposits are sufficient to satisfy the home requirements both for the manufacture of refractory materials and for that of pharmaceutical preparations. Plans are being made to raise the output to 50,000 tons a year, thus providing a surplus for export.—(*Weekly Bull. Dept. of Trade and Commerce, Canada, July* 14, 1919.)

Vanadium Extraction in Sweden.—The presence of vanadium in Taberg ore has been known for nearly 100 years, but, as was found by German undertakings before the war, the proportion of vanadium (about 0·2 to 0·3 per cent.) present is too low to permit of profitable extraction. English vanadium is again on the market at a much lower price, and even in Sweden there are better sources, *e.g.*, at Tuoellevaar, but the export from this source is prohibited. It is probable that the accumulated slags at Taberg are rich in vanadium, but their quantity is not great, and the report that a syndicate has been formed to work them lacks confirmation. The large quantity of easily accessible ore at Taberg, estimated at several million tons, is poor in iron (20 to 30 per cent.) and its high titanium content renders it difficult to smelt. These reasons led to the abandoning of work in the 'seventies, and now, owing to the high price of coal, profitable working is even less to be expected. Further, as the ore cannot be economically concentrated, there is little prospect that the slag will be worked for vanadium on any considerable scale.—(*Z. angew. Chem., July* 11, 1919.)

Dye Industry in Denmark.—Under the direction of two chemists of standing, experiments on the manufacture of dyes have been in progress for some time at a factory at Valby, near Copenhagen, the results of which, although kept strictly secret, are understood to be successful. Various intermediate products have already been made, and it is hoped by building up a Danish dye industry to render Denmark independent of foreign dyes.—(*Z. angew. Chem., July* 11, 1919.)

The Cork Industry in Sardinia. Cork trees are indigenous to Sardinia, extensive natural forests occurring on the mountain slopes in the northern part of the island. The crop is cut every nine years—that is to say, a tree stripped of its bark this season will be left untouched until 1928.

The cork industry is in a flourishing condition, as large profits have been made during the war. A big factory at Tempio is now being enlarged to enable it to increase its output fourfold.

The process of making cork stoppers from cork bark, as employed in the Tempio factory, is comparatively simple. The dried bark in its cylindrical form is first thoroughly steamed and flattened out under pressure. It remains in piles for about thirty days and reappears covered with a blue mould. The bark is then carefully scraped on both sides and cut into strips corresponding in width to the varying length of the cork stoppers desired. These strips are cut by hand into cubes, a process which calls for highly skilled labour and an apprenticeship of at least four years.

The cork strips are full of defects, and it requires a skilled hand and eye to obtain from the cork the maximum amount of merchantable material. The cork cubes are put through high-speed finishing machines, which round off the edges and give the required taper. This cutting process involves a waste of 20 per cent., and is being superseded by an abrasive process which wastes less than 3 per cent. The fine cork dust, which is a by-product of the abrasive process, found a ready market in Germany before the war at from 40 to 45 marks per quintal (about £18 per ton). At Terranova cork is prepared in other forms for export. The best cork is baled in sheets for shipment. The inferior cork is ground to a coarse dust and employed with a magnesium surface finish for sound-proof walls and floor coverings. Two American firms absorb practically the entire output of this factory.

The war stimulated the cork industry principally through the demand for trench mattresses, which,

in addition to their light weight, furnish very good protection against cold and moisture. With the possible exception of olive oil, cork is probably the leading article of export produced on the island.—(*U.S. Com. Rep., July* 25, 1919.)

The Sugar Industry in Spain.—Spain is the only European country in which sugar cane is grown; its cultivation is limited mainly to the province of Andalusia, on account of its high temperature and the absence of frosts. The cane sugar industry dates back to the Moorish conquest. By the year 1150 it already produced 1200 tons of sugar a year, and quite double that amount in the 15th century. The cane is planted in double rows in March and ripens by March in the following year, yielding a crop of 18—20 tons per acre with 13—15 per cent. of sugar. During the dry season, which lasts for three to four months, irrigation is essential, also the application of artificial manures. The beet sugar industry is of comparatively recent date. In 1886 there were two factories, in 1889—1890 eleven. In 1903 there were 47 factories with a possible output (including 25,000 tons of cane sugar) of 175,000 tons, an amount which would exceed the annual consumption, which, on the basis of 16 lb. per head and a population of 20,000,000, works out at about 160,000 tons. In 1904 an amalgamation of factories took place to form a syndicate whose aim was to strengthen the position of the industry by monopolising the production of sugar and its sale and by reducing the number of factories. At the present time the outlook of the sugar industry in Spain is not promising. The Government is expected to come to its assistance. All European beet sugar industries are forced to impose duties on tropical cane sugar or they would be overwhelmed by it. This did not apply to Spain so long as she possessed colonies of her own, against whose interests it would been to establish a strong industry at home by means of protection. When she was deprived of her colonies in 1898 there was no longer any need for her to take that course; consequently an import duty was imposed in order to protect the home sugar industry, so that in normal times Spain was not an important buyer of foreign sugar. The declining sugar production and larger exports during the war greatly reduced Spain's reserves. Great Britain, for example, in 1914 took 9348 tons, and in 1915, 1409 tons. Before the war, 1913—14, the annual production of cane sugar was 13,000 tons; in 1917—18 it had dropped to 6000 tons. The total beet sugar produced in 1913—14 was 169,100 tons; in 1917—18 it had dropped to 115,000 tons. On January 30, 1916, therefore, the import duty was reduced from 60 to 25 pesetas per 100 kilo. (say from 23s. to 10s. per cwt.), notwithstanding the protests on the part of the growers. As a consequence the imports rose in 1916 to 18,000 tons, and in 1917 to 39,000 tons. The argument advanced by the Government was that in view of the prevailing transport difficulties the danger of large quantities of sugar entering the country was small. As soon as these transport difficulties ceased to exist the Spanish market was flooded with foreign sugar. Thus during two months in the earlier part of this year about 20,000 tons was imported from Java and the United States, with many further loads on the way. The price of sugar fell 16 points, and the manufacturers felt that unless given protection their industry was doomed. Now, however, the former import duty of about 23s. per cwt. is again being levied, having become effective from May 24 last.—(*El Economista, May*, 1919.)

The Egyptian Sugar Industry.—The Dutch Consular Attaché draws attention to the frequent reports in the Egyptian Press of the satisfactory development of the sugar industry in Egypt during the current year, in the first four months of which the factories have not only supplied the requirements of Egypt and the Sudan, but have exported 43,205 bags of sugar, as compared with 23,853 bags in the corresponding period of 1918. At the present time the sugar cane plantations are not supplying the refineries with sufficient material to keep them fully occupied, and some of the factories have suffered damage in the internal disturbances at Kom Ombo. (*Z. angew. Chem., July* 11, 1919.)

New Coal Deposits in Chile.—The first of several coal deposits recently found in the south of Chile is situated near La Union. It is estimated that forty million tons of very good quality coal can be obtained therefrom. Nine deposits have been found in the Department of Castro, where the coal is of the boghead or cannel type. A large output of coal is anticipated from the mines of Lemuy. A coal deposit has been found at Mailef, ten kilometres from Valdivia. It has been little worked hitherto.—(*Bd. of Trade J., Aug.* 28, 1919.)

The Mineral Wealth of Rio Grande (Brazil).—The British Consul reports that wolfram is by far the most important of the metallic minerals occurring in this State. It is found, along with tin ore, in Encruzilhada, and traces occur in Sao Jeronymo. Copper is found in Camaquam, Cachoeira, S. Sepe, Cacapava, Sao Gabriel and Bage and in smaller quantities in Dom Pedrito, Lavras and Quarahym. Iron deposits occur in all the municipalities, the more profitable being those of Sao Jeronymo, where red hematite is associated with limonite. Gold in small quantities occurs in a number of municipalities. Sulphide of lead is found in Lavras and Cacapava, along with sulphide of zinc. Traces of silver are present in the lead occurring in Encruzilhada. Marble and limestone are very abundant in certain zones, and granite and "porphyros" are being largely quarried. Kaolin is widely distributed, and there is abundance of mica. Graphite, molybdenum and monazite are also present. Efforts are being made to develop the deposits of petroleum, and a company is being formed to manufacture cement, the raw materials for which appear to be abundant.—(*Bd. of Trade J., Aug.* 28, 1919.)

The Sampling of Coal.—Bulletin No. 2 of The Lancashire and Cheshire Coal Research Association, by F. S. Sinnatt, is intended to assist in the evolution of a standard method of sampling coal, an operation which is too often left in the hands of men who do not appreciate the importance of detail. It is urged that as much care should be expended upon the sampling as upon the analysis. One of the chief sources of inaccuracy in heat balance sheets lies in the fact that the sample submitted for analysis does not truly represent the coal used in the trial. Several examples of inaccurate sampling are quoted, and stress is laid upon the necessity for having a correct proportion of the various sizes of all constituents of the bulk. The diversity of the bulk will determine the size of the sample, but in general the larger the sample the more representative it will be of the bulk. The correct relationship to be maintained between the weight of the original sample and the size of the largest piece of foreign matter has been stated by Bailey. (*See* this J., 1909, 357.) The author considers that the gross sample should be from 1-40 to 1-80 of the total weight of coal, so long as the sample does not exceed 1000 lb. Unless a mechanical sampler or a small crusher is available errors are introduced in handling samples larger than 1000 lb.

The ordinary shovelful of 12·25lb. is generally accepted as the smallest unit to be removed during the sampling of lump coal. For slack or washed coal up to nut size, the unit should be 5 lb. When dealing with large lumps a number should be broken, and the unit taken from the broken portion.

The Standard Coal Specification of the Associated Municipal Electrical Engineers of Greater London specifies the limiting percentage of small coal to be permitted in deliveries. (*See* this J., 1913, 410.) **A sieving test upon an uncrushed sample of coal will indicate when variation in quality may be expected.**

It is impossible to obtain a true sample from the surface of stationary masses of coal, the units of the sample should be taken from each barrow or small truck as the coal is being loaded or unloaded. When sampling a seam of coal a pillar about 6 × 6 in. should be taken through the whole depth of the seam and including a portion of the roof and floor. This should be packed in a suitable box, so that an exhaustive examination may be made.

Before coning and quartering a sample, it should be crushed to an extent depending upon its weight, as shown in the following table:—

Weight of sample to be quartered. Pounds.	Greatest size of pieces of coal and foreign matter. Inches.
3,800	1½
1,200	1
460	¾
180	½
40	2 mesh.
5	4 ,,
¼	8 ,,
¼	10 ,,

The same principle being followed in the laboratory, coal passing a 20-mesh screen should not be reduced to less than 3 grms.

The importance of preserving samples in air-tight vessels to prevent variations in moisture content is emphasized. It has been found that the moisture content of the crushed coal sample may increase or decrease with the humidity of the atmosphere to the extent of at least 0·5% during a period of 6 hours.

The samples for use in the laboratory should all be passed through a 20-mesh sieve, taking care that none of the more refractory constituents are rejected at this stage. When the coal is required in a finer state, as for determinations of sulphur and nitrogen, it is conveniently powdered to pass a 200-mesh in a porcelain ball mill. By this means there is little change due to atmospheric oxidation.

The efficiency of sampling is increased by the adoption of mechanical crushers and riffles. A lengthy extract from the Board of Trade leaflet on Coal Sampling is attached to the bulletin.

The Phosphate Industry in Tunis.—The following table gives the total production of the Tunisian mines and the value of the respective minerals in 1913:—

	Tons.	Francs.
Phosphates ...	2,072,000	45,500,000
Lead ore	59,500	9,500,000
Zinc ore	28,600	3,000,000
Iron ore	594,200	7,500,000

The quantities of mineral ores and phosphates transported by Tunisian railways during 1918, and their respective values, were as follows:—

	Tons.	Value in Francs.
Phosphates ...	862,494	25,874,820
Lead ore	30,662	13,031,350
Lead, pure ...	301	361,200
Zinc ore	5,508	1,046,520
Iron ore	445,022	12,238,105
Manganese ore ...	830	49,800
Lignites	41,555	2,493,300

Tunisian phosphates are classed under two categories according as they contain 58—63 per cent. or 63—68 per cent. of tricalcium phosphate with less than 2 per cent. of combined iron and alumina. The activity of the phosphate mines was greatly restricted during the war, and concomitantly the price of superphosphate advanced from 5—6 frs. to 30 frs. per 100 kilos. The exports of phosphates from Tunis to various countries in 1913, 1917 and 1918 were as follows:—

	1913	1917	1918 (1st ½-yr.)
	Tons.	Tons.	Tons.
United Kingdom ...	181,305	204,645	219,343
France	698,529	142,281	80,767
Italy	453,183	225,908	72,344
Portugal	40,404	12,730	—
Spain	52,985	16,315	4,960
Denmark	12,437	10,562	—
Other countries ...	546,037	—	290
Total ...	...1,984,880	612,441	377,704

Exports to neutral countries amounted to 189,000 tons in 1916, 27,000 tons in 1917, and 5,250 tons during the first half-year of 1918. Before the war the United Kingdom imported great quantities of phosphates from Florida, and it is anticipated that the British market will now be more open to African phosphates than was the case before 1913. —(*Bd. of Trade J., Aug.* 28, 1919.)

Motor Fuel.—The comparative merits of various forms of propellents for motor vehicles have formed the subject of some recent articles in the Parisian journal *La Vie du Grand Air*. The objections to the substitution of benzol for petrol as fuel are that its density, 0·840, is high, thus necessitating a heavier make of carburetter. Its inflammability is also high, *viz.*, +15° C., in comparison with −17° C. for petrol, and thus naturally makes the starting of the engine more difficult than with the standard fuel; and, again, the freezing point at −7° C. is much higher than that of petrol (−100° C.), and, consequently, in cold weather benzol solidifies in the pipes and reservoir, and the circulation is impeded. Further, when mixed with air it detonates strongly, and so it is necessary to make the engine stronger and heavier. Benzol mixes in all proportions with either petrol or alcohol, and can be so used with advantage. What is sold under the name of "white spirit" is a mixture of benzol with 25 per cent. of petrol.

Against the use of alcohol it is objected that its combustion only gives 5500 calories, whilst petrol gives 10,000, and the law compels it to be denatured; this is done by means of wood spirit and heavy benzine. In order that alcohol can compete with petrol it is necessary that it be sold at half the price of petrol. Alcohol can be made more serviceable if it is carburetted with benzol, the addition of 50 per cent. of which gives a mixture producing 8000 calories.

The same objection applies to acetylene as to benzol, *viz.*, the explosions produced by its combustion are too strong. With coal gas the loss of power is 25 per cent., as compared with the standard fuel, petrol; and there is a further and very real difficulty owing to its variable quality as produced by different works.

In the above the word "petrol" is used in the English sense; "petrol" in French is equivalent to the English "paraffin oil" (kerosene), whilst "petrol" (English) is always known in France as "essence." To English readers or English people coming to France this is often a point of much confusion and misunderstanding.

Chemical Industry of the Ukraine.—The chemical industry of the Ukraine, quite considerable before the war, is at present in a perfectly hopeless condition. Only three large factories are in operation, and these but intermittently: the alkali works of Ljubimoff, Solve and Co., the glass works of the firm Lievenhof, and the Kusnezoff Company at Lissitschansk. All acid and benzol works are at a standstill. Lack of coal, lubricating oils, raw materials, and derangement of trade constitute the formidable obstacles preventing the resumption of

work. The acid factories are dependent upon the import of iron pyrites and Chile saltpetre. The available supplies of these materials in the Ukraine are limited to 400,000 puds (pud = 36·1lb.) of iron pyrites and about 200,000 puds of nitre. There is, moreover, no immediate prospect of any imports under existing circumstances. Benzol works, with the exception of the Brjansker Works, which can supply about 3000 puds of benzol, are unable to foresee a restart of operations owing to lack of coal. Whereas during the war the whole of the benzol works could, under most favourable conditions, supply 80,000 puds of crude benzol, they could at the present time, under the best circumstances, only supply half that amount.—(*Ekonomitscheskaja Shisn, May* 7, 1919; *Z. angew. Chem., July* 25, 1919.)

REPORTS.

FUEL ECONOMY.

SECOND REPORT OF THE COMMITTEE APPOINTED BY THE BRITISH ASSOCIATION FOR THE INVESTIGATION OF FUEL ECONOMY, THE UTILISATION OF COAL, AND SMOKE PREVENTION.

During the past year the Committee has been reorganised. Members have been co-opted on the nomination of various Societies interested in the question of Fuel Economy, and three separate subcommittees whose inquiries are respectively directed towards (*a*) chemical and statistical, (*b*) carbonisation and metallurgical, and (*c*) power aspects of the question, have been constituted.

Attention is directed to the movement of coal prices in Great Britain and the United States during the war period.

Outputs of Coal and Average Pithead Prices in Great Britain.

Year.	Total output. Million tons.	Annual output per person employed. Tons.	Average pithead Price per ton.
			s. d.
1913	287·4	260	10 1
1914	265·6	238	10 0
1915	253·2	270	12 6
1916	256·3	260	15 7
1917	248·0	247	16 9
1918	227·7	232	24 0

Outputs of Coal and Wholesale Prices of Coal per Long Ton in the United States.

Year.	Total output Million tons.	Output per worker employed at the Mines. Tons.	Wholesale prices per long ton	
			Stove anthracite at New York.	Bituminous Pittsburg, Run of Mine, f.o.b. Cincinnati.
			s. d.	s. d.
1913	508·9	681	—	—
1914	458·5	601	21 1	10 3
1915	474·6	647	21 0	10 3
1916	526·9	732	22 9	12 6
1917	581·7	708	23 5	21 5
1918	—	—	27 1	18 1

A table giving the comparative annual outputs of coal per worker employed in the mines shows that the respective outputs in Great Britain, Germany and the United States for the period 1911—1913 were 254, 263 and 651 tons.

Prof. Bone has shown that in order to obtain comparable results concerning the chief types of constituents of various samples of coal by the action of pyridine, the solvent must be carefully dried and the action carried out in an atmosphere from which oxygen is excluded. A method has been devised for extracting in a pure condition of the resinic constituents of coal (see this J., 1919, 184R).

The Committee is apprehensive of the danger of sterilising fuel research by over-centralisation, and advocates the fuller utilisation of existing laboratories for this purpose.

Data concerning the fuel consumptions in blast furnaces, steelworks and rolling mills are to be published in the Journal of the Iron and Steel Institute shortly.

The Committee is in substantial agreement with the recent recommendations of the Fuel Research Board (this J., 1919, 191 R) concerning future standards of public gas supplies. The opinion is expressed that the fundamental properties of the explosive mixtures formed by different combustible gases with air affect profoundly their uses for power and heating purposes. The Committee suggests that gas might be sold on a thermal basis, provided that (1) its methane content is not less than 20%, (2) its carbonic oxide content not more than 20%, and (3) its contents of "inerts" not more than 12%. Moreover, the gross calorific value of the gas must not fall below 450 B. Th. U's. per cubic ft. Where gas is supplied for industrial use, a relaxation in the above conditions might be permitted.

Attention is directed to the process introduced by Dr. C. Carpenter for the purification of coal gas from sulphur compounds, and the Committee strongly supports the recommendations of the Fuel Research Board in regard to sulphur purification and the more complete removal of cyanogen compounds.

The investigations of the Committee are to be continued.

REPORT ON "FUEL ECONOMY AND CONSUMPTIONS IN THE MANUFACTURE OF IRON AND STEEL."

On behalf of the British Association Fuel Economy Committee, a report on this subject was presented to the Iron and Steel Institute at the meeting of the Institute, held on September 18, by Prof. Bone, Sir Robert Hadfield and Mr. A. Hutchinson. The main part of the report is devoted to an analysis and discussion of the replies received by the Committee from twenty-five firms in reply to inquiries addressed to them with a view to obtaining reliable data as to the present state of fuel consumption and economy in regard to blast-furnace practice and the operations of steelworks and rolling-mills. The analysis of the replies received is prefaced by a valuable historical section in which the advances made in fuel economy due to the labours of Neilson, Bunsen and Playfair, Lowthian Bell, Bessemer, Cowper and Whitwell, Snelus, Thomas and Gilchrist, Siemens, and Gayley are briefly reviewed. By the introduction of the hot blast, Neilson succeeded in reducing the coal consumption per ton of iron produced from 8 tons 1·25 cwts. to 5 tons 3·25 cwts. with blast preheated to 300° F., whilst with blast preheated to 600° F. it was reduced to 2 tons 5·25 cwts. Bell expressed the opinion that "it is useless to hope to smelt a ton of grey iron from the Cleveland stone yielding 41% of pig metal with anything notably under 20·5 cwts. of coke." Gayley, by the use of the dry-blast operating on hæmatite ores containing 53·5% of iron, reduced the coke consumption per ton of iron produced from 2260 lb. to 1815 lb. There is an apparent consensus of opinion that the introduction of the dry-blast to Cleveland practice would not be economically wise. For the achievement of the utmost fuel economy in a modern iron and steel works, concentration of by-product coke ovens, blast-furnaces, rolling-mills and steelworks on one site is essential. Thereafter the matter is one of

scientific organisation and disposition of the plant as a whole with a view to utilising the energy in the surplus blast-furnace and coke-oven gases. In the case of a works so arranged and organised, the "practical ideal" is regarded as 1·75 tons of good coking coal per ton of finished steel sections. For the attainment of this ideal the coke-ovens must be of the regenerative type, the blast-furnaces should be fitted with double bells, the gases leaving the furnace should be dry-cleaned, and the gas engines in the power house should be run thereon. Furthermore, the rolling-mills should be electrically driven, and scientific management and control should be exercised throughout by trained fuel-technologists. The heat recoverable from the molten slag appears to be about 5% of the total heat of the coke employed. The heat recoverable from gas-engine exhausts and chimney gases is the equivalent of at least 1 cwt. of coke per ton of iron. These, and losses connected with the waste gases from open-hearth furnaces and soaking-pits, together with losses originating in the idleness of the steel-plant and rolling-mills during the week-end, deserve attention.

Coming to the analysis of the replies received from the twenty-five firms aforementioned, it is pointed out that twelve of the undertakings owned blast-furnace plants only, nine both blast-furnaces and steelworks, whilst the remaining four had steelworks only. The following table gives the average coke and equivalent coal consumption in the case of undertakings smelting various brands of iron in blast-furnaces:—

Quality of Iron	Cleveland	Lin'shire	Midlands Basic	Haematite
Number of plants averaged ..	7	4	4	6
Average coke consumption per ton of iron. .. Cwt.	23·5	33·0	26·0	21·33
Average coal equivlents. .. Cwt.	32·65	47·0	37·0	30·0

The average coal equivalents per ton of iron are deducted on the assumption that the coal employed yields from 70—72% of coke when carbonised in by-product ovens. The results obtained indicate that considerable economies in current British blast-furnace practice can be effected, more particularly by (*a*) reducing losses at the bells, (*b*) more efficient utilisation of the gas employed for heating the blast, (*c*) substituting gas-driven for steam-driven blast engines, (*d*) instituting a more systematic fuel control.

The fuel consumptions in the case of open-hearth furnaces are as follows:

	Cwt. per ton of ingots.	Average Cwt.
(a) Molten pig processes ..	.. 6·00 – 7.00 ..	6·35
(b) Mixed processes ..	.. 6·25 – 8.75 ..	7·65
(c) Cold processes ..	.. 7·00 – 12.00 ..	9·45

"Molten pig" processes are those in which 85% of the total metal charged was made up of molten pig iron from the blast furnace, "mixed" processes those where the proportion of molten pig iron in the charge varied between 40% and 70%, the remainder being charged in cold. In "cold processes" no molten metal is charged. It appears that a large proportion of recoverable heat is lost from steel furnaces, soaking pits, boilers, etc. This could be recovered by the installation of waste heat boilers.

In the case of the Bessemer practice, the coal employed for steam-raising, at cupolas, and for heating ladles &c. amounts to about 5 tons 2·5 cwts. on the assumption of 70% of coke production therefrom.

The coke consumption for melting steel in crucible furnaces is returned as 2 tons 15 cwts. per ton of steel by one firm and as 23 tons 7·5 cwts. by another for the melting operation only. Both firms reported adversely regarding the substitution of by-product for beehive coke in crucible furnaces, and this opinion appears to be widely held in Sheffield. The opinion is one that the Committee cannot endorse or contradict, and regards it as a subject for investigation.

The concluding remarks of the report are directed to emphasizing the fact that large fuel economies can still be effected in British iron and steel works. The science of combustion appears to be imperfectly understood or very badly applied by those in charge. It is confidently anticipated that in the near future all gas employed in stoves or engines will be cleaned electrostatically. Finally, the problem of fuel economy is one rather of scientific organisation and co-ordination than of the discovery of new principles, and educational facilities should be forthcoming for the provision of competent men to undertake such organisation and co-ordination.

EIGHTH ANNUAL REPORT BY THE DIRECTOR OF THE BUREAU OF MINES TO THE SECRETARY OF THE INTERIOR FOR THE FISCAL YEAR ENDED JUNE 30, 1918. *Pp.* 124. (*Washington: Government Printing Office.* 1919.) *Price* 10 *cents.*

The organisation of the Bureau consists of an administrative department, together with divisions devoted to mining, fuels and mechanical equipment, mineral technology, metallurgy, petroleum and a chemical research laboratory. During the period covered by the Report, the Bureau of Mines devoted considerable time to the investigation of problems connected with the war, and in particular the preparation of toxic gases, the large scale production of which was far in excess of the supply of shells.

It has been found that the oxidation of coke-oven ammonia to nitric acid can be achieved with comparative ease, a yield of from 93—94 per cent. of nitric acid being obtained from the ammonia oxidised. Pure platinum gauze, 80-mesh screen, was found to be the most efficient catalyst. The only serious poison apt to occur in ammonia is phosphine. Hydrogen sulphide and cyanogen of low concentration are not toxic towards the catalyst. Apparently, cyanogen can be oxidised as well as ammonia. An improved oxidation apparatus requiring no electrical heating is being embodied in a plant now being erected. It is anticipated that this plant will be the cheapest to construct and the most efficient in operation yet devised.

Considerable attention has been given to the working up and extraction of metals from low grade ores. The table herewith indicates the annual production in the United States of various minerals in the years specified:—

Mineral.	1913.	1917.	1918. (expected.)
	Tons.	Tons.	Tons.
High grade manganese ore ..	4,000	110,000	250,000
Pyrite	340,000	450,000	500,000-700,000
Chromite ..	250	40,000	
Magnesite ..	10,000	315,000	

The imports of manganese ores, pyrite and chromite in 1917 were respectively 650,000 tons, 750,000 tons and 72,000 tons. It has been ascertained that large quantities of low grade manganese ores of domestic origin are available, and the metallurgy of these ores has received attention with

a view to the utilisation of their manganese content in steel making. The electric smelting of these ores will furnish supplies of ferromanganese and silicomanganese with far less difficulty than accompanies the smelting of the ores in blast furnaces, but the use of such low grade ores will seldom be economical in normal times. Sufficient supplies for all war purposes of chromium and its ores can be obtained from internal sources, and the native supplies of pyrite can be developed to meet any possible shortage.

The possibility of obtaining elemental sulphur from zinc and copper fumes has been examined.

The output of potash from the dust of cement kilns and blast furnaces, from greensands, alunite, brines and from ores has increased rapidly. Fair results were obtained in the recovery of potash from natural silicates, but none such as to indicate that commercial schemes could be evolved for the purpose.

Concentration tests of low grade mercury ores have been made. Investigation has shown that the loss of mercury incurred in the condensation of vapours from low grade mercury ores containing only a fraction of 1 per cent. of mercury is very small. There seems to be no prospect of any considerable domestic output of tin ore.

The conditions under which tungstic acid derived from the treatment of tungsten ores may be efficiently reduced to metallic tungsten have been studied, and the results are to be published shortly. Molybdenum and uranium ores have similarly received considerable attention. A cheap and simple process for recovering zinc from a solution of zinc sulphate has been developed, with results rendering possible the treatment of low grade and complex zinc ores by leaching. The process of recovery consists in precipitating calcium sulphate from the zinc sulphate solution by addition of limestone. An excess of sulphur dioxide is subsequently added, soluble acid zinc sulphite and sulphuric acid being produced. The latter is precipitated as calcium sulphate, and on removal of the excess of sulphur dioxide from the filtrate by heating, normal zinc sulphite is precipitated. Operating in this manner, it has been found possible to recover at least 85 per cent. of the zinc from the solutions in a zinc product containing 38—43 per cent. of zinc and less than 2 per cent. of harmful impurities.

The results obtained in connexion with the volatilisation of lead from sulphide ores have exceeded the most sanguine expectations. Recovery of from 95—98 per cent. of the lead content and from 75—85 per cent. of the silver content of most of such ores can be cheaply effected. An ore containing more than 10 per cent. of sulphur is given a preliminary roast, and to the residue a mixture of calcium and sodium chlorides is added and the whole heated to 850—950°C. The lead and silver chlorides resulting are volatilised, cooled and precipitated electrically. Success has not attended attempts to volatilise zinc from sulphide ores.

The solubility of pure radium sulphate was determined as 2·1 mg. per litre at 25° C. both in water and in sulphuric acid up to 50 per cent. of acid. Radium sulphate is thus one of the most insoluble salts known. Experiments are being made to determine how much barium should be added to a poor radium ore to ensure a maximum recovery of radium. The carnotite deposits of Colorado and Utah, which constitute the largest source of radium-bearing ore in the world, will be exhausted in five or six years. The recovery of mesothorium from monazite sands has been studied with satisfactory results.

The work done on the removal of the lighter hydrocarbons of petroleum by continuous distillation is to be embodied in a report to be published shortly. In this report the thermal efficiencies of various plants are compared, and computations are presented to show the rates of heat transmission in stills, coolers, condensers, etc.

A method of warning in mines, employing a stench in the compressed air delivered to all parts of the mine, has been developed, and promises to displace the system employing electric signals.

Other activities of the Bureau include a survey of nickel deposits, investigations of by-product coking systems, the flotation process for treating ores, oil storage conditions, oxygen-breathing apparatus, fuels for aircraft, and many others.

THIRTY-SIXTH REPORT OF THE COMPTROLLER-GENERAL OF PATENTS, DESIGNS, AND TRADE MARKS, 1918. (*London: H.M. Stationery Office*, 1919.) *Price 2d. net.*

During 1918, 168 applications were made for the avoidance or suspension of patent rights, compared with 223 in 1917, and 146 licences have been, or will be granted; in 6 cases the patents have been suspended in favour of the applicants. Of the 31 applications for the grant of licences under patents vested in the Custodian, 29 were allowed. Under an Order made on October 31, 1918, the benefit of all enemy owned patents was vested in the Custodian. Of Provisional and Complete Specifications, 21,839 were filed (19,285 in 19917), and 10,809 were sealed. There were 10,019 applications for designs, of which 9,597 were registered, and 6,968 applications for trade marks with 3,055 registrations. There are now 4 patents in force which have been prolonged beyond the normal period of 14 years. The number of patent agents on the register at December 31, 1918, was 238.

The receipts from Patents Fees were £314,431, and the total receipts £345,405, compared with £318,149 in 1917. The surplus of receipts over expenditure was £135,890, against £124,427 in the previous year.

The library was used by 65,076 persons; 6,128 new volumes were added, of which 3,729 were scientific text books or periodicals; and the total approximate number of volumes is 172,600.

COMPANY NEWS.

THE BRITISH PORTLAND CEMENT MANUFACTURERS, LTD.

The year ended April 30 last was financially the most successful in the company's history. There was a gross profit of £345,400 (issued capital £2,562,622; debentures outstanding £1,178,145), a net profit of £201,900, and the dividend on the ordinary shares was raised from 6 to 8 per cent. In addition, £78,000 was allocated to depreciation, and £91,500 was carried forward, as against £63,100 and £87,700, respectively, in the previous year.

The eighth ordinary general meeting was addressed by the chairman, Brig.-Gen. the Hon. F. C. Stanley, on September 19. On the conclusion of the Armistice, the bulk of the orders received from Government Departments was immediately cancelled, but this loss was soon made good by increased home demand and improved export business. The policy of the board is directed towards increased production, but shortage of labour, together with difficulties and delays in obtaining plant and stores, present serious obstacles to its realisation. Since 1914 the aggregate cost of labour, fuel, and repairs has more than doubled. Every ton of cement produced requires about half a ton of fuel, hence when the cost of coal rose by 6s. per ton, that of cement production increased by 3s. per ton, or rather more than this owing to the inferior quality of the coal supplied. The shortage of railway wagons is causing the gravest anxiety, and representations made to the

railway companies have been in some cases wholly without effect. There is no doubt that effective use is not being made of the available rolling stock. With regard to labour, the formation of a Whitley Council for the cement trade is well advanced, and in March last a 48-hours' working week and a week's holiday with full pay were granted to all employees. Appreciable economies should result from the closer working arrangement with the Associated Portland Cement Manufacturers (1900), under which eighteen directors have retired.

THE AMERICAN CYANAMID CO.

The report of this company states that a record output was attained in the year ended June 30 last, the total value of the sales being $6,205,400, or $10,700 more than in the previous year. Owing to increased costs, however, the net profit was $813,900 lower at $1,621,500 on an issued capital of $14,588,500; there was a loss of $163,800 on the subsidiary Amalgamated Phosphate Co., $234,000 was written off licences and patents, and the net income for the year was $1,048,800, as against $1,601,400 in 1917-18.

Until the conclusion of hostilities, practically the entire output was sold to the U.S. Government in the form of aqua ammonia, after which the manufacture of "ammo-phos" and sulphate of ammonia was promptly resumed at the New Jersey plant, and a foreign market immediately developed for all material produced. Operations at the phosphate mines were interrupted by a strike in May last.

NEW REGISTRATION.—*Scottish Oils, Ltd.*, has been registered at Edinburgh as a public company with a capital of £4,000,000 in £1 shares to acquire all or any of the ordinary shares of the Pumpherston Oil Co., the Broxburn Oil Co., the Oakbank Oil Co., Young's Paraffin Light and Mineral Oil Co., and James Ross and Co., Philipstown Oil Works; to acquire the goodwills, so far as they relate to Scotland, of the business of the British Petroleum Co. and the Homelight Oil Co., and certain of the assets in Scotland of the last-mentioned two companies, and to undertake all or any of the liabilities in connexion with the business in Scotland, and generally to carry on the business of dealers in and producers, importers, exporters, miners, distillers, etc. (see this J., 1919, 277 R).

GOVERNMENT ORDERS AND NOTICES.

EXPORTS.

Coal Tar Products.—The Board of Trade (Export Licence Department) draws attention to the fact that the export of—

> "Coal tar and derivatives thereof (except solvent naphtha, cresylic acid, and mixtures containing cresylic acid) suitable for use in the manufacture of dyes and explosives, whether obtained from coal tar or other sources, and mixtures and preparations containing such products or derivatives,"

is still prohibited to all destinations.

Certain coal tar products, such as naphthalene and its derivatives, toluol and its derivatives, picric acid, xylol and its derivatives, carbolic acid crystals, anthracene oil, benzol and its derivatives, cresols (ortho, para and meta) and their derivatives, were originally mentioned by name in the British list of prohibited exports, but these prohibitions have now been merged in the inclusive prohibition on the export of coal-tar products. The export of naphthalene, toluol, picric acid, and the other coal-tar products above-mentioned should therefore be regarded as prohibited to all destinations, and applications for licences to export them should be addressed in the usual way to the Controller, Export Licence Department, 1, Queen Anne's Gate Buildings, Westminster, S.W. 1.

Prohibited Exports.—The following heading has been deleted:—(B) Cotton, American.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for September 11 and 18.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 73, Basinghall Street, London, E.C. 2, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
Australia ..	Glass	633
Canada	Dyes, paints, glue, enamel ..	595
,, ..	Iron and steel bars and plates, copper and brass bars and sheets, galvanised sheets	596
,, ..	Dyes, glass, crockery, china ..	638
,, ..	Druggists' requisites	641
,, ..	Leather for motor-car industry ..	*
Malta	Porcelain, earthenware, glass ..	603
Mauritius ..	Glass, paints, lubricating oils, motor spirit	604
New Zealand ..	Asbestos sheets, slates, white lead, paints, linseed oil	645
,, ..	Glass, china, porcelain	645A
Belgium ..	Drugs	653
,, ..	Leather, rubber, waste metals, dyes, minerals, ores, pitch, refractories, mineral, vegetable and animal fats and oils ..	†4657 T&R
Czecho-Slovakia	Chemicals, colours, china ..	656
France	Rubber, gums, linseed	610
,, ...	Metallurgical supplies	659
Italy	Palm oil, hides, skins	615
,, ...	Chemicals, cocoa	660
,, ...	Chemicals, paints, varnishes ..	661
,, ...	Weldless steel tubes, copper wire	662
Netherlands ..	Cardboard food containers ..	618
Rumania ..	Paper, leather, binder twine ..	619
Scandinavia, Finland, Russia	Grease, oils, lubricants, benzine, benzol, etc.	663
Spain	Asbestos, lubricants, paints, varnish	620
,, ..	Tinplate	621
Switzerland ..	Chemicals, metals, hides, leather	625
,, ..	Pharmaceutical goods	667
Morocco ..	Iron, steel	668
Argentina ..	Chemicals, laboratory apparatus, glass, porcelain	670
,, ..	China, earthenware, paints, varnish	671
Brazil	Heavy chemicals	672

*The Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

†Belgian Trade and Reconstruction Section, Department of Overseas Trade, Regent House, Kingsway, W.C. 2.

MARKETS SOUGHT.—A Canadian company manufacturing toilet preparations and perfumes desires to get in touch with importers in the U.K. Applications should be addressed to the Canadian Government Trade Commissioner.

A firm in Spain desires to get into touch with importers in the U.K. of grease, oils, petroleum, gasoline, olive oil and capsicum. [Ref. No. 665.]

TARIFF. CUSTOMS. EXCISE.

British India.—The import of all coal tar intermediates, all direct cotton colours, all union colours, all acid wool colours, all chrome and mordant colours, all alizarine colours, all basic colours, all sulphide colours, all vat colours (including synthetic indigo), all oil, spirit and wax colours, all lake colours, and any other synthetic colours of

whatever form is prohibited except under licence as from September 6. It is understood that licences will always be granted for dyestuffs and intermediates manufactured in the U.K.

British West Africa.—An export duty of £2 per ton will be levied as from October 20 upon palm kernels exported to countries outside the British Empire.

Belgium.—The regulations concerning certificates of origin are given in the issue of the *Board of Trade J.* for Sept. 11. The import duties on beer and brewing sugar have been increased.

Brazil.—The new budget law comes into force on October 1.

Canada.—Certificates of origin and interest are no longer required for goods imported from any country. Shipments may now be consigned direct to importers in Holland and Switzerland.

China.—The new tariff will be taken as the basis for calculating the duties applicable at Chinese Land Frontier Customs Stations.

Denmark.—The prohibition of the export of the following goods, *inter alia*, was withdrawn on August 6: Many metals and their ores and salts, bromine and its compounds, carborundum, emery, certain alloy of iron, fish oil, graphite, hops, matches, paper, printing inks, certain sulphur compounds (but not sulphuric acid).

France.—The export and re-export of, *inter alia*, organic manures, glucose, molasses, de-phosphorised slag, sulphate of ammonia, nitrates of soda and lime, calcium cyanamide, superphosphate of lime and chemical manures are prohibited as from August 26.

France and Algeria.—The import duties on certain kinds of paper and cardboard have been reduced as from August 28.

Germany.—Import licences are required for all classes of goods imported into German territory outside the zone of occupation. Applications for licences should be made to the Reichskommissar for Export and Import Licences, Berlin.

Italy.—With some exceptions all "luxury" goods which under the previous arrangement between the British and Italian Governments could only be imported under licence may now be imported without licence.

Morocco (French Zone).—The consumption duty on certain kinds of alcoholic liquors has been reduced.

Poland.—A Department has been set up under the control of the Minister of Supply which has the sole right to import or authorise the importation of articles of prime necessity, amongst which are many foodstuffs, oil seeds, linseed cake, malt, lard, grease, edible oils, sugar, cocoa, salt, naphtha, petroleum, matches, candles, soap, soda and shoe leather.

Spain.—An export duty has been levied as from August 20 on certain classes of hides and skins.

Tunis.—Export licences are now required for margarine, condensed milk, syrups, edible vegetable fats, oil cake, natural phosphate, bauxite, bones and soap.

United States.—General Import Licence "P.B.F. No. 37" has been extended as from August 15 to permit free importation of pig tin, tin alloys and all drugs and chemicals except those dyestuffs and other articles mentioned in the list. The list is set out in the *Board of Trade J.* for September 18 and includes sugar, salvarsan and its equivalents, and a great many coal tar crude products, intermediates and finished products as well as dyestuffs and medicinals. Potash may now be imported under General Licence "P.B.F. No. 37" from all countries except Hungary and Bolshevik Russia.

TRADE NOTES.

BRITISH.

Trade of Trinidad in Drugs and Medicines.—The importing and selling of drugs and medicines in Trinidad is practically in the hands of five large druggists in Port of Spain. Competition is keen, but the trade is profitable. Most of the drugs and medicines imported into this colony are of American manufacture. The total value of all dutiable drugs and medicines imported into Trinidad and Tobago in 1917 was £21,000, and of those admitted free of duty for the use of the Colonial Government, £3,500. The sources of these imports were as follows:—United Kingdom 37·5%, United States 44·2%, Canada 7·6%, France 4·4%, and other countries 6·3%. In the same year 3604 galls. of medicinal spirits, valued at £6,000, was imported. Of this amount 24·4% came from the United Kingdom and 75·0% from the United States. The duty on drugs and medicines is 10 per cent. *ad valorem*, and the duty on medicinal spirits is 5s. per gall.

Although medicinal plants can be grown in Trinidad, there has been little attempt to prepare medicines locally. Castor seed cultivation has been stimulated, but local attempts to express oil from the seed for medicinal purposes have not met with much success. The difference in tariff on medicinal spirits and medicines already compounded when imported makes it advantageous to the Trinidad druggists to import medicines containing alcohol ready made rather than make up their own.

Malaria is very prevalent in the rural districts of Trinidad, and, together with diarrhœa and enteritis, is the cause of a large number of deaths. Phenacetin and aspirin are in considerable demand. —(*U.S. Com. Rep., Aug.* 6, 1919.)

FOREIGN.

The Chemical and Allied Industries of Italy:—*Oils and Fats.*—The following figures indicate the extent of the Italian trade in olive oil during recent years:—

	Hectolitres.		
	1909-13. (Average	1914.	1916.
Production ..	1,813,000	1,784,000	2,062,007
Imports ..	46,104	205,508	190,982
Exports ..	453,080	324,837	66,260

IMPORTS OF OILS, SEEDS, SOAP, ETC.

	Metric tons.	
	1914.	1917.
Linseed oil, boiled	376	
Linseed oil, other descriptions ..	372	.. 2,672
Cottonseed oil, fine	2,388	.. 242
Coconut oil	3,878	.. 1,421
Palm oil	6,977	.. 7,770
Arachis oil	2,806	.. 2·4
Olive oil	15,422	.. 10,370
Fish oil	4,502	.. 6,883
Oleic acid	6,339	.. 1,227
Various fats	23,354	.. 15,570
Castor seed	9,380	.. 7,200
Linseed	32,380	.. 22,565
Colza seed	21,980	.. 2,158
Sesame and arachis	28,863	.. 16,000
Soap, ordinary	4,092	.. 5,124
Soap, toilet	172	.. 201
Colophony	14,959	.. 19,061
Glycerin	334	.. 4,189

Glycerin.—During the war the prohibition of the use of unsplit fats for soap making led to a considerably increased production of glycerin, and the Oleifici Nazionali of Genoa erected large glycerin works at Leghorn.

Soap.—The average home production amounts to 150,000 metric tons of ordinary and 40,000 tons of

fine soap; the imports (chiefly from Marseilles) to 6000 tons and the exports (before the war to England and North America) to 3500 tons a year. Exportation to England appears to be excluded in the future owing to the high cost of fuel in Italy and to the favourable position of the English factories with respect to raw materials. In 1911 soap makers secured a rebate of duty on imported arachis oil to enable them to compete with Marseilles, but this privilege has not been used since the customs authorities required the oil to be denatured. Taxes were imposed in 1917 on the manufacture and sale of soap (40 and 120 lira, respectively, per 100 kilo. of ordinary soap). The Italian soap industry has lately used much bone fat of which about 25,000 tons was imported in 1913.

Stearin and Candles.—The yearly export of stearin, made chiefly from fish oil, is about 2200 tons; of stearin candles about 300 tons; and (1913) of paraffin and mixed candles about 2108 tons.

In 1911, 611 firms (using 1800 h.p.) and 5000 persons were engaged in the glycerin, soap, stearin and candle industries which are therefore for the most part carried on on a small scale.

Paint and Varnish.—Most of the 2000 varnish works are small; the 30 larger factories use about 1000 h.p. and employ 800 persons in all. Exports in 1913; 200 metric tons, of which 150 tons was oil varnish.

	Imports in 1913. Metric tons.	Source.
Varnish (other than oil and spirit)	2000	Germany 37%; France 30%; U.K. 25%
Spirit varnish	15	—
Oil varnish	1000	U.K. 35%, Germany 30%

Margarine.—About 8000 tons of inferior quality is produced annually in peace time. Exports: about 200 tons. Imports: very small.

Perfumery.—Notwithstanding the large native production of lemon, orange, bergamot and other essential oils, the perfumery industry is but feebly developed owing to the taxation of alcohol and to the necessity in this trade for long-continued and expensive advertising. Fine perfumes are not made in Italy. The Italian Government is likely to foster the essence industry and to organise it better. Exports (1913): Perfumes, 1 million lire; essences (chiefly lemon) and citric acid, 2·75 million lire.

	Imports in 1913. Million lire.	Source.
Non-alcoholic perfumes	1·123	France 67%; Germany 33%
Alcoholic perfumes	1·5	—
Essences	3·0	Germany 67%

Building Materials.—The following figures are for 1913 and partly for 1912:—

Material.	Metric tons. Production.	Imports.	Exports.
Quicklime	895,478	6,663	9,440
Slaked lime	641,400	2,532	9,861
Gypsum	421,538	4,246	2,157
Cement	1,091,976	17,220	49,736
Fireclay brick	24,000	56,436	—

Sixty per cent. of the fireclay brick came from the United Kingdom. Several companies have recently been formed for the manufacture of furnace bricks and similar products, notably one in Milan with a capital of one million lire.

Ceramic Industries.—The total production of majolica, porcelain and terra cotta in 1913 was about 88,721 tons and the exports were insignificant. The majolica industry has sunk to an imitative handicraft, but in the porcelain industry, which shows vigorous life, the exports (1914: 4011 metric tons) are increasing somewhat and electrical insulators of tolerable quality are being made.

Glass.—The total production is about 90,000 metric tons. The small export trade is chiefly of Venetian beads, glass paste, etc., to British India. There are 78 small glass works with more than 10,000 workers; 30 for *articles de luxe* with about 1000 workers and 7 larger limited companies (only 3 dividend-paying) with 11·5 million lire capital. The chief centres of the industry are at Pisa (St. Gobain), where optical glass has been made since the outbreak of war, and Milan. A new company (capital, 0·5 million lire) has been formed at Murano for the manufacture of scientific glassware. The principal products of the Italian industry (which suffers from lack of coal) are the typical wine containers of 1 to 50 litres capacity, and bottles which are also imported (6800 metric tons, of which 3500 came from Germany). The following figures are for 1913:—

Description.	Metric tons. Production.	Imports.	Exports.
Glassware (various)	62,565	10,665	1,227
Sheet glass	19,650	3,079	415
Art objects	1,943	115	154
Beads, etc.	4,500	125	3,950

Artificial Silk.—Before the war this was made only by one large firm, the Cines Company (capital 5·75 million lire), which is also the largest manufacturer of films in Italy. Several new works are said to have been erected during the war.

	Metric tons. 1913.	1915.	1916.
Imports	357·3	365·7	139·8
Exports	152·7	697·0	323·1

Paper.—War conditions have proved profitable to the Italian paper industry, which previously could not stem the flow of imports from Germany and Austria, although well able to supply home requirements. The employment of cheap water power, of which the paper works use about 40,000 h.p., has assisted progress in the production of mechanical wood pulp, of which, in 1914, only 10,000 metric tons was imported, whilst 60,000 tons was produced. The systematic planting of suitable trees is in progress, but there are only three factories for chemical pulp, and these, partly owing to the difficulty in procuring sufficiently cheap wood or Esparto grass, provide only one-ninth of the 90,000 metric tons required annually. The small export of paper from Italy is confined almost wholly to cigarette paper for the East and to some fine paper for South America. About 100 million lire is invested in the Italian paper industry, which possesses about 230 continuous paper machines and employs about 28,000 workers.

Cork Bark and Corks.—Cork is produced in Sardinia (the best product), Sicily and the Maremma. Exports of crude bark in 1913 were 3611 metric tons, and imports, 632 tons. The imports of cut bark are about 600 tons. Practically no prepared bark is exported.

Sugar.—This industry began on a large scale in 1888, but the Italian market was almost completely closed by the action of the Brussels Convention. Heavy taxation accounts for the high price of sugar in time of peace (1·5 lire per kilo.) and possibly for the low consumption per head of population (5 kilo. a year in Italy, 40 in England, 20 in Germany, and 17 in France).

Statistics for 1913.	
Production of sugar beet	2·7 million metric tons.
Capital of 25 largest factories	100 million lire.
Workers in ,, ,,	15,500
Power ,, ,,	25,000 h.p.
Imports of refined sugar (Bohemian)	7,000 metric tons.
Exports of refined sugar	1,000 ,,

In 1913 experiments were in hand on the cultivation of better varieties of beet and on the utilisation of the neglected by-products.

An increased exportation during 1915 and the subsequent diminished production (75,000 tons for 1917-18) brought about a sugar famine and in 1918 the price rose to 3·55 lire a kilo (1s. 3d. per lb.).

Glucose.—The annual production is about 6,500 tons, chiefly by a Milan company. The imports and exports are insignificant.

Wines, Etc.—The average yearly production of wine is 40 million hectolitres and the exports are about 1·3 million hectolitres. In the year 1913 there were exported, 4263 metric tons of wine yeast, 8294 of crude tartar, 2846 of tartaric acid, 348 of cream of tartar, and 356 of vinegar.

The vinegar industry is little developed and the larger factories (in Bologna) are of Austrian origin.

Brewing.—In 1913, 652,000 hectolitres of beer was produced, partly by Italian and party by German undertakings. Imports were 86,000 hectolitres (including bottled beer), 90 per cent. of which came from Germany and Austria.

Alcohol and Spirits.—The production in 1913 was 372,584 hectolitres, of which 177,500 was from sugar and 130,000 from grain. The exports (chiefly to North and South America) are valued at 7·5 million lire and the imports at 1·23 million lire, including more than 1 million lire for cognac.

The following particulars relate to purely chemical and gas companies, and exclude those dealing with metals, textiles, paper, glass, etc. At the end of 1915 there were 102 companies possessing a combined capital of 286·7 million lire; debentures totalled 62·3 and reserves 75·1 million lire. Eighty-nine of the companies earned a total profit of 47·7 and 13 companies a loss of 3·5 million. (*Z. angew. Chem. June* 24, 1919).

Phosphate Deposits in Morocco (French Zone).—The phosphate mines at El Boroudj will probably be put to public tender early next year. It is expected that the concession will call for 100,000,000 francs capital. The Protectorate will welcome British or any capital likely to work the deposits on a large scale. A French company is preparing to tender. Analyses of the deposits and geographical and transport particulars may be obtained by British interests from the Near East Section, Department of Overseas Trade, 4, Queen Anne's Gate Buildings, Westminster, S.W.1.—(*Bd. of Trade J., September* 4, 1919.)

Exports of Chemicals from Norway.—The following figures taken from the Norwegian Official Statistical Bulletin of December, 1918, show the exports of chemicals (in kilo. of 2·2046 pounds) from Norway during 1918, in comparison with those for 1917:—

Chemicals.	1917. Kilo.	1918. Kilo.
Nitric acid	1,021,170	836,686
Oxalic acid	334,089	206,028
Sulphate of ammonia	50,000	—
Nitrate of ammonia	63,578,120	49,587,663
Sodium nitrate	22,711,200	2,636,553
Sodium nitrite	3,536,090	2,097,811
Norwegian saltpetre	35,932,400	53,625,250
Cyanamide	2,312,910	10,490
Calcium carbide	46,066,630	11,771,876
Iodine	1,180	5,373

Exports of matches were given as 5,011,918 kilo. in 1918, as compared with 4,044,680 kilo. in 1917; ferrosilicon, 29,449,710 kilo., against 16,861,278; and gunpowder and other explosives, 1,130 kilo., against 11,667.—(*U.S. Com. Rep., Aug.* 22, 1919.)

Aluminium Food Containers.—The use of leaden containers for foodstuffs, drugs, and cosmetic preparations has been repeatedly condemned as dangerous or unhealthy by the Imperial Board of Health. **The injurious consequences accompanying their use can be avoided by employing aluminium, which possesses all the essential properties, viz., homogeneity, pliability, and compressibility without fracture.** A brochure relating to such containers made of pure aluminium and detailing their dimensions and cubical content is being circulated by the Fritz Neumeyer A-G., Nürnberg 130, and is of particular interest by reason of the original patterns described therein.—(*Z. angew. Chem., July* 18, 1919.)

Dyestuffs Standards for China.—Practical dye-men and Hong-Kong importers of dyes report that the chief factor in the future of the sale of dyes in China is the standardisation of colour shades. One of the chief elements of the success of German dyes in this field was that certain shades popular among the Chinese could be relied upon. The matter of colour is very important among the Chinese. Many of the colours have special significance of a ceremonial sort as well as being regarded as more or less lucky or unlucky. There are large interests in China, especially in Amoy, Swatow, Chuchow, and various South China coast cities, where imported shirtings and sheetings are dyed for sale to the Chinese. The basis of this entire business is the quality of colour in the cloths thus handled, which depends on the uniformity of colour and the quality of the dyes.—(*Bd. of Trade J., Sept.* 11, 1919.)

REVIEWS.

EXPLOSIVES. *By* E. DE BARRY BARNETT. INDUSTRIAL CHEMISTRY, *edited by* DR. S. RIDEAL. *Pp. xvi* + 241. (*London: Baillière, Tindall and Cox,* 1919.) *Price* 12*s.* 6*d. net.*

Those who are engaged in the manufacture of explosives will find nothing new or striking in this book, either in fact, observation, or theory; but it will be of considerable value to everyone interested in technical chemistry who wishes to obtain general information as to the present position of the various branches of the explosives industry. The book has been clearly and concisely written, but there is a marked inefficiency in punctuation, and several of the sentences might have been rewritten with advantage. The author has compressed a large amount of reliable data into 233 pages, and the information has been brought up to date by including the official figures for the cost of producing various explosives during 1918.

In the introductory historical section a useful summary is given of some points in the Explosives Act, the method of construction of danger buildings, and the means taken to ensure, as far as possible, the safety of workpeople. Gunpowder is dealt with in a short section. This country has always had a justifiably high reputation for the quality of its gunpowder, and it is not generally recognised that this has been due, in no small degree, to the hereditary art of the gunpowder maker.

Nitroglycerin, guncotton and nitro-aromatic compounds are treated on familiar lines. The author makes no reference to the modifications made during the war in cotton cellulose and the methods of chemical purification. In dealing with nitro-cellulose waste acid, it is stated that "The residual sulphuric acid still contains 2—3 per cent. of nitrous acid which cannot be removed by distillation, and it is denitrated by steam." Such conditions are certainly quite exceptional, as the general experience is that the residual sulphuric acid contains only the merest trace of nitric and nitrous acid, and has not to be denitrated with steam before concentration. During the war the Gaillard tower has been much more extensively used than is indicated by the author. The available literature on military smokeless propellents is very extensive, and a good résumé has been made of this work.

On page 71 the author confers a knighthood on Alfred Nobel and then credits him with investigations on cordite which were carried out by Sir Andrew Noble. In dealing with smokeless sporting powders the author is naturally handicapped by the fact that there is no published information on the methods of manufacture of some of the most prominent of the English sporting powders. Long experience and investigation have led to the use of special types of nitro-cellulose, special solvents and special methods of manufacture. For many years the methods of manufacturing gelatinous and granular blasting explosives have altered very little. The problems in this branch are connected with decrease of velocity of detonation and the development of inertness after prolonged storage, and the investigator has to deal with many intricate problems in the chemistry of colloids.

The author is hardly correct in his statement that the Werner Pfleiderer machine is usually preferred for incorporating gelatinous blasting explosives, seeing that the McRoberts machine is almost universally employed in this country.

A good selection has been made from the published literature on explosives for use in coal mines, and the experimental galleries at which they are tested.

The author has correlated many of the explosives on the British permitted list, and expressed his opinion as to the influence on the maximum charge of difference in composition, nature of wrapper and method of manufacture.

The reviewer has been closely associated with the experimental work connected with several of the explosives on the permitted list. The longer his experience, the less is his inclination to form definite opinions as to the relative influence of the many factors which are known to affect the test.

Other sections deal with percussion caps, detonators and fuses, matches and pyrotechny, and the testing of explosives.

In the concluding section the author endeavours to forecast the future developments in the explosive industry. G. W. MacDonald.

The Analysis of Minerals and Ores of the Rarer Elements. *By* W. R. Schoeller *and* A. R. Powell. *Pp.* x + 239. (*London: C. Griffin and Co.*, 1919.) *Price* 16*s. net.*

The exigencies of the war have led to a much wider recognition in this country of the many industrial uses for the rarer elements and their compounds. Although several books have appeared on the occurrence and utilisation of these substances, in all these works the analytical examination of their ores has either been ignored or dealt with in a very brief manner. Text-books on analytical chemistry also failed to meet the requirements of the mineral chemist called upon to analyse such material for the first time. The present volume is therefore particularly welcome, as it fills the gap in a very concise and yet adequate manner.

The introductory chapter deals first with various manipulative details, and then considers briefly the mineralogical examination of the material, and in this connection the authors rightly emphasize the need for a good knowledge of mineralogy to chemists who are called upon to deal with economic problems in regard to the treatment of ores of the rarer elements. After giving numerous tables for the qualitative examination of the minerals the quantitative analysis is discussed. The elements thus considered are lithium, rubidium, caesium, beryllium, radium, scandium, gallium, indium, thallium, cerium and its allies, titanium, zirconium, thorium, germanium, vanadium, columbium, tantalum, selenium, tellurium, molybdenum, tungsten, uranium, ruthenium, rhodium, palladium, osmium, iridium and platinum.

The principal theme of the volume is complete quantitative analysis, the general schemes for which are given largely in tabular form, whilst the behaviour of individual elements is considered in detail. The authors frankly invite discussion and criticism of the methods of separation and estimation recommended, but only very occasionally is one inclined to join issue. In the case, however, of the mineral thorianite (p. 111), its decomposition by fusion with bisulphate as recommended appears to be undesirable in view of the fact that the mineral decomposes readily with boiling nitric acid, thus avoiding the introduction of alkaline sulphates into the rare earth solution, and, at the same time, effecting a separation from such minerals as zircon, quartz, rutile and much of the ilmenite. Greater stress might also be laid upon the disturbing influence of titanium compounds upon the solubilities of those of tantalum and columbium—*e.g.*, in the separation of tantalum as potassium fluo-tantalate, and as affecting the insolubility of the oxides in water after fusion with bisulphate of potash.

Numerous footnote references are given to original papers, and in place of the customary subject index we have two—(*a*) an index to minerals, (*b*) index to separations.

To the investigator who has not an extensive reference library at his disposal, the value of future editions of this book might be enhanced by the inclusion of a few tables showing typical complete analyses of the more common rare earth minerals; as it stands, however, the work should prove of value to all chemists who may be called upon to examine minerals and ores of the rarer elements as it appears to be a distinct advance on anything previously published on the subject, either in this country or abroad.

Sydney J. Johnstone.

PUBLICATIONS RECEIVED.

A Treatise on British Mineral Oil. (*With a foreword by* Sir Boverton Redwood). *Edited by* J. A. Greene. *Contributors:* E. H. Cunningham-Craig, W. R. Ormandy, F. Mollwo Perkin, A. Campbell, A. E. Dunstan, *and* A. H. Seabrook. *Pp.* 233. (*London: C. Griffin and Co.* 1919.) *Price* 21*s.*

Principles of Electric Spark Ignition in Internal Combustion Engines. *By* J. D. Morgan. *Pp.* 88. (*London: Crosby, Lockwood and Son.* 1920.) *Price* 8*s.* 6*d.*

Journal of the Royal Agricultural Society of England. *Vol.* 79. *Pp.* 284 + xxxix. (*London: John Murray.* 1918.) *Price* 10*s.*

The Conditions that Govern Staleness in Bread. Changes of Moisture and Soluble Extract with Age. Investigations and Researches Made in the British Army Bakeries in France, 1917-1918. *By* Capt. R. Whymper. *Reprinted from "The British Baker."* *Pp.* 72. (*London: Maclaren and Sons, Ltd.* 1919.)

Notes of Ten Introductory Lectures on Organic Chemistry with Special Reference to Coal. *Bulletin* 1. *Pp.* 32. (*Lancashire and Cheshire Coal Research Association.* 1918.) *Price* 1*s.*

Chemicals and Allied Products Used in the United States. *Prepared by* The Bureau of Foreign and Domestic Commerce, *in collaboration with* The American Chemical Society. *Compiled by* E. R. Pickrell. *Miscellaneous Series—No.* 82. *Pp.* 194. (*Washington: Government Printing Office.* 1919.) *Price* 25 *cents.*

THE HISTORY OF "MUSTARD GAS."

ARTHUR G. GREEN.

In the article by Sir William Pope in the "Review" for September 30 he complains somewhat sarcastically that some process of "mustard gas" production devised by himself and Mr. C. S. Gibson became known as the "Levinstein process," and later as the "American method," and he is seriously perturbed by the possibility that it may eventually be termed in Central Europe the "German method."

Although I am the last to wish to depreciate the valuable services rendered to the nation by the work of Sir William Pope and his collaborators, yet the facts as hitherto presented leave an impression which, in the interest of historical accuracy, cannot remain uncorrected.

In the first place, it must be pointed out that Guthrie, to whom the discovery of mustard gas is usually attributed,* actually obtained it in 1861 by the identical reaction, *i.e.*, the combination of ethylene with sulphur monochloride (see J. Chem. Soc., 1861, 13, 134), which Sir William Pope now claims to be "entirely novel" and to have been discovered by Mr. C. S. Gibson and himself. It is true that Guthrie ascribes to his product the composition of a disulphide $(C_2H_4)_2Cl_2S_2$, and regards it as different from the product of reaction of ethylene with sulphur dichloride, but his description of the compound as a pale yellow liquid of sp. gr. 1·346 at 19° C., the vapour of which attacks the eyes powerfully and "a drop placed on the tongue destroys the epidermis," leaves no doubt but that he actually had in hand the same material as that manufactured by Levinstein, Ltd., and adopted as the British "Mustard Gas." It is still an open question whether this material, which has the empirical composition $(C_2H_4)_2Cl_2S_2$, and the formation of which is expressed by the equation:—

$$2C_2H_4+S_2Cl_2=(C_2H_4)_2Cl_2S_2 \text{ or } (C_2H_4)_2Cl_2S+S$$

is to be regarded as a "pseudo-solution" of sulphur in the monosulphide $(C_2H_4)_2Cl_2S$, or whether it is not rather a loose chemical combination of the monosulphide with an atom of sulphur, such a union [of S with S] being a form of combination not infrequently met with in organic sulphur compounds. Personally, I incline to the latter hypothesis. The facts are that although the sulphur may be removed by distillation, other means of separation fail, and the sulphur atom still remains dissolved or combined even after the material has been kept for many months, and this in spite of the fact that the ordinary forms of sulphur are nearly insoluble in the cold monosulphide. Moreover, if a further quantity of sulphur be dissolved in the "disulphide" at 100° C., this additional sulphur crystallises out again upon cooling the liquid, and in the quantity added, whilst the so-called "colloidal" or "atomic" sulphur still remains dissolved. This "disulphide" mustard gas, discovered by Guthrie, worked out technically by the Research Department of Levinstein, Ltd., and first put into practical manufacture at the Blackley Works, is the only form of mustard gas which has proved capable of production in large quantities in a comparatively simple plant and without grave risks to the workers. After the initial prejudice had been overcome, this process was adopted by the British and American Governments. The reason for this was the discovery that the "disulphide" (or pseudo-solution of sulphur in monosulphide) has a physiological activity fully equal to a molecular quantity of the pure monosulphide, whilst the enormous technical difficulty of handling separated sulphur is entirely obviated in this method of manufacture. Thus, with a well-designed and properly constructed plant there is little more danger in producing "Mustard Gas" in quantity than any other poisonous chemical. The process employed was the result of a careful study of the conditions of reaction between ethylene and sulphur monochloride, more especially as regards the effect of temperature, reacting surface between liquid and gas, manner of presenting the reacting materials, dryness of the ethylene, etc. When the correct conditions are observed, the product is obtained in almost theoretical yield as a pale yellow liquid which deposits no sulphur and requires no further treatment. To put these conditions into effect the Levinstein "reactor" was devised, a form of apparatus ironically described by Sir William Pope as "a cast-iron pot rather deeper than the ordinary lavatory basin." As we are unfortunately precluded on public grounds from publishing the plans of this plant and thus enabling the reader to judge for himself, I can only say that the engineering problems encountered in the design of the "reactor" were no slight ones, and the final apparatus evolved with its complicated system of cooling pipes, high-speed agitators, safety seals, gas inlet and outlet pipes, "fool-proof" cocks, and other devices, was as far removed from Sir William Pope's description as a modern railway engine is from James Watt's tea-kettle.

Whether the Levinstein process constituted or not a "patentable novelty" need not be discussed here. Contrary to Sir William Pope, I am strongly of opinion that it did, but we never had the slightest idea of patenting an invention upon which the life of the nation at one period almost seemed to hang. On the contrary, throughout our work all our information was given unreservedly both to our own and to the allied governments.

Returning now to Sir William Pope's process, it is necessary to point out that in contradistinction to ours the separation of sulphur was here specifically *aimed at* in order to obtain as far as possible the *monosulphide* $(C_2H_4)_2Cl_2S$, which alone was regarded as mustard gas. In the description of the process given to me by Sir William Pope himself in April, 1918, it was stated that the reaction was performed at a temperature of 60° C. (at which

* The early history of this subject is somewhat involved. Prior to Guthrie, the formation of a disagreeably smelling fluid by the action of ethylene upon chloride of sulphur had been observed by Despretz (Ann. Chim. et Phys., **22**, 428), though its vesicant action was not noted. Guthrie, in his paper in 1860 (quoted by Sir William Pope) mentions the vesicant action of the product formed by combination of ethylene with sulphur dichloride, but on the evidence of his analyses, attributes to the body the constitution $C_4H_4SCl_2$. In the same year, but bearing the date December, 1859, there appeared in Liebig's Annalen (1860, **113**, 268) a paper by Niemann in which is described the reaction of ethylene upon "brown" chloride of sulphur (a mixture of sulphur monochloride and dichloride). The following is a translation of this author's account of the toxic action of his product:—"The most characteristic property of this oil is also a very dangerous one. It consists in the fact that the minutest trace which may accidentally come in contact with any portion of the skin, though at first causing no pain, produces in the course of a few hours a reddening and on the following day a severe blister, which suppurates for a long time and is very difficult to heal. Great care is therefore requisite in working with this compound." This product, for which the characteristics of mustard gas are here so clearly set forth, is, according to Niemann's analyses, the disulphide, $(C_2H_4)_2Cl_2S_2$, and hence is apparently identical with the disulphide obtained by Guthrie in the following year from ethylene and sulphur monochloride.

temperature it may be noted in passing there is, when working in iron vessels, a large amount of chlorination and consequent production of inactive by-products); only a moderate agitation was employed, and no importance was attached to the use of dry ethylene. The sulphur, which was stated to crystallise out at the end of the process in approximately atomic proportion, was to be removed mechanically and, with or without previous washing with a solvent such as carbon tetrachloride, was to be employed again for making sulphur monochloride. This process failed completely in practical application owing to the extreme danger and difficulty of removing the sulphur.

Although we have always fully recognised the great assistance which we received by being placed *au courant* with Sir William Pope's experiments, yet the process finally evolved at our works was, as I have shown elsewhere, essentially different in principle from Sir William Pope's process and cannot be described as a large scale application of the latter. It should, indeed, be more correctly regarded as a technical development of the original process of Guthrie. Great as is the credit due to Sir William Pope in directing attention to this reaction, it is an unfortunate fact that the only serious modification made by him in Guthrie's process, *viz.*, the attempted elimination of sulphur, was the very point which rendered the scheme technically impracticable.

It must also be remembered that Pope and Gibson were not the sole workers in this field, for during the autumn of 1917 and the early months of 1918 the action of ethylene upon both chlorides of sulphur was being actively studied by several other chemists. From discussions with some of these at the University of Manchester we received much helpful inspiration.

That at this period Sir William Pope was far from accepting our results as a technical realisation of his laboratory experiments is proved by the fact that it was a considerable time before our statements were credited by him and by the scientific advisers attached to the Government. These gentlemen maintained that the separation of sulphur was an essential part of the process, without which only an inactive disulphide would result. Our product, in fact, was not mustard gas at all. Even when we had convinced Mr. Gibson by a practical demonstration (which, unfortunately, involved his detention in hospital for several weeks) of the correctness of our contention, Sir William Pope still remained sceptical for a time, and when we were pushing forward our preparations to commence the manufacture in bulk, we received from the responsible official of the Government Department concerned the following telegram (dated May 11, 1918):—

> "Referring your letter 9th you are labouring
> "under misapprehension, as I certainly did not
> "instruct you proceed manufacturing HS.
> "Product which you propose making as described
> "in your letter is I think quite unsuitable.
> "Take no further steps to manufacture HS.
> "Wait my letter even date."

Thus, at this critical and urgent period when our soldiers were dying by thousands and the fate of the nation lay in the balance through our inability to reply to the German mustard gas attacks, not only was no call made for the expert help of the dyestuff industry, but even when this help was freely offered it was brusquely declined by a Government Department. Such treatment would have deterred many firms from proceeding further, but knowing the great national need and the certain failure of the method suggested by Sir William Pope, we continued to push on with the erection of the plant at our own risk, and eventually, as everyone knows, the process was adopted as the standard method of manufacture by both the British and American Governments. Sir William Pope says that "of course" our process was communicated to the United States. This was not the view taken by the American Government, who, in officially recognising that our process was the best, expressed great appreciation of the fact that the details of our process and the plans of our plant were placed freely at their disposal without any question of royalty, the more so, they say, as "we have not always had such success."

I assert, without fear of contradiction, that had it not been for these investigations carried out at a dyestuff factory, the process of manufacturing mustard gas from sulphur monochloride would have remained a technical failure, and even if the country had been able to produce mustard gas at all, it would only have been in small quantities and at the cost of heavy casualties. The work of many people contributed to the final success, and without the contributions of others the efforts of Sir William Pope and Mr. Gibson must have remained unrecognised and unrewarded.

To the thinking man who has followed the development of poison-gas offensive during the past four years it must be obvious that we are only at the beginning of this form of warfare, and that the most serious menace to peace in the future may be the secret development by an aggressive Power of the means of preparing and using highly toxic chemical compounds. Only by keeping our national laboratories in active order can we provide against this danger.

GEOCHEMISTRY AND THE WAR.*

P. G. H. BOSWELL.

The borderland between chemistry and geology is a wide country but imperfectly explored. It seems that the stress of war was needed before its little-known tracks could be re-trodden and extended. The co-operation of pioneers pushing forward from both sides the border has led to the clearing away of much of the undergrowth of doubt, and to the consequent discovery of alternative routes and new paths to knowledge. Many of these essays into the unknown have been admittedly exploratory and opportunist; others have resulted in the discovery of ways and means the value of which ensures their permanent retention. In either case the results have justified the early work, and serve to emphasise the benefit accruing to the community from the co-operation of the chemist in the laboratory and the geologist in the field.

The question as to the exact scope of the subject of geochemistry is perhaps a debatable one. A well-known American authority[1] has expressed his view of the functions of the geochemist thus:—"To determine what changes [in the rocks constituting the earth's crust] are possible, how and when they occur, to observe the phenomena which attend them, and to note their final results . . ." In the course of pleas made recently for the establishment of a geochemical institute in this country, the connotation has been extended to include not only the chemical investigation which is required before such problems can be solved, but also chemical research dealing with and controlling the industrial uses to which rocks and minerals may

* Communicated by Section B (Chemistry) of the British Association for the Advancement of Science.

[1] F. W. Clarke "Data of Geochemistry," U.S. Geol. Surv. Bulletin No. 616, 1919, p. 10, 3rd edition.

be put. As would be expected, the industrial application of our knowledge of geological raw materials has been the outcome of pure scientific research. On the other hand, in the course of the solution of practical problems much information of real value to the man of "pure" science has accumulated, and in due time the results will become available.

One outcome of these extended geochemical investigations has been the replacement of certain rock and mineral substances, hitherto imported from abroad, by British materials—either precisely similar in character or as substitutes "just as good," at times distinctly better, and at other times of the character of makeshifts. Not only was shipping thus relieved, or, in the case of certain substances of enemy origin, deprivation overcome, but at the time of the great strain upon internal means of communication and transport it was found possible to indicate suitable sources of raw materials close to works requiring them. In this way carriage was reduced and coastal trade and railway transport diverted into less congested areas.

Shortly after the outbreak of hostilities many British industries connected with the output of munitions or the maintenance and increase of food supplies found themselves wholly or in part deprived of certain essential raw or "semi-manufactured" materials of mineral origin. As examples may be mentioned the key industries of glass-making and steel manufacture (in particular, steel-founding), which suffered from the shortage of potash, glass-sands, moulding-sands, etc., besides other chemical materials made from mineral products. In connexion with food supply, the lack of nitrates, potash-salts, and phosphates became acute. The chemists solved the nitrate difficulty by the fixation of atmospheric nitrogen. The investigation by the geologists and mining engineers of home supplies of potash-bearing minerals, such as felspar, and the recovery by the chemist, in co-operation with the geologist, of potash from blast furnace flues in Britain and cement-kiln flues in America, temporarily overcame the difficulties produced by the absence of German salts. The coprolite-bearing deposits of the Cambridge greensand were, after some delay, opened up for the purpose of obtaining the contained phosphate of lime, and at the date of the armistice were yielding helpful supplies.

The impetus given to the working of home supplies of metallic minerals such as the ores of iron, copper, lead, zinc, tin and tungsten, and of vein-stones like barytes, fluorspar and quartz, are familiar to all. The treatment of the ores and the manufacture of "intermediate" products like ferro-tungsten demanded the co-operation of the metallurgical chemist.

It would perhaps be impossible in a paper of this length to give a list of all the mineral and rock substances, from antimonite, used for fulminate compositions, for percussion detonating, to zirconia, required for refractory and alloy purposes, which have been indispensable for the successful prosecution of the war.

From a perusal of the publications issued during the war by the Geological Survey (Special Reports on Mineral Resources),[1] the Ministry of Munitions[2], Department of Scientific and Industrial Research[4], and the Imperial Institute[5], some conception may be obtained of the increased, if belated, attention which has been paid to economic geology at home. In the publications of certain technological societies, such as the Faraday Society, the Ceramic Society, the Society of Glass Technology, the Foundrymen's Association, the Institution of Mining and Metallurgy, and the Society of Engineers, may be found even more useful information regarding the treatment and behaviour, as well as the resources, of materials like fireclay, ganister, zirconia, felspar, moulding-sands, glass-sands, etc. The manufacture of silica-bricks, magnesite and dolomite-bricks, fireclay-bricks and blocks, glasshouse pots, glass itself, etc.,[6] and their behaviour in the furnace at high temperatures, provide interesting parallels with the phenomena shown by rocks which suffer transformation in or below the earth's crust. G. V. Wilson has shown, for example, that the erosion of a glasshouse pot by the molten glass contained in it is reduced appreciably by the formation in quantity of the mineral sillimanite ($Al_2O_3.SiO_2$) in the surface layers of the pot. It has also been discovered that holes are originated where small pellets of the impurity, iron pyrites, occur in the walls. Geochemical research has shown that the quality of silica-bricks made by burning, at a temperature of over 1300° C., a ground-up mixture of ganister and other siliceous rocks, with 1 per cent. of milk of lime as a bond, may be appreciably improved by burning the bricks for a longer period at a higher temperature than was previously the practice. Greater inversion of the quartz to other low density forms of silica occurring occasionally in rocks, and known as tridymite and cristobalite, was thus ensured, with the consequence that less expansion of the brick subsequently occurred when it was set in the furnace.

For the successful laying down of specifications for refractory materials for particular purposes, a task which was undertaken before the war by the Gas Engineers, and during the war by the Society of Glass Technology and the Iron and Steel Institute, a large amount of geochemical research was, and is still, required. Cognate problems were met with in the production of laboratory porcelain, hard paste, etc. In the Potteries, British felspar, sand and flint were substituted for the unobtainable foreign supplies.

The increased steel production (especially "basic" steel), necessitated by the war, led to big demands for basic linings for steel furnaces. In consequence of the cutting off of supplies of Austrian and Greek magnesite the home resources of dolomite have been largely drawn upon, with noteworthy success. A similar artificial impure product of dolomite, silica, iron oxide, etc., has been prepared in the American cement-kilns, and sold under trade names such as cinderlag, magdalite, etc.

For lining acid-open-hearth steel furnaces large quantities of high-silica sands were formerly imported from continental countries. These have now been replaced by eminently suitable British supplies from Leighton Buzzard, Lynn, Huttons Ambo (Yorks), and many other localities. The sand was of necessity required to be highly refractory to heat and yet to contain sufficient impurities (like compounds of alumina, lime, magnesia, etc.) and to be of such size of grain that it would just "frit" and bind together on the sides of the bath when the furnace bottom was being repaired. Sands of medium to coarse grade, containing 98 or 99 per cent. silica, with an almost entire absence of alkalis, proved to be most suitable.[7]

Very pure sands were also much in demand for the manufacture of the better-class types of glass-

[1] Vol. 1, Tungsten and Manganese Ores. Vol. 2, Barytes and Witherite. Vol. 3, Gypsum, Anhydrite, Celestine, etc. Vol. 4, Fluorspar. Vol. 5, Potash-felspar, Phosphate of Lime, etc. Vol. 6, Ganister and Silica-rock, Dolomite. Vol. 7, Jet, Cannel, Lignite, etc.

[2] Report of the Department for the Development of Mineral Resources, 1918, and other publications mentioned below. Hatch: Average Analyses of British Iron Ores and Ironstones, 1918.

[4] Iron Ores. G. C. Lloyd. 1918.

[5] The World Supply of Potash. Bull. Imp. Inst. 1916. Titanium Ores. Ibid., 1917. Zinc Ores. Ibid., 1918.

[6] See particularly A. Scott: Trans. Ceramic Soc. (This J., 1918, 217 R, 206 A, 695 A.) Wilson, J.: Soc. Glass Techn. Vol. II. (1918), p. 177.

[7] A Memoir on British Resources of Refractory Sands, published at the Instruction of the Ministry of Munitions. London: Taylor and Francis. 1918.

ware. These too were formerly imported from France, Holland and Belgium. In order that as little of the "decolorised" as possible may be used, all glass-making materials, particularly raw substances like felspar and sand, should be as free from iron as possible. The silica percentage of good glass sands is usually 98 or 99, alkalis and alkaline earths are not harmful, but iron, estimated as ferric oxide, should not, for lighting glass and pressed ware, exceed 0·08 per cent., and for optical glass 0·02 per cent. The presence of alumina is an advantage in glasses where toughness and absence from devitrification are required.*

But perhaps the most difficult, as well as the most interesting, problems were those concerned with the use of sands for founding metals and alloys, particularly steel. Sands of very special character and behaviour were formerly imported from France and Belgium. The examination and analysis of these sands led to the exploitation of many British supplies. A high-class steel-moulding sand should be refractory to heat, and therefore must contain a minimum quantity of alkalis and alkaline earths and a maximum of silica. It must also "strip" freely from the castings made in it, and therefore should contain a moderate quantity of hydrated ferric oxide. It should possess a good "bond" in order that it may stand up against the molten metal: the bond is usually a mixture of clay-like and micaceous material, together with hydrated ferric oxide, and is colloidal in character. By virtue of the last constituent the sands are able to take up a good proportion of water without becoming really wet, and after dehydration by the hot metal poured into the mould can be readily hydrated again.

New lines of inquiry are opened up by the consideration of the production synthetically of moulding sands from an admixture of a high-silica sand and small quantities of fireclay and colloidal hydroxides like those of aluminium, iron, or even cerium and zirconium, since the compounds of the two last-named elements would be required only in very small amounts.

Further, it is found that the texture of moulding-sands is of considerable importance. The mechanical composition is characterised by the high proportion of coarse and medium sand grades (diameter of grains greater than 0·25 mm.), the low proportion, or absence of the fine sand and silt grades (0·25 mm. to 0·01 mm.), and the relatively high proportion of the clay grade (less than 0·01 mm.). Chemical analyses of these various grades, which have been separated by elutriation, yield results of much value in steel-founding practice.

A danger exists that in consequence of the cheapness of foreign supplies of raw mineral materials, and of the lowness of the through freight rates from adjacent continental countries, it may be impossible to continue to work British supplies of these materials. It was the energetic exploitation of these mineral resources, so essential for key industries, which saved the situation time after time during the war. A renewal of dependance upon foreign resources is not only grossly unfair to those who have laid down plant and sunk their capital in British mineral enterprises during the last four years, but is a source of grave national danger, inasmuch as it places the country in precisely the same position as that which arose during the early months of the war.

If it is not possible to impose restrictions on the importation of certain foreign raw materials, recourse must be had to the revision of railway freights and the rapid development of internal water transport.

(*) A Memoir on British Resources of Sands and Rocks used in Glass-making. Published at the Instruction of the Ministry of Munitions. London: Longmans, Green and Co. 1918. 2nd edition.

THE BRITISH EXPLOSIVES INDUSTRY AND THE WAR.

The information contained in this article has been compiled from authoritative sources and with the object of showing the development of the explosives industry during the war in so far as chemistry played a direct part in it. The material dealt with has been restricted solely to explosives; and, in consequence, reference to gas manufacture and similar industries allied to the work of the Explosives Department of the Ministry of Munitions has been omitted. The subject has been divided into the following sections:—1. The position of the explosives industry in regard to chemistry immediately prior to the outbreak of war. 2. The development of the industry in regard to chemistry during the war, chemistry being used in its broader sense to cover academic work, research work, and manufacturing work. Each of these has been treated roughly according to the following sub-divisions:—

(a) Nature and quantity of the explosives made in this country for military, naval, and commercial purposes.

(b) Raw materials used.

(c) Processes followed.

(d) Quality of the products, with their cost of production, introducing process control, efficiency, and costing.

(1) Pre-War Position of Explosives Industry.

(a) The publications of the War Office and of the Admiralty give in detail the explosives made and the uses for which they are required. High explosives for bursting charges of shells, for mines, grenades, bombs, etc., consisted chiefly of picric acid or TNT. These two explosives were manufactured in quantities not greater than fifty tons per week. The Government had not adopted to any extent the use of TNT as its shell charge, and that which was made was purified by recrystallisation. The propellant in use by the British Government was cordite, consisting of 30 per cent. nitroglycerin and 65 per cent. of nitrocotton, gelatinised with acetone and stabilised with mineral jelly. The production of this explosive throughout the country did not exceed 50—100 tons per week, including that made for cannon and for rifle ammunition. The manufacture of mines, fuses, detonators, primers, etc., covered the manufacture of small quantities of guncotton, gunpowders, mercury fulminate, tetryl, etc., although this last substance was not used to any extent. Commercial explosives made in this country probably amounted to some 300 tons per week, and included standard gelatin explosives, permitted explosives for coal-mining, with dynamite and various blasting powders. In addition to these trade explosives a variety of sporting powders was made by the various explosives companies.

For the production of the quantities required by the Government a certain proportion was made at the Government factories, Waltham Abbey and Woolwich Arsenal. With these two exceptions the whole of the industry indicated above was in the hands of private companies, and a very large proportion of the production was exported.

(b) The raw materials required and used by the explosives industry consisted mainly of sodium nitrate and iron pyrites for acids manufacture, together with phenol for picric acid, toluol for TNT, cotton cellulose for nitrocottons, glycerin for nitroglycerin, mineral jelly and acetone with nitrocotton and nitroglycerin for cordite, charcoal with potassium nitrate and sulphur for gunpowders, dimethylaniline for tetryl, etc. These covered the chief raw

materials used in making explosives for ammunition. For commercial explosives a variety of raw materials was used in addition to those for nitroglycerin and nitrocotton, which included generally potassium nitrate and perchlorate, ammonium nitrate, woodmeal, potassium chloride, ammonium oxalate, barium nitrate, etc. In the majority of these cases the raw materials were purchased by explosives manufacturers and did not form part of the industry. One intermediate industry which was undertaken by explosives manufacturers was, of course, the production of acids, oleum, sulphuric and nitric, and mention is made of this as during the war the acids industry as a whole was largely concerned with the production of explosives.

(c) It is necessary to preface remarks upon processes by drawing attention to the dangers of manufacture and the numerous safety precautions which had to be taken, and which caused the explosives industry to become a special section of the chemical industry. With regard to the processes, picric acid was prepared entirely from phenol, and TNT was prepared in three stages through mononitrotoluol and dinitrotoluol, the crude trinitrated product being purified by recrystallisation from benzol. Methods of manufacture of nitroglycerin and nitrocottons did not undergo any essential changes during the war, and are already well known from literature. In the manufacture of cordite the acetone used as a solvent was only recovered, either by water or sodium bisulphite, to the extent of not more than 20 per cent. of the quantity used. The manufacture of explosives for fuses, detonators, primers, etc., for sporting powders and for blasting explosives was in the majority of cases well established and well known.

(d) Apart from the control exercised by manufacturers themselves, supplies to the Government were made according to a specification and governmental inspection. In specifications for the finished product were included also specifications for the raw materials and for semi-manufactures. The manufacture of all explosives was subject to the licence of the Explosives Department of the Home Office. The processes of manufacture were carefully supervised by chemists to ensure the necessary quality and properties of the finished materials, and also to ensure as far as possible the safety of the operations. Except possibly in individual cases little attention was paid to the cost of manufacture by the chemists, and generally it may be said that no organised scientific study of this important item of manufacture fell to the lot of the chemists in control of operations in factories. In the explosives industry—leaving out acids manufacture—by-products or waste products were negligible items.

Generally, explosives manufacture in this country from the point of view of chemistry was in a somewhat crystallised state, and the chief work of the chemists lay in: 1. A careful study of the factors influencing the quality and stability of all the explosives made. This was undertaken by the Government, by the Research Department at Woolwich, and in the public interest by the Explosives Department of the Home Office. Manufacturers had also, of course, equally to study the problem. 2. Research work consisted mainly of the study of the theory of explosives, the relatively slow development in the establishment of new products to meet demands, and to some extent research on methods of manufacture, examination of patents, etc. Technology had comparatively little controlling voice in the explosives industry, although the latter from its nature necessitated the employment of considerable numbers of qualified chemists.

(2) Development during the War.

With the outbreak of war it was obvious that considerably increased supplies of explosives would be required, although the amount of the increase was not at once known. The country's chemical industry was badly equipped for the large increase necessary, especially in supplying some of the essential raw materials which formerly came from Germany, or which were imported from other sources. Production consequently was the paramount factor, and initially all attention was directed to obtaining the greatest output possible under the new conditions. Explosives, the properties, uses and methods of manufacture of which were already known, had to be used. The question of output became a question for the chemists themselves to study, so that the utmost capacities of their plants, with possible alterations in the methods of manufacture to increase production, were utilised. The control of supplies for military purposes was retained under Lord Moulton at the War Office until the new Ministry of Munitions was formed, when a separate Department of Explosives Supply was instituted. Meanwhile the decision to erect, amongst others, National Explosives Producing Factories, was taken. The lack of the necessary accurate technical knowledge and data and technically trained men then became apparent.

(*a*) An output of picric acid was provided for during the war of approximately 1000 tons per week. TNT was eventually adopted by the Government, and its output was provided for in similar proportions, of which some 500 tons per week underwent purification by recrystallisation. The capacity for propellant manufacture in this country was eventually increased to some 2500 tons per week. The subsidiary manufactures, explosives for mines, fuses, detonators, primers, etc., were increased proportionately.

In view of the magnitude of these extensions, various causes—for example, raw materials shortage—curtailed the production of commercial explosives for blasting and sporting purposes. The latter manufacture was stopped, but although export of blasting explosives was also stopped, except to our colonies, it was essential that production of a limited quantity for coal mining and other purposes necessary to the war should be maintained. Modifications in the composition of the explosives made were necessary, of which the chief were the substitution of potassium nitrate by sodium nitrate, involving special precautions of manufacture owing to the hygroscopicity of the latter, the reduction in the use of nitroglycerin to conserve glycerol supplies, the adoption of new safety ingredients owing to the stoppage of supply of potassium chloride, ammonium oxalate, etc.

The capacity of production, as finally obtained throughout the country, was divided between (1) Government factories operated directly by the Government; (2) Government factories operated by private explosives firms, as agents for the Government; (3) private manufacture considerably assisted in capital by the Government.

After a period the output from the capacity provided had reached such dimensions that it was possible to devote a portion of the time otherwise given to questions of output to methods of manufacture and costs of production, and at the same time the importation of finished explosives from the United States was much curtailed.

(*b*) The supply of the raw materials required the closest attention from the outset, and called for increasingly greater attention as the war went on, owing to shipping difficulties. This necessitated the control, by those responsible for the supply of explosives, of other industries besides the explosives industry, and necessitated the development to the utmost extent of the sources of supply in this country and the development of new sources and processes of manufacture.

The raw material for nitric acid continued to be sodium nitrate, although during the latter stages of the war the atmospheric nitrogen processes were

receiving very close attention. The sulphuric acid industry used, in addition to pyrites, both sulphur and zinc blende as its raw materials. For picric acid manufacture some 400 tons of phenol were required, of which two factories successfully contributed to it from phenol synthesised from benzene, employing different methods Benzene was also employed directly for picric acid manufacture by way of dinitrophenol from dinitrochlorbenzene. A further demand by the explosives industry on the coal distillation industry was in the requirements of toluol, which amounted to some 500 to 600 tons per week, and in the demand for ammonia for ammonium nitrate. An additional source of supply of toluol was developed by the Asiatic Petroleum Company from Borneo spirit.

The adoption of amatol as the standard charge for high explosive shells required the production of some 3000 tons of ammonium nitrate per week. This product was manufactured by three processes—

(1) From sodium nitrate and calcium chloride, giving calcium nitrate, which was then made to react with ammonium sulphate;

(2) By the ammonia soda process;

(3) Directly from ammonium sulphate and sodium nitrate.

The development of propellant manufacture necessitated the provision of the following quantities of raw materials:—

Refined glycerin.—To the extent of about 400 tons per week, for which the greatest possible production was obtained from the soap and fat splitting industries of this country, by improving existing processes to give better yields.

Cotton Cellulose.—To the extent of some 8/900 tons per week, involving the purification, the whole of which was carried out in this country, of some 1,300 tons per week of raw materials. With the introduction of R.D.B. cordite, Admiralty cordite, and nitrocellulose powder, this bulk production had to be divided into 500/600 tons of improved cotton cellulose for land service cordite, 160 tons per week of sliver (a specially selected and treated raw material), and towards the end of the war up to 100 tons per week of special cotton prepared from linters for nitrocellulose powder.

Acetone.—To the extent of 100/150 tons per week, the bulk of which was imported. Processes were, however, worked out and in operation at two factories for producing acetone by the bacteriological fermentation of maize meal. This process produced only relatively small quantities of acetone with butyl alcohol as a by-product, the uses found for which included the conversion to butyl acetate as a spirit for military cooking purposes, etc. The conversion of butyl alcohol to methyl ethyl ketone was also worked out and the process adopted in Canada, permission having been obtained to use this solvent as a substitute for acetone.

A small proportion of the acetone was also produced from acetate of lime when this was not required for the production of acetic acid. Acetate of lime was obtained from wood distillation, an industry which was considerably developed by the Government during the war.

Alcohol.—R.D.B. cordite and nitrocellulose powder necessitated the supply of some 800/1000 tons per week of alcohol, the whole of which came from distilleries, and of which 40 per cent. was converted into ether by plants erected during the war in this country.

Ammonium perchlorate was also required for certain products, and the manufacture of this was developed at one of the Government factories to the extent of 50 tons per week by electrolytic method from sodium chloride, and by another factory in Flint, following a slightly different method.

The necessary substitution of potassium nitrate by sodium nitrate has been referred to above.

(*c*) New processes for new products, and changes in processes either necessitated by circumstances or for improvement, are instanced generally by the more important examples given below.

In the nitration of phenol for picric acid processes were finally operated by which weak nitric acid and mixed acids were used instead of strong nitric acid, as originally employed. The process starting from benzol, involving the separate manufacture of dinitrophenol from dinitrochlorbenzol has already been mentioned.

The three stage process for the manufacture of TNT, using oleum in the final nitration stage, was replaced by the two-stage process, using mixed acid, and the proper treatment of the waste acids was thoroughly established. By this change the consumption of acids was considerably reduced, although the production of TNT in the United States was carried out by the three-stage process in which the consumption of acids was even less than that obtaining finally in this country. Mention must also be made of the continuous process of manufacture of TNT from mononitrotoluol, which was followed finally on a large scale by one factory. The purification of TNT was originally carried out by recrystallisation from benzol. The necessity for continuing this purification, which during the war resulted in three large explosions, was carefully investigated. The quantity of purified TNT required was obtained by hot or cold washing the crude TNT with methylated spirit, depending on the form in which the crude product was received for purification. In addition to this change, a method was finally worked out, although not put into operation, by which washing could be effected by hot water in a centrifugal machine.

The charges for shells, bombs, grenades, smoke and incendiary powders, etc., underwent considerable changes, the most important of which was the replacement of picric acid, the cost of manufacture of which was some £200 per ton, by, first, TNT alone, and later by TNT mixed with ammonium nitrate. The composition of these latter mixtures changed from 60 parts TNT with 40 parts ammonium nitrate to 20 parts TNT with 80 parts ammonium nitrate. The last composition permitted of relatively simple manufacture and control, and the cost of TNT and ammonium nitrate in the 20/80 amatol worked out at £60—£65 per ton. This explosive was adopted in America as the standard for the U.S. high explosive shells.

Propellants in this country, the production of which actually reached some 2,000 tons per week, underwent considerable changes. The shortage of supply of acetone which was used for standard pre-war cordite, necessitated from 70—80 per cent. of the total production being made with ether-alcohol as solvent. This change required the use of a different notrocotton and a new composition. The product may be regarded as a new powder involving the complete re-study of the processes of manufacture. A large number of practical difficulties was successfully overcome. Apart from the improvements resulting from experience in manufacture, a study of the factors affecting the ultimate consumption of the solvents, acetone, ether, and alcohol, became urgently necessary. This study required considerable research on cellulose and the effect of its properties on solvent consumption and on new methods of recovery. As a result, approximately 35—40 per cent. of the acetone wasted in the early days of the war was recovered. In the manufacture of R.D.B. cordite the attention given to the question of solvent consumption had resulted, in those factories in which the necessary plant had been completely installed, in a recovery of 35—40 per cent. of the ether and 65 per cent. of the alcohol used. By the method of recovery finally adopted the vapours given off during the drying operations were absorbed in cresol, the demand for which, of course, had also to be met.

In addition to the manufacture of this type of cordite a factory was erected, and was in operation during the latter months of the war, although it had not reached its nominal output, for the manufacture of nitrocellulose powder, the standard powder of the United States.

Fuses, detonators, primers, etc., mainly underwent the development required by the considerable use during the war of the high-explosive shell. This necessitated the careful study of and research on the methods of initiation and detonation, either by percussion or time fuses, or both. The chief development was the combination of the pre-war detonating agent, fulminate of mercury, with tetryl as primer. Otherwise, in this section of the industry, little development has to be recorded in the raw materials used and in the processes followed. A considerable amount of research was, of course, necessary on the properties of the explosives themselves, their sensitiveness, means of initiation, the reason for faulty initiation or detonation, *e.g.*, prematures; effects of explosion by measurements of power and velocity of detonation, etc.

(*d*) The huge cost of the explosives during the war and the necessity for conservation of the raw materials from all points of view involved the closest study of efficiency both by the Government and by private manufacturers—using the term efficiency in its broadest sense. As a result of the closest attention to all details—work which fell very considerably to the chemists in the explosives industry—the costs of manufacture were very substantially reduced. The extent of this has been indicated by certain figures given above. The details of the effect of the application of efficiency to the explosives industry are already included in publications issued by the Department of Explosives Supply. Reference is also made to the special researches and the application of the results as regards the safety of manufacture and stability of the explosives. All accidents, however small, were investigated by a special committee of the Ministry of Munitions, and steps were taken to educate those engaged in the manufacture of explosives for the first time during the war to the attendant dangers. Instances of the results of the work done are:—

(1) The inclusion of TNT as a recognised explosive under the Explosives Act, without to any serious extent affecting production. This was only done after exhaustive research on the properties of TNT and the impurities contained in it.

(2) The study of solvent vapour explosions in the manufacture of propellant powders, from which results of scientific interest and practical value to other industries besides the explosives industry were obtained.

The high standard of stability insisted on by the Government before the war was to a very large extent maintained throughout the war period, and although no direct improvements were made in old-established manufactures, researches conducted in this section of the work led to the use of the highest quality raw materials, and purification processes, by which the stability of the products was ensured to the greatest possible extent.

On the signing of the armistice explosives manufacture for war purposes was immediately stopped. Picric acid, TNT, propellants, tetryl, and in a large number of cases the industries supplying the raw materials, completely ceased manufacture within a few weeks. With regard to commercial explosives efforts are now being made to regain the position held before the war. The stoppage of manufacture released considerable numbers of trained chemists for general industrial purposes.

The above remarks give a broad indication of the results which the work of chemistry in all its branches achieved in the explosives industry during the war. These results show that the spirit of initiative and the research work done by chemists in this country are at least equal to those of other countries; they demonstrate the value of the organised application of chemical technology to production; and they should assist manufacturers and consumers, as well as chemists themselves, to realise the material advantages to be obtained.

THE MANUFACTURE OF SULPHURIC ACID BY THE GRILLO PROCESS.

RAYMOND CURTIS.

Since the Ministry of Munitions erected Grillo plants to produce the necessary sulphur trioxide for explosives manufacture, reference to this type of plant is frequently made in the scientific literature. But no short account summarising the main features of the Grillo—particularly of the Government or Quinan type—its efficiency and production costs, has yet appeared; it is hoped that the following brief notes will help to meet this want.

Prior to the war the Grillo oleum plant was but little known in this country, although it was generally regarded in the States as the most efficient of the contact plants. The first of the Government Grillo plants—designed under the direction of Mr. K. B. Quinan—was ready for production in the summer of 1916, and altogether 25 such units (each capable of an output of 25—30 tons sulphur trioxide per day) were erected by the Department of Explosives Supply.

All contact plants are concerned with the same problems, namely, the production of sulphur dioxide, the purification of the burner gases, the conversion of the dioxide into the trioxide, and the absorption of the last named. The only essential difference between any of the contact systems is the method and apparatus used for converting the dioxide to the trioxide. In the Grillo plant the catalyst is platinum on granules of calcined magnesium sulphate.

All the Government Grillo plants consumed sulphur during the war, and had the ordinary type of hand-fed tray burner; but of course any type of burner for any of the sulphur ores can be used. Thus at Avonmouth the Delplace burner for zinc blende is being connected up.

In the purification of the burner gases the following system is employed:—

(*a*) Cooling the burner gases to atmospheric temperature in lead coolers;
(*b*) next, filtering the gases through 24 feet of graded coke at a velocity of about 0·2 feet per second;
(*c*) passing the gases through three sulphuric acid drying towers;
(*d*) and a final filtering through 16 feet of graded coke.

For the conversion of dioxide to trioxide the gases entering the platinum converter require to be at a temperature of 350° C. or thereabouts, and in the Grillo plant the necessary heating of the burner gases after purification is done by heat exchange—from the gases leaving the converter and from the hot burner gases. No fuel need be consumed for preheating. For an output of 25 tons of sulphur trioxide per day, the gases are passed in parallel through two converters each containing 10,000 lb. of mass with 0·3% of platinum. The mass in each converter is equally distributed on four trays, and a careful temperature control of each layer (say, 380°, 470°, 460°, 440° C. on the 1st, 2nd, 3rd

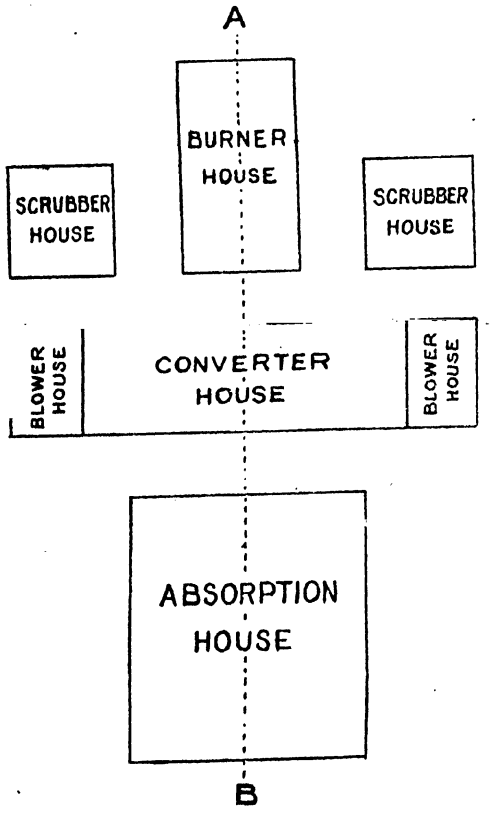
and 4th layers respectively) allows of a 96—97% conversion.

One great advantage of this type of converter is the relative ease with which the mass can be prepared (calcined magnesium sulphate sprayed with a solution of platinum chloride). The converters are packed without difficulty, and it is said that the mass is easily regenerated or a good recovery of platinum obtained should this at any time be necessary.

With correct temperature control the "life" of one of these converters is entirely dependent on the efficiency of the purification system. In the Government Grillo plants the gases entering the converter contained less than 0·02% of impurity (water, and inert dust), and arsenic was of course absent. Except in one or two of the early units, which were very much overloaded, there is at present no indication that any of the mass has deteriorated, but in a privately owned plant where the purification system was quite inadequate for pyrites the mass has been renewed several times.

For absorbing the trioxide, quartz-packed towers are used—two parallel sets of three towers being used for 25 tons of trioxide per day. Practically perfect absorption can be obtained, and the system is ideal for 25% oleum or 98—99% acid; for 65% oleum modifications would have to be introduced.

The accompanying diagram shows the layout of the Government plants—two units being disposed symmetrically about a centre line AB. The objections to such an arrangement as this are (1) the difficulty of control, (2) the large amount of freezable acid in the purification system which is unprotected from the effects of cold weather:—



In the Mannheim and Tentelew plants the whole unit is under one roof, and there is of course no reason why this should not be done in the case of the Grillo plant. The arrangement shown, however, tends to the greater cleanliness of the plant.

Efficiency of the Grillo plant.

Exhaustive tests on the efficiency of these plants (*i.e.*, the percentage recovery of sulphur in the form of acid from the sulphur consumed) were made at each of the Government factories. The following figures are typical:—

Overall efficiency	94·5%
Recovered in absorption system ...	91·5%
Recovered in purification system (from trioxide produced in the burners)	3·0%

A careful analysis was made of the losses and the following figures are again typical:—

Unconverted SO_2	4.2%	(of total sulphur charged to plant)
Unabsorbed SO_3 and acid spray	0·6%	
Dissolved SO_2 in drying acid.	0·3%	
Gas leakages and losses, etc.	0·4%	
Total loss	5·5	

Cost of production.

At the present time no reliable figures for capital outlay for the erection of a Grillo plant could be given, but two years ago it was computed that a unit to produce 25 tons trioxide per day would cost £55,000 (a chamber plant of similar capacity costing £70,000), and this is the figure taken in the following estimate of the cost of production of 1 ton trioxide*:—

	s.	d.
Amortisation	12	6
Labour	6	9
Power and water	3	6
Maintenance	1	0
Rents, taxes, etc.	6	3
Total	£1	10 0

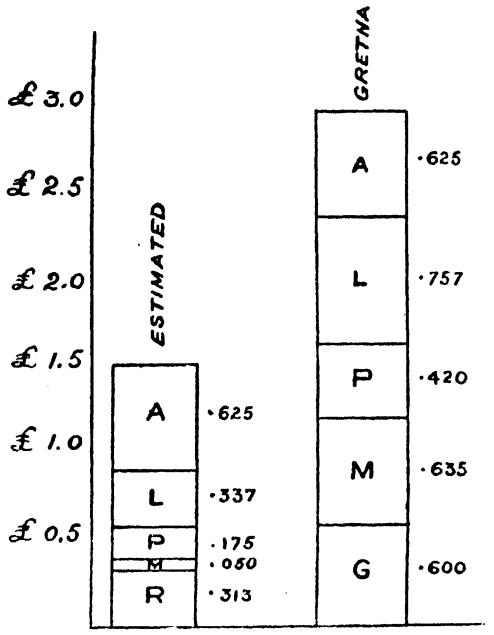
So that according to these figures the cost of 1 ton of trioxide would be the cost of the raw material plus £1·5. If the estimate be compared with the actual costs in any of the English factories it will be found that it is very considerably less than those obtained. In Part II. of "Cost Analysis in Chemical Manufacture" (J., 1918, 225 R), the service charges per ton of trioxide for the Gretna Grillo plant are given as £2·412 (Jan.—June, 1918), and this figure does not include any charge for depreciation. Although these service charges were slightly improved upon at the Avonmouth factory (see chart opposite p. 226 R), this figure may be considered as representing English practice during the war. The accompanying diagram will enable a comparison to be made at a glance between the estimated and the Gretna costs.

The question naturally arises as to whether the English cost is to be considered abnormally high or whether the estimate is much too optimistic. The difference between the two is very largely explained by (1) the high "general" charges in Government factories, (2) higher labour costs, and (3) higher maintenance costs. In privately managed factories the first item could be decreased very considerably; with regard to labour, the experience at Avonmouth showed that the previous Grillo practice in this respect had been too expensive, and that with careful training of unskilled labour the estimated cost (£0·337 per ton trioxide) is not unreasonable. The actual figure at Avonmouth was £0·560, but

* Taken from "Notes on Sulphuric Acid Manufacture" issued by Department of Explosives Supply, 1917.

he plant was really staffed for an output of twice hat actually obtained, so that this figure should be pproximately halved to get a true labour cost.

The question of maintenance charges has been a very "thorny" one. A glance at the chart previously referred to will show that the Avonmouth



A. Amortisation; L. Labour; P. Power, water, fuel; M. Maintenance; R. Rent, taxes, etc.; G. 'General' charges;

factory was the only one where the figure approximates to that of the estimate (£0·138 as against £0·05). The latter was based on the cost for a South African plant which had been running for a considerable number of years, and, on the face of it, there seems no reason why the upkeep of a British plant should be higher than that of a South African plant. It is mentioned in the Report on Cost Analysis (this J., 1919, 225 R) that the maintenance charges on the Government plants have shown a downward tendency. Undoubtedly this is partly due to the greater experience of the staffs, but also—and mainly—to improvements in the plants themselves with the elimination of the inefficient and less durable features. The cost of changes thus brought about (*i.e.*, perfecting new plant) appears as maintenance charges, and for this reason these charges for all the new Government plants are in excess of those necessary for a well-established plant. This largely accounts for the high Grillo maintenance charges, and will partly explain why the Avonmouth plant, which was built with the Queen's Ferry and Gretna experience to go upon, was so much more economical.

Taking the above points into consideration one would anticipate a considerable reduction in the service charge of £2·4 per ton trioxide in any thoroughly established, well-run Grillo plant.

In the Government factories it was found that the cost of trioxide production in the Grillo plants was considerably less than in any of the Mannheim plants or in a well-run Tentelew (see chart p. 226 R for details). Unfortunately there was not a chamber plant run by the Explosives Department, so that no very reliable figures are available for comparing the cost of production in this plant and in the Grillo. In the paper on Sulphuric Acid Manufacture already referred to the cost of manufacture of 1 ton trioxide from pyrites in the form of chamber acid is estimated at £3·562, while the cost of manufacture in the Grillo is given as £3·190. The suggestion is there made that sulphuric acid *of any strength* can be most cheaply made by the Grillo type of plant. However, many manufacturers who have had experience with both types of plant are of the opinion that where weak acid is being obtained from a dirty one the chamber plant will produce acid most economically; and this view is evidently widely held in America too, where the chamber plant is in nearly all cases used for ores (*e.g.*, of copper) which give very impure burner gases. With this exception the experience of the past two or three years seems to indicate that sulphuric acid can be most efficiently and economically produced by the Grillo type of plant.

THE STREATFEILD MEMORIAL LECTURE.

The second annual lecture was delivered on October 2 at the Finsbury Technical College by Professor G. T. Morgan, the retiring professor of chemistry at the College. Dr. M. O. Forster, who presided, announced that the Streatfeild Memorial Prize for practical chemistry had been awarded to Mr. F. D. M. Hocking, and that the Committee of the College had instituted a Streatfeild Memorial Medal to be presented to the lecturer for the year. The lecture was in the main devoted to the subject of "Applied Chemistry in Relation to University Training," but it was interspersed with numerous reflections of a general and topical nature and with appreciative references to the work and character of the late Mr. F. W. Streatfeild (see this J., 1918, 412 R).

The social unrest which is now a feature of the times is largely the result of a disinclination to profit from the wisdom of the past and of failure to realise the vital significance of the Fifth Commandment. The scope of this injunction extends to educational bodies like the City and Guilds of London Institute, and to great teachers like Ayrton, Meldola, Sylvanus Thompson, Castelli-Evans and Streatfeild, all of whom are worthy of a lasting sense of gratitude. The utility of the institute has been manifested in two directions: to individuals it has offered the chance of a higher career, and to the State it has furnished trained men who were fully qualified to apply science to industry. Great Britain was the first nation to reach the industrial phase of human development, and owing to the absence of foreign competition its manufacturers were able at first to thrive on rule-of-thumb methods; but when foreign competitors, utilising scientific methods in their manufactures, entered the field, the demand arose for technical education. This need was first met by the Livery Companies of London, which combined to found the City and Guilds of London Institute, under whose auspices the Technical College, Finsbury, was established in 1878, and the Central Technical College, South Kensington, in 1884. The underlying idea that the chemical department of the former should serve as a training school for that of the latter was not fulfilled, the two departments developing on different lines. Under Professor Armstrong's inspiration chemistry at the "Central" acquired increasingly a biochemical bias, and also became widely known as the London centre for chemical crystallography; but this department was unfortunately closed in 1908. The Finsbury laboratories, on the other hand, worked more in the direction of coal tar dyes and intermediates, and with an equipment which became more and more out of date. In 1916—17, at the lecturer's instigation, extended accommo-

dation and new equipment were provided for the chemical department. These were utilised mainly for investigations connected with the war, and, among other successful achievements, a rotating autoclave was devised which has proved of great utility to many investigators engaged in similar work.

The far-sighted policy of the Salters' Company in spending the available funds of the Salters' Institute of Industrial Chemistry on brains and not on bricks and mortar has a bearing on the alternative policies of concentrating technical instruction in one colossal institution or of distributing it among a number of educational establishments of a less pretentious order. The "Super-dreadnought" theory is espoused by those who demand that the Imperial College of Science and Technology shall be accorded the full status of a university with power to grant degrees in technology; but this scheme overlooks the claims of older foundations which initiated and carried out this work for many years. The Royal College of Science and the Finsbury Technical College should be brought into harmonious co-operation within the fold of the same university, and each should retain its distinctive individuality. It is also important that students of applied science should be brought into close association with a general storehouse of learning and scholarship, and it must not be overlooked that no technical college can claim and maintain a monopoly of this branch of education; existing universities can and do take up similar lines of teaching in technology. So far as college training goes the line of demarcation between science and technology is ill-defined and ever-changing. Teachers who have been appointed to technical institutions on account of their acquaintance with industrial practice soon lose most of their expert knowledge unless they take special pains to remain in touch with the industries in which they previously specialised; and university teachers may become discoverers of processes having great commercial possibilities, and may thus be led to acquire considerable insight into manufacturing conditions. The difference between university and technical college becomes ultimately one of breadth of outlook, with the advantage on the side of the university. Overlapping is inevitable, but not to be deprecated. Fundamentally, there is no difference in principle between pure and applied chemistry; there is but one chemistry, and the great generalisations of the science must be assimilated by all students, whether they subsequently undertake researches of an academic character or investigate problems directly associated with industry.

The objection raised to the low standard of general education demanded of students entering technical institutes is fast losing its cogency; and special provisions have been made at the Finsbury College to secure a high standard of education among those entering upon its courses. Further, the department of applied chemistry in the College was the first to extend its course by adopting a three-year curriculum. At the Royal College of Science for Ireland the full course is extended over four years, thus allowing of a fuller study of electro-technology and of training in a biological science—*viz.*, bacteriology. The absence of any biological teaching is a weak point in the education of many chemical students, and they would also derive much benefit from an elementary course in petrology and mineralogy. A valuable feature of the Finsbury curriculum is the generous provision of time for applied mechanics, machine drawing and electrical engineering; also increased attention has been devoted to the study of processes like filtration, distillation, extraction, etc., under works conditions.

The establishment of Finsbury Technical College on a university basis, preferably under the University of London, is in every way desirable. If undertaken initially in a small way the expense would not be prohibitive, and the greater part of the necessary funds could be obtained from those who would benefit by the increased facilities. Several chemical firms in the London area, and in Sheffield and Manchester, have taken advantage of the new accommodation afforded by the chemical department by sending research chemists to follow special lines of investigation. Thanks to the fees paid by these firms, a large proportion of the outlay involved in establishing the new laboratories has been recovered, and this development is so promising financially that if profit were the only consideration it would pay to drop elementary teaching and to concentrate entirely on post-graduate investigations in industrial chemistry. But such a change would involve abandoning the ideal aimed at by Streatfeild —a combination of elementary teaching and specialised research. The best solution would be to dovetail these two activities, for the association under the same roof of young beginners and post-graduate research workers creates a chemical "atmosphere" and plays no small part in building up a living school of applied chemistry.

THE PLATINUM SITUATION.

In an article in the *Engineering and Mining Journal* (July 26, 1919) Mr. J. M. Hill, of the United States Geological Survey, describes the uses, sources, and modes of occurrence of platinum, gives particulars concerning the interests controlling the deposits and the refining industry, and forecasts the future of the platinum mines.

As is well known, the main sources of platinum are situated in Russia, Colombia, Canada, the United States, and Australia. Canada is placed third, because, although its output of placer platinum is small, comparatively large quantities of the metal (and palladium) are recovered from the nickel-copper ores of Sudbury, Ontario. The yield from this source could be greatly increased. Of the lesser known fields, a small output has been obtained for some years from the gold dredges working on the Irawady River, India, and from the tin dredges in the Dutch East Indies. Platinum, in what may prove to be commercial placer deposits, has been found in the Sierra Ronda, in southern Spain, about fifty miles north-west of the port of Malaga; the concentration of platinum is not high, and it is problematical whether extensive developments will be warranted. Unconfirmed reports have reached the U.S. Geological Survey of discoveries of platinum deposits in Westphalia, Germany, in southern Siberia, at various places in Mexico, and from several localities in Ecuador and Peru. Platinum is known to occur in some of the streams, as well as in certain of the gold deposits of the Minas Geraes districts of Brazil. In south-western Borneo platinum occurs in the gravels of streams rising in the Bobaris Mountains in the Tanath-Laut district.

The following represent typical analyses of the crude placer platinum found in the more important fields:—

Analyses of Crude Platinum.

	Pt. %	Ir. %	Rh. %	Pd. %	Fe.* %	Au. %	Fe. %	Cu. %	Sand. %
Russia Iss. ..	80.10	1.38	0.30	0.30	4.47	0.09	7.68	0.63	—
,, Tagull	76.16	2.68	0.54	0.27	1.50	—	14.72	3.39	—
Colombia ..	86.20	0.85	1.40	0.50	0.95	1.00	7.80	0.60	0.40
California ..	63.30	0.70	1.80	0.10	22.55	0.30	6.40	4.25	—
B. Columbia..	72.07	1.14	2.57	0.19	10.51	—	8.59	3.39	1.69
N.S. Wales ..	75.90	1.30	1.30	tr.	9.30	—	10.16	0.41	1.22

*Osmiridium.

Prior to the war the French Compagnie Internationale du Platine practically dominated the Russian platinum industry by virtue of its mine holdings and purchasing contracts, but several large Russian companies were known to be more or less independent, as also were many small producers. The more important Russian producing companies included those of Shouvaloff, Demidoff, the Nicolo-Pavdinski Co., and the Platina Co. Although dredges were used before the war it was estimated that 80 per cent. of the output was obtained by the hand labour of lessees, who contracted to dispose of their output to the companies owning the ground and to pay a royalty. Since the war the peasants and miners have been virtually in control of all the mines, the original operators having but little to do with the management. Reports indicate that none of the dredges is in operation and but little platinum has been produced since 1914, any accumulated stocks in the country having probably been exported. The Colombian platinum alluvials have been controlled largely by American interests, but late in 1917 a British company was organised to work deposits in the Opogodo River, on the Upper San Juan. In British Columbia a large portion of the platinum placers in the Tulameen district is stated to be controlled by American capital, although Canadian firms are said to have large holdings on the Peace River in the northern part of the Province. An American company has recently been formed to exploit certain areas in the Barkersville region. The Ontario nickel deposits, which have considerable potential value as platinum and palladium producers, are operated by the Mond Nickel Co. and the International Nickel Co.

Platinum refining in the past has been in the hands of a few firms. A large proportion of the Russian output, although sold to a French company, has been treated by Messrs. Johnson, Matthey and Co., Ltd., of London. About 70 per cent. of the Russian output, half of the Colombian, and all the Australian and Indian was sent to Great Britain before the war, but it would appear that all was not refined here, as considerable quantities of crude platinum were exported to the United States. According to Russian statistics, about 25 per cent. of the Russian output was refined in Germany. In France the chief refiners include Quenessen, de Belmont, Legende et Cie, and the Compagnie Internationale du Platine. The United States platinum refiners include Baker and Co., the American Platinum Works, Irvington Smelting and Refining Co., J. Bishop and Co., and several others.

In regard to the future, there is no doubt that many of the Russian platinum deposits are still very valuable, and it seems very probable that the French Compagnie Internationale du Platine will make strenuous efforts to reopen its mines and renew the contracts with other Russian producers. It has been stated that probably it would not be difficult for American capital to obtain control of some of the more important mines, notably the Shouvaloff and Demidoff, and also to secure the output of other mines. English capital, however, is in a stronger position to enter into the Russian platinum producing industry than heretofore. At present the Russian deposits are idle, and it will require much time and capital to re-establish the industry. The known Russian deposits are becoming exhausted, and according to Dupare, the reserves at present known have a life of twelve years at the pre-war rate of consumption.

Colombia appears to have large reserves of platinum-bearing ground, and probably further prospecting in the Choco districts would be well repaid. The Canadian deposits hold some promise for future developments, particularly those along the Rocky Mountains of British Columbia. Dredging for gold and platinum would appear to be feasible on the Willow and Peace Rivers, but the largest Canadian reserves are the Sudbury nickel deposits. A change from the present metallurgical practice will be necessary, however, in order to recover the maximum quantities of platinum and palladium.

An increase in the United States output of platinum does not appear very probable, especially when the arrangements for refining the Sudbury ore in Canada are complete. The U.S. placer deposits carrying platinum are relatively small, many of those in Northern California and Oregon cannot be remuneratively worked, and few can be dredged. As the dredging field along the base of the Sierras becomes exhausted the United States output will decline unless new sources are located meanwhile. It seems probable, however, that the output from Alaska will increase, as new localities are being found each year.

Australia does not hold out much promise as regards future production. The Fifield deposits are apparently nearly exhausted, and the beach deposits of Queensland and New South Wales are of too low grade. Spain has certain undeveloped platinum deposits which have been but little expored, but it would appear from the published reports that they are neither large nor rich. It was announced in 1918 that works had been erected at Wenden in Germany for recovering platinum from a shale which yielded about 1 oz. of the metal per ton.

Discussion has taken place recently regarding the price of platinum, the trend of which indicates that the present price is several times the value of the metal. The price for several years to come will probably not fall to the pre-war level of $45 (£9) per oz., but will rather be nearer $75 (£15). (See also this J., 1918, 338 R.)

"KEY INDUSTRIES" IN AMERICA.

A series of reports has been issued by the United States Tariff Commission detailing the recent development of various "key industries"—optical glass, chemical glassware, potash and its compounds, dyes and related coal-tar products.

Optical Glass.—In 1913 the United States imported optical glass to the value of $506,594, and in 1914 to the value of $617,703, of which one-half was imported from Germany and 27 per cent. from Great Britain. The home production of optical glass was commenced in 1917; the output in April of that year was 28,157 lb., and by October had reached 95,563 lb. The home production of optical glass is by no means sufficient to cover the demand, and even in 1918 about half the pre-war consumption had to be imported. A process has been devised enabling the manufacture of this glass in the pots to be completed in 24 hours, a saving of 12 hours on the old method.

Chemical Glassware.—Prior to 1915 practically all the chemical glassware used in America was imported. In 1913 the imports were valued at between $1,200,000 and $1,500,000. By 1918 the home production had increased to $2,865,774 worth. No factories are engaged exclusively in producing chemical hollow glassware. During the latter half of 1917 the United States exported chemical glassware for the first time in its history. Chemical glassware is imported duty-free if employed for educational purposes, but a 45 per cent. *ad valorem* duty is levied on glass when used for manufacturing and commercial purposes. The withdrawal of the preference in the former case is being urged by manufacturers.

Potash.—The development of the United States potash industry has been previously referred to

(this J., 1918, 12 R, 135 R, 264 R, 1919, 248 R). The following returns show the various sources whence potash was derived during 1918:—

Source.	Number of producers.	Total production.	Available potash (K_2O).
		Tons.	Tons.
Natural brines ..	21	147,125	39,255
Alunite	4	6,073	2,619
Dust from cement mills	9	11,739	1,429
Kelp	6	14,456	4,292
Molasses distillery waste	4	9,505	3,322
Steffens waste water ..	5	2,818	761
Wood ashes	26	609	365
Other sources ..	3	262	92
	78	192,587	52,135

Potash produced classified according to product marketed.

Product marketed.	Total production.	Variation in content of K_2O	Average content of K_2O.	Available (K_2O).
	Tons.	Per cent.	Per cent.	Tons.
Muriate	30,127	38.0–58.5	41.8	12,614
Low-grade chloride ..	6,559	10.0–20.0	13.6	894
Sulphate	6,672	25.0–51.0	47.9	3,188
Crude sulphate and carbonate	122,741	18.0–38.0	25.5	31,311
Crude carbonate and caustic	609	50.0–78.0	60.0	365
Potash char, ash, and ground kelp ..	14,630	12.0–42.5	19.8	2,896
Cement and blast furnace dust, alum, raw and calcined alunite	11,249	2.5–13.0	7.7	867
	192,587	—	—	52,135

Dyes.—Benzol, toluol, and naphthalene are manufactured in the United States in quantities far in excess of the demands of the dye and related industries. With anthracene the situation as yet is not so favourable. It is present in coal tar derived from American coals only to the extent of about 0·3 per cent., and its recovery is difficult of achievement. Certain technical difficulties have still to be surmounted before home supplies of anthracene will be available in adequate quantity and at a sufficiently cheap price. The supremacy of Germany in the supply and price of caustic potash and of ethyl alcohol will probably be offset by the large supplies of methyl alcohol and acetic acid derivable from the wood distillation industry of America, so that it is anticipated that, so far as concerns essential raw materials of the dye industry, no nation will be able to claim a permanent significant advantage over the United States. The subjoined table gives the production of various crudes, intermediates, and finished products during 1918. Group I. is free of duty, Group II. is dutiable at 15 per cent. and 2½ cents per pound, Group III. is dutiable in part at 30 per cent. and in part at 30 per cent. and 5 cents per pound.

	Number of manufacturers.	Quantity (pounds).	Value. (dollars).
Group I.—Crudes, free ..	35	—	22,474,075
Group II.—Intermediates, dutiable	127	354,808,315	123,817,966
Group III.—Finished products	—	75,494,112	83,095,404
Dyes:			
Dutiable at 30 per cent. plus 5 cents per pound	—	52,517,235	57,535,934
Dutiable at 30 per cent.	—	4,638,365	3,770,106
Total of dyes ..	77	57,155,600	61,306,040
Colour lakes, dutiable at 30 per cent. plus 5 cents per pound	29	9,590,537	5,020,023
Photographic chemicals, dutiable at 30 per cent. plus 5 cents per pound	6	316,749	823,915
Medicinals, dutiable at 30 per cent.	31	3,023,352	7,792,984
Flavours, dutiable at 30 per cent.	7	458 256	4,925,627
Synthetic phenolic resins, dutiable at 30 per cent. plus 5 cents per pound	5	4,233,356	2,642,120
Tanning materials .. (synthetic)	1		
Perfume materials ..	6	116,263	584,695

The exports of dyes and dyestuffs amounted to $16,921,888 during the fiscal year ending June 30, 1918. The imports in the fiscal year 1913–14 amounted to 45,840,866 lb. The statistics show that the output of dyes in 1918 exceeded that in 1917 by 45,977,246 lb., valued at $57,796,228. The American industry is especially strong in the production of azo-, sulphur-, and induline dyes. The output of azo-dyes during 1918 was 24,811,141 lb., valued at $31,915,556. The total output of sulphur dyes was 22,510,799 lb., valued at $10,216,905. In the group of induline dyes, Nigrosine was, prior to the war, regularly shipped to Germany. The manufacture of triphenylmethane, diphenylmethane, and diphenylnaphthyl dyes still requires considerable development. The output of synthetic indigo is increasing, amounting to 3,083,888 lb. in 1918, and the productive capacity in June, 1919, was substantially greater than the amount imported in 1914. The manufacture of indanthrene dyes has only just commenced, and the same remarks applies to the indigoids and alizarin derivatives. It is realised that the American dye industry has hitherto been developed one-sidedly and is not at present on a sound economic basis, but it is confidently anticipated that these deficiencies will be removed in the course of time.—(*Board of Trade J., Sept.* 25, 1919.)

MEETINGS OF OTHER SOCIETIES.

THE INSTITUTE OF METALS.

The Sheffield meeting of this Institute, held on September 24 and 25, was the first provincial meeting since the outbreak of the war, and the resumption was marked by an unusually large attendance and a keen interest in the proceedings. In addition to the reading of papers, the programme included many visits to works, as well as certain social functions. The number of papers presented made full discussion impossible, and many would-be speakers were disappointed, but it is to be hoped that the papers will receive fuller discussion before the issue of the Journal.

In a contribution dealing with the season cracking of metals, Dr. Hatfield and Capt. Thirkell put forward the view that highly cold-worked metals, which exhibit this defect, are stressed in the outer layers to such an extent that the normal breaking down point is approached, so that local relief of stress, such as may be produced by corrosion, may cause cracking. The authors refuse to accept the hypothesis of intercrystalline fracture due to prolonged stress as caused by flow of the intercrystalline cement, and a vigorous discussion took place on this question. The paper included measurements of internal stress by a simple and effective experimental method. Messrs. E. A. Smith and H. Turner gave a valuable account of the manufacture and properties of sterling silver, an alloy which has received comparatively little scientific attention. The improvement in properties due to the addition of cadmium was described, and the effect of oxygen in producing "fire-mark" was noticed. Liquidation or segregation is prominent in the casting of this alloy, the fact that it is silver which becomes concentrated at the centre, contrary to the indications of the equilibrium diagram, attracting special notice. The fact was

observed by Robert Austen. The printed paper contains a very full bibliography. Two papers were presented by Dr. Thompson, one describing the occurrence of graphite and of oxide in "nickel-silver" (nickel-brass or German silver), and the other (with Mr. Orme) giving an account of Britannia metal. This alloy contains copper as well as lead and antimony, and may be rendered distinctly harder by rapid cooling. Dr. Stead presented a description of the remarkable ternary alloys of tin, antimony and arsenic, which are characterised by the formation of a compound crystallising in segments of spheres. This type of crystal has no exact parallel in nature, and the effect of the addition of arsenic to the tin-antimony alloys, the crystallisation of which is quite normal, is very striking. Some notes on the structure and behaviour of a bearing metal with a tin base, by Miss Fry and Dr. Rosenhain, led to a discussion on the properties of bearing metals and their suitability for the high pressures found especially in modern marine practice.

Prof. Desch's second report on the solidification of metals dealt with the form of crystal grains and their relation to foam cells, a striking similarity of form being observed. The types of polyhedra occurring in foams were examined, and it was shown that the form indicated by the usual mathematical theory was of rare occurrence. It was not found possible to infer the form of crystal grains from the examination of their outlines in a cross section. In the second section of the report, experiments were described in which the difference of temperature in different parts of the convection cells in cooling liquids were measured. A good discussion followed, in which Dr. Benedicks and Dr. Zay Jeffries laid stress on grain growth as proceeding under the influence of surface forces, and Dr. Bengough showed some photo-micrographs of metals exhibiting two orders of cellular structure. Prof. Boswell presented a valuable survey of the moulding sands suitable for non-ferrous foundry work. Whilst these metals are cast at relatively low temperatures, they present special difficulties of their own owing to "burning-on" and other reactions between sand and metal. The paper included a survey of the geographical distribution of suitable sands. Prof. Turner and Mr. Cosmo Johns dealt in the discussion with the effect of viscosity and the degree of wetting of the mould by the metal. Mr. Leader communicated a paper of local interest on the history of the silver electroplating industry, some of the early incidents of which appear to have been hitherto obscure. The last paper on the list, a note by Dr. Zay Jeffries on the ageing of duralumin, had unfortunately to be taken as read. The explanation proposed by the author is briefly that the low mechanical cohesion of freshly quenched duralumin is due to the presence of the copper-aluminium compound in ultra-microscopic particles, probably often separate molecules, and the increase of cohesion on ageing is due to the agglomeration of these particles. Increase of size of the particles beyond a certain limit, as by prolonged ageing at 200° C., diminishes the cohesion.

Exhibitions of old Sheffield plate, and of the war work carried out by Sheffield firms, were held in connexion with the meeting, the exhibits of the steel and armament firms being particularly striking. The members were also greatly impressed by the enormous extension of some of the local works caused by the development of manufactures required for war purposes.

THE CERAMIC SOCIETY.—Owing to the railway strike, the autumn meeting to have been held at Stoke-on-Trent on October 8 and 9, has been postponed until the end of April, 1920. The spring meeting arranged for London, 1920, has therefore been cancelled.

PERSONALIA.

The death is announced of Mr. J. C. Umney on October 9 at the age of 51.

Dr. J. O. Arnold has resigned the posts of professor of metallurgy and dean of the faculty of metallurgy in the University of Sheffield, owing to ill-health.

Dr. Shipley, Master of Christ's College, Cambridge, has retired from the office of Vice-Chancellor of Cambridge University. The Rt. Hon. A. J. Balfour has been elected Chancellor in succession to the late Lord Rayleigh.

Dr. E. Hope, a research assistant on Professor W. H. Perkin's staff, has been elected fellow and tutor in chemistry at Magdalen College, Oxford.

Dr. R. H. A. Plimmer has been appointed Head of the Biochemical Department of the Craibstone Animal Nutrition Research Institute, which is connected with the University of Aberdeen and the North of Scotland College of Agriculture.

Dr. F. W. Skirrow, for the past four years assistant professor of chemistry at McGill University, Montreal, has resigned this position to take up the duties of chief chemist to the Shawinigan Laboratories, Ltd., the newly founded research organisation of the Shawinigan Water and Power Co., Shawinigan Falls, Quebec.

CORRESPONDENCE.

CHEMICAL COMPENDIA AND ABSTRACTS.

SIR,—I consider that the project of producing an inter-allied "Beilstein" an unwise one. Unless the German publication can be improved upon considerably, which seems improbable, we shall simply be imitating our enemies at the cost of a large amount of money and energy. Money is none too plentiful, but its expenditure would not be so serious as that of the time of innumerable chemists, who would simply be repeating mechanical work which was being done equally well already. A possible effect of issuing a rival publication would be that both would be rendered so expensive to the producers that production would cease. The Germans have shown eminent capability for the compiling of such a work, and it is far better that Englishmen should devote themselves to work in which they can show real skill, such as the writing of scientific and technical books. In the last few years we have been very active in this direction, and many books we have published are most excellent; far better than the corresponding German ones. If the Inter-Allied Chemical Federation can do anything to encourage the production of well-written and reliable books on the many branches of pure and applied chemistry, it will do more to show that chemistry is not mainly a German science than by imitating Beilstein. The writing of such books requires intense and prolonged labour and considerable skill, and the remuneration is but small.

A matter which the Federation might well take up is the United States copyright legislation, the effect of which is to deprive the already underpaid British author of half his royalty on the American sales and put the money into the pockets of the American booksellers. It is to be hoped that the Americans will admit to their copyright books of a scientific or technical character, even though they have not been printed in the States.—I am, Sir, etc.,

A. MARSHALL.

Naini Tal, India. Sept. 4, 1919.

NEWS AND NOTES.

CANADA.

Oil Refineries.—The growth of oil refineries in Canada during the last four years has been very rapid. Additions have been made to all the plants, and those located at Vancouver and Halifax have been greatly extended. The plant at Halifax is now being duplicated.

Gold in Northern Manitoba.—With the advent of the Hudson Bay Railway, a new area for prospecting has been opened up in Northern Manitoba. Geological formations are such as to warrant close investigation of the territory by mining companies. Already large quantities of copper ore have been shipped to Trail, B.C., and recent discoveries of gold a short distance from Le Pas have greatly stimulated the interest taken in this district.

Developments in Steel Production.—It has recently been announced that a new steel plant and rolling-mill, to employ 2,300 workmen, will be established in Toronto by Baldwin's Canadian Steel Corporation, Ltd., which will occupy the premises of the British Forgings, Ltd. British capital to the extent of $10,000,000 will be invested by the owners of Baldwins, Ltd., Swansea, Wales. This firm is represented in Canada by Mr. A. M. Russell, of Hugh Russell and Sons, Montreal. Construction work is now under way.

The Huron Steel Corporation, with a capital of $15,000,000, is to undertake the manufacture of steel specialities at Goderich, Ont. This town is well situated on Lake Huron, and it is expected that a new hydro-power line, furnishing 25,000 h.-p., from Niagara, will be erected. In general, the deepening of the canals from Lake Erie to Montreal is likely to advance greatly the development of Canadian enterprises on the Upper Lakes.

Meeting of the Industrial Commission.—During the week commencing September 15 a general conference was called by the Dominion Government at Ottawa for the purpose of discussing labour problems. This was the largest gathering of representatives of organised labour and industrial capital ever held in the Dominion. A distinctive feature of the gathering was the large representation from technical societies and engineering organisations.

Industrial Conditions in Mining Centres.—Following the settlement of the strike of the silver miners in Cobalt district, the general conditions in large mining centres are better than they have been at any period since the war.

In the large coal mining and smelting district of Sydney, Nova Scotia, lack of shipping facilities has hindered the Dominion Iron and Steel Co. and the Dominion Coal Co. from again undertaking to furnish the St. Lawrence River ports with the quantity of coal they formerly supplied. The employees of the steel company have asked the Dominion Government to investigate the operations of the company in their interests. It is felt that the company ceased operating a portion of its plant without giving the employees reasonable notice.

The Chicago Chemical Exposition.—Thirteen Canadian firms were represented at the Annual Exposition of Chemical Industries of the United States, held at Chicago from September 22 to 27. The interest taken by Canadians in this growing exposition is a matter of considerable importance from the standpoint of trade developments, since the United States offers an excellent market for Canadian chemical and metallurgical products.

The Toronto Fair.—Over 1,100,000 persons paid admission this year to the annual exhibition known as the Toronto Fair, in which many companies interested in fertilisers, cattle food, chemical machinery, etc., took part. It is possible that next year, or later, the Canadian Section of the Society of Chemical Industry may undertake the establishment of a distinct chemical section of this Fair.

BRITISH INDIA.

Industries in Travancore.—An industrial survey of Travancore was recently undertaken by Dr. S. G. Barker, and his report shows that this State possesses very considerable assets both vegetable and mineral. Among the more important industries indicated are shellac, sugar, fibres, dyeing and weaving, and on these immediate concentration of effort is advised. One experiment of especial interest mentioned in the report is the manufacture of acetic acid from the shell of the coconut, for this acid has an important use in the manufacture of rubber, an enterprise which is being taken up by a large number of people in the State. The high price of the acid makes it difficult to carry on the work, and experiment has shown the possibility of cheap and easy production of the acid. Travancore is not in a satisfactory position as regards power, as there is no coal and but few of the waterfalls survive the hot weather. As regards motor spirit, Travancore proposes to strike out in a direction which will produce results of value to the country at large. The Government has a big distillery in the south of the State, and experiments are being made for the employment of the alcohol distilled there to drive engines of small power.—(*Indian and Eastern Engineer, Aug.*, 1919.)

AUSTRALIA.

Minerals in South Australia.—The discovery on the western shore of Gulf St. Vincent of good grade alunite in quantities sufficient to justify the erection of an extraction plant may go far to supply the Australian demand for potash.

Large deposits of low-grade calcium phosphate and aluminium phosphate are known to exist, but have not as yet been exploited.

Prospecting operations in one of the graphite deposits of Eyre's Peninsula have been so encouraging that initial steps have been taken to put up plant there. A Government scheme, operative until 1922, offers a bonus of £1 per ton to persons recovering and marketing graphite locally.

A bonus of £5000 is also offered by the State Government to the person or firm first obtaining 100,000 gallons of crude petroleum which will yield 90 per cent. of useful distillation products.—(*Times Trade Suppl., Sept.* 27, 1919.)

UNITED STATES.

Importation of "Vat" Colours.—Owing to the shortage of vat dyes, the War Trade Board has authorised the importation of six months' supply, and Dr. C. H. Herty, editor of the *Journal of Industrial and Engineering Chemistry*, has been commissioned to effect the necessary purchases in Europe.

Cotton Oil Extraction.—As a result of industrial research, a cotton-oil company has found it possible to recover an average of 13 lb. of oil per ton of seed more than the general average in the industry, and to obtain ½ per cent. more first-grade oil in its refining processes. The meal with lower oil content is more desirable.

Electro-deposition of Gold and Silver.—The U.S. Bureau of Mines Bulletin 150, relating to the electro-deposition of gold and silver from cyanide solution, and prepared by S. B. Christy, is a careful record of experiments covering all phases of the subject, and should be of great value to all investigators of the electrolytic deposition of metals. At intervals over a period of 20 years Prof. Christy has studied the problem, and the monograph records the large amount of experimental work performed.

The Chemical Warfare Service.—The proposal to abolish the Chemical Warfare Service as a separate unit of the United States army and to place its work under the Engineers is being fought by all those really familiar with what is involved. Any future war is almost certain to be one fought along chemical lines, and the Chemical Warfare service has more possibilities than any other branch of the military establishment. It is estimated that in the late war 30 per cent. of the American casualties was due to the chemical warfare of the enemy. There is always a strong possibility that researches in chemical warfare will yield results important to peaceful pursuits, and such research should be continued independently of other military branches.

JAPAN.

Sugar Industry.—The fiscal year ending June, 1918, was a poor one for the Japanese sugar industry. The output of the sugar companies in Formosa during this period was less than 300,000 long tons, being about 134,000 tons below the estimated output. The steady advance in the price of fertilisers and freight rates, coupled with the comparatively low price of Java sugar, had a bad effect upon business. The net profits of the ten leading Japanese sugar companies are estimated at 23,414,756 yen. Large profits are expected for 1918-19. The price of Java sugar has shown an upward tendency, and the price of Japanese sugar has also risen. The output for the year is estimated at 263,000 tons, a little over half of which will be exported.—(*U.S. Com. Rep., July* 29, 1919.)

Camphor Production in Formosa.—The causes of the decreased production of camphor in Formosa during the past three years are summarised as follows:—There is a shortage of labour to gather the crude material, due partly to the higher wages paid by other industries, especially the sugar industry, and partly to the necessity of going further and further into districts menaced by savages in order to get good trees. Labourers prefer to work in safe industries, since the wages they can receive are equal to or even greater than the wages paid in this comparatively dangerous occupation. Good trees have become scarce because of the wanton and unorganised cutting down in the past.

An amalgamation of the various operating companies has recently been effected with the object of systematising the method of gathering the camphor and preventing waste. The combination will also be in a better position to procure labour and to negotiate with the Government in regard to prices. The Camphor Monopoly Bureau does not anticipate that the production will be brought back to the normal until the fiscal year beginning April 1, 1920. From then onwards the annual output is expected to reach 5—6 million kin (3000—3600 long tons); this year it should be at least 4 million kin (2000 tons). The Government is now engaged on investigations into the prospective production from all the wild trees in the island, but these will not be completed for three or four years. It is roughly computed that these trees will yield 5 million kin of camphor a year for the next 10—15 years, after which the trees planted by the Formosa Government will be available.

The Japanese Government has instructed Japanese refiners to sell to refiners in the United States 20,000 lb. of camphor per month at 3 per cent. less than the market price. No stocks of camphor are held over by the Monopoly Bureau.—(*U.S. Com. Rep.*, Aug. 4, 1919.)

GENERAL.

The Effects of Shift-Duration, Seasonal Variation of Temperature, and Ventilation on Output.—Report No. 1 of the Industrial Fatigue Research Board is devoted to a discussion of the influence of hours of work, of temperature and of ventilation, on output in tinplate manufacture. The records of five tinplate works, extending in some cases from 1911 to 1918, and detailing the hourly outputs in fortnightly periods, have been examined. The most reliable records indicate that over periods each including hot and cold seasons in about equal proportions, the average hourly output when working on six-hour shifts was about 11·5 per cent. greater than when eight-hour shifts were being worked. Smaller increases of hourly output, varying from 4·7 to 10·6 per cent., accompanied the reduction of hours in the case of other works in some of which four-hour shifts were being worked. On the average, the hourly output of six-hour shifts is about 10 per cent. greater than that of eight-hour shifts.

In a factory with no system of artificial ventilation and working on eight-hour shifts, the average hourly output during August was 9 per cent. below the average. Thereafter the hourly output rose uninterruptedly to 9 per cent. above the average in January, subsequently falling without interruption except for the month of June. Furthermore, in this unventilated factory, the hourly output was 10 per cent. above normal when the external temperature was under 40° F. (=4·4° C.), and fell continuously to 10 per cent. below normal as the external temperature rose to 65° F. (=18·3° C.). The seasonal variation in the case of a factory possessing good ventilation was found to be ±3 per cent. above or below normal. Allowance being made for weekly and monthly variations in output, it appears that the output in the unventilated mill during the hottest weather was probably 30 per cent. less than during the coldest.

The Petroleum Fields of Alsace.—The exploitation of these fields was begun by the Germans in 1860. In 1912 wells covering 625 acres were producing 47,176 metric tons of oil, and when war broke out developments were in progress which aimed at an annual production of 70,000 tons. The projected new work could not be carried out during hostilities; the production, nevertheless, increased considerably. The oil, which is generally found in pockets at 650 ft. to 1650 ft., and sometimes at 2300 ft., is heavily charged with saline water containing in grams per litre: NaCl 7·96, KCl 0·66, $CaSo_4$ 1·75, and $MgCo_3$ 0·54. American methods of boring are followed; there are no gushers, and the oil is pumped up by electrically-driven Canadian pumps. The oil is conveyed to the refinery by five pipe-lines with a total length of 37¼ miles and covering a radius of 6-7½ miles. In chemical character the Alsatian oil is intermediate between American and Rumanian oils, with an average density of 0·92, and percentage constituents as follows: Motor spirit 5, kerosene 20, heavy oils 65, and residual matter 10.—(*Rev. Gén. de l'Elect.*, Aug. 23, 1919.)

Direct Ammonia Recovery.—The total production of ammonia in the United Kingdom during 1918 was 6 per cent. less than that during 1917. This reduction, although partly due to the poor quality of the coal carbonised, is mainly attributable to the improved methods of carbonisation, including steaming of the charge employed, whereby the weight of coal carbonised per unit volume of gas distributed tends to be continually reduced. Meanwhile, the yield of ammonia per ton of coal carbonised is increased, and the total production of ammonia is determined by these two factors which operate in counter directions. The Chief Alkali Inspector in his Report for 1918 directs attention to the fact that at the Halifax gasworks the yield of sulphate of ammonia per ton of coal carbonised has been increased from the normal amount of 24lb. to 30·54 lb. by charging the retorts with coal which had been sprayed with water. The results obtained

by this practice cannot be regarded as conforming with the general opinion that superheated steam is necessary for steaming the retorts.

The "backward rotation" system of gas purification, combined with downward travel of the gas in the purifiers, possesses a number of advantages when employed in conjunction with the "direct" process of ammonia recovery (see this issue 708 A). In the light of experiments detailed in the report above mentioned it appears that the oxide employed in the first members of a series of oxide purifiers undergoes concurrent sulphiding and revivification. This being accepted, it appears that the correct point for air admission to the purifiers is the first member of the series, in contradistinction to the more common practice of admitting air about midway in the series.

Processes for the manufacture of sulphate of ammonia without the consumption of sulphuric acid other than that derivable from constituents of the crude gas have not hitherto met with much success. In a new process due to Prof. J. W. Cobb, the gas is passed into a solution of zinc sulphate, ammonium sulphate being produced with precipitation of zinc sulphide. The solution is filtered and ammonium sulphate obtained by evaporation of the filtrate. The zinc sulphide is roasted, and the gases evolved, together with an excess of air, are blown through water holding in suspension zinc oxide from a previous roasting. Zinc sulphate is regenerated in this manner. The process is now being tried in a plant capable of yielding one ton of ammonium sulphate per day. The original Feld process of ammonia recovery has been recently modified, the gas being now washed with a solution of ammonium tetrathionate in place of the solution of ferrous sulphate previously employed.—(*Times Eng. Suppl., Sept.*, 1919.)

Distillation of Oil-Shale in Germany.—Prior to the outbreak of war shale was worked in the Rhine provinces and near Reutlingen, but only one company was occupied in producing paraffin and mineral oils. From the bituminous shale which occurs near Messel (containing 40 to 45 per cent. water, 6 to 10 per cent. tar, and 40 to 50 per cent. residues), the following yields per ton of shale are obtained: 135 litres of crude oil, together with 295 litres of ammonia water and 59 cub. m. natural gas, which is burnt as fuel in gas engines or under the vertical retorts. During the war the oil-shale deposits in South and North Germany have been investigated in regard to their yield, but the results have not yet been published.—(*Z. d. Ver. deut. Ingen., July* 19, 1919.)

The Nitrogen Works at Leuna, near Merseburg (Germany).—Dr. Semmler, a member of the German National Assembly, has recently described a visit which he paid to these works in company with other parliamentary and Government representatives. The first sod was dug in May, 1916, and the first output of ammonia achieved in April, 1917. The factory, which is now only three-quarters completed, employs 7000 labourers in addition to a like number of regular employees. The daily output of combined nitrogen is roughly 200 metric tons; eventually it is hoped to produce 560 tons. The main product is 20 per cent. ammonia solution, some of which is transported elsewhere for conversion into nitrate. Owing to the excessive cost of sulphuric acid, ammonium sulphate is being made by the interaction of ammonia with calcium sulphate in a current of carbon dioxide. The daily consumption of lignite is about 11,000 tons, and of water about 15,000 cub. m. per hour, 90 per cent. of which is recovered and re-used. The works contains a store with a capacity of 250,000 tons of ammonium sulphate, equivalent to three months' production.—(*Oester. Chem.-Zeit., July* 1, 1919.)

Soap from Lignite Tar Oils.—Experiments, which are said to have been satisfactory, have been carried out in the laboratory of the Siemens works in Berlin, with a view to converting lignite tar oils into fatty acids by the action of ozone. Similar experiments carried out on a large scale by a process introduced by the City of Wiesbaden are reported to have been equally successful. By treating the fatty acids with potash lye, a lubricating soap giving a good lather is obtained, and treatment with soda lye gives a solid product which can be pressed in moulds. Also by ozonising acetic, propionic, and butyric acids and unattacked gas oil a colourless, high quality paraffin wax results. —(*Mitteil. d. Reichsb. Deut. Tech. No.* 24, 1919.)

The Beet Sugar Industry in Bulgaria.—After a promising start the Bulgarian beet sugar industry has been falling off, especially during the war; although there was a slight increase in production during 1917–18 over 1913–14, the figures being 11,000 tons for the former and 7800 tons for the latter period. During the war, when Austria exported sugar to Bulgaria and Turkey, the price of sugar was about 10 leva, say 8s., per pound; it has now risen to nearly £1. The responsibility for poor yields of beets can be fixed in a very large measure on the growers themselves, inasmuch as the cultivation of the roots is inferior. In many cases the ground is simply ploughed up, the seed sown broadcast, the field hoed once and then left without any further attention until the autumn. And yet it has been proved by experiment that good crops can be grown there. However, the growers seen very unwilling to accept advice offered to them, so that the yield per acre remains poor, in some cases as low as 120 lb. per acre. Also, many growers prefer to prepare their favourite *rakia* from the roots to delivering them to the factory. The Government could do much to help the industry forward by providing better transport facilities, and by paying the growers better prices for their roots. They are receiving 15 leva, or about 11s., per ton of roots, whereas the return for cereals approaches £80 a ton. Until Government aid is forthcoming the prospects of the industry will remain uncertain, and the whole population will continue to demand the importation of sugar from abroad.—(*Deutsch. Zuck. Ind., June* 20, 1919.)

The Russian Beet Sugar Industry.—France, Russia, and Germany may pride themselves on having the longest established beet sugar industries. They all date from the beginning of the 19th century. Germany and Russia, together with Austria, are still the largest beet sugar producing countries of the world. The following figures will be useful for demonstrating the relative positions occupied by them as regards their annual sugar output for two consecutive years taken at random:—

	Metric tons.		
	1909.		1910.
Germany	.. 2,640,000	..	2,502,000
Austria	.. 1,246,000	..	1,542,000
Russia	.. 1,124,000	..	2,115,000

The first Russian beet sugar factory was erected in the Government of Tula in Central Russia in 1802. All the early factories were of a very primitive character and many were provided with insufficient capital. Up to the year 1825 there were only two factories. Later on the number increased rapidly, so that in 1861 there were no less than 432 factories with an annual output of 64,400 metric tons. This vigorous growth was checked by the emancipation of twenty-three million serfs by Alexander II. in 1861 with the result that in 1863, with 402 factories still working, the actual production was reduced to about one-half. Since then the industry has developed continuously and has assumed a more modern character. The introduction of steam and of the diffusion process into the works accounts largely for this progress. Thus

in 1908-4 the output was 1,022,000 tons; in 1908-9 1,375,000; and in 1913-14 1,791,000 tons. In 1914-15 the output was 1,739,000, a figure which does not include sugar manufactured in Poland. During the war the production decreased considerably and for 1917-18 it is given as 1,100,000 tons only. The low production during the war may be ascribed to shortage of beet acreage, partly accounted for by the German occupation, and to inferior crops due to shortage of fortilisers.

The annual consumption per head in Russia is very far behind that of other countries. In 1900 it had increased to 8·4 lb. and to double that amount, namely 17 lb., in 1918. During the war the increase in consumption was maintained owing to the requirements of the military administration, the increased purchasing power of the population and the prohibition of spirits which increased the consumption of tea. The larger consumption and the lower production effectively put a stop to all export, with the exception of limited quantities to Finland and for a time to Persia, where it was exported for the purpose of creating funds for the expenditure incurred by the Russian armies. The continuous rise in the price of the raw material is due partly to the fact that some estates have passed into the hands of peasants who prefer raising cereals to growing roots. Therefore, if the industry is to thrive in the future it will have to be very well organised and supplied with the best technical advice.

In regard to technical development Russia undoubtedly takes first place among beet-growing nations, and many of the improvements have been made by Russian inventors. A good illustration of the satisfactory progress made by the industry is given by the fact that whereas in 1880 only 7—8 per cent. of sugar was extracted, in 1913 the extraction had increased to 10—11 per cent. This improvement led to a decrease in the cost of production of 23 per cent. during the ten years before the war. As much attention as possible will also have to be paid to making full use of by-products. Black molasses, containing 45—50 per cent. of sugar, which is not extracted, is already being employed for the purpose of improving cattle food and in brandy distilleries. The exhausted pulp is employed exclusively for cattle food either in the raw or in the fermented condition.

The first attempt to introduce the sugar industry into Siberia was in the Government of Tomsk. It failed through lack of capital and was followed by the erection of a factory in 1889 in the Government of Yeniseisk in East Siberia. It closed down in 1898, again through lack of working capital and adequate factory equipment. Now the Omsk Government has undertaken to develop the industry in Siberia and for that purpose is offering 30,000 acres of land and other privileges to each factory.—(*U.S. Com. Rep., July* 8, 1919.)

Production of Wolfram in Portugal.—Many tungsten minerals are found in the central and northern Portuguese provinces of Minho-e-Douro, Traz-os-Montes, Beira Alta and Beira Baixa, and the ore worked averages 55—65 per cent. of tungstic acid. The total production is estimated at 900—1500 tons yearly. Before the war the cost of production was approximately 300—450 escudos (£67—£100: escudo=4s. 5½d.) per ton, but recently this has risen nearly 200 per cent. The mines are owned by an American company, and all the ore produced is exported. The industry has been paralysed since the termination of hostilities. Mine owners have protested against the production tax of 180 escudos per ton, imposed in 1917, for there is also an export duty of like amount. A commission is now considering a new law to be presented to the Government, which it is hoped will remove many of the obstacles impeding the development of this industry.—(*U.S. Com. Rep., July* 24, 1919.)

LEGAL INTELLIGENCE.

CUSTOMS SEIZURE OF PYROGALLIC ACID.—*J. Brown v. W. Buckley.*

Before the Vacation Judge, Mr. Justice Greer, on September 24, a motion was heard on behalf of the plaintiff in an action by John Brown, dealer in chemical materials, of London and Manchester, against W. Buckley, an officer of H.M. Customs and Excise at Manchester. The plaintiff asked for an interlocutory injunction to restrain the detention of 5 cwts. of pyrogallic acid bought by him from the Mallinckroft Chemical Works, Ltd., of Montreal, Canada, and shipped from New York to Manchester in July and August, 1919.

It appeared that, according to the plaintiff's case, the goods were detained by the Customs authorities at Manchester upon the authority of a Royal Proclamation made in connexion with the Customs Consolidation Act, 1876 (Sec. 43), which said "the importation of arms, ammunition, gunpowder, or any other goods may be prohibited by Proclamation or Order in Council." The plaintiff said that the Act did not purport to prohibit the importation of pyrogallic acid, nor could the acid conceivably come within the categories of goods set out in the Proclamation in question. Further, even if pyrogallic acid was covered by any general description in any Prohibition of Import Proclamation, it was a chemical well known as a commercial article, was only used in the development of photographs, and it was in no sense a substance which could come under the general description "ammunition or gunpowder," nor was it in any sense a substance *ejusdem generis* with those substances. Plaintiff maintained that the detention was wrongful and asked for relief.

The Attorney-General (Sir Gordon Hewart), for the Customs authorities, submitted that as the plaintiff had started an action in which the whole question of the validity and meaning of the statute would be raised, the present interlocutory application was misconceived. He also said that the meaning of the Section was by no means as clear as had been suggested on behalf of the plaintiff. The Customs were anxious that it should be dismissed and decided when the trial came on, but not upon an interlocutory motion. Even if the plaintiff succeeded the order would be nugatory, as the goods were under the control of the Board of Customs subject to the Act.

Mr. Justice Greer said that he could not decide the question now; it was one of general importance to merchants, and the parties must apply to Mr. Justice Younger (in whose list the action was set for an early trial). While giving no decision, he was inclined to think that the construction contended for on behalf of the plaintiff was correct. He refused the application, and made no order as to costs, except that they should be reserved to the trial of the action.

APPLICATION FOR USE OF GERMAN PATENTS.

An application was made on October 7 to the Comptroller of Patents on behalf of Messrs. Brunner, Mond and Co., Ltd., for licences to work under ten patents of the Badische Anilin and Soda Fabrik, nine of which apply to the manufacture of ammonia and one to the purification of oxygen. The patents in question are Nos. 17,642/09, 17,951/09, 14,023/10, 19,249/10, 19,778/10, 5833/11, 5835/11, 21,151/11, 28,167/11, and 44,509/10.

The grant of the licences was recommended.

C

REPORTS.

FUEL ECONOMY.

A REPORT ON THE PRESENT STATUS OF FUEL ECONOMY IN THE GERMAN IRON AND STEEL INDUSTRY OF THE OCCUPIED TERRITORY ON THE LEFT BANK OF THE RHINE. *Presented to the Iron and Steel Institute by* COSMO JOHNS AND L. ENNIS.

This report records the condition of affairs as found in April, 1919, but owing to the peculiar industrial conditions then prevailing, the trend of progress, as conceived by the authors, is also indicated. The iron ores of the Lorraine district contain less than 30% iron, but can be made up into self-fluxing mixtures which require an addition of one-third of their weight of coke. Except in the Saar Valley few works have their own coke ovens, but depend upon rail-borne Westphalian coke. It was found that the coke constituted 54 per cent. of the cost of pig iron.

The Germans have concentrated their efforts upon the best utilisation of furnace gas. The actual coke consumption per ton of pig iron was (April, 1919) 1125—1500 kilo., being about 200 kilo. greater than the pre-war consumption. One new furnace in the Rombas works was noticed with only three stoves, but with the addition of two recuperators, which utilised the heat in the combustion products from the stoves to pre-heat the air used for combustion.

The dust content of the gas was always reduced to about 0·1 grm. per cu. m. before being used for any heating purpose. Wet towers and fans, the Zschocke wet system, and the Halberg-Beth dry system were noted, and at all works great importance was attached to this matter. With clean gas the efficiency of the stove is increased, leaving a greater surplus for other purposes. Theisen washers were used for the second cleaning of the gas for internal combustion engines; these reduced the dust content to about 0·002 grm. per cu. m., and served to cool the gas. A feature of the works visited was the installation of large gas engines of 1500—5000 h.p., working on cleaned furnace gas. The policy was to make the best use of the power thus generated for the compression of air for blast furnaces and converters and for generation of electric power for rolling mills, etc., so that the maximum quantity of surplus gas was available for steam raising and for furnace heating. Although the gas engine was prominent in the system, steam-turbine-driven generators were usually added to provide elasticity. At the Volkingen works the exhaust gases of a 3000 h.p. gas engine were used in a waste heat boiler.

In most cases the blast furnaces are combined with the steel works, the bulk of the liquid pig iron being treated by the basic Bessemer process. The basic open-hearth furnaces, dealing with scrap from the mills, used 20—25% of pig iron in their charges and produced ingots with a coal consumption of 250 kilo. per ton. Pig iron containing less than 1% silicon and 0·06—0·07% sulphur was being regularly made and did not necessitate the use of active mixers. Such mixers as were used were simply heated by blast furnace or coke oven gas.

The furnace gas contained 10% CO_2, 28% CO, 4% H_2. The tendency is to use regenerated or enriched blast furnace gas for the purpose of reheating ingots.

The power requirements of the majority of steel mills are at present met by tandem compound condensing steam engines, the steam being generated mainly in gas-fired boilers. The Hagondange mills, however, are completely electrified, and probably this represents future practice after the linking up of power stations has been developed.

Proposals which have not yet established themselves in practice are:—1. The electrostatic precipitation of dust from the furnace gases. 2. The enrichment of blast with oxygen. 3. The conservation of the surplus furnace gas at week-ends.

The authors' recommendations for the promotion of fuel economy are:—1. The furnace gas should be cleaned without loss of sensible heat where possible. 2. All power should be generated in gas engines with only such steam turbines as are necessary to provide elasticity. As much steam as possible should be furnished by waste-heat boilers of the fire-tube type attached to the gas engines. 3. Power stations should be linked up to render practicable the electrification of steel works. 4. Cleaned furnace gas should be the principal fuel in melting and reheating furnaces, and also, after enrichment, in open-hearth furnaces.

REPORT ON TRADE CONDITIONS IN BRITISH EAST AFRICA, UGANDA, AND ZANZIBAR. BY T. SLEITH. *Department of Mines and Industries, Union of South Africa. Pp. 64. (Cape Town: Cape Times, Ltd., 1919.)*

In 1918 the author of this report was commissioned by the Union Government to undertake a tour lasting four months with the object of investigating the possibility of stimulating trade between these East African colonies and the Union of South Africa. The main impression he brought back was that Central Africa is of primary and paramount importance to the Union as a source of certain raw materials and products. There exists an unlimited supply of copra, palm oil, groundnuts, sim-sim, sisal, beeswax, hides, and skins, and other commodities of equal industrial importance.

British East Africa.—The principal exports are, in order of decreasing value, hides and skins, fibre, grain and oil seeds, coffee, carbonate of soda, copra. The export of hides and skins will grow as the cattle industry develops. More than 96% of these exports, valued at £156,056 (ox hides, £123,396; goat skins, £31,294) go to the United Kingdom.

Attention is again being directed to the wattle bark industry, hitherto a failure owing to low prices, high freights, and to climatic conditions preventing the air-drying of the bark; 16,000 acres is now under black wattle, and the erection of tannin works is contemplated.

Sisal constitutes 98 per cent. of the total production of fibre; £129,555 worth was exported in 1917, and practically all of it went to the United Kingdom. In 1917, 20,000 acres was under sisal; it is now the premier crop of the Protectorate, although the cultivation, which is not suitable for small settlers, was begun only in 1908. The pre-war price in London of £35 to £45 a ton rose in 1918 to about £100. Much attention is being given to the cultivation of flax, of which there is now about 10,000 acres in the Protectorate, but this area will soon be very largely increased. Cotton is not at present to be reckoned among the resources of British East Africa, nor is wool, of which the exports are valued only at £12,327.

Owing to the local consumption of grain by the military forces the total exports of grain and oil-seeds have recently much diminished; sesamum is the principal crop. The cultivation of maize, for which there is cheap labour and illimitable land of suitable quality, is extending.

The production of copra is practically stationary. In 1917, Italy and France took over 80 per cent. of the total of 28,748 cwts. exported.

The Magadi Soda Lake, 60 miles south of Nairobi, covers 30 square miles and contains an inexhaustible supply of very pure natural soda (constantly being added to by the hot springs) of which 200 million tons is actually exposed. The crystalline blocks consist of a sesquicarbonate of soda free from sulphate which, after drying and crushing, is exported in bags to America, Great Britain,

Africa. This natural soda contains twice as much sodium carbonate as soda crystals, and is therefore economical as regards freight; it is stable in air and may be used instead of high-grade soda ash. In block form it is used in Africa and India as a "salt-lick" for cattle. The quantity exported in 1917 was 2163 tons, valued at £45,056. The production is expanding rapidly.

Soap was imported from Europe in 1917 to the value of £70,000. The South African product of equal quality is said to be excluded by a territorial arrangement between the leading manufacturers. Candles are obtained at present from Burmah and India. The current supply of matches from Japan and India is of the very poorest quality.

There are enormous timber reserves in British East Africa, the greater part being found in the Highlands. Certain areas are being exploited, and the industry is expected to become very important in the near future. Very little timber has so far been exported, but the Government is considering the question of improving harbour facilities for this purpose. The chief varieties available are:—Ironwood, *Olea hochstetterii*, which is almost identical with the South African ironwood—*Olea laurifolia*. It is of great strength and durability, and possesses a very beautiful grain. Its weight is 59 lb. per cub. ft., and there are approximately 500 cub. ft. to the acre. Another excellent wagon wood is "red stinkwood," *Pygeum Africanum*, which, when seasoned, weighs 48 lb. to the cub. ft.; it is not plentiful. Yellowwood, *Podocarpus tracilier* or *Podo*, is comparable with the Kauri of New Zealand. It makes good railway sleepers and construction timber when creasoted. A great future is predicted for this timber, of which many hundreds of thousands of acres exist. The yield is 2000 cub. ft. to the acre, and the weight 37 lb. per cub. ft. Cedar or *Juniperus procera*, which is also very abundant, is much used for building purposes, and is immune to white ants. After 5 years' air drying the average weight is 36 lb. per cub. ft. The price of each of the above-mentioned woods was Rs. 5 per cub. ft. f.o.b. Kilindini.

The Indian community plays a very important part in the commercial affairs of this Protectorate, and a very powerful "Indian Association" exists to promote the interests of Indian traders.

Uganda. Here also the Indian trader is prominent, and his influence is extending. The cultivation of cotton, extending over 133,000 acres, is almost entirely in native hands and is increasing yearly. In 1917, the exports were worth £560,000. Attempts to cultivate sisal some years ago were abandoned. Flax has recently been planted on an experimental scale. The plantain, grown extensively for food, may prove a source of fibre, and the production of raw silk and paper pulp (from elephant grass) are possible developments. Between 10,000 and 15,000 tons of cottonseed, yielding about 12 per cent. of oil, is available annually, but owing to the cost of freight it is practically valueless, and is used for fuel or manure.

Exports of sim-sim in 1916—1917 were 1905 tons. The bulk of the groundnuts and sim-sim formerly went to France. The castor oil plant, the shea nut tree and others of potential value for oil extraction grow wild in Uganda, but have not been commercially developed. Small quantities of beeswax are available. The acreage under Para rubber is about 6000, and of other varieties about 1500; the cultivation is extending. Efforts are being made to improve the quality of hides and skins, of which 1100 tons was exported in 1917-18. Since 1914 native timber has successfully replaced the imported, but there is at present no indication of the development of an export trade. No coal or other minerals of importance have been discovered, and wood fuel is used exclusively. Among the products in demand are paints and distempers and cheap perfumery.

Zanzibar. Clove cultivation, mainly by Arabs, is the chief industry, and about 60,000 acres is under cloves in the islands of Zanzibar and Pemba which yield the bulk of the world's supply. Exports in 1917 were valued at £436,242, of which 66% went to India, 17% to the United Kingdom, and 14% to the United States. Before the war Germany was the second largest buyer. The coconut industry ranks second and the export of copra is steadily increasing, but owing to the lack of drying facilities the product is inferior to that of Cochin or Ceylon. Until the end of 1914, Marseilles was practically the sole market for Zanzibar copra; in 1915 British South Africa became a factor in the market, and later, Italy. Exports in 1917 to the value of £299,653 were distributed between Italy (76%), British South Africa (17%), and France (3.3%). Guano can be obtained in large quantities on the islands adjacent to Zanzibar and on many other islands off the East Coast. Bunker coal, formerly imported from Wales, is urgently required, as is also ammonia for ice plants at Zanzibar and Dar-es-Salaam, and vinegar.

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED EXPORTS.

Headings transferred from one list to another.

From List A to List B:—Aircraft, other than balloons, of all kinds and their component parts, together with accessories and articles suitable for use in connexion with aircraft.

Deleted Headings.—(A) Malt; (A) beer and ale; (A) cakes and meals, the following:—Fishmeal and concentrated fish.

Trading with late enemy and other countries. The Board of Trade has issued new notes on this subject superseding those published in July last. The notes cover the following countries:—Germany; the former Austro-Hungarian Dominions; Turkey and Bulgaria; Norway, Sweden, Denmark, Holland and Switzerland; Poland, Finland, Esthonia, Lettland and Lithuania.

Export Credits. The Board of Trade has made certain alterations in and additions to the scheme of export credits (this J., 1919, 339 R). Full particulars are available at the Export Credits Department, 10, Basinghall Street, E.C. 2.

NEW ORDERS.

MINISTRY OF TRANSPORT. By an Order in Council of September 22 last, the powers of the Board of Trade in relation to railways, light railways, tramways, canals, waterways and inland navigations, roads, bridges and ferries (with vehicles and traffic thereon), harbours, docks and piers were transferred to the Minister of Transport.

THE 1918 CROP RESCUTCHED TOW (IRELAND) (CANCELLATION) ORDER, 1919. Ministry of Munitions, September 26.

THE GAS AND COAL (EMERGENCY) ORDER, 1919, issued on September 26, requires gas undertakings to limit their coal consumption to the production of a gas of 15 per cent. lower quality than that previously supplied, and not exceeding 425 B.Th.U. in calorific value, and authorises reduction of pressure in gas mains at certain periods of the day or night.

MAXIMUM PRICES OF PETROL. New maximum prices were issued under an Order of the Board of Trade on October 1, and these were revised on the following day. The revised wholesale prices for spirit in cans are:—Aviation, per gallon, 3s., special boiling points 2s. 11½d., No. 1 2s. 8d., No. 2 2s. 6d. Maximum retail prices 4½d. per gall. more.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for September 25 and October 2.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 4, Queen Anne's Gate Buildings, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent.	Materials.	Ref. No.
Australia	Chemicals	673
,, ...	Dyes for leather and woollens, tanners' supplies, leather, lubricating oil	676
,, ...	Glassware, crockery, aluminium goods	680
British India ..	Glass, china, leather, soap, chemicals, medicines, perfumery ..	733
Canada	Druggists' sundries, rubber goods ..	737
,, ...	Chemicals for pulp and paper manufacture, paint, soap, fertilisers ..	*
,, ...	Glassware, china, stoneware ..	*
British West Indies	Carbon dioxide, galvanised iron (corrugated), cement, manures ..	680
Egypt	Chemicals, colours, varnish.. ..	691
,, ...	Chemicals, dyes, paint, distemper, varnish, caustic soda, lubricating oils (also catalogues and price lists wanted)	693
Hong Kong ..	Ammonium sulphate, dyes, drugs, industrial chemicals	744
Newfoundland ..	Metals, oils	742
Austria	Copper compounds, soap, candles..	746
Belgium	Piano wire, resistance wire, thermometers, resin solder	700
,, ...	Hæmatite, pig iron, spiegel, ferro-manganese, ferro-silicon	701
,, ...	Metal sheets for roofing, fertilisers	748
,, ...	Pig iron, cast steel	749
Czecho-Slovakia ..	Drugs	707
,, ..	Copper, tin, nickel, aluminium, brass, lead, tanning materials, phosphates	755
France	Boric, citric, carbonic and sulphuric acids, permanganate, copper sulphate, etc.	710
,, ...	Iron, cast iron, paint, varnish, linseed oil	715
Greece	Sugar	718
Italy	Chemicals	721
,, ...	Soap, perfumery	761
,, ...	Oils, fats	†
Norway	Galvanised corrugated sheets, cement	722
Spain	Tinplate, galvanised iron	726
,, ...	Sheet zinc and tin, galvanised iron..	727
,, ...	Oxalic acid, tripoli, emery, bismuth, ammonia, essences, lac, etc. ..	728
,, ...	Skins, leather, grease	729
,, ...	Essence of aniseed	766
,, ...	Iron, metals, lubricating oils ..	768
,, (Canary Isles)	Paints	731
Switzerland ..	Optical goods	771
United States ..	Hides, skins	778
Argentina, Brazil..	Pottery, stainless cutlery, etc. ..	780
Guatemala ..	Paints	783
Central and South America ..	Drugs, medicines, etc.	784

* The Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

† The British Chamber of Commerce for Italy, Via Silvio Pellico, 12, Milan.

MARKETS SOUGHT.—Canadian firms desire to get into touch with U.K. importers of natural oxides, ochres, sulphur, sulphuric acid, zinc oxide and soda ash. Inquiries should be addressed to the Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

A merchant at Hong Kong desires to get into touch with U.K. importers of peanut oil, cassia oil, aniseed oil, camphor oil, tea oil and lard. Inquiries should be addressed to the Department. [Ref. No. 745.]

TARIFF, CUSTOMS, EXCISE.

Argentina.—The export of sugar is prohibited as from Aug. 8, and the re-export after Sept. 15.

Goods for Patagonian ports may be transhipped at Buenos Aires, customs duties being paid in Patagonia.

Brazil.—The regulations laid down in the Budget Law for 1919 respecting the specification of goods in Consular invoices has been prorogued indefinitely.

Bulgaria.—The new import and export regulations are set out in full in the *Bd. of Trade J.* for Oct. 2. Among the articles on the free list are many food stuffs, condensed milk, certain vegetable oils, cod liver oil, washing soap, candles, tar, glue, vaseline, heavy mineral oil, tanning materials, coal tar dyes, mineral colours, chalk, ink, ammonium sulphate, medicines, cement, pottery, porcelain, glass, paper, cardboard, hides, skins, leather, rubber, gutta-percha, ores, metals, alloys, and scientific instruments.

Czecho-Slovakia.—The conditions generally governing the issue of import licences and the payment for shipments are given in the *Bd. of Trade J.* for Sept. 25. Articles in demand include seal oil, iron ore, ferro-manganese, salt, nickel, copper, tin, zinc ore, saltpetre, phosphates, magnesia, pyrites, rubber, tallow, turpentine, amorphous phosphorus, quebracho extract, and hides.

Cuba.—Only legally authorised pharmacists and druggists attached to a hospital, clinic or similar institution may import or produce opium, Indian hemp, chloroform, ether, chloral hydrate, morphine, narceine, heroine, dionine, poronine, cocaine, novocaine, tropocaine, eucaine, stovaine, mariguane, and other products specified as being prejudicial to health.

The original order may be seen at the Department of Overseas Trade.

Egypt.—The customs duty on copper, brass, tin, lead, zinc, antimony, quicksilver and phosphor bronze has been amended as from Sept. 1.

Esthonia.—A copy of the regulations governing foreign trade is set out in the *Bd. of Trade J.* for Sept. 25. The importation of, *inter alia*, iron, steel, grain, sugar, salt, petroleum, benzine, naphtha, lubricating oil, machine and cylinder oils, and leather may be effected without special permit. The import of fancy goods and unnecessary articles is entirely prohibited. The import of all other goods is only permitted by the sanction of the Council for Foreign Trade.

France.—Wine may now be imported without restrictions subject only to the usual customs formalities.

Germany.—General import prohibition remains in force, but lists of free imports will be issued. All raw materials are to be admitted without licence, but half-finished and finished goods will be under control.

Italy.—The new tariff is unlikely to become effective until next year.

Netherlands.—The prohibition of the export of ether has been temporarily raised.

Morocco (French Zone).—The prohibited export list still includes cereals, wood charcoal, and soap.

Rhodesia.—Certificates of origin and interest are no longer required for goods imported into Southern Rhodesia.

South Russia.—All exports from South Russia are duty free.

The sugar monopoly has been abolished and excise duties are now leviable on sugar, matches and tea.

United States.—It is proposed to promote the production of tungsten ores and manufactures thereof by levying a customs duty upon imported tungsten, its ores, alloys and concentrates.

COMPANY NEWS.

MAGADI SODA CO., LTD.

At the eighth ordinary general meeting, held in London on September 22, Mr. S. Samuel, M.P., who presided, said that the trading loss of £48,954 was more apparent than real, as a large proportion of the expenditure on labour would not recur. The sales, less charges, amounted to £12,081. Very serious labour troubles had occurred in East Africa just when production was on the point of starting. The cost of labour had increased by about 200 per cent., and owing to the war it had not been possible to carry into effect the decision to eliminate as far as possible manual labour by substituting mechanical appliances. About the middle of this year it was decided to discontinue production and devote all energies to the completion of the plant for mechanical production and transportation. The stock in hand on December 31 last amounted to £53,175, compared with £10,965 a year previously, and doubtless this would have been realised but for the armistice, which released soda ash for commercial purposes. Moreover, their product had been subjected to a higher rate of duty in India, Japan and elsewhere because it was a raw material. This difficulty would be removed when the company was producing soda ash which should eventuate in the spring of 1920. No compensation had yet been received from the Government in respect of the commandeering of the company's railway and water supply in East Africa, nor for the rent of the works at Irlam, near Manchester, but the claims were still being pressed.

Although the progress of the works in East Africa had been disappointingly slow, he could assure the shareholders that they were in sight of success; meanwhile existing contracts should bring in sufficient to pay expenses. It would be possible to sell soda ash and other products at a price which would defy competition. The production and sale of granular soda were undertaken as a temporary expedient. In conclusion, Mr. Samuel stated that in due course they would certainly be shipping soda ash to the United Kingdom, and they would be able to join issue with the monopoly at present in existence in any possible attacks it might make upon their customers in various parts of the world.

The report states that the caustic soda plant was brought to the productive stage at the end of last year, and that the product is of the highest quality. The company was originally capitalised at £1,312,500, of which £1,250,000 was in ordinary and the remainder in deferred shares. When the issue was made, in July last, of £500,000 debentures, convertible into ordinary shares up to July, 1939, the capital was increased by a further £500,000.

CALICO PRINTERS' ASSOCIATION, LTD.

Mr. Lennox B. Lee, chairman of the company, addressed the twentieth ordinary general meeting at Manchester on September 17.

As no agreement has yet been reached with the Revenue authorities on the question of excess profits duty, a report and the accounts for the year ended June 30 last have not been issued. Among the points at issue is the claim made by the Association that the expenses of restoring machinery are a legitimate charge against profits during the war period. Owing to the calling up of skilled men for Government service, it was not possible to execute repairs as they were needed, with the result that machinery suffered out of all proportion to the saving in wages effected. Another unsettled question is the treatment of stocks at the end of the period of taxation. A White Paper issued in 1917 provided for a period of two years after the termination of the tax in which losses arising from the realisation of stocks in hand should be met to some extent out of the excess profits earned during the period of the tax. There is no indication at present as to how the Government intends to fulfil this promise.

With the signing of the armistice the trade, which had been steadily diminishing, nearly ceased completely, but before the end of the financial year business had revived and during the past three months has been very good indeed. In spite of very high prices there is every probability of the demand continuing. Costs of production are increasing to such an extent that further advances in selling rates will be necessary. The shortage of colours is still acute. "We recognise the progress made by British manufacturers, and though we utilise their products whenever we can, we are still largely dependent upon Swiss supplies, which are insufficient in quantity and range to meet our needs. It is obvious therefore that advantage must now be taken to obtain a share of the stocks and output of German colour secured to the Reparation Committee of the Allies under the Treaty of Peace. All the European countries except Great Britain have obtained colour from Germany, and America is sending a special commissioner to Europe on an urgent mission in order to secure a six months' supply to meet her requirements."

The company's works and mill in France have had a satisfactory year. Trade in France has revived since March last. In June, however, the works were closed owing to a general strike in the Rouen district, and at present only about half of the printing machines is working owing to shortage of coal. The recent addition of 6s. per ton to the price in this country adds £120,000 to the Association's yearly coal bill. About ten tons of coal is consumed for every ton of cloth treated.

LAWES CHEMICAL MANURE CO., LTD.

The 45th, 46th, and 47th ordinary general meetings were held in London on September 25, Mr. E. G. Cubitt presiding.

Dealing first with the accounts, the chairman said that a settlement had been finally reached with regard to the company's liability for excess profits duty up to June, 1918. During the three years the debenture debt of £6,000 had been cleared off, and £25,300 allocated to depreciation. The contingent fund now stands at £38,000, a sum which is none too large in view of the necessity for effecting repairs and renewals which could not be undertaken during the war period. The available balance at June 30 last stood at £30,929, out of which the preference dividend of 7 per cent. will be paid, and also a dividend of 10s. per share on the ordinary shares (£10), together with a bonus on the latter of 2s. 6d. per share, leaving £9,512 to be carried forward. No further dividends in respect of the two previous years are recommended. The issued capital is £328,680.

The difficulty of obtaining adequate supplies of raw materials still remains. The output of phosphate in North Africa is still abnormally low, and the French Government is retaining a larger proportion for its own consumption. There is a scarcity of shipping to convey phosphate from America, the fertiliser trade not having succeeded in inducing the Shipping Controller to provide the necessary tonnage, in spite of the circumstance that its arrival in London would not increase the congestion at the docks. The

curtailment has seriously handicapped the export trade. The accounts for the three years ended June 30 were adopted unanimously.

ASSOCIATED PORTLAND CEMENT MANUFACTURERS (1900), LTD.

The twentieth ordinary general meeting was held in London on October 3. The chairman, Brigadier-General F. C. Stanley, in his address, referred to the closer working arrangement with the British Portland Cement Manufacturers, Ltd., in which the company holds a controlling interest. For some years past the possibility of erecting cement works in India had been under consideration, and a definite scheme to effect this proposal was now being proceeded with. The rest of the address was mainly a recapitulation of General Stanley's speech to the associated company (this J., 1919, 357 B).

The financial year ended June, 1919, was the best in the company's history. The trading profit was £564,400 and the net profit £312,400. The sum of £276,200 is allocated to depreciation, renewals, etc., the two years' arrears of interest on the preference shares are now to be paid off and a dividend of 16¼ per cent. (5¼ per cent. in the previous year) distributed on the ordinary shares, leaving £125,673 to be carried forward.

At an extraordinary meeting held subsequently, resolutions were passed changing the name of the company to "The Associated Portland Cement Manufacturers, Ltd.," and authorising the division of the existing £10 shares into ten shares of £1 each.

SALE OF THE SOAP INTERESTS OF BRUNNER, MOND AND CO. TO LEVER BROTHERS, LTD.—In a circular to the shareholders, the directors of Brunner, Mond and Co., Ltd., announce the conclusion of an agreement with Lever Bros., Ltd., whereby the latter firm will purchase for cash the ordinary shares in Joseph Crosfield and Sons, soapmakers, Warrington, and in William Gossage and Sons, soapmakers, of Widnes, which were acquired by Brunner, Mond and Co. in 1911.

THE UNITED ALKALI CO., LTD.—Arrangements have been completed for transferring the works of this company at Flint, North Wales, to Messrs. Courtaulds, Ltd.

ENGLISH OILFIELDS, LTD.—Dr. Forbes Leslie has informed the *Financial Times* that a seam of torbanite, 1 ft. 8 in. thick, has been struck in the company's ground in Norfolk, yielding 95 to 100 gallons of oil per ton (see this J., 1919, 337 B).

PRICE'S PATENT CANDLE CO., LTD.—An offer has been made by Lord Leverhulme to purchase the entire shares of this company in exchange for shares in Lever Bros., Ltd. The price involves the payment of £1,500,000 in cash and £1,270,000 in shares. It is proposed to preserve the identity of Price's Candle Co., and to retain its present directorate and management, those directors who may desire to retire receiving compensation.

BUXTON LIME FIRMS CO., LTD.—The report for the year ended June 30 last states that the net profit is £33,439, after providing for debenture interest and writing off £20,649. The dividend for the year is 5¼ per cent., and £24,132 is carried forward. The dividend for the previous year was 6 per cent., with a bonus of 2 per cent. (Issued capital, £467,780; debentures, £155,000.)

JOHN LYSAGHT, LTD.—At the meeting of this company, on September 30, the chairman referred to the branch works for sheet-rolling and galvanising established at Newcastle, N.S.W., in close proximity to the steel works of the British Broken Hill Proprietary Co. The new works will be in operation during the coming year, and if the plant in course of erection proves a success, the question of further expansion will be considered forthwith. In view of the bonus received from the Australian Government, the benefit of the tariff and the advantage as regards freight, it is anticipated that the policy of local manufacture will prove a great success.

YORKSHIRE DYEWARE AND CHEMICAL CO., LTD.—For the year ending June 30, 1919, the company secured a record net profit of £55,600, after deducting debenture interest. The ordinary dividend is maintained at 35 per cent., £35,000 is placed to reserves and £8,700 carried forward. Stocks are £26,400 lower at £173,000. The war period has been one of great prosperity for this company, and it has now been decided to capitalise £75,000 from the reserve fund. The capital is being raised from £75,000 to £150,000 by the creation of 100,000 new shares of 15s. each, which will be distributed among the shareholders on a share for share basis. Resolutions embodying these proposals were passed at the annual meeting, and confirmed at an extraordinary meeting, both held on September 30 last.

NEW ISSUES.—*The English Margarine Works (1919), Ltd.*, has been formed, with a capital of £1,500,000, to take over the English Margarine Works at Liverpool, hitherto managed as a branch of Lovell and Christmas, Ltd. These works have a capacity of 1000 tons per week, and it is also intended to purchase the margarine business of the United Creameries, Ltd., in Wigtonshire, Scotland. The capital is divided into 750,000 7 per cent. cumulative preference shares and 750,000 ordinary shares, all of £1 each. The purchase money of £310,164 is payable in ordinary shares, and the public issue of 500,000 preference shares has been oversubscribed.

The South African Carbide and By-Products Co., Ltd., has been formed, with a capital of £307,500, divided into 300,000 7 per cent. cumulative participating preference shares of £1 (income tax free up to 6s. in the £), and 150,000 ordinary shares of 1s. each. The whole of the preference shares is now offered to public subscription. The company is promoted by the Chemico Electro Co., Ltd., to manufacture calcium carbide and to extract motor spirit, tar oil, etc., from coal and shale at Ballengeich Collieries, Natal. A factory is to be erected near the collieries, which are situated on the main line between Johannesburg and Durban, at an estimated cost of £252,500, and a contract has been entered into to provide for a supply of 1000 tons per week of fine coal at 2s. per ton.

TRADE NOTES.

BRITISH.

Imports and Exports of Chemicals.—The "Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions," Vol. I., 1918, has been issued by the Board of Trade [Cmd. 342, 7s. net]. Included in this blue-book are the values, and in some cases the quantities, of the chemicals etc. imported and exported during each of the five years from 1914 to 1918. The heading "Unenumerated" is still conspicuous in these returns; thus of the total dyestuffs imported last year, 60 per cent. is unenumerated; also imported potash compounds are classified into nitrate of potash and "Other Sorts," and are entered by value only.

The total value of imported chemicals, not liable to duty, and exclusive of drugs, dyes, and manures, was £25,623,731 in 1918, compared with £14,178,199 in 1917, and £4,180,400 in 1914. Im-

ports of drugs, containing no dutiable ingredient, were valued at £3,500,056 in 1918, against £2,151,600 in 1914; dyestuffs, exclusive of tanning materials and dye woods, £3,607,516 in 1918, against £2,053,961 in 1914; and manures 465,819 tons valued at £1,953,442 in 1918, and 664,735 tons worth £1,297,214 in 1914.

The values of the chemicals and chemical preparations, other than manures and medicines, exported in 1918 and 1914 were £17,288,713 and £9,356,155 respectively. Exported manures were valued at £921,019 in 1918, and £4,886,474 in 1914; and medicines £2,562,711 in 1918 and £1,968,720 in 1914.

The Dyestuffs Licensing System and the Disposal of German Dyes.—In reply to criticism advanced by the British Chemical Trades Association that the Dye Trade and Licensing Sub-Committee set up by the Board of Trade is not fairly representative of manufacturing and consumers' interests, and that merchants' interests are entirely unrepresented upon it, the Board of Trade states that representation on that Committee cannot be increased. The Association has been given to understand that the Government will take the opinion of various bodies before formulating any definite policy with regard to the disposal of German dyes received in part payment of the war indemnity. The Association suggests that re-exportation of a proportion of the dyes at attractive prices would in some respects be beneficial to trade, and it points out that between 50 and 60 per cent. of the dyes imported into this country before the war was re-exported in the form of finished goods. While recognising that opposition to speculative trading in dyestuffs in recent years is reasonable, the Association submits that the legitimate merchant, by reason of his special organisation and trade knowledge, is a useful factor, and suggests that the dyestuffs in question should be sold in an absolutely open market in small lots, preferably by a Government Department, with expert assistance on the trade and technical side. If this suggestion is unacceptable, the Association, as representing merchants generally, is prepared to undertake the sale on a basis of actual out-of-pocket expenses, with a guarantee that such expenses shall not exceed a certain specified percentage. In any case, should any firm be appointed sole distributing agent on behalf of the Government, it is understood that such firm will not be allowed to sell to one firm and refuse supplies to another at its discretion.

The Gold Coast in 1917.—The total value of imports into this colony during 1917 was £3,386,480, a decrease of £2,613,269, or 43 per cent., as compared with 1916. This decrease was due almost entirely to the difficulty of procuring goods and the lack of tonnage to convey them. The imports of coal and petroleum increased in value by 51 and 56 per cent. respectively, although the quantity of coal imported in 1917 was less than in the previous year. The United Kingdom supplied 69 per cent. and the United States 22 per cent. of the total imports.

The value of the commercial exports from the colony during 1917, exclusive of gold and specie, was £3,810,586, a decrease of £564,680, or 13 per cent. of the corresponding value for 1916; 65 per cent. of these went to the United Kingdom, 12 per cent. to France, and 18 per cent. to the United States. The following table gives the quantities and values of some of the principal articles exported in 1917:—

Cocoa .....tons	90,964	£3,146,851
Kola nuts .....lb.	11,984,645	£239,134
Copra .....tons	736	£19,916
Auriferous by-products lb.	37,501	£22,316
Palm kernels .....tons	4,768	£74,911
Palm oil .....galls.	198,900	£24,770
Rubber .....,lb.	2,961,204	£110,272

The rubber exported increased in value by £31,407, or 40 per cent., and was four times that exported in 1915. This boom was due to better prices and greater demand from Great Britain, and resulted in a better quality of rubber being obtained by the natives, who took more care in its collection and preparation for sale. The copra industry is being developed in the Quittah district. The exports of cocoa show a decrease of 18 per cent. in value, but an increase of 26 per cent. in quantity. Ships have been compelled to give preference to freights of palm oil, palm kernels and ground nuts.

Experiments on the extraction of cocoa butter have been carried out at Aburi. Extraction by primitive means gave a yield of 17 per cent. from unfermented beans. The matter is being taken up by the Agricultural Department, on account of the abnormal depression in the local cocoa market.

The mining of manganese ore in the Dagwin Concession has already been referred to in these columns (this J., 1918, 57 R, 458 R; 1919, 319 R). —(*Col. Rep.-Ann.* No. 988, *Aug.*, 1919.)

FOREIGN.

The Rubber Industry of Japan.—The satisfactory progress made by the Japanese rubber manufacturers during the period of the war will be evident from the figures in the following tables. Judging from the import of crude rubber, which has more than doubled during the three years under review, the annual value of the output of manufactured rubber goods in Japan at the present time probably exceeds six million pounds sterling. In particular notable progress appears to have been made in the cable industry, which has displaced cycle tyres from the first position on the export list of manufactured rubber goods. In connexion with an important contract for sheet and hose to be placed by a foreign Government, the four rubber factories in Tokyo have come to a working agreement regarding the quality to be supplied, and this action is thought by the trade to foreshadow an amalgamation which should greatly strengthen the position of the Japanese rubber industry.

IMPORTS.

Article.	1918. Quantity.	1918. Value. (£).	1917. Quantity.	1917. Value. (£).	1916. Quantity.	1916. Value. (£).
		£		£		£
Crude rubber	5,761*	1,094,756	3,043*	753,114	2,567*	637,189
Automobiles..	1,483	369,414	733	130,761	167	35,123
do. Fittings	—	243,696	—	94,627	—	29,884
Bicycles ..	1,203	25,290	843	11,871	1,176	7,951
Tyres ..	378	105	2,063	533	5,353	1,999
Belting ..	—	38,768	—	28,190	—	20,753
Insulated cables	—	665	—	—	—	129,466
Waterproof cloth ..	—	1,272	—	2,439	—	2,489
Elastic bands	—	30,189	—	2,153	—	25,826
Insulating tape	—	2,385	—	2,626	—	2,727
Dental rubber	—	8,874	—	9,108	—	9,906
Sheet & hose..	—	27,624	—	14,331	—	12,562
Toys	—	5,401	—	3,737	—	3,164

*Tons.

EXPORTS.

Article.	1918. Quantity	1918. Value. (£)	1917. Quantity	1917. Value. (£)	1916. Quantity	1916. Value. (£)
Rickshaws	2,407	12,776	6,395	26,760	8,044	29,235
Bicycles ..	6,146	27,132	4,855	15,418	—	—
Tyres ..	2,061,636	383,042	2,008,237	376,778	1,939,008	381,068
Insulated cables ..	—	658,156	—	280,755	—	101,640
Miscellaneous	—	99,391	—	52,972	—	—

REVIEWS.

ÉTUDES DE PHOTOCHIMIE. *Par* VICTOR HENRI. *Pp. vii.* + 218. (*Paris: Gauthier-Villars et Cie.*, 1919.) *Price* 18 *francs* + 20%.

This book is the first of a short series of monographs which Prof. Henri hopes to publish in the near future. This volume makes a real contribution to the literature of physical chemistry, and contains a fascinating account of the work of a man of great reputation in the field of absorption spectra and photochemistry. It engenders also ceeded in inducing the Shipping Controller to volumes.

In his preface the author explains how he was invited in the early days of the war to take up important work in Russia, and how the greater part of the writing has been done in Moscow and Petrograd. It is possible that to this cause is due a somewhat striking want of reference to work carried out in other cities than Paris. It may be that the extraordinary history of Russia during the last three years has caused the author introspectively to discuss the researches carried out by himself and his colleagues without realising that the laws he enunciates as new had already been published. Various statements made in the course of the book would lead to the belief that the author has not had full opportunity of consulting the work of other experimenters that has been published during the last three or four years. In the case of most books this would be a damning criticism, but it must be remembered that recently the study of absorption spectra has gained a much broader outlook. The quantitative relations enunciated by the author between the frequencies exhibited by substances in the infra-red and ultra-violet regions have opened out a new vista, and while not original they have been independently and amply confirmed. To all who read this book it will be obvious that the chapters have been written at different times with perhaps long periods of time intervening between them. This fact, taken in conjunction with the author's experiences in Russia, will justify our ignoring the above criticism, and the unmentioned authors will surely concur in this.

It is interesting to note that Prof. Henri has entirely treated the subject from the point of view of classical mechanics. Now there is little doubt that the energy quantum theory meets with its greatest success in its application to the phenomena of absorption of radiant energy, and yet this theory only finds scant mention from Henri's pen. This is not the place to discuss the arguments for and against this theory, but when it is remembered that the stabilisation of this theory is so intimately bound up with the quantitative measurements of the absorption and radiation of energy some regret must be felt that no attempt is made to discuss it. Its conception was a real contribution to scientific thought, and it cannot be ignored. One is tempted to believe that this omission is due to the fact that about six years ago Henri and Wurmser published some results which apparently contradicted one of the laws derived from the theory, namely, Einstein's photochemical law. If so, this is unfortunate, since it is highly probable that the contradiction is not a real one, but arose from a want of consideration of the whole photochemical process, as pointed out by Trautz and others. Further, it is unscientific to belaud or condemn any theory which is based only on a single set of unconfirmed observations. To anyone who seeks unbiased after truth it may be said that the quantitative results published by Prof. Henri seem to afford the best evidence yet found in favour of the quantum theory. Further, it would seem that the theoretical conceptions given by the author are at times a little strained, and do not always agree with observations that have been recently published.

Apart from these criticisms the book is admirable. Like every book from the pen of a French scientist, it is thoroughly well written, clear and lucid. It is divided into three sections, the first dealing with the experimental methods. In the second section the author shows how it is possible to calculate the absorption curve of one substance from those of other analogous substances, while in the last section the question of molecular constitution is discussed. The number of observations made by the author and his colleagues is very large. The infra-red and ultra-violet absorption, together with the dispersion, of over 230 substances have been accurately measured. The material on which the author bases his calculations is thus very extensive, and it embraces examples drawn from all the principal classes of organic compounds.

The results given in the chapters dealing with the calculation of absorption bands are peculiarly interesting, for they afford very clear evidence of the extent of the new developments in absorption spectra observations. Apart from the great accuracy necessarily inherent to such measurements, these calculations establish more definitely the remarkably intimate connexion which exists between the molecular frequencies possessed by a substance in the very long wave and very short wave regions of the spectrum. The support given to the arguments first advanced by Lord Rayleigh and by Bjerrum in this connexion is exceedingly strong. They, moreover, confirm very clearly some previous observations that molecular frequencies are directly derived from frequencies which are characteristic of atoms and groups of atoms.

This most attractive book can be strongly recommended to all interested in the modern physical developments of chemistry; it will not only serve to correct some wrong impressions which have gained currency in respect of past work, but will indicate the great possibilities of future research in this field of absorption spectra and photochemistry.

E. C. C. BALY.

PUBLICATIONS RECEIVED.

AN INTRODUCTION TO THEORETICAL AND APPLIED COLLOID CHEMISTRY. ("THE WORLD OF NEGLECTED DIMENSIONS.") *By* WOLFGANG OSTWALD. *Translated by* M. H. FISCHER. *Pp.* 232. (*New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1917.) *Price* 11*s.* 6*d.*

CATALYSIS IN THEORY AND PRACTICE. *By* E. K. RIDEAL *and* H. S. TAYLOR. *Pp.* 496. (*London: Macmillan and Co., Ltd.* 1919.) *Price* 17*s.*

THE CHEMISTRY OF COLLOIDS. *Part I., Kolloidchemie. By* R. ZSIGMONDY. *Translated by* E. B. SPEAR. *Part II., Industrial Colloidal Chemistry. By* E. B. SPEAR. *A Chapter on Colloidal Chemistry and Sanitation. By* J. F. NORTON. *Pp.* 288. (*New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1917.) *Price* 13*s.* 6*d.*

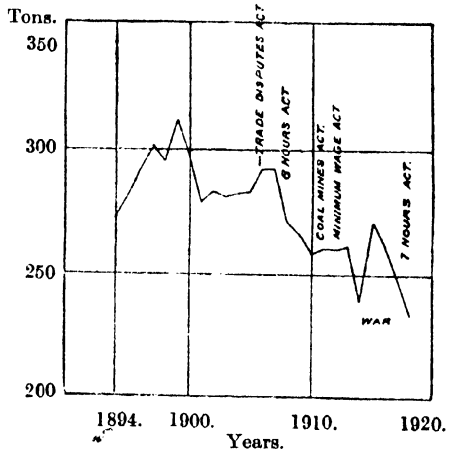
COMMERCIAL OILS, VEGETABLE AND ANIMAL. *With special reference to Oriental Oils. By* I. F. LAUCKS. *Pp.* 138. (*New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1919.) *Price* 6*s.*

CHEMICAL CALCULATION TABLES. *For Laboratory Use. By* H. L. WELLS. *Second edition, revised with a Double Thumb-Indexed Logarithm Table. Pp.* 43. (*New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1919.) *Price* 6*s.* 6*d.*

FUEL ECONOMY.

There has been no subject amongst all the varied issues involved in post-war reconstruction which has been more extensively discussed than that of fuel economy, and there is probably none of more importance to the entire community. It must not, however, be assumed that this, though an urgent post-war problem, owes its origin entirely to the war. For many years we in this country had the advantage of a cheap and abundant coal supply, and as a natural consequence of this state of affairs we made a most wasteful use of this important product. Gradually, as the seams of coal that were most easily and most cheaply won were to a large extent exhausted, and it became necessary to draw upon thinner and deeper seams for our supplies, our superiority in natural advantages became less marked, though the effect was to a great extent masked by the introduction of mechanical appliances and the improvement in our methods of coal getting. The decrease in the production of coal per worker is shown by the following graph, which shows a constant downward tendency since 1899, although it has been most marked since 1915. Of course there are fluctuations depending on the state of trade and conditions of the markets, but none of these can account for the steady fall in recent years, which has been so serious that the output per man per annum is to-day only two-thirds of what it was twenty years ago.

Output of Coal in Tons per Surface and Underground Worker.



The natural decrease above referred to has been immensely intensified by a succession of legislative enactments which have gradually tended to remove the coalminer's incentive to work; the effect of the Eight Hours Act (1908), and still more of the Minimum Wage Act (1912), has been most marked, so that the country is now faced with the serious situation that our supply of coal will not only be very much dearer, but will also be very much less than it has been in earlier days. The increase in cost is the less grave danger of the two, but the probability that the country's output of coal will fall below the country's needs, if we are to maintain a sufficient volume of exports to pay for the necessaries of life that we have to import, is a danger the magnitude of which can hardly be over-rated. It is this pressing danger that renders the problem of Fuel Economy one of such great national importance, and it is small wonder that it has formed the subject matter of reference to numerous Government Committees and Commissions and that both the British Association and the Iron and Steel Institute have discussed it at length within the last few weeks. In spite of the immense amount of attention that has thus been devoted to Fuel Economy, it is a curious fact that no one has yet defined precisely what is meant by the phrase. It can, however, be interpreted in quite a number of different ways; in the first place, a broad distinction must be drawn between what may be called thermal economy and commercial economy. Taking the case of a works requiring large quantities of steam both for power and for heating purposes, it is quite obvious that it would in probably every case be possible to decrease its weekly coal consumption by putting in the very best types of boilers and engines, and by utilising to the utmost every portion of "waste" heat. In this way the work could be carried on by the initial expenditure of fewer heat units—that is to say, by the consumption of a smaller tonnage of coal, and this would be a case of thermal economy. It might well be, however, that the money value of the coal so saved would be considerably less than the interest on the capital required to make the necessary alterations, taking, of course, due account of the depreciation of the new plant thus installed, and if this were the case, the alteration, though thermally economical, would become commercially wasteful. Again, it might be possible actually to increase the coal consumption, and to recover a large number of valuable by-products, the sale of which would bring in an annual sum of money greater than the cost of the additional coal; under these conditions commercial economy might be attained at the cost of thermal extravagance. Suppose, however, that the by-products included such substances as fuel oils, the thermal value of which is greater than that of the additional coal consumption, the total fuel economy might be increased, though the fuel consumption in the works themselves might be greater. The subject is therefore an extremely complex one, and disregard of any of the multifarious conditions is apt to lead to false conclusions. For example, the Final Report of the Coal Conservation Sub-Committee of the Reconstruction Committee advises the erection of large central "super-plants" for the generation of electric power, which would then be distributed from these central plants to users, on the ground that greater economy in the consumption of the coal used to generate the electric power would result, whilst it would also be possible to extract the valuable by-products of the coal. This is quite true as far as it goes, but no account appears to have been taken of the coal lost in transmitting the electric current from the central station. Assume for the sake of argument that a "super-plant" is erected and that electric current is required 50 miles away from it. It is doubtful whether in practice electric current could be transmitted 50 miles with a smaller loss in leakage, resistance, etc., than 10 per cent., so that if 1000 tons of coal were used in generating electric current, only the equivalent of 900 tons of coal would be delivered at the point where the power was required. If, on the other hand, the coal were carried 50 miles by train and converted into electric current at the spot where it is required, the locomotive hauling the train would not burn more than three tons of coal, so that 997 tons of coal would be available for the generation of electricity. Even allowing for the possible economies of very large as against medium-sized plants, it is obvious that the "super-plant" would not economise coal, but quite the reverse, in spite of the contentions

of the Coal Conservation Sub-Committee. Although thermal economy would thus not be attained, there might be savings in other directions, and it is quite possible that commercial economy might result. The question that probably should be looked upon as the most important in this connexion is, "Which form of fuel economy is best for the nation as a whole?" It is not suggested that this question admits of any simple definite answer, and indeed it has already been shown that the data available are not likely to allow of any ready generalisation, whilst their complexity renders it highly probable that each special case will require individual consideration. All that it is desired to do here is to direct attention to the fact that the problem is a highly complex one, that there are a large number of factors, many of them necessarily conflicting, that must be taken into consideration, and that any attempt to find a legislative solution to be applied indiscriminately to the entire country is bound to be attended with failure, and may very easily be productive of more harm than good.

RECOVERY OF NITRE AND PITCH FROM "SMOKE CANDLES."*

E. R. THOMAS.

Among the various duties of an ammunition officer in the field is that of the disposal of dangerous and unserviceable ammunition, the latter being, as a rule, considered unsafe for storage.

Those stores such as "Ground Flares" (consisting of shellac and nitrates) and "Smoke Candles" (pitch and potassium nitrate) which depend for their efficiency on the dryness of the priming composition used for their ignition, are particularly liable to deterioration on exposure, and large quantities are found on examination to be unserviceable.

The author was horrified to find that the unserviceable flares and smoke candles were being burnt or dumped in the English Channel with a considerable expenditure of time and labour. Although he had been advised to conceal his knowledge of chemistry—advice not without its point—he set out to find some simple method for recovery of the pitch and potassium nitrate from the smoke candles. This was soon elaborated, and, with the aid of a band of Chinese coolies, over a ton of pitch and nearly a ton of potassium nitrate were produced daily.

The methods were crude. The extraction was done in Soyer stoves, and the crystallisation in unserviceable cartridge cylinders. The stirrer was part of a broken ammunition box, and the fuel was waste wood from the same source. After all expenses were met, the work resulted in a profit of at least £20 a day, while at the same time avoiding the expense involved in the destruction of the stores.

The pitch was mixed with sand and used as a substitute for timber for flooring purposes. The work was also carried out at two convalescent camps where the labour cost was nil. In both places very large "Physical Training Huts" were completely floored with material from the recovered pitch. The potassium nitrate was stored and ultimately returned to England.

The success of these operations led to their authorisation and extension to many classes of unserviceable ammunition previously dumped in the Channel.

* From a paper entitled "An Ammunition Chemist in the Field," read before Section B of the British Association for the Advancement of Science, Sept., 1919.

GLASS MANUFACTURE AT THE END OF THE WAR.*

MORRIS W. TRAVERS.

During the war many British glass factories were engaged to a very considerable extent in producing goods and materials which had previously been partly or wholly imported from enemy countries, but which were equally indispensable in war or peace. Plant and labour were diverted to these special purposes; and some branches of the industry in which the country had already secured a predominant position suffered severely, other branches developed, and entirely new branches of the industry were established. In common with all other industries, the glass trade suffered severely from shortage of labour and material, and particularly owing to the fact that as soon as the lads became sufficiently highly trained to be really useful workmen they were often called up for military service. Furnaces and plant had been worked beyond the economic limit, and were badly in need of repair before the signing of the armistice made it no longer necessary to carry on at all costs. The fact that much of the new constructional work carried out during the war was essentially of an emergency character, carried out with war materials and at war costs, has also to be considered when reviewing the position at the end of the war.

The British glass trade may well be proud of the part which it has played in the war; but there is no little danger that while we continue to celebrate our victories, we may lose the opportunity of consolidating our position. Any scheme devised for the safeguarding of the industry can only be effective if the industry strain every effort to attain to the highest pitch of efficiency; for we may be certain that our late enemies will also strain every effort to win back the positions which they formerly held. They have still their factories, generally in good working order, much of their trained labour and management, and above all a great store of knowledge and experience.

Circumstances arising out of the war have done much to dissipate the idea that success in industry depends upon the possession of trade secrets. The Society of Glass Technology and the new trade associations have already done much to bring manufacturers together, and to promote the spirit of co-operation. Such research as has been carried out during the war has aimed rather at the solution of problems arising out of the need for producing goods previously imported from enemy countries, and it is difficult to lay one's hand on a really original discovery in connexion with glass. However, the lines which future investigations must follow are fairly well defined.

The difficulties attending the scientific investigation of glass are extraordinary. We have as yet no knowledge of the nature of glass, and experimental methods have yet to be developed. Glass is often vaguely referred to as "a super-cooled liquid rather than a solid," and sometimes as a "colloid." Certain opaline and coloured glasses certainly contain ultramicroscopic particles; but though there is reason to believe that the complex technical glasses are not simple super-cooled liquids, positive information as to their true character is lacking. Vague speculation in the absence of facts is unprofitable.

The difficulty of investigating the properties of technical glasses is enhanced by the fact that, unless

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the precautions taken in the manufacture of optical glass are observed, different samples of glass from the same pot may vary materially in composition. Technical glasses often, if not usually, actually represent unstable systems. That it is difficult to find any close relationship between the composition and properties of technical glasses is not, therefore, to be wondered at. At the outbreak of war the independent workers who undertook the investigation of glass must have been struck with the paucity of journal and text-book literature on the subject, and with the fact that such literature as existed contained no practical details and few analyses. In the case of miners' lamp glasses official tests were established, and the requirements of the makers of lenses, etc., were definitely known. It appeared, however, that few chemists ever tested the glassware they used in their laboratories; the results of a few tests had been published, but as to which of the various brands was really the best was rather a matter of opinion, or even of prejudice, than of scientific proof.

It is generally recognised that, at a comparatively early stage in the war, British manufacturers succeeded in producing glasses for many essential purposes which compared very favourably with the foreign goods, but it will be unfortunate if they fail to realise that there is yet scope for improvement. No resistance glass for chemical glassware has yet been discovered which is sufficiently highly resistant to all ordinary reagents to be considered to be an approach to perfection. It must be admitted that the lamp workers (workers at the table blowpipe) have reason to be highly dissatisfied with the general quality of the tube with which they have had to work. Difficulty of obtaining materials has certainly been a handicap to the manufacturer. However, it is a fact that, while a first-class lamp-working glass must be soft, and must have a low melting point, these glasses "plain" (free themselves from seeds or bubbles) only when very strongly heated in the furnace. The poor quality of much of the tube manufactured in this country is due to the fact that the furnaces are not capable of working at high enough temperatures.

Almost nothing is known of the chemistry and physics of the founding and plaining of glass, exactly why it is, for instance, that a "checked" pot of metal will not "plain," or how and why the various kinds of cords are formed. We have very little quantitative knowledge of the properties of plastic and liquid glass, and very few attempts have been made to work out methods of investigation. Glass has, of course, no melting point, but perhaps the point of cohesion of two pieces of glass in optical contact, which seems to be quite sharp, may serve as a physical constant. The viscosity of glasses, about which nothing is known, is a matter upon which information would be of use to manufacturers who employ mechanical methods of glass blowing.

There is considerable scope for investigations on the materials used in the glass trade, particularly with a view to substituting cheaper materials for those in use before the war. The best quality of resistance lighting ware manufactured in Austria before the war contained a large proportion of boric acid, which would make the goods almost prohibitively expensive at the present price of borax. A good deal has been done during the war in the way of substituting soda for potash in glasses, but the results, at least so far as glass or electric lamp bulbs and lamp-working tube are concerned, have not proved satisfactory. However, systematic research may be fruitful of results. The influence of ingredients of glasses, such as magnesia and alumina, which have generally been introduced into glasses accidentally as impurities in the raw materials, is a subject for research.

Prof. Boswell and others have carried out useful investigations on British sources of important glass-making materials, such as sand and felspar, but the results have not been highly satisfactory, possibly partly owing to circumstances arising out of the war. In 1915 it was still possible to obtain Swedish felspar containing 13 per cent. of potash and very little iron, delivered flour-ground in London at less than £3 per ton. During the present year the cost of Cornish felspar, containing 10 per cent. of potash and a considerable amount of iron, delivered in lumps in London, cost over £7 per ton. The difference in the quality of the material is even more important than the increase in price.

Except in some of the larger works, very crude methods are employed in the handling and treatment of materials, and in this the glass trade may be considered to be very backward. The best methods of grinding and mixing batch and cullet, and the use of magnetic separators, conveyors, etc., in the industry really require investigation. The treatment of different kinds of material requires special study. On the proper treatment of the materials and the mixing of the batch depends the quality of the glass, and the saving of loss due to stones and cords. Glassmakers are hard on machinery, which they cordially dislike, but which they will have to put up with if the trade is to hold its own against foreign competition.

Success or failure in every branch of the industry depends in a great measure on the efficiency and economy with which the "metal," or molten glass, can be produced. Furnace problems therefore rank high in importance, and first among them come those which relate to the manufacture and treatment of refractory materials. Refractories in the glass industry have to withstand not only the high temperatures, but also the fluxing action of glass, and must therefore be studied from the particular standpoint of the industry.

Regenerative or recuperative gas-fired pot furnaces have for some time been in use in this country, but recent attempts to work them intensively have not met with a great measure of success on account of the repeated failure of the refractory materials in the furnaces and pots. When working at full pressure, and using open pots, it is possible to fill the pots after the blowers have stopped work in the evening, and to found, plain, and cool off the metal by the next morning. Thus it is possible to work the factory with a single shift of blowers working about 48 hours a week. However, to work this single shift the glass must be got ready within the twelve hours.

Continental glass manufacturers have succeeded in working in this way, and for the sole reason that they are provided with superior refractory materials. It appears that satisfactory fire-clays exist in this country, and the production from them of suitable fire bricks, siege blocks, pots, etc., should not present insuperable difficulties. The problems await the early attention of the Glass Research Association. The matter is one of vital importance, for the saving of fuel alone is 50 per cent. of that used in the non-regenerative furnaces.

The position with regard to tank furnaces is more satisfactory, but much may be done towards the improvement of the refractories used in their construction. The increase in the cost of fuel and labour also calls for close attention to improvements in gas producers and mechanical accessories.

During the war considerable progress was made in the manufacture of mould-blown goods, such as electric lamp bulbs, and scientific and illuminating hollow ware, which differ from common bottles in that the goods show no seam, the glass being turned in the mould during the process of blowing. Mould-blown goods cannot be classed as artistic, but from

the utilitarian standpoint they are often superior to the hand-made, being consistently true to pattern, and much the cheaper.

Progress in the application of mechanical methods to the production of this class of goods has been made only to the extent of introducing American machines, such as the Empire machine and the Westlake machine, which two British firms have installed for the manufacture of electric lamp bulbs.

Progress in the manufacture of jars, bottles, etc., from glass produced in tanks has been retarded rather than advanced by the war, but manufacturers seem anxious to make up for lost time. It must be admitted that more actual progress is being made in America than in this country, and there is a tendency on the part of our manufacturers rather to purchase the rights to use American machinery than to spend money on the investigation and development of new processes. Enterprise of this kind is very costly, and more than one American invention is credited with having cost those who undertook the development of it more than half a million sterling.

The output of glass tubing has been enormously increased, particularly for uses connected with the war. In many glasshouses men engaged in the hand-made trade became tube drawers, and soon became highly skilled at the work. The methods of working employed varied greatly, and it would be interesting to obtain statistical information as to their relative efficiency. It must be allowed that, as much of the tube was drawn in glasshouses not specially designed for tube drawing, the men were often at a serious disadvantage. If the output is to be large, a tube shop must be so designed that the men have to walk the minimum distance between the processes of gathering, marvering, reheating, etc. Tubes over one inch in diameter should certainly be annealed before issue, which is not usually done.

Several methods of tube drawing by machinery have recently been patented in America, but little is yet known as to their merits.

Our knowledge of the processes of annealing is not satisfactory, but it has certainly been extended during the war, and in this connexion the thanks of the glass trade are due to Mr. F. Twyman, of Messrs. Adam Hilger, Ltd., whose valuable contribution to the study of the subject has been published in the Journal of the Society of Glass Technology. The Hilger instrument for testing goods after annealing has found wide application.

The fact is that both ornamental flint glass and common bottles anneal without difficulty, the one on account of the nature of the glass, the other on account of the fact that the lehrs contain a large mass of hot material the temperature of which must naturally change slowly. However, in dealing with light articles, particularly when, as in the case of chemical or illuminating hollow ware, resistance glasses are used, considerable difficulties are experienced. The glass is first chilled in the mould so as to set up the condition arrived at in the so-called toughened glass. An unannealed beaker will stand any amount of rough treatment, and liquid may be boiled in it. However, it cannot be *cut off*, and it may at any moment fly to pieces. In such an article the outer surface is probably fairly uniformly in compression and the inner surface in tension.

The first stage in the annealing of such goods is to heat them to a temperature not far below the softening point for a sufficient time to eliminate the stresses. This is the vital part of the process, for it seems as if a badly annealed article were practically even more unstable than such an article before annealing, owing to the inequality of the strains. Very even and regular heating is necessary, and this is only attainable in specially constructed lehrs heated from below as well as from above. The cooling must be at such a rate as to avoid the introduction of fresh strains in the glass. The annealing of light hollow ware is of vital importance.

In branches of the trade in which the goods have to go through a number of processes, success or failure depends very largely upon the proper lay-out of the works, and the arrangement for transporting the goods so as to avoid breakage in passing from department to department; and very close attention will have to be paid to working conditions, to the comfort of the workpeople, and to their convenience in the matter of hours of labour. The scientific study of problems relating to industrial administration has made great progress in America, and is now receiving attention in this country.

The foregoing remarks apply to the glass industry in general, but the varied character of the numerous branches makes it quite impossible to deal with matters of detail. At the moment special interest attaches to certain branches of the industry which are scheduled for protection in accordance with the new trade policy. These are:—"Optical glass, including lenses, prisms, and like optical devices. Scientific glassware. Illuminating glassware." The country is now practically self-supporting with regard to scientific hollow ware, and it may be hoped that the labours of the Standardisation Committee of the Society of Chemical Industry, which have aimed at the standardisation of chemical apparatus, may have been of value to the industry. The output of lamp-blown apparatus and of graduated apparatus has increased enormously, but it may be anticipated that this branch of the industry will meet with keen competition. The scientific public, critical of home-made goods, has suddenly awakened to the fact that much of the imported graduated ware was very inaccurate, and is insisting on a higher quality of goods, which the British manufacturers are succeeding in supplying.

Though great progress has been made in the manufacture of illuminating glass ware, neither plant nor labour has been sufficient to cope with the demand. Optical glass was manufactured in this country before the war, but on a scale totally insufficient to meet our requirements, and during the past five years the development of the industry has been extraordinary. It must be remembered that while a very inferior lamp chimney will still serve a very useful purpose, optical glass must be good, indeed, very good, or it will be quite useless.

In this part of the industry refractories play an important part, for if the pots will not withstand the solvent action of the glass, as the pot material dissolves it changes its composition, and also gives rise to stones and cords. The iron oxide from the clay tends to discolour the glass, and the colour cannot be corrected by the use of manganese or other reagents. Stirring the molten glass, which is necessary in order to make it homogeneous, naturally presents difficulties which have been only partially overcome. The reduction of the wastage between the founding of the glass and the formation of the blocks and blanks supplied to the lens maker offers scope for investigation. Though much research work has already been carried out in this country and also in America, where the industry is also a new one, much remains to be done. Very high credit attaches to the work already accomplished.

Finally, while we must try and hold on to what we have won, we must endeavour to win back what we have lost. The diversion of plant and labour previously engaged in the manufacture of high-class ornamental glassware has resulted in the disorganisation of a branch of the industry in which.

the country held a predominant position. It must be remembered that the Central Empires formed one of our best markets for this class of goods.

The replacement of hand-made articles by machine-made goods is perhaps one of the unavoidable consequences of civilisation, and, balancing the advantages and disadvantages, we may, on the whole, gain by the change. While the machine may increase the perfection of the form of the article, though perfection of form may not imply enhancement of beauty, the material almost always suffers in mechanical treatment. There is a play of the lights on the surface of a piece of hand-worked English flint glass which is never to be found in a mould-blown article. American mechanical reproductions of English cut glass are very wonderful, but they absolutely lack the craftsman's touch.

This branch of the trade should remain largely a handicraft. Economies can, however, be introduced in many directions, and there is no reason why the old-fashioned round furnace should still be used. Such fuel-wasting machines should, in the national interest, be prohibited under D.O.R.A., or her successor.

YEAST GROWTH AND ALCOHOLIC FERMENTATION BY LIVING YEAST.

ARTHUR SLATOR.

The methods used by the physical chemist to measure rates of chemical reactions can be applied to investigate the process of alcoholic fermentation by living and growing yeast cells. The results obtained in this way are valuable, for they not only give new information, but also make it possible to bring into line results obtained by other methods. In this communication yeast growth and alcoholic fermentation are considered from this point of view.

The subject matter may be explained by describing the growth of yeast cells in a nutrient medium, and by pointing out the main factors which determine the rate of growth and rate of fermentation at different stages of the reaction.

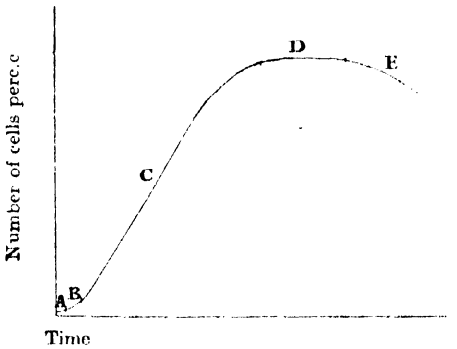


Diagram of Yeast Growth.

A = lag phase in growth; B = logarithmic phase; C = retarted growth; D = yeast crop; E = death of yeast cells.

If a trace of yeast is seeded into malt wort, which is a medium containing all foods necessary for yeast growth and also large amounts of fermentable sugars, the yeast cells bud and grow. If the number of cells is plotted against the time a curve of the type given in the diagram is obtained.

After a certain initial disturbance (lag-phase) the cells multiply regularly, the number increasing logarithmically with the time. All the usual equations employed to calculate the rate of unimolecular chemical reactions can be applied to yeast growth over this period, if note is made that the reaction is increasing in rate instead of decreasing as is the case with ordinary chemical reactions. There are several methods of measuring this logarithmic constant of growth (K) or the generation time (G.T.) which is a number inversely proportional to K. (G.T. × K. = log. 2). Some of them depend on counting yeast cells under the microscope, and others on measuring rates of fermentation from which rates of growth can be calculated.

The results show that when all necessary food is supplied in sufficient concentration yeast cells develop at a rate determined by the temperature and the race of the yeast used.

Temperature coefficients vary greatly with the temperature. At 25° C. the rate is usually about four times that at 15° C. The shortest generation time so far observed is about 1 hour. The retarding influence of carbon dioxide and alcohol, and the necessity of oxygen for yeast growth can be demonstrated and measured by these methods.

Lag-phase in growth.—If yeast cells from an old culture are introduced into fresh wort a period of quiescence is observed before budding takes place. When growth has once started it continues at the normal rate. A bakers' yeast at 30° C. gave a period of one hour before buds appeared and then all the cells, except the dead ones, budded irregularly during the next hour. Older cultures showed more dead cells but not a longer period of quiescence.

The lag-phase in the growth of bacteria has been examined by Penfold (1914) who used the method of "plating" to estimate the number present, and many important observations were made. Some of the results have been submitted to mathematical analysis by Ledingham and Penfold (1914). The matter has been further discussed (Slator, 1917), but an investigation of the lag-phase in yeast growth (1918), leads one reluctantly to the conclusion that Ledingham and Penfold's equation is not of general applicability.

There is no doubt of the interest and importance of this period of growth and yeast cells are well adapted for the purpose of further investigation.

Phase of retarded growth.—As yeast develops in malt wort the first retarding influence which comes into play is that due to carbon dioxide. Continental investigators have rightly laid stress on the preservative action of carbon dioxide; in this country the influence has been recognised, but the effect has been attributed to the exclusion of oxygen rather than to a direct poisoning effect

The retarding influence of the gas can be detected when the yeast concentration has developed to about a million cells per c.c.

Oxygen is necessary for yeast growth, and lack of oxygen soon makes itself felt and is the main retarding influence when yeast cells develop from a few million cells per c.c. to the maximum growth of about 100 million per c.c.

A. J. Brown (1905) was the first to show that arrest of cell reproduction under these conditions is due to this lack of oxygen. H. T. Brown (1914) further investigated the matter and *inter alia* obtained the important result that yeast growth increases proportionally with the amount of dissolved oxygen initially present in the wort. For

the production of 10^{10} yeast cells, 1·7 c.c. of oxygen is required.

Measurements of the logarithmic constants of growth under anaerobic and aerobic conditions have been made. In these experiments malt wort behaved as if it contained a certain amount of combined oxygen available for yeast growth. The results are not in agreement with H. T. Brown's conclusion (1914) that growth under anaerobic conditions is due entirely to oxygen previously absorbed by the yeast.

Alcohol also acts as a retarding agent, but usually growth stops in a fermenting solution before the alcohol concentration is sufficient to have much influence.

Yeast crops.—The cause of the final cessation of yeast growth in malt wort is usually lack of oxygen, but it is evidently possible to arrange conditions under which the yeast crop is determined by other limiting factors.

Lack of fermentable sugar, which also acts as a food for the yeast, may be the limiting factor which finally prevents further growth. A discussion of this typical case will show on what factors yeast crops depend.

During the logarithmic period of growth the yeast growth N during the time in which S grams of sugar disappear (by growth and fermentation) are connected with K the constant of growth and F the fermentative activity of the yeast by the equation $N/S = K/F$. During any other period of growth the relationship $\frac{dN}{dS} = \frac{K}{F}$ holds good for small increments in N and corresponding decrements in S. We have therefore $N = \int \frac{K}{F} dS$, that is, the yeast crop from a small seeding is determined by the value of the integral between the limits S = initial concentration of the sugar to S = 0. The ratio K/F and its variation with different sugar concentrations determines the amount of yeast a given medium can produce. If K/F is constant (which is approximately the case, for both K and F are independent of the sugar concentration except when the solutions are dilute) the growth and the initial sugar concentration will be proportional. H. T. Brown (1914, 226) finds that 2·3 grams maltose disappear when 10^{10} yeast cells are produced.

Yeast growth may cease owing to the production of large amounts of alcohol. The crop under these conditions is determined by the way the ratio K/F varies with different concentrations of alcohol, and the same method can be used to calculate the yeast growth. The integral is in fact of general application whatever the final limiting factor is.

The ratio K/F is independent of the number of yeast cells present. It follows therefore that with a medium of given composition the total possible growth is a constant, the crop being equal to the sum of the seeding and the growth. A. L. Stern (1901), in a series of careful experiments on the point, has proved this experimentally in the case of a Burton yeast growing in a solution containing glucose, asparagin and mineral salts.

A. J. Brown's previous observation (1892) that large seedings of yeast in wort refuse to bud is contrary to this general conclusion that the increase should be the same whatever the seeding is. The non-multiplication in this case is probably due to lag in growth and the very rapid accumulation of retarding influences.

Again Stern shows that yeast crops are almost independent of the temperature of growth. The temperature coefficient of growth and that of fermentation over the range of temperature in these experiments are not equal, but approximate closely enough to account for the results obtained.

Death rates.—When yeast growth has finally ceased the cells suspended in the fermented liquid gradually perish. If the liquid is kept free from other organisms a few living yeast cells may still be found after many years' preservation. Very little information regarding death rates of yeast cells is available, but experiments with bacteria show that micro-organisms under unfavourable conditions usually perish at a logarithmic rate (H. Chick 1908, 1910).

In investigating alcoholic fermentation at high temperatures or in the presence of poisons, death rates and rates of inactivation come prominently into consideration. The process of pasteurisation, the preservation of pitching yeast and pure cultures of yeast depend on death rates which have not yet been investigated.

Growth and fermentation.—The main factors which determine the rate of fermentation during any of these periods are the number of cells present, the fermentative activity of the yeast and the temperature. The rate of fermentation is independent of the sugar concentration except in dilute solutions. Sugar concentrations, therefore, come into consideration only at the end of fermentation.

Maltose, the principal sugar in malt wort, is hydrolysed sufficiently rapidly by culture yeasts to supply adequately the yeast cell with glucose. Dextrin is not fermentable by yeast, but there exist in malt wort substances intermediate between dextrin and maltose which are hydrolysed slowly by yeast and subsequently fermented. Little is known of the rate of fermentation of such maltodextrins or how they are hydrolysed.

If living yeast is introduced into wort or into a solution of glucose, fermentation starts immediately. Quiescent yeast cells are usually rather more active than the smaller growing ones. Fermentation does not become visible until the solution is saturated with carbon dioxide, and hardly shows on a saccharometer until some gas has escaped, but proof of immediate action is obtained by other means.

The results obtained in experiments with malt wort can be used to explain the action of yeast in other cases.

In the use of yeast for bread-making large amounts are put into the dough, and the fermentative activity is of primary importance. Brewery yeast is unsatisfactory for bread-making, for it is rapidly inactivated at high temperatures (35° C.) by certain yeast poisons in the flour. Such yeast grown in distillers' wort is less sensitive, and can be used by bakers. According to J. L. Baker (1917) unboiled distillers' wort contains these toxins and the yeast crops from such media consist only of cells which are immune, and therefore of use to the baker. One suspects, however, that the hops in brewery wort play a part in making the yeast sensitive and useless for bread-making on a large scale. This case is of interest for rates of inactivation come into prominence.

Yeast activity takes place under many varied conditions. It is only by referring back to the simple constants of growth and fermentation, and to the factors which influence these constants, that the results can be interpreted and the process understood.

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NEWS FROM THE SECTIONS.

BRISTOL AND SOUTH WALES.

This Section is to be congratulated on its enterprise in arranging for two meetings to be held monthly instead of one as heretofore. On the first Friday of the month the Section will meet in the Chemical Department of the Bristol University, and on the second Thursday at University College, Cathay's Park, Cardiff. The first meeting of the new session was held in the latter locality on October 3, when Mr. W. R. Bird, vice-chairman of the Section, read a paper on "Fractional Distillation in the Laboratory and in Practice," and exhibited a number of still-heads.

A variety of types of still-heads was described and their advantages and defects pointed out. Special attention was drawn to the necessity of having the bottom of the column of the same diameter as the rest so as to obviate the flooding of the column, which usually happens when this point is neglected. The new form of still-head described by Dufton (see this J., 1919, 45 T) was particularly discussed, Mr. Bird's experience of it fully bearing out the efficiency claimed for it. Distillation with this apparatus yields practically pure products in one operation.

In describing types used in the factory, attention was drawn to the necessity of having large return-tubes to prevent flooding and to the devices for preventing contamination by mechanical spraying. It is generally necessary to use a long column—about 16ft.—with about 20 plates in it and then a dephlegmator. For soft waters, such as are common in South Wales, the dephlegmator tubes should be electro-coppered. The so-called "analysers" are worthless, but considerable success is obtainable with Raschig rings. A discussion followed.

At the meeting held at Bristol on October 9 it was announced that the membership of the Section had increased to nearly 200, and that nearly every local industry was represented in it.

In introducing the subject of "Works Control," Mr. C. J. Waterfall referred to the fact that at the annual meeting of the Society it was emphasised repeatedly that the recent efforts made in the chemical industries must not only be sustained but increased. In the dye industry we had to compete against the splendidly organised works of Central Europe, and with the accumulated technical knowledge of the past 53 years. The hitherto unutilised data in the chemist's notebook, although possibly not of immediate commercial value, might become at any moment of inestimable worth. A very imperfect system of education lay at the root of our troubles.

The position of the works' chemist was then compared with that of the engineer, and a plea entered for better representation of chemists on committees of management. Replying to a criticism that the chemist was not assisting the general manufacturer as much as he might do, the speaker pointed out certain broad directions in which the chemist is helping the manufacturing works in general, and could help more were he permitted. He instanced fuel, water supply, and lubrication, and urged a greater measure of scientific control of fuel consumption. It was suggested that a works should have a sort of balance-sheet constructed from the chemical point of view. The loss up the stack or in the liquid effluent would be taken into account, together with that mysterious waste that so often occurs in works management. The difference between the weight of goods in and the weight of goods out would be checked, discrepancies noted, and if possible accounted for. The comparison of costs between different works and the progress in economy of production brought about thereby was touched upon, also the value of manufacturers meeting together in their trade organisations.

Mr. E. Walls (chairman) pointed out that in the effort for increased output too much attention was directed to increasing the output of labour and not enough to scientific and mechanical means of increase. In many processes the increase of effort on the part of the individual labourer would have only a slight effect on the yield of the process, whereas the application of technical science might result in an improvement of method, followed by a great increase in yield. The standards and controls insisted upon by the Ministry of Munitions had in some works carried processes further forward in one year than in the previous fifty.

Dr. Butler pointed out that the Germans had absolute chemical control in their works, and did not seem to care how much they spent in obtaining it. No matter what the control costs, it was evidently a paying proposition in the end.

MANCHESTER.

On October 3, the new session was opened with an address entitled "Notes on the Rhineland Chemical Works," by the chairman, Mr. John Allan. This address will appear in our next issue.

MEETINGS OF OTHER SOCIETIES.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

The first meeting of the session was held on October 21. The president, Sir Frederick W. Black, was in the chair, and Mr. Arnold Philip read a paper on "Some Laboratory Tests on Mineral Oils." After an appeal for the adoption of standard methods of testing in the petroleum industry, the author dealt in detail with several methods which he had found to give concordant results not only with petroleum products, but also with products from coal-tar and low temperature carbonisation. Details were given of the preparation of representative testing samples from the bulk samples as received in the laboratory, particularly when such samples contained water in suspension, or as an emulsion, and this was followed by a description of a distillation method possessing several novel features for the valuation of crude oils. The distillation is carried out in two portions (1) a topping distillation in a glass flask, in which the products volatile below 260° C. are separated, and (2) distillation of the heavy residue in a metallic still of unique form, and fitted with internal baffle plates. In both distillations the stills are externally heated, a current of air of fixed volume per unit time being used in the first to carry off the vapours produced, and in the second either air or superheated steam or both can be employed. In the first distillation a vacuum equivalent to about 8 in. of water is used, generated by a Lennox blower, but it was not stated if similar conditions obtained during distillation (2). A table was given showing results obtained by this method and those obtained by other workers on a particular crude oil, and also the results obtained by the author on a sample of petroleum from the Hardstoft well.

Dealing with the testing of motor spirit, a method of taking the temperature at which the vapour pressure is equal to atmospheric pressure was described, and suggested as an alternative to the recording of the temperature at which distillation commences.

In a section on the calorific value of fuels, the question of the water values and high and low

calorific values of fuels was exhaustively discussed, the author suggesting that the results should be reported as follows:—(1) The high calorific value determined by the bomb calorimeter. (2) The "water value" of the fuel, "that is, the total "number of units of weight of water obtained "from the combustion of unit weight of the fuel, "by which is meant the sum of the water derived "from the oxidation of the combined hydrogen in "unit weight of the fuel, together with the hygro-"scopic water contained in that weight. From "these two values any form of low or net calorific "value can be obtained by calculation." A method of estimating the "water value" was given. The determination of the amount of water in oils, tar, etc., was then discussed, and a vacuum distillation method used by the author described.

The final portion of the paper dealt with the effect of moisture in mineral oils upon their flash points. A long series of tests was described and tabulated, which brought out the abnormalities arising from this cause. In some oils the flash point is raised by the addition of moisture, while in others it is lowered; generally speaking, discrepancies in the observed flash points are greater in the case of moist oils than in the case of dry ones. In the author's opinion it is not necessary completely to dry oils having a flash point of less than 200° F. before making the tests.

In the discussion, the chairman, Sir Thomas Holland, Dr. Dunstan, Prof. Brame, and Dr. Ormandy all accentuated the need for the establishment of standard methods of testing in the petroleum industry. It was pointed out that the international nature of this question must not be lost sight of, especially with regard to the large amount of work that has been done in the United States. The formation of a preliminary committee for the consideration of this subject was urgently advocated. Dr. Dunstan and Messrs. Mitchell and Lomax criticised the methods of analysis employed by the author, particularly with regard to the method of distillation, suggesting that instead of preventing "cracking" it would tend to accentuate it, as many crude oils were very liable to decomposition when heated to 260° C. in the absence of steam, and also that the second heating of the residue would also have the same effect.

Dr. Dunstan gave an interesting comparison of the results of tests of Hardstoft crude oil, the analysis made by himself on 30 c.c.s. being compared with that given by the author and by Hackford.

	Dunstan.	Philip.	Hackford.
Benzine	5·0% ...	4·8% ...	4·5%
Kerosene ...	32·0% ...	37·5% ...	33·0%
Lubricating Oil	30·0% ...	26·75% ...	29·0%

Mr. Philip reserved his reply to these criticisms until the publication of the Society's Journal.

SOCIETY OF GLASS TECHNOLOGY.

The new session was opened at Leeds on October 15, under the presidency of Mr. S. N. Jenkinson.

The first paper read was "Some recent Improvements in the Designs of Glass Works Furnaces and Gas Producers," by Mr. J. A. Atkinson.

In small installations the use of coke gas has many advantages, for with a coke gas producer of good design the supply of gas is uniform in quality and quantity, and the use of skilled labour is unnecessary. A design of coke gas producer which was in successful use and in which the gas outlet is placed some distance down the side of the producer, instead of over the fuel bed, was described, and its very pronounced advantages detailed. In the absence of coke, a Siemens' Dry Bottom Producer with coal fuel can sometimes be employed with advantage, but it does not yield a regular supply of gas of uniform quality. Better types are the Dawson, Duff, and Wilson, all of which are provided with a water seal which permits of a constant gas supply during the clearing out of ash; on the other hand the quality and quantity of gass are liable to fluctuation.

Producers with revolving grates are very advantageous with certain grades of fuel, and these, in the author's opinion, should contain a very high percentage of ash; however, their prime cost is high and their upkeep expensive. The Talbot, Wood, Hughes, and Morgan producers to a certain extent satisfy the three essentials of a perfect producer, namely, constant feed of fuel, even distribution of fuel over the whole bed, and constant agitation of the upper portion of the fuel bed. The Chapman Agitator, with automatic feed, which can be fitted to most existing types of producers, is the most satisfactory.

Mr. Atkinson next described the recuperative pot furnace of the Stein type, in which the recuperative chambers are placed on either side of the furnace proper, and the air passages are vertical, so that by regulating the chamber chimney a flame pressure above the atmospheric pressure can be maintained around the pots in the furnace. The fuel consumption for a 12-pot furnace is 37·46 per cent. of the weight of glass produced. In conclusion, the author described a tank furnace with a novel arrangement of dampers which permits of control of the individual burners.

A paper on "The Manufacture of Table Ware in Tank Furnaces" was then read by Mr. R. L. Frink, in which he described how high-class crystal glasses, both flint and crown, can be produced in tank furnaces. In his opinion it was possible, with a well-designed furnace, properly operated, to produce a lead glass far superior in quality and homogeneity to any which could be made in pots.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

At a meeting held on October 9, Mr. H. H. Morgan in the chair, Mr. A. de Waele presented two contributions. In the first, "Permeability of Paint and Varnish Films," he described a method of determining permeability to moisture by cementing the film to be tested on to the mouth of a flat-lipped CO_2-flask containing strong sulphuric acid. The flask is kept in an incubator in a saturated atmosphere and weighings made every three hours. The films are prepared by coating tinned iron plates with the varnish or paint, allowing several days for drying, and then amalgamating one edge of the plate with mercury and dilute sulphuric acid; after a few hours the film can be pulled away quite readily. The results showed that for any given pigment, the proportion of medium (spirit-free) to 100 parts of pigment was inversely proportional to the porosity of the film. When comparing different pigments, the impermeability, for a given proportion of pigment to medium, was influenced inversely as the specific oil absorption of the pigment, the specific oil absorption being the minimum proportion of oil necessary to convert the dry pigment into an unmistakeable paste.

The permeability of a varnish film to moisture, as determined by this test, affords no indication as to whether it will protect an iron plate from rusting. Accordingly experiments were made, by using a form of Donnan Osmometer, to test the permeability of these films to ions. It was found that sodium chloride passed freely through the film.

Experiments were also described on the determination of the cause of the "chalking" or "blooming" which takes place when clear oil-varnish films are immersed in water. No very definite conclusions, however, were arrived at.

Although many varnishes made from tung oil do not show this "chalking" effect, such varnishes are not necessarily less permeable to moisture than a linseed-oil varnish which "chalks" on immersion.

The second paper was on "A Suggested Method for Calculating Costs of Ready-mixed Paints." The principle stumbling block in the calculation of ready-mixed paint formulæ is to predict the amount of medium required to thin down the oil paste containing the pigments to the desired fluidity. If, however, instead of thinking of the paste in terms of lb. or cwts., its volume be calculated, from a knowledge both of its composition and of the specific gravities of its constituents, then the following simple rule will be found to hold good over a very wide range of colours:—The ratio of volume of paste to volume of thinners is constant, no matter what the pigment or mixture of pigments contained in the paste may be. This formula will yield ready-mixed paints of uniform fluidity and ease of working. It is, of course, assumed that the composition of the thinners used remains the same throughout and that the paste contains that minimum amount of oil necessary to convert the dry pigment into an unmistakeable paste.

PERSONALIA.

Mr. E. de Barry Barnett has been appointed lecturer in organic chemistry at the Sir John Cass Technical Institute, Aldgate.

Dr. Theodore W. Richards, professor of chemistry at Harvard University, has been elected president of the American Academy of Arts and Sciences.

Dr. F. J. Charteris, lecturer in pharmacy at Glasgow University, has been appointed to the chair of materia medica at the University College of Dundee.

Capt. J. W. McBain, lecturer in physical chemistry in the University of Bristol, has been appointed to the new chair of physical chemistry in that university endowed by Lord Leverhulme.

Sir H. A. Meyers, vice-chancellor of the University of Manchester, has been appointed by an Order of Council dated October 16, 1919, to be a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

In consequence of Lord Wilton having decided to discontinue the Wilton Research Laboratories, Mr. F. W. Atack has been appointed director of the research department of the British Alizarine Co., with headquarters at 57, Dale Street, Manchester.

Mr. B. Mouat Jones has been appointed professor of chemistry at the University College of Wales, Aberystwyth, in succession to Prof. J. J. Findlay. Mr. F. W. Fagan, of the East of Scotland Agricultural College, Edinburgh, has been appointed adviser in agricultural chemistry at the same college.

Salters' Institute of Industrial Chemistry.—In furtherance of its policy of promoting the study of chemistry among industrial workers, the Committee of the Institute has recently awarded grants-in-aid to thirty young persons occupied in chemical factories in or near London to assist them in improving their knowledge of the subject.

NEWS AND NOTES.

UNITED STATES.

Reported Discovery of a New Alkaloid.—It is stated that a new alkaloid has been extracted from *Covillea tridentata*, a shrub which is very common in the semi-arid districts of Mexico. The discovery is claimed by chemists of the U.S. Department of Agriculture and of the Bureau of Plant Industry.

Autumn Meeting of the American Chemical Society.—The meeting held in Philadelphia from September 2—6 was the largest on record, over 1700 members being present. The membership of the Society is now approaching 14,000. Several important resolutions were passed. An emphatic protest was made against the Bill before Congress providing for the reorganisation of the Army, mainly because it does not extend to technical men the same recognition and opportunity throughout every grade and department as are accorded to those trained solely for a military career. The proposed abolition of the Chemical Warfare Service was also disapproved, and a motion was passed urging the vital necessity of adequately remunerating chemists in the national service. It was also resolved to invite the councils of the Chemical Society (London) and the Society of Chemical Industry to appoint a committee or committees on nomenclature, spelling and pronunciation, to co-operate with the corresponding committee of the American Chemical Society in order to secure as large a measure of agreement in these fields as is practicable.

The newly-formed Section of Dye Chemistry held its first meeting with an attendance of over 300, and a Section of Sugar Chemistry was initiated. The Division of Rubber Chemistry held an unusually successful meeting, twenty-two papers being presented and discussed. In the Division of Industrial and Engineering Chemistry a symposium was held on refractories and another on patents, at which much attention was given to the question of annual patent fees for the United States. The Society has been studying patent reforms as affecting the chemical industry for some time past, and legislation is now pending which, if enacted, should do much to improve present conditions.

The programme included nineteen excursions to various industrial plants. In 1920 the Society will meet at St. Louis in the spring and at Chicago in the autumn.

Magnesium in 1918.—The United States produced, in 1918, 284,188 lb. of magnesium metal valued at $615,217, representing an increase of 145 per cent. in quantity, and 163 per cent. in value, over the output of 1917. About three-fifths of the total was sold as sticks and two-fifths as powder. The price was approximately equal to the pre-war price of imported magnesium, *viz.*, from $1·6—2 per lb. Its purity varies from 99 to 99·9 per cent.; the most common impurities being iron, calcium, sodium, potassium, chlorine and oxygen. Of these sodium is the most objectionable, especially where the metal is used for alloys. Some work recently done by the Bureau of Standards in the Washington laboratories gave the following values of physical properties on a casting of 99·9 per cent. purity. Density 1·737 at 20° C., average co-efficient of expansion between 0° and 100° C., 0·0000259 per degree C. It is stated that the metal is barely attacked by a mixture of equal parts of strong sulphuric and fuming nitric acids. Magnesium is extremely useful as a deoxidiser in foundry work. One pound of magnesium will deoxidise from 1200 to 3000 lb. of copper, and is being preferably used in the form of a 10—20 per cent. magnesium alloy with copper. The properties of

the various magnesium alloys are now well known, but a new suggested use is in bearing metal, the wear of the alloy being about half that of best cast iron.—(*U.S. Geol. Survey, July*, 1919.)

SOUTH AFRICA.

Industrial Notes.—*Sugar.*—The present season's sugar crop is expected to be between 150,000 and 160,000 tons, which is fully up to the milling capacity.

Chloroform.—The manufacture of this anæsthetic is about to be undertaken by the Natal Cane By-products, Co., Ltd., and will be run in connection with its ether plant.

Wattle.—A wattle extract factory is to be erected at Paddock, near Port Shepstone, Natal. The plant will be capable of treating 5000 tons of green bark per month.

Bat Guano.—It is reported that a supply of bat guano, calculated to be sufficient to supply all Rhodesia for the next ten years, has been discovered in a series of caves on the north bank of the Umniati river, some forty-five miles from Gatooma. In some places the guano deposits are 20 feet deep. It is expected that the material will be placed on the market forthwith.

Fibres.—In the opinion of a firm of fibre importers in Scotland, the fibre from the South African baobab tree is probably the finest paper-making material that can be found.

A report received from the Imperial Institute on some samples of wild South African kapok (Asclepias floss), states that the material is inferior to other commercial flosses such as Java kapok, Indian kapok, and Akund floss, but that it could be used as a stuffing material in upholstery.

The Institute has also reported on a sample of fibre of *Sida rhombifolia* which is found widely spread and in fair abundance throughout the Union. The sample contained:—Cellulose 76·5 per cent., ash 1·1 per cent., and moisture 10·7 per cent. It behaved normally towards chemical reagents and was not silky. It was, however, of short staple, but this could probably be remedied by cultivation. The product would doubtless find a market in the United Kingdom.—(*S. Afr. J. Ind., July, Aug.*, 1919.)

AUSTRALIA.

Mineral Production of Western Australia in 1917.—According to a recently issued report of the Department of Mines the following quantities of the more important minerals were produced and exported during 1917:—

	Produced.		Exported.	
	Quantity. Tons.	Value. £	Quantity. Tons.	Value. £
Coal	326,550	191,822	—	—
Copper ore .. }	6,488	93,711	966	20,878
,, matte, etc. }			535	64,860
Lead-silver, ore and concentrates }	46,864	144,684	22	593
Lead (pig) .. }			4,661	139,940
Tin ore	307	39,192	383	45,288
Pyritic ore	3,575	1,752	—	—
Molybdenite	—	—	14	158
Magnesite	20.5	21	42	50
Antimony	—	—	12	258
*Gold (fine oz.) ..	—	—	970,317	4,121,645
Silver ,, ...	—	—	222,075	38,339
Tantalite	12.5	1,782	17	2,513

* Exported and minted.

In addition, about half a ton each of bismuth ore and scheelite was exported. No asbestos, mica or wolfram was exported or reported as having been produced during 1917. Coal shows an increase of 25,024 tons over the production in 1916, the whole output coming from the Collie coalfield. Copper was obtained chiefly from the Phillips River, West Pilbarra and Peak Hill Goldfields. The exports of ore and matte show an increase over 1916 amounting in value to £20,905. The lead ore exported shows a decrease of £11,440, but this is compensated by an increase of £65,010 in the value of pig lead exported. Practically the whole of the lead ore was raised in the Northampton Mineral Field. About three-quarters of the production of tin was obtained from Greenbushes Mineral Field, the remainder coming from the Marble Bar district of the Pilbara Goldfield. The exports show a decrease of 80 tons compared with those reported for 1916. The production of gold has been falling since 1904, and shows a further decrease of 386,887 oz., although the recovery per ton of ore increased from 40·34s. to 41·49s. Over 50 per cent. of the output was obtained from the East Coolgardie goldfield. Silver, which is recovered as a by-product in lead smelting, shows an increase of 49,063 oz. Magnesite was obtained from the deposits at Bulong, where the mineral occurs in a fairly pure form in short irregular veins, but these rarely attain a diameter of more than one foot. A small amount of work was done on the graphite deposits at Donnelly river, but none of the mineral was exported.

The Pottery Clays of Western Australia.—Recent investigations into the quality of the pottery clays of Western Australia have been attended with satisfactory results. A very large number of samples obtained from various localities has been tested by the special committee of the Institute of Science and Industry, and considerable public interest has been aroused in the initial experiments. A syndicate which has erected a trial plant for the manufacture of domestic white ware has been in constant touch with the laboratory, and has received advice as to materials and the manipulation of the clays. Endeavours are now being made to convince local potters and brickmakers of the advisability of using some form of temperature indicator in their kilns.—(*Science and Industry, July*, 1919.)

FRANCE.

General Industrial Outlook.—The industrial outlook in France is at present conditioned mainly by two factors: the unfavourable rate of exchange and the transport difficulty. The former is driving home the urgent need for greater production in order to increase exports, and this depends on the second factor, which is of an entirely local order, being handled in the proper way. Unfortunately the strike fever prevails here, too, and the effects of the recent railway strikes in Lorraine and the dockers' strike at Marseilles are still being felt. In Lorraine especially the potash industry has been paralysed and production is still at a low level. At Marseilles goods have been accumulating, and during the strike the city has been lifeless. The market for potash and sodium salts fluctuates continually. Sodium bisulphites are less rare, but sodium thiosulphate for photographic purposes, although derived from the former, shows an increase of 10 francs per 100 kilo.

Labour difficulties are being experienced in Algeria and Tunis. The latter colony is trying to extend the mechanical exploitation of its phosphate ores. The "Compagnie des Phosphates de Constantine" is taking the lead in this direction and claims that, with restricted hand-labour, it can treat 100 tons per hour. In the soap industry the "Consortium de la Savonnerie Française" has been dissolved. It seems that *consortia* are not popular in France and that firms prefer to lead an individual existence. The need of printed tissues is enormous in spite of the prohibitive prices for dyes, and is responsible for the formation of "La Société Anonyme de Teinture et d'Apprêts de la Loire," with head offices at St. Etienne, 17, rue des Teinturiers. Antwerp has definitely been chosen by France to be the clearing port for her commerce with the Rhineland provinces. The com-

mercial base that had been temporarily established at Rotterdam has in consequence been abandoned.

In the metallurgical world an event of importance is the result of the referendum lately taken in Luxembourg, which by a large majority decided in favour of a Customs union with France. Before the war this country produced 2,550,000 tons of pig iron and 1,335,000 tons of steel. This production, added to the French production, makes France the first metallurgical country in Europe and the second in the world.

Present Position of the Alsatian Potash Industry.—In the September issue of *The Chemical Engineer*, Dr. F. K. Cameron, of the United States Bureau of Mines, states that in April last the work of putting the Alsatian potash mines in order was progressing satisfactorily. There were then on hand some 150,000 tons of kainite and 400—500 tons of concentrated salts, containing, respectively, about 18 and 50% of K_2O. The daily output was about 2500 tons of crude salts. It is impossible to arrive at any accurate figures as to costs of production, particularly in view of the fact that the Germans carried off or destroyed all records, and the following estimates must be regarded as "intelligent guesses":—

Cost of Production of Sylvenite (dollars).

	Average of 18% K_2O or more.	Average of 45% K_2O or more.
Mining	4·00	10·00
Milling	0·85	4·12
Bagging	1·50	1·50
Renewals and repairs ...	1·00	4·50
Office charges	0·75	1·88
Interest, etc.	1·00	3·75
Freight	2·00	3·00(?)
Total	11·10	28·75
Cost per unit K_2O ...	0·617	0·639

Charges for amortisation and taxes are not included.

As regards transport, all the plants are connected with the main line between Basle and Strasbourg. Canal transport is available to Marseilles by the Rhine—Rhone Canal, and before long Mulhouse or Strasbourg will be connected by waterway with Havre.

There are at present nine mines (two French and seven German), each of which is provided with two shafts (500—1000 ft. apart, connected below ground and used for ventilation). One thoroughly equipped shaft is capable of bringing up 800 tons of ore daily, and if both were used for hauling the daily output could be increased to 15,000 tons, equivalent to a million tons of K_2O yearly. Unfortunately the labour supply is very poor, few of the employees have had any previous experience of mining, and there is a great scarcity of men competent to act as mine bosses, coal miners from Lens filling these positions at present. It is improbable that any new shafts will be sunk for some time, as existing mines are not equipped up to full capacity. The estimated pre-war cost of establishing a mine is about £600,000.

Growth of the French Chemical Industry.—According to the president of the "Groupement des industries chimiques," French chemical industry developed tremendously during the war. The annual output of sulphuric acid was increased from the pre-war figure of one million tons to two million tons. The monthly output of nitric acid during 1918 amounted to 50,000 tons compared with an annual output of 15,000 tons in pre-war days. The yearly output of cyanamide has increased from 8000 tons in 1913 to 100,000 tons at the present time. Owing to the sudden cessation of hostilities, there is now an over-production of these products to be contended with, a feature not confined to France but affecting all countries. Prospects are favourable for the absorption of part of the output in agriculture. In particular, viniculture should benefit. Copper sulphate is indispensable in the vine industry, and of the annual import of this chemical, amounting to 50,000 tons, viniculture absorbed 40,000 tons. It is unfortunate that the necessary copper, mined in Spain, is controlled by English interests, which also manufacture copper sulphate. (*Schweiz. Chem.-Zeit., Sept.* 10, 1919.)

GENERAL.

The British Association and Post-War Scientific Research.—The following resolution, adopted by the British Association at Bournemouth, has been addressed to the Prime Minister and the Chancellor of the Exchequer:—

"The British Association for the Advancement of Science, in reviewing the results of scientific methods applied to military and other practical arts, recognises that the successful issue of the war has sprung from the efforts of scientific men concentrated on those problems, and with the conviction that the well-being and security of the nation is dependent on the continuous study of such matters, would urge on H.M. Government the necessity for apportioning an adequate sum from that allocated to home administration and the up-keep of the fighting forces for the purpose of a definitely organised scheme of research, as for example on problems connected with health, food, and commerce, on explosives, on chemical warfare, and on physical and engineering problems bearing on military work."

Similar resolutions have been sent to other Ministers.

Driving off Poisonous Gases.—The current issue of the *Proceedings of the Royal Society* (Series A. 96, No. A. 676) contains a paper on this subject by Mrs. H. Ayrton which was received in August, 1917, but was held over for publication after the war. Laboratory experiments are described in which cooled smoke from smouldering brown paper was driven back along a large table by tapping with a small fan upon a miniature parapet erected at the further end of it. The best result was obtained with a wooden fan of 1½ sq. in. area (including the back); by tapping with this for 6 seconds at the rate of 4 taps a second, an advancing smoke cloud about 6 ft. wide and about 3 in. high was very effectively rolled backwards. The method here indicated was in daily use at the Front since May, 1916, chiefly for clearing trenches, shell holes, mine craters, etc., of foul gases. The Army fan is made of waterproof canvas stiffened with cane with a wooden handle. It is 3 ft. 6 in. long, has a blade 15 in. square with a loose end and side flaps, and weighs less than 1 lb. These hand-driven fans are not sufficiently powerful to repel gas-wave attacks in comparatively high winds. Further experiments showed that such a fan in action divides the surrounding space into two areas, separated by a vertical plane parallel to the tip of the blade. Air, in irrotational motion, is sucked from behind the fan in all directions towards it, and is driven forward away from it in rotational (vortex) motion. Each successive stroke produces a vortex, the vortices combine, pool their energy, and attain a far greater distance than any single one. The limiting distance with a 1½ in. model fan was about 10 ft., *i.e.*, 80 times its length. The author intends to study further the problem of expelling undesirable gases by hurling vortices into them. The bearing of these experiments on ventilation in chemical works will be obvious.

War-Time Activities of Dye Plants in Germany.—The following data are taken from the report of the British mission appointed to visit enemy chemical factories in the occupied zone.

By the amalgamation during the war of previously-formed combinations of chemical companies an association was formed known as the Interessen-Gemeinschaft (I.G.), which includes the large companies like Fr. Bayer and the Badische company and some smaller firms. The I.G. works, some of which are outside the occupied area, and were therefore not visited, produced the bulk of the synthetic ammonia and nitric acid needed for the production of fertilisers and explosives, all the poison gas (with the exception of some chlorine and phosgone), and a large proportion of the high explosives. The information as to the war production of the factories visited must be accepted with some reserve.

Explosives.—No arrangements appear to have been made before the war to utilise any of the dye factories for war purposes, and on mobilisation their chemists were called up for military service. Most of the chemical works, however, were producing small quantities of explosives by the end of 1914, but it was not until 1916 that plant was laid down to assist in the enormous production required by the Hindenburg programme. Many chemists were then released from the army, and most of the big extensions of the synthetic ammonia and of the nitric and sulphuric acid plants date from that time. The expansion of output by the factories of the I.G. combination during the war is shown in Table I.:—

I.—Output in Metric Tons per Day.

	Nitric acid.		Sulphuric acid.		Chlorine.	
	1914.	1918.	1914.	1918.	1914.	1918.
Leverkusen ..	56	180	340	470	7	20
Höchst ..	150	375	224	280	4	8
Oppau ..	?	100	—	—	—	—
Ludwigshafen ..	40 (?)	40	275	410	13	35
Weiler-ter-Meer	12	24	48	60	—	—

Of the above works, Oppau and Merseburg produced 250 and 400 tons, respectively, of ammonia in 1918, compared with 25 and nil in 1914.

Oppau can now produce 500 tons of nitric acid daily while still retaining sufficient ammonia for the output of nitric acid at Höchst.

Large new vitriol plants have been erected at Höchst and at Domagen.

Standardised plant for the manufacture of dyes was converted with remarkable speed; for instance, at Leverkusen a TNT plant producing 250 tons a week was put into operation in six weeks. Table II. shows the production of the principal high explosives in the factories visited and of intermediates where these were not converted to finished explosives in the producing works:—

II.—Output in Metric Tons per Week.

	Ammonium nitrate.	Dinitrobenzene.	Dinitrotoluene.	Trinitrotoluene.	Dinitronaphthalene.	Dinitrochlorobenzene.	Picric acid.
Leverkusen ..	—	250	—	250	150	40	—
Domagen ..	—	—	—	—	—	—	600
Urdingen ..	—	60	—	75	—	—	—
Höchst ..	500	140	—	200	—	—	—
Ludwigshafen ..	—	25	50	—	15	300	—
Oppau ..	200	—	—	—	—	—	—
Wiesdorf ..	—	—	120	—	—	—	—
Schlebusch ..	100	—	—	150	—	—	—

Ludwigshafen also produced 100 tons of sodium benzene sulphonate, 35 tons of dinitrophenol and 25 tons of dinitrodiphenylamine per week; Schlebusch 15 tons of hexanitro-diphenylsulphide, and Höchst 30 tons of trinitroanisol per week.

Poison gases.—At first chlorine and phosgene were the main requirements, but afterwards a variety of organic substances was employed. When the Government wished to introduce a new gas a conference of the various firms was held at Berlin to determine how the manufacture should be subdivided in order to use existing plant to the best advantage for the new and sometimes difficult preparations. For example, the initial stages of the manufacture of mustard gas were carried out at Ludwigshafen, and the final stage at Leverkusen. The output of finished poison gases from the works visited is shown in Table III.; large quantities of intermediate products were also sent to other factories:—

III.—Output in Metric Tons.

Poison.	Factory.	Average monthly output.	Total Production if known.	Date of commencement.
1. Chlorine ..	Leverkusen ..	600	—	Prior to war.
	Höchst ..	240	—	,,
	Ludwigshafen	860	38,600	,,
2. Phosgene ..	Leverkusen ..	30[1]	—	,,
	Ludwigshafen	288	10,682	,,
3. Diphosgene	Leverkusen ..	300[1]	—	June, 1915.
	Höchst ..	130	3,616	Sept., 1916.
4. Chlorpicrin ..	Leverkusen ..	200[2]	—	July, 1916.
	Höchst ..	45	1,127	Aug., 1916.
5. Xylylbromide	Leverkusen ..	60[1]	—	March, 1915.
6. Bromoacetone and bromoethylmethylketone	Leverkusen ..	20[1]	—	July, 1916.
	Höchst ..	19	685	April, 1915.
7. Phenylcarbylamine chloride ..	Höchst ..	65	721	March, 1917.
8. Mustard gas	Leverkusen ..	300[2]	4,500	Before July, 1917.
9. Diphenylchloroarsine ..	Höchst ..	150	3,000	May, 1917.
10. Ethyldichloroarsine ..	Höchst ..	78	1,092	Aug., 1917.
11. Dichloromethyl ether	Höchst ..	26	239	Sept., 1917.
12. Dibromomethyl ether	Höchst ..	7	69	Aug., 1917.

(1) Maximum monthly output.
(2) Estimated.

The manufacture of diphenylcyanoarsine was begun at Höchst in February, 1918. (*Chem. and Met. Eng., Sept.* 1, 1919.)

Irish Industries during the War.—A report by the American Vice-Consul at Dublin gives a number of interesting facts concerning the effect of the war on Irish industries. In agriculture, the largest industry, there was an increase in the cultivated area of nearly a million acres between 1916 and 1918. The cereal production was 1,786,166 tons in 1918 against 1,111,378 tons in 1916; root crops during the same period increased from 9,604,613 to 11,516,755 tons. Owing to the large demands for military and aeronautical purposes, the flax and linen industry has made great progress. In 1918 there were 140,000 acres under flax, while in Belfast 70,000 people (nearly one-fifth of the population) were engaged in the linen industry. The returns of the stock-raising industry show considerable decreases in the number of horses, cattle, sheep and pigs as compared with pre-war times.

Much prospecting has been done in regard to minerals, but during the war there has been an all-round falling off in production. A large amount of low-grade copper ore has been proved in County Wicklow, and it is hoped that antimony will be worked shortly in County Monaghan. Borings are being made to determine the deposits of cannel coal, but no results are yet available. The total reserves of good quality coal remaining in Irish coalfields is estimated conservatively at 300 million tons. It is interesting to note that there are extensive deposits of barytes at present undeveloped, and that the soapstone quarries of the North of Ireland produce the bulk of the output of the United Kingdom.—(*U.S. Com. Rep. Suppl., June* 16, 1919.)

LEGAL INTELLIGENCE.

CUSTOMS SEIZURE OF PYROGALLIC ACID. *Brown and Forth v. Buckley* (see this J., 1919, 379 R.)

An application was made on behalf of the plaintiffs to Mr. Justice Younger in the Chancery Division on October 14 that a day should be fixed for the speedy trial of this action, without pleadings.

Mr. R. H. Wright, for the plaintiffs, said that this was a case of the utmost importance not only to his clients but to the public generally, in fact it raised the question whether it was possible to practise tariff reform by executive act without the express sanction of Parliament.

Mr. Justice Younger said counsel would have to agree as to whether they were to bring on the motion started before the Vacation Judge, or whether the action was to be tried without pleadings before him (Mr. Justice Younger), in which case the Crown must assent.

The Attorney General said that he could not give his assent. The whole action was misconceived. A question was raised—he admitted a very serious question—as to whether the Proclamation in question was *ultra vires*, but every argument that the plaintiffs could adduce in this action could be equally well presented in the proceedings under section 207 of the Act which the Crown had instituted for condemnation of the goods. Furthermore, the proceedings were directed against the wrong defendant. The Collector of Customs was only a subordinate officer, who could not return the goods even if the order were made upon him to do so. He could not give his assent to this application, but he would do all in his power to expedite the proper proceedings.

His Lordship remarked that he thought it possible that if the plaintiffs got their order in this action they might not obtain recovery of their goods, and ordered that the case should be tried with pleadings.

FIRE AND EXPLOSION AT A TNT FACTORY. CLAIM AGAINST INSURANCE COMPANIES. *Hooley Hill Rubber and Chemical Co., Ltd.* v. *Royal Insurance Co., Ltd. and Others.* (See this J., 1919, 193 R.)

In the Court of Appeal on October 17 and 20, Lords Justices Bankes, Scrutton, and Duke had before them an appeal by the Hooley Hill Rubber and Chemical Co., Ltd. from a decision of Mr. Justice Bailhache upon a special case stated by Mr. A. M. Langdon as sole arbitrator in a dispute which had arisen between the appellants and the Royal Insurance Co., Ltd., the Atlas Assurance Co., Ltd., the London and Lancashire Fire Insurance Co., Ltd., and the Motor Union Insurance Co., Ltd. The question was as to the liability of the insurance companies under policies of fire insurance upon premises belonging to the appellants.

The premises in question consisted of a TNT factory at Ashton-under-Lyne. A fire broke out in the factory, and after it had been burning for about 20 minutes the heat exploded a quantity of TNT which was in a closed receptacle. There was a clause in the insurance policies which excepted damage caused by explosion, but the assured contended that the clause did not exempt the insurance companies from liability for damage by explosion where the explosion was "only incidental to and in the course of the fire."

The arbitrator decided that under the terms of the policies the insurance companies were not liable for damage arising from the explosion, and that view was affirmed by Mr. Justice Bailhache. Hence the present appeal of the assured.

Mr. Justice Bankes, in giving judgment, said that the point for decision was undoubtedly an important one in fire insurance law. The contention for the assured was, broadly stated, this: That the contract between the parties was a contract of indemnity, and that the general rule in reference to such a contract ought to be applied in this case, namely, that in considering what the cause of the particular damage was, the proximate cause, or what had been referred to in the recent case of Leyland v. the Norwich Union Society in the House of Lords, as the efficient or the effective or the dominant cause, must be looked at, and that if that were done in the present case it was plain that the fire which brought about the explosion which caused the damage was the proximate and effective cause of the loss. On the other hand the general principle applicable to policies of insurance was not disputed; but it was said that there was another general principle, namely, that parties might by express language exclude the operation of that rule in any particular case; and it was said that the rule had, in the particular contracts between these parties, been excluded in express and unambiguous language. It appeared to his Lordship that the important point which had to be decided was whether the contention of the insurance companies with reference to the construction to be placed upon the exceptions in these policies was or was not correct. In his opinion upon the true construction of the exemptions in the policies, any loss due to the explosion was not covered by the policies. But the matter was covered by the case of Stanley v. The Western Assurance Co. (Law Reports, 3 Exchequer, page 71), in which it was laid down that if there were a fire, in the course of which an explosion occurred, for the result of the fire, unconnected with the explosion, the defendants made themselves liable, but not for any consequences of the explosion. For these reasons he thought the arbitrator and Mr. Justice Bailhache were right. Lord Justices Scrutton and Duke concurred.

There was a second question concerning the Royal Insurance Company only, namely, whether that company was estopped from relying on the exception, and as to which the arbitrator and Mr. Justice Bailhache decided that there was no estoppel.

It was agreed that this question should stand over for a week, with a view to the parties coming to an agreement upon it. On this understanding the appeal as regards the insurance companies, other than the Royal Insurance Co., was dismissed with costs.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Oil in Derbyshire.

Mr. Bonar Law, in reply to Mr. Holmes, stated that the Government has come to the decision that no royalty should be payable in the case of oil.—(Oct. 22.)

Importation of German Potash.

In answer to Mr. Chadwick, Sir A. Geddes said that the Board of Trade, since the armistice to date, had placed contracts abroad only in respect of timber and potash. In regard to the latter, the one contract entered into with the German Government represented an amount of £750,000.—(Oct. 22.)

REPORTS.

ANNUAL REPORT OF THE CHIEF INSPECTOR OF FACTORIES AND WORKSHOPS FOR THE YEAR 1918. Pp. 83. [Cmd. 340, 9d.] (*London: H.M. Stationery Office.*)

The present report reviews in considerable detail the abnormal conditions introduced into factory and workshop administration during the period of the war. Of the ten sections the most important to the Chemical Industry is that devoted to industrial poisoning, contributed by Dr. T. M. Legge, H.M. Medical Inspector of Factories.

The incidence of lead poisoning is determined principally by the practicability or otherwise of the efficient removal of dust and fumes by locally applied exhaust ventilation. Where this is practicable great improvement is possible; where it is not the number of cases of poisoning will either increase or remain stationary. It is regarded as axiomatic that all risk lies in the inhalation of dust and fumes. The actual handling of lead is rarely shown to be a cause of poisoning. Subsidiary means for minimising the effects of lead, such as are afforded by cleanliness, periodic medical examination, labour saving devices, movement study, and research on efficient substitutes for lead, must not be neglected.

A recrudescence of "phossy jaw" occurred during 1915-1918, after an immunity extending over many years. Eleven cases were reported from the factory where phosphorus was manufactured, while only one case occurred elsewhere. Careful attention to the teeth of the workers, in the first place by a dentist, supplemented where necessary by the services of a surgeon of the highest standing, is now provided in the factory, and no cases of poisoning have been recently reported. It is interesting to note that the greater proportion of the cases of poisoning occurred with men engaged on the condenser side of the factory. An efficient system of exhaust ventilation is essential, and, further, phosphorus and phosphorus muds must be quickly removed from the condensers.

The increase in the number of cases of arsenic poisoning is attributable mainly to the manufacture of arsenic trichloride. There is danger even when the process is carried out in the open air, or when an exhaust draught is provided for the vessel in which the reaction between sulphuric acid, common salt, and arsenic takes place. Cases of poisoning by arseniuretted hydrogen occur principally in processes connected with the manufacture of zinc and zinc salts. Cases also occurred in the manufacture of intermediate dyestuffs wherein zinc and hydrochloric acid are employed either together, or when the acid is added at a stage subsequent to the reduction. The use of de-arsenicated acid and metal requires attention. At present safety from poisoning by arseniuretted hydrogen depends entirely on the efficiency of the measures taken to prevent escape of the poisonous gases.

The figures for mercurial poisoning show an increase during 1916 and 1917, mainly due to the greatly increased use of fulminate of mercury. The recognised symptoms of mercurial poisoning were present in only a few cases; in the majority the symptoms exhibited were dermatitis of the face, neck, hands, and forearms, associated with conjunctivitis and inflammation of the mucous membrane of the nose and larynx. As a preventive measure the workmen were instructed to dip their hands in a 10 per cent. solution of sodium hyposulphite. The conjunctivitis is beneficially treated by means of a similar 2 per cent. solution.

Anthrax cases increased noticeably during the period under review. It appears that liming, with a view to the destruction of anthrax spores in hides and skins, does not make the handling of these materials in later stages very much safer.

In November, 1915, toxic jaundice due to tetrachlorethane or nitro—or amido—derivatives of benzene or other poisonous substance was added to the list of diseases in Section 73 of the Factory and Workshop Act, 1901. A highly efficient system of ventilation is essential in factories where such products are manufactured or employed. Precautionary measures, embracing a complete change of underclothing and overalls, locally applied exhaust, daily examination of urine, have furnished a complete safeguard against poisoning by dinitrophenol.

In the category of poisoning by fumes and gases are included casualties due to blast-furnace gas, power gas, coal gas, gas from coke fires and limekilns, carbon dioxide, nitrous fumes, petrol and benzol vapours. Cases of poisoning due to carbon dioxide are nearly always fatal. Exposure to nitrous fumes for more than two minutes causes asphyxiation and death while after exposure for something less than two minutes the men rapidly recover on returning to the open air. Efficient ventilation is a prime necessity in all processes employing benzol. Hæmorrhages from the mucous membranes of the gums and nose afford an early indication of the desirability of the exclusion of the affected workmen from duty, with a view to the prevention of chronic benzol poisoning. As an alternative to benzol as a rubber solvent "Xylol compound" can be employed, with very much less danger of causing aplastic anæmia and purpura than benzene.

Protective measures against pitch ulceration include the wearing of protective clothing above the ordinary clothes, spray baths, and the necessary first-aid equipment. Outbreaks of eczema were attributable to (1) chemical irritants such as bichromate of potash, arsenious acid, and certain finished dyes; (2) solvents of the natural grease of the skin, *e.g.*, turpentine, benzene, and its homologues and their derivatives; (3) alkalis, etc., which soften and macerate the skin; and (4) processes such as brushing, etc., which mechanically break the skin.

The past year has witnessed a great advance in the voluntary movement on the part of employers and workmen to reduce hours of labour. An interesting feature of the movement is the increasing number of cases in which work before breakfast is being abandoned. In Chapter I. the effects due to these innovations are instanced by reference to various industries. Generally it may be stated that, almost without exception, reports from employers are entirely favourable to the new system, while the workmen express general approval. The efficiency of the workers has been increased and time-keeping improved. The new system affords a means of increasing the total national production, while costs of production are diminished. The necessity for overtime is obviated.

In regard to the prevention of works accidents, it is remarked that accidents preventable by the institution of safeguards represent only a very small proportion of the whole. A leaflet dealing with Safety Committees is issued by the Home Office (price 1d.) and the Report discusses in detail the constitution and functions of such committees, and the importance of furthering their more general establishment is strongly urged. More particularly in large works, safety inspectors should be appointed to act either in conjunction with or independently of such committees.

The period since 1914 has witnessed a great increase in the use of various labour and fatigue saving appliances, in the textile trades more particularly. Considerable developments in plant for handling material are anticipated in the near future. The subject of "movement study" is receiving increased attention. Efficiency is inti-

mately related to the satisfactory planning and arrangement of the factory. Apparently trivial matters such as the shape and size of tool handles, the provision of lighter barrows and spades have an important bearing upon the fatigue of the workmen and their efficiency. These and kindred matters are discussed in the chapter devoted to labour-saving appliances, illustrations being drawn from a diversity of trades.

The Report also deals at length with the recent growth of welfare work in factories. Such subjects as drinking water, canteens and messrooms, protective clothing and cloak-rooms, facilities for washing, ambulance and first aid, rest-rooms, supply and use of seats receiving attention. It is anticipated that the effect of Home Office welfare orders, combined with the growth in strength and influence of the Welfare Workers' Associations and the Workers' Educational Association, will in time become very great.

In the chapter dealing with the use of electricity in factories emphasis is laid upon the inadequate realisation, both by employers and medical men, of the possibilities of artificial respiration in cases of apparent death from electric shock. Artificial respiration should be persevered with for at least two hours, or until the patient revives.

The subjects of Ambulance and First Aid and Continuation Classes are dealt with in separate chapters.

REPORT OF THE PROCEEDINGS OF THE INDUSTRIES ADVISORY BOARD AND OF THE SCIENTIFIC AND TECHNICAL COMMITTEE. *Jan.-Sept.* 1918, *and* OF THE ADVISORY BOARD OF INDUSTRY AND SCIENCE. *Union of South Africa.* (*Cape Town. Cape Times, Ltd.*, 1919). *Price* 1s.

The report of the proceedings of the Industries Advisory Board and of the Scientific and Technical Committee, now combined as the Advisory Board of Industry and Science of the Union of South Africa, contains several items of considerable interest. The supply of fertilisers has given a good deal of anxiety, the imports having decreased owing to the shortage of vessels, and although the production of fertilisers from abattoir and fishery waste has been encouraged, very little has really been accomplished. Suggestions were made to the Government to assist financially in carrying out experiments for the conversion of the phosphate rock of Saldanha Bay into basic slag in blast furnaces. This, however, was not considered to be advisable, and it is now reported that the experiments are being carried out by private enterprise. Working scale trials of the "Wolters" process for the treatment of Saldanha rock by heating a mixture of finely crushed rock with bisulphate of soda, carbonate of lime and powdered coke have been carried out in the rotary kilns of the Rand Lime Co. Some loss by dusting and by volatilisation of phosphorus occurred, and, depending on the temperature attained, from 78 to 94 per cent. of the phosphoric acid contained in the raw rock was rendered citric soluble. The Saldanha Company having been taken over by a new company the investigations were discontinued as it was understood that the new company had evolved a satisfactory process and would be in a position to supply the finished product in the new year. Inquiries by the Government as to the possibility of obtaining further supplies of guano from the coast line north of Cape Cross showed that there is no appreciable quantity in sight (*cf.* this J., 1919, 228 R.)

In view of the increasing production of cotton the Board advised the Government to assist financially in the erection of an oil-expressing mill at Rustenburg and the Government is considering the matter. As at the present time the seed is only crushed into cake without extracting the oil, and as the annual import of cottonseed oil amounted to nearly 400,000 gallons before the war, it seems desirable that the oil should be expressed locally.

Proposed legislation dealing with the adulteration of leather with Glauber's salt or sodium sulphate has been under the consideration of the Board and certain recommendations have been made. The control over imported leather should in the opinion of the Board be exercised at the point of entry, and that over locally manufactured material at the seat of manufacture.

In South Africa, owing to the population being spread over a very wide area, the linking up of a system of electric generating stations is not in so favourable position as it is in more populous countries, yet when considering the question of the production and utilisation of electric power due attention should be paid to the standardisation of systems of generation and to the uniformity of frequency and phase of the current generated.

The following recommendations of the Board in regard to industrial alcohol have been accepted by the Government and embodied in the New Customs and Excise Act:—That for manufacturing purposes, other than the preparation of medicinal and perfumery articles, suitably denatured alcohol should be duty free; that a duty of 2s. per gallon should be imposed on alcohol used for the production of medicinal preparations and perfumery, provided that the finished product is unpotable as a beverage, and that alcohol required for scientific and teaching purposes should be obtainable under proper safeguards and restrictions in a pure and un-denatured condition and duty free. Owing to the difficulty of obtaining supplies of wood spirit the Board recommended in a special case that 0·5 per cent. of pyridine should be allowed to be substituted for 2 per cent. of wood naphtha making 1 per cent. of pyridine bases in all, but it is emphasised that this should only be a temporary measure having regard to the very great advantages of wood spirit over every other denaturant in that it was only possible to render alcohol so denatured drinkable at very great trouble and expense. It is further recommended that alcohol intended for the manufacture of ether for industrial purposes other than for medical preparations should, like that destined for the production of acetic acid, be duty free.

As the question of the manufacture of motor spirit by the destructive distillation of coal was occupying the attention of experts in Great Britain it was decided to wait for the result of their investigations before attempting anything locally.

Steps are being taken to prepare and circulate lists of scientific and technical serials and other publications, and to render such literature available in the chief centres of population.

REPORT ON THE TRADE OF AUSTRALIA FOR THE YEAR 1918. *By* H.M. SENIOR TRADE COMMISSIONER IN AUSTRALIA. *Pp.* 62. [*Cmd.* 351. 3*d.*] (*London: H.M. Stationery Office.*)

While British manufacturers may confidently anticipate increasing trade with Australia, individual manufacturers may suffer from the revision of the Australian tariff. The urgent necessity for greater attention to commercial organisation is strongly emphasised. The methods of overseas sales and distribution need strengthening, and greater control must be exercised over distribution of goods.

The season's production of sugar amounts to 190,000 tons. The beet sugar industry has made little progress.

So far as possible, all metallic ores are treated within the Commonwealth, and the metals marketed in a refined state. A co-operative

institution exists for smelting silver-lead ores and concentrates, and for refining silver-lead bullion. The output capacity of the works is 160,000 tons of pig lead and 5,000,000 to 6,000,000 ounces of silver per annum. The output of zinc concentrates is controlled and disposed of by an association of the principal zinc producing companies, founded on a co-operative basis, and with Government representation on the board. For the year ended December 31, 1917, the output of zinc concentrates was 284,662 tons; in 1918 it was 345,017 tons. The annual production of copper is about 40,000 tons. The whole is refined in Australia.

The development of the brown coal deposits in Victoria (this J., 1919, 350 R) and of hydro-electric power (this J., 1918, 260 R) are also described.

The imports of metals and machinery for the year 1913 and for 1917—1918 are given below:—

Year.	Metals.			Machinery.
	Unmanufactured.	Partly manufactured	Manufactured (except machinery).	
	£	£	£	£
1913.	1,575,734	1,500,436	11,781,510	4,841,625
1917-18.	221,030	477 852	5,497,485	2,469,068

The imports of plates and sheets in the same years are given in the following table:—

Plates and Sheets.	Total for 1913.	1917-1918.	
		From United Kingdom.	From United States.
	£	£	£
Corrugated, galvanised	937,114	20,990	276,435
Galvanised, not corrugated, and corrugated, not galvanised ..	1,005,845	182.853	108,497
Plain, not galvanised ..	483,033	26,413	171,919

The value of the imports of earthenware and china from Japan has increased from £21,493 in 1913 to £333,953 in 1917—1918. In the latter year, the values of the principal items were:—

China and porcelain ware, £104,952; earthenware, £51,952; sheet glass, £40,342; glass bottles, £46,795; miscellaneous glass articles, £76,148.

On the whole, the supplies were unsatisfactory. The total "competitive" imports from Japan in 1917—1918 were valued at £4,222,000. In a great many instances the goods supplied were of most inferior quality and not up to sample, and it is anticipated that the bulk of trade created during the war will be lost to Japan.

The Newcastle Steel Works of the Broken Hill Proprietary Co., Ltd. has now an annual output of 250,000 tons of pig iron. The development of the vast deposits of iron ore and coal occurring in Queensland is contemplated by the State Government.

Paints and varnishes were imported into Australia in 1917—1918 to the value of £423,397, compared with £666,983 in 1916—1917. The principal decrease occurred in paints prepared for use, which were valued at £137,264 in 1917—1918, against £362,941 in 1916—1917.

The gold output of Western Australia for 1917—1918 was valued at £3,723,167, as against £4,121,645 for 1917. Lime and cement works, and glass manufacturing works are being established in the State; the erection of alkali works, the briquetting of coal, and the extraction of oils and varnishes from the abundant grasstree (black boy) are under consideration.

In Tasmania large extensions of the Electrolytic Zinc Company's works at Risdon, on which £250,000 has been already spent, have been decided upon. The Carbide Company now manufactures its own electrodes, the necessary plant having just been erected. Works for the production of lead sulphate using hydro-electric power are being erected in Launceston.

British manufacturers generally are urged to join the Australian Association of British Manufacturers. The address of the London office of the Association is 32, Victoria Street, Westminster, S.W. 1. Inquiries as regards trade with Australia should in general be addressed in the first place to the Department of Overseas Trade (Development and Intelligence), 4, Queen Anne's Gate Buildings, Old Queen Street, S.W. 1.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for October 9 and 16.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 4, Queen Anne's Gate Buildings, S.W. 1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number:—

Locality of Firm or Agent.	Materials.	Reference Number.
British West Indies	Portland cement	802
,,	Glass, earthenware, leather ..	805
Canada	Sheet metals (black and galvanised), tinplate	789
,,	Druggists' sundries, soap ..	791
,,	Druggists' sundries	796
,,	Drug specialities	797
,,	Soap, soap dyes, gelatin ..	*
,,	Pottery	*
,,	Chemicals, dyes	*
New Zealand ..	Glass, crockery	798
Belgium	Aniline dyes, colours for wool	808
,,	Soap, paint, varnish	810
,,	Chemicals, dyes, caustic potash	862
,,	Perfumery	863
,,	High-speed steel	865
Czecho-Slovakia ..	Chemicals, drugs, dyes, oils ..	868
France	Copper sulphate, fertilisers ..	813
,,	Heavy chemicals, drugs, earthenware, etc.	814
Germany	Edible oils, technical oils, seeds, foodstuffs	811
,,	Oils, soap	821
,,	Fatty wastes	824
Italy	Fish oil, vegetable oils, animal oils, sugar, hides, skins, tanning materials	825
,,	Metals, chemicals, dyes, leather, tanning materials	828
,,	Steel of every description ..	829
,,	Soap	832
Rumania	Tinplate	871
,,	Tin plate, black sheets, iron, zinc, salmiac	835
,,	Glassware, crockery	836
Spain	Chemicals	837
,,	Chemicals and pharmaceutical products	838
,,	Druggists' goods	840
,,	Chemical and pharmaceutical products, dyes, paints, varnish, perfumes	842
Switzerland ..	Chemicals, metals	874
Brazil	Paint, varnish, china, earthenware	876
Cuba	Chemicals, drugs, glass, perfumes	878
Dominican Republic	Paint, zinc plates	848
		849

* The Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C. 2.

MARKETS SOUGHT.

A Canadian firm manufacturing a synthetic drug desires to appoint a suitable agent in the U.K. Inquiries to the Canadian Government Trade Commissioner as above.

A Montreal firm seeks a purchaser for a graphite property in the Province of Quebec. Inquiries to the High Commissioner for Canada, 19, Victoria Street, London, S.W. 1.

A firm in Cuba desires to get into touch with U.K. importers of sugar. [Ref. No. 848.]

TARIFF. CUSTOMS. EXCISE.

Australia.—Recent customs decisions affect thermometers and pyrometers.

Belgium.—The import and excise duties on alcoholic liquors have been greatly increased as from August 29.

Certificates of origin and interest are no longer required for asphalt, cork, ore, and wine imported from Spain.

The import and manufacture of matches containing white phosphorus are prohibited as from March 14, 1920, and the sale of such matches as from September 14, 1920.

Among the articles for which export licences are no longer required are colours, glycerin, gums, lime, olein, phosphates, resin, rubber (crude), turpentine, varnish, and window glass.

British India.—An export duty of 15 per cent. *ad valorem* has been imposed on raw hides and skins, with a rebate of two-thirds of the duty when exported to countries within the Empire.

Denmark.—Export prohibitions have been withdrawn in the case of phosphoric acid, agar-agar, medicinal balsams, barks, leaves, roots, seeds and gums, candles, cellophan, celluloid, cresol, drugs (with some exceptions), dyes, magnesite, mica, paper, paraffin, platinum, polishing wax, vulcanised fibres, and wood (with some exceptions).

Finland.—A copy of the new customs tariff may be seen at the Department. Among the articles the import of which is now unrestricted are animal fats and oils, many foods, chicory root, oilcakes, condensed and dried milk, cocoa, molasses, timber, cork, fibres, paper, hides, skins, glue stock, leather, rubber, gutta-percha, balata, iron, iron alloys, aluminium and its alloys, lead and its alloys, asbestos, certain minerals, lime, clay, ores of all kinds, glass, mineral oil, asphalt, coal tar and its distillates, varnish, waxes, colours, paints, dyes, and many chemicals.

France.—The agreement between the British and French Governments respecting the application of the French import restrictions to goods of U.K. origin and of the U.K. restrictions to French goods has been denounced and will terminate on Oct. 27.

A copy of the decree regulating the customs *régime* for petroleum products may be seen at the Department of Overseas Trade. The decree defines "gas oil," "fuel oil," "rood oil," petroleum pitch, petroleum coke, and other products, and indicates the appropriate rates of duty. Other provisions relate to the control to be exercised over factories, the marking of the containers, the warehousing of the products, and the conditions under which residues for marine engines are exempt from duty.

France and Algeria.—The customs duties on certain kinds of iron and steel tubes are not subject to the "coefficient of increase" established by the decree of July 8, and the rates of duty thereon are those laid down in the tariff.

French West Africa.—The total prohibition of the import of all alcohol and spirits came into force on October 1.

Italy.—Explosives may now be imported freely from the U.K.

Jamaica.—The import surtax on spirits and wines has been increased to 37½ per cent.

The following export duties are in force until March 31, 1920: Coconuts, per 1000, 2s.; hides of cattle—dry or dry salted, per 100 lb., 4s.; green or wet salted, per 100 lb., 2s.; logwood extracts, liquid or solid, on every ton of solid extract therein, £10.

Among the articles subject to the new package tax are bricks, tiles, slates, ironware, pewter, copper, lead, tin, brass, and paint.

Mexico.—Recent customs decisions affect lard, china, porcelain, rubber, and magnesite.

Morocco (French Zone).—A consumption tax has been imposed on certain articles of "colonial produce" and their substitutes as from August 25.

Paraguay.—The export duty on quebracho extract has been raised to 5 dollars (gold) per metric ton, as from August 16.

South Africa.—Recent customs decisions affect bronze foil, Silician Earth, and vegetable black.

South Russia.—No goods may be exported without licence from the Department of Trade and Industry of General Denikin's Government.

United States.—It is proposed to amend the import duties on zinc ores and manufactures thereof, crude manganese ores, manganese concentrates, ferro-manganese, and spiegeleisen. The proposed rates of duty are set out in the issue of the *Board of Trade J.*, for Oct. 9.

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED EXPORTS.

Deleted Headings.—The following goods have been removed from List A:—Mustard seed; cotton-seed oil; oleo; sesame oil; lard, imitation (compound); lard, neutral; all edible oils (except coconut oil, groundnut oil and palm kernel oil, for which licences are still required).

An open general licence has been issued for the export of manufactured whalebone to all destinations.

NEW ORDERS.

ARTICLES SCHEDULED UNDER THE PROFITEERING ACT, 1919.—The Board of Trade has issued an Order, under date October 14, by which the following articles, *inter alia*, come within the scope of the Act:—F. All drugs (excluding quinine sulphate which is controlled), and medicinal powders, including tooth powders, talcum powders and Fuller's earth. G. Medical and surgical appliances and dressings, including thermometers. H. All articles used for fuel and lighting (except coal), including:—Candles, lamp oils, kerosene, petroleum, paraffin, firewood and fire-lighters, methylated spirit, and matches. J. Weights, measures, weighing instruments and measuring instruments.

MAXIMUM PRICES OF PETROL.—The Profiteering Act, 1919, Maximum Prices Order (No. 2) (this J., 1919, 381 R) was revoked on October 14.

THE FLAX SEED (IRELAND) SUSPENSION ORDER, 1919.—Under this Order, made by the Minister of Munitions on October 21, the following Orders are revoked:—The Flax Seed (Ireland) Order, 1918; The Sale of Flax Seed (Ireland) Order, 1918; The Flax Seed (Shipment from Ireland) Order, 1918.

MERCHANDISE MARKS COMMITTEE.—The President of the Board of Trade has appointed a committee to consider:—

1. Whether any extension or amendment of the Merchandise Marks Act is required in respect of the provisions relating to indications of origin;

2. The utility and effect of national trade marks or other similar (collective) marks, and how far they should be authorised or encouraged in this country; 3. How far further international action may be necessary for the purpose of preventing the false marking of goods.

Sixteen appointments to the committee have been made. The chairman is Mr. H. Green, M.P., and the secretary, Mr. M. F. Levey of the Industrial Property Department of the Board of Trade (address: Patent Office, 25, Southampton Buildings, W.C. 2).

COMPANY NEWS.

THE EASTERN CHEMICAL CO., LTD.

The sixth ordinary general meeting was held in London on September 26. The chairman of the company, Mr. H. N. Morris, in moving the adoption of the report and accounts, stated that the gross profit for the year ended March 31 last was £25,094, and the net profit £13,842. Out of the available balance of £21,719 it is proposed to pay a dividend of 10 per cent. on the ordinary shares, leaving £16,631 to be carried forward, from which sum income and excess profits taxes, estimated at £9000, will have to be deducted. The issued share capital remains unchanged at £73,695, but the balance of £26,305 has been offered in £1 ordinary shares to the shareholders at 30s. per share, and the issue has been over-subscribed. It is proposed to convert the 2s. deferred shares into ordinary shares on the basis of one of the former for two of the latter; this will involve raising the nominal capital by £19,000. Various extensions have been made to the company's works; the caustic soda plant, erected to meet the requirements of the Anglo-Persian Oil Co., has been completed, and additions have been made to the copperas, nitric acid, and hydrochloric acid plants. Limekilns have also been built and brought into operation. The directors have adopted a comprehensive plan of development and intend to carry it out gradually. Some of the proposed extensions will necessitate the erection of new works in India. The scheme of development referred to at the last annual meeting will be held up until some action has been taken to give effect to the recommendations of the Indian Industrial Commission.

UNITED INDIGO AND CHEMICAL CO., LTD.

During the year ended June 30, 1919, the trading profit of £63,907 constituted a record; the net profit of £50.271 was slightly lower owing to increased war taxation in America. The issued capital is £95,000. Dividends of 20 per cent. for the year have been paid on both preference and ordinary shares, £3001 goes to the directors as a special bonus, and £43,324 is carried forward. The chairman, Mr. G. Heywood, at the annual meeting held in Manchester on September 26, said the company's works on both sides of the Atlantic had been fully employed. Conditions generally are not too favourable, and it would be unwise to rely upon the maintenance of recent profits.

ODAMS' NITRO-PHOSPHATE AND CHEMICAL CO., LTD.

At the sixty-seventh ordinary general meeting, held in London on October 1, Mr. F. Richardson, deputy chairman, said that the company had made a gross profit of £24,958 in the year ended June 30, 1919, which was £8761 more than in the previous year, and a net profit of £11,546 (capital £45,000, debentures and mortgage £43,500). The directors proposed to place £1500 to reserve, to pay a 15 per cent. dividend and to carry forward £4784. Trade had been better during the financial year, more labour had been available, and, except towards the end of the season, the supply of raw materials was satisfactory.

Mr. F. B. Lacy (managing director) said the main trouble had been with labour. Since June 30 last arrangements had been made with Allied manufacturers for combined purchases, and these were working satisfactorily. Raw phosphate was in short supply because the French Government had deprived the phosphate mines of much of their plant, and the mines in Florida had been closed since May last owing to strikes. The world's supply of phosphate would be very considerably reduced.

TRADE NOTES.

FOREIGN.

Menthol and Peppermint Market in Japan.—The menthol and peppermint market has become somewhat dull, but prices still stand at a strikingly high level. Exports have also become somewhat sluggish. Last season more than 650,000 kin (kin = 1·33 lb.) of menthol and peppermint was exported, the largest buyer being England, the second the United States, and the third Russia. The average prices per kin were 7 yen (yen = 2s. 0½d.) for menthol crystals and 2 yen for peppermint oil. Before the war the exports amounted to 350,000—400,000 kin. Germany was then the largest buyer, England was second, and the United States very low in the list. The pre-war average prices were 6·50 yen per kin for menthol crystals and 3 yen per kin for peppermint oil. At present the prices of 16·50 and 4 yen per kin (25s. and 6s. per lb.), respectively, are too high to tempt foreign purchasers.—(Tokyo, Sept., 1919.)

Shortage of Fertilisers in Spain.—Spain needs fertilisers, particularly for rice cultivation around Valencia. The annual consumption of sulphate of ammonia is from 60,000 to 70,000 tons; 100,000 tons of phosphates is imported annually from Florida and 200,000 tons from Algiers; whilst Spain produces from 16,000 to 18,000 tons of low grade phosphate. All this phosphate is converted into superphosphate, the Government prices for which are: 13—15% phosphoric acid 16·85 pesetas per 100 kilo. (6s. 1d. per 100 lb.) at the manufacturing plant; 15—17% 19·95 pesetas (7s. 2d. per 100 lb.), 16—18% 21·50 pesetas (7s. 9d. per 100 lb), 18—20% 27·25 pesetas (9s. 9d. per 100 lb.).—(*U.S. Com. Rep., Sept.* 9, 1919.)

Exports of Vermilion from Hongkong.—The manufacture of vermilion in Hongkong, interfered with by the war, is now being revived. Mercury comes from China, whither most of it returns as vermilion. The product is exported in cases containing 900 packages of about 1·4 oz. each. The present price is about 3s. 4d. per lb., which is considered very low.—(*U.S. Com. Rep., Sept.* 9, 1919.)

Chinese Tungsten Ore and the American Market.—The normal demand for tungsten ore in the United States in the pre-war period was about 2,000 tons per annum, and during the war this demand increased to about 7,500 tons, which is the estimated production in South China for 1918. The pre-war demand was almost wholly supplied by American mines, and after the war demand for tungsten began to be felt it was possible, by extending workings, to increase the American supply to about 5,300 tons. The high price which resulted from the shortage of the American supply caused increased developments in China, where it was found that tungsten ores were much more accessible than in American fields, and that they could be landed in American ports, even with excessive freight charges, at prices with which American ores could not compete. The low wages in the Chinese mines was an important factor in this situation.

The natural result of this condition was a remarkable exploitation of the tungsten mining areas of South China; but with the armistice came a temporary lull in the American market for Chinese tungsten. The abnormally high prices which prevailed during the war suffered a decided decline, which was immediately reflected in the lessened avidity with which the small Chinese miners sought the ores. It is now generally conceded, however, that Chinese ore can be marketed in America in normal times at good profits in competition with domestic ore; and the Chinese industry is therefore gradually assuming permanent proportions.

An interesting feature disclosed by the American Government statistics is that, with a war demand estimated at 7,500 tons, the United States imported in 1918 a total of 10,362 tons valued at $11,409,237. This was due to the fact that many users of tungsten were encouraged to stock up heavily with ore while there was more or less uncertainty as to the time when the European conflict would end. The results of heavy overstocking were a fall in the American market and the temporary collapse of the industry in China in the closing months of 1918, affecting most heavily the exporters and middlemen. In order to tide over the effect of this overstocking, plans were on foot to erect smelters in China where the ore may be treated and offered in markets which furnish a steady demand for the finished product. It is believed that it should be to the greatest advantage of American manufacturers, whose products are affected by the price of high-speed steel, to continue to draw from the Chinese market. This will not only give their products a lower price in world competition, but will encourage export trade with China by furnishing return cargo. On the other hand, it is argued that by encouraging the importation of Chinese tungsten an American mining industry of vital importance in time of war would receive a very serious if not fatal set-back (cf. this J., 1919, 248 R; 382 R).—(*U.S. Com. Rep., Aug.* 21, 1919.)

The Leipzig Fair, 1919.—According to advices received from Germany about 10,000 firms, mostly German, took part in this exhibition; the attendance was the record one of 118,000, and the number of foreign buyers present was 7,000. Whilst the will to work and to recover prosperity was conspicuous, the general impression created was that German industry as a whole is in a precarious condition, owing mainly to lack of fuel, but also to inability to purchase foreign raw materials through the low exchange value of the mark. German traders appear to think that it will be easier to re-establish relations with America and neutrals than with Great Britain.

From the standpoint of export, the technical section, including new machine tools, mechanical and electrical goods, was probably the most important, for considerable stocks are on hand. The machinery exhibited was of first-class order, but brass was conspicuously absent. There was an abundance of specialised new machinery, and many firms were anxious to dispose of their patent rights to foreign buyers. Orders were also very plentiful for porcelain and crockery ware, but most of the factories were closed down through lack of coal. The production of aluminium does not exceed 10% of the total output capacity of 4,000 tons per month, and most of the German, American, and Dutch buyers of aluminium ware will have to wait many months for delivery. In the section of constructional materials many substitutes for Portland cement were observed, and also much artificial marble (from gypsum). The exhibits of textiles were poor, and the prices of the multitudinous paper textiles were double the pre-war prices of the genuine articles.

REVIEWS.

METHODEN VAN ONDERZOEK DER BIJ DE JAVA RIETSUIKER-INDUSTRIE VOORKOMENDE PRODUCTEN. [METHODS FOR THE EXAMINATION OF PRODUCTS OCCURRING IN THE JAVA CANE SUGAR INDUSTRY.] *By H. A. P. M. Tervooren and H. C. Prinsen Geerligs. Pp. xvi. + 376. Fourth edition. (Amsterdam: J. H. de Bussy,* 1919.) *Price: 7.50 florins* (12*s.* 6*d.*)

In the modern sugar factory the chemist takes the part of a technical accountant, the commodity for which at every stage of the process of manufacture he is responsible being the sucrose entering with the cane and leaving in the form of sugars and waste products (as bagasse, filter-press cake, and molasses). He practises a rigorous system of chemical control; and this demands, not only the exact sampling and analysis of the several products, but also the application of an elaborate system of compiling and collating results.

It is perhaps in Java that chemical control at the present day has reached its highest development. In that colony there are about 140 factories, *all* of which conform to a standard scheme for the elaboration of data under the general supervision of the director of the Experiment Station. It is recognised that it is largely owing to this thorough system of "mutual chemical control" that Java, in spite of difficulties and disadvantages, has for some years past held a foremost position in the sugar world.

This volume is the text-book issued under the auspices of the Java Experiment Station for the use of the Dutch sugar factory chemist in effecting chemical control. Three previous editions have been published under the authorship of Mr. Tervooren, while the revision of the present one has been entrusted to the well-known technologist, Dr. Prinsen Geerligs. It is divided into three parts, dealing successively with (1) general methods for the determination of sucrose, reducing sugars, ash, dry substance, and purity coefficients; (2) the sampling and analysis of the products of the factory, from the cane to sugars and molasses; and (3) methods for the examination of materials used in manufacture, as lime and limestone, sulphur, hydrosulphites, ultramarine, etc. Dr. Geerligs' revision of Mr. Tervooren's text has not been extensive, being chiefly confined to some elaboration in the sections dealing with the determination of sucrose and reducing sugars, and to the methods used in the sampling and the analysis of cane, bagasse, and raw and clarified juices.

For the greater part, the "Handboek" prescribes only well-approved methods that are in use also in other countries, either as such or with only slight variation. It is of interest, however, to note that certain methods differing from those generally adopted are now included in this edition. For example, in the determination of sucrose it is stated that one may obtain good results with Steuerwald's process of double polarisation, in which hydrolysis in the presence of hydrochloric acid is effected by standing for 2—3 hours at the temperature of the tropical laboratory, instead of heating to 68—70° C. for 5 minutes, as specified by Herzfeld; but it is well to note when using this modification that as the amount of hydrochloric acid necessary for inversion under these conditions is double that generally added, an appreciable error may be produced owing to the effect of the excess of acid upon the rotation of the lævulose. When, therefore, the reducing sugars are high (as in the case of molasses) it is advisable to adhere to the ordinary Clerget-Herzfeld procedure. It is now generally recognised that in making the direct reading in the double polarisation method the influence of the basic lead

acetate used in clarification upon the lævulose of the reducing sugars must also be corrected in some way; and in Java this is done by the addition of 1 c.c. of acetic acid (30%) to 100 c.c. of the clarified liquid. Another new method for the determination of sucrose here described is that elaborated by Muller, in which the reducing sugars are destroyed by oxidation, and the polarisation assumed to indicate the sugar present. It may be convenient to follow this process for rapid routine determinations; but it should be borne in mind, as Löhr has pointed out, that the dilution necessitated by the volume of oxidising agent and clarifying solution required is such as to render the result only approximate. Regarding the determination of reducing sugars, as a more rapid alternative to the gravimetric method, Dr. Geerligs recommends the volumetric procedure generally known as Bertrand's, in which the cuprous oxide is dissolved in a solution of ferric salt, and the reduction determined by permanganate. Lastly, it may be mentioned that the method now always employed in Java for the determination of the true dry substance of juices, syrups, and molasses is that in which a solution of the product is absorbed by a coil of bibulous paper placed in a special dish, and desiccation carried out for about four hours at a temperature of 102°—105° C.

This book can confidently be recommended as a reliable manual of modern chemical control in the cane sugar factory. It describes the various methods in an admirably clear and precise manner; it is adequately illustrated; and it gives frequent references to facilitate the consultation of original papers. We express the hope that before long a similar handbook may exist in the English language for the use of British chemists in practising a system of *mutual* chemical control in the several sugar-producing parts of the Empire.

J. P. OGILVIE.

OBITUARY.

J. C. UMNEY.

In John Charles Umney, pharmaceutical chemistry loses a distinguished and prolific worker, and the wholesale drug trade one of its outstanding personalities. The deceased was educated at Dulwich College and trained in pharmacy by the late William Martindale, and at the School of Pharmacy in Bloomsbury Square, where he was subsequently engaged in the Research Laboratory. Later he entered the firm of Wright, Layman and Umney, Ltd., and become a partner and managing director.

J. C. Umney was the author of a very large number of contributions to the Pharmaceutical Society, the British Pharmaceutical Conference, of which he was president in 1913, and to other bodies. His activities were very widespread, and in 1910 he founded *The Perfumery and Essential Oil Record*. He contributed the article on essential oils to the last edition of Thorpe's "Dictionary of Chemistry," and was chosen, with Prof. W. H. Perkin and Sir Wm. A. Tilden, as one of the Fairchild post-graduate lecturers in 1912. His connexion with the Society of Chemical Industry dated from 1905, and it is of interest to recall that he lent his valuable assistance to the late Mr. Thomas Tyrer in his struggle to obtain duty-free alcohol for manufacturing purposes.

PUBLICATIONS RECEIVED.

ASPHALTS AND ALLIED SUBSTANES. *Their occurrence, modes of production, uses in the arts and methods of testing. By* H. ABRAHAM. *Pp.* 606, *with* 208 *illustrations. (London: Crosby, Lockwood and Son.) Price* 25*s.*

THE NATURE OF ENZYME ACTION. *By* W. M. BAYLISS. *Monographs on Biochemistry, edited by R. H. A. Plimmer and F. G. Hopkins. Fourth edition. Pp.* 190. *(London: Longmans, Green and Co.* 1919.) *Price* 7*s.* 6*d.*

STEREOCHEMISTRY. *By* A. W. STEWART. *Second Edition. Text-books of Physical Chemistry. Edited by Sir William Ramsay.* Pp. 277. *(London: Longmans, Green and Co.,* 1919.) *Price* 12*s.* 6*d.*

SEWAGE DISPOSAL. *By L. C.* KINNICUTT, C.-E. A. WINSLOW *and* R. W. PRATT. *Second edition, rewritten, Pp.* 547. *(New York: Jn. Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1919.) *Price* 18*s.* 6*d.*

THE CONDENSED CHEMICAL DICTIONARY. *A reference volume for all requiring quick access to a large amount of essential data regarding chemicals, and other substances used in manufacturing and laboratory work. Compiled and edited by the Editorial Staff of the Chemical Engineering Catalog. Pp.* 525. *(New York: The Chemical Catalog Co., Inc.* 1919.) *Price* $5. *(Bound in flexible leather-cloth cover and with thumb-index,* $6.)

THE CANADA YEAR BOOK, 1918. *Compiled by the Dominion Bureau of Statistics, Canada. Pp.* 686. *(Ottawa: J. de Labroquerie Tache.* 1919.)

PUBLICATIONS OF THE UNITED STATES BUREAU OF MINES, DEPARTMENT OF THE INTERIOR. *(Washington: Government Printing Office.* 1919.)

FUME AND OTHER LOSSES IN CONDENSING QUICKSILVER FROM FURNACE GASES. *By* L. H. DUSCHAK *and* C. W. SCHUETTE. *Price* 5 *cents.*

LABOUR SAVING AT LIMESTONE QUARRIES. *By* O. BOWLES. *Price* 5 *cents.*

SAVING COAL IN STEAM POWER PLANTS. *Reprint of Engineering Bulletin No.* 2.

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. DEPARTMENT OF THE INTERIOR. *(Washington: Government Printing Office.* 1919.)

PRICES OF COAL AND COKE. 1913—1918. *By* C. E. LESHER.

FULLER'S EARTH IN 1918. *By* J. MIDDLETON.

SALT, BROMINE, AND CALCIUM CHLORIDE IN 1918. *By* R. W. STONE.

MAGNESITE IN 1918. *By* C. G. YALE *and* R. W. STONE.

TIN IN 1918. *By* A. KNOPF.

NATURAL GAS AND NATURAL-GAS GASOLINE IN 1917. *By* J. D. NORTHROP.

COKE AND BY-PRODUCTS IN 1916 AND 1917.

COAL IN 1917. PART A. PRODUCTION. *By* C. E. LESHER.

CATALOGUE ON RARE BOOKS ON EXACT AND APPLIED SCIENCE. *No.* 773. *Pp.* 256. *(London: H. Sotheran and Co.* 1919.) *Price* 2*s.* 6*d.*

THE SALE OF GAS ON THE BASIS OF ITS HEATING VALUE.

This proposition is one which has recently come to the fore, and will probably play a leading part in the schemes of reconstruction in the gas industry. In the early part of the year, Dr. Charles Carpenter, Chairman of The South Metropolitan Gas Company, proposed methods for putting the idea into operation, and showed that the sale of gas on a heat basis was not only a practical suggestion, but one which could be carried out very readily without involving a great expenditure of money or labour. Later the innovation received renewed attention from members of the industry when it was learned that the charging of gas on a thermal basis constituted one of the recommendations of the Fuel Research Board in its report on gas standards.

There are apparently various reasons why the present time is considered opportune for the introduction of this new system of charging. During the war both industrial and domestic consumers appear to have suffered considerable inconvenience through the relaxation of the legal standards of gas and the consequent delivery of a quality unsuited for consumption in existing appliances. Moreover, the quality of the gas varied from time to time, and hence, in industrial processes, it was often found impossible to exercise the fullest control over the operations involved. It is felt that the confidence of the gas consumer, which has without doubt been lost to some extent during the war period, will be regained by the introduction of this new system, which does not merely involve the sale of gas on the basis of its thermal value, but also the delivery of gas of a constant calorific power. Further, in view of the fact that it is essential to produce gas on the most economical basis, not only in the interests of industry, but also to conserve the coal resources of the kingdom, it is believed that the introduction of this new system will constitute a means of augmenting carbonising efficiency and, generally, of stimulating progress. Finally, it has been considered advantageous to introduce this system in order to establish a common basis for comparison with electricity, so as to enable the consumer to compare financially the two forms of energy.

In the practical consideration of the scheme by Dr. Carpenter, he has suggested that 100,000 B.Th.U. should represent the standard gas unit. Doubtless a distinct advantage would be gained by the adoption of a unit comparable to the heating value of a Board of Trade electrical unit, *i.e.*, to 3418 B.Th.U., but this apparently presents difficulties. In the first place, owing to the economic superiority of gas over electricity small alterations in the price of gas could only be expressed in very small fractions or decimal parts, and, further, arithmetical complications would be introduced in a system of charging based on a unit of 3418 B.Th.U. With regard to the latter point, it is obvious that if it were adopted the calculation arising from the conversion of cubic feet to standard gas units would be, in the case of a consumption of, say, 57,000 cu. ft. of 480 B.Th.U. gas = $\frac{57,000 \times 480}{3418}$

If, however, the suggested unit of 100,000 B.Th.U. be adopted, the calculation involved would be $\frac{57,000 \times 480}{100,000}$. In actual practice this calculation would be considerably simplified, as the conversion can be directly accomplished by multiplying the meter reading (expressed in hundreds of cubic feet) by the calorific value, and moving the decimal point three places to the left in the resulting product. In the scheme outlined it is suggested that the consumer's meter card should record indexes and consumption in hundreds of cubic feet as now, but should have in addition a multiple or factor for conversion, which would be the figure for the calorific value of the gas supplied. It is thus obvious that by adopting the larger unit, difficulties of computation are reduced to a minimum. Similar methods are applicable in dealing with the slot meter consumer under this scheme, the additional charge for fittings and hire being made per standard gas unit instead of per one thousand cubic feet. In Dr. Carpenter's communication to the *Gas World* of March 15, 1919, tables are given showing the relations between price per standard unit and price per thousand cubic feet of gas varying in calorific value from 300 to 600 B.Th.U., together with a table of charges for fittings and hire for slot meter consumers. There is no doubt but that the practical application of the scheme has received detailed consideration by Dr. Carpenter, who is definitely of the opinion that the alteration to the new basis of charge is one which presents no difficulties, and is capable of being carried into operation within a short space of time.

The new basis of charging when first proposed was not well received by the gas industry, although no serious criticisms have been advanced against the proposition. There is little doubt but that the advantages accruing from the stabilising of the industry on a more business-like and scientific footing will far outweigh any disadvantages arising in connexion with the change over to the proposed system. In the first place, although the thermal efficiency of the gas-making processes are acknowledged to be relatively high, it is believed that the production of heat units instead of cubic feet per ton of coal will cause greater attention to be paid to various factors which have been neglected by the gas engineer in the past. This will naturally result in a marked improvement in the efficiency of his carbonising processes. He will be presented with new problems, such as the relative economy of distributing a large volume of low calorific power gas or a smaller volume of gas of high calorific power. Such questions as the purification, storage, and delivery of the larger or smaller bulks involved will constitute important factors in determining the policy of gas undertakings. Among other consequences the operation of the suggested scheme will result in the more general distribution of gas containing a lower proportion of inert constituents, and thus lead to the general distribution of gas of a higher calorific value. The quality of the gas to be supplied will, however, be a question to be decided by each undertaking, and will doubtless be such as will enable the undertaking to work with the highest economy and efficiency, the standard of efficiency being the optimum production of B.Th.U. per ton of coal at the minimum cost.

It will be generally agreed that this system of charging, being based as it is on the intrinsic value of the gas, must tend to operate directly in the interests of the consumer. To effect this completely, however, means must be devised to ensure that his charge is based on the potential thermal units in the gas supplied, and that these thermal units are delivered in the form of gas of constant calorific power. It is, therefore, necessary to provide some reliable form of recording gas calorimeter and to establish an organisation for the continuous control of the gas distributed.

The increasing importance of town gas supply is becoming more and more evident, both on the score of conserving our fuel resources and providing a higher standard of health and comfort in our cities. In industry also its usefulness is rapidly growing, and manufacturers are likely to welcome

not less than the general public the relief from annoyances and inconveniences, too numerous during war conditions, which the new proposals seem certain to bring about.

NOTES ON THE RHINELAND CHEMICAL WORKS. *

J. ALLAN.

PART I.—MAIN FACTORS IN THE DEVELOPMENT OF THE GERMAN CHEMICAL INDUSTRY.

The time is opportune for us to take stock of our position in the world of chemical manufacture, and an important factor in determining our status must necessarily be the value which we place upon the German chemical industry, the heart of which undoubtedly is located in the valley of the Rhine. Much has been written, and even more said, of the greatness of the chemical works in this area and of the marvellous efficiency of their management. It has never been an attribute of the Germans to belittle themselves or their possessions, and many of the statements made as to the marvels of the country, of the wonders of its factories, and the ability of its people are their own assertions, varied merely by the language in which they are expressed. I do not wish it to be assumed from this statement that there is nothing great in what they have done in the business of applied chemistry, far from it, but I desire to assert that they have no monopoly in the ability necessary to initiate such enterprises and bring them to fruition. Many circumstances have contributed to the enviable position which they now hold in the domain of applied organic chemistry, and we can learn much from a full consideration of some of them, especially with the fuller knowledge which has been acquired and the new perspective which has been created by the many happenings of the past five years. Not the least important of these has been the occupation of the Rhineland areas by the Allied forces, and their presence has made it possible for a survey to be made of practically all of the works within the occupied region under conditions which never previously occurred, and in a small measure to penetrate the wall of secrecy which has for long surrounded them. It is with the view of conveying to you some impressions of a visit to the occupied areas that the subject of this address has been chosen.

The present position of the German chemical industry is the outcome of a variety of causes, and not the least of these is the peculiar combination of natural advantages which arise from the possession by Germany of the Rhine valley and those of its tributary streams. Along the two hundred miles of its navigable length in German territory the greatest of its chemical works are situated. The river provides at once a means of transport for raw and finished products both internal and seaborne, a supply of water for all kinds of technical operations, and a ready means of disposing of effluent, whilst in close proximity to the water front are to be found the great beds of brown-coal which supply fuel at a cost which is almost nominal. The supply of this cheap fuel is only one of the natural resources of this favoured part of Germany, since coal, lime, salt and pyrites are all available within the transport area. These are natural assets, and they have been greatly added to by a network of broad- and narrow-gauge railways which have been laid down wherever there is need, and which are operated under conditions which make their use peculiarly favourable to manufacturers within the districts which they serve.

The mere possession of such facilities, however, does not make an industry, and a glance at the story of the growth of their chemical industry will indicate at once that this is so. The manufacture of the so-called heavy chemicals is the oldest branch of applied chemistry, and in this Britain has for a long time taken a leading place. As a "large" industry both in the home trade and for export, alkali and acid manufacture and the production of articles of trade in which these substances are employed had been in British hands for many years before Germany became a manufacturing nation. It was natural that the development of chemical manufacture in Germany should be along the line of least resistance offered by the field of organic chemistry, a line indicated by Perkin's discovery of aniline-purple or mauve in 1856, followed by the production of aniline-red or magenta by Vergius in 1859. I mention these years, familiar enough as they are, in order that more emphasis may be given to the fact that within a very few years after them the foundations of the greatest German firms were laid. Bayer & Co., Meister, Lucius & Brüning, Kalle & Co., and the Chem. Fabrik Griesheim were all founded in 1863, whilst the Badische Anilin- und Sodafabrik was started in 1865.

Nothing in their small beginnings could indicate how rapid would be their growth, and how small these beginnings were is shown by the fact that Meister, Lucius & Brüning, which, as the Farbwerke Höchst, employed in 1914 about 8,000 workmen and over 300 chemists, found its work efficiently carried out in 1863 by the five workmen it then employed.

It is to be noted also that the men required to carry on the work of developing these concerns were already trained and at hand. The importance of the field of organic chemistry had already been estimated by such chemists as Liebig, Wöhler, Kekulé and others, and their students were ready for the work required of them in the new factories. The advance was rapid, and the training of new men in the principles of research became an integral part of their university career. But there was more than opportunity to induce young men to embrace a scientific career. It was thought fitting for members of the best families in the country to take up the study of applied science, and honours and high positions were awarded to those who attained to eminence in it. The effect of such increased opportunities for study and the honours bestowed upon successful students inevitably created an extraordinarily large supply of trained men, with the result that salaries were always low, and firms could afford to select only the cream of the applicants that were always present in numbers whenever a vacancy in their staffs occurred.

The law of supply and demand should have operated to check this fulness in the market of trained intellects, but another and powerful stimulus began to make itself felt, a stimulus which still retained the attraction of recognised status in society, so dear to the German, and yet saved them in large measure from the necessity of undergoing the full term of three years' military training which it was necessary by law that the whole youth of Germany should undergo. A scientific examination or a certificate of maturity or educational efficiency obtained from a recognised school or university was accepted as a reason for the reduction of this period of service to that of one year only in the class of so-called volunteers. This service could be taken in any troop, the volunteer being trained for the position of an officer in the reserve, in which class he had all the status which is accorded to a member of the officer class, with only short periods of training yearly which reduced the hardship of military service to a minimum. Under these conditions,

* Chairman's Address to the Manchester Section on October 3.

as well as by the national recognition of scientific attainments, the supply of highly-trained men was always in excess of the demand.

The German chemical firms were, like most of our own, begun by chemists, and it is to be noted that those that are great to-day have still prominent men in their direction whose training and habit of mind is essentially scientific, many of whom have been drawn from the class of professors and *privatdocenten* whose worth had already been proved by the close touch which has always been maintained between the factory and the university. I need not go into the detail of this association as it must be familiar to all; its value as a commercial asset needs no argument.

It was in the two great branches of industrial organic chemistry, dyes and fine organic chemicals, that the effect of this application of science to manufacture was most evident, resulting ultimately in a virtual world-monopoly of these products. It is a peculiarity of such manufacture that the manufactured articles are extremely numerous and produced in comparatively small quantities, the result being that small businesses have little chance in competition with larger firms unless they be concerned in the manufacture of highly-specialised articles in the sale of which the profits are relatively large. The prominent firms in the business became great, and their growth provided them with still more powerful weapons to withstand any attack from new commercial rivals, whether of their own or foreign nationality. As in all industry, increased production means reduced working costs and consequently enhanced profits; the over-growing output from these works resulted in competition of the severest kind, and internal working arrangements between firms were soon come to whereby group competed with group instead of firm with firm. The most notable of these amalgamations was the formation in 1904 of the two great groups which included the Badische, Bayer and Berlin firms on the one hand, and the Höchst, Casella and Kalle companies on the other.

These associations, as was inevitable, gradually came more and more together until in 1916 the Erweiterte Interessen-Gemeinschaft was formed, which involved in its composition besides the above group such firms as Griesheim Elektron and Weilerter-Meer, which had previously been in the outer circle of these associations, and many others whose businesses were more concerned with the supply of plant and materials rather than the actual manufacture of chemicals, as was the case with the members of the earlier groups. Of the methods adopted to stamp out competition I shall say nothing here. They were of the most ruthless kind, and by many asserted to be absolutely dishonest. It is of course arguable as to when business policy and tactics cross the line between fair and unfair dealing, but in any cases these associations left no stone unturned to eliminate all interference with their business, and no newcomer was tolerated either in their own or other lands.

It is in no way clear when the German Government first realised how huge was the national asset that was growing up in the country, but once this realisation was arrived at the industry was fostered and supported in no half-hearted fashion by the imposition of import tariffs and the granting of exceptional facilities for carrying on export trade, and, it is said, also by financial arrangements through the large national banks. It has been said that each of these great factories is a "potential arsenal," but how great that potentiality is was not realised, at least by other nations, until the happenings of the last five years established it in no doubtful fashion. In the face of such facts as have been established, no nation in the world, if it values its permanence, can afford to ignore the fact that the position of its chemical industry is the foundation upon which the whole fabric of its being is built up. If that foundation be ignored, the structure is unstable so long as force of arms is left as the means of settling international disputes or may be employed as a means to satisfy a nation's avarice.

It is frequently stated that the facilities offered to manufacturing concerns by the German banks are much greater than can be obtained from English banking institutions, but it is seldom that one can find a statement of the essential difference between the practice in this respect of the banks of the two countries. It may be useful, therefore, to indicate briefly what the German system is, and to show how its application has affected the growth, not only of the chemical, but of all German industries. Essentially our banks concern themselves with investments or the financing of short term loans on the most easily realisable security, and though it is possible to obtain loans on collateral securities from them, these must always be of the most easily realisable character, and business overdrafts are always covered by raw or finished goods in which there is an open market. This arises essentially from the fact that the greatest proportion of the banking business is carried out on monies deposited with the bank and not with the actual subscribed capital of the bank itself, and consequently liquidity of investments is essential to security. The position in the case of German banks is markedly different from this. It is to be noted at the outset that the *cartel* system is as prominent in German banking as it is in industry, even the largest of the banking concerns working in groups to their mutual advantage.

These groups further organise themselves into sections to deal with special types of financial propositions which may be concerned with countries or industries, and large group will work in association with large group in order to handle specially large loans, their practice here being similar to that of the spread of large risks by fire insurance companies. It might be said here that such a system cannot be so safe as that of the English banks, and for our banks the risks would certainly be too great to carry, but the capital of the German banks is so much greater in proportion to their liabilities than is the case in England that their practice is as sound as our own. Whereas some of our largest banks show a proportion of capital to liabilities of only 5 per cent., the ratio in German banks is no less than 45 per cent., and at a very recent date the six leading German banks controlled a capital of £137,000,000, whilst the whole English banking system, excluding the Bank of England, holds a paid-up capital and reserve of £110,500,000.

It is held as a standard of British banking, as voiced by a late president of the Bankers' Institute, that "a banker should never be a partner," but exactly the opposite is the general rule in Germany. From the underwriting necessary at the flotation of a new company, or to increase the capital of an old one, the bank is predominant and retains its interest in the new or old concerns with which it is thus associated, much to the benefit of the enterprise. Georges Lachapelle states that in 1911 the Deutsche Bank was represented on 134 different boards, the Disconto on 114, and the Dresdner on 112. A statement by W. R. Lawson is of more value in this connexion than mine. He says "German banking does not stand aloof from industry—as ours does. The men who direct the German banks are at all times in close touch with the iron and coal industries, the manufacturing and trading classes, and the ocean steam lines. With them finance, industry, and transportation go hand in hand, and are regarded as integral parts of the same problem. The German banker has a finger in everything that is going on. He is represented directly or indirectly on the boards of manu-

facturing, trading, shipping and mining companies. He has his eye on all the staple markets. Underwriting is one of his recognised functions, and Germany is thereby spared many of the scandals of British company promoting. There are few commercial or industrial German ventures, be they private concerns or joint stock companies, which do not have at their disposal a fixed credit, uncovered, or covered by very unliquid securities, with one or more banks. Not only have the banks promoted most of the industrial joint stock companies and retained part of their share capital, but their managing directors remain members of the boards of these companies and draw personally large salaries for their services in this capacity."

German industrial enterprise owes a very great part of its success to this close association with the national banking interest, for the directors of these banks see to it that any appeal for public money with which they associate themselves shall be fully and satisfactorily reported upon by their large staff of industrial experts, and that their arrangements as to capital, management, and scientific assistance are approved by the highly-trained men on their boards. It leaves no question for doubt that such co-operation is a prime factor in the success of German industries in home and particularly foreign trade. An enterprise abroad, financed by a German bank, is compelled as a part of the financial agreement to place all orders for materials with German firms, and most generally firms in which the bank has a financial holding.

In the light of all this the system of extended credits which have been so prominent a feature of German foreign business need only be mentioned to be understood.

So far we have discussed conditions which affect many others besides the chemical industries, and we may now consider some which are more particularly attached to this special variety of industrial enterprise. We have already said that the demand for men having exceptional training in chemical and allied sciences has always been fully met by the German universities, and it is to be noted that the possession of a degree only is not accepted by the large firms as a warranty of fitness for a position on their staff, and in most cases a post-graduate course of two years which has been devoted almost wholly to research is insisted upon. The gateway to positions on the staff is through the research laboratory, and a further sifting out of the men takes place here before they are passed on to a post of departmental control in the works.

The remuneration of chemists in the research departments of the large works has not been on a lavish scale, for prior to the war the commencing salary was on the average 3,000 marks, rising to 5,000 marks at the end of four or five years. The first year of employment has always been recognised as a trial period, after which under satisfactory conditions a service agreement for a further four years is entered into. It has been the usual practice to reward a chemist for successful research which has been translated to the works by paying to him a percentage of the profits which have accrued to the firm as a result of this work, but this form of return has for some time been looked upon as unsatisfactory for a variety of reasons, but mainly on account of the difficulty of determining the fair proportion of the actual work done in bringing a discovery to fruition which is the result of the ability of any single individual. The tendency, therefore, has been to reduce these rewards to a very considerable extent, especially since in some cases the reward to the chemist has been out of all proportion to the actual work done. It has been recognised also that many brilliant pieces of work have gone without return to the chemist, merely because they have been unproductive, and in such cases a bonus has been voted to him, the amount of which is determined by the nature of the work carried out. The necessity for such a return is evident if the percentage principle is adopted, since a brilliant chemist would be penalised by having the most difficult problems set to him, whilst a man of lesser ability might be in the fortunate position of being set an easy task the solution of which brought him a high monetary reward.

The result of much inquiry concerning chemical engineers has led to the general statement that the men who can be designated by this description are the product of the works themselves. Certainly they are not accepted as such when they enter the works, although they may have taken courses at the universities specially designed to fit them for this particular branch of engineering work. The requirements as to their training are the same as those of the research chemist, but on entering the works they are attached to one of the engineers already on the staff, so that they may make a full study of the work they will be required to carry out. Usually a year or more elapses before they are given an independent piece of work to carry out for themselves, and one has only to see the results of their work to judge of the efficiency to which they attain. It is to be noted here also that it is always the chemist who holds the right of final decision as to the arrangement and construction of plant, the engineer being held responsible for the engineering work only, *i.e.*, in such matters as strength of materials, efficiency of power application, and the like.

An outstanding fact which is constantly being forced upon one's notice in these large works is the extraordinary way in which the purely chemical industry in its development has carried forward with it other industries concerned with the supply of the materials, whether for power, plant or process which it demands. This all-round advance of attached industries is in the greatest measure due to the utilisation of applied science and particularly chemistry in all branches of their work.

The preparation of metals having special resisting or other properties would be impossible without the chemist, and the beautiful earthenware and enamelled apparatus which is to be seen in general use has been produced largely with his assistance.

It would appear that the standardising of such apparatus as autoclaves, whether of plain metal or lined with enamel, of earthen pots, tubes and the like, greatly facilitates the work of plant erection, since it only requires a knowledge of the quantity of material to be handled in an operation to determine at once from a manufacturer's list what vessels and appliances have to be ordered, and usually they can be obtained from stock. Large stocks of such equipment as autoclaves, open and closed pans, with and without stirring gear, tiles for lining, tower packings and glass fittings are carried in the large factories, and it is an education in itself to walk through a storage yard in which such materials are contained.

There is no question that in this matter we have yet much to learn, and it may be hoped that with the increasing demand for such materials in this country we shall rapidly acquire the knowledge and technique which provide the German chemical manufacturer with such a wide range of excellent plant materials.

It was of course open to British manufacturers to obtain such supplies from Germany in pre-war times, and it cannot therefore be said that lack of them prevented the maintenance of organic chemical industry in this country, but that we were handicapped by the absence of such supplies at our own doors there can be no doubt, and we shall certainly be better able to meet competition when such a supply is forthcoming from British makers.

CHEMISTRY AFTER THE WAR*

SIR WILLIAM POPE.

One of the most important contributory factors to the late war was the striking contrast between the material resources of Germany and those of the rest of Europe, and in no domain was this more evident than in the chemical industry, which, more than any other branch of technology, is immediately concerned with the arts of war.

Before the war Germany supplied the bulk of the coal-tar colours consumed throughout the world, and so well organised and established was this industry that at the outbreak of war the mere rearrangement of the dye factories at once fitted them for the vast production of high explosives required to meet military demands. In this country facilities for the bulk production of high explosives were practically non-existent, and the state of our unpreparedness can be gauged from the facts that during the first year of war 80 per cent. of our output of TNT was derived from toluene contained in Borneo petroleum,† and we possessed neither the works nor chemists to produce the quantities of cordite required. About 97 per cent. of the world's production of quinine comes from the Dutch colony of Java, and its importation into Europe is practically under German control. The supplies of many essential drugs and anæsthetics, and also of dyes for making panchromatic plates, and of certain special steels were automatically cut off at the outbreak of war, and in this way Germany was able to throw her enemies into confusion by a purely economic method. The elaboration of methods for manufacturing nitric acid and its salts from atmospheric nitrogen was brought to a successful issue not long before the commencement of hostilities, and there can be little doubt that this circumstance was a factor in the declaration of war.

One essential difference is observable between the German practice and that initiated to fulfil corresponding war needs in this country. The German chemical factories were developed on a peace footing, and produced materials required by all countries; they were a source of great national wealth in time of peace, and were available for immediate conversion into explosives factories in time of war. The whole world, Britain included, paid for the erection and extension of these vast munition works. Now that war is over these factories can revert immediately to their former remunerative work of supplying the world with dyes, drugs, etc., and the great synthetic nitrogen works will now be able to supply Europe with a considerable portion of its demand for nitrogenous fertilisers. In this country explosives factories had to be hurriedly constructed for the war-time emergency without regard to their subsequent use for peace purposes. Thus the German chemical industry emerges from the war in a stronger position, whilst our own remains much as it was. Germany has not secured supremacy in fine chemical manufacture by the command of any monopoly of scientific talent; in fact a disproportionately large number of German technical products, and particularly of those used in gas warfare, was discovered by British scientists. Thus phosgene was discovered by John Davy in 1912, chloropicrin by James Stenhouse in 1848, and mustard gas by F. Guthrie in 1860.

The record of Great Britain in chemical discovery is one of which she may be proud, and many chemical industries well established in Germany may justly be said to be based on British discoveries. The coal tar industry and the fixation of nitrogen may be cited as examples, but none of the practical fruits has been gathered in Britain.

One of the truths established by the war is that this country commands a galaxy of scientific, inventive, and executive talent, for each military emergency has been met by rapid invention put into rapid practice by British technical effort. The lessons of the war must not be forgotten. It is essential to build up all branches of chemical industry, and for this a wide extension of scientific education and research is imperative. In one respect at least the British Empire is in a highly-favoured position: in one part or other it produces every raw material needed for its manufactures, although in the past it has left these sources of supply to be exploited largely by the foreigner. A great danger threatens us in the near future. A vast, silent mobilisation of all the resources of German scientific industry is in course of realisation for the purpose of nullifying the legitimate consequences of military defeat. It seems, too, that we are on the eve of a powerful propagandist movement to rehabilitate the German chemist in the eyes of the world.

* Communicated by Section B (Chemistry) of the British Association for the Advancement of Science. Abstract.

† The pre-war accumulation of TNT in Germany was mostly derived from the same source, and it was only some months after the outbreak of war that the Dutch shippers diverted the supply of Borneo petroleum to this country.—Ed.

THE CHEMICAL INDUSTRY CLUB.

Among the signs of the times is the increased measure of importance attached to the gregarious nature of man; the value of the social instincts, of human sympathy and of communal feelings in promoting industrial efficiency is, in particular, becoming recognised to an ever-increasing extent. It is therefore small wonder that this spirit has begun to penetrate and permeate the disconnected units which have hitherto comprised the profession of chemistry. It goes almost without saying that an enterprise aiming at social unity and professional solidarity among chemists must *ipso facto* appeal to them, and when such an enterprise has already successfully bridged the gap between aspiration and achievement the appeal must gain in momentum and ultimately bring all waverers into the fold.

The Chemical Industry Club, born amid the toil and tumult of war and homeless until a year ago, has now proved its worth as a social centre for those who think and practise chemistry and for some of those who traffic in its products; with a membership of 650 and a steadily increasing roll, it has established itself as a valuable addition to the general organisation of chemistry and chemical industry in this country, and as such demands the whole-hearted support of the profession.

The completion, on August 31 last, of the first year of its tenancy of the premises at Whitehall Court, S.W., was officially and appropriately marked by the holding of the annual meeting on October 20 and of the first annual dinner on October 31. The business at the annual meeting was purely formal; officers were re-elected, and on a ballot Mr. J. W. Black, Mr. A. G. Craig and Dr. W. R. Ormandy were added to the committee, which now consists of fifteen members.

The annual dinner was held in the Hall of the Tallow Chandlers' Company, Dowgate Hill, E.C., which was kindly lent by the Company for the occasion. Dr. Hodgkinson, the chairman of the Committee, presided, and there were present, besides a large gathering of members, the following guests: Mr. F. Cooper (Master of the Tallow Chandlers' Company), Sir William J. Pope, Mr. H. B. Ferguson (Technical Adviser to the Military Governor of

Cologne), Mr. John Gray, Dr. Rideal, Mr. Julian Baker, and Mr. R. B. Pilcher. Letters of apology for absence were received from Lord Moulton, Dr. C. C. Carpenter, Mr. R. G. Perry, Sir James Dobbie, Sir Herbert Jackson, and others.

Mr. H. B. Ferguson proposed the toast of the British Chemical Industry, and in doing so contrasted German chemical manufacturing organisation with British, pointing out the weak points in English methods and referring particularly to the need for improvement in the status of the chemist and the trust reposed in him. In replying to this toast, Mr. John Gray, who has been a member of the Club for some time, emphasised the need for such an organisation, and welcomed it very heartily.

Sir William Pope proposed the toast of the Chemical Industry Club. He spoke of the national scheme for amalgamating many of the activities of the different chemical societies, and of the provision of a club in connexion with that scheme. He pointed out, however, that so large a scheme must take time, and meanwhile he not only welcomed the present club, but commended the foresight and perseverance of those who had carried it to its present successful state.

Mr. H. E. Coley, hon. secretary of the Club, responded, and appealed to those leaders of British chemistry and chemical industry who have not already joined the Club to do so, because their moral support and advice were wanted, and because the Club was the only organisation of its kind which provided at a cheap rate club facilities for the younger chemists, who badly needed some such meeting centre. He repeated what has already been pointed out, that the Club is ready to associate itself with the national scheme when that is consummated.

Other toasts were those of the Worshipful Company of Tallow Chandlers, proposed by Mr. H. M. Ridge, and responded to by Mr. Cooper; and "The Guests," proposed by Mr. F. B. Davis, and responded to by Dr. Rideal and Mr. Julian Baker.

Many references were made in the speeches to the value of the Club and the work it is doing, and the whole proceedings were marked by a unanimity of feeling and enjoyment which promises well for its future.

NEWS FROM THE SECTIONS.

NOTTINGHAM.

At the opening meeting, held at the University on October 22, the chairman, Mr. F. H. Carr, read a paper describing his experiences as a member of the Commission sent by the War Office to investigate the "poison gas" factories of the occupied area in Germany. An abstract of this address will appear in an early issue.

BIRMINGHAM.

The first meeting of the session was held in the University Buildings on October 23, Dr. R. S. Morrell presiding in the unavoidable absence of the chairman. It was announced that Mr. L. P. Wilson had been elected chairman of the Section in the place of Dr. E. W. Smith, whose engagements made him unable to accept office, and that Dr. Morrell and Dr. Brownsdon had been elected vice-chairmen.

A paper by Mr. E. C. Rossiter and Mr. C. S. Dingley on "Some Chemical Aspects of the Potash Industry in Great Britain" was read by Mr. Rossiter, who gave the results of an inquiry, not yet complete, into the possible production of potash from the blast furnaces of England and Wales.

The chief source of the potash is the iron ore, containing from 0·526 to 0·153% K_2O (=0·833 to 0·242% KCl), the limestones and cokes not usually containing more than 0·1% KCl. The potash charged into the blast furnace comes out either in the slag combined with silicates, or in the gas as a very fine fume, which, after cooling, may contain the potassium as carbonate, bicarbonate, formate, cyanide, thiocyanate, sulphate, and chloride, with small quantities of bromides and iodides. It usually contains a very constant quantity of chloride with varying quantities of carbonate and a smaller quantity of cyanides, and it varies considerably for each works. In works where the gases are not cleaned, most of the potash carried in the gas eventually escapes up the chimney after the gas is burnt at the boilers and stoves. A small proportion is deposited with the heavy dust collected in the dust catcher and the first portion of the gas main, and a larger proportion (but less than 10 per cent.) in the stoves and boiler flues, where, after the gas has been burnt, it is present as a mixture of sulphate and chloride. The few figures collected indicate about 2 tons of heavy dust and 12 cwts. of boiler and stove dust per 100 tons of iron. The systematic collection of this dust would provide only a very minute proportion of our potash requirements, and owing to the low potash content of many samples it would be suitable only for local use in agriculture.

For the manufacture of potassium salts only that portion of the potash which is carried by the gas is available. The results obtained for 34 furnaces show that a comparatively small proportion of the potash is present in the gas under ordinary conditions of blast furnace practice. The greater the quantity of potash in the ores, the greater is the proportion remaining in the slag, and unless a large proportion of the potash remaining in the slag can be transferred to the gas the question of recovery is not worth considering.

This transference can be to a large extent effected by the simple addition of salt to the furnace charge. To test the view that the addition of salt had little effect in increasing the amount of potash in the gas, and that it merely converts the potash already present into chloride, two furnaces were run concurrently for a period of five days, one using 10 lb. salt per ton of iron and the other no salt. The results were: With salt, 11·5 lb. KCl in the gas per ton of iron; without salt, 1·96 lb.

From the results obtained the authors conclude that in furnaces using North Lincolnshire ores about 80 per cent. of the potash will be volatilised into the gas, and be recoverable by adequate gas cleaning plant; in hæmatite furnaces about 80 per cent, and in furnaces using Cleveland ores about 33 per cent. The best conditions for volatilising the potash are obtained in a highly basic charge subjected to a high furnace temperature, and the authors believe the retarded action of salt in furnaces using Cleveland ores to be due to the low ratio of lime and magnesia to silica in the slags.

On a conservative estimate the blast furnaces of England and Wales would be able to provide potassium salt equal to some 63,000 tons of KCl per annum, which might under favourable conditions be increased to 80,000 tons, representing an output approximately equal to double the pre-war consumption of this country.

NEWCASTLE.

At the initial meeting of the session held on October 27 at Armstrong College, Prof. P. P. Bedson presiding, an address was given by Prof. W. A. Bone on the Second Report of the British Association Fuel Economy Committee (this J., 1919, 356 B), which was followed by a discussion in which

Prof. H. Louis, Dr. J. T. Dunn, Mr. T. Hardie, and Dr. J. E. Paterson took part.

On the evening of October 30, about fifty members of the Section paid a visit to Messrs. Palmers' Iron and Steelworks at Jarrow-on-Tyne, and were subsequently entertained by the company.

EDINBURGH.

The first ordinary meeting was held at Edinburgh on October 28, Dr. D. S. Jerdan, the chairman, delivering an address on "Catalysis." After dealing with the original recognition of catalytic action by Berzelius, and the general characteristics common to reactions of this class, Dr. Jerdan described in greater detail the discovery of the organic catalysts or enzymes, and showed how they were eventually recognised by Moritz Traube to act in the same way as the inorganic catalysts The principal manufacturing processes in which enzymes are made use of were then discussed, special attention being paid to processes where the older empirical methods were giving place to methods based on the results of scientific investigation. The influence of enzymes in the tanning industry was referred to, and particularly the modern substitutes for the old puering process. The relation of enzymes to the butter-making and cheese-making processes was discussed with special reference to the various classes of enzymes at work in the preparation and ripening of cheese.

Recent developments in the application of enzymes or of the bacteria and moulds producing them were described, among them the preparation of acetone by the action of ferments on starch, and the treatment of distillery waste as devised by Effront and carried out at Nesle, in France, whereby large quantities of organic acids are recovered.

Lastly, the probable course of future developments in enzyme chemistry was briefly sketched, culminating in the possibility of the synthesis on the large scale of complex organic compounds by taking advantage of the reversibility of the catalytic processes induced by the enzymes, and in the synthesis of the enzymes themselves when their constitution has been fully investigated.

LONDON.

The first meeting of the session was held at the rooms of the Chemical Society, Burlington House, W., on November 3. After referring to the death of Mr. J. C. Umney, the chairman, Mr. Julian L. Baker, announced that Dr. C. A. Keane, the retiring chairman, had been elected vice-chairman. A vote of thanks was then passed to Drs. Keane and Miall for their excellent work in connexion with the organisation of the recent annual meeting of the Society.

The first paper, on "Black Lead Pencils and their Pigments in Writing," was contributed by Mr. C. A. Mitchell, whose work on writing inks and their analytical detection is well known. The first portion of the paper dealt with the historical aspect of the subject, a very numerous collection of early books at the British Museum and other libraries having been laid under contribution by the author, one of whose slides showed a picture of an English pencil dated 1565. The early manufacture of graphite pencils at Borrowdale was alluded to, followed by references to Faber's works in 1761, Conte's process of 1795, and so on to the modern composition pencils. Numerous tables showing analyses of specimens of graphite and pencil mixtures were shown, and some interesting differences (plainly discernible in the photo-micrographs) were clearly distinguishable, graphite markings in all cases showing highly characteristic striations which are entirely absent from the markings made with lead. The chemical methods employed in the identification of marks made by pencils, and the limits of sensitiveness obtainable in testing for the presence of iron, were then described. It is unfortunate that photo-micrography fails in many cases to distinguish with certainty which of two superimposed pencil marks was made first.

In the ensuing discussion, Prof. Hinchley emphasised the importance of fine grinding of the materials employed: for a high grade pencil, the mixture of clay, wax and graphite might be subjected to eight-days grinding, and even for a cheap variety one day is necessary. Dr. Ormandy referred to the preparation of very finely divided clay by the osmosis process for use in pencil manufacture.

The second paper was by Capt. E. T. Sterne on "Shawinigan Chemical Industries." A general description was given of the Shawinigan Falls, of the developed and available horse-power, and of the industries located near them. At the present time 320,000 h.p. is available, and this may shortly be increased to 625,000. The La Loutre dam forms a lake 400 sq. miles in area. The daily output from a single aluminium works is 60 tons, and one of the paper mills, employing 15,000 h.p., is turning out paper to 207 in. in width. Carbide is produced to the extent of 200 tons daily, and other industries include magnesium, carbon electrodes, aloxite, ferro-silicon and carborundum.

The production of acetic acid and acetone from calcium carbide was described at some length. Between 500,000 and 600,000 cu. ft. of acetylene are generated daily, and this gas is passed into dilute sulphuric acid containing suspended mercuric oxide in a vessel made of a special silicon iron. The mercuric oxide is made by oxidising mercury electrolytically and the residual mercury is recovered. The acetaldehyde so formed is oxidised to acetic acid by means of air in a vessel lined with aluminium; and the conversion of the acid into acetone is conducted in steel tubes which are filled with cast-iron balls coated with the catalyst (hydrated lime with a little magnesia) and maintained at 485° C. The walls of the tubes are also coated with the catalyst.

In 1900 Shawinigan was a forest wilderness; to-day it has 14,000 inhabitants, and in 1918 the products of its chemical industries were valued at 30 million dollars.

Dr. Keane and Mr. G. Patchin exhibited a metallic clip designed to prevent rubber connexions slipping off glass and metal tubing.

YORKSHIRE.

The session was opened on November 3 with an address by the chairman, Mr. W. Mackey, on "The Origin and Growth of Expert Evidence." This was followed by a paper on "The Change of the Refractive Indices of Fixed Oils with Temperature" by Mr. H. Wright. By combining Gladstone's equation connecting refractive index and density with Mendeleeff's equation connecting density and temperature, the author has obtained the formula:—

$$N = (N_1 - 1)\left\{\frac{1 - Kt}{1 - Kt_1}\right\} + 1$$

where N and N_1 are the refractive indices at temperatures t° C. and t_1° C., respectively, and where K is the modulus of expansion, which for fixed oils may be taken as 0·00076. When the refractive index of an oil has been determined at a given temperature, it is therefore possible to calculate its value for any other temperature. It was recommended that all results should be calculated to a standard temperature of 40° C. The author gave a number of examples, including olive oil, oleic acid and linseed oil, to show that the recorded values at different temperatures agreed with his formula.

MEETINGS OF OTHER SOCIETIES.

THE BRITISH COMMERCIAL GAS ASSOCIATION.

The eighth annual conference of this Association was held at Westminster on October 28 and 29. Lord Moulton, in his presidential address, paid tribute to the ready assistance afforded him when head of the Department of Explosives Supply by members of the gas industry. This industry has to get back to the stage of steady production before it can hope to attain the extensions so often discussed during the war. He suggested that effort might be concentrated upon work which did not involve increased capital outlay; and he advised caution with regard to the Government plan for the erection of electric superstations. The race between gas and electricity was about equal at present so far as the distribution of light and power was concerned. In regard to heat distribution, gas stood unrivalled. Gaseous fuel was the one defence against the monopoly of the oil companies in the matter of fuel for motor traction.

Sir Dugald Clerk delivered an address on "Coal Conservation as Aided by the Gas Industry." This subject necessitates the study of a large number of problems and the examination of coal in all its stages of production and use. The co-operation of mining, metallurgical, power and gas engineers was essential to a satisfactory solution. Remarking that the gas industry was responsible for dealing with, but not consuming, about 20 million tons of coal per annum, and that the total available water power in the United Kingdom amounted to 3 million horse-power available twelve hours per day, the speaker passed to a consideration of the relative efficiencies in use of gas and electricity for purposes of lighting, heating and power production on the lines of his recent paper to the Royal Society of Arts (this J., 1919, 104 R).

Sir Arthur Duckham remarked that with coal at twice the pre-war figure, fuel bills should not be much higher than in pre-war days, provided the fuel were efficiently employed. The appointment of electrical commissioners by the Government with a view to securing economy in coal, he regarded as a mistake. Much more necessary was the appointment of commissioners for heat, light and power, to investigate questions concerning gas production and the generation of electricity, the utilisation of coke-oven gas and the "waste" heat from blast furnaces, the development of water power, and allied subjects. It was desirable that gas distributed in the future should possess a uniform calorific value, uniform specific gravity, and be at a uniform pressure. He had recently seen results which showed that the most economical way of obtaining the high temperatures ruling in the electric furnace was by means of surface combustion.

Prof. J. W. Cobb also laid stress upon the desirability of viewing the question of coal conservation from the broad standpoint of light, heat and power production.

Papers were read by Dr. C. W. Saleeby on "The Smoke Nuisance in Relation to National Health" and by Dr. H. A. Des Voeux on "The Smoke Nuisance: A Plea for Action." In the latter paper it was stated that the coal thrown into the air of London in the form of soot amounted to 1000 tons per day. Dr. Leonard Hill dealt with "Scientific Heating in Relation to National Health," and Dr. S. Rideal contributed a paper on "The Hygiene of Gas and Electricity for Lighting." The latter's well-known investigations showed that, with natural ventilation, the proportion of carbon dioxide in the air of a living room was practically the same, whether the room were illuminated by gas or by electric light.

SOCIETY OF PUBLIC ANALYSTS.

The first ordinary meeting of the session 1919—1920 was held at Burlington House, W., on November 5, with Dr. S. Rideal, president, in the chair.

Mr. G. Rudd Thompson, in a paper on "Egyptian Bricks," described his investigations of some authentic specimens of sun-dried bricks some 3000 years old from the vicinity of Pithom, one of the fortified cities of the Captivity, with a view to throwing light upon the expression "Bricks without Straw"; the conclusion arrived at was that "straw" did not enter into their composition. The composition of the mud of the River Nile, as shown by these bricks, was remarkably similar to mud taken from the same source in 1912.

Mr. A. R. Powell and Dr. W. R. Schoeller gave a detailed description of "The Analysis of Brazilian Zirconium Ore." The finely ground material is fused with sodium carbonate, the melt extracted with water and the insoluble portion fused with bisulphate. This treatment eliminates silica and renders all the other constituents soluble. The solution is precipitated with sodium thiosulphate and the ignited precipitate weighed as $ZrO_2 + TiO_2 + Al_2O_3$. Titania and alumina are determined in this precipitate, zirconia being obtained by difference. Iron, manganese, lime, and magnesia are determined in the filtrate from the thiosulphate precipitate.

The last paper was by Miss E. M. Taylor on "The Halogen Absorption of Turpentine." In contradistinction to Wijs solution, a solution of iodine tribromide in chloroform was found to give a distinct resting stage at a halogen absorption equal to 4Br for $C_{10}H_{16}$. This stage was reached practically instantaneously by treating turpentine with a large excess of IBr_3, and titrating back at once; the secondary reactions leading to further absorption were sufficiently slow not to interfere with the much more rapid main reaction.

GAS STANDARDS AND THE SALE OF GAS.

Addressing a meeting of Press representatives at Whitehall on November 7, Sir George Beilby, chairman of the Fuel Research Board, referred to the necessity for revising the legislative conditions determining the sale of gas, and directed attention to the Report on Gas Standards by the Fuel Research Board (this J., 1919, 191 R). Conferences of producers and users of gas have been held under the auspices of the Board of Trade, and these have resulted in a number of resolutions being carried which are to be submitted to the Board of Trade for embodiment in the necessary Bill to authorise the sale of gas according to the new standards proposed. Among the decisions arrived at are the following:—

The proposed system of charging the consumer for the potential thermal units supplied is accepted. The unit to be adopted in charging the consumer is to be 100,000 B. Th. Units, and this will probably be called a "therm." The total units chargeable are to be calculated by multiplying the number of cubic feet registered by the consumer's meter by the declared calorific value of the gas per cubic foot. The calorific value is to be continuously measured and recorded by a standard type of recording calorimeter approved by the Metropolitan Gas Referees, who will also prescribe the method of installing, using and checking the same. The gas delivered is to be free from sulphuretted hydrogen, and during the period of two

years subsequent to the passing of the necessary Act is to contain not more than 20 per cent. of inert constituents, this maximum being reduced to 18 per cent. during the succeeding two years and to 15 per cent. thereafter. The producer is to declare the calorific value of the gas to be delivered and will undertake to adjust, and, if necessary, replace gratis consumers' burners, so that the gas may be utilised with safety and efficiency. A gas undertaking is at liberty to change its declared calorific value, due notice of such change being given to the consumer. The necessary adjustments, if any, of consumers' appliances are to be prepared during the period of such notice. Within a period of five years gas is to be supplied at such pressure that under normal conditions the pressure of the gas in any main or service pipe of at least two inches diameter is at least twenty tenths of an inch of water.

It will be seen that these resolutions are in general harmony with the original recommendations of the Fuel Research Board, although they differ from them in certain particulars, *e.g.*, the ultimate maximum permissible percentage of inert constituents is to be 15 and not 12 per cent. The original recommendation concerning pressure specified one of not less than two inches of water at the outlet of the consumer's meter. The present recommendations supplement and to some extent modify the original recommendations concerning the determination of calorific value and the readjustment of consumer's appliances.

PERSONALIA.

Dr. E. K. Rideal has been awarded the degree of D.Sc. in chemistry by the Senate of London University.

Mr. A. E. Duncan has been appointed Controller of Coal Mines in succession to Sir Evan Jones, who recently resigned.

The British Cotton Industry Research Association has appointed Prof. A. W. Crossley, of King's College, London, to be Director of Research.

Mr. F. G. Edmed, of the Directorate of Chemical Inspection, Royal Arsenal, Woolwich, has accepted the appointment of Superintending Chemist, Admiralty Inspection Department, Holton Heath, Dorset.

Sir Richard Redmayne has relinkquished the temporary position which he accepted in 1917 as Director of Production and Technical Adviser to the Controller of Coal Mines and has resumed his permanent duties as Chief Inspector of Mines at the Home Office.

LEGAL INTELLIGENCE.

CUSTOMS SEIZURE OF PYROGALLIC ACID. *Brown and Forth* v. *Buckley.* (See this J., 1919, 379 R, 399 R.)

On October 29, Mr. Justice Sargant, in the Chancery Division, heard a motion by the Attorney-General on behalf of the Crown to stay this action, After discussion it was agreed that an early day should be fixed for the trial, subject to the convenience of the Attorney-General.

In the King's Bench Division on November, before Mr. Justice Sankey, the date of the trial was fixed for November 18.

NEWS AND NOTES.

FRANCE.

Conference of Leather Chemists in Paris.—In the current number of *Chimie et Industrie* M. Jean Gérard describes the meeting of leather chemists which was held in Paris on September 22 and 23. The International Association of Leather Trade Chemists was founded in London in 1897, and by 1914 had a membership of over 500, recruited from nine different countries; in 1917 it was re-constituted under the title of The Society of Leather Chemists, and membership was then restricted to representatives of Allied and neutral countries. The rules of the Society have now been brought into harmony with those of the International Union of Pure and Applied Chemistry.

The presidential address of Prof. Meunier dealt with the more important advances made in the chemistry of leather since the last congress held in London in 1912. The work of Procter and Wilson, of Abt, Jocum, Becker, Seymour-Jones, Tilley, Schlichte, Wood, Sand, Law, Moeller and Hough was briefly reviewed.

The communications presented were restricted to the discussion of urgent questions relating to official methods of analysis. Measures were adopted with a view to establishing the exclusive use of the shake method for commercial estimation of tannins. The committee appointed to investigate the official hide powder was asked to act rigorously, and it was decided to notify in the Society's Journal each time a new delivery of powder had been tested and approved for use. The committee of the English section dealing with the analysis of leather was enlarged to include French and Italian members, and invited to co-operate with the American association with a view to devising an exact official method. This committee is also to draw up a detailed plan with regard to the drawing of samples from bulk. The official method of analysis for sulphonated oils, provisionally adopted by the English section, was approved. Prof. Baldracco (Italy) contributed a paper on the analysis and detection of mixed tanning materials.

Dr. J. Gordon Parker was elected president for 1920-21, and it was decided to hold the next conference in London in 1921.

The Use of Substitutes in the Construction of Chemical Plant.—It seems very probable that France will adopt for good the war-time practice of using substitutes for copper, zinc, tin, nickel, bronze, and lead in the construction of chemical plant and apparatus. These substitutes consisted in the main of thin layers of metal resting on an iron or concrete base. Thus acid-resisting foundry pig iron, sandstone, glass, etc., have been of the greatest utility, and pans of concrete lined with glassy or refractory material have proved efficient substitutes for copper pans. Reversion to the use of copper, nickel and tin would but swell the volume of imports, depreciate the exchange still further, and involve sacrificing the successful results of the application of much skilled labour. It would appear that the use of copper for chemical plant has been more a matter of routine or habit than of necessity.

AUSTRALIA.

The Tinfields of New South Wales.—The New South Wales Government geologist has recently visited the Ardlethan tinfield and inspected the principal mines. He expressed himself as impressed with the potential wealth of the field, which he regards as a valuable national asset. There is much payable ore which is lost or overlooked by the present method of working the richer shoots.—(*U.S. Com. Rep., Sept.* 12, 1919.)

Projected Steel Works in Queensland.—Experts have been examining the various ore fields in Australia and New Caledonia in connexion with the establishment of State iron and steel works in Queensland, and have reported most favourably on the prospects of shipping ore from New Caledonia to a North Queensland port. The ore deposits of this island are located in the south, where huge quantities occur adjacent to excellent harbours. The quality of the ore is stated to be rich and the mining conditions favourable.—(*Industrial Australian, Sept. 1, 1919.*)

UNITED STATES.

Presence of Zinc in Foodstuffs.—Recent work upon the ash of various foods discloses the presence of zinc in quantities up to 415 mg. per 1000 grms. of fresh material. Bakers' yeast, wheat, oats, corn, barley, rye, rice, milk, and eggs were all found to contain zinc. Inasmuch as this metal constantly occurs in the yolk of eggs, in human, and in cow's milk, it is possible that it plays an important part in animal and vegetable metabolism.

The Forest Products Laboratory.—This research laboratory has now a peace-time staff of about 200 men, and much of the work begun on war problems is being continued with reference to normal requirements. Thus, investigations relating to aeroplane construction are found to be valuable to the furniture and veneer manufacturers. Important work is being undertaken on the use of hard-wood oils and tar for ore flotation, for which pine products have hitherto almost exclusively been employed. In this work the Bureau of Mines is co-operating by conducting the flotation experiments with the materials furnished by the Forest Products Laboratory. The production of high-grade paper from cotton linters of the munition class is also being investigated.

JAPAN.

Japanese Chemical Works.—The following statistics give, A. the numbers of various chemical works in operation in Japan at the end of 1917, and B. the numbers of workers engaged therein:—

Industry.	A. Works. Using power.	Not using power.	Total.	B. Employees. Over 15. Men.	Over 15. Women.	Under 15. Boys.	Under 15. Girls.	Total. Male.	Total. Female.
Dyeing	263	165	428	9,349	2,925	313	264	9,662	3,189
Ceramics	793	579	1,072	41,221	8,703	3,734	566	44,955	9,269
Paper-making	226	97	323	12,742	7,196	922	1,191	13,664	8,387
Lacquer	2	25	27	464	115	41	11	505	126
Leather tanning and fur-finishing	22	10	32	685	21	24	—	709	21
Explosives and Matches	94	95	189	5,491	11,939	1,080	2,972	6,571	14,911
Oils and Wax	97	14	111	4,434	726	14	131	4,448	857
Chemicals	260	13	273	12,755	2,402	71	158	12,826	2,560
Rubber	75	13	88	3,673	2,126	108	163	3,781	2,289
Toilet Goods	10	14	24	330	851	3	176	333	1,027
Soap and Candles	49	9	58	1,293	810	76	155	1,369	965
Dyes, Paints, and Pigments	54	22	76	2,511	411	19	25	2,530	436
Fertilisers	36	6	42	1,789	175	2	—	1,791	175
Fermentation	504	771	1,335	28,846	916	161	12	29,007	958
Sugar	24	3	27	1,994	193	28	31	2,022	224
Mineral waters	71	1	72	1,047	675	28	32	1,075	707
Gas Works	35	2	37	1,571	35	3	—	1,574	35
Miscellaneous Chemical works	130	61	191	5,249	1,800	163	52	5,412	1,852
Total	2,565	1,900	4,405	135,144	42,049	6,790	5,939	142,234	47,988

Wages.—Recent labour propaganda against capitalists has been followed by a very great increase in wages. The following table gives the daily wage rates in some of the chemical industries at the end of 1917. The present rates are on the average about 50 per cent. higher:—

	Male	Female (over 15)
Ceramics	Yen 0·75	0·36
Glass	0·75	—
Leather, fur	0·78	—
Fatty oils	0·77	—
Textile, finishing	0·73	0.35-0.36
Dyeing	0·86	—
Camphor	1·00	0·36

	Male	Female (over 15.)
Paper	Yen 0·85	0·35
Explosives	1·00	0·36
Perfumery	—	0·38
Wines, spirits	0·75	0·38
Fertilisers	0·75	—
Cement	0·80	—

CANADA.

Mineral Production of British Columbia in 1918.—The annual report of the Minister of Mines states that the gross value of the mineral production for 1918 exceeds that in 1917 by 12·9 per cent., but the increased value of metallic minerals alone is only 2·3 per cent. The quantity and value of the principal mineral products obtained during 1917 and 1918 is shown in the following table:—

	1917. Quantity.	1917. Value. $	1918. Quantity.	1918. Value. $
Gold placer (oz.)	24,800	496,000	16,000	320,000
,, lode (oz.)	114,523	2,367,190	164,674	3,403,812
Silver (oz.)	2,929,216	2,265,749	3,498,172	3,215,870
Lead (long tons)	16,655	2,951,020	19,598	2,028,107
Copper ,,	26,342	16,038,256	27,448	15,143,449
Zinc ,,	18,682	3,160,259	18,648	2,899,040
Coal ,,	2,149,975	7,524,913	2,302,245	11,511,225
Coke ,,	159,905	959,430	188,967	1,322,769
Miscellaneous products	—	1,241,575	—	1,038,202
Total value		37,010,392		41,782,474

The armistice caused a heavy drop in the demand, and consequently in the value of lead, copper and zinc. In many cases the producers hold large stocks of ore, but the sales are few.

The zinc ore was raised almost entirely in the Fort Steele and Slocan districts, the output from the first-mentioned being treated at the Trail electrolytic refinery. The chief producers of lead ore were the Fort Steele, Slocan and Ainsworth districts.

The largest production of copper, as in former years, came from the Skeena Division, followed by the Southern Cross and Boundary-Yale districts.

The output of coal was hampered by the shortage of labour. The bulk of the output was obtained by three companies, viz., the Crow's Nest Pass Co. of East Kootenay, the Canadian Collieries and the Western Fuel Co. of Vancouver Island, which produced 23·6, 30·7 and 28·4 per cent., respectively, of the total.

Small quantities of chromite, magnetite, manganese ore, molybdenite, arsenic, fluorspar and platinum were also obtained in 1918.

Meeting of the Industrial Commission.—The Canadian Government held a joint gathering of representatives of capital and labour during the week September 15—22, which was attended for the first time by representatives of technical and professional men, who formed a third or neutral party. The Society of Chemical Industry in Canada was represented by Mr. Crossley, of Toronto. The opinions of professional and technical men in Canada have never been called for by the Government, labour or capital, and it is felt that the time has come when this so-called "neutral" group might be consulted with advantage to all parties.

A New Use for Flotation Machinery.—The Groch Centrifugal Flotation Co., of Cobalt, Ont., has perfected a flotation machine for floating paper stock. The paper mills lose about 7 per cent. of total stock, and while screens can save 50 per cent. of this, the new system would float off 90 per cent. at a cost of less than 20 h.p. per 1000 galls. per minute. It would be profitable to run this machine on back waters carrying as low as 3 cents per ton of water.

Canadian Universities.—With the opening of Canadian universities in October, a very marked increase in attendance is shown, beyond the highest records previous to the war. Science courses are particularly crowded and over 1200 returned soldiers are in attendance at the University of Toronto, a slightly lower number at McGill, Montreal, and somewhat fewer at Queen's, Kingston, Ontario. An era of very rapid expansion is now being entered upon by all educational organisations in the Dominion. The University of Toronto, and the Province of Ontario have promised to support the efforts of the Textile Institute to obtain courses of advanced technical education suitable to the needs of this industry.

GENERAL.

The Harrison Memorial Lecture.—This memorial lecture, which was delivered by Mr. Francis H. Carr before the British Pharmaceutical Conference in July last and of which a reprint from the *Pharmaceutical Journal* has recently been issued, contains the most complete account of the life, character and work of the late Colonel E. F. Harrison (*cf.* this J., 1918, 446 R) which has been published, and it makes us realise more than previously the great loss which chemistry and the country suffered by his untimely and self-sacrificing death. The second part of the lecture contains a detailed description of the preventive measures taken to cope with the lethal gases employed by the enemy. We learn that the total output of the second and more perfect type of box respirator was no less than 20,000,000. The chief absorbents employed were lime, caustic soda, permanganate and wood charcoal, and as much as 300 tons of wood had to be carbonised weekly to supply the demand for the last-named material. After the respirators had been carefully assembled, they were subjected to rigorous tests in an atmosphere containing a determined proportion of the offensive gas—this proportion being raised from its initial value of 1 in 10,000 in 1915 to 1 in 100 in 1917. In all this work, and in much else, *e.g.*, the detection and estimation of minute traces of the various gases, Harrison was responsible in a supreme degree for the co-ordination of pure scientific work, technical effort and manufacture.

The Position in Germany.—Mr. Irving A. Keene, chairman of the committee on drugs, chemicals and dyestuffs of the American Chamber of Commerce in London, has quite recently returned from a tour of inspection of chemical works in the occupied and unoccupied areas of Germany. His report confirms information received from other sources, namely, that owing to the dearth of coal, raw materials and credit, no competition worthy of the name is to be feared from Germany for at least a year. The big firms producing dyes and drugs are working for private German account, and after the demands of the Allies under the Peace Treaty have been met, *viz.*, delivery of 50 per cent. of stocks as at January 1, 1919, there will be practically nothing left for foreign sale. Added to this there is the further condition of surrender to the Allies of 25 per cent. of the annual output until 1925. The reduced productivity of the workpeople, estimates of which vary from 33 to 75 per cent. of the pre-war normal, is largely the result of socialistic agitation, which, Mr. Keene thinks, is unlikely to last, for the German workman will realise before long that social equality, as expressed by idleness, does not put food into his mouth. Apart from the working classes, the German population is as industrious as ever. Although great trouble may ensue during the coming winter through lack of coal, Mr. Keene anticipates that the recent excellent harvest will keep the country on its feet.

Conditions that Govern Staleness in Bread.—In a pamphlet bearing this title Captain R. Whymper describes investigations carried out in the British Army bakeries in France during 1917-18. The results are given under four headings: I. Determination and location of losses occurring in the manufacture of bread; II. Conditions that govern staleness in bread; III. Changes occurring in bread with age; IV. The colloid nature of starch pastes, bread crumbs, etc. It was found that the cooling of bread takes place in three stages, namely, the steam period, during which most of the drying-out takes place in a given time; the condensation period, during which the rate of drying is only one-fifth that of the steam period; and the drying period, in which the rate of drying is about one-fourth that of the steam period. Loss of moisture from the centre of the loaf is inconsiderable until after 100 hours under ordinary conditions, an actual increase being often observed before this time. The zone of drying-out is very narrow in a loaf up to about 100 hours, being about 1 in. inwards from the crust; after 100 hours the moisture diffuses gradually from the centre of the loaf, but at so slow a rate that there is always a pronounced difference between the moisture content of the crumb at the centre of the loaf and that of the crumb beneath the crust. The loss of water during cooling and drying-out is not responsible for staleness. During the process of becoming stale the soluble extract of the crumb decreases, this decrease being followed after a time by an increase. The quantity of soluble starch in bread crumb diminishes rapidly between the sixth and twenty-fourth hours of the cooling period; a similar fall and rise of soluble extract is observed in starch pastes. Staleness may be attributed to deposition of solid starch in the crumb caused by change of temperature during the cooling period and accelerated by the presence of solid starch particles already existing in the crumb. Staleness is also due to polymerisation of starch, which tends to crumble the gelatinous nature of the bread crumb when fresh. Other changes occurring in the proteins of bread crumb may be responsible for staleness, but these have not yet been investigated.

Artificial Honey in Germany.—Artificial honey was consumed in Germany in large quantities during the war. Although the conversion of cane sugar into invert sugar is a simple chemical process, the products of different firms were lacking in uniformity, a considerable portion consisting of a thin fluid. For the production of a thick variety the water content and the inversion of the cane sugar are matters of great importance. The water content must not exceed 22 per cent. and the inversion must be complete to within 5 per cent. The inversion proceeds best when at least 0·1 per cent. of formic acid is present. The strongly acid taste of the product is removed by neutralising with sodium carbonate. The enactment of a law similar to that concerning margarine is recommended in order to prevent confusion between natural and artificial honey in the trade. On economic grounds, thick artificial honey is an indispensable product in Germany.—(*Schweiz. Chem.-Zeit.*, 1919.)

The Aluminium Industry in Germany.—Aluminium has become, in a short time, a factor of considerable importance in the metal market. The many applications of aluminium during the war will remain and be considerably extended in peace time. Before 1914 Germany possessed only one factory for the production of aluminium, in the region of the Rhine (Baden), a factory affiliated to the important Swiss Neuhausene Aluminiumindustrie A.-G., in which company both French and German capital is invested. The output of this factory was only 800 tons annually, and the twenty times greater requirements of German industry had to be supplied by metal imported from Switzerland, France and England. German capital was not forthcoming for the erection of large new works; and, moreover, the price of aluminium prior to the war—M. 1·50 to M. 1·80 per kilo.—was not altogether attractive for this purpose. The shortage of metals, occasioned by the blockade, assisted in the establishment of a German aluminium industry, although this was not achieved without difficulty. With the failure of supplies of bauxite and alumina from Switzerland, Germany was finally thrown upon her own resources. The erection of aluminium factories was decided upon in 1915, and they were completed in an unparalleled short time. The largest works is the Erftwerk, A.-G., at Grevenbroich, on the left bank of the Rhine. In place of copper, aluminium was principally employed in shipbuilding and in the electrical industry. On account of its lightness and the tenacity of its alloys it found considerable application in aeroplane and airship construction. The wide application of aluminium is exemplified by the fact that in America parts of railway and street wagons are customarily built of aluminium, *e.g.*, the sides, tops and doors thereof, while it displaces brass in the construction of armatures. Its field of usefulness extends to the construction of automobiles, agricultural and industrial vehicles, to the chemical and brewing industries, to bell casting, and it is anticipated that for purposes of electric transmission aluminium will enter into keen competition with copper. On account of its low specific gravity, 1 kilo. of aluminium is equivalent to 2·5 kilo. of copper, so that aluminium can be used with advantage in place of copper even when its cost is 2½ times greater. In the electrical industry, owing to the lower conductivity of aluminium, the advantage gained by its use is not so preponderating, but even here 1 kilo. of aluminium is equivalent to 2 kilo. of copper. These facts demand attention on political and economic grounds. Dependent on other countries for copper, nickel, tin, etc., Germany is self-sufficing as regards aluminium. Much capital would remain in the country were the import of copper reduced. The price of aluminium about the year 1905 was from M. 3·25 to M. 3·75 per kilo., and this fell to M. 1·05 to M. 1·25 in 1911, and then increased again to M. 1·80 before the war, and its price has now increased six-fold, and will probably rise still further. Information concerning the price of aluminium in foreign countries is discordant, but it is certain that owing to currency exchange conditions foreign aluminium is to-day considerably dearer than the German product. One fact is of extreme importance: the use of every kilo. of German aluminium reduces the import of copper by from 2—3 kilo.—(*Z. angew. Chem., July* 18, 1919.)

The Mining Industry of Indo-China.—*La Dépêche Coloniale* gives the number of mining concessions granted in Indo-China up to January 1, 1919, as follows:—Coal 63, zinc and lead 91, lead and silver 3, tin and tungsten 30, gold 12, copper 9, iron 3, antimony 4, and mercury 3. Total, 218.

The coal production over the period 1914 to 1918 (inclusive) has remained fairly constant at 650,000 tons per annum, but the exports have fallen from 400,000 tons in 1915 to 252,000 in 1918.

The tin and tungsten mines have shown a steady increase in production from 309 tons in 1914 to 604 tons in 1918. Of the 1918 output, 218 tons consisted of high grade (70%) wolfram and 119 tons of high grade (60%) tin ore, the remaining 263 tons being mixed tin and tungsten ores. Prices have been high during 1918, tin averaging 9000 francs per ton and wolfram 100 to 120 francs per unit of tungstic acid. Unfortunately, want of shipping has only allowed of the disposal of half the production at these favourable rates.

The zinc industry has been seriously hit during the last two years by the loss of the Japanese markets to the Australian producers. The quantities of Tonkin tin ore extracted during the war have been:—1914, 31,000 tons; 1915, 36,000 tons; 1916, 48,000 tons; 1917, 39,000 tons; 1918, 28,000 tons. Total, 182,000 tons. Of this quantity only 130,000 tons has been exported; 57 per cent. to Japan, 34 per cent. to Europe, and 9 per cent. to the United States.

There are extensive deposits of iron ore in Indo-China, but they have not been developed. During the last year, however, several hundred tons have been extracted and smelted at Haipong, where the newly erected furnace produces about 15 tons of iron per day.—(*Bd. of Trade J., Sept.* 18, 1919.)

Salt, Bromine, and Calcium Chloride in 1918.—*Salt.*—The total salt production in the United States was 7,238,744 short tons in 1918, being 3·7 per cent. more than in 1917. The average price was $3·72 per ton, compared with $2·86 in 1917; rock salt was cheaper than evaporated or brine salt, and the price of each varied according to locality. The production costs tended to increase in greater proportion than the selling price, but showed wide variations. Of rock salt 1,683,941 tons was mined, chiefly in New York and Kansas; there is only a demand for small quantities in the Western States, where large deposits exist near the surface.

Various grades of salt are produced by evaporating natural and artificial brine; there is an increasing demand for pressed blocks for salting cattle, the 1918 output of this grade being 94,150 tons (chiefly in Kansas). Chemical companies converted nearly 3,000,000 tons of brine salt into various sodium salts and into calcium chloride, chlorine and hydrochloric acid. Michigan, New York, Ohio, Kansas, and California were the most important districts for brine evaporation.

Most of the salt (7,142,251 tons) was produced for domestic consumption. Imported salt, mainly coarse solar salt from the West Indies and Spain, decreased from 130,804 tons in 1914 to 40,290 tons in 1918. About 17,000 tons of English salt was imported to supply packers. Over 136,000 short tons of salt was exported in 1918, or 20 per cent. more than in 1917. The largest consumers were Canada, Cuba, New Zealand, Mexico, and Panama; South American countries were more largely supplied from England.

The production of salt in Canada (Ontario) amounted to 131,727 tons in 1918. A deposit of rock salt is being developed in Cumberland County, Nova Scotia. Practically all the salt produced in the West Indies, Mexico, and Central America is solar salt; there are salt mines in Guatemala. Rock salt is mined in Chile and Columbia, and sea water is evaporated in Argentina, Brazil, Venezuela, and other South American countries.

In Europe, England produces 2,000,000 tons; Germany 2,000,000 tons, and Austria Hungary 800,000 tons. France, Spain, Greece, Turkey, and Italy evaporate sea water. There are mines in France, Rumania, and Switzerland. Russia produces 2,200,000 tons from salt lakes, rock salt, and by the evaporation of brine. In Spain there are large deposits of rock salt as yet untouched.

China produces 1,800,000 tons of salt under Government monopoly. India imports 150,000 tons of solar salt from Aden and produces over 1,000,000 tons from rock salt deposits in the Punjab, from the Sambhar Lake in Rajputana, from the lesser Rann of Cutch, and from sea-salt factories in Bombay, Madras, and at the mouth of the Indus. Japan and Siam derive their supplies from solar evaporation.

Sea water is evaporated in northern Africa, and South African supplies are derived from salt springs. Salt is imported into other African countries.

Australia draws her supplies from South Australia and Victoria and from England; New Zealand imports from England and the United States.

Bromine.—The bromine production in the United States was 1,727,156 lb. in 1918, an increase of 92·9 per cent. compared with 1917. It was made as usual from the brine pumped in Michigan, Ohio, and West Virginia, and large quantities were exported to Europe as bromine or bromides for use in medicine, photography, and asphyxiating gases. The wholesale price was 25·35 cents per lb. in 1913, it rose to $5·00—$6·50 in 1916, but was fairly steady at 75 cents in 1918 prior to the armistice.

Calcium Chloride.—Large quantities of calcium chloride are produced as a waste product of the ammonia soda process in New York, Michigan, Ohio, Kansas, and Virginia. In addition, 26,624 tons of calcium chloride containing 2—6 per cent. of magnesium was recovered from natural brine in 1918, the average price being $18·90 per ton (*U.S. Geol. Surv., Aug.*, 1919.)

The Uses of Magnesite.—In addition to the primary use of magnesite for refractory purposes, it is also employed in the manufacture of magnesium oxychloride or Sorel cement, the value of which is based on the fact that a finely ground calcined magnesite when wetted with a solution of magnesium chloride of a certain strength solidifies or sets to an exceedingly strong and hard mass. The oxychloride so formed is generally modified by the addition of various filling materials, such as wood flour, cork, talc, silica, asbestos, clay, marble dust, and sand, besides colouring matter. The cement is sold under several trade names, and is commonly referred to as sanitary flooring. When well-laid, magnesite cement has some decided advantages over other cements for use as flooring. It produces a smooth, even floor, which may be laid in large areas without cracking. It takes colour well, and is susceptible to good polish by oiling and waxing. It is laid in a plastic state on wood, steel or concrete. Its surface seems to have a resilience not given by ordinary cement, and it does not pulverise. The use of magnesite cement on floors and as stucco or wall plaster is gaining in importance in the United States; and it was reported that magnesia cement was used by the Germans for gun emplacements, because it sets quickly and attains great strength much sooner than Portland cement.

Californian magnesite has been used for many years in the manufacture of wood-pulp paper on the Pacific coast. Magnesium bisulphite is said to have more solvent action on the free resins of the wood than lime, and it also has an additional advantage in that the residues left in the paper stock are not afterwards injurious to sizing agents. In the sulphite process of paper manufacture magnesium bisulphite is found to be more stable than calcium bisulphite, and it dissolves the noncellulose matter more completely. Sodium bisulphite gives a better product than either of the two mentioned, and strong liquors can be made from it, but it is too expensive for general use. (*U.S. Geol. Survey, July*, 1918.)

Production of Candelilla Wax in Mexico.—The candelilla shrub, of an average height of 25in., grows abundantly and in a wild state in Mexico, more particularly in the Monterey district, where there are several factories for extracting the wax. At the present time (end August, 1919), owing to the low price of the wax, there is only one large factory operating, with a daily output of 662 lb., but it is reported that another large one will be opening shortly. The wax is extracted by putting the shrubs, as gathered, into water, which is then heated to the boiling point. Sulphuric acid is then added, and the separated wax is collected and put in receptacles until it solidifies. It is then treated with steam in another tank, sulphuric acid being again added. Thus refined the wax is cast in moulds and is then ready for shipment.—(*U.S. Com. Rep., Sept.* 12, 1919.)

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Price of Coal.

On the motion for the adjournment, and in reply to Mr. Holmes, who contended that the increase of 6*s.* per ton in the price of coal was no longer justified, Sir A. Geddes said that the only new fact in the situation was that the output of coal for the last quarter was at a lower rate than the estimate. There was also a loss of £22,000,000 on the control arrangements, and this was being borne by the Treasury. Referring to the very large profits which some of the collieries were making, he said that when these profits were reduced to 1*s.* 2*d.* per ton (under the Sankey Report), and when the surplus provided by these collieries was taken to make up the deficiency at other collieries, the apparently great profits would largely disappear. The Board of Trade was most anxious that the price of coal, and especially that of bunker coal, should be lowered, but the best economic opinion was entirely adverse to effecting this by way of granting a subsidy.—(Oct. 27.)

Coal Consumption in Coke Ovens.

Answering Mr. Atkey, Mr. Bridgeman, for the Board of Trade, stated that the quantity of coal carbonised in bee-hive and patent coke ovens in the United Kingdom was approximately 20 million tons in each of the years 1917 and 1918.—(Oct. 28.)

Vegetable Oil-seed Products.

The Under-Secretary of State for the Colonies informed Col. Wedgwood that ordinances have been passed in four West African Colonies imposing, as from October 20, a duty of £2 a ton upon palm kernels when exported to destinations outside the British Empire. This duty does not apply to other kinds of oil-seeds; and (in reply to Mr. Hayday) the object of this duty is to prevent trade in palm kernels reverting to Germany.

In order to secure an adequate supply of oil-seeds and their products, including margarine, for the next few months, the Governments have been requested to prohibit the export of palm kernels, groundnuts and copra to destinations outside the Empire. Licences will be granted for the exportation to lawful destinations of the following proportions of the quantity shipped to the United Kingdom:—Palm kernels, one-ninth; groundnuts, one-fifth; copra, an equal quantity.

Mr. Montagu stated, in reply to Col. Wedgwood, that the Government of India considers it unnecessary to regulate the export of copra and coconut oil from India on the lines of the scheme above mentioned.—(Oct. 29.)

Coal Production.

In response to information asked for by Mr. Hartshorn, Sir A. Geddes issued statistics giving the average number of persons employed in coal production, and the total output for each of the four quarters ended September 30 last; also for four-weekly periods from June to September, together with average output per man per week and per man per shift, percentage of absenteeism, etc. For the quarter ended December 31, 1918, the profit (including interest) was 3s. 4d. per ton raised.—(Oct. 29.)

Flax Production.

Sir A. Boscawen, in a written reply to Mr. Stewart, explained the objects of the Flax Production Scheme of the Board of Agriculture. The capital expenditure on land, buildings and equipment is £750,000; other expenditure, including the training of workers and experiments, £850,000; estimated further expenditure on 1918 and 1919 crops, £9,000,000; revenue to date, £300,000; and estimated further revenue from stocks in hand, £1,300,000. The Board is now considering offers for the purchase of the whole undertaking, and it is confident that with efficient management the industry has every prospect of success.—(Oct. 29.)

Spitzbergen.

The Under-Secretary of State for Foreign Affairs intimated to Sir Martin Conway that the Supreme Council in Paris has conferred the sovereignty of Spitzbergen on Norway. The conditions attached to the treaty will adequately safeguard existing British rights. The territory claimed by British companies is, approximately, 4000 sq. miles, by Norwegian 900 sq. miles, by Swedish 350 sq. miles, and by Russian 100 sq. miles.—(Oct. 30.)

Quinine.

Mr. Bridgeman confirmed Mr. Spoor's statement that the world's production of quinine, apart from a little produced by the Government of India for local use, has lately been made the subject of a monopoly by the Dutch and British producers. The whole question of the prices and supply of quinine sulphate is being investigated under Section 3 of the Profiteering Act.—(Oct. 30.)

Dyes.

Major M'Kenzie Wood asked the President of the Board of Trade if the subsidised dye manufacturers are supplying to woollen manufacturers dyes which are not fast to milling, and if, in consequence, large quantities of good material are being spoiled weekly.

Sir A. Geddes replied that he had received no information or inquiries on this specific question. —(Nov. 3.)

Quality of Gas Supply.

Sir A. Geddes, replying to Mr. Gilbert, who had drawn his attention to the poor quality of gas supplied by certain gas undertakings in the London area, announced that he would shortly introduce a Bill giving effect to the recommendations in the recent Report of the Fuel Research Board, whereby gas will be charged for on the basis of its calorific power.—(Nov. 3.)

Derbyshire Oil.

In reply to Sir A. Fell, Mr. Kellaway stated that progress in boring had been recently somewhat retarded by unavoidable accidents and difficulties in getting material. Oil was still flowing from the Hardstoft boring at the rate of about 260 galls. a day, and there was about 36,500 galls. in stock.—(Nov. 11.)

REPORTS.

MINES AND QUARRIES: GENERAL REPORT, WITH STATISTICS, 1918. *By the* CHIEF INSPECTOR OF MINES. *Pt. I., Divisional Statistics and Reports.* [*Cmd.* 339. 9d.] (*London: H. M. Stationery Office.*)

During 1918 there were 7637 mines and quarries at work, and the number of workers was 1,072,903, showing net decreases of 410 and 12,568 respectively over the previous year. There were 1,487 deaths from accidents, an increase of 48. The total output of minerals is shown in the following table:—

Summary of Output of Minerals from Mines, Quarries and Brine Wells.

Minerals.	Total output, 1918.	Total, 1917.
	Tons.	Tons.
Alum shale	5,231	5,555
Antimony ore	1	—
Arsenic	2,349	2,626
Arsenical pyrites	477	434
Barium (compounds)	66,360	65,557
Bauxite	9,589	14,724
Bog ore	603	1,736
Chalk	2,304,248	2,264,350
Chert, flint, &c.	54,518	66,206
Chromite of iron	140	—
Clays* and shale	6,003,787	5,842,675
Coal	227,718,054	248,499,240
Copper ore and coj per precipitate	1,213¼	1,159¼
Fluor spar	53,498	64,874
Gravel and sand	2,022,567	1,929,164
Gypsum	178,734	173,015
Igneous rocks	3,961,524	4,239,405
Iron ore	11,613,032	14,845,734
Iron pyrites	22,195	8,515
Lead ore	14,784	15,322
Lignite	150	900
Limestone (other than chalk)	10,156,603	10,454,717
Manganese ore	17,456	9,942
Natural gas	(c. ft. 85,000)	(c. ft. 85,000)
Ochre, umber, &c.	9,480	11,216
Oil shale	3,080,867	3,117,658
Phosphate of lime	3,372	—
Rock salt	113,884	122,679
Salt from brine	1,862,130	1,890,709
Sandstone	1,553,151	1,613,579
Slate	110,197	121,524
Soapstone	936	1,233
Sulphate of strontia	1,014	2,577
Tin ore (dressed)	6,378	6,576
Tungsten ores	302	241
Uranium ore	—	13
Zinc ore	9,025	7,484
Total	273,988,449¼	295,401,139¼

* Including china clay, china stone, amd mica clay.

The lengthy reports of the Divisional Inspectors deal largely with details of administration. In many instances output was reduced owing to shortage of transport and loss of foreign markets; furthermore, there was a decrease in the output per man.

In regard to coal mines, much attention was paid to the supply of home-grown timber for pit props; steel props are now employed at many collieries, particularly at Newbattle, Scotland, where the roofs of all roads are supported by arched steel girders, together with brickwork in the main roads. Increased efforts were made to combat the danger due to coal dust explosions by the distribution of stone dust and by the provision of dust-tight trams. During the war there was delay in obtaining material for these and other safeguards, *e.g.*, armoured electric cables, required by the Coal Mines Act, 1911. Ventilation is being improved by splitting the main air currents and conducting the air to the coal face. It would appear that since the nitro-glycerin content of gelignite was reduced to 50 per cent. the products of the explosion often contain a larger proportion of carbon monoxide, together with some nitrous fumes. Further restrictions upon the use of naked lights are proposed.

The effect of the war upon the condition of the mines varied in different localities. While attention was concentrated upon output, development work was in many cases retarded, and extensions are now required. Although haulage roadways were kept in good order, it was necessary to cease work in whole districts of some collieries in order to concentrate the available men, and a heavy outlay will be necessary to reopen such districts.

In connexion with hæmatite mines, an investigation is proceeding to ascertain whether iron-ore dust is liable to cause fibroid phthisis.

REPORT ON THE TRADE OF SOUTH AFRICA, 1918. *By H.M. Trade Commissioner at Cape Town.* *Pp.* 90. [*Cmd.* 357. 6d.] (*London: H.M. Stationery Office.*)

The year under review has been an eventful one, but thanks to the British Navy and Merchant Service, South Africa has been spared the worst effects of the war, and from the economic standpoint the country gained far more than she lost. The curtailment of shipping has caused a considerable development of home industries and of trade with the South-West African Protectorate, East Africa and Zambesi. The epidemic of influenza and the drought at the end of the year affected trade seriously, and there has been much labour unrest; prices have risen enormously.

Prior to the war the trade with South Africa was noted rather for cheapness than quality, but of recent years the increase in spending powers of the working classes (both white and native) has created a demand for better class goods. The agricultural industries are, generally speaking, in a flourishing condition, the area under cultivation having increased enormously. There are, however, still large tracts of virgin land, and it is hoped that a larger white population will be attracted to farming in the future. The scarcity of fertilisers has been a serious handicap, and although South African farmers have learned to dispense with certain products hitherto imported, and the manufacture of sheep dips has been undertaken locally, the Union will continue to rely on imports for its agricultural supplies. Schemes are afoot for installing large grain elevators at Durban, East London and Cape Town, also for extending irrigation work similar to that at the Modder River.

The output of minerals for 1918 was:—Gold, £35,760,000; diamonds, £6,960,000; coal, £3,250,000; copper ore, £360,000; tin concentrates, £450,000; other minerals, £440,000; total value, £47,220,000. The gold industry is passing through a very difficult period owing to the large increase in production costs, while the value of the metal remains at its fixed standard.

The coal output shows a decrease of 1,070,840 short tons over 1917, but the exports have increased from 538,679 to 1,208,386 tons. Recent analyses show that the average steam-raising value of the best Transvaal (Witbank) coal is 12·78 lb. of steam per lb. of coal, and the best grade Natal coal 13·95 lb. Local industries include a new smelting plant for tin which meets all the requirements of the Union.

The chief chemical manufactures include alcohol, ammonia, argol, arsenic, bleach, disinfectants, Epsom salts, glycerin, saccharin, soda, starch, and lead nitrate. The production of chemicals increased in value from £171,040 in 1915-16 to £234,494 in 1916-17. Oxide of antimony has been absorbed locally for the manufacture of paints. The value of varnishes produced in the Union in 1916-17 was £46,420; it is estimated that the South African market for these products approximates to £250,000 per annum. The present demand for cement exceeds the supply. The iron industry at Pretoria and Vereeniging is now established, and pig-iron of good quality is being produced. The following figures give the values of the annual production of the chief chemical industries:—Sugar, £3,065,000; explosives and matches, £1,884,000; breweries, £1,161,000; soap, £882,000; candles, £626,000; tanning, £475,000; distilleries, £382,000; oil and grease, £272,000; and fertilisers £170,000. It is possible that the phosphate deposits at Saldanha Bay may be developed in the near future, but the rock is very high in iron and alumina. It is suggested that British manufacturers could do benefit both to themselves and the Union by starting branch factories in South Africa.

The principal imports are iron and steel machinery, railway materials, and clothing. The total imports for 1918 were valued at £47,397,000, compared with £34,750,000 in 1917 and £38,526,000 in 1913. The chief increases were in cotton piece goods, blankets, chemicals and sugar. About four-fifths of the imports of drugs and chemicals is derived from the United Kingdom. The German trade was formerly about three-fifths that of the British. Importations from the United States have not increased appreciably during the war, but Canada, Japan and Australia have entered the market, and in certain lines will probably retain their position. Glassware has been in short supply during the war, particularly in respect of licensed victuallers' glass. Occasional shipments from Holland and importation of inferior articles from Japan have taken the place of the cheaper wares formerly supplied by the Central Powers; this demand will be large for some time to come. If these Powers are excluded from the South African market, the United Kingdom should have a monopoly for the trade in earthenware and china. Remarkable changes have taken place in the overseas supply of linseed oil. In 1913 the United Kingdom supplied over 99% of the imports, and again in 1915 and 1916; in 1917 these were distributed between U.K. 84%, India 12%, and U.S.A. 3·5%; and in 1918, U.K. 1·8%, India 43·4%, and Argentina 42·4%. America and Canada have been supplying paints, colours and varnishes in increasing quantities since 1916, but with the exception of American paints and leads this competition is regarded as temporary.

Excluding gold, the total value of exported materials was £28,912,736 in 1918, compared with £25,791,923 in 1917, and £26,426,246 in 1913; of these 64·7% went to the British Empire in 1918, against 84·8% in 1913. The shipping position is in a very unsettled state, and large stocks of African produce are held up for want of tonnage. The exports in 1918 and 1913 included:—

	1918.		1913.	
	Quantity.	Value. £	Quantity.	Value. £
Blasting Compounds lb.	3,960,080	156,603	1,057,450	36,567
Diamonds carats	2,571,646	7,063,043	5,503,861	12,016,525
Copper Ore tons (long)	4,665	258,920	7,040	156,748
Do. regulus & smelted tons (long)	1,509	88,330	9,500	292,607
Tin, Block cwts.	1,925	30,146	—	—
Do. ore & concentrates tons	2,156	245,067	2,779	381,042
Wool lb.	115,634,498	9,689,630	176,971,865	5,719,288
Hides & skins lb.	43,679,639	2,082,656	62,580,931	2,010,484
Wattle Bark lb.	107,904,898	287,220	145,717,738	309,329
,, Extract lb.	8,339,459	124,887	—	—
Sugar	5,342,248	70,166	347,244	3,032
Whale Oil galls.	561,577	62,316	2,177,537	122,692

The large decreases in the exports of whale oil during the war were due to a reduction in the number of firms operating, increased local consumption, utilisation in explosives factories, and to the existence of large stocks, the exportation of which was prohibited.

REPORT OF THE COMMISSION APPOINTED TO EXAMINE THE CONDITIONS OF THE IRON AND STEEL WORKS IN LORRAINE, IN THE OCCUPIED AREAS OF GERMANY, IN BELGIUM, AND IN FRANCE. *Ministry of Munitions, July*, 1919. *Pp.* 48, *with maps and plans.* (*London: H.M. Stationery Office.*) *Price* 3*s. net.*

The iron and steel works in Lorraine were very short of fuel during the later period of the war, but those in the Saar Valley continued to work at high pressure. Some of the French-owned works in Lorraine were worked by the Germans, while from works just within the French border plants were stolen and transferred to German works in Lorraine and to Brückhausen. Machinery became seriously damaged through shortage of lubricants, but the effect of bombs was insignificant. Manganese was available only in small quantities, and attempts to use calcium carbide as a partial substitute for deoxidising purposes resulted in the production of a high proportion of waste steel, and powdered anthracite was tried unsuccessfully; in fact, no satisfactory substitute for manganese was discovered.

At the time of the commissioner's visit none of the works was in full operation owing to the failure of the German Government to deliver the full quantity of furnace coke guaranteed under the terms of the Armistice. Only 500,000 tons had been received in Lorraine from Germany, about one-third of the quantity due. There are 68 blast furnaces in the Province of Lorraine, 60 of which were in good condition, but only 5 were in blast at the date of the armistice; since then about 28 had been in blast at one time, but the output was low owing to the dwindling supplies of coke: 13,000 tons of coke is required daily to keep the 60 furnaces in blast, and efforts were being made to secure Belgian coke.

At Moyeuvre, the only coke-oven plant seen in Lorraine, coke was produced from Saar coal mixed with 25 per cent. of Westphalian coal owing to the poor coking properties of Saar coal alone; many ovens in the Saar Valley use a similar mixture. The coke is too friable for transportation, but appeared to be as suitable for furnaces as that produced in Great Britain.

Lorraine iron ore is of two qualities, calcareous and silicious, a self-fluxing mixture of these being used. Average analyses give: Calcareous—Fe 25—30%, CaO 18—20%, SiO$_2$ 7—8%; Silicious—Fe 26—35%, CaO 5—7%, SiO$_2$ 15—20%. The iron content of the ore mixture used runs from 27–33%. The average analyses of the basic pig-iron produced gave Si 0·6—0·8%, Mn 1·2—1·4%, S 0·06—0·07%, P 1·8—1·9%.

Basic Bessemer steel works are attached to nearly all the Lorraine blast furnaces and derive their heat and power from blast furnace gas. In other cases the surplus gas generates power which is supplied to Metz. Two cycle engines of the Klein type were used for blowing purposes and four cycle engines of the Thyssen, Erhardt and Schmer, Nürnberg, and Société Alsacienne types for power generation. Some of the later steel mills were wholly electrified, part of the power being generated by steam turbines.

Relatively small quantities of foundry iron or of special steels are made. Most of the Lorraine works transport ore from their own mines by aerial ropeway, the average cost into furnace being 8 to 9 francs per ton of ore. Large quantities of steel were stored in well equipped stock-yards connected with the works, the steel-maker acting as his own warehouseman.

The acquisition by France of further supplies of ore should enable her to produce 11,000,000 tons of pig iron per annum to dispose of in competition with other countries. It is estimated that the French production of ore will be 42,000,000 tons, or twice the output in 1913, whereas the German production of ore will only be about 7,000,000 tons, compared with 27,000,000 tons in 1913.

Before the war France imported 20,000,000 tons of coal; she will now be able to obtain increased supplies from the Valenciennes district. The iron and steel makers hope to import English coal or coke in exchange for basic pig iron, but transport and transhipment of coke present difficulties. Possibly Durham coking coal may be mixed with Saar coal and converted to coke in Lorraine. (See also this J., 1919, 380 R.)

REPORT ON FOOD CONDITIONS IN GERMANY, WITH MEMORANDA ON AGRICULTURAL CONDITIONS IN GERMANY AND ON AGRICULTURAL STATISTICS. *By* E. H. STARLING, A. P. MCDOUGALL, *and* C. W. GUILLEBAUD. *Pp.* 48. [*Cmd.* 280. 6*d.*] (*London: H.M. Stationery Office.*)

The Report is based on observations made during two visits to Germany; the places visited were Cologne, Bonn, Coblonz, Trier, Berlin, and Upper Silesia, and these were especially favourably situated as regards food supplies. There is therefore reason to believe that conditions in other parts are still worse than those mentioned below. Before the war Germany produced 85 per cent. of the total food consumed by her inhabitants; this large production was only possible by high cultivation and by the plentiful use of manure and imported feeding-stuffs, means for the purchase of these being furnished by the profits of industry. During the war this importation was cut off, and the greater part of the home-produced nitrogenous artificial manure was applied to the manufacture of explosives. The productivity of the soil, consequently, diminished by 40 per cent., a decrease which, during the last few years, has been accentuated by climatic conditions, and the quantity of the live stock has been reduced by 55 per cent. There has been a serious shortage of food in Germany, beginning in the summer of 1916 and lasting to the present time (1919), and the starvation of the population has caused a great loss of body weight and diminished resistance to disease. The death-rate has increased and the birth-rate declined, so that the number of deaths now considerably exceeds the number of births. There is a widespread increase of tuberculosis, the deaths from this disease having increased, according to the locality, from 2·5 to 6 times. Owing to lack of milk, rickets and associated diseases are of common and increasing occurrence. So great is the scarcity of food in Germany that during the coming year she will require, if she is to be restored to a condition in which she can put forth her total working capacity, imported food to the extent of eight billion calories, that is, about one-quarter of the amount imported by the United Kingdom. Manufactures and businesses are paralysed by the lack of raw material, of capital, and of confidence, but the highly efficient organisation, human and material, which made Germany so successful as a producing concern, is still intact. Of raw materials, among the chief requirements are cotton, wool, flax, leather, iron ore and certain other ores; some manures and concentrated feeding-stuffs are immediately necessary. Of foods, fat is particularly required; for the next six months the country can live on the proceeds of this harvest. There are large reserves of coal in Germany, which are at present unexploited, but until this occurs, the loss to Germany of 40 per cent. of her former coal output must diminish the number of workers who can be maintained. Germany is at present over-populated, and it is probable that during the next few years

many million workers (according to some estimates as many as fifteen million) will have to emigrate owing to lack of work and food. It is considered that, in order to obtain payment of the reparation demanded by the Allies, the first essential is to provide working capital for re-starting the mechanism of production in Germany. Numerous statistical tables and charts are given as appendices to the Report.

OFFICIAL TRADE INTELLIGENCE.

(*From the Board of Trade Journal for Oct.* 23 & 30.)

TARIFF. CUSTOMS. EXCISE.

Australia.—Certificates of origin are required in respect of goods imported from Scandinavia, Denmark, Holland, Finland, Switzerland and the reconstructed States which formerly formed part of the Austrian Empire.

Belgium.—Among the articles imported from Germany for which certificates of origin and import licences are no longer required are asbestos ware, celluloid, cork, dephosphorisation slag, emery, carborundum, gums, hides, skins, laboratory glassware, scientific instruments, metal tubes, crude minerals, fats, oils, pitch, plaster, resins, rubber, and wood.

Brazil.—A copy of the new Draft Tariff may be seen at the Department of Overseas Trade.

Bulgaria.—Among the articles which may now be imported are tanning extracts, petroleum, mineral oils, and shoe leather. Among the commodities needed, and for which permits will be issued as soon as conditions allow, are chemicals, dyes, paints, varnish, fats, oils, waxes, drugs, medicines, metals, paper, skins, leather, and scientific instruments.

Finland.—The restrictions on the importation of fertilisers have been removed.

France.—The customs duties on sugar and certain articles containing sugar have been increased.

France and Algeria.—The French Senate has adopted a Bill, previously adopted by the Chamber of Deputies, authorising modifications in the Customs Tariff in respect of chemical products, and admitting free of import duty the German dyestuffs, drugs and chemicals that form part of the levy imposed on Germany by the Peace Treaty.

Germany.—Recent customs decisions affect sheet glass, cocoa beans, rubber, asbestos, and vegetable fibres.

Jugo-Slavia.—Among the articles exempted from import duty for one year from October 5 are lubricating oils, fuel oils, and auxiliary chemicals and dyes required by the manufacturing industries.

Minimum rates of customs duty are applicable, for one year from the same date, to, *inter alia*, printing and writing paper, printing ink, pencils, bottles, jars, and laboratory apparatus.

Minimum rates for six months from the same date apply to chemicals, medicines, and all products used for treating disease.

Netherlands.—The prohibition of the export of acetic acid and raw jute has been temporarily raised.

New Zealand.—It is proposed to levy a surtax on nearly all classes of goods of late enemy origin.

Poland.—The revised import and export regulations are given in the *Board of Trade Journal* for October 30. Among the articles which may be imported without permit are foods, china clay, chalk, potash, silica, sand, borax, celluloid, rubber, cork bark, many metals, scientific instruments, certain chemicals, photographic articles, soap (except toilet soap), and matches.

Portugal.—The customs duty on heavy mineral oil for fuel is fixed at 34½ escudos per metric ton.

Spain.—Recent customs decisions affect sulphur black, iron ingots, iron and steel "tochos," iron and steel bars and plates, and tinplate.

Sweden.—Export prohibitions have been removed from, *inter alia*, oil-seeds, spirits, liqueurs, wines, and glycerin.

Tunis.—Special export licences are required, as from September 12, for organic manures, molasses, glucose, nitrates of lime and soda, cyanamide, sulphate of ammonia, superphosphates, dephosphorisation slag, and chemical manures.

Import prohibitions are still in force for wines, spirits, liqueurs, mineral illuminating oil, compound medicines, vegetable fibres (except cotton), and paper money.

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 4, Queen Anne's Gate Buildings, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers and exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference Number.
Australia	Glass, china, pottery	908
,, ...	Chemicals	912
British India ..	Soap, candles, boot polishes, etc.	915
British West Indies	Paraffin candles	883
,,	Carbonic acid gas	884
,,	Corrugated galvanised iron ..	886
,,	Portland cement	887
,,	Fertilisers	888
Canada	Glassine, greaseproof and parchment papers	937
Egypt	Paper	947
New Zealand ..	Heavy chemicals, salt, tinplate, glass jars, dyes, soap, cod oil, olive oil, greaseproof and parchment papers	940
,, ..	White lead, linseed oil, plate and sheet glass, lubricating oils and greases	941
South Africa ..	Heavy chemicals, superphosphates	944
Belgium	Photographic apparatus	951
,, ...	Iron ore, bricks, machinery, etc.	953
,, ...	Sanitary ware, earthenware, tin foil	*4692 T and R
Denmark ..	Glass, pottery, soap, margarine, salt, petroleum	956
Germany	Soap, soda, margarine	892
,, ...	Cattle cake	893
Greece	Chemicals, paper	959
Italy	Glass, china, crockery, toilet soap	896
Netherlands ..	Tanning extracts	961
Norway	Oils, paints	962
Serbia	Machine oils (catalogues of) ..	965
Spain	Sanitary ware, pottery	901
,, ...	Linseed oil, emery paper ..	967
,, ...	Chemical fertilisers	969
,, ...	Chemicals, pharmaceutical products	970
Switzerland ..	Toilet soap, pharmaceutical goods	902
Algeria	Soap, mineral and vegetable oils ..	972
United States ..	Leather	974
Brazil	Chemicals, cement	906A
,, ...	Perfumery	977
Chile	Drugs, perfumery	978
Peru	Paper, paint, varnish, glass, earthenware	981

* Belgium Trade and Reconstruction Section, Regent House Kingsway, W.C. 2.

Removal to New Offices by the Board of Trade.—The headquarters of the Board of Trade is being removed from Whitehall Gardens to Great George Street, Westminster, S.W. 1. Among the departments already transferred are those dealing with Commercial Relations and Treaties, Industries and Manufacturers, and the Power, Transport and Economic Department.

TRADE NOTES.

FOREIGN.

Industrial Fairs in Switzerland.—It has now been agreed that exhibitions of foodstuffs and of articles connected with agriculture shall in future be held at Lausanne, while samples of products connected with all other industries are to be exhibited in Basle. Exhibitors at Lausanne may, if they desire, exhibit in Basle in any groups of products other than those of foodstuffs and agriculture. For the present the Lausanne exhibition is to be held in the autumn.—(*Schweiz. Chem.-Zeit., Sept.* 24, 1919.)

The Swiss Soap Industry.—This industry suffered many hardships during the war period. Raw materials were difficult to procure even at enhanced prices, and owing to formalities and regulations connected with importation, goods were held up for many months, causing losses in weight during storage. These factors combined to send up the price of soap several hundred per cent. Although on the whole the supplies of raw materials were not much below those of pre-war days, there was a remarkable shortage of the finished article. The supply of alkali from the Sodafabrik Zurzach was continually increased, and the country achieved independence in this respect.

Before the war Switzerland imported 90 per cent. of its requirements of household soaps from France. In 1916, 33 per cent. was derived from Spain, in 1917, 4 per cent., during the first half of 1918, 90 per cent. came from this source. Before the war 20 per cent. of the toilet soaps was imported from France, and 60 per cent. from Germany; in the last year of the war 60 per cent. was imported from France.—(*Schweiz. Chem.-Zeit., Aug.* 27, 1919.)

Dutch Match Factories.—According to a report of the German Consul-General in Amsterdam, the Dutch match factories are to be amalgamated into a single joint-stock company, in which the State will be interested. The capital of the company will be one million florins (£83,333), and a considerable part of the profits will go to the State when these are in excess of the amount necessary for the payment of a certain dividend on the capital. The price of matches is to be fixed by law.—(*Schweiz. Chem.-Zeit., Sept.* 10, 1919.)

The Skoda Works.—The French firm Schneider-Creusot has purchased 40,000 shares in the Skodawerke A.-G. in Pilsen, which was recently nationalised by a vote of the General Assembly. The directorate includes six Czechs, Eugène Schneider and two other Frenchmen. The company will in future bear the title "Akt.-Ges. vormals Skodawerke," and the share capital is to be raised from 72 to 144 million kronen (3 to 6 million pounds at normal exchange).—(*Stahl u. Eisen, Oct.* 23, 1919.)

Crude Phosphate Situation in Italy.—The war has stimulated food production in Italy and consequently increased the demand for fertilisers. Phosphate is obtained chiefly from Tunis, but the Minister of Agriculture states that the Government, though not itself a purchaser, will encourage the importation of American phosphates. There are, however, financial difficulties owing to restricted buying power of manufacturers, and long terms of payment are necessary. The maximum prices to be charged the farmer per unit of citric-soluble phosphoric anhydride vary from 1·37 to 1·40 lire (1s. 1d.—1s. 1½d. at normal exchange) according to position. The phosphates, in canvas sacks of 100 kilo., must meet requirements as to dryness, pulverisation and homogeneity.—(*U.S. Com. Rep., Sept.* 9, 1919.)

The Cacao Crop in the Dominican Republic.—The Dominican cacao crop has been unusually good this year, the yield being estimated at 35,000,000 lb., to which is to be added that of the second crop in October and November. The crop would have been even greater but for the substitution of tobacco in some areas. The price is 18 to 20 cents per lb. inland, and 20 to 21 cents at seaports. Most of the cacao is shipped to the United States, and a small proportion to Europe.—(*U.S. Com. Rep., Sept.* 5, 1919.)

Japanese Foreign Chemical Trade.—During the last three years there has been a remarkable development in the Japanese chemical industries. Although certain chemical and dye works have suffered much owing to shortage of raw materials, the total production has increased enormously and the export values have risen *pari passu*. In the earlier years of the war the exported value of but very few chemical products exceeded ten million yen (£1,000,000 approx.), but now there are seven on the list.

Export Values (in Yen) of Chief Chemical Products, 1916—1918.

	1916.	1917.	1918.
Paper and paper goods	14,350,804	22,118,613	37,436,977
Vegetable and fish oils	8,071,027	16,292,761	27,910,893
Matches	21,103,193	24,585,967	27,742,663
Sugar, refined	17,430,709	27,612,599	25,273,459
Porcelain	12,103,993	14,473,934	19,957,782
Glassware	13,203,361	20,028,431	19,593,046
Spirit and soy	5,888,882	8,484,757	11,115,830

The total values of exported chemicals in the three years amounted to Yen 134,647,836, 190,258,338, and 241,537,267 respectively. Although the foreign market for sulphuric acid was lost, the exports of the following substances showed continuous increases:—Camphor, sulphur, acetic acid, potassium iodide and chlorate, bleaching powder and calcium carbide. On the other hand, the imports of raw materials for the chemical industries also increased considerably. The following are the most striking examples:—

Import Values (In Yen) of Raw Materials etc., 1916—1918.

	1916.	1917.	1918.
Oil cakes	37,470,492	55,435,279	91,499,726
Sugar, crude	12,981,734	11,699,701	33,525,914
Mineral oils	12,200,602	12,292,126	22,817,127
Copra	3,364,965	8,251,282	15,633,856
Vegetable oils	6,090,357	8,008,718	14,774,585
Rubber & gutta-percha	7,246,007	9,130,225	12,948,236
Hides, raw	8,930,210	5,841,410	11,980,455
Soda ash	3,698,440	6,964,120	11,405,021
Saltpetre	6,184,862	9,724,626	11,294,611
Dyestuffs	3,437,584	4,535,986	11,238,021

The percentage proportion of the chemical exports and imports to the total foreign trade of Japan was as follows:—

	1916.	1917.	1918.
Exports	12·1	12·0	12·5
Imports	22·5	19·6	19·9

Thus the ratio of exports is tending to increase and that of imports to diminish. (*Cf.* this J., 1919, 339 R.)

COMPANY NEWS.

NEW COMPANIES & NEW CAPITAL ISSUES.

Evans, Sons, Lescher and Webb, Ltd., wholesale drug manufacturers, has recently offered for public subscription 150,000 ordinary shares of £1 at 30s. per share. The issue was over-subscribed three and a-half times.

The National Mining Corporation, Ltd., with an authorised share capital of £3,000,000 in £1 shares, two-thirds of which has been subscribed for by the directors and their associates, is offering 500,000 shares at par to the public. The Corporation will, it is hoped, effect financial co-operation among the leading mining houses of this country.

Lever Bros., Ltd., is issuing 4 million 7 per cent. cumulative "C" preference shares of £1 each at par in order to provide for the cash consideration in respect of the purchase of over 90 per cent. of the share capital of Price's Patent Candle Co., Ltd., and the whole of the ordinary shares in Joseph Crosfield and Sons, Ltd., and William Gossage and Sons, Ltd., and for developing the company's business generally.

Baldwins Ltd., iron and steel manufacturers, etc., is issuing for sale at par 1,000,000 5 per cent. cumulative "B" preference shares, free of income tax up to 6s. in the £. The company has an authorised share capital of £7,000,000.

Agricultural Industries, Ltd., has been formed with an authorised share capital of £2,000,000, divided into 1,700,000 6½ per cent. cumulative preference shares of £1 each, income tax free, of which 1,200,000 are now offered at par, and 3,000,000 2s. ordinary shares which are offered at 5s. per share.

The interests of the chief German companies working the diamond fields in the South-West Africa Protectorate are to be sold to a new company to be registered at Cape Town as *The Consolidated Diamond Mines of South-West Africa, Ltd.*, with a share capital of £3,750,000. The purchase price is said to be £3,500,000.

REVIEWS.

THE SIMPLE CARBOHYDRATES AND GLUCOSIDES. *By* E. FRANKLAND ARMSTRONG. (MONOGRAPHS ON BIOCHEMISTRY, *edited by* R. H. A. PLIMMER *and* F. G. HOPKINS.) *Third edition. Pp.* x+239. (*London: Longmans, Green and Co.* 1919.) *Price* 12*s. net.*

The chemistry of the sugars is a branch of our science which has had a voluminous literature from quite early times, in which, however, with but few exceptions, there was no order or system until the publication of the memorable researches of Emil Fischer, the chief of which appeared between 1884 and 1908. Fischer's work had its starting-point in the observations of Kiliani on the respective constitutions of dextrose and lævulose, and led to the development of our knowledge of the sugars from a state of comparative chaos to one of the most highly systematised sections of so-called organic chemistry. Following in this great chemist's wake, moreover, numerous other chemists, including his own students, have contributed their quota to the erection of the now proud edifice.

Researches which have led to the development of modern sugar chemistry must be ranked among the most brilliant achievements of the chemist, the value of which to mankind can scarcely be appraised—certainly not exaggerated. In support of this thesis we may instance the physiological importance of the carbohydrates as food materials, and the fundamental significance of their formation in nature to the whole of aërobic life. In regard to those industries concerned with the manufacture of sugars, the utility of recent chemical researches on the subject may not at first sight be quite apparent. Sugar extraction and manufacture from sugar cane is an art centuries old, whilst the beet sugar industry dates back more than a hundred years. Throughout their history the sugar industries have been aided by physics, engineering, botany and chemistry. That branch of the chemistry of the sugars with which the present monograph is concerned has, however, only comparatively recently come within the purview of the technologist. Some of the sugars first brought to our knowledge by synthetic methods in the laboratory will probably be found in nature, whilst one at least has been detected in molasses; glutose, for example, is said to be present in cane molasses to the extent of 1—5%. Moreover, the susceptibility of the sugars to undergo changes by chemical and physiological agencies is alone a sufficient argument that the modern manufacturer must acquire as complete a knowledge as possible of the chemistry of the subject. That this has been fully recognised is shown by the fact that in most works on sugar manufacture and on sugar analysis published recently due attention is paid to contemporary chemical researches.

Dr. Armstrong's monograph is concerned essentially with the history of modern work on the subject. The first edition appeared in 1910 and covered 112 pages, whilst the second was published in 1912 and covered 170 pages. That a third edition, extended by 69 pages, has been demanded is in itself an ample tribute to the value of the work. The present work consists of an introduction, nine chapters, a bibliography, and an index.

Glucose or dextrose and the hexoses in general are dealt with in the first two chapters. Since of the sixteen possible aldehexoses fourteen have been obtained by synthesis, whilst only three have been found in nature, there is here much scope for further research. The γ oxide formula (with a pentophane ring) for glucose, assigned to it by Tollens in 1883, has been found to coincide with the behaviour of the sugar in its α- and β-modifications as well as with the derived glucosides. It will be remembered that Fischer in the preparation of the α- and β-methyl glucosides obtained as a by-product a syrup from which he separated a third methyl glucoside. According to the more recent work of Irvine Fyfe and Hogg, this substance consists of two isomeric glucosides, which appear to be β oxides with a triphane ring. Special attention is called by the author to the significance of this observation, which has led to the conclusion that a third form of glucose exists much more active than the γ oxide forms. Mutarotation, which was first explained by Lowry in 1899, is fully discussed, as well as the work of the author himself and that of C. S. Hudson on the subject. Chapter III. is concerned with mannose, galactose, fructose, sorbose, the pentoses, and the carbohydrate alcohols. A description is also given of the inositols or cycloses.

Chapter IV. deals with the disaccharides. Since the glucosidic constitution was suggested for these compounds by Fischer, we have certainly a more precise notion of their configurations. Ingenious as the arguments are, however, which have led to these formulæ, it is questionable whether they will help us much in effecting their syntheses. It was, we believe, one of the great ambitions of Emil Fischer to synthesise sucrose, yet this was never realised. The trisaccharides and the tetrasaccharide, stachyose, are also described in the chapter.

We are introduced to the biochemical phase of the subject in Chapter V. Evidence has long been furnished that there is sometimes at any rate a combination between enzyme and substrat. Fischer, without going so far as this assumption, likened the relation of an enzyme to its substrat to that of a key to a lock, whilst H. E. and E. F. Armstrong have carried the simile further, suggesting that the combination of enzyme and sub-

strat (and for this there is now experimental evidence) may be compared to the way in which the successive fingers of a glove fit on to a hand.

In Chapter VI. hydrolysis and synthesis are discussed. It will be remembered that v. Baeyer suggested in 1870 that formaldehyde is the first product of assimilation of carbon dioxide and water by green leaves in sunlight, and evidence in support of this has been obtained by Bokorny and by Usher and Priestley, and confirmed by Schryver. All this is noted, as well as the observation of Brown and Morris in 1893, that sucrose is the first sugar to be synthesised by the assimilatory process. This we believe has been confirmed by several subsequent observers. Dr. Armstrong rightly refers to the discovery as "unexpected," and in all probability there is at least one intermediate compound formed between formaldehyde (assuming this to be the first product) and sucrose—possibly a hexose. But it must be remembered that non-reducing carbohydrates—sucrose, starch, and the like—as well as many heterogeneous glucosides—*cf.* p. 188 of the monograph—function in plants as true reserves or resting compounds. The occurrence of reducing sugars in ripening fruits cannot be cited against this view, as here a dynamic and not a static set of conditions reigns.

A most interesting and full account is given of the natural glucosides in Chapter VII., whilst the synthetic glucosides are dealt with in Chapter VIII. The last Chapter, IX., is one of the most suggestive in the monograph. Covering but 14 pages, it puts forward what would seem to be most plausible explanations of the significance of glucosides in metabolism, their products of hydrolysis other than the sugars by specific enzymes stimulating katabolic changes such as normally take place at night. Respiration in plants and the ripening of fleshy fruits is discussed in the same light. The text is based on the researches of numerous observers, among which those of H. E. and E. F. Armstrong (1910-1912) figure largely.

The bibliography is an important feature of the monograph.

We may say of Dr. Armstrong's monograph that it is a useful compilation and fulfils its objects. It cannot fail to prove of great value to future workers on the subject.

ARTHUR R. LING.

CALCULATIONS USED IN CANE-SUGAR FACTORIES.—*A practical system of chemical control for the sugar houses of Louisiana, the tropics, and other cane-producing countries. By* IRVING H. MORSE. *Second edition, re-written. Pp.* 189. (*New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd.*, 1917). *Price* 9*s.* 6*d.*

The original edition of Irvine H. Morse's very useful little book on calculations used in cane sugar factories appeared in 1904. The second edition, which has just been issued, has more than doubled in bulk.

Although the author has had experience in Cuba, his calculations are mainly concerned with conditions and problems as they exist in Louisiana, where the cane never ripens and where early frosts must be reckoned with. Nevertheless it contains so much of general value that a second and up-to-date edition will be welcomed in all cane-producing countries. In this connexion it might be well to direct attention to the need for more consistency in the methods of expressing measurements in cane sugar calculations. Not only do Spanish-speaking manufacturers and growers buy and sell their cane by the *arroba* of 25 lb. Spanish weight, but the Spanish pound equals 460·1 gms., whereas the American (and English) pounds are equivalent to 453·6 gms. Further, the American gallon of 8·331 lb. and the English gallon of 10 lb. are both employed. Finally, in Louisiana the yields are expressed in pounds per ton of cane, and not as in all other countries as per cent. of cane.

This book does not lay claim to being a text-book of sugar analysis, but it contains many, though necessarily brief, directions, together with a very complete set of tables. A very important feature of Mr. Morse's publication is his system of drawing up laboratory reports.

Two problems of economic interest, namely, the two-factory system and the payment of cane by the "unit" system, are dealt with rather fully. Dr. Geerligs has shown very clearly that whenever the cane is allowed to mature thoroughly, as is the case in the tropics, the sugar will be evenly distributed throughout the whole length of the cane. In Louisiana, on the other hand, where the period of growth of the cane is a short one, extending from March to October or November, the greater part of the sugar is found in the lower joints. When immature cane is ground a serious loss occurs from the extraction of sugar from the upper half, but a handsome profit from the extraction of sugar from the lower half. The only sound solution of the problem is undoubtedly to manufacture the upper half into syrup and the lower into sugar. The method of paying for cane by the "unit" system, to which Mr. Morse devotes a whole chapter, depends on the principle of paying according to the intrinsic value of the cane. This unit may be defined as a figure which when multiplied by the price of granulated sugar and the percentage of sucrose in the juice will give the total income to be expected from a ton of cane. This method is fair to both grower and manufacturer, as the price of cane increases or decreases in direct proportion to the value of the commercial products obtained. A brief reference is made to the effect of the war on the cane industry and the problem of the production of cheap sugar. He maintains that it will be met by the introduction of the two-factory system already referred to, and the discovery of an economic process for making standard granulated sugar direct from the cane.

Though dealing to a large extent with problems more definitely connected with Louisiana, the accurate and well-arranged information which the book contains will always be useful; and the many problems discussed will be read with great interest by all associated with the sugar industry.

F. V. DARBISHIRE.

Messrs. Longmans, Green & Co. announce that Dr. J. W. Mellor has been engaged for the last twelve years on the preparation of a compendious survey of inorganic and general chemistry. The complete work will probably consist of six volumes, the first of which is now in the press for publication early next year.

PUBLICATIONS RECEIVED.

IRON BACTERIA. *By* D. ELLIS. (*With* 45 *illustrations and* 5 *plates.*) *Pp.* 179. (*London: Methuen and Co., Ltd.*, 1919.) *Price* 10*s.* 6*d.*

THE PROFESSION OF CHEMISTRY. *By* R. B. PILCHER. *Pp.* 199. (*London: Constable and Co., Ltd.*, 1919.) *Price* 6*s.* 6*d.*

A BIBLIOGRAPHY ON THE ROASTING, LEACHING, SMELTING AND ELECTROMETALLURGY OF ZINC. *Compiled by* H. L. WHEELER. *Bulletin No.* 3, *Vol. IV., of the School of Mines and Metallurgy, University of Missouri, revised to June*, 1919. *Pp.* 386. (*Rolla, Missouri*, 1918.)

Corrigendum.—In the last issue, p. 395 B, line 44, in lieu of "Meyers," read "Miers."

NOTES ON THE RHINELAND CHEMICAL WORKS.

J. ALLAN.

PART. II.—LABOUR CONDITIONS AND RECENT PLANT EXTENSIONS.

It has frequently been said that cheap and docile labour has been a great factor in the success of German industry generally, and that it has contributed not a little to the advancement of their chemical manufacture. A statement of past and present conditions therefore may not be without interest, but it should be emphasised that any existing conditions are probably transitory, and that it is impossible to forecast the state of labour in the future either in Germany or elsewhere. In pre-war times long working hours were general throughout Germany, though there was a growing tendency to curtail them, and the "good firms," so named, which did not necessarily mean the large firms, were adopting "English" time as it was called, which meant working to 12, 1, or 2 o'clock on Saturday instead of the 5 or 6 o'clock which was formerly the rule. Wages in the chemical industry were peculiarly variable, there being apparently no fixed rates in different factories, and in certain districts of a rural character, where it might be thought low rates would rule, they were higher than in more populous areas, though many exceptions to this might be found even in contiguous works in the same neighbourhood. The case of one of the large works may be cited as a general example of the change which has taken place both as to the cost and character of the labour supply. Under pre-war conditions a 66-hour week was common, and the rate of pay for general labour was 0.65 marks per hour or a weekly wage of 43 marks. Since then the 8-hour day has been forced upon employers, and for similar labour the hourly rate has risen to 1·7 marks, which means a weekly wage of 81·6 marks, a 90 per cent. increase in the total wages earned with a reduction in working hours of almost 28 per cent. If it be assumed that the output of work per man per hour has not changed, and chemical processes as a rule cannot be accelerated, it follows that the labour cost for the same output of work as formerly has risen to 112 marks, an increase of no less than 160 per cent. It is quite commonly asserted, however, and it is plainly evident, even to a casual observer who was familiar with pre-war conditions, that the character of the labour has considerably altered both as to subservience to discipline, and the quality of the work done. Lack of attention to instructions and carelessness are common, and the general assertion is that the possible output is now only about one-half of what it was. It is probable that this statement includes the reduction following upon the lessened number of hours worked, as well as that arising from lowered efficiency, as figures derived from industry, such as certain branches of engineering, where output can be carefully determined by the number of articles produced, show a minimum reduction in output per hour of about 25 per cent. How much of this arises from the fact that for reasons of policy the works generally are employing, or more correctly are paying, their pre-war labour force, whilst their actual output is in some cases as low as 10 per cent. of the possible, cannot be determined; it may be assumed that, with fuller employment, present conditions will be modified, but one cannot help feeling that the old conditions will not return, and that the difficulties surrounding present-day labour problems are not to be confined to Britain alone.

In speaking of output, however, some notice must be taken of the present condition of the German factories, and especially of the changes which have taken place in them during the long period of war. All of the factories having facilities for the manufacture of materials for explosives or gas warfare have greatly increased their plants during this time. It is quite evident also that these additions have been made in no haphazard fashion, but that full consideration has been given to the possibility of using these essentially war additions to the buildings and plant for industrial purposes when the war demand had ceased.

In general, and in the case of the large plants certainly so, it has been left to the factory control to provide for the increased output by such means as they chose to adopt, the Government affording every facility in the matter of materials and labour and, it is stated, also providing the money required for the erection of the plant. The system of financing these extensions has apparently been that of repaying from time to time the expenditure incurred, and cases are not wanting in which large new plants have been erected on Government behalf at a late period in the war in which these repayments have not taken place, and firms are now in possession of very expensively erected buildings and equipment which they would not have built in normal circumstances.

There is a generally expressed fear that the abnormal cost arising from the circumstances in which these extensions were carried out will not be met by the new government, and that the factories will have to bear the major portion, if not the whole, of the charges thus incurred. This of course only applies to work carried out during a late period of the war, and many enlargements of plant have taken place which the erectors have obtained on such terms that capital charges upon their peace output will not be excessive. Probably no better example of the permanent character of these hurried extensions is to be found than the Dormagen plant for the production of picric acid and TNT belonging to the Bayer company, which is situated on the left bank of the Rhine and a little way removed from Leverkusen, which is on the opposite side of the river. The buildings which were begun late in 1916 are all solidly constructed of brick and ferro-concrete, the sulphonating and nitrating houses following in detail the general plan which has been adopted as the standard for such work in the Bayer plants. Two units for the manufacture of picric acid were completed, each having a capacity of about 900 tons per month, and the first of these units was in operation within six months of the commencement of erection.

The nature of the buildings and the substantial and finished character of the plant leave no doubt whatsoever that they are intended to be a permanent addition to the Bayer factories, and with very little alteration they can be converted into a large installation for the manufacture of intermediates and dyes. The plants of the dye-producing firms are in excellent condition, and in many cases have been considerably added to in producing power during the period of the war. If competition with German dyes and pharmaceutical chemicals was difficult in pre-war periods, it certainly will be no less so in the era which is opening before us, if efficient plants and large scale production are the important factors in production costs which we all know them to be.

The term "a chemists' war" has been applied over and over again to the great struggle which we have just passed through, and in no sense is the application of the term more true than when it is applied to the fact that without the plants erected in her chemical works for the fixation of atmos-

pheric nitrogen the resistance of Germany would have broken down at a comparatively early date. As an instrument of peace or a weapon of war, such plants are almost invaluable, and the peculiar independence of Germany from the supply of Chilean nitrate is one of her greatest national assets. It is said that the German Government, at the instigation of her military experts, adopted the position of foster mother to the various processes which were being developed in the country in pre-war times.

Their maternal instinct was roused only by the effect which the supplies from these plants would have upon their military needs, and it would appear to be something more than coincidence that the first steps towards initiating a great European conflict were not taken until the Haber process, with its immense possibilities, had been fully established on a large scale by the Badische Co., and that plants were also in existence for the production of ammonia from cyanamide. Important as nitrates are as a provision for war, their value as affecting the foodstuffs of a nation needs no argument, and it may yet be the case that the now generally decried militarism of Germany has given to the country a boon whose worth is inestimable

The plants at Oppau and Merseburg, in which the direct synthesis of ammonia from hydrogen and atmospheric nitrogen is effected, are enormous in their dimensions, and a monument to the skill of the chemists and engineers who have erected them. Similar words may be applied to the plants at Höchst and Leverkusen, in which ammonia is oxidised to nitric acid, and the imposing sight of the interior of the building at Höchst, which houses 256 platinum catalyst vessels with their various connexions, is one which a chemist cannot easily forget. The capacity of this particular plant is 8000 tons of HNO_3 of 100 strength per month, so that approximately 1 ton of HNO_3 is produced by each catalyst vessel per day. The whole installation, with its plant for vaporising ammonia, fans, catalyst vessels, absorbing towers and nitric and sulphuric acid concentrating plants is an outstanding example of the mass production policy which has been so largely adopted by the German chemical firms as a means towards reducing production costs.

A striking feature of this and very many plants for other purposes is that though in the aggregate the output is very great, the plants themselves consist of many units, each of which is a complete plant in itself, and enlargement of output is arrived at by erecting a fresh series of units rather than by increasing the size of the constituent parts of the unit.

The benefits which arise from this system are many, since it is possible to erect a plant of large capacity from a minimum of drawings and patterns, and the ordering and construction of parts become simple. Also it allows of the use of appliances of standard dimensions which are generally kept in stock by iron founders, earthenware manufacturers and the like, so that time is saved in erection as well as in cost, since the parts which call for special construction are reduced to a minimum in number. It might be mentioned that the plant just spoken of, which was completed and put into operation in February, 1918, cost £2,000,000, and was erected in six months.

Another matter which is forced upon one's notice in these large works is the fact that though the variety of their products is great, there is no reck- which is connected in some way or another with what is the essential part of their business. As an example of this we may consider a few of the operations of the Bayer Co. at Leverkusen. It would appear at first sight that the manufacture of superphosphate of lime was clearly dissociated from the essential business of the factory, *e.g.*, the manufacture of dyes and pharmaceuticals. Nevertheless, a superphosphate plant, having a capacity of 50,000 tons per annum, was built and brought into operation shortly before war opened. The reason for this departure was the fact that a large quantity of weak and contaminated sulphuric acid is produced in many of the plant operations which could be made re-usable for such purposes only after being purified and re-concentrated, processes which are costly in time and labour and wasteful of material, since much organic matter has to be oxidised at the expense of the sulphuric acid it is desired to recover. To use new acid for the prime factory processes and waste acid for the purpose of rendering phosphate rock soluble is therefore a perfectly connected development of their business.

Another example: it would appear that the manufacture of 800 tons per month of the mixture of zinc sulphide and barium sulphate known in the paint trade as "lithopone" was outside the field of the manufacture of organic chemicals, but the extensive use of zinc dust for reduction purposes provides the key to this seeming departure from connected extension of the manufactures, since the solution of zinc sulphate obtained from these reductions is the starting material for the preparation of lithopone. An endeavour to recover the sulphur in precipitated calcium sulphate which accumulates in large amount in such a factory is a clear extension of their business, and besides is fraught with immense possibilities, since success in doing so would place an enormous amount of material at hand for the manufacture of sulphuric acid in the shape of the large natural deposits of gypsum. This process is actually being worked on a large scale, but complete success is not yet attained, although several thousands of tons of calcium sulphate have actually been passed through the plant.

As already indicated, a valuable aid to the development of manufacturing processes in the Rhineland area is the great beds of brown coal which lie a little way removed from the river, between Cologne and Crefeld. The ease of working these beds permits of power being obtained at very low cost, and there are several large power stations situated right on the beds which have distributed power to consumers at about 1/5d. per unit in pre-war times, and to-day the cost is stated to be only 2/5ths of a penny.

The Stickstoffdünger Fabrik, which manufactures carbide and cyanamide at Knapsack, in the brown coal area, formerly produced power at slightly less than 1/10th of a penny per unit in its own power station, but recent increased labour and material charges have raised this cost to the still very low figure of less than 3/10ths of a penny per unit. It is not to be wondered at that the development of electrical furnace work and electrolytic processes has been great, and it is difficult to see how competition with these is to be met unless the projected central power schemes proposed for this country can distribute power at equally low rates.

I have already commented upon the great amalgamation of interests which enabled both internal and external competition to be stifled so effectively. This *rapprochement* has had the effect of bringing firms of very diverse interests into extremely close working touch with each other, and whilst similar cases may be found in this country, it may not be without interest to quote some examples of this in German works. As is well known, a process for the synthetic manufacture of acetone was worked out in this country which involved three catalytic operations, viz., the production of acetaldehyde from alcohol, the oxidation of this aldehyde to acetic acid, and the subsequent conversion of the acetic acid into acetone. In the similar process worked in Canada, the first stage was the preparation of acetaldehyde from acetylene.

A pressing demand in Germany for acetic acid led to the establishment of a similar process at the

Farbwerke Höchst, the acetylene being prepared from calcium carbide supplied by the Stickstoffdünger Fabrik at Knapsack. It was apparently early appreciated that it would be highly economical to carry out this process in close proximity to the Knapsack works, since the carbide could then be obtained on the spot, and further, the oxygen required for the oxidation could be obtained from the Linde apparatus, which supplied atmospheric nitrogen to the cyanamide plant in the Stickstoffdünger factory, this oxygen having been practically all returned to the air. This realisation was so far acted upon that a plant belonging to and entirely operated by the Farbwerke Höchst staff was erected within the Stickstoffdünger works, and the separate property of this plant was so far maintained that even the most highly-placed officials of the Stickstoffdünger factory were not allowed access to it. Other cases of a somewhat different nature may be cited. The large ammonia oxidation plant at the Leverkusem works of the Bayer Co. used an oxidising catalyst supplied by the Badische Co., and although the Farbwerke Höchst operates a large plant for the manufacture of hydrosulphites, the quantity of the latter which was used at Höchst in the manufacture of salvarsan came from the Badische factory at Ludwigshafen, because, it was said, of its special purity.

Thus far we have considered, in the main, the great factories which are undoubted models of equipment and control, but there are many others on an entirely different scale, and it must also be said some as badly equipped as the most antiquated of any of our English factories, and this is particularly the case with some of the works engaged solely in making heavy chemicals.

Many others of these smaller works are as efficiently operated as the large ones, and on their own scale are as well provided with plant and scientific control. A peculiarity of German chemical manufacture is the large number of very small firms engaged in the preparation of a very few substances. Their output is invariably specialised in character, the processes used, as a rule, yielding no by-products. Some of these businesses are so small as to be almost one man concerns, the owner of the business being at once works manager and salesman, his factory being erected in what would have been the garden of his house; indeed, in some cases it is in the house itself.

It is probable that the large number of men who have received chemical training is responsible for so many of these small businesses being carried on, and as their operations are outside the field of the large works, their existence is not endangered by competition with them. In some cases they are even useful to works on a greater scale, as they provide necessary articles, the consumption of which is so small that it is not worth while a large firm taking up their manufacture. A case in point is that of decolorising carbon, a well-known brand of which, along with other similar products, is made in a factory of the size of a small private house.

From all that has been said, it will appear that competition with Germany in all branches of chemical manufacture is likely to be even more severe than it has been in the past, and although I have carefully and designedly avoided the temptation to point morals, they are plainly contained in the facts I have placed before you.

I make no assertion that these facts are the sole causes of the growth and success of Germany in her particular branches of chemical industry; but they have certainly contributed most largely to it. I do not advocate a slavish copying of their methods, but profit lies in a knowledge and appreciation of them, and the application of the good that is in them, modified to suit our own needs, will surely be to the benefit of the industry.

THE BRITISH SCIENCE AND KEY INDUSTRIES EXHIBITION, GLASGOW.

An exhibition illustrating the progress that has been made within the last few years in the application of science to industry and in the home manufacture of products for which we were formerly dependent on other countries, and especially on Germany, was opened in Glasgow on November 17 by Sir Charles Parsons, to whose inventions the industries of the Clyde owe so much. Whilst on similar lines to the exhibition promoted in London by the British Science Guild, and containing many of the same exhibits, the present enterprise has some new features. It is promoted by the Corporation of Glasgow, which possesses a hall designed for the purpose of technical exhibitions, and provided with ample power and facilities for practical demonstrations. A local committee of scientific and technical men assisted in securing and selecting suitable exhibits, and this committee has been most heartily supported by the Corporation and its staff of organisers. Arrangements have been made for visits by parties of students, apprentices, and junior technical assistants, the educational value of such a collection of exhibits being very great.

Whilst certain sections, notably those of optical instruments and photography, are less representative than in the London exhibition, the display of engineering and shipbuilding work, as is appropriate in the Clyde area, is very complete. Perhaps one of the best object lessons in the application of science to industry is furnished by the exhibit of Messrs. Barr and Stroud, Glasgow, who show range finders, submarine periscopes, the optophone, kinematographs, and other instruments, displaying marvellous accuracy in gear cutting, optical work, scale engraving, and calculating gears. The same firm manufactures its own optical glass, showing a range of products comparable with the best German glass. In chemical glassware, also, the exhibits of the British Chemical Ware Manufacturers' Association and of the Department of Glass Technology of the University prove that the British products have reached the standard of the wares formerly imported. Dyes, fine chemicals, and drugs are well represented, as are the metallic alloys and alumino-thermic metals, the production of which was begun as a war measure. The latest progress in wireless telegraphy and telephony is illustrated by a large exhibit of the thermionic valve, a most efficient transmitting and receiving device, based on the emission of electrons by a heated metallic filament. The great steel firms have large metallurgical exhibits, and Messrs. Beardmore show, in addition, the recent development of aircraft, both in airships and in large aeroplanes, the complete machinery of one of the latter being shown, whilst Messrs. Howden exhibit a flying boat.

A striking feature is the large number of systems of high temperature welding shown in operation, especially those making use of the electric arc. Arc welding has developed rapidly in the last year or two, and is now finding application in all kinds of constructional work in steel. Some of its applications should be of especial interest to chemical manufacturers. Fuel questions are illustrated by maps and specimens showing the efforts to utilise more economically the national resources in coal and oil, as well as by coal-cutting machinery and by a full-size model of a coal seam in course of working by machinery. The Health Department of the Corporation has a large bacteriological exhibit, and kinematograph films of living pathogenic organisms are being shown. Full use is being made of the kinematograph for the purpose of illustrating exhibits of technical interest. The exhibition will remain open until December 6.

THE USE OF STATISTICAL WORK IN CHEMICAL INDUSTRY.

A Report on the Statistical Work of the Factories Branch has now been issued by the Department of Explosives Supply, Ministry of Munitions, which forms a valuable supplement to the Reports on Costs and Efficiencies for H.M. Factories, a review of which appeared recently in this Journal under the heading of Cost Analysis in Chemical Manufacture (*J.*, 1919, 179 R, 224 R).

The present Report might well be used as a handbook by anyone desirous of adopting an adequate system of recording plant efficiencies and of putting into practice a sound method of cost analysis. In it is described clearly and minutely a system of technical records, the immediate effect of which was to facilitate the control of plant working and the introduction of a most interesting method of cost analysis which depended on these technical records. Further, the Report deals not only with methods of finding the actual cost of the finished product, but also with the cost on a comparative basis. The information supplied is completed by reproductions of specimens of technical records sent in by factories, summaries of such records compiled at headquarters, costs sent in by factories, comparative cost sheets drawn up from these at headquarters, and flow-sheets showing the efficiencies of plants and the consumption of materials involved in the manufacture of explosives, such as nitroglycerin, nitrocellulose, TNT, cordite and picric acid. These reproductions, together with the explanations given of them in the text, illustrate clearly the methods employed.

The Report is divided into the following sections:—

I. *The materials manufactured by the factories, and a general account of the processes involved.*—This serves as an introduction to what follows. It is shown that the manufacture of any explosive may be roughly outlined in the following stages:—

1. Manufacture of nitric acid;
2. Preparation of a suitable mixture of nitric and sulphuric acids;
3. Nitration;
4. Subsequent treatment of the nitrated material to obtain the finished explosive;
5. Treatment of the waste acid from nitration for the recovery of the sulphuric acid and of such nitric acid as it may contain;

and that, in addition to these stages, the manufacture of an explosive or explosives at any factory may involve:—

6. The manufacture of sulphuric acid or oleum;
7. The preparation or purification of the substances to be nitrated;
8. The manufacture, purification, or recovery of various solvents required in the final preparation of the explosive from the nitrated body.

II. *The technical aspect of acids manufacture and treatment, and the technical records concerned therewith.*—This deals with the manufacture of nitric acid and sulphur trioxide, the preparation of suitable mixtures of nitric and sulphuric acids, and the treatment of waste acid.

Records are shown from H.M. Factory, Pembrey, for nitric acid retorts, denitration stills, denitration towers, oleum manufacture (Tentelew process), concentration (Kessler), and acid mixing, together with various acid stock accounts.

III. *The actual cost records dealing with acids manufacture and recovery.* The entire secret of successful cost analysis depends upon dividing each manufacture into a number of separate processes and showing clearly the efficiencies and costs of each. Typical sheets are shown giving the costs of nitric acid manufacture, waste acid denitration, sulphuric acid concentration, etc., at H.M. Factory, Craigleith, and an explanation is given of the headings of expenditure which appear on these sheets. The section closes with an interesting discussion on acid values, *i.e.*, the values to be assigned to strong and weak sulphuric acid and nitric acid, and the fairest method of sharing out the expenses involved in the treatment of spent acid.

IV. *Comparative costs of acid manufacture and recovery.*—In the comparative costs made up by the Factories Branch the aim was to place all the factories as far as possible on a comparative basis, in order to demonstrate to the factory officials their costs of production estimated on the same basis as the costs of others engaged in similar work. For this purpose all raw materials were charged to factories at a uniform flat rate, and allowance was made for factors which operated favourably or otherwise against a factory.

A number of comparative cost sheets is shown giving summaries of total cost and of cost per ton. From the latter graphs showing comparative costs were made, as given in the former reports on costs and efficiencies. In order to demonstrate the numerous service charges most simply in a graphical manner, the headings of expenditure are grouped under wages, fuel, water, steam, and power, maintenance, and general expenses.

V. *Nitration and subsequent treatment of the nitrated material to obtain the finished explosive.*—Technical records and summaries of such records are shown dealing with the nitration of glycerin for nitroglycerin and of cellulose for nitrocellulose, and with the manufacture of cordite, TNT, tetryl, synthetic phenol, and picric acid. A short description is given of each of the processes involved, which serves as an explanation of the data given in the technical records.

VI. *Actual cost of the finished products.*—No difficulties occur regarding the raw materials used and the ordinary service charges, but the question arises as to how the mixed acid used and the spent acid recovered are to be charged against and credited to the product. This matter is discussed, and also the procedure which should be adopted in the case of products such as nitrocellulose and cordite involving considerable labour and other services in the finishing stages.

VII. *Flow-sheets showing the efficiencies of plants and the consumption of materials involved in these manufactures.*—This section is one of the most interesting. In order to summarise clearly and concisely the operations involved in the manufacture of an explosive, and at the same time to provide means for determining accurately and uniformly the consumptions of raw materials in such a way that these may be compared at a glance for various processes employed to obtain the same final product, standardised flow-sheets were introduced in all the big explosive factories. These flow-sheets represent the records of all the acid plants involved in the manufacture of the explosive, quantities of mixed acids used and of waste acids produced, important materials, *e.g.*, sodium nitrate, nitric acid and sulphuric acid consumed per ton of finished product, as well as the quantities of acid to be handled at the various plants. They not only show at once where losses of materials are taking place and the effect of such losses on the total consumption figures, but also, by allowing of comparison between different methods, indicate directions in which modifications might prove advantageous.

A number of flow-sheets are shown for picric acid, TNT, nitroglycerin, nitrocellulose, cordite, and tetryl, with accompanying explanations.

We reproduce here as an illustration one of the simpest, *i.e.*, a picric acid flow-sheet for H.M. Factory, Greetland (page 73 of Report). A thorough explanation of the principles involved in its preparation is given in the text.

All fi

1.	2.	3.	4.	5.	6.	7.	8.	9.
PICRIC ACID MADE.	PHENOL CONSUMED.	SULPHURIC ACID FOR SULPHONATION.	NITRIC ACID FOR NITRATION.	WASTE ACID PRODUCED.	NITRIC ACID CONSUMED AS HNO_3	NITRATE OF SODA CONSUMED.	SULPHURIC ACID CONSUMED AS H_2SO_4.	SULPHURIC ACID CONCENTRATION.
2625·075	1412·856	6091·353 tons H_2SO_4	3755·84 tons HNO_3	5422·81 tons H_2SO_4	3533·964	Nitrate of Soda 5362·826 $NaNO_3$ ..5015·967	5882·942	To be concentr'd 5314·48 To be delivered..5021·121

R.O.V. in sulphonate used.

Acid.	%	H_2SO_4	Acid.	%	HNO_3.	Acid.	%	H_2SO_4.
6410·391	95·0	6091·353	5768·43	65·1	3755·84	11811·43	45·9	5422·81

Used for Nitration 3755·84

Less Recovery at Fume Towers .. 221·876

3533·964

Retorts working

HNO_3 produced 3815·0

Nitrate of Soda 5789·33 (Gross overall.)
$NaNO_3$ ..5414·88 (Retorts usage.)
H_2SO_4 .. ..5168·00

1 ton requires :
Nitrate of Soda 1·518
$NaNO_3$ .. 1·419
H_2SO_4 .. .. 1·355

Retorts efficiency 95·1%

3533·964 tons require :
Nitrate of Soda 5362·826
$NaNO_3$ ..5015·967
H_2SO_4 .. ..4787·284

At retorts ..4787·284

Loss on plant : H_2SO_4 in sulphonate used 6091·353

H_2SO_4 in waste acid .. ..5422·81

Loss .. .. 668·549

Loss in concentration.

A. Before final concentration 108·33

B. In concentration ..293·559 65·2% of 5314·48.

C. R.O.V. plant 25·42

5882·942

Concentrators working over period.
Charged :

Acid.	%	H_2SO_4.
8617·91	66·2	5701·2

Recovered :

Acid.	%	H_2SO_4.
6430·36	83·8	5386·54

Loss .. .. 314·66
Loss % .. 5·52

R.O.V. Plant.
Charged :

Acid.	%	H_2SO_4.
601·39	84·1	505·9

Recovered :

Acid.	%	H_2SO_4.
504·99	95·2	480·48

Loss .. .. 25·42
Loss% .. .. 5·02

Required to produce 1 ton picric acid.

0·538 Yield on phenol consumed, 185·8%

R.O.V. used.

	%			%			%	
H_2SO_4	95·0	2·32	HNO_3	65·1	1·431	H_2SO_4	45·9	2·066
H_2O..	5·0	0·122	H_2O..	34·9	0·766	H_2O..	54·1	2·435
	100·0	2·442		100·0	2·197		100·0	4·499

Used .. .. 1·431
Recovered .. 0·085

1·346

Nitrate of Soda 2·042 (Overall crude figure, including loss in handling.)
100% $NaNO_3$... 1·911 (Retorts usage.)

Retorts .. 1·524
Nitration loss.. 0·255
Concentration :
A. .. .. 0·043
B. .. .. 0·112
C. .. .. 0·040

2·242

Waste acid to be concentrated H_2SO_4 .. .. 2·025

To be delivered from concentrators, H_2SO_4 1·913

Period—Five weeks ending Nov. 2, 1918. 1 ton picric acid required.

0·528 Yield on phenol consumed, 189·3%

R.O.V. used.

	%			%			%	
H_2SO_4	95·0	2·255	HNO_3	64·4	1·380	H_2SO_4	47·9	2·022
H_2O..	5·0	0·119	H_2O..	35·6	0·762	H_2O..	52·1	2·200
	100·0	2·374		100·0	2·142		100·0	4·222

Used .. .. 1·380
Recovered .. 0·120

1·260

Nitrate of Soda 1·888 (Overall crude figure, including loss in handling.)
100% $NaNO_3$... 1·775

Retorts .. 1·691
Nitration loss.. 0·293
Concentration :
A. .. .. 0·036
B. .. .. 0·051
C. .. .. 0·013

2·054

Waste acid to be concentrated H_2SO_4 .. .. 1·985

To be delivered from concentrators, H_2SO_4 1·904

Period—Five weeks ending Sept. 28, 1918. 1 ton picric acid required.

0·536 Yield on phenol consumed, 186·7%

R.O.V. used.

	%			%			%	
H_2SO_4	95·0	2·265	HNO_3	64·5	1·399	H_2SO_4	46·0	2·078
H_2O..	5·0	0·119	H_2O..	35·5	0·770	H_2O..	54·0	2·440
	100·0	2·384		100·0	2·169		100·0	4·518

Used .. 1·399
Recovered .. 0·119

1·280

Nitrate of Soda 1·914 (Overall crude figure, including loss in handling.)
100% $NaNO_3$... 1·791

Retorts .. 1·712
Nitration loss.. 0·187
Concentration :
A. .. .. 0·042
B. .. .. 0·088
C. .. .. 0·019

2·048

Waste acid to be concentrated H_2SO_4 .. .. 2·036

To be delivered from concentrators, H_2SO_4 1·049

B 2

VIII. *Comparative cost of the finished products.*—The question of comparative costs is fairly simple when once the methods of finding actual costs and of constructing flow-sheets have been established.

The items included in the comparative cost of any of the finished products dealt with can be grouped in three sections. One section deals with the service charges, another with the raw materials, and the last refers to the acid usages, the method of showing which is very different from that adopted in the actual costs. When a flow-sheet is available the acid usages can be found at once. As flow-sheets were not always accessible, the method of finding the acid usages on exactly the same lines was developed by means of what are called "Voucher" sheets, examples of which are given, together with an explanation of the headings and instructions appearing on them.

Summaries of total cost and of cost per ton on a comparative basis are given for nitrocellulose, nitroglycerin and cordite.

Following these comparative costs, constructed on what is termed the "normal" basis, some "ultimate comparative costs" appear. In these, in place of the HNO_3 and H_2SO_4 usages, the raw materials, sodium nitrate and sulphuric acid and oleum, expressed as SO_3 or H_2SO_4 appear, and consequently the service charges include not only acid mixing, nitration and finishing, but also the service charges involved in the manufacture of the nitric acid consumed and in the denitration and concentration of the waste acids to be handled. The total cost, of course, is the same, though the method of arriving at it is varied.

Nitroglycerin, nitrocellulose and cordite ultimate costs are shown.

This section closes the Report, but two appendices are added, the first being a reproduction of a complete set of technical records received from H.M. Factory, Queen's Ferry, for the month ending December 29, 1917, and the second being a reproduction of the cost accounts of H.M. Factory, Gretna, for the period (four weeks) ending June 29, 1918.

The earlier Reports on Costs and Efficiencies showed the great improvements that could be effected in chemical manufacture by the help of cost analysis. The present Report on the Statistical Work of the Factories Branch shows each step of the way in the acquirement of the requisite statistics. The advantage of analysing costs so that the cause of a high cost of manufacture cannot be hidden is manifest. To those who study this report the way to arrive at such an analysis is made clear.

A FURTHER NOTE ON "MUSTARD GAS."

SIR WILLIAM POPE.

Only two chemical points are raised in Dr. Green's recent note (this J., 1919, 363 B) on the history of "mustard gas" and these can be settled decisively in the light of our present knowledge.

1. In Guthrie's study of the action of ethylene on sulphur monochloride (J. Chem. Soc., 1861, **13**, 134), the gas was left in contact with the sulphur chloride for 20 hours at 100° C.; the resulting product was shaken with warm water, dried, digested with ether, filtered, evaporated in vacuo, dissolved again in ether, filtered and evaporated in vacuo. The product then gave analytical results corresponding to the composition $(C_2H_4Cl)_2S_2$, and it is stated that "a drop placed beneath the tongue destroys the epidermis and causes a soreness which lasts many days."

Experiment has shown that no $\beta\beta$-dichlorethyl sulphide results from the action of sulphur monochloride on ethylene at temperatures much higher than 60° and that $\beta\beta$-dichlorethyl sulphide or Messrs. Levinstein's product is immediately acted upon by sulphur monochloride at temperatures higher than 60 or 70° C. with production of other chlorinated ethyl sulphides. These latter substances are irritant to an extent which is small in comparison with the activity of mustard gas and which is of the order mentioned by Guthrie. Had a drop of mustard gas been placed under the tongue the patient would certainly have died.

These facts formally disprove Dr. Green's conclusion that Guthrie obtained mustard gas from ethylene and sulphur monochloride; they substantiate my statement (this J., 1919, 344 B) that the method devised by Gibson and myself "was entirely novel; no suggestion had been previously made that any such process was possible."

2. On treating the product obtained by acting on sulphur monochloride with ethlylene at 30° C., and which I have spoken of as a "pseudo-solution" of sulphur in the monosulphide $(CH_2ClCH_2)_2S$, with an organic diluent such as alcohol or ether, the sulphur separates, leaving a solution of $\beta\beta$-dichlorethyl sulphide. This fact conclusively refutes Dr. Green's suggestion that the Levinstein product is a disulphide.

In addition to Dr. Green's two chemical fallacies, which I have exposed above, he is haunted by another, which I had thought was dispelled by my previous note. Dr. Green credits me with being the inventor of a process, the which, having stated, he proceeds to demolish. I never produced any process; my efforts were limited to discovering, in collaboration with Mr. C. S. Gibson, a method for preparing mustard gas which Messrs. Levinstein duly converted into a works process. Dr. Green's failure to appreciate the situation is in part due to his misapprehension of the chemical aspects of the mustard gas reaction; the following facts, stated chronologically, may clear up the misunderstanding.

At the end of January, 1918, Mr. Gibson and I, as "scientific advisers," gave the authorities full laboratory details of an entirely new and quantitative method of making $\beta\beta$-dichlorethyl sulphide by the action of ethylene on sulphur monochloride. In a document handed in on January 28, 1918, and which is on the official records, we state that "the interaction is conveniently carried out by passing a current of dry ethylene gas through sulphur monochloride, S_2Cl_2, either in the cold or warmed. When the reaction ceases, a mixture of sulphur with the $\beta\beta$-dichlorethyl sulphide or a solution of sulphur in $\beta\beta$-dichlorethyl sulphide is obtained." Other particulars concerning the rapidity of absorption at different temperatures and the activity of a catalyst are added. In face of this record no one will credit Dr. Green's statement that three months later he had difficulty in convincing either of us that mustard gas can be produced by acting upon sulphur monochloride with ethylene at 30° or that I was sceptical as to the potency of Messrs. Levinstein's product. Further, since we knew that no disulphide is produced, although Dr. Green thinks it is, his statement that scientific advisers attached to the Government "maintained that the separation of sulphur was an essential part of the process, without which an inactive disulphide would result," is absurd.

Early in February, 1918, the technical chemical advisers to the Government commenced converting our laboratory method into a works process. The scientific advisers were not consulted as to which chemical manufacturers should be asked to collaborate in this work.

On April 19, 1918, Dr. Green informed me that he had interested himself in the manufacture of mustard gas and on the same day I introduced him to the technical authorities dealing with the matter. They did everything possible to forward

Messrs. Levinstein's plans for installing the process and that these efforts were successful is evident from the fact that Messrs. Levinstein had a plant producing early in June, 1918.

Dr. Green gives the text of a telegram sent him on May 11, 1918, which shows that some misunderstanding had arisen; he does not name the signatory, but indicates clearly that the sender was Lord Moulton's chief technical adviser, a very eminent chemical engineer. No scientific adviser was involved in any differences which may have arisen between the two, apparently antagonistic, groups of technical experts.

It will be remembered that I entered upon the present discussion in order to correct the ridiculous assertion that "scientific advisers" prevented the effective development of a mustard gas programme. I claim to have shown that the programme was from the beginning entirely in the hands of technical men—chemical manufacturers and chemical engineers—and that the "scientific advisers" confined themselves to the discovery of a novel reaction which obviously lent itself well to the development of a works process.

NEWS FROM THE SECTIONS.

MANCHESTER.

At the meeting held on November 7, Mr. J. Allan in the chair, a paper on "The Estimation of p-Phenylene Diamine," by Drs. T. Callan and J. A. R. Henderson was read by the former.

Para-phenylene diamine can be accurately and rapidly determined by adding a solution containing it to an excess of a standardised solution of sodium hypochlorite, and titrating back with decinormal sodium arsenite in presence of starch-iodide paper, the available chlorine present being removed by the base as insoluble benzo-quinone dichloro-imide. Naphthalene 1:4 diamine, and p-amido diphenylamine can also be estimated by this method, which, however, fails when a sulphonic group is present in the molecule, owing to the formation of soluble chloro-imides.

The second paper on "The Estimation of Sulphuric Acid in the presence of Organic Sulphonic Acids" was by the same two authors in collaboration with Mr. R. Barton. The presence of organic sulphonic acids might conceivably affect the determination of sulphuric acid owing either to the solubility of barium sulphate in solutions of sulphonic acids or to the precipitated barium sulphate containing admixed barium sulphonate. A number of sulphonic acids of the benzene and naphthalene series containing known amounts of sulphuric acid were analysed, with the result that neither of these possible disturbing influences was found to be operative. A rapid method for the volumetric estimation of sulphuric acid was also described. An excess of N/4 barium chloride is added to the neutralised acid and, after boiling, the excess is found by titrating with N/4 potassium chromate, the end point being ascertained with starch-iodide paper very faintly acidulated with hydrochloric acid.

An electrical distance thermometer was exhibited by the Cambridge Scientific Instrument Company.

BRISTOL AND SOUTH WALES.

A meeting of this section was held at the University College, Cardiff, on November 7. Mr. W. R. Bird who presided, announced that an invitation had been received from the South Wales Institute of Engineers to a special meeting on November 27, to hear a paper from Mr. S. R. Illingworth, on the "Chemistry of Coal."

Mr. F. J. Popham, in a paper on "Peat," outlined the various processes which have been applied on a commercial scale for the production of a good fuel from peat bogs in various parts of the world. The commercial success of the "wet carbonising" or any other process depends on the "heat balance," that is, it must be self-contained, the peat providing its own fuel for the process, and this must absorb less than the total heat units in the dry product. In an efficient plant there would be a margin of 25 per cent. Owing mainly to engineering difficulties, complete success has not yet been obtained.

The meeting at Bristol on November 13, at which Mr. E. Walls presided, was devoted to Chemical Engineering, with particular reference to "Sulphur and Sulphur Burners." Mr. C. A. Hawkes introduced the latter subject, and described the manifold difficulties attending the combustion of sulphur in its various forms and combinations. The discussion was contributed to by Prof. J. W. Hinchley, Mr. H. B. P. Humphries, and Mr. H. Talbot, who attended from London as representatives of the Chemical Engineering Group.

Prof. Hinchley referred to the backward state of this country in regard to chemical engineering, and to the circumstance that we had to rely on American assistance during the war. The type of man required was not in every case a first class engineer, but one who combined sufficient knowledge of both subjects to interpret engineering problems to the chemist and chemical problems to the engineer.

Mr. Talbot outlined the programme and policy of the Chemical Engineering Group, and Dr. Francis spoke interrogatively on the requisite training for a chemical engineer, which to be adequate, would apparently have to cover an unusually extended period.

BIRMINGHAM.

On November 13, at the University Buildings, Mr. L. P. Wilson presided over a well-attended meeting, which included a large number of members of the Birmingham Metallurgical Society. Mr. C. J. Brockbank, of Thorold, Ontario, read a paper on the "Production of Artificial Abrasives in the Electric Furnace." Artificial abrasives require for their production large quantities of electrical power such as can be cheaply obtained from the enormous water power resources of Canada and the United States. In Canada several large plants are devoted entirely to the production of the two kinds of artificial abrasives, carborundum and aluminous abrasives or artificial corundum. These products are known by various trade names, and upwards of 140,000,000 lb. was produced last year.

Silicon carbide is made from petroleum coke and the purest white sand. Precautions are taken to allow free exit for the large volume of carbon monoxide evolved, and to remove impurities. The crushed mass is treated with acid and alkali to remove surface impurities which would spoil the porcelain bond used in making up into grinding wheels. Artificial corundum is made by smelting a mixture of bauxite and coke in an arc furnace, and is obtained as a large pig or ingot. The impurities, silicon, iron and titanium, are found as an alloy in the bottom layer of the ingot, but the presence of one or two per cent. in the corundum increases its toughness.

Silicon carbide is intensely hard and very brittle. It is suitable for grinding brittle materials such as cast iron and marble and is used in the dressing of leather; but it is quite unsuitable for producing the smooth finish required in grinding steel, and for this and similar purposes artificial corundum is employed. These artificial abrasives have entirely superseded natural emery except for a few operations, such as glass polishing.

LIVERPOOL.

The opening meeting of the session was held in the Adelphi Hotel, Liverpool, on November 17. The principal item was the delivery by the new chairman, Dr. E. F. Armstrong, of an address entitled "The Outlook for British Chemical Industry," which was the subject of appreciative remarks by Mr. John Gray, Mr. A. T. Smith, Mr. A. Carey, and others. The address will be inserted in the next issue of the "Review."

MEETINGS OF OTHER SOCIETIES.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

The meeting held on November 18 was devoted to a paper on "The Conservation of Oil," by Rear-Admiral Philip Dumas.

The author, as chief secretary of the Royal Commission on Oil Fuel Engines, has come to the very definite conclusion that waste was the key-note of the mineral oil industry, and he made it the key-note of his lecture. His inquiries had convinced him that wasteful search, wasteful boring, wasteful production, wasteful storage, wasteful use of main and by-products, wasteful transport, wasteful retail sale, waste in the lack of concentrated chemical research into its chemical constituents, and waste in its economic use, combined with a waste of brains with regard to improvements in the industry, were the order of the day, and he wondered why a luxury such as oil should have been given to the people of the world to play ducks and drakes with. He was of the opinion that the large corporations which to-day make huge profits out of oil should endow more universities and provide greater facilities for the training of young brains in the science and technology of mineral oil, so that these might eventually be in a position to help conserve this great source of power. The advantages and disadvantages of oil fuel were described minutely, and the view expressed that the navies of the world are to-day the greatest oil wasters. In times of peace the capital ships of the Navy should use coal, so that the industrial efficiency of merchant shipping might be increased by the more general use of oil fuel. There was vast room for improvement in the economic development of the internal combustion engine, and the time was not far distant when oil fuel, instead of being used under boilers, would be used in improved types of internal combustion engines, which would become the motive force of the ships of the future.

Sir Marcus Samuel, in proposing the vote of thanks to the lecturer, stated that the world's supply of oil was sufficient for many years to come. The English internal combustion engine for commercial purposes had been introduced in several of his company's ships during the war, and had proved their commercial possibilities. Admiral Goodwin, who followed, considered that the internal combustion engine for high power ships was not an economic possibility in the near future. Sir Charles Greenway also supported Sir Marcus Samuel's opinion that the future production of oil was absolutely assured. The supply depended purely on the economic demand, and, if necessary, the output could be doubled within the next ten years. Sir John Cadman remarked that, in spite of criticism, the technology of oil was better understood than the technology of coal, while Mr. Gordon Craig supported the lecturer in his remarks regarding the lack of opportunity for real education in the oil industry, and the need for the clarion call that the oil supplies of the world should be conserved.

TECHNICAL INSPECTION ASSOCIATION.

An address on "The Spectroscope in the Science of To-day" was given by Prof. E. C. C. Baly in London on November 7.

The lecturer pointed out that the complete spectrum is many hundred times longer than that portion of it detectable by the eye; it comprises wave lengths ranging from 0·3 mm. and 0·0001 mm., and the visible portion consists of wave-lengths between 0·00076 mm. and 0·00039 mm. The growth of spectroscopic discovery was briefly reviewed and illustrated by the discovery of the elements rubidium, caesium, gallium, thallium, indium, and the rare gases of the atmosphere. The process of separation of the rare earths is materially assisted by a study of their phosphorescent spectra, developed by cathodic bombardment in vacuo, these affording an invaluable guide to the progress of the separation. A chemically pure substance exhibits no phosphorescence whatever. By utilising the fact that when an element is present in a mixture to only a very small extent, only very few of its characteristic lines are developed in the spectrum, quantitative determinations by means of the spectroscope are possible. The application of absorption spectra to quantitative determination was instanced by Robertson's work on the stability of nitro-cotton and nitro-glycerin when heated. The method might similarly be applied to the inspection of TNT and ammonium nitrate.

The applications of the spectroscope to astronomy were briefly described, special reference being made to the spectra of the stars and nebulæ. There is evidence that stars arise from a process of nebular condensation. The spectra of the youngest stars and the original nebulæ exhibit the lines of hydrogen and helium together with the lines attributed to a hypothetical element, nebulium, hitherto undiscovered on the earth. With increasing age of the stars, the spectral lines characteristic of increasingly heavier elements make their appearance, and the conclusion seems inevitable that all the elements arise by some process of condensation from hydrogen and helium, on the lines originally suggested by Prout in 1815, and supported by the recently discovered phenomena of radio-activity. Further support of the theory is afforded by the existence of what Lockyer has called "enhanced lines" in the spectra of certain stars. Within recent years it has been established that the wave-lengths of the energy absorbed and radiated in any chemical reaction are absolutely characteristic of the substances partaking in it.

In the course of the lecture, Professor Baly entered a plea that a course in up-to-date spectroscopy should form part of the training of every student of chemistry.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

At the opening meeting of the newly-formed chemical section, Sir William J. Pope gave an address on "The Photography of Coloured Objects."

The discussions which took place some twenty years ago on the value of photography as a means of artistic expression in reality centred around the insensitiveness of the ordinary photographic plate to rays of low refrangibility; for representation of parti-coloured objects the plate must be sensitive to red and yellow rays. By staining the ordinary blue-sensitive plate with erythrosine, it becomes sensitive to green and orange, and with the aid of certain cyanine dyes a plate may be sensitised throughout the entire range of the visible spectrum. At the outbreak of war the Allies were entirely dependent on Germany for these sensitising dyes, which are essential in aerial photography. The slight haze which tends to

obscure a distant scene to the naked eye is enormously intensified on an ordinary plate, blue light penetrating a clear atmosphere much less readily than red and yellow. Hence a photograph taken in red light only would give much greater detail. The production on a technical scale of the requisite sensitisers was achieved in the Cambridge laboratories, and at the date of the armistice 80 per cent. of the plates employed in the British photographic air-service was red-sensitive or panchromatic. The best panchromatic plate made before the war possessed about one-third the sensitiveness to red as to blue light, but at the present time a plate much faster to red than to blue light is on the market; thus the rapidity to red light has been increased about four-fold

The chief processes at present available for the photographic reproduction of the colours of particoloured objects were explained and examples of each exhibited.

THE CHEMICAL SOCIETY.

The new session was opened on November 6 with an ordinary scientific meeting, at which the President, Sir J. J. Dobbie, presided. Mr. W. E. Garner read a paper by Prof. F. G. Donnan and himself on "Equilibria across a Copper Ferrocyanide Membrane and an Amyl Alcohol Membrane." The equilibria established across semipermeable membranes are in agreement with Donnan's theory (Z. Elektrochem., 1911, 17, 572) in the case of the copper ferrocyanide and the amyl alcohol membranes. Solutions of potassium and sodium ferrocyanides are in equilibrium across a copper ferrocyanide membrane when the ratio of the potassium to the sodium concentrations is the same on the two sides of the membrane. Solutions of sodium and calcium ferrocyanides are in equilibrium when the ratio of the square of the total sodium concentration to the total calcium concentration is the same on the two sides of the membrane. The results of measurements of the equilibria of lithium and chlorine ions on the two sides of the amyl alcohol membrane also confirmed the theory.

In a paper on "Peroxides of Bismuth," by Mr. R. R. Le G. Worsley and Dr. P. W. Robertson, the latter described the products obtained by the oxidation of bismuth salts by chlorine in an alkaline solution. The product obtained when dilute alkali is used is a mixture of oxides and hydrated oxides which can be separated by the action of nitric acid of various concentrations.

Dr. T. M. Lowry and Mr. R. G. Early contributed a paper on "The Properties of Ammonium Nitrate, Part I., the Freezing Point and Transition Temperatures." The freezing point, which can only be determined with accuracy when the material is ground before drying, is 169° C. On cooling the fused nitrate, distinct arrest points were observed at 125°, 84°, and 32° C.

The final paper was by Messrs. R. R. Baxter and R. G. Fargher on "Some 1:3 Benzodiazolearsinic Acids and their Reduction Products."

At the informal meeting held on November 20 Mr. J. E. Purvis, of Cambridge University, exhibited a series of photographic reproductions of the spectra of some organic compounds.

A NEW PETROL SUBSTITUTE involving the use of alcohol is finding such favour in the United States that the manufacturers propose to erect a new plant to increase production. The fuel costs more than petrol, but is said to give an increased mileage, which compensates for the added cost. A much more important advantage is the cleanliness of the fuel, absence of carbon deposits on spark plugs and in cylinders, and greater safety.

NEWS AND NOTES.

CANADA.

Copper in Manitoba.—The Flin Flon property containing enormous quantities of fair-grade copper ore and much smaller quantities of very rich copper, gold and silver ores, has been sold to a development syndicate. It is hoped to run a railway within 70 miles of Le Pas, and that a large copper smelting industry will grow up within a few years.

Soda Ash Production.—After considerable delay, the new plant of the Brunner, Mond Company of Canada, at Amherstburg, Ont., has started operations. The daily output is stated to be 50 tons, compared with a capacity of 125 tons. The undertaking is entirely self-contained, power plants, salt wells and limestone all being situated on the property.

A Pitchblende Discovery.—The Ontario Government has explored the discovery of pitchblende near Kearney, in the Muskoka district of Ontario. It occurs in a coarse granite pegmatite dyke, some four feet in width, consisting of red and white felspar, white quartz, white and black mica and pitchblende. The last appears to be associated with the red felspar, and is thus similar to the only other occurence known in Canada. Euxinite, giving indications of radium, has been found in Lanark County. The mineral itself contains 63·60 per cent. of uranium, and the felspar with which it is associated, 0·35 per cent. The pitchblende carries 10 per cent. of lead. Since 1914 the province of Ontario has offered a reward of $25,000 to the first discoverer of ores containing radium suitable for commercial extraction.

SOUTH AFRICA.

Manganese Ore in the Transvaal.—At various times, and notably during the war, search has been made for commercially valuable manganese ores in the Transvaal. The neighbourhood of Krugersdorp, among others, has long been known as a manganiferous area, and recently a payable deposit of pyrolusite was discovered there. A company capitalised at £50,000 has been formed to purchase and develop the property.

Exploitation of the Nitrate Deposits at Prieska.—The South African Nitrate and Potash Corporation, Ltd., Johannesburg, which has a capital of £160,000 with power to increase to £500,000, is about to work the shale deposits in the districts of Prieska and Hay, which contain from 3 to 10 per cent. of potassium nitrate, and were described recently in this Journal (1919, 360 T). The Corporation has acquired the rights over some 300 sq. miles of the deposits and intends to work the shales themselves and not the débris, as was formerly attempted. They are to be worked, at least at first, from existing cliff faces and as far back as the shales are oxidised and contain nitrates. The latest view as to the origin of the nitrates is that they have been formed by the action of bacteria, or possibly of electricity, the potash or other base having previously existed in the shales in some other form of combination. The shales are to be broken out by quarrying, passed through a ½-inch screen, and the other portion, which has a high proportion of nitrate, is to be used directly as a fertilising agent. The coarser portion is to be leached with hot water and the solution concentrated and the nitrate recovered by crystallisation. The final mother liquors are either to be used as a fertiliser or as a source of nitric acid. In former years the working of these deposits was hampered by scarcity of water, but an ample supply is stated to be obtainable by boring at a depth of from 50 to 100 feet. At a later date it is proposed to manufacture sulphuric acid from a deposit of pyrites

belonging to the Corporation and to establish nitric acid, fertiliser, and explosive works in the vicinity of a central depôt to be situated at Prieska. This place is convenient to the deposits, and is only 112 miles from De Aar Junction, itself 339 miles from Port Elizabeth.—(*U.S. Com. Rep., Sept.* 30, 1919.)

BRITISH INDIA.

Industries in Bombay.—The Annual Report of the Director of Industries of the Bombay Presidency for 1917—1918, recently to hand, gives a brief *résumé* of the work accomplished by the Department under the war conditions then prevailing, with short notes on some aspects of the chief industries examined.

Handloom Weaving.—This industry has been generally greatly hampered by the high price of yarns, the uncertainty of the market, and the difficulty of obtaining dyes.

Pottery.—The manufacture of bricks, and to a smaller extent of roofing tiles, is carried on in various parts of the Presidency. No other branch of the pottery industry has yet been attempted in Bombay, notwithstanding the abundance of raw material; but it is hoped that when the Demonstration Factory, for which proposals are being prepared, is established, the commercial possibilities of various new lines of work will be indicated. The brick industry is flourishing, but the quality of the product leaves much to be desired, although it has been demonstrated that a brick far superior to the ordinary Kalyan brick can be made from local material. The roofing-tile industry requires encouragement and guiding along right lines of manufacture. Capital is being invested in various districts, and considerable progress may be shortly expected.

Oil-seed Crushing.—The production of vegetable oils has increased of late years. The difficulty, however, appears to be that the right type of machinery is lacking. The introduction of more efficient methods of decortication, de-shelling and washing of seeds would result in the production of purer articles and effect a saving in labour. With regard to the utilisation of the oils, methods of purification are necessary, and such oils would then be of value for edible purposes. A great future awaits the Indian vegetable oil trade with the introduction of hydrogenation. The saving in transport alone would be enormous, apart from the production of a wholesome and efficient substitute for "ghee."

Glass.—War conditions, while generally hampering industries, have temporarily assisted others through restrictions on freight, and glass is one of these. Five glass-making firms have started in Bombay city during the war, and, in spite of difficulties in regard to coal supply, have met to some extent the local demand, in particular for cheap lamp-ware.

Sugar.—The possibilities of sugar manufacture are to be tested by a local syndicate in the Ahmednagar district, where a suitable area of land on one of the new canals has been acquired. The syndicate's operations are watched with considerable interest and must prove of the greatest value as a lesson in the economical use of water and manure.

Miscellaneous.—Brush-making has made some progress and the class of articles produced has undoubtedly improved. Button-making may command more notice in the future. Raw materials for this industry are available in the shape of bone and horn, in addition to the "hoka" nut, found in the south of Kathiawar, and the tali palm seeds of Kanara. The Department has taken over temporarily certain button-making machinery and proposes to experiment and examine the possibilities.

In the absence of any available expert no experiments in tanning have been made on this side of India. Leather belting is made in Bombay, and its suitability to compete with the imported article is under investigation.

FRANCE.

Industrial Notes.—*Chemical Industry.*—The renewal of trade relations with Germany is the great question of the day, especially in view of the great shortage of dyes and intermediates. The lead taken by Belgium in adopting the policy of the open door as regards enemy products has caused quite a sensation in French industrial circles. Common sense and expediency dictated this policy to Belgium because in many respects she was in the same predicament as France, lacking all the most essential materials vital to her industries, such as carbonate of potash, which is required in great quantities for glass-making. It is anticipated that England and America will follow suit, and France, in spite of a strong moral reticence, will be forced by circumstances to follow the example of her Allies.

Prices are rising everywhere, and even war products, such as acetic acid, show the same tendency. The shortage of coal will not improve matters, and the further call made on production by the devastated provinces as they gradually come back to life will in all probability keep up prices for some time to come.

Coal and Transport.—American coal is finding its way to most of the French ports. Rouen has received American and German coal, and there are large stocks on the quays at Bordeaux and Le Havre. The difficulty lies in distribution, country districts being cut off from the ports. The textile industry is, in particular, severely handicapped by lack of transport facilities, cotton remaining stocked at Le Havre which should be conveyed to the looms in eastern France; more than 3,000 workers have thus been thrown out of employment. The Government is taking strong measures to put an end to the transport crisis and has appointed two committees, one to co-ordinate the activities of the different railway companies, and the other, a technical committee, to look after the efficiency of the rolling stock proper.

The French metal market is much disturbed on account of the shortage of raw materials, and it is feared that many factories will have to close down, instances of this kind having already occurred in the North of France. Firms are being driven to import from England and America, notwithstanding the unfavourable rate of exchange; with normal means of transport their requirements could be easily met from home sources, such as Lorraine.

Petroleum.—Prospecting for oil in Algeria has recently been very active. The "New Grosny Oilfields Co., Ltd.," has struck oil at a depth of 180 metres at Mesilla and Medjilla, in Oran, and the bore-holes at these two places are each producing four tons of oil per day. The success of this English company is rousing the French industrials to a sense of keener interest in the development of the natural riches of their colony as well as of the potential oilfields in the Jura and Les Landes districts of France.

Metallurgy.—The tendency of French metallurgy before the war was to be as self-centred as possible. The ideal which each individual company aimed at was to group together the blast furnaces, steel works, and rolling mills, and to obtain command of raw materials by buying or obtaining concessions for iron and coal mines. Once this concentration had been achieved the next step was to increase and intensify production; and this was done slowly by a judicious distribution of the accumulated profits more than by any sudden increase of capital,

thus leaving the latter relatively small compared with the magnitude and importance of the undertaking.

This state of things is being gradually modified as a result of the war, and the tendency now is for such big self-contained firms as Schneider and Co., La Marine, Micheville, and Pont-à-Mousson to extend their spheres of action and become great banking concerns controlling many factories making finished products, navigation companies, etc. This policy first became manifest when Alsace-Lorraine was returned to the mother-country.

French metallurgists are now ousting the Germans from the splendid factories which the latter built in Lorraine, and many are giving up their former policy of gradually extending their own works to share in the riches and development of the recovered province. The present outlook is consequently one of constant fusion, absorption and amalgamation of various interests, and this is paving the way to a sort of State collectivism; owing, however, to the strongly individualistic temperament of the French, it would not be surprising if a reaction were to ensue. The Germans are fully aware of the great possibilities of French metallurgy, but they entertain the hope that the French character and French capital will be unequal to the task of realising them. Meanwhile, the blast furnaces in Lorraine continue to be severely handicapped by the great shortage of coke, adequate supplies of which are dependent on good transport facilities. As a result of recent strikes, the production of iron ore in Lorraine during September was only 440,000, against 655,000 tons in August; the quantity exported was 500,000 tons, of which 100,000 tons went to Germany.

Supply of Potash to France from Alsace.—The following figures show the deliveries of potash in metric tons from Alsace to France during the first six months of 1919: Kainite (12—16%) 77,055, sylvinite (20—22%) 40,048, potassium chloride (50—60%) 14,428. The total (131,531 metric tons) is equivalent to 27,543 tons of pure potash. In 1913 the total consumption in France was equivalent to a maximum of 35,000 tons.—(*Z. angew. Chem.*, *Oct.* 3, 1919.)

UNITED STATES.

New Mining Research Laboratories at Pittsburgh.—The great Pittsburgh laboratories of the U.S. Bureau of Mines were formally opened at the beginning of October. They have been erected at a cost of a million dollars and are designed for investigations relating to mining, including the study of accidents and methods of preventing them; they will also serve as a bureau where miners and operators may obtain information and help. Chemical and physical research is to be pursued on gases, explosives and mineral substances. The research work done under the direction of the Bureau at various stations and laboratories is divided under the headings Mining, Metallurgy, Petroleum, Mineral Technology, and Mechanical Equipment, under which the utilisation of fuel is included.

Detection of Soya Bean Oil in Linseed Oil.—Research conducted at the Bureau of Standards indicates that a satisfactory hexabromide method for detecting even small percentages of soya bean oil in linseed oil is rapidly nearing perfection. Hitherto the iodine number has been the only constant of use in identifying these two oils, but in mixtures of them as much as 30 per cent. of soya bean oil could escape detection since the iodine number would still fall within the limits allowed for pure linseed oil. The hexabromide method, however, may make it possible to detect as little as 5 per cent. soya bean adulteration. The hexabromide figure for pure linseed oils appears to lie between 45·6 and 46·9, while the upper limit for soya bean is about 5, most samples averaging around 2·2.

Institute of Baking.—Representatives of the 28,000 baking establishments in the United States, after two years of preparatory work, have formed the American Institute of Baking, with ample financial support to carry out its programme. The Institute will conduct research on fundamental problems connected with the industry, will study all matters relating to production, and interest itself in educational affairs. The National Research Council will co-operate in selecting problems, proposing methods of attack, and will act generally in an advisory capacity.

Records of Prices of Chemicals.—The War Industries Board has issued a series of valuable bulletins covering the history of prices of various commodities, which may be purchased from the Superintendent of Documents, Government Printing Office, Washington. The chemical group includes minerals, acids, heavy chemicals, miscellaneous inorganic chemicals, fertilisers, soaps and glycerin, essential oils, flavouring and perfumery materials, wood distillation products and naval stores, natural dyestuffs and tanning chemicals, coal-tar crudes, intermediates and dyes, drugs and pharmaceuticals, explosives, proprietary preparations and miscellaneous organic chemicals.

Chemical Glassware.—As a result of complaints regarding a lack of uniformity in American-made chemical glassware, a committee of the American Chemical Society has undertaken to survey the situation, and, where necessary, devise means of improvement. Imported wares were never perfect in this respect, but less experienced manufacturers have shown an inclination to vary dimensions which, it is feared, will make the re-entry of German material much less difficult. The quality of American glassware is very satisfactory, and there is no reason why necessary corrections in size and shape should not be made promptly.

"Chemical Abstracts."—The final volume of the decennial index of "*Chemical Abstracts*" will be issued shortly, and the editors are to be congratulated on some unique features which greatly assist the reader in searching through the chemical literature for the years covered. The "Ring Index" is an original feature which will enable one to trace any ring complex by its formula without knowing its name. Abundant use is made of cross-references, subjects rather than words are indexed, and page references include figures indicating fractions of a page which are especially useful in organic chemistry. The naming of organic compounds according to a uniform system and indexing them under the names of parent compounds gives the index more of the character of a general hand-book of organic compounds than anything attempted heretofore.

Progress in Tanning Fish Leather.—The Bureau of Fisheries of the Department of Commerce reports excellent progress in the tanning of fish skins. A company formed for this purpose has established stations in North Carolina and Florida for the capture of sharks and porpoises, and it is understood that the number of stations will be increased as rapidly as possible. Another company has recently acquired a site for a fish skin tannery in Washington. Samples of leather recently submitted show a marked improvement over earlier efforts. The leather is soft and pliable, and appears to have ample strength for many uses. The Bureau of Standards is to make tests of the leather product as to durability, porosity, tensile strength, pliability, water absorption, wearing qualities, etc. The nets which the Bureau designed for the capture of sharks are proving successful and will be generally adopted. At the fishery stations the liver oil is extracted and the flesh converted into fertiliser.—(*U.S. Com. Rep.*, *Sept.* 23, 1919.)

GENERAL.

The "Jubilee" of "Nature."—The completion of fifty years of service as a scientific periodical has been most fittingly commemorated by the editor of *Nature* by the publication of a Jubilee number, in which the progress and achievements of science and their applications to industry and the arts are authoritatively reviewed. The first number of *Nature* was published on November 4, 1869, with the object, as stated in the original circular issued on its initiation, of "placing before the general public the grand results of scientific work and scientific discovery and of urging the claims of science to a more general recognition in education and in early life." This, amongst other aims, has been consistently maintained, and the founder, Sir Norman Lockyer, and the present editor, Sir Richard Gregory, are indeed to be congratulated on the conspicuous success of their labours and on the high scientific standard that has characterised the contributions to *Nature* during the past fifty years. Throughout this long period they have secured the co-operation of all leaders of science, they have kept actively in touch with the work of scientific societies both in this country and abroad, and have provided an invaluable medium for scientific discussion. Such contributors and contributions have given *Nature* an exceptional place amongst scientific journals. Its comprehensive character and broad outlook have served to educate and stimulate a wide circle of readers, whilst it has been particularly valuable in directing the attention of workers in science to the progress of discovery in fields other than their own. It is from this standpoint that the reviews in the Jubilee issue will appeal especially to those associated with chemical industry or science. Some forty articles, all contributed by representative authorities, are included in the publication, together with "Valedictory Memories" by Sir Norman Lockyer, and an appreciative account of his life and work by Dr. H. Deslandres, of Paris. The chemical contributions comprise "The Progress of Chemistry," by Sir Edward Thorpe; "Chemistry in the Making," by Prof. H. E. Armstrong; "The Discovery of the Chemical Elements since 1869," by Prof. H. B. Dixon and H. Stephen; "Physical Chemistry—Past and Present," by Prof. J. C. Philip; and an abstract of the address recently delivered by Dr. M. H. Nichols as president of the American Chemical Society on "Research and its Application." Other articles deal with almost every branch of science, with borderland subjects of outstanding importance, such as "Radium and the Electron," "Atoms and Molecules," with technical applications of science, with the teaching of science, and with the promotion of research. All are suggestive, helpful, and full of interest. They constitute an appreciative tribute to the conspicuous services *Nature* has rendered towards the advancement of science and mark a happy augury for the successful maintenance of its influence and utility.

Fabric Structure and Design.—A special committee of the Textile Institute, Manchester, has prepared a scheme for giving effect to a proposal for the advancement of fabric structure, colour, and design in relation to woven cotton and mixture fabrics. Mr. John Crompton, a member of the Council of the Institute, has given a sum of £2,000, the annual revenue from the investment of which is to be devoted to the provision of awards to the designers and weavers of original cotton textile fabrics designed and woven by themselves in technical colleges or weaving schools in the British Empire. It is proposed that, with a view to raising the standard of products in the industry, the Committee of the Institute shall act as a collecting and distributing agency in respect of samples of fabrics.

Financial Developments in the German Chemical "Grossindustrie."—The chief firms represented in the "Interessengemeinschaft" (I.G.) are about to double their capital with a view to developing the nitrogen fixation plants. Forty per cent. of the new capital will take the form of 3½ per cent. preference shares, each share entitling its holder to two votes, and the remainder will be offered at 107 to existing holders on a share for share basis. The object of the preference share issue is, it is stated, to prevent the undertakings passing under the control of foreign interests, which have been busy purchasing shares at their present depreciated values.

The Farbwerke Höchst has issued the following communication relative to these changes:—The agreement arrived at in 1916 between the firms constituting the I.G. provided that in certain cases profits and losses should be restricted to individual companies. This arrangement applied, in particular, to the producers of synthetic nitrogen compounds, *viz.*, the Badische Co., the Bayer-Leverkusen Co., and the A.-G. für Anilinfabrikation in Berlin-Treptow. The magnitude of the nitrogen works no longer corresponds to the capitalisation of the companies operating them, and the completed and projected extensions at Oppau and Merseburg alone necessitate an expenditure of 100,000,000 marks. When all the contemplated extensions have been completed there will be available for German agriculture a yearly supply of 300,000 metric tons of combined nitrogen. As from January 1 next all the firms adhering to the Gemeinschaft will be financially interested in the nitrogen industry. The Farbwerke Höchst is increasing its capital from 90 to 180 million marks, and the other companies are acting similarly; in the case of the Höchst company moderate dividends are promised on account of the present financial year, for the payment of which the reserve funds will be encroached upon, if necessary.—(*Z. angew. Chem., Oct.* 24, 1919, *and other sources.*)

The United States and German Chemical Patents.—According to the *Berliner Boursen Courier*, the object of Mr. Irving H. Keene's recent visit to Germany (this J., 1919, 417 R) was to make private inquiries concerning the proposed purchase *en bloc* of the most valuable German patents relating to dyes and pharmaceutical products by a purely financial company in which both American capital and German chemical industry would be represented.—(*Z. angew. Chem., Oct.* 10, 1919.)

The Iron and Steel Position in Spain.—The Madrid correspondent of the "Comité des Forges de France" describes the present position of the Spanish iron and steel industry as follows:—There are in active operation in Spain 23 blast furnaces, 39 puddling furnaces, 31 open-hearth furnaces, 73 re-heating furnaces, 43 forges, and 2 electric furnaces distributed among 15 establishments, owning about 2000 water h.p., 53,000 steam h.p., and 24,000 electric h.p., and employing altogether about 12,000 workpeople. Their total share capital is £8,600,000, and they have issued bonds for the total sum of £2,680,000.

During the war the iron-ore output fell from 9,861,000 tons in 1913 to 5,551,000 tons in 1917, and that of iron pyrites from 926,000 to 376,000 tons, whilst the wolfram production, the whole of which was exported, increased from 235 to 546 tons. The shortage of coal consequent on the decline of imports from England was to some extent relieved by an increased output from the Asturias collieries. Owing to the heavy orders of the belligerents, the Spanish iron and steel industry enjoyed a period of exceptional prosperity during the war, but with the advent of peace it is faced with a grave crisis, for, owing to its inefficient plants and not too highly skilled *personnel*, it is little likely to hold its own in competition with England and America. The

Government, realising the situation, has decided to come to the aid of the industry, and import duties are to be re-imposed.—(*Iron and Coal Tr. Rev., Oct.* 17, 1919.)

Graphite Deposits in Siberia.—On the right bank of the Kureika, a tributary of the Yenisei, in the Turukhan territory, enormous deposits of graphite have been discovered extending for many kilometres in a double layer, the upper one of which is in parts 14 feet thick. The deposits are sufficient to supply all Russian requirements and to provide material for an export trade, which would be facilitated by the inexpensive water transport available. Samples of the graphite show it to be of a steel grey colour and equal apparently to the best pencil graphite. This neighbourhood promises to develop into a new mining district, and the Government proposes to begin operations in the spring either on its own account or through a group of American engineers.—(*Z. angew. Chem., Oct.* 3, 1919.)

Position of the Belgium Chemical Industry.—There were twenty-seven chemical factories in Belgium before the war, and of these only seven were left undisturbed during the German occupation; the remainder was despoiled of most of the equipment material. A number of associations has been formed with a view to securing supplies of raw materials, and these have amalgamated under the title of "Fédération des Industries Chimiques de Belgique." Considerable difficulties are being experienced in the matter of sales. There is little home demand, the market being flooded with foreign products, among which are cheap German goods introduced through Belgian agents. A demand is arising for the prohibition of free imports, and for imports to be granted only to trade associations. Great difficulty is being experienced in regard to exports. Prior to the war Germany was one of Belgium's most important markets, particularly for sulphuric acid, and it is considered that Germany should be made to purchase at least 200,000 tons of Belgian sulphuric acid annually.

The following information regarding the present position of the Belgian chemical industry has been issued by the Comité Central Industriel. There is very little activity in the soda and potash industry. The output of acids amounts to only about 20 per cent. of the pre-war normal. The manufacture of artificial fertilisers is suffering from the lack of mineral phosphate. The dye industry is at a standstill owing to shortage of raw materials. The tar-distilling industry is credited with very little production on account of the small number of coke ovens in operation. There is little doing in the wood-distillation industry owing to lack of timber. The manufacture of explosives is being taken in hand. The match industry is being carried on, but is hampered by the high import duties in foreign countries. In general, there is no activity in the fat and grease industry. The mineral oil industry suffers owing to the high cost of raw materials. The soap industry has restarted operations, but only on a very limited scale. The glue and gelatin works at Hasselt resumed work in May, but the output is only one-third of that of 1914. The two oldest Belgian chemical firms, the Produits Chimiques d'Aiseau, the Produits Chimiques de Moustier and the Société de Superphosphate et Guano, have gone into liquidation, and will be taken over by a new company with a capital of 5,000,000 francs.

A new company with the title of "L'Alliance," with headquarters in Antwerp, is to be formed for trading in vegetable and mineral oils. The capital will be 3 million francs, in 6000 shares of 500 francs each; 2840 shares will be held by the British Petroleum Co., and a like number by the Pétroles Grosny—(*Z. angew. Chem., Sept.* 30, *Oct.* 7, 1919.)

A New Process of Producing Alumina.—According to *Tidskrift för Kemi* (No. 2, 1919), Professors H. and V. M. Goldschmidt, of Christiania University, have worked out a new process of isolating aluminium oxide from the mineral labradorite which occurs in huge masses at Ekersund, Sogne, and other places on the west coast of Norway. This mineral is a mixture of albite ($NaAlSi_3O_8$) and anorthite ($CaAlSi_2O_8$) in the proportion of from 1:1 to 1:3, with an average content of 30 per cent. Al_2O_3. It has been long known that the alumina in labradorite can be extracted with dilute acids, but the Messrs. Goldschmidt were the first to devise a commercial process. They treat the mineral with 30 per cent. nitric acid, whereby silica remains undissolved and the aluminium, calcium, and iron go into solution as nitrates. The solution is evaporated to dryness and the residue ignited at such a temperature that only the aluminium salt is decomposed. The calcium and sodium nitrates are leached out and, after crystallisation, utilised as fertilisers, the alumina being used for the preparation of aluminium salts. The nitrogen oxides evolved during the ignition of the nitrates are recovered as nitric acid. Aluminium sulphate is already being manufactured in quantities sufficient, it is stated, to cover the demand of the paper and cloth industries in Norway, by the Aktiebolget för Elektrotecknisk Industri at Dröbak, but this firm is now experimenting with the Goldschmidts' process.

CORRESPONDENCE.

"BRICKS WITHOUT STRAW."

Sir,—I write in connection with the paper on "Egyptian Bricks," given by Mr. G. Rudd Thompson at a meeting of the Society of Public Analysts, and reported in your last issue (p. 414 R). It may be that the paper itself dealt fully with the theories that have been advanced by others in an endeavour to throw light on the Biblical "bricks without straw," but it seems of interest to recall the investigations of Dr. Acheson, detailed in his interesting account of the steps leading to his invention of the colloidal graphite lubricants "Aquadag," "Oildag," etc. (this J., 1910, p. 246). He found that the difference as regards plasticity, between German and American clays (identical as far as ordinary analysis showed) resulted from a difference in their preliminary treatment. A washing of clay with water containing material, such as tannin, increased its state of subdivision, rendering it much more plastic. Acheson showed that straw treated with water lost 50 per cent of its weight, and that the watery infusion so obtained produced the same effect on clay as the tannin treatment. A sun-dried briquette of treated clay showed a greater tensile strength than a burnt brick of untreated clay. Acheson therefore concluded—and I think very plausibly—that the Egyptians were acquainted with this property of straw infusion, making use of it in their brick-making, and from this arose the outcry when the supply of straw was stopped.

The effect, of course, is a colloidal one. Colloidal matter extracted from the straw exerts a protective action on the finely-divided clay, the particles of which are assumed to be surrounded by the strongly hydrated colloid, and so prevented from coming together to form large aggregates.—I am, Sir, etc.,

Forest Hill, S.E. ALAN A. DRUMMOND.
Nov. 19, 1919.

PERSONALIA.

Dr. R. H. Pickard, Principal of the Municipal Technical School, Blackburn, since 1908, has been appointed Principal of the Battersea Polytechnic.

An offer of £20,000 has been received by the University of Glasgow from Mr. John T. Cargill, director of the Anglo-Persian and other oil companies, for the foundation of a chair of applied physics.

Prof. J. C. McLennan, who has been acting as scientific adviser to the Admiralty in regard to helium and other subjects, is now returning to his duties as professor of physics in the University of Montreal.

The following appointments have been made to the staff of the Bradford Technical College: Head of Chemical Department, Dr. R. B. Abell; Lecturer in Chemistry, Mr. H. P. Stark; Head of Dyeing Department, Dr. L. L. Lloyd.

Mr. P. A. Molteno and Mrs. Molteno have offered the sum of £30,000 to the University of Cambridge for the erection and maintenance of a building to be used as a research institute for parasitology, provided the University finds the site.

The death occurred at Falkirk, on November 14, of Dr. John Aitken, F.R.S., at the age of 80. Dr. Aitken was a recognised authority on atmospheric pollution by dust particles, and in November, 1918, he was awarded the Royal Medal of the Royal Society for researches on the nuclei of cloudy condensation.

The Nobel Prize for chemistry for 1918 has been awarded to Prof. F. Haber, of Berlin University. Prof. M. Planck, of the same University, and Prof. Stark, of the University of Greifswald, have been awarded, respectively, the 1918 and 1919 Nobel prizes for physics. The award of the 1919 prize for chemistry has been held over.

The King has been pleased to approve of the following awards made by the President and Council of the Royal Society: A Royal Medal to Prof. J. B. Farmer, for his notable work on plant and animal cytology; and a Royal Medal to Mr. J. H. Jeans for his researches in applied mathematics.

The Davy Medal has been awarded by the President and Council to Prof. P. F. Frankland for his distinguished work in chemistry, especially that on optical activity and on fermentation; and the Copley Medal to Prof. W. M. Bayliss for his contributions to general physiology and to bio-physics.

Among the Fellows recommended for election to the Council are Sir J. J. Dobbie, Sir R. A. Hadfield, Sir W. J. Pope, and Prof. W. P. Wynne.

LEGAL INTELLIGENCE.

FIRE AND EXPLOSION AT A TNT FACTORY. CLAIM AGAINST INSURANCE COMPANIES. *Hooley Hill Rubber and Chemical Co., Ltd.*, v. *Royal Insurance Co., Ltd., and Others.* (See this J., 1919, 193 R, 399 R.)

In the Court of Appeal on November 3, counsel for plaintiffs stated that the parties had agreed that the order of Mr. Justice Bailhache as to costs against his clients and in favour of the Royal Insurance Co. should be discharged, and save to that extent the appeal should be dismissed without costs to either side.

SALE OF MINERAL JELLY FOR EDIBLE PURPOSES. *B. Bull v. The Morris Beef Co.*

In the King's Bench Division, on November 5, an action was brought by the plaintiff to recover £2500 as money paid under a contract of June, 1918, for the supply of 100 barrels of "bakers' grease," for edible purposes, at 130s. per cwt. It was contended on behalf of plaintiff that the material supplied consisted of petroleum jelly or vaseline, and expert evidence was given to this effect. The defence denied that there had been a verbal warranty that the material was edible, and stated that the jelly was sold to plaintiff through a third party, who was informed by defendants that they were ignorant of the nature of the material, and that it had been sold to them as bakers' grease or mineral oil and fat.

Mr. Justice Sankey found that plaintiff had established his case, and he entered judgment in his favour for £2245 and costs.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Steel-testing Laboratory, Sheffield.

Mr. Kellaway, in reply to Mr. Neal, said that, with the exception of the laboratory in Sheffield taken over in December, 1917, at an annual rental of £500, all other temporary metallurgical laboratories established during the war have been closed down. A laboratory for testing metals required for artillery equipment and aircraft will be needed so long as such materials are supplied to Government Departments. The future annual cost is estimated at £6,100, and it is hoped to recover an approximately equivalent sum from contractors.—(Nov. 6.)

Soap Manufacture.

Mr. Bridgeman, for the Board of Trade, informed Major Barnes that a sub-committee of the Central Committee appointed under the Profiteering Act is now engaged upon an inquiry into the manufacture of soap.—(Nov. 11.)

Vegetable Oil-seed Products.

In reply to Lieut.-Commander Kenworthy, Lieut.-Col. Amery stated that no preferential duty on the export of palm kernels will be applied to the mandatory areas granted to this country under the covenant of the League of Nations.—(Nov. 12.)

Coal Consumption in Coke Ovens.

The Parliamentary Secretary to the Ministry of Munitions, Mr. J. F. Hope, in a written reply to Mr. Atkey, said the only figures available which indicated the amount of coal carbonised in coke ovens were those for the production of metallurgical coke; these were:—1916, 13,422,195 tons; 1917, 13,801,607 tons; 1918, 13,277,007 tons. In 1917 the sub-division for by-product, bee-hive, and retort ovens was 10,866,673, 2,411,244, and 523,690 tons, respectively.—(Nov. 12.)

Recent Trading with Germany.

Following a question by Mr. A. Short, Sir A. Geddes issued a statement of the total value of the import and export trade between this country and Germany during the period Nov. 11, 1918, to Oct. 31, 1919. The imports from Germany were valued at £217,435, and included potash compounds (other than manures), £53,780; manures, £29,269; and dressed leather, £25,990. The total exports to Germany were valued at £16,207,748, of which

£10,798,973 was in respect of home produce and manufactures; under this sub-heading are included linseed oil, £1,613,396; rape seed oil, £206,499; soap, £480,437. Of the foreign and colonial produce exported, animal and vegetable oils were valued at £111,054; raw rubber, £374,409; unwrought copper, £57,500; and sugar, £60,297.—(Nov. 12.)

Gas Supplies (Calorific Standard).

Sir A. Geddes informed Major Barnes that the suggestion made last June by the Board of Trade to local authorities, that they should refrain from taking proceedings against gas companies in respect of deficient calorific power will have to be renewed until the end of April next, owing to the depleted stocks of coal at gas works.—(Nov. 12.)

Feeding Stuffs and Fertilisers.

In answer to Mr. Sitch, and with reference to the Report of the Consulting Chemist to the Royal Agricultural Society on the marketing of worthless feeding stuffs and fertilisers at excessive prices (this issue, p. 444 R), Sir A. Boscawen said that protection against such fraudulent sales was provided by the Fertilisers and Feeding Stuffs Act of 1906, but the Board of Agriculture was now considering the possible amendment of this Act with a view to giving greater protection to the farmer. Prices of fertilisers are not controlled by law; prices and distribution of feeding stuffs are at present under the administration of the Food Controller.—(Nov. 13.)

Lithopone.

In answer to Mr. Wallace, Sir A. Geddes explained that licences to import lithopone are, as a general rule, granted to firms which imported it during the three months preceding September 1, and at the same rate as during that period. Larger quantities may be imported, under licence, if home producers are unable to supply the demand. He was not aware that there was any difficulty in obtaining licences, and was not prepared to enter into a chemical discussion on the exact formula which represents lithopone, but it has to do with the manufacture of paper.—(Nov. 17.)

Opium Cultivation in China.

Mr. Harmsworth stated, in reply to Sir J. D. Rees, that during the past year there has been a revival of opium cultivation in certain provinces of China, which is mainly due to the present unsettled political conditions. H.M. Government has made strong protests.—(Nov. 17.)

Quinine Sulphate.

Sir A. Geddes informed Mr. Hurd that the delay in publishing the findings of the Committee on Prices and Supplies of Quinine Sulphate was due to the necessity of considering certain legal questions connected with the publication of the Report.—(Nov. 20.)

HOUSE OF LORDS.

Patents and Trade Marks Bills.

These Bills were read a second time on November 12, and committed to a Committee of the whole House for consideration in the week beginning November 24.

The Geological Survey of Great Britain and Museum of Practical Geology, Jermyn Street, S.W., have been transferred for administrative purposes from the Board of Education to the Department of Scientific and Industrial Research.

GOVERNMENT ORDERS AND NOTICES.

IMPORTS AND EXPORTS.

The Board of Trade has announced that Lists "D" and "E" have been cancelled, and that the goods formerly included in them have been replaced on List "A"; these goods include:—Apparatus which can be used for the storage or protection of compressed or liquefied gases, flame, acids, or other destructive agents, capable of use in war-like operations, and their component parts.

It is also announced that castor seed, malt flour, and pig-iron have been removed from List "A" of Prohibited Exports, and that barley, barley flour, and barley meal have been placed on that list (export prohibited to all destinations).

The Export Licence Department has been amalgamated with the Department of Import Restrictions. Applications for licences and all inquiries relating thereto should be addressed to the Director, Imports and Exports Licensing Section, Board of Trade, 22, Carlisle Place, S.W. 1; but applications in respect of licences to import dyestuffs should still be addressed to the Secretary, Trade and Licensing Sub-Committee, Danlee Buildings, Spring Gardens, Manchester.

Import of German Dyestuffs.—The Board of Trade has notified the impending arrival of the first instalment of dyes which are due from Germany under the reparation clauses of the Peace Treaty. Full instructions of the procedure to be followed by intending importers are given in the *Board of Trade Journal* for November 13.

Sugar Supply and Prices.—The Royal Commission on Sugar Supply has issued a notice drawing attention to the need for increasing the selling price of sugar in the United Kingdom, owing to the world's demand having overrun supply. It is noted that the beet sugar production in Europe has fallen by 4,200,000 tons since 1914, whereas the cane sugar production has risen by only 1,800,000 tons. The Food Controller has notified increases in the wholesale and retail prices of this commodity, and fixed the weekly ration at 8 oz. per person. The Sugar Commission has decided that the total amount of sugar to be imported in 1920 shall be at least 500,000 tons less than that imported during the present year.

Order Cancelled.—The Gas and Coal (Emergency) Order, 1919 (this J., 1919, 381 R).

We have received a letter from the Board of Trade (Department of Overseas Trade) calling attention to the fact that cases have recently occurred in which delegations of British industries and trades have visited foreign countries and various parts of the Empire without H.M. diplomatic or consular officers or H.M. Trade Commissioner having been previously notified. The object of the above-named Department is to bring commercial, diplomatic, consular, and kindred services into closer personal touch with British firms, and the Board therefore suggests the desirability of previous notification to this department of prospective visits, together with any other relevant information.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for November 6, 13 and 20.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 4, Queen's Anne's Gate Buildings,

London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department mentioned and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference number.
Australia.. ..	Chemicals, drugs	1024
,, ..	Copper sulphate (tenders for)..	32,747
British India ..	Glass, enamelware	984
Canada	China, pottery	987
,, ...	Paper	1030
,, (Newfoundland)..	Linseed oil	1031
,, ...	Quicksilver	*
,, ...	Terracotta, floor, wall and roofing tiles	*
,, ...	Drugs	†
,, ...	Chemicals, drugs, oils	†
,, ...	Whiting, iron oxides, lithopone	†
New Zealand ..	Hexagon cold rolled, bright mild steel (1-2 in. diam.)	1033
,, ,, ..	Glass bottles	1034
Malta	Soap, candles, glass, earthenware	1035
Straits Settlements	Chemicals, drugs, dyes, gums, oil-seeds and nuts, fertilisers, hides, skins	1038
South Africa ..	Pottery	992
,, ..	Tar or tar substitute (tender for)	553
Belgium	Metals, colours, varnish, chemicals, leather, hides, cork ..	1039
,, ..	Drugs, pharmaceuticals ..	1070
France	Fertilisers	999
,, ...	Chemicals, drugs, medicines ..	1045
,, ...	Skins, leather	1047
Italy	Paper, cardboard	1010
,, ...	Metals, chemicals	1735‡
,, ...	Perfumery, medicines ..	1737, 1802‡
,, ...	Minerals, chemicals	1740‡
,, ...	Metals, tinplate	1745‡
,, ...	Drugs, soap, chocolate ..	1746‡
,, ...	Drugs, chemicals, cocoa, sugar	1751‡
,, ...	Perfumery, motor oils and greases	1752, 1760‡
,, ...	Chemicals	1753, 1798‡
,, ...	Perfumery, soap, bottles ..	1755‡
,, ...	Soap, perfumery	1756‡
,, ...	Chemicals, dyes	1761, 1764 1778‡
,, ...	Dyes, chlorides, pharmaceuticals	1768‡
,, ...	Chemicals, metals, oil-seeds ..	1781‡
,, ...	Iron, steel, perfumery	1782‡
,, ...	Linseed, castor seed, cotton seed, cottonseed oil, coppersulphate, cocoa	1788‡
,, ...	Oil-seeds, copper sulphate ..	1791‡
,, ...	Oil-seeds, oils, oleo, stearin, chemicals	1793‡
,, ...	Metals, dyes	1797‡
,, ...	Metals	1799‡
,, ...	Steel, technical utensils ..	1800‡
,, ...	Perfumery	1802‡
,, ...	Leather, skins, greases ..	1803‡
Near East ..	Chemicals, oil, paint, colours, soap, pottery	1057
Netherlands East Indies ..	Glass bottles, gas mantles, paint, enamel, soap	1059
Spain	Chemicals, dyes, paint, varnish	1073
Sweden	Chemicals	1014, 1056
Brazil	Chemicals, paper, tinplate, galvanised sheets, cement ..	**
Chile	Zinc white (paste), galvanised and black sheets, cement, benzine, explosives	1021
Ecuador	Galvanised iron, tinplate, cement, glass, crockery ..	1079
Mexico	Perfumes	1080
Peru	Glass, china, crockery, paper, soap, dyes, perfumery ..	1081

* The High Commissioner for Canada, 19, Victoria Street, S.W. 1.
† The Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.
‡ The Secretary, British Chamber of Commerce for Italy, 7, Via Carlo Felice, Genoa.
** The Secretary, Statistical and Information Department, London Chamber of Commerce, 97, Cannon Street, E.C. 4.

MARKETS SOUGHT.—A firm in the Netherlands East Indies able to export sugar and copra desires to get into touch with U.K. importers. [1018.]

A Canadian Government Department has for disposal quantities of molybdenite and tungsten concentrates.†

A Canadian firm able to export asbestos millboard and asbestos manufactures desires to get into touch with U.K. importers.†

TARIFF. CUSTOMS. EXCISE.

Argentina.—Among the articles still on the list of prohibited exports are scrapped copper, brass, steel, aluminium, antimony, tin, zinc, lead, iron, tin-plate, galvanised iron; sugar.

Australia.—Import licences are now required for absolute alcohol, amyl alcohol, ether, ethyl acetate and chloride, cocoa and chocolate (potable), many metals and alloys, coal-tar oils, certain colours and paints, carbolic and cresylic acids, naphthalene, arsenates of lead, lime and soda, arsenites of soda and zinc, arsenic, arsenic sulphide, sodium sulphate, etc.

The prohibition of the import of soda, caustic soda, sodium sulphide, white lead and red lead has been revoked.

Certificates of origin are still required for all goods imported from Belgium.

Foreign dyes from stocks in the U.K. may be imported from the U.K. under certain conditions.

Austria.—Import licences are required for all goods, and licences will only be issued under certain conditions of price and payment.

The export of raw materials, food, and clothing is prohibited except under licence. The export of other goods is free, but the export of all goods is subject to conditions of payment.

Belgium.—Among the articles for which export licences are still required are bones, cement, dephosphorisation slag, certain kinds of hides, oil-seeds, metal waste, steel, sulphate of ammonia and superphosphates.

Belgium has given notice to withdraw from the International Sugar Convention as from Sept. 1, 1920.

Bulgaria.—Among the articles which may now be imported without previous permission are soap powders, soda, bicarbonate of soda, caustic soda, mineral oils and yeast. The full list may be seen at the offices of the Department.

Chile.—It is proposed to increase the customs duty on certain metals, cement, glass, pottery, zinc white, lithopone, paper and certain chemicals.

Czecho-Slovakia.—Among the articles for which a general import licence will be granted are many metals and their salts, certain chemicals, aniline dyes, some minerals, asphalt, benzol, celluloid, copal, fertilisers (except superphosphates), vegetable fibres, grease, hides, optical glass, certain vegetable oils, mineral oils, resin, rubber, shellac, starch, tanner's bark, waxes and wood.

Among the articles urgently needed are acetone, barium peroxide, citric acid, dyewood extracts, essential oils, paraffin, resin, tanning extracts, tartaric acid, turpentine, carnauba wax, iron sheets, leather, drugs, ferro-manganese, edible and lubricating oils.

East African Protectorate.—The prohibition of the import of sisal hemp, waste and tow has been revoked as from Sept. 3.

Egypt.—The revised regulations respecting the export of goods to all destinations are set out in the issue of Nov. 13. Among the articles for which export licences are still required are alcohol, benzine, biscuits, cattle foods, cocaine, morphine, opium, extracts of hemp, coconuts, dyes, edible fats, gold, groundnuts, kerosene, chemical manures, margarine, molasses, nuts and oils of all kinds, silver, soap, starch, sugar, and wood.

France.—Recent customs decisions affect cellophan, ferro-zirconium, silico-zirconium and hardened casein.

For the present only, rum and tafia from cane grown in French Colonies may be imported into France.

A full statement appears in the *Bd. of Trade J.* for Nov. 6 of the proposed revision of customs duties on chemical products.

French Colonies (other than Tunis and Morocco).—The list of prohibited exports is the same as that for France, except that the export of beetroots from the French Colonies is permitted.

Gold Coast.—The export duty on cocoa has been increased to one halfpenny per pound.

Greece.—The import of copper sulphate and sulphur is prohibited until Oct. 3, 1920.

Italy.—White paper in rolls for newspapers may be imported free from customs duty until Dec. 31.

In order to secure the "conventional" (lower) rates of customs duty, goods of U.K. origin must be accompanied by certificates of origin.

Japan.—As from Nov. 1, the customs duty on benzyl alcohol is fixed at 20 per cent. *ad valorem*.

Morocco (French Zone).—The import of all German goods is prohibited for the present.

Netherlands.—The prohibition of the export of raw kapok and all spirits other than those suitable for immediate human consumption has been temporarily raised.

New Zealand.—The import of saccharin is prohibited unless manufactured in some part of the British Dominions.

Paraguay.—The export duty on quebracho extract has been increased to 8 dollars (gold) per metric ton as from Sept. 20.

Sierra Leone.—The revised rates of export duty on palm kernels, palm oil and kola nuts comes into force on Jan. 1, 1920.

South Africa.—The export of sugar is prohibited except under permits granted only to the Natal Sugar Association.

The export of gold coin, gold bullion and gold ornaments is prohibited except under permit.

Spain.—The import duty on sugar up to 40,000 metric tons is fixed, for the next ten months, at 35 pesetas per 100 kilo.

Straits Settlements.—The import of dyes not manufactured in the British Empire is prohibited unless a licence has first been obtained from the Governor.

Sweden.—Export prohibitions have been removed from, *inter alia*, cork, vegetable fibre, resinous oils, lead ashes and tanning extracts.

COMPANY NEWS.

NITROGEN PRODUCTS AND CARBIDE CO., LTD.

The fifth annual meeting was held in London, on November 11, at Winchester House, E.C. Major C. H. Campbell, who presided, said that the profit for the 18 months under review was £118,814, from which a dividend of 9 per cent. had been paid, £10,000 placed to reserve, and £14,396 carried forward. A claim against the German Government in respect of the occupation of the works at Vilvorde had been lodged with the Foreign Claims Office, and this, together with other claims due to the affiliated Nitrogen Fertilisers, Ltd., amounted to over £270,000. The considerable loss on the works at Dagenham was due to the necessity, imposed by war conditions, of using gas liquor instead of cyanamide as a source of ammonia. The company's plant was designed for the latter process and could not be operated for the former without loss. The Government authorities were very unsympathetic. The company's process was adopted by the French Government, which voted about £15,000,000 for general development purposes, and in September, 1915, started the construction of a large factory at Angoulême, utilising the designs and technical assistance of the company. According to reliable information, the use of the Haber process is not likely to extend far beyond the district in Germany where it has been developed. It is very intricate, very expensive, and is dependent upon coal fuel.

During the period under review an offer was accepted from the Alby Carbidfabriks, Sweden, to buy up all the shares in it held by Nitrogen Fertilisers, Ltd., at a price which gave the latter a profit of over £315,000. The value of the company's properties in Norway was very great, and particularly the Aura Water Power concession, which is capable of giving 250,000 h.-p. per annum. The development of the property is now to be accelerated. The Toke water rights have been sold to the Norwegian Government at a good profit. There is a great future for Norwegian water-power in the electric smelting of iron ore, the manufacture of cyanides etc. In this country the directors had continued their extensive trials to ascertain the most economical means of producing power from coal, and realising that successful carbonising must be carried out at the pithead, they have purchased the St. Helen's Colliery and brickworks at Workington, Cumberland, together with a battery of 40 coke ovens with by-product recovery.

The production of "nitrolin" had to be diverted to the manufacture of explosives in 1916, but by that time its popularity had become well established; there was a great future for such artificial fertilisers once their value had been fully appreciated.

Subsequent to the meeting an extraordinary general meeting was held at which resolutions were passed sanctioning the winding-up of the company and its amalgamation with Alby United Carbide Factories, Ltd.

ALBY UNITED CARBIDE FACTORIES, LTD.

The twelfth annual general meeting of this company was held in London on November 11, Major C. H. Campbell presiding.

The chairman stated that the net profit for the 18 months ended December 31, 1918 (after writing off £34,000 for depreciation) was £25,595; after paying the interest on the preference shares and 6 per cent. on the ordinary shares, £6837 was left to be carried forward. The company has received dividends from the North-Western Cyanamide Co., Ltd., the A/S Meraker, which produces ferro-alloys, and the Nitrogen Products and Carbide Co., Ltd.

Very unsatisfactory treatment had been meted out to the company by the Government authorities during the war. Losses had been incurred owing to the enormous rates of freight on the carriage of coal to Norway; and the Government paid very much lower prices for the carbide than were obtainable from other consumers, and then made large profits by reselling to munition factories. An offer by Norwegian financiers to purchase the whole of the Norwegian assets was declined on the instigation of the Foreign Office, and the company was compelled to accept contracts which showed little or no profit. The Coal Controller enforced the payment of the same prices for coal which were charged to neutrals, with the result that the coal purchased cost more than double the price paid by other British and by Allied firms. Prices of materials and labour and of hydro-electric power in Norway are now 150 per cent. above pre-war prices, which means a very heavy expenditure on constructional work. Excellent progress has been made at the electrode works at Hebburn-on-Tyne, and the quality of the electrodes supplied has been very

greatly improved. The company will continue the policy of running its own steamers; the patent rights held by it are considered to be very valuable; and a financial interest has been taken in several undertakings producing compressed acetylene. The future appears to be secured, trade is improving and the demand for calcium carbide has exceeded expectations.

The resolutions embodying the proposals to amalgamate with the Nitrogen Products and Carbide Co. were passed at the extraordinary general meeting which followed. The capital of the company will, accordingly, be increased to £2,332,916 by the creation of 1,607,916 new ordinary shares of £1 each, ranking *pari passu* with the old; of these new shares 1,499,965 will be allocated to shareholders in the Nitrogen Products company, and 80,261 to shareholders in the Alby United company, leaving 27,690 unissued.

REPORT.

REPORT OF THE CONSULTING CHEMIST TO THE ROYAL AGRICULTURAL SOCIETY, 1918. *Journ. Roy. Agric. Soc., Vol.* 79. (*London: John Murray.*)

In discussing the great difficulties which the farming community has experienced during 1918, attention is drawn to the passage of various Orders controlling the prices of fertilisers and feeding-stuffs. These Orders would have been of greater advantage had they been made applicable to *all* classes of these commodities, but, as matters stood, while the price and quality of certain articles were controlled, a large number of almost worthless materials were sold as food for stock without any control whatever. Of 64 samples of compound feeding meals examined in 1918, over one half were being sold at prices considerably beyond their value. In other words, the Orders tended to encourage the sale, at exorbitant rates, of mixtures frequently composed of waste materials that had escaped being "controlled."

In several samples of feeding materials undesirable and even injurious materials were found. Thus, castor oil bean was found in some compound feeds, mustard seed in rape cake, and salt in excessive amount in foods for pigs and poultry. Cases of loss of and injury to stock arising from these causes are recorded.

The conditions in respect to fertilisers were more satisfactory, a system of control of prices with quality being instituted, and in this connexion it may be noted that the sale of basic slag according to "solubility in citric acid" was practically abolished. Attention is drawn to the dangers likely to result from the continuous application to the land of acid and forcing manures such as superphosphate and sulphate of ammonia, but it is indicated that there need be little fear of these injurious effects if the regular practice of liming or chalking the soil were re-introduced.

In a more detailed account of samples received for examination during the year, attention is drawn to the following points of interest. Several samples of rice products were of very poor feeding quality, one containing 28·76% of woody fibre and 16·46% of silica, whilst a second contained 23·71% of woody fibre and 10·5% of silica.

A sample of fish meal, containing a large amount of salt, was harmful to pigs, and, in another instance, a "pig meal," which had 7·29% of salt, caused the death of five out of eight young ducks to which it was fed.

Two samples of dried milk, damaged and unfit for human consumption, on analysis showed respectively, fat 24·70%, casein 24·63%, milk, sugar, etc., 40·18%; and fat 19·36%, casein 26·31%, milk sugar, etc., 41·27%. These would have made a very useful food for pigs.

A sample of Carrageen Moss (seaweed), collected in Co. Donegal, and said to be used locally for human food, had oil 0·20%, protein 13·56%, carbohydrates, etc., 68·99% woody fibre 2·59%, mineral matter 14·66%, reckoned on the moisture-free material. It was very clean, contained only 0·06% of sand and 0·20% of salt, and undoubtedly possessed high feeding properties.

The results of analyses of flue dusts recorded show the variable nature of this material, according to the source. The samples were, as a rule, alkaline in reaction, but were seldom found to contain constituents injurious to crops.

A sample of tannery refuse was found to contain 41·92% of lime, and as it could be carted away free, should have proved useful on land in need of lime, despite the difficulty of applying it owing to its wet condition.

Attention is drawn to the fact that some agricultural limes are being sold which are not derived from carboniferous limestone or chalk, but are largely magnesian in character, and thus of doubtful suitability for agricultural purposes.

TRADE NOTES.

FOREIGN.

Foreign Chemical Trade of Brazil.—The subjoined table shows the quantities of some of the more important chemical products imported from the countries named during the years 1913 and 1916. There are no figures available giving the present consumption of caustic soda, carbonate of soda, and bicarbonate of soda, but, in view of the large number of cotton mills in Brazil, the consumption of the first two of these must be very great. These products were formerly imported from Great Britain, but have been supplied by the United States during the war. The Brazilian Government is encouraging the establishment of caustic soda factories, and one is now in course of erection at Santos. Washing soda is manufactured from soda ash by two local firms—Messrs. Holland & Co., Rio

IMPORTS INTO BRAZIL (TONS).

Country of origin.	Chloride of lime.		Caustic soda.		Fine chemicals.		Potash carbonate.		Acetic acid.		Sulphuric acid.		Acids not specified.	
	1913.	1916.	1913.	1916.	1913.	1916.	1913.	1916.	1913.	1916.	1913.	1916.	1913.	1916.
Germany ..	257	—	115	—	6,823	3	143	—	128	—	470	—	139	—
Belgium ..	3	—	14	—	124	5	1	—	3	2	31	—	2	—
United States ..	7	470	66	7,267	424	4,903	16	685	1	146	1	126	5	56
France	4	—	2	—	1,786	1,613	6	2	—	—	10	—	140	17
Great Britain ..	740	517	7,263	2,948	5,648	5,162	6,864	4,142	97	78	121	11	99	36
Italy	—	—	—	—	372	155	10	—	—	—	—	—	17	18
Holland.. ..	—	—	—	—	71	3	—	—	72	16	151	—	9	1
Portugal ..	—	—	—	—	276	582	—	—	—	—	—	—	—	—
Total imports ..	1,013	993	7,581	10,327	15,936	12,756	7,078	4,838	315	247	800	155	417	145

de Janeiro, and L. Queiroz, Sao Paulo—the former of which is reported to have sold its interests to an American citizen. The principal manufacturers of fine chemicals are the above-named firm of L. Queiroz and Messrs. Granado and Co., of Rio de Janeiro, and the first of these also makes sodium sulphide, which is used as a depilatory in nearly all the tanning factories.

The Chemical Market in France.—Potash salts are fetching higher prices, especially the carbonate. It is remarkable that glass manufacturers should still prefer to use the high-priced carbonate of potash, derived from beet molasses, when a supply of the much cheaper chloride is available from Alsace.

The prices of sodium salts are also rising; ferrocyanide and ferricyanide are quoted at 1500 francs per 100 kilo.

The prices of vegetable oils are expected to fall within a short time owing to the successful harvest. The demand for soaps is strong, and prices are steady.

Stocks of rubber are diminishing on account of the heavy demand of the Central Powers.

The production of phosphatic manures is far behind the demand. The success attending the prospecting of phosphate beds in Egypt—which compare favourably with those in Algeria and Tunis—is not affecting the market, because the actual and prospective shortage precludes all fear of keen competition.

The Bohemian Glass Industry.—During the existence of the monarchy about 80—90 per cent. of the Bohemian glass production was sold at home and only 19—20 per cent. was exported, but now the home requirements are at most only about 20 per cent. of the output. A development of the export trade is therefore necessary to the industry, and, provided the present restrictions are removed, it is likely to occur, for the whole world is in need of window glass.—(*Z. angew. Chem., Oct.* 3, 1919.)

Olive Oil Situation in Italy.—Last year's olive oil production in Italy, although exceeding the past ten years' average, did not provide for the annual consumption, which is estimated at 1,500,000 quintals. The most favourable estimate for next year's production is 1,300,000 quintals. The actual deficiency will, however, be higher than these figures indicate because redeemed territories must be supplied, and these are almost without edible oils and fats, and butter will be scarce. Consequently, olive oil must be imported and the external market prices must be paid. Two policies are open to the Government: (1) to sell imported oil at domestic fixed price, Government bearing the loss; (2) to raise price of domestic oil to that of imported oil.—(*U.S. Com. Rep., Oct.* 16, 1919.)

Exports of Bismuth, Mica and Asbestos from Hongkong.—Bismuth, a by-product of the wolframite mined in South China, is being shipped in the form of oxide from Hongkong in increasing quantities. It is obtained by coolies or farm people from surface outcrops or pockets, and collected and disposed of by Chinese brokers to foreign brokers or exporters. The present production of this ore is from six to ten tons per month, rather more than 10 per cent. of the world's supply. Most of the wolframite and all the bismuth exported from Hongkong is collected by coolies by very primitive means. Shipments of bismuth this year to beginning of August were worth about £20,500; 60 per cent. went to Great Britain and the rest to the United States.

Export of mica and asbestos from Hongkong is commencing. Hitherto the quality of these minerals has been doubtful; asbestos of excellent quality is, however, now being worked by a Chinese syndicate for the American market. Some mica deposits are being worked similarly.—(*U.S. Com. Rep., Oct.* 18, 1919.)

Rapprochement between the Metal and Chemical Industries in Germany.—With the object of rendering more intimate the business relationships between the three firms, two directors of the Badische Anilin- und Soda Fabrik have been elected to the board of the Metallbank und Metallurgische Gesellschaft of Frankfurt, and one of these (Dr. K. Bosch) has also been elected to the board of the Deutsche Gold- und Silber-Scheideanstalt (which has just declared a dividend of 20 per cent.). No fusion of capital of the three companies is involved.—(*Z. angew. Chem., Sept.* 5, 1919.)

Use of Liquid Air for Mining in Sweden.—An explosives company is erecting seven factories in Sweden for the production of liquid air, in the first place at Kiruna, Malmberget, Grängesberg, Gyttorp and Hagge, whence the various mines will be supplied. Since the necessary machinery could not be obtained in Sweden at moderate prices it was ordered from Germany. The total outlay will be about 1·5 million kroner.—(*Z. angew. Chem., Sept.* 19, 1919.)

Production of Wolfram in Peru.—The activity of wolfram mining in Peru fluctuates with the prevailing prices in Liverpool and New York. It is conducted in a very primitive manner by the Indians, chiefly in the districts of Conchucos and Corongo. The concentrates (58—60 per cent.) are transported over the mountains on the backs of llamas and burros to the railways connecting with the ports of Salaverri and Chimbote. The cost of mining and delivery on the coast is considered to be very low.

EXPORTS OF TUNGSTEN ORE CONCENTRATES FROM PERU, 1913-1917.

	Metric tons.	Value. £	Destination %.
1913 ..	290 ..	19,460 ..	Germany 52; U.S.A. 41; France 2·7; U.K. 4·5.
1914 ..	196 ..	20,400 ..	Germany 62·5; U.S.A. 4·6; France 0·9; U.K. 13·3; Italy 19.
1915 ..	333 ..	52,000 ..	U.S.A. 85; France 2·3; U.K. 12·6.
1916 ..	524 ..	226,850 ..	U.S.A. 98·7
1917 ..	417 ..	101 045 ..	U.S.A. 100.

—(*U.S. Com. Rep., Sept.* 22, 1919.)

OBITUARY.

DR. H. C. GREENWOOD.

We record with deep regret the death, from blood poisoning, of Harold Cecil Greenwood, at Winnington Hall, Northwich, Cheshire, on November 4, at the early age of thirty-two. Dr. Greenwood was a Mercer Scholar of Manchester University, where he graduated as B.Sc., with first-class honours in chemistry, in 1907, subsequently obtaining the degrees of M.Sc. and D.Sc., an 1851 Exhibition Scholarship, and a Beyer Fellowship. He worked for a time with Prof. Haber, at Karlsruhe, on the synthetic production of ammonia and published a joint paper with him on this subject. His work in this country included investigations on ferro-alloys, very important determinations of the boiling points of metals, the specific and latent heats of aluminium and zinc (at the National Physical Laboratory), and from 1916 until quite recently he did excellent service with the Munitions Inventions Department of the Ministry of Munitions on the synthesis of ammonia, his researches on this subject leading to distinct improvements in the process. Dr. Greenwood, whose early death is much to be deplored, was a member of the Committee of the Chemical Engineering Group of this Society, and a paper by him and Mr. A. T. S. Zealley on an apparatus for estimating oxygen in combustible gases and of combustible gases in air appeared in the April 15 issue of this Journal.

REVIEW.

CATALYSIS IN THEORY AND PRACTICE. *By* E. K. RIDEAL *and* H. S. TAYLOR. *Pp. xv.* + 496. (*London: Macmillan and Co., Ltd.*, 1919.) *Price* 17*s. net.*

In this volume, which is excellently printed on good paper, well illustrated, and provided with two indexes, the authors have made a valuable contribution to English chemical literature. Although the unnecessarily dogmatic statement in the preface, that a chapter in Mellor's *Chemical Statics and Dynamics* "has formed, hitherto, the sole treatment in English of the theoretical aspects of the subject," does less than justice to Mr. Jobling's interesting and useful little monograph, it must be recognised that there has been, hitherto, a distinct need for a more comprehensive treatise on the important subject of catalysis.

The subject-matter and scope of the book under review may be appreciated from the following list of its contents: History and Theoretical (61 pp.); Measurement of Reaction Velocity (13 pp.); Oxidation Processes (13 pp.); Hydrogen and Hydrogenation (81 pp.); Dehydrogenation (51 pp.); Fixation of Nitrogen (23 pp.); Hydration and Hydrolysis (18 pp.); Dehydration (35 pp.); Applications to Organic Chemistry (30 pp.); Ferments and Enzymes (33 pp.); Catalysis in Electrochemistry (47 pp.); Catalysis by Radiant Energy (17 pp.); Catalysis in Analytical Chemistry (27 pp.).

Apart from the use of a few unnecessary Americanisms, such as "viewpoint" for "point of view," and "a plot" for "a graph," and one or two clumsy sentences (such as that at the bottom of p. 362), the style of the book is clear and fluent. Many portions of the subject-matter, however, give the impression that the writing and proof-reading have been somewhat hastily done, and the unusually large number of mis-spelt names (*e.g.*, "Thenard" for "Thénard," "Ripple" for "Ripley," "Paen de St. Gilles (or Giles)" for "Péan de St. Gilles," "Buchbock" for "Buchböck," "De Hahn" for "Hahn," "Tessie du Motay" for "Tessié du Motay," "Carenwinder," for "Corenwinder," Brodie" for "Brode," "Payer" for "Payen," and "Messell" for "Messel") seems to indicate either careless proof-reading, or a neglect to go back to the original sources, which is hard to excuse in a book of this kind. One rightly requires of the authors of monographs a thorough acquaintance with the original sources.

Some of the descriptions of technical processes (*e.g.*, of the Chamber Process, p. 77) are not entirely accurate. The section on Tautomerism does not represent the latest stage in the progress of the subject, as the important work of Kurt Meyer is referred to only very briefly, and no mention is made of Lapworth's work on the bromination of acetone. In the section on the oxidation of ammonia, "silica" is mentioned as a catalyst poison when silicon hydride is meant; and the note as to recent work on the vexed question of the influence of sulphur, phosphorus (*sic*), and acetylene on the reaction does not lead the reader to suppose, what is actually the case, that the only information we possess at present is so conflicting as to be worthless. The reference to thermodynamics on p. 18 is not clear; as far as the reviewer understands it, the statement is inaccurate. The allusion to "foxy batches" in the Weldon process as "red solutions" should be to "red precipitates," and it is surely incorrect to speak of spent-oxide as "an artificial sulphide." These are typical of numerous minor inaccuracies which might well have been avoided.

The authors evidently (pp. 19 and 28) take Ostwald's "whip and oil theory" seriously, although they appear to have misgivings as to the real value of the contributions of this writer to the theory of the subject. Ostwald's superficial analogies, and his misdirected criticism of honest attempts to find rational explanations of the causes of catalytic action (which, as the authors correctly emphasise, are probably different in different groups of reactions), have done a good deal to retard progress in this branch of the subject. The authors give a judicial and impartial account of the different theories which have guided workers in this field.

The section devoted to hydrogen is probably the best in the book, and contains a great deal of information, excellently arranged and critically treated. It is interesting to find that one Joseph Jacob, in 1861, "claims the commercial production of hydrogen by the action of steam on iron filings or borings": doubtless he had seen the experiment performed in some lecture before his "invention" took its final shape. Of the other sections, that on ester hydrolysis may be especially mentioned as a careful and accurate account of recent work, and other valuable and interesting discussions are those dealing with the purification of coal-gas, catalysis by radiant energy, the cracking of oils, and enzymes.

This monograph is one which no chemist, whether engaged in academic or industrial work, can afford to be without. The primary need of British chemical industry in the difficult years to come is information, and no one who has followed the recent triumphs of applied chemistry in our own and other countries will dispute for a moment the fundamental importance of catalytic processes in all branches of the science.

J. R. PARTINGTON.

PUBLICATIONS RECEIVED.

ALCOHOL: ITS PRODUCTION, PROPERTIES, CHEMISTRY, AND INDUSTRIAL APPLICATIONS. *By* C. SIMMONDS. *Pp.* viii.+574. (*London: Macmillan and Co., Ltd.*, 1919.) *Price* 21*s.*

REPORT ON THE STATISTICAL WORK OF THE FACTORIES BRANCH. (*Technical Information.*) *Ministry of Munitions, Department of Explosives Supply. Pp.* 202. (*H.M. Stationery Office.* 1919.) *Price* 4*s.* 6*d.*

PRACTICAL LEATHER CHEMISTRY. *A Handbook of Laboratory Notes and Methods for the use of Students and Works' Chemists. By* A. HARVEY. *Pp.* 207. (*London: Crosby, Lockwood and Son.* 1920.) *Price* 15*s.*

LA RÉORGANISATION DE L'INDUSTRIE CHIMIQUE EN FRANCE. *By* EUGÈNE GRANDMOUGIN *and* PAUL GRANDMOUGIN. *Pp.* 277. (*Paris: H. Dunod and E. Pinat.* 1918.) *Price Frs.* 12.50+20%.

THE INDUSTRIAL COUNCIL FOR THE BUILDING SOCIETY. *Published under the auspices of the* GARTON FOUNDATION. *Pp.* 153. (*London: Harrison and Sons.* 1919.) *Price* 1*s.*

TIN ORES. *By* G. M. DAVIES. *Monographs on Mineral Resources, with special reference to the British Empire. Imperial Institute. Pp.* 111. (*London: John Murray.* 1919.) *Price* 3*s.* 6*d.*

MANGANESE ORES. *By* A. H. CURTIS. *Monographs on Mineral Resources, with special reference to the British Empire. Imperial Institute. Pp.* 118. (*London: John Murray.* 1919.) *Price* 3*s.* 6*d.*

THE LIBRARY OF THE CHEMICAL SOCIETY.

Whilst the progress of chemical research and of chemical industries is essentially associated with laboratories and works, the provision of a comprehensive and accessible library forms an essential adjunct whereby the tools of activity may be sharpened and "costing" in respect to redundant labour efficiently reduced. In the larger works and laboratories the value of this provision has become increasingly recognised during recent years, especially in respect to current publications, but the majority of workers in chemical science has little opportunity of access to any chemical literature beyond that associated with a narrow field of vocational requirements, and many are not even favoured with this limited supply. Whatever the extent of such provision, a central library is a central need for all. The building up of a really comprehensive collection of books on even one subject is a work of many years, requiring a continuous policy of wise discrimination and careful direction. From this fundamental point of view the Council of the Chemical Society is to be sincerely congratulated on having taken advantage of that fuller association of science and industry which has been such a hopeful outcome of the war to bring its library within the membership of kindred societies and to extend it towards their more special requirements.

London has long lacked a representative and accessible library of chemical literature, and the action of the Council of the Chemical Society is a first and helpful step to fulfil this need. The conditions that initiated this action have been recently described by Mr. F. W. Clifford, the Librarian of the Chemical Society, in the August number of the *Library Association Record*, where an interesting account is given of the development of the scheme, and a fitting tribute paid to the work of Prof. J. M. Thomson who, as chairman of the Library Committee of the Chemical Society, has contributed very largely towards its realisation.

The following societies and associations have co-operated in the extension by giving financial support to the scheme, and their members now have full use of the library, both for loan and reference, under the conditions notified in this Journal (1919, 77 R):—The Association of British Chemical Manufacturers, Biochemical Society, Faraday Society, Institute of Chemistry, Society of Chemical Industry, Society of Dyers and Colorists, and the Society of Public Analysts and other Analytical Chemists.

To no members of any contributing society is this co-operation likely to be more welcome than to the members of the Society of Chemical Industry. The Council of the Society can rest assured that its contribution towards this development, despite the financial difficulties of the past years, is as fully justified as it is appreciated. Access to the excellent initial library of the Chemical Society, which contains some 23,000 volumes, is in itself an invaluable boon, to which the extension of its scope on the technical side and, to London members, the extension of the library hours form most welcome additions.

Whilst this successful co-operation exemplifies the economy with increased efficiency that can be effected by mutual effort, it is to be hoped that it will also serve as an active stimulus towards further development. The present accommodation available for the library is very inadequate and is lacking in accessories for congenial reading which could add much to its comfort and attractiveness. In addition there is much to be done for a full provision of patent literature and arrangements whereby the inquiries of members for information could be facilitated. The establishment of a Central Chemical House would undoubtedly be the best means of providing these desirable requirements, and there is no better basis of appeal for the carrying out of this long-cherished hope than the urgent need for a central library worthy of the country and of the great national services rendered by chemical science and chemical industry.

The time is opportune to give such aid to the tools of scientific progress and research. The claims of chemical science have never been so urgent as to-day; they have never more fully merited recognition. Surely amongst the 5400 members of this Society there are some who, by an initial gift, could provide the means for bringing this important development nearer realisation.

THE OUTLOOK FOR BRITISH CHEMICAL INDUSTRY.*

E. F. ARMSTRONG.

It is more than doubtful if the importance of the chemical industry has ever been properly appreciated in this country; at all events under war conditions its deficiences were glaringly exposed to the public eye. Although our industry "made good" in a manner unsurpassed by any other, and its achievements have recently been proclaimed by our professorial colleagues, there are lamentably few signs either that the public or Government Departments appreciate its problems or that they are prepared to help in their solution. This is in a large measure due to the diverse character of an industry in which outputs vary from thousands of tons to a few ounces.

Individuality, that marked and most valuable British characteristic, has led in the chemical industry, as elsewhere, to the formation of a number of separate and, generally, small firms, which trade with one another, and consequently incur large expenditure on transport and related charges. In Germany the development has been on other lines, and has resulted in the establishment, particularly on the banks of the Rhine, of huge factories in which all stages of manufacture are carried out. The German chemical industry may be said to be better balanced than our own, and this has been a prime factor in its success. The German dye industry in particular owes much to the co-ordination effected between the manufactures of heavy chemicals, intermediates, the dyestuffs themselves and the proprietary articles made from their by-products, within the boundaries of a single factory.

As is well known, the German firms have established a very far-reaching community of interests, known as the I.G. (Interessengemeinschaft), which involves a pooling of interests without sinking the individuality of the various firms concerned. Manufacturers of heavy chemicals, intermediates, dyes, and fine chemicals, and even suppliers of plant, were all involved in this pool so that the I.G. almost attained a position of domination in the chemical trade of the world before the war. The technical efficiency achieved by the combine resulted in such low production costs that the imposition of import duties to keep foreign competition out of the home markets was rendered unnecessary.

* Chairman's Address to the Liverpool Section, November 17, 1919.

The commercial methods employed by the I.G. have been criticised adversely, and public opinion to-day both here and in America is opposed to trusts. On the other hand, the potentialities of an enterprise, organised for immense output, and relying on a large and rapid turnover with a small percentage of profit, are such as to lead to the conclusion that organised mass production is a necessary and unavoidable future development.

The contrast between Great Britain, Germany, and the United States in the trade contest before the war has been admirably expressed recently in *Sperling's Journal*.

"Great Britain was represented by a multitude of small, rather old-fashioned, manufacturing units, each maintaining its own agencies of sale and distribution, not at all alive to science, stubbornly individualistic both in their products and in their attitude towards other British firms in the same industry with whom they were competing far more fiercely than with the Germans or the Americans, conscious that the smallness of their installation made for inefficiency and waste, but deterred from scrapping and rebuilding them on modern lines by the almost prohibitive cost, and, in the meantime, though with increasing difficulty, retaining a considerable share of the business in markets that British enterprise had been the first to exploit. Germany and the United States, on the other hand, tended more and more to be represented by huge plants, producing a limited variety of commodities in enormous quantities, employing a large body of highly-trained technologists, relying very greatly on specialisation and repetition work, arranging the amount and character of their output by agreement with other firms, disposing of their products through collective selling and distributing agencies; and by thus pooling their resources and organising each industry as a whole, they were enabled to command ample credit, and to marshal most formidable forces against whatever point they selected for attack."

There cannot be the least doubt as to which of these two opposing policies and conceptions is destined to prevail. If we are to have a British chemical industry in the fullest sense of the word, far more attention must be paid to the all-important question of the co-ordination of its branches.

Success in chemical industry depends on the following factors, which are not necessarily arranged in order of importance: Commercial management, technical management, chemists and research staff, engineers, labour.

It is maintained that in addition to ordinary commercial ability the board of a chemical company must include men with the highest technical qualifications. In no other industry do technical considerations play so large a part in the success of the undertaking, and it is essential that men with a full grip of the problems shall have the predominating word in the manner of their solution. The practice of the technical manager submitting a report to a non-technical board can only be detrimental to the firm, and it has often proved to be so in the past. German chemical industry owes much of its success to the fact that technical men of great and even outstanding ability have had the deciding voice in shaping its destinies; in this country it has been otherwise, and probably this is one of the most needed reforms if success is to be ours.

Technical management is a complex subject which appeals especially to the members of our Society, since most of us act in this capacity. The successful manager must be a modern Admirable Crichton, able to get the best alike out of his workpeople and his plant, with both a wide outlook and a grip of detail, and in full sympathy with the laboratory. Unfortunately, with but few exceptions, the positions which demand these qualifications do not command a remuneration sufficient to attract the best type of Englishman, namely the ex-public school boy of the class which has done so much in the administrative services of the Crown to make our Empire what it is. Unless something can be done to bring this type of man into industry, in the future we shall always be hampered in competition with America, which is singularly fortunate in being able to attract her best blood and brains into the works. This is not the place to discuss the vexed question of the training necessary either at school or the university, though it is one which even yet has not been sufficiently ventilated.

The position of the chemist in chemical industry is many-sided. He may be an analyst, a process controller, a research chemist, or be engaged in transfering operations from the experimental to the large scale. Whatever his duties and his previous training, his success depends on his ability to adapt himself to the mental atmosphere of the works. Success of the industry depends on the co-ordination of many factors; the chemist is but one link in the chain, and as such he must submit to discipline. Obviously, in a chemical works a scientific atmosphere should prevail at least as far as the exercise of scientific control, though it is to be feared that this has not always been the case in this country. Probably in no other industry is there such danger of an established process being suddenly put out of competition by a new invention. Necessarily, therefore, the research staff of a chemical works must always be on the alert for new methods, and the future of the establishment will largely depend on its success. It is obvious that only large undertakings can afford to keep a really large staff of research chemists, and this fact is probably one of the reasons for the supremacy of the great German firms.

In Germany, moreover, even in small firms, the man in charge is an academically trained chemist; in this country he is usually a business manager or engineer, the chemist, if any, being relegated to a subordinate position in the laboratory. In consequence, the smallest German works are technically highly efficient. This factor was rightly held to be of determining importance by the members of the Chemical Mission which recently visited Germany.

It is essential that the British chemical industry should employ a far larger number of the best type of chemist in the future, and that it should attract them by offering adequate prospects. The scientifically trained chemist must be given a far higher status. The popular idea that chemical industry is based on secrets is a fallacy, rather does it depend on direction from men of high practical scientific ability combined with business acumen. Personality on the board can overcome many difficulties in matters connected with site, plant and buildings, whereas even an ideal plant will not compensate for bad leadership. At the moment really qualified men are in short supply, but there is no fear that our universities will not be able to give the requisite training provided they receive adequate support from the industry.

The engineer is by no means an unimportant factor in chemical industry, for in addition to the ordinary problems of work, construction and maintenance, there are the special tasks of each section of the industry. Standard types of plant have been out of the question owing to the diversity of operations in the smaller works, and almost every piece of apparatus has to be specially designed. Unfortunately, but largely in consequence of these facts, makers of chemical plant are re-

latively few so that much of the plant has to be made in the works. In the future, standardisation of all types of vessel should be much more common, particularly as the influence of the engineer extends, and it should then be possible to get better delivery of standard vessels at a more reasonable cost. Opinions are divided as to whether success is better obtained by the co-operation of the chemist and the engineer proper, or by the aid of the so-called chemical engineer who professes knowledge of both crafts; but in any case it will be generally admitted that much more engineering is required in chemical industry at present, and that still more will be necessary in the future. The performance of reactions under pressure and at high temperature, the dealing with large volumes of gases, to say nothing of the more general problems of mechanical handling, all require specialised knowledge of Engineering. It behoves us, therefore, to see that the engineer as well as the chemist is trained for our needs.

At the present time Labour is perhaps the greatest problem in chemical, as indeed in all, industry, and its attitude constitutes the greaest menace to success. Its demands are largely political and governed neither by reason nor by economic facts. Higher wages, shorter hours, and less work, all tend to increase the cost of production to an extent which sooner or later must stop buying in our home markets, as it is already doing in our export markets, and the worker will, apparently, only accept economic facts when he sees ruin at his door. Unless production *per capita* is increased, higher wages can only mean higher prices. The labour problem presses unduly heavily on the chemical trade in which so many of the processes are continuous and the work arduous as compared with the light repetition work in some other national industries. Fortunately the handling of these problems is in experienced and capable hands. and our trade has long been one of the most progressive in its treatment of the workpeople.

It is probable that much good will result from the increased education of the worker provided this is undertaken by the industry itself. At pre sent the chemical process worker is classified as semi-skilled, a few months' training serving to fit the intelligent labourer to do what is required in almost any process. Probably, if pains were taken to give the worker a clear understanding of the general principles of the process, and this were followed by all-round experience in the plant, he would be in a position to earn higher wages, and the firm would benefit by continuity of output, a diminished repair bill and higher yields. There is a fundamental difference between the work performed by the chemical process worker and that done by men engaged on operations connected with machines and mass production, such as those in the engineering industries which have brought about specialisation on the one hand and monotonous repetition on the other. The chemical process worker's duties are considerably varied according to the vagaries of his process, and there is every scope for that intelligence which it is the duty of the industry to develop.

The coal problem is intimately bound up with the welfare of chemical industry, and we are undoubtedly wasteful in our use of this fuel. Apart from its scarcity, which, it is to be hoped, is only a passing phase, the steady deterioration in the quality of our coal is a serious handicap, the magnitude of which probably only the technical man can realise. Furnace work in particular is being adversely affected, and the disposal of the large amount of ashes helps to increase working costs.

The possession of a modern, thoroughly equipped plant is both the ideal of every process manager and the main factor in cheap production, though difficult to obtain without great expenditure of capital on account of the rapid invention of new processes in our industry. Unfortunately the very large chemical factories, such as those at Gretna, Queensferry, etc., which were built by the State, regardless of cost, during the war, are almost without exception situated far away from existing private factories and on sites which are considered to be entirely unsuitable for industrial operations. As a consequence they are of no value during the reconstruction period, whereas had they been constructed as additions to some of the existing chemical works, the industry would have benefited enormously, and the State would have recovered its capital outlay. We shall bitterly regret the policy which has brought about this state of things during the next few years, the more so since it has now been established that the reverse policy has been followed by our chief rivals. The war plants constructed in the Rhine district are no hastily erected structures of a temporary nature, but solidly built and perfectly designed additions to established works, a circumstance which places them in a unique position as regards manufacturing potentialities.

No one would question for a moment the great and successful work done by those entrusted with the task of supplying explosives or the urgency of their task, or indeed, the wisdom of carrying out some of their manufactures in these places, but a somewhat more helpful policy towards the chemical manufacturer would have put our industry on a very much stronger basis.

The position of chemical industry in its relation to peace and war has formed the subject of many recent addresses, but it is desirable once more to emphasise that peace-time factories must be so equipped that they can be at once adapted for the production of warlike materials; plant, trained chemists and workpeople must all be available and ready for mobilisation, and never again have to be improvised after the declaration of war.

A problem second only to that of labour in its importance is that of the transportation both of corrosive chemicals and of bulky materials which will not bear high charges. The war has left British transport in a state of chaos, which constitutes to-day probably the greatest impediment to the restoration of trade; in addition a serious increase in charges is now threatened. Manufacturers must combine through their trade association to assure equitable and intelligent treatment of the specially rated chemicals by the carriers, and must avoid unnecessary carriage on materials in course of manufacture. The State must see that nothing is left undone to render our railways efficient.

It was perhaps typical of British individuality that before the war there was no successful trade organisation of chemical firms. Fortunately this has now been rectified, and the formation of the Association of British Chemical Manufacturers is undoubtedly the most important step the trade has taken of recent years. The process of organisation and consolidation of such an association is necessarily slow, but the A.B.C.M. has already done excellent work in a variety of directions, and occupies an influential position in relation to the Government. In addition to investigating the varied commercial problems which confront the trade, it may be expected in the near future to take a prominent part in the study of some of the more technical problems outlined in this address; it undoubtedly deserves the active support of every chemical manufacturer.

In the foregoing an attempt has been made to indicate some of the essential conditions of success in the chemical industry, which, it must be emphasised, is a technical industry. That this

country is capable of winning success there can be no doubt, and the achievements of many branches of the industry seem to endorse this belief. On the other hand there are many lessons to be learned, and it is to be feared that some of these have been overlooked in the recent period of too facile progress when our own markets were closed to outsiders, and we had only to fear American competition, then in its infancy, in the markets overseas.

The outlook is perhaps best described as full of promise, but it needs the wholehearted and intelligent co-operation of all engaged in it if British chemical industry is to occupy the proud place we claim for it. Above all, we must seek the goal made strong by technical excellence rather than by political protection.

THE THEORY OF THE FLOTATION METHODS OF MINERAL SEPARATION.

R. S. WILLOWS.

A paper with the above title was read at the Institute of Mining and Metallurgy on November 26 by Mr. H. L. Sulman, who is to be congratulated on its far-reaching interest and importance. It will probably come as a surprise to many "practical" men to find that the forces at work in a soap bubble are of such technical importance that 60,000,000 tons of ore is now treated annually by the processes described by the author; and as to physicists, the present writer cannot say that he knows more than two who are aware that their science has such useful technical applications. At all events, the paper should forward the education of both practician and theorist, and to that end it is to be hoped that the author will bring his unpublished physical results before one of the societies concerned with physics.

The method of separating sulphide ores from quartz, as practised by Minerals Separation Ltd., consists, briefly, in crushing the material to a fine powder, mixing one ton of this with 4—5 tons of water containing from 0·5—2 lb. of amyl alcohol, cresol, or other suitable liquid which renders the water capable of frothing, and finally blowing air through the mass. The ore is then found to be concentrated in the froth, while the finely-divided quartz remains either suspended in the liquid or sinks to the bottom of the tank. The remainder of the details is not essential to a consideration of the theoretical points involved.

The method is analysed by the author into the three following essentials:—(*a*) A "froth producer," such as amyl alcohol or cresol, which, by reducing the surface-tension of the water, permits the formation of an extensive froth in which the particles become attached. (*b*) A "froth stabiliser," usually a minute amount of an insoluble oil, which being adsorbed at the surface of the mineral, renders the froth more stable, in a manner to be described. (*c*) A "gangue modifier" (mineral acid, alkali, salts, or sols), which renders the gangue particles more easily wetted by water and so prevents their rise into the froth.

The function of the froth producer is, of course, clear. The production of a large froth surface entails the creation of correspondingly large amounts of surface energy. The larger this energy is per unit area, the more unstable the froth becomes, according to the principle that every system will change, if given the opportunity, in such a way as to reduce its potential energy. Thus water containing cresol, having less surface energy than the pure liquid, produces a lasting froth more readily. But the cresol has a further important effect. A film of pure liquid, when thinned by drainage or stretching, soon breaks, because the surface tension cannot accommodate itself to the stresses which vary from point to point. The cresol, since it lowers the surface tension of water, concentrates itself to some extent where it can do this most effectively, *i.e.*, in the surface, in accordance with the principle just noted. When the film is stretched, at first more cresol passes from the interior into the new surface, but the limit of this passage being reached, any further stretching produces a surface containing less of the impurity and having a greater tension; hence further extension is resisted. By this means the area of the film can undergo considerable variations without rupturing. From this point of view, the designation "froth-producer" is not the best, as the most important function of the cresol is to act as a "froth stabiliser."

Retaining the author's nomenclature, the action of the "froth stabiliser" is most interesting physically, and the work on angles of contact deserves the serious consideration of physicists. With soap, tannic acid, etc., it is possible to get a large reduction of surface energy and much froth, which is nevertheless barren of ore. What is needed is a substance which yields a stable film, but does not reduce the surface energy to such an extent as to displace the mineral from the film. A partially soluble liquid like cresol may act both as "froth producer" and "froth stabiliser" (author's nomenclature). Its effect in the latter capacity appears to be to give a wide range of angle of contact of ore-liquid, which is found necessary for flotation. A number of measurements given in the paper shows this effect, and demonstrates also that when a plane surface of the mineral is turned in the surface the angle of contact does not immediately follow the change; there is, in fact, hysteresis. From its mode of action, "contact modifier" appears to be a better term for the added substance than that of "film stabiliser" used by the author.

The next step in the process is to ensure that the gangue is not floated. This is the function of the "gangue modifier," which causes the unwanted particles to be thoroughly wetted and so prevents their entrance into the froth.

The paper reminds one of Pickering's experiments on emulsifying a petroleum oil in water with the help of a solid emulsifier like soot. Also of Clowes' work on oil-water emulsions, in which the disperse phase can be made oil or water at will by the addition of caustic soda or calcium chloride, respectively.

Most physicists and colloid chemists will be inclined to question much of the author's theory, but a just criticism is not possible at this stage, as some of the evidence on which his conclusions are based is not included in the paper. Thus, unlike the text-books, he is clear that zero angle of contact does not necessarily mean complete wetting—complete wetting only occurring when the interfacial energy is zero—but he too readily assumes, or takes as proved, that complete wetting has taken place in the examples he deals with. In this connexion, it may be asked, Does water at 0° C., or just above that temperature, wet ice completely? And how can it be proved? It is known that electro-endosmose occurs with water in an ice tube. Is not this proof that there is energy residing at the ice-water interface which is to be called surface energy? Hence, contrary to the author's opinion, a sol has surface energy.

The author's view that wetting is frequently followed by penetration of the liquid into the solid is well supported by McBain and his co-workers and by Marc, who find that adsorption is followed by solid solution.

It is suggested that a solid in sol form is completely wetted, that, in fact, this is a condition of peptisation, neglecting electrical and valency effects altogether. It must be admitted that the theory of these is very far from complete, yet it is difficult to explain Bredig's method of sol formation—by means of an arc or spark—on such a theory as the author's. Smoluchowski's theory of precipitation, which has received very definite experimental support, and the work of Langmuir and Harkins on liquid films will also have to be taken into account. In addition, questions such as the following will require an answer: If neither of two oppositely charged sols possesses surface energy, how it it that they precipitate each other when suitably mixed? The coagulation must cause an energy decrease. Where is this located?

Work of Edser is mentioned which is said to prove that air is not adsorbed on certain solids, of which quartz is one. Langmuir finds a small but definite adsorption for mica and glass, which increases as the pressure is raised from a fraction of a mm. of mercury.

Space prevents further detailed examination, but sufficient has been said to show that the paper is well worthy of perusal, alike by the mining metallurgist and the pure physicist.

MUSTARD GAS MANUFACTURE.

J. WILLIAMS.

The recent controversy between Sir William Pope and Messrs. Levinstein on the question of "mustard gas" manufacture stands in need of elucidation, as it leaves the impression that the former was entirely responsible for the research work and the latter for its manufacture.

The history of mustard gas up to May, 1918, appears to be shrouded in mystery, as little was known of what was being done towards its production on a scale that would be of value to the Higher Command in France. The writer can, however, detail its history from May, 1918, when its manufacture was taken over by the Department of Explosives Supply.

On that date H.M. Factory, Avonmouth, was asked to take up the manufacture of the gas. No reliable information was given except that it could be produced from ethylene and sulphur chloride. An experimental plant consisting of various types of ethylene generators and reaction vessels was erected in the short period of six weeks and was in commission from June 15 to July 16. Although this plant only produced twelve tons of gas, and this of variable quality, it had served its purpose in that it supplied valuable information and experience required for running a large scale plant. On the information gained, three sulphonators which were on the site were quickly converted into reaction vessels, by means of which over 100 tons of gas was produced during the 27 days they were in action.

Meanwhile, the construction of the permanent plant was proceeding apace, and on September 12 it was put into operation. The total output from this up to the time of the armistice was 500 tons, and plant was being put into operation on that day to produce 40 tons per day, while two weeks later the output would have been 70 tons per day. Actual production figures are recorded at the D.E.S. and the plant now at Avonmouth is convincing proof of the estimated output.

I must admit that the chief obstacle to increased output at Avonmouth was sulphur deposition, but at the same time I should like to point out that low temperature alone is not sufficient to prevent the separation of sulphur, as Messrs. Levinstein discovered when they attempted large-scale manufacture. There are other critical factors, such as degree of agitation and ethylene supply, for it is essential that the reaction between the ethylene and sulphur monochloride be completed in the minimum of time.

On a small scale plant producing only about a ton a day such as Messrs. Levinstein had at Blackley, the conditions are quite favourable for the retention of the sulphur. At Avonmouth the staff concentrated its attention on maximum output throughout the production period. Elimination of sulphur deposition, however, was not overlooked, and measures were about to be introduced which would have overcome this trouble decisively.

NEWS FROM THE SECTIONS.

EDINBURGH.

At the meeting held on November 18 at Edinburgh, Dr. D. S. Jerdan presiding, Mr. F. S. Merrils read a paper on "The Measurement of High Temperatures." In dealing with this subject only instruments used industrially were described. The principles underlying the use of thermo-electric pyrometers were discussed and slides of diagrams and instruments were shown to illustrate their working. Photographs of two installations at Messrs. Brunton's Research Laboratory with their complicated wiring were shown, illustrating how any number of thermo-couples can be taken to a central indicator and the temperature recorded on a chart by means of a clockwork mechanism. A short account of the relation between radiant energy and temperature was given as an introduction to the subject of radiation pyrometers. These instruments are of especial value in the reading of very high temperatures such as obtain in the electric arc. The general principles of optical pyrometers were then explained, and an instrument was exhibited.

NEWCASTLE.

The Newcastle Section held its last meeting on November 19 in Armstrong College. Prof. P. P. Bedson was in the chair.

The Section unanimously and heartily passed a resolution inviting the Council to hold the annual meeting for 1920 in Newcastle. (The invitation has since been accepted.)

Mr. S. H. Collins then read a paper on behalf of the author, Mr. N. N. Sengupta, on "A Study of the Fruit of *Schleichera Trijuga*, with special reference to the Generation of Hydrocyanic Acid in the Seed." The paper, which proved to be a valuable contribution to our knowledge of this little known subject, was divided into three parts:—(1) A general survey of the constituents of the various parts of the fruit from the standpoint of nutrition; (2) a study of the cyanogenesis in the seed; and (3) examination of the fat. From a utilitarian point of view, probably the most important aspect dealt with was the suggested methods whereby the potentially dangerous press cake could be rendered harmless and innocuous for cattle feeding purposes. Provided that this could be done with certainty, the press cake should prove a very valuable feeding stuff on account of the high percentage of albuminoids which it contains.

On November 22, some fifty members of the Section were shown round the works of the Newcastle and Gateshead Co., Elswick, Newcastle, and were subsequently entertained by the company.

GLASGOW.

The first meeting of the session was held in the North British Hotel, Glasgow, on November 28, with Mr. Quintin Moore in the chair. A paper on "A Visit to the Rhineland Chemical Works" was read by Mr. D. A. Bost, who described the visit to German chemical works made by the mission representing the Association of British Chemical Manufacturers. A total of 39 factories was visited.

The author's paper dealt principally with the Leverkusen works of Fr. Bayer (see this J., 1919, 285 R), and mentioned, among other points, that most of the buildings are of brick, about 40 ft. high, and without regular floors, so that plant can be erected to this height in any suitable place; ferro-concrete is not used because such permanent constructional material might interfere with changes in plant. The status of the chemist was also considered, and the success of German chemical industry ascribed to, cheap raw materials, cheap power, and cheap carriage; discipline among the process workers; the business capacity of the chemists; the co-operation of engineers and chemists; and the willingness of the manufacturer to spend money because he had faith in the ultimate results.

In the discussion, Prof. Heilbron referred to the influence of the German universities on research and the support they received from manufacturers; Prof. Wilson discussed the inter-relationships of universities, technical colleges, industry and the State; and Prof. Desch expressed the opinions that the German chemist was not superior to the British, and that the success of German chemical industry was not due to fiscal policy or State support.

LONDON.

An ordinary meeting was held at the Chemical Society's Rooms, Burlington House, on December 1. The chairman, Mr. Julian L. Baker, stated that an opportunity was afforded those wishing to sign a petition in favour of extending the hours of opening of the Patent Office Library to 10 p.m., in conformity with the practice obtaining before the war.

A paper entitled "Ethyl Chloride" was then read by Mr. A. Henning, describing its use as an ethylating agent in the synthesis of dyestuffs and drugs, as a refrigerant, and as a solvent. Large quantities of ethyl chloride were made in Germany prior to the war, the annual output of a single factory in that country amounting to 250,000 kilo.; America has now four factories devoted to its production, and there is also one in Canada and another in Australia. As an ethylating agent it is very much cheaper than the more generally used sulphate, the approximate cost per lb. of the ethyl radical C_2H_5 being 2s. 3d. in the case of ethyl chloride, as against 12s. for the sulphate. There appears to be a widespread illusion that it is necessary to store ethyl chloride in high-pressure cylinders, and that it is, consequently, a dangerous and inconvenient reagent, but it can be stored quite simply in ordinary drums and can even be syphoned or poured in jugs from one vessel to another; it suffers no loss when kept in corked bottles, and it only evaporates slowly when exposed to the atmosphere. Although inflammable it is no more dangerous than alcohol, and it is not possible to ignite it by means of sparks. Tables were shown giving the physical properties of ethyl chloride, and also typical transformations effected by its use in the dye and intermediate industry, in which it is of great value. Types of autoclaves used in ethylating were shown, but for these it is important that no grease be used in the joints, a packing composed of fibre and glycerin forming an efficient substitute. It should also be remembered that the pure material should be employed since traces of the methyl radical cause variations in the shades of colours obtained. A great advantage possessed by ethyl chloride is that it does not become the least acid on prolonged storage, and this greatly enhances its usefulness as a solvent in the works or laboratory. Coming to its use as a refrigerant, the lecturer showed tables of its thermal properties, and stated that there were 150 plants in the United States at present employing it instead of ammonia or carbonic acid. Since it does not act upon metals, a direct circulation variety of refrigerating plant can be used. For laboratory use ethyl chloride is supplied in convenient holders, syphons or small containers, and when ice is unobtainable it is very useful for obtaining low temperatures. Allusion was also made to its value as an insecticide.

The next paper was by Mr. C. E. Barrs on "The Influence of Impurities in Lead when it is heated with concentrated Sulphuric Acid." It is well known that the lead employed in lead chambers of sulphuric acid plants is more or less liable to attack, such action being associated with the chemical composition of the metal employed. In a particular case a lead which contained 0·002 per cent. of copper was attacked at 250° C., whereas another sample which successfully withstood the action of the strong acid up to 296° C. was found to contain 0·021 per cent. A table was shown which indicated the temperatures at which (1) initial action and (2) vigorous action commenced when different metals were subjected to the action of strong sulphuric acid, and evidence was adduced that the most satisfactory percentages of copper as regards increasing the resistance of lead to the action of hot acid lay between 0·002 and 0·05, such lead being able to withstand corrosion up to 280° C. In the discussion which followed, Mr. Lancaster stated that a really pure lead quite free from copper will withstand the action of strong sulphuric acid up to a temperature of 300—310° C. Lead made by the Pattinson process usually contains more copper than that obtained by the Parkes' process, and is consequently more in demand for lead chamber work; it is, however, impracticable to use more than 0·2 per cent. of copper in lead used for sulphuric acid chambers.

MANCHESTER.

The annual dinner of the Section will be held at the Grand Hotel, Manchester, on January 22 next, at 7 p.m. The President, Mr. John Gray, has accepted the invitation to be present, and during the evening Mr. L. E. Vlies, the former Hon. Sec., will be presented with an illuminated address in recognition of his services. Tickets (8s. 6d.) may be obtained from the Hon. Sec., Mr. Guy Radcliffe.

The Committee of the Section has decided to issue an up-to-date edition of the Handbook early in January, 1920, and local members are asked to furnish the Hon. Sec. with the necessary particulars immediately.

MEETINGS OF OTHER SOCIETIES.

SOCIETY OF GLASS TECHNOLOGY.

The November meeting was held on November 19, in the Applied Science Department of the University of Sheffield. In the absence of the president, Dr. M. W. Travers took the chair.

The first paper was entitled "The Reversible Expansion of Refractory Materials," by Mr. H. J. Hodsman and Prof. J. W. Cobb, and was read by the latter.

Silica refractories on firing have a permanent

expansion, whilst fireclay refractories have a permanent contraction. On subsequent heat treatment both types undergo expansion which is reversible on cooling. The paper dealt with this reversible expansion. The authors briefly expounded methods of measuring expansion at high temperatures and described in full the methods actually employed by them. The range of temperatures through which reversible expansion had been investigated was 15°—1000° C., and some very remarkable results had been obtained. It was shown that alumina and kaolin expanded regularly within the above temperature range. Silica, whilst having approximately the same mean expansion between 15° and 1000° C., behaved very differently at intermediate temperatures. Thus between 15° and 1000° C. it expanded regularly at a rate slightly greater than that for kaolin. Between 500° and 600° its mean coefficient of expansion was much greater, whilst between 600° and 1000° C. its expansion was practically nil. The anomalous behaviour between 500° and 600° C. was probably due to a change from α quartz to β quartz. There was nothing in the results to indicate the formation of tridymite between 600° and 1000° C. A mixture of ganister and clay (4:1) behaved like silica. Fireclay and pot-clay behaved similarly to silica, the behaviour being nearer that of silica than that of kaolin. Ball clay, alundum, and carborundum behaved similarly to kaolin. In conclusion, the authors discussed the bearing of the results upon the arching and subsequent heating of glasshouse pots and other refractories.

The second paper was on "A Proposed Standard Formula for a Glass for Lamp Workers," by Messrs. F. W. and F. H. Branson. After reviewing their early work on pre-war tubing for lampworkers, the authors gave an analysis of the tubing they considered most suitable for this purpose, together with the composition of a batch for its production. The tubing was found to be satisfactory in every way. It could be reblown many times without devitrification, and was especially suitable for making plugs, stopcocks, and bulbs. It joined easily with all the best British-made glasses, including the resistant varieties, and was quite suitable for the repair of pre-war imported chemical glassware. The glass was quite free from appreciable colour, and did not darken in the blow-pipe flame.

ROYAL SOCIETY OF ARTS.

The opening meeting of the 166th session was held on November 19, when Sir H. Trueman Wood delivered the Chairman's Address on "Science and Industry." An interesting sketch of the industrial conditions obtaining a century ago formed the prelude to the admonition that all our progress has been accomplished by individual effort; in those days State organisation and control always acted as a brake to the wheels of progress, but to-day public opinion tends to run to the other extreme. After all, it is the nature of man to oscillate like a pendulum; yet, although the latter makes no advance, the clock goes steadily on. The development of industries based essentially on scientific discoveries was then considered, and the relative merits and demerits of German contributions thereto discussed. The lecturer does not hold the view that British manufacturers have ignored science—witness the development of engineering and of the "heavy" chemical industry—but they have been far too slow in grasping new ideas and in risking capital on costly researches. The launching of the Department for Scientific and Industrial Research was an experiment well worth the making, and, in any case, it should prove of great value to many of our smaller industries. The remainder of the address dealt with the provision of new sources of power and with the part played by the Society in promoting industrial progress.

On November 26 Mr. B. Brenan, late H.B.M. Consul-General at Shanghai, China, contributed an instructive statistical paper on "British Trade in China," in which he sketched the foreign trade of China from early in the sixteenth century down to recent times. Towards the end of his address the author stated that Japan now holds a very strong position in the Chinese market, and that it will require very great effort on our part to recover what we have lost during the war. Close corporations, exclusive dealings, trade secrets are things of the past; co-operation, amalgamation, alliance are the watchwords of the future. The very leisurely manner in which the British Government foreign trade reports are issued was criticised and contrasted with the expeditious and up-to-date reports of the American Government. The commercial attaché should not be chosen from the ranks of business men; he must be essentially a diplomatist, by instinct or training. The Chinese as a people are naturally inclined towards the English, and this tendency should be fostered by affording facilities to Chinese students to pursue their studies in this country. In the past England has always maintained her foreign markets—if she has lost one she has gained another—thanks largely to cheap coal and cheap raw materials. At the present time the chief danger is in respect of the latter. Lastly, in trading with China it must be borne in mind that the right kind of advertising pays, that it is hopeless to try to eliminate the Chinese middleman, and that up-to-date methods alone lead to success.

A course of three Cantor Lectures is being delivered by Prof. J. T. Hewitt on "Synthetic Drugs."

SOCIETY OF PUBLIC ANALYSTS.

Two papers were presented at the meeting held on December 3, under the chairmanship of Dr. S. Rideal. Mr. G. van B. Gilmour described "A New Distillation Method for Detecting Adulteration in Butter and for Estimating Fats of the Coconut Group," which consists in separating the volatile acids into two groups depending on their solubility or insolubility in saturated brine. Results were given for the application of the method to the distillate from the Blichfeldt apparatus, indicating that the composition of a fatty mixture deduced in this manner is more reliable and more rapidly obtained than by the combination of the Reichert-Meissl and Polenske-Kirschner methods.

The second paper, entitled "A New Process for the Determination of Arsenic; with Notes on the Chemistry of the Marsh-Berzelius Process," was read by Mr. B. S. Evans. Arseniuretted hydrogen, evolved by reduction with zinc and sulphuric acid, is decomposed by passing it over ignited copper, and the increase of weight of the latter is determined. Heavy metals must be absent. The retention of arsenic in the Marsh-Berzelius test is ascribed to the formation of metallic arsenide and elemental arsenic.

THE CHEMICAL SOCIETY.

Sir J. J. Dobbie, in presiding at the meeting held on December 4, invited signatures to the petition addressed to the President of the Board of Trade in favour of extending the hours of availability of the Patent Office library to 10 p.m. daily, as was the practice from 1888 to 1914.

Dr. T. M. Lowry presented two communications. In the first, "The Separation of Minerals by Decrepitation," he showed how barytes could be separated from galena and blende in a mixed ore occurring at Keswick by heating the mineral to

about 300° C., and then eliminating the unaltered lumps of sulphide and rock by passing through sieves. Experiments on similar ores showed that the barytes was separable by this method in about 50 per cent. of the ores examined. In the discussion the point was raised as to whether decrepitation was due to the expulsion of moisture, or if it was the outcome of unequal expansion or of unequal thermal conductivity along different directions in the crystals. Although there was some presumptive evidence in favour of the latter view, the fact that in the author's experience decrepitation is always accompanied by loss of water shows that the time-honoured explanation cannot be disregarded.

In his second note, "On the Decomposition of Nitric Esters by Lime," Dr. Lowry referred to the work of Prof. W. R. Hodgkinson on the decomposition of cordite with slaked lime and water in presence of pyridine, and then discussed the chemical composition of the products so obtained and their value for manurial purposes. Lieut. K. C. Browning, assisted by Mr. J. W. Farmery, had investigated the products of decomposition and found among them chalk, calcium oxalate, calcium nitrate and nitrite, traces of calcium acetate and formate, and the calcium salts of hydroxypyruvic and dihydroxybutyric acids. Except in one case, when 40 per cent. of pyridine had been used instead of 0·5—5 per cent., no glycerol was detected. Pot-culture tests at Rothamsted showed that the product, which contains about 6 per cent. of combined nitrogen, was in some instances detrimental to plant life, especially during the earlier stages of the decomposition, and further investigation showed that this toxic action was invariably due to calcium hydroxypyruvate. An interesting discussion ensued on the mechanism of the "hydrolysis" of nitroglycerin. The author holds the view, based upon a suggestion first made by Berthelot, that when trinitroglycerol is decomposed by alkalis it yields directly an alkali nitrite and a carbonyl compound, dialdehydeketone, CHO.CO.CHO, which by addition of water forms hydroxypyruvic acid, $CH_2OH.CO.COOH$, as against the alternate hypothesis that the primary products of decomposition are glycerol and nitric acid or a nitrate, and that the nitric acid, in a peculiar or "nascent" form, oxidises the glycerol and becomes reduced to a nitrite.

PERSONALIA.

We regret to record the death of Dr. J. Grossman, an original member of this Society, at Manchester, on November 28 last.

Mr. Alexander Richardson, A.R.S.M., has been appointed Principal of the Cornwall School of Metalliferous Mining.

Dr. J. E. Stead has been nominated President of the Iron and Steel Institute for 1920, in succession to M. Eugène Schneider.

Professor T. W. Richards, who holds the chair of chemistry at Harvard University, has been elected a foreign member of the Royal Society of London.

The impending retirement is announced of Mr. E. Wyndham Hulme, chief librarian at the Patent Office, and of Mr. R. Harrison, assistant secretary of the Royal Society.

Dr. Charles L. Parsons has resigned his appointment of Chief Chemist to the Bureau of Mines, Washington, in order to give more time to his duties as Secretary of the American Chemical Society.

NEWS AND NOTES.

CANADA.

Developments in the Sydney District, Nova Scotia.—Much activity has been shown of late by the steel and coal companies of this district, and a large scheme of extension, involving the erection of a new plate mill and coke ovens, has been carried out. In former times many wooden ships were built in this district, and it is now the ambition of these companies to revive the industry and make the province of Nova Scotia into a shipbuilding centre of the first magnitude.

During the past year, well over one million dollars has been expended on the iron mines and quarries in Newfoundland, from which the steel companies derive their ore. The programme calls for construction work at Sydney plants on a large scale, and the marketing of Wabana, Newfoundland, iron ore in foreign markets. The coal areas are being further developed, and, while the St. Lawrence market has been lost, extensions in other directions have counteracted this loss. The removal of the large coal fleet, which once ran between North Sydney and Montreal, may gradually be restored. Working conditions in the Cape Breton coal districts are better than they ever were previously, more electrical equipment is being installed and operations on new seams are being projected.

BRITISH INDIA.

Industrial Progress.—During the present year there has been an unprecedented boom in the flotation of industrial companies, as was perhaps inevitable. The general industrial development of India is decidedly backward, as many manufactures have been imported which could quite well have been produced in the country. The policy of the Government tended to discourage the introduction of Western industries, as it involved the purchase of nearly all requirements in London through the India Store Depôt, including products which were available in India, such as linseed oil and cotton waste. As the Indian Governments are comparatively large buyers, this had a considerable influence, but even before the war the policy was undergoing modification. The difficulty of obtaining goods from Europe accelerated the change, and in 1916 the Indian Industrial Commission was appointed with Sir Thomas Holland as president. In the following year he was also made president of the Munitions Board, which did much to organise the resources of the country and render them available for the prosecution of the war in Mesopotamia, East Africa, and Palestine. Sir T. Holland is at present in England in connexion with the formation of a separate Department of Industries under the Government of India, but he is expected to return soon to prosecute the matter here.

These developments and the large profits made by practically all industrial undertakings during the war caused the flotation of a large number of new companies, the shares of which were subscribed for very freely, but it is to be feared that many of the new firms have but little prospect of making profits, especially as some of the promoters and directors have no experience of work of this sort. There are, moreover, special reasons which tend to neutralise the advantages of the present time. In consequence of the failure of the crops last year the prices of the ordinary foodstuffs are about twice as high as usual, and it has been necessary to raise wages accordingly. The rupee also has risen to 1½ times its previous value as expressed in gold currency, the effect of which is not only to render competition

with imported goods more difficult but also to cause many people to send their money out of the country. The boom is already falling off in strength. At the same time, there is really plenty of money in India for the erection of factories, etc., if it could only be rendered available, for every year gold and silver in coin or bullion are absorbed to the value of about £30,000,000. Some of this is made into jewellery, but a very large proportion is simply hoarded.

The new ventures include a number that are to work various chemical industries. Pharmaceutical products will be manufactured on a considerably larger scale than previously, and Indian skins and hides will be tanned here with Indian tanning materials instead of being exported whilst large quantities of leather are imported. Undoubtedly there is a great field for chemical industries which will work up the abundant native raw materials.

Proposed Sugar Cultivation in Ceylon.—A special Sugar Committee of the Ceylon Agricultural Society has presented a report recommending the establishment of sugar cultivation on the island. It is considered that the success of the proposal depends entirely upon the amount of assistance the Government will give. It is generally admitted that there are immense possibilities in the way of sugar cultivation, either from the palmyra palm or from the cane, but private enterprise has lost heavily in the past, and therefore there is a desire for Government support by means of land concessions, cheap loans, and experimental mills.—(*Bd. of Trade J., Nov.* 20, 1919.)

AUSTRALIA.

The Prickly Pear.—This plant has become a serious pest in many parts of Australia, and numerous methods have been suggested for its eradication and possible utilisation. Prickly pears belong to the cactus family and are indigenous to America, but several species have become acclimatised in Queensland and New South Wales. Chief among these is the pest pear, *Opuntia inermis*, which covers about 22 million acres in these States and is spreading at the rate of a million acres per annum.

Utilisation.—As a reserve food for cattle in case of drought it appears to have considerable value, but it is not a well-balanced food and needs mixing with other fodder. In Ceylon, India and South Africa, prickly pear has been used as a green manure, but it is necessary to bury the broken parts in wide trenches under about 18 in. of soil.

The fruits have been used for the manufacture of alcohol in Spain and Sicily, but the operations were not a commercial success owing, it is stated, to the heavy excise duty. Investigations made in the United States showed that 140 lb. of the fruit was required to produce one gallon of alcohol, and that in order to make the operation a commercial success it would be necessary that (1) a production of 10 tons of fruit per acre be obtained, (2) a rapid and cheap method of collection be introduced, as hand gathering is too dear even with cheap labour. In view of these facts, it does not seem possible that this method of utilising the fruit would prove remunerative in Australia.

Attempts have also been made to produce alcohol from the green parts of the plant, but even under the most favourable conditions the yield is only 0·5 per cent. of the material treated.

The utilisation of prickly pear as a paper-making material has been tried both in the United Kingdom and in Australia, but the results are not promising owing to the small yield of pulp and the shortness and poor felting quality of the fibres.

The ash of the pest pear, which amounts to about 10 per cent. of the dried plant, contains about half its weight of potash salts, and it has been suggested as a possible source of potash for local use. Large scale experiments have been made in Australia, but in view of the difficulty in collecting the material and the fact that the ash is practically certain to be contaminated with soil, it does not seem likely that the product obtained would repay the cost of treatment.

Eradication.—Once the prickly pear has become established, its removal by ordinary mechanical means is almost impossible. The most successful means so far used has been that of poisoning by means of arsenic compounds. Arsenic pentoxide is the most effective of these, about half a gallon of a 2·5 per cent. solution being sprayed on each cwt. of plant. If an atomiser spray be used, then about 1 oz. of a 25 per cent. solution is employed. Arsenic pentoxide was almost unprocurable in Australia during the war, but it is understood that the Queensland Government intends to manufacture this chemical. Arsenic chloride, heated and used in an atomised spray, has proved very effective for dealing with dense, impenetrable masses of prickly pear. It is being manufactured for this purpose by a firm in Melbourne.

Arsenite of soda or a mixture of arsenic trioxide, caustic soda and common salt, is less efficacious than either of the above-mentioned compounds, and has the disadvantage of requiring large quantities of water, which is frequently very scarce in the infested districts. It is, however, less dangerous to use and cheaper. The cost of eradication by the three above means varies from £2 10s. to £4 per acre, and although this expenditure would be worth while for clearing valuable agricultural land, it would not be profitable on poor scrub.

In certain parts of India and Ceylon the cochineal insect has almost exterminated the tree pear (*Opuntia monacantha*), and experiments in Australia have indicated that the insects will rapidly spread and soon exterminate a large area of the plants. The tree pear, however, is not a serious pest, and the insects refuse to attack any other species. A travelling commission, appointed by the Queensland Government to investigate the natural enemies of the prickly pear, recommended the introduction of certain insects and fungi as a means of eradication. A sum of £2,000 has been placed at the service of the Advisory Council by the Minister of Agriculture for New South Wales for the purpose of further research work in the State, and it seems probable that a similar sum will be allocated by the Government of Queensland.

The Executive Committee of the Advisory Council therefore recommends the establishment of one central and two subsidiary laboratories for studying the effect of insects and fungi on the prickly pear. The central laboratory is to be under the direction of a biologist, who will receive £1,200 per annum, whilst the subsidiary laboratories will be in charge of entomologists at £750 each per annum.—(*Bull.* 12, *Inst. Sc. and Ind., Austral.*, 1919.)

UNITED STATES.

Use of Crystallisers in Cane Sugar Factories.—The economic advantage of employing crystallisers in raw cane sugar factories is being investigated. The data so far collected indicate that a saving of much time and an increase in the yield of sugar may result from the use of such apparatus, thus helping to reduce costs. While crystallisers are in general used by refiners and beet sugar manufacturers, they have been given little attention in making raw cane sugar.

Chemical Warfare.—In a paper on this subject contributed by Maj.-Gen. W. L. Sibert, of the Chemical Warfare Service, to the annual convention of the International Acetylene Association, it is recorded that at the date of the armistice

Germany was making mustard gas at the rate of 10—12 tons a day, and that the American output was then 40 tons, with a daily capacity of 80 tons. Whilst about 30 per cent. of the total casualties in the United States Army was due to gas, only about 3—4 per cent proved fatal, and of the remainder nearly all will recover. A surgeon who had treated 2000 such cases, gassed 4—5 months previously, stated that there were no indications of lung trouble or of any permanent injury. Maj.-Gen. Sibert is of the opinion that as surprise is the essence of success in gas warfare, research connected with it should be conducted in strict secrecy, and in peace time as well as in time of war.

Magnesite in the U.S.A. in 1918.—The crude magnesite produced, sold, or treated in the United States in 1918 amounted to 231,605 short tons, valued at $1,812,601 f.o.b., mines or plants, representing a decrease of about 27 per cent. in quantity and 37 per cent. in value compared with 1917.

There was a decrease of 60 per cent. on the Californian output, but an increase of 40 per cent. on the Washington production. This unexpected change of output in California, after five years of rapidly increasing prosperity, was greatly influenced by the temporary restrictions on shipments of freight, together with an increase in rates. The makers of refractory products insisted on having calcined material, because its use would save 50 per cent. in weight and freight charges, and the prices offered to small producers were so low that many had to discontinue operations.

A vital factor is that the principal markets are 2000 to 2500 miles away from the deposits. It is possible, now that the war is over, that European magnesite may soon be delivered at New York. Should the price of the imported material be even double its pre-war price, it would reduce the United States production to a few thousand tons per annum.

Practically all the magnesite produced in Washington is used for refractory purposes as synthetic (artificially combined) ferro-magnesite. This product is used in basic open-hearth and electric steel furnaces.

It is still an open question whether the amorphous magnesite of California and the crystalline product of Washington are equally suitable for refractory uses, very little evidence being available. The main factors seem to be freight and delivery.—(*U.S. Geol. Survey, Sept.* 16, 1919.)

Fuller's Earth in the U.S.A. in 1918.—Fuller's earth derives its name from its original use in fulling cloth, but only a small quantity, mainly domestic, is now used in the United States for this purpose. It is used principally in bleaching and in clarifying or filtering fats, greases, and oils. It is also used in the manufacture of pigments for printing wallpapers, in detecting certain colouring matters in some food products, as a substitute for talcum powder, and, in medicine, as a poultice and as an antidote for alkaloid poisons. The requirements of a good earth for refining edible oils are that it should bleach the oil permanently, leave no disagreeable taste or smell, have small retentive power of oil, and no tendency towards spontaneous ignition. The English earth is considered to fulfil all these requirements, but the domestic earth usually has one or more failings, although some refiners have used it with success.

The United States product is chiefly used in refining petroleum, and 1918 was a record year in every respect, 97,075 short tons being consumed, or 8 per cent. more than in 1917. The home production amounted to 84,468 short tons (representing 87 per cent. of the total consumption), at an average price of $13.57 per short ton, a value of no less than $1,146,354. Florida was responsible for four-fifths of the total quantity. The total imports were only 12,607 tons of wrought and unwrought earth, fetching an average price of $11.67 and $13.24 per short ton, respectively.—(*U.S. Geol. Survey, Aug.* 27, 1919.)

JAPAN.

The Caffeine Industry.—The manufacture of caffeine from tea dust has been carried on in Japan for about three years. There is one large company in Japan proper, but another company, already making caffeine in Formosa, is to establish a new factory in Shizuoka, Japan; and there are three smaller factories.—(*U.S. Com. Rep., Oct.* 18, 1919.)

GENERAL.

British Dyes.—In his address to the meeting of dye consumers at Manchester on November 28, Lord Moulton, chairman of British Dyestuffs Corporation, Ltd., revealed the interesting fact that he was responsible for the insertion in the Peace Treaty of the clauses which secure for the Allies 50 per cent. of the German dye stocks, as at August, 1919, and the option over 25 per cent. of the total German production during the next five years. The former condition will prevent Germany, the only country possessing stocks of dyes, exercising a monopoly, and the latter will frustrate the favourite German policy of refusing to sell certain "lines" unless the customer buys all his other dyes from the same source. If at the end of five years our dye industry was unable to stand on its own feet, it would not be worthy of further assistance. Of the stocks to be released immediately, Italy, France and Belgium combined are to receive 2200 tons, and America and Great Britain 1500 tons each. Referring to the British Dyestuffs Corporation, the speaker refuted the criticisms that had recently been directed against it, and stated that the country's confidence had been shown by a subscription of £5,000,000. In 1914 the industry was producing only 10 per cent. of the total home demand; by the end of this year it will be able to supply 80 per cent. of the pre-war requirements. At the present time the range of dyes manufactured had perforce to be restricted in order to meet the demand for those of which very large quantities were required. When the necessary plant was available there was no dye of any importance which the Corporation would not be able to supply.

Coke-oven Gas for Town Supply.—In a paper read recently before the Midland Institute of Mechanical, Civil and Mining Engineers details were given of the introduction of coke-oven gas into the town's gas supply of Sheffield (see this J., 1919, 65 R). The coke-oven gas so introduced represents about 10 to 12 per cent. of the total output of the Sheffield Gas Company, equivalent to about 20 to 25 per cent. of the make of gas at the works of the company where it is introduced. The average supply of coke-oven gas over a period of nearly 12 months has amounted to 7,262,860 cub. ft. weekly, of an average calorific value, after extraction of benzol, of 509 B Th.U. per cub. ft. The supply pressure is 36 in. of water. The coke-oven plant located at the Tinsley Park Colliery consists of 55 Kopper's regenerative ovens, and the gas is conveyed a distance of about 2 miles. The alternative plan of utilising the "surplus" coke-oven gas at the colliery for generating electricity was not considered sufficiently reliable owing to the richness of the gas. The "surplus" gas, which is admixed with the town's gas supply, amounts to about 50 per cent. of that generated in the coke-ovens, and it is anticipated that this figure can be improved by steaming.—(*Times Eng. Supplement, Nov.*, 1919.)

Production of Gas from Wood During the War.—Denmark, Norway, Sweden, and Switzerland in particular, have had recourse to making gas from wood during the war, owing to shortage of coal. The process gives rise to many difficulties when carried on in the present form of retorts, chiefly on account of the acid condensates which are formed during distillation, and which attack pipe-lines, gas-meters, etc. Carbon dioxide may be economically removed by passing over red-hot carbon, and this process also removes the major portion of the acetic acid, the remainder being neutralised by ammonia supplied by a small, measured quantity of coal added to the main charge of wood to the retorts. This method has been used at Stockholm. In Denmark peat and wood were alternately gasified in horizontal retorts, the calorific value of the gas produced being increased by mixing with coal gas. It was found necessary to alter the adjustments of all burners owing to the greater density of the gas, but no difference was noticed in the running of gas engines. Germany also made wood gas in some of the gas works during the war, but only in small quantity.—(*Gas J.*, *Oct.* 21, 1919.)

Use of Natural Steam for Power Production in Tuscany.—The natural steam springs at Larderello, in Tuscany, from the condensed vapour of which boracic acid has for a long time been produced, have now been harnessed to produce power. At a depth of from 195 to 390 feet, dry steam at three atmospheres pressure is obtained, and this is passed at about one atmosphere pressure around the aluminium tubes of a sheet-iron tubular boiler, producing in the tubes clean steam at one-half atmosphere pressure. This steam is then utilised in special turbines to generate electric current at 36,000 volts. The current thus obtained is distributed to Siena, Florence, Leghorn, Piombino, where there are iron and steel works; to Massa, where there are iron and copper pyrites mines; and to other places. So far as the Larderillo district is concerned, the coal problem, which is in Italy very acute, has been solved by the utilisation of this natural steam.—(*U.S. Com. Rep.*, *Oct.* 1, 1919.)

Molybdenum Ore in Finland.—Deposits of molybdenum ore occurring in the vicinity of the main line running from Joensun to Nurmes are now to be exploited. They were worked in 1910, but were subsequently abandoned as of little value. When, however, it became known that molybdenum deposits of smaller extent were being profitably worked in Norway, attention was once more directed to them. However, they were not regarded as payable by experts from the firms of Krupp and Creusot, who inspected them before the war; but conditions have materially altered since. Owing to the molybdenite being very sparsely distributed in the mother rock, the latter cannot be marketed; but it should be easily possible, after crushing and sorting, to market the concentrates, as is done in Norway.—(*Z. angew. Chem.*, *Oct.* 21, 1919.)

Principal Industries of Yugo-Slavia.—Speaking generally, the country has considerable stocks of raw materials, and conditions are favourable, but the industries are hampered by their dependence on foreign capital. In 1910 there were nine works manufacturing metals, chiefly iron; but none was of large size, nor was any equipped with the most modern plant. There are, however, rich iron deposits in Serbia, and a great development of mining is expected to take place there. Bosnia and Herzegovina produced some 2,800,000 tons of brown coal and 130,000 tons of first-quality coal, and there are many deposits as yet untouched. Manganese, antimony, pyrites, lead, and zinc mines exist, and in Idria (Slavonia) there are the famous quicksilver mines, which produce yearly 130,060 tons of ore, yielding 820 tons of mercury. Leather is manufactured in several factories, but the better qualities are imported; and there are six large and up-to-date sugar factories in the new provinces, which are capable of supplying the needs of the whole country. Sulphuric acid, Glauber salts, crystal and bicarbonate of soda are produced in Slavonia, and there is a powder factory at Kamnik, as well as some very important tannin factories at Zupanje and Mitrovich, in Croatia. Carbide works and petroleum refineries exist in Bosnia, and a considerable quantity of pure alcohol was formerly made in Batchka, Baranja, and Banat, but production has ceased for want of coal. In Serbia the chemical industry has only recently been introduced. There were a few acid works in Belgrade, as well as a soda works, two soap, one dye, and one match factory. Most of the factories and mines were destroyed during the invasion of the country by the enemy, but hope is entertained that the industries concerned will soon be revived.—(*U.S. Com. Rep.*, *Oct.* 1, 1919.)

New Coating for Safety-Match Boxes.—War shortage of antimony has led to the discovery of an excellent substitute for the preparation of the coating for safety match boxes. The substitute, known as "brilliant friction," and manufactured by Sirkarna in Banska (Slovakia) is lighter, more effective, 50 per cent. cheaper, and effects a saving of red phosphorus and of chlorate of potash in the match heads. In a test over 500 matches were ignited on one box, and 100,000 boxes were coated with 1½ kilo. of amorphous phosphorus and 3 kilo. of "brilliant friction," which contains no pulverised glass or graphite. Large quantities have been exported to Sweden, Denmark, Holland, Austria, and Germany.—(*U.S. Com. Rep.*, *Sept.* 29, 1919.)

Chemical Industry in Sweden.—The preparation of essences has been started by the Roberts Co. in Oerebro. The Svenska Tändsticks Co. now owns the two factories at Trollhättan and Gullspäng, which make sufficient phosphorus, by the electrical smelting method, to satisfy the needs of the Swedish match industry. Potassium nitrate is made solely by the double decomposition method. The manufacture of common salt is being investigated by a Government Commission, and should the present high price be maintained the extraction of salt from the sea-water of the west coast may be undertaken. Uncertainty prevails as to the continuance by the Kväveindustri Co., of Gothenburg of the manufacture of products from atmospheric nitrogen and of that of sodium carbonate by the Leblanc method undertaken during the war. Of the many works started experimentally for the manufacture of chromium salts only one, the Sandsta Elektriska Smältverk will continue production now that importation has been resumed; an import tax on chromium salts is considered necessary to safeguard the future of this nascent industry. A factory is being built at Högonäs for preparing aluminium oxide from refractory loam by a process as yet unpublished for the manufacture of aluminium. The production of carbide and of calcium cyanamide as substitutes respectively for illuminating oil and Chile saltpetre has increased very greatly during the war, and the manufacture of ammonium sulphate from calcium cyanamide was also carried on, on a small scale, at the works at Ljunga. Owing to developments in the manufacture of caustic potash, caustic soda and bleaching powder, Sweden will probably be independent of foreign countries in the future for the supply of these commodities, but the production of sodium hypochlorite will be discontinued. A cyanide works to use 2000 kw. has been laid out at Trollhättan; a project for a factory

using 12,000 kw. to manufacture nitric acid electrically at the same place fell through, but the plans may be proceeded with at Porjus. The only factory placing atmospheric nitrate on the market is the Birkeland-Eyde at Ljunga, where there is also a small ammonia-oxidation plant. There is an extensive production of chlorate at Trollhättan, where some material other than platinum is used for electrodes; perchlorate is also made there.—(*Z. angew. Chem., Sept.* 9 *and* 16, 1919.)

Position of the Dutch Chemical Industry.—The trade section of the Dutch Ministry of Agriculture, Industry and Commerce comments as follows upon the Dutch chemical industry during the first half of 1919:—Dutch chemical industry is in an unfavourable condition. In most branches production is much behind that of 1918. Some of the largest factories are either only operated in part, or are at a complete standstill. Fertiliser manufacturers have been adversely affected by the importation of large quantities of Chilean nitrate, the supplies on hand being more than sufficient to meet the country's demands. Financial difficulties are aggravated by a number of factors, including the delay occasioned by the necessity of securing export permits. Owing to fluctuations in price there is a disinclination to conclude contracts without a guarantee of immediate delivery. Trade generally is uncertain, and shows a downward tendency. Many dealers still possess large supplies, and are desirous of disposing of these abroad. The low exchange value of the mark exercises a considerable influence. Many firms experience difficulty in obtaining export permits, but there are no obstacles impeding importation of raw materials and partly manufactured goods from Central Europe; products of German origin are offered at prices considerably below the cost of the raw materials. In general the outlook for the chemical industry is not good. It is to be feared that the market will be flooded with cheap, foreign products. The export of surplus production is a matter of difficulty, and constitutes a very vital question for Dutch chemical industry.—(*Schweiz. Chem.-Zeit., Sept.* 24, 1919.)

The Dutch paper industry did well during the war, but adverse conditions have ruled since the beginning of 1919. Japan and America have acquired many of the home and foreign markets previously supplied by the Netherlands. The industry is hampered by the high cost of coal and freightage, the necessary labour is lacking, and wages are high. The prospect before the export trade is not particularly bright at the moment, but it is anticipated that trade will gradually recover and a ready market be found in England. Raw materials for the artificial silk industry were more easily obtained during the first half of 1919, and the outlook is in general promising; the chief drawback to trade is the depreciated and fluctuating value of the mark and krone. There was a shortage of gas-making coals in the early part of 1919, and the low output of ammonia and ammoniacal liquor necessitated the importation of much Chile saltpetre. The prices of by-products, more particularly coke, tar and ammoniacal liquor, fell relatively more than that of coal.

The manufacture of foods and condiments, wines, etc., has revived with the increased importations of raw materials, and the outlook is bright. The output of sugar is below the normal on account of the diminished cultivation of the sugar beet, and costs have risen owing to the high prices of coal and limestone and high labour charges. The production of margarine has increased considerably owing to the importation of better raw materials; the future of this industry appears bright. The brewing industry has still to contend with lack of raw materials. Ample supplies of raw materials are still at the disposal of the cocoa and chocolate industries; but the production cannot be exported, and it is feared that foreign markets will be captured by Switzerland and England. The output in the salt industry during the first half of 1919 did not exceed half the normal, and the position of the industry is still uncertain, largely on account of the impossibility of estimating the effect of salt production at Haaksbergen.—(*Z. angew. Chem., Aug.* 15, 1919.)

Chemical Industry in Russia.—During the war Russia, like other countries, made considerable efforts to build up its own chemical industry, and many new chemical factories were erected; but, owing to the fear of future German competition, no foreign capital was attracted. Among the relatively larger new undertakings may be noted "The Russian Chemical Industry Co. (1914)" of Moscow, and the numerous factories of the former War Industries Committees, of which a toluene factory at Baku and a phosphorus works at Troitsk are still working. Although the many small chemical and pharmaceutical works established by the Russian Semstvos, and working simplified processes, are reported to be still active, there has been no progress in chemical industry since its socialisation by the Bolsheviks. Only three large chemical works, the soda factory of Ljubimoff, Solveigh and Co., the Lievenhof Glass Works and the Kusnezoff Factory at Lissitschansk are working in the Ukraine, and these are not fully employed. At the present time the stocks of pyrites and Chile saltpetre in the Ukraine are respectively about 400,000 and 200,000 puds, and further imports to meet the needs of the sulphuric acid industry cannot be reckoned on. Materials of all kinds are lacking, including fuel, and whilst during the war the benzene works could, under favourable conditions, produce 80,000 puds of crude benzol, they could not now produce one-half this amount.—(*Z. angew. Chem., Sept.* 9, 1919.)

Economic Resources of the Cartagena District, Colombia.—*Sugar.*—The Colombian Sugar Co., which owns plantations and a mill at Sincerin and is opening up new lands farther south, is the only large sugar plantation in the entire coast region using modern machinery. The average yield of cane is about 15 tons per acre, although a production of about 22 tons is often obtained. The price paid for the cane is about 10s. per ton delivered at the mill, and the percentage of extraction is over 9. The output averages 100,000 cwts. of refined sugar yearly.

Cotton.—American seed is largely used, but the native varieties are of long staple and high tensile strength, and are much less subject to damage by insects. The local demand exceeds the local supply.

Forest Products.—During 1918 Cartagena exported forest products gathered in the interior to the value of about £110,000, the chief items being ivory nuts, rubber (balata), and ipecacuanha. There is an unlimited supply of corozo (cohune) palms, which are spared for their seeds when pastures are cleared for cattle. The palm matures at the age of four or five years, and then yields two harvests yearly. The nuts, which are easily collected and of high food value, yield when dry about 25 per cent. of oil. Gum-yielding palms occur, but the collection of the gum in marketable quantities is not practised. The forests are rich in medicinal plants such as ipecacuanha, sarsaparilla, cinchona and cascara sagrada; these are exported to the United States to the value of about £10,000 yearly.

Petroleum.—The proved petroleum belt is believed to run from the north-east to the south-west, passing diagonally through Santander del

Norte near the boundary of Colombia and Venezuela (where the Carib Syndicate owns a concession of about 1,500,000 acres), and through Santander del Sur; but although well over £600,000 has already been spent in Colombia on oil exploration—which is much hindered by the broken country, poor climate, lack of transport, etc.—drilling operations so far have been unsuccessful.

Platinum and Gold.—The total yearly export of precious metals from Colombia is valued at about £1,200,000, and the country produces an average of 30,000 oz. (troy) yearly of platinum, practically all of which comes from the Quibdo district. During the war nearly all the Colombian output of platinum was taken by the United States (1916, 25,588 oz.; 1917, 21,278 oz.), and the fixing of the price at $105 per oz. by the U.S. Government during 1918 greatly stimulated the work, although, owing to the dry weather, which necessitated the laborious collection of water for washing, the production did not increase proportionately to the number of workers. The climate is unhealthy, and the quality of the labour unsatisfactory. Many rich samples of copper, lead, silver and palladium ores have been obtained in the Choco district by the native prospectors, but very little is known of the real extent or value of the deposits. There is a decided tendency in mining legislation towards the institution of Government control.—(*U.S. Com. Rep., Sept.* 22, 1919.)

The Spontaneous Ignition of Peat.—As a result of the investigation of many cases of spontaneous combustion in stored peat, Mr. A. Molin concludes that the cause of ignition may well be the same as that which effects the spontaneous ignition of hay, viz., that *aspergilli* cause the initial rise of temperature to 60° C., and that other bacilli raise it further to 70° C., at which temperature inflammable gases arising from the decomposition of twigs and boughs would take fire. The author advises that peat which is to be stored over long period should contain a minimum quantity of smalls and dust, and that commercial analyses should state, in addition to ash and moisture contents, particulars as regards dust-content and trength of texture.—(*Tekn. Tidsk., Kemi a Bergvetenskap.*, 1, 1919.)

Wolfram in Siam.—In the fiscal year 1912-13 the production of wolframite in Siam was 309 tons; in the year ended March 31, 1917, 584 tons, and in the succeeding year about 800 tons, the monthly returns averaging from 70 to 80 tons. Deposits of tungsten ores, chiefly wolframite, diffused through Siamese Malaya and northern Siam, and especially the district Nakon Sritamarat, are said to be unlimited. High grade ores contain from 60 to 72 per cent. WO_3, but mixed ores containing nearly equal parts of tin and tungsten occur.

The war price reached 160 ticals (£12. 6s.) per picul (133⅓ lb.), the present price is about 40 ticals or less per picul. There is no use for tungsten in Siam, and the entire output during the first two years of the war went to the United Kingdom, France sharing to some extent in 1918.—(*U.S. Com. Rep., Sept.* 6, 1919.)

Natural Indigo in the Dutch Indies.—The Swiss Embassy at the Hague reports that considerable progress has been made of late by indigo growers in the Dutch Indies, where the area under cultivation in 1917 was about four times as great as in the preceding five years, but was still only about a half of what it was about twenty-five years ago.—(*Schweiz. Chem.-Zeit., Sept.* 10, 1919.)

Chinese Indigo Crop.—Owing to the very poor indigo crop in China in 1918 a larger acreage has been planted this year, and an increased production of indigo is expected. The crop is an average good one; in certain districts it suffered from excessive rainfall early in the season.—(*U.S. Com. Rep., Oct.* 18, 1919.)

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED EXPORTS.

The Board of Trade (Licensing Section) has announced the removal from List "A" of Prohibited Exports of the following items: Scrap iron; steel scrap; nitrate bags (Nov. 27); and of bean flour; locust bean meal; margarine and oleo-margarine; lupin seed; jute, raw and carded; poppy and sunflower seeds; shea, illipe and babassu nuts (Dec. 5). The Board also intimates that the heading "Soya bean, cake and meal" should be interpreted as including soya bean cake, meal and flour.

NEW ORDERS.

The Order made by the Board of Trade on November 28 relating to the reduction of 10s. per ton in the price of coal supplied for domestic consumption and of coal used in producing gas and electricity for household purposes (this issue, p. 460 R), has been supplemented by instructions issued by the Controller of Coal Mines, under which all coal supplied by collieries for bunkering ships engaged in the home coasting trade is now charged at revised prices, which are the prices given in Schedule A, less 6s per ton.

ORDERS MADE BY THE MINISTER OF MUNITIONS. The Tungsten and Molybdenite (Suspension) Order, 1919, which suspends the operation of the Tungsten and Molybdenite Order, 1917.

The Flax (Irish Crop) Amendment No. 2 Order, 1919, which fixes the prices of six different grades of Irish flax.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Imports and Exports Regulation Bill.

This Bill, introduced in the House of Commons by Sir A. Geddes on November 19, has for its main objects: To constitute a Trade Regulation Committee; to regulate the importation of goods with a view to preventing dumping; to safeguard key industries and industries affected by the depreciation of a foreign currency; to assist the revival of hop-growing; to regulate temporarily the exportation of certain goods; and to authorise the granting of credits and undertaking of insurances for the purpose of re-establishing overseas trade.

The Trade Regulation Committee will consist of seven officials representing the Board of Trade, Treasury, and the Foreign Office, and ten Members of the House of Commons. Any Orders made by the Board of Trade will have to be approved by this Committee. Goods to which a prohibitive Order applies may be imported if the importer pays such sums to the Commissioners of Customs as are equal to the difference between the foreign value and the import price; and similarly such goods may be sold in the United Kingdom if the vendor pays the difference between the price charged and the foreign value, or satisfies the Board that the reduced price is due to depreciation or other cause. In the section dealing with the safeguarding of "key" industries, the Board is empowered to prohibit for three years the exportation of, *inter alia*, fuel, motor spirit, sugar, edible fats, opium and cocaine and their salts. The

list of scheduled articles, the importation of which may be prohibited, contains all synthetic dyes and *drugs, chemical reagents, scientific glassware, etc.*, and is identical with that detailed in this Journal (1919, 314 R).

Sir H. Greenwood informed Mr. Clynes on December 4 that it has been decided to publish forthwith the Report of the Advisory Council to the Ministry of Reconstruction on Anti-Dumping Legislation. On the same date the Prime Minister announced that the Government did not intend to proceed with this Bill during the current session.

The Coal Industry.

In reply to Mr. Adamson, Sir A. Geddes announced that, as a direct aid to the cost of living, the Government had decided to lower the price of domestic and household coal by 10s. per ton; the reduction would also apply to bunker coal for coastal traffic. (See also previous page.) The average price of coal for inland purposes is below the cost of production, but the very high prices ruling for export coal allow of this concession being made.—(Nov. 24.)

Sir A. Geddes informed Sir Evan Jones that the profit for the quarter ended December 31, 1918, was about 3s. 1d. per ton of coal raised, after allowing for interest on loans and debenture capital and payment of royalties. The figure for the March quarter of this year is expected to be about 7¼d. per ton.—(Nov. 26.)

Palm Kernels (Export Duties).

Replying to a question put by Lieut.-Commander Kenworthy, Mr. Dudley Ward stated that the French Government had imposed export duties on oleaginous produce shipped from French West African colonies to all destinations, including France. It was evident, therefore, that these duties had not been imposed as a retaliatory measure for the corresponding duty placed on palm kernels exported from British West African colonies to destinations other than the British Empire.—(Nov. 27).

H.M. Factory, Gretna.

Mr. Kellaway intimated to Mr. R. Young that no definite decision had been arrived at in regard to the future of this factory. Arrangements are being made for utilising such of the machinery and plant as is suitable for the repair of railway wagons.—(Nov. 27.)

Patents.

Mr. Doyle asked the President of the Board of Trade if he would consider the advisability of bringing in a Bill to improve and cheapen the facilities for persons of limited means to take out patents, and to prevent any patentee from selling more than 50 per cent. of his interest in his invention to his employer; and if he would further consider the advisability of appointing an Inventions Committee to consider and advise upon inventions of all persons of poor circumstances, and, if necessary, help them to protect their improvements.

Mr. Bridgeman, in reply, said that the Bill now before Parliament should, if passed, improve facilities for the grant of patents. It would not be practicable or advisable to appoint such a committee as that suggested. Under the present practice of the Patent Office, all possible help and assistance is given by the staff to every inventor in preparing the specifications and other documents necessary for obtaining patent rights.

Patent Office Library.

Sir M. Conway asked the President of the Board of Trade if the library may be kept open till 10 p.m. on two or three evenings a week, as the continued closing in the evening had caused great inconvenience to students.

Mr. Bridgeman replied that the desirability of reopening the library in the evening had not been *lost sight of, but there had been difficulties in* making the necessary arrangements owing to depletion of staff. Arrangements will be made at the earliest possible date to keep the library open every evening for several additional hours.—(Nov. 27) (*cf.* pp. 452 R, 453 R, of this issue.)

Petroleum Oil in Derbyshire.

Mr. Kellaway, answering Lieut.-Col. Clay, said that the Hardstoft well is the only one which has been completed to date, that it has given an average weekly production of 1,734 gallons, and that this yield should be largely increased when pumping machinery has been installed. No adequate estimate of the cost per gallon can be framed at the present time.—(Nov. 27.)

German Dyes.

Sir A. Geddes informed Major McKenzie Wood that approximately 200 tons out of a total of 600 tons so far requisitioned is now in transit. The Reparation Commission has not been formally established, and therefore no final decision has been taken as to the values to be credited to Germany. The prices to be charged to consumers will be announced shortly.—(Dec. 1.)

Price of Coal Gas.

Asked by Mr. Alfred Short if the reduction in the price of domestic coal would carry with it a reduction in the price of domestic gas, Sir A. Geddes replied that he hoped so, but there were other factors besides cost of coal determining the cost of gas. He could not hold out any hope of a general reduction in price before the next quarterly meter readings. Coal used for making gas and electricity is included in the coal to be affected by the 10s. reduction.—(Dec. 1.)

Employees in National Factories.

Mr. Hope, answering Mr. Gilbert, issued a statistical statement detailing the number of workers, male and female, engaged in each of the national factories on November 11, 1918, and at the present time. The total numbers are 305,888 and 33,651, respectively. The explosives factories now employ 3,375 workers, compared with 36,761 a year ago, and the anti-gas factories 216, as against 12,512. (Dec. 1.)

Basic Slag.

Sir A. Boscawen, for the Board of Agriculture, and in reply to Mr. Forestier-Walker, said that it was quite possible to obtain basic slag with a total phosphate content of over 24 per cent. The deliveries of this grade during the five months ending October 31 last were 66,200 tons. Any shortage that may exist is due to excess of demand over supply, and the Board has no control over the production.—(Dec. 2.)

Linseed Cake.

The shortage of linseed cake, said Mr. Roberts in reply to Mr. Remer, is purely local, and is due to lack of adequate transport facilities. The recent export of 5,000 tons of American linseed cake to Holland was permitted as a special measure in order to relieve congestion at the ports.—(Dec. 2.)

Spelter.

In answer to Mr. Bird, Mr. Bridgeman stated that the agreement made in September, 1918, between the Ministry of Munitions and the British Zinc Smelters terminated on November 5 last, and under it the prices paid to the producers by the Government were considerably in excess of the prices realised on sale to consumers, but the actual loss cannot yet be given.—(Dec. 2.)

Superphosphates.

Sir A. Boscawen, in reply to Mr. Harry Hope, who asked that steps might be taken to facilitate the the importation of Algerian and Tunisian rock phosphate for use in superphosphate manufacture in place of the low-grade material now being obtained from America, said that arrangements have already been made in the direction indicated, and that the total deliveries from North Africa to the United Kingdom for the present year will amount to 277,000 tons. Next year much larger quantities should be available from this source.—(Dec. 3.)

Anglo-Persian Oil Co.

Answering Major Barnes, Mr. Chamberlain said that H. M. Government holds 2,000,000 £1 ordinary shares in this company out of a total of 3,000,000, and has agreed to subscribe for a further 3,000,000 shares, of which 2,000,000 will be shortly paid up in full and the call of 19s. on the remaining 1,000,000 will not be paid for some years.—(Dec. 3.)

LEGAL INTELLIGENCE.

WORKMEN'S COMPENSATION AND POISON GAS MANUFACTURE. *H. Dutton* v. *Sneyd Bycars Co., Ltd.*

In the Court of Appeal, on November 10, Lords Justices Warrington and Atkin and Mr. Justice Eve delivered judgment on an appeal from an award of the Judge of the Burslem County Court, sitting as arbitrator under the Workmen's Compensation Act.

Dutton became incapacitated by gas poisoning when engaged in the manufacture of poison gas in the defendants' factory. For a time he received full wages, but when he had partly recovered and was able to do light work for a colliery company these payments were reduced, and he claimed compensation under the Act. It was admitted that the disease contracted was not scheduled in the Act, but Dutton contended that the employers were estopped by their conduct from denying that the case came within the Act, and the County Court Judge upheld his view. Their Lordships, however, upset this decision, holding that the operation of the Act was confined to a certain class of cases, and the parties could not by any form of estoppel or by agreement extend the limited statutory jurisdiction.

ENGLISH PARTNERSHIP IN GERMAN PATENTS. *A. V. Derry* v. *C. R. Altenheim.*

In the Chancery Division, on November 17 and 18, before Mr. Justice Russell, Mr. A. V. Derry, a partner in the firm of W. Edward Kochs and Co., colliery machinery exporters, of Sheffield, sought a dissolution of partnership, dated April 17, 1902, between that firm and Heinrich Koppers, of Essen. The question at issue was whether the patents taken out by Koppers for coke ovens and by-products plant belonged to him or to the firm, and whether the Public Trustee, as custodian in whom the Board of Trade had vested the patents, held them absolutely or as trustee for the partnership (Koppers Coke Ovens and By-Products Co.). It was submitted by the partners that under the contract all English patents taken out by Koppers belonged to the partnership. The Public Trustee on the other hand contended that, but for the vesting Orders, the English patents would all be the property of Koppers, and were now vested in the Public Trustee absolutely.

His Lordship held that, although the patents were in Kopper's name, they had throughout belonged in equity to the partnership.

ALUMINIUM SULPHATE CONTRACT DISPUTE. *T. W. Watson and Co.* v. *Messrs. Mann and Cook.*

This case was argued in the King's Bench Divisional Court on November 20, before Mr. Justice Coleridge and Mr. Justice McCardie, the plaintiffs seeking to set aside an award made by two lay arbitrators in favour of defendants with regard to two contracts for the supply of sulphate of alumina. In February, 1918, Messrs. T. W. Watson and Co., of London, contracted to supply Messrs. Mann and Cook, also of London, with 50 tons and 40 tons of this material at £10 5s. per ton. The goods were not delivered, and defendants bought against plaintiffs at a much higher price, claiming the difference as damages. The arbitrators awarded defendants £517 10s. damages. The motion to set aside this award was based on the alleged erroneous conduct of the arbitrators.

It was eventually agreed between the parties that the matter should be referred to a legal arbitrator.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for November 27 and December 4.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, from firms, agents or individuals who desire to represent U.K. manufactures or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the department mentioned and quoting the specific reference number.

Locality of firm or agent.	Materials.	Reference number.
Canada	Drug specialities	1092
"	Glass, crockery	*
"	Spices and vanilla beans	*
Ceylon	Oils, paints, perfumery, china, glass	1096
Egypt	Carbolic acid, nitric acid, candles, oils, paints, soap, leather, etc. (tender for)	†
New Zealand	Upright incandescent gas mantles	1094
Belgium	Aspirin, serums, pharmaceutical products	1100
"	Aniline and other wool dyes	1101
"	Cement, plaster, refractories, pottery, etc.	1103
"	Margarine, soap, cattle food	1106
"	Special steel for tools, files, springs, etc.	1108
"	Soap, perfumery	1159
Germany	Steel cylinders, spiegeleisen, steel alloys, high speed steel, engine oil, lubricating oil, tar oil	1113
Italy	Soap, perfumery	1115
"	Electric high-tension porcelain insulators	1116
"	Dyes, colours, paints, leather, paper, varnish, oils, roofing tiles	1163
"	Paper, bricks, hides, leather	1164
Netherlands	Metals (copper, tin, zinc, aluminium, etc.), galvanised steel sheets	1165
Portugal	Drugs, hides, metals, cement	1119
Spain	Chinaware	1123
" (Canary Isles)	Perfumery	1125
Palestine	Paint, varnish	1171
Morocco (French Zone)	Paints	1131
United States	Chemicals	1135
Argentina	Iron, steel, black and galvanised sheets, metals	1173A
Uruguay	Paint, glass, china, white metal sheets and wire, yellow metal, copper, zinc	1174
Brazil	Chemicals, drugs, tinplate	1175

* The Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

† The Department of Overseas Trade, 73, Basinghall Street, E.C. 2.

MARKET SOUGHT.—A firm in Portuguese East Africa able to export oil-seeds and copra desires to get into touch with importers in the U.K. [1132.]

TARIFF. CUSTOMS. EXCISE.

Argentina.—It is proposed to raise the import duty on whisky to 1 peso (gold) per litre or per bottle.

Australia.—Licences will be required for all goods on the prohibited list arriving in the Commonwealth after November 30.

Brazil.—Copies may be inspected at the Department of Overseas Trade, 73, Basinghall Street, E.C. 2, of the sections of the proposed new tariff relating to chemicals, drugs, dyes, perfumery and pharmaceutical specialities.

British Honduras.—An export duty at the rate of 2 dollars per 1000 has been levied on coconuts as from October 4.

British India.—The export of raw jute and of certain hides and skins is now generally permitted.

Denmark.—Export prohibitions have been removed from, *inter alia*, aluminium, antimony and its compounds, asbestos, bone oil, casein, cocoa, copper, copper ashes, copper alloys, cork, fatty acids, glue, glycerin, goat skins, gun metal, iron alloys, tinned and galvanised iron plates, kapok, lead, lead ashes, lubricants, nickel, resins, rubber, soap, tallow, tin, tin ashes, tin alloys, tungsten (raw), vanadium ore, vaseline, vegetable fibres, zinc, zinc ashes and zinc alloys.

Dominican Republic.—The new tariff comes into force on January 1, 1920, and is notable for the large number of articles placed on the free list. A copy of the complete tariff may be seen at the offices of the Department, 73, Basinghall Street, E.C. 2.

Esthonia.—The regulations respecting foreign trade are set out in full in the issue for December 4. Among the articles of "luxury" the import of which is prohibited are chocolate, wines, spirits, ornamental pottery, china and porcelain, certain kinds of glass and perfumery.

Falkland Islands.—Export duties of 1s. 6d. per barrel of 40 gallons have been levied on whale and seal oils, and of 1¼d. per 100 lb. on guano of all kinds.

France (*Algeria*).—Copies of the Decree respecting the import, sale and storage of dynamite and other nitroglycerin explosives may be seen at the Department of Overseas Trade, 73, Basinghall Street, E.C. 2.

Germany.—The list of iron and steel manufactures exempt from export duty is given in the issue for November 27.

Jugo-Slavia.—Certificates of origin are required for all imported goods.

Madagascar.—The rates of duty leviable on imports covered by the "coefficients of increase" are the same, with few exceptions, as those leviable on similar goods imported into France under the Decree of July 8.

Paraguay.—The Tariff of Valuations has been revised and the official valuations of almost all imported goods have been greatly increased. Among the articles affected are drugs, medicines, glass, china, stoneware, leather, fine soap and perfumery, but edible oils, kerosene, salt, sugar, and soap are exempt from the increase. The Decree came into force on October 1.

Portugal.—The export surtaxes on cocoa and chocolate have been withdrawn.

Rumania.—Certain customs laws now in force have been extended so as to be applicable in Transylvania, the Bukovina, the Banat and other territories united to Rumania.

South Russia.—Licences will only be issued for the export of goods which have been covered by imports. The export of, *inter alia*, benzine, metals, ores, hides, salt, potash, soda, salomas (solidified sunflower seed oil), alcohol, and oil cake is reserved to the Government.

Spain.—The import of saccharin for use in the manufacture of cigarette papers is now permitted, and duty is leviable at the rate of 50 pesetas per kilogram.

It is proposed to revise the customs tariff and in the meantime to put into force a "transitory" tariff. The permanent tariff will probably be introduced in January, 1921.

Uruguay.—Among the articles the export of which is prohibited are dyes, imported medicines, iron, steel, copper, tin, lead, zinc, aluminium, antimony (and their alloys, including tinplate and galvanised iron), paints, varnishes, and imported pharmaceutical products.

TRADE NOTES.

BRITISH.

Trade of Hong Kong in 1918.—The world-wide shortage of mercantile shipping has had a marked effect upon the trade of the colony, which is almost entirely dependent upon ships for its prosperity. Decreases in the imports of oil (23,536 tons), coal (371,325 tons), and cotton yarn and cotton (23,556 tons) are put down to this cause. The imports showed an increase in the cases of liquid fuel (24,979 tons) and sugar (115,423 tons). Refined sugar was in great demand in China and the Persian Gulf, but here again business was restricted by the shortage of tonnage. The year was favourable for cement manufacturers, demand continuing to be good.

Trade has suffered by the political chaos existing in China. The statistical position of trade in most goods, however, is sound, and with settled conditions the prospects of business would be encouraging.—(*Col. Rep.—Ann.*, No. 1001, Oct., 1919.)

FOREIGN.

Dutch Imports of Chemical Products and Raw Materials.—According to "Maandstatistiek In- en Uitvoer" for 1917, 1918, and 1919 the imports of chemical products and raw materials into Holland for the first half of each respective year were as follows:—

Material.	1917.	1918.	1919.	Source.	Percentage. 1917.	1918.	1919.
	Tons.	Tons.	Tons.				
Soda ..	9,967	2,933	16,278	Germany	13·4	1·12	44·3
				England	65·4	94·9	54·4
Potash ..	4,037	340	710	Germany	100	59·5	94·4
Dyes ..	216	25	109	Germany	99·5	100	100
Organic dyestuffs	138	21	79	Germany	100	100	52
				England	—	—	45·5
Other chemical products	8,131	10,087	12,182	Germany	62·5	46·0	56·4
				England	13·0	4·3	15·4
				Norway	—	14·9	23·6
				Sweden	15·6	17·0	15·6
Turpentine	1,094	—	1,742	England	62·8	—	7·2
				U. States	31·3	—	79·7
Tar ..	201	—	2,259	Germany	1·5	—	31·5
				Belgium	—	—	26·1
				Denmark	—	—	11·6
Wax ..	—	1	251	England	—	100	83·2
Chile saltpetre	24,850	1,128	133,982	England	0·01	—	82·4
				U. States	40·3	—	7·2
				Chile	59·4	100	59·8
Sulphur .	48	—	316	England	—	—	82·3
				Italy	52·0	—	17·4
				Germany	45·4	—	—
Oleic and other fatty acids ..	63	981	4,280	England	100	99·9	83·0

—(*Z. angew. Chem., Oct.* 21, 1919.)

The Dutch Glass Industry.—A "community of interests" (I.G.) has been formed, embracing the firms "Manufacture Royale des Glaces de St. Gobain" in Paris and "De Schie" in Schiedam, which should result in a greatly increased output from the latter firm as soon as economic conditions permit. The former company has also established a "community of interests" with the "Eerste Hollandsche Vensterglasfabriek," in Maassluis. The "Eerste Hollandsche Vensterglasfabriek" contemplates supplementing its manufacture of window glass (Fourcoult process) by the production of other wares.—(*Z. angew. Chem., Oct.* 21, 1919.)

The Pharmaceutical and Chemical Industries of Spain.—In an article in *Le Industrie Italiane Illustrate* it is pointed out that for some time strenuous efforts have been made by the United States, France, and England to secure a hold upon the Spanish market before other countries are in a position to compete with them. Although the home production of a few specialities was increased during the war, it is insufficient to meet the demand, and, undoubtedly, the country offers a good market for pharmaceutical and chemical wares. The present position is, approximately, as follows: Resinous products are manufactured by the important Union Resinera Espanola, which has a capital of 20 million pesetas (peseta =9½d.), with many factories and branches. Important also are: La Pennaroa y La Sociedad Aninima Cros, La Sociedad Barcelonesa de Colas y Abonos, Industrial Quimica de Zaragoza, Etablissements Gallard, Union Espanole de Fabricas de Abonos, and others manufacturing mineral acids, superphosphate, glue, etc. Among companies of lesser importance mention should be made of the promising Solvay firm, which runs its own potash mines.

Three factories are being erected to produce nitrates by fixation of atmospheric nitrogen. One in Viana, has 8000 h.-p. available; another, at Lerida, uses over 25,000 h.-p., which could be increased to 75,000; and the third is in Corcubion. During the war other factories were started, but both their technical direction and their products are so poor that they are expected to close down when better supplies of nitrate become available from abroad. Imports for 1913 were as follows: Vegetable products, including coconut oil, palm oil and other vegetable oils, dye woods and barks, tanning materials, linseed and sesame, medicinal preparations, etc., 75,256 metric tons, of which linseed and sesame accounted for 70,848 tons. Imported dyes included mineral colours, dye extracts, prepared dyes, lakes, inks, tinctures, coal tar dyes, aniline oil, aniline hydrochloride, etc., and of the total 15,770 tons, Germany supplied 30%, France 27%, England 14%, and Italy 7·4%. Products such as acids (acetic, citric, tartaric, hydrochloric, sulphuric and carbolic), naphthalene, carbonates and borates, chlorates, chloroform, ether, phosphorus, lead oxides, etc., were imported to the extent of 23,052 tons, and were derived mainly from Germany, France, and England. Italy supplied chiefly citric and tartaric acids.

The writer of the article urges Italian chemical manufacturers to prepare for keen competition in regard to the supply of citric and tartaric acids not only in Spain, but also in America. Pharmaceutical products were imported from Italy to the extent of 546 tons. Italian manufacturers are advised to develop the production of medical supplies and perfumes, more especially as the raw materials therefor—sulphur, tartaric acid, mercury salts and quinine—are largely of Italian origin. Remarking on the strenuous attempts made by various countries to capture the Spanish market, the writer eulogises the efficiency of English propaganda in the Spanish chemical trade.—(*Z. angew. Chem., Oct.* 21, 1919.)

COMPANY NEWS.

ELECTRO-BLEACH AND BY-PRODUCTS, LTD.

An extraordinary general meeting was held in Manchester on November 14 to consider the directors' proposals to raise the nominal capital of the company from £180,000 to £480,000 by the creation of 200,000 7 per cent. participating preference shares of £1 each, and a like number of ordinary shares of 10s. each, and to issue 80,000 shares of each denomination.

Mr. H. J. Mackinder, chairman, in explaining the above proposals, referred to the profits made by the company for the years 1915—1918 (£31,492, £48,942, £48,068, and £60,751), to the dividends paid on the ordinary shares (7, 7, 10, and 12½ per cent.), and, in answer to the criticism that these were war profits and could therefore not be taken as a guide for the future, said that during these years many exceptional difficulties had been encountered and that their trading had been circumscribed by Government control. The money resulting from the proposed new issue would be devoted to repaying the Government (£45,890) for extensions and purchase of plant, to the redemption of the outstanding debentures (£50,500), and the balance to extensions and development. During the years 1914 to 1918 the sum of £220,793 was spent on buildings, plant, etc., in addition to the purchase price of £150,000, and these items had been written down in the company's books to £256,607. No value had been assigned to goodwill and patents. The profits for the current year were very satisfactory, and an interim dividend at the rate of 12½ per cent. per annum would now be paid in respect of the half-year ended June 30 last. The new shares would rank for dividend, *pari passu* with the old, immediately after the payment of this interim dividend.

Resolutions embodying the proposals were passed unanimously, and these were subsequently approved at separate meetings of the preference and ordinary shareholders.

ZAMBESIA MINING DEVELOPMENT, LTD.

On November 18, in London, Sir Alfred Sharpe, presiding at the sixth ordinary general meeting, stated that during the war the company had acquired the whole of the mineral rights over the extensive Zambesi coal area, in which exist not only coal, but gold, copper, iron, mica, and other minerals. The impending construction of the Beira-Zambesi railway should solve the problem of cheap transport, the existence of accessible coal in large quantities had been proved, and the quality of the coal was now being ascertained. In this connexion the services of Mr. E. H. Cunningham-Craig and of Mr. J. Arthur Greene, as technical adviser on minerals, had been secured. In a preliminary report the former states that the coal, as is common in South Africa, "is somewhat high in ash, but the percentages of volatile matter and fixed carbon are good." An analysis by the Director of Mines of the Companhia da Zambesia gave: Ash, 13·2%; coke, 75%; fixed carbon, 60%; calorific power, 12,400 B.Th.U.

NEW CAPITAL ISSUE.—*Newcastle-upon-Tyne Electric Supply Co., Ltd.*, is issuing 1,500,000 7 per cent. cumulative preference shares of £1 each at par to finance extensions, etc. The company is the largest producer of electrical power in the United Kingdom, the total capacity of its plant being 370,000 h.-p. By means of new plant about to be installed it is hoped to effect a saving of over £100.000 per annum on coal consumption.

SANTA CATALINA NITRATE CO., LTD.

At the nineteenth annual general meeting, held in London on November 19, Mr. F. G. Lomax, chairman, said that the company had continued to manufacture nitrate at full rate until last January, and at half-rate from then to July, when the works were closed down. Hence the profit on only 135,000 quintals, viz., £18,986, had been taken in the accounts. A dividend of 20 per cent. for the year was recommended.

The Nitrate Association, which comprises all the producers except the German and two American-owned companies, which are debarred from joining by the Sherman Law, has made an auspicious start, having recently concluded sales aggregating some 25,000,000 quintals of nitrate for delivery during the coming season. (Quintal = 101·5 lb.)

BRITISH OIL AND CAKE MILLS, LTD.

In his address to the twenty-first ordinary general meeting, held in London, on November 19, Mr. J. W. Pearson said that it was proposed to increase the capital of the company from £2,000,000 to £10,000,000 by the creation of 8,000,000 new shares of £1 each, of which 1,250,000 would be issued at par forthwith. The funds to be provided by this issue are required as additional working capital to finance the steadily increasing business of the company, to facilitate the purchase of raw materials at the high level of prices now ruling, and to add to the company's properties. An extensive soap works is being erected at Hull for the manufacture of toilet and household soaps; a margarine factory, refinery, compound lard factory and oil store are in course of erection at Gloucester; and a site on the James Watt dock at Greenock has just been acquired, upon which it is proposed to erect an oil mill designed, *inter alia*, to deal with palm kernels and copra, both of which materials are new to Scotland. It is, further, proposed to acquire a new site in London, where the company's trade has now outgrown its capacity. The directors look forward to a period of considerable expansion in the seed-crushing trade.

During the year covered by the accounts the entire business was under control of the Ministry of Food, but since the end of March last the trade has practically returned to its normal channels. The company's output is steadily growing, and at the present time is half as large again as that of last year, so that the directors have every confidence in the future. They believe that the speedy removal of every vestige of control by the Government in this and every other section of commerce is the true solution of the many problems that are still confronting British industry. The profit and loss account for 1918, after writing off £50,000 for depreciation and placing £49,441 to reserve, shows a credit balance of £217,567. Fifteen per cent. was paid on the ordinary shares for that year, and an interim dividend of 10 per cent. was distributed in September last on account of the current year.

The proposed increase of capital was sanctioned and confirmed at a subsequent extraordinary general meeting.

CAPITAL INCREASES.—*Minerals Separation, Ltd.*—The share capital of this company has been increased to £500,000 by the creation of 450,000 new shares of £1 each.

British Cotton and Wool Dyers' Association, Ltd.—The nominal share capital is to be raised from £500,000 to £1,000,000 by creating 2,000,000 new ordinary shares of 5s. each. The object of the increase is to enable the company to make a partial return to shareholders of capital previously written off, by issuing one new share for every two shares now held by them.

ANGLO-PERSIAN OIL CO., LTD.

The report for the year ended March 31 last states that the net profit amounted to £2,010,805 which, together with £454,722 brought forward, makes £2,165,527, from which £1,200,000 is to be deducted in respect of all claims for excess profits duty up to that date. The preference shareholders receive 8 per cent. for the year, and the ordinary shareholders 10 per cent., free of tax. The carry forward is £275,528. The throughput of the refinery in Persia shows a substantial increase, and the high productivity of the oilfields is still maintained. Work on extensions has been delayed through difficulty in obtaining delivery of plant and machinery. It has been decided to increase the share capital of the company to £20,000,000 by the creation of 15,000,000 new shares of £1 each, whereof 3,000,000 will be £1 preference shares, 4,500,000 ordinary shares, and the balance of 7,500,000 will be issued as ordinary shares, subject to any direction of the company in general meeting to the contrary. There will also be issued £2,600,000 of 5 per cent. first debenture stock at £85 per cent. (£2,400,000 of this stock is already outstanding). H.M. Government, which in 1914 acquired a controlling interest in the company by the purchase of 2,000,000 ordinary shares, 1,000 preference shares, and £199,000 debenture stock, is subscribing for its proportion of the new ordinary shares. The new preference shares are to be issued at £1 3s. per share.

The above proposals were agreed to unanimously at a meeting of preference shareholders, and at an extraordinary meeting of shareholders on December 2. At the latter the chairman, Sir Charles Greenway, stated that the additional capital was required to extend pipe-lines, pumping stations and refineries in Persia; to complete the refinery in course of erection at Swansea; to establish new fuel oil bunkering installations at many British and foreign ports; to increase the distributing facilities of the British Petroleum Co.; to acquire additional tank steamers; to explore and test new territories; and to provide £1,000,000 towards the capital of Scottish Oils, Ltd. (this J., 1919, 277 R, 358 R).

COURTAULDS, LTD.

The directors have recommended that the capital be increased from £2,500,000 to £4,000,000 by the creation of 1,500,000 new ordinary shares of £1 each, ranking *pari passu* with the old; also that the sum of £1,999,993 be taken from the general reserve account and applied to the payment in full of ordinary shares to be distributed to existing shareholders on a share-for-share basis.

NEW REGISTRATIONS.—*British Cottonseed Products, Ltd.*, was registered on November 26 with a capital of £250,000 in £1 shares, to manufacture fibre, husks and other by-products from cottonseeds or decorticated cottonseeds, etc. The directors include Mr. J. W. Pearson and Mr. E. C. de Segundo.

Russo-Asiatic Consolidated, Ltd., has been formed with a capital of £12,000,000 in £1 shares, of which 8,456,972 shares will be issued in part exchange for the assets of the Irtysh, Kyshtim, Russo-Canadian and Tanalyk Corporations. £614,271 convertible 6 per cent. debenture stock will be issued in exchange for the outstanding debentures of the Irtysh and Tanalyk Corporations. The present programme for resumption of work at

the properties calls for production at the following rate:—Copper 10,000 tons, zinc 20,000 tons, lead 12,000 tons, gold 140,000 oz., and silver 1,700,000 oz. The profit on such output is estimated at £2,400,000 per annum.

REVIEWS.

ASPHALTS AND ALLIED SUBSTANCES. THEIR OCCURRENCE, MODES OF PRODUCTION, USES IN THE ARTS AND METHODS OF TESTING. *By H. Abraham. Pp. 606, and 208 illustrations. (London Crosby, Lockwood and Sons. 1919.) Price 25s. net.*

This admirable monograph has been written from the points of view of the works chemist who tests and analyses the raw material, the refinery manager who blends the asphaltic and bituminous substances, the salesman who vends the finished products, and the engineer, architect and contractor who are the ultimate users.

A valuable historical review introduces the raw materials which were in vogue from about the year 3000 B.C. as cementing agents, as materials for sculpture and casts, for mummification and for building. The story is continued through the ages until modern times, when the use of asphalt for roadmaking forms its chief outlet. It is interesting to note that the first asphalt pavement in England was laid down in Threadneedle Street in 1869, the bituminous medium being Val de Travers asphalt. The nomenclature of the subject has been for a considerable period in a very fluid state; the author, at the outset, gives a convenient system, defining bitumen, pyrobitumen, petroleum, asphalt, asphaltite, tar and pitch, and including in his scheme mineral oil, asphalts, shales, mineral waxes, residual oils, grahamite, gilsonite, peat, lignite, cannel and bituminous coals.

The chemistry of bituminous substances is very briefly described, and it is assumed that the homologous series of paraffins, cyclo paraffins, "polycyclicmethylenes," "cycle olefines," and condensed aromatic systems occur in petroleum and allied substances, although very scanty experimental evidence is forthcoming. It is scarcely correct to say (p. 42) that "the composition of petroleum . . . . has been largely unravelled," although the lighter distillates are pretty well identified. So far as the reviewer knows, excepting the waxes, no definite and chemically characterised individual hydrocarbon has yet been isolated from the high boiling components of petroleum, and still less has any success attended the efforts to formulate the sulphur, oxygen and nitrogen containing constituents.

A convenient trilinear co-ordinate graph for carbon, hydrogen and oxygen in bituminous substances is described in this section, and examples of its application for classification are given. It is somewhat surprising that the author has not discussed the colloidal nature of the materials with which he deals. Attack from the purely chemical standpoint is particularly difficult, in view of the extreme complexity and the impossibility at present of effecting sharp separations between individual substances which are more or less decomposable. The colloidal condition, however, affords another avenue of approach and one of great promise. In the chapter devoted to the geological occurrences of bitumens, the author discusses briefly the origin of these substances, and concludes that they represent the more or less complete metamorphism of petroleum. The refining of asphalt by dehydration, sedimentation and extraction is shortly developed, and then follows a most comprehensive account of the sources, occurrences, properties and uses of the chief varieties of bitumen. This section is very fully illustrated by analyses.

A survey is made of the general methods for the production of tars and pitches, and the bituminous materials associated with the distillation of coal, wood, peat, lignite and shale are described, whilst the asphalts obtained from petroleum by topping, or air blowing, are discussed in detail and their blending described. The manufacture of paving materials, bituminised fabrics for roofing, flooring and insulation, adhesive compounds, waterproofing compounds, paints, cements, varnishes, enamels, and japans is handled very fully and comprehensively. The final chapters deal with the chemical and physical examination of the raw materials, intermediate substances and finished products, and form a most useful compendium from the point of view of the analyst. From the point of view of the get-up, printing, and illustrative matter, the book is exceedingly well produced, and this, in conjunction with the undoubted importance of the subject, makes it an invaluable addition to the petroleum technologist's library.

A. E. DUNSTAN.

THE NATURE OF ENZYME ACTION. *By* W. M. BAYLISS. *Monographs on Biochemistry, edited by* R. H. A. PLIMMER *and* F. G. HOPKINS. *Fourth edition. Pp. viii + 190. (London: Longmans, Green and Co., 1919.) Price 7s. 6d. net.*

The appearance of a fourth edition of this work is a significant indication of its value and popularity as a general account of enzyme action. The principal change introduced in the new edition consists in the rewriting of the old chapter on "The nature of the combination between enzyme and substrate" under the new title, "The mode of action of enzymes." This chapter is of the highest interest to biochemists, inasmuch as it deals with the author's well-known "adsorption theory" of enzyme action, which has been consistently advocated throughout the various editions of this book. The author's view, as expressed in the general conclusions at the end of the book, is "that the 'compound' of enzyme and substrate, generally regarded as the preliminary to action, is of the nature of a colloidal adsorption compound so that the action of enzymes in general must be regarded as exerted by their surface. By surface condensation the reacting constituents are brought into intimate contact and reaction accelerated by mass action. Whether chemical combination between enzyme and substrate occurs in any stage of the process is not yet decided."

It is pointed out that the most serious objection to this view is afforded by the highly specific action with which enzymes are usually credited. To put a simple case. If the hydrolysis of cane-sugar is accelerated by invertase by means of a simple concentration of the sugar molecules and the hydrolytic agent (water or its jons) on the surface of the colloidal particles of the enzyme, why is this enzyme without action on other sugars such as maltose and lactose? And why are the enzymes maltase and lactase equally specific in their action?

The answer to such inquiries is that, in the first place, adsorption has in many cases been shown to be specific and to be conditioned by the chemical nature of the adsorbent and the adsorbed substance, and that, in the second place, it is probable that in many cases of enzyme action the specificity is not absolute but relative, one reaction proceeding very much more rapidly than the other. Both these contentions seem to require much further experimental

confirmation before they can be accepted as a sufficient explanation of the facts, and they obviously afford ample opportunities for research on this fundamental problem.

The frank and suggestive discussion of debatable points is one of the great charms of the present work, and the reader feels that not only is he being put into possession of well-established facts, but that the difficulties are faced and the too frequent gaps in our knowledge clearly indicated.

ARTHUR HARDEN.

STEREOCHEMISTRY. *By* A. W. STEWART. *Second edition. Text-books of Physical Chemistry edited by Sir W. Ramsay. Pp.* 277. (*London: Longmans, Green.* 1919.) *Price* 12*s.* 6*d. net.*

It is close upon half a century since Le Bel and van't Hoff, adopting a suggestion made independently by Wislicenus and Pasteur, developed the theory of stereochemistry, or the space arrangement of atoms in a molecule—a theory which immediately solved with striking simplicity many outstanding problems of isomerism among organic compounds.

The subject—partly from its novelty, and partly, no doubt, from the simple chemical and physical methods of investigation involved—attracted at once a number of workers. The amount of material which has since accumulated, and the various special treatises on the subject which have appeared, attest the interest which the theory has aroused.

The theory is based on the spatial distribution of the bonds or valency directions not only of carbon, but of any multivalent element, provided the bonds are capable of arrangement in three-dimensional space. Moreover, if the central multivalent atom is attached to radicals which differ from one another, an unsymmetrical figure may be produced, which, like a hand or foot, can exist in forms bearing the relation of object and mirror image which do not overlap, and which manifest themselves by rotary polarisation or optical activity of a right-handed and left-handed character.

In this way derivatives of carbon, silicon, sulphur, selenium, nitrogen, phosphorus, lead, and tin have been obtained in optically active forms. Although no very new developments have taken place in recent years, the subject is by no means exhausted, and there remain many unsolved problems which await solution.

The connexion between rotatory polarisation and asymmetry is still unexplained, and there is little apparent co-ordination between the quantitative value of the rotation produced by the combination of different radicals and their nature.

The meaning of the "Walden inversion," or change of sign of rotation by the replacement of one radical by another, as well as of geometrical inversion, or the conversion of one unsaturated compound into the isomeric form by different physical and chemical agencies, is still obscure.

Nor is the action of enzymes, or vital catalysts, in producing one or other of the active forms of carbon compounds the least complex nor the least fascinating of these problems.

Nevertheless, the principle of atomic space arrangement may be said to be firmly established, not only by its remarkable agreement with many authenticated facts, but by the direct experimental evidence of crystal structure so brilliantly demonstrated by the Braggs.

The new edition of Professor Stewart's book follows very much the former arrangement, and deals with every phase of this many-sided subject, which includes not only the stereochemistry of carbon compounds, but that of silicon, phosphorus, cobalt, chromium, and the platinum metals, as well as such subjects as "steric hindrance," in which space distribution of neighbouring radicals is supposed to be the underlying cause, the space formulæ of cyclic structures, including benzene, the arrangement of atoms in crystals, and the relation of stereochemistry to physiology. In the comparatively small compass of 260 pages it would scarcely be possible to enter into any great detail, but the ground is conscientiously surveyed, and the very complete list of references is not the least valuable part of the monograph.

We venture to draw the author's attention to the following errors and omissions which we have noticed in perusing a few of the chapters. The conversion of *l*-aspartic acid into *l*-chlorosuccinic acid by nitrosyl chloride (p. 63) was not the discovery of Walden, but of Tilden and Marshall, and the formula given to valine on the following page is that of aminobutyric acid. In the same chapter, on the Walden inversion, we can find no mention of the many important contributions to the subject by McKenzie and his co-workers, and the interesting case discovered by them of the difference in the effect produced by phosphorus pentachloride and thionyl chloride on the rotation of phenylchloracetic acid is also omitted. The author appears to follow Fischer in deriving *d*-gulose from *d*-glucose, whereas Rosanoff has clearly shown that *d*-gulose, *d*-xylose, and *d*-threose correspond in configuration to *l*-glucose, and that consequently *l*-tartaric acid corresponds to *d*- and not to *l*-threose (p. 57).

The chapter on steric hindrance, which occupied too large a share of the space in the previous edition, has been wisely curtailed and replaced by more valuable material. The book is too well known to need any recommendation from the reviewer, for it is unquestionably the most comprehensive treatise on the subject in the English language.

J. B. COHEN.

PUBLICATIONS RECEIVED.

BACTERIOLOGY AND MYCOLOGY OF FOODS. *By F. W. Farmer. Pp.* 592. (*London: Chapman and Hall, Ltd.*, 1919.) *Price* 28*s.*

IONS, ELECTRONS, AND IONISING RADIATIONS. *By James A. Crowther. Pp.* 276. (*London: Edward Arnold*, 1919.) *Price* 12*s.* 6*d.*

CHEMISTRY FROM THE INDUSTRIAL STANDPOINT. *By* P. C. L. THORNE. *Practical Text-Books of Commercial and Industrial Education. New Teaching Series. Pp.* 244. (*London: Hodder and Stoughton.* 1919.) *Price* 4*s.* 6*d.*

COMBINES AND TRADE ORGANISATIONS. *By John Hilton. Pp.* 138. (*London: Harrison and Sons.*) *Price* 1*s.*

A BIBLIOGRAPHY ON THE ROASTING, LEACHING, SMELTING AND ELECTROMETALLURGY OF ZINC. *Compiled by* H. L. WHEELER. *Bulletin No.* 3, *Vol. IV., of the School of Mines and Metallurgy, University of Missouri, revised to June*, 1919. *Pp.* 386. (*Rolla, Missouri*, 1918.)

PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY. DEPARTMENT OF THE INTERIOR. (*Washington: Government Printing Office.* 1919.)

PHOSPHATE ROCK IN 1918. *By* R. S. STONE.

GRAPHITE IN 1918. *By* H. G. FERGUSON.

SODIUM AND SODIUM COMPOUNDS IN 1918. *By* R. C. WELLS.

ANTIMONY IN 1918. *By* H. G. FERGUSON.

SLATE IN 1918. *By* G. F. LOUGHLIN *and* A. T. COONS.

THE AMERICAN DYE INDUSTRY

The papers presented to the Dye Section of the American Chemical Society in September last, which appear in the November issue of *The Journal of Industrial and Engineering Chemistry*, throw interesting light on the problem of dye production as it presents itself to industrial chemists in the United States. It is now admitted on all sides that the national value of a flourishing dye industry is not by any means to be measured entirely on an economic basis, but is intimately involved in matters of such vital importance to national life as the maintenance of the educational and material standards necessary for defence against both military and commercial aggression. It is clearly realised that the growing American industry, with a present capital of over a hundred million dollars, must, like the British dye industry, be protected during its development against more experienced foreign competitors. This end is being secured by a procedure very similar to that adopted in this country. In the first place, a scheme was devised by which enemy-owned United States patents were compulsorily purchased and their use licensed under payment of royalties, thus rendering them available to manufacturers without risk of subsequent legislation; and, secondly, the Longworth bill, which is at present before Congress, proposes very material increase in the tariff rates on coal-tar products, and at the same time sets up a Licensing Board of consumers and producers to control the importation of such dyes as are not at present economically produced in the United States. The system is to continue for two years, at the end of which period it is thought that the industry will be firmly established.

The many problems arising in the actual synthesis of the colours are being vigorously attacked, and that considerable progress has already been made is borne out by the estimate that nearly twice as many different dyes are now made in the United States as were produced before the war. At the same time much still remains to be done, for less than a quarter of the different dyes imported before the war can as yet be manufactured by the home industry. This, however, includes many special dyes which were not used in large quantities. It will evidently be a very long time before the American dye industry approaches in efficiency the pre-war German standard, for an immense amount of research remains to be carried out even in the identification of the unknown dyes and intermediates, not to mention the working out of processes for their commercial production when identified. Thus, in dyes of the azo group alone nearly a hundred are at present unclassified.

The lack of knowledge of the constitution and method of manufacture of dyes is of course largely due to the complexity of the specifications of patents covering them. In the majority of cases it is extremely difficult to correlate a particular dye and the patent or patents covering its manufacture, for the patentee has naturally taken care to make the relation as obscure as possible, and has multiplied to the full the number of false trails upon which an investigator may be led away from the objective. Nevertheless, the patent literature is of very great value, particularly in indicating lines of research which are likely to give results of importance. The other obvious method for the solution of the problem of an unknown colouring matter, namely, the chemical analysis of the dye, followed by the working out of methods for its synthesis, is in most cases equally difficult. The chemical splitting of the molecule of an unknown dye may give rise to components which, besides being difficult to isolate, are themselves unknown or imperfectly described in the literature. In this connexion a proposal for the preparation of a complete catalogue of dyestuff intermediates is interesting. Such a catalogue, it is suggested, should include a brief description of each known intermediate and its relation to known dyes, and should be revised periodically as fresh information accumulates. A further suggestion is to the effect that the universities should co-operate with the industry both in the preparation of the catalogue and in research work on intermediates, particularly in the case of the amino-derivatives resulting, along with the common bases, from the disintegration of the azo dyes by reduction, these compounds being in many cases imperfectly known. The application of the principle of the direct co-operation of university laboratories in the solution of industrial problems, while no doubt valuable during times of special national stress, would appear to need very careful control if in the long run it is not to produce the very opposite of the effect intended. The university laboratories, which are the nurseries of chemical ideas, require direction from within upon idealistic lines, rather than from without upon utilitarian.

One of the chief difficulties facing the American dye industry is that of the economic production of certain of the more modern and valuable dyes, which, while their constitution and method of manufacture are more or less perfectly known, are so complex that their production on the commercial scale is at present impracticable. Numerous problems in the production of intermediates will have to be solved before such colours can reasonably be produced by American manufacturers. When it is reflected that nearly four hundred intermediates were utilised in Germany and Switzerland before the war for the production of dyestuffs, it will readily be realised that a considerable period must elapse before anything approaching the foreign range of colour products can be attained. The economic production of intermediates is, however, steadily progressing in the hands of American chemists, as may be illustrated by reference to the recent notable advance in the manufacture of phthalic anhydride by the atmospheric oxidation of naphthalene in the presence of a catalytic mixture of metallic oxides.

Besides the actual chemical processes involved in the manufacture of dyestuffs, attention has been given to the numerous problems arising in the mechanical handling of the various products, such as in the efficient drying, grinding and standardisation. These are in general physico-chemical rather than purely chemical questions, and physico-chemical methods have been applied for their solution. There is nothing particularly novel in the tests described for stability during such treatment, but the results are of great value as a guide in large-scale trials. Clearly, the accumulation of accurate information on such subjects as the explosibility and inflammability of materials to be handled in bulk is just as essential as the exact investigation of the chemical processes involved in their synthesis, and, although laboratory methods are not in general so reliable in the former case, they yet afford information which is at the same time serviceable and difficult to obtain in any other manner. A final paper deals with application of physico-chemical methods to the separation and purification of intermediate products and to the analysis of mixtures. Here again the methods described contain nothing new, although, as is pointed out, their present application in industrial chemistry could with advantage be very considerably extended. The physical chemist is capable of supplying invaluable data to the organic chemist

and to the chemical engineer for the solution of the problems of dye manufacture, though up to the present but little of his energy has been expended in this direction.

The dye industry in the United States would appear to have arrived at a stage corresponding very closely with that in our own country. Its development is being taken very seriously both by capitalists and by technologists, and it may be expected that within a very few years characteristic American enterprise and energy will have succeeded in making up much of the long lee-way which at present remains.

NOTES ON THE MANUFACTURE OF LETHAL GASES IN GERMANY. *

FRANCIS H. CARR.

The different stages of the process used in Germany to manufacture "mustard gas" (this J., 1919, 158 R) were curiously enough carried out in two widely-separated factories—the thio-diglycol being made in the Badische works, and the combination with hydrochloric acid being effected in the Bayer factory. At the former works the ethylene was made from ethyl alcohol vapour by passing over a catalyst of alumina contained in an annular tube of copper which was heated by a bath of molten potassium nitrate at 400° C. There were about 60 units, and some were always out of action. The catalyst remained active for about ten days only. The gas was passed through a scrubber to the reservoir, and from this through a meter, together with carbon dioxide delivered through another meter, into a horizontal cylinder which contained the charge of bleaching powder and water stirred by beaters. The hypochlorous acid, set free gradually by the carbon dioxide, entered into violent reaction, which was moderated by external cooling, the liquid being circulated through a coil traversed by cold brine, the temperature being thus kept down to about +5° C. After three or four hours the mixture was pumped through filter presses which retained the calcium carbonate, and the liquor sent to the rectifying still, where it was concentrated to 20 per cent. chlorhydrin. In peace time this was used in the manufacture of indigo, and the greatly increased production is now again available for this purpose. The chlorhydrin is then converted into thiodiglycol in a caustic soda plant near by and concentrated in a Kestner evaporator. After separation of the sodium chloride the thiodiglycol is run into tank wagons to be conveyed to the Bayer works. Here the hydrochloric acid gas is passed through glass tubes into it in a reaction vessel fitted with a good stirrer. The simple, but effective, accessories of this, such as the gravity floats to show the amount of liquid, small sample tubes for testing to find the end of the reaction, etc., were designed by the chemist in charge. Glass hoods connected with exhaust ducts were fitted both above and below the reaction vessels, which were about 7 feet in diameter and 6 feet deep. The operation was thus made so safe that it was claimed that only one casualty, not fatal, was experienced in the history of the process. The contents of the vessel were then sucked into another for washing, and again into another for removal of low boiling impurities by vacuum distillation. The purified product was then diluted with carbon tetrachloride and sent to the shell-filling sheds. The criticism has been made that the method used in Germany was complex compared with that which was worked out and used in this country. The operations, however, proved quite easy to a nation possessing such efficient plant and such a high organisation and co-operation between the chemist and engineer. Probably no great need was realised for a more direct process. The impression gained throughout the visit was that any chemical synthesis was regarded as quite easy; adequate pains and due precautions being taken as a matter of course, the result was sure.

The manufacture of arsenic compounds used in gas warfare was carried out in Germany on the dye plants (in the "azo-house") by a simple method. Diazobenzene chloride was coupled with sodium arsenite in the presence of a little copper, and the phenylarsenic acid formed was reduced by sulphur dioxide to phenylarsenious acid. This was sent to another works to be coupled again with diazobenzene chloride, and the resulting diphenylarsenic compound reduced to the diphenylarsenious compound as before. The product was sent to yet another works to be converted into the chloride by the action of hydrochloric acid. The yields were variable, but averaged 60 to 70 per cent. of the theoretical. The cyanide is easily prepared from the chloride by treatment with potassium cyanide. Ethyl dichloroarsine was prepared by combining arsenious oxide with ethyl chloride at 100° C. with vigorous stirring to form ethyl arsenious oxide. The oil was then chlorinated at a pressure of 12 atmospheres, the reaction taking 12 to 16 hours; and finally treated with sulphuric acid and sulphite.

The preparation of dichloromethyl ether was carried out by the dye factories apparently without sufficient physiological investigation, for it had little effect in the field. It was made by adding chlorsulphonic acid to paraformaldehyde dissolved in sulphuric acid and blowing air through the mixture to get rid of the excess of hydrochloric acid.

The preparation of di-phosgene proved very troublesome. Methyl formate was chlorinated in vessels furnished with chlorine pipes and carefully lined first with lead and then with two layers of tiles. (The cement was said to consist of powdered fire-clay, asbestos and sodium silicate.) These precautions are necessary, because any metal introduced into the mixture from the reaction vessel acts as an anti-catalyst. The temperature has to be varied during the reaction to obtain the best results, and further, the action of light is necessary. This was supplied by Osram lamps of 4000 candle power. The reaction takes from 6 to 8 days for completion, and the escaping gases caused many casualties. After all, the di-phosgene proved no more effective than phosgene, the preparation of which is relatively easy. The carbon monoxide used was made from air, not oxygen. The acting gases were passed through meters and the product condensed by freezing.

Other compounds made for this purpose were brominated acetone (lachrymatory), also methyl sulphate and phenylcarbylamine chloride.

On account of his connexion with the British manufacture of box respirators, the lecturer was specially commissioned to inquire into the German activated charcoal, which had proved so efficient. Analysis of some specimens had shown the presence of zinc in traces. This clue was of assistance, and led to the investigation of a plant used for making the charcoal. Ordinary wood was splintered and treated with hydrochloric acid and a little zinc chloride. It was then gently charred in retorts lined with tiles in order that they might resist the action of the vapours evolved. The finished product was thoroughly washed, and should have been free from zinc. The original presence of the zinc compound in the charred wood produces a highly absorptive charcoal.

* From the Chairman's Address to the Nottingham Section, October 22, 1919.

HISTORY OF MUSTARD GAS.

ARTHUR G. GREEN.

In a further article on "mustard gas" (this Journal, 1919, 432 R) Sir William Pope seeks to correct some "chemical fallacies" into which he believes that I have fallen.

He argues that Guthrie (J. Chem. Soc., 1861, **13**, 134) could not possibly have produced mustard gas by the interaction of ethylene and sulphur monochloride, for the following reasons:—

(1) That mustard gas is not produced by this reaction at temperatures much above 60°.

(2) That mustard gas is at once destroyed (chlorinated) upon heating with sulphur monochloride at temperatures higher than 60° or 70° C.

(3) That had Guthrie placed a drop of actual mustard gas under his tongue death would certainly have resulted.

Sir William Pope also asserts that if the Levinstein mustard gas is diluted with an organic solvent such as alcohol or ether the sulphur separates, leaving a solution of the monosulphide. My suggestion that this product is probably a disulphide is therefore, in his opinion, "conclusively refuted."

Whilst I am loth to join issue again with Sir William Pope on these matters, I am compelled to submit that on all these points he is entirely in error.

To exclude all possible doubt, I have recently carried out some further experiments with the kind assistance of Mr. H. F. Oxley. Though the details of these experiments would be out of place here, I am prepared to demonstrate to Sir William Pope, at his convenience, the truth of the following facts:—

(*a*) Mustard gas can be produced of satisfactory purity and in good yield by reacting ethylene with sulphur monochloride at a temperature which is never below 100° C. throughout the whole operation.

(*b*) Mustard gas, whether the monosulphide or the disulphide, is not materially attacked by sulphur monochloride even when heated with it to 100° C. for some hours. The only essential condition for the success of this and the preceding experiment is the employment of pure materials and the entire absence of iron. The latter condition, though present in Guthrie's experiment, is, of course, not fulfilled in the large-scale manufacture, and hence the necessity in this case of working at a low temperature, upon which point we were the first to insist.

(*c*) The Levinstein mustard gas, when prepared under correct conditions, does not deposit sulphur upon dilution with alcohol or ether. The contrary assertion by Sir William Pope is probably based upon an early observation made in our laboratory which was subsequently found to be erroneous. The small quantity of sulphur deposited by some samples is doubtless due to a little free sulphur arising from by-reactions.

My suggestion that the Levinstein product is a disulphide, possibly having the structure

$$\begin{matrix} C_2H_4Cl \\ C_2H_4Cl \end{matrix} > S - S,$$

is also supported by a molecular weight determination made by Prof. C. S. Gibson. This gave the number 187 (theoretical for the monosulphide 159, for the disulphide 191). It is, however, quite immaterial to my argument whether the Levinstein product is a disulphide or a "pseudo" solution of sulphur in the monosulphide, as in either event it is not identical with Sir William Pope's preparation.

In reference to the latter's third argument against anticipation by Guthrie, I maintain, though I have not tried the experiment, that his belief in a fatal termination is erroneous. There is, in fact, every reason for thinking that a drop of mustard gas would be less injurious when placed upon the tongue than when applied to the external skin, firstly, owing to the repellant effect of the moist surface to the oily insoluble liquid, and, secondly, because of the known power of rapid renewal possessed by the mucous membrane. I am supported by expert medical opinion in the view that an ulcer so produced would heal within two weeks.

To sum up the matter, which I now propose to leave to the judgment of the chemical public, the claim advanced on behalf of Guthrie as the discoverer of the disulphide mustard gas rests on the following evidence:—

(1) The analysis of the product which corresponds to the formula $C_4H_8Cl_2S_2$.

(2) The approximately correct specific gravity.

(3) The physiological action.

(4) Our repetition and confirmation of Guthrie's observations.

Though in the light of the above facts Sir William Pope cannot maintain his claim to have originated this reaction, or to have ever produced the disulphide product prior to our investigations, to him and to his collaborator must certainly be conceded the credit of having been the first to obtain the pure dichlorethylmonosulphide by employing sulphur monochloride; thus lending a great stimulus to the work of others in the field, and contributing to the final successful solution of the problem.

THE IMPERIAL MINERAL RESOURCES BUREAU.

S. J. TRUSCOTT.

As the late war developed into one between materials as well as between men, the absence of effective co-ordination between the various Government Departments concerned with minerals and metals became painfully evident, arousing many almost to fury. To better purpose, the four senior organisations representing the mineral and metal industries, namely, the Iron and Steel Institute, the Institute of Metals, the Institution of Mining Engineers, and the Institution of Mining and Metallurgy, urged upon the Government, through the Department of Scientific and Industrial Research, the formation of a Department of Minerals and Metals, to include the Geological Survey and to be in close touch with similar departments under the Dominion Governments. Other organisations—notably the Imperial Institute—were active in the same direction. As a result, the matter was brought up before the Imperial War Conference in 1917, by whom it was referred to a specially appointed committee for report. This committee recommended the setting up of an Imperial Mineral Resources Bureau, whose duties would be:—

(*a*) To collect, co-ordinate, and disseminate information as to resources, production, treatment, consumption, and requirements of every mineral and metal of economic value.

(*b*) To ascertain the scope of the existing agencies with a view ultimately to avoid any unnecessary overlapping.

(*c*) To devise means whereby the existing agencies can, if necessary, be assisted and improved in the accomplishments of their respective tasks.

(*d*) To supplement those agencies, if necessary, in order to obtain any information not now collected, which may now be required for the purpose of the Bureau.

(*e*) To advise on the development of the mineral resources of the Empire or of any particular parts thereof in order that such resources may be made available for the purposes of Imperial defence or industry.

The above recommendation was endorsed by the Conference, and the Ministry of Reconstruction was instructed to take measures to put it into effect. Accordingly a governing body was constituted by the appointment of one governor by the Home Government to be the chairman, one governor by each of the self-governing Dominions, one each by the Government of India and the Secretary for the Colonies, while six representatives of the mineral and metal industries were appointed by the Ministry of Reconstruction after consultation with the principal organisations representing those industries.

The Bureau so constituted was set up in July, 1918, and received its Charter in June, 1919.

The appointed governors are largely technical men, a minority being administrators, the chairman being Sir Richard Redmayne, lately Chief Inspector of Mines under the Home Office. Among themselves, these governors have divided the work under the following committees:—(1) Intelligence and Publications; (2) Research and Development; (3) Legal Matters; (4) General Purposes and Finance. In addition, they have formed outside consultative sub-committees, some of the members of which have been nominated by the industries concerned. There are, for instance, sub-committees for iron, steel, and metals used in steel-making; lead and zinc; copper; tin, gold, silver, platinum, etc.; chemical industries; refractories; coal and solid fuel; petroleum, etc.

The department of Intelligence and Publications has naturally got to work first, Mr. T. Crook, lately Mineral Assistant on the staff of the Imperial Institute, having been appointed director, and Mr. A. Jones, librarian. It is this department which, using the terms of the original reference, will concern itself with the collection, co-ordination and dissemination of information as to the resources, production, treatment, consumption, and requirements of every mineral and metal of economic importance. For the present, its activities will be largely restricted to the collection and publication of statistics. The figures of production of foreign and colonial mines, formerly issued by the Home Office as Part IV. of its Annual Mineral Report, will in future be issued by the Bureau.

The Department of Research and Development has not yet been completely organised. It was, however, in connexion with this department that an examination was made early this year into the general conditions of the Cornish tin-mining industry.

The Legal Department has set to work with professional assistance to assemble and compare the various mining laws of the world, with the intention of issuing a synopsis, in due course.

In encompassing all it has in view the Bureau will seek to avail itself to the fullest possible extent of all existing organisations, such as the Imperial Institute, the Imperial Colonial Institute, and the industrial organisations already mentioned. The work of these it will co-ordinate, extend, and, where advisable, assist.

The value of prompt and reliable statistics hardly needs to be argued. They enable the trend of output and consumption to be forecasted. They disclose the nature of a decline in output from any particular field, showing whether that decline be due to exhaustion or to catastrophal factors unconnected with the deposit, internal revolution for instance. They make clear the recurring discovery of metalliferous fields. They provide bases for the long-period computation of metal prices, metal production, costs, and mine life. In normal times they allow an intelligent anticipation of scarcity and high price, or abundance and relatively low price.

With regard to textual publications, descriptions of occurrence, together with statements of the use and value of minerals and products, are most valuable, as also are suggestions for the industrial application of new products, and inquiries for products to meet the wants of new industries. Periodical reviews of each industry in turn are invaluable.

In respect to research and development much the same can be said. In case of national necessity—and *faute de mieux*—the Bureau could advise Government to take over and exploit any particular deposit. Ordinarily its assistance would be in the nature of examination and advice, though in special cases it could make recommendations for financial assistance. In the matter of prospecting for new fields, one of the greatest necessities of the day, the Bureau will probably find its chance of being of greatest service to the Empire.

The value of the Bureau in respect to legal matters lies at the moment particularly in the fact that mining laws have to be propounded for the several new countries which have come under British sway. For mining rights in these the Bureau is already receiving inquiries and requests for concessions, and it seems likely that it will issue licences for mineral rights, in the Crown Colonies, at least, just as the Colonial Office now does, and probably in place of that Office.

Co-ordinating these several departments is the Secretary of the Bureau, Major L. M. Henderson Scott, A.R.S.M., with a growing staff.

This Bureau, being an Imperial Bureau, is supported financially by all the Governments separately represented upon it, and its interests, accordingly, are imperial. At present, for instance, it is no more concerned with the development of the mineral resources of Great Britain than it is with those of Canada. Each Government concerns itself with its own resources quite apart from the Imperial Mineral Resources Bureau. Thus, about the middle of this year, a Mineral Resources Development Committee was appointed under the Board of Trade to take evidence as to the needs of the industries of Great Britain. This committee is for non-ferrous metals, and it includes men who are particularly well acquainted with several such metals. It constitutes a step beyond the late Mineral Resources Development Department of the Ministry of Munitions, its principal duty being to appraise the conditions and wants of the non-ferrous industry in Great Britain, with a view to the national development of that industry. If a case is made out then a Ministry of Mines would result, wherein would be assembled all the various mining and associated departments, the Inspection Department from the Home Office, and perhaps the Geological Survey. The chances are that a Mines Department will be set up in the Board of Trade.

Manufacture of Alcohol from Ethylene.—In a paper read before the Cleveland Institution of Engineers, Middlesbrough, Mr. E. Bury, of the Skinningrove Iron and Steel Works, states that a large-scale process has been worked out for producing ethyl alcohol from ethylene, recovered from coke-oven gas, and sulphuric acid. The yield is 1.6 galls. of alcohol per ton of coal carbonised, and the optimum temperature of absorbing the ethylene is 60°—80° C.

THE SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY.

At Salters' Hall, E.C., on December 11, the Salters' Company celebrated the foundation of its Institute of Industrial Chemistry by giving a dinner to which a number of leading chemists was invited. The Master, Mr. W. M. B. Bird, presided, and the guests included Sir William Pope, Sir J. J. Dobbie, Sir Herbert Jackson, Mr. John Gray, Mr. R. A. Perry, Mr. W. J. U. Woolcock, and other representatives of the profession of chemistry. Lord Moulton was unavoidably detained in the House of Lords.

In proposing the toast of the Institute, the Master said that the Company had come to realise that it has more important functions to perform than those of miscellaneous charity and conviviality, and that it must either go forwards or backwards. In truth, the Company in moving forwards is also retracing steps which it took some centuries back when it was identified with chemical industry through its members being recruited from the ranks of those who dealt in "flax, hemp, logwood, cochineal, potashes, and almost every chemical preparation," including beer. As a subsequent speaker remarked, the new policy has for its keynote education, and the Company is to be heartily congratulated on its initiation. One of its aspects, in particular, appeals to commonsense, viz., the devotion of funds to the training of scientific chemists rather than to the erection or elaboration of material structures. Thus there neither is, nor can be, a "housing problem" for the Salters' Institute. At the moment twelve students are in receipt of bursaries, of the value of £250 each, to enable them to continue their post-graduate studies in existing institutions, and thirty-four students of the artisan class are receiving pecuniary assistance to help them to meet their expenses at evening schools and colleges. A point which appeals more especially to those with educational experience is that the beneficiaries are chosen, not on the basis of the results of a rigid set examination, but by a Director who is in every way qualified to assess their qualifications and to guide them in their subsequent studies. In this arrangement the Company has not only shown faith in an autocracy of merit, but also true educational insight.

Dr. M. O. Forster who, as Director, responded to the toast of the Institute, referred to the good work which had been done by many of the Guilds—the Goldsmiths', Clothworkers', Leathersellers', Skinners'—acting jointly as the City and Guilds of London, in promoting scientific and technical education; during the past forty years over a million sterling had been expended in this connexion, and to this sum the Salters' Company, which is not a rich one, has alone contributed between £40,000 and £50,000. The results of this expenditure had been magnificent.

The toast of "Science and Industry" was given by the Upper Warden, Mr. H. L. Cancellor, and responded to by Sir William Pope, and Mr. R. Grosvenor Perry. The latter singled out two points for especial consideration—the freedom from labour troubles in the chemical industry during the past 100 years, which he thought might be ascribed to the comparative wealth of educated men in the industry, and the baneful influence of State control in normal times. The remarks of these and subsequent speakers bore testimony to the unanimous opinion that, in attacking the problem of efficiency in chemistry from the educational standpoint, the Salters' Company had made a most auspicious start, and one well worthy of emulation by sister Companies and kindred organisations.

SOCIETY OF CHEMICAL INDUSTRY

CROSS AND BEVAN ESSAY PRIZE AND LATHAM RESEARCH FELLOWSHIP.

The Council has pleasure in announcing that through the generosity of Messrs. Cross and Bevan, and of Sir T. P. Latham, Bart., of Weybridge, a prize is again offered for an essay on the Interconnexion of Economic Botany and Chemical Industry; also a fellowship endowment. The amount of the first prize will be £30, and it will be in the discretion of the Council to increase this amount in the event of the adjudicators reporting that one essay is of distinguished merit, or, on the other hand, to award a second and possibly a third prize.

A Research Fellowship with the sum of £300, the gift of Sir T. P. Latham, Bart., will be awarded to a successful essayist, subject to the following conditions:—The £300 will be paid either in two or in three annual instalments (at the discretion of the Council) to such one of the competing essayists as may be judged to be of conspicuous ability, as a grant towards his expenses, on the condition that he apply himself during two or three years respectively to research of approved character on a subject cognate with that discussed in his essay.

The immediate object of the donors is to promote the study of Economic Botany, with special reference to its bearing on Chemical Industry, giving the widest possible interpretation of the relationship. They desire, under the auspices of the Society, to assist in forming public opinion in this direction, and to discover and assist the career of a student of promise who may wish to devote himself to work in such a field.

For the guidance of prospective competitors, the following suggestions are made as to various aspects of the subject which may be dealt with, but essayists are not debarred from dealing with it on other lines which they themselves may select:—

1. Investigations by which definite chemical processes occurring in the plant or cell have been established and elucidated in connexion with the production of industrially useful substances. Suggestions or forecast of extension of this line of research.

2. The question of appreciation of values of primary products, *i.e.*, by way of:—(a) Quantitative production or yield; (b) Qualities on which industrial applications depend.

3. In typical cases to show why a plant or crop occupies its present economic position. The prospects of substitution (a) by allied species; (b) by chemical manufacturing processes, *i.e.*, in the case of "molecular" end-products.

Essayists should give as complete as possible a historical account of the work that has been done, with references, and also a bibliography. They are encouraged to give the result of any original work which they have done, and to indicate future lines upon which they consider that research may profitably be conducted in connexion with the subject of which their essay treats.

The Essay Prize will be open to all members of the Society who are British-born subjects, and there is no age limit. The Research Fellowship will be restricted to competitors who shall not have attained the age of 27 years at the time of sending in the essay.

Essays must be received at the offices of the Society not later than December 3, 1920; but in the case of competitors resident in the Colonies or elsewhere abroad, essays will be received up to the end of February, 1921, provided such competitors intimate to the Secretary of the Society, not later than September 30, 1920, their intention to send in competing essays.

The award shall be made as soon as all the essays have been received, but neither the prize nor the fellowship will be awarded unless the essayist, or essayists, shall be deemed to have real merit. The Latham Research Fellow will be required to submit a report at the close of each year to satisfy the Council that he has made, and is likely to make, proper use of the grant.

J. P. Longstaff (*Secretary*).

NEWS FROM THE SECTIONS.

MANCHESTER.

Mr. John Allan presided at the third meeting of this Section, held on December 5, when 127 members were present.

Dr. E. Ardern read a paper on "The Activated Sludge Process of Sewage Purification," embodying a continuation of his earlier work on this subject. A detailed account was given of the working of a large scale continuous-flow unit for the treatment of Manchester sewage (Withington Works) by the Activated Sludge Process. The plant was installed in December, 1917, and was designed to treat 250,000 galls. of sewage per day, with an average aeration period of four hours. No difficulty has been experienced in effecting uniform distribution of the air employed, the consumption of which varies from 0·8 to 1·5 cu. ft. per gallon of sewage treated. The recovered sludge amounts to 0·6 ton (dry matter) per million galls. of sewage, and it contains 6·5 per cent. of available nitrogen. A description was also given of a larger plant erected at the Davyhulme (Manchester) Outfall Works, and of other plants installed in different parts of the country.

The second paper was by Messrs. F. S. Sinnatt and Burrows Moore on "A Method for Determining the Relative Temperatures of Spontaneous Ignition of Coals." The method consists in dropping a small quantity of coal into a crucible maintained at varying but definite temperatures and observing (1) the time at which the coal begins to glow, (2) the time at which spontaneous ignition or explosion occurs, and (3) the time of cessation of glow. Results for a number of coals show that (1) is comparatively regular, and it is suggested that the time-temperature curve obtained should be used for characterising coals. Two examples were given of the curves obtained from coals which are known to produce gob fires, and these curves differ materially from those obtained with ordinary bituminous coals. Preliminary experiments show that the fineness of the coal has a great influence upon the temperature at which glowing occurs, and with mixtures of fine and coarse coal this temperature tends to approach that of the finest material. Other experiments indicated the effect of pre-heating the coal upon the temperature at which glowing occurs. The research appears to be of importance from the point of view of the storage of coal, and, when further work has been done, it may be of value in the study of gob fires.

During the evening a demonstration was given of a "Super-microscope" by Messrs. F. Davidson, of London. This combination of microscope and telescope enables direct microscopic observations to be made on objects which could not be examined upon the stage of a microscope.

NOTTINGHAM.

At the meeting held on December 9 the chairman, Mr. F. H. Carr, announced a forthcoming paper by Dr. E. B. Maxted on the "Fixation of Atmospheric Nitrogen."

Mr. S. Coffey then read the results of a research on "The Effect of Heating Linseed Oil Under Pressure and its Bearing on 'Litho' Oils." Previous investigators had heated the oil in open tubes and had noted certain changes in the physical and chemical constants. The author's experiments were made with sealed tubes, and the changes observed were plotted in the form of curves, which show an increase in the density, viscosity, and free acid values, constancy of the saponification value, and a decrease in the iodine absorption and in the amount of bromine addition product insoluble in ether. A marked discontinuity was apparent in the density, viscosity, and free acid curves after about 21 hours heating at 250° C. After about seven hours a portion of the oil became insoluble in acetone. Theoretical explanations of these effects were put forward.

As regards the production of "litho" oils or varnishes, it appears that there will be a marked difference in the composition of "thin" and "strong" varnishes, the latter consisting mainly of the product insoluble in acetone, while the former will contain less of this product. The product obtained by heating under pressure is lighter in colour and the drying qualities are unaltered.

Dr. E. P. Hedley then read a paper, experimentally illustrated, in which he traced the growth of our knowledge of the discharge through rarefied gases and high vacua from the pioneering researches of Crookes to the counting of the electrons by J. J. Thomson and his collaborators. The question of thermionic conduction due to the emission of electrons from heated metal was then discussed, and it was shown how the theoretical elucidation of Richardson and Langmuir led to the development of the hot kathode Röntgen ray tube at the hands of Dr. Coolidge. The advantages of the new X-ray tubes were discussed and also their uses, together with those of special varieties such as the "kenetron," which serve as thermionic rectifiers, chiefly of high-tension alternating currents.

The important discoveries made in the laboratories of the General Electric Co., of Schenectady were briefly outlined, especially the scientific investigations which led to great improvements in the metal filament lamp, and consequently to the transference of much profitable industry from Europe to America.

Specimens of thermionic rectifiers were displayed which had been lent by the British Thomson-Houston Co., and for many of the experiments thanks are due to the Physics Department of University College, Nottingham.

CHEMICAL ENGINEERING GROUP.

About 150 members attended the Conference on "The Transport and Distribution of Liquids in Chemical Works," held at Newcastle-on-Tyne on December 15. There were two sessions of the Conference, that in the afternoon being presided over by Prof. Henry Louis, who welcomed the group on behalf of the Principal of Armstrong College, Sir Theodore Morison.

The first paper at the afternoon session was by Mr. J. A. Reavell, who discussed the principles of two standard types of the Kestner automatic acid-elevator, the first working intermittently and the second continuously. The Avamore "squeegee" pump was described by Mr. R. A. Pelmore, who claimed that this was the only positive rotary pump which had no high-speed wearing surfaces. Mr. S. J. Tungay read a paper on centrifugal pumps for sulphuric and nitric acids, the great advantages of which are absence of valves and relatively little friction between the moving parts. The author described the Haughton multi-stage or turbine acid pump made of "Ironac," and adduced the results of a number of working tests with sul-

phuric acid of spec. grav. 1·5. He also gave working results for a pump constructed of very high silicon-iron and possessing some novel features, which had been used successfully for nitric acid and mixed acid at Greetland and other explosives factories.

The evening session was presided over by Prof. P. P. Bedson and Mr. George Sisson. A description of the construction and the method of working of the "Marclen" pump was given by Mr. A. A. Stewart, together with a statement of the various purposes to which it is being successfully applied. The pump has no gland of any kind and can be made of almost any material. Mr. W. Hayhurst pressed the claims of ceramic materials for pump construction and then gave an account of the armoured "Ceratherm" centrifugal pump, which possesses only one gland on the suction side, and has high efficiency. The composition of "Ceratherm" was not disclosed, but it is claimed to be very highly resistant to acids, sodium peroxide solution, etc., and to withstand successfully rapid changes in temperature. A comprehensive survey of pumping and elevating plant used in chemical works was given by Mr. J. H. West, and an interesting description of the handling of petroleum in bulk at Thames Haven by Mr. N. A. Anfilogoff. These papers should appear shortly in the "Transactions," and for this reason are but briefly noticed here.

It remains to be mentioned that the exhibition of pumps and elevators held in connexion with the Conference added materially to its success.

MEETINGS OF OTHER SOCIETIES.

THE ROYAL SOCIETY.

At the meeting held on December 4, Sir J. J. Thomson in the chair, papers by Mr. T. R. Merton were communicated "On the Secondary Spectra of Helium" and "On the Spectra of Isotopes." In regard to the latter, the author concludes that spectroscopic measurements seem to provide a favourable method of distinguishing isotopic elements, and that probably the thallium in pitchblende is an isotope of ordinary thallium.

In a paper entitled "A Study of Catalytic Actions at Solid Surfaces," Drs. E. F. Armstrong and T. P. Hilditch show that the catalytic action of metals, like that of enzymes, is reversible. Thus when a mixture of cyclohexanol and methyl cinnamate is heated at 180° C. in presence of nickel, a considerable transference into cyclohexanone and methyl β-phenylpropionate is effected; and dehydrogenation also occurs when hexahydroxylene and dihydropinene mixed with methyl cinnamate are heated at 230° C. in presence of the same catalyst.

THE INSTITUTE OF CHEMISTRY.

The first annual dinner of the Liverpool Section was held at the Midland Adelphi Hotel on December 5, Mr. G. Watson Gray, chairman of the Section, presiding. The guests included Sir Herbert Jackson, President of the Institute, Mr. Alderman W. Muirhead, Mr. R. B. Pilcher, and some ladies. The toast of "Liverpool: Its Industries and Commerce" was given by Mr. John Gray, who, in referring to the heavy chemical industry, remarked that this country had less to fear from foreign competition than from the uncertain position of labour matters at home. Mr. Alderman Muirhead, in reply, suggested the endowment of a chair at the Liverpool University for the purpose of instructing trade union leaders in the principles of political economy. Production is the only road to progress and prosperity; a system of grading workers is necessary, and trade union leaders should recognise that some were able to do more work and better work than others.

The toast of "The Institute" was proposed by Alderman Muirhead and responded to by Sir Herbert Jackson, who congratulated the Liverpool Section—the first to be formed and the first to hold an annual dinner—on its organisation, its activity, and its chairman. He referred to the aims of the Institute, its growth, and the development of its work, especially in the formation of a great professional body composed of trained and competent chemists, and maintaining in the practice of the profession of chemistry the highest integrity and efficiency.

Other toasts given were "The Ladies," by Mr. W. Doran; "The Guests," by Mr. J. Hanley, the Hon. Secretary of the Section; "The Liverpool Section," by Mr. D. Cardwell; and these were responded to by Miss M. Roberts, Mr. R. B. Pilcher, and Mr. Watson Gray, respectively.

ROYAL SOCIETY OF ARTS.

At a meeting held on December 3 a paper entitled "The Seed-Crushing Industry" was read by Mr. J. W. Pearson.

In outlining the history of the development of the industry in this country the author stated that, while there are indications of the existence of oil mills in England in the fifteenth century, the first authentic records of any factory date back to the seventeenth. At first the trade was centred mostly at the principal shipping ports—Hull, London, and Liverpool, but with improvements in shipping facilities the trade gradually extended to the outports. To-day the centres of manufacture are Aberdeen, Bristol, Burntisland, Bridgewater, Colchester, Dundee, Gainsborough, Glasgow, Gloucester, Grimsby, Hertford, Ipswich, Kirkcaldy, Leith, Lincoln, Liverpool, Lynn, Manchester, Rochester, Southampton, Warrington, and Weybridge, all of which are able to put up a very effective competition against Hull and London.

Prior to the outbreak of war the importance of this industry from a national point of view had not been fully realised, but early in the war its importance as a means of supplying glycerin was quickly recognised, as was later on its value as a source of edible oils and cattle cake. The claim of the oil-seed trade to be regarded as a key industry is based on the large quantities of oil required on the one hand in the technical trades, such as soap, paint, and varnish making, and on the other in the edible trades, such as baking, frying, cooking fat, and margarine manufacture. The total consumption of oils for these purposes in Great Britain is estimated at 600,000 tons yearly.

The oil-seeds may be divided into two main groups—(1) those containing 45 per cent. of oil or over, such as groundnut, copra, and palm-kernel; and (2) those containing less than 45 per cent. of oil (such as linseed, cottonseed, and soya). Most of these grow in the Torrid Zone, but the continent of Europe raises considerable quantities of linseed, rapeseed, poppy, and sunflower. As the requirements for oils increase there is little doubt that in years to come, with future scientific developments and treatment, some of the lesser known or more inaccessible oilseeds, such as cohune, coquilla, and coquita nuts will take their place among the important sources of oil supply.

The author sketched the history of the development of the plant used in seed-crushing from the earliest description of an apparatus dating back to about 30 B.C. up to the present time, where a unit of machinery consists of one set of rollers, one kettle with its moulding machine, one battery of four hydraulic presses fitted to take sixteen cakes each, hydraulic pumps, accumulator and paring

table, each unit being worked by a squad of three men and turning out 112 cakes per hour. No system has yet been discovered which will enable the whole process of oil manufacture to be conducted automatically from the cooking kettle to the point of oil expression, and this is the stage where there is much scope for economy in manufacture.

In the other system of treating oil seeds, viz., by chemical extraction, the chief solvents used are petroleum ether, carbon bisulphide, carbon tetrachloride, and trichlorethylene. For a long time the oil obtained by this method was regarded as unsuitable for edible purposes, but the use of purer solvents and improved refining processes has removed this objection. In pre-war days it was generally reckoned that the total manufacturing costs under the extraction process were 50 per cent. greater than those under the hydraulic system.

The consumption of margarine in England has increased three-fold during the war, and the margarine manufacturing plants are now capable of producing over 10,000 tons per week. Before the war the seed-crushing industry was carried out in this country principally for the sake of cake production, but in the last five years numbers of new plants have been erected, of which the major object is the production of oil, particularly for edible purposes. The hardening or hydrogenating process for the conversion of liquid into hard oils normally costs about £5 per ton, and the hard oils generally command in the open market a premium of £10 to £15 per ton over the liquid oils.

The third Trueman Wood lecture was delivered on December 10 by Sir Oliver Lodge, the subject being "Sources of Power, Known and Unknown." The lecturer passed in brief review known sources of power, including solar energy present in sunshine, the internal heat of the earth and the energy of the tides, and the energy of coal. Solar energy could be best utilised by the promotion of agricultural operations. Solar rays falling on barren soil were a reflexion on humanity. The production of power from the tides appeared to offer little prospect commercially. A great degradation and consequent waste of energy necessarily accompanied the employment of all forms of heat engines. Amongst concealed sources of energy the lecturer included the energy of the atom and that of the ether—the latter rather hypothetical, but, if existent, far exceeding in magnitude that of atomic energy, which latter is immense compared with any form of chemical energy, such as that derived from combustion or explosives. The emission of this atomic energy was accompanied by a decrease in the weight of the emitting atom. The emission occurred spontaneously and measurably in the case of radioactive substances. The appearance of quiescence in other cases must not be regarded as symbolical of the absence of atomic energy. Atomic energy was there, but awaited the right stimulus for its exhibition. Cordite or other explosive reveals no trace of its store of energy until appropriately stimulated. In a brief review of the characteristics of the emission of atomic energy the lecturer remarked that helium atoms were emitted from radioactive substances with a velocity sufficient to carry them from London to New York in a quarter of a second, in the absence of obstructions. To some extent these atomic sources of energy are already being utilised. The therapeutic use of radium in the cure of disease is an instance of such utilisation. In the lecturer's opinion the phenomena of vision are attributable to the emission of electrons from the retina, whereby the nerve endings thereat are stimulated. The emission of electrons also finds useful application in the sensitive thermionic valves employed in wireless telephony. What of the future? The lecturer envisaged a world—and possibly at no very distant date—when these atomic sources will be more accessible than at present. At that date energy would be derived from an ounce or two of matter rather than from a thousand tons of coal; the atomic energy contained in 30 grains of matter would, if available, be sufficient to raise a hundred thousand tons through 3,000 ft.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.

At the December meeting a paper on "The Application of Liquid Fuel to Heavy Oil Engines" was read in abstract by Mr. A. J. Wilson.

In this paper the author confined his attention to the heavy oil engine as represented by the two types:—(1) Diesel, or constant-pressure engines, in which the heat of compression alone fires the injected fuel; (2) Semi-Diesel, or constant-volume engines, in which ignition is obtained by the combined effect of compression and the surface heat of a vaporising chamber; and to the liquid fuels for the same. After describing these two types the lecturer dealt with the liquid fuels employed, and the effect of constitution and composition on their efficiency. Specific gravity reveals within limits if an oil is of asphaltic or paraffin base, and whether distillate or not, and, generally speaking, high specific gravity accompanies low calorific value. Viscosity directly affects the thermal efficiency, the more viscous the oil, the lower the thermal efficiency, owing probably to inferior degree of fineness of atomisation. Asphaltum content affects efficiency due to formation of coke, which may attach itself to exhaust valve faces, and gives rise to high exhaust temperatures. Freedom from ash is a necessary factor in these fuels, about 0·06 per cent. being the outside limit for a fuel from petroleum, although a slightly higher percentage is sometimes permissible in the case of tar oils, the ash of which may be of a softer nature. Tar oils require modifications in design, owing to their higher temperature of spontaneous ignition. The methods of handling this class of product were fully dealt with, and the following specification of a suitable tar oil was given:—Specific gravity at 20° C., below 1·10; flash point (open), above 150° F.; coke, below 3%; ash, below 0·5%; matter insoluble in benzine, below 0·25%; total water by volume, below 1.5%; separated water, nil.

In the discussion the President (Sir F. Black) and Mr. Templeton suggested that the designers of the Diesel type of engine should devise an engine which could be run on varied qualities of residual oils, instead of elaborating the present type, for which the quality of oil is restricted to certain limits.

Mr. Anfilogoff took exception to the loose way in which the term "crude oil" was used by those interested in Diesel engines, and also pointed out that the extended use of gas oil did not help to conserve oil supplies, as its manufacture necessitated the production of what are practically useless residuals. He also pointed out the danger of the hot-bulb ignition system in cases where inflammable vapours are likely to be present.

Dr. Ormandy stated that such danger did not exist, owing to the high temperature of ignition of these vapours, but Mr. Anfilogoff gave instances of fires arising from such causes.

Mr. Challener pointed out that the present type of Crossley heavy-oil engine is able to deal effectively with very heavy residual oils; he contended that the figures of spontaneous ignition temperatures in oxygen are practically valueless in determining the suitability of an oil for heavy oil engines. Further, he stated that in Germany at the present time the use of coal-tar oils for Diesel engine work is deprecated, as they are the cause of many breakdowns.

In his reply Mr. Wilson stated that the two-cycle engine would probably solve the difficulty of the use of any fuel, and also that low-grade petroleum residual oil was better than tar oils for the purpose.

THE FARADAY SOCIETY.

On December 15, 1919, at Burlington House, Mr. A. G. Tarrant presented a paper on the measurement of physical properties at high temperatures. The work described had special reference to refractory materials, of which the properties at high temperatures are little known. Thermal expansion, tensile strength and thermal conductivity were investigated, and the author's experimental methods were described in detail, though no actual results were given. For measuring the thermal expansion, the difference between the expansion of the sample and that of a graphite containing tube was measured by means of a simple form of dilatometer. Heating was carried out in a nichrome-wound furnace. The method is only suitable for works tests where comparative results are required; attempts to obtain absolute values were unsuccessful. Tensile tests were carried out in a carbon spiral furnace at temperatures up to 1800° C. In some cases the strength of "soft-burnt" materials was found to be much greater at high temperatures than at normal temperature, due to the "hard-burn" which the sample received during the test. For the determination of the thermal conductivity of refractory materials several methods were used, but without any considerable degree of success, the chief difficulty being the determination of the temperature of the test piece in contact with the heater. In the discussion which followed particular attention was drawn to the necessity for ensuring uniformity of temperature conditions over the specimens in all tests.

A paper by Lieut. W. A. Macfadyen described attempts to deposit iron, by the electrolytic method, on to steel articles which had become worn in service, with the object of reducing scrap and facilitating repairs. The experiments were carried out under war conditions in France, and led to very successful results for many purposes. At first considerable trouble was experienced through irregularities in the coating caused possibly by the deposition of sediment from the solution during the plating operation. This was ultimately overcome by placing charcoal in the solution. In order to render the coatings suitable for meeting service conditions they were submitted to heat-treatment, consisting of annealing and carburising. Inter-diffusion of the deposit and the steel was found to be complete if the annealing temperature exceeded the A3 point of the iron. With lower temperatures the results were not quite so satisfactory. Case-hardening could be applied to the material with success, but even when this was done, a preliminary annealing about A3 point was recommended to obtain the best results. In the discussion which followed a number of further details of the working of the process was given by various speakers.

In addition to the above papers, a note on the vapour pressure of binary mixtures was presented by Prof. A. W. Porter, while papers on the electrolytic formation of perchlorate (J. G. Williams), the solution theory of steel (E. D. Campbell), the relation between the solubility of solutes and their molecular volumes (S. Horiba), the determination of vapour pressure and some properties of copper ferrocyanide (E. J. Hartung) were taken as read.

On January 14 next, at Burlington House, W., the Society will hold a joint meeting with the Royal Microscopical Society, the Optical Society, the Photomicrographic Society, and the Optical Committee of the British Science Guild on the subject of "The Microscope: Its Design, Construction and Application."

NEWS AND NOTES.

UNITED STATES.

The German Dye Situation.—In an address before the Washington Section of the American Chemical Society on November 25, Dr. C. H. Herty gave impressions of his recent visit to Europe in connexion with the purchase of vat dyes from Germany (this J., 1919, 376 B) and his work for the Reparation Commission in Paris.

Germany is ready to re-capture the world's dye trade and to stifle American competition. The threat to American dye interests lies in the fact that until American manufacturers can meet home requirements, Germany can charge extortionate prices for those dyes which are not manufactured in the United States (*cf.* this J., 1919, 456 B). Germany is now manufacturing dyes on a large scale, and owing to the present low value of the mark will be able to underbid the American dye producer in an open competitive market. The only solution lies in the passing of adequate legislation, including the introduction of a licence system, to protect American manufacturers until they can stand on their own feet. In the course of an interview, Dr. Krell, director of the Badische Co., expressed himself fully confident that the German dye firms would regain their business with America, through the medium of their former agencies. Although German industry is confronted with many handicaps, notably with coal shortage and bad transport, it must not be forgotten that the Rhine will be available for the shipment of dyes to Rotterdam. The German dye manufacturer is strong to-day, his plants are even greater than before the war, the *personnel* is practically intact, large stores of material have accumulated, and he is determined to regain his markets.

Dr. Herty strongly dissents from the views expressed by Mr. Irving H. Keene that the Germans were not manufacturing dyes in sufficient quantities to be a menace to the industry in the United States, and that they would not be able to dump enough dyes and dye materials upon the American market to have any appreciable effect (see this J., 1919, 417 B). Mr. Keene, he stated, has no technical knowledge of dyes or of the dye industry.

Proposed Cotton Research Association.—Inspired by the example set in England, and taking the opportunity offered by the recent World Cotton Conference to call attention to the importance of research in the cotton industry, a committee has been appointed to pave the way for the formation of a Cotton Research Association in the United States. Certain work is already being carried on by the manufacturers' associations, the textile schools, agricultural experiment stations and others, but so far co-operation and co-ordination have been lacking. The first work of the committee will be to select the problems of most pressing importance, ascertain what facilities exist for their study, and prepare a budget which can be presented to those interested in the financial support of the work. When formed it is expected that the American agencies for cotton research will co-operate with those in other countries.

The resolutions relating to research passed by the Committee on Research Reports and Statistics of the World Cotton Conference were:—

(1) This Committee recognises the imperative necessity for all countries where cotton is grown or used to establish research institutions, and urges that such institutions should work in close co-operation with each other, especially in matters of fundamental research.

(2) This committee suggests that steps be taken to investigate in all sections of the cotton trade the most favourable hours of labour, rest pauses,

fatigue and other conditions relative to efficiency and the preservation of the health of the workers.

(3) In view of the fact that it is upon the type and character of the cotton fibre that the results of all subsequent treatments are dependent, and in view also of the present impossibility of referring the commercial varieties to any definite strains, it is considered that the researches of most urgent and fundamental importance should be directed towards obtaining strains of definite types in order to make possible the correlation of the ascertainable characteristics of a fibre with the particular strain —pure or mixed—of which it is a member.

(4) With the increased interest at present taken in research work in the cotton industry, and in order to derive the practical benefit of the work carried on by institutions undertaking research, this committee recommends that the work of such institutions should be brought into close contact with the various branches of the industry by carrying out work so far as is practicable in the factory.

The committee recommends co-operative research in methods of testing fibres, yarns and fabrics with the object of securing, so far as possible, standard international methods, and urges a uniform system of expressing results.

The committee wishes to point out the desirability of undertaking research to establish an international regain for cotton and cotton goods.

This committee suggests to the International Cotton Federation that, at its congresses, the subject of scientific research be given a place on the programme, and that the Federation consider the advisability of extending invitations to cotton research associations and others interested in such work.

The Chemical Warfare Service.—The future of this service is still undecided, but its continuation is now regarded as probable. General Pershing has declared in favour of its retention.

The Printers' Strike in New York.—The publication of many scientific and technical papers has now been suspended for many weeks owing to the printers' strike in New York City. In a number of cases arrangements have been made for the permanent transference of printing and publication to other cities.

Tin in the U.S.A. in 1918.—The tin imported in 1918 as metal and metal in concentrate reached the record quantity of 82,854 short tons, an increase of nearly 5,000 tons over imports in 1917. The metal imported and entered for consumption was 71,254 short tons, and the tin produced by the domestic smelters, almost wholly from Bolivian concentrates, was 10,284 tons. The total supply of new tin was therefore 81,538 tons. The world's output of tin in 1918 was about 144,000 short tons, so the tin available for consumption in the United States amounted to 57 per cent. of the world's output. The home production, obtained principally from Alaska, amounted only to 68 short tons of metal. Development is taking place of some smaller deposits found in various States. There was a sharp increase in the amount smelted, which rose to 10,284 short tons of metal, of which 9934 tons was made by the American Smelting and Refining Co. Part of its product is marketed as electrolytic tin, assaying 99·9 per cent. or more, and part as smelter tin assaying 99·3 per cent. or more. The Williams Harvey Corporation commenced smelting tin in November at its plant on Jamaica Bay, Brooklyn, N.Y., and the Andes Electin Co., of New York City, and the Eastern Metal and Refining Co., of Boston, Mass., also produced some tin. The average price of spot Straits tin in New York was 86·8 cents a pound, as compared with 61·65 cents for 1917, and in London the average price was £329 11s. per ton of 2240 lb.—(*U.S. Geol. Survey, Sept. 9, 1919.*)

Discovery of High-Grade Silica Sand in Louisiana.—Deposits of high-grade silica sand underlaid by large beds of glass sand, and estimated to contain about 18,000,000 yards of sand and gravel, have been discovered near Munroe, Louisiana. (*Bd. of Trade J., Nov.* 13, 1919.)

Sulphur Deposits in Alaska.—Deposits of sulphur of the type called *solfataras* occur in many of the Aleutian Islands. One deposit is located in the crater of Makushin Volcano on Unalaska Island, where it is estimated that from 10,000 to 15,000 tons of sulphur can be mined. Another deposit covering from 15 to 20 acres, and containing about 1,200 tons per acre, occurs on Akun Island, while a third deposit is located on Stepovak Bay. (*Bd. of Trade J., Nov.* 13, 1919.)

AUSTRALIA.

Tanning Barks in Western Australia.—A recent publication issued by the Western Australia Forest Department points out that the forests of Western Australia are rich in timbers, leaves, and barks containing tannin. Every member of the eucalypt family holds a certain percentage of tannin, but in only some of them is the proportion sufficiently high to justify the making of extracts from the bark, wood, or leaves. With the exception of mallet bark the percentage of tannin derived from West Australian eucalypts is, as a rule, under twenty. Certain of the mangroves in the northern rivers show a higher percentage, but so far these have only been used locally for tanning purposes. The following list gives the results of analyses for tannin of the barks of certain Western Australian trees:—

Local names.	Tannin content, per cent.
Marri (Redgum), "kino" ...	68
Blue Leaf Mallet Bark ...	47
Silver Mallet Bark ...	45
Brown Mallet Bark ...	41
Swamp Mallet Bark ...	36
Gimlet-wood Bark ...	26
Spotted Gum Bark ...	24
Blackbutt Bark	19
Black Mangrove Bark ...	46
Red Mangrove Bark ...	44

Although valuable for its wood, it is likely that marri or redgum (*Eucalyptus calophylla*) will in the near future depend for its commercial importance mainly upon its kino or gum. This tree is unique of its kind, so far as its kino is concerned. The gum exudes in large quantities and contains a very large percentage of tannin. The objection to its use hitherto has been its red colour, but investigations are in progress with a view to the elimination of this objectionable feature, and if these are successful the kino of the marri of Western Australia will become one of the most valuable products of the State's forests. The tanning material is collected by scraping the trunk of the tree and so removing the kino and kino-impregnated bark. This operation does not injure the tree, and may be repeated at intervals of a few years. It is this perennial yield of gum without destruction of the tree that promises in the future, when means have been found of eliminating the red colour, to be the principal factor in the establishment of a large and stable "kino" industry.

Mallet bark is peculiar to Western Australia and is one of the world's largest yielders of tannin. To this quality is due the fact that the tree has entirely disappeared from some quarters, while in others only seedlings and saplings are visible. Up to 1903 mallet bark was appreciated only in the districts where it existed. In that year the first export was made to the value of £859. Within two years the quality of the bark had been recognised abroad, and a phenomenal demand for it set in, and

in 1905 the exports rose to the value of £154,087. Since then exports have gradually fallen, until in 1913 they amounted to £47,477, and in 1918 to £16,886. Measures are in hand for the regeneration of the destroyed areas and for the planting of new ones. Germany was the largest customer for the mallet bark, which, after treatment, was sent out all over the world, including Australia, in the form of extracts.—(*Austral. Forestry J., July*, 1919.)

Iron and Coal in South Australia.—It is anticipated that not less than 60,000,000 tons of iron ore will be proved at Iron Knob in South Australia. These deposits, which were first worked in 1899, have yielded 1,820,341 tons of ore, and the quality, size, and accessibility of the ore bodies are such as to make this field superior to all other Australian sources of ore suitable for large scale steel production. The larger outcrop extends over about 52 acres. From a smaller deposit in the same region 700,000 tons of hematite containing 68 per cent. iron has already been obtained. The best coal deposits in the State occur at Leigh Creek. The coal is of the "sub-bituminous" class. Hitherto transport costs have militated against its use in the manufacture of briquettes, for steam-raising purposes and for the generation of producer gas, applications for which the coal has been found to be suitable. A bed, 21·5 ft. thick, has recently been located at a depth of 711 ft., and the average composition of the best samples (air dried) was:—Moisture at 105° C., 16·52%; volatile matter, 29·87%; fixed carbon, 41·42%; ash, 12·18%. The calculated calorific value of an air-dried sample was 10,272 B.Th.U. per lb., which may be compared with that of small coal from Newcastle, New South Wales, averaging from 13,000 to 13,500 B.Th.U. per lb. Another seam has recently been struck at a depth of 882½ ft.—(*Bd. of Trade J., Nov.* 13, 1919.)

NEW ZEALAND.

Development Schemes.—A Government Industries Committee has recommended the establishment of a Board of Science and Industry to co-operate with universities and scientific institutions in the organisation and promotion of industrial and scientific research; to award scholarships, bonuses and prizes; and to advise producers as to the results of investigations.

The Committee also recommends the nationalisation of the coal measures of the Dominion and the purchase by the State of privately-owned mines and measures at a valuation; the equipment by the Government of gold-prospecting parties to work under the direction of the Geological Survey Department; and the provision by the State of smelting facilities for the recovery of base metals, for at present only gold and silver are extracted from the concentrates. As there is no well-established firm engaged in the manufacture of iron and steel, it is recommended that the value of all iron deposits should be investigated by an expert metallurgist; that the neighbourhood of the Parapara iron deposits should be prospected systematically for coal; and that the export of scrap iron and steel should be prohibited.

Although some millions of gallons of oil have been obtained from borings in several parts of the Dominion, the results so far have been disappointing, and private enterprise has nearly exhausted its resources—indeed the Government is subsidising one company in Taranaki in putting down one of the deepest bores yet made in New Zealand. The Committee urges the Government to consider seriously the offer of the Anglo-Persian Oil Co. to co-operate with the Government in the search for oil and in the production, refining and marketing of it, if found. It is recommended, further, that encouragement be given to the shale oil industry, which has been suspended for several years.—(*Bd. of Trade, J., Nov.* 20, 1919.)

BRITISH INDIA.

Indian Cotton.—The final estimate of the production of cotton in India in 1918–19, as published in the *Supplement to the Gazette of India* for November 1 is 3,671,000 bales of 400 lb. each, from an area of 20,497,000 acres. For the preceding year the official estimate was 4,065,000 bales from an area of 25,298,000 acres, but the trade estimate was 4,204,000 bales, of which 2,044,000 was consumed in Indian mills, 1,410,000 exported, and 750,000 consumed outside the factories. In both years the yield per acre was very low, being 71·6 lb. per acre in 1918–19 and 64·0 in 1917–18, as compared with 84, the mean of the last 10 years. For the year 1919-20 a much larger crop is expected. In the tracts from which returns have been obtained up to date the area under cotton is 19 per cent. larger than at the same time last year, and the condition of the crops is on the whole good.

Japan is by far the greatest importer of Indian cotton, after which came, before the war, Germany, Belgium, Italy, Austria-Hungary, France, and the United Kingdom, in the order named. During the war Japan took, in addition to its previous imports, most of that formerly sent to the enemy countries, but Italy also about doubled her imports. But little Indian cotton is imported into England on account of its short staple. Its adulteration also prevents it use for the manufacture of high-class fabrics, and the watering of the cotton is specially injurious. In Appendix B of the Report of the Indian Industrial Commission it is stated that "the watering of unginned cotton is not practised on a relatively large scale, and can be put a stop to by the action of the ginners. The watering of ginned cotton by the balers is, however, a much bigger matter; it is done on a large scale and in a thoroughly organised manner, pipes and hoses being used for that purpose in many press compounds, especially in Berar." The fraudulent increase of weight is not the greatest of the evils produced by this practice. Every year there are a number of destructive fires in the cotton green at Bombay in consequence of the self-heating of this wet cotton, although it is thought that some of these fires are due to deliberate incendiarism. Moreover, the quality of the wetted cotton is seriously impaired.

Last year a committee was appointed to inquire into the possibilities of improving the quality and quantity of the Indian cotton crop. That there are possibilities as regards quantity is shown by the fact that the average yield of ginned cotton per acre is 200 lb. in America and 450 lb. in Egypt, but at the same time it must be borne in mind that much of the Indian cotton is grown on comparatively poor soil.

JAPAN.

Petroleum Production.—The production of petroleum in Japan has been decreasing yearly since 1914, while the domestic demand has increased. In 1914 the total Japanese production was 115,849,104 galls.; in 1915, 127,368,528 galls.; in 1916, 127,086,624 galls.; and in 1917, 121,790,640 galls. This decrease is attributed partly to the cessation of imports of iron pipe for the equipment of the wells, and partly to the difficulty experienced in locating new sources of supply.—(*Indian and Eastern Engineer, Nov. 1919.*)

Production of Pyrethrum Flowers.—The flowers of the biennial plant *Chrysanthemum partherium* constitute a very valuable insecticide, being, when dried, harmless to human beings and the higher animals, but acting as a deadly poison to insects.

The production of dried pyrethrum flowers and the manufacture of insect powder in Japan have increased during the war, in fact during the past four years practically the whole world's supply came from this source. The production increased from 1100 tons in 1915 to 2200 tons in 1916. During the period 1913 to 1918 the export of dried flowers and insect powders also increased, as is shown by the following figures. In 1915 Japan exported 175 tons flowers and 105 tons powder; in 1918, 1612 tons flowers and 108 tons powder. As a result of a large falling-off of production during 1919 there is at present a considerable shortage, and prices have been gradually forced up; there is, moreover, little hope of a decline in these prices, since many farmers in Japan formerly producing pyrethrum are turning to other crops.—(*U.S. Com. Rep., Nov.* 10, 1919.)

SOUTH AFRICA.

Prospects of the Cotton Industry.—Mr. A. Canham, the Acting Trade Commissioner for the Union, who has recently been visiting Lancashire with Mr. W. H. Scherffius, the chief of the Cotton and Tobacco Division of the South African Department of Agriculture, states that the outlook for cotton growing in South Africa appeared to be very bright in view of the high prices realised by raw cotton. South African cotton, said Mr. Canham, commands a higher price than middling American. Hitherto the industry has suffered on account of the indifference of the growers with regard to grading, but this is now receiving more attention. The present year's crop is about 800,000 lb., *i.e.*, 2,000 bales of 400 lb. each. Last year's crop was only half this amount, and the increase is due rather to a greater acreage having been planted than to better climatic conditions. About 500,000 lb. was grown in Natal and Zululand, and 300,000 lb. in the Rustenburg district of the Transvaal. There is a large area suitable for cotton growing, and as the picking can be performed by native women and children the output is likely to increase steadily, particularly if prices remain high. With the exception of a small quantity required for local consumption, practically the whole of the crop will be disposed of in Lancashire. An important point, and one which may determine the whole future of the industry, is seed selection. Cotton growing being still in its infancy in South Africa, by proper attention to seed selection it will be possible to secure the growth of the best types of plant and those which best resist insect pests. Stringent precautions are taken against the importation of seed from infected areas. The need for a larger staff of agricultural experts to guide growers is recognised. A considerable proportion of this year's output is already in London, and has been graded for the first time in the history of the industry.—(*Official.*)

FRANCE.

Industrial Notes.—*Chemical Industry.*—There is a great shortage of chemical products on the French market, and importations from England are materialising but slowly. Astonishment is expressed at the fact that German finished chemical products seem to find readier access to Great Britain than the French products, and this is causing French producers to attempt to secure a hold on the German market. A great increase is noticeable in the price of arsenic, which has suddenly risen from 200 to 275 francs per 100 kilo., and the demand continues great. The shortage of British chemicals, and of barium salts in particular, is handicapping the manufacture of hydrogen peroxide, which is much used in the textile industry, and which now commands a high price. The price of barium chloride has risen from 75 to 90 francs in less than a fortnight.

Fuel.—The fuel oil "mazout" has been tried with success by the P.L.M. Railway Co. on a locomotive adapted for the purpose. The company has therefore decided to convert a first batch of 200 engines at the rate of two engines a day. Oil tanks are to be erected at various stations on the line.

Metallurgy.—The outstanding feature at the moment is the intense activity prevailing not in the factories, but in the different companies which control them. As previously described, these companies are enlarging their spheres of influence and their financial capacity. Further impetus has been imparted to this movement by the recent sales in Metz of the sequestrated German undertakings, and also by the sanction given by the Luxembourg Legislative Chamber to liquidate all German property situated in the Grand Duchy. These events have given rise to a redistribution of the various works and to the formation of new combinations which, as in the case of the Meurthe and Moselle firms, show a tendency to allocate to each factory a special line of manufacture. The big "combines" may be briefly classified as follows:—

(1) *La Société Lorraine des Acièries de Roubas*, which operates chiefly in Alsace-Lorraine. Its headquarters is at Roubas (Moselle), and it commands a capital of 150 million francs. (2) *La Société Métallurgique de Kuntange*, which is concerned with mining and metallurgical developments in the recovered provinces. Its head office is in Paris (16, Bd., Malesherbes), and its capital 75 million francs. (3) *La Société Métallurgique des Terres-Rouges* controls all the factories of Gelsenkirchen in Lorraine, in the Grand Duchy, and on the left bank of the Rhine. Its capital is 100 million francs, and the head office at Luxembourg. (4) *Acièries de la Marine* is interested in (1), and is shortly associating with the *Acièries de Micheville* to exercise a joint control of the works of *Homécourt* and *Micheville*. (5) *Les Acièries de Longwy* is reported to have made an agreement with Rochling to share in the production of the Woelklingen works near Saarbrück. (6) *Hauts-furneaux de Pont-à-Mousson* is concerned with the blast furnaces at Pont-à-Mousson; it is war-scarred, but now fully convalescent, and likely soon to recover its former activity.

General.—On the whole the industrial and economic situation in France may be considered hopeful. The results of the General Election have had a steadying effect, and the introduction of new blood into the Chamber and the Cabinet is likely to lead to further general improvement. The Government and the new members stand for a great constructive and national policy to be prosecuted in a sound, public-spirited and business-like way.

Attention must be drawn to the formation of the *Confédération Générale de la production française* —briefly referred to as the C.G.P.—which was called into being by the Government, but is quite independent. It is a sort of advisory body composed of leading representatives of all the chief industries and public utility services. Its essential aim is "to assist the development of the national resources of France and of its powers of production and exportation, to co-ordinate the efforts of the syndicates and various professional associations, and to effect the conbination of producers in defence of their interests."

Preservation of Explosives.—The Government has decided to adopt the process suggested by M. Lefèvre for preserving the huge stocks of nitrocellulose explosives in the country, which are valued at 28 to 30 million francs. The plan consists in submerging them in cold water, to wit, the glacier-fed lakes of the Pyrenees. It is stated that such immersion in no way affects the stability of the explosives, and that, in fact, their normal life of 10—15 years will be prolonged to 50 or 60.—(*La Nature, Nov.* 8, 1919.)

GENERAL.

Ramsay Memorial Fund.—This fund was initiated shortly after the death of Sir William Ramsay in 1916 with the object of perpetuating his memory by the establishment of scholarships, fellowships, laboratories, or other means of assisting in the development of chemical science. The decision of the Executive Committee to found and maintain a School of Chemical Engineering in connexion with University College, London, has already received mention in these columns, and the further project of establishing Research Fellowships, to be tenable wherever the necessary facilities are available, has now been taken definitely in hand. As a part of this scheme it is proposed to found special fellowships that may be held by Frenchmen in any approved University or Technical College in the British Empire, and to this end the Executive Committee is inviting donations, it being understood that money subscribed in America shall be earmarked for the provision of fellowships to be held by Frenchmen in the United States. As full particulars are given in a special pamphlet enclosed in this issue of the "Journal," it is unnecessary here to do more than emphasise the great value of the scheme for the promotion of chemistry and of international goodwill, and to ask our members and readers to pay heed to the appeal in the manner desired by the Executive Committee.

Memorials to the Late Lieut.-Col. E. F. Harrison.—Early in the present year an appeal was made through the Chemical Warfare Department to colleagues and friends of the late Col. Harrison to contribute to a memorial fund for the purposes of presenting a bust or medallion to a scientific institution, and of instituting a medal, prize, or scholarship to be awarded to a young chemist of outstanding ability. As Harrison had many associations with pharmaceutical chemistry, it is now proposed that an additional fund be raised, under the joint auspices of the Pharmaceutical Society and the Pharmaceutical Conference, with the object of adding to the value of the prize or scholarship which formed part of the first scheme. Contributions to this fund should be sent to the Honorary Treasurer, Harrison Memorial Fund, 17, Bloomsbury Square, W.C.

National Association of Industrial Chemists.—At a recent meeting of the Executive Council a further increase in membership was reported. The Association has now been registered under the Trade Union Act, and is thus the only body representing analytical chemists in the United Kingdom which is so registered. With the new powers thus granted to it, the Association anticipates a considerable increase in its influence and in its ability to assist the economic condition and professional status of its members. A full-time assistant-secretary has recently been appointed.

Over a hundred members attended the annual dinner of the Sheffield Section, when the chairman, Mr. A. C. J. Charlier, commented on the omission of all chemists, engineers, technical managers, inspectors and supervisors from the joint councils formed under the Whitley scheme, and urged the necessity for all such men to federate in order to secure adequate representation on these councils. The Birmingham Section also held a successful annual dinner.

Special arrangements are being made to give isolated members a fitting share in the management of the Association. The subscription rate of one guinea for full members and half a guinea for associates is to be maintained. Further particulars can be obtained from the Secretary, The White Building, Sheffield.

Industrial Uses of Manjak in Trinidad.—Manjak is a mineral resembling asphalt in chemical composition; it is almost a pure bitumen, containing 80—90 per cent. of carbon, hydrogen, and a small amount of sulphur. It melts above 204° C. (asphalt 38° C.). The principal deposits occur in Trinidad, about three miles from San Fernando, as long seams between layers of clay; mining operations are as yet only in an experimental stage. The quantity exported is at the rate of about 50 tons per annum, chiefly to the United States.

Manjak is finding an increasing number of uses in Trinidad. Boiled with oil and applied in a liquid state it affords a tough, unbreakable, rubber-like protective coating, impervious to both air and water. It is much used in connexion with rotary drilling for oil, being employed to fill the joints of the pipes between casing-threads and drill stem-threads, for which purpose it is much superior to white lead or any substance previously used. Its possible applications are being investigated by the Government of Trinidad. It possesses lubricating properties, and as a paint efficiently protects iron and steel goods when immersed in sea water. It is a good insulator, and is especially valuable as roofing material in tropical climates. Should business conditions warrant it, mining operations at present confined to the Trinidad-Tarouba Oil Development Co. of San Fernando could be greatly extended. The export of crude manjak at the prevailing price of $35 per ton is not a commercial proposition, but good prices are commanded by marketing manjak compounded with mineral oil. Experiments are now being undertaken to determine whether American oils are more economical and useful for mixing purposes than Trinidad oils. —(*U.S. Com. Rep., Oct. 27, 1919. See also Report by Trinidad Government, Geol. Council Paper, No. 5, 1903.*)

PERSONALIA.

The death is announced of Prof. A. Werner, professor of chemistry in Zürich University and Nobel prizeman for Chemistry in 1913.

Prof. Maurice Nicoll, of the Pasteur Institute, Paris, has been appointed Harben lecturer for 1920 by the Council of the Royal Institute of Public Health.

Prof. C. H. Desch, professor of metallurgy in the Royal Technical College, Glasgow, has been appointed to the chair of metallurgy in the University of Sheffield, in succession to Prof. J. O. Arnold.

Dr. E. Newbery, formerly lecturer in electrochemistry at Manchester University, has recently taken up his duties as professor of physical chemistry in the University of Cape Town, South Africa.

Mr. Richard B. Moore, who until recently was working at the Experiment Station, Golden, Colorado, has been appointed to succeed Dr. C. L. Parsons as Chief Chemist to the Bureau of Mines, Washington.

Instruction in chemistry at the University of Strasbourg will be in charge of M. Hackspill (general chemistry) and M. Gault (organic chemistry), who will also jointly undertake instruction in applied chemistry.

Sir Richard Redmayne, who has been Chief Inspector of Mines since 1908, has resigned this post in order to devote himself to his work as chairman of the Imperial Mineral Resources Bureau and to engage in private practice. In his stead the Home Secretary has appointed Mr. William Walker, who has been acting as Chief Inspector of Mines since 1916.

PARLIAMENTARY NEWS.

HOUSE OF COMMONS.

Ferro-Alloys.

Mr. T. Griffiths asked the President of the Board of Trade if he would state the reason for prohibiting the importation of ferro-tungsten and for differentiating between that alloy and ferro-chrome.

Sir A. Geddes, in reply, said that the importation of ferro-tungsten and of tungsten powder had been prohibited because of their vital importance in the manufacture of high-speed steel for the engineering industries, and because we were formerly entirely dependent upon Germany for their supply. Although the Government recognises the importance of ferro-chrome, the case for special treatment is less strong. The difficulties of British manufacturers of this product are understood to be mainly due to the existence of large stocks in this country.—(Dec. 8.)

Fertilisers.

The Parliamentary Secretary to the Board of Agriculture informed Sir N. Griffiths that no sulphate of ammonia, ground basic slag or raw slag, or superphosphate is being imported from Germany. The maximum prices for basic slag (in the sale of which the Government has no financial interest) range from 62s. per ton for slag containing 12—14 per cent. of total phosphates to 102s. per ton when that content reaches 42—44 per cent. It has not been possible to fix a uniform delivered price for superphosphate owing to the varying cost of importing phosphate rock, but during the 1918–19 season phosphate rock and other materials were sold to superphosphate makers at less than market prices. This assistance has been discontinued. The present quotations for 30 per cent. superphosphate are from £7 5s. to £7 7s. 6d. per ton, free on rail. (For maximum prices of ammonium sulphate see this J., 1919, 338 R).

In reply to Mr. Hohler, Mr. Hope stated that the Ministry of Munitions does not control the supply of the three above-mentioned fertilisers. The Ministry has never traded in superphosphates or basic slag, but at the date of the armistice it had small stocks of sulphate of ammonia, which have since been sold.—(Dec. 8.)

Mr. J. Hope informed Mr. Hohler that the Ministry of Munitions had made no profit on its transactions in phosphate rock, pyrites or sulphate of ammonia.—(Dec. 17.)

Storage of Petroleum.

Sir H. Greenwood, answering Sir W. Seager, said that the need of adequate storage facilities for petroleum is fully realised. A considerable amount of tankage has been erected or is projected both on Government and private account, and the position will be kept carefully under review.—(Dec. 9.)

Oil Cake.

Sir N. Griffiths asked the Food Controller if he were aware that oil cake has recently been contracted forward from the mills at £10 per ton, and is now being retailed at £22—£28 per ton. Mr. McCurdy replied that the Food Controller had no knowledge of any such sales. Palm kernel and rape cakes have been sold at low prices, but farmers appear unwilling to purchase, preferring linseed and cottonseed cakes, which fetch about £25 and £19—£20 per ton, respectively, ex mill. In reply to supplementary questions, Mr. McCurdy said he had no information that the increase in price of oil cake was largely due to the restriction of the sales of palm kernels to a ring of home manufacturers; the present maximum prices for oil cakes were fixed in accordance with the prices in the countries of origin of the seeds from which they are manufactured.—(Dec. 9.)

Anglo-Persian Oil Co.—The Scottish Oilfields.

On the Report stage of the resolution authorising the expenditure by the Government of £2,050,000 on the acquisition of new ordinary shares in the Anglo-Persian Oil Co., the Financial Secretary to the Treasury (Mr. Baldwin) emphasised the desirability of the Government retaining control, through its shareholdings, of the great oilfields in Persia. There was every prospect of the investment proving very remunerative. Attention was drawn by Sir J. D. Rees to the necessity of securing supplies of fuel oil for the Navy and to the value of the investment as a means of furthering British interests in Persia. The motion to agree with the resolution was opposed by Sir F. Banbury on the ground that the Government as a matter of principle should not invest money in such companies. The Resolution was agreed to, and the Bill giving effect to the proposed purchase was accordingly presented and read a first time.—(Dec. 11.) (*cf.* this J., 1919, 461 R, 464 R.)

On the motion for the Second Reading, Mr. Adamson referred to the interest acquired by the company in the Scottish oilfields, and pointed out that the responsibility devolved upon the Government of settling the claims of the miners in those fields. During the later years of the war, when the companies were prospering, the shale miners were refused an increase in wages because, by agreement, these were regulated by those paid in the coal-mining industry. When, however, the coal-miners' wages were increased by 2s. a day and their working hours reduced, under the Sankey award, the shale workers were told that that award applied only to coal-mining, and that the serious fall in the price of oil rendered impossible any increase in pay. In his reply on the debate, Mr. Baldwin said that compared with the position before and during the war, the shale industry in Scotland is in a very parlous condition, so parlous that private companies could not carry it on in the future. The Anglo-Persian Oil Co. was acquiring unused refineries at a price far below that necessary to erect new ones, and it was hoped that the company would be able to do what the small companies could not do, *viz.*, carry the shale industry on its back. In the New Year there is to be a meeting of representatives of the workers and the company to thresh out the questions of wages and hours of labour. (See this J., 1919, 277 R, 358 R, 464 R.) The Bill was read a second time.—(Dec. 12.)

Pulverised Coal.

Sir A. Geddes, in reply to Sir A. Fell, stated that considerable developments in the utilisation of pulverised coal for smelting and power purposes were taking place in this country as well as in the United States, but he could not say whether a saving of 25 to 30 per cent. was effected by its use. The Government is having a great many observations made, and action will be taken as soon as sufficient information has been obtained.—(Dec. 15.)

Industrial Alcohol.

Asked by Mr. R. McNeill if it was the intention of the Government to carry out the recommendations contained in the Report of the Committee on Industrial Alcohol received last June, Mr. A. J. Balfour intimated that these recommendations have been considered by the Department of Scientific and Industrial Research, and that he was taking preliminary steps, in consultation with the Director of Fuel Research, to enable the Department to deal with the alcohol question in an effective manner.—(Dec. 17.)

LEGAL INTELLIGENCE.

CUSTOMS SEIZURE OF PYROGALLIC ACID. *Attorney-General* v. *Brown* (see also this J., 1919, 379 R, 399 R, 415 R, under *Brown and Forth v. Buckley*).

This case was heard in the King's Bench Division before Mr. Justice Sankey on November 27, 28, and December 17.

The Attorney-General, Sir Gordon Hewart, for the Crown, contended that, by Order in Council, the Crown, through its responsible Ministers, had the right to stop the importation of all classes of goods. Replying to the Judge, who remarked that the argument was a little astonishing, Sir Gordon Hewart said that his Lordship was imagining a hypothetical extreme exercise of power. He submitted that a general power to prohibit importation was vested in the Executive, to be exercised in times of emergency. His Lordship pointed out that Section 43 of the Customs Consolidation Act did not contain any reference to "times of emergency." The Attorney-General concurred, and proceeded to comment on the value of pyrogallic acid in aerial photography, stating that it could be used for the production of poison gas, and that it belonged to the same family as picric acid, the explosive. His Lordship reserved judgment.

On December 17, Mr. Justice Sankey delivered his considered judgment. After reviewing the facts and arguments, his Lordship said that the system of prohibiting imports by Proclamation had sprung up during the war and the Proclamation involved in this case was the thirty-second of the kind. During the war practices were pursued which could not be tolerated in peace. The case turned on the construction of Section 43 of the Customs Consolidation Act, 1876, and the point was whether the argument of the Attorney-General that the executive had absolute power to prevent imports was correct or whether the narrower construction contended for by defendant was a correct one.

His Lordship, having recapitulated the circumstances leading up to the passing of the Act, continued: "Could Parliament have intended at the moment of the birth of Free Trade to confer an absolute power of prohibiting the import of any article, and to do so by the addition of a few words at the end of a category of particular goods? There would appear to be every reason why they should not do so and no reason why they should. If Parliament had wanted to confer power to prohibit importation of all goods they need not have used any particulars words, but might have said generally that the importation of any goods might be prohibited." For these reasons he was of opinion that the *ejusdem generis* rule must be applied to the construction of Section 43, that the general words must be restricted to the meaning of the particulars words, and that the words "any other goods" meant goods of the class of arms, ammunition and gunpowder. The Attorney-General's contention that pyrogallic acid was of the same class of goods as arms, ammunition and gunpowder appeared to him untenable, for it was hard to conceive any article that was not used in modern warfare. In so far as it was a question of fact, he found that pyrogallic acid was not of the same class as the articles set out in Section 43.

"I have come to the conclusion that His Majesty had no power to make the Proclamation in question, and that it is illegal and invalid."

Judgment was accordingly given against the Crown and for the defendant, with costs. Leave to appeal was granted on terms.

PHYTOL CHEMICAL CO., LTD.

In the Chancery Division, on November 28, Mr. Justice Astbury made an order confirming a special resolution passed by this company to alter its memorandum of association so that it may carry on the business of manufacturing disinfectants, sheep dips, chemicals, etc., in addition to trading in them.

COLNBROOK CHEMICAL AND EXPLOSIVES CO., LTD.

The statutory first meeting of creditors and shareholders was held before the Official Receiver on November 25, when it was resolved to leave the liquidation in his hands, assisted by a committee of inspection.

The statement of affairs shows total liabilities £95,716, of which £48,886 is unsecured, and assets £9927, whilst the total deficiency as regards the shareholders is £54,464. The company was registered in July, 1915, with a nominal capital of £21,000, to carry on business as manufacturers of guncotton, explosives, and munitions of war; its primary object was to acquire from O. R. Mounsey the benefit of a contract with the War Office for the supply of 200 tons of guncotton and to carry out a contract with the representatives of the Belgian Government for the supply of a minimum quantity of 300 tons of guncotton. The company was promoted by Mounsey, who, in consideration of the assignment of the former contract to the company, received £1,430 and 20,000 management shares of 1s. each.

The directors ascribe the failure to various causes, including incorrect estimates of the company's engineers, late delivery of machinery, and further capital expenditure on plant required to meet the demands of the Ministry of Munitions.

GOVERNMENT ORDERS AND NOTICES.

PROHIBITED EXPORTS.

By an Order in Council of December 16, the following goods were deleted from List "A" of Prohibited Exports:—Pea flour and meal; cocoa butter (from List "B"); cocoa husks, cocoa shells; oleaginous kernels, nuts, seeds, and products of all kinds, except castor seed; soya bean, cake, and meal; meat meal; gram or dhol; millet.

In addition to the above, the Board of Trade has announced the removal from List "A" of mica blocks, mica sheets, and mica splittings, as from December 18.

The following items have been added to List "A":—Benzol and its compounds and preparations; dimethylaniline; meta-cresol; methylaniline; para-cresol; copra; cotton seed; groundnuts; linseed; palm kernels; soya bean, cake, meal and flour.

INDUSTRIAL EXPLOSIVES.—The present Open General Licence for the export of explosives etc. has been withdrawn and a new one issued for the export of industrial explosives and of munitions for smooth-bore guns to:—British and French Possessions and Protectorates, the United States, South America, Japan and Korea, Asiatic Russia, France, Belgium, Spain, Portugal, Greece, Italy, Holland, Switzerland, Serbia, Rumania, Norway, Sweden, and Denmark. Export permitted under this Open General Licence to certain destinations in Africa is subject to certain provisions of the Arms Convention which was signed by the Allied and Associated Powers on September 10, with the main object of preventing the dispersal of stocks of arms and ammunition which are at present accumulated. ("Treaty Series, No. 12 (1919) of the Foreign Office." Cmd. 414, price 3d.)

NEW ORDER.—The Horsehides (Decontrol) Order, 1917. Army Council, Dec. 9.

NOTIFICATION OF EPITHELIOMATOUS AND CHROME ULCERATION.

The Home Secretary has made an Order enacting the compulsory notification of (*a*) epitheliomatous ulceration (due to tar, pitch, bitumen, mineral oil, paraffin, etc.), and (*b*) chrome ulceration (due to chromic acid and bichromates, etc.). Nov. 28, 1919.

OFFICIAL TRADE INTELLIGENCE.

(From the Board of Trade Journal for Dec. 11, 18.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the department mentioned and quoting the specific reference number.

Locality of Firm or Agent.	Materials.	Reference Number.
Australia ..	Druggists' sundries	*58/7/44
,, ..	Aluminium-ware, perfumery, porcelain, crockery	*35/7/27
British India ..	Paints	1182
British W. Indies	Glass and chinaware	1192
British W. Indies and Venezuela	Soap	1194
Canada	Drug specialities, soap dyes,	1185
,, ..	Perfumery soap	1241
,, ..	Galvanised crucible steel strand wire	†
,, ..	Raw material for perfumes ..	†
,, ..	Dyes	†
Fiji Islands ..	China, glass, drugs, perfumes, galvanised iron	1198
Malta	Leather	1199
South Africa ..	Druggists' sundries, patent medicines	1189
,, (Durban) .	Asphalt, flux (tender for, Jan. 28, 1920)	—
Belgium ..	Sugar	1203
,, ..	Rubber tubing for Westinghouse brakes	1207
,, ..	Paper	1254
,, ..	Metals, tinplate, machine oils, chemicals, medicines, oils, perfumes, greases, soap	‡117618TÁR
Czecho-Slovakia	Asbestos, mica and technical rubber goods	1258
Denmark ..	Drugs, waxes, essential oils	1208
France	Boot leather	1214
Germany (Frankfort)	Chemicals, drugs, fats, oils, ores, metals, hides, skins ..	1260
,, (Cologne)	Soap	1261
Jugo-Slavia ..	Drugs, edible and lubricating oils, chemicals, fertilisers, extracts, copper sulphate (goods in demand)	—
Poland	Porcelainware	1220
,, ...	Tallow, lard, grease	1266
Spain	Patent pharmaceutical products	1226
Morocco	Ceresine, ozokerit, carnaubi wax, turpentine, turpentine substitute	1270
,, ..	Chemicals, tinplate, glass, china	1271
Brazil	Drugs, cement, tinplate, galvanised iron	1233
,, ...	Plain and decorated tiles, faience tiles, earthenware, galvanised iron tubes.. ..	1235
Venezuela ..	Window glass, pottery.. ..	1275

*The Official Secretary, Commercial Information Bureau, Australia House, Strand, W.C. 2.

†The Canadian Government Trade Commissioner, 73, Basinghall Street, E.C. 2.

‡Belgian Trade and Reconstruction Section, Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

MARKETS SOUGHT.

A firm in Argentina able to export hides of all descriptions and quebracho extract wishes to get into touch with importers in the U.K. [1232.]

TARIFF, CUSTOMS, EXCISE.

Australia.—The export of animal fertilisers, superphosphates and raw materials for the manufacture thereof is prohibited save with the consent of the Minister for Trade and Customs, as from October 1.

Austria.—Among the articles upon which the import duty is suspended until further notice are sugar, molasses, cereals, certain oil-seeds, fats and oils, condensed and dried milk, quebracho and other tanning woods and extracts, tar, mineral oils, certain metals, copper sulphate, litharge, red lead, casein, paper size and starch.

British India.—The valuations for the purpose of levying the export duty on the various classes of raw hides and skins are given in the issue for December 11.

British West Africa.—All export prohibitions on oils, fats, oleaginous nuts, seeds and products have been cancelled.

France (Algeria).—The consumption tax on alcohol has been increased.

France and Algeria.—As from December 5 the import of petroleum products is subject to authorisation to be issued by the Ministry of Finance on the advice of the "Commissaire Général aux essences et combustibles."

Germany.—The export of certain kinds of glassware and scientific instruments is prohibited, except under licence, as from November 22. The list includes optical glass, raw and ground; photographic apparatus; thermometers; apparatus and instruments of glass (including glass tubes); optical measuring instruments; precision balances; and chemical instruments.

Hungary.—Among the articles which may be imported without licence are many fats and oils, pyrites, gypsum, phosphates, asbestos, magnesite, china clay, camphor, essential oils, tanning materials, rosin, asphalt, turpentine, gums, tar (except lignite and schist tar), vegetable fibres, paper pulp, paper (except paper for spinning), cardboard, rubber, gutta percha, skins, leather, certain kinds of glass, china and earthenware, cement, roofing tiles, pig iron, iron and steel bars, rods, sheets and wire, common metals, solder, certain chemicals, fertilisers, glycerin, glue, rice starch, tar dyes, varnish, ultramarine, candles, soap, and wood matches.

Italy.—The articles affected by the increased statistical tax on imports and exports include oxides of iron, soda, sea and rock salt, crude sodium nitrate, sulphates of soda and copper, silicates of soda and potash, charcoal, metallic ores, iron and steel scrap, pig iron, certain kinds of iron and steel bars, rods and sheets, alabaster, marble, lime, cement, bitumen, graphite, earthenware, bottles and fertilisers.

Jugo-Slavia.—The articles that may be exported in any quantity without payment of export duty include medicinal plants, sumach, lime, magnesite, cement, pyrites, bauxite, antimony metal and oxide, sodium sulphate, calcium carbide, tartar, glue and fusel oil.

New Zealand.—Regulations under the Sale of Foods and Drugs Act affect baking powder, custard powder and cream of tartar substitutes.

Certificates of origin for goods exported from neutral countries in Europe are no longer required.

Spain.—The import duties on mineral oils have been reduced, as from December 1. The full text of the Decree is given in the issue for December 11.

A fee (*canon*) is to be charged on the export of hides, skins, leather, leather belting, etc.

A Royal Order has been issued under which licences will be granted under certain conditions for the export of a total of 20,307,514 kilo. of olive oil, to be valid until March 15, 1920, for hogsheads, and until May 1, 1920, for consignments in tins.

COMPANY NEWS.

CASTNER-KELLNER ALKALI CO., LTD.

The Right Hon. G. W. Balfour presided at the twenty-fourth annual meeting held in London on December 3. In moving the adoption of the report and accounts, he said that the net profit for the year (to September 30, 1919) was £190,655 (capital £1,000,000) and the available balance £239,474. Out of this sum it was recommended to place £50,000 to depreciation reserve, to make the dividend for the year 13 per cent. (the lowest since 1908), and to carry forward £51,876. The somewhat disappointing results of the year's trading were to be regarded as due to the abnormal conditions prevailing, *e.g.*, general uncertainty in the business world, demands for increased wages, and rise in the cost of raw materials. The sale price of the company's products had also risen, but not in proportion to the increased cost of production. A return to normal conditions, which appeared to be dawning, would remedy many, if not all, of the hardships undergone. With regard to the extensions undertaken for purposes in connexion with the war, the directors had arrived at a settlement with the Government under which some of them had been cancelled and the remainder was to be finished as and when required by the company's business. The latter had just been completed, and part of the cost was met by a Government loan repayable over a term of fifteen years. The board anticipated that the annual charge involved would be fully covered by economies in working. The large item of £664,485 due to creditors was made up of the Government loan and about £100,000 for excess profits duty in respect of the previous financial year. No excess profits duty was likely to be payable for the year under review.

The report and accounts were adopted unanimously, and the chairman and Prof. H. C. H. Carpenter, the retiring directors, were re-elected.

LIVERPOOL NITRATE CO., LTD.

At the annual meeting, held in Liverpool on December 4, the chairman, Sir Robert Harvey, said that the combined net profits of the company and the Colorado Nitrate Co. (with which it is amalgamated) were £84,354 for the year, compared with £132,874 in the previous year. The issued capital now stands at £64,800 in 253,200 shares of 5s. each, and in respect of these a total dividend of 7s. per share, free of income-tax, was payable for the year ended June 30 last. Owing to the stagnation in the nitrate trade a number of oficinas had to be closed down, involving great cost, but the amalgamation with the Colorado Nitrate Co. would enable work to proceed at the most economical rate of output. The present need for nitrate was urgent, but the available supply for the coming year would be very limited. The tonnage to carry it was confined to foreign-owned vessels, as British ships were not granted licences to load nitrate, and the unduly high freight rates were entirely to the benefit of the foreign shipowners. He was credibly informed that if the present restrictions were removed, much lower freights would be obtainable and the position of the British shipowner benefited.

LOW TEMPERATURE-CARBONISATION, LTD.

The annual meeting was held in London on December 16. The managing director, Mr. H. L. Armstrong, said that by the company's process the value of a ton of coal was virtually doubled. The products obtainable from one ton were:—Motor spirit, 3 galls.; other oils, 16 galls.; gas, 7000 cub. ft. of 600 heat units per cub. ft., after removal of light oils; sulphate of ammonia, 20 lb.; and smokeless fuel, 14 cwts. The working cost is less than that of other established processes, and the capital cost is lower. In view of the fact that the plant at Barnsley was operated from April to September with satisfactory results, several large schemes have been embarked upon. A contract has been arranged with an electric power company in Yorkshire to erect a plant and supply gas from 500 tons of coal per day, to be burnt in that company's boilers in place of raw coal. Negotiations have been entered into with an influential group of manufacturers in Scotland to provide enormous quantities of power gas from a "super-carbonising" station, the aggregate consumption of coal being estimated at 4000—5000 tons per week. Further, arrangements are practically complete for the erection of a plant near Sheffield to carbonise a minimum of 500 tons daily. Work upon the above plants is expected to start next year.

TRADE NOTES.

BRITISH.

Turks and Caicos Islands in 1918.—The salt and sisal industries in these islands are severely handicapped owing to lack of enterprise and capital. Salt manufacture is carried out by expensive and obsolete methods, and consequently the industry is not able to cope with foreign competition. The exports in 1918, 334,184 bushels of coarse salt (value £6,888) and 526,185 bushels of fishery salt (value £13,316), were the lowest since 1879, owing to shortage of tonnage. Stocks of salt in hand at the close of 1918 were estimated at 750,000 bushels.

The maintenance of the sisal industry was only made possible by the high selling prices prevailing. The East Caicos Fibre Company is to shut down next year, and no effort is being made to replant or to open up fresh areas for planting, in spite of the promising nature of the industry and the favourable climatic conditions. The value of the sisal exported during 1918 was £942, as against £5,950 in 1917.

Cotton appears for the first time among the exports of the Dependency, the value being £617 (which includes £257 for 1917). Efforts were first made in 1916 to induce peasants to take up the cultivation on systematic lines. The native cotton plants are hardy, free from disease, and possess heavy cropping qualities. The 1918 shipment sold for 1s. 8d. per lb., and was reported by the brokers to be of good quality and strength.—(*Col. Rep. Annual, No.* 1009, *Nov.* 1919.)

FOREIGN.

Wood Pulp Trade in Finland.—*Wood Pulp.*—Conditions in the Finnish wood pulp market, though critical in the early summer, improved when a reduction in prices was made and the German market re-opened. Practically the whole stock of wet wood pulp has been sold, and there has been no difficulty in disposing of this year's output: between June and August alone 40,000 tons of wet wood pulp was sold. Prices, however, have been lower than those obtainable in Norway and Sweden. It has been difficult to find a market for dry wood pulp, and of 18,000 tons sold 15,000 tons went to Germany.

Chemical Wood Pulp.—During the first half of the year the uncertainty of the Finnish political situation and the high prices compared with those in Sweden adversely affected the chemical wood pulp market. When the blockade was raised, however, large contracts were made with Germany, the

low Finnish exchange making it more advantageous for Germany to trade with Finland than with Sweden. On the whole, the Finnish chemical pulp trade has been able to hold its own in the market. During the first eight months of the year 37,500 tons of sulphate pulp was sold.—(*Bd. of Trade J., Nov.* 20, 1919.)

Trade of South-West Africa in 1918.—The Administrator of South-West Africa, in his latest report, states that there are indications that the territory is preparing to develop its industries on a commercial scale and in close economic association with the Union of South Africa. Imports during 1918, which were all derived from the Union, were valued at £1,031,534, the volume representing 3·1 per cent. of the total export trade of the Union. During the year diamonds were produced to the extent of 372,139 carats of an estimated value of £749,000. The Otavi Co. exported 7,358 long tons of copper ore, assaying from 12 to 33% of copper and 12 to 22% of lead. At the end of the year the company had on hand 139,322 long tons of ore with an assay value of from 2 to 41% of copper. The Otavi Exploring Syndicate exported 100 tons of copper ore with an assay value of 43.5% of copper. The Khan Mine closed down in February, and the Otjozongati Mine has not recommenced operations since the occupation. The output of tin amounted to 65 tons, assaying on the average 68%; 73 tons was exported.—(*Bd. of Trade J., Nov.* 27, 1919.)

Trade of the Philippine Islands in 1918–1919.—Full returns of Philippine foreign trade for the year ending June 30, 1919, show an import total of $107,774,263, an increase of 30 per cent. on last year's imports, but due to advances in prices rather than to increased trade. Exports totalled $122,729,238, of which less than 40 per cent. is credited to the latter half of the year. Hemp shipments for the first half-year were 96,380 long tons, and for the second half-year 36,268 long tons. This marked reduction of exports during the latter half-year is attributable to the depression in trade following the armistice. The manufacture of coconut oil has increased rapidly, and bids fair to become the chief industry of the Islands. As a natural result not only have copra exports ceased, but 17,093 long tons was imported during last half-year. With the release of tonnage and decline of freights following the armistice the sugar trade improved considerably, and local prices rose from 2·6 to 4·3 cents per lb. Exports at this latter figure were, however, small, owing to the failure of the crops.—(*Bd. of Trade J., Nov.* 20, 1919.)

REPORT.

REPORT OF THE GOVERNMENT CHEMIST UPON THE WORK OF THE GOVERNMENT LABORATORY FOR THE YEAR ENDED MARCH 31, 1919. *With appendices.* [Cmd. 419, 2d.]

The total number of samples analysed was 289,180, representing an increase of 20,062 over the previous year. The decrease of 16,000 in the number of samples examined at the central laboratory was due mainly to the cessation of hostilities and the consequent demobilisation of a part of the naval and military forces. On the other hand, a partial revival of trade, including the removal of restrictions on wine imports, led to an increase of 42,123 in the number of samples of wine examined. Other changes in the nature and volume of the work were a decrease of 4600 samples of army foodstuffs, and of nearly 3000 samples of steels and other metals for the Admiralty. The number of samples from the Food Controller and from the Air Board showed increases of 4813 and 3040, respectively, whilst the samples of coal received from the Coal Controller increased from 55 to 236.

The following numbers of samples were examined for the Customs and Excise:—Finished beer, 18,802; beer as retailed, 7; non-alcoholic beers, etc., 216; beer for export, 8425; imported beer, 29; materials used in brewing, 205; worts of unfinished beer, 8578; cider and perry, 18; table waters, cordials, etc., 183; spirits and spirituous preparations, 23,751; duty-free spirit, methylated spirit, etc., 1560; wines, 84,796; tobacco, snuff, etc., 69,768; tea, 7987; and many other substances. Eight samples of salts and solutions proposed to be used for treating brewing water were found to contain arsenic in excess of the permitted limit, but no excessive quantity of arsenic was present in beer made with water so treated; 966 samples of beer and wort examined were free from arsenic, and of 205 samples of malt and sugar, none contained arsenic in excess of the limit. The manufacture of saccharin in the United Kingdom, which had ceased for some years, was resumed in 1917, and 165 samples of saccharin and of the materials used in its production were examined in connexion with the assessment of duty.

Chemical work for the Admiralty entailed the analysis of 218 samples of food-stuffs and 5938 samples of metals, rubber, soaps, glass, and oils. Over 4100 samples, mainly alloys used in aircraft construction, were examined for the Air Board. The samples examined for the Board of Agriculture and Fisheries numbered 581. During the year no samples of imported fresh milk or cream were received; all the 47 samples of condensed whole milk analysed were free from preservatives, and there was no evidence that any of them had been prepared from skimmed milk. The 20 samples of imported butter examined were genuine and free from excess of water; 12 samples of imported cheese were free from foreign fats. Of 175 samples of butter submitted by the Department of Agriculture and Technical Instruction for Ireland, 32 contained excess of water, but all were free from foreign fat. The 167 samples analysed for the Local Government Board included baking powders, army rations, bread improvers, flour, fruit, pulp, preservatives, chocolate sweets and pastry; the chocolates contained mercury derived from the tin trays used in the process of manufacture, and the pastry had been made with a self-raising flour, in the preparation of which tartar emetic had been employed in place of tartar substitute. The Coal Controller sent 236 samples of coal, water, etc.; a sample of "coal saver" consisted almost wholly of common salt. Work for the Home Office consisted of the examination of lead glazes, paints, and other materials, and the analysis of samples received from the London police; the latter samples included drugs taken in connexion with the regulations limiting the use of cocaine and opium, liquors, etc. Samples to the number of 15,865 were examined for the War Department; these consisted of foods, beer and potable liquids, and drugs. The War Trade Department (now merged in the Board of Trade) submitted a great variety of samples taken by the Customs under the Exportation and Importation Prohibition Regulations; these samples consisted of soap (for glycerol content), disinfectants (for phenol), printing ink, ceramic colours and glazes, lubricants, rubber solutions, metals, coal tar oils, soldering fluxes, drugs, etc. The samples examined for the Office of Works, London, consisted largely of materials supplied by contractors for public service; numerous samples of materials used in the maintenance and construction of public buildings were analysed and samples of water from camp sites and for flax retting were examined. Ninety-seven samples were referred by magistrates under the Sale of Food and Drugs

Acts of 1875 and 1899. These included 82 samples of milk, 3 of whiskey, 2 each of ginger, Epsom salts and dripping, and 1 each of lard, cheese, chocolate, beer, camphorated oil and sausages. In 12 cases the results differed from those reported by the public analyst. Five samples of fertilisers and 6 of feeding-stuffs were submitted under the Fertilisers and Feeding-Stuffs Act. The fertilisers consisted of superphosphate, basic slag, and ammonium sulphate; the feeding-stuffs comprised feeding meals and cakes, milling by-products and poultry foods. Several of the meals contained substances unsuitable for feeding purposes.

REVIEWS.

COLLOID CHEMISTRY.

1. THE CHEMISTRY OF COLLOIDS. PART I., KOLLOIDCHEMIE, *by* RICHARD ZSIGMONDY. *Translated by* E. B. SPEAR, *Associate Professor of Inorganic Chemistry, Massachusetts Institute of Technology.* PART II. INDUSTRIAL COLLOIDAL CHEMISTRY, *by* E. B. SPEAR. A CHAPTER ON COLLOIDAL CHEMISTRY AND SANITATION, *by* J. F. NORTON, *Assistant Professor of Chemistry of Sanitation, Massachusetts Institute of Technology.* (*New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1917.) *Price:* 13*s.* 6*d. net.*
2. AN INTRODUCTION TO THEORETICAL AND APPLIED COLLOID CHEMISTRY: "THE WORLD OF NEGLECTED DIMENSIONS." *By* DR. WOLFGANG OSTWALD, *Privatdozent in the University of Leipsic. Authorised translation from the German by* DR. M. H. FISCHER, *Eichberg Professor of Physiology in the University of Cincinnati.* (*New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd.* 1917.) *Price:* 11*s.* 6*d. net.*

The publication of these two books, both translations of German works, while illustrating the continued and growing interest in the chemistry of colloids among English-speaking students, emphasises the lack of an adequate and satisfactory indigenous English literature of this important branch of chemistry. As the number of British workers in this domain increases, we may, however, hope that the gap in our English chemical literature will be made good.

The former of the two books mentioned above is a composite production, consisting, for the most part, of a translation of Zsigmondy's "Kolloidchemie," first published in 1912 and well known to students of colloid chemistry. To this, however, the translator has added a section of some thirty pages in length on Industrial Colloid Chemistry, and J. F. Norton a short chapter of some five pages on Colloids in Sanitation.

The work of Zsigmondy certainly deserved to be brought more fully to the notice of English-reading students on account not only of the authority with which the writer can deal with the subject of colloids, but also of the independent and characteristic outlook of the author. It is, however, unfortunate that the English translation should have been so long delayed as to appear just before a second and enlarged edition of the German work, and to be, in consequence, somewhat out of date already.

The work before us will probably not be found by students so useful as certain others for giving a general introduction to the properties of colloids. The work reads too fragmentarily and disconnectedly, and for this the classification adopted is, of course, mainly to blame. As no sharply-defined classification of colloids can be given, the author has adopted one depending on a chemical grouping of substances forming the dispersed phase of a colloidal system. After a chapter on "General Considerations" and one on Classification, the "Properties of Colloids" are dealt with in a chapter of less than forty pages, while another chapter of about fifteen pages is headed "Theory." After the more general treatment given in these four opening chapters the author discusses inorganic colloids—metals and non-metals, colloidal oxides, colloidal sulphides, colloidal salts—and organic colloids (especially soaps), dyestuffs, and protein bodies. These later chapters of the book are especially valuable from the practical point of view. Moreover, in his selection of material the author has confined himself for the most part to substances with which he has become familiar in his own investigations. If, thereby, restrictions have been introduced which make the book less valuable for the general student, the increased authoritativeness of the discussion enhances its value for the more specialist reader. Of special interest are the sections dealing with colloidal metals, particularly colloidal gold, in the investigation of which the author has taken an active part. With regard to the medical applications of colloidal metals, especially colloidal silver, the information is not very definite, and the review by Voigt of the state of knowledge in this department, although published some years ago, is not referred to here, as it did not see the light until after the appearance of the first German edition. This is only one of many cases illustrating the fact that the English translation as it stands is already rather out of date, and it is a pity that some attempt was not made to remedy this defect.

With regard to the section added by the translator on applied colloid chemistry, the reviewer, while recognising the importance of the subject, doubts the wisdom of the decision "to devote several chapters in this book to a side of the question that is particularly interesting to the technical chemist." Owing to the small amount of space allotted to this section, the treatment could not be anything but sketchy, and the author of the section has been compelled to omit considerable portions of the subject. The section, however, incomplete as it is, may in any case direct the attention of the reader to this side of the study of colloids, and will indicate something of the importance of applied colloid chemistry. In the chapter on "Colloids in Sanitation" it is also merely a glimpse that is afforded of this particular aspect of the subject.

The second volume under review is, as the author styles it, "a propaganda sheet for colloid chemistry," and is based on a series of lectures which the author delivered in the United States and in Canada during the winter, 1913–14. The work is a very useful one, more especially for the general reader, and also as an introduction to the fuller and more special study of colloids, because it is an attempt to give a general survey of modern colloid chemistry as a pure and as an applied science in a form readily intelligible to the general reader. It makes its appeal to the individual of general scientific culture, and the appeal is, on the whole, very successful. The subjects of the five lectures forming the basis of the book are: Fundamental properties of the colloid state; Classification of the colloids and the dependence of their properties on the degree of dispersion; Changes in state of colloids; Some scientific applications of colloid chemistry; Some technical applications of colloid chemistry. The field covered is a very wide one, the survey of the subject is very satisfactory and can be recommended to anyone wishing to obtain a general idea of what the colloidal state is and of the importance of this state in pure and applied science. It is, so far as the reviewer is aware, the only work of its kind.

The lectures were illustrated by specimens and experiments, and the author is to be commended for

giving full directions for carrying out the experiments shown. The book thereby acquires a greatly enhanced value for the lecturer and teacher. For such a person this book is to be recommended. It will be found of very great value.

ALEXANDER FINDLAY.

GRUNDLEGENDE OPERATIONEN DER FARBENCHEMIE. *By* H. E. FIERZ. *Pp.* ix.+323. (*Zürich: Schulthess and Co.* 1920 [1919].)

Of the four sections into which this highly practical treatise is divided, two are devoted to the fundamental operations involved in the production of coal tar intermediates and synthetic dyes; the third part furnishes technical details of the manufacture of these materials, and the fourth indicates methods of proximate analysis for the testing of the products. The chapter on sulphonation furnishes typical examples of the technology of this operation and includes also exercises in nitrations reductions and alkali fusions leading to the preparation of such important naphthalene derivatives as the naphthylamine-sulphonic acids and the technically valuable aminonaphtholsulphonic acids. To working descriptions suitable for operations on the laboratory scale the author adds useful memoranda concerning the carrying out of these preparations in the factory.

In the chapter specially devoted to nitrations and reductions one is glad to notice the substitution of cheap works recipes for the expensive academic methods of reducing nitro-compounds with tin and excess of acid or with alcoholic ammonium sulphide. The salting out of aniline from water replaces its extravagant extraction with ether.

Suitable examples of chlorination and oxidation are followed by the section on colouring matters, where a typical selection of azo-dyes is introduced.

A patriotic motive has prompted the author to add an interesting chapter on the synthesis of indigestion by Sandmeyer's method. This Swiss process, although no longer employed commercially, is a classical example of the combination of science and technology. It proceeds in five stages from aniline to indigo, giving an over-all yield of 80 per cent. of the calculated amount.

The section on technical details deals with distillation under diminished pressure, with the construction and employment of autoclaves, with the construction of the dye factory, and with other practical details essential to the successful management of a colour works.

The fourth and final section, which offers an introduction to the analytical control of coal tar intermediates might with advantage have been expanded so as to give a more detailed explanation of the analytical operations involved.

This treatise is profusely illustrated with plates and diagrams of apparatus and plants. The entire work is so completely up to date that it seems unnecessary to give it an incorrect date of publication ("1920"), a tampering with time which is not justified even by the most recent and advanced views on relativity.

This manual may be recommended with confidence not only to those making a special study of synthetic dye wares, but also to the general student of organic chemistry, to whom it offers a graduated series of laboratory experiments on the preparation of aromatic derivatives.

G. T. MORGAN.

IRON BACTERIA. *By* D. ELLIS. *With 45 illustrations and five plates. Pp.* 179. (*London: Methuen and Co., Ltd.* 1919.) *Price* 10*s.* 6*d. net.*

This book is designed mainly to assist the water engineer and chemist, by giving descriptions of the chief types of "iron bacteria" at present known, and by indicating the manner in which the knowledge so far gained may help in dealing with the attacks of these organisms.

From the point of view of the bacteriologist it must be admitted that our knowledge of this physiological group is scarcely sufficient to warrant a treatise, but Dr. Ellis's book reviews the present state of the subject, gives a useful list of the literature, and should serve to draw attention to the need for further research.

In the first portion of the book the author describes the various types of "iron bacteria" commonly met with, and gives diagrams and microphotographs illustrating their morphology. As in the case of many other bacteria, a good deal of uncertainty exists as to the specific distinctness of the various forms. For example, the group of *Leptothrix ochracea* and its allied forms *Gallionella* and *Spirophyllum* differ in the twisting and shape of the threads, and the author inclines to the view that they are variations of a single type. It would seem that further cultural study should enable this point to be settled. A similar example is seen in the case of *Cladothrix dichotoma* and its related forms.

However, the chief interest in connexion with the "iron bacteria" is centred round the physiology of their nutrition. The author devotes a chapter to the consideration of the various theories connected with the deposition of iron oxide by the organisms. General attention was first drawn to the subject by Winogradsky's theory, that they derived energy by the exothermic reaction involved in the oxidation of ferrous to ferric compounds. This theory, supported chiefly from an analogy with the sulphur bacteria, has been largely discredited since the behaviour of *Leptothrix* in pure culture was studied by Molisch, who showed that a ferruginous medium is not essential, but that the organism will grow as a saprophyte in the presence of organic matter, and that the presence of this organic matter is essential to its growth.

Molisch has suggested that the iron bacteria make use of organic matter which is in combination with an iron radical, casting out the iron as hydroxide. However, as the author points out, if we accept this theory, we must assume that the organisms possess an exceptional affinity for organic iron compounds. Until the possession of this power has been demonstrated the question of their metabolism cannot be regarded as settled.

The book contains two chapters dealing with the practical aspect of the subject and the detrimental effects of the organisms in reservoirs and water-pipes is described. The author suggests curative measures chiefly depending on the oxidation of the organic food material in the water and on the formation of an alkalinity unfavourable to growth by the addition of lime. At present, however, it is only possible to indicate the broad lines upon which treatment may be effective, and more research is needed before curative methods can be perfected.

H. G. THORNTON.

PUBLICATIONS RECEIVED.

THE CHEMICAL ANALYSIS OF ROCKS. *By* HENRY S. WASHINGTON. *Third edition, revised and enlarged. Pp.* 271. (*New York: John Wiley and Sons, Inc.; London: Chapman and Hall.* 1919.) *Price* 11*s.* 6*d.*

THE PREPARATION OF ORGANIC COMPOUNDS. *By* E. DE BARRY BARNETT. *Second edition, with* 54 *illustrations. Pp.* 273. (*London: J. and A. Churchill,* 1920). *Price* 10*s.*

INDUSTRIAL GASES. *By H. C. Greenwood. Pp.* XVII.+371. (*London: Baillière, Tindall and Cox.* 1919.) *Price* 12*s.* 6*d.*

Birmingham Section.

Meeting held at Birmingham University on November 14th, 1918.

DR. R. S. MORRELL IN THE CHAIR.

PROPERTIES OF THE COLLOID STATE AND THEIR APPLICATION TO INDUSTRY.

BY PROF. W. C. MCC. LEWIS.

Colloid chemistry as a science is in a relatively rudimentary state, somewhat in the same state, in fact, in which the chemistry of solutions of crystalloids stood over thirty years ago, prior to the work of van't Hoff, Arrhenius, and their successors. We have relatively few broad inclusive principles. Our information about colloidal systems is disjointed, and we meet with phenomena which in our present state cannot really be explained.

With all colloid and capillary systems, whether we are dealing with a sol system, as in colloidal solutions, emulsions, and suspensions, or whether we are dealing with a gel system or even with a crystalloid surface, the most fundamental fact is that all such systems are heterogeneous, consisting in general of two phases.

Von Weimarn has attempted to deal with one aspect of heterogeneous systems—that is with the conditions which govern the formation of precipitates—from a very general point of view, in which stress is laid upon the degree of supersaturation as the determining factor which controls the rate at which precipitation occurs and the type of precipitate produced. Whilst considerable success has attended von Weimarn's mode of attack, it is quite evident that a single factor of this kind is after all only one of several factors equally important. Von Weimarn's work, therefore, whilst instructive, is only capable of affording a very incomplete theoretical basis upon which to build up a scientific colloid chemistry. We have to seek other modes of investigation, which will take into account explicitly a further characteristic of colloidal systems. Colloidal systems are not only heterogeneous, they are likewise characterised by the fact that the interface, or more properly speaking the interfacial layer, which separates the two phases, is very great relatively to the mass of one or both of the phases. Colloid chemistry is, therefore, primarily the chemistry of surface layers.

This being the case, it is little wonder that the theory of capillarity has been called in to help, in so far as it can do so, in the clearing up of colloid chemical problems, in the hope that it may be possible to place the various colloid phenomena in their correct perspective and relation to one another. There can be no doubt at all that capillarity plays an essential rôle in colloid problems, but, unfortunately, capillarity is the least understood portion of molecular mechanics. It has advanced little since the days of Laplace. We know, of course, that it is due to the existence of molecular attractions. Laplace's fundamental assumption is that the field of this attraction round a molecule is uniform in all directions, there being no differentiation in intensity in the surrounding space. Starting in this way, Laplace succeeded in expressing capillary phenomena in terms of equations which require to be integrated, for which operation it is essential to know the law of force between molecules. As this is a problem which has not yet been solved satisfactorily, Laplace's theory has not led us far, and indeed it is by no means certain that his fundamental assumption regarding uniformity of molecular field—which he introduced for obvious mathematical rather than physical reasons—is correct. Quite recently the old view of Laplace regarding uniform attraction in space has been set aside and its place taken by the concept of valency, molecules themselves being no longer regarded as the fundamental centres of attraction but certain atoms or atomic groups inside the molecules fulfilling this function so as to give rise to localised regions of attraction. I am referring to the work of Langmuir and of Harkins. This work marks of course a radical change in our view of the origin and basis of capillarity. Personally, I am of the opinion that Langmuir's mode of treatment represents a real advance.

Apart, however, from any molecular mechanism or any law of molecular force, the application of thermodynamics to capillarity has led to an expression of very real importance, the so-called adsorption equation of Gibbs:—

$$\Gamma = -c/RT.\frac{d\sigma}{dc}$$

where Γ is the mass of material absorbed per unit area at the interface in excess of what would have been there had no capillary effects entered, and σ is the interfacial tension. As this expression shows, any substance which lowers the tension will heap itself up at the interface, whilst any substance which raises the tension will be driven out from the surface. This expression has been investigated in a few cases, notably by Donnan, who has verified it. It is unfortunate that in many colloid systems the interfacial tension cannot be determined experimentally, and consequently the equation loses much in practical significance. It represents, however, one of the very few general principles of colloid chemistry.

Not having gained a great deal of help from the classical theory of capillarity—though I think it more than probable that we shall eventually gain much from some such treatment as that developed by Langmuir—we turn to another aspect of colloid systems which possesses something of generality. Experiment has shown that many, if not all, colloid particles, and consequently interfaces in general, are electrically charged. The stability of a colloid solution has thus been connected with this fact of electrical charge, the removal of the charge being one of the causes of instability and coagulation. This is stating the matter in its simplest terms. From this point of view we are justified in the first place in regarding the stability of a colloid system as a problem of electrostatics. As is well known, however, difficulties crop up here also.

From the scientific standpoint the chief problems of colloid chemistry are: The conditions which make for the stability of a colloid system. How are stability and electric charge related to one another? What part does the Brownian movement play in this state of stability? Is there such a thing as a stable two-phase system consisting of only two pure substances? What is the mechanism of flocculation? Can flocculation be reversed? Is there anything in common in these phenomena which would lead to a generalisation apart from the specific nature of the material? If specific nature of the material is a determining cause, how can this specific effect be expressed? Can we, in fact, infer from a certain set of observations what the colloid behaviour of any given substance will be? How are the effects referred to affected by the presence of other colloids which may act either as stabilisers, peptisers, or coagulants? Is there such

a thing as a saturation limit to a colloidal solution? These and other questions readily occur to us. We have to confess, however, our inability in general to answer them except in a partial manner. Let me indicate some of the conclusions arrived at, and some of the many difficulties which still remain unsolved.

We are viewing colloid systems for the moment from the electrical standpoint. We are all familiar with the electrostatic method of charging a body by friction. The conditions under which this can be effected suggest that it is simply a question of removal of electrons from one surface and their deposition upon the other. Is the electric charge on colloid particles brought about by the same process? An absolutely definite answer cannot be given, but the great bulk of the evidence available points very strongly indeed to the conclusion that this is not the case; that, in fact, the charges met with in colloid systems are due to preferential adsorption of ions from the surrounding medium. In view of the work of Bancroft and others we are no longer in doubt as to the fact of the specific or preferential nature of adsorption, even though we have no information as to the reason why one substance is more readily adsorbed than another. The cause of selectiveness in adsorption is a subject for future research. But we are dealing just now simply with the fact itself. The well-known electrical behaviour of albumin, for example, in acid and in alkaline solutions respectively is very strong evidence for the ion-adsorption view of the origin of the charge on the colloid. Parenthetically it may be pointed out that if the charge on the albumin sol is due to preferential adsorption of an ion, it should follow that in absolutely neutral solution the albumin particle would not necessarily be uncharged. If, in fact, the hydroxyl ion is preferentially adsorbed, then the point of electric neutrality of the colloid should be found in faintly acid solutions. Information upon this point would be very interesting. Whether this effect occurs or not, it is not to be confused with the recent observations of Powis—namely, that coagulation does not coincide exactly with electrical neutrality. This is a new and unexpected result, for which no adequate explanation is as yet forthcoming.

As further evidence for the adsorption view of the origin of the electric charge, certain other results obtained by Powis on the preparation of colloidal ferric hydroxide may be mentioned. As ordinarily prepared, colloidal ferric hydroxide is positively charged in aqueous solution. It is usually obtained in this form by dialysing a solution of ferric chloride, the positive charge being attributed to adsorption of ferric ion from the solution, which is relatively rich in this ion. Powis has shown, however, that by allowing a dilute solution of ferric chloride to run slowly into a dilute solution of alkali hydroxide, with constant shaking, a negatively charged colloidal ferric hydroxide can be produced, the charge in this case being attributed to adsorption of the hydroxyl ions. Other evidence in favour of the adsorption view exists.

It may be taken as reasonably well demonstrated, then, that the source of colloid charge is to be found in specific adsorption of an ion of certain sign. The next question is—how is this charge distributed? Is a colloid particle surrounded by a Helmholtz double electrical layer, the charge on the colloid particle being faced by a sheath of molecules of the medium carrying an equal and opposite charge, or, on the other hand, is a charged colloid particle as free as an electrolytic ion? Hitherto the Helmholtz double layer has held the field. A certain instability must be attributed to the layer which is taken account of by the facility of slip (a term introduced by Lamb), for, of course, unless the outer sheath of the layer of charged particles of the medium can slip past the central colloid particle, the charge being handed on to oncoming molecules of the medium; unless this can occur, a system consisting of a double electrical layer with fixed charges of opposite sign would be effectively uncharged as far as an external field of force was concerned. The concept of the Helmholtz double layer virtually assumes, therefore, this facility of slip. It is clear at the same time that there may be different degrees of facility of slip, and hence the magnitude of the electrical charge, which is determined from the speed of movement of the colloid particle in a given field, may be only a fraction of the true complete charge borne by the particle. The fact is that we do not yet know with precision what the charge of any colloid or emulsion particle really is. Different methods lead to different results. Assuming that the Helmholtz layer exists, it is possible to calculate the potential difference which exists between the particle and the surrounding medium, even though we do not know the actual charge. The potential difference works out at approximately the same value—about 0·05 volt—for emulsions and colloid particles of very varied type. But does the Helmholtz layer really exist? This may seem an academic question, but definite information regarding it would be of great value in dealing with technical colloids and emulsions. No really definite information on this point exists. In view of the existence of electrolytic colloids such as congo red, the proteins, etc., in which it appears that the colloid particle simply functions as an anion, we are led to regard such colloids as quite analogous to solutions of electrolytes as far as freedom of the positive and negative charges is concerned. But may not this be so in all cases? In this connection very brief reference may be made to some experiments made by Beans and Eastlack. The results have a direct bearing, at the same time, upon the question as to whether a stable colloid system can be realised with two absolutely pure components, as in the case of a colloidal solution of a metal such as platinum or gold in pure water. At first sight—and more particularly in view of the very mechanical manner in which such solutions can be prepared, namely the well-known Bredig sparking method—such a system appears to consist simply of particles of metal carrying a negative charge in contact with a solvent which is known under ordinary conditions to be chemically inactive towards the metal. The conditions seem to be the very simplest possible in this case. Nevertheless Beans and Eastlack have succeeded in showing, I think, that the case is not really so simple. They approach the problem from the standpoint of the electrical conductivity which such a system should possess. A preliminary calculation based upon the known size, charge, and mobility of the particles in a colloidal solution of gold in water, showed that the specific conductivity of the colloid itself should be of the order 10^{-10} reciprocal ohms. This is only 0·01% of the conductivity of pure water, so that if the colloidal solution consists simply of finely divided metal in suspension in unchanged water, the conductivity of the solution should not be distinguishable from that of the water itself. This, however, is not the case. The solution exhibits a higher conductivity than that of pure water. Further, there is a marked difference in the enhanced conductivity according to the metal employed. Thus, in the case of colloidal platinum the conductivity is eight times that observed in the case of colloidal gold. Beans and Eastlack connect this larger conductivity with the fact that colloidal platinum is more stable than colloidal gold. Their idea is that the greater stability of the colloidal platinum is due to the presence of small amounts of

electrolyte formed by the oxidation of the metal at the high temperature realised locally in the sparking process. The presence of traces of chloride, bromide, iodide, or hydroxyl ions has a marked stabilising effect upon these colloidal metals provided the ions are present already during the sparking process. The conclusion to be drawn from these experiments is that even when the medium is pure—no extraneous electrolyte being added—the stability of the colloid is dependent upon its power of adsorbing or combining with some negatively charged ion, probably, according to these authors, a complex anion containing the metallic atom itself, this complex being produced in the sparking process and conferring the enhanced conductivity upon the solution as a whole. It seems to me that there is no getting away from the conclusion reached by Beans and Eastlack, provided we could be quite certain about the magnitude of the charge on the colloid particle. If their conclusions be accepted as substantially correct—and I am inclined to accept them—then we may conclude that the presence of a third substance—in the present case the complex anion produced in the sparking process—confers the charge and at the same time stabilises the colloid particle. Incidentally the doubt which does exist in this connection owing to the doubt regarding the magnitude of the colloid charge, is an illustration of how one scientific result hangs upon another and how we are retarded in one problem by lack of information in another. The above mode of regarding colloidal metal solutions is obviously in agreement with the well-known emulsifiers and stabilisers employed on the technical scale for the preparation of emulsions of various kinds in medicine and agriculture.

This brings us to the question of the coagulation of colloids, that is the transformation of the sol into the gel form.

It has long been known that the addition of small quantities of certain substances, chiefly electrolytes, to suspensions, emulsions, or colloidal solutions, brings about an agglomeration and precipitation of the finely divided form. The important rule in this connection is that ions carrying a charge of sign opposite to that carried by the colloid particle are the most efficient coagulating agents, and, further, that the higher the valency of the ion, that is the greater the number of unit charges upon it, the greater its precipitating action. This is known usually as the Hardy-Schultze law. The rule is now so familiar that I need hardly quote any data in support of it. It is one of the most useful generalisations which we possess. At the same time it must not be overlooked that there are certain exceptions to it. This has been emphasised particularly by Bancroft, who advances the not very novel explanation that specific adsorption of ions is the real determining factor in bringing about coagulation, rather than the fact of opposite electrical sign. It happens, however, so frequently that the two go hand in hand as almost to justify the Hardy-Schultze rule as a general truth. On the basis of this rule one would not expect precipitation to be brought about by the presence of a substance having the same sign as that of the colloid. Rather one would expect stabilisation, and such indeed is generally the case. Thus peptising agents and protective colloids have in general the same electrical sign as the substance they peptise and protect, that is retain in the sol form. Nevertheless there are exceptions. In at least one case a colloid brings about rapid coagulation of a suspension although the sign of both is the same.

As regards the kind of union which takes place between the active ion, that is the ion with coagulating power, and the colloid sol, practically nothing is known beyond the fact that it is a case of adsorption. That the union is a very close one is illustrated by the classic experiment of Linder and Picton in connection with colloidal arsenious sulphide precipitated by barium chloride. In this case the active ion is the positively charged barium ion—the colloidal arsenious sulphide is negatively charged. On examining the precipitate there was found closely adhering to the arsenious sulphide a certain amount of barium in the form of barium hydroxide which could not be separated by prolonged washing. Simultaneously a quantity of hydrochloric acid was discovered in the supernatant liquid or the filtrate. The whole effect is equivalent to the hydrolysis of the salt. This close union is also frequently found in the colloids present in physiological fluids. Owing to the presence of such ions closely associated with colloid solutions, accurate measurements of the osmotic pressure of such physiological colloids are extremely difficult to carry out.

In the phenomenon of peptisation or protective effect we have the setting up of conditions unfavourable for coagulation. Again, however, it is a question of selective adsorptions of ions. Selective adsorption therefore is not an ultimate explanation in itself either of coagulation on the one hand or of peptisation on the other, although it may be reasonably regarded as representing part of the mechanism. Peptisation, as Bancroft has shown, is a much more significant phenomenon than is usually recognised. The redissolving of certain metallic hydroxide precipitates in excess of the precipitant—the alkali—has been shown to be a case of peptisation. In the same connection reference may be made to some recent work on colloidal arsenious sulphide. This colloid is stabilised or protected in the sol form by the presence of hydrogen sulphide. If the hydrogen sulphide be dialysed away precipitation may be brought about. On readmitting the hydrogen sulphide the precipitate can be made to redissolve, according to Young and Goddard. This is obviously a type of reversible coagulation. Is coagulation a reversible phenomenon in all cases? So far as our knowledge goes we should say no. This appears to be true of coagulation by heat. Possibly however in other cases, such as those in which ions are the coagulants, we have never really reversed the conditions. It is clear that this is a problem which has not as yet been closely enough examined to admit of a definite answer. No subject indeed has suffered so much as colloid chemistry through the lack of really quantitative work.

The question now arises—why is it that the partial or total removal of the electrical charge on a colloid particle should cause coagulation to take place? We are indebted to Mr. Hardy for first making this clear, in the well-known experiments upon the iso-electric point. The particles are kept in agitation and in a certain spatial distribution throughout the medium, as Perrin has shown, as a result of the Brownian movement, that is as a result of the unordered collisions with the molecules of the solvent or medium. Brownian movement therefore has a double function in colloidal chemistry. As a result of the bombardment of a single colloid particle by the molecules of the medium the particle is kept in suspension; this effect is essential to the permanence of the colloid state. On the other hand the movement so imparted to the colloid particles must cause the colloid particles themselves to collide with one another, and if the conditions are favourable the collisions will result in permanent union, ultimately producing coagulation when the particles have grown to sufficient size. The function of the electric charge as a stabilising agency for the sol form is supposed to consist simply in the fact that particles carrying electricity of the same sign repel one another. Coagulation is thereby prevented. This is an

exceedingly plausible view of the case but one is scarcely satisfied that it is comprehensive. It would be a decided advance if this qualitative idea could be formulated in a quantitative expression amenable to experimental test. The difficulty of accepting this very simple view lies in the fact that peptisation and protection—which depend upon adsorptive effects—occur between particles of the same electric sign and therefore presumably repelling one another. I must confess to being not altogether satisfied with the view.

There is a further set of phenomena associated with the existence of electric charges upon colloids and upon interfaces in general, namely electrical endosmose and cataphoresis. A considerable amount of information respecting the origin of these phenomena is due to Perrin, Bancroft, Briggs, and others. Whilst selective adsorption again plays an essential rôle in these cases, it must be recognised that our information is rather qualitative than quantitative. The next development of colloid chemistry must be towards quantitative expression in general. Endosmose already possesess considerable technical importance, especially in the preparation and purification of many substances of colloidal nature. The patent literature, especially the series of patents taken out by the Ges. für Elektro-Osmose, is sufficient evidence in this direction.

Hitherto I have laid stress in turn upon capillary effects and upon electrical effects. The point of view which still remains to be considered is not based directly on either of these, but upon another general property of colloidal systems, namely the relative diffusibility of colloid particles and crystalloid molecules and ions more particularly through membranes. I refer to Donnan's theory of membrane effects, that is with the distribution of an electrolytic colloid in a liquid medium having an inert membrane separating the colloid solution from a solution of a crystalloid electrolyte. The kind of colloid considered is essentially an electrolytic colloid though it is possible that all colloids are in a sense of this type—an electrolytic colloid such as congo red which is capable of ionising into a simple ion (sodium ion) and a colloidal anion. The simple ion can pass freely through the membrane under ordinary conditions, the colloid cannot. Donnan has shown that the apparent permeability of the membrane to the simple ion is greatly affected by the presence of the colloid ion. In certain cases the colloid may be hydrolysed as a result of the presence of the chemically inert membrane, and electrical potentials which are calculable may be set up. This investigation possesses a very direct significance for many problems in physiology, the question of the distribution of colloid and salt in a simple electrolyte usually associated therewith, the problem of permeability and semi-permeability of tissues and other allied problems. It likewise plays a part in the well-known phenomenon of imbibition or swelling of gels, and recently Procter and Wilson have given a very interesting illustration of its applicability to the process of tanning. In Donnan's theory of the membrane effect, relative diffusibility is the underlying principle.

We have therefore a few, unfortunately a very few, general ideas serving to co-ordinate the various phenomena met with in colloid chemistry. Undoubtedly as time goes on these co-ordinating principles will be extended. It is absolutely essential that they should be.

It might appear at first sight that all that I have been saying is only very remotely connected with technical practice. As a matter of fact it is quite the reverse. The phenomena to which I have referred and others which I have not discussed are met with in certain stages in the most diverse kinds of industrial operations, and as a rule not nearly sufficient attention is paid to them from the colloid point of view. The treatment of ores by flotation and sedimentation, electrolytic precipitations or depositions as in electroplating, the preparation of technical emulsions, such as margarine, and de-emulsification processes, the action of certain preservatives, the procedure followed in textile work, dyeing, tanning, and so on, the treatment of sewage, filtration problems, agricultural operations, rubber coagulation and vulcanisation, and numerous other technical matters of the very first importance are already recognised as involving colloid chemistry very directly. Elsewhere we find colloid chemistry cropping up in at least one stage in a series of operations otherwise not regarded as colloidal. In fact a good many of the so-called proper working conditions aim either at eliminating or reducing to a minimum the colloidal behaviour of the material dealt with, or on the other hand aim at isolating the material in the colloid state.

The real trouble in all this is the fact that scientific colloid chemistry has not advanced nearly enough to meet the requirements of present-day technical practice. Many of the technical operations in this field are consequently empirical—a state of affairs which no one can regard as satisfactory. I think I have indicated how the whole range of scientific colloid chemistry bristles with unanswered questions. The fact is that colloid chemistry is only beginning to be thought about seriously. Even at the present time the subject has not yet generally appeared as a distinct subject for instruction and research in our universities and colleges. We cannot hope for real advances in colloid technology until scientific colloid chemistry is put on a proper footing and receives the attention which its fundamental importance deserves.

THE DEGREE OF DISPERSION OF COLLOIDS AND ITS DETERMINATION.

BY GEORGE KING, M.SC., F.I.C.

As a result of investigations over a period of something like ten years, von Weimarn of Petrograd concludes that any substance can be obtained in either the colloid or the crystalloid state according to the physical conditions under which it is produced, and to day a colloid particle is considered as an aggregation of molecules brought about by particular experimental conditions, so that the colloid still possesses many of the physical properties and all of the chemical properties of the molecule. We see, therefore, that the discussion in the earlier literature as to whether a hydrosol is a solution or a suspension is purposeless, since all solutions are essentially heterogeneous mixtures of one substance the disperse phase with another the dispersion medium. It is, therefore, the particular province of the colloid chemist to determine how the properties of the substance depend upon the *degree* of dispersion.

The degree of dispersion is best expressed, according to Ostwald, as the ratio of the absolute surface of an individual particle to the volume of that particle, it is, however, more usually expressed in terms of the linear dimensions or diameter of the particle and the unit used is the micron or 10^{-3} mm. (*a*).

In the systematic study of colloids, or the application of colloidal phenomena to industry, it is necessary to estimate the degree of dispersion of the particular colloid; indeed just as the measurement of conductivity is essential in the study of electro-chemistry so the determination of dispersion is essential in the study of colloid chemistry. Thus, for example, we find the determination of dispersion used to distinguish Russian from American petroleum, to estimate asphalt in oils, for

determining the correct mush in the Weber process, for the manufacture of glass-house melting pots by casting, in the dye and colour industry, in agriculture, for the examination of soil colloids, in physiology for the investigation of body fluids. It is used to determine the degree of homogenisation of milk, homogenised milk being more suitable for the manufacture of ice cream and other commercial products than untreated cow's milk.*

The degree of dispersion may be classified as macroscopic, *i.e.*, particles greater than 200 μ = 0·2 mm.; microscopic, greater than 0·2 μ = 0·0002 mm.; ultramicroscopic, greater than 0·2 $\mu\mu$ = 0·0000002 mm.; and molecular, less than 0·3 $\mu\mu$.

For microscopic particles the upper limit is taken as that of the particle passing the finest sieve in general use. The microscopic lower limit is determined by the resolving power of the best microscope. With an immersion objective of numerical aperture 1·35 and an immersion condenser of 1·3, Johnstone Stoney found 0·2 μ to be the diameter of the smallest particle which he could observe in detail.† Some idea of this lower limit is given by a photomicrograph of a Prussian blue film obtained by Tinker‡ in his investigation of semi-permeable membranes where the particles clearly visible are 0·1 μ to 0·4 μ in diameter. Such particles are approximately a thousand times the diameter of the smallest particle of gold which can be detected in the new Zsigmondy ultra-microscope.

Whilst the colloid chemist may upon occasions trespass into the realm of microscopic or molecular dimensions, he is more particularly concerned with the chemical properties and energy redistribution of ultra-microscopic particles, and to him the ultra-microscope is almost as necessary as the chemical balance.

At the Royal Institution in 1856 Faraday exhibited some solutions which he believed to quote from his paper "to be a mixture of colourless transparent liquid with fine particles of gold . . . specimens of the fluid remain for months without any appearance of settling, so that the particles must be exceedingly divided, still, the rays of the sun when collected by a lens will manifest their presence by the opalescence . . . which is the result of their united action."

Half a century later Zsigmondy rediscovered colloidal gold and observed the opalescence with a microscope, the axis of which was set orthogonally to the illuminating beam. This was the first ultra-microscope,§ it was essentially an instrument for obtaining a dark ground illumination, and the light scattered by the colloidal particles was observed in an ordinary microscope, each particle appearing self luminous like a star. Intensity of the scattered light (I_s) is directly proportioned to the square of the volume of the particle, according to well established laws investigated by Lord Rayleigh‖ and depends also on the indices of refraction of the medium and the particle.

$$I_s \propto \left[\frac{\mu_1^2}{\mu^2} - 1\right]^2$$

where μ represents the refractive index of the medium and μ_1 that of the dispersoid.

Accordingly no matter how intense the illumination if μ does not differ much from μ_1 the particle will be invisible. This unfortunately is the case with hydrosols of albuminous bodies and some other dispersoids.

The ultra-microscope therefore does no more than enable us to detect individual colloidal particles, neither their shape nor size can be directly observed; moreover in hydrosols the particles show rapid Brownian movement and consequently are in the field of view for a very short time. The absolute size of the particle must be determined indirectly by counting the number of particles in a known volume, and the mass and density being known the length of the side of one particle is calculated from the formula $L = \sqrt[3]{\frac{M}{SN}}$, where L is the length of one side, M the mass in unit volume, S the specific gravity, and N the number of particles in unit volume.

The definite volume of colloidal solution in which the count is made is contained in a small observation cell with quartz windows. The main illuminating beam, which enters the cell at right angles to the observation microscope, is controlled by means of a bilateral micrometer slit, so that both the depth and breadth of the image of this slit can be fixed and determined. In the Zeiss instrument the image is about 1/36th of the dimensions of the slit. By means of a micrometer eye-piece a definite and known area of the beam is taken, or for convenience in counting the area enclosed by a square of known dimensions is observed. The depth of the beam of light at this point is made less than the depth of normal vision, and the product of depth and area so determined gives the known volume of solution, in which the number of particles at any particular moment may be seen at a glance. With a depth of vision of 5·05 μ suitable for the writer, the Zeiss slit stood at 15 divisions and particles in a fixed volume of 200 μ^3 were counted. On account of the rapid Brownian movement it is necessary to take the mean of the number of particles observed at ten momentary observations, and the solutions should be diluted with colloid-free medium till there are never more than four particles in the field at the same time. The writer has found it useful to arrange for periodic illumination by allowing a pendulum screen to swing in front of the micrometer slit; the impression of the number of particles seen is then very definite, and that number is conveniently recorded at the same time on a typewriter. The solution in the observation cell should be changed at least ten times and ten momentary observations made for each. The mean of 100 counts gives the number for the particular dilution. One or more controls with fresh dilution should always be made.

After the invention of the slit ultra microscope various other devices for a dark-ground illumination were suggested. The only important types surviving, however, are represented by the paraboloid, cardioid, Leitz, and Cotton-and-Mouton. They serve very well for qualitative observation, but with the exception of the cardioid are only useful for coarse hydrosols; moreover, they are very unsuitable in chemical technology for the rapid examination of colloidal solutions, since for each small quantity observed, the adjustment of the instrument must be disturbed and a fresh small quantity of solution put into the special microscopic slide. With the slit ultra-microscope, once the instrument has been adjusted it is quite a simple matter to pass one solution after another through the cell.

In the cardioid ultra-microscope it is possible to distinguish particles which are beyond the range of the old slit ultra-microscope. This is due to the fact that the hydrosol can be more intensely illuminated. Rayleigh has shown that for the same wave length and same dilution of a particular solution $I_s \propto V^2 I$, or the volume of the particle just visible is inversely proportional to the square root of the intensity of the illuminating beam. Realising the importance of this factor, Zsigmondy* modified the illuminating system of the slit ultra-

* "Colloids in the Arts," Arndt-Katz, p. 35.
† Johnstone Stoney, Jour. Roy. Mic. Soc., 1903, p. 564.
‡ Tinker, Proc. Roy. Soc., A., vol. 92, p. 357.
§ Ann. der Phys., 1903, 1-10.
‖ Phil. Mag., 1871, p. 107, 447; 1889, p. 375.

* Kolloid Zeits., July, 1914, p. 281.

microscope by using objectives of high numerical aperture 1·05, the one at right angles to the other, so that the front lenses, which were of quartz, were both immersed in the hydrosol. Such an arrangement is impossible unless a portion of the front lens and its mounting is cut away. This was accomplished by Winkel of Göttingen and the front lens made water-tight again, so that we have an immersion ultra-microscope, the objectives being immersed in a small quantity—a single drop suffices—of the hydrosol under examination. In the later development, calibration, standardisation, and use of this instrument the author was associated with Zsigmondy, and it was found that whereas 5 $\mu\mu$ was the size of the smallest particles that could be counted in the old ultra-microscope, in the new immersion instrument particles of 3 $\mu\mu$ were counted, and although much smaller particles than 3 $\mu\mu$ can be seen in concentrated solutions, the light scattered from one or two such particles in dilute solution is insufficient for accurate counting. The manipulation of the immersion ultra-microscope does not differ much from that of the slit ultra-microscope already described. In place of the glass cell for holding the liquid a small ebonite cup is used; less liquid is required and a number of solutions can be observed in rapid succession. The instrument is particularly useful for observing viscous liquids and jellies. By means of a special eye-piece observation is limited to particles in a definite illuminated volume. The magnitude of this volume was carefully determined for various adjustments of the micrometer slit controlling the dimensions of the illuminating beam. A check on the agreement of the illuminated volume of the new ultra-microscope with that of the old was obtained by damping down the illumination, in the sol, to approximately the same intensity for both, when it was found that the number of particles per c.c. in a particular sol were for the slit ultra-microscope $5{\cdot}69 \times 10^6$ and for the immersion ultra-microscope $5{\cdot}60 \times 10^6$.

From what has been said it is evident that the new instrument will reveal the presence of particles in a hydrosol which are too small to be seen in the slit ultra-microscope, so that for a hydrosol containing particles of varying sizes, more particles are counted and the average linear dimension is correspondingly smaller. For a particularly bad gold sol the particles per c.c. revealed by the slit ultra-microscope were $3{\cdot}3 \times 10^6$ and by the immersion ultra-microscope $6{\cdot}4 \times 10^6$, the corresponding mean linear dimensions being 9·7 $\mu\mu$ and 7·7 $\mu\mu$.

It has been recognised that the individual particles in a disperse phase are of different sizes; unfortunately so far there is no certain method of obtaining uniform dispersoids. For many colloidal investigations such solutions are absolutely necessary, as for example, in the determination of the effect of dilution on the degree of dispersion. The best solution obtained by the author as the result of systematic observations on 120 gold sols and many hydrosols of mastic, silver, silver bromide, and silver iodide, was a gold sol prepared by using 40 c.c. of a Faraday phosphorus reduction gold solution for seeding a gold preparation containing 10 c.c. of 10% gum arabic and reduced by Zsigmondy's formaldehyde method.* This gold sol was centrifuged for 48 hours, and when some of this solution, suitably diluted, was observed in the slit ultra-microscope, $10{\cdot}81 \times 10^8$ particles per c.c. were counted, whilst in the immersion ultra-microscope $16{\cdot}32 \times 10^6$ particles per c.c. were revealed.

It is well known that in molecular solutions the molecular aggregation often changes with change in concentration, and indeed highly concentrated cane sugar solutions show the Tyndall effect. Among emulsoids the degree of dispersion of a gel varies progressively with the dilution. When an ordinary gold sol is progressively diluted, it has been observed that at five times the dilution there appears to be one half the number of particles instead of one fifth; that is to say relatively more particles are counted with progressive dilution; moreover the count has been found * to increase to a maximum and decrease again. This increase in count with dilution is frequently noticed in ultra-microscopic work and has been observed by the author with silver bromide, mastic, and gold sols. The following results are representative of a number of observations on gold sols. The particles were counted, the sol diluted four times, and the particles recounted.

	Count in 124 μ^3.		
	Dilution 1	Dilution 4	$\frac{\text{Dil. 4}}{\text{Dil. 1}} \times 100$
Au 74	15·5	5·06	32·6
Au 23	11·5	5·4	47·0
Au 116	13·8	7·3	53·0
Au 88	17·2	12·72	74·0

A uniform sol should show 25 in the last column.

The hydrosols selected were of approximately the same degree of dispersion and concentration and were prepared from the same reagents. If the apparent increase in the dispersion were due to the splitting up of particles on dilution into two or more particles, one would expect to find the values in the last column constant. In hydrosol Au 74 where 32·6 instead of 25 particles were found, the solution used was that already referred to as the best hydrosol prepared, containing particles of approximately the same size. The other hydrosols were not so uniform and Au 88 was manifestly bad. It would seem, therefore, that the increase in apparent dispersion on dilution is probably entirely explained by the fact well known to ultra-microscopists that in concentrated solutions containing particles of various dimensions, the smaller particles are masked by the larger and not counted, whereas in a dilute solution containing only one or two particles in the illuminated volume, the small particles, as well as isolated larger ones, are seen.

With the new immersion ultra-microscope a number of different colloidal solutions were qualitatively examined. Solutions of peptone, starch, gelatin, agar-agar, dextrin, in concentrations as used by Findlay and King † in the investigation of the influence of colloids on gas evolution, were examined under the best conditions for illumination, etc., but were optically clear. No doubt the refractive indices of the medium and colloid are nearly equal. Merck's ferric hydroxide sol was countable.

Of physiological interest is the condition of casein in cow's milk and human milk. In the latter the particles are uncountable in the slit ultra-microscope but can be counted in the new instrument, whilst casein in cow's milk can easily be seen in the slit ultra-microscope. Thus it would seem that cow's milk, if it be used for feeding infants, should be so treated as to cause an increase in the degree of dispersion of the casein particles—mere dilution of cow's milk does not do this. We realise to-day that chemical analysis alone does not determine the value of a foodstuff; the physical and colloidal condition of the food is of as much, if not of more, importance to the consumer than the number of calories it represents.

The above review of the method of determining degree of dispersion would be incomplete without reference to methods other than ultra-microscopic. It is often necessary to determine the size of micro-

* *Cf.* Taylor, "Chemistry of Colloids," 1915, pp. 185-186.

* Coward, Trans. Faraday Soc., 1913, p. 146.
† Chem. Soc. Trans., 1913, 1170; 1914, 1297.

scopic particles in a suspension; in such cases Stokes' formula $V = \frac{F}{6\pi\eta r}$ may be applied.* Other methods which have been used are discussed by Henri (Trans. Faraday Soc., 1913, 47), but these methods do not conveniently lend themselves to technical application.

A PROBLEM IN LUBRICATION.

BY W. B. HARDY, F.R.S.

The problem of colloids is the problem of surface energy. The peculiar features of the colloid state are the phenomena of surfaces, and I shall reduce them to two dimensions and treat of surfaces, or as near to true surfaces as the finite size of molecules will permit. Further, the surfaces in question shall be those of fluids or solids in contact with the atmosphere.

The surfaces of glass are covered with a material condensed from the air. The air consists for our purposes of elementary gases, water vapour, and impurities, and a surface of glass seems to condense these last to a greater extent than either the gases or water vapour. The film, when formed, is an exceedingly thin one; it has the general properties of an oil; and therefore Lord Rayleigh speaks of it as a film of "grease." Its thickness has been measured and the measurements all agree, giving to it a depth of the order of 1 $\mu\mu$ or 1×10^{-7} cm.

The condensation from the air which forms these films would on the Young-Laplace theory be due to the greater density of the solid. This, however, is not enough; something else besides relative density operates. Surfaces are selective and selection, broadly speaking, follows chemical lines, as the phenomena of dyeing prove. The histologist is very familiar with the fact that solids condense either acid or basic dyes but rarely both indifferently.

Why does condensation occur? To what can we ascribe it? In general, we may say that it happens because the presence of the film lowers the potential of the inter-molecular forces at the surface. The free energy of a fluid surface is measured by its surface tension, and the film lowers the surface tension. According to modern views on the constitution of matter, the attractive forces which bind the film to the fluid or solid are electrical in character, but they are not merely electrical. Experiment shows that the electricity is decisively polar. The film is at a potential different from the matter on which it rests. The naturally formed film of grease on water is always, in my experience, electro-negative to the water. A machine which could seize the film and tear it off the surface would, in so doing, acquire a potential different from that of the mass. It would, as the phrase is, "generate electricity." Such a machine is an ordinary electro-static friction machine.

A surface which is saturated by a film of condensed matter, and which, owing to the electrical features just described, we might call, for short, a neutral surface, may be expected to have properties differing widely from those of a cleaned or raw surface. It will certainly have the property of adsorption or condensation in a higher degree. The only certain way to form a raw surface is to scrape off the naturally-formed film or to split or scrape a solid. The scraped surface of water has a higher tension and is highly absorptive. Oils, for instance, flash over it to reform a film. And the fresh surface produced by splitting mica has, as Rayleigh pointed out long ago, an electric conductivity very different from that of an old surface. What is not so well known, however, is the fact that the mechanical properties of the raw surface differ from those of the neutral surface. In order to study these properties it is not possible to make a succession of raw surfaces by splitting a solid, but one can, at any rate, remove the "grease" film.

It is not possible to get a raw surface of glass. One cannot cleave glass; but the "grease" film may be removed by rubbing the surface under water. Soaking is insufficient; actual vigorous rubbing is necessary, preferably with the finger tips until a peculiar clinging feeling is produced: the same which is felt when the edge of a finger bowl is rubbed so as to give out a musical note. A surface cleaned in this way has some remarkable mechanical properties, the most striking being that two cleaned surfaces seize when pressed together with a relatively small force. This may be demonstrated very simply by measuring the tangential force needed to produce slipping. That true seizing occurs is proved by the tearing of the surfaces which takes place in the act of slipping.

The function of lubricants is to keep the applied surfaces in the neutral condition by maintaining a "grease" film on each. Not all fluids, however, can act in this sense as lubricants for any particular surface such as that of glass. Water, ether, alcohol, benzene, and strong ammonia are apparently entirely incapable of maintaining a lubricating film on glass. Seizing occurs just as readily when they are present as it does with cleaned surfaces. Glycerin differs from the fluids mentioned above in the fact that though it will not maintain a lubricating film it does prevent seizing when present in excess. For instance, the maximal tangential force which a pair of cleaned surfaces would support without slipping was, measured in grams, 55. Flooding the surfaces with water, benzene, alcohol, etc., left this value unchanged. When a film of glycerin was deposited on the surfaces the force still stood at 55, but it fell to 9 when the surfaces were fully flooded with glycerin.

The expression "film" used above denotes a layer of fluid on the solid surface of the order 10^{-7} cm. in thickness. With a true lubricant the facility for slipping is maximal when a layer of such excessive tenuity separates the solid faces and nothing is gained by increasing the thickness of the layer. Thus with castor oil the weight required just to start one face of glass slipping over another was 10 grms. when only the invisible film of fluid mentioned above was present, and it was still 10 grms. when the surfaces were flooded with oil.

Some fluids indeed seem to lubricate better in thin than in thick layers, to act that is to say in the contrary way to glycerin. Acids as a class behave in this way, the solid faces again being of glass.

Pull in grms.

	Film	Flooded
Acetic acid	40	47
Sulphuric acid	37	47
Oleic acid	10	13

If this result can be fully substantiated it will be an important and striking physical fact likely to throw much light upon the process of lubrication. One broad conclusion emerges from these facts, namely that lubrication depends wholly upon the chemical constitution of a fluid, and the fact that the true lubricant is able to render slipping easy when a film of only about one molecule deep is present on the solid faces, suggests that the true lubricant is always a fluid which is adsorbed by the solid face. If this be so then the problem of lubrication is merely a special problem of colloid physics.

* V=Velocity of fall; F=force acting; η=viscosity; r=radius of particle.

Nottingham Section.

Meeting held at Nottingham on December 11th, 1918.

MR. F. H. CARR IN THE CHAIR.

ANALYSIS OF COMMERCIAL SACCHARIN.

PART II.—THE DETECTION AND ESTIMATION OF IMPURITIES.

BY H. DROOP RICHMOND, F.I.C., AND CHARLES ALFRED HILL.

(For Part I. see this Journal, 1918, pp. 246—249 T.)

Saccharin is official in the British, French, and United States Pharmacopœias under the names of Glusidum, Saccharine, and Benzosulphinide respectively, and the monograph in each case includes tests for the impurities likely to be present. In no case, however, are the tests given specific for any impurity, and we think it will be useful to discuss the various tests that have been put forward for the impurities of most common occurrence.

Moisture. We take the small loss on drying in the water oven as moisture, though if the saccharin be damp a minute portion may be hydrolysed by heating with water. Thus 1 grm. of saccharin containing about 0·25% of water was heated for successive periods after being damped with 1 c.c. of water before each. After 2 hours' heating the residue weighed 0·9986 grm., after 4 hrs. 0·9996 grm., after 6 hrs. 1·0002 grm., and after 20 hrs. 1·0012 grm. After many additions of water the weight rose to 1·1152 grm. and was still gaining when the experiment was stopped. With no further addition of water the weight fell to 1·0976 grm. after four weeks. This fall in weight is probably due to slight volatility.

The following figures, obtained by boiling 6·104 grms. of saccharin with 500 c.c. of water, are interesting as showing that saccharin is hydrolysed (by the action of its own hydrion) in aqueous solution. After boiling for 1 hour 6·3% was hydrolysed; after 2 hours 16·5%; 4 hrs., 34·1%; 7 hrs., 50·9%; 12 hrs., 68·3%; 22 hrs., 82·9%; 48 hrs., 92·8%; 72 hrs., 95·8%; 96 hrs., 97·4%; 120 hrs., 97·4%. In a similar experiment 6·104 grms. of saccharin dissolved in 2500 c.c. of water was kept at room temperature (about 18° C.); after 30 days 0·7% was hydrolysed, after 92 days 6·0%, and after 166 days 17·6%.

The action is not so simple as in the case of hydrolysis with hydrochloric acid, since the hydrion content decreases as the hydrolysis proceeds, owing to the products of hydrolysis being weaker acids than saccharin.

Mineral matter. In estimating ash it is advisable to take advantage of the fact that saccharin sublimes easily, and to heat it gently at first till practically nothing but the mineral matter remains; the organic matter may then be easily burnt off. If the substance is heated too strongly at first, a good deal of carbon difficult to burn is formed.

A qualitative test which indicates chiefly the mineral constituents depends on the fact that saccharin, as well as the common organic impurities if these are not present in large amounts, is soluble in acetone, whilst most inorganic compounds are insoluble. A very poor commercial saccharin was found to contain 3·2% of ash and 3·9% insoluble in acetone. The B.P. specifies that saccharin should be "completely soluble in 12 parts of acetone." It is advisable to dry the acetone for use in this test, since wet acetone extracts larger amounts from commercial saccharin than the dried solvent.

p-Sulphonaminobenzoic acid. The properties on which the tests for the para acid depend are: (1) it is hydrolysed only with difficulty; (2) its solubility in water is small; (3) its solubility in immiscible solvents is greater than its solubility in water; (4) it is a weak acid.

The B.P. test (essentially that of Hefelmann) is as follows:—"1 grm. heated for four hours on a water-bath with 10 c.c. of a mixture of 4 volumes of sulphuric acid and 3 volumes of water completely dissolves, and when the solution is diluted with an equal volume of water and allowed to stand for twenty-four hours no crystals separate." From our experiments we conclude that the limit of sensitiveness is approximately 2%; the test is long and tedious, and the following modification is better: 1·5 grms. of saccharin is heated with 10 c.c. of 70·5% H_2SO_4 so that the liquid boils in 1 minute as nearly as possible, and boiled for exactly ½ minute; the solution is at once poured into 15 c.c. of distilled water, kept cool by immersing the vessel in cold water; after mixing, the solution is cooled under the tap, "seeded" with a trace of para acid, and placed in ice water; para acid if present to the extent of 1% crystallises out in ½ hour or less. If 3% is present the crystals usually begin to separate before seeding on cooling, and when about 10% is present the para acid begins to crystallise when hot. We believe that this test is the most rapid and reliable indication of the presence of para acid, and is roughly quantitative.

The method of Remsen and Burton (Amer. Chem. J., **11**, 403) for the estimation of para acid we find to be approximately accurate only, the results being always low, with a considerable divergence between duplicates, and the method appears to be unsuitable for small amounts. We attempted to weigh the crystals deposited in the B.P. test and in our ½ minute test, but the results were equally unsatisfactory.

Hefelmann (Pharm. Centr.-Bl., **85**, 105) employs a differential method depending on subtracting the *o*-benzoylsulphonimide nitrogen from the total nitrogen (Kjeldahl), while Proctor (J. Chem. Soc., 1905, 242) gives two methods, one depending on the difference between the benzoylsulphonimide and the total acidity, and the second on the extraction of the hydrolysed saccharin solution with ether, and titration of the acid in the extract. The first method is a fairly good one though open to criticism as regards experimental details, but with regard to the second method, we cannot believe that the author made more than tentative experiments in this direction.

Proctor employs Kjeldahl's method of acid estimation by means of iodide-iodate, a method which in our opinion is open to a considerably larger experimental error than direct titration with caustic soda, using phenolphthalein as indicator. Saccharin as well as the two sulphonaminobenzoic acids when titrated with caustic soda, using phenolphthalein as indicator, show an acidity above 100% (saccharin averaging 101·6%, the ortho-acid 101·7%, and the para-acid 100·9%) on the assumption that they are monobasic acids. This is probably due to the constitution of these compounds. When the iodine is liberated by treating saccharin and the acids with iodide and iodate, very variable results are obtained according to the length of time before titration. The following table illustrates this:—

Time	Saccharin		Para acid	Ortho acid
15 minutes	100·8	99·2	95·7	96·5
2 hours	—	101·8	96·6	97·5
16 ,,	101·8	—	100·0	98·7
36 ,,	101·8	—	100·8	98·7
50 ,,	—		101·7	—
60 ,,	—		101·7	—

With the assistance of Miss Ethel A. Taylor the following determinations of the acidity in commercial saccharin by the two methods were made:—

Acidimetric			Iodometric
99·1	...	...	98·9
98·5	...	...	98·4
98·9	...	...	95·5
98·9	...	...	98·9
98·5	...	...	100·0

It is evident from the uncertainty of the end point both with phenolphthalein and iodide-iodate that an estimation of total acidity and therefore of para acid by difference can only be approximate.

Our experiments on Proctor's second method show that ether is not an efficient solvent for the extraction of the para acid; the figures given below show how difficult it is to extract the para acid, and that Proctor's directions would certainly not give an accurate estimation. 2·416 grms. of a saccharin containing 93·2% of benzoylsulphonimide was extracted seven times with ether; the weights extracted after each treatment were: 0·0900 grm. (3·7%); 0·1040 grm. (4·2%); 0·1141 grm. (4·6%); 0·1284 grm. (5·4%); 0·1404 grm. 5·9%); 0·1494 grm. (6·3%); 0·1554 grm. (6·5%). The melting point of the product of the first three extractions was 248° C. and of the last three 270° C. The experiment was stopped before complete extraction had been attained; the first three extractions yielded an impure product, but the last three a fairly pure one.

Accurate results are obtained by substituting ethyl acetate for ether and increasing the number of extractions, dissolving in water, and re-extracting, but the process is rather tedious. The solubility of para acid in ethyl acetate is about 12 times that in water, while its solubility in ether is much less.

A mixture was made of 90 parts of pure saccharin re-crystallised from acetone with 10 parts of pure para acid; this was hydrolysed as usual, the ammonia distilled off, and the solution just acidified, made up to about 25 c.c., and extracted with successive portions of 50 c.c. of ethyl acetate; the following are the weights extracted successively (from 0·6104 grm.): (1) 0·0421 grm. = 6·94%; (2) 0·0162 grm. 2·65%; (3) 0·0144 grm. = 2·36%; (4) 0·0040 grm. = 0·65%; (5) 0·0010 grm. 0·16%; (6) *nil*.

The total weight extracted amounted to 12·76% and to neutralise this to phenolphthalein 3·41 c.c. of *N*/10 alkali was used = 11·3% para acid. The solution after titrating was again made acid and re-extracted five times, with the result that 9·88% was extracted, and the extracted portion required 3·03 c.c. of alkali to neutralise it, representing 9·98% of para acid (m.pt. 272° C.)

Two experiments were made with a sample of commercial saccharin; in the first 0·6 grm. was extracted three times and in the second 6 grms. was extracted seven times; in each case the extract was redissolved and extracted twice, a third extraction removing nothing. The results were 1·73, 1·78% by weight; 1·81, 1·74% by titration.

Other experiments have given equally good results. If a second extraction is made, and when the saccharin is free from amide, titration tends to give slightly higher results than the gravimetric estimation. Amide is indicated by the gravimetric results being higher that the volumetric.

o-Sulphonaminobenzoic acid. This is a possible though unlikely impurity in commercial saccharin and is the only substance which would interfere with the estimation of *o*-benzoylsulphonimide as it is hydrolysed by dilute acids forming ammonia. The only method for detecting and estimating it depends on its greater solubility.

The following table gives the approximate strength of solutions saturated at the temperatures named of saccharin and the ortho and para acids (results in grammes per 100 c.c.):—

Temp. ° C.	Saccharin	*o*-Sulphonaminobenzoic acid*	*p*-Sulphonaminobenzoic acid
0	0·20	1·00	0·020
5	0·21	1·23	0·025
10	0·23	1·48	0·030
15	0·26	1·77	0·040
20	0·295	2·11	0·055
25	0·335	2·50	0·075

* The *o*-sulphonaminobenzoic acid was prepared by hydrolysing saccharin with 7·5*N* sodium hydroxide solution till the sweet taste had entirely disappeared, precipitating the acid by adding strong hydrochloric acid, and re-crystallising from water; its m.pt. was 165° C, and when hydrolysed by hydrochloric acid it yielded ammonia equivalent to 99·6%. On dissolving in water and evaporating to dryness the residue was sweet, indicating a partial re-conversion to saccharin

The method of determining the ortho acid is to shake 2·5 grms. of finely powdered saccharin with 25 c.c. of water for 1 hour, and to estimate the acidity; if this is above that given in the table for saccharin, the ammonia produced by boiling 20 c.c. of the solution for 1 hour with 10 c.c. of strong hydrochloric acid (sp. gr. 1·16) is titrated; if the result when calculated as saccharin appreciably exceeds the amount deduced from the table, the excess is calculated as ortho acid.

The figures deduced from the titration and distillation results usually agreed very closely; 9·1% of ortho acid was found when 10% was added, and 11·6% found when 12% was added.

o-Toluene-sulphonamide. We use the following test for detecting this substance: 1 grm. of saccharin and 0·5 grm. of sodium bicarbonate are mixed together and placed in a dry test tube, about 1 c.c. of water is added, and the froth kept down by jerking the tube against the hand; when effervescence slackens a further 1 c.c. of water is added, with a continuing of the jerking, and later the rest of 3 c.c.; the tube is now closed with the thumb, and after violent shaking the saccharin dissolves completely, leaving the amide undissolved in the form of flocculi. Heavy crystals which settle rapidly are probably undissolved saccharin indicating that the test has not been carried out properly; the details are important. By extracting the alkaline solution with ethyl acetate and washing with water the amide can be estimated, but the process is tedious. Good commercial saccharin contains but small traces of this impurity.

Lead and arsenic. Lead may be estimated as follows: 2·5 grms. of saccharin is boiled with 25 c.c. of water and a few drops of hydrochloric acid, 3 or 4 drops of *N*/10 thiosulphate are added, and the liquid boiled and cooled; 1 c.c. of potassium cyanide solution (free from sulphide) is now added and the liquid made alkaline with ammonia, diluted to 50 c.c., 1 c.c. of a 10% solution of colourless sodium sulphide added, and the colour matched with that of a standard solution of lead acetate which has been treated similarly.

The arsenic test is: 0·25 grm. of saccharin is ignited with 0·25 grm of magnesium and 0·25 grm. of sodium bicarbonate. After cooling the ash is dissolved in 15 c.c. of 10% sulphuric acid, 5 c.c. of 10% $K_2S_2O_5$ added, the sulphur dioxide boiled off, the solution made up to 30 c.c with 10% sulphuric acid, and the arsenic determined electrolytically, using lead cathodes, by Harvey and Hibbert's modification of the Gutzeit test.

Melting point. The m.pt. of pure saccharin is 229° C., and is lowered by moisture as well as by impurities. As saccharin is hydrolysed (with lowering of melting point) on drying, we attach

little importance to this test, although it is official in the French and U.S.A. Pharmacopœias, the former giving 223·5° and the latter 219°—222° as the melting point.

Ammonia. The U.S.P. test for ammonia by boiling with magnesia is not very delicate, though an estimation may be made if ammonia is present by distilling into standard acid. Caustic soda may also be used (*cf.* Proctor, *loc. cit.*). We test for small quantities by means of Nessler's reagent. Ammonia is practically never found except in traces (well below 0·01%).

Easily carbonisable organic matter. The British, French, and United States Pharmacopœias give a test for easily carbonisable organic matter which consists in warming the saccharin with sulphuric acid and noting the brown colour produced. We find that essentially the same coloration is obtained during the boiling with 70·5% sulphuric acid for ½ minute, when testing for para acid, and therefore we eliminate this test, taking the coloration obtained in the test for para acid as its equivalent.

Sweetness. By comparing a solution of saccharin containing 0·1 grm. and 0·05 grm. of sodium bicarbonate in 1 litre of water with a 5% solution of cane sugar, it can be established whether the saccharin is over 500 times as sweet as sugar, and by varying the dilution in case of marked difference the sweetness of the saccharin can be expressed in terms of cane sugar. We are of opinion that the limit of delicacy of this test is about 5% with care and experience.

French Codex identification test (*cf.* Börnstein, Z. anal. Chem., **27**, 165; this J., 1888, 458; Monnet and Koetschet, Bull. Soc. Chim., 1899, [3], **17**, 690). When heated in a test tube with a small crystal of resorcinol and several drops of concentrated sulphuric acid, saccharin gives a liquid at first reddish-yellow then dark green. If this mixture is cooled, treated with water, and supersaturated with caustic soda, a liquid showing an intense green fluorescence is obtained, but the test is not really characteristic of saccharin, since the ortho acid gives the same results and the amide a moderate fluorescence.

This work was carried out in the Analytical Laboratory of Messrs. Boot's Pure Drug Co., Ltd., to whom we wish to express our thanks.

Yorkshire Section.

Meeting held at Leeds on November 11th, 1918.

MR. W. McD. MACKEY IN THE CHAIR.

THE ACCURATE DETERMINATION OF CARBON MONOXIDE IN GAS MIXTURES.

BY J. IVOR GRAHAM.

The author has recently carried out a number of experiments on the estimation of carbon monoxide by means of iodine pentoxide and as a result of these has come to the conclusion that methods of estimation based on the reaction $5CO+I_2O_5=5CO_2+I_2$ are capable of giving exceedingly accurate results if certain precautions are observed. He has adopted two methods for use in the routine estimation of this gas according to whether (*a*) the carbon monoxide content exceeds 0·2%, and an accuracy of 0·02% is sufficient, or (*b*) the carbon monoxide content is about, or less than, 0·2% and a greater degree of accuracy than 0·02% is required.

For the analysis of samples under (*a*), an improved form of the apparatus previously described by the author in collaboration with Mr. T. F. Winmill is used (Trans. Chem. Soc., 1914, **105**, 1996; this J., 1914, 944). Fig. 1 shows the new form of the apparatus. The main improvement consists in replacing the beaker of water, used for heating purposes, by a small steam bath of the construction shown in the figure. The necessity for cooling the iodine pentoxide U-tube to approximately the laboratory temperature before the final reading is taken is thus obviated, since all burette readings are taken with the U-tube at the constant temperature of the steam bath, and thus a considerable saving of time is effected when carrying out a number of analyses.

The steam bath also holds a second small U-tube containing palladinised asbestos (5%), connected on the one side to a three-way stop-cock and thence to the burette, etc., and on the other to the ordinary form of Haldane combustion pipette.

The apparatus is mounted on a wooden stand. *a* is a Haldane burette and *c* a Haldane compensator in the usual water jacket. A, B, etc., are pipettes containing approximately (A) 25% caustic potash, (B) 10% bromine in potassium bromide solution, (C) 40% caustic potash solution. D is a small U-tube containing approximately 2 grms. of iodine pentoxide—the air space over the latter in this tube being less than 1 c.c. E a pipette containing approximately 40% caustic potash solution. F* a small electric heater for boiling water in G, a wide test tube (2″ diam.), fitted with an indiarubber bung through which pass the U-tubes, D (I_2O_5) and I (Pd-asbestos), a thermometer T, and K, a small condenser, the inner tube of which reaches below the bend of the U-tubes; it is pierced with several small holes just below the rubber bung so that the steam from the boiling water passes up to the top of G, through these holes, and the condensed water then drops straight into the test tube without coming into contact with the U-tubes. H and H′ are two boards covered with asbestos and built out at right-angles to the stand in order to protect the main part of the apparatus from radiations from the electric heater. J is the ordinary form of Haldane combustion pipette (with fine platinum wire) connected to the usual mercury reservoir. Several pieces of asbestos millboard are placed in the position, L L′, to prevent undue heating of the connecting tubes from D and I. The whole apparatus is sealed together as far as possible; at certain positions, however, connections by means of india-rubber pressure tubing are desirable in order to facilitate the removal of the iodine pentoxide tube for revivifying purposes. When the apparatus is required for an analysis, the electric heater and the water to condenser are turned on. After about ten minutes with the heater in use in the author's laboratory the water is boiling vigorously and after half an hour the volume of gas in each U-tube has become constant. The levels of the liquids in the various pipettes are brought to their respective graduation marks, the sample taken in and analysed for carbon dioxide (sulphur dioxide and hydrogen sulphide), unsaturated hydrocarbons, and carbon monoxide—following the procedure described in the previous communication already referred to. With care, results can readily be obtained agreeing to 0·02% when the samples are analysed in duplicate. For example, a coal gas and air mixture on analysis gave carbon dioxide, etc., and unsaturated

* The small furnace used by the author was made from an empty cigarette tin just over 2 in. internal diameter and about 3 in. in height. This was covered with a layer of asbestos paper, upon which a suitable length of nichrome resistance wire was wound, and the tin then well covered with more asbestos paper.

hydrocarbons, 1·41, 1·40; carbon monoxide 2·16, 2·16%.

The palladium-asbestos U-tube, I, recently introduced, has been found to work satisfactorily for the estimation of hydrogen in gas mixtures, containing of course sufficient oxygen for the reaction. The oxidation of the hydrogen has been found to be rapid and complete even with a gas mixture containing approximately 20% of hydrogen.

The following analysis is illustrative of the accuracy of the method:—By palladium-asbestos tube 6·53, 6·51%. By combustion over red hot platinum spiral, 6·52.

In passing it may be mentioned that in a mixture of air and carbon monoxide (6·21%), the latter was quite unacted upon by the palladium-asbestos at the temperature employed (100° C.).

In analysing mixtures containing a high percentage of hydrogen in addition to saturated hydrocarbons, the gas should be passed through the last two gases, the carbon dioxide, unsaturated hydrocarbons, and carbon monoxide are first estimated. By turning the necessary stop-cocks the gas is then passed to and fro slowly over the palladium-asbestos, a couple of passages having been found sufficient to oxidise all the hydrogen to water. The connections to the remaining pipettes are "washed out" and the hydrogen oxidised by passage over the palladium-asbestos, the process being repeated until a constant volume is obtained. Two-thirds of the contraction observed gives, of course, the actual quantity of hydrogen present. The methane may then be estimated in the usual way by burning with the aid of the coil of fine platinum wire heated electrically in the Haldane combustion pipette, J, the presence or absence of higher (saturated) hydrocarbons being shown by the ratio of the contraction to the volume of carbon dioxide produced by the combustion. The amount of methane or other hydrocarbon left finally after

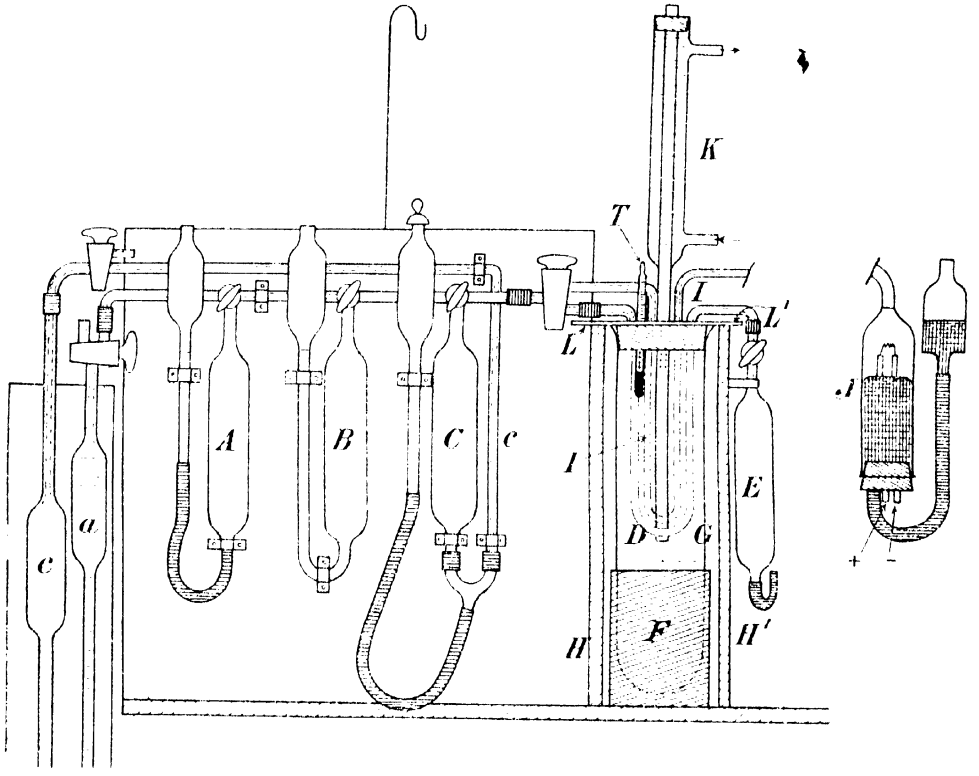


FIG. 1.

tube, I, rather slowly at first, otherwise the palladium-asbestos may attain a high temperature locally and as a consequence partial combustion of the hydrocarbons may occur.* If this precaution is observed, the method appears to give satisfactory results for the separate determination of hydrogen and methane or other saturated hydrocarbons. In the analysis of a mixture containing hydrogen 7·43%, methane 7·17%, no trace of the combustion of the latter took place during oxidation of the hydrogen by the palladium-asbestos at 100° C. When analysing samples containing carbon dioxide, unsaturated hydrocarbons, carbon monoxide, hydrogen, and methane, with sufficient oxygen present for the complete combustion of the removal of the other gases mentioned must be below the quantity necessary to form an explosive mixture, *i.e.*, in the case of methane below 5·6%.

Very often, and especially in analytical work connected with coal mines, it is necessary to estimate very much smaller quantities of carbon monoxide than those dealt with in the apparatus already described, and to obtain results accurate to less than 0·01%. An apparatus made in a portable form has therefore been devised for this purpose. It can be made in either of two forms—the one for use underground in safety-lamp pits and the other for use in naked-light pits or other places. The method employed is substantially the same in each case. A known volume of the air to be analysed is passed over iodine pentoxide heated to a temperature between 90° and 150° C. (after removal of all gases which interfere with the reaction), whereby the carbon monoxide is oxidised

* Further experiments are being carried out with a view to replacing the palladium-asbestos by very fine palladium wire in order to reduce the risk of local superheating during oxidation.

to dioxide and a corresponding amount of iodine liberated. The iodine is absorbed in a solution of potassium or sodium iodide (10%) and titrated with a standard solution of sodium thiosulphate, using starch solution as indicator. The analysis can be completed in about five minutes and an accuracy of 0·005% obtained without much difficulty. The apparatus was specially required for the determination of very small quantities of carbon monoxide in mine air, since 0·2% in air is highly dangerous, and even working in an atmosphere containing 0·02% for a period of eight hours would appear to have unpleasant after effects.

I. *Apparatus for use in safety pits.*

The difficulty met with has been to keep the iodine pentoxide at the requisite temperature. This has now been overcome by using a good thermos, or other vacuum, flask, filled with oil of high boiling and flash point. The latter is heated to about

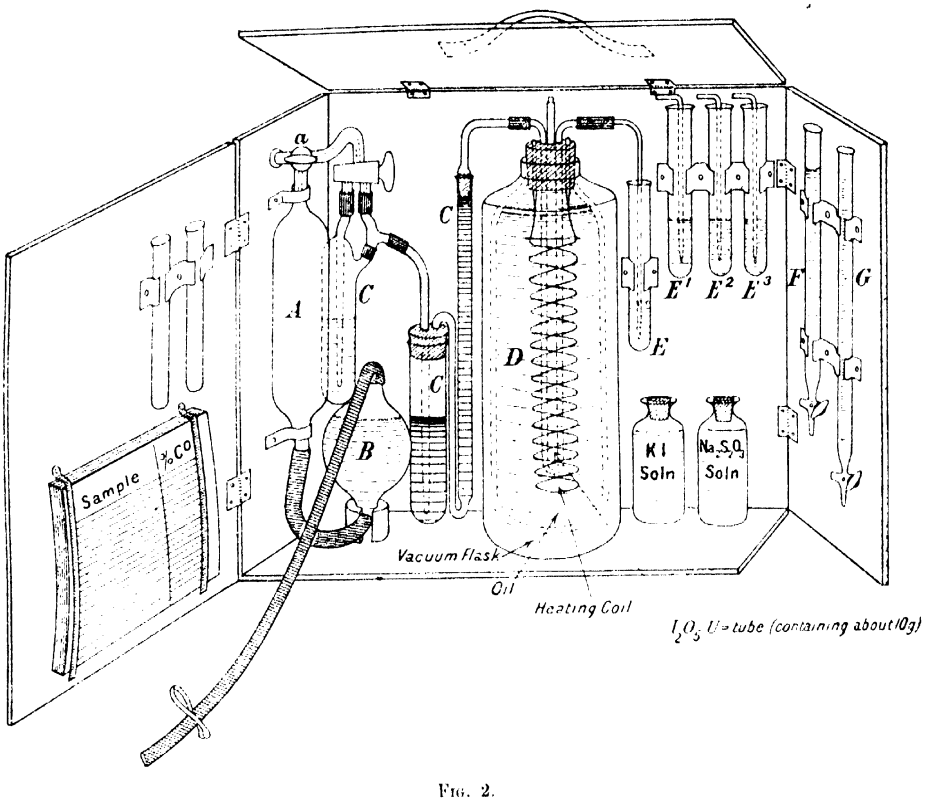


Fig. 2.

150° C. before commencing a series of tests, and the loss of heat has been found to be only such as to reduce the temperature of the contents of the flask to 90° C. after seven hours, thus leaving ample time for a great number of tests underground. To avoid the trouble of taking the apparatus to pieces in order to heat the oil, an electrical method of raising the temperature has been devised, by means of which the contents of the vacuum flask can be raised to 150° C. in the course of about five minutes and the apparatus is then ready for use.

The apparatus (fig. 2) consists essentially of the following, contained in a portable wooden case with hinged front, side and top:—A. Gas sampling vessel, capacity 100 c.c. (or other known volume), fitted with three-way stop-cock, *a*. B. Reservoir connected to A (and containing about 100 c.c. of water) by means of which the sample is taken into A and passed through the apparatus during the subsequent analytical process. The reservoir is fixed and the passage of the gas sample brought about by blowing through the indiarubber tube fitted with a pinch clip. C. Set of absorption tubes for purifying and drying the gas sample; the first contains a strong solution of bromine in potassium bromide solution, the second saturated caustic soda solution, and the other solid caustic soda, calcium chloride, and finally phosphorus pentoxide. The bromine vessel is fitted with a small glass valve, so that when the apparatus is standing practically no bromine vapour diffuses over into the strong caustic soda solution. Since mine air contains practically no trace of unsaturated hydrocarbons under ordinary conditions, it has been found useful to have a second three-way tap so that the gases can either be passed directly through the caustic soda solution if unsaturated compounds (which interfere with the action of iodine pentoxide on carbon monoxide) are known to be absent—or if the contrary is the case, by turning the tap the other way the sample may be made to bubble in a fine stream through the bromine solution, and then passed on through the concentrated soda solution. D. A vacuum flask, containing oil and fitted with a bung holding the U-tube containing about 10 grms. of iodine pentoxide, a thermometer, and two narrow tubes containing a small quantity of mercury, into the bottom of which are sealed copper leads connected to the heater. The latter is made of nichrome or other high resistance wire. It has a resistance of approximately 220 ohms when required for use where the ordinary lighting circuit is 220 volts. In order to raise the oil to the necessary temperature, two leads from the lighting circuit are placed in the mercury cups and the current passed until the requisite temperature is obtained. E. Delivery tube connected at one end, by an indiarubber connection, to the iodine pentoxide tube, the other end

being so drawn out and dipping into the potassium iodide solution in a test tube that the gas passing through the apparatus comes out of E in a series of very small bubbles. Complete absorption of the iodine is thus ensured. E^1, E^2, etc. Spare test tubes containing 10% potassium (or sodium) iodide solution. F. Ungraduated burette containing starch solution (approximately 1%). G. 5 or 10 c.c. burette graduated in 0·1 c.c. containing sodium thiosulphate of such strength that each 0·1 c.c. (*i.e.* 2 drops) of solution is equivalent to 0·01% of carbon monoxide when using 100 c.c. of sample.

To carry out an analysis, the tap, *a*, is turned to connect to outside atmosphere, and by opening the pinch clip and blowing through the tubing connected to B, A is filled to the tap with water from B. The pressure in B is then released and the water allowed to flow back from A to B until the 100 c.c. mark is reached (the quantity of water in A and B is just such that the levels are the same at the 100 c.c. mark).

The tap is then turned to connect to the purifiers, C, and the 100 c.c. sample forced rapidly through the apparatus—the tube, E, being not yet connected. This preliminary "washing out" process fills the purifying tubes, etc., with the sample to be analysed. A second 100 c.c. sample is then taken in as before, the tube, E (dipping into the potassium iodide solution in the test tube), is connected to the iodine pentoxide tube and the sample then passed through the apparatus at such a speed as to complete the passage in approximately two minutes. The tap, *a*, is then turned to the horizontal position, thus shutting off A from both air and purifier.

E is then disconnected and the test tube containing potassium iodide solution removed from the spring clip; a little of the solution is drawn up into E by suction in order to rinse out the inside of the tube, and a few drops of starch solution are added—the characteristic bluish-violet colour of starch iodide being produced if any appreciable quantity of carbon monoxide has been present in the sample. Standard thiosulphate solution is then added, drop by drop, until the blue coloration completely disappears.

When more than 0·3% of carbon monoxide is present in the sample under investigation, a portion of the iodine liberated may condense in the upper part of the iodine pentoxide tube or in the delivery tube, E. To obtain accurate results in such a case, 100 c.c. of the sample may be passed through the apparatus and the iodine liberated absorbed (without the preliminary "washing out" of the purifiers, etc.), followed by the passage of 200 c.c. of fresh air—or air of small known carbon monoxide content. Any condensed iodine will then be volatilised completely and carried through into the potassium iodide absorption tube. The amount of carbon monoxide present in the air used for "washing out" the sample is then deducted from the actual amount found. The accuracy of any determination can be increased by passing several 100 c.c. lots through the apparatus without changing the tube, E, or the potassium iodide solution.

Before commencing any series of tests, *i.e.*, just after heating the contents of the vacuum flask to 150° C., it is advisable to do a blank test on 200 c.c. of fresh air. The potassium iodide solution should give no appreciable colour on the addition of a couple of drops of starch solution.

A number of spare test tubes with delivery tubes are fitted by means of spring clips into the case. The same solution and tube can, however, be used over and over again provided the decolorisation has been very carefully effected in each case.

The complete apparatus in case weighs about six pounds.

The following results give an idea of the accuracy obtainable with careful working of the apparatus:—

TABLE I.

Carbon monoxide and air mixture.

	Vol. of sample	Temp. of I_2O_5	Time of passage of sample	% CO by titration	Actual quantity CO present
		° C.	mins.		%
1	200 c.c.	83	2½	0·056	0·061
2	,,	84	5	0·058	0·061
3	,,	115	8	0·061	0·061
4	,,	120	3	0·060	0·061
5	,,	136	4½	0·061	0·061
6	,,	137	4½	0·060	0·061
7	,,	161	5	0·066	0·061
8	,,	165	8	0·070	0·061
9	,,	170	4	0·067	0·061
10	100 c.c.*	96	2	0·270	0·277

* Washed out with 300 c.c. of air and corrected for the CO content of the latter.

Similar results have been obtained with other mixtures containing carbon monoxide. The apparatus has also been employed very successfully underground. The results given above show that the best range of temperature for carrying out the analysis is 90°—150° C.

The thiosulphate solution can be standardised to refer to samples measured at 15° C. or any other temperature. Any variation in temperature can then be allowed for—for example, if the thiosulphate solution is standardised for use at 15° C. and the apparatus is being employed in an atmosphere at 20° C., the correction to be added to the titration result will equal 1·5% of the latter. Correction should also be made for pressure when this differs considerably from normal.

II. *Apparatus for use in "naked-light" pits or other places.*

This is essentially the same as that described for safety-lamp pits, with the exception that the iodine pentoxide tube is heated in a hot-air bath produced by passing a current of approximately 2 amps. from a 2-volt accumulator cell through a coil of wire surrounding the iodine pentoxide U-tube, the whole being contained in a vacuum flask as before. In this way an air bath remaining more or less constant at 110° C. can be obtained. The 2-volt accumulator used should last for about six hours under these conditions. The air bath and iodine pentoxide tube take ½ to ¾ of an hour to attain the requisite temperature (approx. 100°—110° C.) from the time of first switching on the current. By using two 2-volt cells, and with suitable switch connections, the time taken to heat the iodine pentoxide tube in the first place may be considerably reduced by connecting the cells in series until the requisite temperature is reached, and then switching over to put them in parallel. Under these conditions the apparatus will remain for a much longer period at the necessary temperature. A small electric bulb, with short pieces of flexible connections, can also be fixed to the case and used to illuminate the apparatus.

If the apparatus is required for use in places where the temperature approximates to the freezing point of water, certain modifications are necessary owing to the very slight volatility of iodine vapour at low temperatures. For example, at 0° C. a sample containing more than 0·02% of carbon monoxide would deposit crystals of iodine after leaving the iodine pentoxide tube and becoming cooled to the atmospheric temperature. To overcome this difficulty and to make the apparatus of general use, the iodine vapour is prevented from condensing before reaching the potassium iodide absorption tube, by continuing the heated resistance wire with a few coils round the tube, and as near as possible to the connection, to E. This

portion of the iodine pentoxide tube is then covered with asbestos paper in order to retain a maximum quantity of heat. It is advisable to have the bung, fitting the vacuum flask, made of asbestos.

Instead of absorbing the iodine in potassium (or sodium) iodide solution, it may be absorbed in a definite quantity of some organic solvent such as carbon tetrachloride, and the quantity absorbed determined by colorimetric comparison with standard solutions of iodine in the same solvent. For the most accurate work, however, the titration with thiosulphate is recommended. This has been found to be done quite easily underground or anywhere else by the aid of artificial light.

It has been shown previously (*loc. cit.*) that hydrogen by itself is not attacked by iodine pentoxide provided the temperature of the latter is kept below 130° C. These experiments were carried out using the laboratory form of apparatus, with which the experimental error may be considered to be 0·02%. Tests with hydrogen mixtures of varying concentration have been carried out recently by the iodine titration method. The results of these are given in Table II.

TABLE II.

Hydrogen	Error estimated as CO	Temp. of I_2O_5	Time of passage of 100 c.c. sample	
%	%	° C	mins.	secs.
4·0	0·005	117	1	35
6·5	0·014	118	1	45
9·0	0·006	133	0	40
9·6	0·022	138	2	0
9·6	0·007	143	0	30
10·0	0·002	116	0	30
16·5	0·006	110	0	45
17·5	0·010	108	2	30
18·0	0·017	119	—	
20·2	0·004	98	2	40
21·0	0·001	97	0	40
22·0	0·007	109	0	30
23·0	0·017	116	—	
36·0	0·002	93	1	0
40·5	0·005	94	1	0
96·0*	0·02	127	—	

* This mixture, on being allowed to stand in contact with the hot iodine pentoxide (at about 120° C.) for one hour produced considerable decomposition of the latter.

From the above figures it will be seen that the error produced is largely dependent on the period of exposure of the gas mixture to the iodine pentoxide, as well as on the temperature of the latter. For the complete oxidation of carbon monoxide in quantities of about (or less than) 0·2%, the time of passage of a 100 c.c. sample of the gas should not be less than 1½ minutes in order to obtain a result accurate to within 0·005%. If the temperature of the iodine pentoxide be kept below 100° C. up to 20% of hydrogen may be present without an appreciable amount being attacked. As the temperature of the iodine pentoxide is raised and the time during which the gas is exposed is also increased, the error produced becomes appreciable. It has been previously shown (Graham and Winmill, *loc. cit.*) that although hydrogen alone is attacked to an extent equal to less than 0·02% of carbon monoxide, provided the temperature is below 130° C., with mixtures of hydrogen and carbon monoxide—unless these gases were present in quantities less than 20% and 8% respectively—results accurate to 0·02% could not be obtained even with the iodine pentoxide at about 100° C.

The following tests have therefore been carried out to see whether the method just described is sufficiently accurate for the determination of small quantities of carbon monoxide in the presence of comparatively large amounts of hydrogen.

TABLE III.

H_2	CO found	CO present	Error in percentage of CO	Temp. of I_2O_5	Time of passage of 100 c.c. sample	
%	%	%		°C	mins.	secs.
6·1	0·007	0·008	−0·001	107	3	0
9·0	0·147*	0·160	−0·013	101	1	0
16·7	0·036	0·023	+0·013	105	—	
17·4	0·034	0·025	+0·009	103	1	35

* Oxidation probably incomplete owing to too rapid passage of gas mixture.

If the results for the carbon monoxide, as found, be corrected for the small error produced when hydrogen alone, in an equivalent amount and at a corresponding temperature, is passed over iodine pentoxide—*i.e.*, from the results given in Table II.—the corrected results in the case of the last two tests (Table III.) agree very well with the theoretical, considering that the experimental error of the titration alone may easily amount to 0·003%.

Influence of methane and higher saturated hydrocarbons.

Methane has been found to be unattacked by iodine pentoxide at the temperature employed. Normal pentane in quantities less than 0·2% is only slightly attacked, but when present in larger quantities a considerable quantity of iodine is liberated by the reaction.

As has been already explained, however, the portable apparatus just described (Fig. 2) was designed specially for work in safety-lamp pits. Hydrogen and higher hydrocarbons in such quantities as will affect appreciably the accuracy of the method, have not been met with in samples from working places underground.

DISCUSSION.

Mr. F. W. RICHARDSON asked whether the apparatus might not be applied to determining the presence of minute amounts of carbon monoxide in blood.

The CHAIRMAN complimented the author on devising an apparatus by means of which accurate results could be rapidly obtained. He asked whether the colorimetric method would be suitable for use in a pit, also whether the drop burette was sufficiently accurate.

Prof. J. W. COBB asked if the author had used his apparatus for the analysis of the products of imperfect combustion such as might occur when a flame struck a cold tube. An analysis of that kind was by no means simple because of the difficulty of distinguishing quantitatively hydrogen, paraffins, olefines, aldehydic substances, carbon monoxide, hydrogen peroxide, etc., some or all of which might be present in small quantity. The palladium combustion tube appeared to give satisfactory results, although it was not generally regarded favourably. In his experience the colloidal palladium pipette was only reliable when used with special precautions.

The AUTHOR, in reply, said that probably the carbon monoxide in blood could be estimated by agitating the sample and passing oxygen through it to remove the carbon monoxide. The colorimetric test was not so satisfactory as the starch test, but could probably be used in the pit by surveyors and others who would be likely to prefer it to a titration method. He thought the drop burette was sufficiently accurate. The only instance he had examined of incomplete combustion due to a flame striking a cold surface was when he had investigated a case of carbon monoxide poisoning due to a geyser not being provided with a suitable flue, resulting in the formation of considerable quantities of carbon monoxide.

Birmingham Section.

Meeting held at Birmingham University on Wednesday, November 27th, 1918.

MR. HENRY SILVESTER IN THE CHAIR.

NOTES ON CHEMICAL STANDARDS AND THEIR BEARING ON THE UNIFICATION OF ANALYSIS.

BY C. H. RIDSDALE, F.I.C., AND N. D. RIDSDALE.

Introductory.

At the present time, when the Iron and Steel Institute, through its No. 5 Committee, has in progress the preparation of analytical steel standards, it appears opportune and important that information connected with the subject should be gathered and carefully considered and discussed. By this means valuable experiences and ideas may be elicited, and there should be greater likelihood that any standards issued as authoritative may really possess all the qualifications necessary to warrant their acceptance.

Besides treating the matter generally, the authors wish to place at the service of those interested certain views arising from many years' study of the subject, and their own experiences of the preparation and issue, both of private standards and —particularly over the last three years—of standards prepared on a much wider basis. It is important, too, to record for reference as many points as possible, as some which may seem minor, and hence be easily overlooked, are really vital. Only matters which have come under the authors' own observation will be dealt with.

Discrepancies in chemical analysis.

If two or more chemists, say, a seller and a buyer, test the same sample, their results do not always agree, and a dispute may arise involving perhaps the rejection of material. Many of the misconceptions as to disagreement are, of course, due to differences in sample, but even with an absolutely homogeneous and identical sample, differences may arise which are merely an indication of the limitations of analytical methods.

The authors have had abundant evidence of this when compiling the results of the co-operators for each of their own recent standards issued. Here the question of want of homogeneity was absolutely ruled out, whilst all the chemists were men of standing. Yet considerable differences were obtained, as will be shown later.

One valuable point about standards is that by demonstrating these differences between analysts, even under exceptional conditions of uniformity of sample, they force very close attention to and searching investigation of methods themselves.

The commercial need for the unification of analysis.

As pointed out by the authors in a former paper:* "It is astonishing that where sales are made to specified limits of analysis this state of things has been tolerated so long. Buyers and sellers have a right to demand that figures specified should not have uncertain values. Meanwhile a figure such as, say, 0·07% phosphorus, has no fixed value. It depends entirely on the personality of the reference chemist; if he finds a high result this may limit the steelmaker to 0·055%, or, on the other hand, allow him up to 0·08%."

The small limits allowed in carbon, phosphorus, sulphur, or other element do not really give the latitude they seem to. Take, for instance, carbon 0·40—0·45. This means in practice that the steel must always be so uniform that no part of a cast must come outside the limits, and hence the effective margin may be almost *nil*. But there are differences in the same cast, and even in the same section at different parts, to say nothing of different casts; so even if the manufacturer can keep all casts to average on the whole 0·425%, it only allows 0·025% variation from this. With phosphorus and sulphur, the margins are appreciably less than with carbon, and the difficulties greater.

As differences between the results of various chemists may equal or exceed the limits allowed, it is very important to the manufacturer to have a means of gauging the particular reference chemist's testing, on whose results the acceptance or rejection of large batches of material depend.

Attempts to meet the need.

Standard methods of analysis.—In 1886 Baron Jüptner von Jonstorff gave a paper before the Iron and Steel Institute on "The Introduction of Standard Methods of Analysis" (*Journal of the Iron and Steel Institute*, No. I, pp. 80—115) and (p. 68) a number of "the causes that bring about differences in analyses" were reviewed, the remedy advocated being clear from its title.

The authors' first efforts in the cause of unification were directed to evolving a system of standardised methods of analysis for certain elements, in which not only was the procedure minutely and exactly defined, but the standardising was automatically brought about, the conditions fixed, and the number of operations greatly reduced, as described in their papers before the Iron and Steel Institute in 1911 and 1913.

In the first of these papers the need of unification of analysis was again dwelt on, and how the want of it adversely affected commercial matters. Mr. Herdsman again dealt with the same subject in November, 1911,† but still no action was taken by any Society to bring about unification.

The system referred to has been proved to give accurate results quickly, millions of analyses confirming abundantly that it has gone far towards solving the problem, and particularly towards raising the reliability of results when working under hurried conditions, and led the authors to take the further step.

Chemical standards.—The appreciation of the need of standards as a means towards the unification of analysis is still confined in the main to chemists, and it is surprising how many who, it might have been supposed, would thoroughly understand it—such as works managers and leading engineers—have no conception of the meaning and function of standards. Therefore the fact should be pressed home that as an absolute value, neither specified compositions nor certified analytical results are by any means definite *unless expressed in terms of a specific analytically standardised sample*. By the popular and comprehensive term "*chemical standards*" is meant samples in suitable condition for analysis which have been already analytically standardised, and are taken as having a definite recognised composition.

The function of standards.

Scientific.—For the checking of analysts' work—especially that of young and less highly trained

* "Mechanicalising Analysis," *Journal of the Iron and Steel Institute*, 1911, No. I., p. 332.

† "Standardising Rapid Analytical Methods for Steelworks and other Purposes," West of Scotland Iron and Steel Institute, Session 1911-12.

assistants, where the senior has little time for personal supervision.

For the advancement of methods of analysis and checking their accuracy.

For comparison of the value of quick or works methods commonly employed with that of longer methods regarded as more accurate, in which all sorts of precautions are taken.

For standardising and checking volumetric solutions, e.g. acids and alkali in the estimation of phosphorus in steel, or bichromate, etc.

For indirectly checking the purity of reagents.

Commercial.—We have already seen that under present conditions no analytical figure has an absolute value which can be readily checked in such a manner as a weight or a measure can be.

But chemical standards, properly used, serve as a gauge to composition. This is not, therefore, merely a question of academical interest to chemists. It affects works managers and specifying engineers or Government departments even more vitally, facilitating production by minimising delay and rejections, owing to the former being enabled to attune their manufacture and testing to that of the referee.

In this connection it may be mentioned that when the authors represented this to the Admiralty Steel Inspection Department and the Ministry of Munitions (Land) Service, requesting them to co-operate in the testing of these standard steels, they willingly acquiesced, thus showing their desire to assist and work harmoniously with manufacturers, and to remove as far as possible difficulties out of their way.

The practical application of standards.

By engineers and other buyers.—These should make an invariable practice of only specifying "in terms of"—that is, referring their figures to a recognised standard sample. Then anyone working to their specification would know exactly the value of their figures. It is extremely desirable that they should appreciate the practical importance of this to their own interests and those of the industry generally. There need be no objection even should they not care to accept the general average of all the analysts' tests as correct, as they can take any of the figures or even test it themselves and affix their own value to it.

By chemists.—It is generally recognised that two or more tests done side by side by the same analyst and method almost invariably agree, but this in itself is no proof of accuracy. For this reason it is customary in high-class work, although it causes delay, to make tests by different methods and operators or at different times. If, however, with a sample of unknown composition a standard analysed sample of recognised composition is run through, and the results accord with those recognised for it, those of the sample can also be accepted with confidence, and this course is not only an advantage as saving time, but also from the sample being gauged by something definite.

If, on the other hand, there is an appreciable difference for any element, the chemist's attention is at once drawn to it, and he has an opportunity of ascertaining whether this is due to the method or the assistant who made the analysis. In case of incomplete agreement, although generally the chemist will prefer to repeat his tests until they yield a right result, yet if it is considered desirable, the findings of tests can be "expressed in terms of standard," that is, corrected in a degree corresponding to the differences found in the standard from the recognised figure. Thus, if the test of the sample showed carbon 0·38%, and the standard which ought to have come 0·41% showed actually only 0·39%, or 0·02% too low, the sample might also be regarded as having shown too low, and really to contain 0·40%.

The qualities standards must have.

PHYSICAL: *Homogeneity.*—Every single portion of the sample taken for analysis must as a whole be absolutely the same as every other, but segregation makes it a very difficult task to ensure this.

Condition of the material.—Great importance attaches to this, both that it may allow for thorough mixing, and for other reasons.

All sorts of attempts had been made by the authors to counteract the effects of segregation, such as by using small pieces of fine wire or strip (representing, of course, the whole cross section) cut up into very short lengths; and they even for a while carefully considered the possibilities of dust or fine shot tabletted after thorough mixing. All of these, however, were impracticable, and there seems no doubt that for metals which can be drilled, turned, or milled, these are the best ways of dealing with them. Of course, the larger the weight taken for analysis, the easier is it to ensure uniformity with a body like steel. For example, there is much less likelihood of variability between 5-grm. portions (for silicon) than between 0·1-grm. portions (for colour-carbon tests).

Obviously, however, special measures must be taken to prevent the pieces obtained being too large, and provided the material turned out is right, it matters nothing which method has been used for preparing it. The pieces should be so small that at least several go to a tenth of a gramme, and thus tend to secure an averaging effect apart from that brought about by thorough mixing of the sample. With ordinary cutting appliances and certain steels, however, the tendency is to yield either long coils or large curly pieces if thin, or else thick lumpy pieces. The former are unsuitable as weighing too much unless broken up—which is impracticable—and the latter, besides usually weighing too much, are quite unsuitable for certain tests, such as carbon by direct combustion, for which the pieces should be thin. On the other hand, if prepared in the ordinary way in very thin drillings too much of the substance may be in powder form, which is objectionable not only for colour-carbon tests, but also from the difficulty of always weighing off a fair proportion of powder and larger pieces. This difficulty applies with still greater force to a material like grey cast iron, in which a considerable proportion of light graphitic powder is formed; and for that reason it is recognised as better practice in analysis by some chemists separately to determine the proportion and composition of this and of the main portion. In a cast iron standard, the fine dust may with advantage be excluded.

These and many other points affecting the ultimate homogeneity of the standard, and varying for standards of each type of material, must be very clearly borne in mind and acted on with scrupulous care in their preparation. Some will be dealt with later under that heading.

Weight prepared.—One vital necessity is that there should be enough of a standard, when once standardised, to last every one using it for a long time, say several years. Another is that it should all be prepared at once in its finished condition, as the average mixture of the whole as issued must be standardised. The idea of getting a bar of considerable length cut up into short pieces and turning or drilling only a part is not satisfactory, as, to be reliable, each successive lot prepared would have to be re-standardised with just as much care and trouble as for the first part. Without this there would be no guarantee that there had not been variation or contamination.

CHEMICAL: *Composition.*—There is more need for standards at both ends of the range of composition usually dealt with—especially the upper limit—than even at an intermediate point. Most disputes

arise only when the material supplied is more than normally impure, and it is therefore particularly important to secure standards the composition of which is near to or slightly above the upper limits of impurities allowed by specification, and that contain such elements as when present interfere with determinations. Convenience in obtaining homogeneous materials tends to the selection of only purer types less liable to segregation, but that greatly lessens the practical value of the standards. Many methods which give satisfactory results with material of normal purity break down above or below this. For instance, some phosphorus methods for both steel and cast iron when phosphorus is low, say under 0·04%, or over 0·08%, and arsenic high, as say 0·12 to 0·15%; or when more than traces of titanium are present. Therefore, if the object of providing standards is to make them of real service, some of them should, in spite of the extra trouble involved, be of such compositions.

MORAL: *Authoritativeness.*—It is futile merely to decree that a standard be authoritative. If this is all on which its qualification rests, it will only be accepted under protest. The first step for a standard to become inherently authoritative is to get those sections of the community between whom differences of opinion might arise, as well as independent men, to test it, and to co-ordinate the results. This justifies acceptance, but it is only general acceptance and adoption which confers or can confer authoritativeness.

The co-operative movement organised by the authors.

The scheme and its carrying out.—It may prove instructive, as a concrete example, to describe briefly the causes which led up to and reasons for development in a particular way of the movement in which, by the assistance of a number of voluntary workers, it has been possible, for the first time in this country, to prepare effectively standards on anything like national lines, especially as it proved a prelude to the Institute's own scheme.

In the first place, a large number of chemists in different parts of the country were consulted, naturally commencing with those with whom the authors had come into touch through their "mechanicalised" methods. In the summer of 1916 some preliminary standards were issued, tested by five chemists. In September and December, 1916, circulars as to "Standard Analysed Samples" were sent to about 120 chemists explaining the scheme and proposed formation of the Association, and inviting wider co-operation; and the first standard on this extended basis, tested by eight analysts, was issued in March, 1917. In the system of standardising several elements, and issuing a printed certificate showing the results of each chemist, the practice of the U.S. Bureau of Standards was followed, and acknowledgment is here made to them; but a new feature was introduced which gives exceptional value to a standard, especially for commercial purposes, such as working to a specification or in disputes. This consists in carefully selecting the analysts for each standard, so that there shall be a fair proportion representing each opposite section of the industry, *e.g.* on one side makers who have to work to specifications; and on the second, Government departments, railways, or other users who issue specifications; and on the third, independent referee analysts. The analysts were also selected from widely different districts, and so any idea of local influence being associated with a standard is avoided. They included:—*Referee Analysts (Independent)*: W. H. Herdsman, Glasgow; J. and H. S. Pattinson (per J. T. Dunn), Newcastle-on-Tyne; Pattinson and Stead, Middlesbrough; Ridsdale and Co. (per C. H. and N. D. Ridsdale), Middlesbrough; Riley (Edward) and Harbord (per C. O. Bannister), London. *Railway Chemists*: The late C. J. P. Fuller, and his successor, H. Smith, Lancashire and Yorkshire Railway, E. W. Rowley, North Eastern Railway. *Government Departments issuing Specifications*: Admiralty Laboratories (per J. C. W. Humfrey); Ministry of Munitions Laboratory, Sheffield. *Works Chemists*: F. W. Daw, Ebbw Vale Steel, Iron and Coal Co., Ltd.; B. Deby, Cammell, Laird and Co., Ltd.; L. Duffy, Sir J. Jonas, Colver and Co., Ltd.; T. G. Elliot, Hadfields, Ltd.; C. S. Graham, J. Lysaght and Co., Ltd.; W. Hanson, Dorman, Long and Co., Ltd.; Clarence Steel Works; P. B. Henshaw, Kayser, Ellison and Co., Ltd.; Richard Howson, Samuel Fox and Co., Ltd.; D. Sillars, Bolckow, Vaughan and Co., Ltd; J. L. Thompson, Monk Bridge Iron and Steel Co., Ltd; C. Wilkinson, North Eastern Steel Co., Ltd.; H. J. Young, North Eastern Marine Engineering Co., Ltd.

A typical certificate of analysis of an acid open-hearth steel shows the following figures obtained by twelve analysts, using the methods specified: *Carbon.* By direct combustion in oxygen, 0·904—0·94; average 0·921%. Potassium copper chloride solution and combustion, 0·915—0·93; av., 0·922%. *Silicon.* Solution in HCl, single evaporation, and treatment with HF, 0·115—0·122; av., 0·118%. HCl or *aqua regia*, evaporation only, 0·105—0·128; av., 0·117%. *Sulphur.* Total, by oxidation, 0·044—0·052; av., 0·047%. Evolution of H_2S with HCl and titration with iodine, 0·047—0·052; av., 0·050%. *Phosphorus.* Separation of arsenic as As_2S_3 or $AsCl_3$, and grav. molybdate, 0·049—0·052; av., 0·051%. "Analoid," direct molybdate volumetric finish, 0·050—0·051; av., 0·050%. Direct molybdate ppd. at 80° C., weighing as $PbMoO_4$, 0·050—0·053; av., 0·051%. *Manganese.* Bismuth volumetric, 0·420—0·439; av., 0·430%. Persulphate colorimetric, 0·42—0·438; av., 0·428%. "Analoid" (persulphate volumetric), 0·428—0·439; av., 0·435%. Iron acetate separation and gravimetric, Mn_3O_4, 0·432—0·442; av., 0·437%. *Arsenic.* Distillation and iodine titration, 0·023—0·034; av., 0·028%. As_2S_3 separation and iodine titration, 0·031—0·034; av., 0·033%.

The practice at present, in order not to trouble each co-operator too frequently, and at the same time to turn out fresh standards fairly rapidly, is to have each one tested by not more than ten to thirteen chemists. Already there have been twelve of these later standards, selected and issued in accordance with their importance, whilst several others are already in preparation and arranged for. Four of the earlier ones have been exhausted, but all the later ones, including renewals, are prepared in much greater quantity than at first. A list is given in Table I. In order to co-ordinate the British chemists' standards results with those issued by the United States Bureau, tests of each have been made side by side by the authors. How eagerly standards of such character were awaited may be judged from the fact that, up to the end of October, 1918, 100,000 grms. have been issued in the British Isles and abroad, whilst 150 users have adopted them, including Government departments, leading armament and other works, and public laboratories. This alone to some extent indicates their value, and every fresh supporter, by the act of adopting a standard, automatically endows it with increased value in cumulative proportion.

How the standards were prepared: selection and preliminary tests for homogeneity.—As regards ingots, precautions such as tun-dish pouring, casting in brick-topped moulds, and pressing by the Harmet process were employed, and bars selected

TABLE I.—*A List of the Standards so far Issued.*

No.	Description.	Special Features.	Analysis.							
			Ni	Fe by diff.	Combined C	Silicon	Sulphur	Phosphorus	Manganese	Arsenic
			Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
1	Basic steel— "A.I." [1]	Complete analysis and standardisation of $K_2Cr_2O_7$ or $K_2Mn_2O_8$	...	99·556	0·05 [2]	0·006	0·037	0·026	0·310	0·035
2	"B3" [1]	Complete analysis . . .	...	...	0·412	0·101	0·048	0·060	0·791	0·066
3	"B4"	Complete analysis . . . High P and As.	...	...	0·401	0·027	0·046	0·101	0·735	0·140
4	"H"	C, S, and P standard only .	...	...	0·43	0·15 [2]	0·047	0·035	0·76 [2]	0·03 [2]
5	"I"	C and Mn standard . .	...	...	0·521	...	...	...	0·726	...
6	Acid steel— "O"	C and Mn standard . .	...	...	0·325	...	...	...	0·590	...
7	"Q" [1]	C standard only . . .	...	...	0·676	...	...	...	0·73 [2]	...
8	"S" [1]	C standard only . . .	...	...	0·905	...	...	...	0·55 [2]	...
9	"S.I."	C and P standard only . .	...	...	0·921	0·07 [2]	0·01 [2]	0·051	0·06 [2]	...
10	"T"	Ni standard only . .	3·367	...	0·3 [2]	...	...	...	...	...
11	"N"	Complete analysis . . .	...	...	0·17	0·117	0·034	0·037	0·432	0·029
12	Cast iron— Hæmatite, "A"	Complete analysis . . .	Total C. 3·121	Ti 0·050	0·734	1·989	0·047	0·049	0·688	0·042

[1] Exhausted. [2] Approximate.

from the lower parts and rolled or forged to section—generally about 4½ inch rounds. One of the higher carbon standards was normalised from 830° C.

Bars.—A good deal of work was involved in securing bars of approximately the right quality (which involved drilling and testing at a succession of depths and at each end, as also sulphur prints, etching, or other tests of the cut and polished cross-sections).

In the case of cast iron, a special cylindrical casting thin enough to minimise segregation, but still with sufficient substance to yield the necessary quantity of turnings, was made. It had 2-inch walls, was 10 inches external diameter by 3 feet 6 inches long as finished, and was cast vertically in a sand mould. There was a discard of about 18 inches off the top, and 6 inches off the bottom.

Mechanical preparation of standard turnings, etc.—The homogeneity of the main mass being verified, and slight local variations of skin or core exactly located, the first was liberally turned or planed off, and the second drilled out or inclusion of any portion of it avoided. The portion intended for standardising was then machined off, and this proved in practice to be a very much more onerous and tedious matter than ordinary fitting-shop work.

The authors' experiences were confined to drilling and turning, as they had no facilities for milling. It soon became evident that turning was much preferable, even though it required that bars should be round.

After numerous experiments, during which about a ton of fine material was prepared for standardisation, it was found that a high-speed steel side-shaving tool and a very slow traverse gave material in the best form, *viz.* turnings of even thickness throughout, whilst their breadth was easily controlled.

As an instance of what was involved, it may be mentioned that the mechanical preparation of one standard steel alone took 740 hours, or 92 days.

Some of the earlier steel turnings were rather longer and more curly than desirable, but later on they were prepared in a short thin form by fixing a baffle-plate near to the tool, so as to break them off before they could curl much.

The yield was necessarily low, but has recently been nearly doubled by arranging two tools to take cuts at different depths at the same time. The bar got too hot for it to be advisable to use more tools.

As even this method yielded only about 400 grms. per hour—requiring fifty eight-hour days to turn a single standard weighing 3¾ cwt.—clearly there is room for progress in speeding up, and it remains to be proved whether a milling machine will do this better than a lathe.

When it is remembered that a single spot of grease or water or a flake of wood, sneezing, or other contamination might have spoiled the entire lot of several hundredweights, it will be realised that the whole preparation had to be carried out, not by fitters, but solely by skilled chemical assistants.

After sieving off any dead fine from the turnings, there followed a series of mixings of an exceptionally thorough character on a definite system of successive quarterings, and final subdivision into the respective bottles, just as in dealing with large ore samples. Throughout all operations extreme care was taken to avoid the slightest damp or fumes which would set up rusting, and also that the containers were perfectly dry, and that well-fitting metal caps which make a tight joint were used. No waxing or cork linings were admissible, as contamination would have been just as harmful at that stage as earlier.

Standards properly prepared must be capable of being stored for an indefinitely long period without undergoing change.

Analytical standardisation.—When material, suitable in all respects, had been prepared, portions for analysis were issued to a suitable selection of chemists taking part in the standardisation, and with the samples sent out for testing sheets were also sent for filling up, which enumerated the different methods, so that the chemists with their results should show by which they had worked. These were classified under the proper headings on the certificate ultimately issued with their results.

Compilation of results.—Some of the first results for every standard, and for almost every element standardised, were too divergent, and needed further check tests. With steel samples the differ-

ences were not so great as with cast iron. Variations were obtained between a number of chemists of different types—all, however, accustomed to the analysis of steel and iron—in normal working. The differences do not represent greater care than this, as some of the chemists stated they had taken no extra precautions, but had run them through in the ordinary course. All whose results were far from the mean were told so, and without indicating in what direction, they were asked whether they would care to repeat them. If they still came widely different, they were informed, and in some cases the direction indicated, and a question put as to whether they had followed some procedure which might account for or remove the difference. If after further testing this divergence still persisted, they were sometimes as a guide told approximately what the extremes and averages of the other tests ran; but never, of course, any details or names. In any event they were invited to "stand on" their results if after thorough checking they were satisfied that they were correct, as the authors did not feel justified in acting as umpires, and recognised, too, that the man with the highest or lowest result may be right even though ten or twelve others agreed fairly closely to a different result, because he may have made advances and used improvements in the determination of that substance which they had not. This course was followed not only with works chemists (who, though experts in iron and steel methods, do have their figures questioned at times by those to whose specifications they work), but also with referee analysts to whom in an ordinary way a client would not suggest that their results might be incorrect.

The authors gratefully acknowledge, however, the very kindly way in which, regardless of trouble, the co-operators strove to reveal and overcome any sources of error in their analysis. Such sustained efforts bore eloquent testimony to the earnestness of the chemists in helping forward the movement. The differences between the results on the certificates fairly represent those occurring when working with extreme care. They may also be regarded as indicating the limitations of accuracy of the particular methods used, this covering, of course, all the variable factors involved in conducting them. In fact these analyses afford a unique opportunity, such as has probably never happened before, of correctly gauging the relative accuracy of methods in the hands of a number of reliable workers; for we are able to compare the results they yield, not merely on one or two tests, but on a really large number, with material of exceptional homogeneity, over a wide range of composition, and under different degrees of care.

Although in practice the general average will no doubt usually be accepted as right, this brings out the point that for commercial purposes, at any rate, the main value of a standard is that it is a reliable sample of uniform and known composition, agreed upon by the parties concerned; and whether the general average or one of the individual tests be regarded as the correct figure does not lessen its value.

Indeed it has occurred to the authors that a standard would gain a constantly increasing value beyond that it had when first issued, if the results found by all who used it were registered and available for any other users, and they hope in the near future to put this system into operation.

Not only are the methods tabulated, but, with a view to rendering fuller details readily accessible, their references in a few well-known modern textbooks—or, failing them, scientific journals and pamphlets—have been given (see Table II.); details of recommendations, precautions, etc., in the selection and carrying out of these methods have been given in the Appendix.

Analytical chemistry and its future.

In the light of the course events have taken in this country, considerable interest attaches to the Chandler Lecture for 1916,* by W. F. Hillebrand, chief chemist of the Bureau of Standards at Washington, U.S.A., entitled "Our Analytical Chemistry and its Future," which was recently brought to the authors' notice. In it he refers to "unsuspected defects in methods regarded hitherto as reliable and accurate, and . . . good results were due often to compensation of errors . . ." and to the "limitations of some common methods." He deals also with the arguments for and against standardising methods of analysis, and it is interesting to note that he points out the necessity of some of the features on which the authors insisted in their paper of 1911, and adopted in their standardised methods; such as the narrowing of and defining the range of possible compositions for which methods are accurate, and the exact and minute description of detail. He also combats the idea that standard methods tend to degrade the assistant or check progress. Further, he points out (for those who object to standard methods) that the use of standard samples does away in a measure with the need of standard methods, and with errors due to impure chemicals escaping undetected.

Finally he outlines a scheme for dealing with questions such as standards, standard methods, etc., and in this connection makes some rather emphatic remarks on Committee work. "Committee work . . . does not conduce to the production of results of consistently high standard. My experience makes me feel strongly that the advances to be expected through committees of professional societies are too often slight, and are secured at a cost of time and effort quite incommensurate with the gains. These and other considerations lead to the conclusion that such work should be in the hands of a permanently constituted body of well-salaried men under a director of the very highest ability as an analyst, and of excellent tact and judgment. It has long been my hope that at the Bureau of Standards we might gradually build up a section which should be the clearing-house in all matters of the kind under discussion" (research work, reference work, and educational work).

The views expressed in these later sentences may not meet with all-round approval, but is it wise to pass lightly the utterances of one who has studied the question so profoundly?

It is no easy matter to decide which is really the best course. Committee work is certainly slow, from the difficulty of arranging meetings to suit all the members, and those who attend do so at considerable cost of time and money. Indeed, it is a question whether, to make them really a success and get energetic action, members should not be paid their expenses, if not for their professional services, as for any other visit which took them away from their businesses. There is no doubt a good deal to be said in favour of a Central Bureau or Headquarters under the management of a principal for carrying out such work. The authors' experience has certainly been that this arrangement presents advantages in the matter of elasticity, and the liberty of action permits considerably quicker working than if carried out by some public body through a committee; and provided the lines on which matters are conducted are clearly defined and approved by competent representative men, there is little to be said against such an arrangement. The limitation is, of course, in the authors' own case, that the financial part presses heavily on a private firm which has no

* Printed in 1917 by The Columbia Press, New York.

grant or subscription to depend on, but must take the risk of the undertaking ultimately returning the actual outlay without prospect of receiving any adequate return for their professional services. Also it is not as if a special staff were maintained for them, to deal with the large volume of work entailed.

These difficulties, however, would not apply in the case of a Central Bureau, backed not alone by one, but by several societies.

And that brings us to another point. The question of Standards and Unification of Analysis is so large, being not only of national, but world-wide importance to science and industry, that its interests demand the widest possible support. The authors recognised at the outset that in initiating a pioneer movement they would inevitably stimulate larger bodies; and the Iron and Steel Institute has been the first to take action, not, however, by uniting with and developing the existing movement, but independently, and without recognising it. But any single Institution exists primarily to forward its own specific interests, and its outlook being therefore only from its own point of view, may be too narrow. Therefore it is desirable that Chemical and Engineering Societies also should take part in whatever is done. Combined, they could no doubt set up a Central Bureau on a scale equal to that of the United States Bureau which should meet the financial difficulties; and if the needs of mechanical standards require an Engineering Standards Committee to deal with them, surely chemical standardisation demands equal attention.

There is one point, however, that should be carefully guarded against. There is so much work to do—and the preparation of steel samples is only one small part—that if anything like rapid progress is to be made, all the brains that can be got are needed to work on the subject. Therefore it is desirable, in respect to any Bureau or Institution, that its work should not be done in such a manner as shall result in overlapping, and so rendering useless other work, nor shall it be given such a virtual monopoly or such a policy be adopted as shall choke off or freeze out all effort except through it.

The need for help from every quarter is the more important in that Unification of Analysis (assuming at the outset uniform samples) can only result not from one measure alone, but from the systematic inculcation of a higher plane in every detail of practice by chemists—standardised methods where these are available, at any rate for commercial matters; the regular and constant use of standards and analysed chemicals of standard purity; instruments of checked graduation, etc., and by engineers and other buyers the invariable specification in terms of standards; and every one should help to bring about this state of things.

In conclusion we should like to tender our sincere thanks to the chemists, firms, and Government departments whose names have been given above, and who have co-operated with us in the preparation of standards.

Our thanks are also due to Messrs. The Monk Bridge Steel and Iron Co., Ltd., and Messrs. The Tees Side Bridge and Engineering Co., Ltd., Messrs. Dorman, Long and Co., Ltd., and Messrs. Samuel Fox and Co., Ltd., who have supplied material.

APPENDIX.

Analytical Methods: Details of Recommendations, Precautions, etc.

Steel—Plain carbon and nickel.

Carbon: 1. *Direct combustion.*—This method is recommended for all types of steel and cast iron, on account of its superior speed and accuracy. Two of the most important points to observe are: *(a) Proper temperature—not lower than will melt silver wire (m.p. 960° C.) if inserted in the boat, or higher than about 1000° C.* Further, oxygen should not be supplied fast enough to cause the sample to fuse, or some unburnt metal may remain occluded. *(b)* Sufficiently thin turnings—not thicker than 0·25 mm. if below about 0·2% carbon, or 0·5 mm. if above.

Admixtures.—With care in burning none are necessary. If, however, one is used, alundum (Al_2O_3) or bismuth oxide (Bi_2O_3) is to be preferred. Red lead and magnesia almost invariably contain carbon dioxide, which is persistently retained in the latter even after prolonged calcination in an open muffle furnace. As pointed out by the United States Bureau of Standards, the burnt residue, when not mixed with an oxidising agent, generally contains carbon about 0·01%, even when the turnings are thin, especially in steels containing up to 0·2% carbon. They should be crushed in a steel mortar and reburnt.

Absorption in straight tubes having their stems loosely packed with thirty-mesh soda-lime mixed with 1·0% of powdered phenolphthalein, and the bulbs filled with small chips of caustic potash (not calcium chloride), is much to be preferred to the use of potash bulbs. The phenolphthalein turns pink when the soda-lime is exhausted.

Precautions such as the thorough purification of the oxygen, calcination of boats, asbestos, or other things entering the furnace, avoidance of leakage, etc., are obvious.

Furnaces.—Owing to the better control of temperature, better insulation of heat, and absence of carbon dioxide from burnt gases, electric furnaces such as the Humfrey furnace (made by Messrs. Brady and Martin), or the multi-tube furnaces (by A. Gallenkamp and Co.) are to be preferred to gas furnaces.

2. *Solution and dry combustion.*—This method is not suitable for certain alloy steels, but is valuable for standardising plain carbon steel and cast iron, though it is rather too long for use in works laboratories. Acidified cuprous potassium chloride is favoured rather than cuprous ammonium chloride, as the latter is liable to contain organic matter introduced during manufacture. Any error found is usually negative and due to one or more of the following reasons: *(a)* Boiling of liquid to promote solution, or allowing to stand several days before filtering. *(b)* Too little or too much hydrochloric acid. *(c)* In filtration, allowing much air to be sucked through the separated carbonaceous residue, thereby slightly oxidising it. *(d)* Not packing combustion tube with sufficient copper oxide or platinised asbestos to ensure all carbon monoxide burning to dioxide.

3. *Eggertz colorimetric.*—This has not been seriously taken into account, for although it is decidedly useful for certain purposes under known conditions, it is in many works regarded as obsolete even for stage work, and has long since been considered unsuitable for umpire work. Researches such as those described by Whiteley* substantiate the correctness of this attitude. It should here be emphasised that the long-held claim that standards for the comparison of carbon by colour should be prepared from steel made by the same process of manufacture as the sample, is not justified, but the heat treatment and amount of manganese (and other bodies that affect the shade) should be as nearly alike as possible.

Silicon.—Solution in hydrochloric acid alone and evaporation is recommended in preference to the use of *aqua regia* and sulphuric acid. Even for special work a single evaporation, if properly

* *Journal of the Iron and Steel Institute*, 1918, No. 1., p. 353.

TABLE II.—*Types of Methods Employed by the Co-operating Analysts, and Indicating Current British Practice.*

Notes on these, and points arising with regard to them, are given in the text.

Abbreviations Used.

A. = Analoid Method Sheet No.

A. and I. = "Steel Works Analysis," by J. O. Arnold and E. F. Ibbotson, 3rd edition, 1907.

B. = "The Chemical Analysis of Iron," by A. A. Blair, 7th edition, 1912.

B. and I. = "The Analysis of Steelworks Materials," by Brearley and Ibbotson, 1902.

B. and D. = "The Sampling and Chemical Analysis of Iron and Steel," by O. Bauer and E. Diess (English translation), 1st edition, 1915.

U.S.B. = United States Bureau of Standards, Circular 14, 5th edition, March, 1916.

J. Cd. Inst. E. = *Journal of the Cleveland Institution of Engineers*, 1914, No. 5.

J.I.S.I. = *Journal of the Iron and Steel Institute.*

AmPMo = Ammonium Phospho-molybdate.

STEEL (*plain carbon and nickel*).

Element.	Type of Method.	A.	A and I.	B.	B and I.	B and D.	U.S.B.	J.Cd. Inst. E.	J.I.S.I
			Page	Page	Page	Page	Page	Page	Page
Carbon ...	1. Direct combustion in O_2	...	39	131 and 331	6	140	6	...	...
	2. Solution in acid double copper chloride and combustion of separated residue	...	24	156	12	155	...	...	...
	3. Eggertz colorimetric	...	44	175	5, 18 and 180	...	...	...	...
Silicon ...	1. Solution in HCl and or HNO_3 and single evaporation with or without volatilisation of SiO_2 with HF	...	65	72	21	169	9	...	...
Sulphur ...	1. Oxidation with HNO_3 and estimation as $BaSO_4$	...	108	...	43	257	10	138	...
	2. Evolution of S as H_2S and—								
	(*a*) Absorption in acid CdAc followed by iodine titration	...	...	...	...	...	...	...	1911, I. 412
	(*b*) Ammoniacal $ZnSO_4$	...	...	...	...	...	...	140	...
	(*c*) NaOH	...	122	68	...	...	...	...	...
	(*d*) PbAc in series of tubes	...	117	...	...	...	...	...	...
	(*e*) Bromine, H_2O_2, etc., and estimation as $BaSO_4$	...	115	64	...	252	11	...	...
Phosphorus ...	1. Direct precipitation of P_2O_5 as "AmPMo" at low or moderate temperatures—								
	(*a*) Ordinary	...	113	97	55	228	9	...	...
	(*b*) "Analoid (1914) Pure"	14	...	...	...	...	...	...	...
	2. Evolution of As by means of Zn and gravimetric estimation of AmPMo	...	...	...	...	...	...	...	...
	3. Evolution of part As and separation of part as As_2S_3	...	152	80	...	...	...	...	1904, II. 263
Manganese ...	1. Bismuthate—								
	(*a*) Volumetric	...	92	122	34	216	12	...	...
	(*b*) Colorimetric	...	...	...	...	...	...	...	...
	2. Persulphate, volumetric and colorimetric—								
	(*a*) Ordinary	...	98	131	...	...	...	...	...
	(*b*) "Analoid"	11	...	...	...	...	...	...	...
	3. Acetate gravimetric	...	70	168	30	...	...	...	...
Arsenic ...	1. Distillation and iodine volumetric	...	...	...	105	...	...	...	1895, I. 110
	2. Precipitation and purification of sulphide and iodine volumetric	...	...	...	103	...	...	...	...
Nickel ...	1. Dimethylglyoxime								
	(*a*) Gravimetric	...	...	...	...	270	14	...	...
	(*b*) KCN finish	...	...	333	...	...	...	...	...
	2. KCN volumetric—								
	(*a*) Acetate separation of iron	...	189	...	70	...	...	...	...
	(*b*) Iron held in solution as citrate	...	...	...	...	277	...	...	...
	3. NiO gravimetric								
	(*a*) Acetate separation of iron	...	...	...	...	...	...	...	...
	(*b*) Ether separation of iron	...	...	191	...	...	...	...	...

CAST IRON (*hæmatite or low phosphorus*).

The same methods were used as for steel, together with the following:—

Graphite ...	1. Solution in HNO_3, s.g. 1.20 and dry combustion of residue	...	253	175	20	166	8	...	...
Silicon ...	1. Same as for steel	...	254	72	113	169	9	...	...
	2. Solution in HNO_3, and evaporation with H_2SO_4 (Drown's method)	...	255	...	...	175	...	...	...
Phosphorus ...	1*a*. Modification of method 1 for steel	...	257	97	114	228	9	...	...
	4. In addition to precautions in method No. 3 for steel, TiO_2 separated by fusion, and gravimetric molybdate	...	262	85	173	...	...	...	...
Titanium ...	1. Fusion of residue insoluble in dilute HCl and colorimetric H_2O_2 determination	...	...	...	...	309	9	...	...
	2. Gravimetric determination of TiO_2 from sodium titanate residue obtained from method No. 4 for P	...	...	184	173 and 96	...	...	...	...
	3. Colorimetric determination of Ti in residue referred to in method No. 2	...	238	...	95	...	...	...	...

conducted, will dehydrate all but an insignificant trace of silicic acid.

In the ordinary evaporation process, low results may be due to: (*a*) Insufficient baking of the residue. (*b*) Digesting residue with too strong hydrochloric acid, or delay in filtering off silica. Jüptner von Jonstorff cited a striking example showing 50% of the silica having passed into solution as a result of standing two days before filtering.* (*c*) Ash of filter paper incorrect. (Makes a lot of difference on a sample low in silicon.) The filter paper should be acid-washed, as in the test. Some English papers have an ash of 0·002 grm., which is practically all removed by washing with dilute hydrochloric acid. (*d*) Incorrect allowance being made on account of the non-volatile residue in the hydrofluoric acid.

High results may be due to silica dissolved from the glassware employed. Resistance glass beakers or porcelain basins are recommended. See also (*c*) and (*d*) as under "low" results.

Sulphur.—The authors' experience bears out the view now widely held that for steel the amount of sulphur not evolved as hydrogen sulphide from normally cooled plain carbon steels is negligible, and that the experimental error in working the oxidation method, although done by skilled chemists, makes it questionable whether that process is of greater value, in practice, than the evolution process, even for umpire work and standardisation.

1. *Oxidation.*—The following special points are recommended: (*a*) Digestion with a large excess (50 to 70 c.c.) of nitric acid, sp. gr. 1·42, and subsequent gradual addition of hydrochloric acid when the steel has dissolved as far as possible. This is a necessary precaution to prevent the loss of any sulphur in the gases.† (*b*) Precipitation of the barium sulphate in the cold (15° to 25° C.) in order to avoid the interference of basic iron salts. (*c*) Washing the barium sulphate with a cold mixture of 1 grm. barium chloride, 18 c.c. water, 2 c.c. hydrochloric acid, sp. gr. 1·16, followed by thorough washing with cold water. This removes completely all iron salts without dissolving any barium sulphate. Dilute hydrochloric acid alone exerts a solvent action on it. The barium chloride must, of course, be washed out with plain water afterwards. (*d*) Allowing not less than three or four hours for the barium sulphate to completely precipitate if over 0·01% sulphur on 5 grms. sample, or not less than twelve hours if under 0·04% sulphur.

2. *Evolution* of sulphur as hydrogen sulphide. Special points recommended: (*a*) Solution in concentrated hydrochloric acid, sp. gr. 1·16.‡ The addition of water tends to give low results, especially if much arsenic is present, due possibly to sulphur being arrested and precipitated as arsenious sulphide in the flask. The hydrochloric acid should be specially examined for arsenic for the same reason; it often contains appreciable quantities nowadays. (*b*) Fairly thin turnings, and as rapid evolution of the gases as possible. (*c*) Glass-stoppered evolution flasks are to be preferred, as new rubber stoppers are attacked by concentrated hydrochloric acid and often yield appreciable quantities of hydrogen sulphide. (*d*) Absorption of hydrogen sulphide in acetic acid solutions of cadmium or zinc acetate in preference to alkaline solutions. The former are readily oxidised by bright sunlight, whereas the latter are not. (*e*) Standardisation of the iodine solutions and sod-thiosulphate volumetric solutions should be made against *N*/10 or *N*/20 potassium bichromate, and the theoretical factor value accepted.

Phosphorus.—The preference for any one type of method is not nearly so marked in this case as in the case of carbon or sulphur. The main trouble to contend with is arsenic, which is nearly always present to some extent, and frequently to an extent which interferes very decidedly with determination of the phosphorus by molybdate methods. Some prefer the method always associated in the authors' minds with Dr. Stead, *viz.*:

Separation and removal of arsenic as sulphide, in which it is actually separated and removed before the phosphorus is determined, whilst others prefer by

Low temperature precipitation of the phosphorus, in the presence of the arsenic, to avoid it having any effect. The trouble is that whichever of these methods is used, the determination necessarily takes a long time, say from three to twenty-four hours, whereas all the ordinary really quick methods are affected, but to an uncertain and variable extent, by arsenic—and some of them by silicon.

The "Analoid" ("mechanicalised") method.—In the authors' first "mechanicalised" method described before the Iron and Steel Institute in 1911, the whole of the arsenic was invariably brought down, and could be allowed for by deducting a constant in relation to its atomic weight. Later, in 1913, they described another method on the same lines, but in which, as a concession to popular preference, the arsenic was actually removed as sulphide. This reduced the time to fifty minutes. Shortly after this, however, still searching for a more rapid method which should be unaffected by arsenic or silicon, as the result of a prolonged research the conditions of precipitation which met the need were found, and the "Analoid (1914) Pure" was evolved in which the time taken was reduced to twenty minutes or less. It depends on the right proportioning of the salts, acid, temperature, and degree of concentration.

Neither the research, which revealed many points of interest, nor the modified method evolved, have been described in any paper,§ but it is well known by many chemists. It proved so accurate that for practical purposes it superseded the one described in 1913, and its reliability has been since proved in practice by millions of tests both at home and abroad.

1. *Wet oxidation and direct precipitation.*

(*a*) This method is liable to give results slightly higher than the truth, especially in steel containing above, say, 0·02%, owing to the conditions governing precipitation not usually being sufficiently defined.

(*b*) Owing to the well-defined conditions of working, the "Analoid (1914) Pure" method has been shown to give results uninfluenced by arsenic, even in steel or hæmatite cast iron containing as much as 0·14% arsenic.

2. *Evolution by means of zinc.*—This method has the advantage over the one next to be described (3), in that the ferric salts need only partly reducing with one or two grammes of zinc in order to volatilise the arsenic as arsenious chloride. The complete removal of arsenic, however, may not be as readily effected (if much is present) as by separation of arsenious sulphide.

3. *Removal of arsenic as arsenious sulphide.*—This method (like the wet oxidation process for

* *Loc cit.*, 1906, No. I., p. 101.

† See *Journal of the Cleveland Institution of Engineers*, 1914, Vol. v., p. 161 (N. D. Ridsdale's discussion on Whiteley's paper).

‡ See *Stahl und Eisen*, 1904, Vol. viii., p. 240. Also article by H. B. Pulsifer, *Journal of Industrial and Engineering Chemistry*, July, 1913.

§ It has, since this was written, been given on February 10, 1919, to the Cleveland Institution of Engineers, "Notes on the Determination of Phosphorus in Iron and Steel," by N. D. Ridsdale.

sulphur) is capable of yielding excellent results in the hands of experienced operators, and is therefore a valuable alternative in standardisation. Methods 1 (*b*) and 2, however, are of equal accuracy, and may be performed more rapidly and with less skill. Several operators first found by this process results somewhat higher than what they subsequently decided was the truth.

Special points recommended.—(*a*) For methods 2 and 3 use an acid nitro-molybdate reagent in lieu of adding ammonium molybdate solution to the acidified liquid. This overcomes the tendency to high results which are otherwise frequently obtained when zinc salts are present in quantity. (*b*) Estimation of the yellow precipitate, $(NH_4)_3PO_4,12MoO_3$, is rapidly and accurately effected volumetrically by means of standard sodium hydroxide (free from carbonate) and nitric acid. As an alternative, gravimetric determination, filtering through asbestos in a weighed Gooch crucible, and drying at 120° to 130° C., is convenient. Brushing off filter paper not accurate. Conversion to lead molybdate, though accurate, involves an extra operation.

MANGANESE: 1. *Bismuthate volumetric* is a quick and accurate method, the popularity of which is well justified for reference purposes. Low results are often due to: (*a*) The carbon (or excess reducing agent) not having been completely oxidised —especially when much combined carbon is present —before forming the permanganic acid in the cold. (*b*) The oxidising value of the bismuthate being low (1 grm. should equal not less than 58 c.c *N*/10 ferrous sulphate). (*c*) The reagents not being free from chlorides. High results are usually due to sodium bismuthate or bismuth oxide passing the filter and being reckoned as permanganic acid.

2. *Persulphate volumetric and colorimetric.*—(*a*) Ordinary useful rapid method for works practice, but liable to somewhat variable results, unless a uniform procedure is closely followed and the reagents freshly prepared. (*b*) "Analoid" ("mechanicalised") volumetric modification of the ordinary persulphate method is an improvement on that described in the *Journal of the Iron and Steel Institute*, 1911, No. I., p. 361. It enables very rapid tests to be made which justify their claim to be as accurate as the bismuthate method, whilst there is no filtration of bismuthate compounds to be undertaken. A disadvantage of all persulphate methods for umpire work is that tests must be standardised against a sample of known manganese contents. In the bismuthate and persulphate volumetric methods the advantages of titrating the permanganic acid with sodium arsenite should be more widely applied. They are:—

(i.) Sodium arsenite does not become oxidised at all rapidly.

(ii.) It is quicker, because it is not necessary to add excess and then titrate back to permanganate.

(iii.) It avoids the interference of chromium.

(iv.) In the bismuthate methods, small quantities of bismuth oxide or sodium bismuthate, if they passed the filter, would not interfere as much as if ferrous sulphate were used.

3. *Gravimetric iron acetate separation.* This is too tedious for works practice, though useful for standardising samples, being based on entirely different principles to the foregoing methods. The tendency is to give results somewhat higher than the truth unless the precipitated Mn_3O_4 is purified from traces of silica, iron oxide, etc.

ARSENIC: 1. *Distillation and iodine volumetric.*—This is the most widely used process and capable of yielding very accurate results. A blank test of the hydrochloric acid for arsenic must be made and precautions taken to ensure that no rubber stoppers or joints can be acted on by hot hydrochloric acid, and so allow anything to pass into the distillate which would consume standard iodine solution.

NICKEL: *Dimethylglyoxime.*—This method probably occupies the leading position to-day for accuracy combined with speed. It is not influenced by copper or cobalt. The cyanide volumetric finish is quicker and more convenient than the gravimetric, where regular tests are made.

2. *Potassium cyanide.*—For routine tests, this process is very quick and also accurate, provided that copper and cobalt—which would count as nickel—are absent. There is a decided saving in time, and little if any loss in accuracy, by holding the iron in solution as citrate, instead of separating it with ammonia and ammonium acetate.

3. *Nickel oxide gravimetric.*—This older method is almost entirely superseded by methods 1 and 2 owing to their superiority in both speed and accuracy.

Cast Iron.

The following notes apply *in addition* to those made with regard to steel.

CARBON.—In grey irons, too much stress cannot be laid on the importance of each portion of the sample weighed off for analysis being thoroughly representative. To this end, it is usually advantageous to sieve samples through a 100-mesh sieve, and weigh off separately the right proportion of fine and coarse particles.

Owing to the greater amount of carbon present, the combustion tube should be well packed with platinised asbestos or granulated copper oxide to ensure all carbon monoxide being converted to dioxide.

Total.—Methods employed same as for steel. The direct method, reburning the residue, is of all-round greater reliability than the solution and combustion process for all classes of iron, though it is usual to mix an oxidising agent such as bismuth oxide with the sample.

Graphitic.—Very divergent results may be obtained by other methods than the one given in Table II.

Recommendations: (*a*) In dissolving, heat gently—do not boil vigorously—with a small excess of nitric acid. (*b*) Wash graphitic residue with hot caustic potash or soda (sp. gr. 1·10) in order to dissolve out of the filter silica and combined carbon, which in the case of irons high in these stick very tenaciously. (*c*) Filter through a small transparent quartz Buchner funnel which is small enough to push right into the combustion tube.

Combined.—Whilst this cannot be determined colorimetrically for special purposes, extensive experience has made evident that an analyst who is not expert at determining total and graphitic carbon by combustion, will in the majority of cases get a result nearer the truth by the colour process unless the combined carbon is higher than about 0·7%.

For testing cast iron, generally speaking, steel colour standards are the most suitable for the determination of combined carbon. When properly dissolved—since the iron solution *must* be filtered—the steel standard should be also filtered, both being at once filtered into comparison tubes, so that each may be equally affected.

SULPHUR: *Special recommendations:*—

1. *Oxidation.*—The insoluble silicious matter residue—especially from titaniferous irons high in phosphorus—may contain sulphur, and should be

RELATIVE ACCURACY OF ANALYTICAL METHODS as indicated by the EXTREMES of VARIATION* obtained BETWEEN a NUMBER of CHEMISTS on STANDARDISED STEELS. FIRST RESULTS RECEIVED, representing WORK with NORMAL CARE.

	CARBON				SILICON					SULPHUR					PHOSPHORUS						MANGANESE										NICKEL			
	Direct Combustion (1)		Solution and Combustion (2)			Solution and HF		Solution only		General Average %	Oxidation (1)		Evolution (2a-c)		General Average %	Direct Molybdate (1a)		Standardised ("Analoid") (1b)		Separation As_2S_3 (3)			Bismuthate (1a-b)		Persulphate Ordinary (2a)		Standardised ("Analoid") (2b)		Acetate Gravimetric			Dimethylglyoxime (1a-b)		Cyanide (2a-b)	
	No. of Tests	Extreme Diff.	No. of Tests	Extreme Diff.	Standard General Average %	No. of Tests	Extreme Diff.	No. of Tests	Extreme Diff.		No. of Tests	Extreme Diff.	No. of Tests	Extreme Diff.		No. of Tests	Extreme Diff.	No. of Tests	Extreme Diff.	No. of Tests	Extreme Diff.	Standard General Average %	No. of Tests	Extreme Diff.	No. of Tests	Extreme Diff.	No. of Tests	Extreme Diff.	No. of Tests	Extreme Diff.	Standard General Average %	No. of Tests	Extreme Diff.	No. of Tests	Extreme Diff.
·413	11	0·065	5	0·020																														
·404	13	0·052	5	0·040	A1	0·006	10	0·021	...	...	0·037	8	0·011	10	0·011	0·026	6	0·004	7	0·005	4	0·002	A1	0·310	11	0·040	2	0·016	10	0·014	(1)	...				
·521	11	0·067	6	0·024	B3	0·104	12	0·037	12	0·040	0·048	9	0·015	19	0·006	0·060	7	0·004	7	0·005	4	0·017	B3	0·791	10	0·118	2	0·060	6	0·030	(1)	...				
·325	10	0·062	7	0·039	B4	0·027	6	0·026	9	0·020	0·046	8	0·014	14	0·016	0·101	5	0·017	15	0·019	7	0·029	B1	0·735	12	0·070	3	0·020	7	0·041	...	...				
·676	10	0·065	7	0·015	N	0·117	3	0·007	9	0·023	0·0345	8	0·006	7	0·007	0·037	3	0·003	4	0·003	6	0·005	I	0·726	12	0·088	5	0·015	3	0·028	3	0·026				
·905	14	0·0558	3	0·010																			O	0·590	10	0·016	4	0·044	4	0·017	3	0·016				
·175	10	0·040	6	0·021																			N	0·432	8	0·020	3	0·013	4	0·011	2	0·010	T	3·367	8	0·084	11	0·207
Tests	79		39			31		30			33		50			21		33		27			63		19		34		8			8		11	
Extremes		0·4088		0·169			0·085		0·083			0·046		0·040			0·028		0·023		0·0535			0·352		0·168		0·141		0·052			0·084		0·207
ge of ences Standard		0·0584		0·0241			0·0212		0·0277			0·0115		0·010			0·007		0·0057		0·0134			0·0587		0·028		0·0235		0·0173			0·084		0·207
Test ...		0·0052		0·0043			0·0027		0·0028			0·0014		0·0008			0·0013		0·0007		0·0020			0·0056		0·0088		0·0041		0·0065			0·0105		0·0189

IV.—FINAL RESULTS AFTER INVESTIGATION, representing WORK with EXTREME CARE.

·412	4	0·028	4	0·020																														
·404	7	0·031	3	0·040	A1	0·006	2	0·003	3	0·018	0·037	3	0·002		0·008	0·026	2	0·001	3	0·002	5	0·003	A1	0·310	5	0·020	...	...	4	0·010	(1)	...				
·521	9	0·030	6	0·024	B3	0·104	5	0·010	4	0·016	0·048	4	0·003		0·008	0·060	2	0·002	4	0·004	5	0·005	B3	0·791	5	0·021	...	...	4	0·025	(1)	...				
·325	8	0·040	4	0·023	B4	0·027	2	0·005	7	0·012	0·046	3	0·004		0·004	0·101	(1)	...	6	0·006	4	0·011	B1	0·735	6	0·050	5	0·020	4	0·041	...	...				
·676	7	0·019	4	0·012	N	0·117	3	0·007	9	0·023	0·0345	8	0·006		0·007	0·037	3	0·003	4	0·005	6	0·005	I	0·726	12	0·055	5	0·015	3	0·028	3	0·026				
·905	8	0·040	3	0·010																			O	0·590	8	0·043	3	0·044	3	0·017	3	0·016				
·175	9	0·022	5	0·021																			N	0·432	8	0·020	3	0·018	4	0·011	2	0·010	T	3·367	8	0·084	10	0·107
Tests	53					12		23			18					7		17		20			44		14		22		8			8		10	
Extremes		0·210		0·150			0·025		0·069			0·015		0·027			0·006		0·015		0·024			0·209		0·097		0·132		0·052			0·084		0·107
ge of Extremes per dard Test ...		0·0300		0·0214			0·0062		0·0172			0·00375		0·00675			0·0020		0·00375		0·0060			0·0397		0·0243		0·022		0·0173			0·084		0·107
		0·0040		0·0052			0·0021		0·0030			0·00083		0·00164			0·00086		0·00088		0·0012			0·0048		0·0070		0·0060		0·0065			0·0105		0·0107

SUMMARY showing as a RATIO the COMBINED RESULT of FIRST and FINAL TESTS, both PER STANDARD and PER TEST, the method showing the lowest variation being taken as 100.

Tests) which ined)	131	68		43	53		51	76	29	50	47	107	33	56	20		16	21
	145	100		100	166		100	115	112	100	209	162	141	100	104		100	163

As the general average may not be considered to be necessarily the correct result, the differences from it of the upper and lower extremes may also not be deemed as true a gauge as the variability of each method. Therefore the general ...s are given merely to show the class of material, but the differences given are not variations from these but are the range obtained, the average of course falling somewhere within this, but not necessarily centrally.

Further Notes applying to Table III.

...judging of the relative accuracy of methods, certain points should be borne in mind :—

...When a standard was tested by a method by which *only one* test was made, although the result was included in the general average, of course there could not be a " difference " at all. Single results are therefore not included in the number ...s by which the sum of the extremes is divided. (*b*) When more than one, but still only a small number of tests were made by a given type of method, the probability of any considerable difference was very much less.

...Results are only reasonably comparative between methods by each of which a fair number of tests have been made.

...Provided a fair number of tests have been made by each method, a further number by one of the methods is not so likely to upset the comparison, as further differences will probably fall between the existing extremes.

...though therefore the authors preferred to show the differences obtained for each type of method, from the above considerations, and from the fact that they are clearly not regarded as reliable for highest class work, the figures for the direct ...ate phosphorus method, and the persulphate ordinary and the acetate gravimetric manganese methods, should not be taken as necessarily representative. Also there are only a few results of the nickel methods.

dried and fused with sodium peroxide in order to recover this.*

PHOSPHORUS.—Methods employed in addition to those used for steel.

4. *Separation of arsenic and titanium oxide; gravimetric molybdate.*—This is regarded by the best authorities as necessary when qualitative tests show the presence of titanium. The method is long and tedious, and liable to give widely differing results, unless carried out by skilled operators. The "Analoid (1914) Pure" process has proved to compare very favourably with this process even when titanium up to about 0·2% is present. If only small quantities (say up to 0·1%) of titanium are present, methods of the type 1, (*a*) and (*b*) (see Steel, Table II), will be found to have much less tendency to give low results than those of types 2 and 3.

MANGANESE AND ARSENIC.—No special comments.

TITANIUM: *Recommendations:* As it is unlikely that the titanium will be determined in an iron without the phosphorus, method 3 (Table II.) is usually the most convenient. Small quantities of titanium are much more accurately determined by hydrogen peroxide colorimetric comparison than by the gravimetric method, which often gives results higher than the truth.

In the foregoing notes, no opinions or recommendations are made simply from book statements. They are all either the outcome of the authors' own experiences or are confirmed by them. They add this, because mere compilations have relatively slight value.

DISCUSSION.

The CHAIRMAN said that the question of chemical standards had been taken up 20 years ago by the British Association on somewhat similar lines, and half a dozen standards had been prepared. For some reason, those standards had not become popular; but many chemists had found them useful for comparing their results. His hope was that the efforts to prepare standards would be broadened, and that there would be standards in chemicals as well as in iron and steel. As to standard methods, his own view was that if a chemist could obtain a correct result by one method he should follow that method. The standard method might be used in cases of contracts in which a method was prescribed but, generally speaking, he thought an analyst should be allowed a latitude in regard to the method he adopted so long as the correct result was obtained.

Mr. F. C. A. H. LANTSBERRY said that he did not favour standard methods, because he believed it was only by differences in method that chemists would ultimately attain perfection. Methods were naturally, to a large extent, becoming standardised; but he feared that if methods were standardised the junior assistants would not receive the mental training necessary to equip them for higher work. His view was that even a standard steel would not be of the use the authors supposed. It would certainly be a useful laboratory asset and in comparing various methods, but in his opinion there the utility ended. As to the preparation of the standards he felt that the steel makers' chemists were rather over-represented in the scheme: more users' chemists should have been included. He usually found a great difference between the analysis supplied by the steel maker and that made in his own laboratory; he attributed this mainly to complete lack of homogeneity in the material supplied. Thus, there would be difficulty in referring results to one particular standard. What was wanted was a more homogeneous sample. It would not be well in his judgment to make methods too standardised. The adoption of one method would tend to check analytical progress.

Mr. E. W. ROWLEY pointed out that if the best existing methods were adopted universally for certain work, that would not prevent the use of other methods to confirm their results. For that reason he was personally in favour of adopting standard methods. He had found the standards very useful not only for checking other people's results, but for testing the work of assistants. He agreed as to the need of homogeneity of samples. There were cases where the samples, from the same batch, gave different results; but the standards would be useful in detecting this. It would be well if the matter in relation to the authorisation of standards could be organised by a Bureau of the American type—and brought about, not by a technical organisation, but by some Government Department.

Dr. H. W. BROWNSDON suggested that too much stress had been laid by the authors on the importance of small differences in figures obtained by analysis. He thought the trend of the day was to specify that finished material should reproduce certain defined physical properties and that chemical analysis should be used as a guide to those properties. In certain cases only physical properties were specified in detail, the materials being simply determined as belonging to a "class" without fine analytical limits. This matter of analytical standards required to be looked at in its true perspective. If a material reproduced the physical properties required of it, what did it matter if analyses by different chemists differed in the second or third place of decimals by amounts coming within the limits of experimental error?

Mr. F. J. COOK said that standard methods of sampling were necessary. As to the segregation of sulphur, he thought the drill straight through a pig was better than the usual method of taking samples piecemeal from the surface. He believed the effect of carbon on cast irons was potent, yet how difficult it was to take a correct sample. As to the suggestion for the setting up of a Bureau, he was strongly of opinion that such should not be wholly under Government control. He would like to see aid forthcoming also from the various technical societies, with an Executive Committee composed of representatives of each.

Mr. F. H. ALCOCK pointed out that one effect of standardising was frequently to lower quality. The setting up of standards need not destroy individuality; processes did not matter; what really mattered was the correctness of results.

Mr. G. S. BLAKE, of the Ministry of Munitions Laboratory, Sheffield, said that his Department recognised the importance of standard samples being available for general use of analysts. It had always used a series of standard steels carefully prepared and analysed at the Departmental Laboratory and by referee analysts employed by the Ministry of Munitions. Besides standardising their solutions by the well-known methods, which alone should suffice to give accurate results, they had found that standard samples analysed along with batches of work not only showed how the work of an analyst was running but tended gradually to eliminate the personal factor. The Department had regularly used their own or Messrs. Ridsdale's samples for testing the comparative accuracy of the batch. War work experience showed that such a procedure would gradually remove many discrepancies between the results of analysts. The Ministry of Munitions Laboratory had therefore readily supported Messrs. Ridsdale in their work of producing chemical standards, not simply to make those available, but to recognise the great need

* See U.S. Bureau Circ., No. 14, p. 10, 1916, ed.; also Whiteley: *Journal of the Cleveland Institution of Engineers*, 1914, Vol. v.

of some accurate means of testing analytical work and results so as to attain to a standard of absolute accuracy. The Department desired to make a few recommendations as to the actual work of Messrs. Ridsdale. In taking averages results were often included which were far from the figure finally fixed. In those cases they considered the method adopted by the analyst should be ascertained and if any detail in carrying out the analysis sufficiently explained the unusually high or low result it should not be allowed to influence the final figure. The modification used by one institution certainly explained a regular low sulphur result. The Department also recommended that only those analysts who were actually dealing with the class of material should be asked to make the analysis. They were scarcely in favour of imposing unification of analytical methods which would cause inconvenience and have the tendency of making errors gravitate always in one direction. Mechanicalised methods did not assist in making intelligent chemists. An analyst should be allowed to use his own judgment as to what method or modification he adopted. The Department thought methods might be recommended as most readily giving accurate results.

Mr. J. C. Mann emphasised the value and importance of standardised methods in relation to valuation of products from coal tar distillation. There need be nothing "cast iron" about them; there should be a committee responsible for adjusting the standards, and as improvements were found the methods could be revised. Again there would be no embargo upon the use of their own methods for works tests.

Mr. W. H. Heidsman wrote that the immediate effect of the use of these standards was the confidence given to every analyst in his work, while they were equally beneficial to the business man in reducing at once the necessity for so many reference analyses being made with a consequent saving of the time and cost these entail. The Iron and Steel Institute, stimulated at last apparently by Messrs. Ridsdale's results, had formed a Committee, which had since thrown out a number of local branches in the steel centres, to establish similar steel standards, and by associating with them the National Physical Laboratory gave their standards a fully national character. No exception could be taken to this if the natural course were followed of giving their joint support to Messrs. Ridsdale's work, building up on the foundations they had so well laid a truly National British Bureau of Standards.

Mr. C. H. Ridsdale, in reply, said the attempts to prepare standards by the British Association did not appear to have gone far enough. He had been informed that one fault of their standards had been that the turnings had been too long and large. He did not particularly advocate standard methods: he had simply tried in one or two cases which seemed to lend themselves to "mechanicalised" means to evolve such methods. As to the suggestion of disproportion in the types of chemists making the tests for the standards, the reason why there were more steel makers' chemists was that they preponderated. When any dispute arose it was always assumed that the steel makers' chemist was wrong, so naturally they were anxious to adopt any course that would help them to prove their correctness. He insisted that the detection of fractional differences in analyses was most essential: he had known engineers reject material owing to the slightest excess of phosphorus. On the commercial side, chemical agreement was of the first importance, apart altogether from material having the necessary physical properties. There were better methods than drilling straight through for dealing with segregation, and before sampling a piece there should be a study of how it was segregated. There was a decided tendency towards standardisation of method in the Admiralty and Ministry of Munitions laboratories. They systematised every detail, and the result was excellent analyses even from assistants who had not had long training.

Bristol Section.

Meeting held at Bristol on November 21st, 1918.

DR. T. H. BUTLER IN THE CHAIR.

HISTORY AND MANUFACTURE OF FLOORCLOTH AND LINOLEUM.

BY M. W. JONES.

There is no record as to the actual origin of floorcloth, and its early history is meagre in the extreme. It is most probable that the fabric gradually emerged into being, but it is certainly remarkable that such a large and flourishing industry has no text-book, and that the pioneers of the manufacture have left so few traces of their handiwork. All the available information we have concerning its early development is contained in patent specifications, or in odd paragraphs in various publications, often where one would least expect to find it. And even there the investigator treads upon uncertain ground, owing to the term oil-cloth being early applied to floorcloth, as well as to an older product of the nature of tarpaulin, which after soaking in oil and drying was used as waterproof wrapping.

In the eighteenth century, the history of this fabric is based upon a surer foundation, and the first patent for the manufacture of floorcloth was taken out in 1763 (No. 787) by Nathan Smith, of London. The composition was made of rosin, pitch, and Spanish brown, in equal quantities, with the addition of beeswax and linseed oil, the quantity of which was varied according to the season of the year. It was applied to the canvas in a melted state, and rolled in by pressure from a hollow iron roller heated by fire. In 1754 Smith established in Knightsbridge the first works for the manufacture of floorcloth. In 1794, the original building was entirely destroyed by fire, but the works were rebuilt during the ensuing year, and were reconstructed in 1824.

In the *Builder* of January 16, 1858, it is stated that Smith was the first to use wood-blocks in the printing of floorcloths. It also states that before the year 1754 he made floorcloth in pieces of two or three yards square—by the only method known at that time; the plan of laying on the tints of the patterns was the same as that used in the stencilling of wall patterns, viz. either by cut cardboards or thin metal, through the interstices of which the colours were applied.

That floorcloth was upon the market in the last twenty years of the eighteenth century is further borne out by two announcements of the sale of household effects, which appeared in the *Bristol Gazette and Public Advertiser* during 1789.

The oldest surviving firm in the trade is that of Messrs. John Hare and Co., of Temple Gate, Bristol, the founder of which came to Bristol in 1782, and commenced business as a painter and colourman. His advertisement of floorcloths first appeared in the *Bristol Gazette and Public Advertiser* of Thursday, Feb. 7, 1788, and is most probably the first trade announcement. In Sep-

tember of the same year, there is another advertisement in the same paper, announcing that Hare and Withers manufacture floorcloth at the same address, and at their manufactory, without Temple Gate. This partnership was of but short duration, for in 1789, John Hare and John Withers had separate factories, the former "without Temple Gate," and the latter at Callowhill Street.

That Bristol was active in this industry in those early days is further borne out by the advertisement of another firm, James Sanders and Co., which appears in Felix Farley's *Bristol Journal* of Jan. 4, 1794.

The advertisement of Hare mentioned above contained the phrase "Old cloths new painted, and printed of any pattern," and later ones of all three firms mentioned, conclude with the statement that "Old floorcloths and carpets will be painted." This was a method of renewing the life of worn fabrics and was in vogue until about 1865, when the cheapening of floorcloth rendered this less necessary. The same treatment was accorded to worn floorcloth, and in those days new goods cost 7*s.* 6*d.* per yard and repainted ones about 2*s.* 6*d.*

At one time in its history, floorcloth was a product upon which excise duty was levied. The manufacturer had to pay a yearly tax of £10 for the privilege of producing his product, and excise officers visited the factory to measure up the length made and assess the duty thereon. This duty of 3½*d.* per yard was established in the year 1787, and was finally abolished in 1860.

A copy of an old manuscript drawn up about 1856, and kindly supplied by Mr. Peter O. Byrne, of Messrs. Barry, Ostlere and Shepherd, Ltd., of Kirkcaldy, gives a list of the floorcloth manufacturers established in and around London since the first commencement of the manufacture, with the approximate number of years each had been established before 1856. As this list is of historical interest it is given in full, with the addition of the year of establishment (assuming the figures to be correct), but those mentioned in connection with the works of Messrs. Smith and Baber, of London, and John Hare and Co., of Bristol, are certainly understated.

In the London district these are set forth:—Barnes, City Road, established about 70 years, 1786; Bathe and Kingdon, Old Kent Road (5 years), 1851; Buckley and Co., West Road (80 years), 1776; Cobbett and Jevees, Deptford Building (40 years), 1816; Downing and Co., Chelsea (60 years), 1796; Harvey and Knight, Lambeth Marsh (60 years), 1796; Hayes, Hackney Road (70 years), 1786; Haywood, Newington Causeway (80 years), 1776; Irons, Pimlico, Little Chelsea (50 years), 1806; Lyons, Old Kent Road (24 years), 1832; Mace, Old Ford (20 years), 1836; Main, Reed and Co., Great Dover Road (40 years), 1816; Ridley, Lower Road, Islington (35 years), 1821; Smith and Baber, Knightsbridge (93 years), 1763; Southgate, London Road (60 years), 1796; Spofford, Gray's Inn Road (80 years), 1776; Squire Wells, Camberwell (15 years), 1841; Turney, Whitechapel Road (80 years), 1776; Wentworth, Whitechapel Road (70 years), 1786; Welch, Paddington (40 years), 1816.

In the provinces the list gives:—Hare and Co., Bristol (54 years), 1802; Kirkpatrick, Liverpool (50 years), 1806; Kempson, Birmingham (45 years), 1811; Hardcastle, Newcastle-on-Tyne (60 years), 1796; Robinson and Co., Newcastle-on-Tyne (20 years), 1836. A factory was in operation for some years in Manchester, now discontinued.

The table baize and varnish floorcloth manufactories in and around London comprised:—Bathe and Kingdon, Old Kent Road (5 years), 1851; Soulston, Old Kent Road (15 years), 1841; Lawson, Kingsland Road (28 years), 1828; Lyons, Walworth (14 years), 1842; Manns and Sayon, Malden Lane (20 years), 1836; Rolls, Jas., Kennington Lane (9 years), 1847; Rolls, Josh., Old Kent Road (21 years), 1835; Turner, H., St. John Street; and Williams, Marlborough Place, Westminster (table baize only, no record).

Of all the firms mentioned, that of John Hare and Co. is the only one still in existence, but the list is not quite complete, for Michael Nairn established a works at Kirkcaldy in 1847, which is still a going concern, and there was a firm then manufacturing in Dublin under the name of Franklin and Co.

In the early days of the manufacture, John Hare had mills in the St. Philip's district, for the weaving of canvas, which forms the base upon which floorcloth is built up, and this fact taken in conjunction with the white lead works in the same district, and the colour making and oil refining factories near by, gives this firm the unique distinction in the trade of being the only one that ever made floorcloth in its entirety. The looms in these mills were worked by hand, and produced canvas measuring 27 feet in width, with a length of 70 yards, all in one piece, and were the largest in the world, for nowhere else has canvas of a greater width than 24 feet been woven. This branch was established about 1804, and we are thereby enabled roughly to fix the date when the manufacture of floorcloth in small pieces ceased, and gave way to the production of standard lengths.

At different times flax, hemp, and jute, either singly or in combination, have been used to form the canvas which is essential to all qualities of floorcloth, but to-day jute is the principal fibre used, and its manufacture is practically confined to Dundee and district, where it forms a large and flourishing industry. This was not always so, for in 1799 Hare obtained his supplies from firms in Reading and Abingdon; at that time the price was about 1*s.* per sq. yard.

Floorcloth, oilcloth, or waxcloth, to mention the three names by which it is known, is produced by painting this canvas foundation on both sides with several layers of well-made oil paint, and in most cases finishing by printing a pattern in one or more colours on the final layer. There are two qualities, the heavy or hand made, which is produced in a maximum length of 25 yards, with a width of 8 yards; and the light or machine-made product, which has a maximum width of 12 feet, and which weighs only 3½ lb. per square yard as against 7 to 8 lb. in the case of the hand-made article. The machine-made quality is now turned out in much larger quantities than the hand-made, but as the latter is still manufactured and is the older variety, we will first consider the method by which it is produced.

The canvas is first nailed to specially constructed frames 25 yards in length and 8 yds. in height, with a space of 3 feet between them, in which permanent scaffolding, carrying 4 tiers of planks, is fixed, to enable men to work on the face of the suspended fabric, which is first of all treated with a dilute solution of size applied by means of brushes. This serves the triple purpose of adapting the surface to receive the first coating of colour, shrinking the canvas, and rendering it less sensitive to any acid action of the paint oil. This when dry is covered with a layer of stiff ground oil-paint, which is thrown upon and spread over the fabric, by means of a specially constructed tool which represents and does the same work as a plasterer's trowel, and enables the worker to spread the coating of paint both quickly and evenly over the fabric. When the first coating has been applied to both sides, the canvas is allowed to hang for about ten days, or until the paint is thoroughly dry. When this first coat of paint is quite dry, its surface is

worked over with a sharp-edged tool known as a "knotting-knife," which removes all knots or ends which the surface of rough canvas naturally presents. Then the whole is rubbed down with blocks of pumice stone to obtain a fine, uniform surface, and a second coat of paint is trowelled on in a similar manner to the first. This when dry (which again takes 10 days) is rubbed down with pumice stone, and the third coat of paint is applied in the same manner. This third coating is the final one as far as the back or underside is concerned, and whilst the face is white or tinted, the backing paint is strongly coloured with red oxide of iron or yellow ochre. The face receives two more coats of paint, making five in all, these latter being thinner and applied by means of a brush instead of the trowel, to ensure more even and perfect covering. The floorcloth is now ready to receive its final covering, which in most cases consists of a printed pattern in one or more colours, and the product at this stage is canvas covered with layers of paint to an uniform thickness. It is rolled up and taken to the printing tables, which are covered with several thicknesses of felt to give a slight yielding surface, and here the pattern or design is printed upon it by means of wooden blocks, usually eighteen inches square, a separate block being necessary for each colour of which the final pattern is composed. The various colours are ordinary painter's pigments ground in refined linseed oil and are spread upon pads made up of fine canvas over flannel.

In the early days of the industry the pattern was applied to the surface of the fabric by means of a stencil, and in 1812, Hubball and King took out patent No. 3593, for the reverse of this method, in which, after the goods were painted, the surface was covered with gold-size or other glutinous liquid, and when this was nearly dry, patterns of paper or thin parchment were laid upon the surface, and such portions of the fabric not so covered were rubbed over with iron ore, previously pulverised in a mortar. The stencil gave way to a rough cut wood-block, but in the modern blocks the pattern is formed in relief, helped where necessary by the addition of pieces of round or flat brass wire, each point of the relief taking up a definite and regular amount of colour when the block is pressed firmly upon the colour pad. Each block is fitted with guides to ensure accurate placing of one pattern over another and so preventing any margin showing. When the block bearing its quota of colour is placed upon the floorcloth surface, it is firmly squeezed into contact by a simple arrangement of a screw press—an improvement over the hitting with a heavy mallet formerly in vogue—and when the block is raised, that particular colour and portion of the pattern is left upon the fabric. Thus block after block, each with a distinct colour and portion of the pattern, is applied, until the required design is complete.

The printed floorcloth is now passed into a specially constructed high building, where it is suspended from battens and allowed to hang for a period of from nine to twelve months, in order that the finished product may "age" or mature, a process that is essential in the case of high-class, heavy goods, which are required to withstand wear and tear. At different times various modifications of the materials used in the coatings have been tried, with the object of shortening this ageing process or doing away with it altogether, in order to overcome the holding up of capital for so lengthy a period, but nothing has been found which can replace it.

A lower grade is made to suit the popular demand, and is produced entirely by machine. Such fabrics, as already mentioned, have a maximum width of 12 feet, but are principally produced in widths of 6 feet. The canvas backing is of lighter texture than that already considered, the layers of paint are fewer and are applied by a trowelling machine, and the final pattern is printed by rollers —one for each colour—with the pattern in relief as in the case of blocks, and the resulting product is turned out at a comparatively rapid rate. The canvas for this quality of floorcloth comes upon the market in rolls of about 400 yds. in length, and the starch or size is applied by a machine fitted with a steel knife, which spreads it evenly over the surface of the canvas and scrapes off any excess. The cloth is then led over a series of steam-heated drums—usually eight or more in number—to dry thoroughly, and after leaving these it is rewound on a roller for transference to the trowelling or paint-coating machine.

This consists of two iron rollers, around which revolves an endless india-rubber sheet or apron, upon which the canvas is supported and travels. The paint is laid upon the surface of the moving canvas, and is spread over its whole width by means of a steel knife, and as this is fixed in close contact with the fabric any excess of colour is scraped off and a thin, uniform layer of paint is left upon the surface. From here it is led into a warm stove to dry thoroughly, and it passes in and out of the stove and through this machine until it has received a sufficient number of coats, usually four on the surface and two on the back; in between it is run through a "cropper," a machine fitted with revolving blades on the lawn-mower principle, which removes all knots or irregularities natural to the canvas, and in some cases these machines are fitted with revolving pumice stone rollers, or the fabric is lightly calendered to produce a smooth surface.

When this stage is finished it is ready for the printing machine, which impresses the final coloured design upon the surface. Attempts were first made in this direction to use the ordinary 18-inch blocks described in the hand-made process. In this machine the blocks cover the width of the fabric and are caused to rise and fall alternately, firstly upon the colour pad which is run underneath them, and then upon the surface of the floorcloth which travels upon a table underneath. The register is kept in alinement by inserting, through the edge or selvedge of the cloth, steel projections carried by an endless steel band which travels along each side of the table. These early machines were cumbersome, expensive, and slow, but have been much improved of late years, although the roller printing machine is more generally used.

This is very similar in type to the well known calico-printing machine, in connection with which Thomas Bell took out in 1783 patent No. 1378 for a six-colour continuous printing machine for textiles, and as this was fitted with a scraping knife or "doctor" it may be regarded as the ancestor of the present highly complicated machine which will print up to twenty different colours on all classes of fabrics, but to Nicholson for No. 1748 of 1790 must be accorded the distinction of having taken out the first patent for a printing machine for floorcloth.

This consists of a large iron revolving drum or bowl, against which are pressed the rollers, to which the colour is fed by means of hollow iron cylinders covered with gelatin and revolving in a trough of the paint. These are known as furnishers, and it is their function to supply or furnish the raised surface of the printing roller with the necessary amount of colour; to ensure the even deposit of this on the printing roller a thin round iron bar, known as a doctor, is adjusted with the necessary pressure against the furnisher as it leaves the trough of colour.

The floorcloth to be printed passes between the

iron drum and the printing rollers, and the point where they impinge is where the colour and pattern are transferred to the fabric. In order that the raised portions of the printing roller may be well pressed against the surface of the floorcloth several thicknesses of woollen cloth are wrapped round the drum to act as a cushion. Each roller prints only one colour and one portion of the design, and therefore as many rollers are required as there are colours in the pattern.

The printing rollers consist of an iron core surrounded with wood, thickly coated with gelatin, and this is cut away to leave the pattern in relief. Where the design requires a deposit of colour in a mass, rollers of this type alone are used, but in tessellated or mosaic designs, or in parquet, in which the grain of wood is imitated, and also in fine matting effects, brass or copper strips, or wire, are inserted into the wood, to obtain the fine detail which would be impossible with gelatin or composition-covered rollers alone.

It is in the rollers that we find the difference between floorcloth and calico-printing machines. As we have seen, the pattern on the former is raised on wood, whereas in the latter it is engraved (or exists in intaglio) on copper cylinders, but it is interesting to note in this connection that in 1910, patent No. 15,291 was taken out by Gray and Ridley, for the use of such copper rollers for printing cork carpets and linoleum.

Linoleum.

Floorcloth made as described has the fault of being cold to the feet, and in that respect is not an ideal floor covering. It was not until india-rubber came upon the market in quantity that an article reasonably effective in this respect was produced, and which after many modifications ultimately gave us linoleum and corticine.

In what we may look upon as the transition stage between the establishment of floorcloth on the one hand and the birth of linoleum on the other, many diverse substances were suggested as floor coverings, and a study of the patent literature of that period is interesting both as showing the trend of the inventive mind, and the gradual steps which led to the production of fabrics made from cork.

In 1844, Elijah Galloway took out patent No. 10,054, which proved to be an important step in the right direction. India-rubber was made plastic by steam heat, and after mixing powdered cork with it the mass was rolled to the desired thickness between smooth cast-iron rollers. The resulting product was put upon the market under the name of "Kamptulicon," and at first was merely cemented to the floor, but after a time was improved by being attached to a canvas backing. It was largely used for office floors, and whilst very satisfactory was always expensive, being *3s. 9d.* per square yard for plain qualities, and owing to an increasing demand for rubber in other manufactures, the price of that commodity steadily advanced, and so the demand for Kamptulicon was killed and its manufacture ceased, although the name still survives, being even now occasionally met with in Government and other specifications.

Wood (Eng. Pat. 197, 1864) patented a process in which buffalo hides, soaked in water slightly acidulated with hydrochloric acid (1 in 1000) for two days at 80° F., were reduced to a fibrous mass in a rag engine, then incorporated with rag pulp and hair and collected on the wire of a paper-making machine. The fabric so obtained was coated with varnish or oil paint. This was put upon the market under the name of "Boulinikon," and enjoyed a ready sale until the manufactory was burnt out. Its wearing properties are highly spoken of by those who remember it.

About 1860 Frederick Walton established the first experimental works at Chiswick for making linoleum with the use of oxidised linseed oil. Later the factory was transferred to Staines, where the firm Walton, Taylor, and Co., commenced the manufacture, and in 1864 became the Linoleum Manufacturing Co., Ltd., which is still in existence. Walton's first patent for the manufacture of oxidised linseed oil was taken out in 1860, and is numbered 209. The practical process based upon it is known as the "Scrim," and the first stage consists of heating the oil with metallic driers, preferably 5–10% of lead acetate—the temperature being between 212° and 550° F. This heated oil is pumped up into a trough at the top of a chamber about 24 ft. high, and then forced through perforations of $\frac{1}{16}$ inch in the bottom of the trough, on to sheets of stout cotton known as "scrims," which hang below almost down to the floor. The temperature of this chamber is kept at about 100° F., and the sheets are subjected to alternate floodings and dryings about twice daily for several weeks, or until the resulting films of oxidised oil attain a thickness of nearly an inch, when they are stripped off, cut up, and lightly ground through iron rolls, the "scrims" being used over again. At this stage the product looks like badly coloured bread-crumbs, and cannot be left lying about for long, owing to a tendency to take fire, caused by further and rapid oxidation. It is promptly placed into a steam-heated pan fitted with a mechanical agitator, in which has been melted a mixture of resin and Kauri gum in the proportion of about 30% of the weight of oxidised oil added. After a time the heat causes the mass to become liquid and boil, and when a suitable consistency is reached, the pan is tipped up and its contents allowed to cover a prepared floor to a depth of about six inches. When cool, this mass is cut up into small blocks, and is now known as cement, and is stored away until required for mixing with the cork at a later stage.

The result is an excellent product which works well, but, as will be seen, the process of oxidation on the "scrims" is very slow, and later Walton overcame this defect by what is known as the "Shower-bath and smacker" process, which was the subject of patent No. 7126, 1894: by its use a satisfactory product is produced in five or six days, as against several weeks in the older method. In this operation linseed oil is heated to 50° C. with metallic driers, and pumped up into a tank fitted with a perforated bottom, through which it falls through the air into a tank below in which it is kept at the same temperature. This pumping and percolation are carried on alternately, until the product becomes so thick or stringy that it will no longer pass through the perforations, when it is transferred to a closed vessel fitted with a steam and water jacket and mechanical agitator, known as a "smacker," so that the whole is violently knocked about into a spray, thus exposing a large surface to a current of air heated to about 55° C. which is continually blown through the mass. A violent reaction speedily results which must be carefully controlled by the water-jacket, or the whole will be rendered useless, and this heating and agitation are continued until a sample taken out is no longer "stringy" or treacle-like, but breaks off somewhat "short" from the mass. When this stage is reached, the contents of the pan are poured into shallow trays which are taken into a well ventilated stove heated to 40° C. and kept there for two or three days, during which time the product swells and matures. After removal from the stove it is passed through a shredding machine and stored under cover for a week or so, and is then ready for making into cement as already described. It now resembles bread with the colour of honey in general appearance.

In both these processes the resulting product is

almost completely oxidised, so that in the further manufacture into linoleum but little "ageing" or seasoning is required during the process, and very finely powdered cork can be used.

This differs from corticine, where the cork used is not so finely ground, and the linseed oil not so highly oxidised, leaving a large balance of this essential chemical change to be made up during the manufacturing process.

The treatment of linseed oil for the making of corticine was the subject matter of patent No. 1738 of 1871, taken out by Taylor, and the practical process, which bears very little resemblance to the specification, is as follows:—The oil is treated in lots of from 2 to 5 tons in an open pot heated by fire, and when the temperature has reached 300° F. 2 to 3% of litharge or other suitable lead drier is added and well stirred in. Air is now blown through the oil for two or three days, care being taken to keep the liquid at or about 300° F. The liquid gradually darkens, finally assuming a reddish hue, and possessing an unpleasant acrid odour. When this stage is completed the oil is transferred to smaller pots holding 12 to 15 cwt., and heated by fire as before. In these the temperature is raised to 450°—500° F. and a rapid reaction takes place, which must be kept under control by drawing the fire, or by other methods as experience dictates. After the reaction has subsided the temperature is raised to 600° F. at which it is maintained for some hours, until a sample shows signs of becoming "stringy" when cooled. The pot is then lifted by suitable gear, and its contents tipped into a prepared bay on the floor, and before the mass is quite cold it is cut into blocks and stored away. The resulting product is dark in colour with a decided resemblance to crude india-rubber, and it is ultimately mixed with the necessary cork dust, either by itself or with an addition of resin.

The crude cork is obtained from the forests of Spain, Portugal, and Algeria, and after being thoroughly dried it is passed through a form of disintegrator or bone-breaking machine, which by means of saw-toothed rollers running at different speeds, tear the lumps apart, into pieces varying in size from that of peas to filbert nuts. This is then passed through flat millstone grinding mills of from 4 to 5½ ft. diameter, which deliver the cork as fine powder. It is next sifted through revolving sieves of wire-gauze, similar to those used in flour mills, and having a mesh varying from 20 to 60 to the inch, according to the fineness desired. This powdering process produces great quantities of dust, and care has to be exercised to prevent explosions and subsequent fire; to obviate these risks as far as possible the crude cork is carefully picked over to remove nails or metallic impurities, or any substance likely to produce a spark by friction.

The proper proportions of cement, cork dust, and such colouring matters as may be required are now amalgamated in a series of masticators or horizontal mixers of the same type as bread kneading machines; the resulting product is known as "dough." In the manufacture of ordinary linoleum or corticine, this dough is then passed through a calender—a machine fitted with four heavy steam-heated rolls. The canvas backing is brought in at the rear of this and the mixture delivered upon it, and in passing through the first set of rolls it is made to adhere firmly to the canvas by being pressed into the interstices and so keyed upon the fabric; the second set of rolls is used for polishing, or imparting an attractive face to the material. As it leaves this calender it is wrapped around steel or iron centres and passed on to the backing machine, which covers what is to be the under-side with a waterproof coating of oil paint. It is then led into a heated stove in which it is hung vertically from battens, and allowed to remain for a period of from two to four weeks, according to the thickness of the covering and the fineness of the cork. The result is either plain or coloured linoleum or corticine; if a printed product is desired, the fabric is taken out of the stove after a few days and run through either a rotary or block printing machine such as already described, and when the pattern has been applied to the surface, it is taken back to the stoves, again hung up, and left to dry and mature. It is then passed through a trimming machine which cuts off the selvedges, and the product is rolled up into convenient lengths—usually 25—30 yards—and is ready for the market. These two fabrics are principally made in widths of 6 feet for the home, and 2 metres for the continental markets, but special lines are also made with a maximum width of 12 feet. The thickness of the various grades varies from 1·5 to 8 mm.; a good average household quality will have a thickness of 2 mm., with a weight of from 5—6 lb. per square yard.

The difference between linoleum and corticine is, broadly speaking, that the oxidised oil used in the former is made by one or other of the Walton patents, whereas in the latter it is obtained by Taylor's process. Both products have equal merits and differ but in slight details. In linoleum finer ground cork is used and a certain amount of wood-flour is added; the resulting fabric, which has a smoother face than corticine, is used in hospitals and other institutions where it is essential to have a floor covering of close texture that is readily cleansed from dirt and germs. In corticine the cork used is not so finely powdered, and the resulting product is therefore more porous, but being of a softer nature is consequently more silent when walked upon, and, as it is a bad conductor of heat, is very warm. It is largely used in dwelling houses, churches, libraries, and other institutions where absence of sound is an advantage, and large quantities are used for the between-decks of our battleships of all types.

However satisfactory a newly printed piece of linoleum may appear, it will be evident that the pattern will not last as long as the bulk of the fabric, and shabbiness on the surface will ultimately result. To remedy this defect many processes have been suggested, and these ultimately merged into what is known as inlaid linoleum, the acme of this class of floor covering and in which both colour and pattern go through from the surface to the canvas backing.

As early as 1863, F. Walton took out patent No. 3210 in this connection, for "improvements in the manufacture of floor coverings," in which he proposed to pass sheets of coloured linoleum through rollers, one of which had a pattern cut into it, and the other an embossing roller on which the design was raised exactly where it was depressed on the first. The rolled fabrics were placed face to face, so that the raised portions of the one entered into the recesses of the other, and were then rolled into intimate contact, afterwards being cut apart by a splitting machine into two separate fabrics. In the same patent he also proposed to take sheets of differently coloured linoleum, and after punching out pieces of various designs, to insert these into corresponding holes in a sheet of another colour, and either to cement the result upon a backing, or by attaching the canvas to both surfaces and afterwards splitting, to obtain two fabrics.

These propositions were never put into practice on an extensive commercial scale, and the first real inlaid variety of linoleum was the subject of patent No. 2307 of 1880, taken out by C. F. Leake, and is produced as follows: A travelling table carries the canvas, upon which suitable stencil

plates—one for each colour—are placed, and through these is fed directly upon the canvas the requisite amount of granulated linoleum material, each colour through its own particular stencil. The moving canvas then passes through heated rolls, or in the case of mosaic or granite patterns through a hydraulic press, in order that the mixture shall be well keyed into the backing fabric. It is then run through a calender to impart a polished surface, but when taken into the drying stoves, has to be laid horizontally, as it will not stand the bending necessary in hanging from battens, as in drying ordinary linoleum. The machinery for the effective carrying out of this process was the subject matter of patent No. 18,110 of 1888, granted to Godfrey, Leake, and Lucas.

In 1882, Walton took out patent No. 6039, relating to machinery for mosaic floorcloths, which was one of a long series granted to him and others, and ultimately he perfected a machine for making inlaid linoleum which turns out a high class product at a rapid rate, and works upon an entirely different principle from the method just described. The machine, which is very massive, is too complicated to describe here, but its essential features consist in the cutting out from sheets of differently coloured linoleum, up to six in number, the pieces required to form the desired pattern, with the fitting together of these separate units or tesseræ upon the canvas backing, and by means of heat and pressure uniting the whole into one perfect sheet, the operations being continuous and automatic. In certain of the patterns turned out by this machine, some of the separate pieces are so small that sixteen of them only cover one square inch, and in one working day over ninety millions of these units are separately cut out, and placed with unerring accuracy in their proper position in the design.

All the machines used in the manufacture of linoleum or corticine must of necessity be massive, for cork being such an elastic material will readily spring back when the pressure is removed, and the strain put upon the rolls of the various machines is very considerable. In dealing with the ordinary widths of linoleum, the rolls are of solid chilled iron 2 feet in diameter, weighing about 5 tons, but for wider goods they average 3 feet or more in thickness, with a weight of 20–30 tons.

In addition to these floor coverings, there are several closely related products used in other connections, and of these may be mentioned table-baize, leather-cloth, and the wall-covering Lincrusta-Walton, all of which are manufactured by methods very similar to those described for either floorcloth or linoleum.

The industries described are carried on in many centres throughout this country. London is represented by works at Greenwich, Staines, and Ponder's End, and in the provinces there are flourishing establishments in Northallerton, Sowerby Bridge, Wigan, Lancaster, and Bristol, and across the Scottish border there are several in Fife, especially around the town of Kirkcaldy, and one in Dundee. Abroad the chief centres are in the United States, France, Belgium, Italy, Sweden, Russia, Germany, and Austria.

The trade in these products is a growing one, and whilst it is impossible to ascertain the output of the various manufactories mentioned for home consumption, satisfactory figures are obtained from the export returns issued by the Board of Trade. During the five years ending 1874, the total quantity exported was 3,989,000 sq. yards, valued at £267,000, and this included table-baize, leather-cloth, and articles of similar manufacture; whereas in 1913 (which is the last complete normal year for which returns are issued, and in which the figures for floorcloth and linoleum are shown apart from those of oilcloth used for other purposes) the total exports are given as 32,566,000 sq. yds., valued at £1,870,118, of which 18,771,000 sq. yds., valued at £1,028,787, went to British Colonies and possessions, whilst imports were 1,333,136 sq. yds., valued at £86,653.

My thanks are due to Messrs. John Hare and Co. for placing their early records and patterns at my disposal, and to the Exors. of the late Charles H. Scott (Messrs. Summers and Scott) of Gloucester, and Messrs. Hulse and Co., Ltd., of Manchester, for photographs of machinery made by them and used in the industries, with permission to exhibit these as lantern slides.

Discussion.

The Chairman asked whether any means had been adopted for reducing the time required for maturing the machine-made floorcloth. He also asked how long it took to oxidise linseed oil in the manufacture of linoleum when using the modern "shower bath method," also whether any other drying or semi-drying oils such as soya bean oil had been used with any success in place of linseed oil.

Mr. Waterfall asked the extent to which the oxidation of linseed oil was carried in the manufacture of linoleum.

Dr. Rixon inquired as to the nature of "cork carpet."

Mr. De Waele asked if the author had any knowledge of the action that took place in the cement pan and what vapours were given off in the process of maturing, also whether he had found any lead on the walls of the maturing room.

Mr. Jones, in reply, said that the complete process of producing machine-made floorcloth, which was dried in heated stoves and carried much less paint, only occupied one month. The length of time taken to oxidise linseed oil by the "shower bath" process was 5 or 6 days, but varied somewhat according to the origin of the seed from which the oil was extracted. From his own experience in Russia when working with Baltic oil, it was possible to eliminate the first part of the process, and by using only the "smacker," to obtain a satisfactory product in from 48 to 60 hours. The oxidation of the oil by any of the processes mentioned except that of the "scrim" appeared to be complete. Cork carpet was a thick variety of corticine, used principally where silence was essential. The action in the cement pan was merely one of melting the ingredients together, no chemical action taking place. No test had been made in the Bristol factory to ascertain whether any deposit of lead salts existed on the walls of any of the process rooms.

Edinburgh Section.

Meeting held on January 14th, 1919.

MR. D. B. DOTT IN THE CHAIR.

RUPTURE OF CAST IRON IN CONTACT WITH MIXED ACID.

BY A. C. CUMMING.

In connection with the manufacture of trinitrotoluene considerable amounts of mixed acid were used, consisting of approximately 50% of nitric acid, 45% of sulphuric acid, and 5% of water. The mixed acid was moved about by blowing with

cast-iron acid eggs, and about 2 years ago two serious accidents occurred through two of these eggs bursting. One egg was 4 feet internal diameter by 4 ft. 9 in. deep, the average thickness of the wall was one inch, and the capacity about 55 cubic feet. The second egg was 6 ft. in diameter, 6 ft. deep, and at least 1¼ inches thick. The working air-pressure could not at any time exceed 60 lb. per square inch, and was normally much lower.

In each case while blowing was in progress the egg burst with a noise like a muffled explosion. The egg appeared to disrupt suddenly into small fragments and to fall in rather than be blown out.

Examination of pieces of the iron showed that the corrosion, so far as removal of the iron was concerned, was practically negligible. When the metal was freshly broken there was no apparent difference between the metal near the inside and outside, but on breaking a washed piece of the iron the odour of acid was strongly noticeable. After a day or two, the faces of the fracture were rusted for about ¼ inch from the inside, the outer half of the fracture remaining bright. This suggested that the acid was percolating into the metal. The tensile strength of iron from the inner surface was found to be still fully equal to that of the original iron, and so far as tensile strength was concerned the egg should have stood pressures many times greater than that actually employed.

Photomicrographs taken by Dr. Desch showed graphitic plates of large size forming a network of surfaces along which acid might enter the metal. Near the surface of the iron, these plates were aggregated to form "nests." The defect of the iron from the point of view of resistance to acids was its coarse or open structure, which allowed acid to penetrate to a considerable depth. Examination of the fractured surface showed that acid had actually penetrated to a depth of about one-third of the thickness, and in many places small masses of crystallised iron salts could be seen in the interior. The expansive force of these crystals, growing in the interior of the iron, was doubtless responsible for the disruption of the iron, even though the actual corrosion of the metal was comparatively negligible.

It is interesting to observe that R. Knietsch (Ber., 1901, **34**, 4090) notes a similar danger when cast-iron vessels are used with fuming sulphuric acid. He suggests that the disruption is due to gases liberated in the pores of the metal.

"This remarkable phenomenon is caused by oleum diffusing into the pores of the cast-iron, and there beginning its work of destruction, inasmuch as it is converted into sulphur dioxide and hydrogen sulphide by the reducing action of the iron, and may even give rise to carbon dioxide from the carbon in the iron. All of these substances are gases with comparatively low critical temperature, and consequently cause high pressure in the interior of the cast-iron. If such a piece of iron is broken, the presence of sulphur dioxide and hydrogen sulphide may be recognised by the smell, and the evolution of gas when it is immersed in a suitable fluid."

It appears to us much more probable that the weakening and final disruption of the iron is due to the growth of salt crystals in the interior of the iron.

Examination of some open cast-iron measuring pots which have been used for mixed acid but have never been under pressure shows that these are cracking in a similar manner, proving conclusively that the fractures are not the result of undue pressure.

In view of the grave danger which arises from this phenomenon, it may be well to point out that cast-iron should not be used for any purpose where it comes into contact with nitric or fuming sulphuric acid, whether pressure is employed or not. Disruption of the metal will occur, sooner or later, even if no pressure is applied.

Lothian Chemical Co., Limited,
Edinburgh.

Yorkshire Section.

Meeting held at Queen's Hotel, Leeds, on November 11th, 1918.

MR. MCD. MACKEY IN THE CHAIR.

A READY METHOD FOR THE EXTRACTION AND ESTIMATION OF DISSOLVED GASES IN WATER.

BY F. W. RICHARDSON, F.I.C.

The extraction of gases dissolved in water is not quite as simple as might at first be supposed. Widely differing forms of apparatus have been suggested for the purpose, but in all of them the first vessel or container has been completely filled with the water, which on heating and upon the application of a vacuum flows partly over into some second vessel.

Dr. J. C. Thresh, in his work on "The Examination of Waters" (1904, p. 286), describes an apparatus which has the defect that no provision is made either for sending back the water thus driven over, or for heating the vessel, or for the complete expulsion of gases from the water contained therein.

The apparatus described by F. Hoppe Seyler (Z. anal. Chem., 1892, **31**, 367) is complex, and its general character is open to objection.

O. Petterson (Ber., 1889, **22**, 1434) describes a modified form of extraction apparatus, but from his own statements it is obviously unsatisfactory. For example, he says that as soon as the water in one of the vessels is cooled the carbon dioxide is to some extent re-absorbed.

By the aid of a simplified and more effective form of eudiometer described by a colleague and myself in 1909 (this J., 1910, 198) I have been able to extract with relative ease the gases dissolved in natural waters. The first extractions were made by the aid of a pear-shaped thistle funnel of about 250 c.c. capacity which had been completely evacuated by means of an air-pump. By immersing the lower tap in a measured volume of the water and by opening the tap, about 200 c.c. of the sample was drawn into the funnel, the upper stoppered tube of which was connected with the first burette of the eudiometer.

A simpler and more satisfactory method has now been adopted. A stout glass quart bottle is completely filled with the water.

The lower tube of a bulb or thistle funnel head, of 50 c.c. capacity and provided with two stoppers, as described in our previous paper (*loc. cit.*), is passed through a rubber stopper, the bulb is evacuated, and the stopper inserted in the bottle, thereby connecting the tube with the water. When the lower tap of the bulb is opened a little of the water rushes up, and it becomes possible to press the cork firmly into the bottle neck. Evolution of gas at once begins. If the bottle is placed in a vessel of water at about 40° C. and the gases occasionally removed from the small bulb, the water will continue to boil until all gases have been removed. Carbon dioxide is tenaciously held by

water, and when it is present alone repeated evacuations of the small bulb are necessary, but a number of experiments have proved that carbon dioxide can be completely removed in the apparatus. For example, a quantity of distilled water was boiled for two hours and then quickly cooled. The quart bottle was three-fourths filled with the water and 0·1 grm. of pure sodium carbonate was added, followed by an excess of dilute sulphuric acid; 21·0 c.c. of gas was recovered, whereas theory required 21·06 c.c.

When the water contains much dissolved air in comparison with the amount of carbon dioxide, the latter is more easily removed as the other gases help the evacuation.

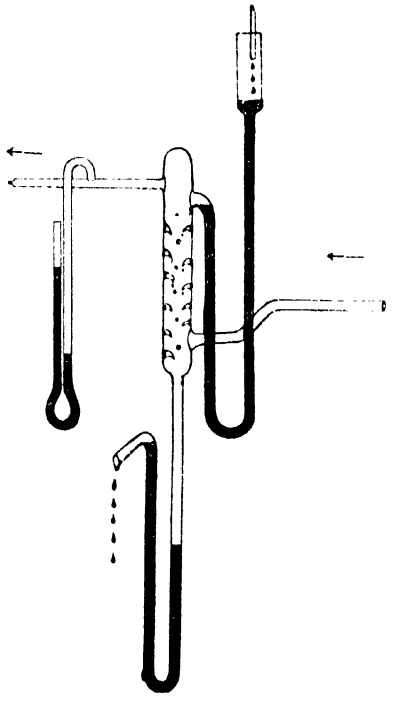
Meeting held at Queen's Hotel, Leeds, on December 16th, 1918.

MR. W. McD. MACKEY IN THE CHAIR.

APPARATUS FOR THE CONTINUOUS TESTING OF GASES WITH SPECIAL REFERENCE TO ACID OR ALKALINE CONSTITUENTS.

BY C. A. KING, M.SC., A.I.C.

In the course of working a plant for the recovery of ammonia from Mond gas the need was felt for some form of apparatus which would indicate at any time whether complete absorption of ammonia was being effected or whether traces of ammonia were passing through the plant, with consequent loss in the recovery of ammonia as sulphate. A



simple piece of apparatus was devised to show continuously the alkalinity or neutrality of the exit gas from the plant (see figure). A current of the gas from the outlet main is caused to pass upwards through a small glass absorption chamber about 7 cm. long and 1½ cm. in diam., provided with projections from the inner wall to effect more efficient contact with a solution of a suitable indicator, which flows from a U-shaped tube into the upper end of the extraction chamber. The indicator solution drains away from the lower end of the absorption chamber through a similarly shaped tube in which any change in colour of the solution is noted. The inlet and outlet bends are of such a length that the solution forms a liquid lute against the pressure of gas in the apparatus. The indicator used is a solution of methyl red with sufficient acid added just to develop the true red colour of the acid indicator. The colour change from red to yellow (in alkaline solution) can be readily observed by artificial light. Complete absorption of ammonia takes place with a flow of gas through a 2 mm. diam. jet (about 5 cub. ft. per min.) and with the indicator solution set at a fast dropping rate a very sensitive indication can be obtained. The apparatus has only been used qualitatively but with suitable calibration it might be employed for approximate quantitative estimations.

It is suggested that a similar form of apparatus might be conveniently used for other purposes, *e.g.* the detection of acid vapours in chimney gases, but obviously it can only be used where colorimetric tests can be applied, owing to the fouling of the observation tube by anything in the nature of an adherent precipitate.

The arrangement as shown is made specially to obviate siphoning of the entering liquid, though under certain conditions, siphoning at intervals might be a distinct advantage.

Discussion.

Mr. J. Ivor Graham wrote that the apparatus should be very useful for the continuous detection and possibly quantitative determination of small quantities of carbon monoxide, using the iodine pentoxide method, the iodine liberated being absorbed by a continuous stream of potassium iodide solution to which had been added a few drops of starch solution.

Dr. J. F. Dufton suggested an absorption chamber of similar pattern to his "Ideal" still-head in which the gases traversed a narrow spiral passage formed by a helically wound metal wire.

Mr. Frank Levy said that a "home-made" form of fractionator of similar construction had long been in use in the Leeds University laboratories. It was made by softening three points at the same level on the wall of a piece of thick-walled glass tubing and then making projections of the softened glass, towards the inside of the tube and slightly downwards, with the sharp end of a file; the projections almost touched in the centre of the tube, and acted as spouts down which the condensed liquid flowed. The rows of three projections were repeated at intervals of 1½ inch over the whole length of the tube (say 3 ft.). This form of fractionator would be found, for most laboratory purposes, to be quite equal to the ordinary pear-shaped still-head.

Mr. King, in reply, said that no special claim was preferred as to the precise form of absorption chamber. The efficient working of a simple fractionating column of similar form was endorsed. No difficulty had been experienced in trapping all the ammonia in this form of absorption chamber. The objections to the "Ideal" pattern of condenser were the contact of metal with the reagent solutions, and also the presence of tar oils in most gases to which the test would be applied.

Communications.

THE CONSTRUCTION OF GRAPHS FOR CALCULATING THE REVIVIFICATION OF SPENT ACIDS.

BY R. A. FOWLER.

Mixed sulphuric and nitric acids are used in many processes, notably for the manufacture of nitro-explosives, and it is often the practice to revivify the spent acid formed by mixing with it calculated quantities of revivifying and sulphuric acids—the revivifying acid being a mixed acid containing a higher percentage of nitric acid than that required for nitration purposes. Usually a quantity of spent acid is run into the mixing vessel and analysed, and the quantities of revivifying and sulphuric acids necessary to bring the blend up to specifications are calculated.

The calculations are somewhat involved and tedious, and the present paper shows how a graph may be constructed by means of which the required quantities of revivifying and sulphuric acids may be readily and quickly determined.

The principles upon which the graph is constructed are applicable to the revivification of any spent acids where revivifying and sulphuric acids are used. The graph will therefore be found equally useful for adjusting the strength of blends that do not come up to specifications. It is assumed that the compositions of the spent and revivifying acids vary from time to time, but that the percentage composition of the sulphuric acid remains, for practical purposes, constant. These conditions of course obtain in usual works practice. The actual graph to be constructed for any specified composition of nitrating acid will be a portion only of a general graph which will be first considered.

Let the percentages of H_2SO_4 and HNO_3 in the nitrating acid be x and y respectively, in the spent acid x_1 and y_1, and in the revivifying acid x_2 and y_2, and the percentage of H_2SO_4 in the sulphuric acid x_3. These compositions may be shown in graphical form, plotting percentages of H_2SO_4 on abscissæ and of HNO_3 on ordinates, as on diagram 2.

For any given case x and y are both fixed quantities. Let the point (x, y) be N, and the point (x_3, 0) lying on the x-axis, V. If the points V and N be joined and this line produced indefinitely, the portion produced is the sulphuric acid line.

Now x_1, y_1, x_2, y_2 vary within certain limits according to plant working. Let the points (x_1, y_1) and (x_2, y_2) for any particular case be S and R respectively. Now the line SR will cut the line VN produced, for if not revivification by means of the revivifying and sulphuric acids available is impossible (see below). Let P be the point of intersection.

(In what follows an acid having a composition represented by the point S will be shortly called "S acid" and similarly for other points.)

It can be readily shown that by mixing S acid and R acid in suitable proportions, any acid of composition lying on the line SR may be made, and no other composition can be made, by mixing S acid and R acid (see diagram 1). For if x_0 be greater than x_1, the sulphuric acid content of any mixture of the two must be greater than x_1 and less than x_2, that is it must lie between x_1 and x_2.

Similarly the nitric acid content of any mixture of the two must lie between y_1 and y_2.

Let D be any point lying between x_1 and x_2 and also between y_1 and y_2 and let its co-ordinates be x_0 and y_0. To obtain an acid whose sulphuric content is x_0 (by the ordinary rule for mixtures) S acid is to be mixed with R acid in the ratio $(x_2-x_0):(x_0-x_1)$. Similarly, to obtain an acid having a nitric acid content of y_0, S acid must be mixed with R acid in the ratio $(y_2-y_0):(y_0-y_1)$. In order that both nitric and sulphuric acid contents may be satisfied $(x_2-x_0)/(x_0-x_1)$ must be equal to $(y_2-y_0)/(y_0-y_1)$. Let the ordinate x_0 cut RS at C and the ordinate y_0 cut it at H. Then $(x_2-x_0)/(x_0-x_1)=CR/CS$, since the ordinates are parallel, and $(y_2-y_0)/(y_0-y_1)=HR/HS$ similarly. For $(x_2-x_0)/(x_0-x_1)$ to be equal to $(y_2-y_0)/(y_0-y_1)$, HR/HS must be equal to CR/CS, that is C must coincide with H, and D must lie on

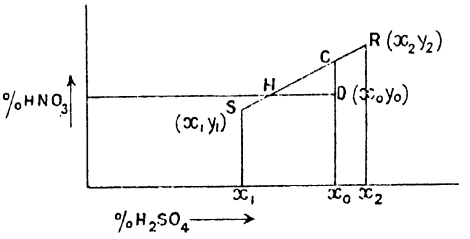


FIG. 1.

SR. Therefore if R acid and S acid be mixed, the composition of the resulting blend lies on SR. Since P lies on SR, the acid represented by it may be made by mixing S acid and R acid in the proportion of the lengths of PR to PS (see fig. 2). Similarly since N lies on PV, the acid represented by it (nitrating acid) may be made by mixing P acid and V acid in the proportions of the lengths of NV and NP.

Now since both N and V are fixed points the length of NV is constant and equal to $\sqrt{y^2+(x_3-x)^2}$ and the tan. of the angle that NV makes with the x axis is $y\div(x_3-x)$.

Consider the case of a unit weight of P acid and suppose PN equal to VN÷m, then, in order to obtain N acid, V acid and P acid must be mixed in the proportion PN to VN, *i.e.*, $\frac{1}{m}$ of V acid to every unit of P acid, giving $\frac{m+1}{m}$ units of N acid. Therefore if the line VN produced be graduated towards P with divisions each equal to $\frac{1}{z}\sqrt{y^2+(x_3-x)^2}$, where z is any convenient integer, each graduation will represent $\frac{1}{z}$ units of V acid to a unit of P acid.

Similarly if ON be joined and produced it becomes the water line. It may be divided in the same manner as the sulphuric acid line into divisions each equal to $\frac{1}{z}\sqrt{x^2+y^2}$. The tan. of its angle is $\frac{y}{x}$. This may be found useful in extreme cases for blends in which the content of sulphuric and nitric acids is high, for in such cases the line joining B (the point representing the composition of the blend) to S may not cut the sulphuric acid line and the point P will then fall on the water line. This, however, should only happen in exceptional cases, as it is obviously bad practice to add water, if it can possibly be avoided, since it involves the introduction into the system of water which must be removed at a later stage.

Now for any particular composition of nitrating acid it is plainly not necessary to construct the whole of the graph as shown on the diagram. Only that portion need be drawn as shall contain the points N, S and R (both S and R varying accord-

ing to plant working), and this portion should be enlarged to a suitable size. The limits within which the composition of spent and revivifying acids vary in plant practice can readily be determined and the graph constructed accordingly. The highest nitric acid content in revivifying acid and the lowest in spent acid will fix the nitric acid limits, and similarly for the sulphuric acid content. The limits being fixed, the point N is found and from it in the direction of P a line is drawn making an angle having a tan. of $y/(x_3-x)$

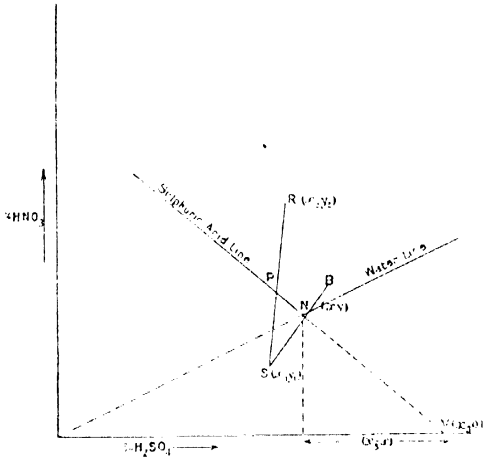


Fig. 2.

with the x-axis and produced right across the graph. This line is divided into equal divisions from N towards P, each division being equal to $\sqrt{y^2+(x_3-x)^2/1000}$ units (or some convenient multiple of it). Then each division will represent 0·001 ton of sulphuric acid per ton of (revivifying + spent) acid. The graph is then complete.

The water line may be inserted if thought desirable. From N a line is drawn in the proper direction, as in the diagram, making an angle with the x-axis having a tan. of y/x, and is divided into equal divisions each equal to $\sqrt{x^2+y^2/1000}$ units (or some convenient multiple). Each division will represent 0·001 ton of water per ton of (revivifying + spent) acid.

The method of using the graph is simple. The compositions of the spent and revivifying acids to be used are plotted by means of two pins; a graduated ruler is placed close to these and the distances SP and RP are noted. Then tons of spent acid x SP/RP gives tons of revivifying acid required. And (tons spent + tons revivifying acid) × reading on the sulphuric acid (or water) line gives tons of sulphuric acid (or water) required.

When using the graph for adjusting the strength of blends that do not come up to specifications, the point B is plotted representing the composition of the blend. (*a*) If B falls on either the sulphuric acid or the water line the addition required is immediately read off, for tons of blend × reading gives tons of sulphuric acid or water required. (*b*) If B falls above the sulphuric acid (or water) line the blend may be mixed with spent acid in the same manner in which revivifications are made. (*c*) If B falls below the sulphuric acid (or water) line, revivifying acid may be used in the same manner in which revivifications are made.

Example. It is required to construct a graph for the revivification of spent acid varying in composition between 19 and 21% HNO_3 and 60 and 62% H_2SO_4. The revivifying acid produced on the plant varies between 28 and 32% HNO_3 and 59 and 63% H_2SO_4. The nitrating acid is to be 62·15% H_2SO_4 and 23% HNO_3 and the sulphuric acid available contains 93% H_2SO_4. The limits of the graph are in this case 19 to 32% HNO_3 and 59 to 63% H_2SO_4, and therefore a scale of 1 inch to 1% will be convenient. The tan. of the angle that the sulphuric acid line makes with the x axis $\frac{y}{x_3-x}=\frac{23}{93-62\cdot15}=\frac{23}{30\cdot85}$. The sulphuric acid line can then be drawn. If considered necessary the water line can be inserted as well. The tan. of its angle is $\frac{y}{x}=\frac{23}{62\cdot15}$.

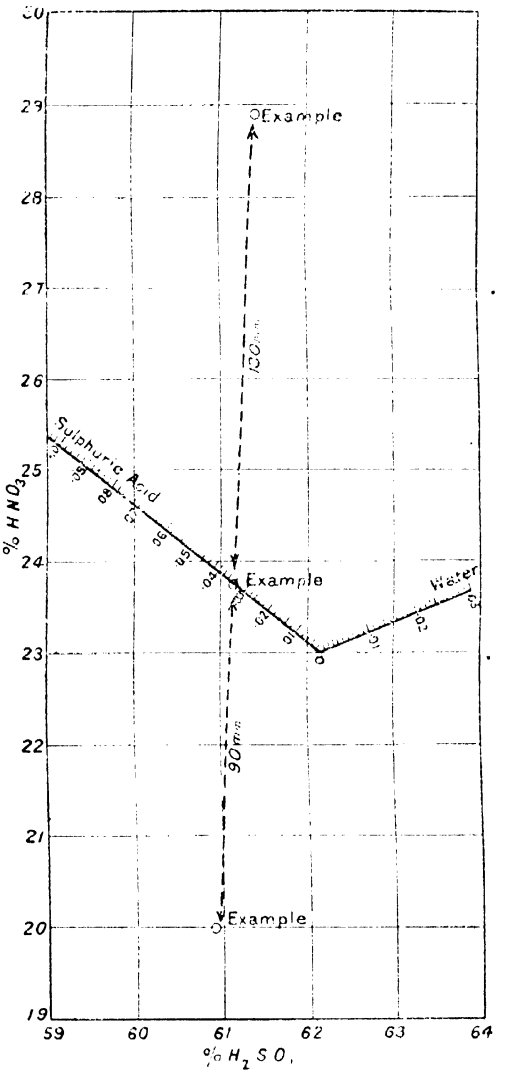


Fig. 3.

The divisions must now be marked off on the sulphuric acid line. Each is to be $\sqrt{y^2+(x_3-x)^2+1000}$ inches, *i.e.*, approximately $\frac{1}{30}$ in. Consequently if divisions of $\frac{1}{15}$ inch be marked off they can be numbered 0·002, 0·004, 0·006, etc. The divisions on the water line are to be $\sqrt{x^2+y^2}\div1000$, or nearly $\frac{1}{15}$ in.

An example of a revivification by the above graph is given. Spent acid 60·9% H_2SO_4, 20% HNO_3; revivifying acid 61·4% H_2SO_4, 28·9% HNO_3. The

distance PS is 96 mm. and RS is 130 mm. The sulphuric acid reading is 0·034. Therefore 100 tons of spent acid will require 100 × 96 ÷ 130 = 73·85 tons of revivifying acid, and the amount of sulphuric acid required will be 173·85 × 0·034 = 5·91 tons. A reduced sketch of the above graph is given in diagram 3.

In practice at this factory the graph is mounted on a sheet of composition board strengthened with an edging of batten and is covered with tracing cloth to preserve it. When the pin holes become too numerous the tracing cloth is renewed.

The graph is approximately 14 by 8 inches and any constituent can be readily calculated to within 0·02% in the nitrating acid.

H.M. Factory, Gretna.

SAFFLOWER OIL AS A DRYING OIL.

BY HAROLD H. MANN AND N. V. KANITKAR.

Among the oil seeds grown in Western India there is a special interest attached to safflower. The plant was formerly the source of a valued cotton dye, but except for local production in a small area in Gujarat, it has ceased to be cultivated for this purpose. The plant is, however, still extensively grown, more particularly in the driest areas of the Deccan, for its oil seed. In these districts the oil is one of the most valued of edible oils, and the oil cake, as prepared after thorough decortication, is one of the most valuable and most used cattle foods, as well as one of the principal manures for sugar cane and other crops in Western India. Our special interest in the seed has arisen from its being one of the two important oil seed crops of the dry Deccan uplands, and hence any possibility of extending the use of the seed and its products might lead to a more satisfactory utilisation of large areas at present of very little value.

Examination of a number of samples of safflower seed which have passed through our hands gave the following average figures: Husk, 50·8%; kernel, 49·2%; oil in whole seed, average of 55 samples 31·6%, maximum 36·9%, minimum 25·4%. The percentage of husk is very high, and so far no use has been found for it. It is brittle and useless as food, since when used in large quantities it has an irritant tendency. It contains little nitrogen and hence reduces the manurial value of cake which retains it, and in ordinary practice in village oil-pressing most of it is either thrown away or sold at a very low price for burning bricks.

The kernel, after decortication, is, on the other hand, very oily and highly nitrogenous. Determinations of oil in four typical samples showed 54·05, 49·60, 49·50, and 52·09%, respectively, average 51·31%. The oil produced is used at present in Western India entirely or almost entirely for edible purposes, and it forms the chief ingredient of the "sweet oil" used for cooking in very large areas of country.

The most striking feature of the oil at first sight is its drying quality. Its iodine value was found by Crossley and Le Sueur,* as a result of the examination of many samples from various parts of India, to vary from 126·9 to 149·9. Over 60% of their samples gave figures between 140 and 150. These must have been old samples or samples prepared from old seed, however, for our figures are usually much lower than this, though they vary considerably. Four samples of oil were used. The first two of these, (*a*) and (*b*), were obtained from the bazaar, the third (*c*) was pressed cold by a hand-mill in the laboratory, while the fourth (*d*) was prepared from the seed by extraction with ether. The analytical figures—all four from fresh oils—were as follows:—

—	(*a*) Bazaar sample	(*b*) Bazaar sample	(*c*) Oil pressed in laboratory	(*d*) Oil extracted with ether
Sp. gr. at 26° C. ..	0·914	0·914	0·914	0·914
Butyro - refractometer reading at 40° C.	63	63	64	64
Reichert-Meissl value	0·3	0·5	0·2	0·2
Saponification value	177	185	202	203
Acid value	2·6	1·8	0·6	0·6
Iodine value	116	111	122	116
Hehner value	94·8	—	—	—
Maumené test	94° C.	85° C.	—	—
Tintometer reading (Lovibond) ½-inch layer ..... red	0·6	0·5	0·2	—
do. ..yellow	1·6	1·2	0·4	—

In the laboratory-pressed sample the mean molecular weight of the fatty acids was 294; the unsaturated acids amounted to 72·05% and the saturated fatty acids to 11·83% of the fat. Stearic acid only occurred in traces, most of the saturated fatty acids consisting of palmitic acid.

The oil seems to have possibilities as a drying oil, and it has, as a matter of fact, been used in this way in India for many years in one particular manner. It is boiled by heating in earthenware vessels for two hours, during which time a considerable amount of acrolein is given off, and it is then put into vessels partly filled with water. In this it quickly solidifies to a gelatinous mass, which is sold as "*roghan*" or "Afridi wax" and is used for the preparation of Afridi wax cloth. Lewkowitsch states that this is less a product of drying in the ordinary sense than of polymerisation, but he gives no evidence for his statement. As an ordinary drying oil it does not appear to have been used successfully, and has been stated not to be capable of replacing linseed oil in varnishes, though it is said to be employed successfully as an addition to linseed oil.

The present inquiry was concerned with the characters of the oil after heating under well defined conditions, partly to test the opinion of Lewkowitsch that the oil simply polymerises on heating, and partly to ascertain the properties of the product obtained and the possibility of its utilisation. Samples of the fresh oil were, therefore, heated first in presence of oxygen and secondly in presence of carbon dioxide to 100° C., 186° C., and 300° C. for various times, and the characters of the products determined in each case. The oxygen or carbon dioxide was bubbled through the oil during the time in which it was heated. If the alteration in the oil on heating is due to polymerisation and not to oxidation, the changes characteristic of such heating should take place equally or almost equally well in the absence as in the presence of oxygen. The effect on the constants of the oil of heating for various lengths of times in an atmosphere of carbon dioxide is shown by the first table on page 37 T.

Thus, when heated in carbon dioxide, the oil undergoes very little change (as judged by these constants) even in twelve hours at either 100° C. or 186° C. The colour is improved, probably by the coagulation of small quantities of dissolved materials, but otherwise there is little change. Even at 300° C. any extensive change on heating only takes place very gradually, and except for an increase in the acid value and a reduction in the iodine value, there is little change during the first four hours. Then decomposition sets in, the acidity increases rapidly accompanied by a rapid

* This J., 1898, 989.

reduction in the iodine value and in the saponification value. On the other hand, the colour darkens, and the specific gravity and the refractiveness of the oil rapidly increase. The viscosity does not, however, increase nearly so fast as in the case of oil heated in oxygen, and the characteristic much more rapid change in colour when the heating is conducted in oxygen, but otherwise the reaction seems very similar. The saponification value, however, remains fairly constant in oxygen while becoming considerably lower in carbon dioxide. The real difference is in the viscosity, for the oil

Oil heated in carbon dioxide at	100° C.				186° C.				300° C.			
	1 hr.	4 hrs.	6 hrs.	12 hrs.	2 hrs.	4 hrs.	6 hrs.	12 hrs.	1 hr.	4 hrs.	6 hrs.	12 hrs.
Sp. gr. at 26° C.	0·919	0·919	0·919	0·919	0·919	0·920	0·920	0·920	0·920	0·922	0·932	0·952
Butyro-refractometer at 40° C.	62	62	62	62	63	64	64	64	64·5	65	70	81
Tintometer reading (¼-inch layer[1])												
red	0·6	0·6	0·4	0·2	0·4	0 2	0·3	0·2	0·1	0·4	0·4	1·4
yellow	1·6	1·8	1·4	1·0	0·8	0·8	0·8	0 8	0·4	1·0	1·3	7·0
Reichert-Meissl value	0·37	0·24	0·21	0·37	0·7	0·36	0·46	0·56	0·81	0·90	1·4	3·8
Saponification value	233	234	239	241	235	238	238	234	195	187	129	138
Acid value	2·7	2·8	3·5	2·7	0·9	0·9	0·9	0·9	4·3	9·3	17·2	46·5
Iodine value	—	—	133·5	128	131	123	134	135	91·8	95·1	67·2	48·6

[1] The figures for tintometer readings of the samples heated at 300° C. are for ½-inch layer.

roghan does not appear to form so easily or completely. The changes appear to be due to decomposition through long heating at 300° C., polymerisation possibly following the decomposition.

The characteristic changes on heating safflower oil can be followed very clearly when the oil is heated in oxygen, the products obtained giving the following figures:—

heated in oxygen becomes very much thicker than in carbon dioxide.

These results appear to justify the conclusion that the change in safflower oil is largely of the nature of decomposition with some polymerisation, and is only to a minor extent due to oxidation. It will be seen, however, that the latter is important in connection with its use as a drying oil.

Oil heated in oxygen at	100° C.					186° C.					300° C.				
	1 hr.	2 hrs.	4 hrs.	6 hrs.	12hrs.	1 hr.	2 hrs.	4 hrs.	6 hrs.	12hrs.	1 hr.	2 hrs.	4 hrs.	6 hrs.	12hrs.
Sp. gr. at 26° C.	0·919	0·919	0·919	0·919	0·922	0·919	0·920	0·920	0·922	0·963	0·925	0·925	0·930	0·947	0·976
Butyro-refractometer at 40° C.	62	63	64	64	64	63	64	64	64	64	66	67	72	77	86·5
Tintometer reading (¼ inch layer)															
red	0 4	0·4	0·4	0·4	0·04	0·4	0·3	0·2	0·1	0·1	0·5	0·3	0·8	2·0	7·4
yellow	1·4	1·2	1·2	1·0	0·4	1·0	1·0	0·8	0·4	0·2	1·4	1 2	2·5	9·0	20·0
Reichert-Meissl value	0·4	0·5	0·6	0·6	0·9	0·6	0·6	0·6	0·9	0·7	1·2	0·9	1·6	2·2	3·4
Saponification value	236	230	223	222	226	182	173	175	180	175	166	187	193	201	206
Acid value	2·3	2·1	2·2	2·1	2·4	0·98	0·92	0·89	0·97	0·97	11·8	10·0	20·8	13·4	6·5
Iodine value	123	122	111	127	111	145	158	176	184	183	77·5	61·5	64·4	60·6	49·0
Viscosity at 60° C.*	—	—	—	—	—	—	*	—	—	—	216	260	750	2525	24600

* Seconds required for 50 c.c. to flow in Redwood's apparatus.

It is thus obvious that heating in oxygen at 100° C. for as much as twelve hours has little effect on the character of the oil, whilst even at 186° C. there is comparatively little change, at least until the oil has been long heated. The decrease in colour is exactly similar to that observed in carbon dioxide and only slightly greater at 186° C. than at 100° C.

These figures show that it is only at 300° C. and in oxygen that the characteristic results of heating safflower oil become evident. Even here the change is not very rapid at first, but after heating for two hours, it proceeds more and more rapidly. The specific gravity and refraction increase rapidly. The colour, after becoming somewhat less intense in the first hour of heating, darkens rapidly and the oil becomes brown. Heating the oil in oxygen causes a rapid increase in the acidity, which afterwards disappears, probably owing to volatilisation of the volatile acids produced. The iodine value falls equally rapidly until it is less than half the original value. The change in the viscosity is the most characteristic feature of the heating of safflower oil, and after two hours' heating (during which little change takes place) it increases very rapidly till the oil becomes almost a semi-solid mass —the *roghan* of the Indian bazaars.

By comparing the figures obtained at 300° C. in carbon dioxide and in oxygen it is easy to see which of these changes depends on the presence of oxygen and which proceeds equally well in its absence.

The figures for twelve hours' heating show a

Oxygen absorbed by heated oils.—The oils which had been heated were mixed with litharge or red lead, exposed in a thin layer to air at 32°—34° C., and the increase in weight determined. This may be taken as the amount of oxygen absorbed under these conditions. The differences were very small in oils heated to 100° C. and 186° C. The oil heated to 300° C. was not examined in this sense. The actual figures were as follows:—

With litharge: Original oil absorbed 8·2% of oxygen; oil heated to 100° C. in oxygen, 8·2%; in carbon dioxide, 7·2%; heated to 186° C. in oxygen, 6·8%; in carbon dioxide, 9·4%. *With red lead:* Original oil absorbed 6·7% of oxygen; oil heated to 100° C. in oxygen, 8·8%; in carbon dioxide, 10·0%; heated to 186° C. in oxygen, 7·1%; in carbon dioxide, 7·2%.

Time required for the drying of heated safflower oils.—In order to determine the time required for the heated oils to dry, they were mixed with manganese borate, spread on glass in thin layers, and allowed to become hard. Raw safflower oil similarly treated required 66 hours to become hard. The oils heated to 100° C., whether in oxygen or in carbon dioxide, showed considerable reduction in the time required for drying, but this was not increased on further heating. By heating to 186° C. in oxygen, a very marked reduction in the length of time required for drying is obtained almost at once, and only slight further increase in drying capacity takes place on prolonging the heating. By heating in carbon dioxide, very little increased drying power is obtained. Heating at 300° C. has the

unexpected result of decreasing the drying capacity, both when the heating is done in oxygen and in carbon dioxide. The figures * are given below:—

Relative length of time required for drying.

(Raw safflower oil = 100.)

Oil heated to	100° C. in oxygen	100° C. in carbon dioxide	186° C. in oxygen	186° C. in carbon dioxide	300° C. in oxygen	300° C. in carbon dioxide
One hour	68	70	37	—	69	66
Two hours	—	—	56	69	69	64
Four hours ..	68	70	50	69	71	103
Six hours	68	61	50	69	109	103
Twelve hours	68	69	34	69	109	103

* As the times required for drying varied much with temperature and weather, we give the relative times of drying only, raw safflower oil being taken as 100 under identical conditions.

A development of this work consisted in studying the rate of drying of paints made up with 10 grms. of the oil and 7·5 grms. of white lead, without any drying agent, and comparing the results with those for a paint made at the same time with boiled linseed oil.

The oil heated in oxygen to 186° C. in the former experiments with driers (manganese borate) gave much more rapid drying than the raw oil. In the experiments with white lead only, heating the oil in oxygen decreased the drying capacity in practically all cases. What the cause of this difference is we cannot at present state, but its existence seems certain, and may account for anomalies in using safflower oil as a drying oil which have led to its abandonment on many occasions. This inquiry is being pursued further.

In the meantime, it may be noted that white lead paints prepared with all grades of heated safflower oil, without driers, gave a far more glossy surface than those made with boiled linseed oil, and equally hard.

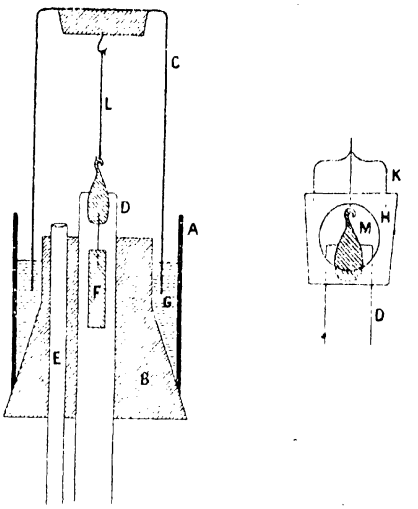
GAS PRESSURE GOVERNOR FOR ONE BUNSEN BURNER.

BY G. R. CLARE.

Where it is not expedient to have the gas supply to the whole laboratory reduced to a certain fixed pressure by a governor fitted to the gas main, it is frequently necessary to have the pressure of gas for one Bunsen burner controlled.

The governor described was designed for this purpose and has been operating satisfactorily for several months, the pressure being controlled to 1½ in. water column. The apparatus can be made from materials used in every laboratory, can be fitted together in a very short time, and may be moved from one bench to another. The inlet valve is made by accurately grinding a piece of glass rod into a glass tube, the end of which has been suitably shaped as the socket, and is suspended from a cork fastened into the bell with gelatin solution.

The governor is shown in the accompanying figure. A a brass tube, 2 in. inside diameter, 2 in.



long, B a rubber stopper 2¼ in. in diameter, 2 in. long, C an ordinary glass weighing bottle 1⅝ in. diameter, 3 in. long, D the gas inlet tube $\frac{7}{16}$ in. diameter (containing the valve), E the gas outlet tube, $\frac{5}{16}$ in. diam., F a lead weight fastened to the valve by platinum wire, to prevent the valve from sticking due to occasional high pressure; and G a mercury seal. The bell is kept vertical by means of the arrangement shown at X. H is a ⅞-in. cork fixed on to the gas inlet tube, D, and holding a glass tube, K, drawn out to a small hole which serves as a guide for the wire, L. The gas passes from D into the bell, C, by the hole, M. The required controlled pressure can be varied by means of the weight, F, or by placing an additional weight centrally on the top of bell. The length of the suspending wire (of 0·02 inch thickness) must be determined by experiment.

London Section.

Meeting held at Burlington House on January 6, 1919.

DR. CHARLES A. KEANE IN THE CHAIR.

ESTIMATION OF BENZENE AND TOLUENE IN PETROLEUM.

BY F. B. THOLE, D.SC.

Though the presence of aromatic hydrocarbons in petroleum from many sources has been recognised for several years and certain petrols are fractionated on a large scale to yield supplies of toluene-petrol* containing 50% and upwards of toluene, the methods hitherto in vogue for the analysis of petroleum and petroleum distillates for their content of aromatic hydrocarbons appear to be very unsatisfactory.

The procedure adopted by most chemists consists in preparing a petrol boiling up to say 160° C. and so containing all the benzene and toluene present in the oil. This is subsequently distilled through a good fractionating column, fractions being collected between certain temperature limits and assumed to contain respectively all the benzene, all the toluene, etc. These fractions are then assayed by treatment with nitro-sulphuric acid, fuming sulphuric acid, liquid sulphur dioxide, or dimethyl sulphate, reagents which absorb the aromatic hydrocarbons by chemical attack or by selective solution, and measurement of the volume of aromatic compound thus absorbed. Each of these operations is liable to a number of errors, is largely influenced by the personal factor, and involves assumptions of very doubtful validity.

Previous Work

Moore, Morrell, and Egloff (Met. and Chem. Eng., 1918, **18**, 396) and Rittman and Moore (Met. and Chem. Eng., 1915, **13**, 713) extract the mixture several times with liquid sulphur dioxide at a temperature below −15° C. The extract consists principally of aromatic hydrocarbons mixed, however, with a certain proportion of non-aromatic hydrocarbons since these are somewhat soluble in sulphur dioxide, especially when this contains dissolved aromatic hydrocarbons. To determine the amount of non-aromatic compounds extracted, the extract and the undissolved portion are freed from sulphur dioxide and the refractive indices determined. Knowing the refractive index of the pure aromatic hydrocarbon the percentage of aromatic hydrocarbon in the extract is calculated by the law of mixtures. These authors admit this procedure to be unsatisfactory with a petrol containing both paraffins and naphthenes (as nearly all petrols do), since they clearly demonstrate that naphthenes are more soluble than paraffins, so that the non-aromatic hydrocarbons in the residue cannot possess the same physical constants as those in the extract. Moreover, the method cannot be employed with mixtures containing fairly high proportions of aromatic compounds, those containing over 50% of aromatics being entirely soluble in sulphur dioxide.

Bowrey (J. Inst. Pet. Tech., 1917, **3**, 287) proceeds on similar lines but first extracts the petrol repeatedly and then separates the concentrated benzene-toluene-xylene extract by very careful fractional distillation. Even though working at −35° C. he finds that a certain amount of non-aromatic hydrocarbon is extracted, and he applies a correction based on specific gravity determinations with these fractions. He assumes that (no matter whether the petrol is naphthenic or paraffinoid) the specific gravities of the non-aromatic hydrocarbons associated in boiling point with benzene, toluene, and xylene are 0·690, 0·720 and 0·760 respectively,* Bowrey's procedure considerably improves on that of Moore, Morrell, and Egloff, but in addition to depending on invalid assumptions necessitates the employment of a considerable volume of liquid sulphur dioxide and of somewhat complex apparatus. Moreover, in both these methods it is assumed that the refractivity- or specific gravity-composition curve for aromatic-non-aromatic hydrocarbon mixtures is linear, an assumption examined later in this paper.

Valenta (Chem.-Zeit., 1906, **30**, 266) and F. M. Perkin and Harrison (Analyst, 1908, **33**, 2) have employed dimethyl sulphate as a selective solvent for aromatic compounds, but the latter chemists have abandoned the method as unsatisfactory.

Fuming sulphuric acid containing up to 20% of free SO_3 has been used by a number of workers, since this readily sulphonates and dissolves aromatic hydrocarbons. The reaction is always accompanied by the production of sulphur dioxide (indicating the oxidation of non-aromatic compounds) and at temperatures above atmospheric this oxidation proceeds to a grave extent, thus vitiating the results, which are calculated from the volume of unabsorbed spirit. The extent of this side-reaction may be greatly minimised, though not nullified, by the use of acid containing a smaller percentage (say 3%) of SO_3. Naphthenic hydrocarbons appear to be more readily attacked than paraffins though certain of the latter are very susceptible to attack.

A mixture of nitric acid with excess of sulphuric acid has been employed for many years for the analysis of coal tar benzene containing "paraffin," since aromatic compounds are nitrated by this mixture and the nitro-compounds are soluble in the excess of sulphuric acid. Experiments with mixtures of known composition show that the volume absorbed by the acid is too high; also it is well known that certain paraffins form nitro-compounds under these conditions and it is at least conceivable that naphthenes may undergo a certain amount of oxidation, while the mutual solubility of non-aromatic hydrocarbons and the nitro-aromatic product cannot be entirely ignored.

The suggested adoption of a colorimetric method (Formanek, Knop, and Korber, Chem.-Zeit., 1917, **41**, 713) based on the solubility of certain indanthrene dyestuffs in aromatic but not in non-aromatic hydrocarbons and the matching of saturated solutions of such colours in the hydrocarbon mixture with standard solutions, has not proved in the writer's hands to possess sufficient sensitiveness to bear any favourable comparison with the method described later.

The Assay of Petrol containing Benzene or Toluene.

In the present research an attempt has been made to recognise and avoid the most prominent errors, to test the assumptions usually made, and to devise methods of assay and technique of preliminary distillation which will give reliable results.

It will be convenient to deal first with the second stage of the estimation, namely the assay of mixtures of benzene or of toluene with non-aromatic hydrocarbons; such mixtures may be referred to as benzene-petrol or toluene-petrol. It is evident that the assay involves two operations: the removal of

* In order to maintain a clear distinction between "benzene" and "benzine" the latter term has been replaced in this paper by the word "petrol," which is understood to indicate the portion of a natural petroleum boiling below 160° C.

* Hexane has a sp. gr. 0·663 and cyclohexane 0·783, and petrols may range in chemical nature from nearly pure paraffins to nearly pure naphthenes.

the aromatic hydrocarbon and the determination of the amount so removed. These two operations may be discussed separately.

The Absorption of the Aromatic Hydrocarbon.—Selective physical solution methods are unsatisfactory as the separation is never even approximately complete while the manipulative difficulties are frequently considerable. Oleum and nitro-sulphuric acid, though more discriminating in their selective action, have an appreciable action on non-aromatic compounds. The most suitable reagent is concentrated sulphuric acid of about 98% strength (compare Gilpin and Bransky, U.S. Geol. Bull. 475 (1911), p. 17). This sulphonates in the cold about one half its volume of toluene and somewhat less of benzene, but little heating occurs as compared with that resulting from oleum or nitro-sulphuric acid, and no sulphur dioxide is evolved nor is there any sign of carbonisation. It appears to be without chemical action on paraffins or naphthenes. Brooks and Humphrey instance di-isopropyl which is unattacked by concentrated sulphuric acid while 15% oleum decomposes it to the extent of 32% in 30 minutes.

The method of treatment of a toluene-petrol or benzene-petrol in the experiments dealt with below has consisted in shaking vigorously in a stoppered 50-c.c. cylinder at frequent intervals during half an hour three volumes of 98% sulphuric acid and one volume of the hydrocarbon. External cooling is only necessary with mixtures rich in aromatic compounds, and it is obvious that this proportion of acid is an ample excess for mixtures containing less than 50% of aromatics. Using these quantities with a 50% benzene-petrol, the water resulting from the sulphonation would dilute the residual sulphuric acid to 96% concentration; such acid is still capable of sulphonating benzene. For richer mixtures it would be advisable to separate the supernatant spirit and treat it with a fresh quantity of acid. The residual spirit is then washed with alkali and water and dried with calcium chloride.

Determination of the Amount of Sulphonated Hydrocarbon.—The usual procedure of measuring directly the volume of the supernatant layer of unattacked hydrocarbon, though simple, is liable to much larger errors than the alternative method described below. In the first place readings cannot be made within 0·1 c.c. in a 50-c.c. cylinder (*i.e.*, with about 10 c.c. of petrol) which gives a possible error of 4%. The complete separation of the two layers and the drainage of the acid from the walls of the cylinder require several hours, and incomplete separation and drainage create an error of considerable magnitude. Moreover, the non-aromatic hydrocarbons are appreciably soluble in arylsulphonic acids though not in sulphuric acid. This fact is illustrated by the following experiments. 9·5 c.c. of aromatic-free spirit shaken with 35·7 c.c. of sulphuric acid in which 2·4 c.c. of toluene had been dissolved lost 2·2%. The same loss occurred when the experiment was repeated with sulphuric acid saturated with the spirit before the addition of the toluene. Repetition of these two experiments with sulphuric acid containing no toluenesulphonic acid gave no loss in either case.

In order to avoid these errors the method adopted has been to determine the specific gravity of the initial fraction and of the residual spirit after acid treatment. Knowing the specific gravity of the calculated component the percentage present may be calculated from the formula

$$\%\ \text{aromatic} = \frac{\text{Initial sp. gr.} - \text{final sp. gr.}}{\text{sp. gr. of aromatic} - \text{final sp. gr.}} \times 100.$$

This method has the following advantages:—

1. A higher degree of accuracy of measurement is attainable as specific gravities can be readily determined with exactitude to the fourth decimal place by means of a 5 c.c. Sprengel pyknometer.

2. It is not necessary to wait for complete separation and drainage as the volume of spirit is not measured.

3. If the non-aromatic mixture is dissolved as such (*i.e.*, no selective solution) by the sulphonic acid solution, the final specific gravity and hence the calculated aromatic content is not affected. If on the other hand naphthenes are dissolved to a greater extent than paraffins, the error thus introduced is far less than would be found by the "volume absorption" method. This may perhaps be illustrated more clearly by considering the following exaggerated case:—Suppose the initial mixture contained 70% of paraffins of sp. gr. 0·700, 20% of naphthenes of sp. gr. 0·770, and 10% of toluene of sp. gr. 0·871, the sp. gr. of the mixture would be $\frac{70\times0{\cdot}700+20\times0{\cdot}770+10\times0{\cdot}870}{70+20+10}=0{\cdot}7311$.

Suppose during the acid treatment one-fifth of the naphthenes and one-fourteenth of the paraffins were absorbed by the acid. The sp. gr. of the residual spirit would be $\frac{65\times0{\cdot}700+16\times0{\cdot}770}{65+16}=0{\cdot}7138$. Then % of toluene actually present = 10%, % of toluene by sp. gr. method $= \frac{0{\cdot}7311-0{\cdot}7138}{0{\cdot}871-0{\cdot}7138}\times100 = 11\%$, % of toluene by volume absorbed = 19%.

Since this calculation involves an exact knowledge of the specific gravities of the pure aromatic hydrocarbons the following data for sp. grs. at 15·5°/4°, which appear to be the most accurate hitherto published, may be quoted (Perkin, J. Chem. Soc., 1896, **69**, 1191): Benzene, 0·8841; toluene, 0·8712; *o*-xylene, 0·8807; *m*-xylene, 0·8680; *p*-xylene, 0·8618.

For the purposes of this investigation pure benzene and toluene the specific gravities of which agreed with those found by Perkin were used. The toluene was purified by conversion into crystallised toluene-*p*-sulphonic acid and subsequent hydrolysis of this by superheated steam (Inglis, this J., 1918, **37**, 288).

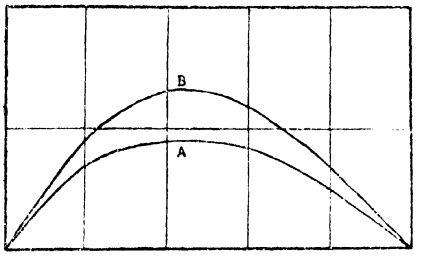
The Specific Gravity Deviation Correction.—The expression for % Aromatic quoted above is based on the assumption that the specific gravity-composition curve for mixtures of aromatic and non-aromatic hydrocarbons is a straight line. Contrary to Bowrey's statement this is not the case, the specific gravity being slightly less than that calculated according to the law of mixtures. It is possible, however, to correct for this deviation by the construction and use of a "deviation curve."

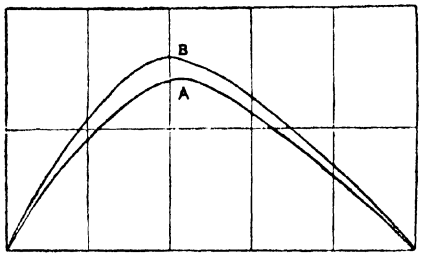
To construct such a curve it is necessary to prepare known mixtures from non-aromatic and aromatic hydrocarbons of known specific gravity and to determine the actual specific gravity of these mixtures. Such curves have been constructed for the non-aromatic portions (b. pt. 40°—95° C.) of a petrol A, mainly paraffinoid in nature, and a petrol B, mainly naphthenic, with benzene and of the corresponding portions (b. pt. 95°—122° C.) of these petrols with toluene. These temperatures were selected for the reasons dealt with below, the non-aromatic hydrocarbons being prepared by extraction of the fractionated petrols with 98% sulphuric acid till no further specific gravity change could be detected. One example will render clear the method of constructing such a curve.

Non-aromatic. Acid-washed spirit A. (b. pt. 95°—122°), 11·98 c.c., of sp. gr. 0·7229.

Aromatic. Pure toluene, 3·02 c.c., of sp. gr. 0·8712. Sp. gr. of mixture = 0·7516. Volume of mixture $= \frac{11{\cdot}98\times0{\cdot}7229+3{\cdot}02\times0{\cdot}8712}{0{\cdot}7516} = 15{\cdot}023$ c.c. % toluene actually in mixture = 20·1%. % toluene by sp. gr. method $= \frac{0{\cdot}7516-0{\cdot}7229}{0{\cdot}8712-0{\cdot}7229}\times100 = 19{\cdot}35\%$. Deviation = 0·75%.

The necessary correction to be added to any result drawn from specific gravity determinations can at once be read off from such curves. Although, strictly speaking, each individual petrol possesses its own specific "deviation curve" the difference between the curves for a paraffinoid and for a naphthenic petrol is not great, and as a consideration of the specific gravity of the non-aromatic hydrocarbons will indicate the nature of these the two curves figured will afford sufficient data for most analyses.





The following table illustrates the accuracy attainable by this method, mixtures of known composition made from toluene and non-aromatic hydrocarbons being used.

Non-aromatic	Aromatic	% Arom. present	% by vol. absorption	% by sp. gr.	Deviation corr.	% Arom. by sp. gr. corr. for deviation
Petrol A	Toluene	10·2	10·3	9·8	0·3	10·1
B. pt. 95°-122°	,,	20·1	21·2	19·35	0·75	20·1
Sp. gr. 0·723	,,	40·3	41·1	39·3	0·9	40·2
	,,	60·7	—	59·9	0·8	60·7
Petrol B	Toluene	9·7	11·1	9·6	0·5	10·1
B. pt. 95°-122°	,,	19·3	20·2	18·5	0·9	19·4
Sp. gr. 0·716	,,	48·3	50·4	46·9	1·4	48·3

The Influence of Olefines and Sulphur Compounds on the Estimation of Aromatic Hydrocarbons in Petrol.—It may be urged that these conclusions have been arrived at by the use of pure aromatic hydrocarbons and non-aromatic hydrocarbons unattacked by sulphuric acid, whereas normal petrols may contain, in addition, hydrocarbons and sulphides which are extracted by sulphuric acid. It has been shown already that the selective absorption by the acid of a small amount of non-aromatic compound has little disturbing effect on the results given by the specific gravity method, especially when this absorbed compound differs but little in specific gravity from the unabsorbed portion, as is the case with the lower olefines. Moreover, in a normal petrol (unmixed with cracked spirit) olefines are extremely rare; no case of the presence of more than a minute trace has yet come within the writer's experience, while the presence of much less than 1% can be detected by the immediate decolorising effect on dilute potassium permanganate. It is the custom in some laboratories to remove possible olefines by a preliminary wash with concentrated sulphuric acid. This is highly undesirable unless acid of less than 90% concentration is used, since aromatic compounds are certain to be sulphonated, thus introducing an error very much greater than could be created by the ignored presence of a small olefine content. The problem of higher olefine contents due to the addition of cracked spirit introduces complexities which are beyond the scope of this investigation.

The influence of the sulphur compounds present in commercial petrols is necessarily so small as to be negligible, but these compounds could be removed, if desired, by any suitable reagent before assaying the spirit.

The Segregation of the Benzene and Toluene in Petrol as a Preliminary to Assaying.

For the estimation separately of benzene and toluene it is necessary to fractionate the petrol in such a way as to achieve as nearly as possible the concentration of all the benzene into one fraction, the toluene into a second, and the xylene into a third. It is impossible to do this completely owing to the possibility of formation of constant-boiling mixtures and to the "spreading" effect of the large proportion of non-aromatic hydrocarbons.

The obvious fact that the removal of the greater portion of the non-aromatic hydrocarbons would facilitate the sharper separation of the aromatic compounds by fractional distillation, led Bowrey to extract the petrol repeatedly with liquid sulphur dioxide, yielding an extract containing a much higher proportion of aromatic compounds, this extract being then fractionated. This method of attack is undoubtedly a sound one and afforded results of fair accuracy which might be improved by the adoption of the precautions and methods described above. The principal drawback is the necessity for the use of considerable quantities of liquid sulphur dioxide, of apparatus adapted to manipulation at −35° C., and of a complex and fragile type of still-head.

The manifest impossibility of complete segregation of the aromatic hydrocarbons leaves an alternative method of attack. This is to select arbitrary cutting temperatures such that the amount of benzene which is missing from the "benzene fraction" shall be as nearly as possible balanced by the amount of toluene which passes over too soon and so is collected in this fraction. Similarly, the cutting points of the "toluene fraction" may be selected so that the amount of toluene lost to the earlier and later fractions is balanced by the amounts of benzene and xylene which find their way into the "toluene fraction."

If a petrol containing aromatic hydrocarbons is carefully fractionated in short-range fractions the aromatic content or specific gravity of which is determined and the results plotted, maxima are found near 80°, 110°, and 140° C., and minima near 95° and 122° C. These latter temperatures manifestly indicate approximately the suitable cutting points and, moreover, a slight uncertainty as to the exact cutting point introduces a minimum error since the aromatic content at these points is a minimum. It is possible that petrols of different origin and different aromatic content may require slightly different cutting points, but the experiments here described with standard mixtures of naphthenic (B) and paraffinoid (A) petrols with definite amounts of aromatic compounds of the order usually found in natural aromatic-containing petrols seem to indicate in each case 95° and 122° C. as the most satisfactory cutting points.

To determine the suitable procedure specimens of the aromatic-free petrols boiling up to 100° were mixed with definite quantities of benzene, toluene, and xylene. The mixture was distilled, using a 5-section Young-Thomas column, at a speed of one drop per second, this rate being lowered to two in three seconds when a temperature within 3° of the

cutting point was reached. The fractions so obtained were redistilled under the same conditions, each succeeding fraction being added to the residue in the distilling flask when the cutting point was reached. The fractions were then measured and assayed. In order to avoid specific gravity errors arising from evaporation of the lightest hydrocarbons during manipulation, the portion boiling below 60° C. was rejected in the earlier experiments. This was found to result in loss of benzene, and the lower limit of the benzene fraction was therefore fixed at 40° C. As the result of a number of experiments the cutting temperatures finally selected were for benzene fraction, 40°—95° C.; toluene fraction, 95°—122° C.

In order to determine the best upper limit for the xylene fraction it would have been necessary to add trimethylbenzenes to the mixture, but it was not considered advisable to introduce further complications into the investigation, especially as an exact knowledge of the xylene content of a petrol is not of great importance. Further, no certain specific gravity figure could be adopted for "xylene" without a definite knowledge of the proportions of the three isomers present.

The following results obtained with four consecutive mixtures indicate the accuracy obtainable:

Non-aromatic component	% Benzene added	% Toluene added	% Xylene added	% Benzene found	% Toluene found
Petrol A	2·7	4·5	3·6	2·8	4·5
,,	2·7	3·6	4·5	3·9	3·4
,,	3·0	4·0	5·0	3·2	4·0
Petrol B	3·0	4·0	5·0	3·0	1·0

In the course of this investigation specific gravity data have been collected for corresponding fractions of the non-aromatic components of petrols from various sources. These show very clearly the difference in the chemical nature of these hydrocarbons, the lower specific gravities indicating the predominance of paraffinoid compounds and the higher the predominance of naphthenes.

Sample	Sp. gr. of non-aromatic fraction — 40°-95° C.	95°-122° C.	122°-155° C.
I	0·6·8	0·718	—
II	0·683	0·721	0·738
III	0·722	0·746	0·760
IV	0·722	0·747	—

Discussion.

The Chairman asked whether the deviation correction applied to mixtures of naphthenes and paraffins and whether it was an additive factor when the two were present. In connection with the results given in the two tables it would also be of interest to know the relative influence of the deviation factor as the concentration of the hydrocarbons varied considerably in the two series of experiments. In the fractionation of benzene and toluene mixtures Prof. Sydney Young's results had shown a tendency towards a lag on the part of the higher-boiling hydrocarbons, whereas Dr. Thole had spoken of the benzene being carried into the toluene fraction; this rather suggested the possibility of a tendency in a somewhat different direction to that found by Prof. Young.

Mr. E. W. Yeoman said that the author's curve of cutting points gave results which were accurate if the total percentage of aromatic compounds was only about 10%, and also provided that the substance boiled evenly. If the substance did not do this along the whole scale, the results were liable not to come out as shown by the author. Therefore in analysing a substance such as petrol it was necessary by a preliminary test to see if it contained 10% or more of aromatic compounds. When working with small amounts of petrol, say up to 500 c.c., it was necessary not to have a shortage of fractions distilling at the cutting points, and the total amount of aromatic hydrocarbons present should not be more than 10%. He had found that although 1½ vols. of 100% sulphuric acid would remove toluene and xylene, it was insufficient to remove benzene if present in large quantity. With regard to the sp. gr. of mixtures of paraffins and aromatic hydrocarbons the maximum effect was observed with about 60% of aromatic hydrocarbons, the observed value being less than the calculated by 0·004 in the case of benzene and 0·002 for toluene and xylene. If the value of the expansion for different percentages were plotted, the proper correction could then be made in the author's formula or, from previously constructed curves, the percentage of aromatic hydrocarbon including this correction could be found directly.

Mr. F. Esling recalled the fact that F. D. Brown (Chem. Soc. Trans., 1881, **39**, 202) had shown that when benzene and hexane were mixed the volume increased but the temperature decreased. Dr. Thole's "deviation constant" was another interpretation of Brown's figures, which showed the "straight line curve" assumption to be incorrect.

Dr. H. G. Colman said that undoubtedly expansion occurred on mixing aromatic hydrocarbons and paraffins and he believed that F. D. Brown had also stated this to be the case in the paper referred to. An abnormal point in connection with benzene was the high rate of expansion caused by the addition to it of small amounts of paraffins; in connection with these tests this was not of much importance but it was very material in the converse test of determining small amounts of paraffins in benzene from the specific gravity. In conjunction with Mr. Yeoman he had plotted graphs which permitted direct reading of the corrected percentages of benzene, toluene, and xylene from the sp. gr. of the fractions before and after sulphonation.

Dr. P. E. Spielmann said he was surprised to hear that Dr. Thole had made successful extraction with 98% acid. His experience had been that, for the removal of benzene with 100% acid even, it was necessary to have a very considerable excess; he had found that 3 to 5% oleum was preferable, and that this strength scarcely attacked naphthenes. For the toluene and xylene fraction a 100% acid was strong enough, and this certainly did not attack the naphthenes.

Dr. W. R. Ormandy asked how the method would work with cracked petroleums.

Mr. J. E. Hackford said that many crude distillates, especially those coming from the southern part of California, contained naphthenes and aromatic compounds, whilst the Mexican oils contained sulphur compounds. It was much more difficult to estimate aromatics in such a mixture than in those clean mixtures artificially made by Dr. Thole. In the first place, it was necessary to remove the sulphur and unsaturated compounds without touching the benzene and toluene, before a start was made to estimate the aromatics. The unsaturated compounds were quantitatively extracted by boiling with an 80% sulphuric acid solution for about half-an-hour in a flask under a reflux condenser, the neck of the flask being composed of a graduated burette in which the losses sustained in the operation could be read directly. The sulphur compounds were decomposed by prolonged boiling under the reflux condenser until no more hydrogen sulphide was evolved. The residual sulphur compounds after this treatment were practically unacted upon by strong sulphuric acid. Having thus cleaned the original sample, the distillate was then treated with acid and the aromatic compounds estimated by substantially the same method as that outlined by Dr. Thole.

Dr. Thole, replying to the Chairman, said that the specific gravity curve for mixtures of paraffins and naphthenes was linear. The difference in the concentrations of aromatic hydrocarbons shown in the two tables was due to the different objects in

view in two series of experiments. Concentrations up to 60% were employed to test the accuracy and efficiency of 98% sulphuric acid in assaying mixtures of a wide range of concentration. In the second table hydrocarbon mixtures with an aromatic concentration similar to that obtaining in natural petrols used as a source of toluol concentrates were dealt with. The extent of the deviation reached a maximum between 40% and 50% of aromatic compound; at lower concentrations it would naturally be less. The cutting points 95° and 122° were not applicable to mixtures very rich in aromatics, but for petrols containing small amounts of aromatic compounds (up to 30%) they had proved quite satisfactory. The doubt expressed by Dr. Spielmann and others as to the efficiency of 98% sulphuric acid in removing all aromatic compounds appeared to be conclusively answered by the results obtained with mixtures of known composition, although it was true that benzene sulphonated less readily than toluene. Dr. Spielmann had expressed a preference for 3% oleum, but the author after long experience with this reagent had abandoned it because it invariably caused oxidation with production of sulphur dioxide and consequent erroneous results. With sulphuric acid no oxidation whatever occurred. He agreed with Dr. Colman that expansion resulted when aromatic and non-aromatic hydrocarbons were mixed. The presence of olefines and diolefines introduced complexities which had not been dealt with, since the method was only designed for the analysis of straight-run distillates from a crude oil. Further investigations were necessary to overcome the difficulties arising from the presence of considerable quantities of olefines. The effect of the presence of sulphur compounds had been considered because certain of the petrols examined were derived from sulphurous crudes, but the amount of sulphur compounds appearing in the petrol was too small to cause serious errors, and moreover these compounds could readily be removed by suitable reagents before proceeding to the sulphuric acid assay.

ESTIMATION OF CYANOGEN COMPOUNDS IN CONCENTRATED AMMONIA LIQUOR.

BY PERCY E. SPIELMANN, PH.D., B.SC., F.I.C., AND HENRY WOOD.

The methods of estimation of these substances in crude gas liquor have been either worked out or re-examined most carefully by Linder, whose valuable results have been published in various of the Alkali Inspector's Reports. They are, however, not immediately suitable for employment in the examination of concentrated ammonia liquor, partly on account of the large percentage of ammonia present, but particularly on account of the occasional smallness in quantity of one or other of the cyanogen impurities.

Determinations of considerable accuracy can be made very simply by a colorimetric method (compare Young, Alkali Inspector's 43rd Rep., 1906, p. 42), by employing the Lovibond tintometer.

The substances to be estimated are:—Ammonium thiocyanate: highest percentage met with 0·185%, average quantity about 0·06%. Ammonium cyanide ("volatile cyanide"): highest percentage met with 0·024%. Ammonium ferrocyanide: highest percentage met with 0·44%, average quantity about 0·1%.

The usual titration method for estimating thiocyanate as cuprous thiocyanate is scarcely admissible in the present connection, mainly on account of the end point being somewhat troublesome (*loc. cit.*, p. 47); thus the percentage of ammonium thiocyanate found in two successive examinations in concentrated ammonia liquor was 0·0538% and 0·0526%, and in crude liquor 0·237% and 0·275%.

Feld's method for estimating cyanide can be employed, but it is somewhat tedious; and it is necessary to modify it—on account of the large quantity of ammonia present—after adding to the liquid 50 c.c. of concentrated lead nitrate solution, by neutralising the remaining ammonia by running in 2*N* nitric acid, until a little lead hydroxide still remains undissolved. Distillation and titration are then proceeded with as usual.

Feld's method of estimating ferrocyanides, though applicable, is lengthy and cumbersome as compared with Williams' elegant reaction with cuprous chloride (this J., 1912, 468).

The basis of the scheme of analysis which is being advocated is the following:—

(1). Conversion of the ammonium thiocyanate into ferric thiocyanate and measurement of the depth of colour obtained;

(2). Interaction of a further quantity of the original liquid with ammonium polysulphide, whereby the ammonium cyanide originally present is converted into ammonium thiocyanate, and the estimation of the total ammonium thiocyanate as ferric thiocyanate. The increased quantity found over and above that found directly (without polysulphide treatment) is a measure of the quantity of cyanide originally present.

The presence of ferrocyanide compounds causes no complication, as the conversion of any proportion of the ferrocyanide into thiocyanate by the polysulphide solution can be avoided.

After a considerable number of experiments and trials on known mixtures and on commercial samples, the following procedure is recommended, and it is advised that details be closely adhered to.

Estimation of ammonium thiocyanate.—10 c.c. of the sample is run into about 40 c.c. of water and the liquid is acidified with dilute sulphuric acid, shaking and cooling being continuous all the time. Iron alum is added until the liquid becomes red in colour, and it is then warmed to coagulate the precipitate. It is allowed to stand for half an hour, and after filtering and washing the precipitate, and cooling, 10 c.c. of acid solution of iron alum (100 c.c. of saturated alum solution with 10 c.c. of pure concentrated nitric acid) is added, the volume is made up to 100 c.c., and the liquid examined in the tintometer.

If the depth of colour is too great, the liquid must be diluted by taking 50 c.c., adding 10 c.c. more of the acid alum solution, and making up to 100 c.c. If this further addition of iron alum be not made, the dilute solution is less than half as deep in colour as the stronger solution.

Estimation of ammonium thiocyanate together with ammonium cyanide, after conversion of the latter into thiocyanate.—If ferrocyanide is absent, 10 c.c. of the sample is run into a little water, ammonium polysulphide solution is added until the liquid is distinct yellow, and the mixture is diluted to 100 c.c. The polysulphide solution is made (Alkali Inspector's Rep., 1906, p. 47) by diluting 200 c.c. of 0·880 ammonia to one litre, saturating half of this with hydrogen sulphide, adding the other half of the diluted ammonia solution, and then saturating with sulphur (which takes about a week). The liquid under examination is then heated to boiling point, whereby all ammonia is driven off, treated with iron alum as before, and examined in the tintometer. The difference between this reading and that obtained for thiocyanate alone, gives, by simple calculation, the percentage of cyanide in the original sample.

During the boiling stage, the precipitated sulphur occasionally becomes greenish. This does not indicate that there is necessarily any appreciable quantity of ferrocyanide in the precipitate: it may be due to a very small trace of sulphide of iron.

Estimation of ammonium cyanide when ferrocyanide is present.—The removal of the ferrocyanide is carried out as follows: 25 c.c. of the sample is run into polysulphide solution which is to be kept in excess as judged by its yellow colour. After standing for 20 minutes the liquid is acidified with dilute sulphuric acid, with continuous shaking and cooling (the latter precaution is important), and iron alum is added until the liquid becomes reddish in colour. It is then warmed (not above 60° C.) to coagulate the ferrocyanide precipitate; this is helped by the addition of a few crystals of sodium sulphate. After standing for half an hour, the precipitate is filtered off and washed as usual, and 50 c.c. of acid iron alum is added to the filtrate. If the volume of the latter is about 500 c.c. or more, a small addition of nitric acid is advisable.

The different procedures recommended for the estimation of thiocyanate and cyanide, when ferrocyanide is or is not absent, result from the necessity of avoidance of heating when ferrocyanide and polysulphide (added or original) are present together, or when cyanide may react, undesired, with polysulphide. It would be perfectly feasible, however, to employ the method given for the determination of cyanide when ferrocyanide is present to a sample when the latter is absent, but the procedure recommended is a quicker one.

Estimation of ferrocyanide.—The precipitate obtained during the estimation in the previous paragraph consists of ferrocyanide and sulphur. This precipitate is treated according to the method given in the Alkali Inspector's 46th Report, 1909, except that after decomposition by sodium hydroxide, it is distilled according to Williams' method.

The applicability of the method, and its limitations, are shown by the following figures obtained from known mixtures:—In 5 c.c. of a solution of potassium ferrocyanide containing 0·01840 grm. and 5 c.c. of *N*/100 solution of ammonium thiocyanate the amount of ferrocyanide found was 0·01842 grm., whilst the same colour was obtained as when 5 c.c. of thiocyanate solution was examined alone.

The behaviour of ferrocyanide towards polysulphide solution was tested by preparing a solution of ammonium ferrocyanide by precipitating a known quantity of potassium ferrocyanide with excess of iron alum, treating the washed precipitate with ammonia (sp. gr. 0·880), and converting into thiocyanate by boiling with polysulphide solution. The experiments showed that when ferrocyanide is present in only a very small quantity, the whole of it may be converted by the "hot method" into ammonium thiocyanate, making the cyanide figure too high; when, however, the ferrocyanide is present in a quantity above 0·001%, an indefinite portion is converted, rendering results incapable of interpretation. The whole trouble may be avoided by using the "cold method."

Here the authors are in disagreement with Linder, who advocates (Alkali Inspector's 54th Rep., 1917, p. 25) boiling off the excess of volatile ammonium compounds from the mixture after reaction in the cold; their general experience of the reaction may be exemplified by the following figures obtained with a commercial sample:—Ferrocyanide, 0·0682%; cyanide, absent; thiocyanate, running into boiling water (Linder's method), 0·180%; boiling down, as usual, 0·180%; by "cold method," 0·178%; polysulphide, and boiling down (Linder's latest method), 0·300%.

Without going further into the subject, it is of value to remember that the ferrocyanide precipitate appears to vary greatly in commercial samples of concentrated ammonia liquor, both in the ease or obstinacy of its appearance and formation, and in the velocity of its decomposition by sodium hydroxide.

Two artificial mixtures were made up and examined with the following results:—

	No. 1 Taken	No. 1 Found	No. 2 Taken	No. 2 Found
Ammonia 0·880...	70 c.c.	19·35%	50 c.c.	14·25%
H_2S passed in ...	—	1·25%	—	0·248%
Ammonium thiocyanate solution	10 c.c. = 0·076%	0·076%	10 c.c. = 0·076%	0·074%
Hydrocyanic acid (as KCN)	10 c.c. = 0·0151%	0·0164%	1 c.c. = 0·00151%	0·00141%
Ammonium ferrocyanide solution	10 c.c. = 0·0284%	0·0284 %	5 c.c. = 0·0076%	0·0076%
Water	—	—	34 c.c.	—

The small discrepancies between the quantities taken and found, are within the limits of accuracy of the method.

Estimation of polysulphide.—Linder has described (Alkali Inspector's 54th Rep., 1917) how polysulphide in a sample of concentrated ammonia liquor can be estimated by its reaction with excess of cyanide to form an equivalent quantity of thiocyanate. This can obviously be determined by means of the tintometer, when the procedure would be the following:—(1) Determination of thiocyanate as such. (2) Addition of excess of cyanide solution and boiling as described above. In this case reaction of existing cyanide and ferrocyanide is of no consequence, as the final result is the conversion of polysulphide into thiocyanate. The difference between the two results is the measure of polysulphide in terms of thiocyanate.

Mode of Employment of Tintometer.

In the usual practice of colorimetric methods, it is customary to compare the colour obtained experimentally with that given by a known strength of the substance which is being estimated, and this usually entails making up at least one fresh standard for each experiment or batch of experiments.

When a tintometer is available and a considerable number of samples have to be examined, it is economical in time and trouble to measure once for all the depth of colours of known mixtures of various strengths and to record them on squared paper, so that any subsequent colour can be compared with the graph so constructed. In the present case the authors had a Lovibond tintometer in use, and this was found to be a very suitable instrument for the purpose.

The instrument was set up pointing to the interior of a box blackened on the inside, with a strip of truly white paper opposite the end of the instrument. Extraneous light was excluded from the front opening by a curtain of black velvet. Inside, a half-watt lamp was used as a source of illumination, screened with three thicknesses of truly white tissue paper in order to temper the light to a suitable intensity.

Measurements of depth of colour are made by matching the tint of the liquid with red and yellow glasses, but as a considerable latitude was found to be associated with the yellow colour, the strength of thiocyanate is best plotted against the red colour units only.

In making up the standard colours, the following quantities of ammonium thiocyanate were taken, treated with acid iron alum and diluted to 100 c.c. 1 c.c. of *N*/10 ammonium thiocyanate contains 0·0076% of the salt. Suitable quantities were diluted and measured in three cells, giving three different thicknesses of liquid.

Cells	Ammonium thiocyanate % wt./vol.	Red units
½ in.	0·0019	1·3
	0·0076	4·6
	0·0300	13·65
¼ in.	0·0019	4·6
	0·0038	7·6
	0·0076	11·9
1 in.	0·0019	7·6
	0·0038	13·0

It was found that above 12 or 13 units, the colour

was so deep that matching became uncertain. If colours requiring stronger glasses than those given are obtained, they must either be measured in the cell of less thickness or further diluted (see p. 44).

It was found that under the conditions of testing the known solutions, the limit of sensitiveness of the eye was 0·15 red unit in the $\frac{1}{2}$" and in the $\frac{1}{8}$" cell, which is equivalent to 0·00021% ammonium thiocyanate and 0·00007% hydrocyanic acid. Therefore the figures found are as close as is possible.

The source of light was standardised on a solution of potassium bichromate, saturated at 20° C., in order that the present work and all other work with colours of the same order can be referred to a definite standard.

Source of illumination	Cell	Red units	Yellow units	Intrinsic brightness above standard (not affecting depth of colour)
4-Watt lamp*	$\frac{1}{2}$ in.	5·8	16·5	0·01
	$\frac{1}{8}$ in.	10·8	34·0	0·02
Daylight	$\frac{1}{2}$ in.	8·0	38·0	—
	$\frac{1}{8}$ in.	13·25	38·0	—

* Two different lamps were tested and found to be alike.

The following points in connection with the tintometer readings should be noticed:—Increased thickness of tissue paper for tempering the source of light increases the amount of standard yellow for matching the experimental liquid. A lamp with frosted glass is preferable to a plain glass bulb shielded with tissue paper. If the liquid is intrinsically brighter than the colour glasses neutral tint should be added, after which matching of colour is more reliable.

We take pleasure in acknowledging the courteous manner in which the experience of The Tintometer Limited has been placed at our disposal.

DISCUSSION.

Dr. H. G. COLMAN said that his experience with colorimetric methods for thiocyanate had not been satisfactory, testing with solutions containing known amounts of thiocyanate, but he had not tried the method using the tintometer, which might be more accurate. He asked the author whether with liquids such as these, containing phenols, the pink colour resulting from the action of the ferric salt on these did not interfere with the test, and whether phenols were added in testing the check solutions. He also asked if hydrogen sulphide was present in the check tests given for cyanide, as he and Yeoman had always obtained low results in its presence, although in its absence the results were satisfactory.

DR. SPIELMANN in reply stated that it had been substantiated by direct experiment that the colour given by even 1% of phenol and the subsequent addition of a little cresol had no appreciable detrimental effect on the method of analysis. In regard to the presence of hydrogen sulphide when making check tests it would be seen from the two examples given in the paper that this was present in both cases.

Yorkshire Section.

Meeting held at Queen's Hotel, Leeds, on December 16, 1918.

MR. W. MC D. MACKEY IN THE CHAIR.

THE LIMITS OF SEPARATION BY FRACTIONAL DISTILLATION.

A NEW STILL-HEAD.

BY S. F. DUFTON, D.SC., M.A.

Fractional distillation in the laboratory is a tedious and wasteful process, and as hitherto practised is inapplicable to small quantities of material. The separation of a number of hydrocarbons in small amount, obtained in a research on which Professor J. W. Cobb and the author are engaged, being impossible with existing apparatus, a still-head for fractionating small quantities was designed. A column was made by creating a spiral track in a narrow annulus between a glass tube, 17 mm. internal diam. and an inner tube closed at each end, 13 mm. external diam., round which was wound a spiral of wire 1 mm. diam., with a pitch of 20 mm. When the still-head was in use the wire collected to itself, as anticipated, the greater part of the descending liquid, and became sealed by this liquid to the tubes, causing the ascending vapours to pass along the spiral track, so that, although the annulus was very narrow, the ascending vapour and descending liquid passed one another freely.

When tested with a 50% mixture of benzene and toluene the column was found to have an efficiency far greater than that of the Young pear bulb column in common use, and it was hoped that with a column of not inconvenient length, it might be possible to distil pure benzene directly from this mixture.

After some attempts a successful column was made 150 cm. long, with the tubes and wire of the dimensions quoted above, the pitch of the wire spiral being 18 mm. at the top and 22 mm. at the bottom. The column was protected from too rapid cooling by being packed with a thickness of about 2 inches of cotton-wool wadding, covered with asbestos yarn. It was found possible with this still-head to distil 45 c.c. of benzene, at constant temperature, from a mixture of 50 c.c. of benzene and 50 c.c. of toluene, the initial rate being 4 c.c. per min. A rise of 0·1° C. occurred in the collection of the next 1 c.c. and the distillation slowed down considerably. On raising the flame slightly the thermometer rose rapidly and pure toluene began to distil after 55 c.c. had been collected.

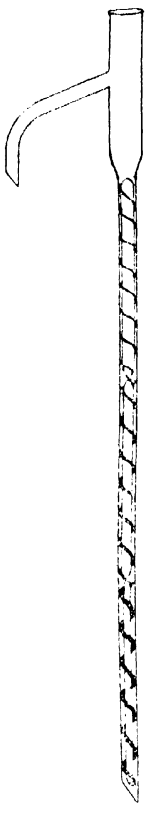
An attempt was then made to approach more nearly the still-head of minimum working volume capable of this order of separation. It was found that a length of about 120 cm. was needed, and this length proved to be very convenient in use, for with the burner standing on the floor and the distilling flask immediately above it, the delivery tube of the still-head comes at a convenient level above the bench. The following considerations gave the clue to the design adopted.

Let us assume that a mixture of 1 part of benzene and 10 parts of toluene is in process of separation by a perfect still-head. The vapour rising from the distilling flask will contain approximately 2·5 parts of benzene to 10 of toluene if 2·5 be taken as the evaporation constant for these two substances. If, therefore, 12·5 drops are evaporated from the liquid in the flask in 1 sec. and 1·5 drops of pure benzene are distilled into the condenser in the same time, 11 drops per second of condensed liquid, consisting of 1 part of benzene and 10 parts of toluene (of the same composition as the mixture boiling in the flask) must run back.

If the still-head be worked adiabatically with a condenser at the top, as in many commercial stills, a uniform flow of this amount must be returned down the tube. But, if condensation take place uniformly all the way up the tube, the flow will vary from 11 drops per sec. at the bottom to a mere trickle at the top, and the total volume of liquid in the still-head will be only half as great as in the former case. If liquid requires n seconds to pass through the still-head, the actual volume will be $5·5\ n$ drops. A rapid descent of the liquid in the still-head is therefore essential to a low working volume. If the rate of distillation be halved, only half as much liquid per sec. is returned to the flask, and the working volume is halved.

Let us next assume that a mixture of 1 part of benzene and 100 parts of toluene is being distilled: a vapour of 2·5 parts of benzene and 100 of toluene will be produced if the same evaporation constant

still applies. If in one second 1·5 drops of benzene pass away to the condenser, 101 drops of mixture, containing 1 drop of benzene and 100 drops of toluene, *i.e.*, ten times as much as in the case first discussed, must flow back into the still. Under these conditions the still-head would probably flood, as it can only deal with a certain return flow. The rate of distillation through the condenser must, therefore, be steadily reduced as the concentration of benzene in the still diminishes; in other words the heat supply to the distillation flask must not be increased while benzene is distilling.



The benzene and toluene necessarily present in the still-head to enable it to work at the particular rate of distillation are inseparable, and their amount is independent of the volume of liquid distilled. For suppose a mixture of benzene and toluene to have been so far distilled through a perfect still-head that pure toluene remains in the flask and the last drop of pure benzene is passing away to the condenser. The column at this stage is filled with liquid and vapour ranging from almost pure toluene at the bottom to almost pure benzene at the top. Increase of heat below will drive pure toluene vapour into the column, and drive out some of the mixture at the top into the condenser. When the whole of the mixture has passed away pure toluene distils over.

If the still-head be longer than necessary, there is no consequent increase in the amount of inseparable mixture, since, before any mixture is driven out at the top, the extra length at the bottom becomes filled with pure toluene vapour and liquid.

A still-head 120 cm. long was now made of glass quill tubing in sections increasing in diameter downwards. The top section was of such a size that a bicycle spoke, 1·4 mm. diam., round which was wound a spiral wire 0·7 mm. diam., would fit with slight friction, the next section below had wire 1 mm. diam., the third 1·2 mm., and the last 1·4 mm., all wound spirally on similar cores, with increase of pitch from 6 mm. at the top to 12 mm. at the bottom. The gradation is necessary to carry away the increasing volume of condensed liquid. The column was wrapped as before, the thermometer coming considerably below the top of the wrapping.

This still-head gave the following very gratifying results with a mixture of 5 c.c. of benzene and 10 c.c. of toluene distilled from a small flask. No condenser was required, the rate of distillation being at the outset 10 drops a minute:—

Temp. observed (uncorrected) °C.	Volume collected	Time from commencement	
79·2	2·0 c.c.	6 min.	
79·2	3·5 ,,	12 ,,	
79·2	4·2 ,,	20 ,,	
79·2	4·6 ,,	25 ,,	
79·3	4·7 ,,	30 ,,	
79·8	4·8 ,,	35 ,,	(raised gas slightly)
94·0	4·9 ,,	— ,,	
107·0	5·15 ,,	50 ,,	
108·2	5·3 ,,		(pure toluene distilling to end)

Total distilled	13·3 c.c.
Drained back into flask	1·4 c.c.
	14·7 c.c. (loss 0·3 c.c.).

Thus 4·6 c.c. of benzene and 9·4 c.c. of toluene were recovered by direct distillation. The unseparated intermediate portion 0·7 c.c. is, as theory indicates, not far removed from the actual working volume, for at the end of the operation the total volume which was found in the flask was just twice this amount. It will be noticed that the volume of liquid collected at the cut point 94° C. gives an accurate measure of the volume of benzene in the mixture.

A mixture of 5 c.c. of benzene and 95 c.c. of toluene yielded with the same still-head 4 c.c. of benzene the boiling point of which ranged within 4° when the liquid was boiled completely away in a small distillation flask.

The still-head is more easily constructed of one length of tubing of approximately uniform bore, the gradation of the annulus being obtained by winding the spirals upon cores of decreasing diameter.

These still-heads have the great practical advantage that the distillation, having been started at the proper rate, slows down and stops when the limit of each pure constituent is reached. Thus if a mixture of benzene, toluene, and xylene, or a commercial benzol containing these substances, be distilled, the still if carefully adjusted can be left to itself and will automatically cease working when the temperature needs raising to drive off the next constituent. With such still-heads it is possible to analyse mixtures of benzene, toluene, and xylene, by direct distillation; the main portions are obtained pure and the intermediates are so small in amount that there is no appreciable error in the use of a midway cut point for estimation of the total quantity of each constituent. A practical test gave the following results, no allowance being made for loss by evaporation:—

Mixture taken	Found	
Benzene ... 60·5 c.c.	59·7 c.c.	(cut point 94°)
Toluene ... 23·0 ,,	23·3 ,,	(cut point 124°)
Xylene ... 16·5 ,,	16·5 ,,	(residue in flask)
100·0 ,,	99·5 ,,	

The estimation of such substances in crude benzol by direct distillation with a still-head which gives each product at a constant boiling point has the great advantage that these products can be separately examined for specific gravity, etc. Further, it becomes possible with a sample of crude benzol to find out in the laboratory by direct distillation precisely what results should be obtained in the works still from the bulk, for the new laboratory still-head can be made to effect precisely the same separations as the works plant.

Experiments are in progress on the adaptation of the still-head to the evaporation of small quantities of substances of high boiling points, and it is hoped that the still-head will become a refined instrument enabling the chemist to separate even small quantities of liquids more easily than he separates solids by crystallisation.

A similar arrangement provides also a very efficient method of washing a gas with a small quantity of liquid. In this case the annulus is made of the same size throughout, and the pitch of the wire spiral is kept as small as practicable in order to reduce the speed of descent of the liquid. The washer has the advantage over most bubbling arrangements of effecting more intimate average contact between liquid and gas and of introducing no hydrostatic pressure.

Birmingham Section.

Meeting held at Birmingham University on Thursday, December 12, 1918.

DR. R. S. MORRELL IN THE CHAIR.

RUBBER AS A COLLOID.

BY D. F. TWISS.

When Graham first definitely grouped substances into crystalloids and colloids he expressed his consciousness of the fact that such distinctions are not absolute and that there is no abrupt transition between the two types; substances of intermediate characteristics are known which form the links necessary to demonstrate the continuity between the two states.

Rubber is so completely and typically colloidal that it is a matter of some difficulty to decide what details should be selected in order to give briefly a general indication of its colloidal character. The difficulty is increased by the fact that so many of the definite results of scientific investigation refer to simpler artificially prepared colloids.

Colloidal substances are commonly classified into suspensoids and emulsoids. In the former, finely dispersed particles, microscopic, ultramicroscopic or even smaller, exist in a state of more or less stable suspension. In the latter the conditions are similar, except that the substance of the particles is fluid and is soluble to a considerable extent in the dispersion medium.

RUBBER LATEX.

It is a rather striking fact that natural rubber makes its first appearance in a condition which may be described as doubly colloidal. The latex obtained by tapping various rubber trees is a milky fluid containing minute globules of a colloid, probably rubber itself (Hinrichsen and Kindscher, this J., 1910, 34), in a state of colloidal suspension in an aqueous fluid or serum. In the latex from *Hevea brasiliensis*, which is the origin of all Para rubber, wild and cultivated, the globules are microscopic and range in diameter from 0·5 to 2 μ in diameter; they show a distinct Brownian movement. Other less common latices hold the rubber in varying degrees of dispersion; *e.g.*, in the latex of *Funtumia elastica* the particles of rubber are smaller and their Brownian movement is therefore more marked, although the general phenomena are comparable with those in *Hevea* latex (Spence, this J., 1908, 1123).

Most solid substances in contact with water become negatively charged, and therefore the particles of most colloidal suspensions in which water is the dispersion medium will, in an electrical field, tend to migrate from the cathode towards the anode. Positive suspensoids are of course also known but are in the minority.

If a quantity of rubber latex, dialysed or otherwise, is submitted to the action of an electric current, the globules wander towards the anode so that the liquid gradually becomes clear at the cathode, whilst at the anode the amount of rubber in suspension is considerably increased. This behaviour, which forms the basis of a patented method for the separation of rubber from latex, proves rubber globules in latex to possess a distinct negative charge. Rubber latex therefore is a negative suspensoid and it is not surprising that the precipitation of rubber from *Hevea* latex exhibits certain analogies with the precipitation of such substances as clay or arsenious sulphide from colloidal aqueous suspension. The precipitation of negative suspensoids such as these is greatly accelerated by the addition of acids, and as is well known, most of the rubber produced to-day is separated from its latex by the addition of small quantities of acetic acid; as is mentioned below, this may not be due merely to the effect of hydrogen ions on the negative suspensoid. Alkalis on the other hand increase the stability of negative suspensoids, including rubber latex. The relative effect of acids and alkalis suggests that the cathion is the agent involved in the acceleration of the precipitation of the disperse phase of the negative suspensions, and this is confirmed by the relative effect of salts of univalent, bivalent, and tervalent metals, the effectiveness increasing to a quite disproportionate extent with the valency (see Schulze, J. prakt. Chem., 1882, **25**, 431; 1883, **27**, 320; Hardy, Z. physik. Chem., 1900, **37**, 385; Freundlich, *ibid.*, 1903, **44**, 144).

Hevea latex as a colloidal suspension can be freed from soluble saline constituents by dialysis through a suitable colloid membrane; after purification by prolonged dialysis through a collodion film until its electrical conductivity due to saline impurities is reduced from 3300×10^{-6} to that of ordinary distilled water, it is almost unaffected by salts of univalent metals, whereas salts of the bivalent alkaline-earth metals cause flocculation of the rubber if above $N/1$ concentration and salts of the heavy bivalent metals (which are also frequently acidic on account of hydrolysis) and of tervalent metals such as iron and aluminium cause flocculation at approximately $N/20$ concentration; acids cause the separation of the rubber from dialysed latex at approximately $N/2$ concentration (V. Henri, Comptes rend., 1907, **144**, 431). The necessary concentrations will naturally be lower for the crude latex because this already contains certain inorganic salts which will facilitate the separation of the rubber. According to the concentration and the specific effectiveness of the coagulant, the rubber may separate as a loose flocculent mass or as a tenacious elastic cake, the former probably representing an incomplete stage of the latter; in either case separation is preceded by a cessation of the Brownian movement due to the increasing size of the particles by coalescence. As the quality of the finished raw rubber to a considerable extent is dependent on the nature of the coagulum obtained, the conditions of coagulation and the selection of a coagulant are matters of importance, and on rubber plantations a more or less standardised coagulation process is adopted.

From the behaviour of various colloidal suspensions it is known that the presence of an additional colloidal or emulsoid substance can increase the stability of the suspensoid, and indeed this knowledge is applied in the production of silver bromide emulsion for photographic plates and in the stabilising of colloidal solutions of metals, *e.g.*, palladium and platinum in water by the addition of such substances as gelatin or sodium protalbate or lysalbate (decomposition products of albumin).

Hevea latex contains protein matter amongst other substances, besides water and rubber, and the presence of this likewise increases the stability of the suspensoid, the dissolved protein matter acting as a protective colloid.

Dilution naturally reduces the effectiveness of the protective agent and the addition of water to latex in consequence accelerates the spontaneous separation or "creaming" of the globules.

The addition of a reagent capable of removing the protein by precipitation will evidently also increase the rate of flocculation or coagulation of the suspensoid. The protective agent is not of albuminoid character in all cases, *e.g.*, latex from *Funtumia elastica* contains no albuminoid but a peptone, which serves a similar purpose, and in this

case peptone precipitants such as formaldehyde will cause coagulation, although this substance actually increases the stability of *Hevea* latex (Fickendey, Z. Chem. Ind. Kolloide, 1910, **8**, 43).

The phenomena surrounding the coagulation of rubber latex are however further complicated by concurrent, but to some extent independent, processes capable of effecting a similar result. Although acids of a sufficient concentration can unquestionably effect the coagulation of latex by their own influence, the effect of the very small proportion of acetic acid used on the plantations is not a simple acidic effect. Ordinary raw latex which has been sterilised by heat does not behave normally with the customary proportion of acetic acid, but on the addition of a little fresh latex, the usual coagulation occurs. This might be due to the presence in crude latex of micro-organisms capable of converting the accompanying dissolved carbohydrates into lactic acid (Eaton, this J., 1918, 99A). There is evidence however that the spontaneous coagulation cannot be attributed entirely to bacterial action of this kind and that except under unusual conditions it must be essentially an enzyme process analogous with the setting of milk by rennet (Barrowcliff, this J., 1918, 48 T; Whitby, Agric. Bull. Fed. Malay States, 1918, **6**, 374). It is therefore probable that the very small proportion of acetic acid used on the plantation accelerates the process by a favourable influence on the activity of the enzyme; with a gradually increasing proportion of acid a point of minimum effect is observed, due probably to a decomposition of the enzyme; with still higher concentrations the rate of coagulation again begins to increase, the effect then being that of an acid on a negative suspensoid.

Reference should be made to the possibility of coagulating latex by altering the nature of the dispersion medium; the addition of acetone or alcohol or mixtures of these with other liquids has frequently been suggested for the purpose of separating the rubber in a coherent mass.

Raw Rubber.

When masticated rubber is immersed in a solvent, the latter is slowly absorbed, the rubber swelling enormously and finally, especially if the process is aided by agitation, yielding a colloidal solution of high viscosity. Some solvents such as carbon bisulphide, chloroform, and benzene, yield almost transparent, clear solutions, but with others such as shale naphtha, petroleum spirit, and ether, the solution obtained is milky in appearance. This turbidity is not merely due to the difference between the refractive index of the solvent and of the suspended particles but is caused by the presence in rubber of constituents of different solubility, so that whereas the rubber is almost entirely soluble in the first-named liquids, it is in reality only partially soluble in the latter set, the insoluble portion becoming finely dispersed throughout the solution, and remaining in colloidal suspension; the dissolved portion of the rubber in this case doubtless exerts a protective influence on the colloidal suspension. Even in the apparently clear colloidal solutions, *e.g.*, of the emulsoids gelatin and agar-agar, the ultra-microscope is able to detect discontinuity due to the presence of submicroscopic particles, and clear solutions of rubber are no exception, the particles of dissolved rubber being too small for detection by direct microscopic examination although manifest from the Tyndall effect and visible in the ultra-microscope. The turbid solutions of rubber in petroleum spirit are to be regarded as colloidal solutions of a lower degree of dispersion than the clear solutions in carbon bisulphide, the dispersed particles being probably in part microscopic, whilst the so-called "vulcanising solutions" of the manufacturer consisting of rubber solution with sulphur and perhaps litharge in more or less permanent suspension are still coarser in nature.

Although rubber latex is closely comparable with the ordinary suspensoid colloids, rubber itself is an emulsoid. Emulsoids are as a rule much more viscous than suspensoids and the proportion of dispersed substance to medium is often much higher; the more or less rigid colloidal substances or gels such as gelatin, agar-agar, and gelatinised silicic acid are believed to retain the emulsoid nature and to consist of a colloidal substance dispersed through a colloidal medium, the result being a sponge-like or cellular structure, too fine however to be detected by ordinary means. Raw rubber may be considered as a fairly extreme case in which the rubber hydrocarbon is in a fine state of dispersion throughout a medium, probably consisting in part of the protein matter from the latex; however, as rubber freed from protein matter still retains its typical consistency, the emulsoid state must be attributed mainly to the presence of rubber in at least two forms of different molecular weight, or at any rate of different molecular condition, the rubber thus supplying not only its disperse phase but also its own dispersion medium. Other peculiarities in the behaviour of rubber confirm this lack of uniformity, *e.g.*, the "freezing" or stiffening of raw rubber, which may be compared with the very marked increase in viscosity of gelatin solutions at lower temperatures, is accompanied by the development of a turbid appearance; this is easily observable in smoked sheet rubber which has been kept in the cold for any length of time. Purified gutta and balata pass from an opaque to a semi-transparent appearance at higher temperatures and even solutions in benzene show an analogous reversible gelatinisation and concurrent opalescence under similar conditions. In each case the phenomenon is explicable by a lack of uniformity, which is to be attributed to the variable magnitude of x in the formula $(C_5H_8)_x$ for any sample of pure rubber, balata, or gutta. The effect of heat, light, or acids in producing a marked reduction in the viscosity of rubber solutions may be due to alteration either in the colloidal condition or the molecular condition, or indeed in both. The lower viscosity of solutions of gutta percha and balata, and the manner in which these substances separate from solution in some solvents, suggests that the hydrocarbon of gutta and balata has a less complex nature than the hydrocarbon of rubber.

Adsorptive Power of Rubber.

A striking property of the emulsoids is their power of condensing or adsorbing substances at surfaces of contact with another phase; the adsorption of dyestuffs from solutions by fabrics or by charcoal and of gases by charcoal are examples of this characteristic. When colloidal arsenious sulphide is precipitated from aqueous suspension by the addition of electrolytes, the precipitate is found to contain some of the precipitant ion in the adsorbed condition and removable only with difficulty (Whitney and Ober, J. Amer. Chem. Soc., 1902, **23**, 842). It is therefore not surprising to find that when salts or acids are used to aid the coagulation of rubber latex, these tend to be retained tenaciously by the rubber coagulum and to resist removal during subsequent washing. This supplies an obvious reason for avoiding the use of non-volatile salts or of mineral acids in artificial coagulation and for the use of as small a quantity of coagulant as possible whatever its nature. Reference has already been made to the presence of protein matter in ordinary rubber latex and to its protective effect on the suspension; such protective effect is actually dependent on the adsorption of the protein at the surface of the globules and as a consequence washed and dried raw rubber contains several units

per cent. of protein matter; the presence of a similar proportion of resinous material may be due to a similar cause; the occasional discovery of a very appreciable quantity of *l*-methylinositol, a sugar-like substance soluble in water (Pickles and Whitfield, Proc. Chem. Soc., 1911, 54) adsorbed from the latex and retained in spite of washing process, is perhaps more unexpected.

If the newly formed rubber coagulum is allowed to remain in a moist condition for several days, the protein matter undergoes partial putrefactive decomposition with formation of basic substances and amino-acids which remain adsorbed in the finished washed and dry rubber and exert a very marked effect in accelerating the rate of vulcanisation; indeed the slightly greater variability in the rate of vulcanisation of plantation rubber as compared with the Brazilian product is largely due to the varying amount of such adsorbed vulcanisation catalysts. In view of these facts it is hardly surprising that on soaking freshly coagulated rubber in caustic soda solution some of this is adsorbed, with the result that the rate of vulcanisation is greatly increased. Regenerated rubber in the production of which alkali has been used, in spite of careful washing often retains sufficient alkali to affect the rate of vulcanisation of mixings containing it.

The behaviour of rubber as a colloid is so general as to have led to doubts as to whether vulcanisation is a chemical process at all (Höhn, Gummi-Zeit., 1899, **14**, 17, 33; Ostwald, Z. Chem. Ind. Koll., 1910, **6**, 136; **7**, 45; see also this J., 1917, 787). When the excess of sulphur remaining uncombined after vulcanisation is removed by prolonged treatment with acetone, the rate of extraction is such as to indicate that some of this sulphur at least has been adsorbed (Spence and Scott, this J., 1911, 816) and not merely dissolved by the rubber. Adsorption certainly must play a considerable part in the changes which rubber undergoes during vulcanisation, but it is now fairly generally accepted that the combined sulphur really is in a state of chemical combination. The adsorption process, however, does not cease at the free sulphur stage, because in the vulcanised product the amount of combined sulphur may vary to a remarkable degree and gives little indication of the formation of any definite compound; yet even in a lightly vulcanised product, the whole of the rubber has lost the characteristics associated with it in the raw condition and cannot be regarded as a simple mixture of vulcanised and unvulcanised material. In order to explain these peculiarities, it appears necessary to suppose that the part of the rubber which combines with the sulphur is adsorbed irreversibly into the remaining bulk, thereby producing in it a colloidal—and possibly polymeric—change comparable with the setting of a solution of silicic acid or the coagulation of albumin. Vulcanised rubber must be regarded as still retaining the emulsoid condition although in a more rigid and more stable modification than raw rubber. In vulcanised rubber the adhesiveness of raw rubber has disappeared almost entirely and working between steel rollers merely reduces the material to crumb, whereas raw rubber under similar treatment forms a coherent sheet which with further working becomes gradually softer and more plastic, this effect probably being due to the influence of the mechanical treatment on the emulsoid structure. The operation of reclaiming or regenerating raw rubber as commonly practised consists in so treating the vulcanised rubber—generally with heat—as to modify its colloidal characteristics and to restore to it some of the adhesiveness associated with raw rubber.

Solvent Power of Rubber.

On account of the considerable power of rubber as a solvent the rate of entry of gases into its surface will not depend so much on the molecular velocity of the gas as on the specific rate of solution. Hydrogen will diffuse through a fine aperture or fissure much more rapidly than the heavier carbon dioxide, but the rate of diffusion of carbon dioxide through a rubber septum is much greater than that of hydrogen and the relative rates of other gases do not stand in any simple relation with their molecular weight. Graham's law of diffusion therefore does not apply. The processes involved will be solution (or possibly adsorption) at the surface, subsequent absorption into the body of the rubber, and finally escape at the far side, thus completing a steady flow of diffusion through the septum.

From the general phenomena of dialysis, it is well known that colloids do not penetrate gels, or at any rate penetrate them less rapidly than do crystalloids, which are able to diffuse through them readily.

The migration of dissolved uncombined sulphur from the interior of a soft vulcanised rubber to the surface, causing "sulphuring up" or "blooming," is an example of the permeability of a gel to a non-colloid substance. Rubber as a colloid should be capable of acting as a semi-permeable membrane under suitable conditions, and an interesting application of this idea has been mentioned in a patent for the purification of rubber; the remarkable alteration in rubber caused by vulcanisation is here emphasised by the use of soft vulcanised rubber as a semi-permeable membrane for the dialysis of dissolved raw rubber; if on one side of such a membrane there is placed a solution containing rubber and sulphur in any suitable solvent and on the other side a quantity of the pure solvent, the dissolved rubber will not penetrate the vulcanised rubber sheet, but the dissolved sulphur will gradually pass through so that by continually supplying fresh solvent the whole of the sulphur may be extracted from the solution (Debauge, Fr. Pat. 426,457; this J., 1911, 968). Hancock's well-known method of vulcanisation by immersion of rubber in a bath of molten sulphur also obviously depends on the power of sulphur to penetrate rubber.

Despite the advances that have been made, our knowledge of the nature of colloids is still so limited that much of the behaviour of rubber and other natural colloids remains obscure. One of the greatest obstacles in the way of the production of synthetic rubber is the colloidal nature of the material. The problem is not merely to produce a substance of known molecular weight and structure, as was the case with indigo, because the required material is of undetermined molecular magnitude and is less desirable in a pure condition than when containing certain so-called impurities. Recent reports on the synthetic rubber manufactured in Germany during the last few years suggest that these difficulties have been experienced to the full and that despite the extraordinary incentive the results have been such that although the products obtained resembled raw rubber so far as to be of use for vulcanite and the less elastic forms of soft rubber, the general successful replacement of natural rubber in rubber goods has not yet been accomplished.

Discussion.

Dr. Twiss, in reply to questions, said that under the customary plantation conditions as to concentration of acid and proportion of rubber in the diluted latex, the coagulation process was in all probability primarily due to the enzyme the activity of which was increased by the acid present. Acetic acid was the acid commonly used, but acids generally were capable of hastening coagulation and lactic acid was no exception to this rule. Owing to the shortage of acetic acid during the war

considerable attention had been paid to the possibilities of "spontaneous" coagulation, and this method had been shown to be of much promise and would probably retain a certain amount of favour even although an improved supply of acetic acid became available. The amount of saline matter in latex was relatively small and the proportion of rubber, which was generally adjusted to a definite standard by suitable dilution before coagulation, could be determined more easily by the hydrometer than with an ultramicroscope. In the combination of rubber and sulphur as effected in vulcanisation there were no sharply defined stages and the only indications of the formation of a definite compound appeared when the rubber hydrocarbon was chemically saturated with sulphur, this condition being represented by the formula $C_{10}H_{16}S_2$. The representation of the rubber molecule, whether vulcanised or not, by a cyclic structure was already customary; there appeared to be no reason now for doubting that during vulcanisation chemical combination really did occur between the rubber and at least part of the sulphur. As the vulcanisation process was exothermic, although only feebly so, the heat of combustion of vulcanised rubber would be less than that of its constituents in the free state. It was generally accepted that the rate of diffusion of a gas through rubber was dependent on the solubility of the gas in the rubber and that the molecular velocity of the gas was relatively unimportant in this direction. The process of dialysis to which reference had been made would not be capable of effecting the re-conversion of vulcanised rubber into raw rubber because not only would chemically combined sulphur resist separation in this way, but vulcanised rubber could not be obtained in solution without such drastic treatment as would seriously alter its nature. It was unlikely that inorganic salts would be able to diffuse through a vulcanised rubber membrane although water would do so with extreme slowness.

Edinburgh and East of Scotland Section.

Meeting held at Edinburgh on March 12th, 1918.

MR. D. B. DOTT IN THE CHAIR.

THE ISOLATION AND EXAMINATION OF THE TEXTILE IN RUBBER-PROOFED COTTON FABRICS.

BY R. D. PORRITT, M.SC. (LOND.), F.I.C.

The problem of the thorough examination of either the proofing or the textile, or both, in rubber-proofed goods is complicated by the fact that the clean separation by physical methods of proofing and fabric is usually impracticable. Sufficient proofing for analysis in general can be obtained by soaking the sample in a low boiling rubber solvent, such as benzene, and removing the swollen rubber by scraping with a blunt instrument, but the quality employed for the surfacing is frequently different from that which constitutes the body of the proofing and consequently the material may not be representative should it be removed superficially. Such a superficial removal of the proofing, moreover, not only damages and distorts the fabric, but leaves the interstices between the threads unaffected. With unvulcanised materials proofed with pure rubber, for example, diving dress fabric, the separation of rubber from cotton can be readily effected by treatment with any of the recognised solvents for the former, but generally the rubber has been rendered insoluble by vulcanisation and is usually associated with mineral matter. Drastic treatment with reagents, such as strong nitric acid or ozone, is inadmissible, whilst it is impossible to dissolve the cotton in ammoniacal copper oxide, zinc chloride solution, or carbon bisulphide and caustic soda.

In view of these difficulties it seemed that the employment of high boiling solvents offered the best prospect of successfully separating the fabric intact from the constituents of the proofing.

Among the liquids suggested for use in the direct determination of mineral matter in rubber mixings are nitrobenzene, α-nitronaphthalene, xylene, paraffin, phenetol, and cumene. A preliminary experiment using nitrobenzene resulted in a satisfactory separation of fabric and proofing in a sample coated with a vulcanised "pure" mixing after about one hour's boiling, but as the appearance of the material suggested that the treatment was resulting in degradation of the cellulose it was decided to substitute an indifferent solvent of lower boiling point.

For this purpose a paraffin "white spirit" was selected having sp. gr. at 15·5°/15·5° C. 0·7798; 48% distilling at 170° C. and the whole at 225° C. A preliminary experiment showed that, after heating for about an hour at 160° C. in this solvent, the separation of the proofing from a fabric coated with a "pure" mixing was almost complete. When, however, mineral matter was present and the degree of vulcanisation high, the rubber appeared to be somewhat less amenable to the treatment. The initial investigations to determine whether the method could be put on a quantitative basis were therefore limited to the former type of mixing, which is usually employed in the manufacture of materials required to be gas-tight.

With this object, three pieces of light two-ply material in process of manufacture were selected for treatment and samples of the unproofed cambric from each were secured in addition to pieces of the finished material.

The weights of the dried materials, raw and stripped, agreed well enough to show that the results obtained by this method were sufficiently accurate for technical purposes. It was decided next to compare the factory weights as determined on whole pieces of scoured cambric in the natural condition with those deduced in the laboratory from small dry samples of raw and stripped fabric with the aid of a humidity factor. The following comparative results were obtained in this way on a 50-yard piece of scoured cambric:

Unproofed			Proofed	
Whole piece	Small sample		Small sample	
	End I.	End II.	End I.	End II.
2·33	2·34	2·34	2·38	2·37

A sample of the unproofed cambric was next weighed and subjected to the stripping process with the result that the weights before and after treatment were found to be identical, thus showing that the satisfactory agreement shown by the preceding figures could not be attributed to compensation of errors.

In order to ascertain the changes in dimensions which occur during proofing, the measurements of a series of pieces of raw cambric were compared with those found on the completion of the processes of manufacture. It was found that an initial total length of 518½ yards had increased, after spreading, to 519 yards, while the average width had diminished from 44″ to 43½″. A slight increase will therefore probably occur in the weight per unit area of any textile during proofing as a result of the shrinkage which occurs in the weft. With proofed material, therefore, the weights may tend to indicate a somewhat heavier textile than was actually used, and in fine fabrics the number of

threads per unit length may be slightly increased in the warp and correspondingly diminished in the weft direction. Occasionally, however, fabrics are proofed in the "grey" condition, without scouring or bleaching, with the warp yarns still weighted with size. This dressing will be removed largely in the stripping process, and the results obtained will consequently suggest the use of lighter fabric than was actually the case. In such instances the material usually appears brownish after the paraffin treatment and on boiling with water the washings will be found to give a strong reaction for starch. When, however, the weight of the fabric has been determined in the way already described and its weave and quality settled, a blank experiment can usually be made on a sample of equivalent material in the "grey" condition in order to ascertain roughly the correction to be employed in order to deduce the approximate proofing weight. The following table shows the loss experienced by two typical fabrics in both the grey and finished condition on successive treatments with various reagents likely to be employed to remove the proofing constituents.

Weights (oz./yd.²) dry condition

Sample	Initial	Extracted with paraffin and ether	Boiled with water.	Boiled with 2*M* caustic soda solution
No. 1 grey (unsized)	6·06	5·99	5·88	5·67
,, scoured	6·01	6·02	5·95	5·77
No. 2 grey (sized) ..	4·36	4·28	4·00	3·76
,, bleached ..	3·88	3·86	3·82	3·75

A further series of tests showed that the heating to which the dried samples were subjected during the treatment with paraffin had no effect on the tensile strength of the material.

During the preceding investigations, it was noticed that a preliminary extraction with carbon bisulphide resulted in marked swelling and weakening of the proofing, and appeared to facilitate its removal by the subsequent treatment with the paraffin solvent. It was, therefore, thought advisable to employ this preliminary treatment in the subsequent experiments on the compounded and more highly vulcanised proofings. A short extraction in a Soxhlet apparatus was found in many such cases to result in a remarkable softening and disintegration in the proofing which could in the main be removed by lightly scraping the swollen material with a blunt knife. The organic portion of the residual proofing was readily dissolved by digestion with hot paraffin, and by these means the cotton was left free from rubber* and fit for inspection though still containing an appreciable amount of the mineral constituents of the proofing mixture.

Before the weight of textile could be determined, therefore, it was necessary to remove this contamination as far as possible, or to leave only compounds the weight of which could be ascertained for deduction by merely incinerating the cotton and weighing the residual ash. Dilute solutions of weak organic acids must be employed to remove basic substances, but in view of the variety of such adjuvants encountered in technical practice, each instance must be considered individually. In certain cases, even, it may be found simpler to determine the weight of cellulose present by combustion, an estimation which might be conveniently and rapidly effected with a furnace of the Denstedt type ("Quantitative Chemical Analysis," Cumming and Kay, 1913, p. 339).

As a preliminary quantitative experiment, two materials were selected, one spread and the other calendered on one surface with different mixings, both containing lampblack, litharge and whiting as the mineral constituents, and both vulcanised by the dry heat process. Two samples were cut from each in addition to samples of the raw fabrics. After being subjected to the stripping process already described, the samples of each were respectively further treated as follows:—(1) Boiled with several changes of water, dried, and weighed. (2) Similarly treated, and subsequently boiled with two changes of 2*M* sodium carbonate solution, washed, warmed with two changes of 2*M* acetic acid solution, washed and dried. The percentage of ash indicated that the mineral matter had been removed satisfactorily by treatment (2) but not by (1), and it was decided to test the method on a further series of four typical proofed fabrics. The following particulars will indicate the nature of these, and the treatment to which each was subjected.

No. 1 was a heavy white surgical sheeting spread on both surfaces with a rubber-sulphur mixing heavily compounded with "white substitute" and lithopone and vulcanised in steam. On standing a few hours in carbon bisulphide the rubber surface coatings separated almost completely from the cotton which was removed, dried, and any residual rubber eliminated by the paraffin treatment. The material was afterwards treated with *M*/1 alcoholic caustic soda to dissolve any substitute left by the preceding treatments, boiled with dilute sodium carbonate solution, followed by dilute acetic acid, and finally washed, dried, and weighed. No. 2 was a cheap, light batiste proofed on both surfaces with a rubber mixing containing a large proportion of "white substitute" and vulcanised with sulphur chloride vapour. This was treated in the same way as No. 1. No. 3 was a heavy, calendered garment fabric, coated on one surface with a high quality rubber-sulphur mixing containing lampblack, litharge, and whiting, and vulcanised by the "dry heat" process. The proofing was removed as before, but the after-treatment with alcoholic caustic soda was omitted. No. 4 consisted of a heavy red surgical sheeting spread on both surfaces with a good quality rubber-sulphur mixing containing antimony sulphide, zinc oxide, whiting, and magnesia, vulcanisation being effected in steam. In this instance, after stripping the proofing the residual mineral matter was removed by successive treatments with dilute acetic acid, aqueous 2*M* caustic soda and tartaric acid, a thorough washing with distilled water following the application of each reagent.

In every case the cotton fabric was weighed in the piece prior to proofing, and small samples removed from either end for a confirmatory test in the laboratory. Samples were taken also from both ends of the finished material, and after the weight of the isolated cotton had been determined the residue was incinerated in order to ascertain the completeness of the removal of the mineral matter.

The results obtained for the weight of the textile calculated in oz./yd.² under normal conditions, together with the ash in grammes obtained on samples 3" × 3" before proofing and after stripping, are shown in the following table.

Quality	Unproofed			Stripped		Ash	
	In factory	In laboratory		In laboratory		Unproofed	Stripped
		End I.	End II.	End I.	End II.		
1	3·90	3·89	4·22	3·87	3·95	0·0133	0·0368
2	1·90	2·09	1·97	1·94	1·91	0·0006	0·0040
3	5·16	5·12	5·37	5·00	5·04	0·0062	0·0010
4	6·30	6·33	6·32	6·33	6·22	0·0052	0·0043

* The presence of a light coating of rubber on a material can be demonstrated by staining with a benzene solution of a disazo compound such as Sudan III, which leaves the cotton practically uncoloured while the rubber is dyed an intense red.

The foregoing figures indicate that it is generally possible to determine the initial weight of the cotton material in a small sample of a rubber-proofed fabric with sufficient accuracy for technical purposes, and to obtain the material in a fit condition for textile examination. In cases, however, in which intractable mineral fillers such as zinc, cadmium or mercuric sulphides are present, it may be necessary to resort to combustion or some solution method in order to secure a trustworthy result.

In two of the foregoing samples, the agreement between the laboratory weights of the two ends of the pieces of raw fabric was not altogether satisfactory, and it was thought desirable to ascertain whether the results obtained by weighing small samples of cotton fabric could be accepted as an index to the average weight as determined on the piece. With this object a set of materials was selected varying from a 22-oz. duck to a 2-oz. fine cambric, and the results obtained by weighing in the piece (*a*) were contrasted with those obtained from either end in the laboratory in the following ways:—(*b*) samples 12″ × 12″ weighed in the natural condition, (*c*) samples 3″ × 3″ weighed in the dry condition, (*d*) samples 12″ (warp) × $3\frac{1}{2}$″ (weft) weighed in the dry condition. In calculating the results in oz./yd.^{2} from (*c*) and (*d*), the usual $8\frac{1}{2}\%$ allowance was made for humidity regain. The agreement obtained was unexpectedly good, and it would indicate that in general the separation and identification of the textile in rubber-proofed cotton material can be satisfactorily effected in a small sample of about 3 ins. square.

While the analytical results obtained by this procedure may be regarded as very useful and in general accurate, the fact that the small pieces of material employed do not constitute average representative samples must not be overlooked.

The unformity of the weight of a textile depends to a great measure on the uniformity of the yarn employed in the weft, and the use of a shuttle of heavy yarn or the presence of a bad weaving fault may, therefore, invalidate any conclusion as to the average weight of a textile based on the results obtained from the examination of a small sample.

Research Laboratory,
Castle Mills,
Edinburgh.

Glasgow Section.

Meeting held at Glasgow on January 28th, 1919.

MR. QUINTIN MOORE IN THE CHAIR.

THE DETERMINATION OF SULPHITES, AND OF SULPHUR DIOXIDE IN GASEOUS MIXTURES.

BY PERCY HALLER, M.Sc. (SHEFFIELD).

The work described in this paper was carried out with the primary object of finding a reliable method for the volumetric determination of sulphur dioxide in the gases used in the catalytic production of sulphuric anhydride.

There are two general methods in use for this determination: firstly, absorption of the sulphur dioxide in iodine solution of known strength, and secondly, absorption in sodium hydroxide and titration of the resulting solution of sodium sulphite. For technical purposes the first method is usually modified by measuring the volume of gas necessary to decolorise a known quantity of standard iodine solution to which a little starch has been added: this is the well-known Reich test. It is a very rapid and handy method, and in spite of the fact that the end-point, owing to the initial presence of a large excess of iodine mixed with the starch indicator, is somewhat uncertain and liable to variation, it is exceedingly useful and probably accurate enough for many purposes. Its chief defect is that it only gives an idea of the strength of the gases at the moment the test is made, and it is often desirable to obtain results showing the average composition of the gases over fairly long periods. An average result of this kind may be obtained by using a large excess of iodine, passing the gases through slowly for the desired period, and titrating the excess of iodine with standard thiosulphate solution. This method is capable of yielding accurate results, but the use of such a solution as that of sodium thiosulphate, calling for frequent standardisation, is usually inconvenient and undesirable.

The method based on the absorption of sulphur dioxide in caustic soda is adaptable for use in short or long tests, and for this reason it was closely studied with a view to eliminating all sources of error. The three main defects to be looked for are:—(1) Incomplete absorption of sulphur dioxide by the sodium hydroxide solution used. (2) Loss of sulphur dioxide through the dissolved oxygen oxidising the sulphite to sulphate. (3) Errors met with in the volumetric determination of the sulphite.

The natural order in which to study these three points is, firstly, to find means of eliminating the spontaneous oxidation of the sulphite; secondly to find a reliable method for determining the sulphite; and thirdly, with the aid of this information, if forthcoming, to study the conditions necessary for obtaining complete absorption of sulphur dioxide from the gases to be tested.

Prevention of the oxidation of sulphites in solution by dissolved oxygen.

The reaction between dissolved oxygen and sulphites in aqueous solution is one of those definitely known to be susceptible to the action of "negative" catalysts.

Ruff and Jeroch (Ber., 1905, **38**, 409) carried out a few determinations of sulphites, using mannitol as a negative catalyst. Their results showed that the addition of mannitol exerted a pronounced beneficial effect on the accuracy of the results, but only a few measurements were published and no criterion was given as to their accuracy. Further they considered it necessary to exclude air during their experiments, and as the gases to be examined contain 10% to 15% of oxygen, the results obtained by these authors are not of much assistance for the purposes of this investigation.

Titoff (Z. physik. Chem., 1903, **45**, 641) carried out a very complete investigation of the stability of sulphite solutions. For the purposes of this paper, his main conclusions can be summarised thus:—A solution of a sulphite in absolutely pure water would be unaffected by the presence of dissolved oxygen, but even the use of the purest conductivity water fails to reduce the speed of oxidation to zero. The oxidation will only proceed in the presence of minute traces of catalysts. These "positive" catalysts, of which the chief are the salts of copper and of iron, it is impossible to exclude, as sufficient will always be dissolved from the walls of the reaction vessels to produce a measurable speed of oxidation. Thus a concentration of one gram-molecule of copper sulphate per million litres is sufficient to produce an acceleration in the speed of oxidation that is well outside the experimental error. It is possible, however, to prevent oxidation altogether by the sufficient addition of "negative" catalysts, the function of which seems to be to combine in some

way with the positive catalysts inevitably present, with the formation, presumably, of non-ionisable compounds. Thus, when copper sulphate is present as positive catalyst to the extent of 10^{-8} to 10^{-9} normal, the addition of 1800 grm.-mols. of mannitol per grm.-mol. of copper sulphate is sufficient to prevent the oxidation of the sulphite altogether.

There are many substances capable of functioning as negative catalysts; the one chosen for trial in this work was glycerin, as being the most accessible under the circumstances in which the work was carried out and at the same time a fairly powerful agent. A few tests carried out under manufacturing conditions quickly showed that the addition of a little glycerin to the caustic soda solution used in the absorption led to a considerable increase in the amount of sulphur dioxide found in the gases tested. Determinations were made in duplicate, the sulphur dioxide being caught by passing the gases through 10% caustic soda solution, with the addition in the one case of about ½% of the total solution volume of glycerin. The tests were run slowly over a period of about eight hours. The sulphite was determined by direct titration of the solution with standard iodine.

The results are shown in table 1.

TABLE 1.

Effect of added glycerin in SO_2 determinations by the sulphite method.

No.	1	2	3	4	5	6
Without glycerin	1·11% SO_2	1·11	1·34	1·31	0·86	0·81
½% glycerin present	1·37	1·44	1·40	1·76	1·19	1·20

It will be noted that while in each case the addition of glycerin brought about a clear increase of the amount of sulphur dioxide found, there was no constant relationship between the two sets of figures. This only points to the fact that in the absence of glycerin the amount of spontaneous oxidation of the sulphite must be liable to wide variations on account of the varying quantities of positive catalysts present, and it is reasonable to hope that the figures obtained when using glycerin approximated closely to the truth.

It was decided on this evidence to proceed at once with the study of the method of determining the sulphites.

The volumetric estimation of sulphites.

A short summary of work done on the estimation of sulphites by iodometric methods will be found in Treadwell and Hall's "Analytical Chemistry" (Vol. 2, p. 692, 1915 ed.), and it will be seen that the literature of the subject has become rather involved and contradictory. Beyond the work mentioned by these authors there are two points which perhaps deserve some emphasis.

Washburn (J. Amer. Chem. Soc., 1908, **30**, 32) gave calculations based on accurate measurements of the equilibrium constants of the reactions involved, showing that an accurate determination of arsenious oxide by means of iodine can be obtained only when the hydrion concentration in the solution at the end of the titration lies between the limits 10^{-4} and 10^{-9}. This condition can be obtained by the use of such mixtures as sodium bicarbonate and carbonic acid, boric acid and borax, etc., the presence of which ensures the removal of any acidity or alkalinity developed during the titration, and so keeps the hydrion concentration within the desired limits.

Now, so far as is known to the present author, no such calculations or measurements have been made in the case of the reaction between iodine and sulphites, and in the absence of such definite knowledge we are not entitled to assume that it is possible to keep the hydrion concentration low enough to ensure the complete oxidation of the sulphite without making it so low that some iodate is formed. The use of sodium bicarbonate in this titration is thus purely an empirical measure.

Raschig (Z. angew. Chem., 1904, 580) proved that when normal sodium sulphite is converted to the "acid" salt by the addition of acid, or the reverse change caused by the addition of alkali, some of the sulphite is always converted to sulphate. He ascribed this oxidation to the catalytic effect of the hydrogen or hydroxyl ions at the moment of their entry into the solution. A similar effect was noted by Baker and Day (Analyst, 1912, **37**, 439), who found that sulphurous acid is readily oxidised by dissolved oxygen in the presence of dilute acids and that the oxidation is greatly facilitated by reaction between acids and alkalis in the solution. Now, when sulphur dioxide is absorbed in caustic soda, an alkaline solution of the normal sulphite is formed and this solution must be acidified, thereby changing the sulphite to the "acid" compound, before direct titration with iodine. Thus a certain loss of sulphur dioxide is bound to occur, unless the suggested addition of glycerin is capable of preventing this oxidation also.

The method of Giles and Shearer (this J., 1884, 197, and 1885, 303) depending on the addition of the sulphite to a known excessive quantity of iodine and titration of the excess iodine with thiosulphate, seems to be very reliable, but it was specially desired in this work to avoid the use of two standard solutions, and particularly to avoid using thiosulphate.

The method finally chosen for trial was first described by Andrews (J. Amer. Chem. Soc., 1903, **25**, 756), and applied to the estimation of sulphites by Jamieson (Amer. J. Sci., 1914, **38**, 166). The titration depends on the use of potassium iodate in strongly acid solutions, and is of general application in the titration of iodine, iodides, and many other substances. The fundamental reaction is that between potassium iodate and potassium iodide in solutions containing at least 15—20% of hydrogen chloride. In feebly acid solution the reaction is $5KI+KIO_3+6HCl \rightarrow 6KCl+3H_2O+6I$. In strongly acid solutions the reaction can be carried on further by the addition of more iodate, the free iodine liberated being transformed to iodine monochloride, which is comparatively stable in presence of the excess of free acid: $4I+KIO_3+6HCl \rightarrow KCl+3H_2O+5ICl$. Thus in strongly acid solution the reaction between iodate and iodide becomes $2KI+KIO_3+6HCl \rightarrow 3KCl+3H_2O+3ICl$. Andrews found that the completion of this reaction, marked by the complete disappearance of the free iodine liberated at the beginning of the reaction, can be detected with the utmost sharpness by having present a globule of chloroform. The chloroform dissolves most of the free iodine and gives a clearly visible violet colour as long as the least trace of iodine is present. It is of course necessary to shake the solution vigorously towards the end of the titration to allow the iodine dissolved in the chloroform to be transferred to the aqueous solution and reacted on by the iodate.

When sulphites are titrated the reaction becomes in strongly acid solution $2SO_2+KIO_3+2HCl \rightarrow 2SO_3+KCl+H_2O+ICl$. The end-point, as before, is the disappearance of the iodine first liberated.

The reasons which led to the adoption of this method were: Firstly, it disposes of the question of the neutrality or otherwise of the solution, met with in all iodometric titrations, and fixes the acidity at 15—20% free hydrogen chloride; secondly, it eliminates the use of thiosulphate and necessitates only one standard solution, namely of potassium iodate, and this solution is extremely stable; thirdly, the titration is quick and accurate, and

the end-point very sharp; fourthly, it eliminates the use of starch, which is apt to be an unsatisfactory indicator unless prepared with great care.

Jamieson, in testing this method, compared the results obtained by its use with those obtained by the method of Giles and Shearer. It was decided here to test the method in a manner independent of any other determination.

As a first step a solution of neutral potassium iodate was prepared. The iodate used was not pure, so the solution was standardised against pure "A.R." potassium iodide which had been dried at 150°–160° C. Weighed quantities of this iodide were dissolved, in a glass-stoppered bottle, in pure concentrated hydrochloric acid, previously well cooled, to which a little pure chloroform had been added. (Sufficient acid was taken to give at least 15% hydrogen chloride in the solution at the end of the titration.) The iodate solution was run in quickly from a burette, the test solution being rotated gently, until the iodine colour had reached a maximum and begun to disappear. Iodate solution was then added cautiously, with vigorous shaking of the solution between successive additions, until the iodine colour just disappeared from the chloroform globule.

The results obtained in standardising the three lots of iodate solution used in this investigation were as follow: No. 1. Grms. KI taken, 0·1978 to 0·9151; c.c. KIO_3 solution required, 12·72 to 59·16; equivalent of 1 c.c. KIO_3 solution in grms. KI, 0·01550, 0·01546, 0·01549, 0·01547, 0·01548, 0·01547; mean 0·01548; variation + 0·13% of mean. No. 2. Grms. KI taken, 0·1090 to 0·4004; c.c. KIO_3 solution required, 10·91 to 40·18; equivalent of 1 c.c. KIO_3 solution, 0·009964, 0·009968, 0·009964, 0·009970, 0·009973, 0·009955; mean, 0·009968; variation + 0·05% of mean. No. 3. Grms. KI taken, 0·0501 to 0·1170; c.c. KIO_3 solution used, 13·79 to 32·14; equivalent of 1 c.c. KIO_3 solution, 0·003633, 0·003633, 0·003632, 0·003630, 0·003635, 0·003632, 0·003632, 0·003687, 0·003632, 0·003640; mean, 0·003634; variation + 0·14% of mean.

These results indicate that the titration is sufficiently accurate for most purposes.

The iodate solutions so standardised were next applied to the determination of sulphites. A precaution recommended by Jamieson was the use of a solution of iodine monochloride, carefully adjusted to contain no free iodate or iodine. The purpose of this solution was to prevent the loss of sulphur dioxide by volatilisation when comparatively large quantities of sulphite were added to the strongly acid solution before titration. Iodine monochloride, by reacting at once with the sulphite, would liberate free iodine exactly equivalent to the sulphite added, with the formation of sulphate. Loss of sulphite would thus be prevented and no difference made to the titration.

In the present experiments, however, it was found impossible to keep this stock solution of iodine monochloride in the required state of balance, *i.e.*, free from iodate and iodine, for even so short a period as two hours. After exactly adjusting the solution, free iodine always made its appearance in the chloroform in the course of an hour or two. No reference was made to this phenomenon by either Andrews or Jamieson, but its appearance was only to be expected from the fact that iodine monochloride is an indifferently stable substance. The presence of a large quantity of free hydrogen chloride renders it stable in so far as it inhibits the hydrolysis to free iodine and hydrochloric acid, but this factor would seem powerless to prevent decomposition according to the equation $3ICl \rightarrow ICl_3 + 2I$. This decomposition goes on slowly at ordinary temperatures, and the presence of chloroform probably serves to increase it, this solvent being known to give rise to this dissociation to a very marked degree (*cf.* Abegg's "Handbuch," Vol. 4, p. 475). The necessity for suppressing this reaction is a very strong reason for keeping the solution cool during titration. No further work was carried out on this point, but in view of the inconvenience of using a stock solution requiring readjustment at short intervals, its use was abandoned, and this course was fully justified by the event. The use of iodine monochloride is an unnecessary refinement.

It was of course evident that this decomposition to the trichloride might possibly give rise to trouble by making its appearance before a titration was finished. It was found later that when a solution under titration was allowed to stand for an hour or two after the end-point had been reached, free iodine did appear in the chloroform, and the amount increased with further standing. Nevertheless, the appearance seemed too slow to have any effect on the accuracy of the titration, and the results to be given shortly prove that no error of this sort is to be feared.

In testing the accuracy of the method as applied to sulphites, the iodate solutions were standardised against quantities of sodium sulphite, the exact amount of sulphite taken being obtained by weighing. As it was found impossible to prepare solid sodium sulphite of sufficient purity and constancy of composition to serve as a standard, recourse was had to pure sulphur dioxide. This was obtained by evaporation from the middle fraction of a cylinder of the liquid and was assumed to be sufficiently pure for the purpose. To carry out a standardisation, a simple gas-washing flask was taken, of about 100 c.c. capacity, and nearly filled with a solution of sodium hydroxide containing a known volume of glycerin. The flask and contents were carefully weighed and sulphur dioxide was then passed in. The flow of the gas was so adjusted that absorption was almost complete, in order to avoid any loss of water vapour. When sufficient of the gas had been absorbed, the flask was disconnected and weighed again, the weight of sulphur dioxide taken being thus obtained by difference. The solution in the flask was then transferred to a graduated flask, made up to a known volume, and aliquot portions titrated.

The necessity for the use of glycerin during the absorption was shown by a few standardisations which were carried out without the use of this agent. Two typical cases are given in full.

Experiment 1. Sulphur dioxide taken (weighed), 0·2710 grm. Solution made up to 250 c.c. and successive lots of 25 c.c. titrated. C.c. iodate taken, 17·81, 14·25, 13·75, 12·68, 11·85, 10·91. 17·81 c.c. of iodate is equivalent to 0·2503 grm. SO_2, calculated on the basis of the strength of the iodate solution used, as obtained from its previous standardisation with potassium iodide.

Experiment 2. Sulphur dioxide taken, 0·2551 grm. Solution made up to 250 c.c. and titrated as in experiment 1. C.c. iodate taken, 16·15, 15·35, 12·28, 11·90, 11·02. 16·15 c.c. is equivalent to 0·2265 grm. SO_2.

These two experiments showed that when no negative catalyst was present sulphur dioxide was lost at such a rate by oxidation that titrations could not be duplicated and even the result obtained first was low.

When glycerin was used in the absorption, constant results were always obtained for the different titrations, no matter how long the solutions stood after being made up. This showed that the glycerin was capable of preventing the oxidation of the sulphite by dissolved oxygen. That it was also capable of preventing the catalytic oxidation caused by

acidifying the solution (*cf.* Raschig, *loc. cit.*) was shown by the agreement between the amount of sulphur dioxide as determined by weighing and by calculation from the iodate used, utilising in the latter case the values obtained by standardisation against iodide.

A series of such titrations was made with satisfactory results, as shown in the table below. It was found that the accuracy of the results was very largely dependent on the thoroughness with which the solution was shaken towards the end of the titration. Carelessness in this respect might easily lead to errors of 1 or 2%.

TABLE 2.

Estimation of sulphur dioxide, absorbed in sodium hydroxide and glycerin.

100 c.c. of 10% NaOH to 20 c.c. of glycerin used.

Number	SO_2 taken, grms. (weighed)	SO_2 found, grms. (by titration)	Error as % of SO_2 taken
1	0·9630	0·9592	−0·4
2	2·177	2·188	+0·5
3	1·471	1·475	+0·3
4	4·123	4·103	−0·5
5	1·475	1·476	+0·1
6	0·8655	0·8636	−0·2
7	0·5173	0·5140	−0·6
8	0·6549	0·6521	−0·7
9	1·265	1·269	+0·3
10	0·8542	0·8490	−0·6
		Average error	±0·4%

Each of the figures given in the column "SO_2 found" in the above and succeeding tables was arrived at by taking the mean of at least three closely concordant titrations, the maximum divergence allowed being 0·02 c.c.

In order to make these standardisations more comparable to the test as carried out on gases containing oxygen, it was judged advisable to test the accuracy of the method when, in addition to the oxygen dissolved in the solution, additional oxygen was blown through. This was not strictly necessary, as the fact that the sulphite solutions remained unaltered in litre for days proved that the glycerin was amply fulfilling its duty of preventing oxidation. Nevertheless a series of tests was carried out on these lines; a quantity of air was blown through the solutions after the weight of sulphur dioxide had been found, the solutions being then made up and titrated as usual. The results appear in the following table.

TABLE 3.

Estimation of sulphur dioxide, absorbed in caustic soda and glycerin, after air has been blown through the solution.

No.	SO_2 taken, grms.	SO_2 found, grms.	Error as % of SO_2 taken	Conditions
1	0·8747	0·8763	+0·2	Air blown vigorously for ½ hour.
2	2·895	2·898	+0·1	
3	1·821	1·830	+0·5	Air at 2–4 c.c. per sec. for 1½ hours.
4	1·071	1·074	+0·3	14 litres of air blown through in about an hour.
5	0·4213	0·4209	−0·1	
6	0·9073	0·9079	+0·1	
7	4·280	4·298	+0·4	
8	1·148	1·149	+0·1	
9	0·8461	0·8459	−0·0	
10	0·7282	0·7310	+0·4	
		Mean	±0·3	

In all the experiments so far reported the proportion of glycerin used was rather high (20% by volume), and tests were next made to determine if a smaller quantity could be used. No attempt was made to determine the minimum quantity that can be used successfully, as this figure will vary very widely with the variations in the amount of positive catalysts present. All that was sought was a suitably small quantity that would yet be large enough to eliminate oxidation in all ordinary circumstances. The figure 5% by volume of glycerin was arbitrarily fixed upon. This is a convenient amount, and the following results show that it was ample under the circumstances under which these tests were made.

TABLE 4.

Estimation of sulphur dioxide absorbed in caustic soda, in presence of varying quantities of glycerin.

Number	SO_2 taken, grms.	SO_2 found, grms.	Error as % of SO_2 taken
A—Absorbing in 100 c.c. NaOH and 20 c.c. glycerin.			
1	0·5536	0·5535	−0·02
2	0·4247	0·4248	+0·02
B—Absorbing in 100 c.c. NaOH and 10 c.c. glycerin.			
1	0·5452	0·5465	+0·2
2	0·3381	0·3384	+0·1
3	0·3265	0·3271	+0·2
4	0·1469	0·1476	+0·5
5	0·3323	0·3329	+0·2
C—Absorbing in 100 c.c. NaOH and 5 c.c. glycerin.			
1	0·1920	0·1920	nil.
2	0·5008	0·5033	+0·5
3	0·8310	0·8302	−0·1
4	0·5347	0·5347	nil.
5	0·9335	0·9346	+0·1
6	0·3407	0·3415	+0·2
7	0·3455	0·3457	+0·06
8	0·6300	0·6312	+0·2
9	0·1240	0·1245	+0·4

These results show that under the conditions present at the time the tests were made, an addition of 5% by volume of glycerin to the caustic soda used in absorption is quite sufficient to prevent oxidation. This concentration will probably be found sufficient in all circumstances, but if at any time it is insufficient the fact will at once be apparent, as it will be found impossible to obtain concordant results for successive titrations, and the addition of more glycerin will be indicated.

As a final and drastic test of the stability of the sulphite brought about by the presence of the glycerin, the effect of exposure to high temperatures was tested. At a temperature of 100° C., the rate of oxidation will be many times greater than at ordinary temperatures, so that exposure to such a temperature makes a very severe test upon the inhibiting effect of the glycerin.

A series of experiments was carried out, in which the solutions, after the sulphur dioxide had been weighed, were allowed to stand in the steam bath for an hour, after which they were cooled, made up to the required volume and titrated as usual. The results appear in the following table.

TABLE 5.

Effect of heating to 100° C. on the stability of sulphite solutions preserved by means of glycerin.

(5% by volume of glycerin added.)

No.	SO_2 taken, grms.	SO_2 found, grms.	Error as % of SO_2 taken
1	0·7341	0·7333	−0·1
2	0·5970	0·5980	+0·2
3	0·2140	0·2153	+0·6
4	0·6152	0·6155	+0·05
5	0·5034	0·5046	+0·2
6	0·7098	0·7098	nil.
7	0·4468	0·4466	−0·05
8	0·6606	0·6603	−0·05

With these results it is evident that the method of estimation is capable of furnishing satisfactory results under the most adverse conditions.

A last point remains to be dealt with. It might be feared that the iodate solution would have some oxidising effect on the glycerin used. If any such

effect were exerted, however, the results already given in table 4, where the effect of variation in the amount of glycerin used is shown, prove that it is too small to make any difference to the accuracy of the estimation. The glycerin used throughout this work was a fairly good quality of the refined material, of a pale brown colour. It was found to interfere very slightly with the end-point of the titrations in that some of the brown colouring matter seemed to be dissolved by the chloroform, making the detection of the end-point very slightly more difficult. A little experience with the titration, however, made it very easy to obtain the end-point quite as sharply in the presence of glycerin as in its absence. As regards any oxidation effect, a few tests made, in which 10 c.c. of glycerin was added to a solution at the end of a titration, showed that the iodine liberated in no case required more than about 0·05 c.c. of iodate solution for removal; and as in the actual titrations only about ½ c.c. of glycerin was present, this effect was quite negligible.

Efficiency of absorption of sulphur dioxide in caustic soda and glycerin.

It was a simple matter, now that the preservation of the sulphite and its accurate estimation were assured, to test the efficiency of absorption by passing the gases to be examined through two absorption vessels in series.

Somewhat contrary to expectations, it was found that perfect absorption can be secured with very simple apparatus. Thus it was found that on passing 10–15 litres of gas containing 5–7% of sulphur dioxide through about 250 c.c. of 10% caustic soda solution (with 5% by volume of glycerin), contained in a bottle giving a six inch column of liquid, the gases bubbling through at the rate of 1–2 litres per hour, no trace of sulphur dioxide could be found at the exit of the absorption bottle.

It is thus very easy to ensure complete absorption of sulphur dioxide in carrying out the tests.

Summary.

The principal results obtained may be summarised thus:—

1. The addition of a little glycerin to solutions of sulphites, or to caustic soda solutions used in absorbing sulphur dioxide, prevents any loss by spontaneous oxidation to sulphate. About 5% by volume of glycerin is a suitable quantity, and will usually be found ample. Passage of air and exposure to high temperature have no effect in the presence of glycerin.

2. The use of glycerin does not interfere with the accuracy of the estimation of the sulphite.

3. By titration with potassium iodate in solutions strongly acid with hydrogen chloride, sulphites can be estimated with a satisfactory degree of accuracy. The use of a stock solution of iodine monochloride, as recommended by Jamieson, is inconvenient, on account of its instability, and is, moreover, unnecessary.

4. The absorption of sulphur dioxide from gases containing it, by means of caustic soda, is a very easy matter, perfect absorption being obtained with very simple apparatus.

In conclusion it may be pointed out that the method arrived at in this paper leads to very much higher results for sulphur dioxide in gases than are given by absorption in caustic soda to which no glycerin is added.

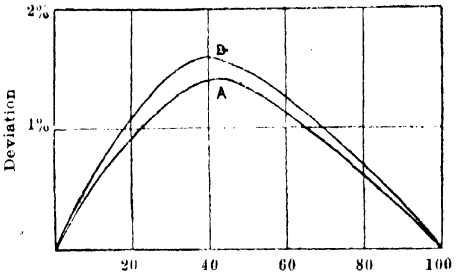
This work was carried out for Messrs. Nobel's Explosives Company, in the Sulphuric Acid Laboratory of their Ardeer factory, and it is by their permission that this paper is published. For their kindness in allowing publication, the author wishes to express his appreciation and thanks.

Errata.

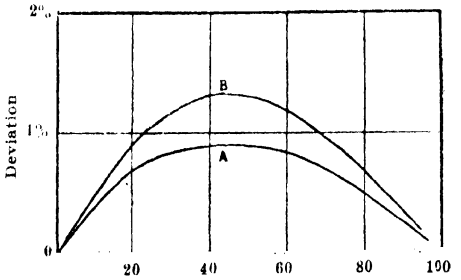
ESTIMATION OF BENZENE AND TOLUENE IN PETROLEUM.

BY F. B. THOLE, D.SC.

The lettering round the curves in the above paper (this J., 1919, 41 T) was inadvertently omitted. The correct curves are given below:—



Per cent. benzene by sp. gr. method.



Per cent. toluene by sp. gr. method.

London Section.

Meeting held at Burlington House, on March 3rd, 1919.

DR CHARLES A. KEANE IN THE CHAIR.

DETERMINATION OF BENZENE, TOLUENE, ETC., IN COAL-TAR AND SIMILAR PRODUCTS, AND IN THE INTERMEDIATE PRODUCTS OF TAR DISTILLATION.

BY H. G. COLMAN, D.SC., AND E. W. YEOMAN, B.SC.

During the past few years the authors have carried out a large number of tests of these products by methods of which sectional accounts have been published in some cases from time to time. Owing to the necessities of the time, it was found advisable to publish these sectional accounts without waiting for their extended investigation, and as further experience has resulted in various modifications and additions to these methods, a general account of them, and of the principles on which they depend, is given in the present paper.

The general aim of the investigation has been the elucidation of methods which would give results of reasonable accuracy with products of widely varying composition. Where the products to be analysed only vary in composition within moderate limits, simpler and shortened methods can be employed giving results of sufficient accuracy for many purposes, but where such methods are used on products differing widely in composition, they are apt to give results which with abnormal samples are far from accurate.

General scheme of analysis adopted.

By distillation of the various tars, and subsequent fractionation of the lower-boiling distillates after treating them with concentrated sulphuric acid and caustic soda to remove unsaturated hydrocarbons and phenols, the lighter tar constituents are separated into the following fractions:—(1) Fraction up to 90° C., (2) 90°—140° C., (3) 140°—160° C., (4) 160°—200° C.

The first fraction "up to 90°" when the fractionation is carried out under specified conditions contains the aromatic hydrocarbons benzene and toluene only, but may also contain carbon bisulphide and saturated paraffin hydrocarbons or naphthenes of similar boiling point when these are present in the original tar or oil analysed.

The second fraction "90°—140°" contains only the aromatic hydrocarbons benzene, toluene, and the xylenes, together with paraffins or naphthenes of similar boiling point if present in the tar.

The third fraction "140°—160°" contains chiefly the constituents of the "solvent coal-tar naphtha" of commerce, namely, xylenes, cumenes, and other benzene homologues boiling for the most part between 140° and 170°, and also any paraffins or naphthenes of similar boiling point present in the original tar.

The fourth fraction "160°—200°" represents approximately the "heavy solvent naphtha" of commerce, and consists mainly of benzene homologues boiling at about those temperatures, with paraffins or naphthenes present in the tar.

Owing to the large number of the individual hydrocarbons present in each of the last two fractions, and to the small differences between the boiling points of the various constituents, no determination of the relative amounts of each has been found practicable by distillation methods.

In the first two fractions, on the other hand, it is possible by simple distillation methods to ascertain with a considerable degree of accuracy the quantities of benzene, toluene, and the sum of the isomeric xylenes present, and to ascertain from sp. gr. determinations the amounts of carbon bisulphide and paraffin or naphthene hydrocarbons present. The same methods can be employed for the analysis of commercial benzol and commercial toluol, which are in general similar in composition to the fractions "up to 90°" and "90°—140°" respectively.

Preliminary distillation of the tar or other crude oil.

A known volume of the tar or oil is distilled from a metal still. (It is frequently more convenient to take a known weight of the tar or oil, and calculate the volume from the weight taken and the specific gravity of the sample.) The tar is then carefully distilled until the thermometer in the vapour shows a temperature of 230° C., to ensure that all the low boiling constituents of the tar or oil are driven over into the distillate. In many cases, such, for example, as the benzolised oil resulting from the washing of coal-gas with oil for benzol recovery, it is often more convenient to blow steam through the oil in the still when the thermometer indicates a temperature of 130°—140° C. and to continue passing the steam until about 100 c.c. of water has condensed in the receiver for each litre of tar or oil taken.

The distillate, after separation of water, is then re-distilled from a round-bottomed glass or metal flask fitted with a Young 12-bulb pear fractionating column, or other efficient column of a form which drains almost completely, the rate of distillation being maintained as nearly as practicable at about 4 c.c. per minute.*

The distillation is continued until the thermometer at the head of the column shows a temperature of 200° C.; the volume of this distillate, less any water present, is then read off and its percentage of the original volume of tar calculated.

The quantity of tar or oil originally taken should be such that the amount of distillate to 200° thus obtained is at least 250 c.c. For greater accuracy a larger quantity is advantageous, but the time required for the test is considerably increased thereby.

In the case of a product which only contains up to 25% of constituents boiling above 200° C., such as the "crude benzol" recovered from coal-gas by washing, 250—500 c.c. of this material is directly fractionated using a Young 12-bulb pear column, and the distillate to 200° collected, the preliminary distillation to 230° being omitted in such cases.

Purification of the distillate to 200° C.

In order to purify the distillate, not less than 200 c.c., and preferably at least 250 c.c., is shaken with one-quarter of its volume of 10% aqueous caustic soda, allowed to settle, the caustic layer run off, and the oil washed with water, which is also run off, and the volume of residual oil measured. The loss of volume represents approximately the volume of tar-acids in the volume of oil taken.

* The usual method of specifying the rate of distillation in "drops per second" is unsatisfactory, as the size of the drop may vary at least threefold, according to the diameter, slope, and exact shape of the end of the condenser tubes. As the specification of "drops per second" is, however, most convenient for timing, the number of drops per second equivalent to any given number of c.c. per minute may be readily ascertained with the condenser used. With a vertical condenser, having an end cut off square, one drop per second is usually approximately 4 c.c. per minute.

After alkali-washing, the remaining oil is shaken for 5 minutes with 8% of its volume of concentrated sulphuric acid and allowed to settle for 15 minutes.*

The strength of acid used should closely approximate to 95% H_2SO_4. Water is then carefully added down the side of the separating funnel so that it floats on the top of the acid layer, which thus becomes visible. With some oils the darkening on shaking with acid is so great that the boundary between the two layers can only be perceived with great difficulty until water is added in this manner. The acid layer is then run off, and the oil washed by allowing a thin stream of water to fall through it without shaking. After running off the water, the oil is shaken successively with 10% aqueous caustic soda, and finally with water, only gentle shaking being employed so as to avoid, as far as possible, the formation of emulsions.

The difference between the volume now remaining after complete separation of water and the volume remaining after washing with alkali gives an approximate indication of the volume of unsaturated hydrocarbons (chiefly olefines) which have been absorbed by the sulphuric acid.

In addition to the olefines, other unsaturated hydrocarbons are present (dienes, etc.) which are not absorbed by the sulphuric acid, but in its presence chiefly undergo polymerisation, yielding high-boiling hydrocarbons of unknown constitution boiling mainly from 300° to 400° C., which remain dissolved in the oil, the olefines also yielding polymerised hydrocarbons to some extent. The actual amount of such condensable hydrocarbons varies greatly, and is much higher in products derived from the carbonisation of petroleum products than in those obtained from coal. An approximate estimation of the quantity of these is obtained from the volume of the residue left at 200° on re-fractionating the washed oil.

This oil, after freeing from water as completely as possible, is again distilled from a round-bottomed flask fitted with a Young 12-bulb pear column, at the rate of 4 c.c. per minute, and separated into fractions. The method of collecting the fractions is varied somewhat according to the composition of the washed oil.

(1) Where not less than 50% of the washed oil distils under these conditions below 90° C., the fractions are directly collected as follows:—

(*a*) up to 90°, this fraction then containing only benzene and toluene, together with carbon bisulphide, and paraffins of similar boiling point.

(*b*) 90°–140°, this fraction consisting of benzene, toluene, and xylene, except for paraffins of similar boiling point.

(*c*) 140°—160°, consisting of xylenes, cumenes, etc., with paraffins.

(*d*) 160°—200°, consisting of higher homologues of benzene, with some paraffins.

(*e*) Residue at 200°, consisting chiefly of the polymerised hydrocarbons formed by the action of sulphuric acid on the dienes, etc., in the original tar or oil.

(2) If the amount boiling below 90° is less than 50%, as is often the case with crude naphtha from coal-tar, some xylene may also distil over with benzene and toluene below 90°. Where the distillate up to 90° does not amount to 50%, therefore, the first fraction is collected up to 95°, and the second fraction from 95° to 140°, and the remainder of the fractionation made as in (1). The fraction up to 95° is then re-fractionated, and the distillate up to 90° collected. The residue at 90° contains all the xylene and is then added to the fraction 95°—140°, the combined amounts forming the fraction 90°—140°.

(3) When the proportion of xylene and higher-boiling constituents is low, it is often not possible to continue the distillation up to 140°, owing to vapours in the later stage all condensing in the fractionating column. In such cases, xylene is added to the residue after the fraction up to 90° has been collected, and the distillation then continued to 140°. In that case the determination of the fractions 140°—160° and 160°—200°, and residue at 200° is omitted, or if required, a larger quantity of the original oil must be taken. The xylene must not be added before the fraction up to 90° is collected, as otherwise xylene would come over with that fraction and would count in the analysis as toluene.

Sometimes the oil after washing with sulphuric acid, caustic soda, and then with water, forms a very persistent emulsion with the latter, which is only separated with great difficulty. In such cases, the emulsion may be steam distilled, when the polymerised unsaturated hydrocarbons remain behind, the distillation being continued until the volume of condensed water approximately equals half the volume of spirit condensed. The difference between the volume of the steam distillate obtained after separation of water and the volume of oil after acid washing, gives an approximate figure of the total unsaturated hydrocarbons present, i.e., the combined amount of olefines and polymerised hydrocarbons. In the subsequent fractionation of the steam distilled oil, this is stopped at 160°, and the residue at 160° taken as the fraction 160°—200°. Some loss of the lower-boiling constituents, especially of benzene, is, however, difficult to avoid when steam distillation is carried out.

Determination of benzene, toluene, and xylene in the fractions "up to 90°," "90°—140°," and in commercial benzol and commercial toluol.

Before these methods can be adopted it is necessary that the samples shall be freed as completely as possible from unsaturated hydrocarbons and phenols. This is the case when the fractions have been properly washed with sulphuric acid and caustic soda as described, but in the case of commercial benzol and toluol this may not be the case.

The ordinary method of ascertaining whether such products are sufficiently free from unsaturated hydrocarbons consists in shaking 90 c.c. of the sample with 10 c.c. of sulphuric acid of 90% strength, and judging from the coloration of the acid layer whether these have been sufficiently washed, this not being the case if the coloration exceeds a deep yellow or light brown colour. This test, although useful as a quick test for works control purposes, is far from satisfactory as a reasonably accurate method for giving a comparative indication of the amount of unsaturated compounds present, and is by no means certain in its indications, some samples which are in reality well

* In the process of shaking with concentrated sulphuric acid, small quantities of aromatic hydrocarbons are absorbed in addition to olefines, so that the percentages of the former subsequently found are always rather lower than the quantity present in the original material. As, however, in practice, the products have also always to be washed with concentrated sulphuric acid, the results obtained for the percentages of aromatic hydrocarbons truly represent the maximum quantities of these which could be obtained, provided that the washing to which they are subjected on the small scale is not more severe than that which they receive in large scale practice to remove the unsaturated compounds. The quantity of acid given above, namely 8% of 95% acid with 5 minutes' shaking, has been found to effect a satisfactory removal of the unsaturated compounds with all samples tried, and not to cause extensive absorption of aromatic hydrocarbons, and such absorption of these as does take place chiefly affects the xylenes, which are more readily attacked by sul huric acid than is toluene, whilst benzene is still less affected.

Satisfactory washing can be obtained with many samples by the use of less than 8% of sulphuric acid, but it is not an easy matter to judge, except by trial, how far this can be reduced, and the use of the full 8% does not appear to cause undue removal of the benzene, and toluene in any case, if shaking is not prolonged for more than the specified 5 minutes.

washed giving a bad discoloration, whilst others, in reality badly washed, may only give a slight discoloration. A much more satisfactory test, which is quickly carried out and gives a relative quantitative indication of the proportion of unsaturated hydrocarbons present, is the determination of the quantity of oxygen the sample will absorb from an acid solution of potassium permanganate, at the ordinary temperature. This test is carried out as follows:—

80 c.c. of water and 10 c.c. of dilute sulphuric acid (made by adding 1 part by weight of concentrated sulphuric acid to 3 parts by weight of water) are placed in a stoppered bottle of about 300 c.c. capacity, 10 c.c. of the commercial spirit to be examined added, and the whole shaken. The temperature of the liquid should be between 15° and 20° C. 50 c.c. of $N/10$ potassium permanganate is then added, and the whole shaken continuously for exactly 3 minutes; if at the end of the first half minute the permanganate solution is markedly decolorised, a further 50 c.c. of $N/10$ permanganate is added, and the shaking then continued for a further 2½ minutes. The excess of permanganate is then destroyed by the addition of 10 c.c. of a 10% potassium iodide solution, with vigorous shaking. The resulting solution containing iodide is then titrated with $N/10$ sodium thiosulphate solution, shaking well between each addition, until both layers in the bottle become colourless. The end-point of the titration is sharply indicated by the final disappearance of the violet colour from the spirit layer, and there is no need to add starch as indicator unless the original spirit was coloured. The number of c.c. of thiosulphate solution required for the titration is deducted from the volume of permanganate solution taken, the difference giving the number of c.c. of decinormal permanganate solution reduced by 10 c.c. of the sample under the above conditions, and this figure gives a comparative indication of the extent to which the sample contains oxidisable impurities. If the number of c.c. of permanganate solution reduced by 10 c.c. of the sample is multiplied by 0·008 (1 c.c. $N/10$ $KMnO_4$ 0·0008 grm. oxygen) the resulting figure gives the number of grams of oxygen absorbed from permanganate by 100 c.c. of the spirit.

Well washed samples show the reduction of from 1 to 10 c.c. of permanganate for 10 c.c., or 0·008 to 0·08 grm. oxygen absorbed per 100 c.c., but others give much higher figures owing to insufficient washing.

A completely unwashed spirit may also be tested in a similar manner to ascertain approximately the amount of washing it requires. In such cases, 10 c.c. of the sample is diluted with pure, well-washed benzene to 100 c.c., and 10 c.c. of the diluted spirit taken for the test.

Any insufficiently washed commercial benzol or toluol, *i.e.*, any sample giving a higher oxygen absorption than 0·2 grm. per 100 c.c., should be subjected to further acid-washing before testing. For this purpose a volume of 150—250 c.c. of the sample is shaken with 2% of 95% sulphuric acid, if the oxygen absorption is about 0·2 grm. per 100 c.c., an additional 1% of sulphuric acid being used for each additional 0·1 grm. of oxygen absorption. After removal of the acid layer and washing with water, aqueous caustic soda and again with water as described on p. 58 T, the washed spirit is transferred to a round-bottomed flask, fitted with a glass tube for the introduction of steam, and connected to a condenser, and distilled without introduction of steam until about two-thirds has distilled over; steam is then carefully blown through the liquid until about 50 c.c. of water has condensed for each 100 c.c. of the sample taken. The difference between the volume of spirit in the distillate, and the volume originally taken, gives the loss due to acid-washing, the percentage of which is calculated and allowed for in determining the percentages of aromatic hydrocarbons in the original insufficiently washed sample.

Analysis of fractions "up to 90°" and "90°–140°."

The percentage of benzene and toluene in the fraction up to 90°, and of benzene, toluene and xylene in the fraction 90°—140°, may be determined with considerable accuracy by distilling these under specified conditions from a simple distillation flask of standard dimensions, and a comparison of the volume of the fractions obtained between fixed temperature limits with those obtained by distilling mixtures of known volumes of the pure hydrocarbons in the same apparatus and under the same conditions.

The apparatus required for the purpose consists of: (1) A standard Engler 100 c.c. distillation flask, as employed in the petroleum industry, having the following dimensions:—Internal diameter of bulb, 6·5 cm.: length of neck, 15·0 cm.: internal diameter of neck, 1·6 cm.; vertical height of side tube above surface of liquid when flask is charged with 100 c.c., 9·0 cm.; angle of side tube, 75·0°. Flasks which do not vary more than 3% from any of these dimensions may be employed.

(2) An efficient water-cooled condenser. This is preferably a 10-inch Liebig condenser placed vertically, the connection with the flask being made by an adapter, or by having the side tube of the flask sufficiently long and bending it to fit the upper end of the condenser. The condenser used must in any case be of a form which drains quickly and as completely as possible.

(3) A set of calibrated graduated cylinders (50 and 100 c.c.).

(4) An accurate thermometer, which is fixed in the distillation flask with the top of the bulb just below the bottom of the side tube. With the above dimensions of the flask, the length of stem below the cork is then about 100 mm.

The accuracy of the determinations probably depends more on the correct reading of the thermometer than on any other single point. The thermometer used should preferably have a bulb of moderate size, and should be graduated in $\frac{1}{5}$ degrees C. over a range of at least 70° to 130°; the 80° graduation mark should be about 140 mm. from the bottom of the bulb, so that when the thermometer is fixed in the flask in the correct position, this point is well above the top of the cork.

Calibration of the thermometer. The thermometer should be graduated with an immersion of 100 mm. (this being the extent to which the stem is heated by the vapours under the conditions of the test) and then no correction is necessary for the length of the mercury column not heated by the vapour. Previous to use, it should be verified, or the corrections ascertained, for the temperatures 80°, 85°, 90°, 100°, 105°, and 116°, with 100 mm. immersion. In order to avoid mistakes in reading the thermometer it is convenient to put a distinctive mark on it at the actual graduation found to correspond on that thermometer to the corrected temperatures 80°, 85°, 90°, 100°, 105°, and 116° Nat. Phys. Lab. standard.

Correction for barometer. Before making a test, the reading of the barometer in millimetres (corrected to 0° C.) is taken, and the barometer correction ascertained from the usual formula, barom. corrn. $= 0{\cdot}00012\ (760-p)\ (273+t°)$, where p = the height of the barometer in mm. corrected to 0° C., and $t°$ the boiling point. The magnitude of the correction increases with increasing boiling point, but within the range 80° to 120° the following

table of corrections for barometric pressures from 772 to 720 mm. is of sufficient accuracy :—

p	corr.	p	corr.	p	corr.
772	−0·55	754	+0·30	736	+1·10
770	−0·45	752	+0·35	734	+1·15
768	−0·35	750	+0·45	732	+1·25
766	−0·30	748	+0·55	730	+1·35
764	−0·20	746	+0·65	728	+1·45
762	−0·10	744	+0·75	726	+1·50
760	0·00	742	+0·85	724	+1·60
758	+0·10	740	+0·90	722	+1·70
756	+0·20	738	+1·00	720	+1·80

A thermometer which has been calibrated with the stem completely immersed may also be used for the test, but in that case the correction for unheated mercury column must be made in addition to the barometer correction, in accordance with the usual formula, stem correction = $0{\cdot}000143\ (T-t^{\circ})N$, where T = the observed boiling point, t° the temperature of the air around the unheated portion of the steam, and N the length of the emergent mercury column, expressed in scale degrees. Tables for the value of this correction are given in Young's "Fractional Distillation" (Macmillan and Co.), p. 13, and a graph for the purpose by Wheeler (this Journal, 1916, 1198).

Before using a thermometer for the test, a few blank tests should be made with it, using mixtures made up of known amounts of pure benzene and toluene, and of pure benzene, toluene, and xylene, in order to ascertain that the results obtained with the thermometer are substantially correct. It has been found in one or two cases that certain thermometers, although quite correctly graduated, do not give correct results, as they have a pronounced lag. The cause of this has not been definitely ascertained, but appears to be due to the nature of the glass used in the manufacture of the thermometer. It is also advisable to carry out periodically similar blank tests on known mixtures with any thermometer in use for the analysis, to make sure that the readings given have not undergone change since its verification.

Method of distillation. In carrying on the distillation, a measured volume of the liquid to be tested is distilled from the Engler flask at the rate of about 7 c.c. per minute. A slightly higher rate has no material effect on the results, but if the rate falls much below 7 c.c. appreciably increased fractional condensation takes place in the top and neck of the distilling flask, and may cause incorrect results. The flask is heated by means of a small Bunsen flame impinging directly on the bottom of the flask, the distillation being carried out at a spot as free from draught as practicable, a cylinder of fine wire gauze being also placed to surround the burner and flask up to the level of the top of the bulb of the flask. The distillates are collected in the graduated cylinders, and when the thermometer reaches the specified temperature, the flame is extinguished, the condenser allowed to drain, and the volume of the distillate measured.

Measurement of volumes and determination of specific gravity. The specific gravities employed in the determinations are, throughout, those of the liquids at 15·5° C. compared with water at 15·5° C., and all volumes given are those of the liquids at 15·5° C. To correct the observed sp. gr. at any other temperature to that at 15·5°, in the case of spirits, 0·0009 is added for each 1° C. the observed temperature is above 15·5°, or deducted for each 1° below that temperature. In the case of tar or products consisting chiefly of high-boiling oils, the factor used is 0·0007.

Fraction "up to 90°" and commercial benzol.

When mixtures of benzene and toluene are distilled from a distillation flask under the specified conditions, the percentage of distillate at any given temperature is constant, and if the volume of distillate from 100 c.c. of the mixture to any temperature is determined for a definite rate and for a definite size of fractionating flask, then with an unknown mixture of benzene and toluene, the percentages of benzene and toluene can be found by comparing the volume of distillate obtained under the same conditions with that found in the case of mixtures containing known amounts of the two constituents (James, this J., 1916, 236).

The results obtained with pure mixtures of benzene and toluene are most conveniently plotted out in the form of a graph, temperatures suitable for the collection of the distillate being 85° corr. for mixtures containing up to 25% of toluene, and 90° corr. for mixtures containing from 20 to 40% of toluene. The percentages of toluene are plotted as ordinates, and the percentages of distillate as abscissæ. In compiling Graph 1 the following mixtures were employed :—

Up to 85° corr.		Up to 90° corr.	
Benzene c.c.	Toluene c.c.	Benzene c.c.	Toluene c.c.
97	3	80	20
94	6	75	25
90	10	70	30
85	15	65	35
80	20	60	40
75	25	55	45

In the case of the fraction "up to 90°" or of any mixtures of benzene and toluene only, not containing more than 45% of the latter, 100 c.c. (or less if the quantity available is insufficient) is distilled from the Engler flask under the same conditions and the percentage of distillate to 85° corr. or 90° corr. ascertained. From Graph 1 the percentage of toluene is read off corresponding to the percentage of distillate found, that of benzene being found by difference.

Carbon bisulphide and paraffins. When these impurities are absent, the reading obtained from the graph gives directly the percentages of benzene and toluene in the sample. The percentages of the above impurities, when present, can be ascertained, together with the necessary correction in the amounts of benzene and toluene, from a determination of the sp. gr. of the fraction or sample before and after removal of carbon bisulphide from it.

Carbon bisulphide. To carry out this determination, the sp. gr. of the sample is taken by any method giving results accurate to the third place of decimals. A further 100 c.c. (or the combined distillate to 85° or 90° and the residue from the distillation test) is then mixed with 100 c.c. of alcohol or industrial methylated spirit (free from paraffins), 5 grms. of roughly powdered caustic soda added, and the whole shaken for five minutes. 200 c.c. of water is then added, with renewed shaking; after settling, the lower aqueous layer is run off, and the spirit washed twice with successive quantities of 25 c.c. of water and dried with ignited calcium chloride. The sp. gr. of the dried spirit is then taken accurately to the third decimal place.

From the sp. gr. of the spirit before and after removal of carbon bisulphide, the percentage of carbon bisulphide present may be calculated (see Nickels, Allen's "Comm. Org. Analysis," Vol. II., part 2, p. 183; Spielmann, this J., 1916, 396) on the assumption that the sp. gr. of carbon bisulphide is 1·27, and that no expansion or contraction occurs on mixing the latter with benzene or mixtures of benzene and toluene, for then if a is sp. gr. of spirit after removal, and b the sp. gr. before removal of CS_2, and x the percentage by volume of CS_2, $1{\cdot}27x+(100-x)a=100b$, or $x=100\times(b-a)\div(1{\cdot}27-a)$.

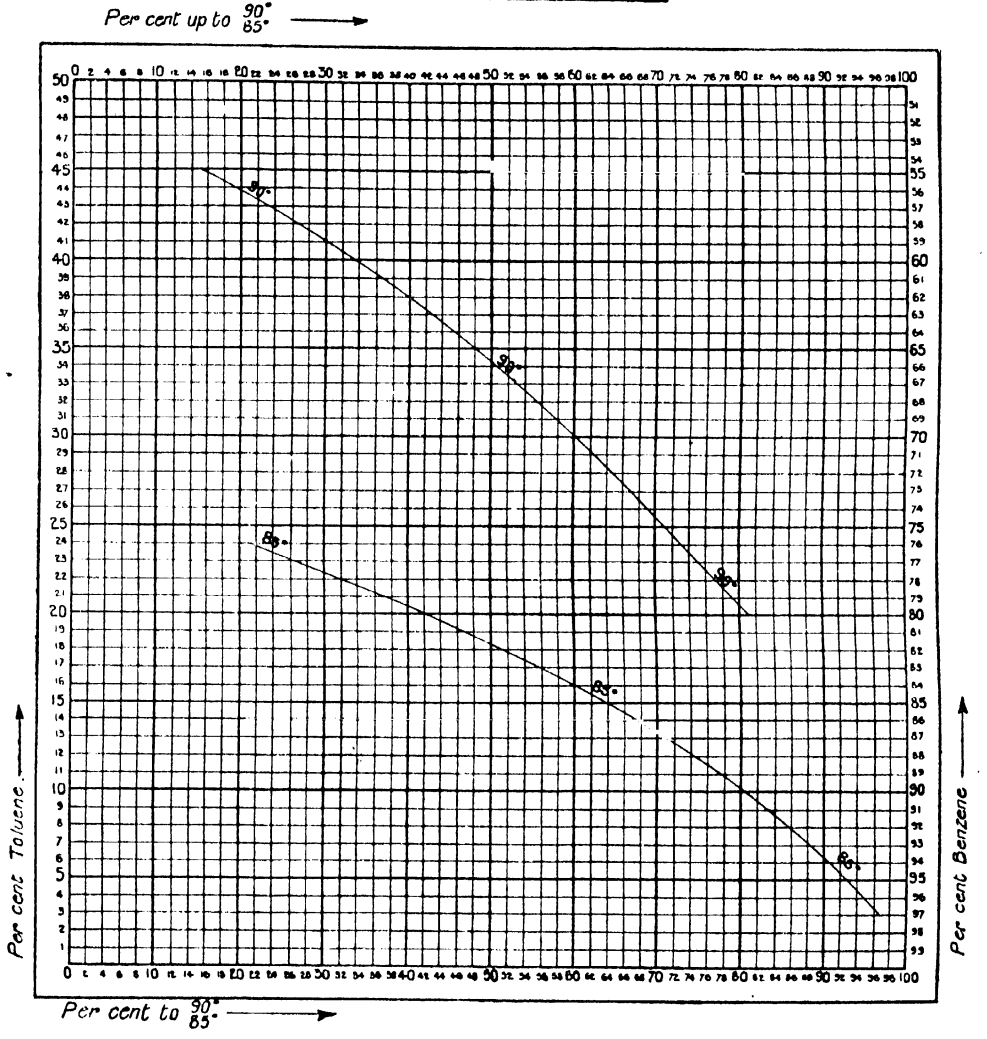
In fact, however, the assumption that no expan-

sion or contraction occurs on mixing carbon bisulphide with benzene or mixtures of benzene and toluene is incorrect, as appreciable expansion does occur (see F. D. Brown, J. Chem. Soc., 1879, **35**, 552; 1881, **39**, 205), and the observed specific gravity of mixtures of benzene or of benzene+toluene with carbon bisulphide in known proportions, is always lower than that calculated from the percentage of the components and their specific gravity by a definite amount, k, and to obtain the percentage of carbon bisulphide by volume corrected for this expansion, the value, $b+k$, must be substituted for

Graph 2 has been compiled to enable the direct reading off of the percentage of CS_2 in the sample from the sp. gr. before and after removal of CS_2, the correction for expansion being made in setting out the graph. The lower line of ordinates gives the observed sp. gr. before CS_2 removal, and the abscissæ the observed sp. gr. after CS_2 removal, the percentage of CS_2 being read off from these on the broken black lines marked 0—5% of CS_2.

Paraffins.—In a similar manner, the percentage of paraffins present may be calculated from the observed sp. gr. of the sample after removal of CS_2,

BENZENE - TOLUENE GRAPH 1.



b in the above formula, which then becomes

$$x = 100 \times \{ (b+k) - a \} \div (1{\cdot}27 - a).$$

The value of k varies with different proportions of carbon bisulphide and also slightly with differences in the proportion of toluene present, but an average figure for this value for percentages of carbon bisulphide up to 5% may be taken without material error as follows:—

% CS_2	k
1	0·0010
2	0·0015
3	0·0020
4	0·0024
5	0·0027

and the sp. gr. which a sample containing the percentage of toluene found would have if paraffins were absent. As no material expansion occurs on mixing benzene and toluene at any rate with the amounts of the latter found in the fraction "up to 90°" or in commercial benzol, this last figure may be directly calculated with sufficient accuracy from the percentage of benzene and toluene found by the distillation to 85° or 90°.

Expansion does, however, occur on mixing paraffins with benzene or mixtures of benzene and toluene, and correction must be made on this account in the case of paraffins as well as with CS_2, and the necessary formula becomes:—

percentage by volume of paraffins in CS_2-free spirit
$=100\times\{(a+k')-c\}\div(p-c)$.
where a is observed sp. gr. after CS_2 removal, c the sp. gr. of paraffin-free benzene-toluene mixture calculated from the distillation to 85°, p the sp. gr. of paraffins, and k' the correction for expansion.

The exact sp. gr. of the paraffins present is unknown, but it has been found by isolation of them from these products, that this may be taken without material error as 0·730 in this fraction up to 90° or in commercial benzol. The value of k' also varies considerably according to the percentage of paraffins present (the expansion being much greater on the addition of the first 1% than for any succeeding 1%) and also slightly with the percentage of toluene in the mixture, but for practical purposes, the following values of k' may be taken.

Paraffins %	k'
1	0·0017
5	0·0021
10	0·0025
15	0·0029
20	0·0033

From the observed sp. gr. of the sample after removal of CS_2 and the percentage of toluene found by Graph 1 uncorrected for paraffins, the percentage of paraffins in the sample after removal of CS_2, may be read directly from Graph 2. The upper line of ordinates gives the "uncorrected" percentage of toluene found, and the abscissæ the observed sp. gr. of the sample freed from CS_2, the percentage of paraffins being read off from these on the full black lines marked 0–25% of paraffins.

The percentage of paraffins thus found, is that in the sample after removal of CS_2, and to obtain the true percentage of the paraffins in the original sample, this figure must be multiplied by 100−C, and divided by 100, where C is the percentage of CS_2 found in the sample.

The percentages of benzene and toluene found by Graph 1 are those which would be the case if no carbon bisulphide and paraffin were present. The total number of volumes of benzene+toluene present in 100 volumes is 100−C−P, where C and P are the percentages found of these two impurities. In the distillation to 85° or 90°, carbon bisulphide behaves as though it were benzene, and if paraffins are absent but CS_2 present, the result obtained by Graph 1 gives the true percentage of toluene correctly, and the true benzene figure is 100−C−T, where T is the percentage of toluene found.

Whether the paraffins, when present, are of such boiling point that they are proportionately divided between the benzene and toluene fractions is uncertain and probably variable with different samples, but the evidence appears to show that they are in fact roughly proportional, and that if this is assumed no material error results.

Making this assumption when CS_2 and paraffins are present, the percentages of benzene and toluene may be calculated as follows:—The total volume of benzene and toluene present is 100−C−P. Then if B^1 and T^1 are the percentages of benzene and toluene found by Graph 1 from the percentage distilling to 85°, and B and T the true percentages of benzene and toluene corrected for paraffins and carbon bisulphide present,

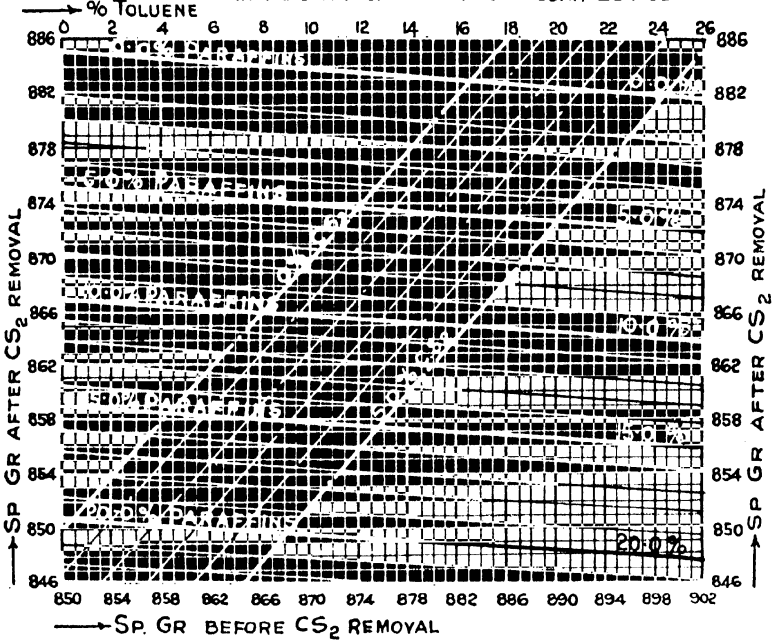
$$B=(100-C-P)(B^1-C)\div(100-C),$$
$$T=(100-C-P)T^1\div(100-C).$$

With most products from tar consisting chiefly of benzene, the percentage of paraffins and CS_2 present is comparatively small, that of carbon bisulphide being mostly from 0·5 to 1·5%, and that of paraffins not exceeding 5—6%, being in the majority of cases much less: in such samples the percentage of benzene and toluene corrected for these may be obtained with sufficient accuracy by a simpler calculation, namely by multiplying the percentages of those found by Graph 1 by 100 *minus* the combined percentages of carbon bisulphide and paraffins found by Graph 2, and dividing by 100, in which case

$$B=B^1\times(100-C-P)\div100, \text{ and}$$
$$T=T^1\times(100-C-P)\div100.$$

With only such amounts of carbon bisulphide and paraffins present, the figures obtained by the shorter method differ only by fractions of 1% from those found by the longer method, *i.e.*, by an amount which is smaller than the unavoidable experimental

GRAPH 2. PERCENTAGE OF CS_2 AND PARAFFINS IN FRACTION "UP TO 90°" AND IN COMM BENZOL



errors. The longer method is only necessary with products such as the "fore-runnings" collected in large scale distillation previous to collecting "commercial" benzol containing much CS_2 (see Spielmann and Butler-Jones, this J., 1916, 911) and with products containing very high proportions of paraffins, such as are sometimes obtained from vertical retort tars, or from the low temperature carbonisation of coal.

Commercial benzol. Samples of commercial benzol may be analysed by the method given for the "fraction up to 90°" (see page 60 T), but in certain cases slight modifications are advisable, namely if (1) the percentage of toluene present is less than 3—4%, and (2) if the percentage of toluene is high.

Where the percentage of toluene is below 3—4%, the method is slightly modified by distilling to 85° a mixture of 95 c.c. of the sample with 5 c.c. of pure toluene. From Graph 1 the percentage of toluene in this mixture is read off from the percentage distilling to 85°, and this figure *minus* the 5 c.c. of toluene added, multiplied by 100 and divided by 95, gives the percentage of toluene in the original sample, the difference between this figure giving the percentage of benzene in the sample, if carbon bisulphide and paraffins are absent. The corrections for these are ascertained as specified above.

Where the percentage of toluene is high, this is mostly accompanied by small quantities of xylene, and in the test such xylene counts as an equal amount of toluene. For many purposes this is immaterial, and the results given by the test are correct if the figure found for toluene is recorded as "toluene+xylene." If it is desired to ascertain the separate percentages of toluene and xylene, 500 c.c. of the sample is distilled with a Young 12-bulb pear column, the fraction "up to 90°" analysed as above, and the residue at 90°, consisting of benzene, toluene, and xylene, analysed by the method given below for the "fraction 90°—140°." With a product such as the commercial 50/90's benzol, which always contains considerable amounts of xylene, this procedure is always advisable.

Unwashed benzol. In some works it is the practice to fractionate the crude naphtha previous to washing with acid, etc., and then to subject the unwashed benzol and unwashed toluol separately to the washing process.

To analyse such a sample of unwashed benzol, it is washed with 8% of its volume of concentrated sulphuric acid, in the manner described on p. 58 T. The washed spirit is transferred to a round-bottomed flask, fitted with a tube for introducing steam, and distilled with steam as already described (p. 57 T). The distillate after removal of water is analysed by the method just described, due allowance being made for the loss on acid washing in calculating the percentages of benzene, toluene, carbon bisulphide, and paraffins in the original unwashed sample.

Fraction 90°—140° C. and commercial toluol.

The principle upon which the determination of the percentages of benzene, toluene, and xylene in such samples is carried out is as follows:—When the distillation of mixtures of these hydrocarbons in known proportions is carried out in the same apparatus and under the same conditions as described for the "fraction up to 90°," it has been found that the percentage of the distillates obtained between fixed ranges of temperature is quite constant, and that if a graph be drawn up in which the percentages boiling below a fixed temperature are plotted as ordinates, and the percentages of residue at a higher fixed temperature as abscissæ, the points on the graph corresponding to the known percentages of benzene and toluene in the mixture lie on regular curves. From the results obtained in a large number of distillations of mixtures containing varying but known amounts of pure benzene, toluene, and xylene and measuring (1) the percentage boiling up to 105° corr. and (2) the residue left at 116° corr., Graph 3 has been plotted in the manner mentioned, the continuous line curves giving the percentage of toluene and the broken line curves the percentage of benzene corresponding to the percentages of distillate up to 105° and above 116°. With a mixture of benzene, toluene, and xylene in unknown quantities, the percentages of distillate up to 105° corr. and above 116° corr. are ascertained and the percentages of benzene and toluene present may then be directly read off on Graph 3 from the broken line curves and full line curves respectively. The percentage of xylene is found by difference. There seems no reason why a similar method should not be employed for determining three successive members of any homologous series provided that they do not form constant boiling mixtures and that their boiling points are not too close together.

Note. In the method as originally published, the temperatures for the interruption of the distillation were taken as 105° and 117°, and for special reasons which were only of a temporary nature, the thermometer graduated with complete immersion of the stem, and an approximate correction for barometer and unheated stem employed. For several reasons it has been found better to employ a thermometer graduated with 100-mm. immersion to avoid the necessity of making any correction for unheated stem, which makes slight alterations in the form of the graph, and in order to avoid confusion between the old and new graphs, the latter was drawn up for a different temperature interval.

The method, with the specified interruption points of 105° and 116° only holds generally for samples containing 50—75% of toluene, and for such as give at least 5% of distillate up to 105° and 5% above 116°. Samples which do not fall within these limits can, however, be readily analysed by the method by adding to them such known amounts of pure benzene, toluene, or xylene as bring the mixture within these limits, and distilling the mixture under the standard conditions. From the percentages of benzene, toluene, and xylene found in the mixture, and from the known amounts of benzene, toluene, or xylene added to it, the percentages of the hydrocarbons in the original sample are readily calculated.

If in addition to xylene small quantities of cumenes or similar higher boiling aromatic hydrocarbons are present, the results obtained by the test are unaffected, except in so far that the difference figure between 100 and the percentages of benzene plus toluene then gives the percentage of xylene plus higher boiling aromatic hydrocarbons instead of that of pure xylene.

Carbon bisulphide, if present in the sample in more than a small amount, renders the results less accurate, but it is never present in appreciable amount in the fraction 90°—140° prepared as described. Commercial products, such as 50/90's benzol, may contain more of this impurity, but such samples, as already mentioned, should first be distilled into a fraction up to 90° and residue at 90°, and the two fractions analysed separately.

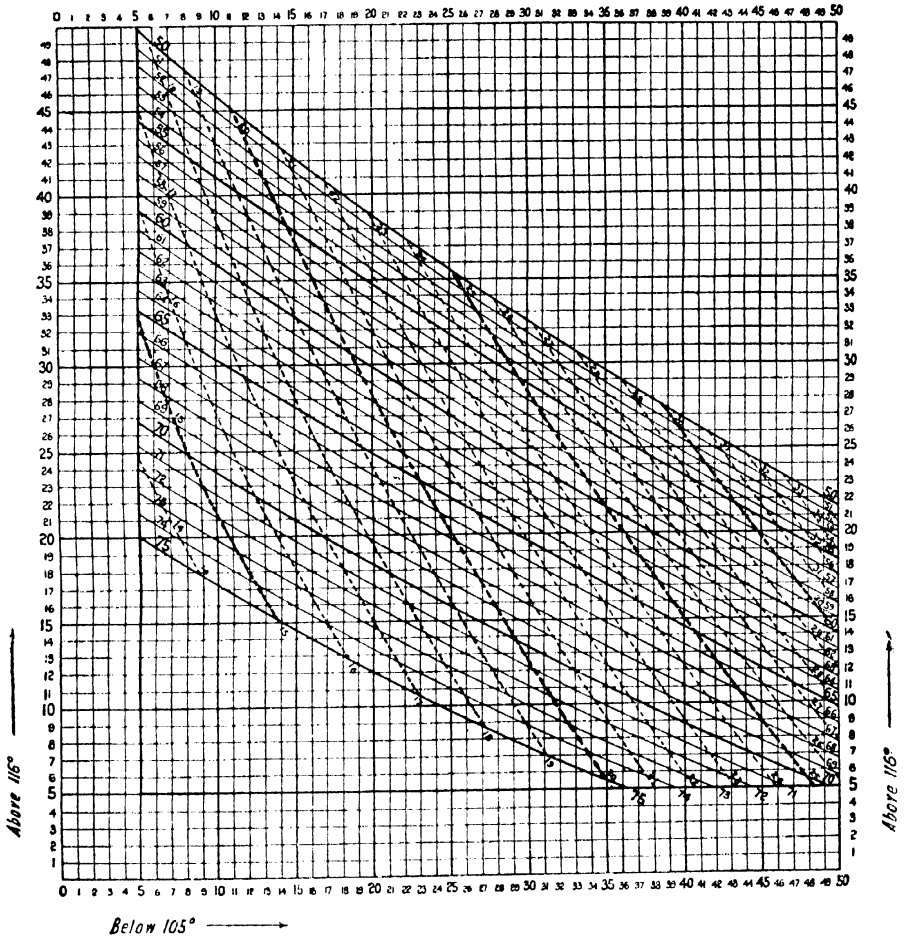
Paraffins, when present, affect the results somewhat, but a correction for the error thus caused and an estimation of the percentage of paraffin present can be ascertained from the sp. gr. of the sample in the manner described later.

Method of distillation. As in the case of the fraction "up to 90°," 100 c.c. of the fraction 90°—140° is distilled from the standard Engler flask at the rate of about 7 c.c. per minute. When the thermometer shows a temperature of 105° corr. the dis-

tillation is stopped, the condenser allowed to drain, and a fresh cylinder placed under the condenser. The distillation is then continued under the same conditions until the thermometer shows a temperature of 116° corr., when the distillation is again interrupted. The residue, after cooling, is poured into a third cylinder, and the contents of the three cylinders are measured at a temperature approximating to that of the 100 c.c. taken for analysis. The total volume of the three fractions up to 105°, 105°—116°, and above 116°, should not amount to less than 99·5 c.c.

In the absence of paraffins, the percentages of benzene and toluene are directly read off from the

BENZENE-TOLUENE-XYLENE GRAPH 3 *Benzene Curves Black Dotted* *Toluene Curves Black Full.*



percentages below 105° and above 116° by means of Graph 3.

If as the result of the distillation, values for the fractions up to 105° and above 116° are obtained which give no value for benzene and toluene on Graph 3, owing to the composition of the sample being such that it does not fall within the limits already specified, a further portion of the sample is taken less than 100 c.c. and made up to 100 c.c. with a known amount of pure benzene, toluene, or xylene. The quantities of these which it is necessary to add vary according to the composition of the sample, but with a little practice it becomes very easy to estimate the amounts which should be added. The following are examples frequently met with:—

(1) The percentage of the sample boiling either up to 105° or above 116° may be below 5%. In this case 90 c.c. of the sample is taken and mixed previous to distillation with 10 c.c. of benzene, if the distillate up to 105° was below 5%, or with 10 c.c. of xylene if the residue above 116° was below 5%. Thus, if the first test showed less than 5 c.c. below 105°, and a mixture of 90 c.c. of the sample with 10 c.c. of benzene gave 10 c.c. to 105° and 21 c.c. above 116°, then from Graph 3 the amount of benzene in the mixture is 15%, and that of toluene 72%. As 10 c.c. of benzene was added, the 90 c.c. of the original sample contains 15−10=5 c.c. of benzene and 72 c.c. of toluene, whence, in the original sample benzene $=5\times100\div90=5{\cdot}5\%$; toluene $=72\times100\div90=80{\cdot}0\%$; xylene $=100-5{\cdot}5-80=14{\cdot}5\%$.

(2) The percentage boiling both below 105° and above 116° may be below 5%. In this case 80 c.c. of the sample may be mixed with 10 c.c. of benzene and 10 c.c. of xylene, or if the percentage of toluene is very high, 75 c.c. of the sample is mixed with 15 c.c. of benzene and 10 c.c. of xylene. The percentage of benzene found in the mixture, less the quantity of benzene added and that of toluene found

(without deduction) multiplied by the number of c.c. of original spirit taken and divided by 100, then gives the percentages of benzene and toluene in the original, that of xylene being found by difference.

(3) The percentage boiling above 116° may be so high that no reading can be obtained on the graph. With this class, 80 c.c. is mixed with 20 c.c. of benzene and the mixture analysed, the percentages of benzene, toluene, and xylene in the original sample being calculated in a similar manner.

(4) The percentage boiling below 105° may be so high that no reading can be obtained on the graph. In such cases, which include samples with rather high percentages of benzene, and in many cases the fraction "90°—140°" obtained as specified above, 80 c.c. of the sample is mixed with 20 c.c. of toluene. Where the percentage of benzene is very high, the mixture of 80 c.c. with 20 c.c. of toluene may still contain below 50% of toluene. This rarely occurs with the fraction 90°—140° obtained as specified, but may happen with products such as 50/90's commercial benzols. In such cases a smaller volume of the original and a larger amount of toluene may be taken, but the smaller the proportion of the original taken, the greater is the unavoidable experimental error in the results. Where results are desired as accurate as possible, and the quantity of the sample available permits of it, it is then better to distil 250 c.c. of the sample with a column into the fractions "up to 90°," and "above 90°," and to analyse these separately, the first by the method given above for the fraction "up to 90°" and the second by that for the fraction "90—140°."

Paraffins in fraction 90°—140°.- The results obtained in the manner described give the percentages of benzene, toluene, and xylene, on the assumption that no paraffins are present. When these are present, they count in the test as aromatic hydrocarbons, and thus bring about an error in the results. From blank tests made with mixtures of the three aromatic hydrocarbons with paraffins, it has been found that when the percentage of paraffins does not exceed 5--7%, no material error is caused by assuming that the result for each of the three aromatic hydrocarbons is affected in proportion to the total percentage of paraffins present, and that the true percentages of benzene, toluene, and xylene may be obtained by multiplying the "uncorrected" percentages found as above by 100 *minus* the percentage of paraffins present and dividing by 100.

The percentage of paraffins present may be found with a fair degree of accuracy, from the sp. gr. of the sample, in a manner similar to that employed in the case of the benzene fraction. The sp. gr. of a mixture of benzene, toluene, and xylene of the "uncorrected" percentages found can be calculated from the sp. gr. of pure benzene, toluene, and xylene.

If there were no expansion or contraction occurring when benzene, toluene, and xylene are mixed, and also no expansion or contraction on the addition of paraffins to this mixture, then if a is the calculated sp. gr. of paraffin-free mixture, b the observed sp. gr. of the sample, and c the sp. gr. of paraffins present, the percentage of paraffins present would be:—

$$100 \times (b-a) \div (c-a).$$

But, in fact, expansion occurs both when benzene, toluene, and xylene are mixed and also on addition of paraffins to these mixtures. If k^2 is the fall in sp. gr. due to expansion on mixing benzene, toluene, and xylene, and k^3 the further fall on addition of paraffins to this mixture, then

$$\% \text{ paraffins} = 100 \times \frac{\{[b+(k^2+k^3)]-a\}}{\{c-(a+k^2)\}}.$$

The value of k^3 varies somewhat, but within the range of the proportions of benzene, toluene, and xylene usually present in the fraction 90°—140° or in commercial toluol, it may be taken as having a constant value of 0·0010. The value of k^2+k^3 for the combined fall in sp. gr. on mixing benzene, toluene, xylene and paraffins has been found experimentally as an average value as follows:—

Paraffins %	k^2+k^3
1	0·0012
2	0·0014
5	0·0019
10	0·0022
15	0·0025
20	0·0030

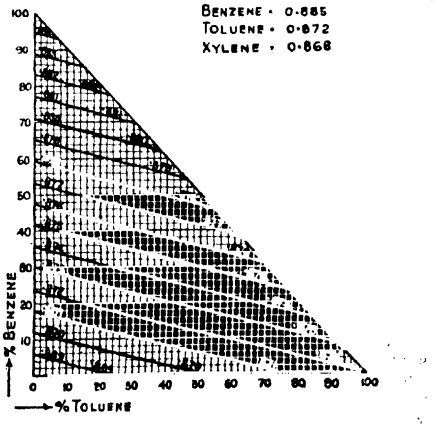
The average value of the sp. gr. of the paraffins present in this fraction may also vary, but has been found by isolating them to be usually about 0·74 which is taken as the value of c.

The sp. gr. of benzene, free from paraffin hydrocarbons, is 0·885. With regard to the sp. gr. of pure toluene, authorities differ. The figure is usually given as 0·870, which is rarely exceeded in samples of commercial "pure toluene" obtained from coal-tar. W. H. Perkin, senior, however (J. Chem. Soc., 1896, 1191), showed that when such toluene is converted into the sulphonic acid and the latter purified and reconverted into toluene, the hydrocarbon thus obtained, absolutely free from paraffins, has the sp. gr. of 0·8721, and a repetition of his work has confirmed this figure. The sp. gr. of toluene, free from paraffins, is therefore taken as 0·872.

In the case of xylene, the sp. gr. is in any case uncertain, as this is a mixture of *o*-, *m*-, and *p*-xylene, each of which has different boiling point and different specific gravity. Perkin found the sp. gr. of these three xylenes, when pure, to be:—*o*-xylene 0·8818, *m*-xylene 0·8691 and *p*-xylene 0·8661; as the mixtures of xylenes from coal-tar etc. usually consist to the largest extent of *m*-xylene, with a smaller amount of *p*-xylene, and still smaller amounts of *o*-xylene, the average sp. gr. of the xylene mixture entirely free from paraffins may be taken as 0·868. Commercial "pure xylene" rarely has a higher sp. gr. than 0·865—0·866, and like the commercial "pure toluene," still contains small amounts of paraffins.

Having obtained the "uncorrected" percentage of benzene, toluene, and xylene in the sample in the manner already described, and also the sp. gr.

GRAPH 4 CALCULATED SP GR OF PARAFFIN-FREE MIXTURES OF BENZENE, TOLUENE AND XYLENE

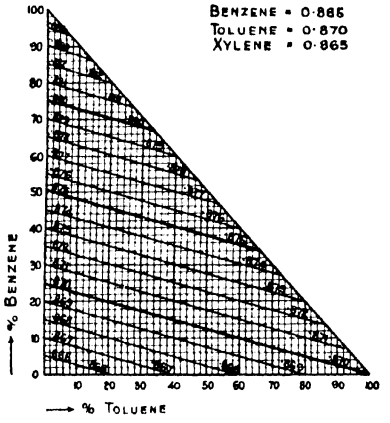


of the sample, the percentage of paraffins is determined as follows:—from Graph 4 the calculated sp. gr. of the mixture is read off from the percentages of benzene and toluene found (the sp. gr.

of the pure hydrocarbons being taken as 0·885, 0·872, and 0·868 respectively), and the percentage of paraffins is then read off from the observed and calculated sp. grs. by means of Graph 5, which is drawn up from the formula given, allowing for the expansions which occur. The "corrected" amounts of benzene, toluene, and xylene are then obtained by multiplying the "uncorrected" figures by 100 *minus* the percentage of paraffins, and dividing by 100.

For many purposes it is frequently desired to ascertain the percentage present, not of the true paraffin-free toluene or xylene, but that of the percentages of ordinary "commercially pure toluene" of sp. gr. 0·870 and of "commercially pure xylene" of sp. gr. 0·865. To enable these percentages to be ascertained readily Graph 4A has been drawn up in exactly the same manner as 4, but taking the sp. gr. of toluene as 0·870 and of xylene as 0·865, and the readings obtained from these Graphs 4A and 5 give directly the percentages of commercially pure toluene of sp. gr. 0·870 and

GRAPH 4A. Calculated Sp. Gr. of Paraffin-free Mixtures of Benzene, Toluene and Xylene



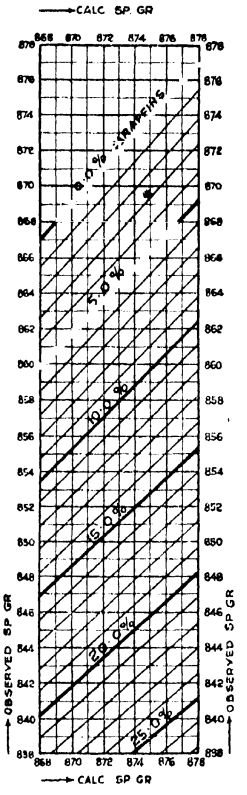
commercial xylene of sp. gr. 0·865. The percentage of paraffins, of course, then comes out slightly less, as a small amount of these is included in the "commercially" pure toluene and xylene.

As previously stated, when the percentage of paraffins exceeds about 7%, the "uncorrected" figures obtained for benzene, toluene, and xylene are not necessarily in proportion to the true percentages present, and the "corrected" figures obtained in the manner specified may be in error to the extent of 2—3%. With most coal-tar products, the percentage of paraffins rarely exceeds 5%, but in certain samples, such as the products from coal-tar obtained in vertical retorts, the percentage may rise to 20%, and is often still higher with products obtained by very low temperature carbonisation.

Blank tests with known mixtures of the aromatic hydrocarbons containing up to 10—25% of paraffins have shown that this error may be greatly reduced, if in the distillation of the fraction "90°—140°" such quantities of benzene, toluene or xylene are added to it that the mixture contains between 52 and 58% of toluene uncorrected for paraffins, and on distillation gives not less than 20% respectively of distillate up to 105° and residue "above 116°." For percentages of paraffins above 25%, whilst the method gives fairly accurate figures for the percentage of paraffins, no method has been found whereby it is possible to get accurate determinations of the percentages of benzene, toluene, and xylene present.

Unwashed toluol. In some cases in works practice the toluol fraction is separated by distillation from the crude naphtha previous to acid washing. For the analysis of such samples, 150—250 c.c. of the spirit is washed with acid and steam distilled in the manner described for unwashed benzol on

GRAPH 5. Percentage of Paraffins in Fraction 90°–140° and in Comm. Toluol.



p. 57 T. If the percentage of xylene is not required, instead of steam-distilling the residual oil after treatment with sulphuric acid etc., this may be distilled without steam, using a good column, and collecting the distillate to 140° (adding a little xylene if the thermometer does not reach 140°) and making up the distillate with pure xylene to the volume of unwashed toluol originally taken.

Fraction 140°–160°, and commercial solvent naphtha.

The fraction 140°—160°, obtained from the preliminary distillation of coal-tar etc. in the manner described, consists of the constituents present in commercial coal-tar solvent naphtha, namely, xylenes, cumenes, and other aromatic hydrocarbons of boiling points up to about 170° C. If to the percentage of this fraction found there is added the percentage of xylene (calculated on the original tar) found in the fraction 90°—140°, the combined figure gives an approximate estimation of the quantity of commercial solvent naphtha contained in the tar.

Owing to the large number of hydrocarbons present, and the fact that the boiling points of the constituents are in many cases so near together, it is not possible by any distillation method to make any determination of the relative amounts of the individual constituents. The composition of the commercial products varies considerably,

but when prepared from crude tar fairly free from paraffin hydrocarbons, its sp. gr. is usually from 0·865 to 0·866. Each 0·001 that the specific gravity of a sample of xylene or solvent naphtha is found below 0·868 indicates the presence of approximately 1% of paraffins. The commercial product also often contains a higher percentage of unsaturated hydrocarbons than is the case with commercial benzol and toluol, since for many purposes for which solvent naphtha is employed, the complete removal of these is unnecessary, and therefore the acid washing to which it is subjected in practice is less severe.

Benzene and toluene in commercial solvent naphtha. The commercial product mostly contains varying amounts of toluene and in addition sometimes contains small quantities of benzene. To determine with accuracy the amount of these hydrocarbons present, 250 c.c. of the sample is distilled with a good column at the rate of about 4 c.c. per minute, and the distillate to 142° collected. This first distillate is then again fractionated in the same apparatus, the distillate being now collected to 138° and its volume measured. This second distillate is essentially identical with a commercial toluol, rather high in xylene and low in benzene content, and is analysed by the method given above, the quantity of benzene and toluene found being calculated to percentages of the original solvent naphtha.

A quicker method, giving results sufficiently accurate for many purposes, is to distil 100 c.c. of the sample with a column, the distillate to 138° being collected in a 100 c.c. cylinder. To this is added 20 c.c. of benzene, and the contents of the cylinder then made up with toluene to 100 c.c. This mixture is then distilled, and the fractions "up to 105°" and above 116° determined, and the percentages of benzene and toluene in the mixture read off on Graph 3. The percentage of benzene found in the mixture, less the 20 c.c. added, and the percentage of toluene found, less the amount added to make up 100 c.c. give directly the percentages of benzene and toluene in the original solvent naphtha.

Fraction 160°—200°.

The amount of this fraction, obtained from the original preliminary distillation of the tar or oil, gives an approximate figure of the amount of "heavy solvent naphtha" contained in the tar. Commercial heavy solvent naphtha, like the light solvent naphtha, consists chiefly of aromatic hydrocarbons, but in the heavy naphtha, the boiling point of these lies mainly from 160° to 200°. Any paraffins of similar boiling point present in the original tar are also contained in this fraction. As with solvent naphtha, the number of constituents is so large and their boiling points so close together, that their estimation by any distillation method is impracticable. The sp. gr. of the fraction from different tars also varies so much that even an approximate estimation of the percentage of paraffins present is hardly practicable by this means.

Degree of accuracy of method.

During the past four years some hundreds of blank tests have been made of mixtures made up with known amounts of pure benzene, toluene, xylene, carbon bisulphide, and paraffins in order to determine the degree of accuracy which may be expected in the analysis, especially of the fractions "up to 90°" and "90°—140°" corresponding to commercial benzol and commercial toluol.

In the case of the fraction "up to 90°" when this consists of benzene and toluene only, the figures obtained show that when using an accurately calibrated thermometer and adhering to the conditions specified, the results given by the analysis differ only from the quantities actually taken by less than 0·5%, and even when paraffins are present, unless their percentage is high, the results rarely differ from the true figures by more than that amount. The percentage of carbon bisulphide usually comes out correct within 0·1%.

With the fraction 90°—140°, and in properly washed commercial toluol, in the absence of paraffins, the results obtained for all three constituents benzene, toluene, and xylene are almost always within 0·5% of the true figures. A series of 140 tests of mixtures of known amounts of pure benzene, toluene, and xylene in which the relative amounts were varied as much as possible, showed that of the 420 separate determinations of the three constituents, none differed from the correct figure by 1%, and in only six cases was the error more than 0·5%. The average quantities of benzene, toluene, and xylene in the 140 mixtures taken were as follows:—Benzene 21·4%, toluene 61·7%, xylene 16·9%, and the average quantities found were identical, the errors in the individual tests balancing each other.

With quantities of paraffins not much exceeding 5%, the experimental error is slightly greater, but rarely exceeds 1%. With higher percentages of paraffins the possible error increases, but if the precaution is taken mentioned on p. 66 T with regard to the composition of the actual mixture distilled to determine the percentages boiling below 105° and above 116°, the error rarely much exceeds 1% up to 25% of paraffins, though in the absence of this precaution the error in the percentage of toluene present may rise to 3%. Above 25% of paraffins the magnitude of the possible error increases considerably.

The length of time required for the preliminary distillation of the tar or oil varies considerably according to the quantity of the latter which has to be taken to give a sufficient quantity of the light fraction for the further analysis, and also, as is well known, especially according to the amount of water and solid matter ("free carbon") in the tar. The further complete analysis of the unwashed fraction to 200° takes from 3½ to 4 hours, but if the analysis of two or more samples is carried on simultaneously, the average time required is considerably less.

In the subjoined schedule, the detailed results are given resulting from the analysis of a "crude benzol" from gas made in vertical retorts, containing carbon bisulphide and a somewhat large percentage of paraffins, which exemplifies the carrying out of the method and the necessary calculations:—

Analysis of crude benzol from vertical retorts.

Volume taken for analysis, 500 c.c., sp. gr. at 15·5° C. 0·854:—

Original sample.

Distillate to 200°	462 c.c.
Residue at 200° (diff.)	38 ,,

Unwashed fraction to 200°.

Vol. after alkali washing	458 c.c.
Loss	4 ,,
Vol. after acid washing	420 ,,
Loss	38 ,,

Fractionation of washed distillate.

		Sp. gr.
Up to 90°	160 c.c.	0·856
90°-140°	147 ,, ...	0·840
140°-160°	37 ,, ...	0·824
160°-200°	30 ,, ...	0·840
Residue at 200° by diff.	46 ,, ...	—

Washed distillate "up to 90°."

100 c.c. gave 83·3 c.c. up to 85°.
From Graph 1. Benzene=90·0% unc.
Toluene=10·0% ,,
Sp. gr. before CS_2 removal, 0·856
,, after ,, 0·854
From Graph 2. CS_2=0·5%. Paraffins=17·2%.

	% Comp. of fraction	Comp. of 83·3 c.c.
CS_2	0·5%	... 0·8 c.c.
Paraffins	17·2%	... 27·5 ,,
Benzene	74·1%	... 118·6 ,,
Toluene	8·2%	... 13·1 ,,

Washed distillate 90°–140°.

81 c.c.+19 c.c. Toluene+0 c.c. Benzene.

		From Graph 3
Up to 105° ...	39·8%	Benzene=29·3%
105–116° ...	35·3%	Toluene=53·6%
Above 116° ...	24·5%	Xylene=17·1%

	In 81 c.c. of w.d. 90°–140°	In 100 c.c. of w.d. 90°–140°
Benzene, unc.	29·3 ...	36·2
Toluene, unc.	34·6 ...	42·7
Xylene, unc.	17·1 ...	21·1
Sp. gr. of fraction		0·840
Calc. sp. gr. of paraffin-free sample from Graph 4		0·876

Therefore, from Graph 5 paraffins=24·7%.

	% Comp. of fraction	Comp. of 147 c.c. of fract.
Paraffins	24·7%	... 36·3 c.c.
Benzene	27·2%	... 40·1 ,,
Toluene	32·2%	... 47·3 ,,
Xylene	15·9%	... 23·3 ,,

In order to check, as far as possible, the accuracy of the results, a mixture was made up of the number of c.c. found of CS_2, petrol (free from aromatic hydrocarbons) boiling from 80° to 140°, pure benzene, pure toluene, solvent naphtha free from toluene, and heavy naphtha. To the naphthas, however, were previously added paraffins of similar boiling point to make their sp. gr. approximately 0·83 and 0·84. This mixture was then analysed in the prescribed manner, the following results being obtained:—

	Taken %	Found %
CS_2	0·2	0·2
Paraffins to 140°	17·1	16·5
Benzene	42·2	43·3
Toluene	16·2	16·5
Solvent naphtha	16·2	14·1
Heavy naphtha	8·0	9·4

——	Fraction up to 90°	Fraction 90°–140°	Fraction 140°–160°	Fraction 160°–200°	Loss on alk. washing	Loss on acid washing	Fraction over 200° wash. dist.	Fraction over 200° original	Total in 500 c.c. original	Percent. of original
CS_2	0·8	—	—	—	—	—	—	—	0·8	0·2
Paraffins to 140° ..	27·5	36·3	—	—	—	—	—	—	63·8	12·8
Benzene	118·6	40·1	—	—	—	—	—	—	158·7	31·7
Toluene	13·1	47·3	—	—	—	—	—	—	60·4	12·1
Solvent naphtha ..	—	23·3	37·0	—	—	—	—	—	60·3	•12·0
Heavy naphtha ..	—	—	—	30·0	—	—	—	—	30·0	•6·0
Loss on alk. wash ..	—	—	—	—	4·0	—	—	—	4·0	0·8
Loss on acid wash ..	—	—	—	—	—	38·0	—	—	38·0	7·6
Above 200° washed distillate	—	—	—	—	—	—	46·0	—	46·0	9·2
Above 200° in original	—	—	—	—	—	—	—	38·0	38·0	7·6

• These contain approximately 40–45% paraffins.

Newcastle Section.

Meeting held at Bolbec Hall on February 12th, 1919.

PROF. P. F. BEDSON IN THE CHAIR.

THE SOFTENING POINT OF PITCH.

BY PERCY E. SPIELMANN, PH.D., B.SC., F.I.C., AND G. CAMPBELL PETRIE, F.I.C., A.R.T.C.

When it becomes necessary to characterise, by a numerical value, a property which is practically non-existent, there must inevitably arise a considerable number of empirical and arbitrary assumptions and restrictions.

The softening of pitch occurs at no particular moment: on rise of temperature, pitch gradually and imperceptibly changes from a brittle or exceedingly thick and slow-flowing material to a softer and less viscous liquid. For this reason the softening point has to be assumed to be at an arbitrarily fixed point, and many attempts have been made to standardise it and make it easily reproducible.

The following are some attempts, both simple and relatively complicated, to achieve this end:—

Biting test. Even recent literature has described this primitive method as being one still in use—the feel of the pitch when bitten between the teeth.

Change of appearance has been employed by Klimont (*Z. anal. Chem.*, 1900, **13**, 761; Analyst, 1900, **25**, 300), and also by Richardson (Allen's Commercial Organic Analysis, 1910).

Twisting test. The facility with which pitch can be twisted without being broken at a particular temperature is only a slight improvement on the biting test, and cannot be satisfactorily standardised.

Bending and sagging tests. These tests are somewhat more precise. When a bar of pitch is supported at its centre in water, of which the temperature is raised at a definite rate, the temperature at which the pitch deviates from its original horizontal position is fairly definite.

Muck (*Z. anal. Chem.*, 1890, **29**, 153; *Z. Berg- und Hütten- und Sallenwesen*, 1889) and Maybury and Sieplein (*J. Amer. Chem. Soc.*, 1901, **20**, 16) have employed this test under specified conditions. The present authors have been required to employ the test in the following manner:—A bar of pitch 1½ in. long and ½ in. by ½ in. section was suspended at its centre in a beaker of water which was heated at the rate of 1° C. a minute. The softening point could hardly be determined to within about 2° C., but was fairly easily reproducible.

Powder compressed by weight. Powdered pitch was introduced into a specially shaped receptacle, and was subjected to pressure by means of a

definite depth of mercury or by a weighted piston. Schenk zu Schweinsberg (Z. angew. Chem., 1890, 3, 704) and Kraemer and Sarnow (Chem. Ind., 1903, 36, 53) appear to have been the first to have worked out this method; whilst Margosches (Chem. Rev. Fett- u. Harz-Ind., 1904, 11, 227), Wendriner (Z. angew. Chem., 1905, 18, 622; Analyst, 1905, 30, 251), Bauer (Chem. Ind., 1905, 26, 55), Kolbe (Inaug. Diss., Zurich, 1908) and Klinger (Analyst, 1914, 39, 136, 321) have all adopted Kraemer and Sarnow's method with certain modifications.

Dropping test. The temperature at which a pellet of pitch drops from a support, such as the bulb of a thermometer, from a plate pierced with a hole, and so on, has been adopted by Buchanan (this J., 1894, 13, 1098), Korvacs (Chem. Rev. Fett- und Harz-Ind., 1902, 9, 136; this J., 1902, 1077), Church (J. Ind. Eng. Chem., 1911, 3, 230), Hubbard ("Laboratory Manual of Bituminous Materials," 1916), and Mansbridge (this J., 1918, 37, 182T).

The authors have been required to adopt the "½-inch cube method" as follows:—A cube of pitch of ½ in. side-length was suspended in a beaker of water by a copper wire about No. 18 gauge, bent at right angles and inserted into the centre of one side of the cube. The distance between the base of the cube and the bottom of the beaker had to be from 3 to 3½ in. The temperature was noted when the pitch had descended to within ½ in. from the bottom of the beaker. The test is a fairly definite one with limited applications, but is arbitrary and requires somewhat close attention.

Miscellaneous methods.

Troughton and Andrews (Phil. Mag., 1904, 7, 347; this J., 1904, 680) have developed a rotating torsional apparatus. Church (J. Ind. Eng. Chem., 1911, 3, 230) employed a breaking and also a slide test. French (Analyst, 1912, 37, 62) suspended pitch powder in a liquid (dilute sulphuric acid) heated by electrolysis, and noted the temperature at which the powder clotted together.

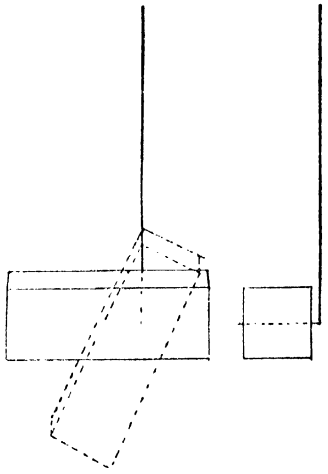
The papers of Weiss (J. Ind. Eng. Chem., 1916, 8, 841) and of Mansbridge, on oil pitch (this J., 1918, 182T), are of considerable interest.

There is much information in the various standard books on the subject; but there still seemed to be room for a method which should be simple to carry out, require a minimum of time and attention, be based on the minimum of assumptions, and give sharp and accurately reproducible results.

The ½-inch cube method, employed as described above, has been found to be simple and reliable within limits. It is, however, unsuitable for testing hard pitches owing to the buoyant action of air bubbles which appear on the surface of the block, even when freshly boiled water is used. These are most difficult to remove at temperatures above 70° C. when the surface of the pitch is softening. Further the time taken, when heating the water at the rate of 1° C. per minute, is much longer than in the case with the proposed method —about 19 minutes for the lower temperature pitches and about 24 minutes for samples of hard pitch, the higher figure being due to the effect of bubbles.

The method of carrying out the test is as follows:—A pitch block 1¼ in. long by ¼ in. square is made by running the hot pitch into a sheet iron mould, the edges of which are welded, of the dimensions (internal) 1¼ × ¾ × ¾ in. When the pitch has solidified the mould is rapidly heated round the sides and turned upside down; the block slides out and can be cut to the required size when almost cold. In many cases it is more convenient to cut the testing block from the sample.

A piece of copper wire of No. 17 standard gauge is bent in the form of an "L," the foot of which is ¼ in. long. The shaft is heated gently in a Bunsen flame until the foot is sufficiently hot to penetrate the block. The wire is inserted in the side of the block at a point ¼ in. from one end, and must pass through the block symmetrically.



After cooling for 3 hours, the foot of the "L" exterior to the block is scraped free from adhering pitch. The block is suspended about 2 in. below the surface of cold water (freshly boiled) in a beaker of 750 c.c. capacity. A thermometer with its bulb on a level with the block and an arrangement for stirring complete the apparatus. Heating at the constant rate of 1° C. per minute is preferably carried out with an Argand burner; the water is stirred slowly at intervals until the test is almost complete. The flame is removed when the upper horizontal edge (which must be sharp) of the cube comes in line with the upright copper wire. Stirring is continued until the temperature begins to fall: the maximum temperature observed is taken to be that of the softening point of the sample.

Different rates of heating, especially with soft to medium pitches, gave results which varied up to 4° C. For a hard pitch 3° per minute can be adopted in cases where a rapid test is essential.

Copper wire of 14 and 10 standard gauge only increased the softening point indicated and tended to cause the sagging of the pitch block.

A time test was tried using a bath at a fixed temperature for each grade of pitch:—Soft 40° C., medium soft 50° C., medium 60° C., hard 70° C. This was abandoned as constant results were not obtained.

A comparison of results obtained with the ½-inch cube method and that now proposed is given in the following table which shows the results of tests made on different grades of commercial pitch. A large number of determinations have been made on many samples, but those given are characteristic of all.

	Soft °C.	Medium soft °C.	Medium °C.	Hard °C.	Floated °C.
½-in. cube ...	53	59–62	70–71	76–79	95
Proposed ...	34	40–42	50–53	53–55	70

DISCUSSION.

Mr. WM. DIAMOND referred to the difficulty of sampling pitch properly. To determine the softening point an average sample was sometimes suspended in a bath of water and heated until it could be twisted with the fingers, a method which, though rough and ready, was generally adopted.

Mr. G. WEYMAN said that the paper showed the

need of a rational method of testing, the results of which would give information from which the properties could be inferred more definitely than by arbitrary methods. Until this was done the method outlined by the authors seemed to be superior to other methods.

Dr. J. T. DUNN thought that arbitrary tests would answer the purposes of a single person through whose hands samples were constantly passing. None of them could be properly called tests, since the results were not strictly reproducible by different workers. He thought that, perhaps, the authors' results might be more closely imitated than others. His own view was, however, that each person who had to test pitch would probably adopt his own method for his own particular purpose.

NOTE ON THE EXTRACTION OF THALLIUM FROM PYRITES FLUE DUST.

BY GEORGE SISSON AND J. S. EDMONDSON.

During the progress of the war, the Research Department of the Ministry of Munitions requested chemical manufacturers to investigate their waste products, with a view to recovering useful substances. They mentioned more particularly selenium from sulphuric acid works, this element being valuable on account of its property of altering its electrical conductivity when subjected to light of varying colour or intensity. In response to the above request, we collected for experiment a quantity of dust and refuse deposited in the flues of the sulphuric acid plant of the Blaydon Chemical Works. The flues mentioned lead the sulphur gases from the pyrites kilns into the Glover concentrating tower, and require to be cleared out periodically. The kilns are charged with copper pyrites from Spain. Such pyrites contains perhaps 2% of copper and small quantities of a large number of other elements. Some of the constituents such as arsenic, antimony, tellurium, thallium, selenium, are volatilised or burnt off with the sulphur, the iron, copper, etc., remaining in the burnt ore. The more volatile constituents, such as the sulphur, arsenic, and selenium, are carried forward principally beyond the flue into the Glover tower.

The flue dust itself consists of materials carried over mechanically such as iron oxide, small quantities of copper and lead, and volatile substances condensed at the flue temperature of about 450° C., such as antimony, bismuth, thallium, etc.

After making several experiments on this material we failed to separate any appreciable quantity of selenium; no doubt the temperature of that part of the plant was too high for condensation, the hot gases carrying forward into the sulphuric acid any traces of selenium contained in the pyrites.

We then turned our attention to thallium, which was known to occur in such deposits. In fact the metal was discovered in and isolated by Crookes from a similar deposit from the Harz Mountains ore (Chemical News, 1861, 3, 193, 303). Lamy also isolated a specimen from a lead-chamber deposit in 1862 (Annales de Chimie, [3], **67**, 385).

Although thallium compounds are somewhat widely distributed they occur in very small quantities, associated with other metallic sulphides in various ores, and the flue dust of sulphuric acid factories is still the only practicable source. Such dust may contain up to 8%, but only rarely is more than 0·25% of thallium present. The quantity of dust we collected was about 15 cwt. in six months, representing the burning of 1500 tons of pyrites. The dust contained 0·25% or a total of 4 lb. of thallium, equal to 1 part per million of pyrites.

The method we used to separate the thallium depends chiefly upon the sparing solubility of the chloride and the solubility of the sulphate, the operation being to treat the dust with boiling water acidified with sulphuric acid in a wooden or earthenware vessel, using live steam injection; on settling, the clear liquid is treated with hydrochloric acid. The crude chloride precipitate is separated, washed, and converted into sulphate by heating with strong sulphuric acid, the excess of acid is driven off, the remaining sulphate dissolved in water, filtered, and re-precipitated as chloride. The purified chloride after drying is mixed with potassium cyanide and sodium carbonate, and fused in a crucible, care being taken not to use too high a temperature in order to avoid loss by volatilisation. Or the chloride may be reduced by zinc and the resulting metal melted in a current of inert gas. Instead of hydrochloric acid sodium chloride may be used to precipitate the thallium from the sulphate solution. The crude dust must be washed repeatedly to extract the whole of the thallium salt. Several ounces of the metal were obtained by this method.

An alternative method is to precipitate the thallium as iodide from the sulphate solution, the iodide being less soluble than the chloride, but the cost of the iodide is an objection.

DISCUSSION.

Prof. P. PHILLIPS BEDSON suggested that it might be possible to take advantage of the change of colour which occurred on heating thallium iodide in determining the heat of bearings, as had been done in the case of mercuric iodide. He recalled that in 1901 he had assisted in a search for thallium among alkali waste materials, but without success.

Mr. EDMONDSON, in reply to a question, said that thallium was not found in all samples of pyrites.

Sydney Section.

Meeting held on November 20th, 1918.

MR. B. J. SMART IN THE CHAIR.

NOTES ON AUSTRALIAN TANNING MATERIALS AND THE MANUFACTURE OF SOLE-LEATHER.

BY F. A. COOMBS.

A number of workers at the Sydney Technical College have just completed a series of comparative tests which were expected to give results directly related to the leather-producing properties of Australian tanning materials.

Australia has large supplies of tannins in the kinos and barks of the numerous species of eucalypts. The tannins in the barks of *E. sideraphloia* were tested by the process which has been described in previous papers.* The results show that under normal conditions it would be extremely difficult to get these tannins to penetrate into the centre of the hide. In this experiment the standard tannage (wattle bark tannins) gave the usual result and the sections were "struck through" at the end of the fourth week, but at this stage the sections in the liquors obtained from the bark of *E. sideraphloia* showed a broad untanned streak in the centre

* See this Journal, 1917, 189.

of the hide. After the sections had been in the tan-liquors for ten weeks it was found that the eucalyptus liquors had made no perceptible progress under what was considered to be normal conditions, and therefore a continuation of the experiment was not considered necessary.

A mallet bark (*E. occidentalis*) tannage gave a hard brittle leather after drying from the wash-pit. The same leather was "damped back," drummed with weak liquor for one hour, and finished as sole-leather. It was then free from any brittleness.

This change might be considered to be due to a large amount of uncombined tannins etc., which would have a tendency to make the leather brittle, and one hour in the drum would remove the soluble substances and enable the leather to dry to a normal and mellow condition. While this may be true to a certain extent, yet it is probable that the mechanical action in the drum broke up the leather and was an important factor in reducing it to its mellow state. However, this is the only good leather the author has seen which was tanned by a straight eucalyptus tannage.

The barks of the eucalypts and their exuded kino-tannins are not popular with Australian tanners. In a few of the sole-leather tanneries a small proportion of mallet bark is used, and the results appear to indicate that this bark improves the colour obtained from the local tannage, but while it gives a firm leather, there is always a tendency to a brittle grain if the tanning process is confined to the pits, and it increases the time required for the various liquors to penetrate into the centre of the hide. If mallet bark, with its high percentage of tannins capable of imparting a good colour to leather, is not used to any great extent in Australia, it does not seem probable that the barks or kinos of other eucalypts will be used in large quantities unless it can be shown that they have an increased value owing to their special leather-forming properties. The extract from mallet bark contains a low percentage of non-tannin matters and therefore it is an ideal cheap adulterant for mixing with extracts that have better leather-forming properties. Probably a large portion of the mallet bark exported to other countries has been used for this purpose.

The eucalypt tannins, especially mallet, may give much better results when they are used in a drum tannage, but at present they cannot be considered an important factor in the production of Australian leather.

Wattle bark is the principal tanning agent used by Australian tanners, and while the supplies of this material are equal to the demands, other tanning materials without special leather-forming properties are not likely to be used in large quantities. This bark is used for the production of all classes of leather and its general leather-forming properties are superior to those of any other known Australian tanning material. It is doubtful if a more useful catechol tanning material is produced in any part of the world, and when the natural supplies of tannins are exhausted the wattles can be cultivated to meet the demands of tanners. A straight wattle tannage produces a mellow leather which is suitable for the currier, and it can be converted into kip, bag, strap, and harness leathers etc. A mixed tannage of wattle and imported tanning materials, such as gambier, myrobalans, sumac, and valonia, is used by some tanners for the production of the above leathers, but in all cases the wattle tannins are in excess of the sum of all the others.

Previous experiments indicate that the tensile strength and elasticity of the wattle-tanned leather is greater than that of any leather tanned with other Australian tanning materials. If it be desirable to reduce the elasticity or stretch of wattle-tanned belting leather, this leather could be tanned with a mixed tannage of wattle and pine or wattle and mangrove. These mixed tannages would bring about a slight reduction in the tensile strength, but if skilfully controlled they should not make any appreciable difference in the resulting leather. Leather tanned with wattle tannins does not offer a great resistance to the penetration of water. Pine and mangrove give better results than wattle, and pine is superior to mangrove.

From the percentage of fixed tannin calculated on the hide-substance ("degree of tannage") we find that the pine tannins return the greatest percentage of insoluble leather. In other words these tannins have the best weight-producing properties, mangrove being second and wattle third. It has been shown that the resistance to water is proportional to the amount of fixed tannin. It would be extremely difficult to obtain wattle and pine leathers suitable for comparative tests and both containing the same amount of fixed tannins, hide-substance, etc. One of the best tests for the water-resisting properties of any tannage is to "damp back" the dry unrolled leather to a condition suitable for splitting, drum-stuffing, or setting up. It is not necessary to go into the details of this process. Briefly the wattle leather is quickly and easily prepared for this work. The pine-leather appears to resist the penetration of water into the fibres and apparently never reaches that mellow condition known by the "feel" which is so hard to describe but is well known to all practical men who handle wattle-tanned leather for the manufacture of dressed goods.

Wattle tannins when used as the greater portion of a suitable mixed tannage give good results in the manufacture of sole-leather. Under the heading of Australian tanning materials, one might say that the most important work at the present date is to help in the expansion of the wattle-bark industry and secure for the Australian tanning industry the necessary supplies for its future requirements.

The tannin values of wattle bark as supplied to the tanners range from 30 to 39%. Adelaide bark (*Acacia pycnantha*) with few exceptions contains 34–39% tannin. Mr. G. H. Maiden describes the "*Acacia decurrens* group of wattles" in "Forest Flora of N.S. Wales." He has reduced what are described by some botanists as species to varieties of *A. decurrens*. According to the same authority there are a number of varieties of *A. decurrens* and the following contain considerable amounts of tannin in their bark: *Acacia decurrens*, varieties *normalis, mollis, pauciglandulosa, Leichardtii*, and *dealbata*. The variety *mollis* (*A. mollissima*) appears to be the best of the *decurrens* group and the bark contains from 31 to 39% of tannin. This variety is hardy and probably the most suitable for cultivation. Some of the other varieties are not much inferior to *mollis*, but it is extremely difficult to procure commercial samples and therefore it is impossible to give their true tannin values. Generally the barks sold in Sydney are mixtures of *normalis* and *mollis* varieties and the tannin values are above 30% excepting when the sample contains a large proportion of *dealbata*. Commercial samples of *dealbata* have returned 20% of tannin. Apparently there is no great botanical difference between the five varieties named above, but there is a marked difference in the tannin value of *mollis* and *dealbata*.

In Australia the supplies of wattle bark have not been equal to the demand, and large quantities of this bark have been imported from South Africa. The South African bark, reported to be *decurrens* varieties with *mollis* predominating, differs from the Australian bark from the same species. It appears to contain a larger proportion of the thin bark from the young branches, and some tanners say that it does not give up its tannin so freely

during the leaching process. A number of our local tanners prefer to keep the wattle bark for several months before using it. They claim that their practical experience has shown that they leach more tannin from the old bark. One tanner suggests that the solubility of the tannin increases when the bark is allowed to age. The tannin in bark that is stored for several months generally changes to a red colour. This would probably bring about a decrease in the solubility of the tannins. The improved results obtained might be due to the change that would take place when the moisture in a bark is reduced to a low percentage. Under these conditions the cells etc. would contract, and this contraction, in conjunction with the subsequent swelling when the bark is placed in water, would cause ruptures and strains which would help the tannin to diffuse out of the bark. South Australian bark (*A. pycnantha*) is supposed to have better leather-forming properties than the bark from Australian and South African varieties of *A. decurrens*. This difference could probably be traced to the methods used to prepare the bark for the markets. The South Australian bark industry is controlled by men who are far superior in systematic methods and general knowledge of the industry to other bark-strippers in Australia and South Africa. South Australian bark is generally ground in the mill before it is sent to Sydney. The bark must be dry before it will pass through the mill, so that the men who strip and prepare this bark are forced to reduce the water to a low percentage and therefore no bark is exported before it is thoroughly dry. Bark stripped in New South Wales and South Africa is generally exported as chopped bark and it often reaches the tanner with a high percentage of moisture. The former may show signs of moulds and the latter sometimes contains green bark from young branches. The red appearance of South Australian bark is probably due to the bark being stored for a longer period after stripping. It generally contains more red tannins, which would probably increase its weight-giving properties and justify the claim of certain tanners that this bark gives the best weight returns. The basil tanners, who have to consider colour as the most important factor, generally prefer the chopped barks from New South Wales and South Africa, but there is no great difference in the colour of the leather tanned with these barks.

The pine barks have not been used in large quantities by Australian tanners. Much credit is due to Mr. Greatrex for his great effort to place this bark in the Australian sole-leather tanneries. He has stripped large quantities of the bark (*Callitris calcarata*), and analysis would appear to indicate that when this bark is rossed the tannin values are above 20%. Samples taken from a ten-ton lot gave 23·5% of tannin. The general opinion is that before these tannins become popular with tanners they must be sold in the form of an extract.

We have described the valuable water-resisting properties of leather tanned with pine-tannins, and there is no doubt that the pine bark used in a mixed tannage with wattle bark would produce a sole-leather with water-resisting properties that are superior to results obtained with a straight wattle tannage. A straight pine-tannage produces a red leather, inclined to be harsh, with splendid water-resisting properties and giving good weight returns. Small quantities might be considered useful for dressed leathers but practical experience does not support this.

The mangrove tannins sold in Australia consist largely of a mixture of three genera, *Ceriops*, *Rhizophora*, and *Brugiera*. This bark produces a red leather which does not reach the same high standard for resistance to the penetration of water that has been noted for pine-tanned leather. The tannins from the bark of *Ceriops* are not so red as the tannins from *Brugiera*, and *Rhizophora* appears to occupy an intermediate position. One would expect these tannins to be in the same order for the "time for penetration" and the production of a soft leather. As a mixture they are slower than wattle tannins, and *Brugiera* used alone would probably produce a harsh leather with a tendency to a brittle grain.

The value of any tanning material will depend on its leather-forming properties and the cost of producing tannin in solution. The mangrove tannins are inferior to the wattle tannins in their general leather-forming properties. Mangrove, when used alone for the production of sole-leather, gives very fair results, but the water-resisting properties are apparently not up to the standard required for this leather. When black labour is available large quantities of mangrove tannins can be obtained in solution at a cheaper rate than from any other tanning material, and this appears to be the reason for their use by tanners. The mangrove tannins appear to have no outstanding feature which would make them valuable for the production of some special leather. The tanners' problem is how much can they use of this cheap tanning agent without making any appreciable difference in the quality of their leather. At present mangrove tannins are generally used as a small portion of a mixed tannage for the production of sole-leather, and if the resulting leather is red the colour can be improved by using a weak solution of titanium salts. The mangrove tannins vary from a yellow to a deep red colour; reducing agents such as sulphur dioxide temporarily remove a portion of the red colour. The tannin values of a few commercial samples of this bark range from 30 to 37%. The bark from British Papua has not given the same high tannin values as the bark from North Queensland. Probably only the best of the mangrove bark in certain localities has been stripped and placed on the markets. The tannin values may be lower when larger quantities of these barks are stripped in the above districts. The author has taken samples for analysis from Cairns and Cooktown in Queensland, and on the coast of Papua near Yule Island, and the results seem to indicate that this bark could be supplied to the tanner in large quantities and the tannin values should not be expected to fall below 30%, while some lots would reach 37% for rossed bark.

The tanning process for sole-leather may be divided into two parts. The first consists of converting the raw pelt into leather, and the second would cover the addition of weighting and filling agents which in some cases improve the quality of the leather. The time required to convert the pelt into leather by the aid of a mixed tannage with wattle bark predominating is generally about four to five weeks, and this part of the process ends when the tannin has penetrated into the centre of the hide. If acid be employed for plumping purposes its use should be restricted to the early stages of the first part of the tanning process. It has been shown that the tensile strength of a leather decreases when it has been fixed by tannin in a swollen condition, so that the use of acid to make leather thicker adversely affects the wearing quality of the leather if, as the author's experience seems to indicate, the resistance to wear is proportional to the tensile strength. When an experienced buyer is examining sole-leather he generally notes if the leather be "firm" or otherwise. It would be difficult to give a scientific explanation of this factor. As a general rule one could say that starting with a good hide and tanning it by a process known to give good sole-leather results, one might expect to have a hide of leather which would be firm in the butt but not firm in certain other

portions of the hide. There are a great number of factors which assist in the production of a firm sole-leather, but it is only proposed to deal here with one, as it may justify to a certain extent the use of acid for the production of this leather.

It has been shown in a previous paper * that the acid is responsible for a harder, more rigid, or firmer leather, which appears to offer a greater resistance to water penetration. Sometimes it is necessary for a tanner to "damp back" his dry leather, and the quickest way to obtain this result is to place the leather with water in a revolving drum. While the drum is in motion the leather is continually falling from the shelves to the bottom. This mechanical action breaks up any thin film etc. which forms a temporary barrier to water, expels the air from the capillaries by a pressure which only lasts for a fraction of a second, and leaves a vacuum which is immediately followed by a flow of water into the leather. The rate at which water is absorbed by leather is proportional to that mechanical action which is responsible for stresses which adversely affect the compactness of the leather. Under natural wearing conditions sole-leather is exposed to this mechanical action, and the resulting strains decrease with a firmer or more rigid leather.

Apparently there is some evidence to justify the use of acid in the manufacture of sole-leather that is required for a wet climate, but it is doubtful if it has any value if the leather is tested under conditions natural to a dry climate. The tannage of certain imported sole-leathers consists of a high percentage of myrobalans and valonia, and under these conditions the acidity of the liquors would be high. These leathers do not always give good wearing results under dry weather conditions common to Australia. They are too rigid for comfortable walking and the fibre is inclined to be brittle. Australian tanners who use myrobalans and valonia generally work on the safe side, but it should be noted that the addition of acid or acid-producing substance in conjunction with these tanning materials may produce a harsh, brittle fibre, especially in the centre of the hide.

Fixed tannin in excess of the amount required to convert the hide into leather may be classed as the most important filling agent known to tanners at the present time. The second part of the process of tanning sole-leather has for its object the partial filling of the leather with fixed tannins, and to obtain successful results the tanner must use strong tan-liquors and suitable tannins, and the leather must remain in the liquors for several weeks. This is the more costly part of the tanning process.

There can be no doubt as to the value of layaways for increasing the amount of fixed tannin as found by analysis when the unleached bloom-yielding tanning materials are placed between the hides. Procter† states that the same rule holds with hemlock, quebracho, and mimosa, which yield no bloom but difficultly soluble tannins (reds or phlobaphenes). He states that in contact with the hides the small proportion of these reds which is soluble in the liquors is replaced from the material as rapidly as it is absorbed by the leather, while when liquors or extracts only are used the greater part of these solidifying and weight-giving constituents remains unutilised in the spent tanning materials. So far as wattle bark is concerned we have no practical results to show that this is the true theory for these layaways. Before accepting the above theory one must be prepared to acknowledge that the amount of fixed tannins increases as the solubility of the tannins decrease, or that the hide would fix difficultly soluble tannins (reds) in preference to the easily soluble tannins. This appears to be correct and in accordance with practical results. It would now appear that the fixed tannins were proportional to the percentage of reds in the tan-liquor. Procter's theory appears to be that at constant temperature and concentration the amount of reds in solution will be constant and any loss, such as combined tannin, etc., will be renewed from the bark. The reds in tan-liquors are proportional to the temperature maintained during the process of extraction. Some of the reds pass out of solution when the liquors cool to ordinary temperature, but the percentage would still be much higher for a hot-water extraction when compared with results obtained by extraction at ordinary temperature.

The layaways are generally made up of ground bark and a liquor taken from leaches where hot water is used in the process of extracting the tannin from the bark. Tannin is extracted from the bark in the layaway at ordinary temperature, but Australian experience seems to indicate that the reds are left in the bark. If it is desirable to get the maximum amount of reds in the leather, the tanner should not place the bark in the layaway, but he could use that bark in the leaches and increase the concentration of the liquor by the amount of tannin extracted from this bark. Then one would expect a stronger liquor which would maintain a greater percentage of reds when it is brought in contact with leather.

There are other important factors connected with layaways, such as the large number of hides that can be placed in a pit and the small volume of liquor required to cover them, also the extra labour required in handling the hides and removing the bark to the leaches. Remove the layaways (which appears to be feasible as regards Australian tanning materials) and the tanning and leaching processes become less difficult to control.

There is no reason why the fixed tannins in excess of those required to convert the hide into leather should not be replaced by other substances as filling agents. A vegetable-tanned leather filled with a plaster substance insoluble in water might be expected to give good wearing results in a dry or wet climate, but, like chrome-tanned sole-leather, it would differ from the present vegetable-tanned leathers which are capable of being "damped back" to a pliable condition. This wet, pliable condition enables boot manufacturers to work the leather to the required shape. The value of damping back is only known to tanners and leather workers, and it must be noted that it would not be possible to obtain this result with a leather which would completely resist the penetration of water. Water-solubles must be reduced to a minimum and sulphuric acid entirely removed from the vegetable-tanning process before any great improvement will be made in the quality of sole-leather.

Leather which contains a medium percentage of fixed tannin and solid fats and also a low percentage of water-solubles would probably give the best results without bringing about any great changes in the present methods of tanning sole-leather, but quicker returns and better results are possible when a substitute is found for the excess of fixed tannins.

A chrome-tanned sole-leather filled with waxes, etc., gives better wearing results than the average vegetable-tanned sole-leather. The former does not contain any substance similar to the excess of fixed tannin which is considered such an important constituent of the latter. If the vegetable-tanned leather were treated with waxes etc. after it has passed through the first part of the tanning process, the resistance to wear might equal that of the chrome leather. Tanners would then have to consider which is the cheaper process. The basic chromic solution would take one week to convert the hide into leather, and vegetable tannins would require four weeks to do the same work. This is a big advantage for the chrome-tannage, but it is

* This Journal, 1918, 76T.
† "Principles of Leather Manufacture."

more than counterbalanced by certain advantages on the side of the vegetable tannage.

When the vegetable-tanned sides of leather have passed through the first part of the tanning process, they can be trimmed and classed to suit the demands of the tanner's customers. The butts can be filled with waxes or fixed tannins. The offal can be "dried out" and sold to various buyers who damp it back and prepare it for various sections of the leather industries. Australian tanners could ship picked sides and offal to London and English tanners would prepare it for their own markets. A large number of tanners who manufacture harness and belting leathers, also make sole-leather from their culls etc., and the sides for these leathers could be sorted out at the stage mentioned above. Now chrome-tanned offal etc. cannot be shipped and sold for the purposes described under the vegetable tannage because this leather cannot be "damped back." Only the butts are generally used for chrome sole-leather and the offal receives a vegetable tannage. So comparing the two tannages it is found that the first part of the process required to produce vegetable-tanned sole-leather can be used for the production of all the heavy leathers and the whole side can be tanned as one piece.

The Australian tanners should be prepared to depart from the rigid rules laid down in other countries for the manufacture of sole-leather. They should aim at producing, with the aid of Australian tanning materials, leathers that will suit the local climate and the export trade.

The following is a statement of the comparative positions for leather-forming properties of Australian tanning materials, the best material being given first: *Resistance to water-penetration*: Pine, mangrove, wattle. *Colour*: Mallet, wattle, mangrove, pine. *Degree of tannage*: Pine, mangrove, wattle. *Tensile strength*: Wattle, mangrove, pine. *Penetration of tannin into pelt*: Wattle, pine, mangrove. *Soft leather*: Wattle, mangrove, pine, mallet. *Elastic properties*: Wattle, mangrove, pine. *Acidity of liquors*: Pine, mangrove, mallet, wattle. *Firm leather*: Mallet, pine, mangrove, wattle. *Percentage of tannin*: Mallet 36–42, wattle 30–39, mangrove 30—37, pine 18–23%.

The local tanning materials used for the manufacture of Australian leathers may be summarised thus: *Wattle*: Kips etc.; split grains for colours; harness, bridle, strap, sole-leathers; belting leathers; basils, book-binding leathers. *Pine and mangrove*: Sole and belting leathers. *Mallet*: Sole-leather.

OIL FROM THE SEED OF LOCALLY GROWN "MEXICAN BUCKEYE" (UNGNADIA SPECIOSA).

BY EDWIN CHEEL AND A. R. PENFOLD.

The plant known as "Mexican buckeye" (*Ungnadia speciosa*) is a native of Texas. It belongs to section *Harpullia* of the family *Sapindaceæ* and was described as far back as 1883 by Endlicher (Atakta T 36 Nov. stirp. Dec. 75 N 86). It is also referred to by Gray (Letters of Asa Gray, Vol. 1, p. 222, 1893).

In "Contributions from the U.S. National Herbarium," Vol. 2, p. 66 (1891–94) it is stated that *U. speciosa* Endl. is a deciduous shrub or very small tree common along rocky valleys and in the mountains from the valley of the Trinity through western Texas to New Mexico. The seeds or "beans" are in shape and size much like small chestnuts and are poisonous.

The seeds from which our investigations were made, were gathered from a solitary plant in the Botanic Gardens, Sydney, where it has grown for the past 25 years. The plant is about 15 feet high, with a somewhat spreading bushy habit, and although it receives no special attention, it flowers fairly freely during October, and yields a fairly good crop of fruits which contain usually three rather large, shiny, brown seeds without arillus. In April, 1917, some fresh seeds examined by Messrs. Lever Bros. Ltd. were found to yield 60% of oil.

Although this species should be a profitable crop-plant, the plants being easy to cultivate and the nuts easily collected, no serious steps have been taken in Australia to cultivate the plants for the production of oil. The results of the tests given below will, it is hoped, be of sufficient interest to induce agriculturists to give the oil-seed industry a trial, especially as there is a growing demand for oil suitable for the manufacture of soap and other purposes. We have already been successful in raising about three hundred plants, a number of which have been submitted to the Department of Agriculture who have distributed them in various parts of the State for trial.

Chemistry. The oil was first examined by Schaedler (Pharm. Zeit., 1889, 340) and his results are recorded by Lewkowitsch ("Oils, Fats, and Waxes," 3rd Ed., Vol. 2, facing p. 404), and by Wright and Mitchell ("Oils, Fats, and Waxes," p. 435). Schaedler states that the seed contains from 40 to 50% of a pale yellow oil which has a bland taste recalling that of almond oil and forms a good salad oil. It resembles ben oil in not becoming rancid for a long time after exposure to the air. It contains no free fatty acids. The constants of the oil are sp. gr. at 15° C., 0·912; at 100° C., 0·854; solidifying pt., −12° C.; saponification value, 191–192; iodine value, 81·5–82; Hehner value, 94·12; iodine value of fatty acids, 86—87; m.pt. of fatty acids, 19° C.

Seeds of the Australian plant were examined for one of the authors early in 1917 by Messrs. Lever Bros., Sydney, who reported as follows:—Brown and glossy round seed (three in each case), average size of seed 10·6 mm., weight 1·837 grms., moisture content 5·41%. The kernels constitute 74·4% of the dry nut and contain 61·7% of pale oil, having iodine value 81, saponification value 202·5. The oil has a mild taste resembling that of ground nut oil. The oil extracted by ether contains a froth-producing substance (? saponin).

Another crop of the seeds has been examined recently by the present authors, with the following results: Yield of oil (ether extract), 50%. Sp. gr. (15°/15° C.), 0·9117; n_D^{20} 1·4666; acid value, 9·38; saponification value, 203; iodine value (Wijs, 1 hour), 83·5–84·0; unsaponifiable matter, 0·6%. After removal of unsaponifiable matter the fatty acids had sp. gr. (30°/15° C.), 0·8848; n_D^{20} 1·4607; n_D^{34}, 1·4565; m.pt. (capillary tube), 26° C.; neutralisation value, 194·46; mean mol. wt., 288·22; iodine value (Wijs, 1 hour), 86—87; Hehner value, 93·4. No bromides insoluble in ether were obtained, and only traces soluble in petroleum spirit.

Free acidity. The constants of the locally grown product thus compare closely with those of the sample from Texas examined by Schaedler as far back as 1889, with exception of the saponification value and acidity.

The unpleasant effects experienced both after tasting the oil, and during expulsion of the ether from extracted oil, aroused suspicion of the presence of hydrocyanic acid. On examining the aqueous washings from the separation of the fatty acid, hydrocyanic acid was readily detected by the Prussian blue and isopurpurate reactions, the amount as shown by the Reichert-Meissl method being 77% of the total free acidity. The presence of a cyanogenetic glucoside and an enzyme in the seeds was confirmed by tests with sodium picrate paper at 20° C.

It seems remarkable that although the seeds are recorded as being poisonous, no hydrocyanic acid was detected in the oil by Schaedler; this is evident from the acid and saponification values. Although the amount of hydrocyanic acid would not be so great in the oil expressed on the large scale as when extracted with solvents, still small amounts would undoubtedly be present. This would militate against its use as a salad oil, but if suitably treated it is well suited for soap making.

In conclusion the authors wish to express their thanks to Dr. G. Guthrie who determined the refractive indices of the oils, and to Messrs. Gillard Gordon Ltd. for allowing the chemical work to be carried out in their research laboratory.

Communications.

THE THEORY OF ABSORPTION TOWERS FOR NITRIC ACID MANUFACTURE.

BY J. R. PARTINGTON AND L. H. PARKER.

Two elementary principles. The object of an absorption tower is to take up from a mixture of gases one or more of the constituents by means of a liquid solvent. The two elementary principles on which all tower design is based are as follows:

(I) As much of the soluble gas should be removed as is possible during passage through the tower.

(II) The liquid solution should be as concentrated as possible.

From these principles certain equally elementary results follow:—

(1) The gas and liquid should be brought together on the counter-current system. The objection to counter-current flow often made, that with tall towers it is necessary to bring the gas from the top of a tower to the bottom of the next tower by a gas-main outside the tower, which adds to the expense and difficulty of construction, has very little weight when it is remembered that such a construction is practically always adopted in hydrochloric acid towers, which are built up to 100 ft. high. It has been found that the increased efficiency so ensured pays for the more complicated construction. The gas may also be carried downwards by an internal pipe or duct. (2) The tower should not be too wide compared with its height, otherwise efficient distribution of liquid over the packing will be difficult. It is a useful rule in tower construction that the diameter should not usually exceed one-fifth of the height. When therefore it is proposed to reduce the number of towers of a given height required to give a fixed capacity, by increasing the diameter from, say, 10 ft. to 20 ft., it should be remembered that this alteration may lead to difficulties in the distribution of the liquid. It may quite well be that a 20 ft. tower will be even less efficient than a 10 ft. tower for the same height, owing to bad distribution of liquid. (3) It may be necessary to take out the strongest liquid from some intermediate tower rather than the first, on account of different temperatures in the various towers, or other factors, such as the graded admission of secondary air to the towers.

Two factors of efficiency. The two elementary principles already referred to show that the efficiency of a tower system will depend on two factors:—

(1) ***The rapidity and completeness of absorption.*** This may be determined by the weight of soluble gas extracted per minute per cub. ft. gross tower space, and the overall percentage absorption. (2) ***The concentration of the solution produced.*** This factor, which is always kept in mind in designing towers for condensing hydrochloric acid, appears to have been largely overlooked in nitric acid towers. It is, however, of considerable importance, as the costs of handling, storing, and working up 30% nitric acid are obviously much greater than the corresponding figures for 50% acid.

Rapidity and completeness of absorption. The rapidity may be stated in the form of the number of pounds of NO_2 absorbed per cub. ft. gross tower space per minute. The completeness may be estimated from the overall efficiency of absorption, *i.e.* the percentage of oxides of nitrogen removed from the gases entering the towers during their passage through the towers.

The rate of absorption will only increase with the rate of circulation of the absorbing liquid when *the diffusion in the gas, assisted by turbulence, is always sufficient to supply soluble material to the liquid layer at a rate exceeding the rate of absorption.* Beyond this point there is no purpose served in going to higher rates of acid flow, except for purposes of cooling. It is evident that there will be an optimum rate of acid circulation for any given tower, which may often be calculated.

The absorption coefficient. The weight in lb. of nitrogen dioxide absorbed in one minute per square foot of acid surface, which we shall call the *absorption coefficient*, depends on the following conditions:—(1) The partial pressure of NO_2 in the gas (p_{NO_2}); (2) the partial pressure of oxygen in the gas (p_{O_2}); (3) the concentration of the acid used for absorption (S); (4) the temperature (T); (5) the turbulence of the liquid and of the gas (t_l, t_g); (6) the amount of oxidation space allowed for the NO produced during the absorption (v); (7) the rate of renewal of liquid surface, *i.e.* the acid flow through the tower (*f*).

It is evident that this coefficient is an exceedingly complicated function of the various conditions. The absorption of oxides of nitrogen is, in fact, much more complicated than, for instance, that of hydrochloric acid, in which one has simply to consider the partial pressure of the gas, the surface exposed, the temperature, and the acid strength. In this case it is merely necessary to allow the requisite number of square feet of wetted surface to absorb all the hydrochloric acid passing through the tower per minute. But the absorption of oxides of nitrogen is governed by three successive chemical reactions:—

$$(1)\ 2NO_2+H_2O=HNO_2+HNO_3;$$
$$(2)\ 3HNO_2=HNO_3+H_2O+2NO;$$
$$(3)\ 2NO+O_2=2NO_2.$$

Both the liquid and gaseous phases are involved.

The dependence on the partial pressure of NO_2 is sufficiently evident on comparing the tower capacity used for such dilute gases as are produced in the arc, with that which is sufficient for the much richer gases obtained by denitration:—

Gas	% NO_2 in gas	Cub. ft. gross tower space per lb. NO_2 per min.
Arc	1	5000
Denitrator ..	20	200

The dependence on the strength of acid used for absorption is known from the work of Foerster and Koch; it is represented roughly by the curve

In fig. 1, from which the relative rates of absorption come out as follows:—

% strength of acid used for absorption	Rate of absorption
0	1·00
10	0·99
20	0·95
30	0·90
40	0·80
50	0·70
60	0·55
65	0·32
68	0·00

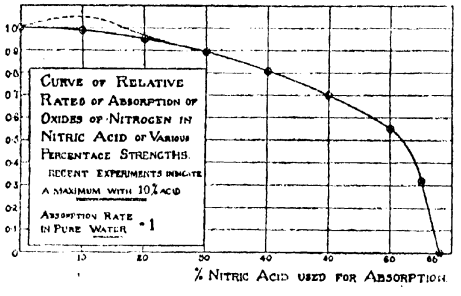


FIG. 1.

Up to 35—40% acid the rate of absorption is very little different from that in water; with 50% acid it is still 70% of that with water; and even up to 60% acid the rate of absorption has fallen only to half that with pure water. From this point it falls off very quickly to zero with 68% acid. There is evidence of a maximum speed of absorption in 10% acid.

Elimination of nitrous acid. The primary reaction in the absorption of nitrogen dioxide in water is the formation of one molecule each of nitric and nitrous acids. The elimination of the nitrous acid from the liquid now follows, because it is found that the acid produced in absorption towers rarely contains more than about 0·3% of HNO_2.

This elimination of nitrous acid is, so to speak, an extra load put on the towers, since it is certainly a reaction which requires time for its completion. Incidentally, it is clear that if imperfectly oxidised gas is admitted to the water towers, say by having no oxidising tower in the series, this load will be further increased, since in that case the nitrous acid formed from the still unoxidised NO will be in excess of the nitric acid.

Only NO_2 in excess of the proportion $NO_2 : NO$ is available for nitric acid formation; the rest produces nitrous acid: $(NO+NO_2)N_2O_3+H_2O = 2HNO_2$.

The exact mode of elimination of the nitrous acid from the liquid is not at present definitely settled, and there are different theories on the subject:

(1) *The nitric oxide theory.* According to this the nitrous acid decomposes according to the equation: $3HNO_2 \rightleftarrows HNO_3+2NO+H_2O$.

In the presence of an atmosphere of nitric oxide this reaction reaches an equilibrium when nitrous and nitric acids are present together in the solution. In actual tower practice, however, there is an excess of oxygen and of indifferent gas. Both these factors will tend to reduce the nitrous acid concentration in the solution; the first by removing the supernatant NO, with formation of NO_2, which then re-dissolves, and the second by reducing the partial pressure of the NO. There is no doubt that, in so far as this reaction plays a part in the removal of HNO_2, both these factors are of influence.

(2) *The volatilisation theory.* Nitrous acid in aqueous solution above a certain strength exhibits a marked blue colour, owing to partial dissociation with the formation of N_2O_3. Obviously this dissociation will increase, the less water is present, *i.e.*, the more concentrated is the solution. The N_2O_3 will tend to escape from the solution owing to its volatility, and the brown fumes above the blue solutions produced by pouring liquid nitrogen dioxide into water, consist largely of N_2O_3. If liquid nitrogen dioxide is poured into ice-cold water, the nitrous anhydride in fact separates as a heavy, deep blue liquid layer; if the temperature is raised this disappears and torrents of gaseous N_2O_3 are evolved.

(3) *The oxidation theory.* In absorption towers, where excess of oxygen is present, the reaction $2HNO_2+O_2=2HNO_3$ undoubtedly takes place, and probably to a still greater extent in the Pohle lifts, where a very efficient churning together of the liquid and the air used for working the lifts occurs. The use of oxygen instead of air in working the lifts would greatly increase this oxidising action.

In the present state of our knowledge, the question as to exactly which of the above reactions plays the most important part in the elimination of nitrous acid in absorption towers cannot be answered. From what is already known it may, however, be permissible to draw the two following conclusions:—

(1) The rate of elimination of nitrous acid, in presence of excess of air and with average turbulence, is fairly rapid, and is probably greater than the rate of absorption of nitrogen dioxide in the liquid.

(2) The elimination proceeds to such an extent that about 0·3% of nitrous acid (HNO_2) is left in the liquid acid, independently of the content in nitric acid of the latter.

Under average conditions it may therefore be assumed that the elimination of nitrous acid proceeds at a rate sufficient to allow it to be neglected in considering the rate of solution of the oxides of nitrogen.

Oxidising space in towers. Although some of the nitrous acid produced in the absorption towers is eliminated in solution by oxidation, as described above, and thus ceases to put a load on the towers, it is indisputable that the greater part reappears in the gas phase in the condition of nitric oxide, arising from the reactions: (*a*) $3NO_2+H_2O=2HNO_3+NO$; (*b*) $2NO+O_2=2NO_2$. Equation (*a*) appears to be the sum of two separate reactions, involving the intermediate formation of nitrous acid (see equations (1) and (2), p. 75 T). Reactions (*a*) and (*b*) constitute a cycle, in which out of 3 mols. of NO_2 taken, two are absorbed, and one remains for further absorption. One-third of the NO_2 therefore remains after each cycle. Thus, after 4 cycles, about 99% of the oxides are absorbed.

The regeneration of NO_2 by reaction (*b*) is not, in ordinary tower practice, carried out under ideal conditions, because this reaction appears to take place in two stages: $2NO+O \rightarrow N_2O_2$ (rapid), $N_2O_2+O \rightarrow N_2O_4$ (slow). This is practically true because, although N_2O_2 does not appear to have an individual existence (except in traces) under

the conditions of working, yet the mixture of equal molecules of NO and NO_2, if presented to an absorbing medium (*e.g.* sulphuric acid, or caustic soda), is rapidly absorbed as N_2O_3. The equilibrium $NO+NO_2 \rightleftarrows N_2O_3$ is therefore very rapidly displaced to the right. If this mixture is brought in contact with water it is almost completely absorbed as nitrous acid: $H_2O+NO+NO_2 \rightleftarrows N_2O_3+H_2O \rightleftarrows 2HNO_2$.

The cycle of reactions, under these conditions, will now be as follows:—

(1) $3N_2O_4+2H_2O=4HNO_3+2NO$.
(2a) $2NO+\frac{1}{2}O_2=N_2O_3$.
(3) $N_2O_3+H_2O=2HNO_2$.
(4) $3HNO_2=HNO_3+2NO+H_2O$.

It can be shown that, with these reactions, it is necessary to go through at least ten cycles to produce the same effect, if N_2O_3 is produced in the re-oxidation, as with four cycles in which the gas presented to the liquid is fully oxidised N_2O_4. This will very much increase the tower space required. Patents have been framed to obviate this formation of N_2O_3, by removing the gas after each contact with water, and allowing it to be fully oxidised before again bringing it into contact with water or acid. The actual conditions obtaining in towers are, however, more advantageous than would appear at first sight, for the following reasons:—(1) The oxidation in the free space will proceed beyond the stage N_2O_3, and a portion at least of the gas will be in the state of fully oxidised N_2O_4 after each cycle. (2) Opportunity for complete oxidation will occur in the connecting pipes between the towers (if these are provided, as should always be the case).

It may, however, be noted that the absorption coefficient we have decided to adopt below has been found by experiments in which the re-oxidation occurred in the same way as in actual towers, and the speed of re-oxidation may therefore be taken as included in these numbers.

Mist formation in towers. An important phenomenon which makes its appearance during the absorption of oxides of nitrogen in water is the formation of a white mist, which is carried away by the inert gas passing through the towers, and appears in the exit gas. It has generally been assumed that the loss due to mist is negligibly small ("less than 1%"). The mist is found, however, to consist of quite strong nitric acid in the form of droplets. These droplets are formed as soon as the oxides of nitrogen enter the train of absorption towers, *i.e.* in the strong acid tower, and pass unaltered and uncondensed through the remaining weak acid towers, escaping at the end in the shape of a fog, usually described as "steam," or "traces of ammonium nitrate." It was found that this fume, when condensed, gave a liquid containing 30—60% of nitric acid, and quite appreciable losses may arise if it is allowed to escape.

In the absorption of gases from arc furnaces, the gases coming from the water towers contain a considerable quantity of acid mist, which normally passes into the soda towers and is there absorbed as sodium nitrate. If soda towers are not used, this mist escapes condensation, and even with soda towers the absorption is incomplete. By means of electrical precipitation apparatus it is possible to condense the mist to 35% nitric acid, *i.e.* acid corresponding with that in the first tower, in which the oxides of nitrogen meet liquid acid of this strength, which had passed unchanged through towers in which the acid is much more dilute. This at once refutes the common criticism that the mist cannot contain any strong acid because it has passed through towers containing only weak acids, *e.g.*, 5%, and cannot therefore be any stronger than these.

Theory of tower design. In this we shall take account of the variation in composition of the gas in passing through the tower. Since it is impossible to solve this by arithmetical methods, it will be necessary to consider the problem generally, but the result will be found to be quite simple and capable of practical application.

Consider a tower of height X ft. (fig. 2) and cross section A sq. ft. Take any horizontal plane at a height x feet from the base of the tower and

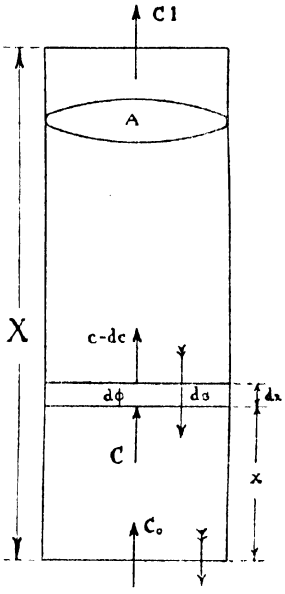


FIG. 2.

another similar plane x+dx ft. from the base. These planes enclose an elementary section of the tower, of volume A.dx cub. ft. Let the free space associated with this volume = dφ A.f.dx, where $f=\frac{1}{A}\cdot\frac{d\phi}{dx}$ = fraction of free volume per cub. ft. gross volume. Let the surface presented by the packing in this volume be dS sq. ft. = k.A.dx; where $k=\frac{1}{A}\cdot\frac{dS}{dx}$ = sq. ft. surface per cub. ft. gross volume occupied by packing.

Let all concentrations be expressed in terms of lb. NO_2 per cub. ft., and let:

Concentration of NO_2 in gas entering section = c lb. NO_2 per cub. ft.

Concentration of NO_2 in gas leaving section = c—dc lb. NO_2 per cub. ft.

Concentration of NO_2 in gas entering tower = c_0 lb. NO_2 per cub. ft.

Concentration of NO_2 in gas leaving tower = c_1 lb. NO_2 per cub. ft.

Let the velocity of gas-flow through the tower = V cub. ft. per min.

NO_2 absorbed in section in time $\frac{d\phi}{V}$ mins. = $k^1.dS.\frac{d\phi}{V}$ lb. = [1].

where k^1 = absorption factor (for gas of concentration c, and with any particular acid concentration) = lb. NO_2 per sq. ft. per min. absorbed.

NO_2 contained in dφ cub. ft. of entering gas = dφ.c lb. NO_2.

NO_2 contained in dφ cub. ft. of exit gas = dφ.(c—dc) lb. NO_2.

∴ change in concentrations = −dφ.dc lb. NO_2 = [2].

Evidently if there is no leakage, [1]=[2].

$$\therefore -d\phi.dc=\frac{k^1 dS.d\phi}{V}.$$

(If there is leakage of liquid through the walls of the tower, or otherwise, such that a fraction λ escapes per foot of tower, this is easily taken into account.)

It may be taken as a first approximation that k^1 is proportional to the concentration of the gas, for a given strength of acid and temperature:

$$k^1 = K.c \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1),$$

$$\therefore \quad -dc = \frac{K.c.dS}{V}.$$

But $$dS = k.A.dx,$$

$$\therefore \quad -\frac{dc}{c} = \frac{K.k.A.dx}{V}.$$

Or $$-\log_e c = \frac{K.k.A}{V}x + \text{const.}$$

When $x = 0$ we know that $c=c_0$.

$$\therefore \quad \log_e \frac{c_0}{c} = \frac{K.k.A}{V}x \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2).$$

If

X = total height of tower

$c_x = c_1$=concentration of effluent gas,

$$\therefore \quad \log_e \frac{c_0}{c_x} = \frac{K.k.A.X}{V} = \frac{K.k.v}{V} \quad . \quad . \quad . \quad . \quad (3),$$

where v = gross volume of tower.

If only part of the tower is occupied by packing, it is not difficult to take this into account.

It is assumed that the concentration of liquid acid passing down the tower is constant, and this condition is, in fact, closely realised in practice, where the acid flow is usually so large that there is no appreciable change of concentration in the separate towers. The case where the change of acid concentration is taken into account is more complicated, and as it has very little practical utility it is omitted here. In the case where the acid strength is assumed constant in the tower, the value of K (equation 1) for any particular strength of acid is given in the following tables. The values must, of course, be taken at the temperature which exists in the tower.

Values of $K \cdot 10^2$ *at* 50° *C.*

% NO_2 in gas	1	2	3	4	5	6	7	8	9	10
% acid strength										
5 ..	1·97	1·97	2·05	2·14	2·31	2·53	2·71	2·83	2·93	3·00
10 ..	2·59	2·48	2·16	2·55	2·64	2·75	2·85	2·91	2·99	3·00
16 ..	1·57	1·57	1·59	1·73	1·89	2·12	2·31	2·47	2·59	2·67
25 ..	1·10	1·10	1·12	1·18	1·32	1·57	1·73	1·98	2·12	2·23
37 ..	0·63	0·63	0·655	0·668	0·723	0·786	0·857	0·912	1·0	1·06
42 ..	0·471	0·471	0·471	0·471	0·51	0·576	0·628	0·687	0·770	0·850
52 ..	0·196	0·157	0·157	0·177	0·220	0·275	0·359	0·412	0·524	0·605
60 ..	0·079	0·079	0·079	0·079	0·110	0·171	0·259	0·334	0·419	0·571

Values of $K \times 10^2$ *at* 40° *C.*

% NO_2 in gas	1	2	3	4	5	6	7	8	9	10
% acid strength										
5 ..	2·91	2·63	2·57	2·59	2·62	2·71	2·78	2·83	2·86	2·89
10 ..	2·41	2·44	2·49	2·53	2·59	2·63	2·78	2·85	2·91	2·93
16 ..	2·20	2·28	2·36	2·41	2·48	2·58	2·65	2·71	2·75	2·78
25 ..	1·97	1·89	1·91	2·01	2·12	2·20	2·26	2·30	2·34	2·38
37 ..	1·73	1·57	1·49	1·49	1·57	1·65	1·73	1·77	1·81	1·85
42 ..	1·49	1·34	1·26	1·28	1·32	1·42	1·49	1·56	1·62	1·65
52 ..	1·18	0·943	0·865	0·845	0·895	1·01	1·12	1·22	1·31	1·37
60 ..	0·354	0·255	0·262	0·324	0·393	0·524	0·684	0·845	0·985	1·12

Values of $K \times 10^2$ *at* 30° *C.*

%NO_2 in gas	1	2	3	4	5	6	7	8	9	10
% acid strength										
5 ..	2·28	2·12	2·23	2·39	2·48	2·59	2·67	2·73	2·79	2·83
10 ..	2·12	2·12	2·23	2·39	2·48	2·59	2·69	2·78	2·84	2·88
16 ..	1·96	2·01	2·20	2·32	2·44	2·55	2·62	2·67	2·71	2·75
25 ..	1·81	1·89	2·10	2·26	2·34	2·38	2·44	2·47	2·49	2·52
37 ..	1·65	1·65	1·71	1·83	1·96	2·11	2·20	2·28	2·32	2·36
42 ..	1·57	1·45	1·52	1·63	1·81	1·96	2·09	2·18	2·26	2·31
52 ..	1·41	1·10	1·12	1·24	1·43	1·73	1·91	2·06	2·18	2·26
60 ..	0·746	0·559	0·575	0·746	1·04	1·40	1·67	1·87	2·04	2·12

The figures given in these tables are derived from a series of experiments on the rate of absorption of nitrogen dioxide, from mixtures of the gas with air in different proportions, by nitric acid of different strengths at different temperatures, made by Dr. E. K. Rideal. The graphical representation of these experiments, by means of which the constants in their present convenient form were derived, was carried out at our suggestion by Dr. G. N. White. It is hoped that Dr. Rideal's researches will be published in the immediate future, and we wish to record our indebtedness to him for his permission to use the results in the present communication.

Tower design.

The application of these results in tower design will now be illustrated by two examples.

Calculation 1. 500 cub. ft. of gas containing 10% of NO_2 by vol. is passed per min. through towers in which 30% HNO_3 circulates at 30° C. The effluent gas is to contain 1% of NO_2 by vol. Find the dimensions of the towers required for absorption.

k^1 for 10% gas and 30% HNO_3 at 30° C. $=3{\cdot}1\times10^{-4}$ lb. NO_2 per sq. ft. per min.

Concentration of NO_2 in 10% gas $=0{\cdot}0128$ lb. NO_2 per cub. ft. $=c$.

$$\therefore\ K=\frac{k^1}{c}=\frac{3{\cdot}1\times10^{-4}}{1{\cdot}28\times10^{-2}}=2{\cdot}42\times10^{-2}.$$

$$\log_e\frac{c_0}{c}=\log_e 10=2{\cdot}303.$$

V = 500 cub. ft. per min.

If we assume that packing exposes 40 sq. ft. per cub. ft. free space, and occupies 50% of the packed space, then:

$k=20$ sq. ft. per cub. ft. gross space.

Then, if v = gross volume of towers,

$$2{\cdot}303=\frac{2{\cdot}42\times10^{-2}\times20\times v}{500}.$$

$\therefore\ v=2100$ cub. ft.

Taking a useful practical rule for tower construction: height = 5 times the diameter.

we have, if x = diameter in ft.,

$$\frac{5.\pi.x^3}{4}=2100 \text{ or } x=8{\cdot}1 \text{ ft.}$$

The dimensions of the tower will then be:

Height = 40 ft.
Diameter = 8 ft.

If we had 30% acid in each tower, this single large tower could be replaced by 8 towers each 15 ft. high and 3 ft. 6 in. diameter.

Calculation 2. It is required to absorb the oxides of nitrogen from 500 cub. ft. of gas per minute containing 10% of NO_2 by vol., so as to produce 50% nitric acid with an overall efficiency of 90%. Find the number of towers required, the height and diameter of these towers, and the nature of the packing.

The following data are given:

V = cub. ft. gas per minute = 500.

c_0 = initial concentration of NO_2 = 10% by vol. = 0·0128 lb. NO_2 per cub. ft.

c_1 = final concentration of NO_2 = 1% by vol. = 0·00128 lb. NO_2 per cub. ft.

Acid made = 50% HNO_3; therefore the water to be passed through per minute can be found:—

500 cub. ft. of gas containing 10% of NO_2 by vol. contains $500\times0{\cdot}0128=6{\cdot}4$ lb. NO_2.

$$\therefore\ NO_2 \text{ absorbed per minute}=\frac{9}{10}\times500\times0{\cdot}0128 \text{ lb.}$$

Water to produce 100% HNO_3 from this

$$=\frac{18}{2\times46}\times\frac{9}{10}\times500\times0{\cdot}0128=1{\cdot}125 \text{ lb.}$$

$\therefore$ Total water per minute = 2·25 lb.

We will assume the absorption brought about in stages, such that the acid put down in the first tower is 30% HNO_3 and that withdrawn is 50% HNO_3. Average strength of acid in first tower = 40%. Assumed temperature at which first tower is kept = 30° C. Below this strength, at 30° C., the value of K is not very largely influenced by the acid strength and may be taken as $2{\cdot}303\times10^{-2}$.

The composition of the gas leaving the first tower is fixed, since the NO_2 absorbed is that required to concentrate the 30% acid entering the tower to 50% acid.

Weight of acid entering the first tower $=2{\cdot}25\times\frac{10}{7}=3{\cdot}22$ lb.

Weight of acid leaving the first tower $2{\cdot}25\times\frac{10}{5}=4{\cdot}5$ lb.

$\therefore$ NO_2 + oxygen absorbed in first tower (to form N_2O_5) = 4·5 − 3·22 = 1·28 lb. per minute.

$\therefore$ NO_2 absorbed in first tower $=1{\cdot}28\times\frac{92}{108}=1{\cdot}09$ lb. per minute.

NO_2 entering first tower = 6·4 lb. per minute.

$\therefore$ concentration of gas leaving first tower $=0{\cdot}0128\times\frac{6{\cdot}4-1{\cdot}09}{6{\cdot}4}=0{\cdot}0106$ lb. NO per cub. ft. = 83% by vol.

Dimensions of first tower.

(i) Packing assumed to be rings and stars (see table appended):

k = 42 sq. ft. per cub. ft. tower space.

(ii) k^1 = absorption coefficient for 10% gas in 40% HNO_3 at 30° C. $=2{\cdot}95\times10^{-4}$ lb. NO_2 per sq. ft. per minute.

Comparison of various types of tower packing.

Packing	Exposed area of unit, sq. in.	Volume of unit, cub. in.	No. of packing units per cub. ft. tower space	Total surface of packing units in sq. ft. per cub. ft. tower	Total volume of packing units in cub. ft. per cub. ft. tower	% Free space	% Gross space occupied by packing	Sq. ft. exposed per cub. ft. gross space to leave 80% free space
Small Raschig rings ..	5·46	0·368	{2,130 (1) 1,700 (2)	80·6 64·5	0·452 0·362	54·8 63·8	{45·2 36·2}	35·6
4-Point star *	5·81	0·597	545	22	0·188	81·2	18·8	23·4
Guttmann balls	23·4	3·05	75	12·2	0·132	86·8	13·2	18·4
Concentrics	16·5	6·1	152	49	0·538	46·2	53·8	18·3
Large rings and concentrics	93·6	13·15	64	41·6	0·489	51·1	48·9	17·1
Large rings	47·1	7·07	64	20·9	0·262	73·8	26·2	16·0
Rings and nodules ..	Ring 47·1	7·07	14·8	4·85	0·0606	89·6	10·4	9·33
	Nodule 11·1	2·91	25·7	1·98	0·0432			3·78
				6·83	0·104			13·11

* A form of tower packing designed by the authors.
(1) Thrown into tower.
(2) Stacked in tiers.

$$K = \frac{2{\cdot}05\times10^{-4}}{1{\cdot}28\times10^{-2}} = 2{\cdot}3\times10^{-2}.$$

$$\therefore \log\frac{c_0}{c_t} = \frac{k.v}{100.V},$$

$$\therefore \log\frac{10}{8{\cdot}3} = \frac{42\times v}{50{,}000},$$

$$\therefore v = \frac{50{,}000\times0{\cdot}0809}{42} = 963 \text{ cub. ft.}$$

If diameter of tower in feet = x,

$$\frac{5\pi x^2}{4} = 963 \text{ or } x = 6{\cdot}25 \text{ feet.}$$

∴ first tower is 31¼ ft. high and 6¼ ft. diameter.

Oxidation space beyond this tower will be amply provided by 15-in. gas mains.

Further absorption towers must reduce the gas from 8·3% to 1% NO_2.

$$\therefore \log\frac{8{\cdot}3}{1} = \frac{42\times v}{500\times100} \text{ or } v = 1095 \text{ cub. ft.}$$

This would be provided by three further towers of diameter 5 ft. and height 25 ft., giving a total volume of 1500 cub. ft. Of this, 1160 cub. ft. is packed, leaving 400 cub. ft. for oxidation space. This oxidation space would be distributed as follows:—4th tower, completely packed; 3rd tower, 300 cub. ft. empty = 15 ft. of tower; 2nd tower, 100 cub. ft. empty = 5 ft. of tower.

THE STABILISATION OF BLEACHING POWDER.

BY ANDREW NORMAN MELDRUM.

The author undertook work on the stabilisation of bleaching powder at the request of the Indian Munitions Board and submitted to the Board a statement of his preliminary results on May 24, 1918. This statement was communicated by the Board to the Director-General of the Indian Medical Service.

Work with the same object has since been undertaken in Britain at the request of the Medical Research Committee, and a paper entitled "A new bleaching powder for use in hot countries" was contributed to the Edinburgh Section of this Society by Rettie, Lorrain Smith, and Ritchie (see this J., 1918, 311 T).

The author therefore considers it desirable to give a summary of his preliminary work.

Commercial bleaching powder always contains water, and experiments were made with a view to ascertaining the effect of removing this water. The hygroscopic agents that were used were:—(1) Sodium hydroxide in powder. (2) Calcium chloride (basic) in grains. (3) Phosphorus pentoxide. (4) Sulphuric acid.

The bleaching powder was carefully mixed to ensure uniformity, and 10 grms. was placed in a weighing bottle in a desiccator containing the hygroscopic agent. For comparison an equal weight was kept in a desiccator containing no hygroscopic agent. The desiccators were placed in a dark cupboard, and the loss of weight and the "available chlorine" in the bleaching powder were ascertained at intervals. The results are shown in the table below.

The results show that bleaching powder is more rapidly dried by alkaline agents (sodium hydroxide and basic calcium chloride) than by acid agents (phosphorus pentoxide and sulphuric acid), and also that the tendency of bleaching powder to lose "available chlorine" is much decreased by desiccation.

Further it was observed that the atmosphere in the desiccators containing phosphorus pentoxide and sulphuric acid was rich in chlorine. Evidently bleaching powder loses chlorine in addition to water during the drying process, which is absorbed by alkaline desiccating agents. Since the net effect of drying is to raise the amount of "available chlorine," the amount of chlorine lost by the bleaching powder is small. Also it would seem that an atmosphere of chlorine hinders loss of water by bleaching powder, that is, lowers the water vapour pressure of the bleaching powder.

The bleaching powder that had been dried as above by sodium hydroxide and phosphorus pentoxide, in each case contained over 25% of "available chlorine" after a year. The author has also ascertained:—

(1) That in the drying of bleaching powder there are two stages, consisting in (*a*) loss of water and hypochlorous acid, (*b*) loss of water and chlorine. Since hypochlorous acid is lost in stage (*a*) it was necessary to prove that the gas produced in stage (*b*) is not chlorine monoxide, but is chlorine, and this has been done.

(2) That bleaching powder can be dried more rapidly by phosphorus pentoxide than by sodium hydroxide if in addition to the phosphorus pentoxide an absorbent for chlorine is present: the absorbent used was a mixture of mercurous chloride and mercury. This result indicates that when bleaching powder is evolving off water and chlorine, the partial pressures of the water vapour and the chlorine are dependent on one another.

	Loss of weight %						"Available chlorine," %					
Time in days	3	6	9	12	49	192	0	3	6	9	12	49	192
NaOH ..	13·3	13·4	13·45	13·45	13·7	13·7	27·3	29·2	28·1*	28·6	29·9*	27·8	27·55
$CaCl_2$ ..	13·1	13·4	13·4	13·4	13·8	13·9	27·3	29·2	29·6	29·0	28·8	27·9	22·2
P_2O_5 ..	6·9	11·4	13·75	14·0	14·4	14·5	27·3	28·1	27·9	28·4	28·5	27·5	26·7
H_2SO_4 ..	7·3	12·3	14·0	14·1	14·4	14·9	27·3	28·1	27·5	28·0	28·1	28·0	24·5
"Blank" ..	0·3	0·2	0·0	0·0	0·0	0·8	27·3	27·2	26·95	26·55	—	24·5	18·7

* These results are irregular and are perhaps inaccurate. The calcium chloride was basic.

Madhavlal Ranchhodlal Science Institute, Ahmedabad, India.

London Section.

Meeting held at Burlington House, on March 3rd, 1919.

DR. CHARLES A. KEANE IN THE CHAIR.

NOTES ON THE SETTING TIME OF PORTLAND CEMENT.

BY F. ESLING, A.C.G.I., A.I.C.

The setting time of cement, although of secondary importance, is often the cause of trouble. Temperature of room and materials when gauging; length of period of time for aeration; temperature of room or chamber during aeration; condition of atmosphere to which the cement is exposed while being aerated; and also the chemical nature of the water used for gauging the cement, are all points that tend towards variations in initial and final setting times. The first three points are matters long since recognised as governing factors by the manufacturer and cement chemist; the last two, in the author's opinion, have received too little attention.

The influence that the chemical nature of the water used for gauging often exerts on the setting of a cement came to the notice of the author some time before the war in the following way:—A company of cement manufacturers were supplying a contractor with frequent parcels of medium-setting cement, samples from each parcel were tested by the contractor's chemist and reports, satisfactory or otherwise, made both to contractor and manufacturers. The latter frequently raised objection to the initial setting times as reported by the contractor's chemist on the ground that they were considerably quicker than their own tests. The knowledge that a number of consecutive parcels had been rejected on this test alone led the author to investigate the cause of the trouble, with the discovery that the differences were almost entirely due to the chemical nature of the two waters used by the different operators in gauging their cement for setting time tests. The manufacturers obtained their water supply from the greensand strata of North Kent; and it was not exposed to the atmosphere for any length of time before use. That used by contractor's chemist came from town supply, which was obtained from chalk beds; it was no doubt exposed to the atmosphere in reservoirs for a considerable time before entering the service main. A difference in the chemical nature of the two waters would naturally be expected. The town supply contained between 3 and 4 times the quantity of calcium carbonate and less sulphate.

To follow up this matter still further, an investigation of the influence of different waters and solutions of salts on the setting of a more or less normal cement was undertaken. To observe at the same time the effect of varying periods of times for aeration, portions of the cement selected for this work were exposed to the atmosphere for 14, 24, and 48 hours.

The cement used for these tests gave the following figures on analysis:—SiO_2 22·68%, Al_2O_3 7·98%, Fe_2O_3 3·20%, CaO 62·36%, MgO 1·26%, SO_3 0·92%, CO_2 and H_2O 0·69%, insoluble matter 0·70%, Na_2O and K_2O 0·21%, $CaSO_4$, counting all SO_3 as calcium sulphate, 1·57%, CaO, after subtracting that present as sulphate, 61·71%, ratio $CaO:(SiO_2+Al_2O_3)$ 2·42. Sp. gr. 3·17. Physical tests showed the cement to be quite normal.

The Vicat instrument, with needle of $^1/_6$ in. square and weighted to 2½ lb., was used for these tests on account of its being more readily employed in the examination of a large number of pats under observation at the same time. Initial setting time was taken as the time when the needle first failed to penetrate to the glass on which the pat was made up, and final setting when the needle, gently applied and allowed to exert its whole weight for a few seconds, ceased to make an impression.

In the investigations set out in Table I, it will be observed that the quantity of solution or water used in gauging was in every case 23 c.c. for 100 grms. The temperatures of the room, solution, and cement were as nearly as possible the same at the beginning

TABLE I.

Effect on initial and final setting times of a cement using various solutions and waters, the cement being unaerated, and also aerated for different periods.

—	Temperature			Unaerated			Aerated 14 hrs.			Aerated 24 hrs.			Aerated 48 hrs.		
				Initial	Final		Initial	Final		Initial	Final		Initial	Final	
Solution †	Cement	Solution	Room	Mins.	Hrs.	Mins.	Mins.	Hrs.	Mins.	Mins.	Hrs.	Mins.	Mins.	Hrs.	Mins.
	°F.	°F.	°F.												
a	67	66	69	35	3	25	22	3	30	30	3	25	25	3	20
b	67	66	70	30	3	10	25	3	5	29	3	0	24	2	50
c	67	67	68	35	3	15	35	3	30	35	2	40	30	2	35
d	67	67	68–72	30	3	45	30	3	55	35	3	45	30	3	30
e	67	67	68–72	15	2	40	15	2	25	15	2	15	13	1	50
f	68	68	68–72	40	5	15	40	5	15	40	5	0	40	5	0
g	68	68	68–72	43	4	0	40	4	0	40	3	55	35	4	0
h	68	68	68–72	45	3	35	40	3	40	38	3	30	35	3	20
i	68½	67½	67½–70	25	5	45	22	5	15	17	4	45	8	4	10
j	68½	67½	67½–70	30	3	35	27	3	30	25	2	35	25 *	2	15

† 23 c.c. of each solution was used per 100 grms.

It is obvious that temperature differences alone could not account for the excessive variations obtained.

Period of aeration is interesting as showing the speeding up effect with certain solutions; it is also curious how other solutions are unaffected as regards their setting time values.

of the tests, but in some cases the room temperature increased during testing.

The following waters and solutions were used:—(*a*) Distilled water containing no dissolved solids (not air-free). (*b*) Water from town supply, containing 0·038% solids, a large proportion being chalk (not air-free). (*c*) Boiled water, town supply, containing 0·0166% solids (almost air-free). (*d*) Lime water, solution in distilled water containing 0·141% CaO in solution. (*e*) Calcium bicarbonate solution, containing 0·0984% $CaCO_3$, saturated with carbon dioxide. (*f*) Sea water, taken from outside the Nore, containing 3·022% NaCl and other salts (not air-free). (*g*) Calcium sulphate solution, containing 0·1414% $CaSO_4$ in distilled water (not air-free). (*h*) Magnesium sulphate solution, a 1·0% solution of $MgSO_4,7H_2O$ in distilled water (not air-free). (*i*) Sodium carbonate solution, containing 2·5% anhydrous Na_2CO_3 in distilled water (not air-free). (*j*) Sodium bicarbonate solution, containing 2·5% $NaHCO_3$ in distilled water (not air-free).

TABLE II.

Percentage variation in initial and final setting times, due to different periods of aeration.

\+ = accelerated. − = retarded.

Solution or water	Initial setting	Final setting		
	Difference between time for unaerated cement and cement aerated 48 hours	Difference between time for unaerated cement and cement aerated for:—		
		14 hours	24 hours	48 hours
a	+30%	−2½%	nil	+ 2½%
b	+20%	+2½%	+ 5%	+10½%
c	+12%	−7½%	+18%	+20½%
d	nil	−4½%	nil	+ 6½%
e	+13%	+9½%	+15½%	+31%
f	nil	nil	+ 5%	+ 5%
g	+19%	nil	+ 2%	nil
h	+22%	−2½%	+ 2½%	+ 7%
i	+68%	+8½%	+17½%	+27½%
j	+17%	+2½%	+23%	+37%

It is noteworthy that with carbonates, and particularly bicarbonates, aeration causes considerable quickening of final setting time, and with distilled water, calcium sulphate solution, and sea water, final setting is practically unaffected by aeration.

The apparent lack of relationship between initial setting time variations and those of final setting times, with reference to aeration, would suggest that the initial setting is a chemical operation unrelated or only indirectly related to final setting.

It may occur that with another sample of cement aeration will produce entirely different results, since there are so many not easily controlled factors governing its composition and internal structure.

Effect of different solutes. Considering the results obtained with 24-hour aerated cement and comparing the effect of different solutions, and for convenience taking distilled water as the standard, it will be observed that:—(*b*) Town water accelerates initial set 3·3%, accelerates final set 7·7%. (*c*) Boiled water retards initial set 16·6%, accelerates final set 22%. (*d*) Lime water retards initial set 16·6%, retards final set 10%. (*e*) Calcium bicarbonate accelerates initial set 50%, accelerates final set 34%. (*f*) Sea water retards initial set 33%, retards final set 46%. (*g*) Calcium sulphate retards initial set 33%, retards final set 14·6%. (*h*) Magnesium sulphate retards initial set 26·6%, retards final set 2%. (*i*) Sodium carbonate accelerates initial set 43%, retards final set 39%. (*j*) Sodium bicarbonate accelerates initial set 16·6%, accelerates final set 24·4%.

The destructive influence of a too rapid initial setting time is well illustrated by the following results obtained by gauging cement with three different strengths of sodium carbonate solution Comparative results obtained with distilled and tap waters are also given. The temperature of the room, cement, and water or solution was 66° F.

TABLE III.

Solution	Vol. used	Initial	Final		Tensile strain	
	C.c.	Mins.	Hrs.	Mins.	Neat cement	Sand 3 : 1
Distilled water	22½	20	2	10	603	253
Tap water ..	22½	23	3	0	610	247
2½% Na_2CO_3 solution ..	22½	3	3	0	512	228
5% ditto ..	22½	2	3	0	447	192
10% ditto ..	22½	1	3	0	353	140

N.B.—Neat briquettes were gauged with 22½% solution or water; sands were gauged with 9% solution or water; tensile strains are in lb. per sq. in. on 7-day briquettes, and figures are means of 6 briquettes in each case.

The cement and tap water used were the same as in the previous work after a lapse of two months.

The very rapid initial setting times are noteworthy and the consequent falling off in tensile strength due without doubt to "killing," *i.e.*, working of the cement after it has passed the period of its initial setting time.

Conclusion.

The results obtained above indicate the necessity of a further revision of the standard specification for cement testing in respect to the water that should be used in gauging a cement for setting time tests, and for this purpose distilled water suggests itself as the most readily obtainable standard.

When available, a sample of water likely to be used by contractors in their construction work would often be of value to the analyst and manufacturer's chemist in settling disputed points, and for establishing the variations, should any exist, between it and distilled water.

DETERMINATION OF AROMATIC HYDROCARBONS IN PETROL.

BY H. G. COLMAN, D.SC., AND E. W. YEOMAN, B.SC.

The authors have during the past year or two made a number of examinations of petrol for aromatic hydrocarbons by the method recently described by F. B. Thole (this Journal, 1919, 39 T), and their results substantially confirm his. In one respect, however, they have carried the investigation somewhat further, and a short account of the results may be of value.

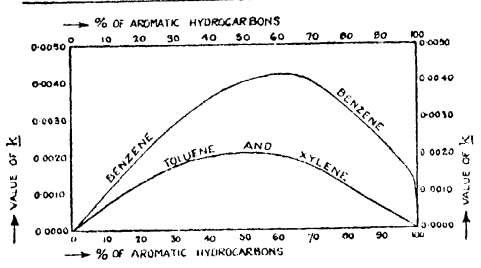
The matter in question relates to the calculation of the percentage of benzene, toluene, and xylene in the respective petrol fractions containing them from the sp. gr. of the fraction before and after the removal of the aromatic hydrocarbons by sulphonation. On the assumption that no expansion or contraction occurs when the hydrocarbons of the different series are mixed, the volume/volume percentage of aromatic hydrocarbon present is found by the formula: % aromatic hydrocarbon $= (b-a) \div (c-a) \times 100$, where a is the sp. gr. after sulphonation, b the sp. gr. before sulphonation, and c the sp. gr. of the aromatic hydrocarbon.

But, as Thole points out, expansion occurs on mixing the two series of hydrocarbons, so that there is what he terms a "deviation" from the true result in the figures thus obtained, for which a correction must be made. The extent of this deviation depends entirely upon the magnitude of

this expansion, which varies with both the individual aromatic hydrocarbon and its percentage in the mixture. To facilitate its estimation we have determined the expansion occurring when each of the aromatic hydrocarbons is mixed in varying proportions with paraffins of approximately the same boiling point. Slight differences occur with different qualities of petrol, the chemical nature of which varies especially according to the relative amounts of paraffins and naphthenes, but these differences are small and for the purposes of this test may be neglected.

The method adopted was to make mixtures of known and varying volumes of the aromatic hydrocarbon with petrol of known sp. gr., to determine the sp. gr. of the mixture obtained, and to note the amount by which this observed sp. gr. was less than that found by calculation, this difference being termed k.

The values found for k are summarised in the accompanying graph, from which it will be seen



that whilst the expansion in the case of toluene and xylene is practically the same, in the case of benzene it is almost double. The benzene curve shows also an abnormality, inasmuch as the addition of very small amounts of paraffins to pure benzene (0·25%, 0·5%, 0·75%, and 1·0%) causes a very high proportionate expansion and reduction of the sp. gr. For the purposes of this test, this is of but little importance, but it has a material bearing in the converse test, namely the determination of small percentages of paraffins in benzene.

As the expansion in the case of benzene is double that obtained with toluene and xylene, the deviation from the true result is much greater in the former case; in all cases, however, where the percentage of aromatic hydrocarbons is 10% or less, the deviation is small and within the range of the other experimental errors, but at higher percentages it is material, and for example with 50% of benzene amounts to 2%, the calculated figure without the correction being 48%.

If therefore a^1, a^2, and a^3 are the respective sp. grs. of the benzene, toluene, and xylene fractions after, and b^1, b^2, and b^3 the sp. grs. before sulphonation (all at 15°/15° C.), then the true number of volumes of benzene, toluene, and xylene in 100 volumes of each fraction is:

(1) Benzene $= 100 \times \{(b^1+k^1)-a^1\} \div (0{\cdot}885-a^1)$
(2) Toluene $= 100 \times \{(b^2+k)-a^2\} \div (0{\cdot}872-a^2)$
(3) Xylene $= 100 \times \{(b^3+k)-a^3\} \div (0{\cdot}868-a^3)$,

k being the amount by which the sp. gr. of a mixture of that percentage of the aromatic hydrocarbon and petrol is lowered by the expansion which occurs on mixing them.

The sp. gr. of pure benzene free from paraffins and naphthenes is 0·885 at 15°/15° C., and that of toluene, also completely free from paraffins, is 0·872, although commercial pure toluene rarely exceeds 0·870, owing to the presence of small amounts of paraffins. That of xylene varies according to the proportions of *o*-, *m*-, and *p*-xylene present, so that no very exact figure can be given. W. H. Perkin, senr. (J. Chem. Soc., 1896, **69**, 1192), found the sp. gr. of pure *o*-xylene to be 0·8812, that of *m*-xylene 0·8691, and that of *p*-xylene 0·8661, all at 15°/15° C., and it appears that *m*-xylene is the isomeride usually present in largest proportion, then *p*-xylene and only small amounts of *o*-xylene. Failing more exact information in this respect, the sp. gr. of pure xylene for the purposes of the test may be taken as 0·868.

To facilitate the calculation of the percentages of benzene, toluene and xylene from the sp. gr. of the respective fractions before and after sulphonation, graphs have been drawn up, from which the volume/volume percentages of each, corrected for the deviation due to expansion, may be directly read off.

The percentages of benzene, toluene, and xylene thus obtained give the number of volumes occupied by what is chemically benzene, toluene, and xylene in 100 volumes of the mixtures. As, however, expansion occurs when the two series of hydrocarbons are mixed, so conversely, contraction occurs when the hydrocarbons are separated from the mixture. Thus for example a mixture of equal volumes of benzene and normal hexane would on separation of 100 c.c. of the mixture into the constituent hydrocarbons only give 49·75 c.c. and not 50 c.c. of each. Hence to convert the volume/volume percentages found by the formula or read off from the graph into volume percentage of the separated hydrocarbon, the figures must be multiplied by $b \div (b+k)$. This again is only necessary in the case of high percentages of the aromatic hydrocarbons, as with low percentages the figure is not materially altered by the factor.

To convert the volume/volume percentages found by the formulæ or directly read off on the graphs into percentage by weight, these must be multiplied by $c \div (b+k)$, where c is the sp. gr. of the aromatic hydrocarbons the quantity of which is to be determined.

Manchester Section.

Meeting held at the Grand Hotel, on Friday, December 6, 1918.

MR. W. THOMSON IN THE CHAIR.

THE INDOPHENINE REACTION.

BY EDWARD WRAY.

It is stated in all the well-known text-books and books of reference that by shaking benzol containing thiophene with sulphuric acid and isatin, a blue coloration of the sulphuric acid is produced (see Beilstein, 3rd ed., Vol. 3, p. 738).

Some few years ago I had occasion to use this reaction, and to my surprise I did not obtain the blue coloration as I expected, but a green coloration of the sulphuric acid. I made the test in a separating funnel and noticed that where a small quantity of the reagents wetted the stopper a blue coloration was slowly produced, which suggested that moisture or slow oxidation by means of air was necessary for the production of the indophenine coloration. On repeating the experiment under varying conditions using synthetic thiophene and pure sulphuric acid, a green coloration was always obtained which, however, on the addition of an oxidising agent, immediately turned to an intense blue. As this observation was new to me I searched all the literature at my disposal and found that the same observation had been made by Bauer in 1904.

The reaction was first described by Adolf Baeyer (Ber., 1879, **12**, 1311), who found that benzol condensed with isatin in presence of sulphuric acid, forming a dark-blue product, whereas toluene, xylene, naphthalene, and other hydrocarbons formed colourless condensation products. Baeyer isolated the blue product and assigned to it the formula $C_{20}H_{15}NO$. Victor Meyer (Ber., 1882, **15**, 2893) showed that benzene obtained from benzoic acid, or commercial benzol after exhaustive treatment with sulphuric acid, does not give the reaction, which he later (Ber., 1883, **16**, 1465) showed to be due to thiophene; he assigned to the coloured substance the formula $C_{12}H_7NOS$, a composition confirmed by Baeyer and Lazarus (Ber., 1885, **18**, 2637).

In 1904, F. W. Bauer (Ber., **37**, 1244) stated that the indophenine coloration does not take place when pure sulphuric acid is used, a green solution being obtained which, however, turns blue on addition of oxidising agents such as nitric acid or ferric chloride. L. Storch confirmed this statement (Ber., 1904, **37**, 1961), adding that the blue coloration is also produced in presence of pure sulphuric acid if a little water is added or if the mixture is warmed.

C. Liebermann and B. Pleus (Ber., 1904, **37**, 2461) maintained that the indophenine reaction is given by pure sulphuric acid free from nitrous or nitric compounds. Bauer, however, controverted this (Ber., 1904, **37**, 3128) and also the statements of Storch as to the effect of water or heat.

I have repeatedly endeavoured to obtain the reaction by adding water or by heating the mixture, and my experience is entirely in accord with that of Bauer. I suggest, however, that in view of the high state of purity of present-day commercial sulphuric acid it is advisable in all cases to add an oxidising agent, preferably a drop of nitric acid, to the sulphuric acid when making the indophenine test for thiophene in commercial benzols.

The test is carried out as follows:—25 c.c. of a solution of 0·5 grm. of isatin in 1000 grms. of pure sulphuric acid is placed in a stoppered cylinder of 100 c.c. capacity. 1 c.c. of the benzol to be tested is added, followed by 25 c.c. of pure sulphuric acid, to which 1 drop of concentrated nitric acid has been added; the cylinder is then closed and the whole well shaken, when the blue indophenine coloration is immediately obtained. This addition of nitric acid may be employed with advantage also for the colorimetric determination as described by Schwalbe (Chem.-Zeit., 1905, **29**, 895; this J., 1905, 988).

Discussion.

In reply to a question by Mr. Radcliffe, the author said that Victor Meyer had carried out the condensation of thiophene with various o-diketones, all of which gave a colour reaction. The indophenine reaction had been used as the basis of a method for estimating thiophene in benzol, but he considered that more accurate results were obtained by weighing the mercuric acetate addition compound of thiophene.

NOTES ON THE QUANTITATIVE TESTING OF RAINPROOF AND WATERPROOF CLOTH.

BY GEOFFREY MARTIN, D.SC. (LOND. AND BRISTOL), PH.D., F.I.C., AND JAMES WOOD, M.A., B.SC., F.I.C.

The tests described below are, we believe, all well known in the trade but not much appears to have been published on the subject; consequently the following notes may interest chemists who are called upon to examine a cloth in regard to its waterproof quality.

Among the chief waterproofing processes may be mentioned:—

(1) *With aluminium acetate.* The fabric is immersed in a solution of aluminium acetate, squeezed, and dried, aluminium oxide being deposited in the fibre. Fabrics thus waterproofed are porous and permeable to air. They are not strictly waterproof, and consequently are sometimes described as "showerproof" or "rainproof."

(2) *With gelatin, glue, isinglass, casein, etc.,* followed by treatment with a solution of alum, tannin, etc. Here again the articles are not usually absolutely impermeable to water.

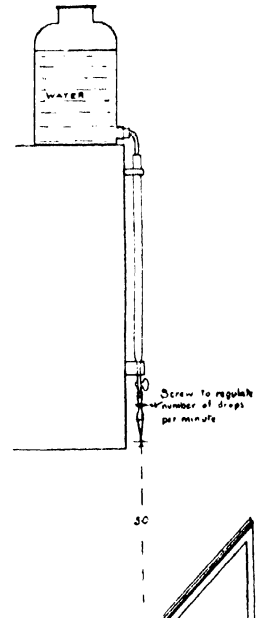
(3) *With paraffin and other waxes.* Articles treated in this way are usually impermeable to water.

(4) *With indiarubber.*

(5) *With oil.* A mixture of raw and boiled linseed oil (mixed with colouring matter, resin, and other materials) is spread in thin layers on the fabric, which is dried between successive applications. Oiled silks, oil-skins, etc., impervious to water and air are thus prepared.

(6) *With ammoniacal cupric oxide.* The "Willesden" fabrics are waterproofed by this process.

The tests to which the cloth must be subjected in order to reveal the nature of the waterproofing are obvious. Thus, the analysis of the "ash" will show what inorganic salts have been used in treating the cloths. The presence of rubber, paraffin wax, and fats, etc., can be detected both



SIDE ELEVATION

FIG. 1.

from the appearance of the cloth and also by extraction with a volatile solvent and examining the extract.

We have found the following scheme of examina-

tion of waterproof cloths to give all the information required:—

Determination of waterproof value. Absolutely waterproof articles are uncomfortable to wear because they are not permeable to air. Hence it comes about that most of the so-called "waterproofs" are intended to admit air and are permeable to water after a certain time.

The drop test. This is the War Office test and is especially valuable in that it furnishes a fairly accurate numerical value of the degree of waterproofing. It reproduces more or less exactly the actual conditions to which a cloth is subjected in practice, imitating the natural fall of rain.

The method of carrying out the test in our laboratories is shown in Fig. 1. The sheet of cloth to be tested is laid upon a sheet of white blotting paper which in turn rests upon a sheet of plate glass, supported by a frame at an angle of 45°. The cloth and blotting paper are fixed in position by strips of lead about an inch wide, bent at the far end and laid over the cloth. Beneath the plate glass is a mirror, placed as shown. Water is then dropped from the burette on to the cloth, about 5 feet below. By means of the clip the flow of the water is kept at 20 drops per minute. This is continued until the water passes through the waterproofed cloth and stains the blotting paper below. By viewing the mirror from behind, the exact moment at which the stain appears can be determined and the number of drops required to produce this result is noted. Even in the same sample of cloth, considerable variations occur in the waterproofing, as is shown by the following results:—

	Samples	1	2	3
Number of trials		16	12	7
Average number of drops per trial...		6·4	15	18
Maximum number of drops ...		10	22	22
Minimum number of drops... ...		5	10	12

It will be seen that there is a considerable variation between the minimum and maximum number of drops required for penetration, but the average for a set of tests (say 20 trials to ¼ sq. ft.) seems characteristic for any given piece of cloth. Nos. 2 and 3 represent a very good class of cloth, but No. 1 is sufficiently impermeable for most purposes.

To pass the War Office test, an average of 60 drops is required. This is considerably in excess of that usually needed in civilian garments.

After carrying out the above test, the waterproofed cloth should also be subjected to the following tests:—

(1) The cloth should be rinsed 3 or 4 times in cold water, dried, and tested again. A more severe test is to soak the cloth in cold water for 24 hours, dry, and then again test. A properly waterproofed cloth should not show much variation when treated in this manner, although most of the samples we have examined show a considerable deterioration.

(2) The cloth should now be covered with a damp cloth, ironed, and again be subjected to the drop test. It is still better to put the cloth in a Hoffman press and blow steam through it. The object of this test is to be sure that the waterproofing is of such a nature as to resist the treatment to which the cloth will be subjected in the tailors' hands.

The following are some of the other tests for determining the waterproof value of the cloth, as carried out in the trade:—

Dash test. **This consists of holding the cloth horizontally and pouring water on it. On a properly waterproofed cloth the water will run about like mercury. It is purely a qualitative test, and has no particular value.**

Trough test. A trough is made by suspending the cloth from its four corners, and into this some 500 c.c. of water is poured. Most cloths, even if indifferently waterproofed, will retain the water for 24 hours or more; consequently this test is of little value (except as a test for holes), as the quantitative estimation would take far too long.

Filter test. This test is widely used in the trade, but is not nearly so good as the "drop test" described above. It is, however, very useful for detecting the presence of pinholes in a piece of cloth. A square piece of cloth of 10-inch (25 cm.) side, cut from the piece, is folded like a filter paper, placed in a 60° glass funnel, and loaded with 300 c.c. of distilled water. At the end of 24 hours nothing more than a few very small, evenly diffused drops should show on the under side and the stuff itself should not be wet through.

A modification of this test, which gives good results, and which may be described as the "thistle funnel test," is carried out as follows:—A piece of cloth 2½ in. square, containing no selvedge (as this is usually more pervious than the fabric proper), is stretched across the mouth of an ordinary thistle funnel with face of cloth towards the inside, and fastened securely by means of a string round the neck of the tube. The thistle tube is inverted, filled with cold water, and supported by a clamp above a graduated cylinder, and the amount of water passing through in 5 hours and in 10 hours is measured. A fabric which allows no water to pass through in 10 hours is considered excellent. The time which elapses before the appearance of the first drop on the outer surface should also be noted.

It is very difficult to estimate the relative value of goods which are so thoroughly waterproofed as to allow very little moisture to come through after many hours. In Gawalowski's apparatus (on the principle of the wet and dry bulb thermometer), which has been used for this purpose, a glass box, ABCDEFGH (fig. 2), is provided with a tightly fitting door, BCGF, in front and a tightly fitting lid pierced by four holes, 1, 2, 3, and 4, and is divided into two parts by a glass partition, MNOP. The opening, 1, in the cover is an air hole. Through 2 is inserted the graduated burette, 5, 37 cm. long and fitted with a cover at the top. The lower end has fitted to it an attachment resembling a polarimeter tube, but instead of the glass disc usual in such tubes, the sample of cloth forms the cover. A circular disc is punched or cut out of the cloth, and fixed in position, being rendered watertight at the edges by indiarubber rings. Fixed to the lower end is a metallic drainer which allows the water to drop into the graduated measuring glass placed below. Two thermometers, 3 and 4, graduated in tenths of a degree, pass through the cover as shown, one on each side of the partition.

In order to carry out the test the burette is filled with water to the zero mark, after inserting the cloth punching at the lower end, and the time required for the water to drop through is noted. 30 cm. (about 12 in.) of water is then allowed to act on the cloth, a 24-hour test usually being necessary. If no appreciable amount of water has passed through in 24 hours, but a little moisture has collected on the underside of the sample, this will be indicated by the thermometer, 3, reading a slightly lower temperature than the thermometer, 4.

Determination of ash. **A weighed sample is ignited in a porcelain dish.** *Determination of*

matter soluble in 3% hydrochloric acid. The fabric is treated with the acid for 15 minutes. *Determination of ether extract,* carried out in a Soxhlet apparatus. *The weight of the fabric,* expressed in ounces per sq. yard, is determined by weighing a suitable quantity, say 1 sq. ft. *The tensile strength* of the material should be determined. *The amount of wool, cotton, and silk* present is determined as follows:—The wool is separated from the cotton in the usual way by boiling with 5% caustic potash solution for 15 minutes; 4% is then added to the weight of the cotton residue. The difference between this figure and 100% represents the amount of wool present. Wool can be separated from silk by immersing the fabric in concentrated hydrochloric acid for 3 minutes at 50° C., when the silk dissolves. Linen is separated from silk by treating with an alkaline glycerol-copper solution, wherein the silk dissolves.

Fabrics proofed with rubber.

In the case of fabrics proofed with indiarubber, the War Office has distinct specifications as regards the composition of the proofing material.

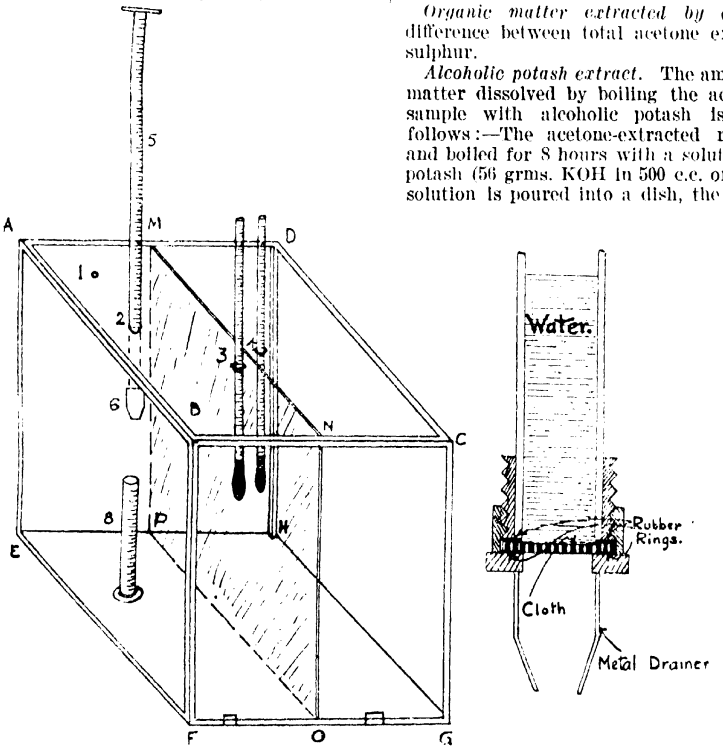


FIG. 2.—GAWALOWSKI'S WATERPROOF TESTER.

Thus the material for proofing coats with vulcanised indiarubber mixings must contain: mineral matter not more than 41%; sulphur not more than 3%; indiarubber not less than 56% on the average, and no single coat may contain less than 54%. In the case of cyclists' waterproof capes, however, a different composition may be used for the proofing. The mineral matter must not exceed 52%, sulphur 3% (the free sulphur in this to be not more than 1%). The rubber must not be less than 45% on the average, and no single garment may contain less than 43%. Civilian garments may consist of different qualities from these, which represent a very high class of waterproofing.

Mineral matter. A part of the sample is ignited and the weight of the ash determined. Due corrections are made for oxidation to sulphates. When antimony sulphide and copper are present these should be estimated in the usual way. The mineral matter used for colouring the proofing of cyclists' capes usually consists of zinc oxide and litharge. Small additions of other ingredients such as are generally recognised as having a beneficial influence are officially recognised. The presence of calcium carbonate and magnesium carbonate is often prohibited in War Office contracts.

Sulphur is estimated in the usual way as barium sulphate, oxidation being generally effected by nitric acid and potassium chlorate. From a determination of the amount of antimony and other metals present as sulphide in the preliminary operation, a correction for the amount of sulphur combined with antimony and other metals can be made.

Free sulphur is regarded as the sulphur extractable by boiling acetone. The substance is extracted by boiling acetone for about one hour, the acetone evaporated, the residue oxidised, and the amount of "free sulphur" determined as barium sulphate.

Organic matter extracted by acetone is the difference between total acetone extract and free sulphur.

Alcoholic potash extract. The amount of organic matter dissolved by boiling the acetone-extracted sample with alcoholic potash is estimated as follows:—The acetone-extracted rubber is dried and boiled for 8 hours with a solution of alcoholic potash (56 grms. KOH in 500 c.c. of alcohol). The solution is poured into a dish, the rubber washed twice with alcohol and boiled two or three times with water, the washings added, and the alcohol distilled off and recovered; the residue is evaporated, washed into a separating funnel, acidified with hydrochloric acid, and the fatty acids extracted with successive portions of ether. The ether is distilled off and the residue dried to constant weight in the water oven.

The rubber residue left after boiling with alcoholic potash is washed free from potash by water, dried to constant weight in the water oven, and cooled *in vacuo.* The ash and sulphur in the dried residue are then estimated and hence the weight of organic matter in the residue is calculated. This weight is deducted from the weight of organic matter in the residue after extraction with acetone

(obtained by deduction of ash and combined sulphur) and from the difference the loss of organic matter by extraction with alcoholic potash per 100 parts of rubber is calculated.

The indiarubber proofing should be free from grit and large-sized particles. In the case of capes a three-inch square of material should have at least 0·13 grm. of proofing between the two fabrics.

DISCUSSION.

Mr. JULIUS HUEBNER inquired as to the difference between the tests for water repellency and waterproofness. Was it possible to establish comparative values?

Mr. H. L. TERRY considered that the best test for a waterproof article was the weight of proofing material on a given area. Inequalities in spreading were frequent and the principle of the War Office test of taking the number of grains of proofing on a certain superficies was about the best test available. Another way was to test for permeability to light—this more particularly in connection with rubbered goods.

Mr. R. E. CROWTHER inquired whether any frictional factor entered into the "drop" test, as it was well known that in the case of merely showerproof fabrics friction facilitated penetration.

Dr. J. GROSSMANN did not consider it advisable to adopt as correct the average of tests which showed such enormous differences in their values. Like a chain, waterproof cloth should be judged to a great extent by its weakest parts, and for this reason the numbers and proportions of the highest and lowest results obtained in testing should be reported upon. A filtration test carried out under a partial vacuum with a standard gelatinous mass would probably give more reliable results.

Mr. HOLROYD pointed out there was a discrepancy of about 50% between the maximum and the minimum tests. Would it be possible to have a filter paper soaked with phenolphthalein, and drop a dilute solution of sodium carbonate, taking as the reading the number of drops required to produce a pink coloration? His experience was that a cloth which would hold water for 48 hours would, if in contact with any hard substance, or subjected to friction, permit moisture to permeate in a few minutes.

Mr. L. G. RADCLIFFE referred to the destruction of impermeability to moisture caused by folding the fabric when putting it on one side or hanging it up, and asked if the "drop test" was applied to the creases.

Dr. W. R. ORMANDY said that the fact that there was difficulty in the "drop" test was due, to a large extent, to the warp and wefts in the fabrics varying considerably in thickness from place to place. The threads of any cloth might vary 100% in thickness in a length of a few inches and at the thin place the thread was more strongly twisted than elsewhere. This fact was well known to those who tested the single threads for tensile strength. Showerproof garments rapidly became wet at the shoulders and knees, where there was friction, and a test which would give numerical figures for waterproof materials under friction was undoubtedly needed.

The CHAIRMAN thought that a different test ought to be applied to fabrics which were water-repellent only from those which were waterproof. For the latter a good test was to put a drop of the water on the surface, place the fabric on blotting paper, and tap the drop with the finger; this would frequently force the water through so-called waterproof fabrics and stain the paper.

Dr. MARTIN, in reply to Mr. Huebner, said that the best method of testing for the purpose he mentioned would be that of air diffusion. Apparently no satisfactory test had as yet been evolved in the case of friction. The "drop" test was a good method of judging waterproof material quickly and the saving of time was frequently of great importance. The gelatinous material test would probably take too long. The question of maximum and minimum did not affect the matter at all; it was the average which counted. Tests should be devised for dealing with fabrics which were folded.

Communications.

AN APPARATUS FOR THE AUTOMATIC ESTIMATION OF SMALL AMOUNTS OF OXYGEN IN COMBUSTIBLE GAS MIXTURES OR OF COMBUSTIBLE GASES IN AIR.

BY H. C. GREENWOOD, D.SC., F.I.C., AND A. T. S. ZEALLEY, B.SC., A.I.C.

In many technical operations the need has been felt of an apparatus for giving an alarm automatically when a certain impurity present in a given gas mixture exceeds a prescribed value.

The apparatus described in the present paper is directed to the estimation of impurities which give rise to a contraction when a platinum wire is heated in the gas mixture, *e.g.*, oxygen present in hydrogen or *vice versâ*.

As instances of cases for which such an apparatus is specially suitable may be mentioned the following:—

(1) Examination for oxygen of the gases used in the synthetic production of ammonia, in which connection the presence of oxygen is deleterious both from the standpoint of the catalysis and, in a lesser degree, from a danger standpoint.

(2) Examination of hydrogen and oxygen produced by electrolysis, which are liable to mutual contamination owing to perforation of the diaphragm, or other causes.

(3) Examination of the air in mines, benzol distillation factories, etc., for the presence of combustible gas, *e.g.*, methane in the case of mine air.

Naturally the degree of sensitiveness required will vary from case to case; the present apparatus is capable of detecting from 0·1% of oxygen, for example, up to the explosive limit for the particular gas mixture in question.

In addition to furnishing an alarm when the given impurity exceeds a pre-determined limit, it is desirable that such apparatus shall be capable of giving a continuous quantitative indication, not necessarily recorded, which will show at any moment the actual concentration; this is often useful in indicating the inception of abnormal conditions.

The above considerations, together with the desirability of producing an instrument the indications of which shall be free from uncertainty, have been the guiding principles in the design of the apparatus.

Briefly described the principle involved is that of the combustion of the oxygen or other impurity by means of an intermittently heated platinum wire with automatic arrangements for (1) making and breaking the required electrical contacts; (2) sealing up the combustion vessel during the heating period; (3) cooling the gas and measuring the contraction which results; (4) ringing an electric bell at a specified oxygen percentage; (5) flushing out the spent gas by a new charge.

The apparatus will now be described with reference to the diagrammatic representation, fig. 1.

Description of apparatus.—A continuous stream of the gas to be examined is supplied at a roughly constant rate—the minimum speed being as

specified below—through the wash-bottle, M, containing water for the purpose of approximately saturating it with water vapour. Leaving M, the gas passes *viâ* the T-piece, Q, to a capillary U-tube, I, which may be opened to the passage of gas or closed by periodically pressing up mercury from the vessel, K; the water-seal, for example about 1 cm., in the bottle, N, is such that a small column of mercury in I suffices to cause the gas to escape through N and R to the atmosphere, without any disturbance of the mercury in I. Assuming the level of the mercury to be at AA, the gas will pass through the capillary tube leading from I to the vessel, B, and will displace the gas therefrom through the tube in its upper part, finally escaping through the U-tube, J, to the T-piece, R, and so to the atmosphere. B is fitted with two electrodes led in by gas-tight rubber connections, the upper electrode being water-cooled internally and carrying radiator fins for rapidly cooling the gas after the heating period described later. Between the two electrodes is fixed a thin platinum wire about

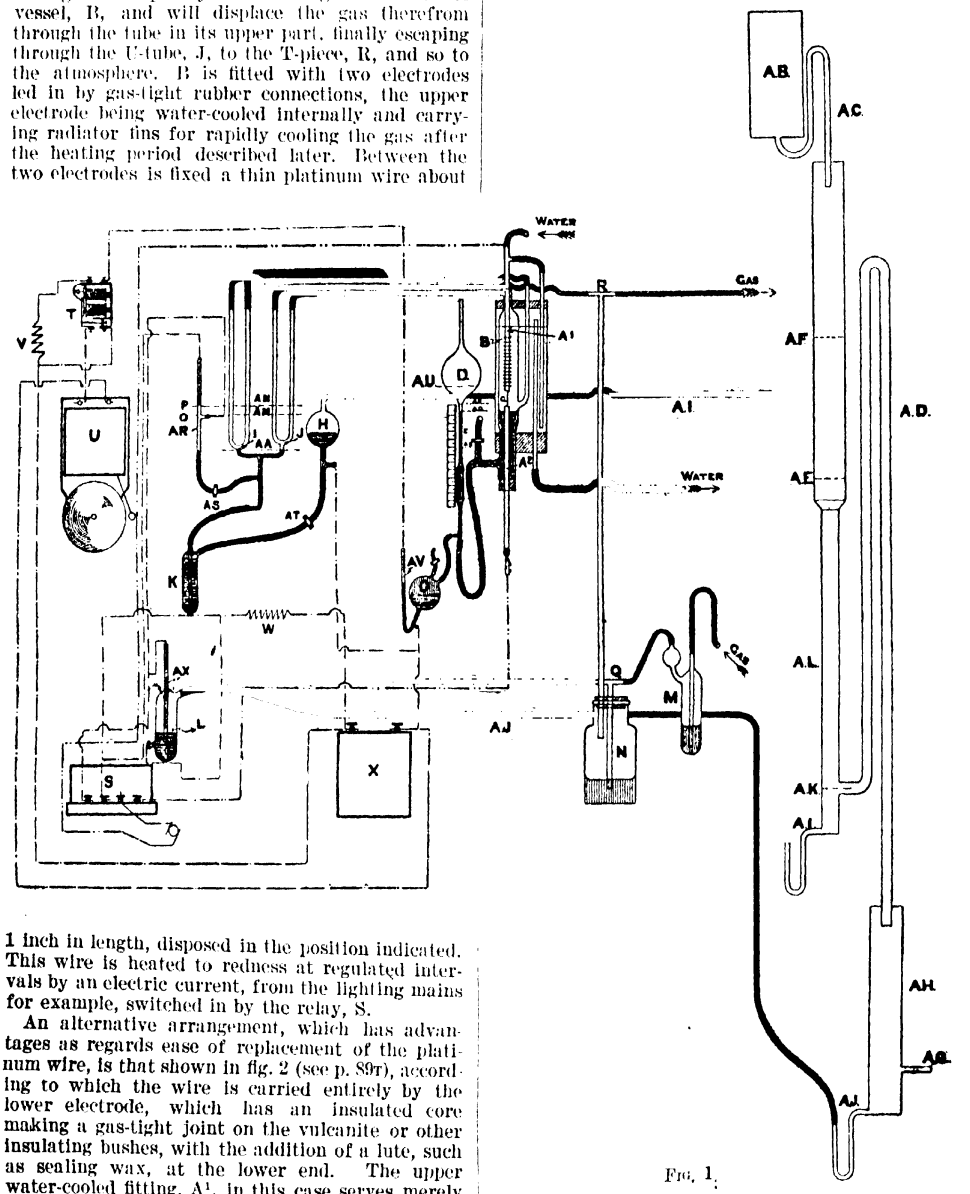


Fig. 1.

1 inch in length, disposed in the position indicated. This wire is heated to redness at regulated intervals by an electric current, from the lighting mains for example, switched in by the relay, S.

An alternative arrangement, which has advantages as regards ease of replacement of the platinum wire, is that shown in fig. 2 (see p. 89T), according to which the wire is carried entirely by the lower electrode, which has an insulated core making a gas-tight joint on the vulcanite or other insulating bushes, with the addition of a lute, such as sealing wax, at the lower end. The upper water-cooled fitting, A^1, in this case serves merely as a cooler.

This arrangement has been adopted on account of its greater convenience and in the subsequent description A^1 is to be understood as serving merely for cooling.

The vessel, B, is filled with water nearly up to the gas inlet side tube. In order to perform automatically the requisite movement of the mercury seals in I and J, the intermittent siphon arrangement shown in the figure is employed. A slow, steady stream of water from a "constant head" device is allowed to flow into the vessel, AB. On filling up to a certain point the vessel is emptied by the siphon, AC, into the tall brass vessel, AL, which is thus filled to the point, AE. The period of the siphoning intervals is conveniently fixed at two minutes, but exact constancy is not of importance. The bottom of AL, which is filled with water up to the level, AK, is connected by a tube, preferably of rubber and filled with water, to the vessel, H, the upper half of which is filled with water; the lower half is filled with mercury and is connected by a rubber or glass tube to K, which, together with the connecting tube, is also filled with mercury. On the water in AL rising from the level AK, to the level AE, on the first delivery

of the siphon, AC, the following operations are performed by the pressure transmitted to H, which has a diameter of about 1″ or more, so that the level of mercury therein does not alter appreciably: (1) The U-tube, I, is sealed with mercury, and the pressure in B (which may be slightly above atmospheric owing to friction of the gases passing through the capillaries of I and J) is reduced to atmospheric: to cause the closing of I before J the former is about ¼ in. lower than the latter. (2) The outlet of the vessel, B, is closed by the seal, J, and (3) a suitable electric current is switched on to the filament, C, by the relay, S, which is operated by the platinum contact wire at O, the mercury rising in the small tube, AR, preferably capillary, which is connected to K by a rubber tube and is adjustable in height. The height to which the mercury rises is adjusted by suitable proportioning of the vessels, a seal of about 1—2 cm. in J being found satisfactory, and the rates of rise in I and J on the one hand, and in AR on the other, are regulated by adjustment of the screw clips, AT and AS respectively. On the application of the heating current there is a more or less sudden expansion of the gas in B, which causes the water in E to flow into the bulb, D, with the production of only a slight positive pressure in B, and on the seals, I and J. The diameters of the connecting tubes between B and E are suitably proportioned to avoid excessive kick on the mercury seals. The level of the water in E is primarily AO, *i.e.*, in equilibrium with that in B when both mercury seals are open and no gas is passing through B. During the heating period the level may rise to some position such as AU.

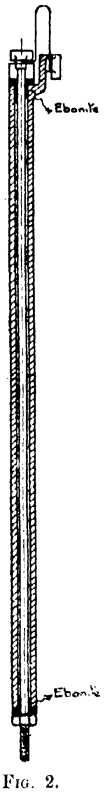


FIG. 2.

On the completion of the next siphoning period, the vessel, AL, is filled up to the level, AF, sufficient to cause a further slight rise in the mercury seals and also in the tube, AR, making contact with a second platinum wire, P. This electrical contact has the effect of short-circuiting the relay so that the main heating current is cut off. (In order to avoid running down the battery, X, a suitable resistance, W, is inserted in the circuit, as indicated in the drawing.) During the third period the gas is cooled down both by the fitting, A^1, and also by the water bath: it is found that the water-cooled fitting, A^1, with fins as described, is essential for the rapid cooling of the gases, particularly when their thermal conductivity is low. For accurate indications with this apparatus it is important that the temperature of the gas, after completion of the heating period, should be restored to that obtaining before such heating, and this is realised by the use of a suitable current of tap-water which flows first through the fitting, A^1, and then through the water-jacket, which is made as small as possible; if necessary a tank of water at room temperature could be employed, but it is found that no appreciable variation in the temperature of ordinary tap-water occurs over the usual period of about 5 minutes in question, provided that the water is allowed to run for some 10 minutes before taking observations. If no substances producing a contraction in the presence of the heated platinum wire, C, be present, the final level of the water in the tube, E, at the end of the cooling period will be at a level slightly higher than AO, *viz.*, A^1, owing to compression of the gas in B by the rising of the mercury in the seals, I and J. This level, which is readily determined once and for all, represents the zero of the instrument. If, on the other hand, a contraction takes place, *e.g.*, if 0·5% oxygen be present in hydrogen, the contraction will be approximately equal to 1·5% of the original volume, as the gas is saturated with water vapour both before and after the combustion, and the water vapour formed is thus removed as liquid.

This contraction results in a fall in the level of the water in E. Sensitiveness is given by keeping the portion E as narrow as possible. For some purposes, of course, sensitiveness may not be desired, in which case there is no need to make E narrow. A fall of more than say 7 cm. is best avoided, as the mercury seals may suffer rupture on the emptying of the large siphon, AD, see below. With a suitably proportioned apparatus the fall may conveniently be of the order of 5 cm. without causing trouble due to excessive resistance in E and consequent tendency for too great a "kick" in the mercury seals, I and J. The percentage may be read off directly at the end of the cooling period by a scale attached to E and experimentally calibrated by the use of gas mixtures of known composition; the lower part F is made larger in diameter than E, for indicating the larger percentages of impurity. In order to render the contraction capable of giving an alarm, the vessel, G, is attached to F or E; it consists of a bulb, the upper half of which is filled with water and the lower half with mercury. By means of the attached tube, AV, any fall in E is accompanied by a proportional movement of the mercury in AV, which can be caused to break an electric circuit at the platinum contact therein at the position corresponding to any desired reading on the scale attached to E. To prevent oxidation of the mercury surface a small quantity of paraffin oil is used. If necessary, a screw-clip may be used on the tube connecting F and G, in order to prevent excessive oscillation of the mercury in AV. The relatively small volume change in G has little effect on the extent of the movement in E, if AV be capillary. On breaking contact in AV the relay, T, is arranged to switch an electric bell or other indicator into circuit, as shown in the diagram. If desired, however, a continuous record could be obtained by recording the variation in the electrical resistance of the platinum wire (which in this case would be preferably very thin), a variable proportion of which is short-circuited by the mercury in AV. When the cooling period is ended and the necessary reading taken, the vessel, AB, being again filled up, siphons over and fills the vessel, AL, over the level of the siphon, AD, which then empties AL down to the level, AK. In order to prevent the disturbing "kicks" produced in the seals, I and J, by the current being momentarily switched in and out as the pressure in H falls to its original value, the siphon, AD, is arranged to empty into the vessel, AH, which is about 1 ft. in height and has, some two inches above its lower end, a constricted run-off, AG. The tube, AJ, is connected, conveniently by a rubber tube, which is filled with water, to the vessel, L, the lower half of which contains mercury, the other half being filled with water. The siphon, AD, overflows and the vessel, AH, is filled up, the excess water running to waste. The filling up of AH raises the mercury in L, so as to make contact with the platinum wire, AX, connected as shown in the diagram, thus keeping the relay, S, short-circuited during the period of emptying of AL and for some time afterwards (*i.e.*, until the water has slowly run out of AH), giving ample

time for the mercury actuating the seals to fall to the level, AA. Passage for the gas supplied at Q to the vessel, B, is now restored and during the next period of siphoning (*i.e.*, of AB) the residual gas in B is displaced by the current of fresh gas; it is convenient to arrange for the rate of gas passage to be so proportioned to the intervals of siphoning that some 5—10 times, for example, the volume of B is passed through during this period, at the end of which the seals are closed and the current is switched on as already described. A flow of about 1 cub. ft. per hour is found amply sufficient when the capacity of B is about 50 c.c.

Operation of the apparatus. The apparatus is started by the admission of a steady stream of water from the constant head to the upper or small siphon, AB: this stream is regulated so as to fill and siphon over into the large siphon, AL, every two minutes. This has been found (see below) a safe and convenient time-period. The complete cycle is then of three phases; *i.e.* three siphonings of AB into AL, the third charge causing AL to siphon over and thus start the cycle over again. The three phases may thus be summarised as to their effect:—1. Mercury rises one stage; seals inlet and then outlet of gas burette, and then switches in current on heating wire. 2. Mercury rises to second stage, thereby cutting off current on heating wire. 3. Mercury falls to original (lowest) level, thereby opening inlet and outlet to gas burette, without interfering with the electric heating arrangements.

The water in the jacket and the fitting, A^1, is turned on some time before the apparatus is started up. The water supply having been satisfactorily adjusted the gas to be examined is admitted at M, the rate being determined by causing a definite small rise of the water-level, AO. The gas should be allowed to flow freely through the apparatus for a few minutes (on "open" phase) to ensure the gas burette being free from an explosive mixture before the heating current is switched in. The battery, X, is next switched on; also the power supply to heat up the platinum wire in its appropriate phase. If no oxygen be present the level at the end of the second phase will be about AP, the rise above AO (the open-phase water level with no gas-flow) being due to compression caused by rise in I and J. This level, AP, we will call the "reading zero" and from this point the scale showing the percentage of oxygen present is reckoned.

Calibration and testing of the apparatus. As an indication of the permissible latitude as regards different variables the following tests may be cited.

A. The difference of reading in E caused by varying the time-period of the siphoning, a steady flow of gas of constant oxygen content being used throughout:—

Gas used: hydrogen with 0·5% oxygen present.

Time period	Depression caused
1 min. 10 secs.	4·2 cm.
1 ,, 40 ,,	4·6 ,,
2 mins.	4·7 ,,
3 ,,	4·8 ,,

It is thus demonstrated that the time period which affects (1) completeness of combustion, (2) the degree of flushing, and (3) the cooling of the gas after combustion, is not of importance provided that it exceeds 1½ mins.

B. Influence of the temperature of the platinum wire. In the foregoing experiments the temperature of the wire was kept at bright redness. Experiments were then conducted in order to see how much latitude is consistent with complete combustion.

The following table shows the depressions caused by various conditions of the heating wire with gas containing 0·5% of oxygen and a period of about 2 min.

Current	Condition of wire	Depression
1·3 amps.	Barely visible	4·4 cm.
1·6 ,,	Dull glow	4·6 ,,
1·64 ,,	Bright glow	4·6 ,,

It is seen that so long as the wire has a decidedly visible redness, no greater heating is necessary.

As an example of the sensitiveness of the apparatus, the following calibration table is given for a capacity of some 50 c.c. in the vessel B and with diameters of about 4 and 8 mm. respectively in E and F.

Gas used: N_2+3H_2, with various percentages of oxygen as shown; time period throughout, 1 min. 40 sec.

Percentage of oxygen	Depression caused
0·28	1·8 cm.
0·4	3·3 ,,
0·56	4·3 ,,
0·63	4·7 ,,
0·9	7·1 ,,
1·2	8·0 ,,
1·4	8·9 ,,
2·0	9·6 ,,

From these figures a graph is plotted (Fig. 3), and from the graph a table of depressions and corresponding percentages is constructed. It will

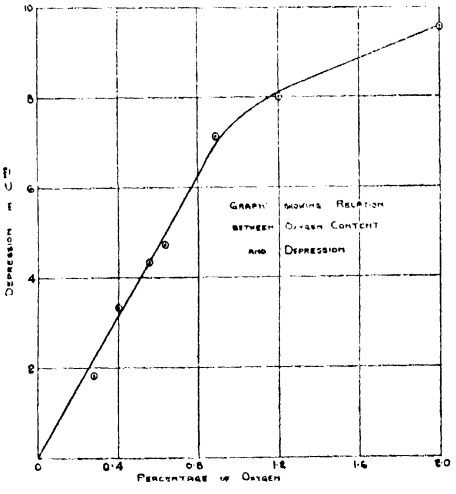


Fig. 3.

be noted that there is a break in the curve at about 7·5 cm. owing to the change in section of the indicator tube at this point.

It has been found that the above apparatus gives very little trouble in continued practical operation. One of the most valuable features is the certainty of the indications, since the platinum wire is not liable to poisoning and there are no absorbents to renew. If any attention should be required the fact would be at once obvious from a glance at the apparatus. All the parts, with the exception of the siphon gear, fit compactly into a small glass-fronted case.

The authors desire to express their thanks to the Controller of the Munitions Inventions Department for permission to publish the above paper.

M.I.D. Research Laboratories.

THE TENSILE STRENGTH OF RUBBER-SULPHUR MIXTURES.

BY O. DE VRIES AND H. J. HELLENDOORN.

Our knowledge of the properties of the mixtures used in vulcanisation, even of the most simple ones, is still very incomplete; systematic research, at least as far as published results go, is still in most cases wanting.

This paper contains a short review * of investigations of the changes in tensile strength with increasing cure for mixtures of rubber and sulphur only. In preliminary notes † we published some data, tending to show that for our ordinary mixture of 92½ rubber and 7½ sulphur, vulcanised in the usual way ‡ at 148°, the tensile strength for short cures increases rapidly with increasing cure, till it reaches a maximum; it then decreases and at last the stage is reached at which the rubber becomes brittle and gives low and irregular breaking points.

This maximum of tensile strength may be of importance in several ways. In the first place, the maximal tensile strength is a property of a more definite and typical character than the tensile strength at an intermediate state of cure, and therefore perhaps better suited to express and compare the properties of rubber in this respect. In the second place, from a practical point of view a maximum is of special value for testing purposes, especially when it is flat, as small deviations due to experimental error in the neighbourhood of the maximum have very little influence on the numerical result which is to be determined. We, therefore, undertook to make a further study of this point.

Fig. 1 gives the stress-strain curves obtained on the Schopper testing machine for one sample of rubber, and the changes in breaking load for increasing cures, which may be regarded as a typical example of this relationship; the figures are contained in the following table:—

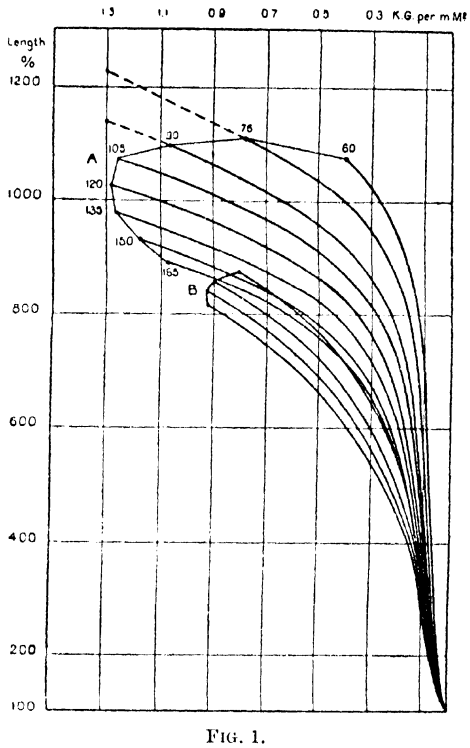


FIG. 1.

Cured for	Number of rings	Rings rejected	Tensile strength	Final length	Length at 1·30 kilos.	Coefficient of vulcanisation %	Coefficient of vulcanisation Length at 1·30 kilos.
60 m.	14	0	0·40½ ± 0·016	1079 ± 3·3	—	2·55	—
75 „	15	0	0·79½ ± 0·014	1114½ ± 4·8	ca 1225	3·15	1225 ?
90 „	50	0	1·07 ± 0·009	1098½ ± 1·3	1134 ± 1·4	3·77	1137
105 „	30	2	1·26 ± 0·008	1070½ ± 1·7	1076 ± 1·7	4·38	1080
120 „	56	2	1·28 ± 0·008½	1024 ± 1·4	1027 ± 0·7	4·99	1024
135 „	47	1	1·26 ± 0·011	977 ± 2·2	984 ± 1·1	5·44	985
150 „	11	6	1·17 ± 0·018	931 ± 3·4	953 ± 1·5	5·82	953
165 „	5	3	1·08 ?	894 ?	928 ?	—	—

Owing to the accidental nature of the breaking points a very large number of rings was necessary to obtain accurate average values; in the table the probable error in breaking load and final length are given. We made extensive determinations of breaking points in three other samples of crêpe-rubber, using 497, 192, and 416 rings respectively; the curves of breaking points are represented in fig. 2, and show the same general character as in fig. 1. Less extensive series for 14 other samples of rubber of different grades all showed the maximum of tensile strength very clearly, so that it may be regarded as sufficiently proved that—under our conditions of curing and testing—every type of plantation rubber at a certain time of cure shows a maximum of tensile strength. Analogous curves, though partly incomplete, may be gathered from publications of others.*

When curing—as is often done—for a fixed standard time (with a fixed temperature and fixed composition of the mixture), the samples of plantation rubber, having a different rate of cure, are brought to a different state of cure and thus a different position of the stress-strain curve is reached; the resulting difference in tensile strength is often used to judge the properties of the rubber, but it can only be a check on the maximal tensile strength if the curves of fig. 1 and 2 are known for every case, so that the maximal tensile strength may be deducted from the tensile strength at any arbitary state of cure. Otherwise it is necessary to bring the samples to the same (or to a comparable) state of cure and—in order to get an insight into the real strength or resistance to breaking—to compare the breaking loads obtained for one definite (preferably a standard) state of cure.

This is perhaps best illustrated by the following example. By partial coagulation of latex a "first clot" may be obtained possessing anomalous and

* Full figures and details of the experiments to be described here may be found in Archief voor de Rubbercultuur, Vol. 2, English text, p. 785.

† India Rubber J., 1916, 52, 717: Archief voor de Rubbercultuur, 1, English text, p. 230; this J., 1916, 1226.

‡ India Rubber J., 1917, 53, 101.

* See especially van Rossem, Comm. Netherl. Gov. Inst. Delft, part 5, p. 156: further van Heurn, *ibid.*, part 6, p. 208, and Fol and van Heurn, *ibid.*, part 6, p. 189.

interesting qualities, about which we published some data in another place.* This first clot is obtained by adding, say, one quarter of the total quantity of acetic acid, and stirring slowly till the rubber partially coagulates. The clot is then taken from

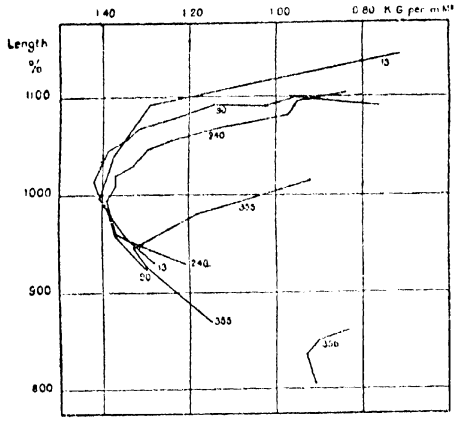


FIG. 2.

the serum, and the remaining latex coagulated by adding the rest of the acetic acid. The very different qualities of the two clots so obtained may be summarised as follows:

—	First clot	Remainder
Percentage of total ..	15–25%	85–75%
Colour	saffron yellow to brown	pure white
Relative viscosity	1·97–2·16	1·74–1·80
Maximal tensile strength ..	1·35–1·40	1·45–1·50
Standard time of cure ..	90–95 minutes	105–120 minutes
Slope	35–36	35–36½
Coefficient of vulcanisation for standard curve ..	5·64%	4·63%
Nitrogen	0·64%	0·47%
Ash	0·48%	0·25%
Acetone extract	5·6%	2·7%

The remainder has approximately the normal qualities of plantation crêpe.

The connection between tensile strength and time of cure of these different clots from the same latex is shown in fig. 3, from which it will be seen that the tensile strength of the first clot (I) is lower than that of the remainder (II) in all comparable states of cure. The curves for the breaking points are congruent figures; the tensile strength for our standard curve (dotted line in fig. 3) is 1·48 and 1.40 kilos. per sq. mm. respectively for the first clot and remainder.

On curing both samples for the same time, for instance 90 minutes, the first clot gives a higher tensile strength (1·39 kilos. per sq. mm.) than the remainder (1·26 kilos. per sq. mm.), but by giving the slower curing remainder a longer cure of 115—120 minutes, its maximal tensile strength is developed, and it becomes evident that in reality it gives stronger rubber.

Situation of maximum. Whilst the maximum of tensile strength for first latex crêpe and smoked sheet lies very near to the standard stress-strain curve which we chose for our testing (for which the length at 1·30 kilos. is 990%), this is not the case for other types of rubber. The lower grades also show a maximum of tensile strength, but lower down on the paper, that is with a smaller elongation for a given load. Such a case is reproduced in fig. 1; the lower tensile strength and the difference in position of the maximum for sample A (first quality crêpe) and B (crêpe from washing) is evident. At the same time the difference in slope of the stress-strain curves of these two samples is distinctly seen in fig. 1. Determined as usual

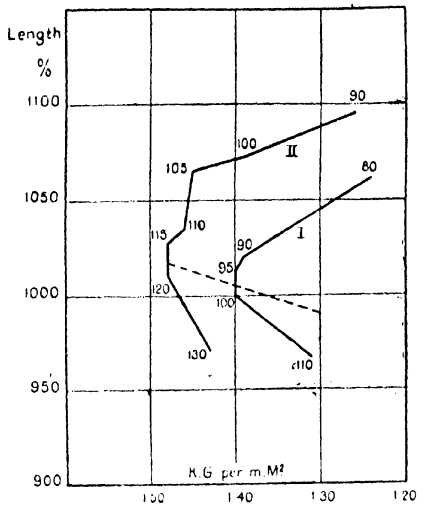


FIG. 3.

according to the method of Schidrowitz and Goldsbrough* the slope of these samples was found to be 36 and 53.

The maximum of tensile strength is found higher on the paper the flatter (smaller) the "slope," that is the better the type or quality as determined by this property. Owing to the difficulties in determining exact average breaking points and to the flatness of the curve near the maximum, the exact stress-strain curve for which the tensile strength reaches its maximum value can only be estimated with more or less accuracy. For the 18 samples tested the average values were:

Slope	Position of stress-strain curve for maximal tensile strength, expressed by its length at 1·30 kilos.
35	1002
36	992
37	997
39	984
42½	943
52	923

The figures are somewhat irregular, but the relation between slope and situation of the maximum is nevertheless evident.

It is interesting to note, that according to Schidrowitz' speculations† the curve for his "correct cure" lies lower down on the paper as the figure for slope or type increases. We were not able to ascertain if there is any direct relationship between the maximum of tensile strength and Schidrowitz' "correct cure," as he has not yet published the details of his method of calculating the "correct cure."

The interesting question as to how far the state of cure giving the maximal tensile strength may constitute a criterion for comparing for different types of rubber will have to be studied further.

Curves for other mixtures. It should be clearly understood that the above-mentioned relationship

* Archief voor de Rubbercultuur, 1, English text, p. 185; this J., 1917, 1104.

* India Rubber J., 1916, 51, 505; this J., 1916, 550
† The Rubber Industry, 1914, 212; this J., 1916, 495.

only exists for mixtures of 92½ parts of rubber with 7½ parts of sulphur. With other compounds totally different results may be obtained. Though interesting data on this point may be gathered from several publications,* our knowledge is still very insufficient, the curves for the breaking points are often incomplete and mostly irregular, the number of rings tested apparently having been too small to give reliable average breaking points, whilst perhaps in some cases the vulcanisation was not so rigidly standardised and controlled as is indispensable for research work of this kind.

We ourselves published some data in a preliminary note † for samples of rubber with 5, 7½, and 10% of sulphur; the tensile strength, plotted against time of cure, gave a sharp maximum with 10% of sulphur, which became flatter for 7½%, whilst with 5% of sulphur the maximum was not yet reached in 4½ hours cure at 148° C.

More extensive data are to be found in our recent paper,‡ whilst the schematical curves in fig. 4

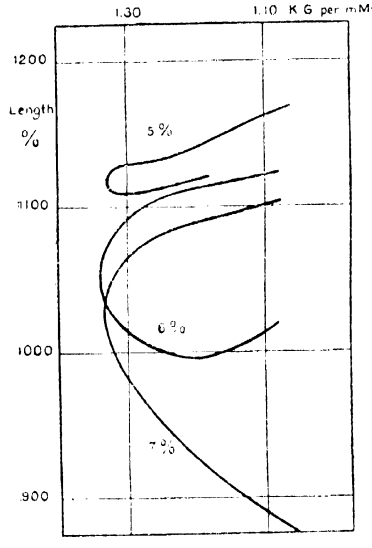


FIG. 4.

may give a general idea of the relation between tensile strength and state of cure in such cases. For a mixture with 7½% of sulphur only part of the curve, showing the maximum of tensile strength and the lower parts, is reproduced in fig. 4. The curve for a mixture with 6% of sulphur shows a maximum also, but situated somewhat higher on the paper; by prolonged vulcanisation, however, the curve of breaking points does not go straight down to the region of brittleness as in the case of mixtures with 7½%, but goes upwards again, forming a kind of loop. The maximal tensile strength is reached with 4·7% of combined sulphur (calculated on the mixture), the lowest point of the curve with 5·7%. The stress-strain curve in this case by prolonged vulcanisation at first shifts downwards and to the left as for mixtures with 7½% of sulphur, but after longer cures goes upwards and to the right again.

This behaviour is still more pronounced for a mixture with 5% of sulphur (see fig. 4). At first the breaking points show very much the same course as in mixtures with 7½% of sulphur, but when the combined sulphur has reached the amount of nearly 4·5% (out of 5) the tensile strength reaches its maximum, the stress-strain curve oscillates for some time round the same position and for longer cures recedes again. For such a mixture with 5% of sulphur a certain stress-strain curve may therefore represent two states of cure, one with a low coefficient of vulcanisation for short cures before the maximum was reached and one with all sulphur combined, and cures longer than for the maximum. We found analogous facts for mixtures with 3, 2, and 1% of sulphur.

This behaviour of mixtures in which all or nearly all of the sulphur has combined with the rubber is interesting in so far as it may give an insight into the changes caused by heating when no further chemical change (or at least no further combination between rubber and sulphur) is possible. For mixtures with 7½% of sulphur and more this stage, in which all the sulphur has combined, lies in the region where the product is brittle, so that no stress-strain curves can be obtained.

The stress-strain curves in our experiments with mixtures of the same sample of rubber with different sulphur-content showed the same form as exactly as this can be judged on the scale produced by the Schopper testing machine; the figures for "slope" for curves in the same position were also the same. It may however be mentioned that for instance for mixtures with 5% of sulphur the stress-strain curves having the same position show a difference in slope according to whether the cure is short or long. The maximum of tensile strength for some mixtures with 5% of sulphur showed an analogous difference in position as for mixtures with 7½%, the maximum being found lower down on the paper, the higher the figure for "slope."

Buitenzorg, Central Rubberstation.

* Gottlob, Gummi-Zeitung, 1916, **30**, 303, 326: Eaton and Grantham, this J., 1916, 1048: Spence, Kolloid Zeits., **11**, 278: P. Breuil, Caoutchouc et Gutta Percha, 1911, 5298: Stevens, this J., 1916, 872.

† India Rubber J., 1916, **52**, 717; this J., 1916, 1226.

‡ Archief voor de Rubbercultuur, **2**, English text, p. 789.

PRECAUTIONS NECESSARY IN GRINDING SAMPLES OF COKE FOR ANALYSIS.

BY A. E. FINDLEY.

The experiments described below were suggested by a recent note by J. Hughes ("Gas World," Feb. 1, 1919) in which it is stated that the ash contents of a recent delivery of coke were reported by different analysts at from 1 to 5·6%, and it is suggested that the differences may be due to the methods adopted in grinding the samples. It is pointed out that if coke is ground by means of an iron pestle and mortar, the sample becomes contaminated with particles of iron which can be separated by a magnet, whereas if placed in a strong linen bag and broken into fragments sufficiently small to be ground to a fine powder in an agate mortar, no such contamination results. One sample showed 4% of ash when ground by the first method and only 1% when prepared by the second.

The present author found that all the samples of coke which had been ground in an iron mill were magnetic. In one sample showing 35·4% of ash, 12% could be separated with a magnet; the ash in the magnetic portion amounted to 67·25%, and in the non-magnetic portion to 27·3%, showing that the coke itself was magnetic, probably owing to the reduction of the pyrites in the coal during coking.

A clean piece of coal, yielding 1·55% of pale yellow ash, was ground by means of an agate pestle and mortar and coked in a platinum crucible. One portion of the coke was ground in an agate pestle and mortar, the second in an iron pestle and mortar. The first was non-magnetic and yielded 1·72% of a pale yellow ash, whilst the second was distinctly magnetic and yielded 1·90% of red ash different from that of the original coal. This small difference is, however, probably due to the fact that this coke was soft and easily ground to powder. The first sample was probably non-magnetic because the original coal contained very

little iron. The experiment was repeated with a coal known to contain an appreciable quantity of pyrites (red ash, 7·3%); it was ground to a powder by means of a glass pestle and mortar, coked in a silica crucible, and the coke reduced to a small size in a glass mortar. One half of the coke was reduced to a fine powder by means of an agate pestle and mortar, the other half by an iron pestle and mortar, with the following results: Ash in coke from agate mortar 14·9%, from iron mortar 14·85%. Both samples were magnetic. The quantity of ash was increased to 14·95 on grinding for 30 minutes by means of an iron pestle and mortar, and to 15·05 on grinding for 60 minutes. Another sample of coal (ash 20·9%) gave a coke showing 28·15% of ash from an agate mortar and 28·3% from an iron mortar when treated in the same way. Samples of coke prepared from several other coals rich in iron were all magnetic even when they had been reduced to a powder in an agate mortar; the difference between the two results was roughly 0·2%. There can thus be little doubt that no very appreciable error is introduced during the conversion of a coarse powder to a fine powder in an iron mortar. The contamination must therefore occur during the conversion of the small pieces to a coarse powder.

A Durham coking coal was next ground to a fine powder and coked. The coke was divided into two portions which were crushed to a fine powder (1) in an agate mortar, (2) in an iron mortar; (1) gave a grey ash, 13·5%, (2) a red ash 14·2%. A piece of coke large enough to require considerable treatment before reducing to a powder was divided into four approximately equal parts, portion (1) broken up in cloth by hammering and reduced to a powder in an agate mortar; (2) broken down in an iron mill and reduced to a powder in an iron pestle and mortar; (3) broken up and reduced to a powder in a hardware mortar, and (4) retained for comparison. The coke taken was of the hardest type procurable at the time and was used in the University for melting crucible steel. All the powdered samples were magnetic. The ash in sample (1) was 7·0%, in sample (2) 8·2%, and in sample (3) 8·5%. From this it seemed possible that sampling in the bulk had caused the trouble, but sample (4) ground in an agate mortar showed 7·15% of ash.

In all the foregoing experiments it has been surmised that the increase of ash is due to the introduction of extraneous matter during grinding. In order to prove that this is the case the iron in the ash of the four samples of crucible steel coke was estimated with the following results:—

Sample	Ash %	Iron, as Fe_2O_3 %
1	7·0	1·875
2	8·2 and 8·4	2·915 and 3·125
3	8·5	1·885
4	7·15	1·885

Samples (1) and (4) show that there is about 1·88% of iron as Fe_2O_3 in the coke. Sample (2) shows that of 1·2% increase in ash during grinding in an iron mill over 1% is definitely due to iron. Sample (3) shows that although there is 1·5% of additional ash from the hardware mortar, there is no increase in iron, consequently the extraneous matter is due to hardware from the mortar.

It thus appears that it is usually during breaking the sample from small pieces to coarse powder that the largest amount of abrasion takes place, and Hughes seems to offer a satisfactory solution of the difficulty in the use of a strong linen bag. Once the coke is in the powder form, grinding in a mortar does not appreciably increase the quantity of the ash. The question of abrasion of the linen itself naturally arises, but for a coke containing 10% of ash it requires 10% of linen in the coke to reduce the ash by 1%, and it seems unlikely that this amount could be introduced however carelessly the sample is prepared. Efforts to estimate the quantity of linen that becomes incorporated with the coke were not successful; the effect on the percentage of ash is, however, exceedingly small.

Applied Chemistry Laboratory,
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TREATMENT OF SOAP LYES FROM WASTE FATS.

BY J. W. YATES.

Analysis of the 80% glycerin manufactured at the A.O.D. Soap Works, Salonica, revealed the presence of 7—9% of organic impurities instead of 3·0%, which is the maximum allowed. With a view to reducing this, the effect of all available clearing agents was tested on the lyes, suitably prepared, and the remaining organic matter estimated by the International Standard Method, 1911, with slight modifications of temperature. Comparative experiments gave the following results:—

No.	Treatment	Clarity of lyes	Rate of filtering	% impurity removed
1	Sodium aluminate	Very clear, water white	Very good	75·0
2	,, silicate	Faintly yellow	Poor	71·0
3	Aluminium hydroxide	Fairly ,,	Very good	54·0
4	,, chloride	,, ,,	,, ,,	37·0
5	,, sulphate	,, ,,	,, ,,	37·0
6	Tannin soln.	Quite ,,	,, poor	Undetermined

It is thus seen that the clarity of the resulting lyes closely follow the percentage of organic impurities removed. Concentration of the resulting lyes from the aluminate treatment and further treatment removed more organic impurities; the final works glycerin by this method contained 2·4% of organic impurity in 83% glycerin.

Treatment with ferric chloride, tried afterwards, gave a poorer result, and more filtrations were required.

Method of estimating organic impurities in 80% *glycerin.* It was found, as shown, that approximately 75% of the organic impurity was removed by treating soap lyes with sodium aluminate. 80% glycerin was made to the approximate strength of lyes, and, after gentle warming, treated with a known volume of aluminate solution and hydrochloric acid until the mixture was just neutral to phenolphthalein. After filtering, washing slightly twice to remove most of the glycerin and salt, and drying at 100° C., the residue was transferred to a platinum dish, dried at 160° C. to constant weight, heated to red heat, and weighed again, any remaining salt in the residue being extracted with hot water and estimated volumetrically. It was found independently that 22% of the weight of aluminous residue must be deducted from the loss in weight between 160° C. and red heat to find the true weight of organic impurities.

Examples	(1)	(2)
Glycerin taken	1·651	1·506
Loss in weight 160°—red heat ...	0·151	0·146
Salt found	0·025	0·070
Residue (excluding salt)	0·321	0·327
∴ Organic impurities	$=0·151-0·321\times22+100=0·081.$	$0·146-0·327\times22+100=0·074.$
∴ Organic content	$=0·081\times\frac{100}{1·651}\times\frac{100}{75}=6·55\%.$	$0·074\times\frac{100}{1·503}\times\frac{100}{75}=6·58\%.$

Value found by Int. Stand. Method, 6·75%.

Manchester Section.

Meeting held at the Grand Hotel on February 7th, 1919.

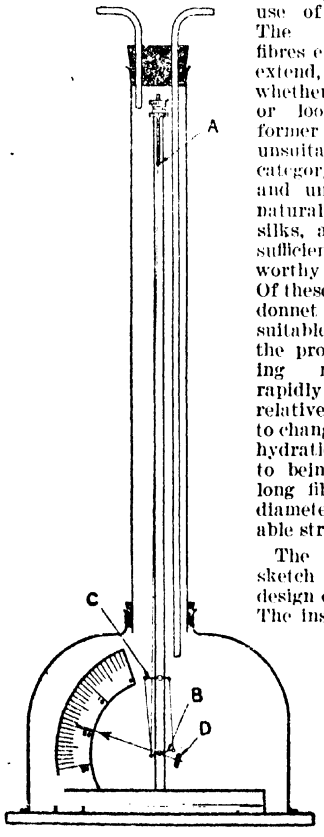
MR. W. THOMSON IN THE CHAIR.

DEVICE FOR MEASURING SMALL QUANTITIES OF MOISTURE IN GASES.

BY A. J. CROCKATT, M.SC., AND R. B. FORSTER, D.SC.

In the course of work in which ethylene was used, it was found necessary to have some rapid means of estimating the quantity of moisture present, and if possible to devise some form of hygrometer which would be suitable for the purpose and which could be read by an intelligent workman. It appeared to us that such an instrument might also find extensive use in many operations in which the moisture in the gas has an important bearing on the success of the particular process, for example, in spinning, producer gas manufacture, SO_2 production (inlet air), blast furnace practice (air supply), etc. We have devised an instrument which served our special purposes well, and we believe that if it were elaborated it would render service in many industries.

It is well known that fibres expand more or less with increase in moisture, and some forms of qualitative hygrometers make use of this property. The ordinary spun fibres either contract or extend, depending upon whether they are tightly or loosely spun; the former are therefore unsuitable. In the category of loosely spun and unspun fibres only natural silk, artificial silks, and hair are of sufficient length to be worthy of consideration. Of these we found Chardonnet silk to be most suitable, as it possesses the property of absorbing moisture very rapidly and exhibits a relatively high tendency to change in length upon hydration, in addition to being obtainable in long fibres of uniform diameter and considerable strength.



The accompanying sketch illustrates the design of the apparatus. The instrument is made of metal and placed in a bell-jar fitted with a wide glass tube. To the upper end of the latter is fitted a rubber stopper containing the gas inlet (short tube) and outlet tubes. One end of an artificial silk fibre (about 20 inches long) is attached to the adjustable hook, A, and the other to the short arm of the first magnifying lever, B. The long arm of the latter is attached to the short arm of the second lever, C, the long arm of which is attached to the pointer. The latter connections are made with very fine metallic wire. By these means the elongation of the fibres is so magnified that one scale division represents a difference of about 0·05% of moisture. The tension on the fibres may be adjusted by altering the position of the milled nut, D, on the pointer.

We desire to express our thanks to Messrs. Levinstein, Limited, in whose laboratories this work was carried out, for permission to publish this note.

DISCUSSION.

The CHAIRMAN mentioned that many years ago he had made a hygrometer by pasting together strips of parchment, end to end, to make a tape a yard or more long. The length varied considerably with the humidity of the atmosphere, so that by using a sufficiently large dial it was possible to obtain satisfactory hygrometric indications. He thought the apparatus described in the paper must be dependent on the temperature of the gas.

Mr. JULIUS HUEBNER said that the use of Chardonnet silk was very interesting, and he intended to apply it to the hair hygrometers in use at present. In order to obtain reliable results it was the practice to use two hair hygrometers at the same time. He supposed that the method of adjusting a hair hygrometer could be applied to the instrument under discussion, *i.e.*, to adjust the pointer to 100 in an atmosphere saturated with water vapour.

Mr. CROWTHER asked whether the authors had any idea of the time of lag for slight variations in the degree of humidity of the gas under examination.

Dr. A. C. DUNNINGHAM inquired the degree of accuracy of the instrument in dealing with very small quantities of moisture. He had had to deal with the estimation of gases for refrigerating, in which case a very high degree of dryness was required. In one particular case on which he had been working, the maximum amount of moisture it had been possible to leave was something like 0·1 mgrm. per litre. The estimation was carried out by the weighing method, using sulphuric acid or phosphorus pentoxide, the test being taken over a long period. The instrument described by the authors would be very useful for continuous estimation and for reading off directly a continuous record of moisture.

Dr. CRAIG mentioned the possible use of catgut for the purpose required.

Mr. PAUL asked whether the instrument, without special calibration, could be used for different gases irrespective of their nature.

Dr. FORSTER, in reply, said that human hair had been tried, but there was difficulty in obtaining hair long enough for the purpose; in addition, hair was not suitable, being hollow, besides varying in diameter. In the experiments conducted in the manner described in the paper the gas was passed through the apparatus continuously. He could not give any reliable figure as to the time of lag, as only a few experiments were made. Gelatin fibres had not been used. With regard to detecting traces of moisture, he believed the problem could be solved by making an instrument of a little finer workmanship. It was simply a question of magnification. As to whether the elongation was independent of temperature he was of the opinion that it depended on a number of factors of which temperature was one. He did not know what difference it would make in the reading, but if it were appreciable the instrument could be calibrated for various temperatures. The ordinary catgut of commerce was a twisted fibre, and would elongate or shorten

according to whether it was tightly or loosely twisted. Silkworm gut (ordinary fishing gut) had also been tested, but it was not nearly so sensitive as Chardonnet silk. The instrument had only been used on one gas (ethylene), but providing there was no action on the fibre he saw no reason why the nature of the gas should make any difference.

THE VOLUMETRIC DETERMINATION OF SULPHUROUS ACID.

BY THOS. J. I. CRAIG, D.SC., M.SC.TECH.

The method described in this paper depends on the following reactions:

(1) $SO_2+H_2O_2=H_2SO_4$;

(2) $5H_2O_2+2KMnO_4+3H_2SO_4=K_2SO_4+2MnSO_4+8H_2O+5O_2$.

The sulphurous acid (also sulphite or bisulphite) in solution in water is added to a known excess of acidified hydrogen peroxide and the residual hydrogen peroxide is determined by titration with standard permanganate.

Samples of sodium sulphite, potassium metabisulphite, and commercial sodium bisulphite liquor were employed to test the method. It was found that the action of hydrogen peroxide on sulphur dioxide is best carried out in a solution which is not too dilute; afterwards the liquid may be diluted before titrating back with permanganate.

Proposed method. 1 grm. of the sample is dissolved in from 25 to 50 c.c. of distilled water and gradually added to a decided excess of standardised hydrogen peroxide—an excess equal to about 10 c.c. of *N*/2 permanganate should suffice. The amount of hydrogen peroxide taken is noted and stated as its equivalent in c.c. *N*/2 solution—say x c.c. 10 c.c. of dilute (1:3) sulphuric acid is now gradually run in and the whole well mixed. The mixture is cooled to ordinary temperature and the residual hydrogen peroxide determined by titration with *N*/2 permanganate. The volume of the permanganate used is noted y c.c. Then $x-y$=c.c. of *N*/2 permanganate equivalent to the sulphur dioxide present in the portion taken for analysis.

Since sulphites and bisulphites in dilute neutral or acid solution rapidly deteriorate, as short a time as possible should be allowed to elapse between dissolving the sample in water and adding it to the hydrogen peroxide. Alkaline sulphite solutions do not deteriorate so quickly. The hydrogen peroxide solution is standardised by titrating 10 c.c. (of "10 volume" solution) with *N*/2 permanganate under conditions similar to those in which the analysis is made.

RESULTS. *Potassium metabisulphite.* 0·5 grm. was treated with 10·2 c.c. of hydrogen peroxide. $x-y$=14·5 c.c.=80·22% $K_2S_2O_5$. Another test similarly carried out, but using 6·8 c.c. of hydrogen peroxide, gave the same result. Comparative tests made by another chemist using the iodine method gave 80·10%, 80·21%, and 80·32% $K_2S_2O_5$.

Potassium metasulphite crystals. By iodine 90·5% and 90·5% $K_2S_2O_5$. By author's method 90·41% and 90·37%.

Sodium sulphite crystals. By iodine method 90·91% and 90·85% $Na_2SO_3,7H_2O$. By author's method 90·97% and 90·72%.

Sodium bisulphite liquor. By iodine 12·71%, 12·70%, and 12·72% SO_2. By author's method 12·73% and 12·72%.

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DISCUSSION.

Mr. CROWTHER asked for information as to the rate of deterioration of neutral sulphite and of bisulphite solution. Most samples of sodium sulphite on the market were alkaline and deteriorated rapidly, but on neutralising the alkalinity with sulphur dioxide there was an appreciable increase in stability.

Dr. T. CALLAN understood that the determination involved the use of *N*/2 permanganate solution, which necessitated keeping a stock of a solution which did not keep very well. Had Dr. Craig tried the effect of measuring the volume of oxygen evolved in the reaction, as in that case as long as excess was employed the actual strength of the permanganate solution would be immaterial?

Dr. CRAIG, in reply, said that he was not able to give any figures with regard to the rate of deterioration of sulphites, but a sample of metabisulphite tested six months previously at 90% and recently at 80%. It was of course well known that standard permanganate, however carefully prepared, lost a certain amount of strength on standing. There were means of obtaining it sufficiently stable for all practical purposes. For instance, if a solution were allowed to stand for a considerable time before it was standardised the subsequent deterioration of the permanganate was exceedingly slow. *N*/10 solutions tended to be more accurate in titration than *N*/2 solutions. He had found *N*/2 permanganate quite convenient for technical work, and by making a litre at a time the solution was usually finished before any marked deterioration had occurred. As Dr. Callan suggested, it should be quite possible to determine the excess of hydrogen peroxide by measuring the oxygen evolved on adding permanganate. This method had already been proposed by Winkler ("Technical Gas Analysis," 1885, p. 106), but it was doubtful whether it would be any more rapid or accurate than simple titration with standard permanganate.

DETERMINATION OF ALKALI IN PERMANGANATE LIQUORS.

BY THOS. J. I. CRAIG, D.SC., M.SC.TECH.

During the early stages of the manufacture of permanganate there is present an excess of alkali over the amount finally required to form alkali permanganate with the permanganic acid which is produced. Different methods have been employed to separate this excess of alkali or to separate the permanganate from it. For instance by subjecting an alkaline manganate solution containing excess of free alkali to electrolysis, using a diaphragm,

permanganate is formed in the anode compartment, and alkali is transferred to the cathode side of the diaphragm. It is often useful to know the proportion of alkali to permanganic acid in such liquors, as the electrolysis proceeds.

The method hereinafter described is applicable to determine caustic alkali, alkali carbonate, and alkali combined with permanganate or manganate, and depends on the reaction between hydrogen peroxide and permanganate or manganate in alkaline solution, thus:—

$$5H_2O_2+2KMnO_4=2KOH+2MnO_2+4H_2O+4O_2.$$

The alkali in the permanganate is liberated in the form of hydroxide, and the total neutralisable alkali (hydroxide and carbonate) may then be determined by titration with standard acid and alkali, after filtering off the insoluble manganese compound. By deducting the alkali equivalent to the permanganate, the other alkali present in neutralisable form (*i.e.*, hydroxide or carbonate) is arrived at. If the proportions of these two last are required they may easily be found by determining volumetrically the amount of carbon dioxide and calculating to alkali carbonate.

With manganates the reaction with hydrogen peroxide is represented by the equation,

$$H_2O_2+Na_2MnO_4=2NaOH+MnO_2+O_2.$$

In analysing mixtures containing both permanganate and manganate, the proportions of these compounds may be found by treating a portion with carbon dioxide or alkali bicarbonate to convert the manganate into permanganate, collecting the precipitated manganese dioxide (which contains manganese equivalent to one third of the manganate), and determining the amount by ferrous sulphate and standard permanganate. The action of carbon dioxide is represented thus:

$$3Na_2MnO_4+2CO_2=2NaMnO_4+2Na_2CO_3+MnO_2.$$

The method described below does not, of course, affect or determine alkali which is present combined with acids such as sulphuric acid, nitric acid, etc.

Whilst the action of hydrogen peroxide upon neutral or alkaline permanganate solution is well known, it would appear that no method of volumetrically determining the neutralisable base in solutions containing permanganate or manganate and alkali hydroxide or carbonate has hitherto been published. Gorgeu (Comptes rend., 1890, **110**, 985) has stated that hydrated manganese dioxide is precipitated combined with a certain amount of alkali.

Procedure.

Neutral hydrogen peroxide is added to the portion of liquor taken for analysis until the liquid is completely decolorised; the liquid is then heated on the steam bath to decompose any excess of hydrogen peroxide which may be present, phenolphthalein is added, and standard acid run in until excess is present. This is in order to decompose any alkali manganite which may have been produced by the decomposition with hydrogen peroxide. The insoluble matter is filtered off and washed free from acid, and the filtrate and washes are titrated with standard alkali at the boil. Methyl orange may be employed as indicator, in which case the solution is titrated when cold.

The number of c.c. of standard acid minus the number of c.c. of standard alkali represents the neutralisable alkali and the alkali which was combined with permanganate. The permanganate may easily be determined in another portion of the liquor by known methods and its equivalent of alkali deducted from the total gives the alkali hydroxide and carbonate.

Results.

(1.) 20 c.c. of *N*/2 permanganate, treated with neutral hydrogen peroxide, heated, filtered, and the precipitate washed, required only 1·2 c.c. of *N*/1 acid to neutralise the alkali in the filtrate and washes.

(2.) Another similar trial required only 1·1 c.c. of *N*/1 acid. These low results (theoretically 2 c.c. of *N*/1 acid should have been used) are due to the formation of manganite, as explained above—some of the alkali remaining insoluble combined with manganese dioxide. It was found that accurate results can be obtained by acidifying with standard acid after treating with hydrogen peroxide, and then titrating back with standard alkali.

(3.) 20 c.c. of *N*/2 permanganate treated with hydrogen peroxide till decolorised, then heated to decompose excess of the latter, treated with 5 c.c. of *N*/1 acid, filtered, and the precipitate washed, required 3 c.c. of *N*/1 alkali to neutralise at the boil, using phenolphthalein as indicator. The volume of acid used (2 c.c.) is the theoretical amount.

(4.) In another similar trial, using 31 c.c. of *N*/2 permanganate a net amount of 3·15 c.c. of *N*/1 acid was required, *i.e.*, 0·05 c.c. over the theoretical quantity. The theoretical amounts of KOH in the last two trials were 0·1122 and 0·1739 grm.; the amounts found were 0·1122 and 0·1767 grm. respectively.

A composite liquor made by mixing *N*/2 permanganate, sodium hydroxide, and sodium carbonate was tested; the results were as follows:—20 c.c. *N*/2 $KMnO_4$+10 c.c. *N*/1 NaOH+0·25 grm. Na_2CO_3 were mixed and tested as described above. Results:—

	Theoretical amount in c.c. acid	Found, using phenolphthalein c.c.	Found, using methyl orange c.c.
(5)	16·71	16·8	—
(6)	16·71	16·8	—
(7)	16·71	—	16·6 c.c.
(8)	16·71	—	16·7 c.c.

For some reason slightly higher results appear to be obtained with phenolphthalein than with methyl orange.

Discussion.

Dr. J. Bloch observed that the method did not disclose the quantity of permanganate in the alkali solution. He had personally solved a problem somewhat similar to that dealt with by Dr. Craig, but he had done it in a different way, without using hydrogen peroxide, which liberated caustic potash, reacting upon the permanganate and forming some manganate. He had used alcohol. A few drops of alcohol added to an alkaline solution of permanganate reduced it completely to manganese dioxide. By making a blank test with neutral permanganate it was possible to determine the alkalinity produced, and by titrating the alkaline solution with phenolphthalein an accurate result was obtained.

Dr. Forster said he had been able to keep *N*/10 permanganate solution for about two years without marked deterioration. He believed deterioration was due to organic matter in the water, and if the solution were allowed to stand for a month or two before standardising, a *N*/10 solution would keep practically indefinitely providing no other organic matter were introduced.

Mr. Crowther mentioned that light apparently accelerated the rate of deterioration.

Dr. Craig, in reply to Dr. Bloch, said that permanganate in alkaline solution could easily be determined by acidifying and applying one of the usual methods. Permanganate was completely destroyed by hydrogen peroxide so that no manganate could be formed. He endorsed the remarks about preparing a permanganate solution some time before it was required for use, and in that way obtaining a stable standard solution. He could not say whether a *N*/10 solution kept better than a *N*/2 solution.

Yorkshire Section.

Meeting held at the Queen's Hotel, Leeds, on January 13, 1919.

DR. H. T. CALVERT IN THE CHAIR.

SODAMMONIUM SULPHATE. A NEW FERTILISER. THE UTILISATION OF NITRE CAKE IN THE FIXATION OF AMMONIA.

BY H. M. DAWSON, D.SC., PH.D.

The substitution of nitre cake for sulphuric acid in the production of ammonium sulphate represents a proposition which has no claim to novelty. The utilisation of nitre cake in this way was suggested by Kirkman (Eng. Pat. 5703 of 1889; this J., 1890, 391), and a process for the separation of ammonium sulphate from the mixed sulphates has been described by Chatfield (Eng. Pat. 19,530 of 1893; this J., 1894, 735). In this process, the difference in the solubilities of sodium sulphate and ammonium sulphate at low temperatures is used for the separation of sodium sulphate in the form of Glauber's salt, whilst ammonium sulphate is obtained in crystalline form by the evaporation of solutions at or near their boiling points. In so far as these features of Chatfield's process are concerned, they are entirely justified by the results which have recently been obtained in the investigation of the equilibrium relations in the ternary system, $Na_2SO_4-(NH_4)_2SO_4-H_2O$, although the feasibility of the process as a whole is extremely doubtful.

Under war conditions, the shortage of sulphuric acid made it necessary to replace to some extent by nitre cake the sulphuric acid used for the absorption of ammonia, and this partial substitution of free acid led to the production of "ammonium sulphate" containing varying proportions of admixed sodium sulphate. The production of such mixtures is a matter which has been recently discussed at some length by Parrish (Gas J., 1917, **137**, 345; this J., 1917, 326) and does not fall within the scope of the present paper, which is concerned with the production of pure ammonium sulphate and also of the double sulphate.

The products which separate when solutions of nitre cake or of mixtures of nitre cake and sulphuric acid, neutralised more or less completely by the absorption of ammonia, are brought to crystallisation, depend on the solubility relations which are characteristic of the ternary system, an account of which has already been given by the author (Trans. Chem. Soc., 1918, **113**, 675; this J., 1918, 577 A).

The chief points to be noted in connection with the equilibrium relations are:

(1) The interaction between Glauber's salt and ammonium sulphate with the formation of the double salt, sodammonium sulphate, according to the equation,

$$Na_2SO_4,10H_2O+(NH_4)_2SO_4 = Na_2SO_4,(NH_4)_2SO_4,4H_2O+6H_2O.$$

This reaction occurs if the temperature is not lower than −16° C.

(2) The decomposition of the double salt at 59·3° C. according to the equation,

$$Na_2SO_4,(NH_4)_2SO_4,4H_2O = Na_2SO_4+(NH_4)_2SO_4+4H_2O.$$

(3) The gradual lowering of the temperature at which Glauber's salt is converted into anhydrous sodium sulphate by the addition of increasing quantities of ammonium sulphate from 32·4° C. to a minimum at 26·5° C. At this temperature the added ammonium sulphate is sufficient to bring about saturation with respect to the double sulphate.

At the three temperatures in question, which are characteristic of the so-called invariant systems, the solutions are saturated simultaneously with respect to three solid phases, namely, Glauber's salt, ammonium sulphate, and double salt at −16° C.; Glauber's salt, sodium sulphate, and double salt at 26·5° C.; and ammonium sulphate, sodium sulphate, and double salt at 59·3° C.

In order to obtain a survey of the complete equilibrium relations over the range of temperature, limited, on the one hand, by the eutectic temperatures, and on the other, by the boiling points of the solutions, it is necessary to supplement the data characteristic of the invariant systems by information relative to the various univariant systems in which the solutions present are saturated with respect to two solid phases. At a given temperature such solutions have a definite composition determined solely by the nature of the co-existing solid phases. A knowledge of these solutions has been obtained by systematic measurements of the solubility over the range of temperature −19·5° C. to 100° C. The survey of the relations in question is greatly facilitated by the use of a space model.

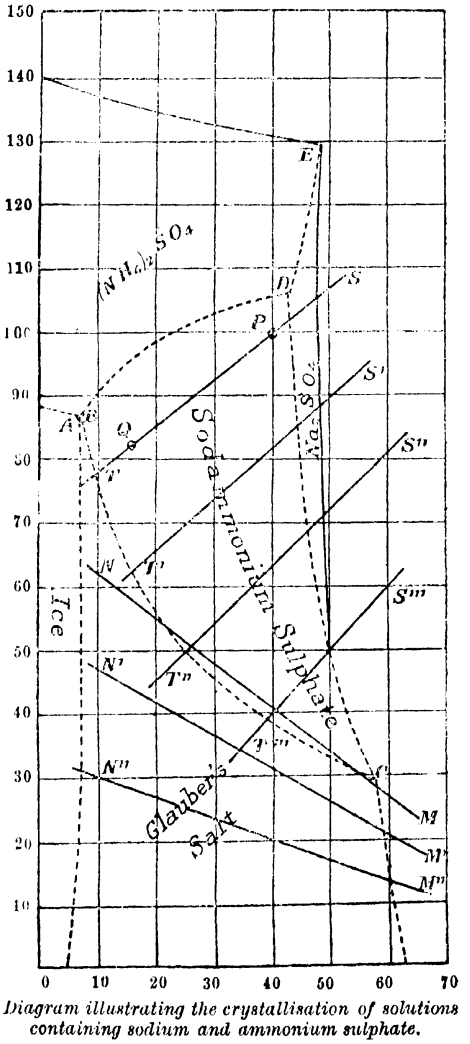


Diagram illustrating the crystallisation of solutions containing sodium and ammonium sulphate.

Such a model may be conveniently constructed by expressing the composition of the solutions in terms of the ratios $Na_2SO_4 : H_2O$ and $(NH_4)_2SO_4 : H_2O$,

the values of which are measured off along rectangular co-ordinates, the third variable factor, the temperature, being represented along a third axis at right angles to the plane of the concentration axes. The solid model thus obtained affords a more or less complete picture of the equilibrium relations which are characteristic of the ternary system.

The accompanying diagram represents the projection of this model on a plane at right angles to the temperature axis. The vertical and horizontal co-ordinates give respectively the concentrations of the ammonium sulphate and sodium sulphate expressed as molecules of salt per 1000 molecules of water. The saturated solutions corresponding with the invariant points at −16° C., 26·5° C., and 59·3° C. are represented respectively by B, C, and D. The point, A, which lies very close to B, represents the ternary eutectic with ice, Glauber's salt and ammonium sulphate as the three solid phases. The curve, BD, represents solutions saturated with respect to ammonium sulphate and double salt, and in the same manner solutions saturated with respect to Glauber's salt and double salt are represented by BC, whilst solutions saturated with respect to anhydrous sodium sulphate and double salt are represented by CD. Finally the curve, DE, corresponds with solutions which are in equilibrium with sodium sulphate and ammonium sulphate. These curves divide the plane surface into zones representing solutions which are saturated in respect of one solid phase. The zones characteristic of the divariant systems, in which the solutions are saturated with reference to ammonium sulphate, Glauber's salt, anhydrous sodium sulphate, and sodammonium sulphate are indicated on the diagram, which also shows the corresponding zone for ice as the solid phase.

The particular feature of the diagram to which the author desires to call attention is that it affords an extremely convenient means of representing the change in the composition of the solutions when crystallisation occurs as a consequence of change in temperature. So long as the crystals which separate are homogeneous in the sense that they consist of a single chemical compound, the index point, which represents the gradual change in the composition of the mother liquor during the process of crystallisation, will move along straight lines which may be referred to as crystallisation lines. The crystallisation lines corresponding with the separation of Glauber's salt are represented, for instance, by the lines, MN, M′N′, M″N″ . . . , and those corresponding with the deposition of the double salt by the lines, ST, S′T′, S″T″ . . . So long as the crystallisation lines on the diagram fall within the borders of the corresponding salt zone, they represent changes which have a real significance in that they correspond with transformations in actually realisable and stable systems. It is thus possible to predict the conditions under which the various crystallisable products may be severally obtained in pure condition by cooling solutions which contain both sodium and ammonium sulphates.

With reference to the possible large-scale treatment of such mixed solutions, attention may in the first instance be directed to the separation of the constituent sulphates with the production of ammonium sulphate and Glauber's salt. The conditions under which this separation can be effected have already been described in detail (Dawson, Eng. Pat. 114,236, 1918; this J., 1918, 241 A). In its main features the process depends on the fact that the ratio of the solubilities of ammonium sulphate and Glauber's salt at low temperatures is much greater than the ratio of the solubilities of ammonium sulphate and anhydrous sodium sulphate at the boiling point. If solutions of the mixed sulphates, the concentration of which has been suitably adjusted, are cooled below 0° C., Glauber's salt crystallises, and under favourable conditions, mother liquors are produced which contain ammonium sulphate in relatively large proportion. The molecular ratio of ammonium sulphate to sodium sulphate may in fact be raised to about twelve without the deposition of ammonium sulphate as such or in the form of the double salt. If these liquors are then evaporated at or about 100° C., pure ammonium sulphate crystallises until the relative proportion of ammonium sulphate in the hot liquor has fallen to a much lower value. The evaporation may in fact be continued so long as the molecular ratio of ammonium sulphate to sodium sulphate does not fall below about 2·7. By subjecting the residual hot mother liquor to the same treatment as the original solution, the mixed sulphates, produced by the use of nitre cake or a mixture of nitre cake and sulphuric acid for the absorption of ammonia, may be completely resolved into crystallised ammonium sulphate and crystals of Glauber's salt. The proportion of the dissolved salts which may be obtained in crystalline form from a given solution, increases as the temperature attained in the refrigeration process falls, and under favourable conditions the proportion obtained in one phase of the cycle may reach 75%.

The above process for the separation of the ammonium and sodium sulphates from solutions of the mixed sulphates requires artificial cooling if economic working is to be achieved. The plant required consists of tanks in which the nitre cake may be dissolved, saturators, evaporating pans, cooling tanks, and refrigerating machinery. In respect of working costs, the refrigeration required for the separation of the Glauber's salt represents a phase of the process for which there is no parallel in the ordinary methods of manufacturing sulphate of ammonia, and chief attention will naturally be focussed on this phase of the process. In the present abnormal condition of the cost of labour it would serve no useful purpose to attempt to estimate the cost of refrigeration in absolute terms. Relatively, however, the cost of separation of the Glauber's salt by cooling is estimated to be very nearly the same, weight for weight, as the cost of ice production.

The alternative process, above referred to, in which the more or less completely neutralised solutions containing sodium and ammonium sulphates are treated in such a way as to produce the double salt, $Na_2SO_4,(NH_4)_2SO_4,4H_2O$, may now be briefly considered. The most important difference to be noted between this process and that which has been described in the previous paragraphs is that the production of the double salt does not require the use of refrigeration plant.

Chemically the change which is characteristic of the process may be represented, in general form, by the equation,

$$mNa_2SO_4,nH_2SO_4+(m-n)H_2SO_4+2mNH_3+4mH_2O = mNa_2SO_4,(NH_4)_2SO_4,4H_2O,$$

in which the nitre cake or other acid sodium sulphate is represented by the molecular formula, mNa_2SO_4,nH_2SO_4. In the case of an average sample of nitre cake containing 30% of free sulphuric acid, this equation assumes the form

$$Na_2SO_4,0{\cdot}62H_2SO_4+0{\cdot}38H_2SO_4+2NH_3+4H_2O = Na_2SO_4,(NH_4)_2SO_4,4H_2O.$$

In the actual carrying out of the transformation represented by these equations, due regard must be paid to the characteristics of the equilibrium diagrams and to the course of the crystallisation lines. As already pointed out, ST, S′T′ etc. represent the changing composition of the solutions from which the double salt crystallises as a consequence of a fall in temperature. The length of the crystallisation line, which falls within the double salt zone, BCD, on the plane projection diagram, affords an approximate measure of the quantity of the double salt which may be obtained in maximo from a given solution, and it will be observed that the extension

of the line is considerably greater for solutions which contain ammonium sulphate in excess of the sodium sulphate, than it is for solutions which contain approximately equivalent quantities of the two sulphates. The lengths ST and S‴T‴ afford clear evidence of this. The upper and lower limits of the temperature range within which the double salt crystallises also become more widely separated as the proportion of ammonium sulphate in the solutions increases. This interval, which in the case of a solution containing equivalent quantities of the two sulphates, extends from 20° to 41° C., increases with the proportion of ammonium sulphate until it covers approximately the range between the temperature of formation of the double salt (−16° C.) and the temperature at which this is decomposed (59·3° C.).

Having regard to these facts, the crystallisation of the double salt is most advantageously carried out under conditions in which the solutions contain an excess of ammonium sulphate.

If a solution represented on the diagram by the point, P, the composition of which corresponds with the molecular formula,

$$1000H_2O : 40Na_2SO_4 : 100(NH_4)_2SO_4,$$

is allowed to cool from about 60° C. to the ordinary temperature (15° C.), the pure double salt crystallises and the residual liquor is represented by Q, which point is given by the intersection of the crystallisation line drawn through P with the isothermal for 15° C. The composition of the mother liquor corresponds with the formula,

$$1000H_2O : 16Na_2SO_4 : 83(NH_4)_2SO_4.$$

If the constituents removed from the solution by the separation of the crystalline double salt are added to the mother liquor, Q, in the form of a mixture of nitre cake and sulphuric acid, the free acid in which is neutralised by the absorption of ammonia, the original solution, P, will again be obtained. If this solution, after adjustment of the absolute concentration by evaporation of any excess of water, is again allowed to cool, a further crop of sodammonium sulphate is obtained, and it is obvious that this may be repeated indefinitely.

Assuming that the nitre cake employed contains 30% of free acid and that the process is operated between the points, P and Q, then the change during crystallisation may be represented by the equation,

$$1000H_2O,40Na_2SO_4,100(NH_4)_2SO_4 = 25{\cdot}5Na_2SO_4,(NH_4)_2SO_4,4H_2O + 0{\cdot}9(1000H_2O,16Na_2SO_4,83(NH_4)_2SO_4)$$

and the regeneration of the original solution by

$$0{\cdot}9(1000H_2O,16Na_2SO_4,83(NH_4)_2SO_4) + 25{\cdot}5\{Na_2SO_4,0{\cdot}62H_2SO_4+0{\cdot}38H_2SO_4+2NH_3 + 4H_2O\} = 1000H_2O,40Na_2SO_4,100(NH_4)SO_4.$$

The solution, Q, which, it may be noted, contains ammonium sulphate, in considerably greater quantity than sodium sulphate, may be regarded as the solvent in which the reacting constituents—nitre cake, sulphuric acid, ammonia, and water—are dissolved, and from which they separate in the form of the double salt, $Na_2SO_4,(NH_4)_2SO_4,4H_2O$, when the warm solution is allowed to cool. Considerable latitude is permissible in practice with regard to the composition of the "solvent," and the presence of sulphuric acid in moderate quantities does not interfere with the operation of the process. Although the yield of double salt from a given solution of the mixed sulphates increases as the final temperature reached in the crystallisation process falls, the economic production of sodammonium sulphate can be carried out without the use of refrigerating plant. The temperature attainable by air cooling or by the available water supply is sufficiently low for efficient working.

If any attempt is made to compare the cost of fixing ammonia by the ordinary sulphuric acid process with the cost of fixation by the sodammonium process, one is immediately confronted with the question of the relative prices of nitre cake and sulphuric acid. During the period of the war the relative values have varied within considerable limits and the post-war value of nitre cake is largely a matter of conjecture. In attempting a rough comparison of the costs of fixation, the author is fully cognisant of the difficulties which these circumstances involve. The figures tentatively put forward refer to the cost of fixing a ton of ammonia (1) by sulphuric acid with the production of ammonium sulphate, (2) by a mixture of nitre cake and sulphuric acid with the production of sodammonium sulphate.

Sulphuric acid process: Per ton of ammonia, 3·60 tons of 80% H_2SO_4 is required.

3·60 tons 80% H_2SO_4 at £4 = ...	£14	8	0

"*Sodammonium*" *process:* Assuming the use of average nitre cake containing 30% of free sulphuric acid, the fixation of the ammonia is represented by the equation

$$Na_2SO_4,0{\cdot}62H_2SO_4+0{\cdot}38H_2SO_4+2NH_3+4H_2O = Na_2SO_4,(NH_4)_2SO_4,4H_2O,$$

according to which 6·0 tons of nitre cake and 1·36 tons of 80% sulphuric acid are required per ton of ammonia

6·0 tons of nitre cake at 15*s.* = ...	£4	10	0
1·36 tons of 80% H_2SO_4 at £4 = ...	£5	9	0
	£9	19	0

As compared with the sulphuric acid process, the cost of fixation by the sodammonium process thus shows a balance to the good of £4 9*s.* per ton of ammonia.

In the particular case of nitre cake with a content of 30% of free acid, it may be noted that 62% of the acid used in the fixation of the ammonia is derived from the nitre cake. This percentage increases with the acidity of the nitre cake and reaches 100% in the case of sodium bisulphate. If a product of this composition were available, the fixation of ammonia could therefore be carried out by the "sodammonium" process without the use of free sulphuric acid and the reduction in cost would be correspondingly greater.

The proposal to utilise sodammonium sulphate as an artificial manure will naturally raise the objection that the relatively low ammonia content of the double salt in comparison with that of ammonium sulphate implies an appreciable increase in the cost of transport per unit of ammonia. Whilst this is a disadvantage which necessarily attaches to the substitution of sodammonium sulphate for ammonium sulphate, it seems probable that it is more than offset by advantages which accrue from the manurial value of the sodium sulphate in the double salt. In this connection, reference may be made to results obtained at Rothamsted, where certain plots have received large dressings of sulphate of soda for many years in succession. In a recent report, the Director of the Experimental Station gives a comparison of the results which have been obtained on these plots, showing clearly the influence of sodium sulphate on the production of wheat over a period extending from 1852 to 1911. These results indicate clearly that the addition of sodium sulphate to a dressing of ammonium sulphate and superphosphate has been attended by a very considerable increase in the yield per acre, which extends throughout the whole of the period covered by the experiments, and the observations leave no room for doubt as to the accessory fertilising value of the sodium sulphate.

During the summer of 1918, preliminary pot experiments on the fertilising action of sodammonium sulphate were carried out with a crop of mustard on the Manor Farm at Garforth. These observations, for which the author is indebted to Dr. J. A.

Hanley, of the Agricultural Staff of the University of Leeds, have shown that the manurial value of sodammonium sulphate when added to a dressing of calcium carbonate and potassium phosphate is very approximately the same as that of ammonium sulphate containing the same amount of nitrogen.

Available agricultural data thus afford strong evidence in favour of the suitability of sodammonium sulphate as a fertiliser. Its production from nitre cake or other acid sodium sulphate represents a very simple process, for the carrying out of which on the large scale the only plant required consists of evaporating pans and crystallising tanks in addition to the saturators. On the assumption that nitre cake is available at a comparatively low price, the cost of fixation of ammonia by the sodammonium process may be expected to be very much smaller than by the ordinary sulphuric acid process.

DISCUSSION.

Mr. C. P. FINN said that in October, 1915, he had instituted experiments with a view to utilising nitre cake as a substitute for part of the acid required in the manufacture of ammonium sulphate. These had been successful, but had been abandoned when the Government had requisitioned ammonia in the form of concentrated liquor and utilised it for the manufacture of ammonium nitrate. The subject seemed to resolve itself into a question of cost, firstly, that of nitre cake compared with sulphuric acid, and secondly the alteration of existing sulphate of ammonia plants to suit the new process.

Mr. B. A. BURRELL said that many nitre cakes contained a small quantity of undecomposed sodium nitrate, in some cases as much as 4 or 5%. Would this be liable to crystallise out with the sulphate of ammonia, or would it remain in the "mother liquor"? If the former, it would add to the fertilising value of the sulphate of ammonia.

Mr. C. A. KING asked whether, in a continuous plant in which the circulating liquid was always kept acid, the presence of acid in the liquor would alter the equilibrium between the sodium sulphate and ammonium sulphate, and result in a different product being formed.

Dr. DAWSON, in reply to Mr. Burrell, said he did not think the presence of sodium nitrate would give rise to any complication in the production of the double salt. He agreed that the commercial possibilities involved in the production of sodammonium sulphate depended upon the respective prices charged for sulphuric acid and for nitre cake. If vested interests were brought to bear and controlled the price of nitre cake, then of course the position would be made difficult. On the other hand it should be borne in mind that at the present time there were in this country sulphuric acid plants having a capacity greatly in excess of the demand, and if there were competition sulphuric acid manufacturers would probably find it necessary to work up their by-products and make use of the nitre cake. What he had put forward was based upon experimental results obtained in a long and systematic investigation. Replying to Mr. King, Dr. Dawson pointed out that the process described was not a continuous process; the presence of moderate quantities of free acid should not interfere with its operation. Manurial experiments on a small scale with the sodammonium sulphate had been distinctly satisfactory, and there was no doubt that on certain soils, especially those which contained potash in non-available form, the new fertiliser would be advantageous.

Meeting held at Queen's Hotel, Leeds, on February 10th, 1919.

MR. W. MCD. MACKEY IN THE CHAIR.

POLYMERISED AND OXIDISED LINSEED OIL.

BY HARRY INGLE, D.SC., AND A. WOODMANSEY, B.SC.

The two principal methods of preparing linseed oil for use in paint, *viz.* "boiling" and "blowing," have similar objects in view; these are (*a*) to thicken the oil and remove the mucilage; (*b*) to incorporate a drier or catalyst and so increase the power of the resultant oil to absorb oxygen.

It is unnecessary here to describe the commercial processes in detail, but a brief reference will be made to the outstanding features of each.

Boiled oil (polymerised oil). The action of heat, say up to a temperature of 500° F. (260° C.), on linseed oil is first to drive off moisture, and secondly to coagulate the mucilage, with the formation of "frog-spawn" or "break." In boiling, the mucilage is apt to char and darken the oil, hence for fine varnishes an old tanked oil is preferred. "Tanking" (the meaning is obvious) has the effect of allowing the mucilage to settle and also to oxidise and separate. The oxidation of the mucilage occurs before that of the oil. If the tanking be too prolonged (which of course rarely happens) the oil absorbs oxygen and the oxidised oil becomes brown on heating. The mucilaginous matter, probably a form of lecithin, decomposes at the high temperature, emitting a strong odour of trimethylamine. This accounts for a complaint which has often arisen that a freshly pressed oil, containing much mucilage, when heated, has a fishy odour, quite wrongly attributed to the presence of fish oil.

An analysis of the "frog-spawn" or "break" gave oil 91·4%, dry mucilage 8·6%. The latter contained 14·9% of ash, including 2·7% of P_2O_5. The action of heat also brings about polymerisation, which takes place first of all with the linolenic portion of the glycerides, as witness the reduction in the yield of hexabromides (Ingle, this J., 1911, 344). The oil so produced is mainly polymerised; any oxidation is adventitious.

It is not our intention to discuss the composition of the products in the intermediate stages of the polymerisation process (this has been done by Morrell; see this J., 1915, 105). A gelatinised oil obtained by boiling, such as is used in the manufacture of corticine and cork-carpet, gave a yield of ether-insoluble substance of 44·7%. To distinguish the latter from "linoxyn" (a similar but oxidised ether-insoluble product) the name "polyolin" is proposed, and for the petroleum spirit-insoluble acids of polymerised oil, "poly-acids." Samples of polyolin were rolled into sheets and exposed to air for eight years. They show no hardening and are as elastic as when first made—a remarkable proof of the permanence of the boiled or polymerised linseed oil.

An examination of a sample of polymerised oil, seventeen years old, showed (in the middle of the sample) an iodine value of 43·6. It contained 70·6% of matter insoluble in methylated ether. This high value is evidence against any extensive molecular disruption having occurred (compare with the value in the case of superoxidised oil in a later section of the paper). On saponification with alcoholic potash and liberation of the acids of the soap, the composition of a newly made polyolin (iodine value 53) was found to be as follows:—Acids

insoluble in petroleum spirit 45·0%; acids soluble in petroleum spirit 45·0%; ash 4·7%; glycerol etc. 5·3%. The combining weight of the acids insoluble in petroleum spirit as found by means of the barium salt was 348·4. Calculated from the iodine value (for 21, 346). The agreement of the figures obtained for the combining weight is striking, but unfortunately such figures do not agree with any conceivable formula without presupposing a splitting up of the chain of carbon atoms during saponification or in the boiling process itself. Morrell's figures (this J., 1915, 107) for the acetone-insoluble acids in acetic acid solution (363—452) are not very dissimilar, but his iodine values (108—135) for these are considerably higher. They, however, represent the results with intermediate products.

The position of the double linkages in the acid chain is not definitely known, and it appears to the authors that they act tautomerically under certain conditions. By the transference of a hydrogen atom a double linkage can exert its function in almost any portion of the chain where a suitable chemical change under these conditions can take place. The work of Morrell (*loc. cit.*) amply confirms this view.

Goldsobel and others have adduced experimental evidence to show that in both linolic and linolenic acids there is no ethylenic linkage in the neighbourhood of the carboxyl group, but in the determination of the iodine value an unsaturated linkage certainly shows itself in close proximity to it (Ingle, this J., 1902, 587). Similar but more slender evidence is apparent in the following. It seems probable that when linolic or linolenic acid radicles polymerise, ring formation occurs with the production of rings with six or eight carbon atoms. The latter, if found, would show the resemblance to rubber with the characteristic grouping:—

$$\begin{array}{l} -CH-CH=CH-CH- \\ \quad\quad\quad\

It was further decided to investigate the changes occurring during the oxidation of a film of cold-boiled oil by spreading on a sheet of glass, exposing to the air, and scraping off portions at intervals for analysis.

The oil (original iodine value 183, and containing 1% of lead driers) was oxidised in bulk at 170° F. (86° C.), the sp. gr. of the product being 0·966.

—	Oil before exposure	Oil after drying :— 3 days	5 days	7 days	10 weeks
	%	%	%	%	%
Unoxidised oil ..	100	45·7	33·9	10·9	17·5
Partially oxidised oil ..	—	52·5	50·1	43·6	28·9
Linoxyn	—	1·8	16·0	45·5	53·6
Unoxidised oil					
Unoxidised acids (calculated to oil)	87·1	35·5	24·5	9·2	13·35
Oxidised acids (calculated to oil)	12·9	10·2	9·4	1·7	4·15
Partially oxidised oil					
Unoxidised acids (calculated to oil)	—	14·6	10·0	17·2	9·51
Oxidised acids (calculated to oil)	—	37·9	40·1	26·4	19·39
Linoxyn					
Unoxidised acids (calculated to oil)	—	—	4·9	12·6	7·34
Oxidised acids (calculated to oil)	—	—	11·1	32·9	46·26

In interpreting these results it must be remembered that each sample, especially in the intermediate stages, was not homogeneous, the surface being more nearly dry than the interior. This is inevitable in a film of any appreciable thickness.

In the first place about half the oil is transformed into partially oxidised oil soluble in methylated ether but insoluble in petroleum spirit. Linoxyn increases in amount at the expense of the partially oxidised oil fraction. At a certain point the quantity of unoxidised oil increases. The oxidised acids in the partially oxidised oil and the linoxyn increase throughout.

Although the above results are incomplete and more or less empirical, some general conclusions may be drawn from them.

Let us suppose that linseed oil consists largely of mixed glycerides. For simplicity we will represent it as follows :—

$$C_3H_5\begin{cases}O.CO.CH_2(CH=CH)_3-CH_2-, \text{linolenic}\\ O.CO.CH_2(CH=CH)_2-CH_2-, \text{linolic}\\ O.CO.CH_2-, \text{stearic}\end{cases}$$

leaving out the oleic acid. This may be supposed on oxidation to have two atoms of oxygen attached to each ethylenic grouping, with formation of peroxide. Under favourable conditions of temperature and time, such a compound might suffer a redistribution of acid groups, thus :

$$3C_3H_5\begin{cases}LnO\\ LnO\\ LO\\ St\end{cases}=C_3H_5(LnO)_3+C_3H_5(LO)_3+C_3H_5(St)_3$$

where LnO represents the oxidised linolenic, LO the oxidised linolic, and St the stearic radicle. If we assume that $C_3H_5(LnO)_3$ and $C_3H_5(LO)_3$ together form the major portion of what is usually known as "linoxyn," then it is clear that linoxyn can be produced with a loss of partially oxidised oil and an increase of unoxidised oil, with no diminution in the iodine value of the total oxidised oil.

This is exactly what occurred in the experiments of ageing without oxidation. Now under the action of heat the peroxidised oil might be supposed to give up oxygen to some of the portions of the oil which had not been previously oxidised and thus reduce the iodine value of the whole (autoxidation). It would in a measure explain the results obtained, but we are of opinion that much more far-reaching changes take place in melting an oxidised oil; probably aldehydes are formed by the direct action of heat on the peroxides. These aldehydes may condense with the oil products present or among themselves, but there is no direct evidence of this. Be it as it may, the oil loses 2·5% on melting

The question of the rate of change into linoxyn was of interest, and determinations of this were made. Samples of oxidised oil (blown solid for linoleum cement) were analysed; with manganese drier the rate of formation of linoxyn in the oil was found to be as follows :—In 1 month 0·61% per month, in 21 months 0·59% per month, and in 13 months 0·66% per month, whereas in the case of an oxidised oil made with a lead drier the rate of increase was 0·14% per month in 22 months.

Thus the manganese drier catalyses the transformation into linoxyn four times as rapidly as lead. As the samples examined were cut from the interior portions of the substance, which had not been exposed to the air, the change into linoxyn must have resulted from a molecular rearrangement of the glycerides, and as it has previously been shown that this takes place without any material alteration in the iodine value, it cannot be due to "autoxidation."

Linoxyn is not a very stable substance, readily forming "superoxidised oil"; therefore the authors are of opinion that manganese driers are inferior to lead as regards permanence of the product.

Superoxidised oil. Some years ago, W. F. Reid (J. Soc. Arts, 1891, **39**, 398; also this J., 1894, 1020) described the product obtained by exposing films of linseed oil for a considerable time (five years) and showed that an extremely sticky and viscid mass resulted which was acidic in character and quite unlike the original films. No analytical data as to its composition were given, but the importance of this substance in the deterioration of old paint and pictures was pointed out. One of us can confirm this from practical experience with linoleum and printed floor-cloth colours. The printed surface of some old rolls of floor-cloth was very sticky, and it was found that the red and dark shades of the printing colour had barytes and china-clay as a base and that the stickiness only affected the darker parts, whereas the white-lead portions and those containing whiting were quite dry but brittle. The latter was able to neutralise the acids formed. Similar softening of oxidised oil by heat, moisture, and exposure has been noted in samples of linoleum returned from India.

One of us possesses a piece of linoleum oxidised-oil skin (scrim) which has hung in the laboratory for seventeen years. Before superoxidation it showed the following composition :—Unoxidised oil 11·8%, partially oxidised oil 32·5%, linoxyn 55·3%, iodine value 50. The stickiness now extends right through the mass, nearly $\frac{3}{4}$" thick.

A portion of this specimen was treated with a cold 5% solution of sodium carbonate for 15 hours. Most of it dissolved and was strained off. The solution was then precipitated with dilute hydrochloric acid; very little of the precipitate dissolved in petroleum spirit, the main bulk formed a clot which adhered to the sides of the separator. After washing with water, methylated ether was added; again very little dissolved. After further washing with water, the residue was treated with alcohol and the solution made up to 100 c.c. One 25 c.c. portion was titrated against *N*/1 potassium

hydroxide, another saponified, and a third evaporated and the iodine value of the residue determined. The results calculated on the weight of residue left after evaporation were :—Acid value 83, saponification value 317, iodine value 244. The above results show that we are dealing with a very complex substance, probably a peroxidised glyceryl acid, the occurrence of which was indicated in a previous paper. At a still later date, a portion of the substance was analysed by the solvent method, giving :—Soluble in petroleum spirit, 14·2%; soluble in methylated ether, 57·9%; "linoxyn," 27·9%. The proportion of the first constituent is about the same as we have frequently found in the examination of dried oil films. The somewhat low value for linoxyn suggests a break-up of the insoluble oxidised molecule into constituents soluble in methylated ether and insoluble in petroleum spirit (compare with polyolin).

The formula of the "superoxidised oil" soluble in sodium carbonate, neglecting the saturated acids, may be something of this type :—

$$C_3H_5\left\{\begin{matrix}O.CO.(CH_2)_x.\left(\begin{matrix}CH.CH\\ |\quad |\\ O{-}O\end{matrix}\right)_x.(CH_2)_x.COOH\\ \vdots\\ \text{3}\end{matrix}\right.$$

also neglecting any mixed glycerides.

On determining the acid value, the free carboxyl groups would react, and on determining the saponification value, the glyceride would be saponified and the peroxides would decompose, leading to an increased result.

Without a long investigation it is impossible to say more, but one interesting point stands out, *viz.* that even after seventeen years the oil still has an iodine value, though a low one. The possibility of "steric hindrance" playing a part has been suggested; it may be that the proximity of the carboxyl group to the drying groups prevents complete oxidation.

Below are formulated two views of the production of acidic glycerides and perhaps aldehydes, by the spontaneous decomposition of the peroxide (since it penetrates into the interior of the oxidised oil "skin") and by further oxidation and the action of moisture.

(*a*) Spontaneous decomposition of the oxidised oil and subsequent oxidation of the products.

$$\begin{matrix}-CH{-}CH-\\ |\quad |\\ O{-}O\end{matrix} \rightarrow \begin{matrix}-CH\\ \|\\ O\end{matrix} + \begin{matrix}CH-\\ \|\\ O\end{matrix} \xrightarrow{+O_2} \begin{matrix}-CO\\ |\\ OH\end{matrix} + \begin{matrix}CO-\\ |\\ OH\end{matrix}$$

(*b*) Action of water on the peroxides.

$$\begin{matrix}-CH{-}CH-\\ |\quad |\\ O{-}O\end{matrix} + H_2O \rightarrow \begin{matrix}-CH_2\\ |\\ OH\end{matrix} + \begin{matrix}CO-\\ |\\ OH\end{matrix}$$

We have arrived at the following general conclusions :—

(1) For permanency, a polymerised oil is superior to an oxidised oil as a paint vehicle.

(2) The iodine value of either never falls to a negligible quantity. Steric hindrance is probably the factor preventing complete absorption of oxygen by the unsaturated groups.

(3) A redistribution of acids in mixed glycerides would explain certain facts brought out in the analysis of oxidised products.

(4) The oxidised oil produced either by "blowing" or by "cold boiling" after forming peroxides (drying) may be decomposed by lengthy exposure, with the formation of liquid acidic compounds, which in the case of a paint containing, say, white lead or whiting may be neutralised to form a more or less brittle coating, but if the paint consist of inert bases such as china clay, barytes, black pigments, or iron oxide, will render it sticky and easily removed by soap. This has been borne out by the experience of painters and linoleum printers using raw oil and a drier instead of boiled oil in their work, which in these circumstances cracked or weathered badly.

Discussion.

Mr. A. B. Craven asked if the authors had formed any opinion as to the extent of polymerisation necessary to give immunity from superoxidation in an oil used for paint. The observation of the increase in the unoxidised portion upon ageing an oxidised linseed oil was interesting. He confirmed the statement that manganese used as a drier gave ultimately a more brittle oxidation product than did lead.

Mr. H. Waites referred to the remarkable differences obtained by the use of lead and manganese as "driers," and said that it would be interesting to compare the results obtained by the use of cobalt in similar circumstances. He recalled the results obtained by Toch some years ago from the use of cobalt and soya bean oil.

The Chairman, commenting on Dr. Ingle's experience with manganese and lead, said that as manganese was generally understood to be a more active catalyst than lead, one would expect it to give some such result compared with lead as the authors had found. He remembered some years ago having to investigate the "perishing" of rubber used for waterproofing fabric, and he had found that it was then well understood in the trade that with fabric containing salts of manganese and copper the "perishing" was comparatively rapid; there was, however, no mention of salts of lead. He believed also that the same applied in the case of fabric used in making oil skins.

Dr. Ingle in reply said that he had had no experience of the catalytic action of cobalt in converting partially oxidised oil into linoxyn without the action of air, similar to the results recorded with oils charged with lead and manganese. He referred to a paper published by Mr. Mackey and himself in which it had been shown that as an oxygen carrier cobalt was the most active element known (this J., 1917, 316). He had observed that a cobalt oil film was more like a lead oil film and did not shrivel so much as a manganese film. It was difficult to say why this should be so. The Chairman's remarks on the "perishing" of rubber containing manganese and copper were interesting. Mr. Mackey and himself had not found copper to be an active drier on olive or linseed oil: perhaps in the metallic state it might injure the rubber by the removal of some of its sulphur of vulcanisation. In the manufacture of "oil skins" manganese was rarely used.

Mr. Woodmansey, in reply to Mr. Craven, stated that with our present knowledge it was impossible to define the point in the boiling, if there was one, beyond which superoxidation was entirely precluded.

Communications.

THE DECOMPOSITION OF NITROUS ACID.

BY JOSEPH KNOX, D.SC., AND DOUGLAS M. REID.

Practically no data on the rate of decomposition of nitrous acid, and the factors which influence it, are available. Rây, Dey, and Ghosh (Chem. Soc. Trans., 1917, **111**, 413; this J., 1917, 1175) studied the velocity of decomposition of nitrous acid in dilute solution and found that the reaction was monomolecular and that the rate of decomposition increased with temperature. They give, however, no details of their method. Preliminary experiments in this laboratory had shown that the rate of decomposition of nitrous acid varied enormously with the conditions, *e.g.*, with the surface exposed; with the presence or absence of excess of air; with temperature, and with agitation of the solution. The results of Rây, Dey, and Ghosh were obtained presumably in absence of excess of air, with small surface exposed to air, and without shaking. These conditions, although interesting from the theoretical point of view, do not approximate even remotely to the conditions obtaining in absorption towers. The following investigation was therefore undertaken to determine the influence of various factors on the decomposition of nitrous acid.

Influence of surface and shaking.

Equal volumes of *M*/10 sodium nitrite and *N*/10 nitric acid were mixed, giving an initial concentration of *M*/20 nitrous acid. The rate of decomposition of the nitrous acid varied according to the conditions, as the following figures show. These figures are reproduced graphically in Fig. 1. The nitrous acid was determined by withdrawing a definite volume with a pipette, running it into excess of acidified *N*/10 potassium permanganate at 40° C., warming to 80°, reducing the permanganate with a slight excess of *N*/10 oxalic acid, and titrating back with *N*/10 permanganate.

(1) 50 c.c. *M*/10 $NaNO_2$+50 c.c. *N*/10 HNO_3 in a narrow stoppered 110 c.c. bottle (*i.e.* very little air and small surface exposed). Allowed to stand without shaking at about 16° C. (Curve C, Fig. 1.). Initial conc. of HNO_2=0·05*M*.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·05*M*	—
5	0·049	2·0
20	0·0484	3·2
60	0·0471	5·8
120	0·0457	8·6

(2) 20 c.c. *M*/10 $NaNO_2$+20 c.c. *N*/10 HNO_3 in stoppered Winchester (*i.e.* large surface exposed and excess of air present). Let stand without shaking at 18° C. (Curve A, Fig. 1). Initial conc. of HNO_2=0·05*M*.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·05*M*	—
5	0·046	8
20	0·040	20
60	0·025	50
120	0·016	68

(3) 25 c.c. *M*/10 $NaNO_2$+25 c.c. *N*/10 HNO_3 shaken in stoppered Winchester (*i.e.* large surface, agitation, and excess of air present). (Curve B, Fig. 1.) Initial conc. of HNO_2=0·05*M*. T=16° C.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·05*M*	—
5	0·0275	45
20	0·0105	79
60	0·00422	91·5
120	0·00201	96

The slow decomposition of nitrous acid in the first case (very little air, small surface, and no shaking) is probably due to supersaturation of the liquid with nitric oxide formed in the reversible reaction, $3HNO_2 \rightleftarrows HNO_3+2NO+H_2O$. On pipetting out the liquid in this case, bubbles of gas were liberated, which made the measurements inaccurate. Such a supersaturated solution of nitric oxide is equivalent to a higher partial pressure of nitric oxide in the gaseous phase, which shifts the equilibrium in favour of nitrous acid. Some of the dissolved nitric oxide is also probably oxidised by permanganate, and this increases the apparent concentration of nitrous acid. For the rapid decomposition of nitrous acid agitation of the liquid to prevent supersaturation with nitric oxide is essential. The removal of the nitric oxide produced, either by oxidation to peroxide by excess of air, as in (3), or otherwise, also promotes the decomposition, as is evident from the equation. The effect of the removal of the nitric oxide by a current of air or of carbon dioxide blown through the liquid is seen in the following experiments, which may be compared with experiments (1) and (3) above.

Effect of shaking and surface on decomposition of M/20 nitrous acid.

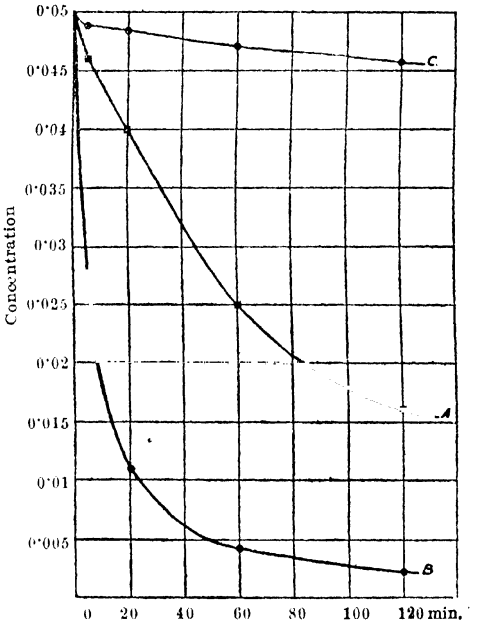


Fig. 1.

EXPERIMENT 2.

A. Not shaken but with large surface (40 c.c. in Winchester).

EXPERIMENT 3.

B. Shaken in Winchester 50 c.c.

EXPERIMENT 1.

C. Not shaken (100 c.c. in 110 c.c. bottle).

(4) 25 c.c. *M*/10 $NaNO_2$+25 c.c. *N*/10 HNO_3 in narrow 100 c.c. bottle. Current of air bubbled through the liquid. T=18° C.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·0500*M*	—
5	0·0341	31·8
20	0·0134	73·2
60	0·0046	99·1
120	0·0017	99·7

(5) 25 c.c. $M/10$ $NaNO_2$+25 c.c. $N/10$ HNO_3 in narrow 100 c.c. bottle. Current of CO_2 bubbled through the liquid. T=18° C.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·0500N	—
5	0·043	14
20	0·029	42
60	0·0126	74·8
120	0·0053	89·4

Influence of concentration of nitrous acid.

The velocity of decomposition of nitrous acid is much greater with high concentrations of nitrous acid than with low concentrations, as may be seen by comparing the percentages decomposed in 5 mins. and in 20 mins., starting with $M/1$ and $M/2$ nitrous acid, with the corresponding figures for $M/20$ nitrous acid (experiment (3)).

(6) 25 c.c. 2 M $NaNO_2$+25 c.c. 2 N HNO_3. Shaken in Winchester. T=18° C.

Time (mins.)	Conc. HNO_2	% decomposed
0	1·00M	—
5	0·108	89·2
20	0·037	96·3
60	0·024	97·6
120	0·014	98·6

(7) 25 c.c. $M/1$ $NaNO_2$+ 25 c.c. $N/1$ HNO_3. Shaken in Winchester with excess of air. T=17°–18° C.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·500M	—
5	0·087	82·6
20	0·0203	96
60	0·0065	98·7
120	0·0036	99·3

Influence of excess of air.

The series of reactions which take place on shaking the solution of nitrous acid with excess of air is complex, involving the decomposition of nitrous acid according to the equation

$$3HNO_2 = HNO_3 + 2NO + H_2O,$$

the oxidation of the nitric oxide to peroxide, the absorption of the $NO-NO_2$ mixture as nitrous acid, and the subsequent decomposition of this nitrous acid according to the same series of reactions. Yet the effect of the excess of air in removing the nitric oxide and allowing the decomposition of the nitrous acid to proceed more rapidly is distinctly evident from the following experiments.

(8) 10 c.c. 2 M $NaNO_2$+10 c.c. 2 N HNO_3 shaken in Winchester. Initial conc. of HNO_2, 1·00 M. Conc. after 140 mins., 0·00204 M.

(9) 25 c.c. 2 M $NaNO_2$+25 c.c. 2 N HNO_3 shaken in Winchester. Initial conc. of HNO_2, 1·00 M. Conc. after 140 mins., 0·0207 M.

(10) 10 c.c. 2 M $NaNO_2$+10 c.c. 2 N HNO_3 shaken in 3½-litre bottle. Initial conc. of HNO_2, 1·00 M. Conc. after 140 mins., 0·00204 M.

In (8) and (10) about 1·2 litres of air is necessary for complete oxidation of the nitrous acid to nitric acid, whilst about 2·5 and 3·5 litres respectively was present. In (9) about 3 litres of air is necessary for complete oxidation, whilst only about 2·5 litres was available. In the same time the decomposition of the nitrous acid in (8) and (10) has gone much further than in (9).

Influence of temperature.

The effect of increase of temperature in accelerating the decomposition of nitrous acid is seen in the following series of experiments. In each experiment 25 c.c. of $M/10$ sodium nitrite and 25 c.c. of $N/10$ nitric acid were shaken in a Winchester. In (11) the temperature was approximately 0° C., in (3) 16° C., and in (12) approximately 50° C.

No. of expt.	(11) (0° C.)		(3) (16° C.)		(12) (50° C.)	
Time (mins.)	Conc. HNO_2	% decomposed	Conc. HNO_2	% decomposed	Conc. HNO_2	% decomposed
0	0·05	—	0·05	—	0·05	—
5	0·0331	33·8	0·0275	45	0·0135	73
20	0·0183	63·4	0·0105	79	0·0051	89·8
60	0·0083	83·4	0·00422	91·5	0·0026	94·8
120	0·0033	93·4	0·00201	96	0·0010	98

The influence of temperature on the decomposition of nitrous acid in absence of excess of air, with small surface exposed and without shaking, is evident from a comparison of the results of experiments (1) and (13).

(1) 50 c.c. $M/10$ $NaNO_2$+50 c.c. $N/10$ HNO_3 in narrow 110 c.c. bottle at 16° C.

(13) 25 c.c. $M/10$ $NaNO_2$+25 c.c. $N/10$ HNO_3 in narrow 110 c.c. bottle at approximately 50° C.

Owing to the evolution of bubbles of nitric oxide, the results, especially at 50° C., are not very accurate.

No. of expt.	(1) (16° C.)		(13) (50° C.)	
Time (mins.)	Conc. HNO_2	% decomposed	Conc. HNO_2	% decomposed
0	0·05	—	0·05	—
5	0·049	2	0·0455	9
20	0·0184	3·2	0·0156	8·8
60	0·0171	5·8	0·0297	40·6
120	0·0457	8·6	0·0156	68·8

The results of these experiments on the influence of temperature, (11), (3), (12), (13), are shown graphically in Fig. 2.

Effect of temperature on decomposition of nitrous acid. 50 c.c. of M/20 nitrous acid shaken in Winchester.

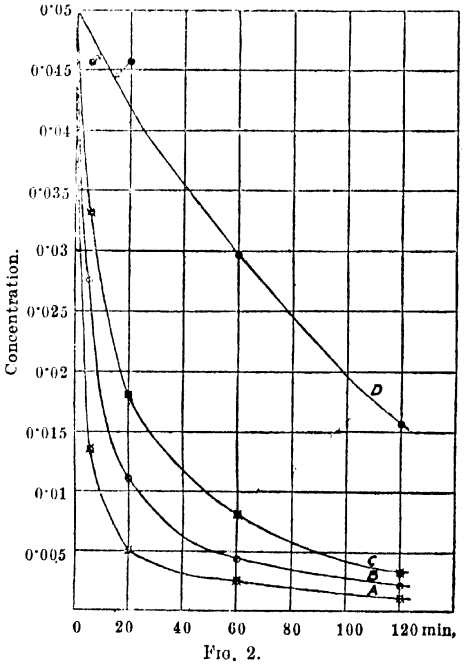


FIG. 2.

Curve A, Experiment 12 (50° C.).
" B, " 3 (16° C.).
" C, " 11 (0° C.).
" D, " 13 (50° C.)

The influence of temperature was also investigated as follows. A rapid current of air was drawn through a solution of nitrous acid in a small wash-bottle immersed in a thermostat at a definite temperature. The nitrous acid solution contained a slight excess of free nitric acid, and was prepared by mixing equal volumes of standard sodium nitrite solution and standard nitric acid. The air was washed, before entering the nitrous acid solution, by being bubbled through a wash-bottle, also immersed in the thermostat, containing a solution of sodium chloride of the same concentration as the sodium nitrate produced by mixing the sodium nitrite and nitric acid. The nitrite and acid solutions were brought to the appropriate temperature before mixing. The air-current was constant through each series, but was not exactly the same in the different series. It was approximately 2·5—3 litres per minute.

The results were as follows:—

(14) In each case 10 c.c. 5·02 *M* $NaNO_2$ was mixed with 10 c.c. 6*N* HNO_3, giving 2·51 *M* HNO_2+0·49*N* (8%) HNO_3. The air-current was drawn through the solution for 5 mins.

Temp. ° C.	Initial conc. of HNO_2	Conc. of HNO_2 after 5 mins.	% decomposed
5	2·51*M*	0·268*M*	89
20	2·51*M*	0·102*M*	96
30	2·51*M*	0·056*M*	97·8
40	2·51*M*	0·025*M*	99
50	2·51*M*	0·016*M*	99·4

(15) In each case 10 c.c. 0·102 *M* $NaNO_2$ was mixed with 10 c.c. *N*/1 HNO_3, giving 0·051 *M* HNO_2+0·45 *N* (2·8%) HNO_3. The air-current was drawn through the solution for 5 minutes.

Temp. ° C.	Initial conc. of HNO_2	Conc. of HNO_2 after 5 mins.	% decomposed
5	0·051*M*	0·0036*M*	93
20	0·051*M*	0·0026*M*	95
30	0·051*M*	0·0019*M*	96·2
40	0·051*M*	0·0012*M*	97·7
50	0·051*M*	0·00075*M*	98·5

The results of the series of experiments (14) and (15) are shown graphically in Fig. 3.

Influence of concentration of nitric acid.

The effect of the presence of free nitric acid is to increase considerably the initial rate of decomposition of the nitrous acid. As decomposition proceeds, however, the velocity falls off and finally becomes less than that of nitrous acid in the absence of free nitric acid. This course of the decomposition curve is evidently connected with the much slower absorption of the oxides of nitrogen in presence of free nitric acid. In all cases the brown fume persisted much longer than in absence of free acid, and the greater the concentration of the free acid the more slowly did it disappear. In the case of the strongest acid at ordinary temperature (7·25 *N* or 37%) and with 5 *N* (27%) acid at 50° C. there was still a distinct brown fume in the bottle after 2 hours.

The following are the experimental results.

(16) 25 c.c. *M*/10 $NaNO_2$+25 c.c. 5 *N* HNO_3 was mixed, giving *M*/20 HNO_2+2·45 *N* (14·2%) HNO_3. Shaken in Winchester at 17°—18° C.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·050*M*	—
5	0·0188	62·4
20	0·00815	83·7
60	0·0036	92·8
120	0·0028	94·4

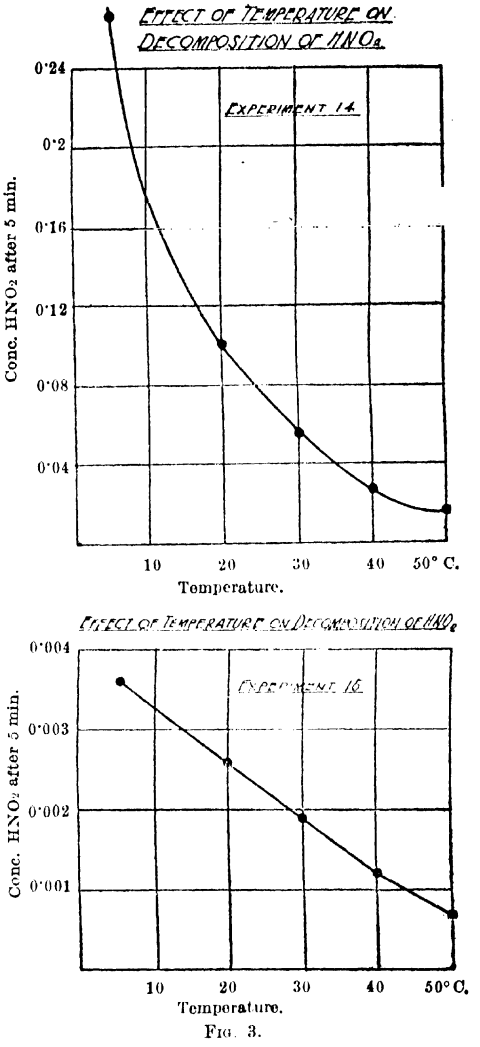


FIG. 3.

(17) 25 c.c. *M*/10 $NaNO_2$+25 c.c. 10·1 *N* HNO_3 mixed, giving *M*/20 HNO_2+5*N* (27%) HNO_3. Shaken in Winchester at 16° C.

Time (mins.)	Conc. HNO_2	% decomposed.
0	0·050*M*	—
5	0·016	68
20	0·0073	85·4
60	0·0049	90·2
120	0·0030	94

(18) 25 c.c. *M*/10 $NaNO_2$+25 c.c. 14·6 *N* HNO_3 mixed, giving *M*/20 HNO_2+7·25 *N* (37·1%) HNO_3. Shaken in Winchester at 17°—18° C.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·050*M*	—
5	0·0127	74·6
20	0·0070	86
60	0·0045	91
120	0·0036	92·8

The results of experiments (3), (16), (17), and (18) are shown graphically in Fig. 4.

If experiments (16), (17), and (18) are compared with (3), the initial acceleration and subsequent falling off of the velocity of decomposition in presence of free nitric acid is evident. This is

probably best seen by comparing the percentages of the amount present at the beginning of each time-interval decomposed in each time-interval in the 4 cases.

No. of expt.	(3) 0% HNO_3	(16) 14·2% HNO_3	(17) 27% HNO_3	(18) 37·1% HNO_3
Time interval	% decomposed	% decomposed	% decomposed	% decomposed
0–5 mins.	45	62·4	68	74·6
5–20 ,,	61·8	56·6	54·4	45
20–60 ,,	59·8	55·8	33	32·8
60–120 ,,	52·3	22·2	38·8	20

Similar results are obtained with higher initial concentrations of nitrous acid and at higher temperatures.

Decomposition of M/20 nitrous acid in presence of nitric acid. All shaken in Winchester.

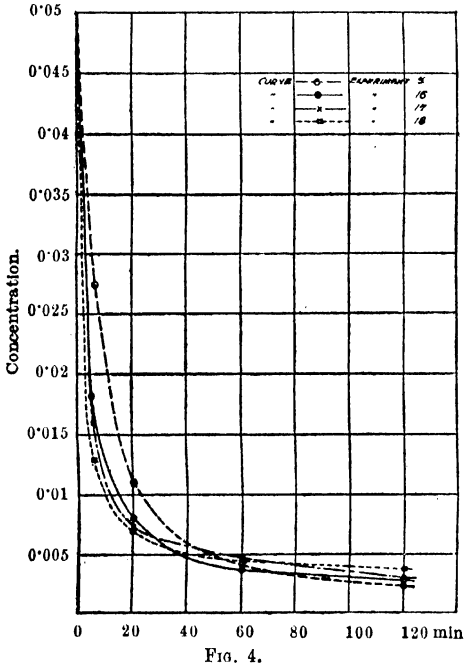


FIG. 4.

(19) 25 c.c. 2 *M* $NaNO_2$ + 25 c.c. 12 *M* HNO_3, giving *M*/1 HNO_2 + 5 *N* HNO_3 (27%). T=18° C. Shaken in Winchester.

Time (mins.)	Conc. HNO_2	% decomposed
0	1·00*M*	—
5	0·055	94·5
20	0·0175	98·2
60	0·0097	99
120	0·0067	99·3

This should be compared with experiment (6). In the following table the percentages of the amounts present at the beginning of each time-interval, decomposed during the time-interval, are compared.

No. of expt.	(6) 0% HNO_3	(19) 27% HNO_3
Time-interval	% decomposed	% decomposed
0–5	89·2	94·5
5–20	65·7	68·1
20–60	35·1 (?)	44·5
60–120	41·7	30·9

(20) 25 c.c. *M*/1 $NaNO_2$ + 25 c.c. 11 *N* HNO_3, giving *M*/2 HNO_2 + 5 *N* (27%) HNO_3. Temp.= 17° C. Shaken in Winchester.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·50*M*	—
5	0·0257	94·8
20	0·010	98
60	0·00475	99
120	0·0047	99

This should be compared with experiment (7).

No. of expt.	(7) 0% HNO_3	(20) 27% HNO_3
Time-interval	% decomposed	% decomposed
0–5	82·6	94·8
5–20	76·9	61·1
20–60	68	52·5
60–120	44·6	—

(21) 25 c.c. *M*/10 $NaNO_2$ + 25 c.c. 10·1 *N* HNO_3, giving *M*/20 HNO_2 + 5 *N* (27%) HNO_3. T=approx. 50° C. Shaken in Winchester.

Time (mins.)	Conc. HNO_2	% decomposed
0	0·05*M*	—
5	0·0119	76·2
20	0·0061	87·8
60	0·0035	93
120	0·0027	94·6

This should be compared with experiment (12).

No. of expt.	(12) 0% HNO_3	(21) 27% HNO_3
Time-interval	% decomposed	% decomposed
0–5	73	76·2
5–20	62·2	48·7
20–60	49	42·6
60–120	61·5	22·8

In comparing the velocities of decomposition of nitrous acid at different temperatures and with different concentrations of free nitric acid, it should be remembered that the rate of oxidation of nitric oxide to peroxide varies with temperature, and that the rate of absorption of oxides of nitrogen varies with temperature and concentration of free nitric acid.

(22) The influence of concentration of free nitric acid on the decomposition of nitrous acid was also investigated by a method similar to that employed in (14) and (15) for the influence of temperature.

In each experiment 10 c.c. 5·02 *M* sodium nitrite was mixed with 10 c.c. of nitric acid, the concentration of which was varied so as to give different concentrations of free nitric acid in the solution. The temperature was 30° C. throughout and the air current, which was kept as constant as possible throughout the series, was passed for 5 minutes in each case. The following are the results.

Conc. free HNO_3	Initial conc. HNO_2	Conc. HNO_2 after 5 mins. of air current
0·25 *N* (1·6%)	2·51 *M*	0·08 *M*
1·74 *N* (10·4%)	2·51 *M*	0·057 *M*
3·6 *N* (20·2%)	2·51 *M*	0·036 *M*
4·99 *N* (26·7%)	2·51 *M*	0·020 *M*

These results when plotted in the form of a curve give almost a straight-line graph.

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THE EXAMINATION OF ACETONE OILS.

BY WILLIAM JACOB JONES.

Introductory.

In addition to acetone and hydrocarbons, the following substances have been identified in acetone oils:—Methyl ethyl ketone (b.pt. 79·6° C.), methyl propyl ketone (101·7°), methyl isopropyl ketone (94°), methyl *n*-butyl ketone (127·4°), cyclopentanone (130°), and acetaldehyde (20·8°). All these substances, with the exception of the hydrocarbons, are soluble in sodium bisulphite solutions

(P. and A. Buisine, Comptes rend., 1898, **126**, 351; *ibid.*, 1899, **128**, 561, 885).

Although the matter is one of importance to those in charge of operations in which large quantities of these oils are produced, no method whereby the content of the various ketones may be determined has hitherto been proposed. The methods described in the present communication are an attempt to fill this gap. The accuracy attainable, which is not great, will be seen by an examination of the examples which follow.

The method of procedure differs according to whether the oil consists of the first runnings obtained in the rectification of crude acetone, or of acetone oils which boil at a higher temperature than the boiling point of acetone.

The examination of the first runnings obtained in the rectification of crude acetone.

Dehydration. About 150 grms. of the oil is dried over anhydrous sodium sulphate.

Specific gravity. The specific gravities of the oils as received, s_0, and of the dried oil, s, are determined at the prevailing atmospheric temperature by means of a float hydrometer.

Dissolved water. Some of the oil as received is placed in a graduated cylindrical glass vessel. The volume, V c.c., is read off, about 2V c.c. of benzene or of toluene is added, and the vessel is stoppered. The whole is shaken by hand for 5 minutes and is then allowed to settle. When the aqueous layer, if any, has separated out, its volume, v c.c., is read off. The percentage by weight of dissolved water in the oil is given by the expression $100v/V.s_0$.

Reducing substances (acetaldehyde). A pipette is calibrated to deliver known volumes of a good representative oil. A known volume, u c.c. (about 1 c.c.) of the oil under examination is measured out by means of the pipette into a stout bottle. 20 c.c. of concentrated ammonia solution and 100 c.c. of $N/10$ silver nitrate solution are added, and the bottle is immersed for 8 hours in a bath of boiling water. After having been allowed to cool, the contents of the bottle are diluted to 500 c.c. with water, and the reduced silver is filtered off. Should the filtrate be coloured, it is treated for an hour with animal charcoal, and is then again filtered. The clear filtrate is acidified with nitric acid, and is titrated in presence of ferric alum indicator with standard ammonium thiocyanate solution. If the total amount of $N/10$ silver solution reduced is represented by t c.c., the percentage by weight of acetaldehyde in the oil is given by the expression $0{\cdot}22t/u.s_0$.

Acetone. Some of the dried oil is placed in a graduated cylindrical glass vessel. The volume, U c.c., is read off, about 5U c.c. of water is added, and the vessel is stoppered. Let U′ denote the volume of the residual oil in c.c. Then the percentage by weight of acetone in the original oil is given by the expression:

$$\frac{79(V.s_0-v)(U-U')}{V.U.\ s.s_0}-\frac{0{\cdot}22t}{u.s_0}$$

Substances other than water, acetaldehyde, and acetone. The percentage by weight of these substances is given by the deficit from 100 of the sum of the percentages of water, of acetaldehyde, and of acetone.

The examination of acetone oils which boil at a higher temperature than the boiling point of acetone.

The oil is dehydrated, and is examined for specific gravity and for content of water as already described.

Fractional distillation. About 100 grms. of the dried oil is weighed in a tared 150 c.c. round flask, and a piece of porous pot is introduced. The flask is fitted with an efficient fractionating column of a form which retains the minimum of adherent liquid. The column is provided with a thermometer and with a water condenser. An adapter leads the condensate from the latter into a graduated cylindrical glass vessel provided with a stopper. The distillation is conducted regularly and the following fractions are collected in separate graduated vessels:—up to 68° C., 68° to 90° C., and, if necessary, 90° to 140° C. At the end of the fractionation the round flask is weighed and the weight of the residue, R grms., above 140° C. is determined.

Estimation of methyl ketones in each fraction. Strong sodium bisulphite solution of sp. gr. 1·2—1·3 is freshly prepared, either by dissolving sodium metabisulphite in water, or by passing sulphur dioxide to saturation into sodium carbonate crystals covered with a layer of water. Let the volumes of the respective fractions be V_{68}, V_{90}, and V_{140} c.c. To each receiver is added a volume of the bisulphite solution equal to three times that of the fraction. A stream of cold water is directed from a tap against the outside of the first receiver, the stopper is inserted, and the contents are gently shaken. Owing to the development of heat of reaction, this shaking requires careful regulation, in order to prevent loss of material by evaporation. When the reaction has moderated the contents of the receiver are vigorously shaken until there is no further change in the relative volumes. The receiver is thereupon allowed to stand until separation is complete. Each receiver is in turn treated in this way. Let U_{68}, U_{90}, and U_{140} denote the respective volumes of the supernatant oils at the end.

We shall assume that the density of the methyl ketone in each fraction is equal to the density of that fraction. We then have the following:—

Percentage by weight of acetone in the original oil $=\dfrac{80.(V.s_0-v)(V_{68}-U_{68})}{V.s_0.(0{\cdot}80V_{68}+0{\cdot}80V_{90}+0{\cdot}81V_{140}+R)}$.

Percentage by weight of methyl ethyl ketone in the original oil $=\dfrac{80(V.s_0-v).(V_{90}-U_{90})}{V.s_0.(0{\cdot}80V_{68}+0{\cdot}80V_{90}+0{\cdot}81V_{140}+R)}$

Percentage of ketones which boil at a higher temperature than methyl ethyl ketone and which form bisulphite compounds, by weight, in the oil $=\dfrac{81(V.s_0-v)(V_{140}-U_{140})}{V.s_0.(0{\cdot}80V_{68}+0{\cdot}80V_{90}+0{\cdot}81V_{140}+R)}$

Fractions of acetone oils distilling above 140° C. do not contain appreciable quantities of ketones reactive with sodium bisulphite. It appears probable that the reactive substances, which are still present in small amount in these higher fractions, are low-boiling aldehydes and ketones which are the pyrogenetic decomposition products of aldols and of similar condensed substances.

The resolution of acetone oils into methyl ketones and substances which are non-reactive with bisulphite solutions.

For the purpose of establishing the correctness of the present methods it was necessary to resolve samples of acetone oils, and to isolate the various ketones and the various non-reactive substances.

Resolution of the first runnings obtained in the rectification of crude acetone. **A sample of the runnings was washed first with water and then with saturated sodium bisulphite solution. The residual, non-reactive oil was separated and was finally washed with water.**

Resolution of an acetone oil obtained from the tailings in the rectification of crude acetone. A large sample of the oil was fractionally distilled, and each fraction was exhaustively treated with saturated sodium bisulphite solution. The residual, non-reactive oils were dried, and then twice fractionated. The crystalline separations from the bisulphite liquors were washed with fresh bisulphite solution and with ether, and then dried in the air. The methyl ketones were regenerated, and were fractionally distilled. In this manner considerable amounts of methyl ethyl ketone and of methyl propyl ketones, and small amounts of higher methyl ketones were obtained.

The examination of acetone oils of known composition.

By suitably blending various methyl ketones with the non-reactive substances of corresponding boiling points, acetone oils of known composition were now reproduced. These oils were examined by the methods previously described. The results obtained were as follows.

1. *Reproduction of the first runnings obtained in the rectification of crude acetone.*

Components	Composition, % by weight Actual	Found
Water	0	0
Acetaldehyde	12	11
Acetone	43	44
Non-reactive substances	45	45

2. *Reproduction of a light acetone oil.*

Components	Composition, % by weight Actual	Found
Water	0	0
Acetone	32	33
Methyl ethyl ketone	47	50
Methyl propyl ketones	21	17

3. *Reproduction of a heavy acetone oil.*

Components	Composition, % by weight Actual	Found
Water	1	1
Acetone	5	4
Non-reactive substances boiling below 68°	0	0
Methyl ethyl ketone	48	48
Non-reactive substances boiling between 68° and 90°	3	7
Methyl propyl ketones, methyl butyl ketones, and non-reactive substances boiling between 90° and 140°	38	37
Non-reactive substances boiling above 140°	5	3

4. *Reproduction of the oil which is thrown out of solution when the direct product of dry distillation of calcium pyrolignite is diluted with water.*

Components	Composition, % by weight Actual	Found
Water	0	0
Acetone	13	13
Non-reactive substances boiling below 68°	0	2
Methyl ethyl ketone	21	22
Non-reactive substances boiling between 68° and 90°	4	2
Methyl propyl ketones	2	3
Non-reactive substances boiling between 90° and 140°	16	13
Non-reactive substances boiling between 140° and 165°	13	
Non-reactive substances boiling between 165° and 200°	6	45
Non-reactive substances boiling above 200°	25	

The estimation of water in acetone oils.

In order to test the method described in the preceding, mixtures of ketones and water of known composition were analysed. The results obtained were as follows.

Ketone in the mixture	Hydrocarbon used to displace the water	Content of water % by weight Actual	Found
Acetone	Toluene	15	15
Acetone	Benzene	17	18
Acetone	Benzene	5	5
Methyl ethyl ketone	Toluene	10	10

The completeness of separation of the methyl ketones in the fractional distillation.

Although the amounts of the various ketones in their corresponding distillates are proportional to their amounts in the original oil, it is not to be inferred that, therefore, separation is complete. For instance, some of the methyl ethyl ketone passes over below 68°, whilst some of the acetone remains behind above 68° C. With efficient fractionation these amounts are small, and they compensate each other. In order to see how far error was introduced on this account in absence of the higher ketone to effect this compensation, the following experiment was undertaken. A mixture containing 65% of acetone and 35% of non-reactive substances boiling throughout the temperature range 68° to 90° C. was fractionated until the temperature of the vapour reached 68°. The distillate represented 61% of acetone, whilst the remaining 4%, which was found in the residue, would have been reckoned as methyl ethyl ketone. It is to be remembered that this particular mixture is highly artificial. No natural acetone oil boiling within these temperature limits contains such a high percentage of substances other than methyl ketones. Further, all natural acetone oils boiling within these limits contain methyl ethyl ketone.

The completeness of extraction of methyl ketones by sodium bisulphite solutions.

In order to test the completeness of the extraction of the methyl ketones from the accompanying oils under the conditions described in the preceding, various mixtures of known composition containing acetone, methyl ethyl ketone, and non-reactive substances were prepared. Each of these mixtures was vigorously shaken by hand for 5 minutes with three times its volume of fresh sodium bisulphite solutions of sp. gr. varying in different experiments from 1·24 to 1·30. In each case the volume of the residual oil was equal to that of the non-reactive substance contained in the mixture.

In some cases, when using too concentrated solutions of bisulphite, trouble is experienced through the separation of crystals of the ketone-sodium bisulphite compound. In such cases, either the separated mass is redissolved by the cautious addition of water, or the determination is repeated *ab initio*, and rather more dilute bisulphite solution is used.

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THE SETTING OF MIXTURES OF SUPERPHOSPHATE AND AMMONIUM SULPHATE.

BY F. SCOTT FOWWEATHER, M.SC., A.I.C.

Owing to the scarcity of organic nitrogenous fertilisers and the Government control of the price of ammonium sulphate, the latter has for some time been the cheapest and most easily obtainable form

of nitrogen for use in artificial compound fertilisers. Many of these consist almost entirely of a mixture of superphosphate with ammonium sulphate, with or without the addition of some form of potash. The presence of comparatively large quantities of ammonium sulphate in admixture with superphosphate has had, however, one troublesome consequence which all manufacturers with whom the author has come into contact have experienced, namely that "setting" has occurred, *i.e.* the mixture has set into hard lumps which the farmer has had some difficulty in handling. Frequently the setting does not take place very rapidly, so that a compound fertiliser which appears to be in quite a satisfactory condition when placed in bags at the maker's works, is found sometimes, after storage or transit, to have set into hard lumps which have to be broken and crushed by the farmer before he is able to use the fertiliser. In some cases the setting has been so considerable that the fertiliser could not be removed from the bags in the ordinary way, it having been necessary to cut away the bags.

When a manufacturer has a great deal of space at his disposal and is able to manufacture some time in advance of the demand, he can largely overcome the difficulty of "setting" in bags by storing the fertiliser for some time after mixing, and letting it set in bulk before leaving his works. When "setting" or "maturing" is complete, the mixture is ground before being put into bags and little or no further setting takes place.

Storage in this way for the period necessary for complete setting (which may be up to two or three months) is not always practicable, and the following experiments have been carried out with a view to discover the conditions that influence the setting, so that if necessary the setting can be accelerated so as to be completed in a reasonable time before leaving the maker's works, or to be retarded so that the fertiliser may reach the farmer before setting has occurred to any considerable extent. For the present no theoretical interpretations are attempted of the conclusions arrived at, the work having been undertaken originally with the object of giving practical suggestions to manufacturers.

In the experiments mentioned below, mixtures of superphosphate (about 30% soluble phosphate) and ammonium sulphate, sometimes with other material added, as described, were placed under a heavy weight to bring the particles into intimate contact and imitate somewhat the conditions obtaining when such mixtures are stored in a large heap. The mixtures were examined after various periods. They were made in such proportions as would give a fertiliser yielding 3·5%–3·6% of ammonia, these proportions being then in use on the manufacturing scale in a works under the author's notice. The particular proportions in the mixtures used in the experiments do not greatly affect the conclusions to be drawn, as this phenomenon of setting is general in mixtures which are composed almost entirely of superphosphate and ammonium sulphate, though in previous experiments it was found that it occurred to the greatest extent in mixtures containing ammonium sulphate equivalent to 5–6% of ammonia.

Experiment A.—Mixtures were made up containing 100 grms. of superphosphate having 6·53% of free acid (calculated as P_2O_5) with ammonium sulphate containing 1·07% of moisture as follows: (1) 16·8 grms. of ammonium sulphate; (2) 17·7 grms. to which had first been added a further 1% of water; (3) 18·5 grms. to which 2% of water had been added; (4) 19·3 grms. to which 3% of water had been added. The weights of ammonium sulphate were such that each mixture should contain the same percentage of ammonia.

After remaining under the weight for seven days, the setting was not great, and the mixtures were moist, whereas when setting has occurred to any very great extent the mixtures were much lighter in colour, dry, and gritty. Nos. 3 and 4 had set more than Nos. 1 and 2, each pair being of about equal hardness. The setting of Nos. 3 and 4 was not markedly greater than that of Nos. 1 and 2.

The mixtures were then broken up, re-mixed, and placed under the weight for a further five days. Some further setting took place and apparently to about the same extent in each.

Experiment B.—The mixtures were the same as for experiment A, except that each contained 5·6 grms. of ground Gafsa phosphate in addition. After the first period of seven days, the setting was found to be greater than in experiment A and the mixtures were much drier. Nos. 3 and 4 were much harder than Nos. 1 and 2, and the increase in hardness from No. 2 to No. 3 was very marked. The condition of Nos. 3 and 4 appeared to be very satisfactory.

After re-mixing and placing under the weight for a further five days, some further setting took place, which was mostly, though not entirely, due to pressure. There was now less setting in Nos. 3 and 4 than in Nos. 1 and 2, indicating that the setting of Nos. 3 and 4 was more nearly completed at the end of the first period than was that of Nos. 1 and 2.

Since the mixtures of experiment B showed setting to a greater extent than those of A in the same period, it would appear that the presence of raw phosphate and hence reduction of free acid in mixtures B, is largely responsible for the increased rapidity of setting.

It is to be noted also that in mixtures B the rapidity of setting was much greater in Nos. 3 and 4 than in Nos. 1 and 2. Now the former pair contained more moisture than the latter. Hence it follows that the presence of moisture is also responsible for increased rapidity of setting, the setting of Nos. 3 and 4 being fairly complete after seven days while that of Nos. 1 and 2 extended fairly uniformly over twelve days. This effect of moisture seemed to be indicated in the results of experiment A, but only imperfectly. Thus while the presence of moisture tends to increase the rapidity of setting, its effect is much more marked when accompanied by reduction of free acid.

If it is desired to hasten the completion of setting of such mixtures of superphosphate and ammonium sulphate it is apparent that a sulphate containing 3—4% of moisture is preferable to a dry sulphate.

The effect of reduction of free acid was again clearly shown in the following experiment:

Experiment C.—In this case 100 grms. of superphosphate containing 5·23% of free acid was used, with 16·8 grms. of the ammonium sulphate used previously. Varying quantities of ground Gafsa were used as follows:—(1) 4 grms.; (2) 6 grms.; (3) 8 grms. (4) 10 grms. On examining these mixtures after being under the weight for only four days, it was found that their setting was appreciably greater than that which had occurred in seven days with the mixtures in which a superphosphate containing more free acid was used. The most direct comparison is between No. 2 of this experiment and No. 1 of experiment B, and there was no doubt whatever that the setting of No. 2 C was greater in four days than that of No. 1 B in seven days, again showing that reduction of free acid is conducive to setting.

Considering the mixtures of experiment C, the whiteness, dryness, and hardness are in order of the amount of raw phosphate present. The setting of Nos. 3 and 4 was very great.

After re-mixing and placing under the weight for a further eight days, the setting was again fairly considerable, that of No. 1 being most and of No. 4

least. There was a marked increase in dryness and suitability for spreading, in Nos. 2, 3, and 4 over No. 1.

After a further period of eighteen days under the weight, a little further setting had taken place in No. 1, still less in No. 2, and none in Nos. 3 and 4.

Experiment D.—The effect of reducing the free acid of the superphosphate by the presence of small amounts of ground limestone was studied. The mixtures were made up of 100 grms. of the superphosphate and 16·8 grms. of the ammonium sulphate (as used in experiment C) with (1) 2 grms., (2) 4 grms., (3) 6 grms., and (4) 8 grms. of ground limestone. After four days, the setting was not quite so great as in experiment C, but the dryness, light colour, and gritty feel of No. 4 were greater than in any of the C mixtures. The dryness etc. of the D mixtures was in the order of the amount of ground limestone present. As regards setting, No. 4 was much the hardest, and very distinctly harder than No. 3, which in its turn was slightly harder than Nos. 1 and 2, these latter being about equal.

After re-mixing and placing under the weight for a further eight days the hardness of No. 4 was much less than any of the others, being almost nil. The setting of Nos. 2 and 3 was not very great and less than that of No. 1, which was still slightly moist. The mixture No. 4 was very satisfactory and evidently the setting of such a mixture is very rapid.

Comparing experiments C and D, it would appear that the latter mixtures take less time for setting than the former, except in the case of No. 1 mixtures.

In the two following experiments the conclusions arrived at above were tested from the opposite direction, viz. by noting the effect of increasing the free acid in the mixtures. This also has the result of showing the effect on setting of the use of ammonium sulphate containing acid.

Experiment E.—Superphosphate (100 grms.) was mixed with ground Gafsa phosphate (5·6 grms.) and ammonium sulphate as follows: (1) 16·8 grms.; (2) 18·5 grms. of sulphate to which 2% of its weight of 50% sulphuric acid had been added previously; (3) 20·1 grms. of sulphate to which 4% of 50% sulphuric acid had been added. After six days, all were fairly moist, No. 3 being most so. All had set to a fairly considerable extent, No. 1 more than the others.

After re-mixing and placing under the weight for a further eighteen days all had set again to a considerable extent, No. 1 rather less than Nos. 2 and 3, which were about equal. All were now fairly dry, white, and gritty, No. 1 being driest, and it appeared as if the setting of this mixture was now almost completed.

This experiment shows fairly clearly that increase of free acid retards setting. This effect is more clearly brought out by the last experiment of the series.

Experiment F.—The mixtures were the same as for experiment E except that no raw phosphate was present. After six days little setting or drying, or whitening, had taken place in any of them. After an additional eighteen days, all were still moist and smooth and little whitening had taken place except in No. 1, where some setting had evidently occurred.

Conclusions.

The conclusions to be drawn from the results of these experiments are obvious, and have already been stated, namely that the rate of setting of mixtures of superphosphate and ammonium sulphate is increased by the reduction of free acid in the mixtures. The presence of moisture also tends to increase the rate of setting, but this effect is not very marked unless accompanied at the same time by reduction of free acid. No doubt the addition of a small amount of moisture alone to a mixture in which the superphosphate is already low in free acid, would have a marked effect, though this has not been tested experimentally. It is of course highly probable that other factors influence setting. Their effect has not been marked in these experiments since the only conditions which have been consistently varied are the amount of moisture and of free acid in the mixture, and the amount of substances necessary to bring about reduction of free acid, and the variation in these conditions (amount of moisture and free acid) in the different mixtures has probably been of such an extent as to mask the effect of other factors.

The author is very sensible of the incompleteness of the investigation, but the results are offered at this stage because they are quite definite, so far as they go, and it is hoped that they will therefore be of use to those concerned with the manufacture of compound fertilisers.

Some of the conclusions arrived at have already been tested on the large scale and have been fully borne out. Thus a compound fertiliser made from fairly fresh mineral superphosphate and ammonium sulphate to which a small amount of limestone was added, set very considerably when stored in a heap for a few days, and after re-grinding and putting into bags, no further trouble was experienced as regards setting.

It has of course long been known that setting can be prevented to a large extent by mechanical means, by preventing too intimate contact between the superphosphate and ammonium sulphate by the addition of neutral substances such as sand, powdered peat, sawdust, soot, etc., but this dilution of the fertiliser by such substances is not always practicable or desirable.

With regard to the question as to whether it is preferable to bring about the completion of setting before the fertiliser leaves the maker's works, to avoid any possibility of further trouble, or to attempt to prevent setting, the decision depends largely on the conditions obtaining in any particular works, such as storage space etc. The complete prevention of setting by the means outlined is difficult. A reduction of free acid always tends to take place as a superphosphate ages. Still it will be possible to retard setting to such an extent as to cause little trouble in the time which elapses between the manufacture of the fertiliser and its application to the soil, provided this time is not unreasonably long. There is to be taken into account, however, the effect of free acid on the bags containing fertiliser, and the relative conditions of a fertiliser in which setting is prevented, and one in which setting has been largely completed. A fertiliser which has not set is moist and sometimes sticky, whereas one which has set and has been ground again after setting is very dry and altogether in much better condition for use on the land. At present while prices of compound fertilisers are controlled and the demand is generally in excess of the supply, good condition has little monetary value. When control is entirely removed and the supply is abundant, condition will again become an important factor and will help to decide the advisability of preventing or completing setting.

62, Dale Street, Liverpool.

Liverpool Section.

Meeting held at the University on February 21st, 1919.

MR. A. T. SMITH IN THE CHAIR.

THE MODERN CONCEPTION OF EMULSIONS.

BY W. CLAYTON, M.SC.

An emulsion is an heterogeneous system in which a liquid is dispersed as droplets in some other liquid with which it is only partially or not at all miscible. Theoretically two types of emulsion become possible according to which liquid be dispersed as drops. The two phases are distinguished as the "disperse phase" and the "continuous medium," the former appearing as globules dispersed in the latter. The outstanding characteristic of such a system is the relatively large interfacial separating layer between the two phases, whereby surface phenomena become pronounced. It is well, therefore, to recapitulate a few of the more fundamental notions connected with the physical chemistry of surfaces, such as surface tension, drop number, adsorption, etc., since these factors are frequently mentioned in this paper.

The expression "interfacial separating layer" refers to a very attenuated layer due to the interpenetration of both phases. The depth of this layer is only a few millionths of a centimetre. For noticeable effects to come into play, the specific surface, *i.e.* surface/volume, requires to be increased to at least 10,000 times the original value. Limiting this discussion to a consideration of oil dispersed in water, it is found that there is an interfacial tension between the oil and the water, since the surface energy has increased, and hence the total surface of the oil phase tends to diminish. It has been demonstrated that if a third substance now be added, which will affect the value of this interfacial tension, concentration phenomena appear, *i.e.* the concentration of the added substance will be different in the main bulk of the continuous phase from what it is at the interfacial separating surface.

Willard Gibbs worked out the mathematical relationship involved, his simplest equation appearing in the form:—

$$U = -\frac{C}{RT}\cdot\frac{ds}{dC}$$

where U is excess concentration at the boundary surface in grms./cms., and C the concentration of solute in bulk of solution.

Since $\frac{ds}{dC}$ is the differential co-efficient of the function connecting surface tension and concentration, it follows that it is positive when the solute increases the surface tension, and negative when it decreases it. Consequently U is positive when the added substance lowers the surface tension. That is to say, the added substance will be adsorbed in the boundary surface between the oil particles and water, if by its adsorption the interfacial tension is reduced; this is a most important result and essential to the theory of emulsification in general.

Instead of Gibbs' formula a purely empirical relation, due to Freundlich, is sometimes employed in investigations on emulsions and adsorption. The formula has no theoretical basis and involves two constants which rather tends to its undue elasticity. It is:—

$$\frac{x}{m} = aC^{\frac{1}{n}}$$

where x is the amount of substance adsorbed, m the mass of adsorbent in grms., C the equilibrium concentration after adsorption is effected. a and n are constants, n being greater than unity. The equation is that of a general parabola and may be written in a simpler logarithmic form,

$$\log. x - \log. m = \frac{\log. C}{n} + \log. a.$$

This is the equation of a straight line, as may be seen by plotting log. x against log. C, the two variables.

It is very striking that at low concentrations the adsorbed quantities are relatively great and only increase slowly with rise in concentration. Adsorption is reversible, *i.e.* there is an equilibrium state which as a rule is very quickly attained. In most cases rise of temperature favours adsorption at liquid interfaces.

Attention must now be drawn to another point connected with surface tension and of much prominence in papers on emulsification, viz., the so-called "Drop number." When a drop of liquid hangs from a capillary tube, there exists a balance between the force due to the weight of the drop and the surface forces supporting that weight. Obviously if the surface tension were to be decreased, the weight of the drop must decrease, *i.e.* a smaller drop will result. In work on emulsions one deals with the numbers of drops obtained from a given liquid such as oil, when a definite volume is allowed to form drops in another liquid such as water. Donnan made use of this principle in showing that surface tension plays an important part in emulsification (Z. physikal. Chem., 1899, 31, 42).

Disturbing factors apart, it can be stated that the surface tension is inversely proportional to the "drop number," the number of drops obtained from a given volume under set conditions.

In dealing with emulsions and taking only the very simple case of pure oil and water, it is theoretically conceivable to prepare two sets of emulsions over a whole range of concentrations, one set to consist of oil dispersed in a continuous medium of water, the other set of emulsions to be water dispersed as drops in an oil medium. The first case of oil-in-water emulsions is familiar enough, but it is only quite recently that investigators, particularly American chemists, have seriously studied the preparation and properties of emulsions of water in oil, and even now no general theory of emulsification applicable to all cases has been formulated, though a mass of interesting data exists which throws much light on the question.

Oil emulsions may be made in several ways, the chief of which is agitation or beating up of the oil in water or aqueous solution. Owing to the large extension of surface area of the oil, a large amount of surface energy is produced. If this energy can be reduced the process of emulsification becomes much easier; such a reduction of surface energy may be brought about by using an aqueous solution of low surface tension, *e.g.* soap solutions or gelatin solutions. This third substance is then termed an emulsifier or an emulsifying agent.

The oil becomes dispersed as drops of small diameter, the smallness of the drops depending on the efficiency of the emulsification apparatus employed. Other things being equal, the smaller the drops the more stable or permanent will be the emulsion. In cream, for instance, the butter fat globules range from 0·003 mm. to 0·005 mm. diameter, and in milk from 0·01 mm. to 0·0016 mm. In general we may say that 10^{-5} cm. is the usual order of the diameter of emulsion globules.

These drops are electrically charged, this charge bearing a negative sign since the oil phase has a

lower dielectric constant than the water phase. The charge has been assumed to have its origin in a manner akin to frictional electric charges, though a school now exists which inclines to the view that adsorption of ions from the medium furnishes the charge. The whole question of the charge of the particles, however, is far from being satisfactorily answered.

It will be noticed in passing that the effect of the electric charge on the emulsion particles is opposite to that of surface tension. Consequently the process of emulsification is assisted by the charge assumed by the drops in accordance with the view already advanced that decrease of tension is favourable to emulsification.

Between the oil globules and the continuous medium there exists a potential difference which admits of fairly accurate measurement. This P.D. amounts to about 0·05 volt, and has been shown by Ellis (*Z. physikal. Chem.*, 1911, **78**, 321—352) to be independent of the kind of oil used or even the degree of purity of any given oil. This contact potential or potential difference is very intimately connected with the stability of an emulsion, such stability decreasing as the P.D. is made to decrease as, *e.g.*, by the addition of mineral acid. It was until recently thought that when the P.D. decreased to 0 the stability became nil, *i.e.* a complete breakdown of the emulsion occurred. However in 1914 Powis showed that there was a critical potential, viz., 0·030 volt, at which an emulsion is most stable. If the P.D. be now made to decrease, coagulation follows with a velocity which is approximately the same for all values of the potential, and the point of complete instability need not necessarily coincide with a zero potential, the so-called iso-electric point. More work still needs to be done on this very important question.

Finally another property possessed by the oil globules in an emulsion is that of Brownian movement which helps to keep them in a state of suspension. This motion is due to the bombardment of the oil particles by the molecules of the continuous medium and this bombardment being a series of uncoordinated collisions, the oil particles execute a zig-zag motion, which varies inversely as the size of the particles. When the diameter of the globules exceeds about 4μ, *i.e.* 4×10^{-3} cm., the Brownian movement ceases.

If an attempt is made to emulsify a pure oil in distilled water, it soon becomes evident that an extremely weak and very unstable emulsion results. To obtain an emulsion of even moderate concentration a third substance must be added. Thus by using soap Pickering (*J. Chem. Soc.*, 1907, **91**, 2002) made an emulsion of 99% oil in 1% water. By means of suitable third agents the reverse type of emulsion is possible, *viz.* a concentrated emulsion of water in oil. Thus Schlaepfer (*J. Chem. Soc.*, 1918, **113**, 522—526) made an emulsion of 70% water in 30% kerosene, using carbon, in the form of soot, as an emulsifier.

Many theories have been advanced to explain the process of emulsification and account for the stability and permanence of the subsequent emulsions, but until recently they only dealt with the special case of the oil-in-water type of emulsion. A useful theory must be perfectly applicable to both types:—

(A) In 1910 Ostwald (*Kolloid Zeits.*, 1910, **6**, 103) argued that the chief cause determining the *type* of emulsion was the relative concentrations of the two phases. He reasoned that as the concentration of one phase was increased, a critical point was reached beyond which the continuous medium then became the disperse phase. Starting now with an emulsion of the new type, and increasing the concentration of the disperse phase, a new critical point was reached, which however did not coincide with the first (*cf.* also *Kolloid Zeits.*, 1910, **7**, 64).

Ostwald assumed two things:—(1) That the emulsion particles were spheres of equal size, and (2) that the continuous medium changes to drops when the original globules come into contact. But as Bancroft points out (*J. Phys. Chem.*, 1912, **10**, 179) "it is probably very rarely true that all the drops are even approximately of one size." Again it does not necessarily follow that the coalescence of the globules must take place when they touch. A certain elasticity of shape may be conceived whereby the globules can be "squashed down until the space between them is only vanishingly small." (Bancroft, *loc. cit.*) Ostwald's theory is all the more difficult to accept in view of the fact that as early as 1891 Pickering had made his well known experiments on the emulsification of even 99% oil in 1% water.

Briggs and Schmidt (*J. Phys. Chem.*, 1915, **19**, 478—499) showed in their work on the emulsification of water in benzene, that given the right emulsifying agent, the relative concentrations of the water and benzene were quite immaterial.

(B) Another theory advanced to account for emulsification was the viscosity theory, according to which an emulsifier had to be a viscous substance or lead to a viscous continuous medium when in solution. Now it is an undoubted fact that high viscosity is very favourable to emulsification. Thus in margarine manufacture a very stable and permanent emulsion can be made from oils and milk at 24° C., where the oil mixture is very viscous, but a more perfect emulsion is produced at, say, 50° C., since rise in temperature favours emulsification, but in this case the stability is diminished, due partly to the increased liquidity of the oils. The viscosity notion, valuable though it is in some instances, is not general in its application, and Hillyer has pointed out (*J. Amer. Chem. Soc.*, 1903, **25**, 513) that 50% glycerin and 6% gum solutions of marked viscosity will not emulsify kerosene or even so viscous an oil as cottonseed oil, but dilute soap solutions with only a small viscosity are excellent emulsifying agents and will easily emulsify kerosene or cottonseed oil.

(C) Pickering put forward an interesting theory of emulsification in which the main idea is that films of insoluble particles envelope the oil globules. He showed that the insoluble basic salts of iron, copper, nickel, and aluminium are good emulsifying agents with respect to mineral oil and water. He showed, too, that clays, lime, silica, plaster of Paris, and other insoluble powders could act just as well. In this connection it is interesting to recall Schlaepfer's very stable emulsions of water in kerosene, where the emulsifying agent was also an insoluble solid, *viz.* soot. Pickering expressed the opinion that emulsification depended solely on the size of the particles constituting the precipitate, and that the average size of the globules in an emulsion was dependent on the size of the particles of the emulsifier employed. In illustration of this may be mentioned the manufacture of the technical emulsion margarine, where soured milk containing flocks of casein is churned up with a mixture of oils. Other things being equal, the finer the particles of casein in the sour milk the better the emulsion. Such a condition of the casein is readily obtained by a certain process based on colloidal chemistry.

We now know that in the use of insoluble emulsifiers the main question to be asked is, will the solid be more readily wetted by the oil or by the water? That phase which wets the solid the more easily will become the continuous medium and the other phase will be dispersed in it. The ease of wetting of a solid by a liquid is a function of the interfacial tension between the two phases, and the lower this tension, the more readily does wetting take place. Hence, if the solid particles of an emulsifying agent have a lower interfacial tension against water than against oil, it follows that the resultant emulsion

will be of the oil-in-water type, and *vice versâ*. The film or pellicle so described by Pickering has been investigated by Clowes (Kolloid Zeits., 1910, 7, 11) who actually visualised several cases. The particles constituting the film must necessarily possess little power of agglomerating, since their main effect is to coat or envelope the oil globules in such a manner as to prevent these coalescing when brought into close contact.

An extension of this theory has been applied to liquid emulsifiers such as solutions, of soap, gums, gelatin, etc. By adsorption at the surface of the oil drops there is assumed to be present a solid film derived from the emulsifying agent present in solution in the continuous medium. Thus milk, containing about 3·6% of fat emulsified in water, has led to much controversy around this very question. Storch and his school believe the fat globules in the milk to be surrounded by a membrane or by a gelatinous mucoid substance, semi-liquid in nature, and usually referred to under the Danish name of "slim-membran." Storch claims to isolate this mucoid body by treating cream until the lactose, casein, etc., have been washed away. Staining milk with ammoniacal picro-carmine, Storch examined the fat globules under the microscope and observed a stained layer enveloping each globule. Though he claims this fact as additional evidence for his "slim-membran" theory, the modern notion of adsorption can account for such staining without assuming a mucoid surface at all.

The idea of a surface film or pellicle surrounding emulsified particles must necessarily postulate an equilibrium condition, *i.e.*, particles of the solute are continually being re-dissolved and re-precipitated. Cases of spontaneous de-emulsification, *i.e.*, separation of the oil and water into bulk, are thus explicable on the view that coalescence of the oil globules is possible when the solid protecting film is removed by solution.

Lately Fischer (Science, 1916, **43**, 468) has put forward the view that the presence of a hydration compound is essential for emulsification, the mechanism being that by agitation of oil in, say, soap solution, the oil is dispersed as globules which at once become coated with hydrated colloid. The idea is very similar to the older notion that an emulsion of oil in soap solution consists of oil particles surrounded by a concentrated soap solution, the whole being bathed by a dilute soap solution (see also Roon and Oesper, J. Ind. Eng. Chem., 1917, **9**, 156—161). Fischer's theory is completely worked out in "Fats and Fatty Degeneration," by Fischer and Hooker (Wiley, New York, 1917).

In connection with emulsifying agents there is still a vast amount of research to be undertaken. To mention one point, apparently Moore and Krumbholz (Proc. Physiol. Soc., London, 1898, **54**, 22) are the only investigators who have published data concerning the power possessed by an emulsifying agent to stabilise an emulsion. I propose to use the term "emulsifying efficiency" to express the ease with which, say, gelatin can permit the emulsification of a given oil in water, and then help to maintain stability of the emulsion produced. Moore and Krumbholz graded certain physiological substances in the order of their emulsifying efficiency, *viz.*:—Albumose, serum, egg-white, and acid and alkali albumins. These substances in the order given are successively more capable of conserving an emulsion when used as the emulsifying agents.

These physiological emulsifiers, however, constitute a special case, and it still remains to arrange all emulsifying agents in a definite order as regards their capacity or power of stabilising a standard strength oil-in-water emulsion. I have recently begun such an investigation and propose to look for a possible connection between the so-called "colloidal protective action" and "emulsifying efficiency" of a series of substances including starches, gums, albumin, gelatin, dextrin, casein, and lecithin. There may possibly be some definite relation between the gold number of these emulsifiers and their capacity for inducing and conserving emulsions of a given oil, such as pure olive oil, in water. At the same time I hope to determine the influences of such factors as the viscosities and interfacial tensions and so obtain some definite *quantitative* data on this very important subject.

A natural corollary of such a research would be to take some definite emulsifier like gelatin, and arrange pure oils in the order of their "capacity for emulsification" at definite concentrations and temperatures. Such quantitative work is much needed in view of the increasing technical importance of emulsions in numerous industrial operations.

It is interesting to note in passing that a good emulsion acts as a most efficient emulsifying agent, and use is made of this fact in pharmaceutical preparations, by the production of so-called "emulsion nuclei" (*cf.* Roon and Oesper, J. Ind. Eng. Chem., 1917, **9**, 156—161).

It now remains to discuss the latest views on the nature of emulsification, these views being essentially based on surface tension ideas due to early investigators such as Plateau and Quincke, later and more fully by Donnan, and then modified so as to admit of general application to both types of emulsion by Bancroft, Clowes, Briggs, and others, in America (*cf.* Plateau, Pogg. Ann., 1870, **14**, 44; Quincke, Wied. Ann., 1888, **35**, 589; Donnan, Z. physikal. Chem., 1899, **31**, 42, and J. Amer. Chem. Soc., 1903, **25**, 1215; Bancroft, J. Phys. Chem., papers in 1912 and 1913; Clowes, Kolloid Zeits., 1914, **15**, 123—126, J. Phys. Chem., 1916, **20**, 407—451; Briggs and Schmidt, J. Phys. Chem., 1915, **19**, 478—499; Robertson, Kolloid Zeits., 1910, **7**, 7—10; Lehner and Buell, J. Ind. Eng. Chem., 1916, **8**, 701—703; Groschuff, Kolloid Zeits., 1914, **9**, 257—259; Newman, J. Phys. Chem., 1914, **18**, 34—55).

In 1891 Rachford showed that a purified and neutral oil, when shaken up with dilute sodium carbonate solution, would not form an emulsion (J. Physiol., 1891, **12**, 72). If, however, traces of free fatty acid, *e.g.* oleic acid, be added, emulsification would take place. Later Donnan (Z. physikal. Chem., 1899, **31**, 42) showed that specially purified and neutral oil gave exactly the same drop number in dilute caustic soda solutions as it did in water, but that when not so purified, the oil gave a drop number nearly six times that given in distilled water.

Nature of oil	Drop number in water	Drop number in NaOH 0·001*N*
Commercial olive oil (acid) ...	58	331
Purified ,, ,, (neutral)	55	58

Pure hydrocarbons exhibited similar effects, traces of stearic acid at once rapidly increasing the drop number in alkali. Now such an increase in drop number indicates a diminished interfacial tension, due to the presence of soap formed by the union of the soda and fatty acid. Consequently the first principle to be enunciated is, as shown earlier in the paper, that a decrease in surface tension favours emulsification. Indeed this was considered the *sine qua non* for emulsification in general, until Pickering obtained concentrated and permanent emulsions using such third agents as basic iron sulphate, which certainly has no influence on surface tension. Also the formation of emulsions of the water-in-oil type was not adequately explained on this theory. Consequently the idea was advanced, and is now firmly established, that although surface tension plays a most important rôle in emulsification, the main consideration is that of an adsorption effect, whereby oil particles or water particles, as the case may be, receive a coating or surface film which acts in three principal directions:—(*a*) The

interfacial tension is decreased so that the dispersed particles do not coalesce so readily. (We have already seen that lowering of interfacial tension and adsorption are coincident.) (*b*) An electric charge is conferred on the particles, possibly by ionic adsorption, and this charge will cause electric repulsion between the particles. (*c*) There is a purely mechanical action keeping the particles separated.

According to the adsorption theory, the type of emulsion obtained is simply dependent on the nature of the adsorbed surface film, *i.e.* on the nature of the emulsifier employed. Whether this third substance or film is more easily wetted by oil or by water, is a most important factor. Consider a film one side exposed to oil, the other to water, the water wetting it the more easily. The surface tension on the water side is lower than on the oil side, and consequently the film will curve so that the side with the higher surface tension will be concave, and oil drops be formed enclosed in a water medium. This is simply an illustration of the fact that a sphere has the smallest surface for a given volume of oil, and that owing to surface tension, there is always a tendency for surface reduction to a minimum. The area of the inner surface of a film is less than that of the outer, consequently the area of the side of the film of higher surface tension is at a minimum compared with that of the lower surface tension.

The adsorbed film may be of various natures. Thus soot wetted more easily by oil than water, leads to an emulsion of water in oil. Soaps may lead to both types of emulsion, as shown by Clowes:—"Soaps of the monovalent cations Na, K, etc., used as emulsifying agents for oil and water, cause the formation of an emulsion of oil in water, whilst soaps of Ca, Mg, and other di- and tri-valent cations give a reverse type of emulsion." Another type of stability may be furnished by simple ions alone, the electric charge and the size of the globules then being the main factors. Thus Ellis (*Z. physikal. Chem.*, 1912, **83**, 597) showed that such an emulsion was comparable to a colloidal suspension, and its stability was not a function of surface tension but of the interface potential, being a maximum when the contact potential was a maximum.

The present adsorption theory does not recognise any limiting concentrations for oil in water, the dispersion being quite independent of the volumes employed. Rather does it lay emphasis on the fact that emulsification is influenced by (*a*) the mass of the emulsifying agent present; (*b*) the ease with which the emulsifier can be adsorbed at the interfacial separating surface; (*c*) the nature of the ions adsorbed by the resultant film. Other things being equal, if there is an excess of negative ions adsorbed by a stabilising membrane formed between the oil and water phases, there will result an oil-in-water type of emulsion; an excess of adsorbed positive ions leads to the reverse type.

Several results, especially those obtained by Clowes may be quoted to support the views of the adsorption film theory. Thus if an oil is emulsified in a soap solution, it is always found that the ratio between the drop number and the concentration of the soap solution is logarithmic. Again to prove that ions are adsorbed on the interfacial membrane, Clowes took an emulsion containing oil, water, soap, and sodium hydroxide. Adding sodium chloride in regular increments up to a concentration of *N*/10 and titrating against hydrochloric acid, he found that "the amount of hydrochloric acid required, exhibited an approximately logarithmic relation to the amount of sodium chloride added, and a similar result was obtained by titrating soap suspensions, to which alkali and varying proportions of sodium chloride had been added, but without the addition of any oil, thus showing that the phenomenon in question is attributed to an effect exerted on the soap particles themselves." (Clowes, J. Phys. Chem., 1916, **20**, 424.)

It is a striking fact that practically all emulsifying agents are colloidal in nature. Thus gelatin, casein, albumin, starches, etc., are true colloids. The soaps also furnish colloidal systems, and it is very interesting to find that the sodium salts of the lower fatty acids are not emulsifiers, lauric acid being the first in the series to be effective, and that such salts have been found *not* to yield colloidal solutions whilst the sodium salts of lauric acid and onwards do (Mayer, Schaeffer, and Terroine, Comptes rend., 1908, **146**, 484).

Again in Pickering's work it was soon evident that the finer the state of subdivision of the solids used, the more perfect was the emulsion, but the finer the particles become the more nearly do they approach true colloidal suspensions.

The marked increase in viscosity accompanying emulsification is anticipated by a consideration of the adsorption diaphragm produced. In illustration of this the homogenisation of milk or cream may be cited. By forcing milk or cream warmed to 50° or 60° C. through minute orifices under great pressures, often 5000 lb. per sq. in., the fat globules are so reduced that their diameters are now about $\frac{1}{100}$th of their original value. When such a milk or cream is allowed to stand no separation occurs. The surface tension is decreased, a vigorous Brownian movement is exhibited, and a remarkable increase in viscosity takes place. This is due to casein adsorption by the fat globules so that the milk is much thicker than ordinary milk of the same fat content. Wiegner reduced the average diameter of fat particles in milk from 2·9μ to about 0·27μ. From viscosity measurements he calculated that in ordinary milk about 2·0% of the casein is adsorbed whilst 25% is adsorbed in the homogenised sample. Skim milk cannot be homogenised, since it is nearly fat free, and the casein present is already in a high degree of dispersion. Homogenised cream cannot be churned into butter. Also it cannot be whipped, and unless a colloid such as gum tragacanth be added, no permanent foam is produced.

Emulsions in which soap is the emulsifying agent also increase in viscosity, and Bancroft asserts that it is due to the viscosity of the adsorbed surface films of soap. He points out that "if we have an infinite number of very small semi-solid films or membranes, we have practically a cellular structure and consequently the maximum rigidity."

The adsorption film theory of emulsions is readily applicable to the peculiar instances of an emulsion of one type being converted into one of opposite nature, *e.g.* if an emulsion of olive oil in dilute sodium hydroxide be shaken with increasing quantities of calcium chloride the original oil-in-water emulsion will change over to an emulsion of water-in-oil as soon as the concentration of calcium chloride relative to sodium hydroxide exceeds the ratio of 1 : 4. Emulsions of oil/water can be converted into emulsions of water/oil by shaking with salts of Ca, Mg, Fe, and other di- and tri-valent cations, and the change may be prevented or the reverse change induced by shaking with a sufficient excess of sodium hydroxide. Clowes emphasises the fact that "these antagonistic effects are attributable to a balance between cations on the one hand and anions on the other, adsorbed on or reacting with soaps or other colloidal constituents of surface films or membranes." Thus with calcium chloride the cation Ca is more readily adsorbed than is the Cl anion, whilst in the case of sodium chloride the Cl anion is more readily adsorbed than the Na cation (*cf.* also, Shorter and Ellingworth, Proc. Roy. Soc., 1916, A, **92**, 231—247).

Clowes illustrates his theory by reference to a honeycomb structure in which, for example, the water phase is surrounded by the continuous wax walls of the cells. "Corrosion of the walls promotes the continuity or inter-communication of a previously dispersed water phase."

If sodium hydroxide is added to an emulsion of water in oil stabilised by a calcium soap, the drop number increases, this increase being in a logarithmic ratio to the amounts of sodium hydroxide added. The increase in the number of drops indicates the greater dispersion of the film and its consequent greater permeability to water. Finally sufficient sodium hydroxide will have been added to so increase the number of oil drops that a continuous chain of drops is the result; this indicates that the system is now absolutely permeable to water, the critical point having been passed, and an emulsion of oil in water has been produced.

Clowes followed the conversion of an oil-in-water emulsion to the water-in-oil type under the influence of calcium salts by the microscope, and observed that "the oil globules dispersed in the water are first elongated as the critical point is approached, and Brownian movement is very marked. At the critical point, extremely active movements of large oil and water masses is probably due to the existence of two continuous phases. Beyond the critical point the emulsion consists principally of large drops of water surrounded by oil, which are characterised by the fact that they still contain numerous oil globules in rapid Brownian movement. The complete conversion of the system into an emulsion of water in oil at the point at which sodium oleate is entirely converted into calcium oleate, is perhaps more readily recognised by observing the point at which the Brownian movement of these oil globules dispersed in water entirely ceases."

In connection with this problem of the conversion of one type of emulsion into another, there is the interesting case of the transformation of the fat in milk, an oil-in-water emulsion, into butter, a water-in-oil emulsion. Here, however, the mechanism is entirely different and appears to have some connection with the observations of several investigators to the effect that over-agitation of an emulsion causes it to break down. Hence butter-making is simply the de-emulsification of cream, whereby separation into the two phases occurs, some water being mechanically absorbed by the butter fat nuclei.

To sum up the whole position: An emulsion of oil in water is produced if the emulsifying agent is a colloid soluble in water, or more easily wetted by water than oil, and an emulsion of water in oil is obtained when the emulsifying agent is an oil-soluble colloid or is more readily wetted by oil than by water.

In concluding a paper on emulsions the possible methods of attack in investigation work of this nature should be mentioned. Within recent years an instrument has been devised for measuring the relative strengths of emulsions, called a nephelometer (*cf.* Richards, Amer. Chem. J., 1904, **31**, 235). Bloor used the nephelometer for the determination of fat in milk, "by comparison of the light-reflecting power of a watery suspension of the milk-fat with that of a similar suspension of a standard fat, viz. triolein" (J. Amer. Chem. Soc., 1914, **36**, 1300—1370). The nephelometer is very useful in emulsion work and is simply based on the fact that if light be directed horizontally through a suspension or dilute emulsion the intensity of the reflected light, viewed at right angles, is directly proportional to the number of particles present, *i.e.*, the concentration (Ellis, Z. physikal. Chem., 1912, **80**, 598).

Another instrument used in emulsion work is the drop pipette or stalagmometer. We have already noted that drop number and surface tension are inversely proportional. Much emphasis has been laid on the use of the drop number, *e.g.* Clowes believes that "the drop method affords an accurate means of determining the exact effect exerted by given substances on the colloidal equilibrium of the interfacial films which play so important a rôle in the establishment of emulsion equilibrium." On the other hand Briggs and Schmidt assert that the drop number cannot be used directly as a measure of the probable efficiency of a substance as an emulsifying agent for a given liquid. Determining the benzene drop number in various media they gave the following table:—

Aqueous phase	Drop number
Distilled water	88
Sodium oleate 1%	230
Sodium resinate 1%	210
Gum arabic 1%	61
Gelatin 1%	23—62

They state that attention must be drawn to "the great elasticity and strength of the semi-solid films formed about the drops of benzene which permitted the drops to become comparatively large in some instances and quite irregular in shape."

It is sometimes necessary to determine whether a given emulsion is one of oil in water or water in oil. Several methods have been proposed: (1) The *indicator method*, due to Robertson (Kolloid Zeits., 1910, **7**, 7—10), in which use is made of the oil-soluble dye Sudan III. If this colour be lightly sprinkled on to an emulsion of oil in water, the colour grains remain confined to those particles of oil with which they just happen to come into contact. But if it is sprinkled on to an emulsion of water in oil the colour rapidly spreads over the whole surface since the oil is now a continuous phase. This method is very useful and specially suitable for microscopical examinations of solid emulsions such as margarine.

(2) The *drop method*, due to Briggs, is based on the fact that an emulsion can be diluted by adding more of the continuous medium but not by adding excess of the dispersed phase. Thus if to a drop of a benzene-in-water emulsion a drop of water is added with stirring, the emulsified particles will spread in the water. Should no spreading occur it would indicate an emulsion of water in benzene. This method has been extended to the investigation of solid emulsions. Thus butter, a solid emulsion of water in oil, will gradually dissolve if placed in olive oil. An artificial butter may be prepared of the oil in-water type, which will remain unchanged if placed in oil.

(3) It would be interesting to learn whether there is any difference in the *electrical conductivity* of two emulsions, in all respects similar except that they were of opposite type. Possibly the oil-in-water type, especially if electrolytes are present, would have a much greater conductivity relatively to the other type, where oil—an insulating material—is now the continuous phase. An obvious extension of such a research would be to investigate the electrical conductances of solid emulsions, remembering in this connection that set jellies conduct quite normally.

(4) So far no work has been published on the *heat conductivity* of emulsions. Possibly no great difference would be found between the heat conductances of solid emulsions of opposite types, though with liquid emulsions such a difference may occur, since conductivity of this nature is based on convection currents, which again would be profoundly influenced by viscosity. Since the viscosities of the two phases are unequal, the conductance of heat by convection would presumably be easier when water was the continuous phase

I take this opportunity of thanking Prof. W. C. McC. Lewis for many helpful and interesting

conversations on emulsion problems and for his kindly criticisms, suggestions, and advice.

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DISCUSSION.

DR. A. HOLT asked how it was possible to make an artificial butter of the water-in-oil type of emulsion. In ordinary butter-making, cream was better to use than milk; was this due to the percentage of fat or to a difference in casein concentration? Then in the "flotation process" for zinc and lead ores, an emulsion of certain oils was used (*e.g.* eucalyptus oils); certain other oils would not do. Was there any connection between the power of "wetting" the particles of sulphide and the success of one oil over another in this process?

MR. E. GABRIEL JONES said that one important aspect of the subject was in connection with disinfectants, emulsions being more effective than solutions; various medical opinions suggested Brownian "bombardment," adsorption effects, etc., as the mechanism of bactericidal action of disinfectants, and, as a matter of fact, rise of temperature was known to favour adsorption as well as disinfecting power. There was no really efficient method for comparing the detergent powers of soaps. Did these properties depend solely on emulsifying power? Anti-emulsifiers were of great importance in extraction of alkaloids etc. from complex natural mixtures by means of organic solvents.

MR. W. R. SIBBALD quoted an experience in connection with demulsification. A solution of 50% water, 25% sodium soap, and 25% of oil formed an emulsion in which oil globules of irregular shape were dispersed in the watery medium; this diluted with 4—5 volumes of water showed perfectly spherical globules of oil in water. Did this indicate the possibility of two emulsions being formed and dilution producing a secondary effect?

MR. W. MANSBRIDGE mentioned the case of a 500-ton lot of mineral lubricating oil which had been discharged from the ship's tanks as an emulsion containing 1½% of water which would not separate by heating etc. It had been found that a leak of oil had occurred from the tank and sea-water had taken the place of the oil escaped. When clarification was attempted by blowing steam through the emulsified oil, the colour was darkened considerably, thus adversely affecting the market-value of the oil. How was it possible to demulsify without recourse to steam? He had proposed using an anhydrous salt to remove the water. It might be possible to approach the critical point of stability of such an emulsion and thus effect separation at ordinary temperatures. The readiness of formation of emulsions of fish and vegetable oils containing albuminous matter and cellular débris was an instance of stabilisation by interfacial films containing these insoluble substances.

MR. W. CLAYTON, in reply, said that there were various methods of tackling demulsification problems. Hatschek had used calcium carbonate filters; then in the absence of colloids (*e.g.* gelatin, albumins, etc.) it was a favourite practice to add electrolytes, *e.g.* mineral acids and inorganic salts, remembering that the higher the valency of the metal ion the greater the electric charge and the bigger the effect (*e.g.* Al''', Fe''', Cr''', etc.). Another method was to add substances which produced colloidal suspensions which would settle out. With regard to butter-making, a suitable emulsifier was chosen; *e.g.* oil beaten up in milk and the mixture rapidly cooled; the composition of the emulsion formed depended on the nature of the phase to start with. Cream was better than milk in butter-making because the concentration of fat was an important factor—the acidity also affected the adsorption of casein into the emulsion. In the flotation process interfacial tension and "wetting-power" were the properties which decided the use of an oil like sandalwood or eucalyptus oil. In the case of disinfectants, an emulsion had a lower surface tension than a solution and hence more easily "wetted" the disinfected material; possibly also adsorption played an important part. To estimate the capacity for emulsification of an oil, a 1–5% solution of gelatin in water at a constant temperature could be agitated with the purified oils in varying concentrations until the best conditions for emulsification were found: it was convenient to state what volume of oil could be emulsified in a certain volume of, say, 1% gelatin solution at a certain constant temperature. Some important work on the detergent power of soaps had been done by Shorter and Ellingworth (Proc. Roy. Soc., 1916) and by Pickering (Chem. Soc. Trans., 1917, **111**, 86); and Bancroft (also Donnan) had shown that too great a concentration of soap gave "brittle films" and there was a definite concentration for maximum efficiency.

In the example of emulsification of mineral oil with 1½% of sea-water mentioned by Mr. Mansbridge, it might be worth while to find out the amounts of caustic soda solution to be added which would give the critical state of transition from oil-in-water to water-in-oil type of emulsion, according to Clowes' definite relation—then separation might be effected.

Manchester Section.

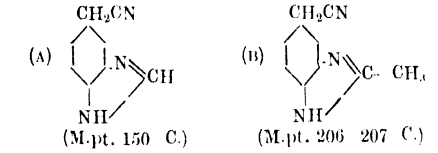
Meeting held at the Grand Hotel on March 7th, 1919.

MR. WM. THOMSON IN THE CHAIR.

A NOTE ON THE REDUCTION OF THE NITRILE GROUP.

BY J. J. BLOCH, D.SC.

In 1913, Dr. D. Maron, Miss M. Kantorovitsch, and the author described (Ber., 1913, **37**, 1347) the preparation of 5-cyanomethylbenziminazole and its 2-methyl derivative. Later experiments were made by the author with the object of reducing the nitrile group in these two compounds:



Those experiments were not successful, but a résumé of the results may be of interest, as they confirm what Johnson and Guest * call an abnormal reduction. Instead of the reduction following the normal course, with the formation of the amino-ethyl compounds, the following reaction took place: $R.CH_2CN+6H \rightarrow R.CH_3+CH_3NH_2$.

The reduction of the nitrile group is a complicated and difficult operation. Even in the case of benzylcyanide $C_6H_5CH_2CN$, reduction to phenyl-ethylamine by means of sodium and alcohol is far from quantitative, the best yield recorded being 43% (Johnson, *loc. cit.*), whilst a series of experiments showed yields varying from 30 to 43% for

* Amer. Chem. J., 1909, **42**, 340.

only slight changes in the proportions of the cyanide, sodium, and alcohol used, without any indication as to why the yield should be better in one case than in another, although he states that part of the benzyl cyanide underwent reduction by the sodium to toluene with formation of ammonia and methylamine. In 1910, Wohl* obtained a yield of 39—53·4% of sulphate, but this is no better than the former authors' results, the sulphate being impure. In 1912, Becker and Decker,† working according to Wohl's method, obtained a yield of free phenylethylamine of 23·6—29·2% in seven experiments; they consider that a partial saponification of the cyanide to phenylacetic acid takes place, with the formation of sodium cyanide and ethyl benzyl ether thus:

$C_6H_5CH_2CN+NaOC_2H_5 \rightarrow CNNa+C_6H_5CH_2OC_2H_5$.

Sodium cyanide was found in the mother liquors after the distillation of the base.

In the reduction of benzyl cyanide with sodium and alcohol, the present author obtained varying yields (150 grms. of benzyl cyanide gave 86 grms. of hydrochloride, which yielded 64 grms. of the acetyl derivative). The addition of toluene seemed to improve the results, allowing the use of a smaller quantity of alcohol; the yield was fairly constant at 35–40%. Toluene, ammonia, methylamine, and sodium cyanide were always formed. The two main reactions are probably the normal reduction to phenylethylamine and $C_6H_5CH_2CN+Na+H \rightarrow C_6H_5CH_3+NaCN$.

As it is known that the CH_2 group of the benzyl radicle reacts with metallic sodium, this reaction is not abnormal. Indeed the last reaction becomes the predominant one when instead of benzyl cyanide some of its derivatives are reduced.

In 1909, Barger‡ succeeded in preparing *p*-hydroxyphenylethylamine from *p*-hydroxybenzyl cyanide; the yield is not stated, but was probably low, since later Barger and Walpole§ tried other and more complicated methods to obtain this amine.

Johnson‖ states that "an attempt to synthesise *p*-aminophenylethylamine by reduction of *p*-aminobenzyl cyanide with sodium and alcohol was unsuccessful; the nitrile was reduced abnormally, an excellent yield of *p*-toluidine being produced. He cites Bamberger and Immerwahr's observations that diphenylacetonitrile is reduced under these conditions, giving a mixture of diphenylmethane and unsymmetrical diphenylethylamine, and notes that one reason for the small yield of *p*-hydroxyphenylethylamine from *p*-hydroxybenzyl cyanide is that part of the nitrile is reduced abnormally, giving *p*-cresol.

The author has attempted to reduce *p*-acetylaminobenzyl cyanide, using 10 grms. with 50 c.c. of absolute alcohol, 30 c.c. of toluene, and 10 grms. of sodium; the product was diluted with water and distilled with steam, producing *p*-toluidine, recognised by conversion into its acetyl compound (2 grms., m.pt. 258°—260° C.). It is possible that saponification of the acetyl group only took place after the addition of water.

Reduction of 5-cyanomethylbenziminazole (A) and its 2-methyl compound (B). 17 grms. of the 2-methyl compound was dissolved in 250 c.c. of absolute alcohol, and 15 grms. of sodium added slowly to the boiling solution. When the sodium had dissolved water was added and the solution distilled with steam; only traces of ammonia and methylamine passed over with the steam. The alkaline solution remaining in the flask yielded on extraction with ether a white crystalline substance, m.pt. 197°—198° C.,

Calculated for $C_9H_{10}N_2$	Found
73·97% C	74·13
6·85% H	6·89

identified as 2.6-dimethylbenziminazole (see Bössneck, Ber., 19, 1757). Here the cyanomethyl group has been reduced to methyl.

15 grms. of 5-cyanomethylbenziminazole was dissolved in 250 c.c. of absolute alcohol, and 13 grms. of sodium added slowly to the boiling solution; when solution was complete, water was added and the solution distilled with steam. The distillate yielded a thick, nearly colourless oil, which soon solidified into a crystalline mass, m.pt. 110°—113° C.; after crystallising once from alcohol the m.pt. was 114° C. The product obtained proved to be 6-methylbenziminazole.

In these two cases the reduction of the nitrile proceeded mainly according to equation $R.CH_2CN+Na+H = R.CH_3+NaCN$. Other ways of reduction were then tried. 3·5 grms. of 5-cyanomethylbenziminazole was dissolved in 6 c.c. of glacial acetic acid, the solution diluted with 180 c.c. of water and 6 c.c. of a 1% solution of colloidal palladium added; the mixture was then shaken with hydrogen under a pressure of $1\frac{1}{3}$ atm. No absorption took place, even after many hours.

A palladium hydrosol prepared according to the directions of Skita and Meyer (Ber., 1912, 45, 3579) was added to a solution of 3·5 grms. of 2-methyl-5-cyanomethylbenziminazole in 40 c.c. of 4% hydrochloric acid, and a stream of hydrogen was introduced under a pressure of 720+200 mm. of mercury; 900 c.c. of hydrogen should have been absorbed (4 atoms). The amount absorbed during the first half hour was 50 c.c. and slightly less in the next six hours. After separation of the palladium and making alkaline practically the whole of the unchanged 2-methyl-5-cyanomethylbenziminazole was recovered. Steam distillation only gave a trace of a base.

A trial reduction of the 5-cyanomethylbenziminazole with iron and acetic acid was not successful, the glyoxalylbenzylcyanide being recovered unaltered.

5-Cyanomethyl-2-methylbenziminazole (3·5 grms.) was dissolved in 60 c.c. of 10% acetic acid and 100 grms. of 2·5% sodium amalgam was added slowly, the solution being kept slightly acid by addition of 10% acetic acid. The solution was filtered and then rendered alkaline, when the 5-cyanomethyl-2-methylbenziminazole was recovered unaltered. Steam distillation of the liquor gave only traces of a base.

To a solution of 3·5 grms. of 5-cyanomethyl-2-methylbenziminazole in 100 c.c. of 10% acetic acid 10 grms. of aluminium amalgam was added, and the mass was shaken from time to time. At first there was strong evolution of hydrogen and of heat; the reaction was complete after 24 hours, when the gelatinous mass was made alkaline and distilled with steam; only a minute quantity of a base distilled over. The alkaline residue was evaporated to dryness and extracted with alcohol, when some of the unchanged nitrile was recovered.

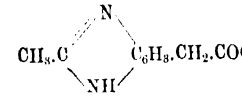
3 grms. of 5-cyanomethylbenziminazole was dissolved in 50 c.c. of glacial acetic acid, the solution boiled under a reflux condenser, and 10 grms. of zinc dust added slowly. When solution was complete, the liquor was rendered alkaline and distilled with steam. Nothing passed over with the steam; the alkaline solution yielded to ether some unaltered 5-cyanomethylbenziminazole.

12 grms. of 5-cyanomethyl-2-methylbenziminazole was dissolved in 500 c.c. of hydrochloric acid (170 c.c. of crude acid, 350 c.c. of water) and 120 grms. of zinc amalgam was added. The flask

* Ber., 1910, 43, 2184.
† Ber., 1912, 45, 2405.
‡ J. Chem. Soc., 1909, 95, 1123.
§ J. Chem. Soc., 1909, 95, 1720.
‖ Amer. Chem. J., 1910, 43, 313.

was connected to a reflux condenser and boiled for a few hours (*cf.* Clemmensen, Ber., 46, 1837). The solution, which was slightly brown at first, soon became clear. When the reaction was at an end, only ammonia and iminazolylphenylacetic acid could be isolated. *Instead of a reduction, a saponification had taken place. Further experiments proved that as soon as a mineral acid, even diluted, was present saponification took place.*

2-Methyliminazolylphenylacetic acid,



$$CH_3.C(N\!=\!)(NH)C_6H_3.CH_2.COOH + 2H_2O,$$

is a white crystalline powder, m.pt. 117° C., very slightly soluble in cold water, more soluble in boiling water, slightly soluble in alcohol, scarcely soluble in any other organic solvent, easily soluble in alkalis, ammonia, and their carbonates. The aqueous solution of the acid gave a white precipitate with a solution of mercuric chloride; the mercuric salt decomposed without melting at 230° C. The anhydrous acid has m.pt. 218°—219° C. On analysis the hydrate gave H_2O 16·01%, nitrogen 12·51%; calculated for $C_{10}H_{10}N_2O_2+2Aq$, H_2O 15·92%, nitrogen 12·39%.

Discussion.

Mr. L. E. Vlies asked whether an attempt had been made to reduce the nitrile group by dissolving the product in cold strong sulphuric acid, and cautiously adding aluminium powder.

Mr. Strafford inquired whether iso-cyanide was present in the benzyl cyanide used.

Mr. L. G. Radcliffe asked if it was possible to effect a reduction by using titanous chloride.

Dr. Bloch replied that he had not attempted to reduce with strong sulphuric acid and aluminium because by dissolving such a nitrile in strong sulphuric acid an amide was formed immediately, even if the acid was very cold. The best way of producing the amide was to dissolve the product in strong sulphuric acid. In his experiments he had used both pure benzyl cyanide obtained from Kahlbaum and also some he had prepared himself from benzyl chloride. The results had been identical. He did not think iso-cyanide had been present. In the case of the benzyl cyanide prepared by himself there had been a small amount of untransformed benzyl chloride present, but it had not interfered with the reaction. In reply to Mr. Radcliffe, he said that the use of strong hydrochloric acid resulted in hydrolysis taking place.

NOTE ON A DEPOSIT IN REFINED SOYA BEAN OIL.

BY R. BRIGHTMAN, M.SC., A.I.C., A.C.G.I.

In the refining of soya bean oil by means of sulphuric acid it was occasionally observed that the refined oil after some time became cloudy through the formation of a white, flocculent, crystalline deposit which prevented the oil from burning. This deposit was, however, very small in quantity, and after its removal by filtration, the filtered oil could be burned, though not so well as before the formation of the deposit.

A small quantity of this deposit, collected by filtration, was examined. It was contaminated with dirt, earth, and oil, but was examined as received. The sediment as received had a distinctly acid reaction. 10 grms. required 1·1 c.c. of *N*/1 sodium hydroxide to neutralise, with methyl orange as indicator, and 5·8 c.c. with phenolphthalein. These figures correspond to 5·39% of free sulphuric acid, and 13·3% of free fatty acid, calculated as oleic acid. The deposit was soluble in light petroleum spirit to the extent of 64% at 100° C. and 17% in the cold. Since bean oil itself is freely soluble in this solvent, there could not be more than 17% of bean oil present. The presence of free sulphuric acid was proved by a direct test with barium chloride. The deposit contained 8·5% of sulphur and 1·3% of ash, chiefly ferric oxide.

Since the acidity of the deposit and its partial solubility in petroleum spirit suggested that it consists mainly of a dihydroxystearic acid or a homologue of this acid, its solubility in alcohol was examined. Hot alcohol extracted a white substance, which separated from the solvent in soft white crystals melting at 32° C. This substance, however, was neutral and showed on analysis sulphur 7%, saponification value 94·3, iodine value 120·5, unsaponifiable matter 3·5%, increase on acetylation 5·5%. The unsaponifiable matter itself melted at 37·5° C. and did not gain in weight on acetylation.

The fatty acids obtained by saponification of this substance gave the following figures:—M.pt. 25° C., neutralisation value 208, iodine value 123·4, mean molecular weight 308, sulphur nil.

These figures make it evident that the sulphur in the complex forming the deposit is eliminated on saponification, and to reconcile the low saponification value of the deposit with the neutralisation value of the fatty acids it is necessary to assume that the two molecules of glyceride are condensed through a sulphonic group, thus:—

$$SO_2(O.CH_2.CHOR.CH_2OR)_2.$$

Such a complex would break up on saponification into two molecules of glycerol, the several molecules of fatty acid, and sulphuric acid. The figures obtained for the fatty acids agree well with those characteristic of the fatty acids of bean oil.

There is the alternative possibility that a sulphur-containing complex is formed through condensation of sulphonated fatty acids. It is probable, however, that sulphonation of the fatty acids would require rather a high temperature, and hence such complexes would be less readily formed and less readily decomposed than complexes such as that first suggested. The substance is easily decomposed by heating with acetic anhydride, a fact which tells against the theory of condensation by sulphonated fatty acids. Moreover the high iodine value of the deposit is also evidence against condensation through sulphonated fatty acids. The sulphonation would take place at the double bond and the iodine value should therefore be lowered considerably, whereas such is not the case.

Although the deposit therefore is presumably a complex sulphonated glyceride, the possibility remains that dihydroxystearic acid or other hydroxy-acids are present in that complex. The product obtained by acetylating the purified deposit showed an increase of 5·5% in weight, contained no sulphur (thus indicating the decomposition of the complex) and had a saponification value of 232, which apparently represents the saponification value of the acetylated fatty acids or of their glyceride.

The fatty acids obtained from the deposit were almost completely soluble in petroleum spirit; the soluble acids melted at 27·5° C. and were easily acetylated, the acetylation product showing m.pt. 29° C., saponification value 229, mean mol. wt. 245. These figures point clearly to the presence of hydroxylated fatty acids in the complex.

The deposit would therefore appear to be a complex sulphonated glyceride of the type formulated above. Its mode of formation remains uncertain. One explanation is the condensation of mono- or di-glycerides at high local temperatures under the influence of the sulphuric acid. This involves

the presence of mono- or di-glycerides in soya bean oil. Determinations of the glycerol in soya bean oil gave no decisive evidence on this point, but the figures given below show clearly that the oil can be acetylated and that it contains hydroxylated fatty acids. Some difficulty was encountered in obtaining satisfactory results for the acetyl value. The method was therefore adopted of determining the Reichert-Meissl value of the oil before and after acetylation. The results obtained are shown in the following table:—

—	Sample A		Sample B	
	Original oil	Acetylated oil	Original oil	Acetylated oil
Saponification value	187·5	196·8	192·9	208·8
Reichert-Meissl	1·0	7·85	0·9	7·4
Polenske	0·3	0·5	0·3	0·5
Fatty acids	Before acetylation	After acetylation	Before acetylation	After acetylation
Melting point	24° C.	—	23·5° C.	25° C.
Mean mol. wt.	287·7	—	290	324·1
Saponification value	—	210·9	197·2	223·3
Iodine value	141·5	129·7	141·8	117·6

I am indebted to Messrs. Price's Company, Limited, Belvedere, Kent, for permission to communicate the results of this investigation.

DISCUSSION.

Mr. L. G. RADCLIFFE thought that Mr. Brightman's theory was well founded and he was supported in that opinion by results obtained in experiments conducted by himself.

The CHAIRMAN inquired the strength of the sulphuric acid used for purifying the oil.

Mr. BRIGHTMAN replied that he was not at liberty to mention the strength or quantity of sulphuric acid used, but the strength was sufficient for local action to be possible.

New York Section.

Meeting held at the Chemists' Club on January 17th, 1919.

MR. C. E. SHOLES IN THE CHAIR.

PRESENTATION OF THE PERKIN MEDAL.

The thirteenth impression of the Perkin Medal was awarded to Dr. F. G. Cottrell in recognition of his work on electrical precipitation.

Following some introductory remarks by the Chairman and Mr. C. McDowell, Prof. C. F. CHANDLER, in presenting the Medal, said that Dr. Cottrell was born in Oakland, Cal., in 1877. After studying at the Universities of California and Leipzig he became Instructor in Physical Chemistry at the University of California in 1902; later assistant Professor. This position he held till 1911, when he joined the staff of the Bureau of Mines in Washington. Here he was at first the Consulting Chemist, then successively Chief of Physical Chemistry, Chief Chemist, and finally Chief Metallurgist, which position he still holds.

Dr. Cottrell's elaborate and valuable investigations relating to electrical precipitation of particles of liquids and solids began in 1906 with his work on sulphur trioxide fumes, which are not easily absorbed by water. It had long been known that electric brush discharges caused fog to clear. Sir Oliver Lodge had worked along this line. Dr. Cottrell described his first fundamental experiment in 1911 in a paper on "The Electrical Precipitation of Suspended Particles" (J. Ind. Eng. Chem., 1911, 3, 542–550). This marks the beginning of one of the most important contributions to industrial chemistry. Cottrell says: "The clue to the solu- "tion of this difficulty came from an almost acci- "dental observation. Working one evening in the "twilight when the efficiency of the different points "could be roughly judged by the pale luminous "discharge from them, it was noticed that under "the particular conditions employed at the time, "this glow only became appreciable when the "points had approached the plates almost to with- "in the distance for disruptive discharge, while "at the same time a piece of cotton-covered magnet- "wire which carried the current from the trans- "former and commutator to the discharge elec- "trodes, although widely separated from any con- "ductor of opposite polarity, showed a beautiful "uniform purple glow along its whole length. The "explanation lay in the fact that every loose fibre "of the cotton insulation, although a relatively "poor conductor compared with a metallic point, "was still sufficiently conductive from its natural "hygroscopic moisture to act as a discharge point "for this high potential current and its fineness "and sharpness, of course, far exceeded that of "the sharpest needle or thinnest metallic wire. "Acting on this suggestion, it was found that a "piece of this cotton-covered wire when used as a "discharge electrode at ordinary temperature "proved far more effective in precipitating the sul- "phuric acid mists, which were then the object of "study, than any system of metallic points which "it had been possible to construct. Perhaps the "greatest advantage thus gained lay in the less "accurate spacing demanded between the electrodes "of opposite polarity in order to secure a reason- "ably uniform discharge."

The first installation of his system was made at the Hercules Powder plant, at Pinoli, Cal., where there was a small contact sulphuric acid plant. There he used a 6600-volt alternating current, rectified into a direct current by a motor-driven contact apparatus, and sent this current, by means of pubescent (hairy) asbestos electrodes, through the wet sulphur trioxide fumes, and effected precipitation.

This process, though successful, was not sufficiently profitable to warrant extensive use. It would probably have died had it not been that the nearby Selby smelter was in trouble. This smelter had a large plant near one of the tunnels of the Southern Pacific Railroad, and with certain winds, the fumes of sulphur trioxide from the silver dissolving house would fill this tunnel with choking fumes, and finally legal proceedings were started to close the smelter plant. At this juncture Cottrell erected a small electrical plant which met the difficulty completely, and is running to-day, yielding dilute sulphuric acid as a by-product. But for these legal proceedings the Cottrell process might never have materialised. The knowledge that fumes and smoke could be "Cottrellised" induced farmers all over the West to sue the smelters, and satisfied the Courts and juries that they were not asking the impossible of the smelters.

The Cottrell process has not only removed the trouble due to sulphuric acid waste fumes of smelters, but it has brought down poisonous arsenic, saved metal dust otherwise going to waste, saved the orange groves from cement kiln smoke, and recovered potash from that cement smoke.

The great expansion which the process has undergone is shown in the recent installation at the Washoe reduction works of the Anaconda Copper Mining Company, Montana. The stack is over 585 ft. high, is 80 ft. in diameter, and the walls are 5 ft. 4 in. thick at the base. The stack contains the equivalent of 6,672,214 common bricks. The smoke is conducted through a vast flue system from the furnaces, and is passed into chambers wherein hang 111 miles of chains, electrified by a high-tension current; the dust particles are repelled by the chains and adhere to large plates between which the chains are suspended. When the plates have become thickly coated, the current is shut off, and the accumulated dust falls into hoppers.

Dr. Cottrell's more recent work has been concerned with securing helium for war balloons; being incombustible, it is an excellent substitute for hydrogen, while it is only slightly inferior in ascentional power. The helium is obtained from certain gas wells, by liquefying out all the other constituent gases.

Dr. Cottrell, having expressed his deep appreciation of the honour conferred upon him, gave a full account of the history and development of the recovery of helium from natural gas. Dealing first with the separation of air into its components, he said that he had been for many years greatly impressed with the ultimate possibility of producing very cheap oxygen for industrial purposes by liquefaction and distillation of air, but had been equally impressed with the crude thermodynamics which all the earlier systems represented.

Oxygen as sold to-day in steel cylinders is so expensive that it usually fails to suggest even faintly the ultimate possibilities for low-cost production, in which latter case it would be piped at moderate pressure straight from the separating plant to the furnace. Thus, $200 a ton is a very low price for even moderately pure oxygen in steel cylinders to-day, whereas on the very large scale where unit cost of plant, overhead and sales expenses and the like are greatly reduced and compression into cylinders, transportation of same, etc., are completely eliminated, the power consumption for the actual separation would become the largest and dominant factor of ultimate cost. The individual steps in the process of liquefaction and separation of gaseous mixtures may all be made thermodynamically reversible to much the same extent in practice as are those of the steam engine and the air compressor. The chance for inventive skill lies chiefly in the selection of these individual steps from the alternatives long since clearly recognised and their combination into a consistent series. The difference in efficiency of present commercial processes resides in the acumen with which this choice and combination have been carried out and in the mechanical perfection of the apparatus in which the system is embodied.

The final measure of theoretical efficiency is, of course, the degree to which reversibility in the thermodynamic sense has been approached. No energy has to be supplied in the separation of air to overcome chemical affinity, but it is necessary to overcome what we may call the force of diffusion of the two gases in effecting their separation. Thus, figured mechanically, the work necessary to separate five volumes of air at atmospheric pressure into one volume of oxygen and four volumes of nitrogen, each at atmospheric pressure, is simply that of bringing each of the partial pressures of the two gases as they existed in the mixture up separately to that of the original mixture. Or, it is the work necessary to compress the oxygen from five volumes at ⅕ atmosphere to one volume at one atmosphere plus that to compress five volumes of nitrogen at ⅘ atmosphere into four volumes at one atmosphere, all isothermally. Or, to put this even more concretely, if the heat interchangers and stills were thermodynamically perfect in their operation, it would only be necessary to compress the original air isothermally to a pressure of approximately 10 lb. per sq. in. above atmospheric, to effect its complete separation into pure oxygen and pure nitrogen, each at atmospheric pressure. Per ton of oxygen separated this works out at 60 h.p.-hr. on the basis of isothermal compression. This is, of course, the theroretical limit for a perfect reversible cycle, which cannot be attained in practice, but we may hope to approach it to much the same degree that we have the corresponding limit in the steam engine and the air compressor—say 50 per cent. as at least a legitimate goal for early endeavour. It seems doubtful whether any large-scale air-separating plants at present in service are greatly exceeding 10%. But even 10% would mean oxygen at a power cost of only 600 h.p.-hr. per ton, which in itself should present startling possibilities to the minds of most chemists and metallurgists.

That there has not been more actual development is chiefly due to the magnitude of the project, requiring as it does the closest co-operation and support of the whole undertaking from both the users and producers of the oxygen. The transition from the present bottled oxygen stage of the industry to that of production directly at and as a part of the large metallurgical plant, let us say, where it is to be used, means not only a complete re-design and development of larger production units but a complete reorganisation of sales and business policy. Some experiments in this direction were indeed undertaken in Belgium before the outbreak of war, but were on an entirely inadequate scale to furnish conclusive results.

Let us consider for a moment the tremendous efforts already expended to concentrate up to the limit the ores and all the other raw materials entering a furnace and then remember that we are still adding the oxygen with four times its weight of inert nitrogen, all of which reduces the intensity of the chemical reactions and causes waste of valuable fuel, to say nothing of additional expenses due to excessive size of equipment.

But to return to the narrative. In 1916, as a result of a memorandum handed to me by Director Manning of the Bureau of Mines concerning a new process for air separation, I came in touch with Mr. Fred E. Norton, of Worcester, Mass., who had in 1913 entered the employ of Mr. E. A. W. Jefferies to undertake the engineering development of a process of air separation patented by the latter and which he had arranged with the General Chemical Co. to test at one of their plants. After spending between $50,000 and $100,000 on this project the General Chemical Co. decided to drop it. Messrs. Jefferies and Norton then pooled their patents as the Jefferies-Norton process and, with the financial help of a few friends, continued experimental development. The parts of their process particularly attracting my attention were those Mr. Norton had introduced after cessation of the work at the General Chemical Co. and which radically changed the fundamental cycle upon which he in common with others had been working previously.

I found that, after making application for patents, they had discussed the work very freely with those who should be best able to judge of its merits and possibilities, but had made little progress toward securing practical and financial backing toward large-scale development. Following our custom in the Bureau in such cases, an effort was made to put Mr. Norton and his associates in touch with people who might have sufficient use for such a process to justify their aiding in its further development, but I fully realised the difficulties and uncertainties in the way of definitely securing such co-operation.

At the same time as the above development, but

quite unknown to me, another thread of the story was being spun in England. On February 28, 1915, Sir William Ramsay wrote to Dr. R. B. Moore, of the U.S. Bureau of Mines: "I have been investigating blowers, i.e., coal damp rushes of gas, for helium for our Government. There does not appear to be any in our English blowers, but I am getting samples from Canada and the States. The idea is to use helium for airships." The importance of this proposed use of helium for balloons and particularly for airships of the Zeppelin type lies in the inertness and non-inflammability of helium and the fact that it is of all known substances the next lightest to hydrogen, having about 92% of the latter's buoyant effect. It also shows only about half the rate of diffusion and consequent wastage through the balloon fabric. At the time of the receipt of Sir William's letter the United States was not in the war, and nothing immediately came of the suggestion in this country. Dr. Moore remembered, however, that in 1907 Dr. H. P. Cady, of the University of Kansas, had found more than 1% of helium in some natural gases from Kansas. In 1917, following a meeting of the American Chemical Society, Dr. Moore brought the matter to the notice of Dr. Parsons, who promised to have it presented to the War Department.

News of Ramsay's suggestions also reached this country through other channels and eventually came to our attention. Professors Satterly and Patterson, of the University of Toronto, commenced experimentation on the subject January 1, 1916. Col. G. A. Burrell, who headed the research department of the Gas Warfare Service at the American University, states that Cady's experiments had also suggested similar possibilities to him.

However, no definite step toward securing action seems to have been taken in the United States until June 1, 1917, on which date Messrs. Moore and Burrell, of the Bureau of Mines, explained the subject to Colonel Chandler, in charge of the balloon service for the Army. He was intensely interested, and asked that a report be made to him, giving all available details. He also took the matter up with Mr. G. O. Carter, in charge of hydrogen plants for the Navy, who had had several years' practical experience in the Linde Air Products Co. with the liquefaction and separation of gases by their process. Mr. Carter also immediately appreciated the importance of the subject, and urged this upon the attention of his superiors in the Navy.

Up to this time in the whole world there had probably not been more than 100 cub. ft. of helium separated as a pure gas, and its price in the small lots in which it was sold was about $1700 per cub. ft. About this time I was called into the conferences and was much impressed by the weight which the British Admiralty apparently laid upon the cost of separation of the gas as a determining factor in its practical availability. I was given to understand that they had figures on the basis of the well-known commercial processes for separating gases by liquefaction and distillation, and were unable to see how production could be hoped for from these at less than $60 to $80 per thousand cubic feet, which they felt to be practically prohibitive for the programme they then had in mind. At this stage Mr. Norton was asked to act as a consulting engineer of the Bureau of Mines and prepare plans and estimates for an experimental plant, the supervision of which for the Bureau of Mines devolved on Mr. Burrell.

In due course a report was transmitted to the War Department, and although this report was as yet fragmentary and based on very inadequate data concerning the practical conditions to be met in the field, the Aircraft Board, on July 31, 1917, recommended an allotment of $100,000, half each from the Army and Navy, which became available for the use of the Bureau of Mines on August 4. A detailed survey of field conditions, to determine the best available supply of natural gas for the purpose, was at once begun, as also the preparation of working drawings for the experimental separation plant. The work was commenced by Mr. Burrell, and by him carried through its early critical stage. The general supervision of the project was for a short period at one time placed in the hands of Prof. W. H. Walker. Mr. Burrell next communicated with the two well-established operating companies controlling, respectively, the Linde and Claude systems of gas liquefaction and distillation, to determine whether it would be possible to work out a plan of general co-operation and pooling of information and facilities for this specific war purpose. This did not, however, prove practicable, though both companies expressed themselves as anxious to co operate individually with the Government and to undertake independently the erection of plants of their own respective designs at cost, or even less, and have ever since done all that was in their power to make the work as a whole a success.

At this juncture a special commission from the British Admiralty, headed by Commander Cyprian D. C. Bridge, arrived in America to collect data and exchange ideas on what was being done, and from the resulting conferences the possible importance of the work in hand became so evident that the Aircraft Board on October 17, 1917, recommended that a further allotment of $500,000 be made jointly by the Army and Navy to permit of immediately starting the construction of complete plants under all three processes. In accordance therewith, Mr. Norton was directed to prepare plans for a somewhat more complete plant embodying his process than had originally been contemplated as a first step. This brought the total estimated cost of the plant to about $150,000. Owing to official delays, however, it was not until February, 1918, that the additional $100,000 became available for the Norton project. In the meantime contracts had been closed with the Linde Air Products Co. and with the Air Reduction Co. for the construction and experimental operation of a Linde and a Claude plant respectively, each for an estimated daily production of about 7000 cub. ft. of helium, and construction was well forward on each. These plants were to be at North Fort Worth, Texas, and to utilise a natural gas containing about 0·9% by volume of helium; of this gas the Lone Star Gas Co. was bringing some 20,000,000 cub. ft. daily through its pipe line from the wells at Petrolia, more than a hundred miles north-east of Fort Worth, to that city for domestic and industrial consumption. After careful study of field conditions it was decided to erect the Norton plant at Petrolia in direct proximity to the wells, a procedure which had not been deemed practical for the two other plants on account of their larger demands for power and water supply.

Parallel with the Bureau of Mines work on processes of extraction, Dr. A. F. Rogers, of the U.S. Geological Survey, undertook a recognisance of all natural gas fields in the United States with regard to their possible helium supply, as this might be judged from sampling and analysis of existing wells combined with a study of geological conditions. The Bureau of Standards also undertook the determination of certain physical properties of the gases, more especially the latent and specific heats and specific volumes of methane over a wide range of pressures and temperatures, and the diffusion of helium through balloon fabrics. The data will be published shortly by the Bureaus.

In order to co-ordinate properly all the different agencies concerned, the conduct of the helium work

as a whole was about this time placed in the hands of a committee consisting of one representative from each of the three departments chiefly concerned. Mr. G. O. Carter, as chairman, represented the Navy, Dr. Harvey N. Davis the Army, and Mr. Geo. A. Orrok the Interior.

The Linde plant, costing in round figures $300,000, was the first to be started. It commenced operation March 6, and on March 22 produced gas containing 28% of helium. By April 21 this purity had reached 50%, the yield being at first small, but both quantity and purity were steadily increased up to a maximum daily production on September 6 of 7755 cub. ft. of 67% purity, with an average production of, say, 5000 cub. ft. at over 70% purity; the gas was then further purified in a second step to about 92 or 93% purity.

The Claude plant, costing about half as much as the Linde, commenced production some weeks later than the latter, and has also gradually increased its production and the purity of its product. Although up to date these are still considerably behind the performance of the Linde plant, a new still is just being installed at the Claude plant which it is hoped will materially improve both yield and purity.

Due to present pipe line limitations coupled with heavy consumption of fuel gas at this time of year, it has been necessary for some months past for the Lone Star Gas Co. to substitute for part of the Petrolia gas some from other fields carrying less helium, so that the helium content of the gas at present being treated at Fort Worth has fallen to between 0·4 and 0·5% by volume, which proportionately cuts down the production at both plants.

At the time of signing the armistice the first shipment of 147,000 cub. ft. of 93% helium was on the dock about to be loaded aboard ship for Europe.

The Army and Navy have now jointly entered upon a larger production programme under the immediate direction of the Navy, and have allotted some $5,000,000 for the purpose, including the construction of a new pipe line and additional units of the Linde plant at Fort Worth. General Squire states plants are under construction to give at least 50,000 cub. ft. a day at an estimated cost of not more than 10c. per cub. ft. If present expectations of the Norton process are fulfilled this cost may be still further greatly reduced.

The Norton, or Bureau of Mines, plant at Petrolia was completed as far as initial construction is concerned in the middle of October, and since that time its various parts have been successively undergoing tests and adjustments. The multitubular heat interchangers and large expansion engines, which were among the new departures in this plant, over which most anxiety was originally felt, have thus far worked very well, and now seem to be performing their allotted tasks to complete satisfaction. A good deal of difficulty was at first encountered by occasional floods of oil and salt water from the gasoline extraction plant, which immediately clogged up the interchangers. This has now been eliminated by installing adequate settling chambers and traps. It is hoped that helium production will soon be attained, but as this plant has a rated production capacity of several times that of either of the other two, each change or adjustment in its parts requires rather more time, apart from the fact of the entire novelty and experimental character of many of its parts.

In studying the different systems of gas liquefaction and separation it is very essential at the outset to distinguish clearly between the production of liquid as an ultimate product and the utilisation of liquefaction and re-evaporation as a mere step in a separation where the ultimate products desired are still gases and at essentially the temperature of the original mixture fed to the apparatus. In the former case a very considerable expenditure of work is represented in what may be termed the refrigerative properties of the liquid delivered. But in the second case, where the liquid is not drawn off from the apparatus and its amount therein remains constant, the part continually evaporating serves to condense nearly an equivalent amount of the incoming gases. Also the cold gases furnished by this evaporation take up heat from and cool the fresh incoming gas while they themselves are returning to room temperature.

Ideal equal pressure process.

The continuous process of liquefaction and re-evaporation of a single gas may be illustrated diagrammatically, as in fig. 1. Ideal conditions would consist in perfect heat interchange horizontally between the two legs of the U-tube, A and C, and perfect heat insulation lengthwise along each of these and from their surroundings. If these conditions were fulfilled and the whole system once brought to a steady state by, let us say, refrigeration of the bottom of the U-tube by some extraneous source of initial cooling while gas was slowly passed through it, we may imagine a certain amount of liquid condensed at the bottom of the U and a uniform gradient of temperature established along its two legs. Now, if the initial extraneous source of refrigeration were removed but gas still passed slowly into the system, the gas would progressively cool in A, liquefy at B, re-evaporate at B_1, and warm back to the atmospheric

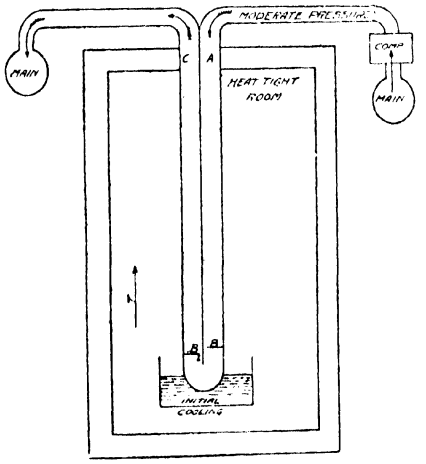


FIG. 1. IDEAL EQUAL PRESSURE SYSTEM.

temperature in passing up C. Under these ideal conditions, with a single gas, the slightest imaginable difference in pressure between A and C should serve to perpetuate the process.

Whatever heat leakage there is, however, either through the walls of the insulating chamber or down the legs of the U-tube, represents a loss not of energy itself but of its availability for the purposes in hand: *i.e.*, of thermodynamic potential, the practical result being the necessity of expending mechanical work to compensate for these heat leaks. If, in addition to this, we are dealing with a mixture instead of a single pure gas, the constituents will in general liquefy and re-evaporate with varying ease, tending to set up temperature differences between adjacent parts of the two legs of the U and thus requiring a further expenditure of work to operate the cycle. Looked at from the point of view of gas separation, the first of these

effects represents pure loss, but the second is due, at least in part, to overcoming the "force of diffusion" in separating the gases, and should thus be counted as useful work.

The problem is, therefore, to provide just enough refrigeration at the proper temperatures and places to cover these two demands after they themselves are reduced to as low a value as possible in the design of the apparatus and by use of the best heat insulation attainable.

The three systems for gas separation now before us differ perhaps most strikingly of all in the way in which they produce this refrigeration.

Linde system.

In the case of the Linde, fig. 2, the gas mixture to be separated is pumped at very high pressure (say 1500 to 3000 lb. per sq. in.) into leg A and allowed to expand through a regulating throttle to a lower pressure at B_2 and return through D, the refrigeration being usually credited to the "Joule-Thompson effect." The specific heat of highly compressed gases is usually less than that of the same gas at lower pressure, so that a given weight of gas passing down leg A under high pressure in falling from one temperature to another will give up fewer calories of heat than the same weight of gas coming up the leg D will absorb between the same two temperatures. Thus it is evident that on

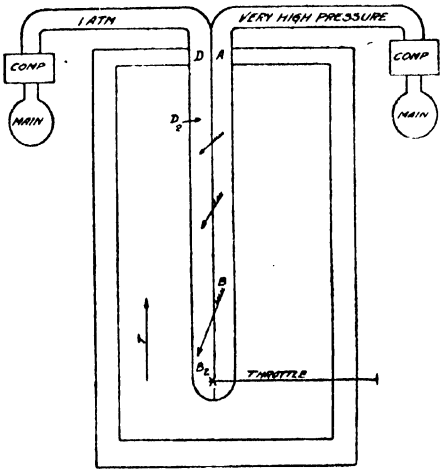


FIG. 2. LINDE SYSTEM, SELF-COOLING.

the whole more heat will be carried out of the system by the issuing gas than is brought in by the incoming, with resulting refrigeration.

The fact that these differences of specific heat only become important at considerable pressures and the pressure created for this purpose is practically wasted at the throttle, as far as useful mechanical effect is concerned, makes this process decidedly inefficient from a thermodynamic standpoint; *i.e.*, from the question of power consumption. Its chief merit lies in its extreme simplicity and freedom from moving parts. It is the type of system first developed both in the laboratory and commercially. As cooling proceeds, liquid finally forms at B_2. For the purpose of separating the constituents of the mixture the leg D is developed into a "column still" on the same principle as those used for rectification of ordinary liquids, but, to avoid confusion, not shown in the present cuts.

Claude system.

In the Claude system, schematically represented in fig. 3, another principle is introduced. It was early pointed out by Lord Raleigh and others that if some sort of expansion engine could be substituted for the free expansion throttle in systems of the Linde type and the work of these engines expended outside the heat-tight room, greater refrigerative effect would be produced even if all the mechanical work so produced were allowed to go to waste, for in its mere production it would have already extracted an equivalent amount of heat from this room. As, for the purposes in hand, these engines must work at very low temperatures, grave mechanical difficulties were seen in the problems of lubrication, brittleness of valves, stoppage by frozen impurities from the gas and the like. George Claude, of Paris, was the first to solve these difficulties, at least in a commercial way. By use of an expansion engine Claude was able to drop the initial gas pressure to from 400 to 600 lb. per sq. in., or even lower in some of the larger units recently erected for air separation. At these pressures the effect depended upon by the Linde system practically disappears, so that, in practice, the Claude system works essentially on

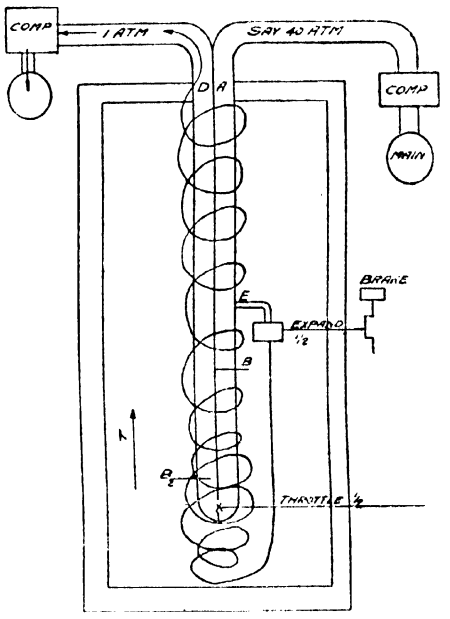


FIG. 3. CLAUDE SYSTEM, EXTERNAL WORK FOR COOLING.

a wholly new principle rather than by the superposition of this upon that of the Linde process.

However, as Claude confined himself to one expansion engine (though this is in many cases compound, having a high and a low pressure cylinder), it was necessary for him, with the moderate initial pressure used, to locate the engine's gas intake at a level in the interchanger sufficiently low so that the exhaust would reach the lowest temperature desired in the system and still be able to absorb quite an appreciable amount of heat at this temperature.

With the one engine taking its gas from the incoming side of the U, it is also evident that for efficient liquefaction only a part of the gas can be expanded through the engine, for, if liquefaction takes place in its cylinders, expansion to that extent is lost. The remainder of the gas must, therefore, be retained under pressure in the U and cooled down and liquefied by heat exchange with the expanded gas returning as indicated by the spiral line around both legs of the U. The gas after liquefaction in leg A is let into leg D through

the throttle, and there under the lower pressure rapidly drops still further in temperature by its own evaporation. Here it undergoes fractional distillation as explained above.

Jefferies-Norton system.

Coming finally to the Jefferies-Norton system, fig. 4, it will be noted that this differs from the Claude in at least three important points, *viz.*: (1) The system employs more than one engine (in the illustration three, AE, BE, and CE), each working through a different temperature range. The number of these temperature steps depends upon conditions, increasing with the total range of temperature to be covered and also with decreasing initial pressure employed. (2) The pressure in the outgoing leg of the U is only enough lower than in the incoming leg to allow for proper control of flow, unavoidable friction, head of liquid in the still trays and the like. (3) The engines work upon the gases after their liquefaction and distillation, thus permitting all the gas to be so treated. Incidentally, this also insures freedom from easily frozen impurities entering the engine valve chambers and cylinders and in many cases greatly simplifies the whole problem of initial purification of the gas to be treated. Engine C corresponds in a way to Claude's one-engine

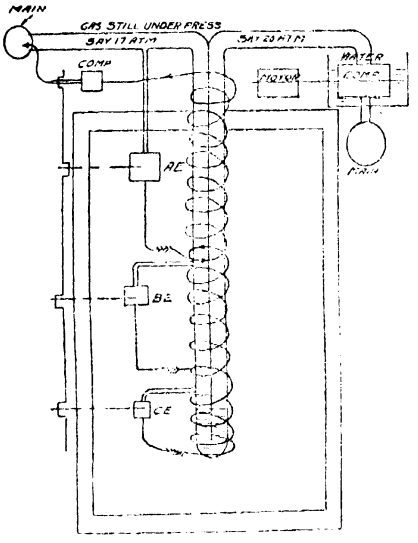


FIG. 4. JEFFERIES-NORTON SYSTEM, TEMPERATURE COMPOUNDED.

system, but as the initial pressure used in the system can, on account of its greater efficiency, be much less than in the Claude, the temperature range over which this engine works will be much less than in the latter. Since, when expanding a given weight of gas between two definite pressures, the work obtainable from it (and consequently the number of calories its expansion will extract from the system) is greater the higher its temperature, engine A will extract the most heat from the system and deliver the most power to the crank-shaft per unit of gas used, and engine C the least, which still further emphasises the importance of this development.

Rough analogies, though suggestive, are often dangerous to accuracy in scientific and technical explanations, but without laying any great stress upon it, the following may here be helpful to those not especially familiar with this subject. It was pointed out at the start that a considerable amount of the refrigerative effort which has to be expended in any of these processes is to remove the heat which, despite the best insulation, still leaks in from without. Now in this sense the expansion engines of the last two processes may be thought of as engaged partly in pumping out this heat from the refrigerated system back to the outside, much as mine pumps are kept busy pumping out the water which leaks into a mine. Just as water may be coming in at various levels in the mine, so heat is leaking into parts of the system at all levels of temperature. The one engine of the Claude system is analogous to the mine with a single pumping station at the bottom where all water entering at any part of the mine is allowed to drain clear to the bottom and is then all pumped from there to the surface, while the Jefferies-Norton system is analogous to the installation of several pumping stations at different levels so that water from the upper levels is pumped out over the shorter lifts, thus saving power.

The really salient feature brought out in these diagrams is perhaps the progressive approach toward the ideal of thermodynamic reversibility and the high degree to which this is fulfilled in the basic principles of the Jefferies-Norton system.

Meeting held at Chemists' Club on March 21, 1917.

MR. C. E. SHOLES IN THE CHAIR.

A NEW DEPARTURE IN PHOTOMICROGRAPHY.

BY ALEXANDER SILVERMAN.

The use of a new type of lamp* in photography has yielded interesting results which have been described in American journals.† A new type of rheostat, described here for the first time, permits of such latitude in the control of light-intensity as to render the apparatus much more valuable than at first anticipated.

The lamp consists of a ¼-inch colourless or blue (daylight) glass tube containing a single tungsten filament. The tube is bent into a circle of 35 mm. outside diameter. While the lamp is a 0·7 ampère, 9 volt unit, with a life of about 900 hours, it is operated at 0·9 ampère and 13 volts for visual work, under which conditions its life is about 150 hours—a long one for microscopic work. For photographing it is worked at 1·02 ampère and 18 volts; under these conditions the life is about 3½ hours. Exposures are made in from 10 to 40 seconds, usually about 15 seconds, so that the cost, including time required for focussing, would not be more than one cent per plate. The lamp is silvered a little more than half-way round. A plane passing through the edges of the reflector is inclined towards the stage at an angle of about 45°. This reflects light conically from the circular source to the portion of the object under examination.

The holder containing the lamp is shown in fig. 1. The holder contains three iris-like fingers which clamp it to the objective. These are actuated by springs which are controlled by thumb pieces so as to clamp the holder to any objective. If the lamp is to be maintained at a constant distance from the object a tube may be clamped to the stage of the microscope, the lamp attached to the tube, and the objective raised or lowered inside the tube. If it should prove desirable to cut off the light from one

* U.S. Pat. 1,267,287; Canadian Pat. 185,283; Italian Pat. 48/485.

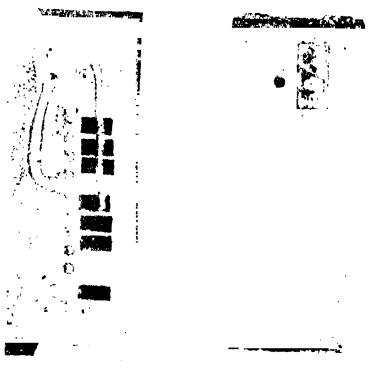
† J. Ind. Eng. Chem., 1917, 9, 971; 1918, 10, 1013; Chem. and Met. Eng., 1918, 19, 508.

half of the circular source, a disc may be placed under a portion of the lamp. The disc can be fitted with fingers which slip into the lamp.



FIG. 1.

The Rheostat.—The new rheostat (fig. 2), which is built for 110 volt or 220 volt lighting circuits, has nine connecting posts so that the lamp may receive the proper current for deviations from the normal



BOTTOM TOP

FIG. 2.

line voltage. It is equipped with a push switch for visual work and a spring contact for photographic work. The latter lies on a shunt circuit so that it may be operated alone or while the push switch is on.

Photography.—Objects to be photographed are placed on the stage in the usual way. The light intensity and quality are such that a camera without shutter or lenses may be attached to the tube of the microscope. With a 10 × eyepiece and 16 or 32 mm. objective an exposure of 15 seconds is usually ample. The lamp travels with the objective, so that the height of the surface to be photographed, above the stage, is immaterial.

Most modern microscopes are equipped with vertical illuminators. The tube length is computed to include the vertical illuminator tube. If this is removed it is necessary to raise the collar to about the 176 mm. point to focus for a uniformly good image on the ground glass. Focussing may be facilitated by greasing the ground glass with vaseline, afterwards rubbing it as dry as possible.

In metallographic work the plate appears almost like the positive printed from a negative taken with vertical light. This will necessitate a re-interpretation of the picture, but the wealth of detail visible in photographs taken by the new method justifies the step. Depth is shown which it is impossible to obtain with the vertical illuminator, and in slag pits which look black under vertical light, the slag content is visible by the new method.

Light-absorbing surfaces which are almost invisible under vertical light display surprising detail under the new light. Paper, textiles, insulating materials, botanical specimens, ceramic materials, etc., when examined by the two methods furnish all the evidence necessary. In examining deep, hollow objects like steel test dishes employed in the enamel industry, the light may be lowered into the object with the objective. It is impossible to use the vertical illuminator for this purpose.

With the disc-type vertical illuminator one not only looks through the disc but also encounters transmitted rays. As the new illuminator surrounds the objective, only reflected rays pass into the microscope tube. The light is soft and very little, if any, eyestrain results.

Successful results have been obtained with 8 to 60 mm. objectives combined with 5 to 12½ × eyepieces. The illuminator works well on binocular microscopes fitted with ordinary objectives. A holder or adapter is being designed for double objectives of elliptical cross-section. Experiments will be undertaken shortly to determine its value in oil-immersion work. There is a possibility that important developments may result with high-power objectives in the field of bacteriology by producing a sort of ultramicroscope effect.

The advantages of the apparatus are that the lamp travels with the objective, the light adjustment necessary with most of the older illuminators is eliminated, and the whole process is simplified. The author recently exposed ten plates and in two hours had ten perfect negatives. By using the ordinary Bausch and Lomb micro-camera in a vertical position and placing the rheostat on the floor it was only necessary to press the spring contact by stepping on it while focussing on the ground glass.

School of Chemistry,
University of Pittsburgh.

Sydney Section.

Meeting held at the University on November 20th, 1918.

MR. B. J. SMART IN THE CHAIR.

NOTE ON THE MARKING OF PAPER BY METALLIC STYLES.

BY W. J. KIRCHNER, B.SC.

A series of experiments was carried out to ascertain the effect of metal styles on paper which had been coated with a metallic oxide mixed with a solution of glue in water (2 grms. in 30 c.c.), and then dried. The following substances were tested:—Commercial zinc oxide, 6·5 grms.; precipitated zinc hydroxide, 6·5 grms.; magnesium oxide, 2·8 grms.; aluminium oxide, 4·0 grms.; calcium carbonate, 7·1 grms.; barium oxide, 10·9 grms.; stannic oxide, 9·6 grms.; arsenious oxide, 14·1 grms.; antimony trioxide, 20·5 grms. It was found that styles of copper, brass, tin, zinc, lead, aluminium, silver, nickel, gold, platinum, and magnesium gave marks of varying intensity on all the papers except that coated with precipitated zinc hydroxide (this was only very faintly marked by a few of the softer metals); the papers coated with antimony oxide and arsenious oxide also failed to show a mark with copper, brass, zinc, nickel, platinum, and iron. A solution of gum arabic, 6 grms., in water, 30 c.c., gave similar results to those with glue solutions. Papers coated with solutions of glue or gum arabic alone failed to give markings.

Yorkshire Section.

Meeting held at Leeds on April 14th, 1919.

MR. W. M. MCD. MACKEY IN THE CHAIR.

THE IODINE VALUE (WIJS) OF PALM KERNEL OIL.

BY R. H. ELLIS, F.I.C., AND ERIC M. HALL, B.SC., A.I.C.

The iodine values of oils and fats given in Lewkowitsch's and other works are usually collected from various sources. The names of the observers are sometimes given, but the method used and the number of samples examined are rarely specified.

Though Lewkowitsch maintains that iodine values obtained by Hübl's method agree perfectly with those obtained by Wijs' method, it has been shown (Allen, "Commercial Organic Analysis," Vol. 2, p. 32) that the former method gives lower values than the latter, this being most noticeable in the case of the highly unsaturated oils. This may account in part for the fact that the iodine values for palm kernel oil as given by Lewkowitsch are lower than those found in the samples under review, which were all obtained by Wijs' method. Lewkowitsch ("Oils, Fats, and Waxes," Vol. 1, p. 328) and Allen (*loc. cit.*, Vol. 2, p. 72) give the range of values for palm kernel oils as 13—17 and 10·5—17·5 respectively, and Lewkowitsch mentions one value of 17·5. Fryer and Weston give 10—17 as the usual variations, with 13·5 as an average figure, whilst Bolton and Revis ("Fatty Foods," p. 155) give 14 to 19.

The values given below have been obtained from oil expressed from kernels crushed in the mill under ordinary works conditions. Very large quantities have been dealt with and the samples examined were the seller's samples of those taken in the ordinary course as between buyer and seller.

The following table gives the maximum, minimum, and mean values found for the years 1916—1918 for both crude and refined oil:—

Year	Kind	No. of tests	Maximum	Minimum	Mean
1916	Refined	63	22·5	15·7	17·9
1916	Crude	356	22·6	16·6	18·8
1917	Refined	193	22·5	16·2	18·5
1917	Crude	489	22·8	16·1	18·7
1918	Refined	318	22·6	15·6	17·8
1918	Crude	391	22·9	15·6	18·3
3 years	Refined	574	22·6	15·6	18·1
3 years	Crude	1236	22·9	15·6	18·6

The values for 1918 have been analysed with the results shown below:—

	Refined (318 samples)	Crude (391 samples)
Below 16·0	5	1
16·0—16·9	77	56
17·0—17·9	126	94
18·0—18·9	55	71
19·0—19·9	35	69
20·0—20·9	13	70
21·0—21·9	5	27
Above 22·0	2	4

Average samples of the oil made each month have been tested with the results given in the subjoined table; these samples represent very large quantities of oil.

Year	Kind	Maximum	Minimum	Mean
1916	Refined	19·9	16·6	17·9
1916	Crude	19·9	17·8	18·8
1917	Refined	20·4	17·1	18·5
1917	Crude	19·7	17·6	18·7
1918	Refined	20·2	16·7	18·0
1918	Crude	20·5	17·3	18·3

Official samples of kernels were extracted in the laboratory with results as follows:—

	No. of Tests	Maximum	Minimum	Mean
"A"	27	17·4	16·0	16·5
"B"	8	16·9	16·6	16·7
"C"	32	18·7	15·6	16·9

Fourteen samples of oil extracted from palm kernel cake have also been examined; the values obtained were maximum 21·21, minimum 16·41, mean 18·87.

Conclusions.—The mean iodine value of the expressed oil is in every case outside the range of values given in the books of reference mentioned except in that of Bolton and Revis. The quantity of oil represented is large enough to be taken as thoroughly representative of the palm kernel oil now on sale.

The number of samples of oil extracted directly from the kernels is comparatively small, but would appear to show that such oil has a lower iodine value than expressed oil; the data available at present is not sufficient to enable reliable conclusions to be drawn.

It seems clear, however, that the usually published values are too low, and that the normal range of iodine values (Wijs) for palm kernel oil is 16—23. Any oil giving a value outside this range would be of doubtful purity, though if it were only just outside confirmation would have to be obtained from other data.

Communications.

THE DETERMINATION OF BENZENE IN CRUDE BENZOLS.

BY WILLIAM JACOB JONES.

Introduction.

Two years ago a cryoscopic method whereby the content of benzene in commercial "pure" benzols could be rapidly and accurately determined was described by the author. An account of this method was officially circulated in England among persons interested in the purity of benzols, and it has since been published (J. Soc. Dyers and Col., 1919, **35**, 45; see this J., 1919, 216 A). The purpose of the present communication is to describe how the method may be applied to the determination of benzene in the crude benzols of commerce.

In view of the increasing use of these products as motor fuel, this question has latterly assumed considerable importance. For this purpose the value of the benzol depends largely on its content of benzene. The less volatile constituents, viz., toluene and the xylenes, are of less value, whilst the constituents containing sulphur, *viz.*, carbon bisulphide and thiophen, are objectionable. Moreover a high content of benzene (b. pt. 80° C.) is in general indicative of good rectification and of a low content of carbon bisulphide (b. pt. 46° C.).

The principle of the present method consists in elevating the freezing point of the crude benzol by admixture with a suitable quantity of a fairly pure benzol to the region, viz., 0° C. and upwards, where the freezing point is proportional to the content of benzene.

Apparatus.

Where a Beckmann apparatus is not available, the necessary apparatus may be assembled as follows: A litre beaker, provided with a stirrer of stout copper wire, and filled with a suitable mixture of ice, salt, and water, serves as an outer cooling bath. Centrally fixed in the beaker stands a wide test-tube, within which is concentrically fitted a narrower test-tube to serve as freezing-point tube. The air space between the test-tubes serves as a cooling air mantle. Through a cork in the neck of the freezing-point tube there pass a standardised thermometer graduated to 0·10° C. or 0·20° C. and extending over the range 0° C. to 6° C., and a copper wire stirrer. Failing a certified thermometer an instrument which has been set against melting ice

(0° C.) and freezing, carefully purified benzene (5·488° C., Richards and Shipley, J. Amer. Chem. Soc., 1914, 36, 1825) may be used. To this thermometer, and with its bulb half way up the emergent mercury column during the determination, is fixed a subsidiary thermometer for the purpose of evaluating the stem correction. This correction, which is to be subtracted from the freezing point, T° C. as read on the standard thermometer, amounts to 0·00016N (t^1−T), where t^1° C. denotes the reading of the subsidiary thermometer, and N the length of the emergent thread of mercury in the standard thermometer from the surface of the benzene expressed in number of degrees.

Procedure.

The freezing point of the "pure" benzol which is to be used for the purpose of elevating the freezing point of the crude benzol is first determined.

The temperature of the cooling bath should not exceed 5° C. below the freezing point of the liquid. As the freezing point is being approached the temperature indicated by the standard thermometer falls continuously, then reaches a minimum owing to supercooling, next abruptly rises, and finally attains sensible constancy during the initial stages of solidification. The highest temperature reached during this period of "constancy," corrected for the temperature of the emergent thread of mercury, is taken as being the freezing point. Under the conditions described it will be found that the extent of supercooling will not exceed 0·3° C. The stirring should be at the rate of an up-and-down movement of the inner stirrer about once per second. In order to minimise the effect of lag the thermometer should be tapped with the finger before a reading is taken.

It is advisable to preserve the benzols to be analysed in contact with a little water, and to refer their freezing point to the equation which applies to wet benzene, viz., $x = 90{\cdot}68 + 1{\cdot}73t$, where x is the content of benzene per cent. by weight in the sample, and t the freezing point of the sample.

Should the crude benzol be contaminated with acid or alkali, preliminary complete washing with water is necessary.

The content of benzene in the "pure" benzol which is to be used for diluting the crude benzols having thus been determined, we proceed to find out what proportion of the crude benzol is required to be added to the "pure" benzol in order to depress the freezing point of the latter by about 5° C. For this purpose a trial experiment is carried out as follows: The crude and "pure" benzols are put in separate burettes and by admixture of various amounts of the two and determination of the freezing points of the mixtures, it is found out what proportions of the two yield a mixture which freezes in the region 0° to 1° C.

These proportions having been approximately fixed, a mixture is prepared of those proportions containing accurately known amounts of the crude and of the "pure" benzol and its freezing point is determined carefully. For this purpose the inner freezing-point tube is provided with a cork and with a copper wire whereby it may be suspended from the beam of a balance. The tube is weighed, the suitable volume of the "pure" benzol is introduced, the tube is again weighed, then the suitable volume of the crude benzol is introduced, and the tube is weighed a third time. The freezing point of the mixture thus obtained is determined.

We are now in a position by means of the equation, $x = 90{\cdot}68 + 1{\cdot}73t$, already referred to, to calculate the percentage by weight of benzene in the crude benzol. How this is done is best illustrated by means of the following examples.

The determination of the content of benzene in mixtures representing benzols of known composition.

To test the accuracy of the present method, three mixtures containing those substances which are present in considerable quantity in crude benzols were prepared. The substances used in making up these mixtures had each been subjected to careful purification. The composition of the three mixtures and their descriptions were as follows:—

Components	Mixture—weight % A	B	C
Aliphatic hydrocarbons...	1·0	2·0	1·0
Carbon bisulphide	0·5	4·3	1·
Thiophen	0·5	0·5	1·0
Benzene	79·9	69·1	44·3
Toluene	16·1	23·1	41·7
Xylenes	2·0	1·0	11·0

All these mixtures were saturated with water. It was found that two parts of water per 1000 parts of the mixture was more than sufficient to saturate them.

Further particulars of these mixtures are given below.

	Mixture A	B	C
Sp. gr. 15·6°/15·6° C.	0·876	0·880	0·872
Distillate (from flask) % by weight up to 100° C. ...	91·7	90·8	51·6
Ditto, up to 120° C.	—	98·5	93·2
,, ,, 125° C.	—	—	96·2

The "pure" benzol used for the determinations was saturated with water, and, possessing a freezing point of 4·49° C., contained, by the formula, 98·45% of benzene.

Mixture A.—22·108 grms. of the "pure" benzol plus 13·174 grms. of the mixture A, gave a mixture the freezing point of which was 0·51° C., and which, therefore contained 91·61% of benzene. Now 22·108 grms. of the diluent "pure" 98·45% benzol contained 21·765 grms. of benzene, and the 35·282 grms. of the 91·61% mixture contained 32·322 grms. of benzene. By difference, 13·174 grms. of the mixture A contained 10·557 grms. of benzene, *i.e.*, the content of benzene in the mixture A was 80·1% by weight.

Mixture B.—26·601 grms. of the "pure" benzol plus 9·607 grms. of the mixture B gave a mixture the freezing point of which was −0·06° C., and which therefore contained 90·58% of benzene. Now 26·601 grms. of the "pure" 98·45% benzol contained 26·189 grms. of benzene, and the 36·208 grms. of the mixture 90·58% contained 32·797 grms. of benzene. By difference, 9·607 grms. of the mixture B contained 6·608 grms. of benzene, *i.e.*, the content of benzene in the mixture B was 68·8% by weight.

Mixture C.—30·843 grms. of the "pure" benzol plus 4·974 grms. of the mixture C gave a mixture the freezing point of which was 0·29° C., and which therefore contained 91·18% of benzene. Now 30·843 grms. of the "pure" 98·45% benzol contained 30·365 grms. of benzene, and the 35·817 grms. of the 91·18% mixture contained 32·658 grms. of benzene. By difference 4·974 grms. of the mixture C contained 2·293 grms. of benzene, *i.e.*, the content of benzene in the mixture C was 46·1% by weight.

These results are here summarised.

	Mixture A %	B %	C %
Content of benzene, actual ...	79·9	69·1	44·3
,, ,, found ...	80·1	68·8	46·1

It will be seen that in the case of the so-called "90%" benzols the present method affords a good measure of the content of benzene, whilst even in the case of the so-called "50%" benzol the result is still of value.

The trial experiment in the case of benzol of unknown approximate composition takes half an hour to perform. The final precise determination can also be completed in that time. The accurate determination of the content of benzene in a crude benzol can thus be completed in an hour.

By no method of determination of benzene in crude benzols hitherto described can an accuracy or a rapidity comparable with that of the present method be attained.

Summary.

The content of benzene in a crude benzol can be determined by suitable dilution of the benzol with a purified benzene so as to bring the freezing point up to the region 0°—1° C. From the weights of crude benzol and of purified benzene used in the preparation of a mixture freezing in this region, and from the carefully determined freezing points of the purified benzene and of the mixture, the content of benzene in the crude benzol can be calculated. Such a determination can be completed in an hour.

The author wishes here to record his indebtedness to Dr. J. T. Hewitt, F.R.S., for advice and encouragement in the present work.

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NOTES ON CARBON IN 80 : 20 CUPRO-NICKEL MELTED IN THE ELECTRIC FURNACE.

BY F. C. THOMPSON, D.MET., B.SC., AND W. R. BARCLAY, A.M.I.E.E.

The avidity with which molten nickel absorbs carbon, and the instability of the carbide, Ni_3C, formed, render the presence of this element as an impurity a possible source of much trouble in nickel and most of the nickel alloys. The thermal-equilibrium diagram nickel-carbon has been investigated by K. Friedrich and A. Leroux (Metallurgie, 1910, 7, 10—13; this J., 1910, 159), whose conclusions were as follows: Nickel holds up to 1% of carbon in solid solution; a eutectic occurs at 1307°—1318° C. with somewhere between 2 and 2·5% carbon. An alloy containing 2·6% of carbon contains primary crystals of a second constituent the nature of which could not be determined. The alloy containing 1% of carbon was so brittle as to be broken by a hammer, but the alloys containing larger quantities of carbon were so tough as to need a planing machine for cutting sections. O. Ruff and W. Martin (Metallurgie, 1912, 9, 143; this J., 1912, 285), who worked on the same subject a little later, arrived at the following conclusions: The solubility of carbon in molten nickel increases with the temperature up to a maximum of 6·2% at 2100° C., corresponding to the compound Ni_3C. Above this temperature the solubility is constant. The carbide was so unstable that even rapid quenching failed to prevent completely its decomposition into nickel and graphite. Rapidly cooled specimens, however, contained a constituent which was identified with the compound. As a result of slow cooling or by reheating the alloy to a temperature above 700° C., a decomposition of the Ni_3C occurs, the carbon being precipitated in the graphitic condition. The ease with which this occurs is due to the fact that the reaction, $Ni_3C \rightarrow 3Ni+C$, is an exothermic one, 394 cals. being liberated.

The authors have recently come across a most interesting example of trouble arising from this cause in cupro-nickel containing 20% of nickel. The alloy had been melted in the Héroult electric furnace, in the neighbourhood of the electrodes of which an extremely high temperature is locally attained. The nickel alloy forming the bath possesses, therefore, a very considerable power of dissolving carbon either directly from the electrodes or as carbon or carbon compound vapours. At 3000° C.—the temperature of the electric arc—pure nickel would, according to Ruff and Martin's work, hold 6·2% of carbon in solution, and though the copper present will tend considerably to reduce this figure for the cupro-nickel the value will still be high. Further, although the mean temperature of the bath will be much lower than that of the arc, say 1400° C., a process of diffusion will result in carbon taken up under the electrodes travelling as Ni_3C throughout the bath until this becomes more or less saturated. The extent of saturation will depend on the temperature and on the duration of the melt. The following figures for five different heats will give an idea of the carbon which may thus be taken up: Carbon, %, 0·178, 0·220, 0·220, 0·235, 0·35. The exact value of the saturation content is not known but is probably not far from 0·35%.

This absorption of carbon by the bath was so pronounced that a special decarburising process had to be included in the melting. Before this was done much trouble was experienced, an account of which is the purport of these notes.

The structure of the ingots cast from the metal high in carbon was of a perfectly normal character, as will be seen from fig. 1 which reproduces the "as-cast" structure of an alloy with 0·12% carbon magnified 200 diams. and etched with nitric acid of sp. gr. 1·20. The normal dendritic pattern is seen to be free from graphite, the carbon occurring in the ingots in the combined form. The cold rolling properties of this material were excellent, the nickel carbide in solution rendering the alloy considerably superior to a similar one with lower carbon content in its behaviour in the rolls. Ingots 1½ in. thick were repeatedly rolled down to 0·04 inch strip without a single annealing.



Fig. 1.—× 200 diams.

So far the material could not have given greater satisfaction, but trouble arose immediately the finished strip or the ingot in any intermediate stage was annealed. After the heating the alloy was utterly brittle and devoid of any ductility, in fact the alloy was more ductile in the hard rolled state than when annealed. This "biscuit" strip was quite useless for the purpose for which it was required. The reason for this was not at first known, and many theories were propounded and experiments conducted, but without success. The strip had to be delivered in the soft condition, but as soon as annealing was carried out, under whatever conditions, a brittle material was obtained which could not be improved by anything short of remelting.

The microstructure of this "biscuit" strip magnified 200 diams. and unetched is shown in fig. 2, and affords at once a complete explanation

of the remarkable physical properties. Each crystal will be seen to be surrounded by an intercrystalline net-work of a dark constituent of

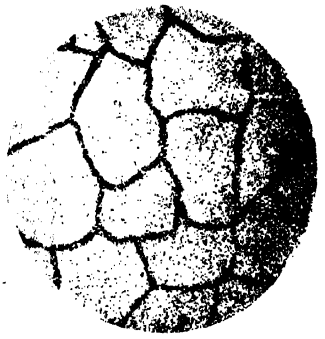


Fig. 2.—× 200 diams.

considerable thickness. From the known chemical composition of the alloy this could hardly be anything else than gas-fissures or graphite, and an analysis at once showed the presence of free carbon. The mode of occurrence of this, however, is most unusual. So far as the authors' experience goes, whenever graphite separates out from any metal or alloy *in the solid state* it does so (with the exception of the present case) not in the form of intercrystalline cell walls but as isolated rosettes.

Fig. 3 is the microstructure for comparison of a normal cupro-nickel treated in the same way as that of fig. 2, but etched with nitric acid.



Fig. 3.—× 200 diams.

The next stage in this rather remarkable history occurred when, as a result of reheating a piece of the brittle strip to about 1000° C. in an atmosphere of hydrogen, Mr. W. R. Garratt succeeded in converting the sample which before treatment could be readily broken with the fingers into a material which could be bent backwards and forwards several times without fracture. Further similar heatings in nitrogen, carbon monoxide, carbon dioxide, and air also rendered the brittle strip ductile, and demonstrated the fact that the nature of the atmosphere in which the annealing was carried out was of little or no importance, the essential point in this regeneration of the strip lying in the high temperature to which it had been heated. Fig. 4 shows the structure at 200 diams. of the regenerated material, and explains at once the renewal of the ductility. The cell walls of free carbon have disappeared, their place being taken by isolated patches of graphite of what may be called normal character.

This change brought about by the high temperature suggested that it might prove a way out of the impasse. It was argued that if the presence of free carbon in the massive condition did not appear seriously to affect the ductility of the material then, if the ingots themselves were

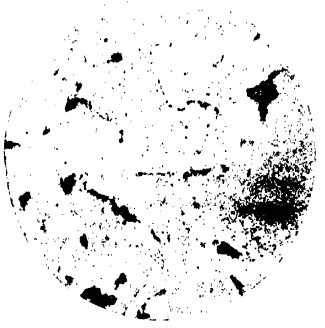


Fig. 4.—× 200 diams.

annealed at 950°—1000° C. before being taken to the rolls, the graphite would be already in a more or less innocuous state and further treatment would be unlikely to reproduce the "biscuit" condition. Experiments on these lines were carried out but never became a practical success. Although the nodular condition was obtained for the graphite the material could never be rendered quite ductile enough to pass the drastic tests required. This treatment was, therefore, never followed up, and as the only remaining way out of the difficulty seemed to be to oxidise the carbon in the furnace the special treatment already referred to was adopted and proved completely successful.

In order to determine as exactly as possible at what temperature the nickel carbide in solution in 80 : 20 cupro-nickel becomes unstable a series of strips of high-carbon cupro-nickel were annealed in a salt bath for 15 minutes at gradually ascending temperatures. The annealed strips were tested for brittleness by a bending test and qualitatively for free carbon. The results are given in Table I.

TABLE I.

No.	Temperature of annealing	Number of bends endured	Free carbon
	C.		
1	620	3	Absent
2	680	5⅓	,,
3	740	1½	Present
4	810	3	,,
5	880	4	,,
6	950	4⅓	,,

As will be seen the strips annealed at temperatures up to 680° C. were each softer and more ductile as the temperature was raised, a result which would be expected since the best annealing temperature for 80 : 20 cupro-nickel is in the region of 720° C. The next strip, however, annealed at 740° C., was quite brittle and possessed the structure of fig. 2. The further increase of temperature results in some return of the ductility, which went on, though at a continuously slower rate, up to the highest temperature tried. The structure of No. 6 was that shown in fig. 4. The temperature at which nickel carbide becomes unstable is apparently in the region of 700° C., which is in good accord with the estimate of 650°—700° C. due to G. A. Boeddicker (J. Inst. Metals, 1912, 7, 181).

A few determinations were made of the specific gravity of samples in the as-cast condition, *i.e.*,

with the carbon in the combined form, and also after annealing at 1000° C. to precipitate the carbon in the graphitic state. In each case the precipitation of free carbon resulted, as might be expected, in a decrease in the density of the alloy.

TABLE II.

Carbon %	Sp. gr. in as-cast condition	Sp. gr. after annealing
0·042	8·915	8·884
0·061	8·900	8·882
0·073	8·887	8·879
Mean	8·901	8·882

A large number of records have been examined to determine if possible at what percentage of carbon graphite is first precipitated and what is its solubility in the alloy in the solid state, the pertinent results being collected in Table III. It will be seen that in two cases less than 0·02% of carbon remains in the combined form, and that with no more than 0·02% of total carbon graphite may be precipitated.

TABLE III.

Total carbon	Combined carbon	Free carbon
%	%	%
0·098	0·056	0·042
0·06	0·03	0·03
0·06	0·03	0·03
0·059	0·012	0·047
0·03	0·03	trace
0·02	0·02	trace

Carbon contents of less than 0·01% are in practice rarely harmful.

In conclusion it may be worth while to point out that cupro-nickel melted in the crucible may contain sufficient carbon to result in a precipitation of graphite on annealing producing typical biscuit metal. Carbon contents of 0·106 and 0·124% have been observed in the crucible-melted material, both of which yielded brittle strip when annealed, and in no case have the authors examined typically biscuit cupro-nickel in which free carbon was not present.

The authors wish to record their thanks to Mr. J. Kent-Smith for his cordial co-operation, and to Mr. W. R. Garratt who made the very considerable number of chemical analyses necessary in this investigation.

NOTES ON THE ESTIMATION OF PHENOL IN TAR OILS.

BY G. CAMPBELL PETRIE, F.I.C., A.R.T.C.

A number of experiments were carried out to compare the different methods now in use for the estimation of phenol in fractions from coal tar oils, with a view to devising a more rapid method.

Lowe's method was not examined as it requires rather a large bulk of liquid; that by Knight, Lincoln, and others (J. Ind. Eng. Chem., 1918, 10, 9) gave a low result and involved very tedious working. The methods by Fox and Barker (this Journal, 1918, 265 T) and Weiss and Downs (J. Ind. Eng. Chem., 1917, 9, 569) compare very favourably, the latter giving a slightly higher result. It was decided to experiment with the quicker method, namely that of Fox and Barker, and to shorten this if possible. The experiments indicated that calcium chloride was not a satisfactory agent for drying.

When the crude phenol acids, washed to remove sulphuric acid and containing ether, are dried over this substance an obstinate sludge is formed. Difficulty is also experienced in washing the phenol acids free from sulphuric acid; if that process is not complete the phenol distillate will be contaminated with hydrochloric acid, owing to small pieces of calcium chloride being transferred with the viscous liquid to the distillation flask. To obviate this the crude acids containing ether were distilled without drying and the ether and water distillates collected separately in a separating funnel, distillation being continued to 210° C. after changing the condenser. This distillate, free from water, was collected in a 300-c.c. round bottomed flask, tightly stoppered to exclude moisture. The first condenser was washed out with the ether, which was then added to that in the separating funnel and the aqueous distillate was saturated with sodium sulphate. The contents were well shaken, the water run off, and the ether solution dried over plaster of Paris and filtered into the distillate to 210° C. On fractionation over a Young's 12-pear head, only a trace of moisture was observed in the head after the ether had distilled off. The first two or three drops coming from the side tube were discarded in case they were contaminated with ether vapour and moisture; the condenser was changed and distillation continued to 195° C. (corrected). On drying these distillates with fused calcium chloride variable results were obtained, as was also the case with other dehydrating agents used. The results of this procedure were 1·5—2·5% too high on mixtures containing 15—26% phenol. A quantity of calcium chloride was prepared by fusing in a porcelain crucible placed in a muffle and cooling in a current of carbon dioxide. This sample was tested both on distillates to 195° C. and on mixtures of phenol and *o*-cresol of known solidifying point to which some water had been added. The effect of plaster of Paris and anhydrous sodium sulphate on the same samples was tried.

No.	Original	Solidifying point after drying with: Fused calcium chloride	Plaster of Paris	Anhydrous sodium sulphate
	°C.	°C.	°C.	°C.
1	19·1	19·1	19·25	—
2	18·45	—	18·55	—
3	18·35	—	—	—
4	17·45	—	18·25	—
5	16·85	17·2	16·1	16·85

Nos. 1—3 are figures for the final distillate to 195° C. Nos. 4 and 5 for the same after addition of water.

A mixture of 70·5% phenol and 29·5% *o*-cresol was made up and 0·5% of water added. The solidifying point of the mixture was 20·8° C. (without water 23·05° C.). Portions were dried over various drying agents with the following results:

Drying agent	Solidifying points After 12 hours °C	After 18 hours °C
Calcium chloride	21·7	21·7
Plaster of Paris	19·7	19·55
Anhydrous sodium sulphate	20·8	20·8

Thus none of the drying agents employed extracts all the moisture from phenolic mixtures. It has also been found that the percentage of phenol, calculated on the original sample, was not altered appreciably by drying the distillate before finally mixing with pure phenol. The solidifying points were raised by one sample of plaster of Paris and lowered by another, although both samples set well.

The method mentioned above was modified and tested with a synthetic mixture. The ether used for

washing the sulphate liquor was replaced by benzol, which dissolves only about 0·2% water. The mixture is dissolved in twice its volume of benzol and extracted with a 10% solution of caustic soda. Two extractions are necessary, first with 400 c.c. and finally with 100 c.c. The carbolate solution is allowed to settle for about 30 minutes, run off, and distilled with steam. To prevent dilution it is preferable to heat the solution almost to boiling before passing the steam, and to continue heating with a small flame during the distillation; about one hour is sufficient to drive off all the neutral oil and naphthalene. After cooling and transferring to a 2-litre separating funnel, the phenol acids are liberated by means of dilute sulphuric acid (1 : 1), keeping the liquid cool. The liquid gradually turns milky and the acid point is reached, when evolution of carbon dioxide from carbonate in the commercial caustic soda becomes permanent; this is observed on opening the stop-cock after shaking. After standing for about 4 hours the sulphate liquor is separated and the phenol acids are transferred to a 300 c.c. separating funnel. The sulphate liquor is extracted three times with benzol, using 30 c.c. for each extraction. The benzol is added to the phenol acids and the water which separates is run off and discarded. The liquid is transferred to a 300 c.c. round-bottomed flask and fractionated over a Young's 12-pear head. The flask and head are separately protected by means of cylindrical wire gauze screens about 3—4 in. diameter. The water distils off with some benzol at about 75° C., after which the remaining benzol passes over practically free from water. (Globules of water can be removed from the bulb of the thermometer and inside of head above the side tube before the benzol is completely removed.) The first two or three drops of phenol distillate, coming over at about 180° C. from the side tube of the column, are discarded in case they are contaminated with benzol vapour and moisture. The condenser is then changed and the distillate to 195° C. collected in a tared apparatus from which moisture is excluded. A round-bottomed flask should be used for this purpose in case *o*-cresol has to be added to give more than 50% of phenol acids in the distillate. The distillate is mixed with pure phenol, without previously drying, and the percentage of phenol is read off from the curve. In one experiment the mixture actually contained 15·25% of phenol; 14·91% was found.

The solidifying point of this distillate varies greatly for different mixtures and also with the speed of distillation, and it is advisable that the rate of distillation should not exceed 1 drop a second, especially if this distillate will contain less than 50% of phenol. Theoretically if only phenol and *o*-cresol are present the solidifying point should not fall below 19° C., and the solidifying point of this distillate should give a rough measure of the other cresols present and also of the efficiency of fractionation. However, it has been found by experiment that if the distillate contained excess of *o*-cresol, the solidifying point can fall as low as 5° C. without affecting appreciably the final results. The solidifying points given in the table were obtained using the same original oil, and with plaster of Paris as a dehydrating agent for the ether solution as described above, but keeping the rate of distillation at less than 1 drop a second.

From the figures given for the oil of unknown phenol content, it would seem that the better the fractionation the higher is the percentage of phenol found. All the distillates were over 50% calculated on the phenol acids and therefore complied with Fox and Barker's recommendation. None of the fractions was appreciably affected by the dehydrating agents. As regards the synthetic mixtures, the phenol content found was too high in the experiments in which drying was employed and only slightly low when no drying agent was used. It remained therefore to choose between drying with an agent which would give a high result, and eliminating the water with benzol by

% Distillate to 195° C., on phenol acids	Phenol in distillate	Solidifying point E. °C.	Solidifying point T. °C.	Phenol in original oil	
	%	°C.	°C.	%	
56·7	61·3	16·05	ap. 20	34·76	
57·3	64·4	18·35	,, 21	36·88	
58·03	64·8	18·45	,, 21	37·6	
Synthetic mixture, ether solution dried.				% Phenol in mixt.	% Phenol found.
63·5	43·1	9	19	26·0	27·4
58·2	30·2	10	22	14·7	17·1
78·1	65·68	19·1	22	50·03	51·33
Synthetic mixture, not dried					
53·5	27·8	about 5	22	15·25	14·91

E. represents solidifying point as found. T. is solidifying point from Fox and Barker's curve, if distillate only contained phenol and *o*-cresol.

distillation and careful exclusion of moisture afterwards. The latter procedure is much quicker and seems to be justified, since none of the existing methods gives the true value of phenol within 1% either way.

If the oil under examination contains more than 50% soluble in alkali, it is advantageous to mix it with twice its volume of benzol before extracting with caustic soda; this results in a quicker and better separation and also shortens the time of steam distillation.

A 10% solution of caustic soda has the advantage of dissolving less neutral oil and gives less trouble with sodium sulphate crystals when there are phenol acids liberated. No noticeable decomposition of the cresols occurred during steam distillation when alkali of this strength was used. The volume of sulphate liquor obtained is about 700 c.c., which is not too large to handle during washing.

Comparing benzol and ether as solvents, the ether extracts more phenol from the sulphate liquor but takes up much water. Heat is liberated on addition of wet ether to the wet phenol acids; this great affinity may be a disadvantage when separating by distillation. Benzol extracts practically all the phenol, dissolves much less water, and, as stated before, carries off all the water on distillation.

The paper by Fox and Barker, previously cited, should be referred to for thermometer corrections and for the method of taking the solidifying point.

In conclusion, I wish to record my thanks to Dr. Percy E. Spielmann for his continued interest and for the valuable advice which he has given during the preparation of this paper.

THE EFFECT OF COOLING BURNER GASES ON THE CATALYTIC ACTION OF PLATINUM IN SULPHURIC ACID CONTACT PLANTS.

BY S. T. T. GEARY, B.A., A.I.C.

In order to start the reaction $2SO_2+O_2 \rightleftarrows 2SO_3$, in presence of platinum, it is necessary to heat to at least 300° C.; the reaction proceeds with maximum velocity when the temperature ranges from 380° to 450° C. The reaction is strongly exothermic, 45,200 calories being evolved. The higher the temperature the more rapidly is a state of equilibrium attained, but the more unfavourable is the final state of equilibrium for the yield of SO_3, as the reverse action increases rapidly with temperature, when the

gases are in contact with platinum, although in the absence of contact substances sulphur trioxide is very stable at high temperatures.

In working a contact plant, the temperature of the gases before entering the platinum chambers is brought up to about 420° C. by means of a battery of pipes passing through the flues of a strong coke fire. An intense evolution of heat takes place where the gases first meet the platinum, and consequently their temperature increases very considerably as they pass through the whole system, so that on emergence they may be as high as 540° C.; at this temperature the back reaction will have proceeded to a very considerable extent, resulting in a serious loss in efficiency.

In order to reduce this final temperature, experiments were conducted, in which the gases were cooled as they passed through the later platinum elements. The cooling was effected by means of air pipes fitting in grooves and passing over and under the platinum elements. The air was supplied as a continuous blast from an air compressor working at 60 lb. to the square inch. Needless to say this would be an expensive method to be adopted; but it served the purposes for which the experiments were carried out.

The maximum conversion will take place in contact with the first platinum element, and the idea was to reduce the temperature at emergence back as far as possible to the original temperature (400°—420° C.) before the gases entered the second element, and to repeat this in the successive platinum elements employed.

Tests were carried out on two separate units, A and B, and comparative conversions recorded by means of continuous tests running over 12 hours, and also by catch samples of the gases taken at any time. First, B unit was running without air cooling, whereas A unit was having its platinum elements cooled by means of the air blast. Keeping the preheater temperature at 420° C. during 24 hours, the temperature on emergence from platinum elements dropped from 522° C. to 475° C., *i.e.* 47° C. The corresponding temperature of B unit was 518° C. The following table shows the results over the period concerned.

TABLE 1.

	A Unit				B Unit			
Time	Preheater temperature	Temperature on emergence	Catch conversion	Continuous test conversion	Preheater temperature	Temperature on emergence	Catch conversion	Continuous test conversion
10 a.m.	420°	520°			420°	518°		
12 noon	420°	512°			,,	,,		
3 p.m.	422°	500°	88·5 %	89·0 %	,,	,,		88·5 %
6 p.m.	424°	496°			,,	,,	88·5 %	
9 p.m.	420°	490°			,,	,,		
12 m'nt.	426°	486°			,,	,,		
3 a.m.	420°	484°	89·7 %	90·1 %	,,	,,		87·6 %
6 a.m.	420°	481°			,,	,,		
9 a.m.	416°	475°			,,	,,		

It can scarcely yet be said that the A unit has become settled—although even now there is a decided tendency for the percentage conversion to increase. During the next 24 hours, a striking rise was noticeable on A unit, B unit remaining stationary at 89·0%. Keeping the preheater temperature the same on both units the exit temperature on A dropped another 7° C., owing to continued air cooling—the lowest temperature recorded being 468° C. The results are tabulated below :—

TABLE 2.

	A				B			
Time	Preheater temperature	Exit temperature	Catch conversion	Continuous test conversion	Preheater temperature	Exit temperature	Catch conversion	Continuous test conversion
9 a.m.	416°	475°			420°	518°		
10 a.m.	422°	478°			,,	,,		
12 noon	426°	472°			,,	,,		
3 p.m.	416°	472°		90·2 %	,,	,,		86·7 %
6 p.m.	420°	470°			,,	,,		
9 p.m.	424°	472°	88·9 %		,,	,,		
12 m'nt	420°	470°	89·9 %		,,	,,	87·1 %	
3 a.m.	424°	472°	90·4 %	91·1 %	,,	,,		89·0 %
6 a.m.	422°	468°			,,	,,		
9 a.m.	420°	468°			,,	,,		

The main fact is now clear, namely, that the conversion on A unit has risen about 2%, whereas on B unit no great improvement is apparent. The conditions on both units are the same, with the exception of the exit temperatures. With a preheater temperature of 420° C. we have almost reached the lowest possible exit temperature obtainable by this method of cooling. It was now decided to reduce the preheater temperature to 400° C. and to note the further effect on conversion and exit temperature. The results are shown in table 3.

Unfortunately the continuous test failed for the 12 hours 9 A.M.—9 P.M., but the other results are sufficiently consistent to allow conclusions to be

TABLE 3.

	A Unit			
Time	Preheater temp'ture	Exit temp'ture	Catch conversion	Continuous test conversion
9 a.m.	420°	468°		
12 noon	392°	468°		
3 p.m.	400°	464°	90·1 %	Test failed.
6 p.m.	406°	463°		
9 p.m.	400°	458°		
12 m'nt	402°	454°	90·0 %	
3 a.m.	398°	446°		90·6 %
6 a.m.	402°	442°		

drawn. With a further drop of 26° C., *i.e.* 76° C. in all, the indication is for the conversion to drop slightly, or at all events, not to increase. During the whole 24 hours, B unit remained as on the two previous days, with an exit temperature of 518° C. On reducing the preheater temperature to 400° C. the lowest exit temperature recorded was 504° C. and the highest conversion 88·0%.

We have now reached the lowest temperature (442° C.) at which it is safe to assume the maximum forward reaction; and the air cooling was now withdrawn from A and transferred to B unit, so that its exit temperature was allowed to rise as high as it might, with a preheater temperature of 400° — 420° C. By thus transferring from A to B, it is towards improvement later. It should be mentioned that owing to an electric power breakdown a whole 24 hours' interval elapsed between the times of finishing tests on A unit and commencing on B, and this also accounts for the comparatively low exit temperatures obtained on restarting experiments.

The results still show a great deal of variation, yet it is quite clear that A conversions are decreasing, and B increasing, although not with the same decisiveness that A increased. The 91·5% conversion on B at 6 P.M. is very probably too high.

During the next day the preheater temperatures of both units were dropped to 410° C.; and in consequence the exit temperature on B unit dropped as

TABLE 4.

	A				B			
Time	Preheater temp.	Exit temp.	Catch conversion	Continuous test conversion	Preheater temp.	Exit temp.	Catch conversion	Continuous test conversion
9 a.m.	420°	510°			*400°	*468°		
12 noon	,,	,,			420°	478°		
3 p.m.	,,	,,		Failed	424°	474°	Condition too unsettled.	Failed.
4 p.m.	,,	,,			424°	470°		
5 p.m.	,,	,,			416°	466°		
8 p.m.	,,	,,			410°	466°		
12 m'nt.	,,	,,			416°	466°	91·0%	
3 a.m.	,,	,,	88·6%	88·6%	424°	472°	90·7%	89·1%
6 a.m.	,,	,,			424°	472°	89·8%	
9 a.m.	,,	,,			416°	472°	91·0%	

* The air cooling had recommenced at 6 A.M.—before the coke fire had been made up to normal strength—whereas on A unit, no air cooling had taken place. The exit temperature has remained almost steady at 472° (the temperature that appeared to be most satisfactory on A unit), and although the tendency is towards improvement, it is not very marked. The most noticeable result is the surprising drop on A unit to 88·6% from 91%. During the next 24 hours, the preheater temperatures were again maintained at 420° C., and on B unit the exit temperatures dropped to 460° C *i.e.* a total drop of 58° C., and a further drop from the previous day of 12° C.

TABLE 5.

	A				B			
Time	Preheater temp.	Exit temp.	Catch conversion	Continuous test conversion	Preheater temp.	Exit temp.	Catch conversion	Continuous test conversion
9 a.m.	420°	518°			416°	470°		
12 noon	,,	,,			424°	470°		
3 p.m.	,,	,,		87·0%	426°	462°		89·3%
6 p.m.	,,	,,			416°	460°	91·5%	
9 p.m.	,,	,,			424°	464°		
12 m'nt.	,,	,,	87·6%		414°	466°	89·8%	
3 a.m.	,,	,,		89·2%	422°	470°		90·6%
6 a.m.	,,	,,			428°	470°		
9 a.m.	,,	,,			420°	468°		

TABLE 6.

	A				B			
Time	Preheater temp.	Exit temp.	Catch conversion	Continuous test conversion	Preheater temp.	Exit temp.	Catch conversion	Continuous test conversion
9 a.m.	420°	518°			412°	464°		
12 noon	410°	510°			420°	466°		
3 p.m.	,,	,,		88·0%	410°	462°		89·5%
6 p.m.	,,	,,			412°	460°	89·4%	
9 p.m.	,,	,,			412°	454°		
12 m'nt.	,,	,,	88·8%		410°	456°		
3 a.m.	,,	,,		88·6%	410°	456°	89·2%	89·5%
6 a.m.	,,	,,			410°	454°		
9 a.m.	,,	,,						

possible to eliminate any irregularity one unit possesses over the other, and to which irregularity any of the above results might be due. The exact constructional similarity of the two units should be emphasised. The preheater temperatures were again brought up to 420° C. on each unit and the maximum supply of air put on B. As in the case of A unit, the results were somewhat inconclusive during the first day but showed a decided tendency low as 454° C.—a further drop of 6° C. and a total drop of 64° C.

The same result is now apparent, as on A unit, when the preheater temperatures are dropped below 420 C. and the exit temperatures become correspondingly low, namely, that the conversions again drop and we now have them again approaching the 89% figure.

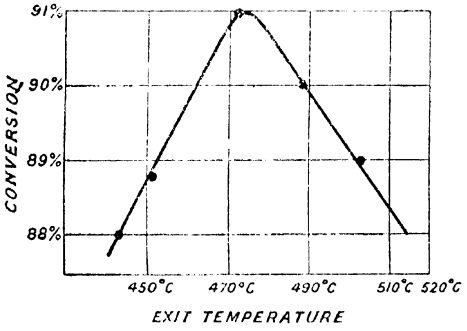
During the last day, the preheater temperatures

on both units were 400° C. but no lower exit temperature was recorded, and the results show a similarity in the conversion figure, *viz.* 454° lowest temperature and 89·3% the highest conversion as against 88·4% on A unit with exit temperature at 510° C.

From these results the same conclusion can be drawn as when A unit was subjected to air cooling, namely that the preheater and exit temperatures have decreased below the value for maximum conversion. The same figures show up remarkably well on both independent units—preheater temperature 420° C. and exit temperature 470° C., yield maximum conversion of 91%—a 2% average increase over the figure obtained when the unit was working without being air-cooled.

Attention should be drawn to the condition of the platinum during these experiments. It was in a comparatively fresh condition, and the elements in both units had been inserted simultaneously.

Summary.—An average conversion of 89% is obtained when the reaction in the platinum chamber is allowed to run its course with no attempt at cooling. When the maximum amount of air cooling was brought into play with a preheater temperature of 420° C., the exit temperature dropped to 470° C., and an average conversion of 91% was obtained, showing an increase of 2%



corresponding to a drop of 50° C. Finally, the preheater temperatures were lowered to 400° C., resulting in a further drop of exit temperature to 450° C., *i.e.* 70° C. in all. The conversions now started to decrease, eventually reaching the figure 89%, the same as without cooling, this also being the average figure for the other unit working concurrently with no air cooling. The results may be expressed graphically as shown in the diagram.

Note.—In plants working with sulphur (98—99%) direct, this 2% increase in efficiency does not carry so much importance as in plants using pyrites containing only 40—50% S, and from which ore it is very difficult to extract the whole of the available sulphur. Usually an unavoidable loss in efficiency is due to 5% available sulphur remaining in the cinders, although with care, and proper working of the burners, this may be reduced to 3% or even lower. In order to make a pyrites contact plant work satisfactorily, great care must be paid to every opportunity of increasing the efficiency, and the two most important means are: (1) Maximum conversion—*i.e.* minimum gas escape at exit; (2) minimum sulphur content in burnt ore.

The first has been already considered, the second can only be attained by careful and scientific working of the pyrites burners.

DETERMINATION OF BENZENE, TOLUENE, ETC.

BY H. G. COLMAN AND E. W. YEOMAN.

(See this J., 1919, 57 T.)

Dr. P. E. SPIELMANN writes: "The authors are to be congratulated on their valuable work and co-ordination of methods, which must henceforth be accepted as the standard pronouncement on this section of analysis. The only weak point that I can detect—and it is not a serious one—is the assumption that in a sample of crude benzol the proportion of paraffin associated with benzene, toluene, and solvent naphtha is approximately the same: my experience is, on the contrary, that, on an average, paraffin is found with these three products in the ratio of 1 : 2 : 6. Further, the authors are not correct in stating that the method employed in estimating carbon bisulphide (as described by myself and Wheeler) does not allow for the changes in volume when benzene and carbon bisulphide are separated: this allowance is made automatically by interpretation of results being made by means of an experimental and not a calculated curve."

Canadian Section.

Meeting held at Ottawa on February 20th, 1919.

PAINT PIGMENTS: THEIR HISTORY AND DEVELOPMENT.

BY S. J. COOK, B.A.

The practice of our most ancient ancestors of daubing their bodies with various coloured earths mixed with fats or greases probably marks the earliest use of paint pigments. The savages often painted their huts as well. The use of cosmetics was not unknown to "the ancients," for a face powder found in its original pottery-box of about B.C. 400, in the neighbourhood of Athens, proved to be a mixture of white lead and whiting. Theophrastus, Pliny, and Vitruvius describe the manufacture of white lead and vinegar, and modern processes do not differ essentially from those of the days of the classical writers.

The history of pigments is really one with that of paints, which is closely bound up with that of varnish. The manufacture of varnish has probably been continuous since the time when the Egyptians varnished the cases in which they enclosed their mummies; some of those which now exist are at least 2500 years old, and the varnish is still in an excellent state of preservation.

The trend of thought on the subject of painting in pre-Revolution days is indicated by the following paragraph: "The simple habits of the early settlers, their poverty and struggles for subsistence, prohibited the use of paint for decorative purposes, while the abundance of timber rendered it unnecessary to be at any great expense to protect the wood from the destructive action of the elements; so that the use of paint was not only discouraged as extravagance, but history records that the Rev. Thomas Allen, of Charleston, near Boston, was called to account in 1739 for having paint on his dwelling. It was considered that by so doing he was encouraging the tendency to show aristocratic ways of living that would endanger the morals of the community."

Fortunately, there is no longer any question as to the importance of the use of paint and paint materials with sufficient frequency to protect and preserve buildings and structures of all kinds from decay, rot, and final destruction. Prof. King said recently that the losses ensuing in Kansas through lack of paint were much greater than the losses sustained by fire.

The paint industry is doing a large part in stemming the tide of economic waste, and in the United States the campaign undertaken by the Paint Manufacturers' Association has resulted in the increased and more intelligent use of mixed paints. In Canada the campaign advocating the greater use of paint has only been taken up in very recent years, but it is significant to note that in spite of the war the use of paint increased very largely, and was reflected in the increased business done by leading makers.

For the classification of paint pigments two methods have been used. Both serve to define the classes, the difference being due to the differing purposes for which they were framed. The first, really an artist's classification, is due to Sir Arthur Church; the second, a paint manufacturer's outline, is a modification of that chosen by Maximilian Toch in his "Chemistry and Technology of Paints."

Church suggests eight different groups, which he says form a convenient, though not scientifically correct, classification. The eight groups are: (1) Oxides. (2) Sulphides. (3) Hydrates. (4) Carbonates. (5) Silicates. (6) Other inorganic salts. (7) Organic compounds. (8) Elements.

The second and more common classification—one principally according to colour—consists of nine groups:—

(1) The white pigments. (2) The inert fillers or extenders. (3) The oxides of lead. (4) Red pigments. (5) Brown pigments. (6) Yellow pigments. (7) Blue pigments. (8) Green pigments. (9) Black pigments.

Reference will only be made here to the first two groups of the second classification.

The white pigments.—Of the white pigments the oldest and best known and still the most extensively used is white lead. White lead and lithopone are both precipitation products; the zinc oxides, leaded zinc, zinc lead, and basic sulphate white lead or sublimed white lead are fume process pigments. Theophrastus (373—287 B.C.) is generally credited with being the first maker of white lead; he is quoted by Klein in his "History of Stones" as follows: "Lead is placed in earthen vessels over sharp vinegar, and, after it has acquired some thickness of a sort of rust, which it commonly does in about ten days, they open the vessels and scrape it off, as it were in a sort of foulness; they then place the lead over vinegar again, repeating over and over again the same method of scraping it till it has wholly dissolved. What has been scraped off they then beat to a powder, and boil for a long time, and what at last subsides to the bottom of the vessel is 'Ceruse.'" This old method undoubtedly produced the basic carbonate of lead, and the clay pot method is still in use, though in a somewhat developed form.

White lead is made by one of two processes in general. Either the old clay pot method or Dutch process, or the newer and commonly called "quick process," is used. In the Dutch process a buckle of thin sheet lead about four inches wide is rolled up and placed in a clay pot of about a quart (or less) capacity. This pot contains acetic acid. In the bottom of the stack moist tanbark is spread. The pots are then placed on shelves over the bark and more pots are placed on boards, which rest on the underlying pots until the stack is complete. After about three months the metallic lead has been entirely corroded; the stack is then taken down, the white lead broken up, washed, and prepared for the market. Very often it is ground with oil while still wet and the water thus displaced by oil. Some water remains in this instance, but there is the advantage, according to some authorities at least, that a small percentage of water (under 3%) adds to the working qualities of this pigment in prepared paints. In 1914 the estimated world's production of white lead, according to Klein (Paint and Varnish Soc., London, 1915), was 275,000 tons annually, distributed as follows: United States, 120,000 English tons dry; England 55,000, Germany 36,500, France 22,000, Belgium 15,000, Russia 14,000, Italy 4500, Holland 2500, Spain 2500, Canada 2500 tons. The amount made by the stack or Dutch process was about 180,000 tons. To-day the stack process is said to have been practically discarded in Canada, partly because of the slowness of the process, but mostly because the white lead makers are satisfied that the product of the quick process is quite as good, and it involved no long tying up of capital as does the older process.

Of the quick processes there are many, but the principle of most of them is the same. The attempt is made to produce artificially and in greater concentration the conditions which prevail in the stack. In the Carter process as used in the United

States, metallic lead is granulated, placed in large revolving drums, and sprayed with acetic acid and water. Carbon dioxide is passed into the drum and the agitation is continued for a period of from six days to two weeks. The white lead produced is thoroughly levigated and then dried. In one Canadian factory the process only differs in that acetic acid is sprayed over a tank full of granulated lead and the lead acetate formed returned until it reaches a certain density. Carbon dioxide is then blown through the liquid and the white lead thereby produced.

Quick process white leads ordinarily require more oil to make paste lead than the Dutch process. For the latter, about 5 lb. of oil will work up with 100 lb. of lead. In point of ease of application white lead is undoubtedly the painter's favourite. It also has greater covering power than the other white pigments except perhaps lithopone. When used alone with linseed oil, however, white lead dries to a rather soft surface, which weathers to a chalky coat and is easily abraded. White zinc or zinc oxide, on the other hand, when mixed with oil, dries more slowly and yields a hard, almost vitreous surface. For this reason combinations of basic carbonate white lead and zinc oxide are very desirable and are much used. A favourite combination is 60% basic carbonate white lead and 40% zinc oxide.

Basic sulphate white lead dates back only to 1872, and its introduction is due to the work of Lewis Bartlett at that time. It is extremely stable, very fine and amorphous, has good covering power and durability, and has come into great prominence as a constituent of paints in recent years. Its composition conforms closely to $PbSO_4$ 75, PbO 20, ZnO 5%. Much discussion has arisen regarding the propriety of calling this product white lead, and the Paint Manufacturers' Association of the United States took up the question, with the result that in 1916 it was decided that all forms of the carbonate or Dutch process lead should be called "basic carbonate white lead," and all the sublimed lead products should be known as "basic sulphate white lead."

The great competitor of white lead is zinc oxide, which has been made commercially as a paint pigment since about 1850. The New Jersey Zinc Company, working on Franklinite ore, developed a direct process which is now used for making the greater part of the zinc oxide on the American market. Franklinite ore, which is a zinc-iron-manganese spinel, is the only ore used in the production of lead-free zinc oxide. The ore is mined, washed, crushed, and passed by a belt conveyor over a separating table where the franklinite is removed by an electro-magnet. The separated ore contains about 60% of iron, the balance being manganese and zinc. The ore is then mixed with coal and spread on grates through which air is blown, whereby the zinc in the ore is reduced. The oxidising atmosphere converts the volatilised zinc into oxide, which is drawn by the aid of fans through large cooling pipes into fabric bags, and these are tapped at the bottom from time to time. White enamel paints usually have zinc oxide alone as their pigments.

The ore used in the manufacture of leaded zincs and zinc lead pigments, which are also made by the fume process, are zinc-lead ores. The first used were those from Leadville, Colorado, and resulted in a pigment containing about equal parts of lead sulphate and zinc oxide. During recent years the process has been considerably improved, and now a 60—40 zinc oxide-lead sulphate pigment is the one used. The term "leaded zinc" is now used to describe American process zinc oxides made by directly subliming and oxidising a zinc ore containing varying proportions of lead. These ores are plentiful, while the ores suitable for making lead-free zinc are not so widely distributed. These leaded zincs were the only ones available for use in the manufacture of paints, in the United States, during the war, the other ore being required for the production of spelter. Four grades are recognised in the trade, containing respectively 5, 10, 20, and 35% of basic lead sulphate. Zinc lead white is said to possess all the virtues of both zinc oxide and basic sulphate white lead.

Lithopone was apparently first produced by Orr in 1874, and at once developed in England and on the Continent. In America production is increasing and this pigment is finding many new uses, notably in the manufacture of oilcloth and linoleum as well as in making many paints. It is a very white pigment and has great covering power. It is produced by double decomposition of solutions of zinc sulphate and barium sulphide. The composition is approximately $BaSO_4$, 70%; ZnS, 30%. The precipitated pigment is calcined, quenched, washed, and dried. The quenching after the calcining seems to be essential if the resulting product is to be a good paint pigment. Further oxidation of the zinc sulphide is thereby prevented. The formation of zinc oxide in appreciable quantities is a defect characteristic of the earlier makers. Heating not only dehydrates the zinc sulphide but produces a change in its physical condition, so that it forms a dense mass with a good body which can be ground more readily. Gardner, in his "Paint Researches," states that a mixture of ground barium sulphate and zinc sulphide is deficient in covering power, while lithopone is conceded to be quite as good in hiding power as white lead. He explains this phenomenon by saying that in the mixture there are transparent particles and opaque particles; while lithopone consists of transparent particles which have adsorbed the opaque substance, and consequently lithopone has considerably the greater covering power.

The inert fillers and extenders. The use of the inert fillers or extenders as constituents of mixed paints is probably the most debated practice in the paint-maker's work. Originally the use of such materials as barytes or *blanc fixe* or silica in paint of any sort was regarded as *primâ facie* evidence of adulteration. Nowadays, however, a paint is not judged on the evidence of its chemical analysis alone; the question of the purpose to which the paint is to be put is also considered, and the use of such fillers is justified from this point of view.

Barium sulphate comes on the market either as the mineral barytes, ground finely, and usually water-floated, or as *blanc fixe*, the precipitated form. In neither form is it in use as a pigment alone, but it is used in large quantities in admixture with white lead and zinc. It is said to give greater body to a lead paint, and to produce far greater permanence in the finished work than is obtainable by the use of white lead alone. It probably finds its most useful application, however, as a base on which various coal tar colours can be precipitated. Many para-red paints are made which contain 90% of barium sulphate, on which 10% of para-red has been precipitated. A small percentage of an inert filler is often used to prevent a white lead paint from settling out to a hard cake in the can. Another use which is ascribed to them is that of giving the property of "tooth" to the painted surface, so that, when repainting becomes necessary, the surface will hold the new coat of paint satisfactorily. Silica and asbestine are more used for this purpose, however. Barium carbonate is practically new as a paint pigment. Only the artificial product is used. Ordinarily it is used mixed with zinc oxide to form the basis of a very good flat wall paint. Silica is inert as a filler or

extender, but is used to give "tooth" to the paint. It is made by heating quartz rock to redness, quenching in water, and grinding under water by aid of dragstones; it is then washed, floated, dried, and bolted, and comes into commerce as an impalpable white powder.

Gypsum (or hydrated calcium sulphate is often used as a lake base, and this is true to a somewhat less extent of whiting or calcium carbonate. White mineral primer, Paris white, and gilder's white are other names for chemically similar products.

Kaolin is the china clay of commerce, and asbestine is a short fibre asbestos.

London Section.

Meeting held at Burlington House on February 3rd, 1919.

DR. CHARLES A. KEANE IN THE CHAIR.

REFRACTOMETRY AND ITS APPLICATIONS IN TECHNICAL ANALYSIS.

I.—THE PHYSICAL PRINCIPLES UNDERLYING REFRACTOMETRY.

BY JAMES C. PHILIP.

The chemist has long been in the habit of employing physical constants as means of identification, as criteria of purity, and for the purpose of ascertaining the composition of mixtures or solutions. The determination of density and the measurement of optical activity are common examples of such physical analysis, and everyone is aware of the daily use of these methods by the analytical and technical chemist.

Refractive power is a property which belongs to the same category and may be similarly employed for the characterisation and analysis more especially of liquids and solutions. That its use for this purpose has become very general only within a comparatively recent period is mainly due to the fact that the earlier standard methods for measuring the refractive index of a liquid were too complex and tedious for the requirements of the analyst. It was not, indeed, until the spectrometer and hollow prism were replaced by the critical angle refractometer that the accurate measurement of refractive power could be made with reasonable rapidity and so become of practical utility in the chemical laboratory.

When a ray of homogeneous light, passing from air into glass at a point, A (see Fig. 1), makes an angle, i, with the normal in air, and an angle, r, with the normal in the glass, then, as is well known, the refractive index of the glass is given by the relationship $N = \frac{\sin i}{\sin r}$. For a given glass, a given temperature, and light of a given wave-length, N is a constant whatever be the value of i, the angle of incidence, and it should be borne in mind that, according to the accepted view, the value of N is the ratio of the velocities of the light in air and glass respectively.

If the angle i is at a maximum, *viz.* 90°, that is if the ray enters the glass at A under grazing incidence, then the angle of refraction will also be at its maximum with a value given by $N = \frac{1}{\sin r}$

As is well known, the path of this limiting critical ray in the denser medium (No. 3 in Fig. 1) marks a boundary between light and dark, and if the exact position of this border line can be determined, the index of refraction of the glass can be evaluated forthwith.

The foregoing argument may be generalised, and it follows that for any two media, *e.g.*, liquid and glass,

$$\frac{\text{velocity of light in the less dense medium}}{\text{velocity of light in the denser medium}} = \frac{1}{\sin r}$$

where r is the critical angle already defined—the

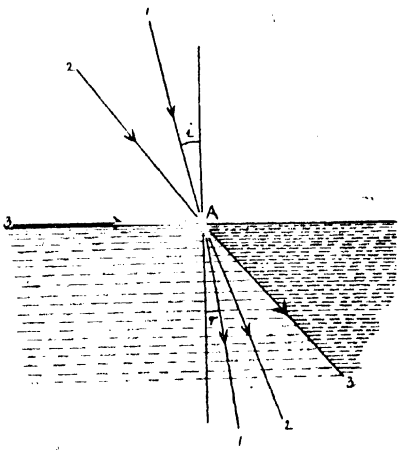


FIG. 1.

so-called angle of total reflection. Hence, if N and n are the refractive indices (relatively to air) of the glass and the liquid respectively, $N = \frac{1}{n \sin r}$ or $n = N \sin r$. It is clear, therefore, that if N is known, and if the angle r can be found by determining the position of the border line in the glass, the index of refraction of the liquid can be calculated.

This very simple relationship, $n = N \sin r$, which is the basis of all critical angle refractometers, finds application, for example, in the Heele instrument, an account of which was presented to this Section by the late Dr. Lewkowitsch (this J., 1909, 773). The characteristic feature of this instrument, theoretically one of the simplest, is a prism in the form of a circle quadrant (see Fig. 2), the horizontal upper surface of which carries at its central edge a small cell with the liquid under investigation. Monochromatic light enters the prism

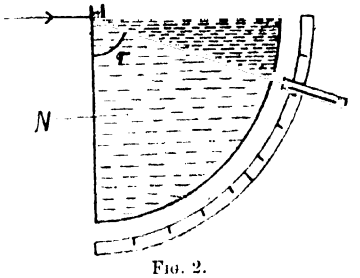


FIG. 2.

through the liquid at grazing incidence, and the corresponding critical rays pass radially through the quadrant, making an angle r with the vertical. These radial rays pass out of the prism without change of direction, and the position of the corresponding boundary between light and dark is ascertained by a telescope which rotates about an axis coinciding with the central edge of the prism quadrant. The telescope having been adjusted so that the boundary passes through the intersection of

the cross-wires, the value of r is read off on the circular scale of the instrument. The refractive index of the prism being known once for all, that of the liquid is then readily obtained.

In all other common refractometers the critical rays pass out of the prism body at a plane surface, and accordingly undergo further refraction there, unless it so happens that they are perpendicular

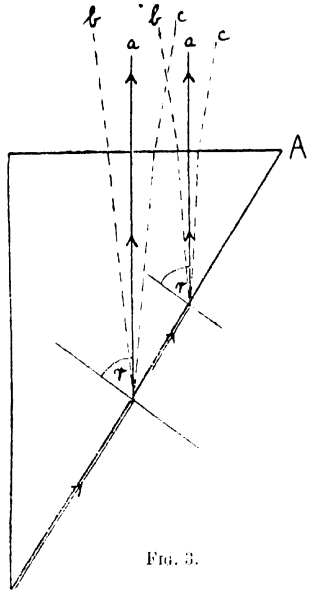


Fig. 3.

to this surface. This latter contingency would arise, for example, when the refracting surface is the hypotenuse face of a right-angled prism, and when the indices of refraction of the prism and of the liquid in contact with it are such that r, the angle of total reflection, is equal to the refracting angle A of the prism (see Fig. 3). In this case the critical ray proceeding from each point on the hypotenuse face which is illuminated by monochromatic light entering from the liquid at grazing incidence is perpendicular to the upper horizontal face of the prism, and will emerge from it without change of direction. Two such parallel rays are shown at a, a, in Fig. 3.

For a given prism of this kind there will obviously be only one value of n which gives a pencil of critical rays perpendicular to the upper surface. If the liquid in contact with the hypotenuse face has a refractive index slightly greater or slightly smaller than this particular value of n, the critical rays will undergo a change of direction on emerging from the upper surface, but will still remain parallel as shown, for example, by the dotted lines, b, b, or c, c, in Fig. 3.

For a limited range of refractive index (of the liquid) on either side of the value given by $n = N \sin A$, the deviation of the emergent critical rays from the vertical will not be very great, and in such conditions the rays can be focussed by the objective of a telescope to which the prism is rigidly fixed. The position of the border line between light and dark obtained in the focal plane of this objective may be read off on a scale situated in the focal plane, and the scale reading can be converted, if desired, into the corresponding refractive index.

The arrangement just sketched, where the common liquid-glass surface is the hypotenuse face of a right-angled prism in rigid connection with a telescope, has been developed for practical purposes in two well-known instruments, the butter refractometer and the dipping refractometer. In the nature of the case, the telescope being rigidly connected with the prism, each instrument is adapted for the investigation of liquids with a comparatively narrow range of refractive index. The range of the butter refractometer is from $n = 1{\cdot}42$ to $n = 1{\cdot}49$, whilst that of the dipping refractometer is from $n = 1{\cdot}325$ to $n = 1{\cdot}366$. Contact between the liquid and the hypotenuse face is secured by quite different methods in the two cases. In the butter refractometer a second right-angled prism is employed, and a thin film of the oil or melted fat is enclosed between the two hypotenuse faces. In the dipping refractometer, on the other hand, employed as it is for dilute aqueous solutions available in bulk, the prism is simply immersed in the liquid.

The principle involved in the construction of the butter refractometer and the dipping refractometer may be applied in such a way as to be applicable to liquids of widely differing refractive index. For this purpose, however, the prism must be separated from the telescope, and capable of rotation about an axis parallel to the refracting edge of the prism.

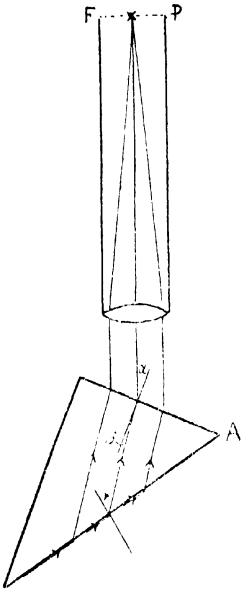


Fig. 4.

If the refractive index of the liquid which is in contact with the prism, and which is illuminated with monochromatic light at grazing incidence, differs appreciably from the value given by $n = N \sin A$, it will not be possible, with the upper face at right angles to the axis of the telescope, to get the emergent critical rays focussed in the focal plane of the telescope. By rotating the prism, however, this can be done and a position found such that the border line passes through the centre of the focal plane (see Fig. 4). If the angle α through which the prism has to be rotated in order thus to get the emergent critical rays parallel with the axis of the telescope is known, it is easy to compute the refractive index of the liquid from the following relationships: $\frac{\sin\alpha}{\sin\beta} = N$; $\beta + r = A$; $n = N \sin r$.

By elimination of β and r it follows that

$$n = \sin A \sqrt{N^2 - \sin^2\alpha} - \cos A \sin\alpha.$$

The arrangement just sketched has been developed for practical purposes in the well-known Abbe instrument, in which, as in the butter refractometer, a very small quantity of liquid, enclosed

between the hypotenuse faces of the refracting prism and a lower auxiliary prism, is sufficient for examination.

There is yet another way in which a right-angled prism is employed in the determination of the refractive index of a liquid. Instead of the hypotenuse face, one of the others plays the rôle of the refracting surface, and the right angle itself

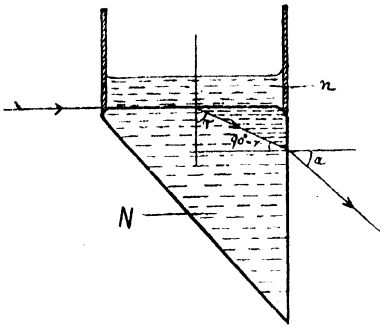


Fig. 5.

is the refracting angle. If the two faces at right angles to one another are respectively horizontal and vertical, and the liquid in contact with the upper surface is illuminated by monochromatic light at grazing incidence, the path of the critical rays will be as shown in Fig. 5. Here again for the border lines between light and dark in the prism the relationship $n = N \sin r$ holds good. The value of N is known once for all, and that of $\sin r$ is obtained indirectly from a measurement of α, the angle which the emergent critical rays make with the horizontal. Thus

$$n = N \sin r = N \cos (90^\circ - r) = N \sqrt{1 - \sin^2 (90^\circ - r)}$$
$$= N \sqrt{1 - \frac{\sin^2 \alpha}{N^2}} = \sqrt{N^2 - \sin^2 \alpha}.$$

Strictly speaking this is a special case of the formula already quoted in connection with the Abbe instrument, *viz.* :—

$$n = \sin A \sqrt{N^2 - \sin^2 \alpha} - \cos A \sin \alpha.$$

If $A = 90^\circ$, this formula obviously reduces to $n = \sqrt{N^2 - \sin^2 \alpha}$.

The arrangement just discussed represents the plan of the Pulfrich refractometer. This instrument, it should be noted, is employed not only in the examination of liquids, but also to a very large extent in the commercial testing of optical glass.

In the foregoing brief outline of the principles underlying the refractometers commonly used by chemists, it has been assumed that in each case monochromatic light was used for illumination. If white light is employed, the border line, owing to the different dispersion in liquids and in glass, exhibits a fringe of colour and is quite unsuitable for obtaining exact readings. This difficulty has been got over by introducing a so-called compensator between the prism and the objective of the telescope, which corrects the dispersion and gives a border line which is both sharp and free from colour. This compensator consists of a couple of direct vision prisms capable of being rotated in opposite directions, and so neutralising the dispersion. Such a compensator is a prominent feature of the Abbe and the dipping refractometers, for which therefore it is possible to use either white or monochromatic light.

In addition to the wave-length of the light employed, another important consideration in refractometry is the temperature. The refractive power of liquids and, to a considerably less extent, of glass alters with the temperature, and for accurate work with any refractometer it is necessary that there shall be adequate temperature control. The attempt to secure this has for the most part resolved itself into a jacketing of the prisms. In the Abbe, the butter, and the Pulfrich refractometers the prisms are set in a metal casing through which a current of tempered water is passed while the measurement is being carried out. Obviously, however, the prisms cannot be completely encased and doubt may be expressed whether the temperature control is altogether satisfactory, especially in those cases where there is an appreciable difference between the air temperature and that at which the measurements are carried out.

II.—IMPROVED TYPES OF BRITISH REFRACTOMETERS.

BY F. STANLEY.

The Abbe refractometer is suitable, and was primarily designed, for the measurement of refractive indices between 1·3 and 1·7 to an average accuracy of two units in the fourth decimal place. It was intended that the instrument should be employed where a large number of substances of differing refractive indices had to be examined, and for the purpose of the identification of such substances as oils, glasses, fats, etc. It will be found that the accuracy of measurement obtained is amply sufficient for the purpose.

The dipping refractometer should be used where solutions have to be examined or standardised, as the accuracy of this is considerably higher than that of the Abbe refractometer, reading as it does to 1/3 unit in the fourth decimal place, although over a smaller range of refractive indices.

As these instruments are generally well known, I intend to deal principally with some improvements which have lately been effected in their construction.

The Abbe refractometer holds probably a unique position in so far as its manufacture has remained for over 35 years entirely in the hands of one firm, while other optical instruments, such as telescopes, microscopes, range-finders, etc., have been manufactured in large numbers by numerous firms scattered throughout the world. This, no doubt, accounts for the fact that, while the instruments named have had vast improvements made in their construction and general efficiency, the Abbe refractometer has remained optically in a state somewhat of stagnation. The secret history of the manufacture of the Abbe refractometer by the firm of Zeiss must be interesting. From our own experience with a large number of different models of the instrument placed on the market at different times, we should assume that after Abbe had laid down the general optical principles on which the instruments were to be constructed, they were taken in hand by a staff more concerned with the financial side of the question than with the efficiency. It is, unquestionably, a fact that the latest pre-war instrument of 1914 was at least no more efficient or convenient to handle than that of 25 years ago. But as the refractometer is improved in design, new fields will be opened up for its use, and we have ourselves already applied it, with most promising results, to several British industries which hitherto have ignored the use of scientific control.

For several years past both Mr. Bellingham and myself have been considering the construction of refractometers, and when the war stopped all imports from Germany we at once started their manufacture. We were already familiar with the defects of the German types of instrument from the user's point of view and had decided on the

modifications necessary. We did not, however, realise the serious defects which were actually embodied in the German design until we began to receive a large number of these refractometers for repair. In the first place, nearly all the instruments sent to us were received with the complaints that little light and contrast were obtainable and that the measurement of liquids of refractive index greater than 1·52 was practically impossible, in spite of the assertions in the German catalogue. In the instrument as actually constructed by Zeiss, it appears that a crown glass prism of low refractive index (n_D=1·52) has been substituted for the dense flint prism (n_D=1·75) used at first as the lower or illuminating prism. The contact surface of this prism is left unpolished, so as to scatter the light entering the liquid film. The process of wiping the surface to remove the liquid which has been examined results in the removal of the thin sharp walls left by the abrasive, and thus the surface approximates to a polished face. When this is the case very little light can fall on the contact surface of the liquid and the upper prism at angles greater than the critical angle, unless the lower prism has a refractive index greater than that of the liquid under test; for it is only when this condition is satisfied that light entering the liquid is bent away from the normal. Several such instruments have been rendered serviceable for the measurement of liquids of refractive index as high as 1·70 by replacing the crown illuminating prism by one of suitable dense flint.

In addition to rectifying this serious optical defect, we have carried out some important improvements in the mechanical construction of the instrument. In the first place, the prism box of the German instrument opens in the wrong direction —that is, towards the observer—and this prevents the use of the mirror for the examination of solid bodies, when as much light as possible is needed. Zeiss state in their catalogue that for this purpose the instrument should be inverted and the lower prism-box opened out and used as a reflecting surface. If this advice is followed it will be found that the scale figures are upside down, nearly all illumination is cut off from the scale owing to the reader supports being in the path of light, and that the instrument is at such an angle as to be unstable. Zeiss could have eliminated some of these defects by leaving room enough between the prism-box and the mirror to allow of the lower box being turned round far enough to escape the light reaching the mirror, but if the prism-box is so arranged strain may be thrown upon the axis of the instrument to such an extent as to give incorrect readings. In the new instrument we have arranged the prism-box to open away from the observer, so that the solid can easily be applied to the prism surface and the lower prism-box can be entirely removed without the aid of tools. With this arrangement solids can be measured as easily as liquids and full illumination is given by the mirror, which can now be used as in the case of liquids. A new fastener for the prism-box has also been introduced; this is so designed that a reverse turn will open the boxes sufficiently to overcome the suction.

Another disadvantage found in the German instrument was the swinging, or tilting, motion given to the instrument as a whole. This is somewhat objectionable, as the bearings become loose and it is necessary to be continually tightening and adjusting them or it will be found that the instrument itself is moving instead of the reader arm. From a careful study of the Zeiss catalogue it would appear that this swinging motion was introduced to aid in the examination of solids, but we have been able to eliminate this motion by lengthening the illuminating mirror and placing it in the correct position near the prism-box so that full illumination is obtained for all parts of the scale. The mirror is also mounted on a hinge so that it can be turned out of position when charging the prisms with liquid and is thus kept free from falling drops. The prism-boxes, when open, can also be much more easily cleaned, and as both the prism faces in the new instrument face the light, it is far easier to see when they are clean.

A further mechanical improvement is the addition of a slow motion adjustment to the reader arm, by which the border line may be set with greater ease and certainty on the cross wires and there is also considerably less chance of movement while reading the scale after an observation.

With regard to the optical system, we have, in addition to improving the Abbe prism, made the observation telescope of slightly shorter focus than the latest German model, and by careful arrangement we have been able to obtain more light and greater contrast together with better definition of the border line. The optical performance of the German lens-system is very far from perfect, consisting as it does in some cases of two single lenses, with no attempt at colour correction.

In regard to the accuracy of these instruments we find in practice that this is limited by the quality of the dense glass obtainable for the prisms. We have found prisms cut from the same block of glass to vary in refractive index, and have had to overcome this difficulty by selecting batches of prisms of as nearly as possible the same refractive index after cutting. There is no difficulty in dividing the arcs to an accuracy considerably beyond that called for in these instruments.

The dipping or immersion refractometer has been designed to measure refractive indices over a smaller range but to a higher degree of accuracy than is possible with the Abbe type of instrument, so as to allow of the refractometer being applied to the accurate determination of the strengths of solutions. The instrument affords the most convenient and rapid means of determining, for instance, the percentage of alcohol in beer, the strengths of sugar solutions, tannin, and glycerin, the examination of adulterated oils, milk, mineral waters, malt, essential oils, mixtures of mineral salts, etc.

The dipping refractometer of the German type as previously supplied was fitted with a fixed prism cemented into its holder. This renders the instrument liable to leakage, especially in hot and moist climates, the solution creeping up through the cement on to the upper face of the prism. As this cannot be removed by the user, it is necessary to return the entire instrument to the makers, which often means several months' delay. Further, as the prism cannot be changed, the instrument is limited to the examination of solutions of refractive indices between 1·325 and 1·367.

In the improved instrument the prism can be easily and quickly removed by the user for cleaning purposes; it is held in position by a sleeve and clamping ring, making a perfect water-tight joint, and as no cement is used the liquid cannot creep up on to the upper face of the prism. Further, the prism with range of refractive indices between 1·325 and 1·367 may be changed for others giving ranges of refractive indices up to 1·55, thus rendering the instrument suitable for the examination of nearly all liquids except those of very high refractive index.

III.—ACCURACY CONTROL IN THE MANUFACTURE OF ABBE AND PULFRICH REFRACTOMETERS.

BY F. TWYMAN AND F. SIMEON, D.SC.

In securing accuracy in the manufacture of scientific instruments, the tendency is towards one of two extreme types of procedure, according to

the nature of the instrument, and the quantities in which it is to be made. In the first method, the trained testing department also does the adjusting; and accuracy in the finished instrument is attained by adjustment of the instrument in the finished state. In the second method, the component materials and parts of the instrument have been tested during manufacture, individually and in groups, such a limit of accuracy being stipulated as will ensure that the instrument is accurate on assembly. The testing department in such case, after making a severe test of the instrument, confines itself to definitely passing or rejecting it. This is the method we have adopted in the case of the Abbe refractometer. The resulting identicality of parts brings in its train the advantage of interchangeability of parts.

There are two constants of a refractometer prism which are of prime importance; these are its angle and its refractive index. With regard to the former, it is sufficient to say that the angle chosen is such as can be checked to high precision optically (*i.e.*, a submultiple of two right angles), and that the angle of each prism is checked by the extremely accurate methods applicable to such angles. The means now employed with great success for controlling the variation of refractive index of the glass used are as follows. From every block of the proposed melting of glass, a small rectangular piece is cut. These pieces are polished plane parallel, the polished faces put in optical contact, and the whole joined together to form one plate by an "adhesing" process (see Eng. Pat. 103,233 of 1916; U.S. Pat. 1,206,177; this J., 1917, 85). The composite plate so produced is then ground and polished accurately plane parallel, so that one can look through all the pieces simultaneously. It is important that the method of joining the pieces be such that no relative movement can take place during the polishing of the second face of the composite plate, as in the delicate test subsequently applied, a variation of thickness would have the same effect as a variation of refractive index, and it may be remarked that methods of cementing have not yielded the same satisfactory results as the "adhesing" process.

Examination is now made of the finished plate on the interferometer (Eng. Pat. 103,832 of 1916), wherein variations of refractive index are shown by shift of the interference bands, which are quite straight and continuous before the insertion of the "adhesed" plate. The amount of shift gives a measure of the variation of index, and the melting is not allocated to the manufacture of refractometer prisms, if these variations are greater than 0·00001.

As regards the absolute value of refractive index, this is measured on a high precision spectrometer, and the actual prism so measured is used as the standard for the homogeneity test. A consequence of this rigorous control of refractive index is that in the case of the Abbe refractometer, the considerable number of prisms available for which the same scale applies, makes possible the preparation of a perfectly automatic attachment to a dividing engine for producing these scales. We have ourselves made such an attachment, so that it is now only necessary to place the scale arc in position, and start the engine, thus avoiding the laborious process of engraving a non-uniform scale with the additional possibility of human error.

The above and other controls and methods have secured a very high level of accuracy in the finished instruments, the maximum error permitted being 0·0001.

In regard to the direct vision prism of the compensator on the Abbe refractometer, this attachment, which consists of two such prisms capable of rotation at equal speeds in opposite directions, is primarily to enable measurements of the refractive index for sodium light to be made while employing a source of white light. In order that correct scale readings be obtained, it is essential that these prisms be made direct for the D lines to a high accuracy, and here again application is made of the interferometer for control of this element during manufacture, sodium light being now employed in place of the mercury light ordinarily used with this instrument, or white light used in the homogeneity tests. A further use of these prisms is the measurement of C—F dispersion, which can be made by noting the reading of the compensator drum when the dividing edge of the field is achromatised, and using the tables supplied with the instrument. The accuracy attainable in this measurement is approximately that of refractive index measurements, being controlled by the accuracy of judging achromatism in the field. The dispersion of the compensator prisms is controlled to ensure this accuracy, a standard prism being kept to which all others must conform, and being carefully checked from time to time to ensure that it does not alter.

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IV.—THE REFRACTOMETER IN THE SUGAR INDUSTRY.

BY HUGH MAIN, B.SC.

The estimation of water in sugar solutions, such as the various syrups which occur in the sugar factory or refinery, has always been a slow and uncertain process. The method usually adopted has been to determine the loss on drying in a hot-air oven or steam bath, or *in vacuo* accompanied by heat. In order to give a free and sufficient area for the escape of the water, various substances such as sand, pumice stone, and filter paper have been employed. It is, however, never certain when the operation is complete, as in beet sugar some of the non-sugar organic substances, and in cane sugar the lævulose present, begin to decompose on continued heating. Concordant figures are difficult to obtain, and if obtained it is by no means certain that a true result is recorded. The process requires an hour or more for completion.

Another method consists in determining the specific gravity by a hydrometer, Westphal balance, or pyknometer, and referring to a table of equivalents. The more impure the sample, however, the more does the figure obtained differ from the truth, and the figure found is usually called the apparent Brix or percentage of sugar or solids which subtracted from 100 gives the percentage of water.

In 1905 I made some experiments on the estimation of sucrose by means of the Abbe refractometer and found, as some others had done, that for pure sugar solutions the refractive index was an accurate measure. A table was made showing the percentage of sucrose corresponding to the refractive index at 20° C., the normal temperature adopted for the polariscope in temperate countries. For impure syrups, however, it was seen that the figure corresponding to the refractive index in the table indicated the "total solids," *i.e.*, the sucrose and other solids present. Dextrose and lævulose have nearly the same refractive index as sucrose, but that of the various other substances present being different, the values obtained differ from the true total solids according to the proportions and amount of these other substances in the sample. For practical purposes, however, it was found that

the "total solids" or the water (=100−total solids) was a useful and reliable figure; it could be determined with rapidity, ease and accuracy, and only required a very small sample for the estimation.

I communicated my results to Herzfeld, and Prinsen Geerligs and others at the Congress of Sugar Chemists in Berne in August, 1906. Prinsen Geerligs[1] took up the study of the subject in connection with the cane sugar industry in Java and published a table of refractive indices of sugar solutions at 28° C., the standard temperature in the tropics, together with a table of corrections for readings at other temperatures. He also showed that, for equal concentrations, calcium salts have a higher refractive index than sucrose whilst sodium salts have about the same. Potassium salts have a lower refractive index. He concluded that the potassium and calcium salts probably neutralise the deviations of each other, causing the complex of salts to yield indices which accord fairly with those of sucrose solutions of the same concentration as that of the salts. His experiments led him to recommend the refractometer as a reliable instrument to determine the actual amount of dry substances in all products of the cane sugar industry.

At Herzfeld's instigation, A. E. Lange [2] in Berlin studied the subject as it affected the beet sugar industry, using my table which was published in the "International Sugar Journal," October 1907.[3] He published a paper giving the results of his investigations on products from various factories and refineries. He discovered that for the higher products the percentage of water found by the refractometer agreed very closely with the true figure (*i.e.*, that obtained by desiccation) coming as a rule between this figure and that obtained by the specific gravity method. For the lowest products, however, there was a greater difference than was permissible between the results. An average of 11 samples quoted showed that the dry matter found by the refractometer was about 1% higher than the true figure (*i.e.*, by desiccation) while by the specific gravity method it was about 1% higher still. He considered that by parallel estimations from time to time in a factory a constant correction might be employed to obtain the true figure from that found by the refractometer. As mentioned before, however, the desiccation method does not necessarily give a correct figure with low products.

Tolman and Smith[4] in America studied the question independently and in 1906 published a table of refractive indices of pure sugar solutions which agrees very closely with that of Prinsen Geerligs and with mine. I should, however, accept as the most accurate that of Otto Schönrock,[5] published in 1911, who also determined the corrections to be applied when readings were made at temperatures other than 20° C.

I find that it is quite easy to work in the laboratory at 20° C., and so avoid the necessity of corrections. The prisms of the instrument can be kept at this temperature by the use of a current of water through the jacket, and a small quantity of the sample can be stirred in a nickel or aluminium dish by a thermometer and rapidly brought to the required temperature by the heat of the hand or by cooling with water or ice as may be necessary, and two or three drops immediately transferred to the refractometer. Raw sugars and masseeuites etc. containing crystals of sugar may be dissolved in a known weight of water, the refractive index determined, and the percentage of water calculated.

For such samples, however, and indeed for any sugars or syrups which have to be analysed, V. Stanek[6] has described a method for determining the water by means of the Zeiss immersion refractometer. The basis of his system is the table of Bernhard Wagner [7] giving the grammes of sucrose per 100 c.c. corresponding to the scale-divisions of the instrument when the solutions are read at 17·5° C. For sugars, masseeuites, and thick molasses, 20 grms. is weighed out and washed into a flask calibrated to contain 100 c.c. Mohr (the volume at 17·5° occupied by 100 grms. of pure water weighed in air with brass weights), dissolved, made up to volume after standing in a water bath to attain room temperature, and thoroughly mixed. The refractometer reading is made and the temperature simultaneously observed. The scale reading, if not made at 17·5°, is corrected and the corresponding percentage of water found by reference to tables given by the author.

For thin syrups and thick beet juices Stanek employs 30 grms., and for medium juices 40 grms. Thin juices and washings are read directly in the instrument and referred to a table of Th. Hubener giving grammes per cent. sucrose, after correction for temperature if necessary by a table of Stanek. The various weights taken are employed so as to bring the readings within certain limits, viz., 74 to 106 scale-divisions, corresponding to 15·5 to 23·5 grms. of sucrose or dry substance.

Most of the tables above mentioned have been brought together and published with other tables and information valuable to the sugar chemist in Circular No. 44 of the Bureau of Standards, Washington, 1918.

Stanek also mentioned the use of a continuous observation beaker for use with the immersion refractometer. Messrs. Bellingham and Stanley have constructed one at my suggestion, for their instrument, and I have found it extremely valuable for rapid work. The beaker has a water jacket which can be kept at the desired temperature by a current of water. The solution is introduced through a small funnel and when it is seen to overflow, the beaker is emptied by pressing a spring clip which closes an outlet in the bottom; the process is repeated and a satisfactory reading can be made on filling for the third time. A nickel dish holding about 50 c.c. contains enough solution for a determination, and the contents are easily brought to the required temperature before being filled into the beaker.

It would lead to uniformity and standardisation of methods if new tables were made with 20° C., and a volume of 100 true c.c., as the basis for use with the immersion refractometer.

Besides the employment of refractometers in the laboratory as above mentioned, a valuable method has been recently described by Miller and Worley,[8] for controlling the concentration and crystallisation of syrups by means of an instrument which will show at any time the refractive index of the liquid portion of the contents of a vacuum pan. A simultaneous reading of the temperature allows the supersaturation to be determined by reference to a table arrived at through the researches of the authors. A description of the instrument is promised and will be looked for with great interest by all those who have to do with the problem of the control of the boiling of low sugar products. The present methods, even with the usual refractometers, are not as rapid as one would wish for this particular kind of work.

There are many other openings for the application of determinations of refractive index which

[1] Prinsen Geerligs, Archief v. d. Java Zuckerind., 15, 623; Int. Sugar J., 1908, 10, 68-81.
[2] Lange, Z. Ver. Deuts. Zuckerind., 58, 626, 177–198.
[3] Main, Int. Sugar J., 1907, 9, 481–487.
[4] Tolman and Smith, J. Amer. Chem. Soc., 1906, 1480.
[5] Schönrock, Z. Ver. Deuts. Zuckerind., 61, 421–425.
[6] Stanek, Z. Zuckerind. Böhmen, 34, 501, 35, 57–64, 187–199.
[7] Wagner, "Tabellen zum Eintauchrefraktometer," Sonderhausen, 1907.
[8] Miller and Worley, this J., 1918, 98 T.

will no doubt occur to chemists employed in the sugar industry, and it is to be hoped that the work of British opticians in making new and improved instruments will meet with the support and assistance of those who employ this valuable physical method in chemical analysis.

V.—THE USE OF THE REFRACTOMETER IN THE DETERMINATION OF THE PROTEIN CONTENT OF SERA.

BY ANNIE HOMER, D.SC.

In the methods adopted for the concentration of antitoxin sera on a commercial scale it is customary at present to heat the serum prior to its fractional precipitation with ammonium sulphate. The protein precipitated between 30 and 44 or 50% of saturation with ammonium sulphate contains the bulk of the antitoxin; it is isolated and dialysed. The dialysis residue after the addition of 1% of sodium chloride and 0·35% of tricresol is filtered through sterile filter candles ready for distribution.

Those engaged in the work are often nonplussed by irregularities in the process, such as difficulties in the filtration of the serum-ammonium sulphate mixture through paper and of the end products through the sterile candles, variations in the degree of concentration, undue losses of antitoxin, etc.

The results of an investigation undertaken to ascertain the causes underlying these irregularities have shown that the successful concentration of sera is dependent on the extent of the denaturation of the serum proteins, and unless the latter is systematically controlled there can be no assurance of consistent or reliable results.

The study of the factors regulating the extent of the denaturation of the proteins involved a considerable number of determinations of the protein content of sera and of the serum-ammonium sulphate mixtures. In order to save time, as it was desired to apply the results to the routine work with all possible speed, the estimations were made with the aid of the Zeiss immersion refractometer rather than by the usual gravimetric methods.

The gravimetric estimation of protein is a somewhat lengthy procedure, as it involves the coagulation of the protein; the separation of the precipitate by filtration; its washing first with water until free from adsorbed salts and then with alcohol and ether; and the drying of the precipitate at 110° C. until its weight is constant.

The method of procedure with the refractometer was as follows: The protein solutions were poured into the refractometer beakers, which were immersed in the bath containing water at 17·5° C. When the temperature of the solution in which the refractometer prism had been immersed had reached the temperature of the bath, the compensator of the refractometer was adjusted until the separating line became sharp and colourless. The position of the separating line on the scale of the instrument was accurately read with the aid of the micrometer adjustment.

The clear liquid, thus read, was transferred to a stoppered test-tube, which was heated for about 5 minutes in a freely boiling water bath in order to coagulate the protein: the liquid was allowed to cool and filtered.

The position of the separating line for the filtrate, which contained the water and salt constituents of the protein solutions, was read and compared with that obtained for the original liquid. The difference between the two sets of readings gave the scale index reading for the protein constituent. Thus:—

Scale Division Reading for the original liquid A, *i.e.* for water, salts and protein, = X.

Scale Division Reading for the filtrate after the coagulation of A, *i.e.* for water and dissolved salts, = Y.

Difference in Scale Divisions representing the protein in A = X − Y.

When determining the scale reading for the water and salts constituent of serum, it was necessary to dilute the serum with an equal volume of a 2% solution of sodium chloride prior to the coagulation of the protein; otherwise, in the undiluted serum, the bulky coagulum of protein retained in its meshes so much liquid that there was forthcoming an insufficient amount of filtrate for the refractometer reading. In this case the number of scale divisions representing the protein constituent of the serum was arrived at as follows:—

Scale Division reading for the serum = M.

Scale Division reading for the filtrate from the coagulated serum diluted with an equal volume of 2% sodium chloride solution = N.

Scale Division reading for 1% solution of sodium chloride = P.

Scale Division reading for the salts of the serum = 2(N − P).

Scale Division reading for water at 17·5° C. = 15.

Difference in Scale Division due to the protein in original serum = M − [15 + 2(N − P)].

The actual amount of protein represented by the difference in the scale reading of the liquids before and after the coagulation of the protein was calculated from the data given by Emil Reiss (Verh. 76, "Versammlung deutsch. Naturforscher und Aerzte," Breslau, 1904, 36).

T. B. Robertson (J. Biol. Chem., 1915, **22**, 233) considers that Reiss' figures are too high. It is my experience that the values for the amounts of protein in solution, calculated from Reiss' table, are consistently lower than those obtained from the gravimetric determinations of the solutions. The discrepancy experienced by me may be explained on the assumption that, in my liquids, while the bulk of the protein is present in an emulsified condition, there is a small amount present as a suspension, the aggregates of which are insufficiently agglutinated to allow of their detection by the eye. The protein present in a suspensoid condition, while not affecting the refractometer reading, will be registered in the gravimetric determinations.

An investigation of the degree of accuracy to be expected in the refractometric determination of the protein content of solutions of the individual serum proteins is required. But, in the elucidation of the problem under discussion, where the *relative changes* in the protein content of the solutions only are concerned, it is immaterial whether the figures given by Reiss, and which I have used, are above or below the true value.

VI.—THE USE OF THE REFRACTOMETER IN THE EXAMINATION OF CHLORHYDRIN.

BY A. E. BERRY.

The manufacture of a special type of munition necessitated in the initial stages the preparation of large quantities of ethylene-chlorhydrin. The process employed for the manufacture resulted in the formation of this substance as a dilute aqueous solution, mixed with more or less varying percentages of chlorine and ethylene, and it was most desirable to have at hand a ready means of ascertaining the exact yield and rate of production in order to ensure speedy output and efficient working.

As is well known, chlorhydrin is miscible with water in varying proportions, and it was found that the best results were obtained by producing

at the outset a solution containing approximately 5% of glycol-chlorhydrin. Concentration of this dilute solution was the first step, and it became at once apparent that some ready and effective test must be devised for ascertaining the percentages of chlorhydrin in the distillate and the yields that were obtained.

The usual chemical works' procedure of ascertaining the specific gravity by means of the ordinary Twaddell hydrometer was suggested, but the readings were not sufficiently delicate for the process workers to control efficiently, and although an estimation of the specific gravity by weighing samples in an ordinary weighing bottle would give more accurate results, yet during the process of distillation the time before changing over the liquor from one fraction to another would be too long, and a method had to be found which would enable the man in charge to ascertain during a few seconds of time when the distillate should be changed from one receiver to another.

The method of estimating the amount of chlorhydrin by heating with nitric acid and silver nitrate, and subsequent weighing of the silver chloride formed, was much too slow, and altogether out of the question for practical working.

On the recommendation of the University of St. Andrews the refractometer was used for the required control, the information supplied indicating that the refractive index of the mixture gave an accurate and trustworthy indication of the percentage of chlorhydrin present in the distillate. The refractive index of a 20% solution of ethylene-chlorhydrin in water is 1·3554, and that of a 10% solution 1·3444, while that of pure water is 1·3334. There is therefore a linear relationship between the chlorhydrin concentration and the refractive index, so that the man in charge of the distillation need be supplied only with a chart showing at a glance the percentage of the distillate during working.

In respect to this application of the refractometer, Prof. Irvine states that, in his experience, its best application is in distillations where the composition of fractions is not clearly indicated by the boiling point. In such cases the cutting of the fractions can be controlled with great uniformity by taking drop samples and estimating the refractive index. It uses less material and is quicker than the polarimeter, and its range of application is also greater, but of course the results have to be used with caution in dealing with unknown materials. It is certainly very useful in dealing with optically active oils, as a double check (rotation and refractive index) is obtained as to the composition of distillates. Another application which does not affect technical practice so directly is in distillations under diminished pressures. When a very high vacuum is being used, the differences in boiling point of different constituents in a mixture become smoothed out, so that the thermometer becomes of little or no service. In such cases, we have the refractometer on the bench, and the operator taps off drop samples regularly and tests them at once. His cutting of the fractions is thus done by change in refractive index and he does not trouble about the thermometer.

DISCUSSION.

Mr. ARTHUR R. LING said that the refractometer had been extensively employed with great success in the determination of solids in solutions, and it was more particularly from that point of view that he wished to introduce the subject. In former years the determination of total solids in such products as commercial sugar solutions, worts, etc. was made by taking their specific gravity. By this method more accurate comparative results could be obtained than by the ordinary forms of refractometer, such as the Abbe instrument, and the immersion refractometer. But it must be remembered that both by the specific gravity method, and by the refractometer method, comparative accuracy only was obtainable. The reason for this was that liquids such as commercial sugar solutions, worts, etc. contained a mixture of dissolved substances, all of which had a different influence on specific gravity as well as on the refractive index. As an example of this, it might be pointed out that commercial sugar solutions contained, besides sugar, nitrogeneous organic matter and mineral constituents. The sugars increased the specific gravity of solutions by only about half as much as the same weight of mineral matter, whilst many of the nitrogenous substances, notably the proteins, had, in solution, little or no excess specific gravity over that of water. On the other hand, the effect of different quantities of dissolved matters on the refractive index of solutions was very much closer, so that the method was not only more expeditious than the specific gravity method, but it could be applied over a larger range of mixtures of substances. In practice errors arose in determining the refractive index due to the dark colour of solutions; for example, when the method was used for determining the total solids in molasses. A method of obviating this had been suggested by Tischtschenko (Z. Ver. Deut. Zuckerind., 59, 103), who reduced the colour by the addition of a solution of pure sucrose of about the same density as that of the liquid required to be examined, and calculated the total solids by means of a formula. Although the refractometer method was more rapid than the specific gravity method, and had a wider applicability, it was less delicate. Some 18 years ago Mr. Thomas H. Pope and himself (see this J., 1901, 20, 755) had examined Tornoe's so-called spectro-refractometer (Z. ges. Brauw., 1897, 20, 373, 387) with reference to its use for the determination of the original gravity of beers. It had been found that the results were accurate to 1–5 units in the fifth place. It was therefore not quite so accurate as the specific gravity method. There was a form of refractometer which depended on interference, which appeared to admit of very much greater delicacy than any other. It was first devised in 1896 by Lord Rayleigh for his investigations on argon. Instruments of the kind had been in use for some years in German brewing laboratories, and the principle on which they were based had recently been described in a simple manner by Dr. R. S. Willows (J. Inst. Brewing, 1917, 23, 457). He would like to know why English manufacturers had not turned their attention to the construction of these instruments to meet industrial requirements.

Dr. T. M. Lowry said that his interest in refractometry was physical and not analytical, but there were two points he would like to mention which might come within the scope of the discussion. These concerned the control temperature and the wave length of the light used. With regard to temperature, the Pulfrich type of refractometer had as one of its features a very imperfect jacketing of the liquid under examination. There was, in fact, no jacketing round the liquid itself, which was merely surrounded by a block of wood, although there was a water jacket round the prism. Dr. Philip had already referred to the fact that the temperature control was imperfect. In the course of his work he had tried to find out what the error was. He made a measurement first with everything at 20° C., *i.e.*, the circulating water, the

room, and the whole system was kept at that temperature. He then carried out similar measurements with everything cold, about 10°, and finally, he carried out a third set of readings in which the temperature of the room was 10°, and the bath was at 20°; the refractive index of the liquid then showed it to be 1° below the temperature recorded by the thermometer of the instrument. Hence with a drop of 10°, in the temperature of the air, the liquid in the refractometer was a whole degree below the temperature registered by the thermometer. It followed that if the room were at 20°, and readings were taken at 70°, the temperature of the liquid would be wrong by no less than 5°. He had got out a type of instrument in which the liquid was jacketed as well as the prism and he believed it gave better results although he was not able to push the matter very much further at the time.

With regard to wave lengths, he had found it a serious drawback in comparing refractions and rotations that the readings on the refractometer were based on the three hydrogen lines and the sodium doublet, whereas if they tried to get the same wave lengths on the polarimeter, great difficulty was experienced in getting readings. Therefore, in all optical work, the tendency should be encouraged to work to a standard wave length which would eliminate the unsatisfactory hydrogen lines. Already in commercial and scientific laboratories there was a marked tendency to use the mercury green line instead of the sodium line as the standard for polarimeter work. The urgency for that was much less in refractometer work, but it would be a definite advantage if instruments could be calibrated, and tables provided, so that readings could be taken with the green mercury line as well as the yellow sodium line. English makers of instruments should publish tables enabling their instruments to be used not only for the sodium and the three hydrogen lines but also for the green and violet mercury lines and possibly also for the cadmium lines. The latter might have to be regarded as an academic proposition, because the cadmium lamp was not yet freely on the market, but he had used the cadmium lamp a good deal and it was a beautiful instrument. Ultimately, he believed the cadmium lines would prove preferable to the mercury lines, but for the present he would be satisfied with an instrument showing the mercury, and possibly the cadmium lines as well. In measuring a refractive index for sodium light with an ordinary spectrometer, what was measured was the average of the D_1 and D_2 lines. The same applied to the polarimeter, but when a refractometer based on total reflection was used, then D_1 only was measured. A different refractive index was obtained therefore according to whether a refractometer or a spectrometer was used. A convenient way of getting the mercury green and violet lines for use in a refractometer was to put a globule of mercury in the hydrogen tube, the mercury being warmed before passing the discharge. The violet mercury line then overlapped and completely masked the violet hydrogen lines. The general points which he wished to make were that British instruments should be supplied with tables which would enable them to be read not only for sodium and hydrogen but also for certain of the two mercury lines and the three cadmium lines, the red, green, and blue.

Mr. Forester said that whilst interned in Ruhleben the patent agent, or the gentleman who had charge of elaborating the patents of the firm of Zeiss, and who was an Englishman, had also been interned in the camp where he had continued his work for the firm. This agent had shown him papers which he had received from Jena regarding innovations and improvements which had been, until the time of the entry of the United States into the war, regularly patented there. He also mentioned that new methods had been evolved in the Zeiss works for casting glass, particularly spherical forms of glass, which practically eliminated the necessity for polishing the surfaces, and he had been told that in this way it had been possible to go on manufacturing for the German armies special forms of lenses for searchlights within 24 hours. Recently, Zeiss had given up the manufacture of the so-called small instruments in favour of the so-called large instruments. He had found it did not pay to manufacture articles like binoculars or microscopes. They had also improved their general glass plant and were supplying glass in bulk. He also found out that a certain form of glass used for hydrogen electric lamps for shop window lighting was made by a secret process at Jena.

Mr. Hugh Main said he believed that a further acquaintance with the possibilities of the use of the knowledge gained from the refractive indices of liquids would lead to fresh openings for the employment of the refractometer in many industries. With regard to a remark of Mr. Ling, he said that a refractometer had been made by Zeiss, in which it was possible to ascertain the percentage of carbon dioxide in flue gases by a measurement of the refractive index based on the shift of the interference bands. This physical measurement would be much simpler than the chemical method usually employed, the apparatus for which was always difficult to keep in continuous running order. In regard to the employment of a single standard temperature for tables of refractive indices, and the difficulties which arose when 20° C. was attempted to be used for essential oils etc. in the tropics, he was of opinion that it was a great advantage to be able to use the refractometer at about the temperature of the room. In sugar laboratories the difficulty had been met by adopting 20° C. as the standard temperature in temperate countries, and 28° C. in Java and other parts of the tropics. A simple correction could be ascertained for conversion from one temperature to another.

Mr. G. Nevill Huntly said that measurements of the refractive index of liquids by interference methods were attended with greater difficulties than similar determinations for gases. In the case of a gas it was easy to produce a continuous alteration of path by reduction of pressure: with a liquid such an alteration was more delicate to carry out and the temperature control was more difficult.

Captain Dyke Acland said in regard to the practical use of the refractometer in the examination of fats, it was very useful as a kind of first approximation, but without a knowledge of the several glycerides present and their respective indices of refraction it was not possible to do more. The refractometer would serve to classify oils roughly into drying, semi-drying, and non-drying oils, and give a fair idea of what the oil really was. But that was only one of quite a number of tests and perhaps not one of the most certain. Another direction in which it might be useful in fat analysis was in connection with blowing drying oils. Some work in that direction had been done by Morrell who had found that in the case of most oils, when they were blown, the iodine value decreased and the refractive index increased, but that when blowing tung oil the two values fell more or less together. Another point in this connection was that the refractive index changed before the iodine value changed. The first thing that happened was that the double bond moved say from the centre of the chain to one end. That was shown on the refractometer but not by the iodine value, so that it was possible that the refracto-

meter would be of considerable use in investigating what was a most important and interesting problem. It had also a certain use in connection with the hydrogenation of oils, for although in cases the iodine value and the refractive index changed more or less together, the relationship between the two was different for different oils. There were, however, two points about its use. One was that when hydrogenation started, the iodine value fell comparatively rapidly and so did the refractive index, but when hydrogenation was nearly complete, the differences were not so great, so that the refractometer might not be so satisfactory as it seemed at first sight. He thought that a continuous reading instrument was necessary for this purpose. Another difficulty in its application to this process was that when hydrogenating at high temperatures he thought he was correct in saying that the linoleins and the oleins were reduced at about the same rate. When hydrogenating at a lower temperature, however, this was not so, and that introduced a complication. Yet another important point was the temperature at which the refractive index was taken. In his opinion the temperature should always be 40° for the examination of fats and oils.

Dr. G. S. WALPOLE appreciated the suggestion of Dr. Lowry that instruments should be available for use with different wave lengths. However, probably 95% of instruments were used not for academic research but as a means to an end under conditions where it was satisfactory to know that precisely the same reading was obtainable whether a candle, gaslight, or an electric lamp, or daylight was used. In ordinary commercial instruments no consideration of wave lengths was required, and it was one of the triumphs of their manufacture that it was possible to get an achromatic dividing line on the instrument. If a measure of dispersion were required, it was simpler to note the scale reading on the achromatising collar than to take refractometric readings with different spectral lines. In a communication to the "Kolloid Zeitschrift" it was stated that refractive indices of proteins varied with varying electrolytes accompanying them in solution. That was incorrect; the real refractive index of any protein was almost a linear function of its concentration up to 10% and independent of the nature of any accompanying electrolyte. In all quantitative examinations of protein solutions the refractometer was of inestimable value.

Mr. E. T. BREWIS pointed out that for some years past the refraction had been used as an additional physical measurement in the examination of essential oils, comparable in a sense with the measurement of the optical rotation of oils. Essential oils were not simple substances. The specific gravity of oils had been found to vary within certain limits, and as the rotation might vary within certain limits, so the refractive index of normal oils varied within certain limits, and when these variations were tabulated, they formed meshes in the net to catch adulterations. The refractometer had been used with advantage in the examination of the oil of male fern. A few years ago, the oil of male fern which came from South Germany had been found to be heavily adulterated with castor oil, and E. J. Perry had been able, by the use of the refractometer, to identify that adulteration, which had not occurred since then. It was also particularly useful in the examination of cinnamon oils, which should have a fairly high refractive index, and only last December, C. T. Bennett published in "The Perfumery and Essential Oil Record" an account of some work with adulterated aniseed oil, in which he had been able to show that the refractometer could be used with good effect. In the latest edition of the British Pharmacopœia (1914) refractive indices were given for most, if not all of the essential oils, and most of them were taken at 25° C. In common with other chemists, he thought it was a pity that so many temperatures were quoted in connection with refractive indices, and for essential oils he believed that 20° C. would be the right temperature. He suggested that a temperature of 40° C. should be adopted for fatty oils, while that of 20° C. would be more reasonable for essential oils, and other liquids that could be examined at that temperature, as he did not think that essential oils were examined in the country of origin but in more temperate climates. In reference to the use of light filters, he in common with many others used the sodium light with the polarimeter. He found a difficulty in getting a sufficiently bright light to work with, and some time ago, he had communicated with Dr. Mees of the firm of Messrs. Wratten and Wainwright, but had been told that it was quite impossible to get a filter giving a sufficiently narrow band for anything equivalent to sodium light. A filter giving a band narrow enough, and at the same time giving a sufficiently bright light, would be very useful.

Mr. J. S. G. THOMAS said that one of the facts which always struck the physicist attacking any question dealt with in the more technological branches of science was that there rarely seemed to be any standard specification of temperature with regard to which any physical measurement in technical chemistry was carried out. Chaos reigned in regard to measurements of specific gravity in technical chemistry. There were 53 scales of specific gravity employed, and the chaos was made worse by the fact that these scales themselves in some cases were calculated incorrectly. Therefore, he suggested that it was a question of practical politics for the Society that it should appoint a Committee to lay down at the beginning what temperatures should be employed for the specification of the refractive indices for various oils etc. Nothing was accomplished by the statement of individual preferences as regards the temperature at which the refractive index should be measured; and work in the future would be very much easier for anyone who had to deal with the subject if some definite temperature or temperatures were specified and universally accepted. With regard to Dr. Lowry's remarks as to the use of specified spectral lines, the difficulty was that in technological practice one would have very little opportunity for employing say the hydrogen, cadmium, or mercury lines, as the case might be. The beauty of the refractometer was that it could be used with any kind of light, the adjustment to achromatism being effected when the reading corresponded with that for the D lines. Of course one could not specify the refractive index of an oil for white light. It might be possible without in any way restricting the use of white light, to produce refractometers employing filters which could be made to isolate a very narrow band of the spectrum. In that way he believed it would be possible to determine some one constituent of an oil or solution, as the case might be, by the use of two such filters. If they measured the dispersion, it should be possible to determine the relative amounts present of two constituents of the solution. In regard to the use of the interferometer, mentioned by a previous speaker, it was available for works use and was made by an English firm. The original interferometer depended upon the adjustment to coincidence of two interference patterns, one being produced by the transmission of light through a liquid or gas, and the other by the transmission of light through the air space above the column of liquid or gas. The adjustment was

effected by a variation of pressure. White light had necessarily to be used in the operation because the centre point could only be located by the use of white light. Such an instrument had actually been used by Haber in connection with his work on ammonia synthesis. The instrument, however, was now in a more practical form, the pressure of the column of gas being varied by rotation of a glass plate in one or other of the interfering beams.

Dr. J. C. PHILIP said that in connection with the question of the temperature at which refractometric determinations should be made, the fundamental equation for all critical angle refractometers—$n = N \sin r$—ought to be kept in view. On this simple relationship between n, the index of refraction of the liquid, and r, the angle of refraction in the prism, was based the scale of the instrument (if direct-reading) or, alternatively, the conversion tables which accompanied the instrument. In both cases the computation involved a given value for N, the index of refraction of the prism. Any change in this value, such as occurred when the instrument was used at any temperature other than that at which the scale or the tables were exact, required the introduction of corrections, and diminished the rapidity with which measurements of refractive index could be made.

Mr. K. C. BROWNING thought that 20° C. was too low a temperature for examining essential oils. An instrument set at that temperature could not be used conveniently in most of the countries where the essential oils were made. It would be difficult in warm countries to get the temperature down because not only would it be necessary to have artificially cooled circulating water available but there would also be the difficulty that in hot damp places the condensed moisture collected all over the instrument.

In regard to the view that these oils were not examined in the country of origin but in more temperate climates he said that he had examined these oils in one of the countries where they were produced, for ten years past. That was a practice which was adopted very largely because of the atrocious adulteration which took place in certain countries, which was having the effect of condemning the whole of the sales of the products from these countries. The difficulties he had experienced in such examinations were very great for the reasons he had given. He hoped it would be possible to have an instrument standardised at 40° C.; that would be suitable for most fatty oils as well. Mr. Ling had referred to the interference refractometer. One instrument of this kind had come under his notice, better than the Zeiss instrument, which had a number of faults, especially of construction and temperature control. Many of the defects had been got over in the instrument made by Messrs. Hilger. The Jean-Amagat oleo-refractometer was extremely useful in the examination of fats. The readings were left to right from the centre, most vegetable oils going in one direction (with the exception of coconut oil and Chinese vegetable tallow) and the animal oils in the other. In this way various oils were distinguished where the butter refractometer showed no marked distinction. One disadvantage of the usual pattern of dipping refractometer was that, although it was very sensitive, its range was very small, but Messrs. Bellingham and Stanley had made an instrument in which the prism could be changed by simply unlocking a ring, which had the effect of giving the full sensitiveness of the dipping refractometer with a greater range. It also had one great advantage over the Zeiss instrument, in which there was a long prism fitted into a metal holder, mounted in cement. Occasionally the liquid worked round to the back of the prism and the shadow line which was ordinarily seen so sharply in the dipping refractometer faded gently away. When the instrument was taken out the shadow line came back again. The great advantage of the English instrument was a watertight ring which enabled the instrument to be cleaned without difficulty. It had another advantage in that it prevented insects from getting in and building nests, as they had a habit of doing in hot countries. So great had these troubles been in his experience that it was necessary to have three instruments in order that there might always be one in use. One was constantly travelling back to Europe for cleaning and overhauling. That difficulty was done away with in the English instrument. Hilger's were also arranging their instruments so that they could be taken to pieces on the spot and put together again correctly. The instrument to which he had referred was particularly useful for determination of small quantities of alcohol, although it was found that as the strength increased the accuracy fell off.

(COMMUNICATED REMARKS.)

Dr. JOHN S. ANDERSON: The importance of efficient temperature control is very fundamental. The usual type of water-cooling jackets for the prisms may be good enough for refractometers of the Abbe type, but where an accuracy of 1 in the 5th decimal place is desired, as in the case of very accurate work with the Pulfrich refractometer, the only feasible method is to have the instrument in a constant-temperature room. The water-cooling in a Pulfrich instrument can only be of use when the temperature of the water differs very little from that of the room, since a considerable surface is exposed to the air, the specimen of glass or of liquid contributing largely both to the volume to be thermally controlled and to the exposed surface.

The accuracy aimed at in refractometers of the Pulfrich type as being 1 in the 4th decimal place for absolute refractive index and 2 in the 5th place for dispersions had been referred to by Mr. Simeon. There is in use at the National Physical Laboratory a Pulfrich refractometer, made by Zeiss, with which an accuracy of about 2 in the 5th decimal place for dispersions is obtained, provided, of course, that the specimens examined give excellent definition. The instrument in many respects is not satisfactory for very accurate work; the accuracy indicated has been attained only after very careful calibration and exhaustive studies as to the best conditions of illumination etc.

Mr. T. F. HARVEY wished to enter a plea for the recording of all refractive indices at one standard temperature in the case of all substances which are liquid at common temperatures. A large number of observations for oils, methyl and ethyl alcohols, sugar solutions, etc., are already on record at 20° C. The writer in conjunction with A. Tompkin published (this Journal, July 15th, 1905) the refractive indices of some 530 samples of genuine fixed and essential oils at 20° C. and also the necessary corrections for converting the Abbe readings of 45 different oils taken at temperatures lying between 10° and 25° C. to the chosen standard temperature of 20° C. He further published in conjunction with J. M. Wilkie (Chemist & Druggist, 1910, **76**, 442) the refractive indices at the same temperature of about 1400 samples of fixed oils and 1200 samples of essential oils, along with some further temperature corrections.

A temperature of 20° C. was also adopted in Mr. Hugh Main's tables for sugar work. Distilled water at 20° C. ($n_D = 1{\cdot}3330$) is by far the most convenient standard substance for checking the accuracy of the instrument setting, and obviates entirely the very objectionable use of so-called "standard fluids" which have been supplied by the makers of some refractometers with only limited

scales. A further reason for working at ordinary temperatures whenever possible is that the most convenient and rapid method in using instruments of the Abbe type is to allow water from the main to come through a small intervening tank to give a constant head, and circulate through the prism jackets for half an hour, and then to proceed with the work, correcting the observations to a standard temperature. It would be inadvisable to attempt large temperature corrections to say 40° C. and would probably entail appreciable errors. He was unable to agree with the idea that since butter or other fats must be examined at high temperatures it were best to examine oils at the same high temperatures for the convenience of the food analyst. Such an argument is capable of extension to the determination of other factors such as the specific gravity of lard and oils. It is also obvious that elevated temperatures are quite unsuitable for observations upon essential oils, and all volatile liquids. The corrections for fixed oils vary only from 0·00036 to 0·00038, and 0·00037 may be used all through. For essential oils the corrections vary from 0·00039 to 0·00052 according to the oil under examination. The temperature corrections for fixed oils published in Bulletin No. 77 of the U.S. Dept. of Agriculture lie between 0·000360 and 0·000370, averaging 0·000366, which agrees well with the above figure. Only linseed and castor oils have a correction of 0·00038. It is surely undesirable to adopt as standard temperatures either 25° or 40° C., because they have been much used in connection with the German butyro-refractometer.

Yorkshire Section.

POLYMERISED AND OXIDISED LINSEED OIL.

BY H. INGLE AND A. WOODMANSEY.

(*This J.*, 1919, 101—104 T.)

ERRATUM.

Page 102 T, col. 2, line 2, after table, *for* "insoluble" *read* "soluble."

Communications.

PROCESS FOR THE ESTIMATION OF BUTTER FAT, COCONUT FAT, PALM KERNEL FAT, AND THEIR MIXTURES.

BY S. H. BLICHFELDT.

Several years ago (this J., 1910, 792) the author described a process for estimating butter and coconut fats in margarine. Since then the method has been used in laboratories connected with margarine and oil works, and a large number of analytical results and statistics have been collected. Further, the process itself has undergone alterations in the hands of the different chemists who have from time to time worked it. These developments of the process have been mainly due to Mr. P. S. Arup, Chief Chemist of The English Margarine Works, Ltd., and Mr. M. Pettersen, Chief Chemist of Planters Margarine Co., Ltd.

The process now used is as follows:—

Special solutions required:—

(*a*) Caustic potash, made by dissolving potassium hydroxide in an equal weight of distilled water.

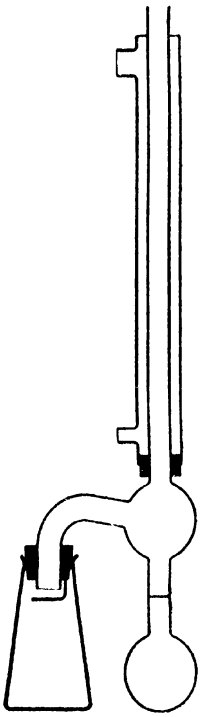
(*b*) Sulphuric acid containing 12½ grms. of concentrated acid per litre.

(*c*) Iron alum indicator, made by adding to a saturated solution of iron alum half its volume of nitric acid (one part of concentrated acid to three parts of distilled water).

20 grms. of the filtered fat is weighed accurately into a 300 c.c. resistance conical flask, and 8 c.c. of potash solution (*a*), 25 c.c. of glycerol, and a few small pieces of broken porous tile are introduced. The mixture is cautiously heated over a naked flame, with constant shaking until saponification sets in, care being taken to avoid over-heating.

The product, which should be straw-yellow in colour, is cooled and is then made up to 200 c.c. with distilled water which has been boiled for some time to free it from carbon dioxide.

50 c.c. of this soap solution, corresponding to 5 grms. of the original fat, is measured into a 300 c.c. resistance conical flask, 100 c.c. of sulphuric acid solution (*b*) added, and 0·1 grm. of pumice powder sifted into it through butter muslin.



The flask is now connected to the apparatus, and the requisite quantity, indicated by the mark between the two bulbs, is distilled over in about 20 minutes. As soon as the distillation is finished, the flask and condenser jacket are removed, and the side tube is closed by a cork. 0·5 c.c. of a 1% phenolphthalein solution and a known excess of from 5 to 10 c.c. of *N*/10 sodium hydroxide solution is now introduced through the condenser tube, which is then closed with a cork. The volatile acids are completely dissolved in the hot alkali-solution by shaking; at the beginning of the shaking operation the cork is withdrawn once or twice to lower the pressure inside. The resulting solution of sodium salts of the volatile acids is transferred to a 200 c.c. measuring flask, and the condenser tube is rinsed out several times with warm water into the flask. The volatile acids are then determined in the cooled liquid by difference by titrating the excess of alkali with *N*/10 sulphuric acid solution, a deduction of 0·4 c.c. for a blank experiment being made.

The insoluble silver salts are now precipitated from this neutral liquid by adding *N*/10 silver nitrate solution (5 c.c. in excess of the number of c.c. of *N*/10 sodium hydroxide required to neutralise the volatile acids), and complete precipitation of the insoluble silver salts from the solution is effected by dissolving in it 20 grms. of pure sodium nitrate. The liquid is then made up to 200 c.c., repeatedly shaken for about 5 minutes, and 175 c.c. filtered into a measuring flask. The filtrate is transferred to a 300 c.c. conical flask, and, after adding 15 c.c. of the iron alum indicator (*c*), titrated with *N*/10 potassium thiocyanate solution until a red coloration just appears. The number of c.c. of thiocyanate solution required × 8/7 subtracted from the number of c.c. of silver nitrate solution used gives the equivalent of the insoluble silver salts; the latter subtracted from the figure representing the total volatile acids gives the equivalent of the soluble silver salts.

The special condenser has undergone no alterations from that described in 1910 (see fig. p. 150). The complete apparatus is obtainable from Messrs. F. E. Becker and Co., Hatton Wall, London, E.C. The mark between the two bulbs indicates 100 grms. of water at 65° C. It is advisable to test the accuracy of the mark by filling the bulb with 100 grms. of water and placing it in a water bath at 65° C.

In the course of the discussion, when the process was first described, attention was drawn to the value of the melting points of the volatile acids in differentiating between coconut and palm kernel fats. This hint was followed up (mainly by Mr. Arup whilst working at the Maypole Laboratory), and a great number of figures have been determined for the melting points of the insoluble volatile acids, not only of the pure coconut and palm kernel fats, but also of their mixtures. The figures for coconut fat have been found to be between 8° and 12° C., and for palm kernel fat between 21° and 24° C., and the melting point of the mixtures is found to coincide with the direct calculations from these figures. The insoluble volatile acids for the melting point determination are either obtained by making a second distillation and simply using the oil floating on the top, or they are liberated from the precipitated silver salts remaining on the filter in the course of the general method.

A few abstracts are given below from notes and reports which have been sent in from laboratories where the distillation process has been in use for several years.

Mr. Pettersen, of Planters Margarine Co., writes that he still prefers the original method of titration with sodium chloride and potassium chromate. For the purpose of obtaining the free fatty acids for melting point determination he proceeds as follows:—"The silver salts from the insoluble volatile acids are well washed on the filter with distilled water and then removed from the filter paper to a narrow glass cylinder. Here the acids are liberated by shaking with one or two drops of hydrochloric acid. Ether is then added (about 10 c.c.) and the mixture shaken. The top layer, which is the ethereal solution of the insoluble volatile acids, is drawn off with a pipette, and the operation repeated with a fresh quantity of ether. The collected ethereal solutions are then evaporated in a beaker by gentle heat, and when the last trace of ether has evaporated the melting point of the residue is taken in the usual way by means of capillary tubes.

By this method Mr. Pettersen has found the melting point of the insoluble volatile acids from the silver salts to lie between 8° and 10° C. for coconut fat and between 21° and 24° C. for palm kernel fat. Mixtures of the two fats give insoluble volatile acids having melting points corresponding fairly well with the percentage of each present.

Mr. Pettersen further states that it is of importance to avoid, as far as possible, exposure of the free volatile acids to the laboratory atmosphere, owing to their affinity for ammonia, the ammonium salts having a much higher melting point than the acids themselves.

With regard to the melting point of acids, Mr. Arup writes as follows:—

"The results from acids direct and from silver salts were very similar, *e.g.*,

Silver salts	Direct
15·6	16·7
17·8	17·6

"It was found that heating too long or too strongly when separating the acids by action of dilute acid on the silver salts drove off some of the lower melting acids of coconut fat, and therefore made the distinction between coconut and palm kernel fats less sharp by raising the melting point of acids from the former. I have no doubt that this applies whichever method is used for the separation of the acids."

Below are given a few tables of results obtained by the method.

Maypole Laboratory.

Average figures from 200 analyses of coconut fat:—Total figure, 21·0; insoluble, 17·6; soluble, 3·4.

CHARACTERISTIC FIGURES FOR COCONUT FAT.

Trade name	Total	Insoluble	Soluble	M. pt. of insol. vol. acids, °C.
Vegetaline ..	20·2	17·0	3·2	11·5
Cocose ..	21·2	18·0	3·2	12·5
,, ..	20·8	16·9	3·9	10·0
,, ..	21·5	18·8	2·7	12·5
Neutreine ..	19·3	16·3	3·0	10·5
,, ..	21·0	18·3	2·7	11·0
,, ..	21·1	17·3	3·8	9·4
,, ..	21·7	17·4	4·3	9·3
,, ..	22·3	18·6	3·7	11·0
,, ..	22·0	19·3	2·7	10·8
,, ..	21·9	19·0	2·9	12·0
,, ..	20·3	16·5	3·8	7·8
,, ..	21·0	17·6	3·4	11·0
Neutrex ..	21·4	17·9	3·5	10·7
,, ..	21·8	19·1	2·7	11·0
,, ..	20·4	17·2	3·2	11·6
,, ..	21·6	18·3	3·3	12·1
,, ..	23·1	19·7	3·4	10·9
,, ..	29·9	18·3	2·6	11·7

Average figures from 81 analyses of palm kernel fat:—Total figure, 13·7; insoluble, 11·0; soluble, 2·7.

CHARACTERISTIC FIGURES FOR PALM KERNEL FAT.

Trade name	Total	Insoluble	Soluble	M.pt. of insol. vol. acids, °C.
Summer Neutrex	13·5	11·3	2·2	23·5
,, ,,	12·5	10·1	2·4	21·0
,, ,,	12·9	10·0	2·9	23·5
,, ,,	12·9	9·4	3·5	22·8
,, ,,	13·0	9·9	3·1	23·0
,, ,,	14·1	11·0	3·1	23·0
,, ,,	12·8	10·3	2·5	21·0
,, ,,	14·3	12·0	2·3	22·5
,, ,,	14·1	10·9	3·5	22·5
,, ,,	13·5	11·4	2·1	24·0
,, ,,	14·1	11·7	2·4	23·5
,, ,,	14·0	11·9	2·1	24·5
,, ,,	14·0	11·9	2·1	22·8
,, ,,	13·0	10·7	2·3	21·0
Medova ..	15·4	12·9	2·5	21·0
,, ..	14·0	11·4	2·6	24·0
,, ..	13·9	11·2	2·7	24·0
,, ..	12·8	9·9	2·9	22·0
,, ..	12·6	10·6	2·0	21·7

Butter varies a great deal according to the season and the country in which it is produced, and during the war it has been found that the figures for home-produced butter have been considerably lower than before the war.

Average figures from 15 analyses of home-produced butter for this period:—Total figure, 29·6; insoluble, 5·0; soluble, 24·6.

CHARACTERISTIC FIGURES FOR BUTTER FAT GENERALLY.

Total	Insoluble	Soluble
26·4	4·2	22·2
27·4	4·1	23·3
27·4	5·2	22·2
27·9	4·4	23·5
28·1	5·1	23·0
28·3	4·0	24·3
31·5	5·7	25·8
31·6	4·4	27·2
32·5	5·7	26·8
33·9	6·5	27·4

Planters Laboratory gives the following figures as the averages of a great number of analyses carried out during the last five or six years:—

—	Total vol. acids	Insol. silver salts	Sol. silver salts
Coconut fat ..	21·0	18·0	3·0
Palm kernel fat ..	13·5	11·0	2·5
Butter fat	32·0	4·0	28·0

Mr. Arup (English Margarine Works Laboratory) has supplied the following figures:—

—	Total	Insoluble	Soluble	M. pt. °C.	Iodine value
Coconut fat ..	16·8	15·2	1·6	25·5	—
" " ..	19·5	17·6	1·9	24·5	—
" " ..	19·5	17·6	1·9	25·0	—
Erith neutrex ..	21·3	18·4	3·4	24·5	9·4
Cocose	21·5	18·8	2·7	24·9	8·9
Vegetaline ..	20·1	17·1	3·0	24·8	8·7
Neutrex ..	22·2	19·5	2·7	24·8	8·5
Nucoline ..	20·9	18·2	3·7	24·5	8·1
Nutreine ..	20·0	17·5	2·5	24·6	8·8
Schlink palm kernel ..	14·5	12·9	1·6	27·8	12·8
Summer neutrex ..	14·6	12·1	2·5	29·3	15·3
70 % coconut fat .. 10 % palm kernel .. 20 % oil	14·6	11·2	3·4	—	—
Jus	—	0·7	—	—	—
Lard	—	0·4	—	—	—
Arachis oil ..	—	0·5	—	—	—
Sesamé oil ..	—	0·5	—	—	—
Corn oil	1·7	0·6	1·1	—	—

Blank tests 0·5 c.c., 0·5 c.c., 0·3 c.c. Blank tests, substituting phosphoric acid for sulphuric acid, 0·2 c.c., 0·2 c.c., 0·2 c.c.

COMMERCIAL COCONUT STEARINS.

—	Total	Insoluble	Soluble	M. pt. °C.	Iodine value	Saponification value
Erith coconut stearin	12·7	12·1	0·6	30·3	7·1	251·5
Schlink coconut stearin	20·5	19·0	1·5	26·4	7·3	252·7
Bramwell & Fern coconut stearin.	16·8	15·4	1·4	28·0	9·4	253·1
F. Boehm Cacaoline 5	13·5	11·1	2·4	29·2	3·8	257·8
" " 7	10·3	9·5	0·8	32·0	4·5	253·8
Faircloughs Chrystoline	13·9	12·0	1·9	29·1	7·7	254·0

DETERMINATION OF BENZENE, TOLUENE, ETC.

BY H. G. COLMAN AND E. W. YEOMAN.

(See this J., 1919, 57 T.)

In reference to Dr. Spielmann's remarks (this J., 1919, 136 T) the authors reply: The statement attributed by Dr. Spielmann to the authors "that in a sample of crude benzol the proportion of paraffin associated with benzene, toluene and naphtha is approximately the same," is nowhere made in that paper. On the contrary, in the analysis given at the end of the paper, showing the composition of a sample of crude benzol somewhat high in paraffins, it will be seen that in the fraction consisting chiefly of benzene (up to 90°), the paraffin percentage is about 17%, in the fraction consisting chiefly of toluene (90°—140°) about 27%, and in the solvent naphtha 40—45%. What is stated is that *in the fraction 90°–140°*, consisting chiefly of toluene but also containing benzene and xylene, no material error in the end result of the analysis is caused by making the assumption that *in this fraction*, when the paraffin percentage does not exceed 5–7%, the paraffins are present in equal proportion in all three constituents.

There is also no intentional statement in the paper that Spielmann and Wheeler's method of determining carbon bisulphide does not make correction for changes in volume when benzene and carbon bisulphide are mixed; the statement made refers only to the general principle underlying the method, but as written, it might perhaps be taken also to refer to the graphs given by Spielmann and Wheeler. It should therefore have been made clear in our paper that the expansion which occurs was allowed for in their graphs in another manner.

Birmingham Section.

Meeting held at Birmingham University on May 6th, 1919.

DR. E. W. SMITH IN THE CHAIR.

CHLORINATION OF BENZENE.

ANALYSIS OF MIXTURES OF BENZENE, CHLOROBENZENE AND DICHLOROBENZENE, ETC.

BY PERCY F. FRANKLAND, S. RAYMOND CARTER AND DOROTHY WEBSTER.

The method described in this paper was devised by us some two years ago as a convenient one for determining the composition of the reaction mixtures resulting from the chlorination of benzene on the industrial scale.

The process is essentially similar in principle to that employed by H. G. Colman for the determination of the percentages of benzene, toluene and xylene in commercial toluol (J. Gas Lighting, 1915, **129**, 196—198; this J., 1915, 168—170). Colman has more recently given a fuller account of the method (this J., 1919, 57–68 T).

Description of the method.

The sample (100 c.c.) is distilled from an Engler flask under uniform conditions and the distillates are collected in measuring cylinders. Three fractions are obtained by interrupting the distillation at 122° C. (corr.) and again at 142° C. (corr.). The volumes of liquid which distil below 122° and above 142° are noted and the percentages of benzene and chlorobenzene present in the original mixture are obtained from a graph which has been constructed from experiments with mixtures of known composition. The dichlorobenzene may be found by difference.

Experiments with mixtures of known composition have shown that the percentages of benzene and chlorobenzene deduced from the graph are not affected by the other products which are likely to be formed during the chlorination of benzene.

Detailed description of the apparatus.

Flask.—A standard Engler flask (100 c.c.), having the following dimensions:—Internal diameter of bulb, 6·5 cm.; length of neck, 15·0 cm.; internal diameter of neck, 1·6 cm.; length of side tube, 20·0 cm.; vertical height of side tube above surface of liquid when flask is charged with 100 c.c., 9·0 cm.; angle of side tube, 75·0°. The side tube is bent at a distance of 10 cm. from the neck to allow of connection with the condenser.

Condenser.—A 10-inch Liebig condenser, with four bulbs blown on the inner tube, arranged vertically. The end of the condenser is ground to an angle of 45° to facilitate the timing of the drops.

Cylinders.—A set of 50-c.c. and 100-c.c. graduated cylinders. They should be standardised by running into them known volumes of liquid from a burette.

Thermometer.—A thermometer registering up to 200° C. and having scale divisions sufficiently wide apart to estimate 0·1°.

Correction of thermometer.—It is assumed that the thermometer reads correctly to 0·1° with thread immersed at 100·0° C., 122·0° C., and 142·0° C. respectively. It should therefore be checked against a standard and the corrections (if any) applied.

Each day, before testing, the thermometer correction must be ascertained by placing it in a distillation flask with the top of the bulb just below the side tube and boiling distilled water in the flask. The difference between the thermometer reading and 100° is taken as the correction of the thermometer. Thus if the water is found to boil at 99·2°, 0·8 must be deducted from 122·0° and 142·0° respectively and the points of interruption in the distillation as shown by the thermometer must be 121·2° and 141·2°. This correction includes those required to be applied for variations in the barometric pressure and exposure of the stem respectively.

Method of distillation.

The Engler flask and condenser are dried before each experiment. 100 c.c. of the chlorobenzene mixture (of known temperature and weight) to be tested is poured into the flask through a small funnel from the graduated cylinder, the latter being drained out only. A small naked flame is placed under the flask and the latter surrounded by a wire gauze screen to protect the flame and bulb of the flask from draughts. The top of the thermometer bulb is just below the side tube of the distillation flask. The rate of distillation is regulated to 7 c.c. per minute from the end of the condenser, the distillates being collected in measuring cylinders. When the thermometer reaches 122° C. (corrected) the heating is stopped, the condenser allowed to drain, and the receiver changed; the distillation is continued till the thermometer reaches 142° C. (corrected), when the heating is again stopped. The condenser is now allowed to drain, and the residue in the flask after complete cooling is drained into a cylinder. The number of c.c. distilling (1) below 122°, (2) between 122°—142°, and (3) above 142° C. is read off at a temperature approximating to that found for the original sample when measuring out the 100 c.c. for analysis. Most of the experiments have been carried out at 18° C. The combined volumes of the three distillates should not amount to less than 99·0 c.c.

If solid *p*-dichlorobenzene separates out in the third fraction the volume should be read at a slightly higher temperature while the mixture is still homogeneous, and a correction applied for expansion on the basis of 0·02 c.c. per 10 c.c. of liquid for each 1° C.

From the amounts boiling (*a*) below 122° C. and (*b*) above 142° the volume percentage of benzene and chlorobenzene is found by means of the accompanying diagram. Thus if the percentage boiling below 122° C. is 24·9 and that above 142° C. is 20·4, the amount of benzene in the original sample is 20·3%, that of the chlorobenzene 64·7%, and that of dichlorobenzene, found by difference from 100, is 15·0%.

The weights of the constituents are deduced by means of their specific gravities. The following values may be used if the liquids have been measured at approximately 18° C.: Benzene, 0·880; monochlorobenzene, 1·110; dichlorobenzene, 1·30. The figure 1·30 refers to the weight of the volume occupied by dichlorobenzene when dissolved in benzene and chlorobenzene solutions, and is applicable to either the ortho or the *para* compound.

The composition of the above mixture by weight would be obtained as follows:—

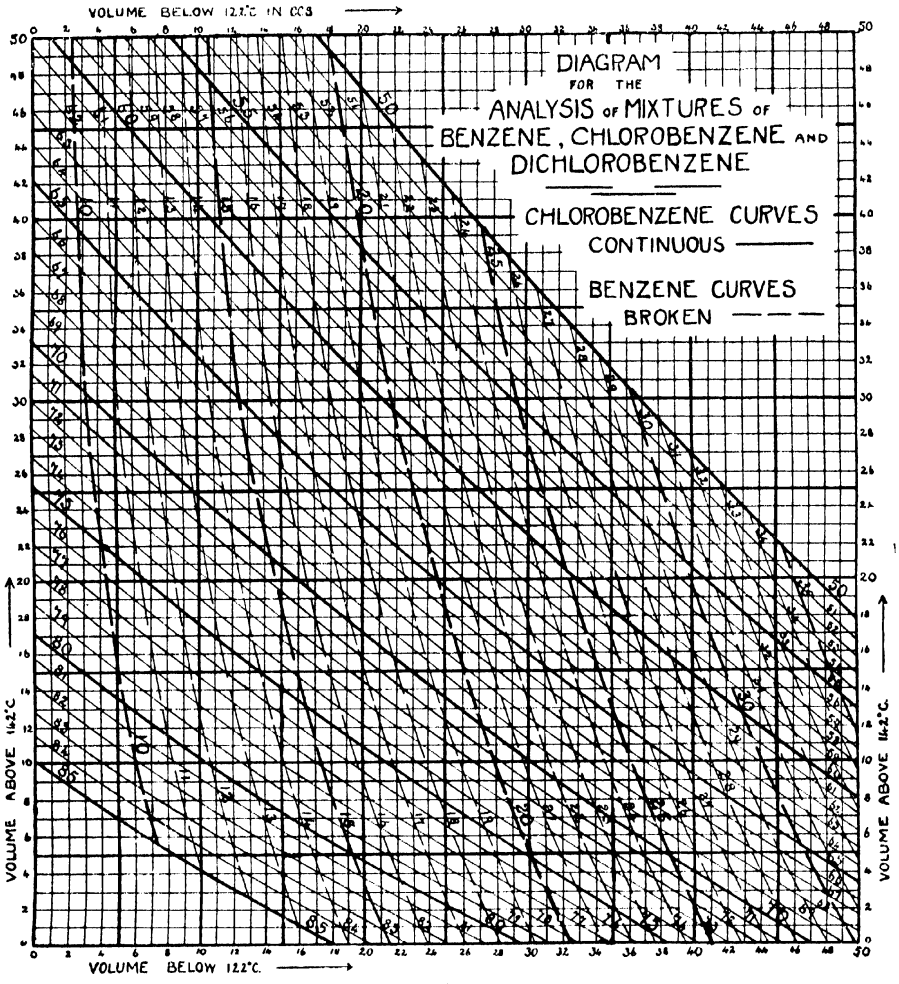
	Weight in grms. Found	Taken
Benzene = 20·3 c.c. × 0·880 =	17·9	17·6
Chlorobenzene = 64·7 c.c. × 1·110 =	71·8	72·1
Dichlorobenzene = 15·0 c.c. × 1·30 =	19·5	19·5
	109·2	109·2

The weight (109·2 grms.) of the 100 c.c. is determined directly, and the weight of the dichloro-

benzene (19·5 grms.) may also be found by difference. (109·2 − 17·9 − 71·8 = 19·5.)

The diagram only holds good for samples containing 50—80% chlorobenzene, and for those which contain such amounts of benzene and dichlorobenzene as yield not less than 5% or more than 50% either below 122° or above 142°. In cases where a sample does not fall within these limits the analysis may be made in the following manner.

A measured amount of the sample less than 100 c.c. is taken, and made up to 100 c.c. by the addition of such measured volumes of benzene, chlorobenzene, or dichlorobenzene that the resulting mixture comes within the specified limits. The percentages of benzene and chlorobenzene in this mixture are then ascertained in the manner described above, and from these percentages are deducted the volumes of benzene and chlorobenzene (if any) which have been added to make up the



100 c.c. The figures thus obtained give the number of c.c. of benzene and chlorobenzene contained in the volume of the original sample taken for analysis, and the percentages in this sample are found by multiplying these figures by 100 and dividing by the volume taken.

Thus, for example, a sample gave 65 c.c. below 122° and 4 c.c. above 142°, both of which values fall outside the limits of the graph. It was therefore treated in the following manner:—70 c.c. of the sample was mixed (previous to distillation) with 20 c.c. of chlorobenzene and 10 c.c. of dichlorobenzene. When distilled this gave below 122° 43·8 c.c.; 122°—142° 37·9 c.c.; above 142° 18·0 c.c.; total, 99·7 c.c. From the diagram this indicated a percentage of 32·3 for benzene and 54·8 for chlorobenzene. The composition of 100 c.c. of the original mixture was therefore:—

Benzene. $32{\cdot}3 \times 100 \div 70 = 46{\cdot}2$ c.c.

Chlorobenzene. $(54{\cdot}8 - 20) \times 100 \div 70 = 49{\cdot}7$ c.c.

Dichlorobenzene. $(12{\cdot}9 - 10) \times 100 \div 70 = 4{\cdot}1$ c.c.

If the composition by weight is required, it is preferable that the weight of the 70 c.c. of original mixture should also be known.

The influence of other reaction-products.

o-Dichlorobenzene. Pure *p*-dichlorobenzene was used in the experiments for the construction of the diagram, but it has been shown that the presence of *o*-dichlorobenzene does not materially affect the accuracy of the process even if the ortho constituent forms about 40% of the total dichlorobenzene present in the mixture.

Benzene hexachloride is sometimes formed during the chlorination of benzene and, if it is present in excess, it should be filtered off before the distillation test.

Owing to the limited solubility of the hexa-

chloride the amount left in solution will be small, and in such a case it is not sufficient to affect the accuracy of the determination of the benzene and chlorobenzene.

If the percentage of the hexachloride is required, it may be estimated by taking advantage of its sparing solubility. The fraction "above 140° C." contains all the hexachloride, and that portion which separates out from this at room temperature is collected, washed with light petroleum (b.pt. 65° C.) and dried. The mother liquor is concentrated and the further solid which separates on cooling is also collected, washed, dried, and weighed with the first lot of benzene hexachloride.

Typical example of analysis of a mixture containing benzene hexachloride.

A mixture having the following composition was prepared.

	Weight (grms.)	Volume in c.c. at 18° C.
Benzene	17·6	20·0
Chlorobenzene	72·1	65·0
Dichlorobenzene	18·0	15·0
Benzene hexachloride ...	3·0	
	110·7	100·0

This was distilled under the usual conditions and the following fractions were obtained:—Up to 122° 25·6 c.c.; 122°—142° 55·4; above 142° 18·0; total 99·0 c.c.

Reference to the diagram showed the mixture to have the following composition.

	Volume (c.c.)	Weight (grms.)
Benzene	20·2	20·2 × 0·88 = 17·8
Chlorobenzene ...	65·8	65·8 × 1·11 = 73·0
Dichlorobenzene, including benzene hexachloride ...	14·0 (diff.)	19·9 (diff.)
	100·0	110·7

The amount of hexachloride present was then ascertained in the following manner:—The fraction "above 142°" was allowed to cool and the solid was separated by filtering under pressure. The mother liquor was removed from the filter flask and the solid, which consisted largely of benzene hexachloride, was carefully washed with light petroleum (about 20 c.c.) to remove the dichlorobenzene. The residue was dried in the steam oven and weighed (weight = 2·5 grms.). A small quantity of the hexachloride still remained dissolved in the mother liquor, and this was also recovered by distilling the liquid up to 170° C. in a small flask fitted with a short column. The residue (which had thus been reduced to about one-third its original bulk) contained the remaining hexachloride, and this was filtered off, washed with light petroleum (20 c.c.), dried, and united with the hexachloride already obtained (weight = 0·4 grm.). Total weight of hexachloride found = 0·4 + 2·5 = 2·9 grms.

The corrected weight of dichlorobenzene is thus 19·9 − 2·9 = 17·0 grms.

The results of the complete analysis were:—

	Weight in grms. Found	Taken
Benzene	17·8	17·6
Chlorobenzene	73·0	72·1
Dichlorobenzene (difference)	17·0	18·0
Benzene hexachloride ...	2·9	3·0
	110·7	110·7

Chemistry Department,
University of Birmingham.

Canadian Section.

Meeting held at Montreal on May 17th, 1919.

DR. W. L. GOODWIN IN THE CHAIR.

THE PRODUCTION OF ACETONE AND BUTYL ALCOHOL BY A BACTERIOLOGICAL PROCESS.

BY HORACE B. SPEAKMAN, M.SC.

During the war period greatly increased demands for many essential commodities had to be satisfied, and the abnormal conditions obtaining proved a great incentive to investigations in many fields of science, both in the laboratory and the factory. Old methods were improved upon, greater efficiency and better yields obtained, and industrial methods have been considerably enriched by the successful operation of newly developed processes. In no branch of war work is this illustrated so well as in connection with the successful efforts which have been made to increase the supply of solvents, especially acetone, used in the manufacture of cordite. The processes which have proved successful in Great Britain, the United States, and Canada are very different in type, and represent a great deal of original research work in biological, organic, and inorganic chemistry, and in the industrial application of these. The present paper deals with certain features of the work of producing acetone by a bacteriological process at the British Acetones plant in Toronto, Canada. The work represents another stage in the use of the organic catalysts in industrial methods. Many of the devices used will probably be applicable in other similar enterprises, and as a whole they represent the essentials in what was a new development, namely, a large industrial plant in which a bacteriological process was conducted under perfectly sterile conditions.

During the years 1908-1910 numerous investigations were in progress in European countries in connection with the synthesis of rubber. An alliance was formed between several organic chemists and business people in England * and A. Fernbach, of the Pasteur Institute. Eventually it was demonstrated beyond doubt that rubber could be synthesised by the polymerisation of butadiene or isoprene, and the problem was how to obtain liberal supplies of butyl alcohol and acetone starting from cheap and abundant raw materials. It was due to the diligent and original work of Fernbach that advantage was taken of what had long been known to students of general bacteriology, namely, that certain species or strains of one species of organism are able to decompose carbohydrates with the production of acetone and various alcohols and acids. In connection with this synthesis an organism was isolated which was capable of fermenting potato starch, and relying on supplies of this material the work of building up the synthetic rubber industry proceeded.

During the war period similar work has been carried on in Germany. So far the only information available is contained in patent literature, and is therefore very limited.

Dr. C. Weizmann, subsequent to the developments mentioned above, made a new contribution to the subject by concentrating on a new and more abundant supply of raw material, viz., maize, and succeeded eventually in securing an organism

* Perkin, this J., 1912, 31, 616.

which would ferment actively a fairly concentrated mash and give good constant yields of acetone and butyl alcohol. This investigation was carried out in the Biochemical Department of Manchester University, and in 1914-1915 a small vessel holding five gallons of mash was running almost continuously in connection with the work. Dr. Weizmann realised the possible assistance which such a new development might give to the War Departments, and in the latter part of 1915 the work was continued as a piece of Admiralty research work. In a large distillery in London it was possible to carry on experimental work on a large scale, and eventually an aluminium fermentation vessel holding 500 gallons of mash was erected, and in it several successful fermentations were carried out. The work was not free from anxiety, and the results were by no means as consistent as those obtained in the laboratory. About Christmas 1915 an experimental plant was ready for use at the Royal Naval Cordite Factory, Poole. The installation consisted of an aluminium fermentation vessel, or seed tank, holding 500 gallons of mash, erected over and connected by pipe to a large wrought iron fermenter holding twelve thousand gallons of mash. This tank was originally intended for an acid mixing tank in the nitrocellulose plant, and was incapable of withstanding more than 1½ lb. steam pressure.

The seed tank mash during these trials was cooked in the vessel with heat supplied from a steam coil. For three hours the pressure was maintained at ten pounds, and the mash was then cooled by a stream of water through the coil. The culture was then added from smaller pail fermentations prepared in the laboratory. Working under these conditions the seed tanks were almost without exception good, and the culture sufficiently active to be used as inoculant. It was on the large scale that troubles were encountered and experience gained which pointed out the necessary fundamental principles in the designing of such a plant and its manipulation.

The mash for the large fermenter was prepared by running the required volume of water into the tank, and then, with the cone stirrer within rotating at about forty revolutions per minute, the maize meal was shaken into the water through the manhole above. When this mixing was completed steam was passed through the coil and the temperature raised to about 105° C. This temperature was maintained for from ten to fifteen hours, and then the mash was cooled down to the required temperature. This cooling operation required nine hours. The seed tank culture was then run into the mash and mixed in by stirring. Gas measurements were made by passing the stream of gas through a large wet meter. During the first three months of 1916 several fermentations were attempted under these conditions, and the results were most uncertain. It is for several reasons that I propose to discuss this portion of the work. It was only the stress of war conditions that allowed the work to continue in view of these adverse results, and yet those actively engaged in the work realised that in the light of the seed tank and laboratory results the process was possible, and given certain conditions could be made as sure and certain as any other commercial undertaking. Also it was following on this work that in certain localities the work was successful, and in others results were still variable. The fundamental weakness in the scheme obtaining at Poole at this time was that owing to the shortage in the supplies of steel and mechanical contrivances the scientific staff instead of being able to design and outline certain fundamental requirements, were of necessity compelled to operate a plant which represented what could be obtained at the time. In the history of the relationship between scientific men and business enterprises there are no doubt many examples of this inability to reproduce as closely as possible the conditions which the investigator knows to be essential, with consequent losses to industrial method.

During the preparation of the mash the heavier constituents of the meal settled at the bottom of the tank and formed large pieces; the stirring apparatus could not be speeded up. The temperature, 105° C., whilst in theory sufficient to cause the destruction of all bacteria if maintained for ten hours, was not so in practice. Tests were made, and after cooling, mash prepared in this way very rapidly developed a rich and varied flora. Assuming the presence of a few organisms, *e.g.*, spores, after the heating was complete, the cooling period of nine hours was far too long, and by the time the mash was ready for inoculation any such organisms had increased in number. The failure to sterilise the mash was also to some extent due to the caking at the bottom of the tank. Another source of weakness was due to the absence of any means of sterilising the pipe lines to the meter, seed tank, and the coils used to condense the vapours when the fermented mash was distilled. It was problematical whether the air was ever removed during the cooling period from these lengths of pipe with dead ends, and if during the cooling period one of the control valves on these lines leaked, contamination ensued. Such lines coated with mash residues constitute almost ideal conditions for the growth and multiplication of organisms from the air. When this system was analysed and compared with laboratory methods it seemed quite clear that on a factory scale the following principles would have to be rigidly obeyed: (1) the mash must be carefully prepared and rendered homogeneous by agitation during the preliminary heating; (2) the mash before inoculation must be sterilised in a vessel capable of withstanding steam pressures up to at least ten pounds; (3) mash must be cooled quickly and under aseptic conditions to the fermentation temperature; (4) fermentation must take place in a vessel which is in a sterile condition; and (5) all lines along which such mash must pass must likewise be constantly sterile. In this paper I do not propose to consider the methods adopted in the preparation of an adequate supply of a strong pure culture with which to inoculate the fermenter, but the following is an outline of the manner in which the above principles were applied in the plant of the British Acetones, Toronto, Limited, where operations were commenced in May 1916.

Mashing.—The four mash tuns situated in the Gooderham & Worts distillery were admirably suited for the purpose of preparing a homogeneous mash. In former days they had been used successfully in the preparation of a much more concentrated mash than the acetone organism could ferment. The body of the circular tun was made of pine staves, and covered with a conical wrought iron roof through which steam escaped. The mash was heated by means of a two-inch copper steam coil, and if necessary live steam could be injected also. Rakes fitted into a central column covered the whole of the flat bottom, and when in rotation prevented any accumulation of meal and formation of lumps. The meal from bins above each tun was shaken slowly and evenly from a mechanical shaker into the charge of water, the temperature of which was between 120° and 125° F. (49° and 52° C.). After about thirty minutes' heating the mash was boiling and ready to be pumped across an intervening yard to the cookers situated in the general distillery.

In the connecting line on the discharge side of the pump a system of convolutions with sharp double bends was introduced (Fig. 1). Along these

portions of the line were numerous steam connections terminating in small nozzles through which jets of steam alternately in line with and at right angles to the stream of mash could be discharged. A thermometer bulb was fitted in the line on the far side of these jets, and connected to a recording instrument situated on the mash floor. The control

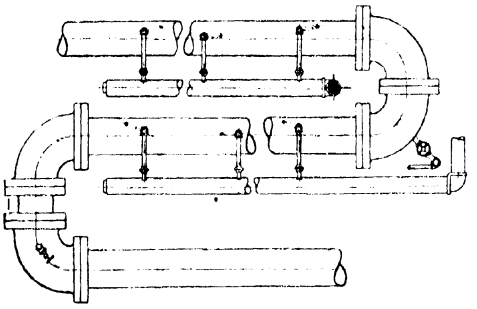


FIG. 1.—Steam injector in mash line showing details in joints and steam jets.

valves for the pumps used to send over the mash and for the steam jets were placed below this recording instrument, and by this system the operator could regulate and control the temperature of the mash as it reached the cooker. As far as possible the temperature was maintained at 240° F. (116° C.). In the passage through the line the mash was not only heated but treated very violently in the bends. Several beneficial results followed. The meal was further disintegrated and more starch converted into paste form, and by our ability to use a coarser meal the capacity of the mill was increased. The mash was made practically sterile. The results varied, and it was sometimes possible to find after incubation *Bacillus mesentericus* in mash taken from the line. It was also a great help in active operations to pass mash already heated to 240° F. into the cookers, thereby avoiding falls in pressure in the latter and consequent loss in time. By centralising the controls it was possible for two men to weigh out maize for the four tuns, prepare the mash, and send it over at the required temperature. In the twenty-four hours each day the three shifts prepared 200,000 gallons of mash.

Cooking.—The cookers used in the work were four small steel tanks holding 8000 gallons. Before this work began they had been used as small open fermenters in the general distillery. They were reinforced with beams at the base, and a conical cover fitted to each, and in this way rendered sufficiently strong to withstand an internal steam pressure up to 18 lb. In the centre there was a 3½-in. vertical pipe passing almost to the base, and terminating in a horizontal piece of pipe which was open at the two extremities of the ⊥. Down this central column the steam supply passed during the cooking of the mash, and it was rotated through a half circle by hand. The steam supply was maintained by a Locke Regulator at 22½ lb., and when the steam was on and the horizontal arm moving there was a great amount of disturbance within the cooker. By the method previously mentioned most or all of the flora in the mash was destroyed, and in the cookers emphasis should be laid on the cooking of the mash and not on its sterilisation. In view of this fact our inability to use high pressures, *e.g.* 30 lb., was not a handicap. By cooking the mash for 1½ hours at 10 lb. the mash was not discoloured and little dextrinisation had occurred. It must be borne in mind that to ferment starch was our aim. At the end of this period a test for sterility was made. An interesting question arises here as to what constitutes a safe rapid sterility test in a factory working at high pressure, where delays are undesirable. Obviously there is a point where organisms can be seen in such mash, but these may be active or inactive, and incubation or plating for 24 hours is the only sure method of coming to a true decision. The mash was therefore only pronounced sterile and ready for use in the fermenter when the slide showed no organisms. This test, bearing in mind the previous treatment of the mash, was considered safe and practicable. Occasionally cookers were held and maintained at 10 lb. pressure beyond the usual time, owing to doubts existing in the mind of the bacteriologist in charge.

A permanent record was kept of quantities and times of each operation in connection with the individual mashes and cookers, and the only person responsible for the use of each cooker was the person making the sterility test.

Cooling.—In the choice of the most suitable type of cooler for use in this process it was impossible to rely entirely on the past experience of distillery operators, because conditions and methods are not the same. It was only after several months' active operations in Toronto that conceptions could be formed regarding essential features in a cooler and the best way to secure them. I propose to speak of the needs of the operator as a bacteriologist, and to describe briefly the type of cooler designed by the Engineering Department under Mr. Shaw to satisfy these requirements.

(i) In all the plant used for this work it is necessary to avoid the use of joints as far as possible. The latter may be satisfactory in every way from the engineer's standpoint, and yet give constant trouble to the bacteriologist, whose ideas regarding leaks are necessarily different. In no portion of the plant is this so vital as in a cooler, where usually water, unsterilised and under pressure, is flowing around pipes through which mash is passing. As far as possible, therefore, continuous pipes are necessary.

(ii) If such leaks do develop the operator should be able to detect them quickly, because otherwise a whole day's work may be wasted, with the loss of thousands of dollars.

(iii) The organism works best between very clearly defined temperature limits, and the range is not large. For this reason the cooler should discharge mash at a constant temperature. When the culture used as inoculant is passing along the mash line a slight rise in temperature might seriously impair if not destroy its activity.

(iv) If for any reason the temperature must be changed, the cooler must respond quickly to the desires of the operator and not fluctuate for a considerable time.

(v) The cooler must be easily and effectively sterilised, and at intervals the mash tubes must be cleaned, otherwise the loss in efficiency is rapid and very considerable.

When we consider the cooler question from the more general business point of view it is necessary to think of the efficiency of a cooler with regard to gallons of water used per unit gallon of mash cooled through the required interval of temperature, and also the heat transfer units per gallon of water used. Both these points played a large part in our calculations, because as the production in the plant increased we finally reached the limit in the water supply and boiler capacity. By increasing the efficiency of the coolers more mash was cooled with the same water, and by raising that water to a higher temperature and using it on the mash flow a large economy in steam was brought about with a subsequent increase in the capacity of the plant.

In Fig. 2 a small portion of the later type of Shaw cooler in use at the British Acetones plant

is shown. The drawing represents a portion of one of the four boxes or compartments into which the cooler was divided. The four sections were mounted in pairs, one pair above the other. Each box contained eight copper tubes, 1 in. outside diameter, and 30 ft. in length, bent in the manner indicated, there being 28 loops in each length. Each pipe is coupled by means of a steel Diesel joint to the corresponding tube in another box, and if these joints are of this design and the necessary workmanship obtained the tubes are virtually in continuous lengths. It will readily be seen from the diagram what a vigorous scouring action takes place when mash is pumped through such tubes at the rate of 10,000 gallons per hour. Similarly by means of the sloping baffles cast into the water passage-way not only is there a cross flow secured but also the whole volume of water circulates at right angles to the direction of its general movement through the cooler.

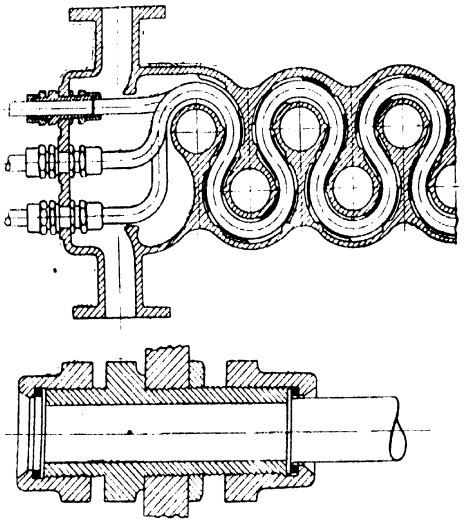


FIG. 2.—Shaw cooler showing detail of portions of one box or section; the nature of water passage-way is clearly indicated, and also a more detailed drawing of one Diesel joint.

In the exit pipe connected by a special fitting to the eight tubes a thermometer was inserted, and the operator by controlling the speed of the cooler pump could obtain fine control to 0·5° F. in the temperature of the stream. The whole volume of water was generally in use, and for this reason did not need to be adjusted except when starting up and slowing down.

In the event of a leak developing the tubes could be tested independently and any coil easily removed from the box. Twice each day the plant closed down for one hour, and the following operations were carried out. A reservoir of sterile water obtained by the condensation of exhaust steam from various units in the plant was connected to the cooler pump. When the last cooker of the eleven-hour period was empty this sterile water was pumped as quickly as possible through the coolers and through the mash line connecting the coolers to the fermenters, and the coolers were then isolated from the line. The boxes were filled with cold city water, and live steam (high pressure) was passed through the coils. In this way water was allowed to condense in the coils, and at intervals the whole contents of the coils were discharged with a violent rushing of steam by opening the drain from the lower header on the coils every fifteen minutes. It is impossible, even when using such a cooler in which the stream of mash is so violently agitated, to avoid completely the formation of deposits within the coils and the subsequent loss in efficiency. During the eleven-hour periods this loss usually amounted to 5—7%, but the majority of this loss in efficiency was recovered during the sterilising periods. During the week there was, however, a gradual but much smaller loss, and each Sunday was devoted to a complete and thorough examination and cleaning of the coolers, using instead of distilled water in the manner previously described a strong solution of caustic soda which was passed continuously through the coils. By these methods not only were the coolers kept in a sterile condition, but also their efficiency remained remarkably constant. The latest type of cooler required from 1·2 to 3 gallons of water per gallon of mash cooled. Water at 130°—140° F. was available in more than the necessary amounts for use on the mash floor, where time and steam were saved in considerable amounts.

Mash line.—Assuming that the mash leaving the cooler is sterile, we must now consider the methods adopted to safeguard the mash against contamination in its passage through the line to the various fermenters. It was of course necessary to have flanged joints in the line and valves controlling outlets into individual fermenters and to drains. It was possible to assume that by constant supervision these joints and valves could be kept not only liquid-tight but air-tight, and the methods used could have been based on this assumption. There is not the slightest reason to doubt that constant failures and loss of money would have ensued. After earlier experience in England and in the first few months' work in Toronto the conclusion was forced upon us that no valve from the bacteriologist's point of view can be assumed to be reliable. Following on this conclusion no trust was placed in the ability of a valve to prevent air reaching the mash stream, and the following devices and methods were adopted.

Throughout the plant a general principle was adopted that tanks of all sizes and lines along which mash or culture flowed must be in one of the two following conditions: (1) under pressure from steam, fermentation gases, or mash discharging from the pump; (2) cooling after sterilisation with wide padded openings through which filtered air could pass. Thinking of the lines only it will readily be seen how the first condition was brought about in practice. The lines were never allowed to remain at atmospheric temperature and pressure. If for any reason interruptions occurred in the day's programme, the lines were drained and put under steam pressure until work could be resumed. It has also been found unnecessary and risky to place relief valves in the line. By using Locke Regulator steam at 22½ lb. pressure and having a proper system of relief valves in the steam line system itself, safety valves in the actual fermentation vessels and lines, provided these are of the right construction, can be dispensed with. This matter will be discussed more fully in connection with the fermenters. In connection with the drains (see Fig. 3A) double valves were used with a steam jet between. When the line was under steam this seal was not used, but during the filling of the fermenters when the line was full of mash an absolutely safe seal was made on all the open ends of the line. In the same figure a similar type of seal is shown in connection with the beer line along which the fermented mash was sent to the stills. This line was under the control of the distillation department, and could not be kept sterile. In ordinary distilling practice a single gate valve separates the fermenter from such a line, which at times may be under high pressure due to gas produced in dead sections of the line. The acid

nature of the mash causes slow corrosion of gates, and very soon valves begin to leak, speaking again from the bacteriological standpoint. The diagram will show how it is possible to connect a fermenter

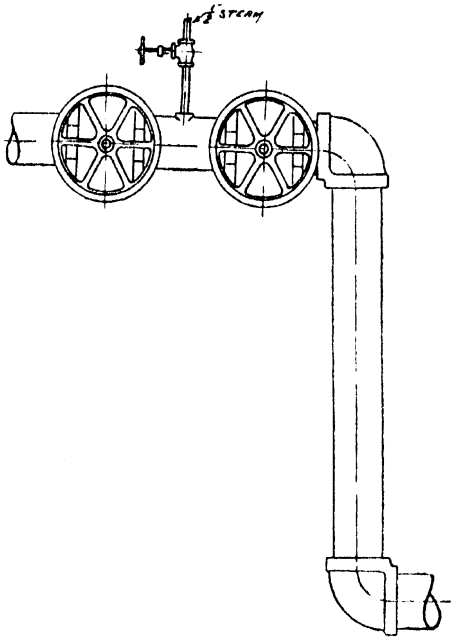


FIG. 3A.
Steam-sealed drain connection on mash line.

in which pure culture work is going on to a line which is in a septic condition. The seal formed between the three valves was blown out through the drain about every hour, and considering the results obtained the amount of steam required is negligible.

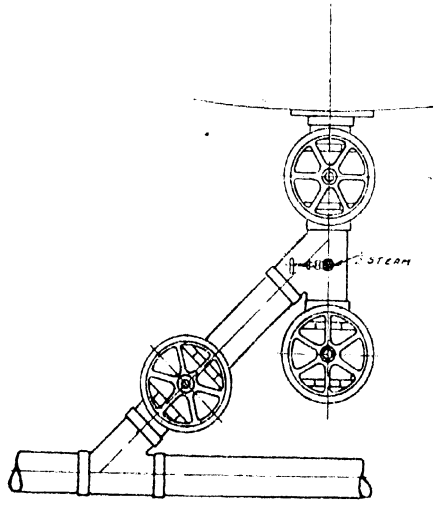


FIG. 3B.
Steam-sealed connection between fermenters and beer line.

Perhaps the most difficult situation to deal with in connection with the mash line, which was about 450 ft. in length, forming an oblong, was just at the time when filling the fermenters was about to begin. The line was under steam, and was about to be filled with mash at body temperature. In the earlier months, in order to change from steam pressure to mash pressure as quickly as possible, the stream of mash was run along the line still in a very hot condition. The shaking and rattle in the line were very bad, and no doubt weakened many connections. On the other hand, if time is allowed for steam to condense a point is reached at which a vacuum is formed and the principle which is governing all such work is broken. Fig. 4 shows a simple apparatus which enables the operator to change over from steam to mash with complete confidence. The source of steam for sterilising the line is shown. Just previous to starting up the foreman in charge

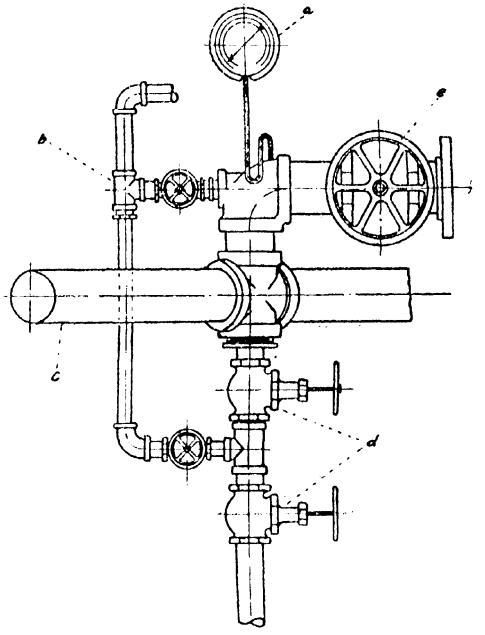


FIG. 4.—Cooling device on mash line, *a* gauge, *b* steam connection for sterilising mash line, *c* mash line, *d* steam-sealed drain from mash line, *e* flanged gate valve, wire-gauze tray within the flange, the cotton pad not shown.

performed the following operations: (i) Drain the line and seal the drains. (ii) Blow steam through the valve *e* shown in Fig. 4, close the valve, and sponge out with dilute carbolic acid solution. (iii) Cover the copper-wire gauze plate within the flange with a fresh, clean cotton-wool pad, six layers between cheese-cloth, and fasten securely with tape. (iv) Shut off steam in the line and watch the gauge. (v) When pressure is at zero open valve *e* and allow the line to cool for ten minutes. (vi) Signal by whistle to one of the operators to open the valve to the first fermenter to be filled. Close *e* and start the pump.

By this method the jarring of the line, the formation of an uncontrolled vacuum, and the overheating of the first batch of mash were eliminated; all are sources of possible contamination or delay in operations.

The fermenters.—The fermenters situated in the general distillery had been used for the fermentation of molasses. Each tank was constructed of $\frac{5}{8}$ in. plate, 18 ft. in diameter by 20 ft. high, with a slightly dished bottom and no cover. The tanks had single riveted lap joints, and rested on brick piers. A new conical roof of $\frac{1}{4}$ and $\frac{5}{16}$ in. plate with an 18 in. rise was placed on each. The new fermenters, 14 in number, were constructed of $\frac{1}{4}$ in. plate, and differed slightly in several dimensions but in no fundamental particular from the above.

The great difficulty in connection with these tanks was with regard to their sterilisation. They were not of sufficient strength to allow more than 1 lb. steam pressure to be used. Also if for any reason, such as a failure in the steam supply, a slight vacuum was formed, the bottom began to leave the piers and the connection to the beer line was broken. The various fittings in connection with the fermenters (see Fig. 5) will now be described.

At a distance of 12 in. from the base and half-way up the tank a sampling cock was fitted to allow temperature control tests to be made, and also for laboratory samples to be obtained. An extension bulb from a Taylor instrument recording ther-

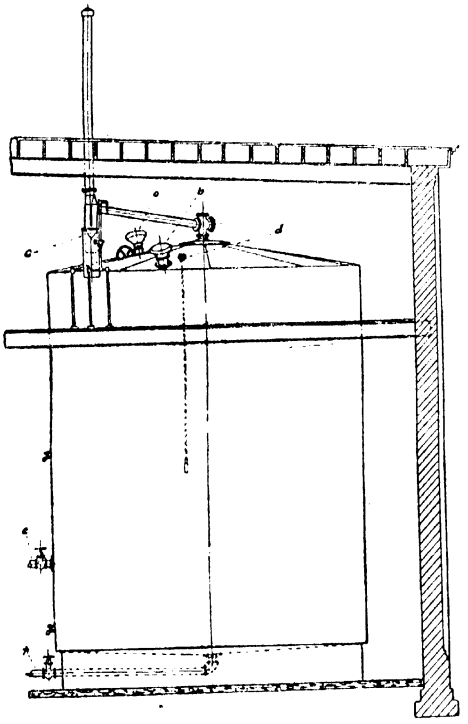


FIG. 5.—Fermenter, showing *a* air valve, *b* vacuum valve *c* antiseptic seal and connections, *d* thermometer, recording instrument is not shown, *e* mash filling line connection, *f* beer-line connection.

mometer was suspended through the roof of each tank, passing through a properly designed joint. The air which was allowed to enter the fermenter during the cooling period passed through a specially designed air valve. The valve proper was carefully fitted into a 4-in. threaded flange in the roof by means of a close nipple. Above the valve a copper funnel was soldered securely into a nipple. This funnel had an upper cylindrical portion 2 inches deep, and resting inside on the upper edge of the funnel itself there was a circular copper tray of strong wide-mesh gauze. A specially designed vacuum valve was placed on each fermenter. These valves are sensitive, and also from the bacteriological standpoint are satisfactory because they can be thoroughly cleaned. The valves are not supposed to be perfectly tight, and are accordingly protected by an air filter funnel similar to those on the air valves. At the side on the board carrying the recording thermometer instrument there was also placed a glass tube manometer showing water pressures up to about 14 inches. This manometer was connected to the fermenter by a rubber and copper tube through a specially designed cross with cocks, so that after foaming the narrow tubes could be thoroughly cleaned, and also when the tank was actually foaming the manometer could be disconnected. The manholes are of the usual type with two arches, and a special rubber gasket was used. Asbestos gaskets are not satisfactory.

Special mention must be made of the device used for taking away and roughly measuring the gases produced by the fermentation. The seal which is here described is also an excellent pressure controller during sterilisation and the only suitable safety valve which has so far been used. During the early months of the work in Toronto and in England safety valves of standard types were fitted on the fermenters. The average safety valve is somewhat complicated, and can be handled with safety only by experienced men. It would have been, for example, very easy to overload a valve in Toronto, and by creating excessive pressure (above 1 lb.) in the fermenter cause serious damage in the plant. Also safety valves cannot be kept clean, and when filled with mash provide situations in which air organisms grow readily. The seating gets into this condition, and when the tank cools down (2 in. vacuum showing on water manometer) unfiltered air passes through the safety valve. To overcome these difficulties the simple water seal used in laboratory work was elaborated. At the top of the fermenter there was a 6-in. flange, and above this a specially designed cast iron cross. Two of the hinged flanges on this cross were intended for use when cleaning the fermenter. The sloping gas pipe was designed to help condensed liquors to flow back to the fermenter. This rise was limited by head room in the building. The device itself, shown in Fig. 6, consists of a 6-in. square copper box about

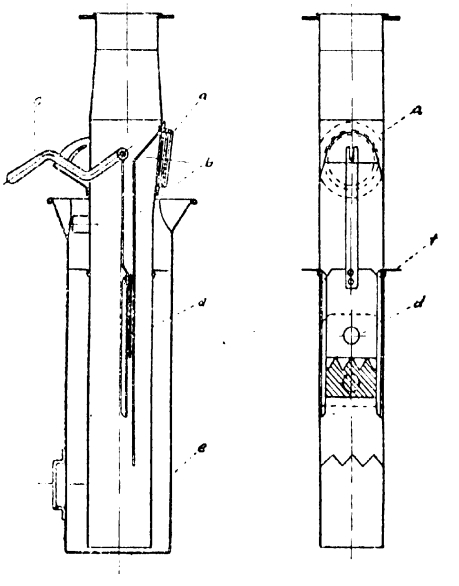


FIG. 6.—Antiseptic water seal, *A* longitudinal section, side elevation, *B* longitudinal section of inner portion, front elevation, *a* threaded-flange connection to gas line, *b* partition in inner portion, *c* lever controlling the orifice shown in lower position, orifice = 4 in. pipe, the smaller orifice *d* is shown above the large one, *e* outer can holding dilute carbolic solution in position to create pressure of 10–11 inches in fermenter, *f* guide.

46 in. long, becoming circular at the top, where it is flange jointed to the 6-in. exhaust pipe, and with an open bottom. The dividing plate running down the centre has cut in it a rectangular orifice with a notched upper edge, permitting the easier discharge of gas. This orifice is equivalent in area to a 4-in. pipe. There is a gate on the dividing plate

controlled by a lever from without, and by raising and lowering this gate the orifice can be changed from 1¼ in. to 4 in. The outer can is made of copper also, and the size 10 in. by 30 in. This can is filled with a dilute solution of carbolic acid, and can be raised so that the inner box is almost submerged, or lowered according to the requirements of the operator by means of sash cord and connections over pulleys to a balanced weight. The pressure created in the fermenter by the discharge of gas through the orifice is measured on the manometer, and varies according to the condition of the fermentation and the orifice (1¼ in. or 4 in.) in use.

When a fermenter was to be used for the first time the sterilisation described below was repeated three times at intervals of twelve hours when the fermenter was at room temperature. By this discontinuous method complete sterility was assured. After each fermentation the tank was sterilised once before refilling.

To sterilise a fermenter, the can of the water seal was lowered and live steam injected into the fermenter through a 2-in. connection at the base. The air valve was closed. When the thermometer began to record constant temperatures the steam was reduced and the outer can of the seal was slowly raised, causing the production of from 10 to 11 in. pressure in the fermenter. The operators were able by a little adjustment of the steam valve and watching the manometer to keep a steady temperature and also avoid waste of steam. The whole tank, including the gas connections, was at this temperature down to the surface of the liquid through which the steam discharged. The level of this solution was kept constant by the operator. In the event of a steam break occurring and the vacuum valve failing to operate, the liquid in the can would pass into the fermenter followed by air, and no damage to the tank would ensue. This pressure and temperature were maintained for eight hours, and the fermenter was then cooled down. Before steam was cut off the operator allowed a small amount of steam to blow through the air valve. The parts of this valve and the vacuum valve above the seating were then thoroughly sponged with a fairly strong solution of carbolic acid. Clean pads of cotton-wool, six layers between cheese-cloth, were tied securely over the funnels, and fresh carbolic acid added to the seal-can liquid. Steam was then cut off, and the operator watched the gradual fall in pressure on the water manometer. At zero the air valve was opened gradually and air passed through the pad. The cooling operation lasted about 2½ hours, and the temperature fell from 214°—216° F. to 98°—100° F. Obviously the success of this operation in preserving the sterility of the tank depends on the care taken by the worker, *e.g.* in preparing pads of the proper size and thickness. Success and continued repetition of such operations are liable to lead to carelessness and all the care taken in the rest of the process is useless. This work at the British Acetones plant was done by women, whose conscientious care exercised in repeated performance of small but essential duties played a great part in the good results obtained.

When the tank reached the required temperature the mash was pumped in through the filling line from which a connection ran to each fermenter six feet from the base. Usually four fermenters were filled together in series, one cooker of 6000 gallons passing into each in turn until there was 24,000 gallons in each. During the first cooker cooling period repeated samples were taken from the lower cock, and the temperature read and communicated to the cooler operator. When the body of mash was at the required temperature the inoculant was injected by gravity into the stream of mash in the line. During the remainder of the filling period temperature readings were taken at half-hourly intervals, and every hour during the fermentation. One hour after the tank was full the outer can of the water seal was lowered and filled to the usual level with fresh solution. If during the filling period, as a result of cooling, the contraction in volume of the contents of a fermenter was greater than the increase due to gas formation, a vacuum was formed; to prevent this the air valve was opened, otherwise it was closed during this period, and there was usually a pressure on the tank all the time. When the pail was lowered the manometer indicated a pressure due to gas passing through the smaller orifice, the level being raised. During the fermentation, pressure rose to considerable amounts, and to prevent this the lever was lowered when the pressure reached 5 in., and thereby increased the orifice to 4 in. The underlying reason for this operation was to prevent as far as possible the occlusion of large amounts of gas in the slimy albuminous mash, which was liable to foam over with great violence when such pressure began to diminish towards the end of the fermentation. During this period when the pressure fell to about 0.2 in. the orifice was again reduced and the pressure thereby raised, and finally when the pressure had fallen to zero the contents of the fermenter were handed over to the distillation department.

In connection with this description of the methods and apparatus used in Toronto it should be stated that after the plant had developed into the condition described, *i.e.* in April 1916 until the armistice was signed, when operations ceased, no fermenters out of a total of 3458 inoculated, each holding 24,000 gallons of mash, were discharged into the drain and not distilled.

The plant and the methods which have been described represent the united and disinterested efforts of bacteriological, engineering, and chemical departments. Together we are indebted to our late chief, Colonel Gooderham, for his encouragement and enthusiastic leadership.

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PROBLEMS IN THE UTILISATION OF FUELS.

BY RAYMOND F. BACON AND WILLIAM A. HAMOR.

The most efficient utilisation of our wealth of fuel supplies is a subject which is being accorded constantly increasing attention. Interest in this topic in the United States has generally been confined to the advocates of the conservation of our natural resources. The fuel supply is still abundant and in industry it has usually been found to be a more convenient policy to burn high-grade coal, or fuel oil, than to be concerned with the problems encountered in the use of peat, lignite, or some of the poorer grades of coal containing a high percentage of ash. It also frequently happens that, in some mining districts, a portion of the coal is regarded as refuse, and is either burned to eliminate it, used for filling, or thrown on the culm piles. The reserves of bituminous coal and lignite in the United States are immense, but the supply of some of the higher grades of solid fuel, such as coking coal and anthracite, may be exhausted during this century, and accordingly the importance of the conservation of all classes of fuels cannot be over-emphasised. This contribution presents a discussion of some of the most important engineering problems in the utilisation of fuels.

The utilisation of low-grade fuels.

The present period of commercial and industrial activity in the United States and Canada,[1] in combination with the use of liquid fuels for automobiles and marine purposes, has accentuated the inadequacy of some of our commercially developed fuel supplies and has directed specific attention to the fact that certain known sources of fuel are being rapidly depleted. With the present limited development of our water powers and of our deposits of low-grade fuel, the American nation is dependent largely upon localised mining activity in the regions where deposits of high-grade coal and of petroleum are found. Large sections of the country receive their fuel supplies by long rail or water routes. The cost of freight usually prohibits the transportation of any but the highest grades of coal for distant consumption. In such parts of the country there are often undeveloped deposits of low-grade fuel which could be used locally, by several available methods, in connection with existing equipment. An accurate estimate as to the quantity of such fuel is difficult to obtain; but, based on the area in which it is found, the amount, unquestionably, largely exceeds the supply of fuel now being commercially utilised.

This fuel has been classified into two divisions, *viz.*, lignites and peats, and graphitic coal, such as is found in the New England States and in the Canadian Northwest; and, in addition to these comparatively undeveloped sources of fuel, modern methods of coal mining, together with the necessity for taking out the thinner veins, have resulted in an increase of mine-waste which is not turned to use, but which possesses utilisable fuel value.

The reasons for the lack of development and utilisation of low-grade fuels may be summarised as follows:—

(1) The cheapness with which the high-grade fuels could, in the past, be mined and transported to the markets.

(2) The need of basic experimental and development work, which is required in order to utilise the full thermal efficiencies of such fuels.

The use of low-grade fuel for steam generating purposes.

Important work has been accomplished in power-generating stations in the direction of increasing the thermal efficiencies of the higher grade fuels; but much more investigation remains to be carried out along that economic line, particularly in the utilisation of the full value of the fuel at high rates of combustion. High rates of combustion are, especially in large power plants, of extreme economic importance, the capital investment being reduced in direct proportion to the rates of burning. In nearly all of the accepted types of boilers the efficiency of the absorption of heat at high rates of combustion is greater than that of the furnace in the actual generation of heat. This is particularly the case when the boiler equipment is supplemented by economisers or other means of utilising the heat lost through high waste-gas temperatures. Owing, however, to the low specific heat of the gases, the heat loss due to high stack temperatures is not as great as is popularly supposed.

[1] A peculiar situation exists in respect to Canada's fuel supply: *viz.*, that over 50 per cent. of the consumption is imported from the United States. The Canadian coal-fields are situated in the extreme east and in the western provinces, while the great central provinces of Ontario and Quebec are more easily and economically supplied with coal from the coal-fields of Pennsylvania. Further, no anthracite coal occurs in Eastern Canada, and Canadians have grown dependent upon Pennsylvania for anthracite, which is not only the main house-fuel in Manitoba, Ontario and Quebec, but is imported even into the eastern coal districts of Canada. During 1917 Canada produced about 14,000,000 tons of coal, of which 1·7 million tons was exported; during the same year 15·5 million tons of bituminous coal and 5·3 million tons of anthracite were imported.

Low-grade fuel may be burned on grates in furnaces of special construction for each class of fuel, and special mechanical appliances (stokers and grates) are available for burning high-ash coal and lignite and also coke braize (breeze).[2] It is probable, however, that low-grade coal and lignite can be utilised more advantageously in pulverised form. Lump coal, when burned on the grate in a hand-fired furnace, usually requires about 100% of excess air, although with the best types of modern mechanical stokers this excess can be considerably reduced. With most kinds of pulverised fuel 25 or 30% of excess air is, however, sufficient, and, with proper attention, the amount needed may be even less. The resulting temperature of the fire is, of course, a limiting factor. Other factors having a bearing on this problem are the construction of the furnace, the proportion of heat radiated directly to the tubes, and the fusibility of the ash. Properly constructed furnaces and burners should be able to use any form of pulverised fuel which has sufficient carbon content. For the firing of steam locomotives, pulverised fuel offers a method which is worthy of serious consideration in all parts of the country where the use of oil fuel is not more economical; in addition, it furnishes a means of utilising certain neglected solid fuels.

In the case of peat, and of bituminous coal rich in combined nitrogen, the value of ammonia as a fertiliser renders the by-product gas producer worthy of very careful consideration for large installations. The gas generated may be burned under boilers supplying steam turbines or it may be used directly in internal-combustion engines.

Comparatively little has been done in America in following this line of European development. Possibly the higher cost of machinery in this country has caused our engineers to look askance at a type of plant which requires a considerable initial investment. And, besides, the American farmer has not so far been adequately educated in regard to the advantages of fertiliser for the intensive cultivation of crops. Our chemists have, however, been endeavouring to awaken the nation to the importance of the nitrogen industry; and the generation of large amounts of power in hydro-electric plants has been advocated for the special purpose of making synthetic nitrogen compounds. Why not recover the nitrogen content of our fuels before burning them? Why not invest the capital required for hydro-electric developments in by-product gas producer plants for electrical power generation?

On the utilisation of coal washer-waste.

It is clear that one of the chief fuel problems of the future is to be that of utilising low-grade fuels, such as peat, lignite, mine-slack, bone-coal, and many other waste materials which, at the present time, are being discarded as too low in combustible matter to be of economic value. Some progress has been made in this direction in Europe, where the necessity of conserving fuel supplies has been more keenly felt than in the United States. Peat, in particular, has been exploited in England, Russia, and other European countries, and has come to be regarded as a rather important power fuel, especially on account of its high nitrogen content.

Coal-slack has also found some application in Europe as a fuel for by-product producer-gas manufacture, but, owing to its comparatively low nitrogen content, it has not been widely used for this purpose. It is claimed by certain gas manufacturers in England that low-grade coals containing as high as 40 to 50% of ash have been successfully gasified in by-product producer-gas plants. The first cost of plant and operating charges are, however, con-

[2] "On the Utilisation of Coke Braize," see Hamor, Coal Age, 1917, 11, 780.

sidered to be too great for the economic utilisation of such coals *per se* in this country within the near future.

The industrial use of high-ash fuels has, in fact, demanded much more attention in Europe than in the United States; but, so far as known, no special effort has been made to utilise bituminous coal washer-waste, or other similar waste materials, containing 50 to 60% or more of inert matter. An investigation has been carried out by Dr. C. B. Carter, under the direction of the authors, in an effort to devise a suitable method for the utilisation of coal washer-waste or refuse. Although this waste material contains too little combustible matter to be of direct value as a fuel, it readily undergoes spontaneous combustion in the large dump piles accumulating at the washeries and accordingly becomes a nuisance. The object of the work conducted at the Mellon Institute of Industrial Research has been to find an economic method of preventing or abating this trouble. To this end, a number of possible uses for the material have been evolved, but in no case could serious consideration be given to these uses unless their practice would require a large daily consumption of raw material. The reason for this becomes evident when it is borne in mind that a big washery produces several hundred tons of refuse per day.

Flotation as a method of recovering the coal contained in washer-waste.—It has been demonstrated by us that the combustible matter contained in coal washer-waste of all grades can be almost completely recovered by suitable oil-flotation, a concentration process which, as is well known, is widely used on ores. Recoveries of 70 to 90% of the total combustible matter present have been made by us, the extent of the recovery being dependent upon the oil used, the size of the material, the degree of agitation, the method of grinding, etc. The ash content of the recovered coal has been found to depend upon several factors, such as the percentage of recovery, the method of grinding, etc.

If washer-waste is ground in such a way that the grains of coal are subjected to a rubbing or rolling action, the yield of recovered coal will be small and it will contain an excessive amount of ash. On the other hand, if it is crushed or ground in such a manner that the grains of coal are subjected to a minimum of this rubbing or rolling action, the recovery will be large and the recovered coal will be relatively free from ash. For the best results it has been found that the washer-waste should be *crushed* to pass a 48-mesh screen, the word crushed being here used in contradistinction to the word ground. The coal particles show the maximum floating properties when they are sharp, angular, and lustrous. Grinding in machines of the disc-type destroys these physical properties, and the yield of recovered coal from refuse ground in this way is small and its ash content is high.

The amount of ash present in the recovered coal depends also upon the quantity of coal recovered. In general, the larger the recovery the greater will be the ash content of the recovered coal. If it is desired to increase the recovery from, say, 70 to 90%, it is necessary materially to increase the agitation of the pulp in the flotation cell, and the ash in the concentrate will be increased, as a consequence, from 20 or 25% to 30 or 35%. This is doubtless due, in part, to the greater violence of agitation, but is attributable, perhaps in the main, to the fact that, even in the finely ground material, much of the coal is intimately bound to grains of slate which are carried over the walls of the flotation cell by virtue of the selective action of the coal for oils. With less violent agitation the buoyant action of air on the coal particles thus weighted down will not be great enough to carry them to the surface. Another factor which affects the ash content of the flotation concentrate is the percentage of pyrites in the washer-waste. Pyrites floats readily, and therefore the ash in the recovered coal will increase or decrease proportionately as the pyritic content of the waste increases or decreases; it is probable, however, that this could be controlled by preferential flotation. In recovered coals showing 25% of ash, from washer-waste containing 65—70% of mineral matter, as much as 40—50% of the total ash is generally attributable to pyrites alone.

Conservative estimates show that a plant erected complete to handle 500 tons daily of ordinary bituminous coal washer-waste, and to recover the actual coal contained in it, will cost at a maximum $135,000; and a similar plant to handle 250 tons daily will not cost over $90,000. In the case of the first plant, it is computed that the coal can be obtained from refuse with 65 to 70% ash, to the extent of 75% of the total coal present, in the form of dry 25% ash concentrate, at a cost of $1·84 per ton. The same coal can be produced in the second plant at a cost of $2·00 per ton. If it is assumed that the recovered coal contains 32% of ash, the recovery will be greater, and the cost of production becomes $1·45 per ton for the 500-ton plant and $1·58 per ton for the 250-ton plant. These estimates are only approximations, and it is quite probable that the actual costs of production would be much below the figures given. On the other hand, they are sufficiently reliable to indicate that it is doubtful whether oil flotation can be employed, at the present time, as an economic process for the recovery of the coal contained in such high-ash materials as washer-waste. The process is, however, also applicable to mine-slack, bone-coal, and certain other high-ash fuels which contain a higher percentage of combustible matter than the usual washer-waste of to-day, and this use will undoubtedly receive early consideration.

Although oil-flotation may not be an economic process for the recovery of the coal in most low-grade fuels under present conditions, it will undoubtedly play a leading *rôle* in meeting prominent fuel problems of the future. The results of this research, therefore, constitute a reserve of knowledge until the time when it becomes necessary to utilise the various solid fuel wastes of the present.

Re-washing as a method of recovering the coal contained in washer-waste.—Intensive re-washing seems to offer a satisfactory solution to the problem of recovering usable coal from accumulated waste. From the results of the above-mentioned inquiry it appears quite probable that washer-waste of the type described can be re-washed by up-to-date washing machinery and that the final refuse will not be subject to spontaneous combustion, as it will contain 85—90% of inert material. The combustible matter remaining in the final refuse will be integral with the slate and widely disseminated, and, for this reason, should not be greatly affected by weathering. The concentrate or re-wash will contain most of the combustible matter in the form of 30% ash coal and it is estimated that this re-wash can be produced at a cost of about $0·20 per ton. It could be employed either directly as a fuel for boiler firing, or admixed with low-ash coal as a fuel for by-product producers. In the first-mentioned application it would be equal in heating value to bone-coal or mine-slack of the same composition, and those fuels have been found to be quite satisfactory for boiler firing in plants where mechanical stokers are in use. In the latter case it would probably be necessary to mix it with an equal amount of good coal, in order to increase the nitrogen content to such a value that the recovery of ammonia would be profitable.

General conclusions.—The most practicable solution of the problem of utilising bituminous coal

washer-waste economically would therefore seem to be to employ it as a fuel for the production of gas in a by-product producer-gas plant. In order that it may be used for this purpose, the ash content would have to be decreased considerably and the nitrogen content increased. There are two methods of accomplishing this. A sufficient amount of good coal could be mixed with the refuse to reduce its ash content to 30% or less, and the nitrogen content would, at the same time, be raised to approximately 1%. This method would demand an enormous plant capable of handling at least 1500 tons of coal per day. The second method would require a plant of about 500 tons daily capacity. It would entail the re-washing of 600 tons of refuse, from which would be obtained 150 to 200 tons of re-wash containing approximately 30% of ash. By mixing this re-wash with sufficient good coal to produce 500 tons of fuel, and then gasifying it in a by-product producer-gas plant, the waste material could undoubtedly be economically utilised.

Shallow piling as a means of preventing spontaneous combustion.—A number of methods of coal storage have been described in the literature. As the result of a study of these methods, it is believed that shallow piling could be employed as a means of preventing spontaneous combustion in washer-waste bings. The method would require the distribution of the material over a large area, in layers not exceeding a few feet in depth, each layer being exposed to weathering conditions for several months before another layer is added. The very rapid weathering in the shallow layers would obviate serious heating when the pile reached greater depths. The subject of the spontaneous firing of coal requires more inquiry from a fundamental standpoint; the entire process is essentially one of "surface combustion," but between the initial absorption of oxygen by the coal substance and its final expulsion in the products, water and carbon oxides, an entire series of complex phenomena may be involved. The points demanding experimental study have been indicated by Bone [3] and need not be mentioned here.

On the commercial status of American oil-shales.

It is extremely important that additional supplies of liquid fuel be obtained—a problem which essentially resolves itself into finding suitable substitutes for petroleum products. Indeed, it is certain that this fuel problem will come more and more into the foreground; and if in any way it were possible to provide a supply for only a small proportion of the liquid fuel consumed, it would be a most desirable attainment from the point of view of national economics.

Animal and vegetable oils are, of course, of too much value for a variety of other industrial purposes to find their way into the fuel market, where large quantities and low prices are essential. Wood and coal products—in particular, alcohol and benzene—can only be expected to relieve the motor fuel problem to a very limited extent; while peat oils do not give any indication of entering into the field in the near future, although the quantities of peat available in various parts of the world are sufficient to warrant some degree of local optimism.

Attention is accordingly being increasingly centred on shale-oil—a crude petroleum-like oil obtained from bituminous shales ("oil-shales") by subjecting them to destructive distillation in special retorts. Shale-oil has been found to be an entirely satisfactory substitute for petroleum, affording similar results on refining; but the output of the product in Scotland, the home of the shale-oil industry and so far the only important producer, is not and never will be sufficiently large to make any serious impression on the fuel market.

Much publicity, a considerable part of which has been of a misinformative nature, has been accorded the enormous deposits of oil-shales occurring in the Uintah Basin, which occupies the northern portion of Utah, south of the Uintah Mountains and extending eastward into Colorado. Perhaps an even greater area of oil-shales exists in a region of western Wyoming occupying the Green River Basin northward from the Uintah Mountains to Wind River Mountains. A third deposit of large size is situated 60 miles further east on the Colorado-Wyoming border. In addition, an area of approximately 2500 square miles of oil-shale has been located in the central part of Utah near Manti; while near Elko, Nevada, on the Western Pacific Railroad, there occurs a small area upon which a number of locations have been made. Indeed small areas of oil-shales up to 100 square miles in extent may be found in various localities all over the Rocky Mountain region. The deposits in the Uintah and Green River Basins are, however, the most notable and certain areas of them constitute reserves which are in readiness whenever it is deemed expedient to establish a great American industry to supplement the failing supply of petroleum from the oil-fields.

The oil-shales of the United States have so far received comparatively little technical attention, mainly because petroleum has been abundant. It may be mentioned, however, that, prior to the establishment of a petroleum-refining industry in Pennsylvania, the Mormons destructively distilled shale for oil near Juab, Utah; that numerous attempts have been made in the past to distil cannel coal, and that some experimental work has been conducted on the Devonian black shale of the East. But no shale-oil industry has ever been established in America,[4] although various bituminous materials were distilled for the production of illuminating oil by a large number of "coal-oil" companies about 1860. The process followed in this short-lived coal-oil industry was very crude, and ammonium sulphate production, found to be the necessary adjunct of the Scottish shale-oil industry, was never attempted. Consequently, although a number of the coals and other substances used were of high grade, and merit investigation as to yield of crude oil, gas, and ammonia according to present-day knowledge, it is not surprising that the refining of petroleum paralysed the industry.[5]

The oil-shale of the Green River formation in north-western Colorado and north-eastern Utah is to be regarded as a fuel reserve of great economic importance—a reserve which should now receive attention because the demand for petroleum and its products really exceeds the supply. The economic study of this shale was begun in 1913 by the United States Geological Survey, and the results of preliminary investigation demonstrated a promising yield of crude oil when the mineral was subjected to destructive distillation. More detailed examination along the north, east, and south-east sides of the Uintah Basin, in north-western Colorado and in eastern Utah, has later indicated that, although the thickest and richest beds of oil-shale are exposed along the southern margin of the basin, nearly every section studied contains beds of shale more than three feet thick which will yield petroleum-like oil. In fact, in Colorado alone it has been estimated by geologists that there is sufficient oil-shale, in beds that are three feet or more thick

[3] "Coal and its Scientific Uses," 1918, p.162.

[4] The oil-shales of Canada are not discussed in the present contribution. For information regarding Canadian deposits and their importance, see especially Ells and Hamor, Canada Dept. Mines, Report No. 55, Mines Branch, 1910.

[5] See Bacon and Hamor's "American Petroleum Industry," 1, 203–212; 2, 807–844.

and capable of affording more crude oil per ton than the average shale now mined in Scotland, to yield about 20,000,000,000 barrels of crude oil, from which approximately 2,000,000,000 barrels of gasoline might be obtained by the usual procedures in refinery practice. In Utah it is probable that there occurs an equal amount of oil-shale, just as rich in oil-forming material, or kerogen.

It is important to mention here that oil-shale cannot be profitably worked on a small scale and that the existence of a shale-oil industry in this country can only be assured by the most rational treatment of a sufficiently kerogenous shale to give a satisfactory production of an easily refinable crude oil. Numerous field tests as well as the laboratory findings of the authors point to the fact that the quality of the crude oil yielded by certain of the oil-shales of Colorado and Utah compares rather unfavourably with that of the product obtained from the oil-shale of the Lothians in Scotland; and it is also clear that, before any method for the distillation of oil from nitrogenous oil-shale can be regarded as an efficient process, the production of ammonium sulphate (*i.e.*, commercially satisfactory conversion of nitrogen into ammonia) must be secured. These problems can, no doubt, be solved in a suitable experimental plant. The working of American shale will become as important an industry in this country as the distillation of carboniferous shale has become in Scotland, only after the manufacture has been based upon a retorting procedure developed in plant constructed primarily in accordance with the best experience.

Considerable preliminary investigation is accordingly essential. The particular object of such investigational work should be to ascertain the conditions for, as well as to determine the plant modifications necessary in, obtaining the maximum production of the best grade of crude oil in the retorts which are selected for development. The profits resulting from the sale of the products of an additional stripping plant, namely, gasoline and fuel oil, would probably make such pioneer research work actually self-sustaining. Including the necessary condensers and tankage, and laboratory and shops, an experimental unit retorting plant having a throughput of, say, 100 tons per day should not entail the expenditure of over $50,000. Its erection should immediately follow the demonstration of the continuity and uniformity of the seams through a desirable area; and it should not be enlarged to, say, a plant of 1000 tons daily capacity until after the successful conclusion of extensive study.

Quite a number of processes have been proposed for the production of crude oil from American shales, but, until December 1, 1918, none of the several Western companies was producing. A number of patents have been issued, but it is doubtful whether many of them possess any commercial importance; in fact, it is questionable whether any improvement or additions to previous knowledge are presented which would withstand legal consideration. To quote from a recent report [6]: "In the attempt to reduce the modest amount of labour required by the successful Scottish retorts, many mechanical monstrosities have been evolved whose operation would require a gang of mechanics and a heap of repair parts. Others exhibit the utmost ignorance not alone of distillation methods, but of furnace design and the principles of combustion and chemistry. It would seem that some company organised primarily to get shale-oil would be well advised to erect Scottish retorts and adapt them to local conditions. These well-tried furnaces are mechanically good—they operate on recovered gas with a minimum of labour, make a good yield of satisfactory crude oil with an increasing amount of paraffin, and permit the recovery of large amounts of ammonium sulphate. Should labour-saving devices be considered essential, the modern by-product coke-oven with its marvellous mechanical equipment could be taken as a model, and so modified as to produce the regular temperature cycle needed for maximum yield."

The contention is not made in this paper that any type of Scottish dual-purpose retort [7] should constitute the actual basis for the development of an American shale-oil industry, for this retort is not the design which is required to-day to handle most economically all grades of oil-shale; but it is essential that more careful consideration be given to Scottish experience in retorting practice. This successful experience and the misfortunes of those who attempted to establish shale-oil industries in Australia and New Zealand have demonstrated that the retort and its operation must be adapted to the specific shale to be retorted, and always with due regard to local industrial, financial, commercial, and meteorological conditions. The dual-purpose retort was a failure when used in Australia because it was totally unsuited for dealing with the richly kerogenous, yet non-nitrogenous, shale of New South Wales; whereas the oil-shales of Scotland are generally low in yield of oil and relatively high in yield of ammonia, when destructively distilled in the same type of retort. It is therefore not surprising that a large amount of money was lost in this attempt to obviate experimental work by adopting a retort which was very successful on a totally different variety of oil-shale under entirely dissimilar economic conditions. American oil-shales are comparatively high in characteristic kerogens,[8] but in the Western States they are generally low in nitrogen-content, while in New Brunswick, for instance, the oil-shale is highly nitrogenous, although it yields an oil inferior to the Scottish. In fact, almost every condition to be encountered on this continent differs materially from the conditions which have been responsible for the Scottish dual-purpose retort.[9]

A Henderson retort, one of the Scottish types, has been erected by the Southern Pacific Railroad at Elko, Nevada, and, with adequate financial support and technical supervision, this attempt to adapt Broxburn practice to an American deposit should result in the accumulation of valuable information. It may be noted here that two small modified Henderson retorts were erected near DeBeque over a year ago by another organisation. One of these retorts was operated for a short time, while the other was given more recent trials, but not much crude oil was produced in either attempt. It is doubtful if more than 20 barrels of crude shale-oil was produced up to January 1, 1919, from western oil-shale. Much of the oil-shale agitation is unfortunately company publicity and it is clear that proper development is impossible as long as the stock promoter remains the prominent feature of the situation. The successful exploitation of our oil-shale reserves will require careful investigation on the part of a competent technical and sales staff. For the assurance of successful large-scale operation, a retorting process must be used which will give good yields of economically refinable crude oil and, wherever commercially possible, of ammonia; easy methods must be perfected to separate the

[6] Chem. and Met. Eng., 1919, **20**, 30.

[7] Simpson (Chem. and Met. Eng., 1919, **20**, 204) employs this term to illustrate the fundamental object of Scottish practice, *viz.*, the production of crude oil and ammonia in one retort.

[8] On American oil-shales, see Baskerville and Hamor, J. Ind. Eng. Chem., 1909, **1**, 507; Orig. Com. Eighth Internat. Cong. Appl. Chem., **25**, 631; Ells and Hamor, *loc. cit.*; and Bull. U.S. Geol. Surv., Nos. 581–A and 641–F.

[9] On the principal factors involved in Scottish shale-oil technology, see Bacon and Hamor, *lib. cit.*, **2**, 807 *et seq.*

unstable compounds from the products of the crude oil, and the market must be educated to absorb the finished products of the refinery.

Some specific engineering problems in the utilisation of fuels.

From an industrial engineering standpoint, the problems arising in connection with fuels and their use are various indeed. The operating engineer is, however, chiefly concerned with the many difficulties encountered in securing perfect combustion; the proportioning of boiler heating surfaces, combustion spaces, and grate areas; flue-gas baffling within the boiler for utilising the maximum amount of heat; and clinkering.

While engineers have generally agreed as to the draught requirements and grate areas for various kinds of fuel, no definite data are available regarding the furnace volumes required and the rates of combustion for various types of fuel. How can we most economically ensure proper and complete combustion of coal on boiler grates and elimination of losses due to improper firing? How can we minimise heat losses due to scale, flue dust and improper boiler settings? A practical method of heating material with less unused space in furnaces is also an appropriate subject for research. The determination of reasonable specifications for Kentucky, Tennessee, and other coals and cokes requires consideration. What is the best method of burning efficiently low-grade coals which clinker badly? What is the most suitable method of burning high-sulphur coal without clinker or fusion? Attention should be accorded to the development of a satisfactory furnace-lining for high-sulphur fuels. How can peat and lignite best be used in rotary furnaces, such as dryers and kilns? What is the most efficient type of automatic grate for burning screenings or slack coal? Successful automatic stokers are wanted for burning low-grade anthracite fuel. Inquiry has also been made for a relatively inexpensive, simple, mechanical stoker which would be suitable for installation under process furnaces where the consumption of coal is limited. And, then, what is the most satisfactory means for burning coal and wood refuse in combination?

In modern designs of steam-boilers it is not possible to convert over 13% of the total heat value of the coal into steam power. To find the remedy for this loss of fuel, it is first essential to standardise a raw fuel by concentrating it into a fuel of homogeneous structure. This may be accomplished by coking and briquetting processes, each of which has its special advantages. The manufacture of artificial fuels or briquettes is a field in which great advancement can be made, for it enables a number of lower-grade fuels to be mixed with those of greater density and consolidated into a fuel which may be moved without breakage and at a minimum transportation cost. Fuel briquetting in America has not met with the success up to this time which it rightfully deserves, although, of course, certain of the difficulties have grown out of the inexperience of the operators as well as the fact that a number of the plants have not had adequate financial support. Of over 50 installations which have been made in the United States, only 10 are now in operation. Recent work on the briquetting of Clinchfield coal is of interest here. One process is to remove first a small amount of the volatile matter from a tar-bound briquette and then to harden it by further heating.

The development work done in combustion through the use of stokers, in combination with under-grate blowers and retorts, has about exhausted the possibilities in this direction, and a radical departure from the existing practice is necessary in order to utilise to the fullest possible extent the thermal energy of fuel. The use of fuel in pulverised form offers a basis for further development work in this connection.

With pulverised coal, we have the problems of crushing and drying, explosibility and storage, injection into the fire-box, and erosion of refractories. In particular, the most economical method of storing and handling pulverised coal with boilers requires more exhaustive investigation. And what over-all boiler efficiencies are obtained in burning pulverised coal? Easily cleaned regenerators for furnaces using pulverised coal are desired. And, finally, what is the relative value on a heat and cost basis of pulverised coal, fuel oil, and producer gas?

The hope of eventually abolishing completely the smoke evil lies principally in three general directions. The first is a wider extension of the use of gaseous and powdered fuels for heating purposes. The second is the adoption, along very broad lines, of electricity as a motive power. The third lies in the trend of manufacturing some form of semi-carbonised coal as a smokeless domestic fuel at a price which will not exceed that of raw coal.

In the case of gas fuels, there are the important problems of the improvement of burners and methods of air-mixing. In producer-gas technology, not much trouble is reported with mechanical-type producers; but with the fixed-type, clinkering, incomplete burning of coal, air-holes and pressure have been causes of complaint. What is the most economical size and shape of producers for gas to be used for heating purposes? The economic utilisation of the tar by-product from producers requires more study; and engineers request research on the automatic, separate control of the steam and air blasts in producers, and a practical automatic check and regulation to maintain the uniform quality of producer gas. A large steel company has been investigating the problem of making a washed by-product gas luminous on burning. But perhaps the greatest need in gaseous fuels is to obtain a cheap fuel gas from a central station large enough to conduct profitable by-product recovery, and this problem is now receiving attention by two American companies.

With fuel oil, there are the problems of explosibility, storage, burning for perfect combustion, and action on furnace refractories. Insufficient and improperly adapted oil-burners have caused expensive difficulties in burning oil. Some trouble is still experienced in burning heavy asphalt-base fuel oil; and burners clog occasionally, even with light fuel oils. Localised heat renders the use of fuel oil less desirable than washed producer-gas, according to some engineers. The combustion of fuel oil to secure good heat regulation where different temperatures are required at various stages of the operation of chemical apparatus, and the use of fuel oil instead of coal for steaming and open-evaporating, with relative costs, are problems of chemical industry. There are also inquiries regarding a widely applicable method of utilising waste heat from oil- and gas-fired apparatus, more efficient oil and gas burners, and a simple and efficient combination gas and oil burner.

The most potent factors in the conservation of fuel during the last twenty years have been: (1) the development of water power, (2) the concentration of the production of power from fuel in central stations where the most economical methods may be utilised, and (3) the distribution of power electrically. There is still much to be done in the way of replacing inefficient isolated power plants of various kinds and sizes with electric power. From the point of view of fuel conservation the most important field remaining for the more extended use of electricity is on the railways. One-fourth of all the coal mined in the United States, as well

as a considerable quantity of oil, is consumed by steam locomotives. The locomotive is an isolated power plant of but medium efficiency, and the only excuse for its continued existence is the cost of electrification.

Fuel problems in the refractories industry.

The fuel difficulties encountered in the burning of refractories divide themselves into two classes, one of which deals with the efficient use of the heat units developed and the other relates to the securing of heat.

When heat balances are made in connection with kilns they show that from 8 to 12% of the heat is used to develop the ware, *i.e.*, to expel moisture, complete the chemical reactions which may take place, and thoroughly shrink the refractory article. From 40 to 75% of the heat is lost to the kiln itself, in heating it and by radiation. From 10 to 25% of the heat is carried out by the hot stack gases. These difficulties are largely overcome by the use of continuous kilns, whereby the fuel requirement is decreased from 1950 lb. to 700 or 750 lb. per thousand bricks. There are three problems of this general nature, *viz.*:—(1) Decreasing radiation loss; (2) decreasing stack losses; and (3) decreasing kiln loss.

However, the most important problems pertain to the development of the heat. (1) The heat must not be too intense at any one point or some ware will be burned unnecessarily far and other ware will require to be reburned. (2) Producer gas must be conveyed from a central plant to the various kilns without losing a great amount of heat, *i.e.*, by the cooling of the gas. (3) The pulverised fuel problems consist in the prevention of the deposition of ash-dust and in developing a feeder which will work slowly at low temperatures and yet give combustion. This feeder must be a unit in itself, since a central shaft cannot be used as a source of power with round kilns. (4) Good draught must be secured at all times. (5) In the fire-boxes the tendency is to clinker. At the lower temperatures these boxes must be "cleaned" after about the fourth day. When the full heat is applied the boxes must be cleaned every 6 to 12 hours, depending upon the fuel. Every time they are cleaned the fire practically goes out, cold air rushes in, and the temperature of the kilns falls 50°—200° C. This problem resolves itself into the provision of suitable draught as well as fuel, but is caused mostly by the clinkering of the coal used. (6) A minor problem arises from the tendency of the ashes to fall on the bricks and remain on them. This troublesome deposition may spoil 500 to 2000 bricks in a kiln. As a rule, old bricks are put in these ash-collecting positions, and are used over and over again.

Fuel problems in the glass industry.

In the glass industry the problems related to fuels may be divided into two groups, *viz.*, economic and engineering problems.

Economic problems. The supply of fuel must be continuous. An interruption in the supply of fuel may necessitate a virtual rebuilding of the furnace. The second requirement is a fuel of low cost. The cost of fuel averages about 10% of the total manufacturing cost of the glass.

Natural gas has fulfilled both these requirements to an admirable degree; but since the price has risen above $0·20 per 1000 cubic feet, and especially since the supply is becoming inadequate and intermittent in certain localities, the glass industry is facing the economic problem of a new source of fuel. Fuel oil is being used as an emergency fuel, but it is too expensive for general use. Coal is therefore considered, from the economic standpoint, as the most suitable source of fuel, since it satisfies both of the conditions noted above. Experiments are in progress on the use of electrical energy for melting glass, as well as for heating the annealing lehrs and kilns. The possibility of utilising electricity in glass-making opens up a large field, with many problems both of an engineering and economic nature.

Engineering problems.—The application of oil as a fuel involves practically the same engineering considerations as that of gaseous fuels. Mechanically and thermally it is an entirely satisfactory fuel. Coal is sometimes burned directly in the pot type of furnace, but this is inefficient and is not the usual practice. It is not applicable for tank furnaces, and the transformation of coal into producer gas is therefore the most general and efficient manner of using coal in the glass industry. Improvements in the design of producers and the application of the lower grades of coal offer opportunities for the betterment of the glass industry. Powdered coal has been tried for melting glass, but has not been successful because of the ash and other impurities which contaminate the glass and choke up the flues. Successful elimination of these factors would go far towards fuel economy in glass making. Powdered coal is, perhaps, applicable to pot furnaces and to the newer types of muffle annealing lehrs and kilns, but some form of gaseous fuel would be necessary for the "glory holes," the "fire polishing" flame, and the small "cracking off" and melting flames employed in finishing certain kinds of glassware.

One of the most important problems in the glass industry is that of heat economy. Glass furnaces are notoriously wasteful of fuel. Accurate measurements of the heat balance of glass furnaces are few, but it has been shown in the case of a plate-glass furnace that of the total heat supplied only 17% was required to melt the glass, while 56% was lost through radiation and conduction and in the chimney gases. Even in some of the modern tank furnaces the loss of heat is deliberately increased by air blasts against the outer walls of the furnace.

Scientific research in the standardisation of furnaces; in the determination of the most efficient number, size and position of the ports, in the arrangement of the baffles, in regulating the air supply and the gas pressure, and in the most efficient construction of the regenerators, will, without question, effect marked economies in the amount of fuel required in the glass industry. The furnaces used for melting glass in closed pots are far less efficient, thermally, than tank furnaces. Owing to the arrangement of the pots the heat for melting the glass must be conducted or radiated through only the top and back walls of the pot. A furnace designed to heat the pots evenly on all sides would greatly reduce the heat loss in this thermally inefficient type of furnace. There is need for a more uniformly heated lehr and for more accurate regulation of lehr temperatures. Such control would result in more uniform annealing and less subsequent breakage, and would in many cases eliminate the necessity for a second annealing in the kiln. The same remarks might apply to the annealing and decorating kilns, which could probably be replaced by a really efficient continuous lehr.

Fuel problems in the iron and steel industry.

The economic manufacture of iron and steel is dependent not only upon the raw materials available, but also on the judicious combination of their utilisation and the recovery of all by-products.

Everything is concentrated that goes into the furnace (ore, coke, fluxes, etc.), except the oxygen of the air. If more concentrated air or even pure oxygen could be used, a great saving could be effected, and there could be done in combustion furnaces much that is now only possible in electric furnaces. This problem has been frequently discussed, but comparatively little research has been devoted to it.

The problem of sulphur is one of the most important in iron metallurgy. The ash problem is next in importance.

Another series of serious problems in iron metallurgy relates to the closely allied by-product coke industry. An important problem is the reduction in cost of plant. The large amount of capital invested for even a small sized by-product coke-oven plant is such as to deter many who would otherwise be willing to instal by-product coke-ovens. There is no doubt that much can be done toward decreasing this cost by simplifying the means of operation and possibly by the use of less expensive materials of construction. There are also possibilities in the way of improving the heating of the coke-ovens. Much has already been accomplished in this direction, for it is only a few years ago that by-product coke-ovens were making practically no surplus gas, whereas records from recently constructed plants show as much as 62% surplus gas. The importance of any scheme for further reducing the amount of fuel required for coking the coal depends, of course, upon the value of the heat units saved in any particular locality. The value of the heat units required to coke one ton of coal in existing plants is about 80·30, so the possibilities of further saving are limited to fractions of this amount. Another problem relates to the improvement of the refractory materials used in by-product coke-oven construction. Much has been accomplished by the substitution of silica brick for the old firebrick, and, if there were available a succedaneum for silica brick that would make a proportional improvement, the advantages to the industry would be very great. Possibilities have also been considered in the way of making the coking process a continuous operation, and, finally, there is a great field for improvement in the recovery and utilisation of the by-products.

One of the greatest needs of all industrial life is particularly required in the manufacture of steel. Reference is made to some method of gas production which will enable the gasification of coal with high efficiency and with the product possessing a calorific value of not less than 500 B.Th.U. per cubic foot.

It has been maintained that tar-oil can advantageously replace coal in many instances for the heating of open-hearth and other furnaces in which a regular temperature and neutral atmosphere are required. Certainly this replacement requires the consideration of research. The question of the recovery of the whole of the gas from coke-ovens is a problem which is encountered by all builders in new installations. If ordinary producer gas is employed for heating the coke-ovens, and advantage is taken of double regenerators to heat up both this gas and the air supply, it is claimed that all the gas from the ovens will be recovered. The application of approved types of producers adapted to low-grade fuel is another problem; it is contended by some engineers that these should be used exclusively, and, of course, in large installations the recovery of the by-products from the producers can be taken into account.

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Communications.

THE REGENERATIVE EFFECT AS INFLUENCING THE LIGHTING EFFICIENCY OF THE INVERTED INCANDESCENCE BURNER.

BY J. S. G. THOMAS.

Two outstanding physical facts differentiate the upright incandescence burner from the inverted incandescence burner. (1) Owing to the fact that the motion of the mixture of air and gas just prior to combustion in the case of the upright burner is upwards, and in that of the inverted burner is downwards, with the former more air can be naturally induced at the gas injector per unit volume of gas than is the case with the inverted burner. The natural motion of the coal gas is upwards, and however the injector may be disposed with regard to the orifice at which the gas is burnt, this natural tendency will, in the case of the inverted burner, react upon the air-inducing power of the gas at the injector in the direction of diminishing this power irrespective of whether the injector itself be directed upwards or downwards. (2) In the case of the inverted incandescence burner, the heated products of combustion stream back over those parts of the burner inside which the mixture of gas and primary air flows prior to its combustion. A certain amount of what is termed heat regeneration is to be anticipated from this circumstance, and the experiments described herein were performed to ascertain how far the efficiency of an incandescence burner is affected by the application of heat, applied regeneratively or otherwise to the mixture of primary air and gas. Bearing in mind that the total radiation from within an enclosure at uniform temperature—the thermodynamic and realisable analogue of a perfectly black body—is proportional to the fourth power of the absolute temperature of the enclosure, it is anticipated that a slight rise in the temperature of combustion of the gaseous mixture would be accompanied by a great increase in efficiency in the light radiation from the burner, should the light radiation from the mantle follow any law approximating to that for the perfectly black body. Bunte (German Association of Gas and Water Engineers, 1907; J. Gas Lighting, 1907, **99**, 27) states that it is well known that a slight rise in the temperature effects a relatively great increase in the light radiated, and it was by taking advantage of this fact that the inventors of high pressure and intensified gas burners secured an enhanced duty. The subject has been investigated experimentally in the following manner:—

A "Metro" No. 3 inverted burner was supplied with coal gas and primary air, so that the proportion of primary air to coal gas corresponded with that necessary to secure a well-defined inner cone such as is produced when the primary air supply is induced by the gas injector. For this purpose, the usual air holes of the burner were enclosed completely within a chamber to which a supply of air under adjusted pressure was led through tubes entering the chamber at diametrically opposite points. The pressures of the gas and air supplies were suitably governed, and the volumes supplied to the burner were determined by meters inserted in the respective services. A determination of the candle power of the burner at successive angles of 10° below the horizontal was made, the burner not being enclosed within a globe. Arrangements were then made whereby the portion of the burner near the injector could be kept cool by means of cold water, which circulated through a compartment surrounding the injector. Maintaining the supplies of gas and primary air at their previous values, or as near thereto as possible, the radial distribution of luminosity was determined as before. Very little alteration of efficiency was produced by this treatment. Arrangements were therefore made whereby the mixture of gas and primary air could be cooled right up to the point at which the gaseous mixture was burnt. For this purpose a stream of water was maintained within the cylindrical jacket surrounding the injector, and likewise through a cylindrical jacket of annular section extending to the lowest part of the burner nozzle. The mixture of gas and primary air passing through this latter chamber

prior to its combustion was efficiently cooled as determined by subsequent experiment. The cooling of the gaseous mixture in this manner was accompanied by the efficient cooling of the products of combustion in their subsequent passage over the portion of the burner adjoining the nozzle. The trickling of such cooled and liquefied products of combustion determined with the incoming mixture maintained cool up to the point of combustion, or as near thereto as practicable. For purposes of comparison, a series of experiments was carried out with an upright incandescence burner, the primary air supply to which could be preheated to any desired temperature. Attempts to preheat the supply of coal gas

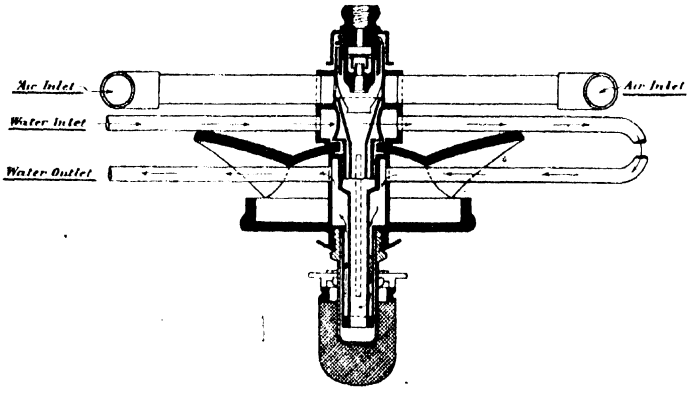


Fig. 1.

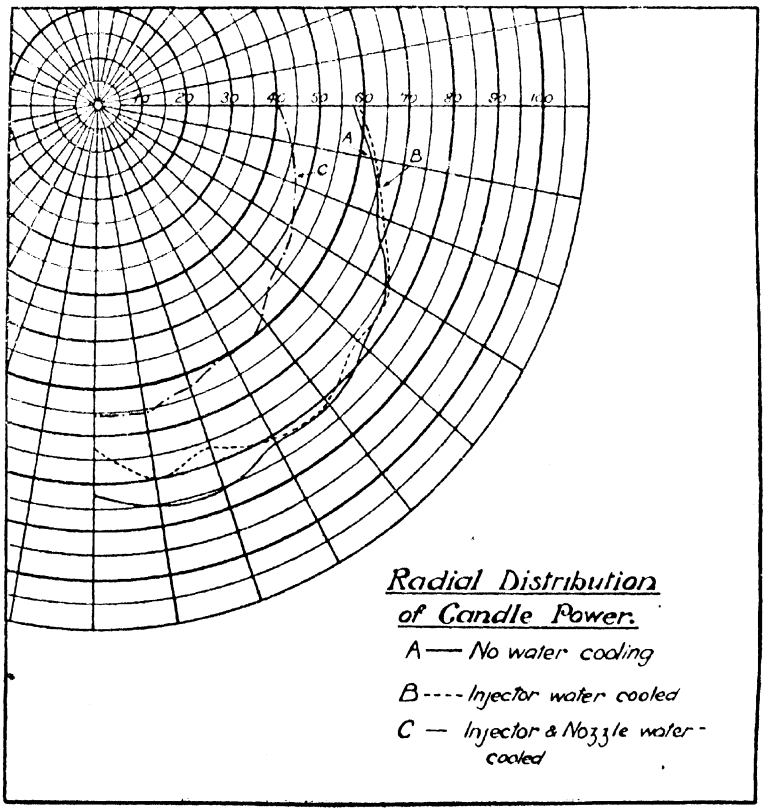


Fig. 2.

over the nozzle would result in the breakage of the latter; this was prevented by employing the dished receptacle shown in Fig. 1, which served to retain any liquid deposited in the cooled parts of the burner tube. In this manner it was found that the radial distribution of luminosity could be readily

were vitiated by the fact that when exposed to an elevated temperature, certain hydrocarbon constituents of the coal gas are decomposed. The procedure therefore was as follows:—The air holes whereby the upright incandescence burner ordinarily derives its supply of primary air were closed.

The primary air was supplied under regulated pressure through an iron tube coiled within a small gas furnace whereby the coil could be raised to a white heat. Precautions were taken, by providing the furnace with an elongated flue, that the incandescence gas burner did not derive any of the secondary air necessary for combustion from the products emitted by the furnace. The gas supply joined the air supply some little distance from the point at which the pipe conveying the latter emerged from the furnace. Uniformity of temperature of the gaseous mixture was ensured by the insertion of a large number of pieces of copper gauze within the pipe conveying the mixture to the burner, this portion of the supply pipe having a length of about 6 inches, and being enclosed within asbestos. Just prior to entering the Venturi tube of the burner, the temperature of the gaseous mixture was ascertained by means of a thermocouple of Pt, Pt-Rh. The respective volumes of gas and primary air were separately metered and maintained throughout as nearly constant as possible. A series of experiments was carried out in which the primary air was heated to various temperatures, and the candle power of the upright burner supplied with such air, ascertained in a horizontal direction. The results obtained for the inverted and upright incandescence burner are tabulated herewith:—

Results.

Metro No. 3 inverted burner. No water-cooling. Pressure at gas injector 25/10″.

Gas consumption (corrected to 60° F. and 30″ pressure), 3·85 cub. ft. per hr.

Primary air (corrected to 60° F. and 30″ pressure), 10·29 cub. ft. per hr.

A Ratio: $\frac{\text{Primary air}}{\text{coal gas}} = 2{\cdot}67.$

Angle below horizontal.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
Candle power	57·1	62·7	67·0	74·5	78·2	81·9	81·5	85·4	85·5	82·2

Metro No. 3 inverted burner as before, but with region of injector water-cooled.

Gas consumption (corrected to 60° F. and 30″ pressure), 3·84 cub. ft. per hr.

Primary air (corrected to 60° F. and 30″ pressure), 10·21 cub. ft. per hr.

B Ratio: $\frac{\text{Primary air}}{\text{coal gas}} = 2{\cdot}66.$

Angle below horizontal.	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
Candle power	58·4	63·6	68·4	75·6	76·7	81·2	80·7	76·9	79·5	72·3

Metro No. 3 inverted burner with region of injector and the nozzle maintained cool by a current of water flowing at the rate of 800 c.c. per minute.

Gas consumption (corrected to 60° F. and 30″ pressure), 3·85 cub. ft. per hr.

Primary air (corrected to 60° F. and 30″ pressure), 10·26 cub. ft. per hr.

C Ratio: $\frac{\text{Primary air}}{\text{coal gas}} = \frac{10{\cdot}26}{3{\cdot}85} = 2{\cdot}66.$

Angle below horizontal	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
Candle power	10·6	44·1	47·5	50·6	52·6	58·0	60·0	62·3	65·9	65·6

The results detailed above are set out graphically on the accompanying chart (Fig. 2) and also summarised in Table I.

The results obtained with the upright burner, showing the effect produced by preheating the gas upon the lighting efficiency of the gas when used in conjunction with a mantle, are given in Table II.

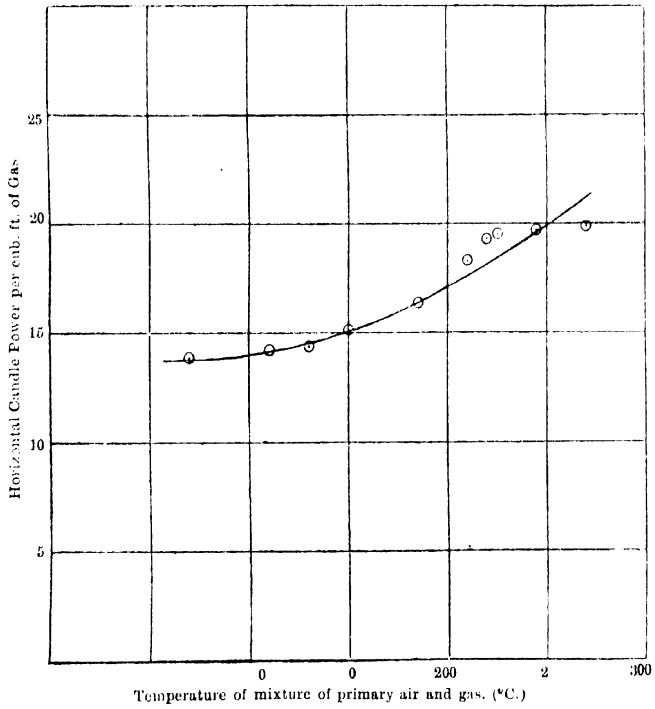


Fig. 3.

and are plotted in Fig. 3, abscissæ representing the temperature to which the mixture of gas and primary air is preheated, and ordinates the efficiency of the burner expressed in candle power in the horizontal direction per cubic foot of gas consumed.

TABLE I.

No. 3 Metro burner.*

—	(A) Without water-cooling	(B) Region of injector water-cooled	(C) Nozzle and region of injector water cooled
Gas consumption (cub. ft. per hr.)	3·85	3·84	3·85
Primary air (cub. ft. per hr.)	10·29	10·21	10·26
Ratio : Primary air : coal gas	2·67 : 1	2·66 : 1	2·65 : 1
Horizontal candle power	57·1	58·4	40·6
Candle power at 50° below horizontal ..	81·9	81·2	58·0
Mean radial candle power	75·6	73·3	54·7
Candles per cub. ft. at 50° below horizontal	21·3	21·1	15·1
Mean radial candles per cub. ft. of gas ..	19·6	19·1	14·2

* This burner is not the most efficient of its class, but it was selected for the experiment in order to reduce the possibility of errors arising from the use of a smaller unit.

TABLE II.

Results with upright incandescence burner.

Temp. of gas and primary air mixture prior to combustion	Gas consumption (corrected to 30" and 60°F.)	Primary air (corrected to 30" and 60°F.)	Ratio, primary air to gas	Candle power in horizontal direction	Horizontal candle power per cub. ft. of gas
°C.	cub. ft.	cub. ft.			
70	4·80	11·7	2·44	66·1	13·8
110	4·80	11·7	2·44	68·0	14·2
130	4·80	11·8	2·46	69·1	14·4
150	4·80	11·9	2·48	72·8	15·2
190	4·80	12·0	2·50	78·6	16·4
210	4·80	12·0	2·50	87·8	18·3
220	4·80	11·9	2·48	92·5	19·3
225	4·80	12·0	2·50	98·3	20·5
245	4·80	11·8	2·46	99·5	20·7
270	4·80	12·0	2·50	100·2	20·9

Conclusion. The experiments clearly indicate that an increased lighting efficiency is obtained when the gaseous mixture of coal gas and primary air is preheated. Whether such preheating is achieved by a separate heating device, as in the case of the experiments with the upright burner, or by the flow of gaseous products of combustion over the incoming supply, as in the case of the inverted burner, the same result is obtained. No appreciable diminution of lighting efficiency is to be anticipated from cooling the region of the injector of the inverted burner employed in these experiments, as it has been shown (see this J., 1918, 165—170 T) that the temperature in such a region is normally only about 60° C. Considerable decrease of lighting efficiency is produced when the gaseous mixture is maintained cooled down to the point of ignition. These results are in accord with those obtained by Bunte (see J. Gas Lighting, 1907, **99**, 27), who found that the efficiency of an inverted gas burner of special construction was reduced from 24·5 mean radial candles per cubic foot of gas, to 15·5 mean radial candles per cubic foot by water-cooling the burner nozzle. Bunte points out that the outer mantle of flame in the case of the water-cooled burner had an area of 65 sq. cm. compared with an area of 45 sq. cm. in the case of the uncooled burner, an increase of flame surface being accompanied by a decrease of lighting efficiency. Smithells, in his article on "Flame" in Thorpe's Dictionary of Applied Chemistry, attributes an efficiency of from 20 to 40 candles per cub. ft. of gas (dependent upon pressure) to the upright incandescence burner, and an efficiency of from 20 to 70 candles per cub. ft. of gas (likewise dependent upon pressure) to the inverted incandescence burner. It is noteworthy that an equal lower limit of 20 candles per cub. ft. of gas is attributed to both upright and inverted burners. It would appear therefore that according to Smithells no increased duty is to be anticipated from the heat regenerative effect present in the case of the inverted burner. This result is contrary to results obtained in the Physical Laboratory of the South Metropolitan Gas Company, in the case of an extremely large number of upright and inverted burners, which have from time to time been submitted to test, with the invariable result that a well-designed inverted burner gives a duty per cubic foot of gas of the order of 50% greater than is the case with upright burners. An increased efficiency of this order is seen to be obtained by preheating the gaseous mixture supplied to the upright burner to about 250° C., and a similar decrease by water-cooling the mixture in the experiments with the inverted burner. Smithells (*loc. cit.*) states: "The inversion of a Bunsen flame modifies its form in such a way as to make it more efficient for heating a mantle. The outer film of flame becomes shorter, thicker, and more globular, and as the products of combustion necessarily drift back past the flame, there is a certain recuperation of heat." It is difficult, if not indeed impossible, to reconcile this statement of greater efficiency for mantle heating in the case of the inverted flame, and the further statement of heat recuperation, with the subsequent statement of the respective performances of upright and inverted burners. In the light of the present experiments, the effect of heat recuperation upon lighting efficiency is clearly evidenced, and it is surmised that the anticipated effect can be absent from any type of inverted burner only when, owing to faulty design of the burner, no appreciable degree of preheating of the mixture of gas and primary air occurs.

The investigation and its publication were suggested by Dr. Charles Carpenter, to whom the author of the paper desires to express thanks for the ready provision of the necessary facilities and inspiring interest in the work.

MUSTINESS IN TOBACCO.

BY LOUIS J. RILEY, F.I.C.

An investigation was made of the cause of mustiness in some tins which formed part of a lot containing an inferior type of tobacco, which had undergone shipment. Among the features revealed were the remarkable power shown to be possessed by mould growth for neutralising substantial amounts of nicotine; also the fact that mild fermentation of the tobacco inhibits mustiness.

Physical examination of several batches of leaves from which the finished article was said to have been prepared revealed no grounds for suspicion. The nicotine content, although markedly low, was similar to that characteristic of this type of tobacco leaf.

It appears that during the manufacture of the finished article the drying subsequent to moistening and cutting was carried out in inefficient plant supplemented by manual labour, and that superheating of part of the tobacco was likely to occur. Again, the tins of tobacco were heated prior to sealing, so as to exclude as much air as possible. Obviously the centremost tins, particularly at summer temperature, would remain hot much longer than the outermost tins. The moisture content could not have been the primary cause of the trouble, for some samples which were sound contained more moisture than one or two which were bad.

Examination of the tobacco revealed mycelia—

just visible to the trained eye—in patches of the tobacco. It was also seen that the tobacco contained a substantial amount of sliced mid-rib (thick in this type of leaf) or stem.

Tins of which the tops and bottoms were slightly convex and from which there would be an escape of gas on puncturing, invariably contained sound tobacco, whereas musty tobacco was only found in tins which did not possess these characteristics. This and the preceding observations show that the tobacco could not have been subjected to uniform conditions; also, that mild fermentation inhibited mould development.

It is to be inferred from the above that portions of the tobacco were subjected to excessive heat in the course of manufacture, thereby destroying the enzymes promoting fermentation, so that during carriage and storage—particularly in a warm situation—mould developed, whereas this warmth provoked mild fermentation in the moderately heated portion of the tobacco, which kept it sound. The amounts of moisture and nicotine were determined in leaves, of approximately the same size and colour, taken from the same batch, the laminar portion of which had been completely cut away from the mid-rib and stem. The results were:—

	Moisture	Nicotine in moisture-free tobacco
Laminar portion of leaf ...	13·00%	... 1·67%
Mid-rib and stem of leaf ...	19·20%	... 0·36%

These pieces of mid-rib, or stem, thus constituted the most favourable part for and would be centres of mould development.

In order to ascertain the influence of nicotine on mould development from (*a*) its vegetative form in active growth, (*b*) its spore form, and especially to obtain an idea of the approximate amount of nicotine which would be inhibitive to mould development, the following series of experiments were carried out:—

Series (a). Vegetative form in active growth: A number of flasks were suitably prepared and 30 c.c. of dextrose-gelatin was transferred to each flask and sterilised. Before the gelatin medium solidified the flasks were held so that the medium set with its surface at an angle of about 60° to the horizontal. These flasks constituted set 1. At the same time six 150 c.c. lots of the same dextrose-gelatin were sterilised in other suitable flasks. To four of the latter set of flasks was then added 0·52%, 0·79%, 1·29%, and 2·44% respectively of pure nicotine, the flasks being then placed in hot water and agitated, so as to liquefy the medium and incorporate the nicotine without volatilising more than a negligible amount of nicotine. The two remaining flasks were used for supplying controls. When the content of each flask of this set (set 2) was judged to be sufficiently cool not to liquefy contiguous gelatin which was set, 30 c.c. was poured into several of the set 1 flasks on the side of the flask opposite to that already occupied by medium, and the flask inclined, so that the second "hemisphere" of medium solidified in such a position that its lower part, in every case, was similarly in contact with the opposite "hemisphere" of non-nicotinised medium. This procedure gave several sets of flasks each containing two equal "hemispheres" opposite to each other and contiguous at the base—the one consisting of dextrose-gelatin, and the other of the same medium plus 0·52%, 0·79%, 1·29%, 2·44%, and nil, respectively, of nicotine.

Series (b). Spore form: Portions of the various fluid nicotinised and non-nicotinised dextrose-gelatin media with which the above flasks were charged were allowed to solidify in the usual slanting position in sterilised test tubes to form a series in triplicate, and were then inoculated with spores of *Penicillium glaucum* in the usual manner. The procedure adopted to inoculate approximately the same spot in the non-nicotinised "hemisphere" in the flasks of Series (*a*), in order to ensure, as much as possible, inoculation of that spot only, was to charge a little water with spores from the same culture employed for inoculating the test tubes, agitate it thoroughly, so as to ensure that there was nothing floating, dip the end of a platinum wire into the liquid, convey the wire to the flasks which had been previously removed as far away as possible from the scene of operations, and inoculate the spot chosen which was remote from the surface of contact. The tubes and flasks, plugged in the usual way with cotton wool, over which a rubber cap was placed, were then put aside at room temperature (10°—15° C.) in such a position that any fluid produced as a result of mould development would flow to and rest on the vacant side of the flask.

The results at the end of four weeks were as follows:—

Nicotine content	Series (*b*). Spore form experiments	Series (*a*). Vegetative growth experiments
Nil (control)	Surface completely covered by growth	Both surfaces completely covered by growth
0·52%	Slight growth at inoculation point only	do.
0·79%	No growth	Nicotinised surface about half covered
1·29%	do.	Surface about one-fourth covered
2·44%	do.	No growth

The above results show that with the materials employed and under the uniform conditions obtaining, the amount of nicotine inhibitive to mould growth lies between 0·52% and 0·79% in the case of the spore form, and between 1·29% and 2·44% in the case of the vegetative form in active growth. It follows that mould in the process of growth must elaborate a substance capable of neutralising the powerful toxicity of nicotine. This is confirmed by the observation that a feature of the mould development was the progressive clearing of the haziness, imparted to the gelatin medium by the inclusion of nicotine, in the zone in front of the line of growth. The point arises as to whether the amount of antitoxin elaborated is normal, or whether the presence of nicotine stimulates the production of an abnormal amount. It should be mentioned that the mould growth in the course of expansion does not abruptly encounter the full charge of nicotine, for nicotine diffuses very slowly at the line of junction into the non-nicotinised medium, as is shown by the slow development of the haziness characteristic of the nicotinised medium.

Comparison of the last-mentioned figures showing the inhibitive value of nicotine with those showing the nicotine content of the mid-rib and stem portion of the tobacco leaf and that of the laminar portion of the leaf previously recorded, leave, I believe, no doubt as to the genesis and *rationale* of mould development in the tobacco. The mid-rib or stem portion forms the nidus for development from the spore to the vegetative form, which is then capable of propagation, especially under favourable conditions of moisture and temperature in virtue of the antitoxin it elaborates, into the comparatively highly nicotinised laminar portions, which constitute the bulk of the tobacco.

London Section.

Meeting held at Burlington House on April 7th, 1919.

DR. CHARLES A. KEANE IN THE CHAIR.

DRYING BY HEAT IN CONJUNCTION WITH MECHANICAL AGITATION AND SPREADING.

(A Contribution from the Chemical Engineering Group.)

BY EUSTACE A. ALLIOTT, B.SC., A.M.I.MECH.E.

In selecting a dryer for any given purpose there are many things to take into consideration. No one type can be said to be best except in the narrowest sense as applied to a particular problem under particular conditions. The dryer must not only suit the material to be handled but other factors have to be taken into careful account. These will include the available sources of heat and power, and also the questions of space, labour, perfection and strength of mechanical and structural details, and, not least, the available funds, and the nature of the market for the dried material.

Influence of Degree of Final Dryness.

In considering a drying problem, a most important factor—in addition to the quantity to be dealt with and the total amount of moisture to be removed—is the nature of the final dryness required. In connection with this matter "bone dryness" is often referred to, but as this term may cover quite a wide range of moisture percentage, even in regard to the same material, it is not sufficiently explicit. In case of a material such as ammonium perchlorate it may mean 0·25% of moisture, and in the case of organic manures it may be in the neighbourhood of 10 or 12%. Further, one user may be satisfied with 3% or 4% residual moisture, while another dealing with the same product will require say ½%. The importance of the influence of the final dryness, not only on the time factor but also on fuel economy, is, perhaps, not sufficiently realised.

The following curves show the influence of both

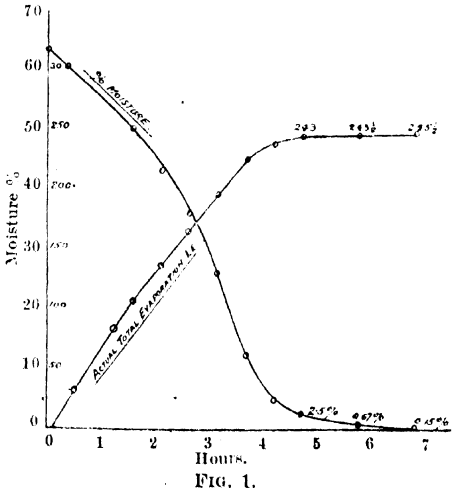


FIG. 1.

initial and final moisture on length of drying and other factors. They relate to an experiment carried out in a small jacketed pan, 4 ft. in diameter, of a type more particularly described later. This pan was provided with agitators, and worked under vacuum. The test was carried out by the author at the Works of Messrs. Manlove, Alliott & Co., Ltd., Nottingham, by whose special permission it is possible to give the following particulars. It may be said that while these figures refer to a particular dryer, they also have an important bearing on results in other types. The curves in fig. 1 show the amount of moisture in the material at every moment throughout the process, and also the amount evaporated. The particular material dealt with was Prussian blue, and the figures all relate to a charge of 140 lb. of dry colour. It will be noted that the moisture percentage falls fairly regularly to about 5%, but that under 2½% the time lengthens out very much. The rate of evaporation remains fairly steady to about 12½%, when it falls off very rapidly.

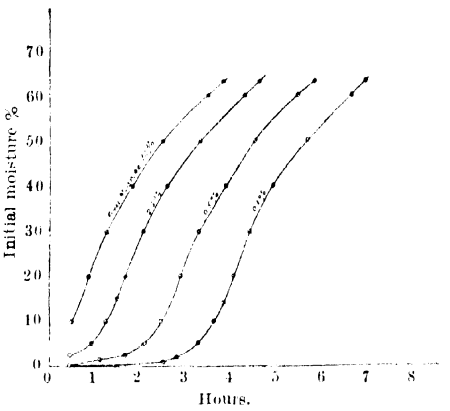


FIG. 2.

The curves in fig. 2 indicate the length of the operation, including charging, heating up, and discharging the material. This time varies very definitely with the moisture conditions. From 60% to 0·1% the time is 7¼ hours, from 60% to 2·5% 4·6 hours, but from 60% to 10% only 3·7 hours. From 30% to 2½%, 2¼ hours; from 10% to ½% nearly 2¼ hours, and from 2½% to 0·1%, 3¼ hours. It will

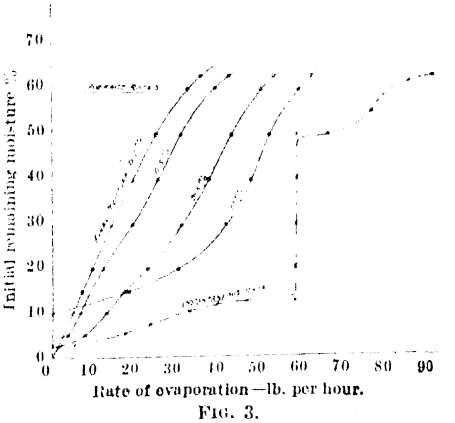


FIG. 3.

thus be seen that the drying period may be distinctly longer, even with a much smaller amount of moisture to be removed, if the final moisture is decreased.

In fig. 3, the four curves on the left show the average evaporation during the period the material is actually in the machine. From 60% to

10% it will be observed that the average rate is 58 lb. per hour. From 60% to 0·1% little more than half, or 32 lb. per hour. From 2½% to 0·1% the rate is barely 1 lb. hourly. The discontinuous curve shows the instantaneous rate of evaporation. It will be seen from this that the momentary rate at which water comes away at any particular moisture content varies curiously. At 63% the rate is about 90 lb. hourly; this falls rapidly with decreasing moisture to a little under 60 lb., where it remains constant for quite a wide range of moisture contents. Below 12½% it again falls rapidly to zero, though if this portion of the curve were drawn on a time basis it would be seen that from this point of view the fall is a slow one. In the case of certain other materials the three parts of the curve merge smoothly into one another.

Fig. 4 shows the average output reckoned in lb. per hour, throughout the whole operation, including allowances for charging and discharging. At 60%

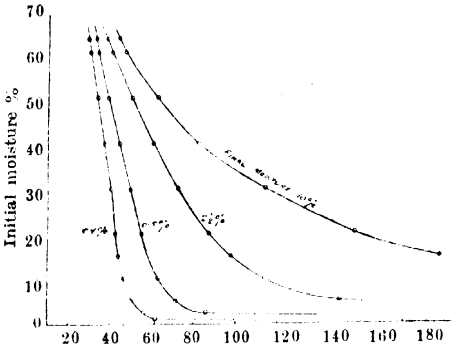


FIG. 4.

initial moisture the outputs are 37 lb. per hour for 10% final moisture, and 20 lb. per hour for 0·1%. For 10% to 2½% the output is about 1 cwt.; these weights refer to the dry material absolutely free from moisture. For the lower moisture percentages better results would be shown if the charge were somewhat larger.

The steam consumption follows similar lines to the foregoing (see fig. 5). It should be said that the test results were irregular owing to condensed water draining in from the steam supply pipes.

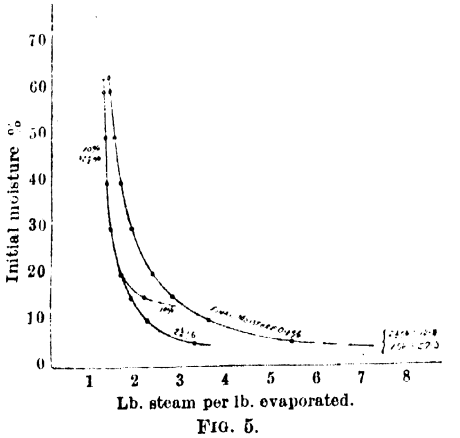


FIG. 5.

In getting out these figures, therefore, a suitable loss of heat has been assumed. This method of calculation is perhaps a little unfavourable in the case of very low moisture contents, and the figures might also be expected to benefit at slightly heavier charges.

The curves for the final moistures of 10% and 2½% are almost identical from 63% to 20% initial moisture, and vary from 1·23 to 1·65 lb. of steam per lb. evaporated. The figures for the 10% curve are of little interest below this point. The final moisture of 0·1% has a steam consumption ranging between 1·4 lb. to 2·4 lb. for initial moistures between 60% and 10%. For 2½% initial and 0·1% final the figure is 13 lb.

Fig. 6 gives the amount of dried material per lb. of steam. This varies from roughly ½ lb. at 60% initial with almost any final moisture, and 3·3 lb. for 2½% initial to 0·1% final moisture.

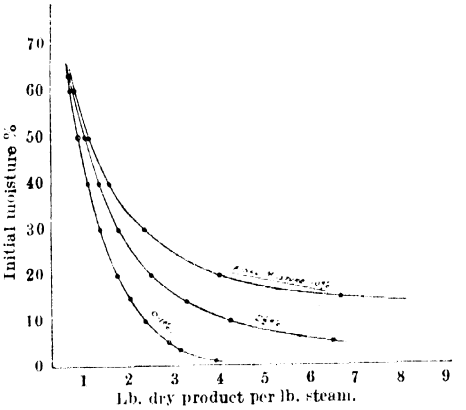


FIG. 6.

INFLUENCE OF CHEMICAL AND PHYSICAL PROPERTIES OF THE MATERIAL.

The chemical properties are mainly important as they influence the material of which the dryer can be constructed. If iron or steel are out of the question, one is largely limited to stationary types, as, generally speaking, agitated dryers of other materials are either very expensive, or are subject to very great difficulties of construction, or reduction in the efficiency of the dryer.

Of materials other than iron and steel, copper is perhaps the most used for pans or rollers, but it wears rapidly if scraped closely. Wood is a very useful material where hot air is the drying agent, and is employed with advantage for rotating cylinders. Lead or enamel is possible where the agitation is of a light nature and the agitators do not press on the lined surface. Enamel of course is a distinct hindrance to the efficient conduction of heat.

The temperature-sensitiveness of the material to be dried affects design, output, and economy in an important measure. Generally speaking, low temperature means low economies, especially in hot-air drying. Materials sensitive to heat may be dealt with in vacuum or by hot air, or, in suitable cases, by film-drying or sprays. In the latter instance the time of drying may be exceedingly short and the average temperature also low.

The specific heat has little influence except at low initial moisture contents or high final temperatures. The conductivity and the diffusion factor have undoubtedly an appreciable influence, especially when the amount of surface moisture is small and the material is in masses. The exact importance of this influence is, however, difficult to determine.

METHODS OF HEATING.

Methods of heating include furnace or direct heat, steam, hot water, and warm air.

In furnace-heated plant the economy is strictly dependent on the method of application. Control

is a very important factor, but economy is also dependent on a high average initial temperature, with a low ultimate temperature for the used products of combustion. Batch machines are not economical when heated by direct furnace. In the case of a single machine the gases cannot be cooled sufficiently before they pass away to the flue, while if several machines are placed in a row the result is cumbersome brickwork, and varying conditions from machine to machine. It should be remembered that, in comparison with steam, gases are poor transferrers of heat, and their efficiency is dependent upon high temperature and intimate contact with the cool material. The most suitable plant for utilising furnace heat is the rotary continuous dryer, which has the advantage of both high output and good economy.

The evaporation per lb. of fuel varies enormously with the conditions. In an ordinary efficient plant, with medium conditions regarding material and no very special supervision, 5 lb. of evaporation per lb. of fuel would be obtained, while under the best circumstances 10 lb. or more may be attained. In regard to fuels, coke is superior to coal where the products of combustion come into direct contact with the materials, while gas gives ease in control and requires little supervision.

Direct steam if economically raised and used may almost vie with direct fire-heat as regards economy. If it is assumed that 1 lb. of coal at the boilers will produce 6 lb. of steam at the dryer, from 3 to 5 lb. of evaporation may be expected per lb. of coal at ordinary figures, though these may be less or more in extreme cases. Steam is a most efficient agent for batch drying, although it is applied with advantage to some continuous dryers with equal results.

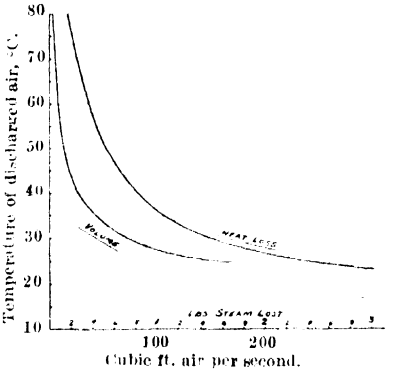
Superheated steam is, generally speaking, a delusion as a source of heat for drying. As it is a gas, its capacity for transferring heat is poor, and the capacity of a plant is liable to be much diminished by its use, which is only justified for very special requirements. Dry steam is all to the good, as there is less water to drain away from the heating surface. Hot water has to be used sometimes in order to dry delicate materials at low temperatures, but in this case again a great reduction of capacity may be expected. Steam at less than atmospheric pressure would be preferable to hot water in some ways, but it is not quite so easily applied and controlled.

Hot air has the great advantage that it can be brought into very intimate contact with suitable agitated and divided material, and thus large outputs may be obtained even at low temperatures. In certain cases its use, especially at low temperatures and high saturations, imparts a quality and texture to the product otherwise unobtainable. The air may be heated by a furnace-fired heater, but saturated steam is generally employed for this purpose. Under certain circumstances, where temperatures of 500°—600° F. are requisite, a gas-fired heater may be employed with advantage.

The economy is decidedly less than with fire-heated machines owing to the lower initial temperature and output, especially with materials containing any appreciable amount of water. One lb. of coal under the boilers may evaporate 1·2 to 2 lb. of water in the dryers, the air being heated to 80° or 90° C. Under the best conditions one might possibly get 3 lb.

A great consideration is the amount of heat carried away by the discharged air. At low temperatures it will be seen from the curve in fig. 7, that the amount of air required to remove 100 lb. of water, if half saturated, is very great; and consequently the proportion of heat lost is great. The upper curve shows this loss reckoned in lb. of steam, at 60 lb. pressure, condensed in the heater, per lb. of water removed. If this temperature o discharge can be raised in any way, the amount o air may be reduced in greatly increasing propor tion, and this loss much diminished.

Now, with losses, such as that in the heate

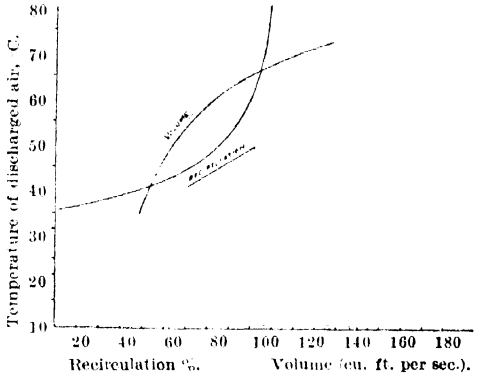


Assumptions.—Air initially saturated at 10° C. discharged half saturated.

PROPERTIES OF AIR.

FIG. 7.

material, equalling the expenditure of heat in evaporation, an initial temperature of 90° is needed to give the heat required to evaporate the amount of water the air will carry at 35° C.; while initial temperatures of 800° C. to 1000° C. or more are needed if the discharge temperature is 70° C. or over. To enable similar economies to be obtained with lower initial temperatures, the air may be brought out of the dryer at a higher final temperature than would be economical under ordinary conditions, and a portion of warm moist air is taken back to the heater and through the drying chamber, re-utilising the heat, and attaining the required degree of saturation, so that the whole of the evaporation is carried away in the discharged portion.



RECIRCULATION.

Relation of discharge temperature to percentage of air recirculated and cubic ft. of air per second passed through dryer to evaporate 100 lbs. per hour.

Assumptions.—Air discharged 50 %, saturated; outside air saturated at 10° C. Radiation losses plus heat given to material equal heat for evaporation.

FIG. 8.

The value of this device increases when the normal discharge temperature is low, for, as will be seen from the curve, a small increase in temperature means a large corresponding decrease in the loss of heat. It is also much affected by the temperature and saturation of the atmosphere at any given time; by the degree of moisture in the

product being treated, and the readiness with which this is given up.

The curves in fig. 8 represent, for a given initial temperature of 90° C., the final temperature attained with various degrees of re-circulation, together with the volume of air which passes through the dryer to evaporate 100 lb. of water.

These curves illustrate the general tendency, but it should be observed that these are necessarily drawn on certain fixed assumptions. In practice it is necessary to exercise much judgment as to saturation percentages etc. obtainable in each case.

The Use of Vacuum.

The uses of vacuum are to increase the capacity per square foot of heating surface; to allow the use of exhaust or low-temperature steam, if available; to shorten the period of drying and exposure of material to heat, and to reduce the average temperature of the material during drying. It is of special value where the last traces of moisture are to be removed.

There is little or no direct economy of fuel when vacuum is used. There is a certain reduction of heat losses and power, due to lower temperatures and accelerated drying, but these at times will be largely counterbalanced by the power used for the pump. It is too readily assumed that the temperature in a vacuum dryer is the boiling point of water under the vacuum used. It may approximate very closely to this, so long as the moisture is evaporating freely, but as the water loses its mechanical freedom, the temperature will rise. When the moisture is entirely in the pores of the material, especially if this be of a close texture, or the material is in masses or balls, the temperature will rise approximately to that of the heating medium, as a rule soon after the moisture has been reduced to 5%.

The output per square foot of heating surface varies very much with conditions. For ordinary steam-heated, agitated dryers, not under vacuum, the evaporation will be from 2 lb. to 3 lb. per square foot for fairly moist materials, reduced to a point at which they are dry to touch and appearance; with only 3% moisture reduced to under 0·5%, and a badly conducting material, the evaporation might only be $\frac{1}{3}$ to $\frac{1}{4}$ lb. per square foot per hour. With materials of a nature from which the water evaporates very freely, such figures may be exceeded under suitable conditions. On the other hand, even where a fairly thin layer of moist material is worked between two heated surfaces, an evaporation less than 1 lb. per square foot hour may be obtained. If the material is in the form of a thin film, outputs of from 2 to 8 lb. without vacuum are recorded. With materials which were not specially favourable, in ordinary agitated vacuum dryers, this latter would be an extremely high figure, though not unattainable on occasions. A more usual figure for most moist materials would be 4—6 lb.

Means of Agitation.

The object of agitation is to bring fresh portions of material into contact with the heating surface, and to break it up and turn it over to permit the free escape of vapour, thus materially increasing output, especially in the case of very low moisture contents. In some cases its use results in a very definite saving in fuel, as, for instance, in utilising direct fire-heat to its best advantage. In other cases, the fuel consumption may be the same or greater but there is a very definite saving in labour and increased output for space occupied. In considering any type of agitator it should be remembered that the properties of the material may be very different at various stages of the process. A not unusual sequence is a thin, almost liquid paste, passing through a heavy clayey stage to large masses, which break down into more or less fine granules, ending up in a dusty powder. Hence the best design of agitator is usually a compromise. Possibly the material may tend to roll into balls, and it is then largely a question of the relative conductivity, porosity, and cohesion as to whether this will prevent further drying or whether the balls will dry satisfactorily with further agitation.

Materials which cling closely to hot surfaces demand powerful knives or ploughs. Some materials will tend to grow into a hard layer under such ploughs, unless, as is often arranged in film dryers, the knife edge can be adjusted close to the surface at every point. An occasional remedy in such cases, where the rubbing action of the plough appears to lay the material on to the hot surface rather than to remove it, is to keep the scrapers or combs clear of the bottom, and follow up with hard-pointed chisels. In some cases it will be found that either no layer is formed, or that, if there is a layer, it will be comparatively soft, and will be effectively picked up and flaked off by the chisels as rapidly as it is formed. Rakes with staggered blades, arranged to push first in one direction and then in another, are very useful for materials which lack cohesion and which are not worked very deep.

Rotating cylinders fitted with lifting vanes are very effective agitators, especially for non-cohesive materials, when the vanes can be shaped to give an even curtain of falling material right across the machine. Balls or scrapers may be very useful adjuncts where the product tends to mass or build up on the shelves. Balls are very effective if they can be lifted and dropped, and if they are made with a hole through them they will have less tendency to collect a hard layer of dried product on their surface. They prevent material cohering in masses or adhering to the shell of the dryer.

The speeds of agitators and revolving drums should, as a rule, be fairly low; too high speed absorbs power, may tend to cause the material to ball, and adds little, if anything, to the rate of drying.

In order to spread material in layers, it may be allowed to fall on to a travelling band passing over a hot surface. The most usual method is, however, to spread it or squeeze it on to rotating cylinders. The special advantage of this method is the shortness of the exposure to heat.

Examples of Actual Machines.

We now come to the consideration of some actual machines. In regard to the figures of outputs etc. an attempt will be made to give those which will represent, not test or special results, but such as may reasonably be expected in ordinary practice.

Agitated Batch Dryers.

One of the simplest plants is a steam-heated pan dryer, with flat jacketed bottom and jacketed sides,

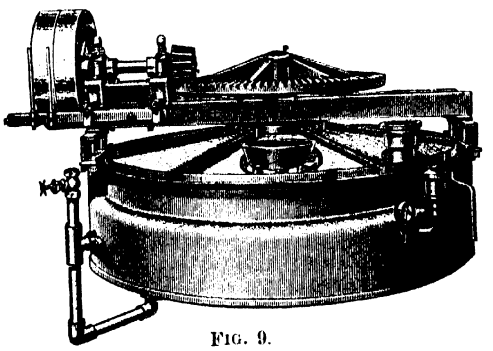


Fig. 9.

and provided with agitating gear. The latter is driven by a belt, through a bevel gearing of strong pattern (fig. 9). The top of the pan is fitted with

a loose cover to minimise the escape of steam etc. into the working space. This top is set on a slope, and provided with a lute which prevents any condensed moisture from running back into the pan. It is fitted with a vapour outlet, charging door, and a balanced discharge door in the bottom.

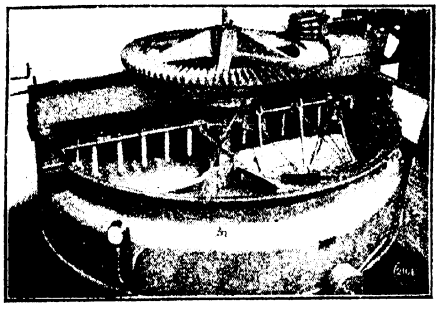


FIG. 10.

The main stirrers (fig. 10) are knives or ploughs which rotate. Other agitators of various shapes are hinged to the top bars. Three of these are circular discs, and one is a flat plate. The ploughs carry round a wave of material which is continually flowing over them, and as it passes under the hinged scrapers these assist in turning it over and breaking it up. The forks also break the top of the wave as it passes below them. Other forms of stirrers are provided for particular problems.

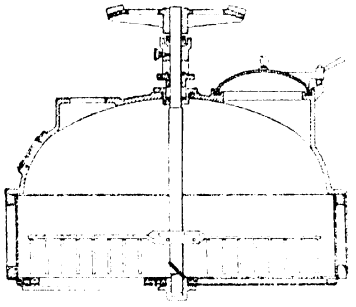


FIG. 11.

This class of machine is manufactured especially for manure, sludges, pastes, and granular substances. Its special advantages are simplicity of operation, and the fact that the material can be shovelled quickly into the machine, left to dry, and then automatically discharged on opening the balanced door below. The final product varies from a course meal to a fine powder, according to the material and the length of the drying period. In dealing with such products as tannery "skutch," pressed sewage, fish manures, blood, etc., the charge for an 8 ft. diameter machine would be one ton, and the material would be dried from 70% to 10% moisture in 6 to 7 hours, or from 35% to 10% in, say, 3 hours. In dealing with crystalline matter reduced from, say, 3 or 4% to under 0·5%, an average charge might be 15 cwt., dealt with in, say, 2½ hours, inclusive of charging and discharging. In certain cases very much larger charges may be dealt with, depending on the properties of the materials. The speed of agitation is about 7 revs. per min.; the power absorbed is not great. An 8 ft. machine would take 4 or 5 HP with average materials.

The same class of machine may usefully be arranged for working under vacuum, and is then more suited to fine materials requiring low final moisture contents, or which are sensitive to prolonged drying (see fig. 11). The charging door will be noted. The arrangement of agitators comprises a combination of ploughs and rakes. The bottom footstep works well with many materials, but with some the shaft is better carried entirely from above. The typical machine is 6 ft. in diameter and the charge may vary from 7 cwt. to half a ton, and the time of drying from 2½ to 6 hours according to material. Such a material as Prussian blue will be reduced from 63% to 5% moisture in about 4½ hours or less, inclusive of charging and discharging. After a slightly longer period the residual moisture will be reduced to 1%, while 0·2% or even 0·1% is practicable within a reasonable time. The power for a 6 ft. machine, including the vacuum pump, with materials which are not unreasonably heavy, would be an average of, say, 4 to 5 HP, and might vary during the process from 6 HP to 3 HP or less. It might be thought that dust would be created, but this is not the case under any ordinary circumstances, and even when the material is taken down to a very low degree of dryness, very little should be carried over owing to the slow speed of the scrapers. The steam consumption will be, say, 1½ lb. of steam per lb. evaporated under average conditions, and at best as low as 1·1–1·2 lb. of steam per lb. evaporated. The amount of labour required is small. A 6 ft. machine could be charged in from 10 to 15 minutes, and this also will be more than sufficient for discharging.

A variation on this machine is the horizontal cylindrical dryer (fig. 12). This is often worked under vacuum, but more usually under atmospheric pressure. In the latter case it is usual to take the vapour to a simple jet condenser, and it is an advantage to connect to a chimney with good draught, or a fan, to draw off the uncondensed gases. This is

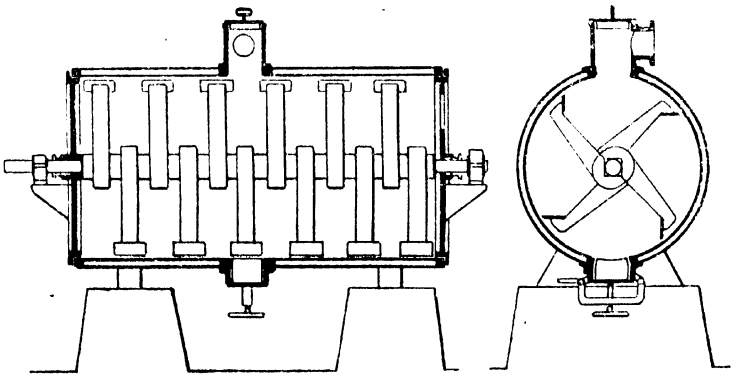


FIG. 12.

found to improve output. As will be seen from the figure, the machine has an upper dome with vapour outlet and charging door. Sometimes a charging shoot is fitted in the cylinder end.

The agitators are plates carried on strong girder or cast iron arms. They are usually set at a small angle, in order the more readily to push the dried material out at the central discharge opening when the door is dropped. As a rule the product will empty quite rapidly by its own tendency to gravitate, even if the blades are straight.

In a very good arrangement of cast iron stirring arms (fig. 13) there is only one arm at each point along the shaft, and at right angles to this is fixed

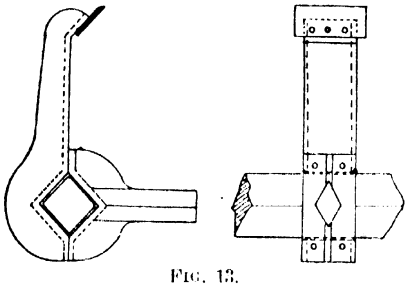


FIG. 13.

a shorter arm, which serves to break up any mass of material which may be lifted by the main arm and rolled over the shaft. There is no disadvantage in the single arrangement of arms, as the rate of drying is not appreciably affected thereby, and less power is absorbed. Other forms of stirrers are sometimes employed, including two spirals—one inner and one outer—working in opposite directions, but these are not good where there is much resistance to motion.

This class of machine is regarded as standard for manures, fish refuse, offal, blood, garbage, excreta, etc., and for any sludge or paste which has no undue tendency to build up on the shell or cling round the centre of the shaft.

filled very full, and a charge may usually vary from one-eighth to one-third of the total cubical contents, but occasionally is two-thirds or more: A machine of the size mentioned, fitted with double paddles, working on 25 cwt. of poultry manure, took 15 BHP at the start, and this diminished to 5 BHP. towards the end. A usual speed of scrapers is 7 r.p.m.; 15 or even 25 are occasionally employed, but there is little to be gained by this, while additional power is consumed. The steam consumption depends largely on the efficiency of the lagging—1½–2 lb. of steam per lb. evaporated will be usual figures. Labour is small and depends on the general lay-out rather than on the machine. Charging such a machine would take, say, 20 minutes; the discharge is automatic on opening the door.

A special development (fig. 14) is the vacuum ball dryer. In this case the shell itself is steam-jacketed and revolves, and the balls take the place of scrapers in breaking up the material, and in keeping the heating surfaces free from accumulations. The steam enters the drum through one trunnion, by which also the condensed water leaves, the trunnion being divided for this purpose. The other trunnion has connections to the vacuum pump and in some instances, as indicated in the figure, there is also a special connection for admitting gas under pressure, so that the machine is an autoclave also. The whole machine is carried on tyres, revolving on single rollers, and in the case of small installations may be driven by friction, while larger ones require a spur gearing.

This type of machine is quite effective for colours, drugs, etc., its special advantage being that the product can be reduced in course of time to a very fine powder if desired, which is advantageous in extracting the last traces of moisture. A machine 2 ft. 6 in. in diameter by 5 ft. long should take a charge of 3 to 4 cwt. of wet sludge, which it should dry from 60% to 5% in say three to four hours. Rather more dust will be produced than with the pan pattern with plough scrapers, on account of material clinging to the sides. The power required to drive such a machine will be 1½ to 2 HP.

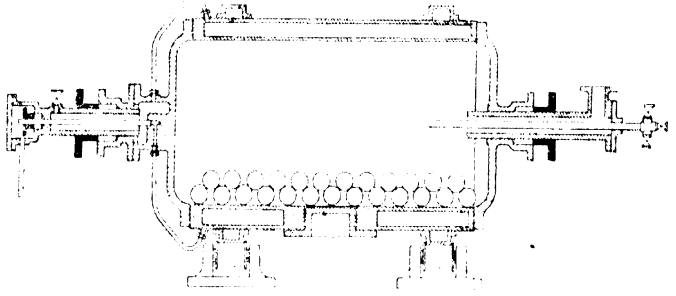


FIG. 14.

Such a machine may readily be arranged for vacuum working, with beneficial results both as to output and prevention of escape of noxious vapours, and also the retention of ammonia in the case of organic manures.

The typical machine is 6 ft. diameter by 12 or 13 ft. long. This will take a charge of 25 cwt. to 30 cwt. of material such as hen manure, fish offal or tallow bottoms. A charge containing 70% of moisture will be reduced in about 6 hours, and with 40% in about 3 hours, though better drying may be obtained with certain materials. Larger charges, such as 4 tons or more of fish offal, are sometimes worked, but more time and power are required, and most users favour the smaller weights.

In handling tallow bottoms the time of drying is dependent on the amount of grease left in the material. Machines of this class are not as a rule

CONTINUOUS DRYERS.

In the Passburg continuous vacuum dryer, originally introduced for dealing with brewers' grains etc., the material is charged into a hopper, which can be isolated from the machine, and passes through a rotating valve or other feeding mechanism into a horizontal cylinder provided with a steam jacket (see fig. 15). Another hollow cylinder, to the interior of which steam is admitted, works inside this and carries on its surface segments of a worm which works the material along between the two hot surfaces, squeezing it against them. At the end of the first cylinder it passes through into a lower one, in which the rotating element is somewhat different. In this case the agitating cylinder is fitted with shelves which lift the material up, causing it to travel along by its own tendency to spread. Close to this lower rotating cylinder are

arranged steam-pipes which give additional heating surface. The dried material passes to a receiver or else to a rotating valve, which automatically discharges it. In the typical machine the upper cylinder is 20 ft. by 2 ft. 8 in. diameter, 7 r.p.m. The lower is 19 ft. long by 5 ft. 9 in. diameter. It

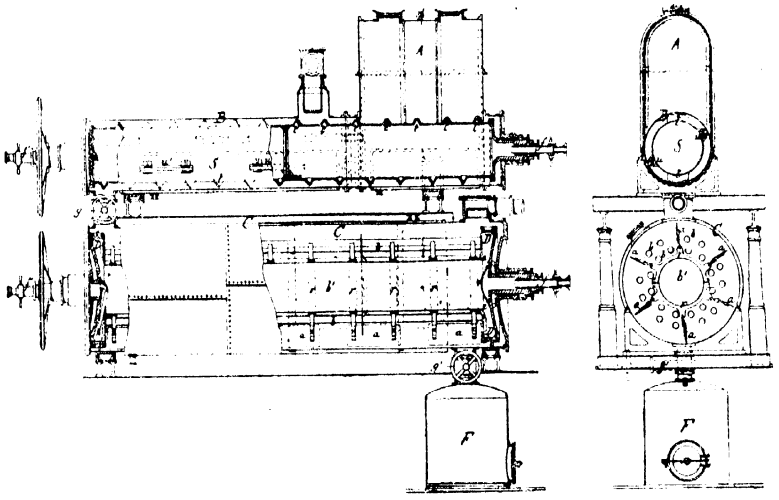


FIG. 15.

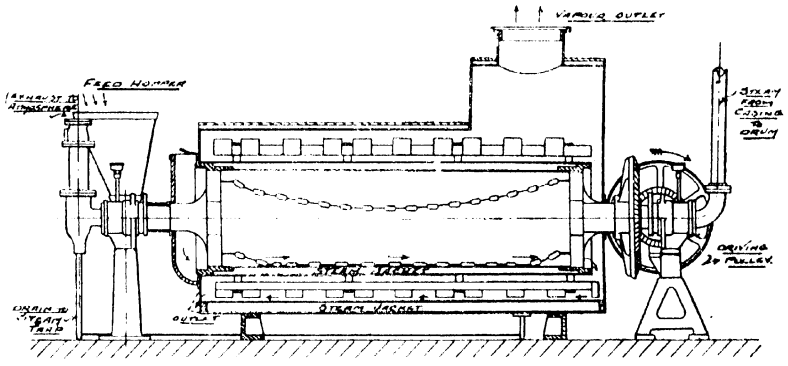


DIAGRAM SHOWING SECTION THROUGH "NORWICH" TYPE DRYER.

FIG. 16.

deals, according to the inventor, with 14 cwt. hourly of wet brewers' grains, from 75% initial to 7—12% final moisture, or 8 tons hourly of damp grain containing 20—30% moisture.

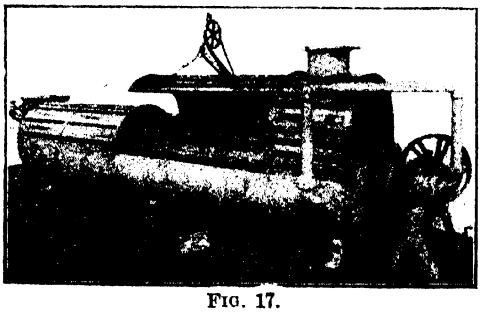


FIG. 17.

In a modification of this machine the arrangement is simpler, there being only one jacketed cylinder, in the interior of which revolves another cylinder fitted with paddles, this inner cylinder being also steam heated.

The "Norwich" dryer (figs. 16 and 17) works under atmospheric pressure. Instead of the inner rotating cylinder being fitted with paddles on the outside only, it is replaced, in this instance, by a jacketed cylinder, with paddles on the outside; but the material is first admitted to the interior, where it is heated and partially dried before it passes to the exterior section containing the agitators. The interior of this inner cylinder is provided with chain scrapers, or balls, to prevent clogging. The outer cylinder is steam-jacketed on the lower portion only, the upper part being lagged and arranged for easy removal for inspection of the paddles. The material is discharged from the machine at the same end at which it enters. The machine is horizontal and the material travels through it owing to its tendency to spread out. The hood at the end is for the vapour, which passes through to a chimney or ventilating shaft.

This apparatus will deal with such substances as filter-pressed gluten, bran, etc. Owing to the great amount of heating surface in a relatively small space, the output is high and exhaust steam can be used with advantage. A machine 4 ft. 6 in. by 21 ft. externally will deal with about 4—5 cwt. per hour of gluten containing about 70% moisture, reduced to 1% or 2%. The steam consumption will be about 1¼—1½ lb. per lb. evaporated, and about 3 HP will be required to drive the machine. It the material can be fed automatically and discharged to a travelling band, it may fairly be said that no labour is required.

In designing a continuous rotary dryer (see figs. 18—21) the first consideration is the temperature to which the product may safely be subjected, or which can conveniently be attained. It is usual to consider that the air at exit should be saturated up to a given percentage. In ordinary cases 50% saturation is a very good figure, as above this point the drying effect is greatly reduced, and moreover re-deposition of the moisture may occur before the air has finally escaped.

The air should leave the plant with a sufficient margin of temperature above its saturation point, depending on how directly the air is taken from the machine. If the air is discharged to dust chambers etc. a bigger margin is necessary.

A most important point is the air speed that can be used. This is limited by: firstly, the speed at which too much dust will be carried away or the material itself prevented from travelling through the machine; secondly, the time required for the air to give up its heat and absorb the required moisture. Air-speed seldom exceeds 7 ft. per second at exit from the dryer and may be as low as 3 ft. per second; 4—5 ft. per second is a usual figure, this speed being reckoned on the gross area of the dryer. A normal time for air to be in the dryer is from 5 to 10 seconds.

Another factor of importance is the length of time the material takes to give up its heat under the temperature conditions in use, as the dryer must have enough capacity to allow the material to remain in for a sufficient length of time, without the machine being so heavily loaded as to choke the rate of evaporation. The material may be in the machine for quite a short period, such as say ten minutes in the case of sugar, while for slower drying materials or those containing more moisture the period may extend to over an hour.

The volume and speed of the air is the basis for calculating the diameter of the machine, while the length is mainly determined by the time factor of the material, though when this is low the time factor of the air has to be considered. The machine is usually set on a slight slope to aid the material to travel along, though horizontally arranged machines are in use which give good results. The slope and speed are interchangeable factors to some extent. For quick-drying materials the machine will be kept short, and set at an angle of 1 in 15. For slow-drying substances, the machine will of course be longer and the slope reduced to 1 in 45 or 1 in 50. The function of speed is to lift and drop the material a suitable number of times through the hot air during its passage through the machine, and to bring fresh layers of material in contact with the hot shell. The time the material takes to travel through the machine will vary with the speed of rotation. This gives a useful control over this factor. Speeds may be as low as ¼ r.p.m. in a fire-heated machine dealing with a dusty material, but speeds of 4 to 8 r.p.m. are more usual.

The draught is generally induced, as there is less tendency to blow hot air and dust out of the joints of the machine. In certain cases the warm air coming from the machine may be re-circulated, thus giving an advantage in fuel economy and allowing the average temperature in the machine to be higher without loss. Even without re-circulation, a rotary dryer with opposite flow will generally utilise the air capacity to better advantage than a stationary type.

With sticky materials the shelves are better straight, not curved, so as to give the material less opportunity to build up. The shape and spacing of the shelves may differ at various points along the machine to suit the different properties of the material at different stages, and they should be staggered to prevent air getting through without doing its proper work. With steam-jacketed or fire-heated dryers with external heating, dealing with very dusty products, it is sometimes possible to omit the shelves altogether without any specially adverse results, especially if the air speed is not high. Such an arrangement is also useful for dealing with sticky materials. A wood hammer, which automatically drops at intervals and jars the shell, is sometimes arranged to free the material from the shelves.

A typical modern steam-heated rotary drying plant has at one end of the cylinder an air heater, which is divided into separately controlled sections; at the other end is a suction fan, delivering to a cyclone dust separator (fig. 18). The joints at the cylinder ends may be of a simple labyrinth pattern, or may be rings of canvas, asbestos, or other suitable material. The interior is fitted with shelves.

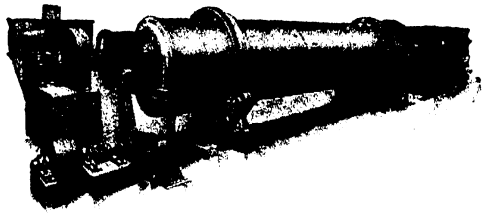


FIG. 18.

Typical varieties have an unjacketed cylinder or a cylinder fitted with a steam drum in the centre, in both of which types the outer cylinder and paddles may be constructed in wood if desired. In another much used form (fig. 19), the shell is steam-jacketed, while occasionally the machine is fitted with a jacketed shell and an inner drum in addition.

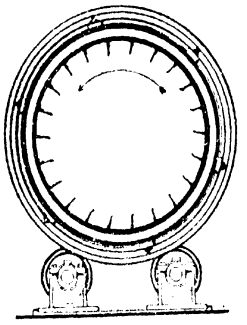


FIG. 19.

The drying cylinder is supported on a pair of heavy cast iron or steel rings, having broad faces. Each of these runs on two pairs of large-diameter rollers, carried in two swinging arms, pivoted on an axle, and so constructed that true alinement is secured. This arrangement allows the rollers to bed themselves to the path ring, and greatly assists easy running. The cylinder is kept in position lengthways by special thrust rollers. For light machines single rollers are sometimes used, but should be of ample diameter. This gear is an important part of the machine, and unless it is carefully and substantially designed will show wear, especially when the rollers are of the single pattern.

Steam-heated rotary dryers may be used for very varied purposes, but as usually constructed they are mainly applied to granular materials, containing from 2½% to 5% of moisture, which require to be dried down to 0·5 or 0·2%. An unjacketed dryer,

4 ft. diameter by 22 ft. long, with air heated to 82° C., will deal with about 1 ton per hour of a hygroscopic material such as ammonium nitrate, drying it from say 3½% initial to 0·4% final moisture. In connection with such work, with steam at 100 lb. pressure in the heaters, very high air temperatures, ranging up to about 143° C., have been recorded. Taking an initial temperature at 90° C., the temperature at the exit from the cylinder would be say 30° to 35° C. The air would carry away about 4—5 grains of added moisture per cubic foot. The temperature of the material leaving the machine would be in the neighbourhood of 60° C. A similar machine, with air at 127° C., has dealt with 30 cwt. of ammonium nitrate per hour, reduced from 3% or 3½% to 0·2% and heated to 82° C.

The power taken to drive such an installation, inclusive of fan of ordinary pattern, would be 6 to 7 HP. A large machine 9 ft. diameter by 15 ft. long took only ¼ HP to turn, apart from the fan, when empty. It was fitted with double swinging arms to carry the rollers, and when filled with material would take about 6 HP under normal conditions.

In dealing with materials such as ammonium nitrate, which contain but little moisture, and require to be heated as well as dried, the heat carried away in the dry product is usually more than that used for evaporation. The heat lost in the exhaust air may easily be 20% or more of the total. The steam consumption works out at about 4—4½ lb. of steam per lb. evaporated, the useful work, including heating, amounting to about 60% of the heat supplied to the machine. The evaporation per lb. of coal under the boilers works out at about 1½ lb., while about 50 lb. of material is dried per lb. of coal used—this supposes that 6 lb. of steam is delivered to the plant per pound of coal. Labour, of course, with this class of machinery is practically nil if automatic charging is employed. If it is hand-fed, a machine of the size mentioned should be adequately attended to by a man and a boy.

The "Brownell" patent rotary dryer is a machine specially modified and adapted to handle materials, such as oilseeds, practically all forms of nuts and beans, copra, oats, maize, etc., in fact all substances that require long and complete exposure to



FIG. 20.

hot air in order to dry them, and which are of a fairly large granular nature, without special tendency to stick or to build up. Externally the machine itself is very much on the lines previously described, but internally it is fitted with a series of spiral volutes (fig. 20). The material to be dried is fed into the periphery of the first spiral, ascends to the centre of the spiral, then through to the centre of the next spiral, which is opposite-handed, and on the periphery of which the material passes outwards till it is again caught up by the following one and so forth. To prevent the material falling off the spirals, these are separated by screens of wire gauze.

In order to break the product and utilise the space properly, a number of lifters or buckets are fitted to the channel of the volute. These are of two types, (1) the "fall-off" buckets, which carry the material almost to the vertical and then drop it back, and (2) the "carry-over" buckets, which carry a certain portion of the material right over the centre of the spiral, so that it drops back on the far side. This arrangement helps to lengthen the journey through the dryer, as a certain portion is going one step forward and making another back. A current of air, of suitable volume and temperature, is blown through the volutes. It should be noted that only material of a certain specific gravity will resist the tendency to blow caused by the pressure of the drying air current, though the use of the wire screens permits a much higher air speed than usual, so long as the material is not of such a nature as to be readily blown against and to choke the mesh. The least size of grain which may pass through the machine is governed by the mesh of the wire screen, and this would not ordinarily be less than 8-mesh, as the fan resistance would then be too great. Again, articles of very large size can never be dried very efficiently, as the moisture will only come to the surface very slowly and heat would have difficulty in penetrating.

The standard machine is 9 ft. diameter by 15 ft. long, and it contains 14 spirals about 10 inches wide. The total length of the spirals is somewhat over half a mile, and at about 4 r.p.m. the material would take about an hour to appear at the discharge end after commencing to feed. An ordinary air temperature at inlet would be about 90° C. and 43°—48° C. at outlet. In dealing with such materials as oilseed an evaporation of some 10—15 cwt. of water per hour would be effected, and in some cases as much as 3—4 tons of oilseed could be dealt with hourly, reduced from 25% to say 5% moisture. By adjustment of the air speeds, it is possible to work with temperatures as high as 150° C. at inlet. Since large quantities of air are being dealt with, the machine is fitted with a re-circulating arrangement.

The simplest fire-heated rotary machine is fitted with a furnace at one end and a fan at the other, the products of combustion passing right through the machine. Whether the furnace is at the material discharge or inlet depends on circumstances, the most economical arrangement being usually the counter-flow type. When drying vegetable matter it is, however, desirable to take the material and the gases through the machine in the same direction, so that by the time the material is nearly dry, the gases are sufficiently cool to avoid injuring it. The general appearance is very similar to the steam-heated dryer (fig. 16), except that a furnace is substituted for the air heater.

Another type of machine (fig. 21) is arranged with a brickwork flue round the shell, labyrinth glands being provided where the cylinder passes through the walls. The hot products of combustion from the furnace travel over the exterior of the machine and are removed by a fan which forces them into the interior. Here they pass through showers of material, meeting first the hot dry product and finally the entering wet material, thus being effectively cooled before they are removed by a second fan and passed to the chimney. By adjusting the dampers the air pressure in the dryer is very effectively regulated and leakage prevented. The great advantage of this arrangement is that the material is heated by contact with the hot shell, as well as by the gases. Further the gases give up a good deal of their heat while passing round the

machine, and may be reduced to two-thirds or even half their original bulk before entering the cylinder. For the same speed of gases through the cylinder, it is therefore possible to take a much greater weight of combustion products through the machine, and the gases have an adequate opportunity of giving up their heat, even in a short machine, thus distinctly increasing its capacity. Finally, the dry product only comes in contact with partially cooled gases, being heated less highly and carrying away less heat.

If it is important that the products of combustion do not come in contact with the material, the dryer may of course be heated simply on the outside. This does not give a good output, and does not permit the temperature of the gases to be reduced sufficiently for economy. An air-heater may be fitted, but this adds very greatly to the cost, and a fuel consumption of some 30—40% more is necessary. An effective way, as shown in the diagram, is to fit the interior of the machine with a number of coils having a large surface, through which the hot gases pass. The material is lifted by shelves, and caused to fall over these coils, being thus effectively dried. This method is suitable for such materials as powdered ores of a sandy, loose nature. Another way is to pass the gases through a central tube and return them through passages in the outer shell.

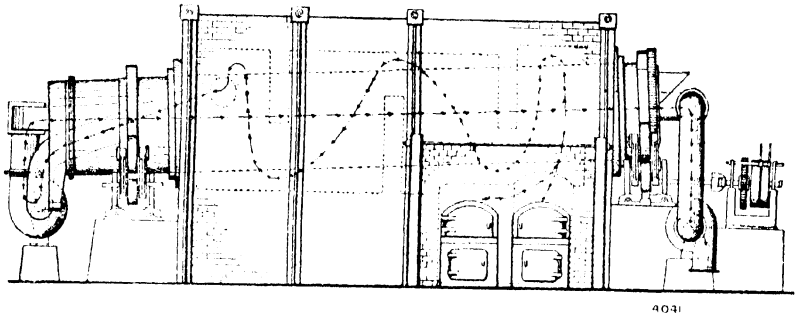
In general, fire-heated dryers are used for dealing with sand, sewage, powdered ores, clay, coal, etc.; also sludges such as oxides, chromes, etc., containing high percentages of moisture.

An ordinary output for fine products with a machine 4 ft. in diameter by 20—30 ft. long, drying material from 50% down to 1—2%, would be ½ ton evaporation per hour. Where conditions are favourable and high gas speeds are permissible this might be increased to as much as 30 cwt.

For a fine sand, such as is used for glass-making, a machine of the external flue type, 4 ft. in diameter, removing from 5% to 12% of moisture, will turn out about 4 tons per hour. It should be clearly understood that the amount of evaporation is strictly limited by the speed of gases permitted by the nature of the material. The power required is very little more than for the steam-heated type.

Fuel consumption varies greatly with varying conditions. Under the best conditions, with no dusty and sticking qualities, so that output is high, such a machine may be over 80% efficient on test results, having regard to both heating and evaporation. Under average working conditions, about 5 lb. of evaporation per lb. of fuel would be obtained, while 4 lb. would be a very ordinary figure for low moisture contents. With very careful working, high moistures, high gas speeds, and good conditions, 6—8 lb. or even more of evaporation per lb. of fuel has been recorded. The radiation losses are not great, and may vary from 15% downwards according to output. If the amount of moisture is low the dry material may carry away quite easily 30% or more of the calorific value of the fuel, and under some conditions this loss may rise to 2 or 3 times the amount of heat required for evaporation. The heat lost in the exhaust air may be from 10% up to 20%, and is less with higher initial temperatures. Labour is of course comparatively small, and depends on circumstances.

In order to obtain the best results for a machine of this class it should be in charge of a man who is familiar with the art of stoking, and the machine should at least be fitted with dial thermometers for gases at inlet and outlet. It is an advantage if continuous charts are kept. Regularity of quality of material, rate of feed and temperature employed is important, and this can only be obtained by modern methods of control. If the



FIRE-HEATED DRYER, SHOWING DIRECTION OF COMBUSTION PRODUCTS.

FIG. 21.

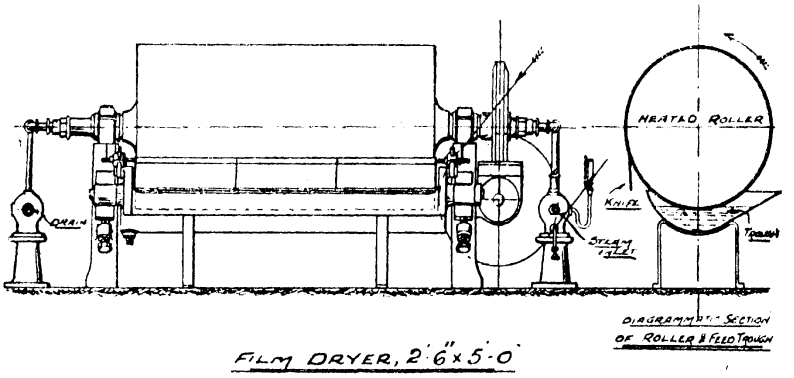


FIG. 22.

feed or quality of material is irregular, the tendency is always to cut the average feed down, so that the maximum upward fluctuation is still within the capacity of the machine, and of course for any lesser amount the heat in the gases would not be fully utilised. In the same way, the tendency is to stoke up to the maximum the whole time, so that no moist material comes through even with the greatest fluctuation of feed.

Cylindrical Film Dryers.

In one type of film dryer (fig. 22) the roller dips in a trough, fitted with a constant level arrangement. A film of material, proportional to the speed and length of periphery immersed, is taken up and dried rapidly on account of its thinness. On the opposite side of the machine is a knife or doctor.

For dealing with materials of extreme cohesiveness, this knife is supported by a strong girder, having adjustments for angle and pressure, while there are separate adjustments for each portion of the knife and at points along the blade. Such a knife is, generally speaking, necessary for milk, yeast, dyes, and fine drugs; certain materials, however, flake off very readily, and a much simpler knife may be used. In fact it may not even be necessary for it to touch the surface of the roller. To ensure smoothness of working and adequate speed reduction, the machine is driven through a worm and wheel.

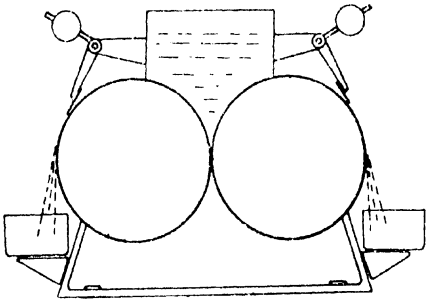


Fig. 23.

A common form is the twin-roller machine, in which the rollers work inwards, squeezing out the material, which is contained in a trough, the bottom of which is formed by the rollers themselves (fig. 23). The knives are then removed to a position near the top of the rollers. This arrangement is used for liquids, but is more especially valuable for pastes of semi-liquid, or even of fairly stiff consistency, which can be squeezed out to a thin, even layer.

In feeding liquids—especially those sensitive to heat—to such a machine it is desirable not to fill the trough, but to spray or distribute them continuously on to the upper part of the rollers. Overheating and foaming are thus obviated, while any bubbles or such inequalities are flattened out at the "nip" of the rollers. The single roller machine can be used for thick liquids if fed by a smaller feed roller. This arrangement also has the advantage that the bulk of the liquid is kept cooler.

A machine with a single roller 2 ft. 6 in. diameter by 5 ft. long will evaporate up to 300 lb. per hour with suitable materials, though in many cases in dealing with drugs and dyes it may be only from 100 to 150 lb. per hour. The steam consumption will vary from about 1·3 to 2 lb. of steam per lb. evaporated. Machines are made with rollers as large as 4 ft. diameter by 9 ft. long. They are also worked under vacuum with advantage to output.

A special tubular dryer, patented by Mr. Brownell, is used for dealing with adhesive, plastic, or semi-fluid substances, such as green curds from skimmed milk, or the residue left from the refining of sugar, known as sugar mud. It consists of a number of tubes in a steam box (fig. 24). The material is forced under great pressure into the tubes by a worm or other device, and as it enters is sliced by a knife which helps to break it up. To

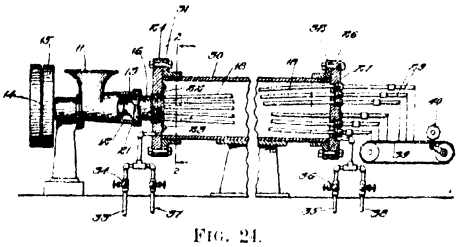


Fig. 24.

prevent the material being forced out of the tubes by the evaporated steam, stops are fitted in the pipes, which have the effect of forcing the material into a tube shape something like macaroni. The steam tends to form a layer between the material and the inner surface of the drying tubes, and it is found that the material does not burn, and does not stick to the tubes. It is believed that the steam layer forms a protection. On the material emerging from the tubes, the moisture escapes very speedily into the atmosphere. By a suitable adjustment of the temperatures almost any desired degree of dryness may be obtained. The ends of the tubes are arranged so that they are not vertically over each other, and the separate threads or tubes of material fall clear. The device in the upper right hand corner is a slicer.

This machine has been used for drying casein to a point at which it has lost its tendency to stick and make up, the final drying being completed in the rotary machine previously described.

In conclusion, it will be recognised that the working of a drying plant may often be improved, with great benefit to output, by a slight modification either in the plant itself, or in the condition of the material supplied to it. With the best will in the world on the part of the maker, it is often only those in charge of the plant who are in a position to see what may be desirable in this connection. To get the best value out of a drying plant means not only study, but a continued contact with the conditions not merely in the machine itself, but also in the preceding and following processes.

Discussion.

Mr. H. M. Ridge asked whether the author had considered the question of dust losses. He had had a lot of trouble about 20 years ago with drying daily some 300 tons of Broken Hill ore and had installed four rotary dryers 10 and 12 metres long by 1 and 1¼ metres diameter for drying that material from 2½% moisture to 0·1%, but as soon as the moisture content of the material increased to 4% difficulties arose, and only about half the tonnage could be treated, whilst in rainy weather when it increased to 6% the output was very small. The dust loss was an important item. He had been dealing with old tailings with from 8 to 12% of lead. The actual loss in dust was about 1½%, and for drying large quantities of ore he had been compelled to design special plant. Edison drying towers at first appeared promising, but later big machines of a new type had been used with greatly improved results as regards fuel saving and mechanical efficiency, and at the same time the dust loss was practically overcome, but nothing had yet been published about them.

Prof. E. G. Coker asked the author what degree of accuracy the cylinders for film drying were

turned to. It seemed that if they were not very accurately machined cylindrically there would be difficulty in peeling off the film with the knife. Again, what was the efficiency produced by regenerative heating? In some of the machines illustrated there was re-circulation and presumably there was some economy, perhaps a considerable amount, to be gained in this way. The most notable example he was acquainted with—and no doubt there were others which were highly economical—was the Mond gas plant, in which the principle of regeneration had been carried out most successfully, and it seemed to him that in drying chemicals there must be a large field in that particular direction.

Captain C. J. Goodwin said that with the present increased cost of fuel it very often paid to remove a percentage of the moisture from a product rather than to pay for its transport. In the case for instance of iron ore containing about 20% of moisture, it paid to reduce that moisture to about 6%, before dispatching if the freight was more than 7*s.* 6*d.* per ton. The author had referred to the use of hot water instead of steam in the case of some of his dryers, and he mentioned in this connection the Merrill system of industrial heating which had been applied to evaporators and other chemical plant in America. It consisted in the circulation of a non-inflammable fluid having a high boiling point and a safe working temperature of 315° C. Considerably higher temperatures could be employed than with water or steam, and at the same time there was the benefit of using a fluid which was not under pressure for transmitting the heat to the substance to be dried instead of a gas, as in the case of superheated steam. The engineer's fetish regarding the use of superheated steam had often led to failure in connection with evaporating and drying plant.

Dr. T. M. Lowry said that he had seen some of the author's dryers in use during the past two or three years for drying ammonium nitrate. One point which had not been mentioned in the paper, but which had been worked out successfully in practice, was in connection with the tendency of the suction fan in rotary dryers to suck cold air in. An excellent remedy was to provide a suction fan at one end and a pressure fan at the other end. The lower end of the rotating drum could then be made a neutral point through which neither cold air could enter nor dust escape. Another point in connection with rotary dryers was that there were really two stages in drying, and if rough drying was wanted, a different type of apparatus was required as compared with drying, say, to 0·1%. The disadvantage of the rotary dryer was that it dried the outside of the ammonium nitrate crystal long before the inside, which remained comparatively wet. The rotary dryer when used in this way was therefore essentially a "rough-dryer." It owed its success as a dryer of ammonium nitrate in connection with explosives manufacture very largely to the fact that a great deal of drying took place in the subsequent stage of milling. Apart from this it was usually necessary to grind and dry in two stages, *e.g.*, to rough grind and dry and then fine grind and dry. Both stages could, however, be effected by using a dryer with a series of blades in it in order to break down the crystals, which was a very important factor in drying.

Mr. H. F. V. Little asked whether, apart from possible losses from dust in the case of a dryer, drying under vacuum, and working as a ball mill for grinding at the same time, there would be choking of the condenser through the dust deposited in the tubes.

Mr. H. Talbot said that a point which had been touched upon by Dr. Lowry was the extraordinary difficulty of getting rid of the last traces of moisture, between 3% and 0·1%. It seemed to him that it *might be possible to deal with drying in two stages,* one corresponding to the easy evaporation of water and the second stage corresponding to the difficult removal. In dealing with large scale drying it might be advisable to have a dryer designed very much on the lines of the ordinary apparatus for rough drying and to have another apparatus, perhaps with re-circulation as an essential feature and which might be extremely slow, in order to get rid of the last traces. Would it pay to do that?

Dr. H. C. Greenwood asked whether experiments had been conducted, in cases where high desiccation was necessary, to see whether it would be economical to effect preliminary desiccation of the air used by processes such as those employed for drying the air for blast furnaces, for example, by refrigeration. The air fed into the circulatory system might be dried and circulated until the moisture content reached a certain value and then extracted from the system at the required rate.

Mr. J. S. G. Thomas referred to an aspect of removing the last traces of moisture which was rather of physical than mechanical importance. The last traces of moisture existed principally in minute capillaries which were in the material to be dried, and it was a well-known fact that the vapour pressure in such narrow capillaries was less than on a flat surface. The result, of course, was that the amount of moisture required to produce saturation in these capillaries was very much less than the amount required to produce saturation in the atmosphere above a flat surface. There was a diminished tendency therefore for the water to evaporate and, moreover, the force necessary to produce appreciable motion of the vapour in these capillaries, being inversely proportional to the fourth power of their radii, might assume extremely high values. For this reason he thought it would be advisable if, prior to the final drying, the material could be broken up into very much finer particles than was contemplated in the dryers which had been described by the author.

Mr. P. Parrish said that none of the apparatus which the author had described would deal with the huge quantities of superphosphates which were required as artificial manure, and as regards the ammonium sulphate industry the plants that had been referred to were altogether too mechanical. Two essential considerations had to be taken into account in this connection. The first was that after the sulphate left the centrifuge it had to be stored. The ammonium sulphate trade was a seasonal one, the demand in pre-war times probably existing for only about three or four months in the year, during which time there might be requests for deliveries of 2000 to 3000 tons per week. The question therefore arose, ought the material to be dried at the outset or ought it to be stored and finally dried when the order came along? If they had to deal with say 3000 tons per week, and it was decided to dry on receipt of the order, then such plant was unduly large. On the other hand, if the material was dried when manufactured it might conceivably acquire moisture during the storage and the whole efficacy of drying would then have been rendered nugatory. He had recently seen a description of a method of drying ammonium sulphate mechanically, but it seemed to him that the methods adopted five or six years ago on the Continent to dry this and similar salts might be employed. A common type of dryer consisted of a jacketed trough, U-shaped, 20 ft. long × 4 ft. 6 in. deep, exhaust steam being used, and the power required to drive the shovels was about 2 or 3 H.P. No attempt was made to arrange the shovels in the shape of an Archimedian screw. The drying was absolutely positive because the speed at which drying was effected depended on the angle of repose: as the sulphate became drier so

the angle of repose became less sheer and the ammonium sulphate overlapped the path of adjacent shovels. Thus movement of the sulphate was secured and the speed of operation was determined by the dryness of the salt. With regard to the drying of superphosphates, there again they were face to face with an important physical principle because under certain conditions of temperature and humidity of the drying medium reversion of the soluble phosphates occurred, and instead of the product containing say 26% of soluble phosphates there was only about 20%.

Mr. S. H. Blichfeldt referred to a new drying process used for milk. The milk or similar substance was blown in a fine spray into a room containing hot air under reduced pressure, the moisture being almost instantaneously removed, and the dried material falling to the ground as a finely-divided powder. Very large quantities of milk dried in this way had come into this country from the United States, and the results obtained with this very difficult material seemed to show that this method of drying was superior to other methods. The process was comparatively new and not very well known.

Mr. Alliott replying to the discussion said that the dust loss referred to by Mr. Ridge, *viz.* 1½%, was not at all an unreasonable percentage if the product contained fine particles and left the plant very dry, unless great trouble was gone to in settling the dust. It was usual to slow the gases down in a dust chamber and sometimes even to pass them through a spray of water to ensure no dust being carried away. In reply to Prof. Coker he had no figures available with regard to the accuracy with which the film drying rollers were turned. The rollers when dealing with a substance such as milk had to be polished and very true in order to get the milk to peel away properly from them. On the other hand many products could be satisfactorily dealt with without special precautions. Heating by oil referred to by Captain Goodwin might be an advantage where very high temperatures were concerned. He agreed with Dr. Lowry that it was impossible to get crystals of ammonium nitrate completely dried internally with one passage through the machine. They had to be broken up. When trying to reduce the moisture to 0·25 or 0·1%, the material had to be very finely broken up to allow the vapour to escape from the capillary passages which had been spoken of. In reply to Mr. Little's point, he had not found any choking of the condenser tubes by dust. Dust should not ordinarily be carried into the condenser and if it did it should soon be thoroughly washed away by the condensing vapour. He had not personally any experience of preliminary desiccation of the air by cooling or freezing, but he should imagine it would be a very useful method when dealing with substances which had to have their moisture taken away at very low temperatures because there would be an increased carrying capacity in the air if all the initial moisture was taken out of it before it was put into the drying apparatus. For large plants and low temperatures it might have very distinct advantages. In reply to Mr. Talbot, two-stage drying for large quantities was quite a practical proposition, two or three rotary dryers bringing the material down to an economical moisture percentage, the nearly dry residue passing into one large dryer, either of the rotary or other type, specially adapted for dealing with it and getting rid of the final traces of moisture. This would give additional opportunity for dealing with the dust problem. Stationary shelf dryers did not come within the scope of the paper. He had no figures immediately available in regard to steam cylinders working in vacuum but might be able to give some later. As regards the drying of superphosphates, mentioned by Mr. Parrish, he should imagine that the dryer described would work very well. At the same time such materials as ammonium sulphate might be dried in rotary cylindrical dryers.

Meeting held at Burlington House on May 5th, 1919.

DR. CHARLES A. KEANE IN THE CHAIR.

ESTIMATION OF CARBON BISULPHIDE: A CRITICAL EXAMINATION OF THE VARIOUS METHODS USUALLY EMPLOYED.

BY PERCY E. SPIELMANN, PH.D., B.SC., F.I.C., AND F. BUTLER JONES, B.A., A.I.C.

Lack of sufficient information as to the trustworthiness of the various known methods of estimating carbon bisulphide led the authors to examine them with regard to their relative value, the conditions of best results, and the limits of accuracy of each.

The following methods have been examined:—

(1) *Solution in alcoholic potash* and elimination of oils insoluble in water by extraction with water, followed by subsequent treatment according to one of the following methods:

(A) *Change in specific gravity.* In the case of carbon bisulphide being extracted from another liquid such as benzol, the change in specific gravity of the liquid may be measured before and after complete removal of the bisulphide by means of alcoholic potash.

(B) *Oxidation with bromine* and estimation of the sulphuric acid in the ordinary way as barium sulphate.

(C) Acidification of the alkaline solution with acetic acid and *estimation of xanthate* as cuprous salt either (*a*) by titration with standard copper sulphate solution, using potassium ferrocyanide as indicator, or (*b*) by precipitation of cuprous xanthate by excess of copper sulphate solution; the precipitate being either filtered, washed, and ignited to copper oxide; or, again, by decomposition by bromine or nitric acid and the copper in solution estimated by a volumetric method.

(2) *Precipitation by phenylhydrazine* of phenylhydrazine phenylsulphocarbazide.

(1) The potassium xanthate is ordinarily recommended to be prepared by means of absolute alcohol, but experiments showed that a considerable quantity of water does not inhibit its formation. Pure benzol was freed from carbon bisulphide and its sp. gr. determined by means of the sp. gr. balance. 0·4% vol./vol. of carbon bisulphide was then added and the sp. gr. of the mixture was determined. Mixtures of alcohol and water were made up containing various percentages of alcohol (estimated by determining the sp. gr.) and these were used to prepare alcoholic potash of uniform KOH strength (approximately 10%). A portion of the benzene-carbon bisulphide mixture was then shaken for 2 hours with half its volume of alcoholic potash, except in one case, when four times this volume was used. The mixture was then washed five times with water, dried with calcium chloride, and its sp. gr. determined. From a knowledge of the sp. gr. the quantity of carbon bisulphide removed could be determined. The results are summarised in the table at the top of p. 186.

Nos. 8 and 9 do not belong to the series 1—7. No. 8 was carried out on a mixture somewhat richer in carbon bisulphide in order to ascertain what quantity of the latter substance was removed by alcoholic potash of approximately the same

strength as that used in No. 6; otherwise the conditions were the same as in the series 1—7. It is noteworthy that the same quantity of carbon bisulphide was removed, leaving of course a greater quantity unabsorbed than in the case of No. 6.

	Strength of alcohol % by volume	Ratio Vol. of benzene / Vol. of alcoholic KOH	Sp. gr. Benzene + 0·1% CS_2	Sp. gr. after treatment	Sp. gr. free from CS_2	% on total mixture
(1)	96·1	2	0·8861	0·8844	0·8844	0·45
(2)	89·6	2	0·8861	0·8845	0·8844	0·4
(3)	85·6	2	0·8861	0·8845	0·8844	0·4
(4)	77·5	2	0·8861	0·8845	0·8844	0·4
(5)	69·6	2	0·8861	0·8846	0·8844	0·4
(6)	49·8	2	0·8862	0·8848	0·8844	0·35
(7)	35·8	2	0·8862	0·8852	0·8844	0·25
(8)	48·8	2	0·8874	0·8861	0·8841	0·35
(9)	6·7	0·5	0·8862	0·8854	0·8841	0·2

The purpose of No. 9 was to find out whether alcoholic potash made with alcohol as weak as 7% by vol. would react with carbon bisulphide. A much larger proportion of the alcoholic solution was therefore taken, and the actuality of reaction was substantiated.

It is seen, therefore, that alcohol as low as 70% can be used with safety in the proportions recommended; and that alcohol, as weak as even 7% by volume (when made into 10% alcoholic potash), will suffice to remove some carbon bisulphide from benzene, so that the natural conclusion is that if sufficient treatment is given alcoholic potash made up with almost any strength of alcohol will remove all the carbon bisulphide.

Parallel experiments using alcoholic soda yielded closely similar numerical results to those obtained with alcoholic potash, and showed that its efficiency in removing the carbon bisulphide from admixture with benzene is equal to that of alcoholic potash, 70% alcoholic soda removing the whole of the carbon bisulphide present.

(1A) *Change in sp. gr.* The degree of accuracy depends upon that of the specific gravity measurements. For benzene-carbon bisulphide mixtures, if the specific gravities are measured to the fourth decimal place about 0·03% can be appreciated.

(1B) *Oxidation with bromine* (Allen's Commercial Organic Analysis, Revised Edition, Vol. 3, pp. 227—228). It was already known that this method was accurate, and for this reason exhaustive experiments were not made.

It was found, however, that two precautions have to be observed: (*a*) a good excess of potash must be used in order that plenty of hypobromite may be formed with the bromine, and that the latter must also be added in large excess since a certain quantity of ethyl bromide is formed; (*b*) the mixture with bromine should be allowed to stand for at least an hour at ordinary temperature, otherwise oxidation may be incomplete. The figures given below illustrate the degree of accuracy obtained:—

Carbon bisulphide	
Taken	Found
0·231	0·230
0·081	0·069*
0·081	0·080

The authors have not fully examined the method of Stavorinus (J. Gasbeleucht., **49**, 8; Chem. Zentr., 1916, **1**, 706), which consists of oxidising the potassium xanthate with hydrogen peroxide. A preliminary examination showed that it offers little advantage over the bromine oxidation method, and has the disadvantage of requiring neutral hydrogen peroxide, a relatively large quantity of alcohol in the preparation of the sodium hydroxide solution, and the necessity for a blank test of all reagents for sulphate.

(1C) *a. Volumetric method.* The method of titration of the xanthate solution with standard *N*/10 copper sulphate solution was found to give uncertain results, due in part to the effect of the large excess of acetic acid used.

The potassium ferrocyanide, which is usually employed as an external indicator, can also be used internally. Cuprous xanthate is only slowly decomposed by potassium ferrocyanide, and as the change in the colour of the mixture from yellow to brownish is about as sharp as the change in colour of the drops on a plate, the internal indicator is to be preferred.

The copper standard was calculated assuming the theoretical ratio Cu : $2CS_2$ for the reaction (which is not true; see Macagno). For *N*/10 copper sulphate, 1 c.c. = 0·0076 grm. CS_2.

Excess of acetic acid	CS_2 Taken	CS_2 Found	% error
Very large ..	0·253	0·253	nil
.. .. ..	0·253	0·209	− 17·4
.. .. ..	0·253	0·235	− 7·1
Slight	0·074	0·074	nil
.. .. ..	0·079	0·079	+ 6·8
Very large ..	0·128	0·133	+ 3·9

It will be noticed that whereas the results in two cases are good, the majority were unsatisfactory; the correct results are probably to be ascribed to chance.

These figures are closely parallel with those obtained by Mr. E. G. G. Wheeler of this laboratory, during the working out of a method of analysis of benzols.

Even with the precautions mentioned the method is an undesirable one, both on account of this uncertainty and of the end point not being very sensitive. Possibly, the rate at which the copper solution is added is an important factor.

(1C) *b. Gravimetric method.* As in the case of the titration method, it was found that the estimation of copper in the precipitated cuprous xanthate gave quite variable results, and conditions of precipitation, varied within wide limits, could not be found by which good accuracy could be attained. The author's results agree substantially with the observations of E. S. Johnson (J. Amer. Chem. Soc., **28**, 1209), the errors indicated varying between + 22·5 and − 13·0%.

In the earlier experiments a known volume of xanthate was acidified with the acetic acid, and the copper solution added immediately afterwards. It was thought, however, that owing to its great instability the xanthic acid set free might decompose to an appreciable extent before thorough admixture with the copper solution could take place. For this reason in the remainder of the experiments the xanthate was added, with stirring, to an excess of copper solution and acetic acid already mixed. No improvement in the results was effected, however.

When a short time was allowed for precipitation (1—6 hours) a further minute quantity of precipitate separated from the filtrate on standing. In every case the mother liquor above the precipitate remained very cloudy for some hours after precipitation, but became clear after about four hours' standing, with occasional stirring. The coagulation was hastened by vigorous and prolonged stirring.

The reaction between copper sulphate and xanthic acid takes place in two stages: (1) the production

* Incomplete oxidation due to neglect of conditions (*a*) and (*b*).

of cupric xanthate, and (2) the decomposition of this into cuprous xanthate and xanthogen disulphide (dixanthogen)

$$2(HS.CS.OC_2H_5)+CuSO_4=Cu(S.CS.OC_2H_5)_2+H_2SO_4.$$

The cupric xanthate first formed is a brown substance, which very quickly decomposes into the bright yellow cuprous xanthate.

$$2Cu(S.CS.OC_2H_5)_2=Cu_2(S.CS.OC_2H_5)_2+C_2H_5O.CS.S.S.CS.OC_2H_5.$$

The above results, both volumetric and gravimetric, indicated that the cuprous xanthate was not and could not be obtained pure, the percentage of copper being in most cases too high. A possible explanation is that the xanthate is partially hydrolysed in the alkaline aqueous solution during extraction:

$$C_2H_5O.C.S.SK+KOH=KO.CS.SK+C_2H_5OH.$$

The sulphothiocarbonic acid (set free in the presence of acid) would then yield a copper salt containing more copper than the xanthate.

It is unlikely that the high copper content of the precipitate is due in all cases to the adsorption of soluble copper salts since the results are high even when these are in very slight excess; but it is very probable that the abnormally high results obtained, in some cases, with larger excess of copper solution are at least in part to be ascribed to adsorption.

The suggestion that the high results are due to the formation of copper sulphide or sulphate on ignition of the xanthate is contradicted by the fact that high results are also obtained when the copper is estimated volumetrically.

Note. In order to avoid the possible action of aqueous alkali on the xanthate and also to prevent the escape of xanthic acid from reaction with the acidified copper sulphate solution, the benzene-alcohol-sodium hydroxide solution was shaken directly with the acidified copper sulphate solution, whereby copper xanthate was immediately formed. This mode of precipitation failed owing to mechanical troubles of collection and filtration of the precipitate in presence of two such liquids as benzene and water.

Detailed experiments were not carried out with the estimation of the residual copper in solution after the precipitation of copper xanthate; as it was found that whether copper sulphate or acetate were used the precipitate was not very constant in composition, the remaining excess of copper would also be inconstant.

(2) *Precipitation by means of phenylhydrazine.* This method affords merely a qualitative test of inferior value, though a convenient one, as it can be carried out without previous treatment of the (benzol) sample. The authors disagree entirely with Bay, whose quantitative method was dependent on the sparing solubility of the precipitated substance in benzene. They found that no quantitative results were possible owing to the fact that the so-called "sparing" solubility is far too high to permit washing with benzene. The solubility in that liquid was repeatedly demonstrated, and after the trial of several other liquids, namely, ether, chloroform, alcohol, and light petroleum (the last failing to dissolve, apparently, either the precipitate or phenylhydrazine, and therefore being useless for separating the two), the method was finally abandoned.

The methods of Holland and Phillips (this J., 1884, **3**, 296) and of Goldberg (Z. angew. Chem., 1899, **42**, 75) have not been examined, as they depend on heating the material containing carbon bisulphide in a sealed tube, in the one case with aqueous ammonia and ferric chloride, and in the other with aqueous or alcoholic ammonia. In both cases the subsequent treatment described is comparatively laborious. Neither method can be considered as convenient or more accurate than the extraction as xanthate and oxidation of this with bromine.

Addendum. Experiments were made to ascertain if a better method of analysis could be secured by means of lead xanthate. This salt was precipitated by adding a solution of potassium xanthate to an excess of lead acetate solution containing more than sufficient free acetic acid to neutralise the alkali in the solution of the xanthate added. A pale yellow finely divided precipitate is produced, which coagulates on stirring into very large flocks; these break down on standing into much smaller particles. The liquid clears quickly (in 15—20 minutes) if a fair excess of acetic acid be present.

The precipitated substance is mainly

$$Pb(S.C.S.OC_2H_5)_2$$

but is not quite pure. Since it decomposes slowly at temperatures above about 50° C. and cannot therefore be dried quickly, it is not convenient to make the direct weighing of this substance the basis of a method of analysis.

The quantity of lead contained in the crude precipitate from a known amount of xanthate was estimated in two cases by conversion into lead sulphate. In each case the quantity of lead sulphate found was about 4% lower than that calculated from the quantity of carbon bisulphide in the xanthate.

It was found that lead xanthate is soluble in certain organic solvents including benzene, ether, acetone, and carbon bisulphide. A quantity of the substance was prepared by precipitation as above and was purified by crystallisation from benzene. It separated from this and from other solvents in long, slender needles of pale yellow colour, grouped in star-like clusters. A brown residue of impurity remained undissolved by the benzene, which was not further examined. The crystals were allowed to dry by exposure to air.

The solubility at ordinary temperature of the crystalline substance was found to be (in grms. per 100 c.c. of saturated solution): In benzene (18·2° C.), 0·85; acetone (18·5° C.), 0·71; carbon bisulphide (17·5° C.), 0·38.

The percentage of lead in the crystals was 45·6 against the theoretical 46·1, a result sufficiently accurate to prove the composition of the substance to be $Pb(S.C.S.OC_2H_5)_2$.

References.

Change in specific gravity.

Nickels, Allen's "Commercial Organic Analysis," 1900, Vol. 2, Part 2, p. 183.

Ellerton, this J., 1912, **31**, 11.

Spielmann and Wheeler, this J., 1916, **35**, 396.

Spielmann and Butler Jones, this J., 1916, **35**, 911.

Bromine oxidation.

Barrett Manufacturing Co. Allen's "Commercial Organic Analysis," 4th Edit., Vol. 3, p. 228.

Copper xanthate.

Macagno, Chem. News, 1881, **43**, 138. Allen's "Commercial Organic Analysis," *loc. cit.*

Phenylhydrazine.

Bay, Comptes rend., 1908, **146**, 132.

Liebermann and Seyewitz, Ber., 1891, 789.

DISCUSSION.

The CHAIRMAN said that the accuracy of the process appeared to depend entirely upon obtaining copper xanthate of constant composition, because whether the excess of copper was estimated, or the xanthate weighed, or the contained sulphur determined the constant composition of the copper xanthate was fundamental. He asked the authors whether they had tried the method due to Harding and Doran, in which the precipitation was effected by solution of cupric acetate in presence of acetic acid. They had found under these conditions that

the composition of the xanthate was constant, and that decomposition did not occur nearly so easily as with the ordinary conditions of precipitation.

Dr. W. R. ORMANDY asked whether the experiments had been carried out in the presence of varying quantities of thiophen.

Dr. SPIELMANN in reply said that the authors had carried out a number of experiments in precipitation from copper acetate in presence of acetic acid and could not obtain a substance of constant composition. With regard to thiophen this was left behind in the benzene after the alkaline extraction.

THE ESTIMATION OF THIOPHEN.

BY PERCY E. SPIELMANN, PH.D., B.SC., F.I.C., AND S. P. SCHOTZ, D.SC.TECH., B.SC., F.I.C.

Introduction.

The estimation of thiophen in benzene is a problem of importance to certain industries in which benzene is used. It has been found that aniline prepared from benzene containing thiophen resinifies much more readily than aniline prepared from thiophen-free benzene; that the yield of resorcinol is much diminished unless only very little thiophen is present; that much more resin is formed in aluminium chloride condensations if thiophen be present; that thiophen acts in an inhibiting manner in certain other catalytic reactions.

The published information on this matter is so scanty and contradictory that it was considered desirable to examine the methods closely.

Methods.

Four general methods have been suggested: (*a*) a volumetric method (Denigès, Bull. Soc. Chim., 1896, 862, 1064; Analyst, 1896, **21**, 297, 303), in which confidence is not aroused, amongst other reasons on account of the varying arbitrary factors to be used; (*b*) a colorimetric method (Schwalbe, Chem.-Zeit., 1915, 895), which might work well if the thiophen present is measured by the blue factor in the tintometer and referred to a previously constructed standard scale; (*c*) gravimetric methods of Denigès, also of Dimroth (Ber., 1899, **32**, 758), and of Paolini and Silbermann (Gazz. Chim. Ital., 1915, **45**, II., 388; this J., 1915, 1239), whereby a precipitate is obtained with either basic mercuric sulphate or acetate (in the latter connection it must be remembered that boiling toluene reacts with mercuric acetate, acetic acid being set free; but under the conditions of the estimation this reaction apparently does not interfere); (*d*) a method based on the rate of formation of a precipitate under prescribed conditions with basic mercuric sulphate (Denigès, Bull. Soc. Chim., 1895, **13**, [3], 538; this J., 1895, 893).

The usually employed method, *viz.*, heating the sample in a closed vessel with a solution of basic mercuric sulphate, causes the production of a precipitate not only with thiophen but with other substances accompanying it, for instance, with carbon bisulphide (Denigès, Bull. Soc. Chim., 1915, **17**, [4], 353; this J., 1915, 1142) and with acetone. Schwalbe (Z. für Farben- und Textil-Ind., 1915, **5**, 113) using this method obtained a precipitate even with thiophen-free benzene.

The use of mercuric acetate under various conditions has been studied by several investigators. Dimroth heated 1 kilo. of benzene under a reflux condenser (with continued stirring) with a solution of 40 grms. of mercuric oxide, 300 c.c. of water, and 40 c.c. of glacial acetic acid for ½ hr. A precipitate of $C_4H_4S(HgO.COCH_3)HgOH$ is obtained. Schwalbe (Ber., 1905, 2208) examined the addition compound formed and found the sulphur content of the precipitate to be much lower than it should have been according to Dimroth. Applying this method to pure benzene-thiophen mixtures he obtained too high results, *e.g.* 0·144% instead of 0·1%; 0·662% instead of 0·4%.

Paolini and Silbermann attempted further improvements in this method, which were substantial but insufficient. They boiled a known quantity of the benzene under examination with a slight excess of a solution containing 1 part of mercuric oxide and 2 parts of glacial acetic acid, filtered, and washed the precipitate with ether. Our experience, however, has shown that the mercuric acetate which is so obtained is very sparingly soluble in, and is slightly decomposed by, the commercial ether ordinarily in use; so much so that a blank experiment carried out by us according to their instructions with thiophen-free benzene, after very thorough washing, indicated 0·50% thiophen. Therefore, according to this mode of working it is necessary to know beforehand approximately the quantity of thiophen present in order to work with only a small excess of the precipitating solution, so that subsequent washing with ether should not take an excessive time. In practice when precipitating anything up to 2% (in very rare cases), a considerable excess of the agent must always be present, so that it is only by chance that the correct proportions would be employed, and only by chance, therefore, that a satisfactory analysis would result.

In the examination of the gravimetric methods, tests were made with thiophen-free benzene to which thiophen (b.pt. 84°–84·5° C. (corr.); sp. gr. (15·5° C.) 1·0703) was added in known quantities. It should be noted that owing to the large difference between the molecular weights of the reacting substances, which combine to form an addition compound, a deviation of 10 mgrms. in the weight of the precipitate obtained from 10 c.c. of a 1% solution of thiophen makes a difference of only 0·01% on the weight of thiophen found.

Denigès' method. Methyl alcohol, free from acetone, when used as prescribed, gave an immediate yellow precipitate, although Denigès records that such a solution is stable for 5 to 6 hours. Many attempts to find a stable solution failed.

Ethyl alcohol was tried by us in place of methyl alcohol. In this case, too, a precipitate was formed, and if the proportions of mercuric oxide, sulphuric acid, water, and alcohol are such that the solution remains clear, it no longer properly dissolves the benzene. However, after the preliminary precipitate was formed and filtered off, the resulting solution was stable, but for little more than an hour only; this time, however, was sufficient. This modification was found to cause the method to become sufficiently reliable for use as a routine test which has to be carried out quickly, the mode of procedure being the following:—

20 c.c. of Denigès' reagent (5 grms. of mercuric oxide, 20 c.c. of concentrated sulphuric acid, 100 c.c. of water) is mixed with 60 c.c. of absolute alcohol, shaken well, and filtered. The clear solution is at once mixed with 2 c.c. of the benzol under examination and is allowed to stand for one hour with frequent shaking. After filtering through a Gooch filter or tared filter paper, the precipitate is washed till neutral to litmus and dried for an hour at 110°—115° C.

The weight of precipitate multiplied by 0·1032 gives the weight of thiophen present in the quantity of sample taken. The composition of the precipitate corresponds to $SO_4(HgO)_2Hg,C_4H_4S$, so that 1 grm. corresponds to $84·07 \div 814·272 = 0·1032$ grm. of thiophen. (Denigès gives $84 \div 812 = 0·1034$.)

Usually thiophen is present in benzol to an extent of not more than 0·5%, but if more be present an increased quantity of the above reagent must be used. The results tend to be a little high.

Reagent c.c.	Taken Alcohol c.c.	Thiophen %	Found Thiophen %
20	60	0·052	0·055
30	90	0·52	0·55
15	45	0·52	0·52
30	90	1·07	0·99 0·91

Many experiments were made varying the proportions of reacting substances, the temperature of their preparation and precipitation, time, and amount of shaking. The examples quoted may be taken as being typical for the best conditions of working, and although the difference shown is as much as 6% of the quantity of thiophen taken, the practical error is negligible. The method is, however, much more erratic than a method to be described, and requires some practice for successful working; for these reasons it is the less desirable.

Still another modification has been tried, which however was not successful. 2 c.c. of benzene was dissolved in 90 c.c. of alcohol and 30 c.c. of Denigès' reagent was added and the mixture allowed to stand, with frequent shaking, for 1 hour, or longer if thought necessary. Then about 80 c.c. of 20% sulphuric acid was added and the mixture shaken till the yellow colour of the precipitate had disappeared; the residue was filtered off and treated as before. The results were found to be too high, *viz.* 1·35% and 1·15% instead of 1·07%, the deviation apparently resulting from the presence in the alcohol of some reacting substances, which in the previous mode of procedure were filtered off.

Modified basic mercuric sulphate method. (Recommended.)

This method, which gives very consistent results, depends on shaking the sample with an aqueous solution of basic mercuric sulphate in the cold. Under these conditions only thiophen and none of the accompanying substances reacts. The most important of those likely to interfere is carbon bisulphide, and the following figures show that it takes no part in the reaction:—

Thiophen taken 0·0220 grm. = 1·10%.

Thiophen + 5% CS_2 (on the volume of benzene used) 1·022 grms. = 1·10%.

When testing the method with an approximately 1% solution of hexylene (probably not quite pure) a trace of a yellow substance, corresponding to less than 0·01% thiophen, was obtained, which suggests that the method may be applicable to crude benzols.

Application of the method.

2 c.c. of the benzol under examination and 20 c.c. of Denigès' reagent (see below) are introduced into a strong test tube (about $\frac{5}{8}'' \times 6''$) well closed with a sound wet cork and placed in a shaking machine for 3 hours (even without shaking the reaction takes place to some extent). At the end of that time, the white precipitate which is formed is collected in a weighed Gooch crucible, washed well with hot water till neutral to litmus, dried at 110°—115° C., and weighed. The weight of the precipitate multiplied by 0·0757 gives the weight of thiophen contained in 2 c.c. of benzol.

The composition of the precipitate has been determined by Denigès and found to agree with the formula $2(HgO,HgSO_4)C_4H_4S$, so that the factor is, in this case, 84·102 ÷ 1110·642 = 0·0757. (Denigès gives 0·0758).

Precautions to be observed:—

(1) Making up the reagent. 20 c.c. of pure concentrated sulphuric acid is poured into 100 c.c. of distilled water, 5 grms. of finely powdered mercuric oxide added, and the mixture stirred until almost all has gone into solution. The solution is then filtered, and may be kept in a stoppered bottle for an indefinite time without any signs of decomposition.

(2) The Gooch crucible must be made up fresh for each experiment with good fibrous, specially purified, asbestos, on top of which is placed a perforated porcelain plate (Kahlbaum's "pure asbestos" was found unsuitable for this purpose). The prepared crucible must be dried in the same way before and after using.

On shaking for 5 to 6 hours even with only 0·02 grm. of thiophen, the results are very accurate. When shaking is continued only for 1 or 2 hours, the results are slightly lower; *e.g.*, with 2 hours' shaking, 0·02211 grm. thiophen = 1·10% was taken and 0·02047 grm. = 1·02% found.

The results tend to be low to an extent of about 8% of the (larger) quantity of thiophen taken, but here again this discrepancy is of no serious practical matter; it matters little whether 0·48% is found when 0·52% is actually present; or if 1·00% is found when 1·10% actually exists.

This method, which has been examined for the optimum conditions of accuracy, had led to the following observations.

A quarter of an hour's vigorous shaking carries the reaction to about 80% of its course, whilst the next half-hour causes it to proceed to over 90%; at least a full hour, however, is to be recommended.

The employment of larger quantities of the sample and of stronger mercury reagent led to diminished accuracy and a great prolongation of the time necessary for washing, without any sufficient compensating advantages.

The method of Paolini and Silbermann (*loc. cit.*), depending on the use of basic mercuric acetate in glacial acetic acid—a mixture which is pasty at ordinary temperatures—shows considerable mechanical difficulties which are due mainly to the dough-like nature of the precipitate. The following mode of working, only slightly different from that of the original workers, leads to considerably more trustworthy results.

Modified basic mercuric acetate method. (Recommended.)

4 grms. of Paolini and Silbermann's reagent (previously filtered) is introduced into a suitable test-tube to which 10 c.c. of the benzene under examination is added. The mixture is heated under reflux condenser in a water bath for about ¼ hr., with frequent shaking. When perfectly cooled the precipitate is collected in a Gooch crucible, washed with water till neutral, and dried at 100° C.

The weight of precipitate multiplied by 0·07516 gives the weight of the thiophen in the quantity of sample taken.

	Examples I	II
Thiophen taken	1·06	1·06
,, found	1·01	0·99

The precipitate has a composition agreeing with the formula $SC_4(HgC_2H_3O_2)_4$, hence the factor is 84·07 ÷ 1118·57 = 0·07516.

An improvement was found in the use of water for washing in the place of ether as prescribed, but even so the washing for a single experiment takes a considerable time.

On the whole the modified mercuric sulphate method is greatly to be preferred, because the reagent used is stable, side reactions are notably absent, previous practice is not essential to success, and a high degree of accuracy is attainable.

Further references of value are:—

Denigès' method (gravimetric). Comptes rend., 1895, **120**, 628, 781, 963; 1908, **126**, 1868.

Bull. Soc. Chim., 1898, **19**, 754. Analyst, 1895, **20**, 188.

Dimroth's method. Schwalbe, Ber., 1905, **38**, 2208. Liebermann and Pleus, Ber., 1904, **37**, 2461.

Discussion.

Dr. F. B. Thole asked if experiments had been made to determine whether the presence of di-olefines influenced the results given by the mercuric sulphate method, seeing that these substances were normally present in unwashed benzol and that they yielded insoluble compounds with mercuric sulphate. Removal of such hydrocarbons by a preliminary acid washing and redistillation would of course involve the removal of part of the thiophen.

Dr. Schotz said that no experiments on di-olefines had been carried out. Hexylene was the only substance available for the purpose and it had been used.

Yorkshire Section.

Meeting held at Queen's Hotel, Leeds, on April 14th, 1919.

MR. W. McD. MACKEY IN THE CHAIR.

THE SEPARATION OF SOLIDS FROM LIQUIDS.

BY BASIL G. McLELLAN, F.I.C.

In a very great number of chemical operations the necessity occurs for the separation of solid bodies from liquids in which they are suspended, for the recovery of both the solid and the liquid substances.

The two principles generally adopted in laboratory operations, *viz.*, decantation and filtration, are employed on a manufacturing scale, the former in the slow system of sedimentation or accelerated in a closed basket centrifuge, the latter in the open basket centrifuge, the filter-press and other forms of pressure, suction, or gravity filters.

Complete separation by decantation is not easily attained; the liquid may be obtained free from solid, but not the solid free from liquid.

Water softening by the lime and soda process is a good example of sedimentation. The general condition governing the success of this method is that the downward movement of the solid particles due to their size and specific gravity is more rapid than the upward movement of the water. The difference in specific gravity between the liquid and the solid must be considerable, otherwise there is a tendency for the smaller particles to be carried up with the liquid—a state of affairs which exists in water softening operations, and necessitates a rough filter to follow.

An improvement which naturally suggests itself, and which is mentioned by Stromeyer in his last report to the Manchester Steam Users' Association, consists of giving the liquor a slow horizontal flow, the solid matter separating downwards into the stagnant space below the current. This principle has not, so far as I know, been applied to water softeners; it may find application in other operations. The closed basket centrifuge is an intermittent means for hastening the process of sedimentation. The same factors operate in the employment of the closed basket centrifuge as in sedimentation; in each case a clear liquid may result, but the inter-particle spaces of the solid will always be filled with the liquid.

The [illegible]-basket centrifuge may be regarded as a rough form of filter. These machines are commonly known as hydro-extractors, or in some cases "whizzers." They are usually lined with some form of perforated metal, the size and shape of the perforations being dependent upon the material with which they have to deal. They are employed very largely in sugar refining and other chemical operations for the separation of crystals from mother liquor. Washing can be very thoroughly carried out in a centrifuge, and is fairly economical as regards wash-water.

Attempts have been made to convert a centrifuge into a filter in the generally accepted meaning of the word, namely, by lining the basket with filtering material. This is only applicable in certain cases where the liquor is very easily filtered, and where the sludge will readily form cakes several inches thick under the pressure obtainable by centrifugal action. Any tendency for the liquor to remain in the centrifuge and to swing round independent of the basket usually leads to dangerous oscillation.

Gravity filtration.

The funnel and paper of the laboratory are copied in certain smaller operations, suspended bags of cloth or similar material being used for filtering liquors such as fruit juices. Closely allied also are the Taylor bag-filters, which are very largely used in sugar refining operations. "Filtres Phillipe" may be regarded as reversed Taylor bag-filters.

Filters of the gravity type are exemplified in sand filters used for filtering water and effluents. Here, in some cases, the filtering medium is not so much the sand as the layer of solid—frequently slimy matter—which soon covers the inlet side, generally the top, of the sand bed, increasing the filtration efficiency and diminishing the speed. Porous-tile-filters on the gravity principle are employed in vitriol manufacture for removing precipitated arsenic sulphide.

Generally speaking the type of filter so far described (Taylor bag, sand, Phillipe, etc.) is used for the removal of relatively small quantities of solid matter.

Pressure filtration.

To hasten the filtration process pressure or suction is employed. The filter-press, invented by Danek some 40 years ago, is probably the most universal type of filtering plant.

At the beginning of the filtering operation the sludge enters the chamber and commences to filter immediately, little or no pressure being required. The cloths will thus be hanging fairly loosely on the plates, and practically their entire area will be available for filtration. As they become coated the pressure required to effect filtration increases, the cloth becomes pressed against the supporting projections of the plate, and its filtering surface is decreased by the area of these contacts. As the pressure further increases the cloth stretches, until, if the pressure is very high, it may sag right down into the plate recesses. When this happens, the area of filtration is enormously reduced, and almost the only filtration that can occur is for the liquid to pass right down through the cake, and out through the corner nearest the outlet. An examination of filter-press cakes frequently indicates that something of this sort has been happening, especially if the pressure under which the filtration has been carried out has been excessive. In this connection, therefore, it is important to see that the area of the supports of the cloth be as small as possible, that the cloth be sufficiently strong to prevent this sagging effect, and that no greater pressure be employed than is necessary.

Cast iron presses are usually made with working pressures up to 80–100 lb. With these high pressures provision must be made to prevent any fibrous foreign matter being sent through the pump which might tend to block up the inlet of the chambers—one empty chamber is almost always sufficient to cause the plates on each side to give way.

Washing process. Cake-washing is employed either to purify the cake itself or to recover from it valuable liquids. If only the cake is valuable the quantity of wash-water need not be so rigidly

controlled, but where re-evaporation is necessary, as in the case of valuable liquids, it is important to employ the minimum quantity of wash-water (other liquids, of course, are possible in the washing process). The washing water is introduced on both sides of the plate, passing thence through the cake and out through the other plates. To do this effectively it is important that the water be made to pass through the whole of the cake evenly; consequently provision must be made for flooding the back of the cloth entirely with the wash-water. This is not an easy operation if the filter cloth has stretched down into the recesses of the plate. Further, it may happen that some of these recesses are partly filled with some of the precipitate which has passed through the cloths and lodged there; consequently, it is advisable to wash this out before attempting to wash the cake. This, of course, can be done by leaving all the valves open.

In washing a cake it must be remembered that as the wash-water has a lower viscosity than the liquid which it is displacing, there is a great tendency to channelling, and if this occurs water will pass ineffectively through that portion of the cake which is already washed and will fail to pass through the unwashed, more resistant part.

The recess type of plate is generally employed for processes in which the amount of solid to liquid is relatively small, or where the nature of the material will not permit of the formation of thick cakes. For certain purposes presses with a central feed are stated to be an advantage.

A number of filtering media are possible, cloths such as cotton and wool, also woven wire and spun glass wool being used.

Presses may be made of materials other than iron, for example, aluminium, wood, and lead-covered metal.

For general work it is my experience that a filter-press with plates not more than 2½ feet square is probably the best size from a labour point of view, larger plates causing unnecessary fatigue to the operator.

In a filter-press so many variations are possible to suit different materials that the press is capable of very effective all-round work. The thickness of the cake can be varied from fractions of an inch in the recessed-plate type, up to several inches or even more if desired. The pressure at which the cake is formed, and also the temperature may be varied to suit the particular material.

It is possible, with the aid of a small laboratory press, having chambers some 6 inches square, to make tests, and directly multiply the results obtained so as to translate them into large-scale operations. This is an interesting fact because the translation from small- to large-scale operations is not always such a simple matter. If the material is of such a nature that a definite cake can be formed, and if the precautions already mentioned with regard to washing are taken, the cake washing becomes very efficient.

There are certain disadvantages in the use of a filter-press, the first being that certain liquors cause the cost of the press cloth to be excessive, in which case it is probably better to adopt some other type of filtering apparatus.

The time taken to empty and refill a press is considerable, and with a liquid which filters fairly easily the press may be in operation for only half of the time—that is actually filtering—the remainder of the time being occupied with emptying and redressing the press. To diminish this time, at least two types of press—the Sweetland and the Kelly presses—have been devised, both of which are fairly extensively employed in America. There appears however to be a distinct disadvantage in a press of this type, in that a definite quantity of liquor must be filtered each time, and that the operator must know how much solid material to put into the press, otherwise the cake may be either too thick or too thin for the subsequent washing operation. It is not clear why less wash-water should be required; in fact, one would expect that considerably more would be required than with an efficiently operated "plate-and-frame" press.

The Fohelbur (see Internat. Sugar J., 1917, p. 79) represents a further development of the filter-press. Provision is made for elimination of cloth blockage by the surface of the supports on the plate, and arrangement whereby washing of the cake takes place from each plate instead of from every alternate one. It is claimed that the cakes may be three times the normal thickness with no loss in efficiency. The press is made by the Honolulu Iron Co., Hawaii, and is reported to be giving excellent results in that country on sugar sludges, producing cakes some 4 inches thick certainly an unusual thickness for cakes of this material.

Where the use of filter cloth and contact with metals are to be avoided, filter-presses on the pressure system, employing porous plates (*e.g.* the Bornett filter), should be used.

Suction filtration.

Suction filters are the technical equivalents of the laboratory Büchner. Large funnels and vessels on the Büchner principle, made of earthenware and employing cloth filtering media, are used for small-scale operations.

A notable example of larger plant of this type is the Butters filter, which is largely employed for removing metal-bearing liquids from slimes. In general construction this filter is very similar to the "Filtre Phillipe," consisting of a series of filter-leaves immersed in a tank into which the liquor flows. Suction is applied to the leaves; cakes form on them to a predetermined thickness; the surplus liquor is run off and its place taken by wash-water. After washing, the cakes are dumped. In working a filter of this kind the efficiency may be varied, depending upon the way in which suction is applied. No more suction should be used than is necessary to give a reasonable flow of filtrate, the vacuum being gradually increased as the thickness of cake increases. It is reported that certain of these metallurgical slimes which give only a sloppy cake with high pressure in a filter-press may be made to give a dry cake when subjected to graded vacua in a filter of this kind.

Filters of this type are, of course, intermittent in operation, but attempts have been made to make the process continuous. One of the first references to a continuous suction filter appeared as far back as 1896 (this J., 1896, 883).

Although filters of this kind have been used in this country for some considerable time, it has been left to America to develop and place them upon the market. The Oliver filter is probably the best known of these.

One of the great drawbacks to filtering operations is the fact that where pressure is employed, that is where the filter cake is enclosed, there is a gradual slowing up of the speed of filtration as the thickness of the cake increases. An ingenious arrangement for overcoming this has been invented by Gee. It is a combination of a filter and centrifuge, the centrifuge action being employed to throw the solid material from the filtering medium (see Eng. Pats. 4155/07, 21,421/09, 9365/15, and 106,669; this J., 1908, 227; 1910, 1239; 1916, 1206; 1917, 858).

The author described a number of types of apparatus, and exhibited diagrams, also specimens of filtering media.

DISCUSSION.

Mr. WARD said that in his experience the old bag-filters worked very well in sugar refining. He

drew attention to the uneven texture of some glass-cloth samples which the author exhibited, and said this would militate against its use.

Mr. SEYMOUR described a small rotary filter similar to but simpler than the Oliver, in which no compressed air was used, the cake being just scraped off. Such a filter about 3 ft. in diameter had been used successfully in this country for sulphide of iron and worked for 24 hours continuously before the cloth needed cleaning.

Mr. BARNES asked what was the actual pressure obtained in filtering through an open basket centrifuge or ordinary "whizzer."

Mr. H. W. WATSON drew attention to a method often used in clarifying wines, and adapted to many cases where the solid was not wanted; the material to be filtered was mixed with asbestos fibre and then passed through a filter made of fine gauze.

Mr. R. H. ELLIS mentioned the Sharples centrifugal; the rotor of this machine, which was only 3 inches in diameter, was driven by a steam turbine at 20,000—40,000 r.p.m.

Mr. D. MCCANDLISH asked what advantages were possessed by the central-feed filter-press. He also warned against the use of woollen cloths in filter-presses, which was attended by the danger of choking the liquor channels through shrinkage. He described a filter used for treating beer in which the liquor was pumped into the centre of an annular block of wood pulp.

The CHAIRMAN described his inclined tank system as installed near Bradford for the treatment of 1,000,000 gallons of dyers' effluent per 24 hours. The liquor after the addition of the precipitant (in this case lime) entered the inclined tank at the lowest point so that it had to pass through the sediment already formed, which thus acted as its own filter.

Mr. WATMOUGH mentioned the use of camel-hair cloth for filter presses, and Mr. WOODMANSEY said that such cloth did not "felt" like wool.

Mr. BARNES pointed out that in the choice of filter cloth the value of the used cloth when scrapped must be taken into account.

Mr. HODSMAN mentioned porous tile filters which were very satisfactory for acid liquors but quite useless for strongly alkaline liquids.

In reply to questions, Mr. MCLELLAN said that bag-filters were expensive in capital and operating costs, and this was one of the difficulties which the cane sugar industry had to face compared with the beet industry. The process of adding some solid material to the liquor before filtration, as referred to by Mr. Watson, was now employed, materials such as kieselguhr and artificial porous substances being used. If the filter-plate surface were well designed for liquor distribution, it was difficult to see what advantage there was with central-feed presses as compared with side-feed, the latter being much more simple to dress. Referring to the rotary filter mentioned by Mr. Seymour, it was possible that the reason for the cloth becoming choked so soon was the absence of the clearing effect by compressed air. Each filtering problem must be treated by itself and a study made to find the most suitable filtering medium—an investigation which could be made quite satisfactorily on a small press. The pressure developed in a centrifugal was a variable factor depending, among other things, upon the amount of liquor present in it. For the filtration of caustic liquors, a wire cloth would probably be suitable. It was possible to use cotton cloth for hot caustic alkali solutions up to about 10%, provided the filtration was done rapidly and the cloth immediately washed free from alkali.

Communication.

THE NATURE OF VULCANISATION.

BY DR. H. P. STEVENS.

PART I.

THE COMBINATION OF RUBBER WITH SULPHUR.

Two theories have been put forward to explain the change which takes place in the physical and chemical properties of rubber when vulcanised. According to one theory, vulcanisation is primarily an adsorption process; according to the second, a chemical reaction is involved, the sulphur entering into a chemical combination with the rubber hydrocarbon. It would, however, appear that those who uphold the physical theory admit the possibility of a subsequent chemical combination of the rubber and sulphur taking place, while the supporters of the chemical theory admit that adsorption of the sulphur may precede chemical combination. It remains to be shown whether or no the technical effect of vulcanisation can be produced without any chemical combination between sulphur and rubber hydrocarbon taking place.

The systematic researches of Spence and his collaborators (Koll. Zeits., 1911, **8**, 304; **9**, 300; 1912, **10**, 300; **11**, 28, 274; 1913, **13**, 265), which in the main have been corroborated by later work, clearly show that sulphur enters into chemical combination with rubber during the ordinary vulcanising process as, for instance, when a mixture of rubber and sulphur is heated for an hour or two at temperatures such as 130°—150° C. The velocity of the reaction is proportional to the time of heating at a constant temperature; the temperature coefficient normally lies between 2 and 3 (*Ibid.*, **11**, 32), but is considerably influenced by catalysts (the so-called accelerators).

More recently the subject has been studied by Harries and Fonrobert (Ber., 1916, **49**, 1196, 1390); these authors, without controverting the work of Spence, claim that vulcanisation is essentially a physical process and that vulcanised rubber can be prepared which is free from combined sulphur. This conclusion is based on one vulcanising experiment only, carried out on a rather large scale. The acetone-extracted vulcanisate was practically free from sulphur. In the course of my own work on vulcanisation I have made numerous sulphur estimations in acetone-extracted vulcanisates but have never obtained a figure comparable to that of Harries. It was therefore thought advisable to carry out a control of Harries' vulcanisation experiment before proceeding with further research.

There are several points in regard to Harries' experimental procedure which are open to criticism. The rubber was mixed with 10% of sulphur and discs vulcanised for a short time (½ hr.) at a fairly high temperature (145° C.). The thickness of the discs is not given but, as these were used for tensile tests with a Schopper machine, they were probably 5—6 mm. thick so as to give a ring of standard size. It is doubtful whether sufficient time was given for the heat to penetrate evenly through so thick a layer of rubber, and it is probable that the outer layers were more fully vulcanised than the inner parts of the discs. It is stated that the conditions of vulcanisation were similar to those technically used in the manufacture of inner tubes, but these latter usually contain an appreciable proportion of antimony sulphide in addition to the sulphur which facilitates the conduction of heat through the mass, also of "accelerators" which are capable of reducing the time required for vulcanisation from one-half to one-third of that otherwise required. It is stated

that the physical qualities of the vulcanised rubber were satisfactory, but the tensile figures are not given and the fact that the rubber became soft and sank together during extraction points to very incomplete vulcanisation. This does not happen with moderately under-vulcanised rubber. Harries and Fonrobert extracted a large quantity (500 grms.) with acetone for a long period (60 days).* At the end, the rubber contained only 0·29% of sulphur. It was assumed that, given sufficient time, this residue would eventually have been removed and therefore the sample may be said to contain no combined sulphur. Owing to the large amount of rubber taken for extraction and the defects of the extraction apparatus, it appeared probable that this result would be more quickly obtained by the extraction of small samples, rolled very thin, using a form of apparatus in which extraction takes place at the boiling point of acetone (Analyst, 1913, **38**, 143).

I determined therefore to vulcanise a mixture of Para † rubber and 10% of sulphur under the same conditions as employed by Harries, that is for 30 minutes at 145° C., but in the form of a thin sheet ½—1 mm. thick so as to obtain uniform vulcanisation. At the same time a second experiment was made with the same mixture of rubber and sulphur, vulcanising for 19 minutes only. It is well known that Para rubber from different sources varies in rate of vulcanisation. The experiments were therefore extended to include a sample of fast vulcanising plantation Para rubber. Approximately one-quarter of each sample was removed after 1, 2, 4, and 9 weeks' extraction (1 week = approximately 50 hrs.), and the sulphur estimated with the following results: -

Para rubber A vulcanised in steam at 145° *C.*

Period of extraction	Combined sulphur % (1) 30 min.	(2) 19 min.
1 week	1·54	0·94
2 weeks	1·54	0·96
4 weeks	1·47	0·95
9 weeks	1·55	0·96

Para rubber B.

(3) and (4) were vulcanised to correspond with (1) and (2) above. They were extracted for periods of 2 weeks and 9 weeks.

Period of extraction	Combined sulphur % (3) 30 min.	(4) 19 min.
2 weeks	1·11	0·67
9 weeks	1·08	0·70

Fast vulcanising Para rubber C.

This sample was treated similarly to B.

Analyses were made in duplicate.

Period of extraction	Combined sulphur % (5) 30 min.	(6) 19 min.
2 weeks	2·69	1·40
	2·33	1·53
9 weeks	2·39	1·47
	2·33	1·46

The vulcanised specimens were subjected to physical tests. Ring-shaped test pieces gave the following results:—

Rubber sample	Time of vulcanising (minutes)	Breaking strain, grms. per sq. mm.	Final length (original length = 1)
(1) A ...	30 ...	830 ...	10·7
(2) ...	19 ...	490 ...	11·2
(3) B ...	30 ...	750 ...	11·1
(4) ...	19 ...	290 ...	12·2
(5) C ...	30 ...	1300 ...	10·8
(6) ...	19 ...	890 ...	11·2

With regard to these figures, the breaking strain of (5) is only a little below that normally given for a fully vulcanised Para rubber. This sample contains about 2·4% of combined sulphur whereas a fully vulcanised rubber usually contains 2·8—3% calculated on the rubber (coefficient of vulcanisation). The breaking strains of (1) and (3) are not much over one-half of what would be obtained if fully vulcanised. The final length (length at the moment of rupture) corresponds throughout with the breaking strain and tends to give a lower figure, the higher the breaking strain. It may be said that (1) and (3) are quite typical of a moderately under-vulcanised rubber. All vulcanised specimens, even those vulcanised for 19 minutes only, swell but do not dissolve in cold benzene.

These analytical results show clearly that, within the limit of accuracy of the sulphur estimations (the rubber being in the form of thin sheet), the whole of the so-called free sulphur is extracted in two weeks. A further seven weeks' extraction did not reduce the amount of combined sulphur. To judge from the figures for the rubber A, the extraction of free sulphur is complete in one week (say 50 hours), and for technical work a 5—10 hours' extraction is usually regarded as sufficient.

These results are in total disagreement with those obtained by Harries and Fonrobert. All three specimens of raw rubber contained over 1% of combined sulphur after 9 weeks' extraction when cured for 30 minutes at 145° C. (45 lb. steam pressure), whereas Harries and Fonrobert obtained only 0·29% under less favourable conditions for the extraction of the free sulphur. When vulcanised for only 19 minutes, the figures for combined sulphur are more than double those obtained by Harries and Fonrobert. One can only conclude that these investigators were working with an excessively slow vulcanising and inferior quality of rubber or that, owing to the thickness of the discs used and the short time of vulcanisation, or for some other reason, the rubber was only surface vulcanised. It appears therefore that the technical effect of vulcanisation has not been obtained without an appreciable amount of sulphur becoming insoluble in acetone, that is, presumably combined with the caoutchouc hydrocarbon.

Part II.

THE ACTION OF SOLVENTS ON VULCANISED RUBBER.

Although the process of vulcanisation is of enormous technical importance, it is not possible to formulate a definition of vulcanisation which will enable a sharp distinction to be drawn between a vulcanised and an unvulcanised rubber. Technically, vulcanisation produces a physically improved product, showing greater indifference to changes of temperature and greater tensile strength and elasticity. Of the ordinary soft vulcanised goods, 2—4% of the sulphur cannot be extracted with acetone—the so-called combined sulphur. By "under-vulcanising," the amount is smaller and the product is softer and physically weaker, as already shown in Part I. If the vulcanisation be carried to its limits, a hard resilient solid (vulcanite or hard rubber) is produced, and up to 32 or 33% of sulphur may remain undissolved after prolonged acetone extraction.

Solvents such as benzene and carbon bisulphide are frequently employed to differentiate between vulcanised and unvulcanised rubber (compare Harries, Ber., 1916, **49**, 1196), on the assumption that vulcanised rubber is insoluble and unvulcanised rubber soluble, but tests with different solvents under different conditions showed that the "solubility" of vulcanised rubber in organic solvents is dependent on (1) the nature of the solvent, (2) the time of immersion in the solvent, (3) the temperature, (4) the degree of vulcanisation, and (5) the age of the vulcanised specimen. I have already remarked on the progressive solubility in

* Presumably the extraction was not carried on during the night as the apparatus was leaky. Sixty days may therefore be taken to represent about 500 hours.

† That is, derived from *Hevea brasiliensis*.

benzene of rubber "vulcanised" with benzoyl peroxide (this Journal, 1917, 109), the rubber tending to insolubility in benzene with intensification of the vulcanising conditions as, for instance, by increasing the proportion of benzoyl peroxide. Vulcanisation with sulphur and with benzoyl peroxide is therefore analogous as regards the physical properties and solubility of the vulcanisate.

Raw rubber. It is generally assumed that raw rubber is soluble in solvents such as benzene and carbon bisulphide, but in many cases the solubility is only partial after months of immersion in the solvent. It is necessary to distinguish between:

(*a*) Rubber obtained by evaporation or coagulation without mechanical working—at the most, a pressing of the clot to expel part of the mother liquor and facilitate drying. To this class belong the so-called plantation sheet rubber, "fine Para," and most wild sorts.

(*b*) Rubber which has been worked (crêped) after coagulation in the moist state or by subsequent working (mastication) of the dry rubber of the type described under (*a*). The working, whether crêping or mastication, is accomplished by passing the rubber through differentially geared rollers.

Rubber in category (*a*), when immersed in a solvent, swells considerably unless of low quality, *i.e.* degraded* rubber which is soft, adhesive, or even semi-fluid, owing to unsatisfactory treatment in preparation or preservation. Taking the case of plantation sheet or dry Para rubber, the rubber swells enormously and gradually passes into solution, the mass of rubber retaining its swollen skeleton form. After a long period and treatment with fresh solvent, the skeleton may collapse, leaving a slimy deposit rich in nitrogen. It is probable that the retention in shape and only gradual dissolution is caused by a network of protein films formed when the rubber is coagulated. This is particularly the case with rubber coagulated with tannin or products containing tannin which act on and toughen the protein films. The reticulated structure of these films is macroscopically visible if thin pieces of the rubber are swollen in benzene with due care.

Rubber in category (*b*) readily dissolves in benzene; the amount of swelling depends on a variety of circumstances, including the degree of working to which it has been subjected.

Caspari (this Journal, 1913, 1041) separated samples of rubber into a soluble and a "pectous" variety by prolonged extraction with petrol ether in the cold. I have repeated Caspari's experiments but was unable to obtain concordant results in repeat extractions. The proportion of soluble to "pectous" appeared to depend on the period of extraction. Moreover, I found that the "pectous fraction," if allowed to stand sufficiently long in cold petroleum spirit, dissolved wholly with the exception of a small quantity of slimy nitrogenous matter which settled to the bottom of the containing vessel, so that the behaviour of petroleum spirit as a solvent differed from that of benzene in degree and not in kind. Petroleum spirit is merely a less effective solvent than benzene.

Raw and vulcanised rubber exhibit varying behaviour when immersed in a solvent. This should be noted as indicating the degree of "solubility." The most readily soluble rubber dissolves with little or no swelling, almost like a crystalloid. A less easily soluble rubber swells before dissolving. As the volume of the gel increases, more difficulty is experienced in producing a permanent emulsion with excess of solvent. Vigorous shaking is necessary and eventually one arrives at a stage when gelatinous flakes remain "undissolved." This marks the limit of "solubility." Beyond this stage, the more fully the rubber is vulcanised (*i.e.*, the higher the percentage of combined sulphur), the less the rubber swells in the solvent.

Vulcanised rubber. No investigations have been published dealing with the solubility of vulcanised rubber in solvents such as benzene and carbon bisulphide. The general impression is that vulcanised rubber is insoluble in contrast to the solubility of raw rubber. In connection with the previous paper it was important to ascertain the lower limit of combined sulphur which would confer the property of insolubility in organic solvents. Preliminary experiments showed that the quantity of combined sulphur required to confer insolubility as above defined was very small, and it was therefore found impracticable to vulcanise at the previous temperature of 145° C., as the time of heating was too short and the temperature of the steam digester could not be raised sufficiently rapidly to enable accurate measurements to be made of the time of heating. Therefore a lower temperature was chosen. Specimens consisting of 90 parts of raw rubber and 10 parts of sulphur were vulcanised for 30, 40, 50, and 60 minutes at 125° C., at which temperature the rate of vulcanisation was reduced to about one-seventh of that at 145° C.

The following figures were obtained after exhaustive extraction of the vulcanised specimens with acetone at the boiling point:—

Minutes vulcanised at 125° C.	Sulphur %
(1) 30	0·27
(2) 40	0·39
(3) 50	0·45
(4) 60	0·54

These figures show that the percentage of combined sulphur is approximately proportional to the time of heating, as in the case of more fully vulcanised rubber.

After standing 24 hours, small pieces of the vulcanisates were allowed to swell in benzene overnight. On shaking, (1) dissolved readily, giving an apparently homogeneous solution; (2) appeared to be only partly dissolved and the solution was ropy; (3) gave a swollen mass which was broken up on shaking, gelatinous lumps remaining visible; (4) was unaffected by shaking, the swollen mass remaining unbroken. We have therefore the transition states between solubility and insolubility of the vulcanisate in benzene and, according to Harries, (1) might be taken as the unvulcanised or metastable form, while (4) certainly represents the stable or vulcanised form. On this basis about ½% of combined sulphur is sufficient to confer the property of insolubility in benzene.

Portions of the four vulcanised samples were kept for 3 months at winter temperatures and other portions for the same period in an incubator at 30° C. On examining the specimens for solubility in benzene, those specimens preserved at winter temperatures were somewhat less soluble, the specimen (2) now behaving similarly to specimen (3) when originally tested. Those specimens kept at 30° C. were more altered, being still less soluble; thus (1) could no longer be dissolved in benzene on standing overnight and shaking. It was found, however, that all specimens dissolved to a large extent in benzene when left long enough immersed in the solvent.

It is generally agreed that it is exceedingly difficult to remove the last traces of free sulphur from an unvulcanised mixture of rubber and sulphur. Thus the following figures were obtained on the analysis of an unvulcanised mixture of 90 parts of rubber and 10 parts of sulphur before and after extraction for one week:—Before extraction, 9·84% S. After extraction, 0·13 and 0·12% S.

The unvulcanised mixture dissolved more readily in benzene than sample (1) above. A difference

* The term "depolymerised" is usually employed but this presupposes a molecular change for which proof is wanting. I therefore prefer the term "degraded."

could be detected in the physical properties so that it may be said that sample (1) showed the effect of vulcanisation to a slight degree.

Solvent action of benzene on fully vulcanised rubber. Although benzene has but little solvent action on fully vulcanised rubber in the cold, I find that, by prolonged extraction of the acetone-extracted rubber in a Soxhlet at the boiling point, a considerable proportion may be dissolved. The extracted rubber tends to solidify on the sides of the flask in which the solvent is boiled, but part remains in solution. On evaporation of the benzene, the rubber remaining no longer dissolves appreciably when fresh benzene is added and set aside in the cold or the liquor boiled.* In this respect the solution of vulcanised rubber obtained resembles that produced by the action of ultra-violet rays on a solution of raw rubber and sulphur in benzene (Helbronner and Bernstein, Comptes rend., 1914, **158**, 1343). The recovered rubber is of inferior physical properties. The following experiments were made to ascertain whether it was possible to separate vulcanised rubber into parts containing different proportions of "combined" sulphur.

Two samples of vulcanised rubber, A and B, were extracted with acetone at the boiling point for one week and the combined sulphur estimated. Parts of the extracted rubbers were dried, weighed, and similarly exhaustively extracted with benzene at the boiling point for one week. The extracted rubber was dried and weighed, and the sulphur estimated in the residue.

Benzene extract: (A) 30·8%; (B) 13·7%. Sulphur content of residue before benzene extraction: (A) 3·80, 3·80%; † (B) 8·64, 8·77%. Sulphur content of residue after benzene extraction: (A) 3·85, 3·86%; (B) 8·35%.

It will be seen that, although an appreciable proportion of the vulcanised rubber was dissolved by the benzene, the residue of A contains the same percentage of sulphur as the original acetone-extracted rubber, and the residue of B almost as much.

The benzene extractions were now repeated with portions of the acetone-extracted rubbers, A and B, which had been put aside for 2–3 weeks in the dark. The benzene extracts were (A) 53·3%; (B) 53·1%.

That is to say, the benzene-soluble had increased to over 50% in the course of ageing. I have already drawn attention (8th Internat. Cong. Appl. Chem., 1910, **25**, 585; Koll. Zeits., 1914, **14**, 96) to the rapid deterioration that rubber undergoes after it has been extracted with acetone, particularly when vulcanised. Such "perished" or "resinified" rubber is readily soluble in benzene. In the above cases the extract had the physical properties of a rubber rather than of a resin, although it underwent a further change on keeping, becoming brittle and "resinous." It was also found that, on keeping the above-mentioned acetone-extracted rubber for 5–6 weeks, it dissolved completely in benzene with the exception of a small amount of a flocculent precipitate, probably due to the protein constituent of the original rubber. The benzene solution when evaporated gave a varnish-like film, moderately hard but inelastic. Portions of the extracted rubber and the extracts of A and B were analysed.

The extracted rubber contained (A) 3·57, 3·59%, (B) 8·57, 8·38% S, and the benzene extracts (A) 3·31, 3·36%, (B) 8·09, 8·22% S. In both cases the extract contained slightly less sulphur than the extracted rubber. There was also an apparent loss of sulphur during the ageing of the acetone-extracted rubber. Some weeks later a portion of the acetone-extracted rubber, A, now aged and perished, was found to contain 3·32 and 3·33% S. These figures compare with 3·80% originally present in the acetone-extracted rubber, A.

As the foregoing results show that the solubility in benzene of an acetone-extracted vulcanised rubber depends on the period that has elapsed since the rubber was subjected to extraction with acetone, it was desirable to ascertain in what degree a sample freshly extracted with acetone dissolved in benzene.

A freshly vulcanised sample of rubber, C, was extracted with acetone for one week and immediately extracted with benzene for a like period. It yielded 10·9% of benzene extract. The original acetone-extracted rubber contained 3·80, 3·70% of sulphur, and the benzene extract 3·68%.

The residue was then immediately re-extracted with acetone and gave a small extract amounting to 1·7% containing 3·77, 3·82% S. It appears that the process of benzene extraction, or the removal of the benzene preparatory to extraction with acetone, has produced some degradation of the rubber, as it now yields 1·7% to acetone although previously exhaustively extracted with acetone. There is no appreciable variation in the sulphur content.

A portion of the original rubber, C, was also extracted with benzene without previous acetone extraction. The extract consisted almost entirely of sulphur. The residue contained 3·90, 3·97% S.

These figures are a trifle higher than for the acetone-extracted rubber. The fact that very little rubber was extracted by the benzene seems to indicate that vulcanised rubber with this proportion of "combined" sulphur is almost insoluble in benzene and only dissolves when degraded or oxidised, and that such degradation takes place rapidly when exposed to air after acetone extraction or during the acetone-extraction process itself.

The stability of a vulcanised rubber varies with the sulphur content of the acetone-extracted rubber, that is, the "combined" sulphur. I have shown by physical tests (this Journal, 1916, 872; 1918, 305 T and 340 T) that a vulcanised rubber of this type is fairly stable over a period of 2–3 years under ordinary atmospheric conditions when the coefficient * does not exceed 3. With higher coefficients, such as 6 or 7, decomposition sets in quickly, so that the rubber is brittle or "perished" in a few weeks. It was therefore of interest to compare the behaviour to benzene of vulcanised rubber both with relatively low and high coefficients. A has a relatively low coefficient (about 4·3). To compare with A, a rubber, D, was taken which after one week's extraction with acetone gave 9·36, 9·42% S. It was placed in a desiccator for 26 days and the sulphur redetermined. S=7·41, 7·63%. That is to say, an apparent loss of nearly 20% of sulphur in 21 days. This compares with an apparent loss of approximately 12% in several weeks for sample A.

A great part of this apparent loss is explained by an increase in weight which was found to take place while the rubber was ageing. † To obtain uniform results, ageing was carried out in an incubator at 30° C. A vulcanised rubber, E, was extracted with (1) alcohol one week and acetone one week, (2) as (1) followed by benzene extraction for one week, and (3) benzene extraction only for one

* The rubber sometimes dissolves when covered with benzene and set aside for two or three months.

† Here and subsequently duplicate figures give the results of duplicate analyses.

* The coefficient is the percentage of combined sulphur calculated on the raw rubber present in the vulcanised rubber.

† In a similar manner a rubber not acetone-extracted but vulcanised to give a relatively high coefficient (say over 4) shows a loss of combined sulphur on ageing owing to an increase in the weight of the rubber due to oxidation which accompanies "perishing." Previous acetone extraction of the rubber increases the tendency to oxidation and "perishing" and consequently the apparent loss of combined sulphur is more marked.

week. The extracted samples were dried at a low temperature for a few hours and analysed without delay. (1) 4·05, 3·95, (2) 4·10, 3·89; (3) 3·90, 3·97% S. These figures show that the vulcanised rubber was in all cases exhaustively extracted and contained no sulphur soluble in organic solvents. The extracts consisted almost entirely of sulphur.

Portions of (1) and (2) were weighed after extraction and placed in the incubator at 30° C. They showed the following increases in weight :—

Days ageing	(1) %	(2) %
25	14·7	14·0
49	19·2	18·7

At this stage the specimens contained (1) 3·49%, (2) 3·38% of sulphur.

Assuming the apparent loss of sulphur to be due entirely to the increase in weight, the calculated figures would be (1) 3·35 and (2) 3·37%. During ageing, vulcanised rubber emits a peculiar odour and gives off acid vapours due to a trace of a volatile product containing sulphur. When passed into water, the substance is retained and the solution reduces ammoniacal silver nitrate. A trace of sulphur is therefore lost in a volatile form.

Conclusions.

(1) No sharp distinction can be drawn between the "solubility" and "insolubility" of vulcanised rubber in organic solvents.

(2) The more fully the rubber is vulcanised, that is, the higher the percentage of "combined" sulphur, the less is the tendency to dissolve.

(3) Fully vulcanised rubber, such as that containing 3—4% of "combined" sulphur, is almost insoluble in benzene.

(4) Vulcanised rubber rapidly oxidises after extraction with alcohol or acetone, and becomes soluble to an increasing extent in benzene. "Overcured" rubber with 9—10% of combined sulphur oxidises more rapidly than rubber with 3—4% of combined sulphur.

(5) Vulcanised rubber recovered from the solution in benzene becomes almost completely insoluble in benzene, provided the original rubber was not oxidised (perished). This recovered rubber possesses the nature and general physical properties of vulcanised rubber.

(6) Vulcanised rubber dissolves more readily in benzene the more it is oxidised. At the same time the recovered rubber becomes more inelastic or "resinous" and dissolves more readily in benzene.

(7) The increase in weight due to the oxidation of acetone-extracted vulcanised rubber fully accounts for the apparent loss of sulphur which takes place. But a trace of sulphur is lost in the form of a volatile product of an acid and reducing nature and containing sulphur.

(8) Extraction with benzene does not allow of the separation of a vulcanised rubber into parts vulcanised to different degrees (having different coefficients).

EFFECT OF COOLING BURNER GASES ON THE CATALYTIC ACTION OF PLATINUM IN SULPHURIC ACID CONTACT PLANTS.

BY S. T. T. GEARY.

(This J., 1919, 133—136 T.)

In connection with the above paper Mr. Raymond Curtiss writes as follows :—

From the standpoint of the utility of the experiments carried out, it is unfortunate that no details of the type of contact vessel are given. An exit temperature of 540° C., however, from any platinum converter is altogether too high, and there would be something radically wrong if a reduction of this did not increase the conversion. The significance of the lowering of the preheater temperature (*i.e.*, that of the burner gases, with which the paper is concerned) cannot be estimated unless more detail concerning the converter and the temperature therein be given.

The point, however, which will strike most chemists familiar with contact plants is the comparatively low conversion obtained. Surely 90% is not considered an average figure for platinum contact plants. During the last two years a 96% conversion could be consistently maintained on the Government Grillo plants, while with Tentelew plants the figure is generally 97%. One would have liked to see the author refer to this and offer some explanation for his figure of 90%.

Another point which calls for comment is the author's statement that "a 2% increase in efficiency (conversion) with plants using sulphur does not carry so much importance as with plants using pyrites." Surely the capacity of a contact plant, is the capacity of a converter—designed to convert so much sulphur per day, whether as pure sulphur, pyrites, zinc blende, or any other raw material for acid manufacture. That being so, a loss (or gain) of 2% in the conversion is obviously of much greater account the more costly the raw material, which in this country is of course sulphur.

PROCEEDINGS OF THE THIRTY-EIGHTH ANNUAL GENERAL MEETING,

London, July 15th to 18th, 1919.

The thirty-eighth annual general meeting of the Society was held at the Mansion House, London, on July 15th, the President, Prof. Henry Louis, in the chair.

The Lord Mayor of London (Sir Horace Marshall), in offering the Society a hearty welcome, congratulated the Society on the fact that this was the first meeting held by them since the signing of the Peace Treaty. They knew how much this country and our Allies owed to chemistry and he felt it was right that a special welcome should be given to the Society in that great centre of commerce, the City of London. Whilst chemistry had sometimes been described as the handmaid of commerce, he was not sure that it did not merit the title of mistress of commerce, for the course of commerce was certainly determined by the operations of chemistry. The far-sighted founders of the Society had done a great service to this country when they had organised the chemists into this influential body. To-day there was hardly anything that was bought or sold, or that we needed to use in our daily life—from a postage stamp to R 34—in the production of which the chemist did not have an important part. It was indeed fortunate that at the outbreak of war the Government had been able, principally through the instrumentality of Lord Moulton, to enlist at once the services of highly trained chemists and chemical manufacturers for countering the war devices of our chief enemy in the field. British chemists had risen illustriously to the occasion of our national need, and had done literally wonders. In paying this tribute one must not overlook the benefits gained by the co-operation of the chemists of the allied countries. He understood that distinguished delegates from the chemical societies of our Allies had come to London for the meeting. Happily their alliance with us for the purposes of war was no longer required, yet the alliance continued. This, let it be hoped, was analogous to the position of the allied countries themselves, which had joined together for the purpose of war. The purpose of their union had now passed, but the bonds of their union remained unweakened. He was glad to be able to claim the President, Prof. Henry Louis, as a son of the City of London. He was one of the distinguished men who had received their early education in the City of London School and who had brought honour to that famous institution. By his valuable work, especially in metallurgy, the commerce of the City of London had benefited enormously. He had only to add that it was a profound pleasure to him as Lord Mayor of the City of London to welcome them to the Mansion House and to express the hope that their deliberations would be happy, harmonious, and beneficial to the community.

The PRESIDENT, in thanking the Lord Mayor on behalf of the Society for the kind welcome he had given, said it was no small honour to be received by the first magistrate of the first City in the world, and they thoroughly and keenly appreciated the honour that had been done to the Society. The Society had on past occasions been received by the Lord Mayor's predecessors, but it was many years since that had last happened. Meantime, the Society had this additional claim upon the Lord Mayor's kindness, that it had recently come under the ægis of the City of London. Although they were an old Society their home for many years had been in the west end; certainly they had been forced to abandon that home under the pressure of a Government Department which had commandeered the Society's habitation and they had had to seek a new abode. In so far, they had been forced out, but it had been a matter of free choice that had induced them to come to the City of London. They had felt urgently the great need the country had for the closest possible association of technologists and men of science with the commercial side of our great industries. These had been too long divorced. Napoleon had not really been very far wrong when he had said we were a nation of shopkeepers. We had unfortunately always put the business side before the technical side, and we thought more of the man—and incidentally paid more to the man—who sold the goods than the man who made them. That was in principle wrong and those who were engaged on the technological side and the scientific side of industry were only too anxious to come into the closest possible touch with those who were on the commercial side of the great industries of the country. The fact that they had been welcomed by the Lord Mayor of London showed that the City of London reciprocated that feeling. When both parties felt that close co-operation was mutually beneficial they might be quite certain that co-operation would result and that it would be fruitful. The Lord Mayor had truly said that the chemical industries of the country had been one of the greatest factors in winning the war: to-day it was clear that chemistry and the allied sciences were necessarily going to be one of the leading factors in the reconstruction that must necessarily follow that war, and unless science and scientific technology had the place in the thoughts of the country which it deserved, we should be faced by even greater difficulties than could be foreseen at the moment. It was impossible, speaking at that moment, not to have in mind the very serious revelations of the last few days as to the diminishing output of fuel in this country. Coal was a product upon which the whole of Britain lived. Coal was our sole material for export, and it was not too much to say that coal supplied us with food, drink, and clothing, and with all our necessaries, and that if the output of coal from this country were stopped for only a few weeks the country would starve. Those who had been in close touch with the industry had known for many years that the output was decreasing, but this fact had only recently been forced upon the public attention. In the face of this diminishing output, the only remedy that could immediately be seen was to utilise the smaller output to the best possible advantage; to do that was the task of science, and our scientific and technological men who had not failed under the stress of war would not fail in the strenuous days of reconstruction. He was looking forward with every hope and with every confidence to that magnificent body of chemists whom we had in this country, to step once again into the breach and help the country in the difficult days which were ahead. That could necessarily only be, in the first instance, the task of the scientist, but it could only be accomplished by close and intimate union

between the scientific man and the commercial and industrial man. The Lord Mayor's reception was an augury that commerce saw the need for the scientific man and, he hoped, welcomed him as the Lord Mayor had welcomed them, and he thanked the Lord Mayor not only for his reception but for all that that reception implied. He hoped, like the Lord Mayor, that the co-operation of science and commerce would once again put us and keep us in the place amongst the nations which we deserved.

The Lord Mayor expressed his thanks for the kind words which had been spoken by the President and regretted that his duties elsewhere prevented his making a longer stay at the meeting.

The President then took the chair.

The minutes of the last annual general meeting were read and confirmed.

The President said that it had been proposed by the Council that a telegram of congratulation should be sent by the Society to His Majesty the King. The telegram was as follows:—

"The members of the Society of Chemical Industry gathered at the Mansion House on the occasion of their first annual meeting in London since the commencement of the war, send to your Most Gracious Majesty their sincere congratulations on the Peace that has been secured by the great victory of your Forces in conjunction with those of your Allies and their heartfelt wish that it may be followed by many years of prosperity and happiness."

This proposal was unanimously agreed to.

The Secretary read the following letter dated July 14 from the Private Secretary to the Prince of Wales:—

"I am desired by the Prince of Wales to acknowledge receipt of your letter of the 12th inst. addressed to Sir Sidney Greville in which you ask that His Royal Highness might attend one of the meetings of the Inter-Allied Council of Chemistry which are being held this week. His Royal Highness much regrets that as he is leaving London to-day for a few days after his recent illness it will be impossible for him to attend, but sends to the Council his best wishes for the success of the meetings."

The President said he was pleased to say there was occasion for a ballot for the election of members of Council. It was an exceedingly good sign when that occurred. It showed that the members were taking a keen interest in the affairs of the Society and in the appointment of their Council.

Messrs. H. Talbot and J. H. West were appointed scrutineers for the ballot, and the President announced that the ballot was closed.

REPORT OF COUNCIL.

During the year the Council has held 12 ordinary meetings, and 1 special meeting, Finance Committee 23, Emergency Committee 3, Full Publication Committee 4, Transactions and Abstracts Sub-Committee 23, Review Sub-Committee 23, Chemical Engineering Sub-Committee 4, Annual Reports Committee 7, Committee on the Standardisation of Chemical Laboratory Glassware 11, Committee on the Revision of Board of Trade Import and Export Lists 6, Improvement of Journal Committee 1, Chemical Bibliographies Committee 1, Patent Law Committee 1.

The number of Members on the Register is now 5263 as compared with 4826 last year. Since the last Annual Meeting 656 Members have been elected, and the losses have been 219.

The Council regrets to record the deaths of 67 Members (of whom 11 were Original Members), *viz.*:—

L. Heathcoat Amory, Fredk. E. Bangert, James Blake, Joseph Butler, H. J. Cook, Thomas A. Cook, Brezet de Bedford, J. Bowley, W. A. à Brassard, Adolphe T. Brunner, Sir John Burkard, Pa[illegible]aufort, H. Bertram Brunner, Dr. Ernst Percy W. C[illegible] Bart., Thomas Bryce, Dr. Ernst Crookes, Chlon wh[illegible]l Butler, H. J. Cook, Thomas A. Cook, Dyson, Owef a vi[illegible]opeland, John R. Cowburn, Sir Wm. bald M. Fi[illegible] differ[illegible]arles W. Dick, W. Ralph Dodd, C. E. Fuller, H[illegible] n C. Edwards, Thomas Fairley, Archi- Harrison, Fr[illegible]ch, Harris A. Forrester, Charles J. P. Jenkins, Major [illegible]olmes Greenwood, Lt.-Col. Edward F. D. Raymont Ke[illegible]d. R. Hazard, Julius Hess, Robert F. Kendall, J. Falconer George B. Johnson, Edgar D. Jones, Robert Lane-Hall, A. M[illegible]er, William Kelly, George F. G. C. McMurty, Willia[illegible]King, E. Stanhope Kitchin, Markovitch, George Miller, Robert E. [illegible], Samuel Gerald L. Moss, James Nimmo, Thomas S. Norman, William S. Perry, S. Chas. Phillips, Rowland W. Pickles, G. Pilkington, James C. Pryor, Sir Boverton Redwood, Bart., Ernest L. Robinson, Carl Robitschek, Prof. Norman S. Rudolf, Dr. Alfred U. M. Schlaepfer, John Shanks, Harry Shulman, H. Charles Stephens, Emerson H. Strickler, Francis G. Tarn, Raymond W. Tunnell, Dr. Julius G. Ward, Frank H. Webb, C. J. Whittaker, and A. Zimmermann.

Sir William Crookes, F.R.S., O.M., was President of the Society in 1913, and Sir Boverton Redwood, Bart., was President from 1907 to 1908.

The following members of the Society have died on Active Service:—L. Heathcoat Amory, George B. Johnson, D.S.O., and Robert Lane-Hall.

Professor J. W. Cobb was elected a Vice-President in place of the late Mr. Thomas Fairley, whose term of office would have expired after the Annual General Meeting.

Professor Henry Louis' second year of office as President of the Society expires after the Annual General Meeting, and the Council has nominated Mr. John Gray, of Bromborough, Cheshire, as his successor in office.

Professor Henry Louis has been nominated a Vice-President, and to the other vacancies caused by the retirement of four Vice-Presidents, Professor J. W. Cobb, Mr. E. V. Evans, and Dr. A. Rée have been nominated.

Four Ordinary Members retire from Council, and to fill the vacancies thus created, eleven nominations have been received; a ballot will therefore be taken.

The following Chairmen of Local Sections retire:—Dr. R. S. Morrell (Birmingham), Dr. T. H. Butler (Bristol), Mr. D. B. Dott (Edinburgh), Mr. A. T. Smith (Liverpool), Dr. C. A. Keane (London), Mr. William Thomson (Manchester). The following have been elected to succeed them respectively:—Dr. E. W. Smith, Mr. E. Walls, Dr. D. S. Jerdan, Dr. E. F. Armstrong, Mr. J. L. Baker, Mr. John Allan.

The following changes have taken place among the Hon. Local Secretaries:—Mr. R. F. Easton (Bristol), Mr. L. E. Vlies (Manchester), both resigned, and Mr. Thomas Fairley (Yorkshire), deceased, have been succeeded by Dr. F. W. Rixon, Mr. L. Guy Radcliffe, and Mr. B. A. Burrell, respectively.

The Council desires to express its thanks to the retiring officers for their services to the Society, and has conveyed to the widow of the late Mr. Thomas Fairley an expression of its sympathy and of its high appreciation of the work done by him in Leeds.

The Council was pleased to receive invitations from the London and the Newcastle-on-Tyne Sections to hold the Annual General Meeting (1919) in London and in Newcastle. It was considered most suitable that the first meeting after the close of hostilities should be held in London, and the

invitation from the London Section was unanimously accepted. The Council in expressing its thanks to the Newcastle Section hopes that in the near future an opportunity may be afforded of holding the Meeting there.

The Balance Sheet and Annual Statement of Accounts, which have already appeared in the Journal for June 30, will be laid before the Meeting.

The Journal for 1918 contained 1612 pages of text (Review 482, Transactions 342, Abstracts 788), compared with 1290 pages in 1917. Advertisements, 1918, 1464 pages; 1917, 1207 pages.

The Council has made arrangements with Messrs. W. Speaight and Sons, Ltd., for printing and despatching the Journal, commencing with the issue for September 30, 1919.

The Council remitted to the Publication Committee the question of the improvement of the Journal. A large number of suggestions were considered, and a report was duly submitted to and approved by the Council, containing recommendations many of which have been given effect to while others will be adopted as opportunity occurs.

Volume III of the Society's Annual Reports on the Progress of Applied Chemistry was published early this year, and the sale of this Volume has been accompanied by a considerable increase in the demand for Volumes I and II. Volume I is now out of print.

The Publication Committee was re-elected with power to add one or two members, and it was decided that every member shall be on one or other of the two Sub-Committees which are now entitled respectively "The Transactions and Abstracts Sub-Committee" (formerly Executive Sub-Committee) and the "Review Sub-Committee."

Professor G. T. Morgan, F.R.S., was elected the Chairman of the former Committee, and Dr. C. A. Keane the Chairman of the latter. Professor Morgan, owing to his removal to Birmingham, resigned his Chairmanship at the end of June, and Mr. E. Grant Hooper has been appointed his successor.

Professor J. W. Hinchley has been appointed a member of the Publication Committee as representative of the Chemical Engineering Group.

The Council has appointed a Committee consisting of Dr. Chas. Carpenter, Mr. W. McD. Mackey, and Dr. S. Miall to revise the Society's By-Laws, and members of the Society have been invited through an official notice in the Journal to send in any suggestions they may wish to submit for the consideration of the Committee.

In view of the probability of an Overseas Member being elected as President from time to time, the Council recommends that in the impending revision of the Society's By-Laws, provision shall be made for the appointment of a Chairman of the Council, to be nominated by the President with power to act for him in his absence.

The Council has authorised the formation of the Chemical Engineering Group, regarding which particulars will be found on Page 467 R of Vol. 37, and Pages 97 R and 100 R of Vol. 38 of the Society's Journal. The membership of the Group is now about 500.

The Council has agreed to recommend an alteration in the By-Laws whereby this Group, and similar Subject-Groups which may be formed in the future, will be duly represented on the Council.

The Canadian Section has, with the approval of the Council, been re-organised. The Committee of the Section acts as an Executive for the whole of the Dominion, excluding the Canadian Pacific Section, which is at present an independent one. Branches of the Section have now been formed at Toronto, Montreal, and Ottawa, and it is proposed to establish other branches in important centres. The Executive Committee is an elected body and is representative of the branches, the chairmen of branches being *ex officio* members. It will arrange for the annual Convention of Canadian Chemists, and will act on behalf of the Canadian Branches and members of the Society throughout Canada in approaching the Government or in dealing with other professional matters. It undertakes to defray all expenses incurred in the conduct of the Section beyond the amount which the Council may grant in aid, and it may recommend a levy of not more than $1 per member to meet the expenditure. A new feature is that the Committee of any branch may admit as an Associate any person, not being a member of the Society, who shall satisfy the Committee as to his claims and status as a chemist or person interested in chemical industry. Such Associates pay a fee not exceeding $5 annually to the funds of the branch, but are not entitled to receive a copy of the Journal of the Society.

The Council has learned with pleasure that the Grasselli Chemical Company has founded a Gold Medal to be awarded annually to a member of the New York Section for a thesis offering the most useful suggestions in Applied Chemistry.

The following representatives of the Society have been appointed:—Prof. Louis, Dr. Keane, and Dr. Miall on the Federal Council for Pure and Applied Chemistry.

Sir Boverton Redwood (since deceased), and Sir George Beilby, F.R.S., on the Conjoint Board of Scientific Societies.

Dr. Alfred Holt on the Sub-Committee of the Board of Scientific Societies for considering the future of the International Catalogue of Scientific Literature.

Mr. A. R. Ling and Mr. J. W. Macdonald on the British Empire Sugar Research Association.

Mr. E. V. Evans on the Committee of the British Science Guild, appointed to consider the position of the British Dye Industry.

Prof. F. G. Donnan, F.R.S., and Dr. E. F. Armstrong on the General Board of the National Physical Laboratory; of whom Prof. Donnan is on the Executive Committee of the Board.

Dr. Carpenter and Dr. Keane on the General Committee of the Chemical and Allied Societies.

Dr. E. F. Armstrong, Prof. Baly, Mr. T. F. Burton, Dr. Keane, and Mr. A. R. Ling, on the Joint Committee of the Chemical Society and the Society of Chemical Industry (see Reports of Council 1917 and 1918), appointed to devise methods for preventing overlapping in the abstracting of chemical papers.

Dr. E. F. Armstrong, Mr. D. Lloyd Howard, and Mr. T. D. Morson on the Industrial Alcohol Joint Committee (see Report of Council 1917).

Prof. J. W. Cobb on the Provisional Organising Committee of the Proposed Association for Refractories Research.

Prof. Louis and Dr. Keane on the Joint Library Conference with the Chemical Society.

Dr. R. S. Morrell on the General Committee in connection with the James Watt Centenary Celebration.

Mr. E. V. Evans on the Fuel Economy Committee of the British Association.

Prof. H. Louis, Prof. P. P. Bedson, and Mr. H. Dunford Smith to the Congress and Exhibition (1919) of the Royal Sanitary Institute, to be held in Newcastle-on-Tyne.

The Council has been much interested in the formation of a Federal Council for Pure and Applied Chemistry, the object of which is "to advance, safeguard, and voice the interests of Chemical Science." Particulars regarding it will be found on Pages 18 R and 59 R of the Journal, Vol. 38. The Council is gratified to know that its offer of the services of the Society's Journal as the official organ of the Federal Council has been accepted.

A list of the Society's Representatives on the Federal Council is given above.

At the Inter-Allied Conference of Chemists held in Paris in April the Society was represented by the President, Professor H. Louis, Mr. W. F. Reid, Mr. Edwin Thompson, and Dr. S. Miall. An important feature of the Meeting was the laying of the foundation of an Inter-Allied Federation of Pure and Applied Chemistry. Delegates from five Allied nations were present, but none of these had power to bind the organisation which he represented. A Resolution was adopted that in the opinion of the Delegates present the formation of such a Federation is highly desirable. A Committee of ten was appointed who are to meet in London in July, by which time it is hoped that each of the Allied countries will have sent in its formal adhesion to the Federation. It is understood that Pure and Applied Chemistry will be represented equally in the Federation (see Society's Journal, Vol. 38, page 141 R).

The Empire Sugar Supply (Technical) Committee (see Council Reports 1917 and 1918) is preparing a comprehensive report on the production of sugar in the British Empire which it is hoped will be published shortly.

Arising out of the suggestion made by Dr. Morris Travers, F.R.S., at the last Annual General Meeting, the Council appointed a Committee to confer with other interested bodies on the question of the Standardisation of Chemical Laboratory Glassware with a view to assisting the glass manufacturers in limiting the supply of various classes of apparatus to a certain number of standard sizes. A list of the Members of the Committee was given on Page 77 R of Volume 38 of the Journal. Mr. K. M. Chance has since resigned, and the following additional members have been added:—Mr. F. A. Beesley (Public School Science Masters' Association), Lt.-Col. D. Harvey, C.M.G. (War Office), Mr. T. A. Moore (India Office), Mr. G. A. Mallinson (Pharmaceutical Society), Dr. S. Rideal (Society of Public Analysts), Dr. W. E. S. Turner (Society of Glass Technology). The first part of the Committee's Report dealing with ungraduated apparatus has been submitted to the Council, and will shortly be published in the Society's Journal.

The Council has received a Report of the General Committee of Chemical and Allied Societies on the question of publishing Chemical Bibliographies in the English Language (see Council Report 1918), and has approved the draft scheme suggested and the resolutions adopted by the General Committee. These resolutions embody recommendations, *inter alia*, that the funds required for carrying out the scheme should be in the hands of trustees appointed by the Association of British Chemical Manufacturers, the Chemical Society, and the Society of Chemical Industry; that Editors should be appointed by the Trustees; and that a permanent management Committee should be appointed consisting of representatives of the bodies mentioned; that the Report of the Resolution shall be submitted to the American and French Chemical Societies with a view to co-operation; and that the Federal Council should approach the Department of Scientific and Industrial Research with a view to securing its financial assistance and co-operation.

Two Conferences were held by the Imperial Mineral Resources Bureau dealing with Mineral Resources and Production, and also with the questions of Consumption and Prices. The Council's Representatives at these Conferences were the President, Professor H. Louis, and Mr. H. M. Ridge. The chief points brought out at the Conferences were (1) the importance of an early distribution of approximately correct statistics; (2) the expressed desire of the representatives of all the Technical Societies that issue Abstracts that they should continue their own Abstracts as heretofore; they being at the same time willing to co-operate with the Bureau in any general scheme of Abstracting, so as to prevent overlapping, provided that their own Abstracts were not interfered with; and (3) the views, concurred in by the representatives of the Institutes specially dealing with Mining and Metallurgy, that it was of the utmost importance in the interests of the Mineral Production of the Empire that these Institutions, with the Institute of Metals, should be housed in the same building as the Imperial Mineral Resources Bureau, and that the Government should endeavour to carry such a scheme into effect (see Society's Journal, Vol. 37, page 321 R)

The Board of Trade requested the Council to make suggestions for the improvement of the Classification of Chemical substances in the monthly and annual Statements of Trade. A Committee was appointed which went very carefully into this matter and a list of recommendations on the subject was duly transmitted to the Board of Trade.

The Chemical Society having prepared a scheme for the extension of its Library in the Department of Technological Literature, and for increasing the facilities for the use of the Library, the Council was pleased to give a donation towards the necessary expenses, and an arrangement has been made by which members of the Society of Chemical Industry, as well as those of the other contributing Societies, have the same privileges as Fellows of the Chemical Society in respect of their use of the Library.

The PRESIDENT moved the adoption of the report.

Mr. ROBERT MOND, in seconding, said that the report called for very few remarks. They had to deplore the death of some of their oldest members, and he was sure they would all endorse the choice of the Council of Mr. John Gray as President to succeed Prof. Henry Louis, who had rendered such admirable service during the past two years.

The motion was then put to the meeting and carried.

HON. TREASURER'S STATEMENT.

The HONORARY TREASURER, in submitting the statement of accounts, drew attention to the unfortunate mistake that had been made by the printers in the Statement of Accounts which had been issued in the Journal for June 30th, the first two figures of the amount showing excess of expenditure over income having been dropped out after the final proof had been corrected. The correct figure was £3145 0*s.* 9*d.* The Society had passed through a very difficult period indeed financially. The expenses had mounted enormously and the measures that had been taken to increase the revenue had not yet been fully felt. In regard to the various items of increased expenditure, firstly, though it was not the largest item, there was the expenditure on the staff. The work of the Society had increased enormously in a way that none of them a few years ago could have foreseen. He took the opportunity of pointing out to the members how much they owed to their very able, conscientious, and loyal staff for the admirable work that they did. It had been necessary to increase the staff both during the year under consideration and since, and he trusted that this increase would prevent the members of the staff from being overworked in the way that had unfortunately been unavoidable during a portion of the last few months. The main increase in expenditure had been due to the Journal; part of this had been foreseen when the Council had decided to improve and enlarge the Journal. It had been realised that that improvement might strain the resources of the Society very severely, but the improvement had been decided upon and he for one,

although he was responsible for the finances, did not in the least regret it. The other increase could not have been foreseen, but it was very fortunate that it had only been in the last 18 months of the war that the Society had really felt the war pinch. Had the difficulties occurred earlier, or had the war gone on for another year, the position would indeed have given rise to grave anxiety, whereas at the moment he did not think it did. They were faced with an enormous rise in the cost of printing and a still greater rise in the cost of paper. Added to that, they had had at one time—it almost seemed incredible now—a very serious difficulty in getting permission to obtain any paper for the Journal at all. The amount of paper required was, from the point of view of the printing trade, ridiculously small—a mere matter of 50 tons—and it had only been after the most strenuous efforts that they had succeeded in obtaining the permission of the department concerned to purchase this. He was glad to say that although there was no immediate prospect of a reduction in the labour cost of printing, yet the price of paper had fallen and certain economies had been effected recently in the cost of the Journal, and he confidently expected that a further diminution of expenses would be made in that direction. The net result, however, was that for the year 1918 there had been an excess of expenditure over revenue of £3145 0*s.* 9*d.* Turning to the balance sheet, he pointed out that there was a deduction from the accumulated fund in regard to additional expenditure appertaining to the year ended December 31, 1917. The reason for that was that the Society had had an arrangement with the previous printers of considerable complexity, involving an elaborate system of per contra accounts which rendered it exceedingly difficult to say definitely at any time exactly what their position was, and when matters had to be wound up with Messrs. Vacher last year it had been found that there was a sum which the Society owed Messrs. Vacher amounting to £481 0*s.* 4*d.* which really belonged to 1917. The 1917 accounts, of course, had been closed a year ago so that no alteration could be made to them; the only thing possible was to show it in the balance sheet as a deduction from the accumulated fund. In addition to that they would see another deduction, "Depreciation of investments at this date written off." That was not a matter involving the year's revenue, because in previous years the Society had been in the habit of valuing the investments at cost and showing in another column the present value. The difference between the value of their investments now and a year ago was comparatively small, but the Council had felt that the time had come when it was right to show the actual value at which the investments could have been sold on December 31st of the year in question. This of course made no difference to the cash position of the Society nor to the year's working, but it was a sounder method because it showed the actual value of these assets. With regard to the prospects, he drew attention to the item showing receipts from advertisements in the Journal. For 1918 these amounted to £5604 13*s.* 8*d.*, but he was in the position to say that at the present moment the income from advertisements was coming in at the rate of over £10,000 a year. The reason for that was that the measures which the Council had taken to increase the revenue from advertisements took some time to come into effect, and even up to now the full benefit had hardly been felt. He was convinced, however, that the revenue from advertisements could be largely increased and he felt confident that that would be one of the first matters to occupy the attention of his colleagues and himself when they met again next session. In conclusion he mentioned the very great personal debt of gratitude which he owed to the Finance Committee. This was a sub-committee of the Council which had been constituted rather more than a year ago to sit with the Hon. Treasurer and give him the benefit of their highly expert advice. It was perhaps too early to ask the Society formally to recognise the work of that sub-committee, but he could not conclude without acknowledging his very great indebtedness to them.

There being no comments on this statement, the PRESIDENT formally moved the adoption of the statement of accounts.

Mr. C. S. GARLAND, in seconding, said it was a very sound, straightforward, and clean balance sheet. He felt that the Council had done right in writing off the value of the investments to bring them to their real present-day value, and whilst it might not seem altogether satisfactory that there should be a deficit of over £3000, he thought they were to be congratulated in these times that with an increase of subscription of only 20% the deficit was not greater. But for the public-spirited work of the Hon. Treasurer and the Finance Committee the position would have been a great deal worse. He therefore asked them, in adopting the balance sheet and statement of income and expenditure, to express their sincere thanks to the Hon. Treasurer and the Finance Committee for the work they had done during the year.

The motion was put to the meeting and carried unanimously.

PRESIDENTIAL ADDRESS.

Prof. HENRY LOUIS then read his Presidential Address as follows:—

When I had the honour of addressing you a year ago, not the most sanguine amongst us could have anticipated that complete victory in the desperate struggle in which we were engaged was so near at hand; although no one of us doubted the ultimate triumph of the just cause for which we were fighting, none dared to hope that we were to see it so soon. To-day, on relinquishing the Presidential Chair to which you did me the great honour of re-electing me a year ago, my address to you must necessarily be coloured by the events through which we have passed and must almost of necessity take the form of a retrospect. The events of the last five years are still too near for us to be able to focus them properly, but although we are not able to see clearly all that we have done and suffered, it is nevertheless not too early to put on record such facts as we can gather concerning the work that has been done during those five years, or to attempt to draw from the study of these facts the lessons that they should teach. In particular I hold that it is important that this task should be discharged in respect of the work accomplished by the chemical industries of this country. It is not too much to say that every single chemist in Great Britain has been engaged directly or indirectly on war work in some form or other and no body of men has the right to claim a larger share in the triumphant issue than the chemists of Great Britain, although the general public is even to-day far from recognising how deeply it is indebted to them for what they have done quietly and unobtrusively in their country's cause, a cause to which many have sacrificed their health and not a few unfortunately their lives. Much of the chemist's work has necessarily been done in secret, but even when the results are made evident, few appear to appreciate how much hard brain work, inventive capacity and unremitting attention have been needed for their attainment; when, for instance, an aeroplane is seen in flight overhead, for a thousand of the onlookers who exclaim "What a triumph of engineering ingenuity!" there will probably not be one who will add "and of chemical industry"; yet every portion of that aeroplane has needed chemical research of the

most profound character from the composition of the various metals and alloys that enter into the construction of the engine and framework to the dope that constitutes the indispensable covering for the wings. It is hard to say why the chemist's share in such an achievement should be entirely overlooked; is it because the general public, like the small boy in a well-known book, are only impressed when they "see wheels go round," or is it because the chemical worker, unlike too many of his fellow workers in the engineering shops, has stuck quietly and undemonstratively to his job and has not attracted public notoriety by going out on strike or threatening to strike for the most trivial of reasons? Whilst on this subject I would like to pay a tribute of sincere respect to the workmen in our chemical industries, whose industry and energy in carrying out their disagreeable and even dangerous tasks should not be forgotten by the nation in its hour of triumph. Had it not been for these men, Lord Moulton would not have been able to say, as he has done, that the chemical manufacturers of the country had never kept a shell waiting.

When we look back upon what the British chemical industry was before the war and on what it has accomplished during these five strenuous years, some faint idea may be gained of what the chemist's share has been in the great conflict. I propose to lay before you to-day a brief summary of some of the most important of these achievements. In the vast, multifarious and complex industries embraced under the title of chemical industry, covering as it does practically every corner of the field of human activity, I doubt whether any man can pretend, certainly I cannot pretend, to have any detailed knowledge of the work that has been going on in so many different directions; I have therefore applied to a number of my friends in the Society of Chemical Industry, many of whom I am delighted to see here to-day, for information concerning the various branches of the industry in which they are respectively the acknowledged authorities, and they have been good enough to respond to my appeal and to furnish me with the authentic and accurate information which I propose to summarise to-day, and I hope they will allow me to thank them here collectively for the manner in which they have put these data at my disposal and will accept this general acknowledgment of my indebtedness to them.

The consumption of sulphuric acid is very often taken as a standard of the progress of chemical industries in general, and we may just glance at it here in passing for the same purpose. Before the war our annual consumption of 100% sulphuric acid was about one million tons per annum, of which 25,000 tons was oleum; at the close of the war it was about one and three-quarter millions, of which 310,000 tons was oleum. This increase is significant enough as it stands, but when it is remembered that over half of the former figure was absorbed in two manufactures, namely superphosphates and sulphate of ammonia, while only about 30,000 tons was used in the manufacture of explosives, and consider further that during the war sulphuric acid was mainly used in producing explosives, it is easy to see how enormously the consumption of acid for the latter purpose must have increased, and how much chemical engineering must have gone towards making that increase possible. Furthermore it is gratifying to find that this increase was not due in any sense at all to extravagance, but that the strictest economy prevailed in the consumption of this all-important acid. The chemical industry may fairly be proud of the fact that it is one of the very, very few industries engaged in the manufacture of war material in which haste and waste have not been synonymous terms. The admirable reports on the costs of the various factories controlled by the Department of Explosive Supplies form a most interesting chapter in our war activities, and the excellent system of costing therein employed will no doubt prove of the greatest value to the chemical industry after the war, but these reports must by this time be so well known to all engaged in chemical manufacture that I need say nothing more about them except to record the fact that our chemists have distinguished themselves in administrative capacities no less than in their scientific labours. Take for instance the one fact that in an old-established industry like sulphuric acid manufacture the efficiency of production has risen from 78·8% up to 91% and occasionally even higher, and you have remarkable testimony to the business-like methods of manufacture devised by chemists even during the strenuous days of war. It is impossible to estimate the magnitude of the sums that might have been saved to the country if all other industries engaged in the production of materials of war had been administered on equally sound economic lines.

In a general review of the chemist's war work it would seem almost inevitable to assign the first place to the production of explosives, which is necessarily the undisputed domain of the chemist. At the outbreak of war our manufacture of explosives was practically confined to those used for mining and other industrial purposes; for military purposes we made small quantities of gunpowder, guncotton, cordite, and picric acid, although it is true that the latter, produced by a somewhat primitive process, was used mainly as a dye and to a less extent for service practice. The high explosives for the bursting charges of shells were mainly picric acid and a little trinitrotoluol, the total quantity of the two explosives amounting to less than 50 tons per week. The only propellant used was cordite, containing 30% of nitroglycerin and 65% of nitrocellulose, gelatinised with acetone and stabilised with 5% of mineral jelly, and its production was under 100 tons per week. Small quantities of explosives for fuses, primers, detonators, etc., were also made, but on a quite unimportant scale. The industrial explosives made amounted to something like 300 tons per week, and included standard gelatin explosives, dynamite, various blasting powders, and a number of "permitted" explosives for coal mining, mostly of the ammonium nitrate type, together with gunpowder and a variety of sporting powders.

When the needs of war demanded explosives of every kind, and particularly high explosives in quantities hitherto unimagined, it was soon found that our position was a perilous one, owing to the fact that Germany had for many years before the war practically monopolised all organic chemical products. This state of affairs had come about gradually, almost imperceptibly, nor indeed were the British manufacturing chemists so greatly to blame for it as is sometimes stated. They had developed the heavy chemical trade in this country at a very early stage, and our great works had devoted their attention to the production of such chemicals as sulphuric acid, carbonate of soda, bleaching powder, etc., and had found in these manufactures an ample and lucrative employment for all their energies and all their capital, so that there was neither need nor inducement for them to attempt the development of hitherto untried branches of chemical manufacture. When Germany determined to enter into the field of chemical industry, she quite naturally turned her attention first to the unoccupied portions and therefore initiated the manufacture of organic chemical products; subsequently each country continued to develop more particularly along the lines already

laid down, and thus it was that five years ago we found ourselves with neither the plant nor the experience required to produce a whole range of indispensable substances such as trinitrotoluene, trinitroxylene, dinitrophenol, tetryl, synthetic phenol, acetone, etc., all of which are organic derivatives and can therefore only be made by manufacturers accustomed to deal with this branch of the industry. The immense amount of research and experiment needed before these manufactures could be successfully set going on the required scale of magnitude is difficult to conceive except by those actually engaged in the work. In the manufacture of T.N.T. entirely new methods had to be devised and worked out on the required manufacturing scale, and the requisite plant for its production designed and constructed. To obtain the enormous quantity of toluene required, corresponding to a production of 60,000 tons of T.N.T. per annum, was one of the first of our difficulties; in addition to its recovery from coal gas and from the distillation of coal tar, a number of methods for its production were studied, although, as it happens, it never became necessary to put them into practice. Another problem connected with this explosive was its purification; this was performed originally by alcohol and other inflammable solvents, which were a serious source of danger until the use of sodium sulphite solution for this purpose was discovered. The demand for picric acid soon rose to about 1000 tons per week; it had become evident at an early stage of the war that the supplies of coal-tar phenol would be far below our requirements, and other sources of supply had to be found. We had never made synthetic phenol in this country, and a vast amount of experimental work had to be done before its manufacture from benzene through benzenesulphonic acid could be successfully undertaken. Even with these developments, our production of explosives was less than half of our requirements; for shell filling alone no less than 220,000 tons of high explosives was needed for 1917. Here again the resourcefulness of our chemists came to the rescue by the invention of a new explosive, Amatol, consisting of a mixture of T.N.T. with from two to four times its weight of ammonium nitrate. This explosive, when fired with a suitable fuse, is even more powerful than T.N.T., but here again a vast amount of experimental work had to be done before a properly modified fuse could be devised and rendered practicable. Again the demand for huge quantities of ammonium nitrate for this and other purposes could no longer conveniently be met by the older methods of manufacture, and new and more direct methods of production were worked out; three processes were employed—(1) the interaction of sodium nitrate and calcium chloride, giving calcium nitrate, which in turn was made to interact with ammonium sulphate, (2) the ammonia-soda process, and (3) the interaction of sodium nitrate and ammonium sulphate. By these means about 3000 tons of ammonium nitrate was produced weekly.

The manufacture of Tetryl by the nitration of dimethylaniline had been pretty thoroughly studied before the war; a number of other processes were investigated, such as from monomethylaniline and dinitrochlorobenzene, but were found to present no advantages over the original process. The purification of Tetryl was studied, with the result that acetone which had been used for this purpose, and which was much needed for other operations, was replaced by other purifying agents.

The production of propellants rose to 2000 tons per week, and required about 400 tons of refined glycerin, 900 tons of purified cotton cellulose, 150 tons of acetone and 1000 tons of alcohol, 40% of which was converted into ether in plants erected during the war. The shortage of acetone necessitated the use of ether-alcohol as solvent to the extent of about three-fourths of the output. This change involved the use of a different nitro-cotton, and practically a new method of manufacture, in the course of which a very large proportion of the solvents used, acetone, ether, and alcohol, was recovered.

Add to these researches, which led to new and improved processes, the vast number of others which resulted in the rejection of explosives and of processes after long and elaborate trials, and some small idea may be formed of the work done by the experimental and manufacturing chemists in this one department alone.

The chemist's work has necessarily been closely identified with the preparation and employment of poison gases, work which called for a high amount of scientific knowledge combined with no little courage and self-devotion. The history of the use of poison gas is too well known for me to occupy any of your time by its recapitulation. We all know how the Germans, in direct violation of the conventions of civilised nations, treacherously employed this agent, and how our chemists had immediately to proceed to study and devise in the first instance protective measures so as to neutralise the effect of this new and illegitimate phase of warfare, and then finally to devise effective means of retaliation. As all the world knows, the Hun soon found to his cost that our chemists could beat him at his own dirty game and has learnt to rue the day when he sought to gain a dishonourable advantage by these cowardly methods. I firmly believe that German chemists had persuaded the German Nation, possibly even including themselves, that they were so far superior to the rest of the world in chemical knowledge that any competition with them in this form of warfare would be hopeless. They soon found, however, that British chemists were more than a match for them, and as soon as we felt bound to employ retaliatory measures in kind, it rapidly became evident on which side lay the real superiority in chemical inventive powers and technical ability. I will pass over this phase of the chemist's work in warfare without comment, merely emphasising that it fully vindicated the high qualities of British chemistry. A large number of gases had to be thoroughly studied, and when those most suitable for the purpose had been selected, the difficulty of producing them on a suitable scale had next to be faced. How well our chemists succeeded in this is now a matter of history; to give only one example as quoted by Sir William Pope, our process for the production of mustard gas gave us an output thirty times as great as had been obtained by the Germans, and at one-thirtieth of the cost.

When war broke out, we may be said to have had no acetone manufactured in this country and to have relied exclusively upon importation to cover our needs. There was a relatively small works in the Forest of Dean capable of carbonising about 80 tons of cordwood weekly, which made charcoal and separated acetic acid from the products of distillation, but the acetone obtainable from the acetic acid was not pure enough for the manufacture of cordite. This works was first enlarged and then a number of other works were started, until a total carbonising capacity of 1400 tons per week was reached, and a great deal of experimental investigation was carried out in order to determine the best conditions of distillation for the production of calcium acetate in the highest possible state of purity. Eventually calcium acetate of a purity of about 90% was prepared, the chief impurity being calcium carbonate. The best conditions for the decomposition of the acetate so as to get the maximum

yield of acetone had further to be determined, it being ultimately found that it was necessary to maintain steadily a temperature between 450° and 500° Centigrade in the retorts. Even with all precautions the acetone was not quite up to the desired high standard of purity, and an elaborate series of researches on its purification had to be undertaken, until finally a product was obtained that satisfactorily passed the required tests.

Various other methods of producing acetone were developed, such as synthesis from alcohol, which was used on a considerable scale, and its production by the anaërobic fermentation of potato or maize starch. The former process was a highly interesting one, the operation including three stages, the conversion of alcohol into aldehyde, of aldehyde into acetic acid, and of the latter into acetone, for each of which stages catalytic agents had to be employed. It is to be hoped that some, at any rate, of the plants devised for acetone production will be maintained in operation, and that the country will not be allowed to fall back into its previous dependent position for the supply of this important substance.

Whilst the production of acetone was the main purpose of the wood distillation factories, a number of by-products were also utilised for war purposes, such as wood tar, tar oils, methyl alcohol, wood spirit, and methylethyl ketone, which forms a valuable solvent, used in aeroplane manufacture, whilst the charcoal was used as fuel in the trenches.

I have already referred to the chemical knowledge and research involved in aircraft production; dopes had to be devised that rendered the fabric of the wings airtight; those at first employed deteriorated rapidly in sunlight, and much investigation was needed before a satisfactory process was devised. Now the doping and varnishing of the wings has reached such a stage of perfection that the dope is as permanent as the fabric itself, even under the most extreme climatic conditions. This result has demanded the production in large quantities of substances such as nitrocellulose, cellulose acetate, benzyl alcohol and triphenyl phosphate. Suitable glues for three-ply wood, capable of withstanding the wet and cold of the winter and the dry heat of the tropics, had to be devised, investigated, and finally produced on a large manufacturing scale. After a series of exhaustive tests as to resistance to weather, impermeability, resistance to various physical and chemical agents including the effects of ultra-violet rays, a protective varnish consisting of China wood oil and rosin was finally adopted and found highly satisfactory. Another problem was the production of "dope-resisting paint," that is to say paints and enamels resistant to acetone, and this too was ultimately solved successfully. Even the propellers needed a large amount of chemical insight and research. The wood had to be artificially seasoned—in itself a chemical process, and only the finest qualities of glue could be used in the construction. A suitable filling for the grain of the wood had to be devised and lastly a protective varnish. Rapid laboratory tests for copal varnishes were worked out and found to give reliable results, and ultimately a varnish in which China wood oil replaced linseed oil was adopted. Another triumph was achieved in producing after many difficulties rubber tubing that could be trusted to convey oil and petrol without splitting, in spite of the severe strains and vibrations to which it is exposed. For the lubrication of the aeroplane engines vast quantities of high-grade castor oil were required, this oil having the property of retaining its viscosity at high temperatures; chemical research enabled it to be so modified that without losing this particular quality it could be relied upon not to freeze in the tank of the aeroplane. Chemical research again was needed in the production of suitable fabrics for airships and kite balloons, the qualities especially demanded being light weight, great strength, and low permeability to hydrogen. The generation of great volumes of hydrogen both from stationary and from mobile plants was another problem that has been successfully solved.

In this connection I would refer to the wonderful success that has attended the production of helium in large quantities in the United States for the filling of airships. The possibility of the production of helium on a commercial scale depends upon the fact that certain of the wells of natural gas in Texas contain about one per cent. of helium; as our American friends freely admit, the researches that led up to the possibility of this production were carried out by Sir William Ramsay, and it was the same eminent chemist who appears to have been the first to conceive the idea of using this gas for the filling of airships. Thus, although the natural conditions of the United States have enabled them to monopolise the production of helium, we can fairly claim the chemical work that led up to it as being of British origin and constituting a portion of the war work of British chemists.

In addition to the work above quoted, many other demands were made upon the paint and varnish industries, such as the production of lead-free paints and lead-free stoving varnishes for the interior of high-explosive shells. One of the great difficulties of these industries lay in the fact that linseed oil was reserved for the manufacture of glycerin, and much research work was done on the manufacture of substitutes from the fatty acids of linseed oil.

Cuprous oxide, used for making anti-fouling paint for ships, was all imported before the war, but is now being made on a large scale in this country.

There has been no section of our Army that has rendered more efficient service throughout the war than has the Army Medical Corps; this is not the place to refer to the heroic devotion to duty shown by all ranks in their efforts to save life and diminish suffering, but it is necessary to remind you of the extraordinarily efficient manner in which the daily routine work of the Army Medical Service has been carried out. It has been stated that in spite of the adverse conditions, of the vast numbers of men engaged and of the length of time that the war has lasted, there have been actually fewer cases of typhoid in our Army than there were deaths from it in the South African Campaign. Facts like these speak for themselves and no word from me is needed to bear testimony to the splendid work done by our doctors and surgeons. I may, however, remind you that even the best and ablest of these would have been helpless without a due supply of drugs and anæsthetics, and for these we had to rely on the British manufacturers of fine chemicals. At the commencement of hostilities practically the whole of this trade was in German hands, and we imported from abroad all that we required. There were no makers in this country of antipyretic drugs, such as phenacetin, aspirin, salicylates, etc., of hypnotics such as veronal, sulphonal, chloral, or adalin, of local anæsthetics such as novocaine, eucaine, or orthoform, of special drugs like salvarsan, neosalvarsan, and acriflavin. Furthermore, there were also many important substances of which only small amounts had been manufactured here previously, which were required in considerable quantities, and the production of which had therefore to be undertaken on a very different scale of magnitude, such as acetic anhydride, atropine, formaldehyde, glycerophosphates, hexamine, paraform, etc. It was necessary to work out methods

of manufacture of these drugs and of a host of others and to produce them on the large scale that our extended battle front demanded, and here it need only be said that British manufacturing chemists once again proved themselves equal to their difficult task. Strangely enough, it was not only in the domain of organic fine chemicals that we were deficient, there were also a number of inorganic substances that were not being manufactured in this country. When war broke out, we were manufacturing neither permanganate of potash nor red prussiate of potash; to-day we are in a position to cover all our requirements of these substances from our home production; the latter of these affords a good example of the subtle manner in which the work of the chemical manufacturer underlies all other branches of industry. Let me remind you of the engineer's urgent demand for blue-prints in every shop and every department of his work, and of the fact that without red prussiate of potash such prints cannot be produced.

The important part played by photography during the war is a matter of common knowledge, but few realise what a call was made on the manufacturing chemists in order to produce and maintain the necessary photographic supplies.

Developers like Metol, which had previously been imported, had to be produced here. Dyes for the manufacture of orthochromatic and panchromatic plates were urgently needed, and it is through researches undertaken by some of our chemists that we were enabled to produce sufficient of these to meet our requirements. Photographic paper constituted another difficulty. In pre-war days the special grades of paper required for this purpose, absolutely free from traces of any heavy metals, were produced entirely abroad, and the subsequent process, the coating of this paper with baryta, was also foreign work; now a suitable photographic paper is made on a sufficient scale and the baryta coating is also being satisfactorily carried out in this country.

The soap industry was amongst those that found itself confronted with a series of difficult problems under war conditions; its main attention was directed to the production of the greatest possible amount of glycerin for the manufacture of explosives, whilst it had at the same time to work with fats of inferior quality, no fats capable of being made edible being allowed to be employed. Very large quantities of glycerin were required for the production of nitroglycerin and particularly when ether-alcohol was substituted for acetone as a solvent in the manufacture of cordite. The distillation of crude glycerin and the preparation of glycerin of high quality suitable for the manufacture of explosives had to be undertaken on a very large scale. Another important operation was the refining of edible oils and the production of margarine therefrom. This had been accomplished before the war, but only on a relatively small scale, and the extension of these manufactures to meet the demands of the country was another task of the greatest importance, which our industrial oil chemists accomplished successfully.

I need merely refer here to the production of dyestuffs, a subject which has attracted much public interest, and with the main facts of which most people are familiar. When it is remembered that at the outbreak of hostilities both the blue of our Navy and the khaki of our Army were produced by means of dyes made in Germany, the extent of our dependence upon foreign dyestuffs can perhaps be realised. During the war our output has increased to such an extent that the greater part of the dyes that we require can now be made and are now being made in this country. So far as concerns the work of the chemist and the manufacturer, the problem of producing our own supply of dyes may be said to be in a fair way to solution, and the administrative and financial aspects of the question do not concern us for the moment.

Another important chemical industry, the advance in which is a matter of public knowledge, is the glass industry. Before the war we produced heavy glassware, but very little fine glass and practically none for scientific or optical purposes; elaborate researches were at once set on foot, the problem in this case being complicated by the fact that the raw materials available in this country were not identical with those obtainable abroad. Nevertheless by patient and persevering investigations the difficulties were gradually overcome and optical and scientific glass of good quality is now being regularly produced in this country. To quote one or two examples:—Before the war we made practically no glass tubing at all; to-day we make 15,000 pounds a week. Before the war we made hardly any safety-lamp glasses for miners; to-day we are making over 80,000 per month, whilst our produce of such articles as clinical thermometers and electric lamp bulbs has been practically trebled.

I shall say nothing as to the progress made in metallurgy, although this has been very important; I may just mention that our output of steel, which was 7,664,000 tons in 1913, had risen to 9,539,000 tons in 1918, practically the whole increase being in basic steel made from British ores. It is perhaps worth noting that we are now producing in this country substances such as ferro-molybdenum, ferro-tungsten, ferro-chrome and a number of other alloys used in steel making, for which we were before the war dependent upon imported supplies. There was no 25% ferro-silicon made in this country before the war; now we make considerable quantities. The production of amorphous carbon electrodes for electric furnaces, which were all imported before the war, may also be mentioned here.

I have now put before you briefly, and I fear too imperfectly, an account of some of the principal war activities of certain of our great chemical industries. The narrative is far from complete or exhaustive, but I trust I have said enough to give an idea of the huge amount of work done by British chemists and of the vast field over which their labours have extended. As to the results of this work I need say nothing; these were recorded and officially signed on June 28 at Versailles.

The one great fact that emerges from this mass of detail is that our chemical industry has shown itself capable of sustaining successfully the fiercest and most strenuous competition that it has ever been called upon to face. Utterly unprepared for war conditions and apparently unsuited to war emergencies, it has shown itself more resourceful, more energetic, and more successful than any of us had dared to hope. I venture to submit to you that we could never have built up so rapidly this vast edifice of chemical industry if the foundations upon which we had to build had not been thoroughly sound. I see in these results a triumphant vindication of the thesis that I have more than once urged, namely that in the teaching of science, and more particularly of scientific technology, we are quite on a par with any other nation. It has often been urged by those whose spiritual home is Germany and who look upon German educational methods as the acme of perfection, that we ought to model our methods of technical teaching upon German lines. This war has shown that our teachers who have steadfastly adhered to the methods that suit our national idiosyncrasies can claim to be justified by the results obtained; we can certainly learn much of the organisation of scientific education and much of the respect due to science from our enemies, but we shall assuredly do well to adhere to our

own essentially British methods of technical education. When it is borne in mind that Germany had for forty years been applying her science to the purposes of warfare and that we only began to do so five years ago, we are surely justified in asserting that we succeeded because the science which we possessed available for such application was of a far higher order, and that it is for this reason that we have been able to beat our enemies at all points. This to my mind is the first great lesson of the war. Our scientists and our methods of scientific education have proved their quality; where we fall short is merely in the matter of quantity, and fortunately that is easily remediable; I sincerely trust that the nation will see to it that it is remedied.

One other reflection and I have done: we beat Germany in war because of our superior productivity; we produced more of the essentials needed in warfare than did our enemies—we produced more ships, more guns, more explosives, more of everything that was required for the successful prosecution of the war, and had we not done so we should not to-day be the victors. What is true of the fierce clash of warfare is equally true of the less spectacular but no less severe competition of peace; if we are to hold what we have gained, if we are to maintain our leading place among the nations of the world, it can only be by maintaining our productive capacity and increasing our outputs. This is a task that cannot be accomplished by scientists and technologists alone; they can but devise and organise the methods by which the work is to be done, but they must call upon the body of workers of the country to execute them. I have worked in many lands and have employed men of many different races and different nationalities, and I can say without hesitation that the British working man has no superior as a workman if he only chooses to work, and I therefore see no reason why he should produce less effectively than any of his competitors. He must, however, be taught to grasp thoroughly the great economic fact that only by the nation's work can the nation's prosperity be maintained. This appears to me to-day to be the greatest and most vital of all the lessons that the war has taught us. We won the war by the huge outputs that our industries were able to produce; in this way and in this way alone can we hold what we have gained through the years of strenuous competition that unquestionably lie before us.

Mr. John Gray (President-Elect), in proposing a hearty vote of thanks to the President for his address, said that Prof. Louis had occupied the Presidential Chair for two years, during which time the country had passed through a crisis unprecedented in the world's history. Consequently Prof. Louis had had a great deal of work to do, in a way which perhaps most of them were unaware of, in presiding over the Council meetings, and he was sure they would all desire to express their gratitude to him for the care and attention with which he had presided over the doings of the Council. His unfailing tact and courtesy to every member, his sound judgment, and the untiring interest which he had always taken in everything connected with the advancement of the Society, had earned him the gratitude of every member. They had listened to a very interesting address from him in which he had given a *résumé* of the great part which the chemical industries had played during the terrible struggle through which we had recently passed. Prof. Louis had taken stock of what the chemical industries had done during the past five years and he thought they would all agree with him that the result of that stock-taking was eminently satisfactory. They had now entered upon the great period of reconstruction, and during that period their activities, which had been so very marked during the last few years, must not be slackened nor cease, otherwise the outlook for the future would be very dark. He agreed with Lord Moulton who had said the other day that we had nothing to fear from any nation; all that we had to fear was ourselves. He hoped that the future of the chemical industry would be bright, and that by doing all that lay within their power the Society would be able to assist the progress of the great chemical industries of the country. He asked them formally to accord the President a hearty vote of thanks for the admirable address he had given them and also for the manner in which he had carried out his onerous duties during the past two years.

Mr. E. V. Evans seconded the proposal. As had been explained, he said, the task of the President had not been a simple one during the period he had held office, but they had heard from the Hon. Treasurer that they had now reached the highwater mark of their difficulties. As a member of the Council he could speak as to the amount of work which Prof. Louis had put into the affairs of the Society. He had very much pleasure in seconding the vote of thanks.

The vote of thanks having been accorded by acclamation,

The President thanked the members sincerely for the manner in which the vote of thanks had been received. He would not conceal the fact that the last two years' work as President of the Society had been distinctly hard, but it had at the same time been decidedly pleasurable, and the Council had shown him the utmost kindness and forbearance in assisting him in every possible way, whilst the permanent officials of the Society had worked most cordially and most loyally in order to keep the Society in the flourishing position in which he thought they could say it was to-day. With regard to his address, he would again like to impress upon them the fact that he had been merely the mouthpiece of the chemical industry. All that he had told them had simply been edited by himself. The contributors were the heads of the great chemical industry throughout the country who had been good enough to furnish him with the material, and if he had not succeeded in interesting them it was not because the material was not of the most absorbing interest. He thought the history of the chemical industries during the past five years would always remain as a brilliant page in the records of the industries of the country. He thanked them sincerely for the way in which they had received the motion.

Election of Auditors.

On the motion of Dr. J. T. Dunn, seconded by Dr. M. O. Forster, Messrs. Price, Waterhouse and Co. were re-elected auditors for the ensuing year.

Vote of Thanks.

The President proposed a hearty vote of thanks to the Lord Mayor for allowing the use of the Mansion House for the meeting that day. It was a signal honour done to the Society. It was a recognition of the excellent work the Society had done and they had been exceedingly highly favoured in being received there.

Mr. L. G. Radcliffe seconded the motion, which was carried unanimously.

Result of Ballot.

The President announced the result of the ballot for the election of Council. Mr. John Gray had been elected President, Prof. J. W. Cobb, Mr. E. V. Evans, Prof. H. Louis, and Dr. Alfred Rée Vice-Presidents, and Prof. W. A. Bone, Dr. C. A. Keane, Dr. H. Levinstein, and Prof. G. T. Morgan ordinary members of Council.

The meeting then closed and the members adjourned for luncheon, by invitation of the London Section.

LUNCHEON.

There was a large attendance of members and guests at the luncheon at the Connaught Rooms, at which Dr. Charles A. Keane was in the chair.

In proposing the toast of "The King," the CHAIRMAN said that for the first time in the history of the Society they had been honoured by the patronage of His Majesty the King on the occasion of an annual meeting. It was a tribute to their labours which would be appreciated by all and they welcomed it as evidence of that greater claim that science was gradually gaining in the affairs of the nation; they should recognise it as an encouragement to their efforts for the future as well as an appreciation of their efforts in the past.

M. PAUL KESTNER, proposing the toast of "The London Section of the Society of Chemical Industry," recalled the very cordial welcome extended to him when he had been the guest of the London Section, at the initiative of Dr. Keane, a week prior to the signing of the Armistice. On that occasion he had been present as President of the Société de Chimie Industrielle, a Society inspired by the same traditions as their own and resolved on collaborating with all its strength in the development and permanent maintenance of the understanding which had been cemented between the two nations on the field of battle.

To-day he was present as a French delegate, with Professor Moureu, to the Inter-Allied Federation. The conversations which he had had on the occasion of his previous visit with Professor Louis, Dr. Keane, and Dr. Miall, and friends from America and other allied countries, had given birth to the idea of the Inter-Allied Federation which brought them together in London. The idea had already been considered by them, and the time for its realisation was at hand. The guiding idea in their minds had been that of creating above all an international organisation for abstracting. The plan was that in each country there would be created in the first place a federation of all the associations of chemistry, pure and applied. Each national federation would have the task of organising abstracting work from all technical publications published in its own country, and those alone. These abstracts when completed would at once be sent to the corresponding organisations of all the affiliated nations. There would thus be the great advantage that each nation could devote the whole of its resources to the preparation of its own abstracts. It was thought that the organisations thus created for a definite and immediately realisable purpose might be the best means of cementing the union between our Societies, a structure to be completed later by the addition of other elements.

The federation was now discussing the problem of co-operation in its full extent on the basis of a very extensive plan. The difficulties which must inevitably arise would undoubtedly be overcome as a result of the spontaneous goodwill and enthusiasm of those engaged in the work.

In the course of this painful but victorious war they had formed a new conception of a European science which should not for anyone of us cease to be a national science, but by reason of its fraternal organisation, its moral purpose, and the ideal of general utility which it set before itself, should stand out in complete contrast to the frightful science of the Huns of which asphyxiating gases and the torpedoing of the *Lusitania* would remain as symbols. They all wished to continue national, but yet to combine in order to place themselves at the service of humanity.

It would be a very great honour for him if he could believe that the unofficial negotiations of last year, the splendid reception which they had extended to him in November 1918, as the President of the Société de Chimie Industrielle, and the reception offered in Paris and in the devastated French regions had contributed in some measure to the magnificent realisation which they greeted to-day.

This Federation of the Associations of Chemistry of the inter-allied countries might come to be, nay, it would most certainly be, one of the greatest accomplishments of the human mind. Their ambition was that pure science, as represented by the academies, universities, and public and private colleges should treat as friends and collaborators the representatives of applied sciences, that is to say, those who transferred into the sphere of industrial realisation the great theoretical discoveries which were the glory of the sciences of the nations.

It would be the honour of the London Section of the Society of Chemical Industry to have been the environment in which so many great ideas would have had their birth. Under the successive direction of men eminent in science and technical practical work, it constituted one of those centres from which a wealth of practical and generous ideas radiated.

He concluded by drinking to the health of the London Section and its distinguished Chairman, Dr. Keane.

Dr. KEANE, replying, said it was at the time of the previous visit of M. Kestner to London, to which he had referred, that the first link in the chain of inter-allied co-operation had been forged. That had developed on the lines indicated by M. Kestner, and it was hoped that it would form a true league of nations for the advancement of the interests of applied and pure chemistry. It had been the understanding on the Council of the Society that the first meeting after the cessation of hostilities should be held in London and it was a fortunate circumstance of the present meeting that they should meet together with the Peace Treaty signed, the celebrations of the great victory in Paris on the previous day, and the prospect of our own peace celebrations at the end of the week. The London Section felt the importance of the occasion and had done its best to rise to its responsibilities. The present meeting stood out from its predecessors in one or two respects as of rather a special character. In the first place it was being held in the City of London, which stood for London as a whole far more than any other part of the Metropolis, and it gave them the opportunity of coming among those who did things rather than who talked about things. This welcome environment should enable them to do their share in what was perhaps the most important national problem of reconstruction, the association of science with industrial development. For the holding of their meeting in London they were indebted to the hospitality of the Lord Mayor of London, and the Salters', Goldsmiths', and Clothworkers' Companies, in whose buildings they were holding their meetings. The meeting was distinguished also by the fact that they were honoured by the presence of many foreign delegates, whom they were delighted to have with them. The Society was also to be entertained at a soirée at the Imperial College for which they owed gratitude to the Director and Governing Body, whilst for the reception at the British Scientific Products Exhibition on Thursday their thanks were due to the British Science Guild. It was the earnest hope of the London Section that the arrangements they had made would effectively promote the work of the Society. The Society of Chemical

Industry had been founded in 1881 under the presidency of Sir Henry Roscoe, to whom they owed a very great debt of gratitude for placing it on a sound basis for subsequent development. The membership now exceeded 5000 and there were 14 Sections scattered over the country, the Colonies, and New York. During the 38 years of the Society's existence, much had been achieved but far more was before it, and the Society as a whole and each Section must use every endeavour to frame a policy in order to bring home to the public the colossal importance of the national services of chemistry. We must not rest satisfied with what had been done. We had captured some industries during the period of the war, but in others we had still much to learn and do, and he hoped that the Society would take an active part in the important developments that were still required.

In accepting, on behalf of the Section, the toast proposed by M. Kestner, Dr. Keane expressed his great indebtedness to the members of the Executive Committee, and especially to Dr. Miall, for their invaluable help in the arrangements they had been able to make for the meeting.

Dr. E. F. ARMSTRONG proposed the toast of "Our Guests." He said that Prof. Louis, in his Presidential Address, when sketching the achievements of British industries during the war, had referred to what might be called new industries; he himself would refer to the existing industries—industries that we had upheld in England before the war against the world and which he believed we would uphold against the world in the future. He regarded those as the industries which counted, not the new industries, and he thought a word was due to the men engaged in those industries. Reference, also, had frequently been made to the Explosives Supplies Department of the Ministry of Munitions and to the work of Lord Moulton, but he thought it was due to many of Lord Moulton's faithful lieutenants that their work should be recognised; he referred to the work of Mr. Kenneth B. Quinan, Sir Frederick Nathan, Mr. Macnab, and many others, all of whom had been members of the Society and had helped it along the difficult path to the top of the hill. There was also the work of the women of the country which should not go unrecognised. In proposing the toast of "Our Guests," he coupled with it the names of representatives of two of our great Allies, Dr. Parsons, of America, and Prof. Béhal, of France.

Dr. C. L. PARSONS, in replying, said that during the short time he had been in England he had come into contact with many things which could not but inspire American chemists. The President's address had made him realise how parallel the problems which had been solved here were with those which had had to be solved in America. He regretted that the two countries had not come into contact sooner on some of these problems, because in many of them Americans had already worked out their own salvation. America having come into the war, it had been his good fortune to come into contact with many chemists from Great Britain, France, and Italy and he wished to pay a tribute to their ability, their spirit, and the activity they showed as well as the help they gave. He particularly wished to speak of Major Auld, who had gone to America in connection with the Gas Warfare Service and had been one of the first liaison officers to work there in that connection. He had quickly won the hearts of the American chemists, for he had brought inspiration, information, and friendship. Then there were Captain Dudley and Commander Coates. Dr. Joseph and Dr. Lowry, who had gone over to America on T.N.T. service together with Major Armstrong, had been of the utmost help in some of the important things they had had to do in supplying the American forces with the necessary science of warfare. He was also glad indeed to know that one American chemist had come over here and given some help. There was one thing they were striving to accomplish in America, and he thought they would succeed, and that was to bring together those who were interested in pure science and those who were interested in applied science. They had convinced the applied science man that it paid him to keep in touch with modern chemistry; and they had convinced the pure science man that something might be gained if his science were made fruitful to mankind, and the two were now working hand in hand. He wished they could have been at the last meeting of the American Chemical Society held in Buffalo; there had been 1100 chemists gathered together. It was the most enthusiastic meeting they had ever had and everyone had been convinced that the future of the chemical industry was bright. At that meeting Dr. Langmuir, of the General Electric Co., gave a paper on the composition of the electron to the pure science section; three or four industrial men happened to be present, and the result was that the industrial division called a special meeting and had that paper on pure science repeated before a crowded meeting. He thanked the Society very cordially for its hospitality.

Prof. A. BÉHAL, speaking in French, also replied, expressing his appreciation of the very cordial reception given to him. He commented on the many advantages of mutual intercourse between chemists of the Allied nations, and expressed his conviction that the proposed Federation of Britain, France, Belgium, Italy and America would be the means of establishing each of the nations in its proper place in the chemical world.

INTER-ALLIED CHEMICAL FEDERATION.

On the afternoon of Tuesday, July 15th, the first Conference was held, the chair being occupied by the President, Professor Henry Louis.

The PRESIDENT, in opening the proceedings, said that the Annual Meeting of the Society fortunately coincided with the visit of a number of foreign delegates who had been good enough to come with a view to co-operating with the British members in the effort now being made to lay the foundation of an Inter-Allied Federation between chemists to carry on in peace the work which they had done so well during the period of the war. He called upon Sir William Pope to read his paper and explain the motives and objects of the Federation.

INTER-ALLIED CHEMICAL FEDERATION.

BY W. J. POPE.

During the last few years a great deal of attention has been given in this and allied countries to the subject of inter-allied chemical federation, and, in opening a discussion which will no doubt deal with many aspects of the subject, it is desirable to point out the reasons which make such federation necessary and some of the objects which federation may be expected to achieve.

Federation calls for the organisation of co-operative effort. The suggestion has been made that the worship of organisation by our recent enemies led to the war and that the extension of co-operative effort amongst the Allies may lead to a decadence of national morality similar to that which has occurred in Central Europe. There is a fallacy in this suggestion and the conclusion drawn therefrom. The history of the last ten centuries shows that every item of progress achieved has been the result of co-operative effort and it would be

difficult to name any essential—material, ideal or artistic—which has not been developed by the intimate co-operation of a vast number of people. Our own subject of Chemistry would cease to exist without the co-operation involved in the establishment of large institutions for teaching and research and in the distribution of new knowledge by our numerous scientific societies; since co-operation accompanies every effort of modern civilisation it may be useful to consider how it may be conveniently organised in connection with chemical science and what useful results it may be expected to yield.

A fairly comprehensive scheme for the co-ordination of scientific effort is at present in course of formation under the direction of an "International Research Council"; this body is the co-ordinating head of a series of organisations each dealing with the international aspect of some specific branch of science. Amongst these the "International Chemical Council" represents our own subject. Each country concerned in the movement has either formed, or is in course of forming, a "National Research Council" which covers the national aspects of science and forms the organising head of the Councils representing the separate sciences. Our own "Federal Council" for Pure and Applied Chemistry will, no doubt, ultimately represent Chemistry as a constituent Committee of the British National Research Council. The Federal Chemical Council is, as is well known, composed of nominees of all the large Societies in this country whose interests are concerned with the various branches of pure and applied chemistry. Whilst the precise terms of constitution of these various bodies are not yet defined it will be seen that the draft scheme, now rapidly approaching completion, aims at the organisation of a network of bodies, each representing one science in one country, and that each of these units is under the ægis of the National Research Council of its own country and is in communication with the body representing its own science in other countries. Thus, the British Federal Council for Chemistry comes under the British National Research Council and is to be brought into communication with the corresponding foreign chemical Councils by forming an integral part of the Inter-Allied Confederation of Chemical Societies or the International Chemical Council.

The events of the last few years have led to certain limitations in the scope of the International Research Council; the work of organisation is now proceeding between the Allied nations, enemy and neutral nations at present taking no part in our deliberations. The whole organisation is thus not international but inter-allied; certain changes in nomenclature may prove in consequence desirable.

Concerning the exclusion of the Central Nations from the "International Research Council" it is interesting to note the terms of an important declaration made by the Inter-Allied Conference on International Scientific Relations held at the Royal Society's rooms on October 9 to 11, 1918. The Declaration is as follows:

"Declaration in regard to Enemy Nations."

"When more than four years ago the outbreak of war divided Europe into hostile camps men of science were still able to hope that the conclusion of peace would join at once the broken threads, and that the present enemies might then once more be able to meet in friendly conference, uniting their efforts to advance the interests of science: for ever since the revival of learning in the Middle Ages the prosecution of knowledge has formed a bond strong enough to resist the strain of national antagonism. And this bond was strengthened during the latter part of last century, when branches of science developed requiring for their study the co-operation of all the civilised nations of the world. International Associations and Conferences rapidly multiplied, and the friendly intercourse between the learned representatives of different countries grew more intimate, in spite of their political differences, which were admitted, but not insisted upon.

"In former times war frequently interrupted the co-operation of individuals without destroying the mutual esteem based on the recognition of intellectual achievements; peace then soon effaced the scars of a strife that was ended. If to-day the representatives of the Scientific Academies of the Allied Nations are forced to declare that they will not be able to resume personal relations in scientific matters with their enemies until the Central Powers can be readmitted into the concert of civilised nations, they do so with a full sense of responsibility, and they feel bound to record the reasons which have led them to this decision.

"Civilisation has imposed restrictions on the conduct of nations which are intended to serve the interests of humanity, and to maintain a high standard of honour, such as the recognition of the sanctity of treaties—especially those designed to apply to a state of war—and the avoidance of unnecessary cruelties inflicted on civilians. In both these respects the Central Powers have broken the ordinances of civilisation, disregarding all conventions, and unbridling the worst passions which the ferocity of war engenders. War is necessarily full of cruelties; individual acts of barbarity cannot be avoided and have to be borne. It is not of these we speak, but of the organised horrors encouraged and initiated from above with the sole object of terrorising unoffending communities. The wanton destruction of property, the murders and outrages on land and sea, the sinking of hospital ships, the insults and tortures inflicted on prisoners of war, have left a stain on the history of the guilty nations, which cannot be removed by mere compensation of the material damage inflicted. In order to restore the confidence without which no scientific intercourse can be fruitful, the Central Powers must renounce the political methods which have led to the atrocities and have shocked the civilised world."

Since this declaration has received very general adherence the question of the ultimate entry of the Central Nations into our organisation would seem to be postponed indefinitely, or at least until a new generation assumes the administration of scientific affairs.

The possibility of the admission of neutral nations into the Confederation has led to much discussion and presents difficulties. Thus, in a subject like astronomy, at present without commercial application, no valid reason seems to exist for not inviting the immediate collaboration of neutral nations—in fact, the only ground for excluding the Central Nations lies in the fact that evil communications corrupt good manners. In a subject like Chemistry, with powerful economic potentialities in peace and immense military applications in war, obvious dangers attend an alliance with nations with whom we are not inseparably bound by the ties created by the spilling of blood and the outpouring of treasure in the common defence. Inclusion in an inter-allied chemical federation should have a large financial and economic value; it is difficult for us to contemplate with indifference the entrance of a neutral nation into the inter-allied chemical federation and simultaneously into the corresponding organisation which will no doubt be created by our enemies. This whole question calls for free and candid discussion and for the earnest attention of the International Research Council.

A few of the advantages to be derived from co-operation may now be considered. In such a science as Chemistry, with its vast ramifications

in both pure and applied science, the utmost need exists for the publications of compendia in which are resumed, within a moderate compass, all the essential details concerning any branch of our knowledge. If it were possible, whenever information was desired on the state of knowledge concerning any chemical subject, to turn to a book of reference with the certainty of finding all the necessary particulars recorded, it is obvious that the velocity of increase of chemical knowledge would be very greatly accelerated. Beilstein attempted to provide such a compendium of the preparative side of organic chemistry and the invaluable character of his Handbook led to its ultimate acquirement by the German Chemical Society; Friedländer's compilation and annotation of patents bearing on the coal-tar colour industry in part also fills a gap. The great fields of physical, inorganic, and technical Chemistry have not yet been summarised and indexed with similar completeness. The establishment of an organisation for the compilation and publication of compendia covering the whole field of chemical knowledge naturally falls to an inter-allied chemical federation; it is a huge task and will call for the co-operative expenditure of vast amounts of effort and money. It is impossible to doubt, however, that its achievement would repay its cost manyfold in the stimulus which would result to chemical discovery.

The whole problem presented by the rapidly increasing bulk of chemical publications is one which urgently calls for attention. Perhaps I may be allowed to illustrate this point by a reference to my own experience. I had the good fortune to fall under the chemical tutelage of a man whose wide and accurate knowledge of original chemical literature was the envy and despair of all who came into contact with him. The desire to have at hand all our periodical literature was thereby inculcated and led to my acquiring complete series of between thirty and forty scientific journals at an expenditure of several thousand pounds and a running outlay of about a pound a day to keep the series complete. Further, it is probably no longer possible for any individual or public body to acquire the complete set of journals which the worker in Chemistry must have at hand as an aid to original research; practically all are now absorbed in our great libraries. One possible remedy for the difficulty which is thus arising seems to present itself.

It is now customary to publish in our great journals all contributions which contain any new knowledge; comparatively few, however, of the many thousands of papers which have been thus published during the last century or so are essential to the worker. An inter-allied chemical council would not encounter great difficulty in selecting all the papers of permanent value which have been published hitherto and presenting them for fresh publication in a new journal; these essential contributions might be published in chronological order with cross-references. Such a publication should furnish a powerful stimulus to original work not only by placing all the past technical literature of permanent value in the hands of the chemist of moderate means but by setting a standard for attainment which could not fail to raise the general level of original chemical research. The need for some re-publication scheme of this kind led, no doubt, to the Alembic Club Reprints; this enterprise, useful as it has been, is not on a sufficiently extensive scale to meet the obvious requirements.

Among the set of journals in which our chemical knowledge is contained an immense duplication of systems of abstracting occurs; many original papers are abstracted five or six times in as many journals. An excuse is often advanced for this duplication by stating that each journal presents in an abstract that aspect of an original paper likely to be of special interest to one particular circle of readers; a little reflection suggests that the excuse is not valid. If an original paper contains matter of purely scientific interest together with matter which is purely technical it may be assumed that the two aspects of the subject presented are intimately related; if the scientific part is disregarded in an abstract for a technical journal it may be concluded that the abstract loses in value to the technical reader. In any case, however, no one can doubt that much money and effort are annually wasted in the duplication of abstracts. All attempts to diminish this waste, and they have been many, have been hitherto futile; one of the great objects of an inter-allied chemical federation should be the organisation of a complete and simple system of chemical abstracts.

It may be noted that the production of compendia and the publication of abstracts are closely interconnected. If an organisation for the production of abstracts were in existence, together with an efficient system of indexing, the production of a compendium of knowledge on any branch of Chemistry would involve little more than a condensed transcription from the index. Much economy could be effected if each chemical journal were to prepare abstracts of all its original papers whilst any one number was in the press and to issue these abstracts to central bureaux established to deal with the editing, translation and publication of abstracts.

In working out the details of any large scheme of publication such as would naturally have to be executed by an inter-allied organisation, one further difficult problem will naturally arise; the question of the language or languages employed for purposes of publication. Hitherto, it seems to have been tacitly assumed that German is the most suitable language for scientific publications; this has always seemed to me an unwarrantable assumption.

The French and English languages are probably each known to a much larger number of people than is German. The two former languages are terse, French by the precision of meaning which attaches to its phraseology and English by its large vocabulary; both seem to be easy to learn badly but very difficult to learn well, mainly because they are largely dominated by that subtle characteristic described as literary style. German seems to be difficult to a beginner but, once the rudiments of the language have been acquired, further progress is rapid; it is entirely devoid of literary style in the sense in which that term is applicable to English and French, and much of the heavy and careless writing found in English scientific journals is possibly traceable to German influence. The Teutonic languages are very voluminous; a comparison of the English and German versions of any document will show that the latter occupies nearly one-half as much again of print as the former. The number of educated persons outside Central Europe who cannot read either English or French and the number who, not knowing these two languages, read German, are probably both negligibly small. It seems to be indicated that simultaneous publication of collective chemical works in French and in English would meet the needs of the whole civilised world, as distinct from Central Europe.

Although but few of the many activities appropriate to an inter-allied chemical federation are touched upon in the present note it will perhaps be objected that the projects foreshadowed are on too large a scale. It must be pointed out that every scheme for continued action on any scientific subject of general importance which has been established in the past has been found, within a very few years, to have been cast in too small a

mould. All our organisations for publication, all our establishments for original research, and all our budgets for financial expenditure, whether of recent or distant date of conception, are so insufficient as to impose serious limitations on scientific progress. No one generation is capable of grasping the effect which the constant acceleration of scientific effort has on the magnitude of the scale necessary to scientific operations a few years later. What would the organic chemists of fifty years ago have said if they had been told that, early in the twentieth century, co-operative effort would be searching the whole world for mineral oil and selling a highly purified, carefully rectified light petroleum at a price considerably lower than that paid for soda-water?

It may also be objected that schemes for federation will cost an enormous sum of money which we can ill afford; it is precisely because we can ill afford fresh expenditure that parsimony is impossible. Should we decide not to undertake heavy financial responsibilities in connection with the extension of scientific discovery it is certain that other nations will embark on a large expenditure for this purpose and just as certain that those nations will receive an ample reward in the intellectual and material benefits which must accrue.

Discussion.

Dr. E. W. Washburn said that before the war, as Sir William Pope had pointed out, we had been content to depend to a very large degree upon Germany for the compendia and compilations of scientific literature. It seemed to him that this was largely due to two reasons. The first was that work of this kind did not require originality or ability of the highest order, and as long as the Germans were doing it the rest of the world had preferred to devote their efforts to work which they considered of greater importance—that of carrying out original research. The second reason was that Germany had educated such large numbers of chemists in comparison with the rest of the world that she had had a large number of men to draw upon to carry out enterprises of the kind. Since the war they had appreciated one of the great dangers of committing to Germany the task of undertaking this field of chemical effort—namely the fact that it was in one respect a subtle German propaganda. The world had come to believe, because of the voluminous character of German chemical literature, and the many undertakings which she carried through in connection with chemical literature, that chemistry was a German science, a point of view which was not at all justified. They now appreciated the necessity of taking over this important part of chemical work and of carrying it out themselves. It seemed to the chemists of America that the most practical method of carrying out the bibliographic work which they had under consideration was not to attempt to finance or direct it, or to control it by a central authority organised under an Inter-Allied Chemical Union, but rather for that Union to lay out the field, to decide the different things which were to be done, and to assign the responsibility for each of the undertakings to the different nations gathered together in the organisation, with the understanding that the editorial and the financial responsibility of each undertaking would be centred in the nation to which it was assigned, and that in carrying out the work each nation would utilise the services of those chemists and investigators who were best qualified to prepare the different sections of the work undertaken. In connection with the subject of chemical abstracts to which Sir William Pope had referred, there were many difficulties in the way of making this undertaking a central international one, and it was these difficulties which, in the past, had prevented any co-operative effort whatever in that direction. In America, however, they felt a great desire to do everything possible to bring about the maximum practical degree of co-operation in the preparation and publication of chemical abstracts with the maximum saving of time, effort, and money, and it seemed to them that the best means of accomplishing this, or, at all events, for starting it, was to arrange a system of exchange of abstracts between the different abstract journals now established or which might be established in the future. For example, suppose it were understood that in England the editor of the abstract journal arranged with those responsible for all publications in the British Isles and with certain selected ones from the Continent to receive from them their page proofs previous to publication, that would immediately effect a saving of time. Then from those page proofs the English abstractors would make their abstracts which would be put into type for the abstract journal, and page proofs of those abstracts, as soon as available, would be sent to America, France, and other countries which had an abstract journal. The editor of the abstract journal in each country would then make use of those page proofs in so far as he found them satisfactory and of the nature which his readers desired. This exchange could be effected between all the countries publishing abstract journals. With an air-mail service across the Atlantic the saving in time would be even greater. At the present time he believed that it took on the average six weeks between the date of publication of a paper in a European journal and that of the publication of an abstract from it in an American journal. By the method of co-operation which he had suggested a great deal of that time would be saved. In America they estimated that the cost of preparing the abstracts was about 20% of the total cost of preparing their abstract journal, and he suggested that as much of that 20% as possible might be saved by some such system of International co-operation.

Professor H. E. Armstrong said that the great importance of the Inter Allied movement simply lay in the fact that they were trying to come together and to work together. He felt that the advantages arising from such an exchange as Dr. Washburn had suggested had been very much under-painted. A system such as he had indicated might very easily be brought into operation with great advantage, both from the standpoint of time and expense if they only had the will to work together. During the past twenty years it had been impossible ever to bring about co-operative action between the Society of Chemical Industry and the Chemical Society of London. Indeed it was only within the last few months that the two Societies had begun to work together with a view to preventing the overlapping of abstracts. Twenty years ago Professor Noyes, the Editor of the American Chemical Society's Journal, and he had tried to bring about a conjoint scheme of abstracting for the two Societies, but had not succeeded in overcoming the opposition to the scheme. The war had done something in the way of forcing them to come together. If the Federation could come to an agreement as to what each of them was to do that would be a great achievement. The necessary funds would be found when the will was there to do the work and when they got the right plan and the right organisation. Sir William Pope had said that German was a language without literary form and that the British style of writing had been spoiled by it. He himself took the opposite view. We had grown slovenly in our style of expression. He held that their mission was to

put before chemists something which would attract them, which would cause them to read, and which would be of some advantage to them as literature.

Dr. J. C. CAIN, referring to Dr. Washburn's suggestion for an exchange of abstracts, stated that as Editor of the "Journal of the Chemical Society" he received at the present moment advance proofs of chemical abstracts from America and that the American journals received advance proofs of the Chemical Society's abstracts. Thus the suggested interchange of abstracts was at present going on in England and America.

Dr. W. P. WYNNE said that reference had been made to the question of compendia and to the efforts which had been made in the direction of supplementing, and, as they hoped, replacing the present imperfect literary form with a better one. It was very difficult to arrange concise compendia of chemical literature and at the same time give them the literary style which they all desired. The models which the German Chemical Society, through Beilstein and others, had given them had, by long experience, been found to be the most convenient for purposes of reference, and that was what was required in compendia—an easy method of reference. The Committee which had been set up by the various chemical societies and societies associated with the chemical industries had drawn up a detailed scheme for preparing these compendia, which would take eight or nine years to complete. If the work were to be done it must be begun at once. He suggested that one of the most important things the Inter-Allied Council could do was to give instructions for this great work to be proceeded with.

Mr. H. HIBBERT submitted that one of the weaknesses in connection with chemical literature was the method adopted in indexing certain journals, which made it difficult to find the facts sought for. He had recently given considerable attention to the art of abstracting or of searching chemical literature. One of the weaknesses of his training lay in the fact that he had never been taught how to search the literature. In a recent article which he had contributed to an American journal on the subject, he had attempted to indicate a general outline of a method which the student could adopt with some idea of assisting him in this work.

Dr. T. M. LOWRY said that one of the subjects on which co-operation was desired was that relating to articles for the supply of stocks of uncommon chemicals from which researchers could draw without having to go back to the original raw materials.

Professor ARMSTRONG pointed out that this matter was under the consideration of a Committee of the General Council.

Sir WILLIAM POPE, in reply, said that what they were all very anxious to do at the present time was to elicit as widespread expressions of opinion and as many suggestions as possible. Referring to what Prof. Armstrong had said on the subject of compendia, he pointed out that Dr. Wynne had probably set a perfect example of what was wanted in his article on "Naphthalene" in Thorpe's "Dictionary of Applied Chemistry," and if it were possible for the whole of chemical literature to be reviewed in a series of monographs of that kind, there would be no need to discuss the question further.

The session concluded with an eloquent address by Professor C. Moureu (President of the Inter-Allied Council), delivered in French, on the life and work of the late Sir William Ramsay.

RECEPTION AT THE IMPERIAL COLLEGE.

On Tuesday evening a large number of members and guests attended a reception at the Imperial College of Science and Technology.

CONFERENCE ON POWER PLANT IN CHEMICAL WORKS.

The first Conference of the Chemical Engineering Group was held at the Salters' Hall on Wednesday, July 16.

The PRESIDENT expressed his great pleasure at being able to open the proceedings of the first Conference of the newly founded Chemical Engineering Group of the Society, which was setting such an excellent example of energy and activity. The work of the Conference was of exceptional interest and came at a psychological moment. In a sense, practically all the work of the Conference was devoted, directly or indirectly, to problems of fuel economy. All who were connected with engineering work in any form whatever were aware of the extreme importance from the technical and commercial point of view of exercising the utmost economy in the use of fuel. Possibly in this country we had not been as careful in that respect as we might have been. He had heard it said that one of our difficulties had been that coal had been too cheap, and consequently we had not treated it with that respect which it deserved. He did not think that reproach would be uttered any more in the future. We were faced not only with a great increase in the price of fuel—that might not be an unmixed evil—but we were face to face with a very serious diminution in the output of coal, and that, on the contrary, was a subject of the utmost gravity. Coal was the only material for export in any quantity that we possessed in this country, and it was only by the utilisation of that raw material that this country could live. The production of coal, therefore, was of the greatest and most vital importance to the whole nation. It was only quite recently that the public had been rudely awakened to the fact that our coal production was falling off seriously. As usual, the British public never saw any trouble coming until it had come. Those who had been in close touch with coal mining had seen this coming for many years. Many of them had said, and had had no hesitation in saying, that the moment the Minimum Wage Act was introduced the coal production would necessarily fall off. Facts had borne out only too accurately the truth of that prophecy, and with every successive increase in the minimum wage there had been a corresponding diminution in output. As far as he remembered, the coal mining industry was the only industry of any importance that had a definitely fixed minimum wage, and in the same way the coal mining industry was the only industry of any importance in which the output per man engaged had been steadily falling off. When faced with these definite facts, it was difficult to avoid the definite conclusion to which they pointed, and he personally was convinced that the low outputs to-day were due to the high minimum wage and to the fact that whether a man worked or not he got his pay. A Durham pitman's explanation of the minimum wage was that it was what they received for going down the pit, and if they wanted any more they must work for it. Many of the miners were quite satisfied with the minimum wage, and as long as that position remained we should be faced with low production. It was the duty of those in the chemical industry to make the best of these conditions, and to see that be the output great or small,

it was utilised to the utmost fraction. That was a big problem, and it was essentially one to which their discussions at the Conference would be devoted. He therefore looked upon the Conference as of importance not only to the chemical industry but to the industries of the nation at large. They had met under very favourable auspices by the kindness of the Salters' Company, one of the ancient City Guilds, who had so kindly placed their magnificent building at the disposal of the Society. These Guilds were Associations of men engaged in some particular branch of commerce or industry who met together and worked together for the common good of the particular industry with which they were concerned. They were perhaps the most democratic institutions that could be imagined. Every craftsman had had a free voice in the conduct of their affairs; in the early days of the Guilds industry was not dominated by a comparatively small caucus, but the entire industry freely and democratically discussed their action for their common good. In many senses these Guilds were the predecessors of our modern Trades Unions, but there was one essential difference —the Guilds punished a man and fined him if he did bad work or did too little work, whilst the Trades Unions fined a man if he did too much! Until the Trades Unions could take a lesson from the old Guilds and act on broad honest democratic lines, we were certain to have difficulties. He believed, however, that gradually and slowly the lesson would penetrate through all ranks in the country. We could not help seeing that the greatness of Britain had been built up by the industries which the old Guilds had erected, and if we wanted to maintain our industries on the footing to which they had been brought by the Guilds we should have to work on similar lines to the Guilds. These two points were necessarily most closely connected. It all came back to the same thing, that if we wanted to maintain our position as a nation we must produce to the utmost of our capacity, and we must utilise what we produced to the very best possible advantage. The first part of the problem was essentially a problem of the worker; the second part of the problem was essentially a problem for the scientist. They had met to discuss that particular aspect of the question, and all the papers which were to be read tended directly or indirectly in that direction. In opening the first Conference of the Chemical Engineering Group he could not do better than call upon one who had had a high reputation for many years as a chemical engineer, and who had shown how to economise and utilise fuel to very great advantage, *viz.*, M. Paul Kestner.

M. PAUL KESTNER said that if his career had been successful it was because of the kind welcome he received in his early days when he used to come to this country as an inventor; he received more assistance and help in this country than anywhere else. One often heard that the English were reserved and conservative, but so far as he personally was concerned he could prove that that was not the fact. With regard to the work of the Group, what would the chemical industry be without chemical engineering? It could be said that the first page of the history of the chemical industry had been written in England. It had had its origin in this country, and yet it was surprising that when English people wrote about chemical engineering matters they very often forgot the names of Englishmen who had helped to found the industry. For instance, the name of Howard, the inventor of the vacuum pan, was most familiar abroad, and yet it was almost totally unknown in England. He was very glad to be present at the opening of this first Conference, to see that chemical engineering was regarded as an important science, and also to wish the new Section of the Society of Chemical Industry every prosperity.

The PRESIDENT then called upon Captain Goodwin to read his paper on "Waste-heat Boilers and Pulverised Fuel in Chemical Factories."

WASTE-HEAT BOILERS AND PULVERISED FUEL IN CHEMICAL FACTORIES.

BY C. J. GOODWIN, A.C.G.I., A.M.INST.C.E., B.SC.

Efficient utilisation of fuel of every kind is an obvious national necessity, and while fuel costs are not always a vital item in the manufactured cost of chemical products, no apology is necessary for examining the possibilities of waste-heat boilers and pulverised fuel in chemical factories. Of their application to steelworks, metallurgical plant, cement works and power stations, much has been written; pulverised fuel in particular is attracting full attention and a report by Mr. L. C. Harvey is shortly to be published under Government auspices descriptive of latest American practice.*

The adoption of scientific and properly proved devices for the reduction of waste is one method of securing higher economy and waste-heat boilers are selected merely as an example; the other method, increase in primary efficiency, is exemplified by the application of pulverised fuel.

Chemical engineers derive neither satisfaction nor profit from general descriptions and comparisons of plant and processes nor would there be room for them in this contribution, but an abbreviated bibliography regarding pulverised fuel is appended for the use of those who desire to study the subject in greater detail.

Part I. Waste-heat boilers.

The waste heat of factory chimneys is often partly recovered in Green or other economisers, while for puddling and other metallurgical furnaces waste heat boilers are being increasingly adopted. The heat from the exhausts of internal combustion engines has, however, frequently been allowed to go to waste, while in chemical factories that in the gases from lime kilns, fusion pots, roasting, reverberatory and other furnaces is but rarely utilised.

The recoverable heat in such "waste" gases depends not only on their temperature but on their average specific heat and the reduction in temperature which is permissible before corrosion occurs. Furnace gases usually consist mainly of oxygen, nitrogen, carbon monoxide, and carbon dioxide, the specific heat of the first three being 0·308 cal. per cb.m.; aqueous vapour may be taken as 0·365 and carbon dioxide 0·411 cal. per cb.m. These figures are fairly correct at about 200° C. and are sufficiently accurate for the temperatures usually obtaining in waste-heat boilers. The available heat from open hearth steel furnaces has been calculated in a different way and very completely by T. B. Mackenzie, who also deals with the theoretical considerations underlying the design of waste-heat boilers,† but otherwise the literature in connection with this subject seems almost non-existent.

The heat in calories, H, available per minute may be expressed by the equation

$$H = S \times Q(T_1 - T_2).$$

S is the average specific heat of the gases in calories per cubic metre; 0·32 may be taken as an average figure in most cases. Q is the quantity of gas in cb.m. per minute, T_1 and T_2 are the initial and final temperatures of the gases in ° C.

If in any particular case it is possible to reduce

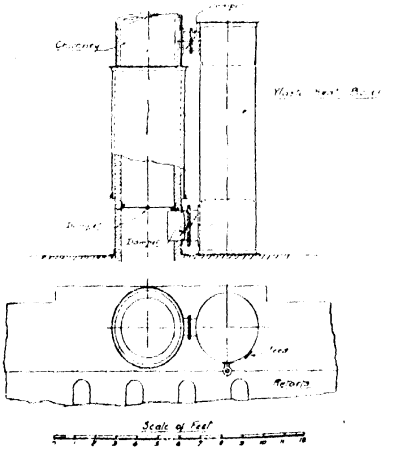
* "Pulverised coal systems in America." Special Report No. 1, Fuel Research Board. H.M. Stationery Office. Price 2*s.* 6*d.* net. (Published since this paper was written see this J., 1919, 190 R).

† J. Iron and Steel Inst. 98, 319–348.

the temperature of the gases below 100° C. a small allowance must be made for the latent heat of vaporisation of the moisture present, which then becomes available. This is possible when the gases leaving the boiler pass through a feed-water heater; to permit of this, induced draught is usually necessary and every precaution must be taken to avoid excessive corrosion in the feed-water heater owing to the low exit temperature of the gases.

As an example from the author's experience, we may take the case of a lime kiln from which 60 cub. metres per minute of gases were discharged at an average temperature of 525° C. As a certain amount of sulphur dioxide was present, it was not thought advisable in the first instance to reduce the temperature of the gases below 210° C., or about 40° C. above the temperature of the steam to be generated. The available heat was $H = 0{\cdot}31 \times 60 \times (525 - 210) = 5859$ calories (23,300 B.Th.U.) per minute. The carbon dioxide in the gases is used in the electrolytic manufacture of sodium carbonate and chlorine, and artificial cooling was necessary before it could be passed into the cells. By passing the gases through a waste-heat boiler having a thermal efficiency of 60% and allowing 7½% for radiation losses, 1700 lb. of steam per hour from and at 100° C. would be generated at a pressure not exceeding 100 lb. per square inch, and the cost of artificial cooling saved. The present cost of installing such a boiler exclusive of pipework etc. would be about £500.

The gas and coke oven industries are probably the principal users of fuel in the chemical industry, and it seems surprising that so little has been done in the past to utilise fully the available heat in suitable cases. In gas works, coke is no longer a drug upon the market and steam is required for producers and various processes. In these and in coke-oven plant working regeneratively, the objection may be raised that if any more heat is taken out of the gases, their temperature would be insufficient to maintain a proper draught; induced draught would overcome this objection, and given suitable conditions for utilising the steam, waste-heat boilers should be quite remunerative after allowing for the power required to drive the fans.



Waste-heat Boiler for set of four continuous Vertical Gas Retorts.

FIG. 1.

Fig. 1 shows one possible arrangement of a waste-heat boiler designed by the Bonecourt Waste Heat Boiler Co., Ltd., and ordered as a trial installation for a standard set of continuous vertical retorts working under natural draught. It will be noticed that by adjustment of the dampers the volume of gas passing through the boiler can be adjusted to correspond with working requirements. The gases enter the boiler at 700° C. and are purposely designed to leave at 300° C. in order to leave sufficient draught in the chimney; a better utilisation of the gases would be possible by using induced draught. A boiler working with the waste gases from a single retort "setting" will give 500 lb. of steam per hour at 100 lb. pressure, so that a gas works comprising, say, 60 retorts could raise 7500 lb. of steam per hour from and at 100° C. in return for a capital outlay of about £4000 and with relatively small operating costs. When the enormous number of gas retorts, coke ovens, and also future low-temperature distillation plants are considered, it is evident that waste-heat boilers should be increasingly adopted in such works and in connection with utilisation of sensible heat in gases produced by the super-power stations and by-product works of the future.

Taking the case of a gas engine, tests made by the Institution of Civil Engineers show that at full load about 38% of the total available heat in the gas is exhausted into the atmosphere and about 30% lost in the water jacket and by radiation. Taking a 1000 h.p. gas engine, the equivalent full load steam production based on 60% thermal boiler efficiency is 2250 lb. of steam per hour, equivalent to about 280 lb. of coal. Allowance must be made for interest, depreciation, maintenance, etc., but taking coal at 35*s.* per ton, and 3500 working hours per annum for the gas engine, the net saving would be about £450 a year on a capital outlay of £600 to £800. An appreciable additional saving can be effected by using the preheated water from the jacket of the gas engine cylinder as boiler feed.

Important advantages are claimed for the "Still" combined internal-combustion and steam engine of which preliminary details have just been published.* The principles involved may be considered as a logical extension of the method of utilising the waste heat from gas engines outlined above, and comparisons of prime and operating costs will no doubt lead to considerable controversy. It would seem, however, that for chemical works where gas engines are installed, the use of a waste-heat boiler is usually to be preferred.

The amount of steam that can be generated in a waste-heat boiler does not vary greatly with the steam pressure required, and the difference between the temperature of the steam generated and that of the gases leaving the boiler varies between 30° and 80° C. according to the type of fire-tube boiler adopted.

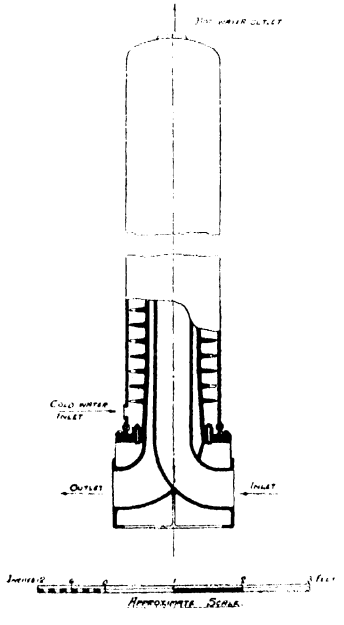
It is not always appreciated that waste-heat boilers present a problem quite different from that of an ordinary boiler, and it is a common fallacy to suppose that the ordinary standard type of water-tube or fire-tube boiler will work really efficiently as a waste-heat boiler. Actually the surface exposed to the gases and the length and number of the tubes used require to be carefully calculated to suit each individual case in order that really good results may be obtained. In the author's opinion fire-tube boilers are usually preferable because it is impossible for air to leak into the waste gases and so cool them. Leakage of air through the brick setting and excessive radiation are, on the other hand, the great drawbacks of water-tube boilers used for the recovery of waste heat, especially when working with induced draught.

The following table in regard to a few sources of waste heat may be useful as indicating what may be possible in analogous cases:—

* Engineering, May 30, 1919, page 708.

Plant	% of oxygen in products	Temperature of products of combustion	Percentage of net calorific value of fuel lost in products of combustion	Probable thermal efficiency of waste-heat boiler at 100 lb. pressure	Probable thermal efficiency at 20 lb. pressure	Minimum ultimate percentage of net calorific value of fuel lost at 100 lb. pressure
Non-regenerative coke oven	10·0	1100°C.	81·0	70–80	72–83	10·9
Regenerative coke oven	10·0	600°C.	42·2	55–65	60–70	10·9
Regenerative open-hearth furnace using producer gas	5·0	500°C.	33·0	48–60	55–67	10·5
Gas engine full load	9·0	480°C.	41·0	47–57	56–66	13·4
Regenerative gas works retorts using producer gas	11·7	410°C.	42·7	35–50	41–61	17·0
Regenerative glass furnace using producer gas	2·9	410°C.	23·9	35–50	10–60	9·4

In chemical processes high steam pressure is the exception, and in many factories quantities of hot water are required or can be efficiently utilised. Waste-heat boilers are therefore particularly suitable for chemical factories. For gas engine installations of less than 100 h.p., the amount of steam that can be generated is usually too small to be of any practical use, but in such cases considerable economies may be effected by installing water heaters instead of boilers. In conjunction with a gas engine, between 10 and 18 gallons of water can be raised from 15° to 90° C. per B.H.P. hour in return for a very small capital outlay. Fig. 2



RUSTON TYPE WATER HEATER

FOR UTILIZING HEAT OF GAS ENGINE EXHAUST

FIG. 2.

shows in part section a "Ruston" type water heater which is neat and simple in design; these heaters should be made of a special grade of cast iron or else "calorised" as described below.

In some chemical factories both high pressure and low pressure steam are often required, the former for power and the latter for evaporation and other processes. Proposals have been made to operate turbines or steam engines with high pressure steam discharging at about 60 lb. per sq. in. for use as low pressure steam throughout the works. The economics of this proposal, by which the turbine or steam engine practically acts as a reducing valve, are somewhat controversial. The use of waste-heat boilers will, however, often reduce the coal bill and save long lengths of steam pipework. Except for purposes of power generation and to keep steam dry, waste-heat boilers in chemical factories should not be provided with superheaters. For normal types of evaporators, heaters, and the like, a slight degree of superheat is only required to compensate for condensation in a long steam pipe line, and it is a common fallacy to imagine that superheated steam is an advantage when used in evaporators. Superheated steam in such cases acts like a gas and the rate of heat transmission is less than when practically dry steam is used, in which case condensation of the steam plays an important part.

On the other hand, high temperatures are required for certain processes such as asphalt melting plant, oil stills, and various kinds of heat treatment. When high pressure steam as distinct from superheated steam is used, the apparatus must be strong enough to withstand the stresses due to the steam pressure, and this often makes design difficult or even impossible. In such cases, the Merrill patent process of fluid heat transmission is often applicable and is mentioned here as it would sometimes come under the category of a utiliser of waste heat. In the Merrill process a highly refined and filtered hydrocarbon mineral oil (free from carbon and having a flash-point of 315° C. and upwards) is continuously circulated through the apparatus and through nests of heating tubes or absorber coils, which latter are either direct fired in a Dutch oven or may be adapted to utilise the waste heat from industrial furnace gases. The efficiency of heat transmission is high both on account of increased "thermic head" or difference of temperature, and because the heat transfer is from a liquid.

The waste gases from many processes contain appreciable amounts of dust or noxious gases. Dust is a frequent source of trouble in waste-heat boilers of the ordinary water-tube or fire-tube type, the dust settling on the water-tubes and brickwork containing them, or tending to choke up the fire-tubes. The obvious remedy is to increase the velocity of the gases sufficiently to prevent deposition of dust, but in the usual types of boilers this is only possible at the expense of efficiency. The Bonecourt Company have overcome the difficulty by using an inner metal tube, as shown in fig. 3, the diameter of which is accurately calculated to give the desired velocity in any given case. The use of the inner tube also eliminates the relatively inactive central core of hot gas and enables fire-tubes of greater diameter to be used. Much will depend upon the nature of the dust in calculating the necessary velocity, which varies between that corresponding to a draught of between 1" and 4" of water. The author has also devised a method of breaking up this hot core of gas * consisting of spirals placed inside the tube at intervals of about six feet, the spiral being made with a pitch decreasing in the direction of the gas flow.

Tubular boilers have been successfully used in conjunction with arc processes for nitrogen fixation, the tubes being unaffected by the nitric oxide present at the temperatures used. For high temperatures, and in cases where sulphur dioxide is present at low temperatures, "calorising" or other

* Eng. Pat. 14,165 of 1915; this J., 1916, 1145.

protection for the tubes is necessary. "Calorised" tubes are now commercially available, the tubes, which may be of steel, copper, brass, or other metal, being heated in stationary or rotary retorts in a reducing atmosphere, with a mixture containing finely divided aluminium. This treatment conducted at a high temperature forms a homogeneous aluminium alloy for a certain depth in the tube varying from a few thousandths of an inch to the permeation of the entire mass. Calorised tubes are almost immune from burning, scaling, rusting, or corrosion, and are likely to find increasing application not only for waste-heat boilers and their feed-water heaters but for pyro-

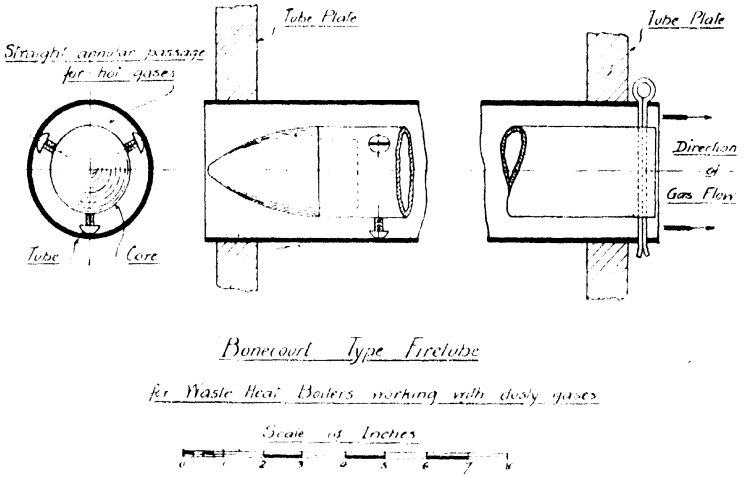


FIG. 3.

meter tubes, furnace castings, and chemical plant generally. Their use in feed-water heaters should in many cases eliminate the danger of corrosion referred to previously and should enable the heat contained in waste gases (particularly where sulphur dioxide is present) to be more completely utilised.

Part II. Pulverised fuel.

The modern tendency in regard to fuel economy aims at the prevention of the use of any coal in the raw state. Distillation of coal is, however, a long way from being universal, and is not usually applicable in the case of inferior or small graded fuel. The use of pulverised fuel in the raw state is essential only in isolated cases such as the cement industry, and while its use will undoubtedly be greatly extended in the present transition period owing to the immediate saving in fuel that can be effected, its ultimate economic value and application lie rather in the possibilities of using inferior fuels, and of such coal and coal dust as have so far been considered commercially useless and have been dumped or left in the mine.

The combustion of pulverised fuel partakes perhaps more of the nature of chemical engineering than the subject of waste-heat boilers, and it is hoped that the following data and general considerations will be of guidance. The subject is such a large one that for the present purpose it was not desirable to do more than bring out salient points and useful facts and figures derived from so many sources that it would be impossible to make acknowledgment to all of them. A considerable amount of new matter has, however, been added together with expressions of opinion in regard to controversial points.

1. *Nature of fuel.* Practically any quality of fuel—bituminous, anthracite, peat and lignite—can b burnt successfully. Choice of fuel is not entirel governed by its cost per unit of calorific value. Th quality rather than the quantity of ash is of th greatest importance, also the sulphur content which should not normally exceed 1%, though a much as 4% and more has been found permissibl under boilers. Bituminous coal with 28% ash an averaging 6% sulphur has actually been burnt i locomotives. 30% volatile and 6 to 10% ash woul be ideal.

2. *Excess air and temperature.* Fig. 4 shows th effect of excess air on the calculated temperatur attained in burning carbon, the figures being due to H. G. Barnhurst. In a hand-fired grate 100% to 200% or even more excess air is required and about 50% with mechanical stokers. With pulverised fuel about 20% is practically standard and

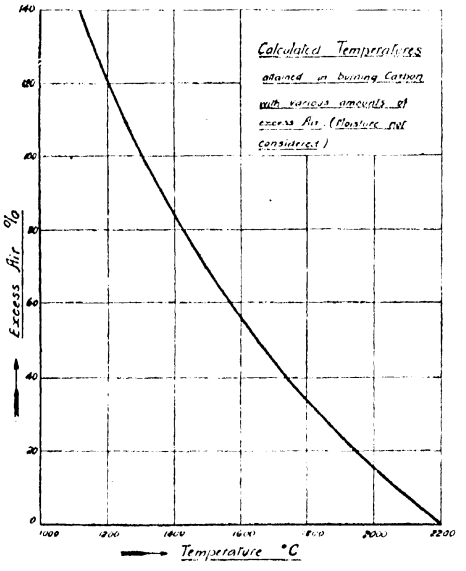
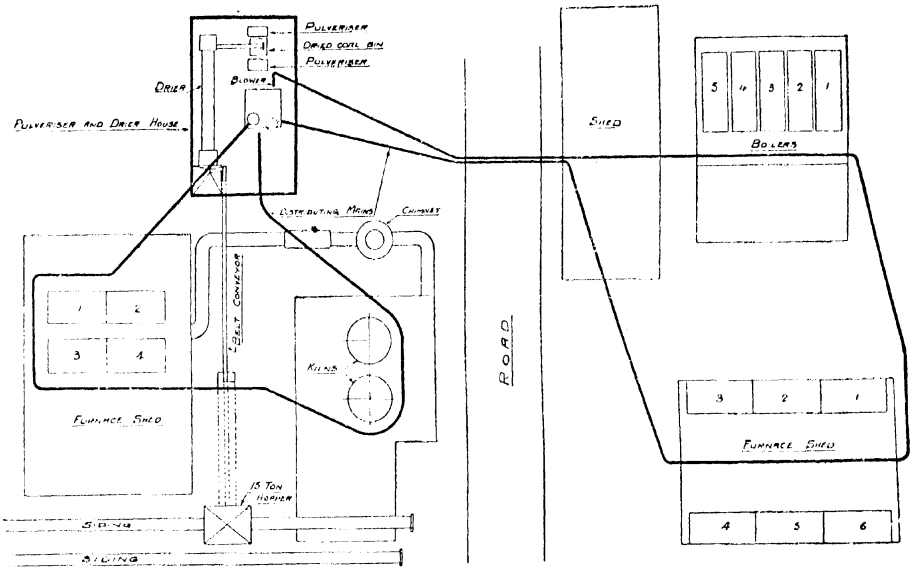


FIG. 4.

considerably less can be used with careful control. The carbon dioxide content of the flue gases when using the theoretical amount of air is 20·7% and

the loss in efficiency when this is reduced to 11% is only about 5%. Further reduction in the CO_2 content entails rapidly increasing loss in efficiency, the loss being as high as 25% of the total fuel burned when the CO_2 content falls to about 6% as in hand-firing practice. With powdered fuel 15% CO_2 represents good average practice. Similarly the higher flame temperature is obviously conducive to more rapid heat transference and therefore higher efficiency. With inferior fuels containing considerable percentages of ash the flame temperature and efficiency are materially reduced and, as previously stated, particular attention must be paid to the quality and properties of the ash and to its action on the brickwork. In fact, before using inferior powdered fuel, very thorough investigation, particularly as regards prime and operating costs, is essential. In regard to the measurement of CO_2 content it should be noted that for controlling the combustion of pulverised fuel it is simpler to measure the volume of air used than to take the CO_2 content of the chimney gases, as the variation in the latter is much less in proportion.

moisture, but it seems well established that apart from inconveniences such as the possibility of freezing and agglomeration during storage, the loss of efficiency due to vaporising and superheating the extra moisture content in the furnace counterbalances the fuel required for drying. The overall cost of drying, however, is greater than the value of the heat lost in vaporising the moisture in the coal, and drying is mainly justified by the necessity of this operation for satisfactory pulverising, transportation, and storage in large plants. Actually if 2% of moisture is removed from the coal by drying, this is only equivalent to about 25% of that contained in the air used for combustion (based on the yearly average) and (allowing for the latent heat of vaporisation which has to be imparted to the moisture content of the coal) may be taken as roughly equivalent to that contained in the combustion air. It follows that for small self-contained pulveriser units, the cost of drying is not usually justified. This point is emphasised by tests recently carried out by E. R. Knowles on an "Acro" self-contained pulverising unit of 5000 lb.



TYPICAL LAYOUT OF PULVERISED FUEL MAINS

C.J.G. 15/9

SCALE OF FEET 0 10 20 30 40 50 60 70 80

FIG. 5.

Modern refractories are now able to cope with the high temperatures obtaining in the combustion chambers without artificial cooling devices such as embedded cooling coils or secondary air blasts. Zirconia bricks will probably be of great value. Correct proportioning of the combustion space is of vital importance, and about 1 cubic foot is usually required for every 3 lb. of coal burned per hour.

3. *Pulverising.* 95% through 100 mesh and 82 to 85% through 200 is now practically standard. The average fineness is 600 mesh or less and the surface exposed to oxidation or combustion is about 26 square feet per pound; combustion is therefore almost instantaneous. Pulverised coal weighs between 38 and 45 lb. per cub. ft. and has an angle of repose of 15°—20°

4. *Drying.* The moisture content is usually reduced to at most 1% before use. It is quite possible to burn powdered fuel containing 4% of

per hour capacity. It was found that coal containing 4% of moisture (of which ½% was combined moisture) was delivered to the collector with only ½% of moisture or entirely free of surface moisture, the latter having been absorbed by the air during pulverisation. In another test wet coal containing 16·4% of moisture was delivered to the collector with only 4·4% of moisture. It should be noted that such results can only be obtained by air separation as moist coal would choke up any screening device.

5. *Ash.* Of the ash content 65% can be collected as fused or semi-fused slag and may be run into a water-filled pit; "hard" and "soft" clinker are removed by blowing in steam occasionally or by mechanical means. The remainder of the ash probably goes up the chimney as a very fine white powder, which seems to cause no inconvenience in large towns.

6. *Costs and efficiencies.* With power at say 0·7*d.* per kw. hour, pulverising varies from 1*s.* 6*d.* per

ton for a 10-ton per hour plant to 2*s.* per ton for a 2-ton plant. Labour represents about 4*d.* in the former and 9*d.* in the latter case, two men being required for either.

A rotary dryer 6 ft. in diameter and 35 ft. long will dry about 10 tons per hour of coal of ¾" and under to about 0·5% moisture, using about 2% of fuel. If the furnace is close to the pulverising plant the waste gases can be used for drying the coal.

Inclusive of unloading, screening, removing "tramp iron," drying, grinding, and conveying to the furnace 2*s.* 6*d.* per ton would be an average figure (including wages) for preparing the fuel in a large plant. Against these costs economies in fuel of between 15% and 30% have been realised, the saving being even greater when a comparison is made between pulverised coal and producer gas in open hearth and other steel furnaces.

The cost of installation is about the same as for a producer gas plant of equal capacity, and according to a British quotation received in April 1919, a plant to burn about 20,000 tons of pulverised coal per annum would cost about £14,500. The total operating cost including depreciation, interest on capital, insurance, taxes, wages, etc., would be about 3*s.* 6*d.* to 4*s.* per ton of fuel exclusive of the cost of the fuel. 15–25 kw. hours are required per ton.

General considerations. Pulverised fuel is almost comparable in use and convenience to fuel oil or industrial gases, and combustion is smokeless and very complete. Temperature control and variation are easy, the desired temperature is very quickly attained, there are no stand-by losses, or loss of fuel as on a grate when a furnace is stopped, there is less ash left for disposal, and overloads up to about 200% can be quickly met. For chemical and metallurgical work it is possible to maintain either an oxidising, neutral, or reducing atmosphere. Screenings and coal dust can be used to advantage in the powdered form and no grading of coal is required. Apart from the possibility of using coal of inferior analysis, the author has suggested* that the semi-fuel resulting from low-temperature carbonisation, and particularly the dust inevitably resulting during transport owing to its rather friable nature, should be utilised in powdered form; it might also be possible to carry out low-temperature distillation of coal in pulverised form and then to burn the resulting semi-coke in pulverised form, the waste gases from the latter process being used to provide a neutral atmosphere for carrying away the products of distillation and to keep the powdered coal in suspension.

The three chief types of powdered fuel plant are:

(*a*) Screw conveyor systems combined with storage bins and fans at each furnace unit.

(*b*) Combined pulverisers and fans on the induced draught principle, one unit being provided for each furnace unit; (*a*) and (*b*) are particularly applicable in power plant, steelworks, etc., where the units to be heated are large and are conveniently placed in relation to each other, though very small units have also been successfully used.

(*c*) The "pneumatic" system, in which the pulverised fuel is carried in air suspension in a closed circuit and simply tapped off as and where required to units of any size. This system is probably that most suitable for chemical works, as it enables the pulverising plant to be concentrated and avoids the transport and storage of fuel throughout the plant. The maximum practicable distance of transmission from the central pulverising plant is about 750 feet, but by inserting a booster blower in the main or by providing sub-stations, the distance can be increased to cover a very large area.

The amount of "primary" air used for "carrying" the pulverised fuel is about one-half that required for combustion, the balance being admitted at the furnace unit from a secondary air main. It is important that the amount of primary air should be less than that giving an explosive mixture.

Fig. 5 shows a typical lay-out; the absence of the special fuel handling and distributing appliances and facilities which often take up much valuable floor space in a chemical works will be noted.

Colloidal fuel. When pulverised fuel is added to fuel oil together with about 1% of a "fixer," the latter causes the powdered fuel to remain in a state of suspension for a month or more. The resulting fuel can be burnt in exactly the same way and in the same burners as the original fuel oil. Various mixtures of this kind have already been successfully tried, using inferior materials such as coke, coal containing 25% ash, anthracite "culm" or washings, crude oil coke, coal tar, petroleum pitch, wax tailings, etc.†

The calorific value of one gallon of colloidal fuel is equal to or greater than that of the original oil, while at the same time the sulphur content is reduced.

Further research in colloidal fuel and in regard to the fixer presents a good field for the engineer in connection with the utilisation of waste products, and while during the war [illegible] fuel has been mainly of interest for [illegible] marines and patrol vessels, the prospective supply of Derbyshire may render its use profitable in industry, particularly if, as is probably the case, it can be used for raising steam in the vitesse-Boucocourt" gas-fired type of boiler. Sufficient modified. It is also within the bounds of probability that powdered fuel can be burnt in suitable boiler using say a zirconia refractory filling. The difficulties in design are, however, very great.

Application in chemical works. Apart from boiler plant, pulverised fuel should be applicable in many cases where industrial gases are now used, and in reverberatory and roasting furnaces of all kinds. The experience gained in cement works will find due application in other rotary kilns such as those treating greensand and felspar for potash recovery, alunite, bauxite, etc. Mechanical salt-cake furnaces, sodium sulphide furnaces, roasters, dryers, oil stills, oil cracking processes, and many other heat treatments readily suggest themselves, and in these days of accurate and scientific control the use of pulverised fuel presents undeniable advantages. Perhaps the greatest attraction is the possibility of materially reducing the number of operatives, two men being able to attend to several units, manual labour being practically eliminated, and supervision and cost-keeping simplified.

Coke is largely used in chemical works, and the mixing of coal of high volatile content with coke readily suggests itself. It is universally stated that powdered coke has been tried and cannot be used as a fuel. This, in the author's opinion, is, however, too sweeping a statement, and further trials under correct temperature and other conditions should be well worth while.

In a Belgian factory, powdered coal was used for making sodium aluminate from a mixture of bauxite, sodium sulphate, and carbon, a neutral or slightly reducing atmosphere being necessary. The supply of coal having been cut off temporarily, powdered coke was tried and found quite satisfactory provided that the combustion space was kept nearly white hot. For starting up, coal was essential, but this example seems to show that,

* This J., 1918, 219 T.

† Submarine Defence Association, New York. See this J., 1919, 165 R.

using high-grade refractory linings, powdered coke may have possibilities in other processes.

General notes. In connection with the use of waste-heat boilers in conjunction with furnaces, the point is often made that the boiler would be idle while the furnace is not in operation. This may be overcome, though with some loss in efficiency, by providing an auxiliary powdered fuel burner and if necessary a combustion chamber for the waste-heat boiler, the powdered fuel being turned on when the supply to the furnace is shut off, or when the rate of steaming requires to be increased.

In conclusion, a suggestion as to the possibility of the *combined* use of pulverised fuel and waste-heat boilers in chemical works may not be out of place. Fig. 6 shows in diagrammatic form a water-tube boiler fired with pulverised fuel directly connected to a waste-heat boiler and feed-water heater. By allowing the products of combustion to leave the water-tube boiler at a temperature about 200° or 300° C. higher than is usual, and then fully utilising the remaining available heat in a well-designed waste-heat boiler, a greater overall thermal efficiency, together with increased output and overload capacity at a lower cost per unit of steam generated, would be attained than in a single boiler unit of standard type fitted with, say, a Green's economiser. The calculations in support of this contention are, however, outside the scope of this paper.

The suggested combination is one peculiarly suitable for chemical works, as the water-tube boiler could supply high-pressure steam for power at say 300 lb. pressure, while the waste-heat boiler would furnish low-pressure steam for evaporation and processes. The high-pressure main would be connected to the low-pressure main through a reducing valve and thus act as a stand-by. The waste-heat boiler in this case would be of the double tube type previously referred to in order to prevent deposition of dust from the powdered fuel.

This arrangement presents a further advantage in that very pure water is only required for the water-tube boiler, to which the condensed steam from turbines or the like is returned. The condensed steam from evaporation and process work cannot usually be returned to the boiler and the ordinary sources of water supply can therefore be used for the waste-heat boiler.

This combination is, of course, also possible with Lancashire and other types of boiler. Sudden demands for steam may be met by increased fuel supply and by reduced feed-water supply to the waste-heat boiler.

While it has been impossible to do more than touch upon the fringe of these subjects, it is hoped that this contribution will have demonstrated that waste-heat boilers, and particularly pulverised fuel, can, given suitable conditions, be successfully utilised in many chemical works and both in small and in large units. It is for the works manager and chemical engineer to take stock of their possibilities during the period of reconstruction and thus to co-operate in the national need of fuel economy.

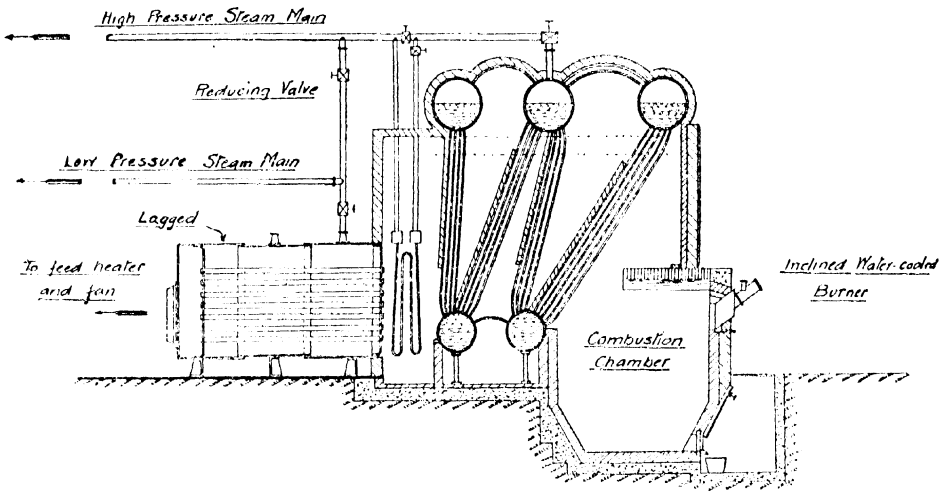


FIG. 6.

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DISCUSSION.

Captain GOODWIN, in the course of some supplementary remarks, said he thought that the gas industry would probably do its full share as regards economy in the present altered circumstances, but would this be the case with the rest of the chemical industry? In the future chemical factories would be judged by what they did both in the national as well as in their own interest, and at the latest price for coal every source of waste heat might be worthy of serious examination. As an extreme case, even the water used for cooling powdered-fuel burners should be utilised. When waste-heat boilers had been first thought of, the chief principle in regard to their use had really been non-interference with the operation of the primary furnace, particularly as regards chimney draught. Experience had shown that induced draught not only paid, but was conducive to regularity and convenience in working.

The use of powdered fuel had long been considered a failure in this country, because except in cement works it was not properly understood and the principles of its application had not been thoroughly worked out by chemical engineers. As in America alone 11 million tons was burned annually, it was now evidently a serious factor, although in this country we should have to confine our attention chiefly to semi-fuels, to anthracite dust, inferior coals, and lignite. Maximum flame temperature was of great importance and was affected by moisture content as well as by ash and excess air. Thus in the "Aero" pulveriser, in which the coal was dried during the process of pulverisation, the whole of the moisture was not eliminated as in a dryer, but went forward with the fuel into the furnace, so that only the heat of vaporisation was saved at the expense of a reduction in flame temperature. He had referred to the "compound" boiler installation with some diffidence, but the analogy between this and the compound steam engine and its economy was evident and encouraged him to make the suggestion, whatever its result might be. As an alternative to the use of an economiser and perhaps a waste-heat boiler, it was possible to pass furnace gases through a recuperator or brick regenerator in which the secondary air for powdered fuel burning was preheated before entering the furnace. Whilst the efficiency of the arrangement would be lower than that of a good waste-heat boiler, the scheme had some possibilities where low-pressure steam or additional steam was not required.

Dr. W. R. ORMANDY, referring to the attitude which science was taking in the matter of fuel, said that in a recent speech Mr. Smillie had referred to the fact that we were using our fuel badly, and adopted that as an excuse for extorting special terms. Reference had also been made frequently to the possibilities of saving fuel if electricity were utilised on a large scale. The reports on this subject were merely preliminary and were open to much controversy, and it was important to exercise the greatest care in making any statements as to the economies which might be effected, because they might be used in the wrong way. It was true that a great deal of fuel had in the past been and was to-day being used uneconomically, but it was also true that a vast amount of this fuel had been wasted because there was as yet no prospect of being able to use it more economically. It was stated, for instance, that the efficiency of using fuel in a glass-melting furnace was something of the order of 2%, and that a very large proportion of the heat was radiated from the face of the brickwork of the furnace, but that if any attempts were made to stop that, the brickwork would fail in a short space of time, and although heat was wasted, there was no immediate prospect of saving it. Much had been said about the waste of fuel in steam raising. It had been his duty to examine the efficiency of many scores of large ranges of steam boilers for the Bradford Dyers and Fine Cotton Spinners for large industrial works in the North. In almost every case these large concerns had economisers and superheaters, but one source of economy that should be aimed at was keeping up the CO_2 percentage above 10%. The power required for the induced-draught fans for a range of boilers was very considerable, and it required very careful examination to find out at what point it was worth while putting in induced draught. If, on the other hand, induced draught enabled the use of a fuel so low in grade that it could not be used on the ordinary type of stoker, then there was much in its favour. Some collieries in the North were now using roofing shale containing 55% of combustible matter which it would be utterly impossible to use without induced-draught plant. So far the only application of powdered fuel in this country had been to cement-burning in rotary kilns. We required much more information with regard to the grade of fuel which could be used. For instance, if it were possible to use a powdered fuel which had previously been subjected to low-temperature distillation, it opened up great possibilities. Low-temperature distillation of a low grade fuel was in many cases rendered uneconomical because, though the apparent value of the oil might be considerable, it was not sufficient to pay for the entire cost of the process, and some use must be found for the high ash residue; but if that residue were easily pulverisable and could be used in the form of powdered fuel, it opened up the possibility of a combined low-temperature process which would enable a large amount of fuel now wasted to be made use of; the smoke problem in that case would be a difficulty, however. The question of the utilisation of comparatively low-temperature gases seemed to him to be bound up very closely with finding some metal or alloy or some method of treating metals which would make them resistant to sulphur dioxide, because the lower the grade of the fuel the more certainty there was of producing large amounts of sulphur dioxide. The temperature of the exhaust of gas engines was also one that should be considered in that connection, because it seemed to him that for feed-water heating and industrial purposes there was an advantage in low-temperature heat. Finally, he asked the author whether he had any records as to the temperature that could be obtained in brick-kilns or pottery furnaces, such as those of the Hoffman type or even down-draught furnaces, using coal-

dust fuel with cold air, and alternatively with hot air, assuming the fuel used to be of a good average calorific value.

Mr. L. C. Harvey said that the principal difficulties with regard to the use of powdered coal had been primarily the accumulation of ash and slag and the cutting away of the refractory brickwork. These were the two chief objections, especially in boiler work, but with modern types of pulverisers these two defects had been entirely overcome. Boilers now were being fired with pulverised coal very successfully indeed, straight line efficiencies of 75—85% being obtainable with fuels which had not been previously usable either with mechanical stokers or with gas producers. Sir Auckland Geddes had stated recently that a loss of 7*d*. per ton on coal delivered in London was due to the loss of smalls. The smaller the coal the better it was for pulverisation, and all that loss in coal delivered in London could be utilised in that form. A considerable quantity of dust and almost what might be called dirt was still left at the mines and was not a saleable fuel. In America during the last two months the lowest grade of fuel, anthracite slush or pit washings, containing less than 5% of volatile matter and 25—30% of ash, had been dried and pulverised and used at the Susquehanna collieries; the results with this fuel were so good, showing a boiler furnace efficiency of 80%, that the new boiler houses of about 4000 H.P. at their collieries at Lykens and Lytle, Pa., were now being fitted entirely with pulverised coal burners and in this way they would only use pulverised slush which previously had been valueless. There was no doubt that we had used our fuels very wastefully indeed, but not more so than the Americans. In this country, in the puddling furnace industry, the fuel consumption was usually 3000 lb. of coal per ton of puddled iron, and nearly all the furnaces were hand-fired. In America, however, puddling furnaces had been converted for use with powdered coal, and the fuel consumption of 3000 lb. and sometimes 3500 lb. had been cut down to 1200—1600 lb. per ton of iron. At the same time five complete heats of puddled iron were obtained per shift instead of four, and without the production of any smoke whatever. The puddling furnace in this country had perhaps been our worst offender for smoke production. Under the old system of using powdered coal with high velocity gases, much of the fine dust which did not fuse in the combustion chamber was taken through the furnace or the boilers at high velocity and up the stack and deposited in the district. One of the secrets of success at the present time was the low velocity of the primary air and therefore low velocity of the gases through the boilers or furnaces, so that 60 or 70% of the ash should be deposited in solid or liquid form in the combustion chamber, 20 or 30% being deposited either in the furnace or on the boiler tubes in the form of very fine dust, ash, or slag, and not more than about 2%, consisting of the finest dust, would be emitted from the stack. There were in America numerous examples of successful installations for re-heating steel and for puddling iron, in which the capital outlay of the pulverised fuel plant had been paid out of profits during the first twelve months. Even so people over here were slow to consider the question. In chemical works one of the deterrents to using pulverised fuel was the cost of the plant, but it was quite probable that very shortly small consumers would be able to purchase pulverised coal and only have to instal in their works self-contained automatic feeder and burner units. These machines were working very satisfactorily in America and they required very little manual attention, and for chemical processes the temperature could be regulated automatically by a thermostat control, so that once the canister of fuel was on the hopper the subsequent operation was automatic. In 1903, with coal at 7*s*. 6*d*. per ton, a pulverised coal installation burning 250 tons per day would have shown a net profit, after deducting all expenses, including interest and depreciation, of £1875 per annum. At the present time, with coal at 30*s*., for the same size plant the saving would be £21,562.

Captain F. S. Sinnatt thought that powdered fuel had a very great future in regard to the utilisation of material in Lancashire that could not be used at the present time, and was being wasted day by day because it was not thought worth while to recover it. In one case the whole field was covered with a fairly good cannel with from 20 to 60% of ash. An attempt had been made during the war to use it for low temperature distillation, but it had not been the complete success anticipated; the fuel was very easy to grind. Soft coal was extremely difficult to grind.

Mr. H. M. Ridge said that the installation of waste-heat boilers was not a panacea for all evils for those who wanted steam or who had waste heat. He believed that the best economy of coal was obtained by restricting the heating use to the primary object which was desired. Take the case of the puddling furnace. If an excessive quantity of coal were burned in the puddling furnace an excessive quantity of waste gaseous products was produced, and then sent through a waste-heat boiler to recover the heat units. That, however, was not the primary purpose. The puddling furnace should be worked properly, and it should not be attempted to make steam in the same operation. If the waste gases were leaving the furnaces at anything like a high temperature the heat units in the waste gases should be recovered and sent back into the boiler by pre-heating the secondary air. In a recent case in which it had been desirable to reduce the consumption of coal as far as possible, the operation necessitated the waste gases leaving the furnace at a temperature of about 1300° or 1400° C., and they were being utilised for pre-heating the secondary air, thus reducing the temperature of the stack gases to about 250° C. That gave a financial result which it would have been very difficult to obtain if these very hot gases had been passed into waste-heat boilers. Whilst in the case he had referred to the quantity of gas was very great, he had done the same thing in a number of installations working on a comparatively small scale, using one or two tons of coal per 24 hours. It was possible, and in a number of cases in this country it had proved satisfactory, to pre-heat the secondary air and to obtain a good efficiency. In certain cases of which he had careful fuel records, the waste gas left the furnace, say, at 1000° C., and sometimes up to 1150° C., the secondary air being pre-heated to between 600° and 850° C.; the reduction in coal consumption had been more than 50%. That had been done in counter-current recuperators because with such a comparatively small coal consumption it did not pay to put in regenerative furnaces with reversing valves, etc. Whilst it was possible to save and use heat units that would otherwise be carried away in the waste gas, there were a very large number of cases in the country requiring further research work, such as the cases in which the gas was very dirty and carried a large amount of very finely divided dust during the first portion of the temperature drop. Finally, he would like to refer to a remark made by Mr. Ingalls about three years ago in "The Engineering and Mining Journal" of New York. He had pointed out that it was not a desirable thing to burn an excessive quantity of coal or producer gas in a furnace in order to get a large

quantity of steam, and he emphasised the desirability of restricting the furnace to its proper use and putting the boilers somewhere else. He quite agreed with that, but one disadvantage of waste-heat boilers was that after any stoppage, if waste gas only was being used for heating boilers, it was not possible to get steam at the beginning when it was most urgently required, and it was necessary to put in subsidiary power arrangements to overcome that difficulty.

Captain GOODWIN, in reply, said he would answer some of the points raised in writing. In a large proportion of chemical factories the greater part of the steam was required for process work, and, in spite of what Mr. Ridge had said, it did sometimes pay to burn extra fuel at one end in order to get steam at the other. At the same time he did not mean to indicate that a chemical factory should not look to the primary efficiency of its furnaces. With regard to induced draught, he reminded Dr. Ormandy that in a powdered coal furnace only about 1/10th inch water gauge was necessary, and with a properly designed waste-heat boiler the means to provide the draught needed did not require anything like the amount of power which Dr. Ormandy had suggested was necessary. He had referred in the paper to means by which corrosion from sulphur dioxide could be prevented, and he did not agree that an alloy would be found which could be used. He believed the solution would lie in coating, and "calorising" had already been successfully applied in soot blowers for boilers and the like. He agreed with nearly everything that Mr. Harvey had said. It was of very great importance that a curve of efficiency showing 75—85% could be obtained in a powdered coal installation at almost all loads between 25% and 200% or more of full load, whereas mechanical stokers lost in efficiency and reliability under overload conditions. He thought that smalls and particularly dust from the semi-fuels of low-temperature distillation should be collected by a central organisation in every large town and burnt in powdered form. He agreed that the velocity of the gases must be low in the boiler and in the combustion space, but it was quite permissible to use a higher velocity in the waste-heat boiler. Mr. Ridge had said that more heat ought to be extracted in the puddling furnace, but more heat could not be extracted there, because the temperature required was so high. He also did not think that 250° C. was a low enough temperature at which to send the gases up the stack; 160° C. would be more satisfactory.

In his written communication, the author pointed out that puddling furnaces and boiler plant *per se* did not really come within the scope of his paper. It was not now correct to say that cement works were the only ones using powdered fuel in this country. There could be no doubt that semi-fuel from low-temperature distillation could be successfully burnt in pulverised form and he did not agree that there would be any difficulty in regard to smoke, as combustion would be practically perfect. "Blending" of fuels might be desirable in some cases. Temperatures sufficiently high for the heat treatment of steel were obtainable with powdered fuel and there should therefore be no difficulty in meeting any reasonable requirements of brick and pottery furnaces; no data were yet available and the conditions, particularly in pottery furnaces, were rather special.

Mr. Ridge did not state the thermal efficiency of the recuperators used; a good waste-heat boiler had an efficiency of over 80% at the temperatures given, or nearly double that obtainable in regenerative working. A low stack temperature was of no value if the heat of the gases was not recovered efficiently.

Dr. M. O. FORSTER then took the chair.

DIFFERENTIAL PRESSURE METERS FOR MEASURING AIR, GAS AND STEAM FLOWS.

BY JOHN L. HODGSON.

(1) This paper contains a summary of the more interesting features of the metering problems mentioned in the title. A fuller treatment of many of the details will be found in the author's paper on "The Commercial Metering of Air, Gas and Steam" (Proc. Inst.C.E., **204**, [ii.]).

(2) The differential pressure required to actuate the indicating or recording devices is obtained in the meters for which the author is responsible, either by means of a constriction placed in the pipe line, or by means of a special form of Pitot tube consisting of a cylindrical rod, at one end of which two pressure holes are bored, the one facing exactly upstream, and the other exactly downstream. These pressure holes are connected by means of suitable passages and pressure pipes to the indicator or recorder. The Pitot tube is inserted in the main so that the pressure holes are at the centre of the main.

The velocity in feet per second, V, of the central filament may be computed from the formula

$$h = \frac{WV^2}{158} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where h is the observed difference of pressure in inches of water, W is the density of the fluid in pounds per cubic foot, and 158 is a coefficient determined by experiment.

When applying this formula to the measurement of the volume passing, due allowance must be made for the distribution of velocity over the cross section and for the diminution in the area of the cross section caused by the insertion of the tube.

There are various forms of Pitot tubes on the market which purport to average the velocity over the cross section by using a number of holes instead of one central hole. Investigation, however, will show that the average velocity over the cross section cannot be obtained in this way if the distribution of velocity is irregular. The Pitot tube should therefore always be installed with good upstream conditions, or if these cannot be obtained, a traverse should be taken in two directions at right angles.

(3) From the point of view of the indicating or recording instrument, the Pitot tube has, in spite of its simplicity, two important defects. (*a*) On account of the low velocities commonly found in air and gas mains, the differential pressure produced is usually very small. (*b*) Owing to the fact that the maximum differential pressure produced depends on the maximum velocity in the pipe line, and that this varies in practice between very wide limits (*e.g.* 15 feet per second in a gas main to 300 feet per second in a main carrying superheated steam) the indicating and recording instruments would, if the Pitot tube were used as the basis of the measurements, have to be designed to deal with the numerous maximum "heads" from the most minute upwards, or else the diameter of the pipe line would have to be altered at the point where the Pitot tube was inserted in order to obtain a reasonable uniformity in the maximum heads dealt with.

Because of these defects, the author has developed only one instrument for use with the Pitot tube; the differential pressure in all other cases being obtained by means of constrictions placed in the pipe line which can be designed to give the differential pressure required by the instruments over a very large range of maximum velocities.

In addition to the above defects, the Pitot tube is much more dependent upon good upstream conditions than a constriction is.

(4) The instrument developed for use with the Pitot tube is termed the "curved tube" manometer

(see fig. 1). It consists of a reservoir containing oil which is connected to the upstream pressure hole, and a curved tube connected to the downstream pressure hole, and so shaped that equal increments in the velocity past the Pitot tip will cause equal movements of the oil meniscus along its length. The manometer is so designed that it can be supplied to work at any maximum head between 15 and 120 mm. of oil. Owing to the equal-spacing scale, accurate readings can be taken down to 1/9th or 1/10th of the maximum flow.

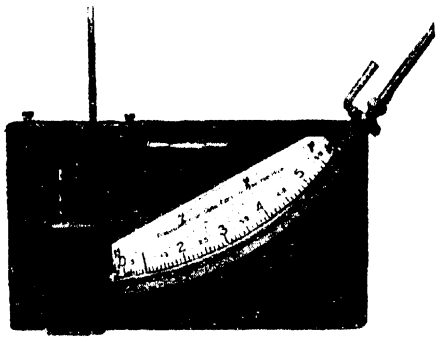


FIG. 1.

A larger type of the same instrument is now being developed in connection with high pressure gas distribution which will enable accurate readings to be taken down to 1/20th of the maximum flow.

The "curved tube" manometer can, of course, also be used in connection with the constrictions described later.

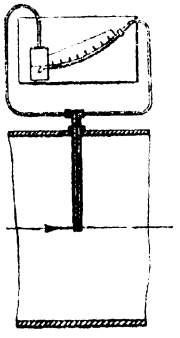


FIG. 2.

Fig. 2 is a diagram showing the "curved tube" manometer connected up to the Pitot tube.

(5) The best form of constriction to use depends upon many factors; the initial cost allowable; the differential pressure required; whether the fluid is of an erosive nature (*i.e.* contains sand particles) or is liable to deposit mud or tar or naphthalene; whether the pipe line can be easily opened up to replace the constriction first inserted by one giving a greater or less throttling effect so as to bring the differential pressure produced within the best range of the indicating or recording instrument etc.

A more subtle consideration must also be taken into account if the coefficients of discharge of similar constrictions of various sizes are to be easily predicted from the calibration of one size alone, and the scales and cams and diagrams of the indicating and recording instruments are to be standardised; namely, the discharge must be exactly proportional to the square root of the differential pressure.

This last consideration, which is assumed as obvious in all elementary text-books, is actually one which it is very difficult to realise even approximately in practice. The position of the pressure holes, any abrupt change in the radius of curvature of the walls of the constriction between the upstream and downstream pressure holes, any undue roughness of the walls, too little guidance of the flow; all these affect the result.

(6) The well-known Venturi tube when properly designed is by far the most perfect of all the types of constriction. It consists of a gradually converging upstream section, a short parallel throat section, and a gradually diverging downstream section. This gradually diverging downstream section enables about 6/7ths of the differential pressure obtained at the throat to be recovered. The smooth curves of the upstream and throat sections ensure that the square root law is almost exactly obeyed, so that the flow through Venturi tubes of very large diameter can be accurately predicted.

From the point of view of gas measurement, the smooth curves of the Venturi tube have the extremely important effect of reducing the tendency for deposit to form to a minimum, a tendency which is on the other hand accentuated in those types of constriction which cause eddying.

The disadvantages of the Venturi tube:—(*a*) its relatively high first cost, (*b*) its great length, (*c*) the expense of replacing it when a higher or lower maximum flow than that for which it was designed has to be measured, have however necessitated the development of other and cheaper types of constriction.

(7) The simpler types of constriction have been mainly developed in connection with air and steam measurement.

The first of these simpler types of constriction used by the author consisted of a thin plate, in which a square-edged hole was bored, placed in the pipe line. The differential pressure was taken across two holes drilled in the pipe line on the upstream and downstream sides of the plate. Experiment soon showed that the same orifice would give different coefficients of discharge if the position of the pressure holes was altered, and that the same size of hole would give different coefficients of discharge if the thickness of the plate were varied, or the edge of the hole slightly rounded.

This led to the employment of a special fitting, the orifice carrier, for carrying the orifice plate, as the pressure holes could then be drilled in the plane of the upstream and downstream faces of the plate, and all sizes made geometrically similar. The employment of this special fitting carrying the orifice plate in which the pressure holes were drilled also enabled an orifice plate to be changed without having to consider how the position of the pressure holes affected the coefficient of discharge for particular diameter of orifice used.

It was found on further experiment that when the diameter of the orifice was more than about three-quarters that of the main, the coefficient of discharge became very dependent upon accurate centering and the smoothness of the pipe upstream of the orifice. This difficulty could have been partially overcome by fitting two or more sets of pressure holes, but as the minimum cost was the end in view, it was decided to concentrate the whole of the area of the obstruction around the pressure holes in the form of a segment of a circle bounded by a chord.

This was found very satisfactory until still higher velocities had to be measured, when it was found desirable to replace the straight chord by the arc of a circle of which the centre was at the pressure hole.

In order to reduce the errors due to inaccurate centering, the size of the hole in the orifice fitting

at the orifice plate was made slightly smaller in diameter than that of the main, being coned down from a diameter slightly larger than that of the main.

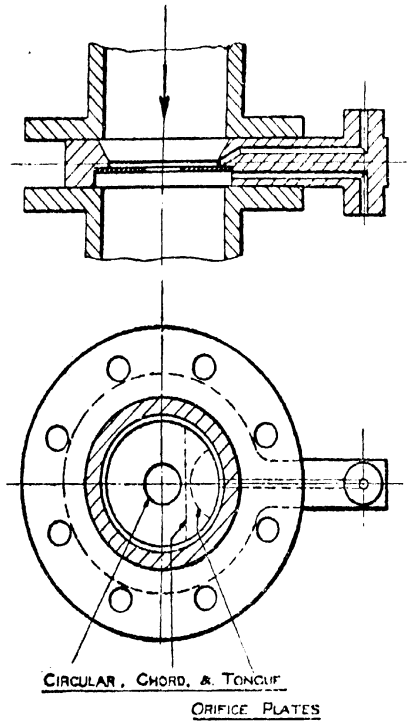


FIG. 3.

In order to reduce the effects of chemical or mechanical erosion, the edges of the orifice plates were rounded, the effects of a given amount of erosion being found to be less on a rounded orifice than on one having originally square edges.

In this way the orifice carrier, the orifice plate, and the circular, segmental and tongue orifice plates were developed.

The various points referred to under this heading are illustrated in fig. 3.

(8) It was found that the field of useful application of the air and steam meters especially would be greatly reduced if only high-priced meters were available. On the other hand it was found impossible to design low-priced meters which would be reasonably accurate over a large range of flow. This will be easily understood when it is remembered that the differential pressure upon which the measurement depends is at one-fifth of the maximum flow only one-twenty-fifth part of that available at the maximum flow, and at one-tenth of the maximum flow only one-hundredth, and so on.

It was therefore decided to concentrate on the production of indicators and recorders which were accurate down to one-fifth of the maximum flow, as it was felt that such meters would cover the most usual requirements.

There were, however, a large number of cases where accurate measurement over a large range was essential. To meet these, a further type of constriction was developed. This consisted of a butterfly valve which could be clamped in four definite positions, the coefficient of discharge for each successive position being approximately double that for the preceding one. With this constriction, the range over which accurate measurement was possible with the indicators and recorders already developed was increased from 1 to 5 to 1 to 40.

The position of the butterfly valve has, of course, to be adjusted by hand when a new maximum flow is decided upon. But it is not necessary to shut down the flow or open up the pipe line, and this in itself is a great convenience.

(9) The law of flow past a constriction may be expressed by the formula :—

$$Q = \sigma . \phi . A \, [(p_1 - p_2) W_1]^{\frac{1}{2}} \quad . \quad . \quad . \quad (2)$$

where Q is the discharge in pounds per second, and σ is the "discharge intensity coefficient" for the particular type of obstruction—a coefficient here used for the first time, which includes the discharge coefficient, Ω, and the ratio of the area of the main to the area left by the obstruction n; its actual value being $\Omega/\sqrt{n^2-1}$.

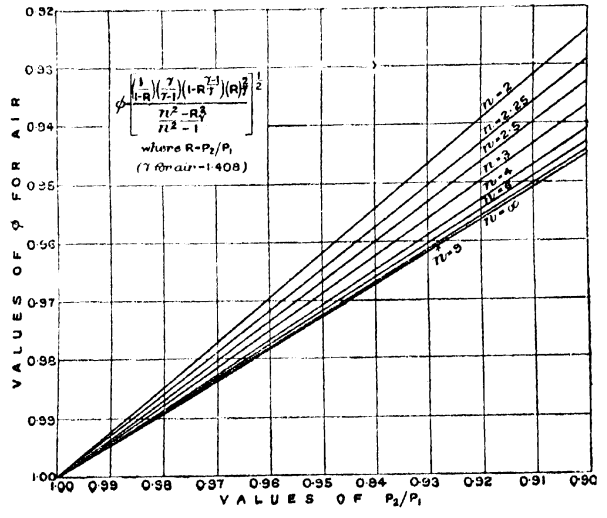


FIG. 4.

ϕ is a term which allows for the compressibility of the fluid. Its value for various values of n and p_2/p_1 are given in fig. 4.

A is the area of the pipe at the upstream pressure hole in square feet; p_1 and p_2 are the pressures at the upstream and downstream pressure holes respectively in pounds per square inch. W_1 is the density of the fluid in pounds per cubic foot at the upstream pressure hole. For pure dry air $W_1 = 2{\cdot}6998\ p_1/T_1$, where T is the absolute temperature in ° F.

For a square-edged orifice having a diameter less than three-quarters of that of the main, and pressure holes in the plane of the orifice, and for which p_2/p_1 is not less than 0·99, Ω 0·608 and $\phi = 1$ (nearly) so that (2) reduces to

$$Q = 0.668\ \frac{A}{\sqrt{n^2-1}}\left[(p_1-p_2)\frac{p_1}{T_1}\right]^{\frac{1}{2}} \text{ lb. per sec.} \quad . \quad . \quad (3)$$

The reason why it is necessary to specify that p_2/p_1 must not be less than 0·99 is that for this type of orifice increases as the ratio p_2/p_1 diminishes according to the empirical relation

$$\Omega = 0{\cdot}914 - 0{\cdot}306\ p_2/p_1 \quad . \quad . \quad . \quad (4)$$

owing to a progressive increase in the diameter of the vena contracta with increase of velocity.

In the case of "stream line" nozzles, this change in the value of Ω with velocity is almost inappreciable.

(10) In certain cases, as when supplying steam to water-gas generators, the usual practice of generating the steam at some 60 to 90 lb. pressure and injecting it into the generator at only a small pressure above that of the atmosphere permits a large drop of pressure across the constriction.

Theory shows that if the ratio p_2/p_1 is less than a certain critical value, which depends upon the ratio of the specific heats of the fluid, and the ratio of the area of vena contracta at the constriction

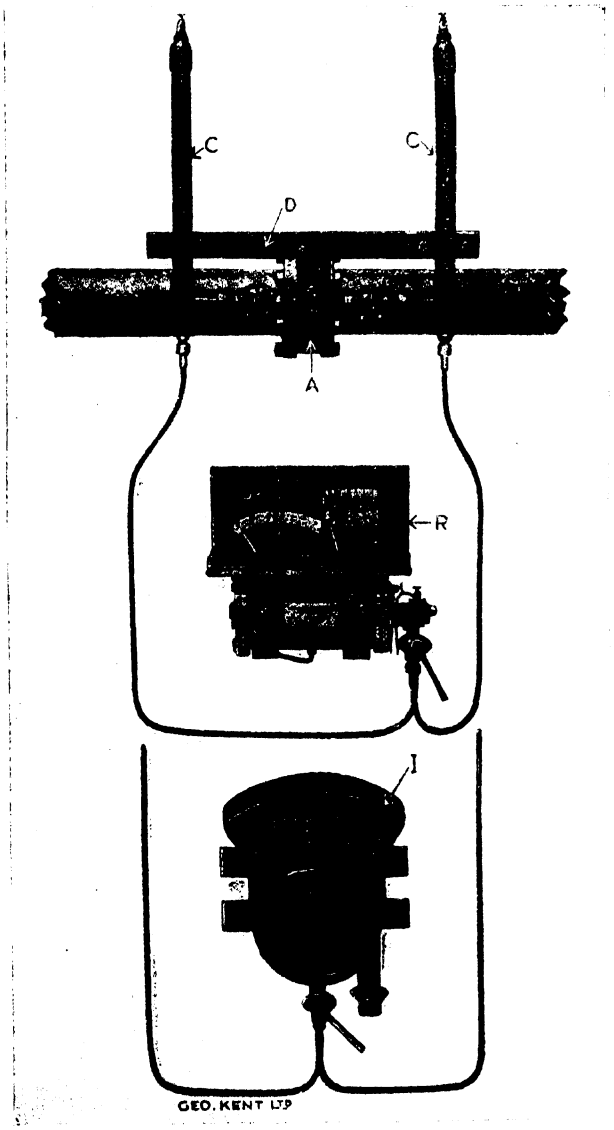


FIG. 5.

to that of the main,* equation (2) no longer holds, the discharge then being given by an equation of the form,

$$Q = \sigma . A(p_1 + a) \quad . \quad . \quad . \quad . \quad (2a)$$

where a is a numerical constant, and p_1 is the absolute pressure in the upstream side of the constriction.

In such cases a simple pressure gauge may therefore be graduated to show the rate of discharge of the steam at a given wetness or superheat, provided that a form of obstruction is chosen for which σ does not vary with p_2/p_1.

Experiments carried out by the author at Messrs. Parson's works at Newcastle in 1912 and at the Taylor air compressing plant on the Montreal River, Ontario, in 1913, showed that while σ varied very considerably with p_2/p_1 for a square-edged orifice as indicated in equation (4), a shaped nozzle could be devised for which σ was practically constant for all values of p_2/p_1.

It may be of interest to note in passing that in both the above sets of experiments, nozzles of over 1000 H.P. capacity were used.

The method of regulating the steam supplied to water-gas generators by means of a pressure gauge connected to the pipe on the upstream side of the obstruction was, as far as the author is aware, first employed by Mr. H. E. Bloor at Birkenhead some 14 years ago. Mr. Bloor, however, used it as a means of regulation only, and not as a means of measurement; as the discharge coefficients of various types of nozzles and the fact that they varied with the flow had not then been determined.

(11) When comparing the discharge of geometrically similar orifices of different sizes the "discharge intensity coefficient," σ, and the coefficient of discharge, Ω, are the same for high velocities for the same values at the ratio of p_2/p_1, and for low velocities for the same values of $\frac{V.D.W}{\mu}$† where D is the diameter of the main and μ is the coefficient of viscosity of the fluid.

"High velocities" may be defined in this connection as those at which the effect of elasticity masks the effect of viscosity.

A fuller treatment of the matters dealt with in paragraphs (9) to (11) will be found in the paper before the Institution of Civil Engineers above referred to.

(12) Certain precautions must be taken when installing the pressure pipes to ensure that the differential pressure produced is truly transmitted to the indicator or recorder. In the case of air and gas meters, moisture or other condensable matters are liable to deposit. To prevent errors due to this cause, the pressure pipes must be of a sufficiently large diameter and must be laid at a sufficient slope to drain, sumps or drainage siphons being provided at the lowest points.

The case of the steam meters is more complicated. Here the indicators and recorders have to be full of water, it being impossible to keep these full of live steam, even if this were desirable. The line of demarcation between the water in the pressure pipes and the steam in the main must, however, always be at the level of the pressure holes, as otherwise the true difference of pressure across the orifice will not be transmitted to the instrument. The desired result is obtained if the pressure holes are brought out horizontally at the same level, and the pressure pipes laid horizontally for a sufficient distance before they bend upwards or downwards to the recorder. This method was patented by the author in 1909. As, however, it gave rise to considerable difficulties during installation another method was developed. This consisted of replacing the two lengths of horizontal pressure pipe by two vertical water chambers, the major part of whose capacity is *above* the level of the pressure holes. Pressure pipes are taken to the recorder from the lower ends of these water chambers. Obviously, as long as the water level in these chambers remains above the level of the pressure holes in the orifice carrier, the true difference of pressure is transmitted. This simpler and more compact arrangement is the one now used by the author. A further precaution to be observed in the installation of the steam meter pressure pipes is that they must be of such a size and must be laid at such a slope that they can be readily freed from any air which may separate out from the water, or which may be trapped when

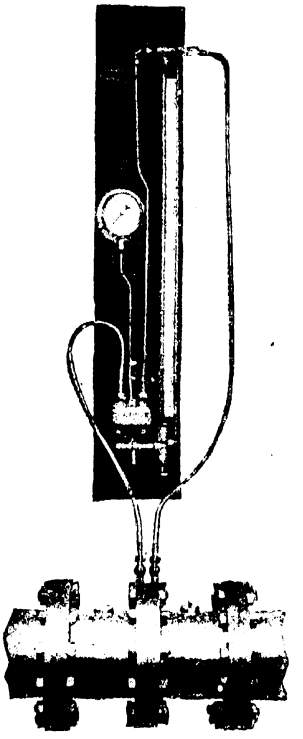


FIG. 6.

connecting up, air vents being provided at the highest points. These water chambers and two forms of steam metering instrument are shown in fig. 5.

(13) Coming now to the indicating and recording instruments. The simplest types are, of course, those which merely indicate or record in terms of the differential pressure alone, the numerical value of the flow being obtained by means of suitable scales or charts.

The most convenient form of manometer consists of a reservoir and a gauge tube, the change of level in one limb only having to be read. This is termed the "single tube" manometer and is illustrated in fig. 6.

The power required to record the differential pressure may be obtained from a float placed in a U-tube, or from an inverted bell sealed by fluid, or from a spring-controlled diaphragm, etc.

Where the static pressure of the fluid is high, the differential pressure producing device must be entirely enclosed and its motion transmitted to the

* See equation (28) Appendix I. of paper before the Inst. Civ. Eng. above referred to.

† For this relation to be strictly true, the geometrical similarity must extend to the relative roughnesses of the surfaces of the constrictions compared.

pointer or pen or cam through a gland. As it is impossible to devise a packed gland which will remain sound indefinitely, the gland is placed in such a position that slight leakage from it will not damage the instrument. The author uses magnetic glands on those instruments where very little torque has to be transmitted to operate the indicating or recording mechanism.

(14) Instruments which indicate or record in terms of the differential pressure only, do not measure the flow with sufficient accuracy in those cases where the density of the fluid metered varies to any considerable extent.

Changes in the density of the fluid may be due to changes in its pressure and temperature, or to changes in its actual composition. The latter condition usually occurs only in the case of gas flows.

It is found in the case of air and steam flows that the temperature or superheat or wetness are usually fairly constant, and that the change of density can be taken as approximately proportional to the pressure alone.

(15) It will be seen on reference to equation (2) that if p_1 is assumed to be proportional to W, the flow becomes proportional to the square root of the product $(p_1-p_2)\times p_1$.

In a so-called "pressure corrected" meter, it is therefore only necessary to obtain and record the value of this product instead of (p_1-p_2).

Reference to fig. 7 will show how this is done in the case of the pressure corrected steam meter.

The curved arm, S, is rotated through an angle proportional to the differential pressure by means of diaphragms contained in the body of the meter, B, while the end of the connecting rod, C, is moved vertically downwards through a distance proportional to the absolute pressure of the steam by means of diaphragms, P, subjected to the pressure in the main and working through the link, L.

The product of these two motions is transmitted to the pen arm, A, and recorded on a diagram, from which an amount proportional to the quantity passing can thus be read off.

(16) An entirely different method has to be adopted in the case of gaseous flows, where specific gravity of the gas relative to air at the same pressure and temperature may be continually varying.

Fig. 8 shows the scheme of a counter meter which takes into account variations in the specific gravity of the gas. In this meter the differential pressure is measured by a water-sealed bell, B, whose motion is transmitted by suitable means to a cam, E. This cam is so shaped that the feeler, H, which comes into contact with it adds on to the counter-reading an amount proportional to the square root of the differential pressure at each revolution of the heart-shaped cam, G, which raises and lowers it. The correction for variations in the specific gravity of the gas is obtained by making the speed of rotation of the heart-shaped cam inversely proportional to the square root of the specific gravity by driving it from a small wet gas meter which is rotated continuously by gas escaping from the main through a small orifice, O, to atmosphere; the pressure across this orifice being maintained constant by a sensitive regulating-valve. In this way the counter is made to register the actual volume passing.

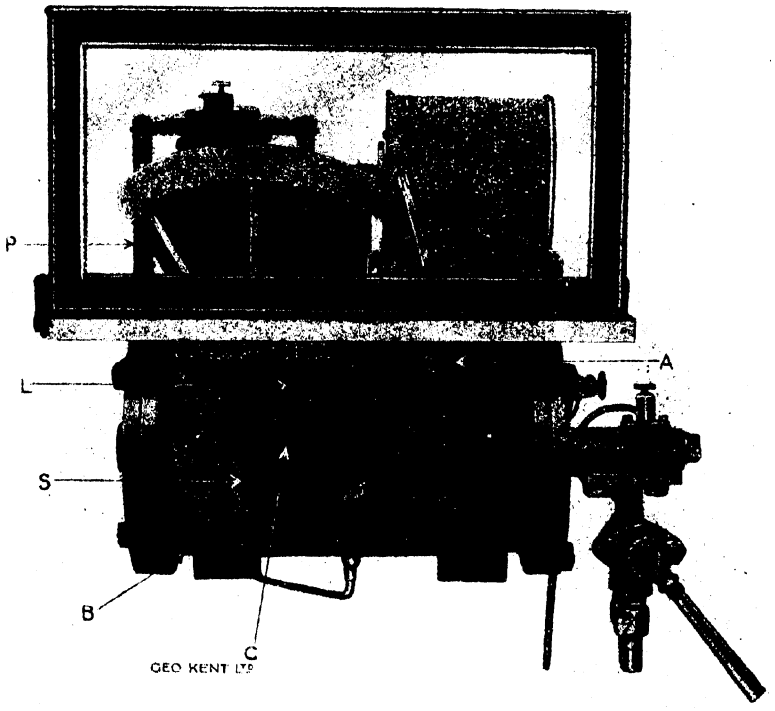


FIG. 7.

Meters of this type, in spite of their apparent complexity, have been found to be extremely reliable in practice and are of course enormously cheaper than the costly station meters they are designed to replace. Their readings are accurate down to 1/10th of the maximum flow, which is usually sufficient for station gas meters. They are superior to the simpler and cheaper rotary meters in that they have no moving parts in the pipe line and are not liable to derangement by tar etc.

(17) The Venturi tube, which is used with these meters, is of course liable to become clogged by naphthalene, tar, etc. In order to reduce such clogging to a minimum, the tube is installed vertically in a by-pass with the gas entering from above so that any liquid carried by the gas will drop right through the tube; the throat and the upstream sections are steam heated, a precaution which practically eliminates deposit; the throat can be cleansed by water jets without opening up the main, and lastly the throat section is made easily removable for inspection and cleaning when the tube is by-passed.

(18) The above paragraphs deal briefly with the theory and construction of the simpler differential pressure meters for which the author is responsible.

Their accuracy under working conditions is within 2% at full load and within 4% at the lowest loads they are designed to measure. When used for the measurement of pulsating flows their accuracy is however less.

The investigation summarised in table II.A of the author's paper before the Institute of Civil Engineers shows that with viscous damping in the pressure pipes the "pulsation constant" to be applied to the meter is practically independent of the wave form of the pulsation, and does not deviate from unity by more than about 7% provided that the variation of the rates of flow at the extreme phases of the pulsation does not exceed 1:2. In most cases where the measurement of pulsating flows is possible, the additional error caused after allowance has been made is less than $\pm 2\%$.

(19) The various differential pressure producing devices made by the author's firm are calibrated with water, this method being simpler, cheaper, and, unless very elaborate care is taken, more accurate than calibration by air or steam or gaseous flows. Check tests are however taken on actual air, steam or gas flows with each new type of constriction. The method of calibrating by means of water flows, which the author developed in 1909, enables a new type of constriction to be quickly tested out, and also enables the effect of difficult upstream conditions to be allowed for by means of scale models.

(20) All the types of meter dealt with can be arranged to register by counter. The integrating mechanism, which is the result of many years of experience and research, is entirely positive in its action. It consists of a powerful and beautifully made clock train which at two-minute intervals rotates a shaft which is thrown into gear with the counter at a fixed point in the revolution, and out of gear at a variable point, this variable point being made to depend upon the flow passing.

(21) In concluding this brief summary, the author would like to refer to the extreme importance of the right selection of materials for the various parts of the meters.

Thus, while a cast-iron orifice carrier and a gun-metal orifice plate may be used when measuring wet steam at low pressure or compressed air, these materials must be replaced by cast steel and nickel when superheated steam is measured.

Or again, a meter which is perfectly satisfactory for measuring coal gas has to be completely revised if it is to be applied to the measurement of coke oven gas, carbon dioxide, chlorine, or ammonia. With each new application, new materials have to be chosen and tested.

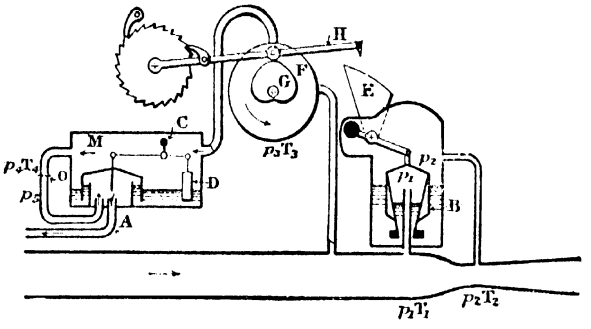


FIG. 8.

(22) The author desires to thank the Institution of Civil Engineers for the loan of the blocks for figs. 4 and 8, and his firm, Messrs. Geo. Kent, of London and Luton, for the loan of the blocks for figs. 5 and 7.

The CHAIRMAN invited written contributions to the discussion of this paper on account of the short time available.

RECENT DEVELOPMENTS IN SURFACE COMBUSTION BOILERS.

BY PROFESSOR WILLIAM A. BONE, D.SC., F.R.S., AND P. ST. G. KIRKE, M.A., A.M.I.C.E.

Introduction.

What is now known as the Bonecourt system of surface combustion embodies the practical results of certain discoveries made by one of us during scientific researches upon the influence of hot surfaces in promoting gaseous combustion. It is recognised nowadays by all chemists that chemical interactions in gaseous systems are promoted by the catalytic action of hot surfaces, and the case of gaseous combustion is no exception to this general law. The researches referred to proved that, if an explosive gaseous mixture be either injected on to or forced through the interstices of a porous refractory incandescent solid, under certain conditions, a greatly accelerated combustion takes place within the interstices or pores; or, in other words, within the boundary layers between the gaseous and solid phases wherever

these may be in contact and that the heat developed by this intensified combustion would maintain the surface in a state of incandescence without any development of flame, thus realising the conception of flameless incandescent surface combustion, as a means of greatly increasing the general efficiency of heating operations wherever it can be conveniently applied.

Perhaps the simplest illustration of this system of flameless incandescent surface combustion is afforded by the diaphragm method of applying radiant heat, and it was obvious from the first that important results would accrue if by any means it could be successfully applied to the raising of steam in gas-fired boilers.

It will probably be generally admitted that up to a few years ago the gas firing of steam boilers had not been very successful from the point of view either of thermal efficiency or rate of evaporation. The low thermal efficiency of boilers fired in the ordinary way by blast furnace gas is notorious, whilst even in the case of boilers fired with coke oven gas the thermal efficiency probably did not much exceed 65% or 70%.

The first experiments made in the year 1909 by the late Mr. C. D. McCourt and one of us upon the application of the principle of surface combustion to the gas firing of multi-tubular boilers, proved the possibility of transmitting between 90% and 95% of the net calorific value of coke oven gas to the water in the boiler. The nature of these early experiments has already been dealt with so often in public that it will be unnecessary for us to enlarge very much upon them. Suffice it to say that the first experiment in Leeds was made with a single steel tube 3 ft. in length and 3 in. in diameter, packed with fragments of granular refractory material, meshed to a proper size, and fitted at one end with a fireclay plug through which was bored a circular hole ¾ in. diameter, for the admission of the explosive mixture of gas and air at a speed greater than that of back-firing.

Experimenting with such a tube, it was found possible to burn completely a mixture of 100 cub. ft. of coal gas plus 550 cub. ft. of air per hour, and to evaporate about 100 lb. of water from and at 100° C. (212° F.) per hour (20—22 lb. per sq. ft. of heating surface), the products leaving the further end of the tube at practically 200° C. This meant the transmission to the water of 88% of the net heat developed by the combustion, and an evaporation per sq. ft. of heating surface nearly twice that of an express locomotive boiler. The combustion of the gas was completed within 4 or 5 in. of the point where it entered the tube. Of the total evaporation, no less than 70% occurred over the first linear foot of the tube, 22% over the second foot, and only 8% over the last foot. This pointed to a very effective "radiation" transmission from the incandescent granular material in the first third of the tube, where the zone of active combustion was located, although it should be remarked that the loci of actual contact between the incandescent material and the walls of the tube were so rapidly cooled by the transmission of heat to the water on the other side that they never attained a temperature even approaching red heat. The granular material in the remaining two-thirds of the tube served to baffle the hot products of combustion and to make them repeatedly impinge with high velocity against the walls of the tube, thus materially accelerating their cooling, and either preventing or minimising the formation of the feebly-conducting stationary film of relatively cold gases which in ordinary practice clings to the tube walls, seriously impairing the heat transmission.

From this initial experiment Bone and McCourt proceeded to construct their first experimental boiler (Figs. 1 and 2) which was made of ten such tubes fixed horizontally in a cylindrical steel shell capable of withstanding a pressure of over 200 lb. to the sq. in. This small boiler was connected with a small tubular feed water heater containing 9 tubes, each 1 ft. long and 3 in. diameter, similarly packed with granular material to facilitate the exchange of heat.

With this simple combination of boiler and feed water heater we were able to transmit to the water 93·3% of the net heat units contained in

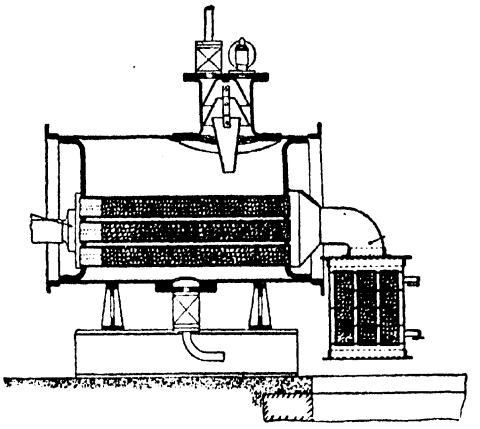


FIG. 1.

London coal gas of 510 B.Th.U. net per cub. ft. at N.T.P. and obtain an average rate of evaporation of as much as 33·9 lb. water per sq. ft. of heating surface per hour (from and at 212° F.); the steam gauge pressure was 103 lb. and the products of combustion left the feed water heater at a temperature of 289° F.

The details of these results are shown in Table 1.

TABLE 1.

	8 Dec. 1910.	8 Jan. 1913.
Net cal. value gas in B.Th.U. per cub. ft. at N.T.P.	562	510
Rate of evaporation lb. water per sq. ft. heating surface per hour from and at 212° F	21·6	33·9
Pressure of gaseous mixture entering the tubes. Ins. W.G.... ...	17·3	40·9
Pressure of products entering the feed water heater. Ins. W.G. ...	2·0	5·14
Steam gauge pressure in lb. above atmospheric	100	103
Boiling point water in Fahr. ...	338°	340°
Temperature products leaving boiler in Fahr.	446°	534°
Temperature products leaving feed water heater Fahr.	203°	289°
Net heat supplied to boiler per hour in B.Th.U.	559,800	728,333
Net heat transmitted per hour in B.Th.U.	527,800	680,000
Efficiency ratio	0·943	0·938

Skinningrove Boiler for Coke Oven Gas.

The success of this first experimental boiler enabled us to proceed immediately with the erection of a much larger plant (Fig. 3) on similar lines for coke oven gas, at the Skinningrove Iron Works in the year 1911. It consisted of a boiler drum 10 ft. in diameter and 4 ft. from front to back, traversed by 110 steel tubes each of 3 in. internal diameter, packed with fragments of suitable refractory granular material. To the front of the boiler was attached a specially designed

gas feeding chamber which delivered washed coke oven gas at the ordinary temperature and under a pressure of 1 to 2 in. water gauge to each of the 110 combustion tubes. This gas, together with a regulated proportion of air from the outside

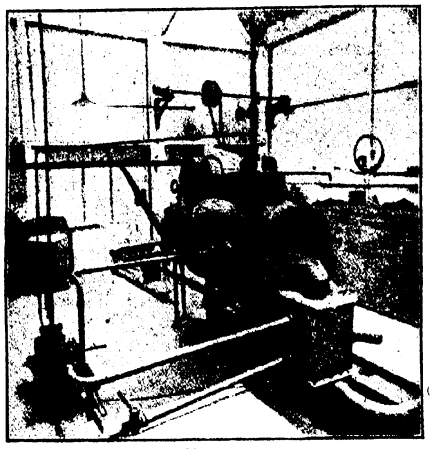


FIG. 2.

atmosphere, was drawn under suction from a fan, through a short mixing tube, into each of the said combustion tubes where it was burnt without flame in contact with the incandescent granular material. After leaving the boiler tubes the products of combustion passed onwards into a semi-circular chamber at the back of the boiler, into a tubular feed water heater and from thence they were drawn by the fan which discharged them at a temperature of 95° C. into the atmosphere.

In a series of independent trials carried out on the plant by an eminent American steam engineer in July, 1912, it was found that, even when the boiler was not lagged and when it was raising steam at a pressure of 100 lb. above that of the atmosphere, 92·7% of the net heating value of the coke oven gas was transferred to the water and sent out as steam, the overall evaporation being at the rate of 14 lb. per sq. ft. of heating surface per hour (see Table 2).

TABLE 2.

Results of Steam Trial.

July 29th, 1912.

Duration of test in hours	10
Mean steam gas pressure in lb. per sq. in. above atmospheric	97·2
Total gas burnt in cubic ft. at N.T.P.	101,853
Net calorific value of gas B.Th.U. per cub. ft. at N.T.P.	510·5
Total *net* heat supplied. B.Th.U. ...	52,003,996
Temperature of products leaving boiler in Fahr.°	386(196 C.)
Temperature of products leaving feed water heater in Fahr.°	202(94·6° C.)
Total water evaporated in lb. from and at 212° F.	49,824
Evaporation in lb. per sq. ft. of heating surface per hour	14·1
% of dryness of steam	99·3
Total heat utilised in B.Th.U.	48,208,399

$$\text{Ratio } \frac{\text{heat utilised}}{\text{net heat supplied}} = 0{\cdot}927$$

Power taken by fan [suction = 20″ W.G.] = 6097 watts = (say) 8·2 h.p.

As is often the case, the first attempt to translate a new idea of this kind into everyday large-scale practice was not unattended with difficulties, the investigation of which has taught us certain valuable lessons. There was no difficulty whatever with the Skinningrove boiler or boiler tubes, or with the gas feeding arrangements Notwithstanding the high evaporation, the mechanical properties of the tubes were not in the least impaired, and the Skinningrove experiences have shown that there is nothing wrong with the evaporating part of the installation. On the other hand the type of fan put down at first to draw the gases through the system and to discharge the cool products of combustion into the atmosphere was found to be unsuitable for dealing with corrosive gases containing small quantities of oxides of sulphur at the extremely low temperature of 95° C., to which the products were reduced by the feed water heater. The burnt products had no corrosive action at all upon the boiler tubes or tube plates, but they were found to attack the outlet tube plate of the feed water heaters and the fan impellers.

The average temperature of the products leaving the boiler when evaporating at a gauge pressure of 95 lb. to the sq. in. was about 195° C., or only 28° C. above the temperature of the steam. The effect of the feed water heater first installed was to reduce this temperature to practically 95° C., which was too low to prevent corrosive action. According to our experience, 120° C. is the lowest limit to which the temperature can be reduced without the risk of corrosive action upon the fan, and to allow a sufficient margin of safety at light loads it would be preferable not to reduce it below 130° C.

As there was no superheater, the work which could be done by the feed water heaters in reducing

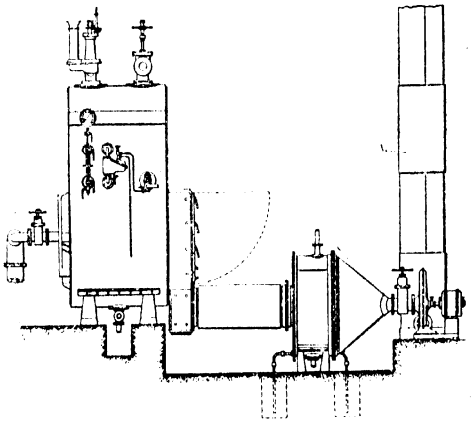


FIG. 3.

the products from 195° C. to 130° C. was so small that it was decided, in altering the Skinningrove plant, to cut out the feed water heater altogether and to substitute fans running at a lower speed, and fitted with water-cooled oil ring lubricated bearings on account of the higher temperature of the products to be dealt with, and this has been done. The efficiency of the plant, now that the boilers are lagged, will still be about 90% on the net calorific value of the gas supplied, even without the feed water heater.

Boilers with Rigid Block Packing for Producer Gas.

Several other boilers of the Skinningrove type, with certain modifications in the packing and burners, and reduced suction, have been installed by the Bonecourt Waste Heat Boiler Co., Ltd., London, on the mains of the South Metropolitan Gas Company and the Gas Light and Coke Company. From a technical point of view we are still prepared to erect large boilers of the modified Skinningrove design for coke oven or coal gas, and to guarantee their high thermal efficiency and smooth working, but as the result of more recent developments in

regard to the structural features of the boiler, we would now recommend one or other of the types to be described presently, which have been duly protected by patent applications.

Although a boiler with 100 or more tubes, each 4 ft. long by 3 in. diameter, packed with loose fragments of a suitable granular refractory material, as in the case of the Skinningrove boiler, is eminently suitable for use with a perfectly dustless and tarless gas, such as coke oven gas, it is preferable, when dealing with gases which are liable to contain dust or tar, to substitute a special rigid system of refractory surfaces (Fig. 4) over which the com-

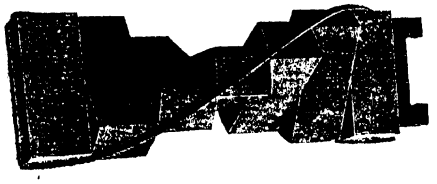


FIG. 4.

bustible mixture sweeps and in contact with which it is burnt at a highly accelerated rate. This has enabled tubes of much greater length to be used, which has the advantage of reducing the diameter of the boiler, reducing the number of burners, and reducing the cost of construction for a given evaporation. A further advantage is that the amount of suction required has also been considerably reduced.

The use of this new rigid system of refractory packing has also reduced the maximum temperature produced on the packing surfaces in the front part of the boiler to a degree certainly below 1000° C., and probably to about 850° C. This has been done by facilitating the heat transmission to the water by free radiation from the whole of the packing surfaces to the tube walls. As an illustration of these newer types of boilers we may describe the constructional features of two boilers erected in the year 1914 in the Birmingham district for generating steam from gas made in Kerperley producers (Fig. 5).

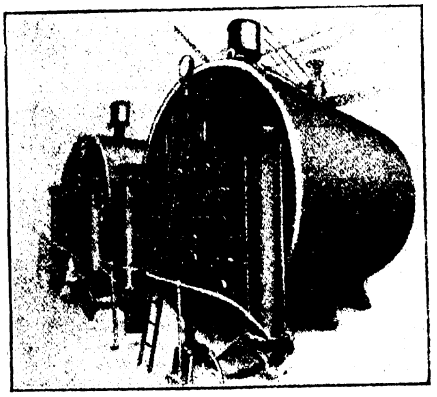


FIG. 5.

These boilers are each 10 ft. diameter by 12 ft. long; each unit contains 38 tubes, 6 in. diameter, packed with the special rigid system of moulded refractory blocks. Each of the tubes is provided with its own gas supply, which can be easily regulated by means of a wheel-valve on the boiler front, whilst the air requisite for combustion, together with a regulated proportion of gas, is drawn into each tube, through a short mixing chamber, by the suction of an electrically driven fan situated at the back of the installation. Each unit will evaporate up to 15,000 lb. of water from and at 100° C. per hour. The combustion in the tubes is perfect, and when operating at a gauge pressure of 85 lb. per sq. in. the products leave the system (there being no feed water heater included in the installation) at less than 250° C.

These two boilers, it may be said, have been running continuously for nearly five years, and no tubes have yet had to be renewed in them.

The only criticism which we have to pass as the result of experience gained in working them, and which led us to adopt further modifications, is that we did not consider that a burner system which involved the use of separate wheel valves for each tube of the boiler could be regarded as finality, and that it would be an advantage, from the point of view of evaporative power, if by any means tubes of smaller diameter and still greater length could be adopted in order to increase the heating surface.

The next step was an important improvement in the design of the burner which has enabled us to dispense entirely with separate control for each boiler tube and to feed a whole nest of tubes from a gas-box controlled by one valve. The elements of this design are shown in Fig. 6. The illustration

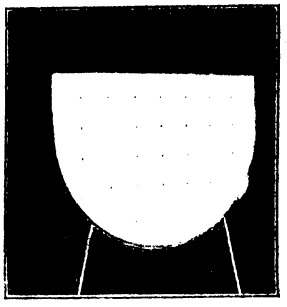


FIG. 6.

of this newest burner shows a gas chamber controlled by one valve capable of supplying gas to a nest of 26 boiler tubes. The gas is fed into the chamber from a main on which there is a cock controlling the pressure in the gas-box. The front of the box is bored with a number of holes, of the correct size, each of which is immediately opposite the axis of one of the boiler tubes. These holes are of uniform bore, but their diameters are adjusted by a rimer in such a way that with a given gas pressure in the box each delivers exactly the correct quantity of gas to each boiler tube even when that quantity may vary slightly in different tubes. Hence the quantity of gas admitted to each tube depends simply upon the pressure in the box which is controlled by the single valve referred to. While the quantity of gas is controlled by the gas pressure, the air is controlled by the fan, and all the operator has to know is how to vary the two together for different loads, which information is given him by the company's expert when the boiler is first put into commission.

Boilers with Spiral Packing.

The next illustration (Fig. 7) shows a small boiler operating on London coal gas with natural draught fitted with such a feeding chamber. The boiler contains 26 tubes, each 2 in. diameter, and are 4 ft. long. Each tube is fitted with an iron packing of spiral form (Fig. 8), the front part of which becomes red-hot and acts as the catalysing surface for the combustible mixture, and so completes the combustion flamelessly in the first foot of the boiler tube. The products of combustion sweep through

the system in a spiral motion and rapidly give up their sensible heat to the water.

Experiments upon Superheat.

During the early stages of the development of our designs we were concerned mainly with the problem of evaporation and heat transmission. The important subsidiary problem of superheat was left until later. It was of course recognised that it would be impossible to develop the system for large power station work where high superheats are required unless a satisfactory solution of the subsidiary problem had been arrived at. During the war the problem was tackled at the Bonecourt Waste Heat Boiler Company's works on



FIG. 7.

an experimental scale, with results which have enabled the boiler design to be modified so as to provide for superheats up to the highest degree required in modern power station practice. As these experiments were begun at a time when we were using tubes of 6 in. diameter, the well-known and well-tried locomotive type of superheater adapted for insertion in flue tubes of 5¼ in. diameter or thereabouts was first tried.

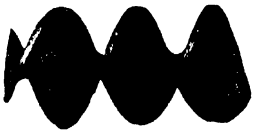


FIG. 8.

In the first experimental arrangement a tube 13 ft. long and 6 in. diameter was packed for the first 4 ft. of its length with the aforesaid rigid block packing, for the next 6 ft. with a superheater element, and for the remaining 3 ft. with a specially shaped packing. The tube was fitted into a boiler shell 18 in. diameter suitable for a working pressure of 100 lb. to the sq. in. The gaseous mixture was burnt and the temperature of the products reduced to 1300° F. (about 700° C.) before reaching the superheater element, and, after leaving the latter, the sensible heat remaining in the products was rapidly given up to the water in the boiler. By means of this arrangement steam at 100 lb. pressure was superheated 192° F. to a total temperature of 530° F., while at the same time the temperature of the products leaving the system was reduced to 442° F., which was only 104° F. (58° C.) above the temperature of the saturated steam in the boiler. No feed water heater was attached in this experiment. In another experiment a superheat of 340° F. was obtained; the total temperature being 678° F., but in this case the temperature of the products leaving the system rose to 500° F., or 162° F. (90° C.) above that of the saturated steam in the boiler.

The improvements already described in the burners of the boilers, and the return to tubes of smaller diameter made it advisable to discard the locomotive type of superheater in favour of a modified type of that commonly used in Lancashire boilers.

Finally a complete unit, as shown in Fig. 9, comprising the boiler, burners, superheater, feed water heater and fan, all on one foundation, has been designed. The boiler itself is 6 ft. diameter by 18 ft. long. There are two nests of tubes which are packed with the iron spiral packing already referred to. Each nest is fired from one burner-box and controlled by one valve. The packing of the tubes is so arranged that the products of combustion will pass from the boiler to the superheater at a temperature of 500° C., more or less according to the amount of superheat required, while the sensible heat contained in the gases leaving the superheater

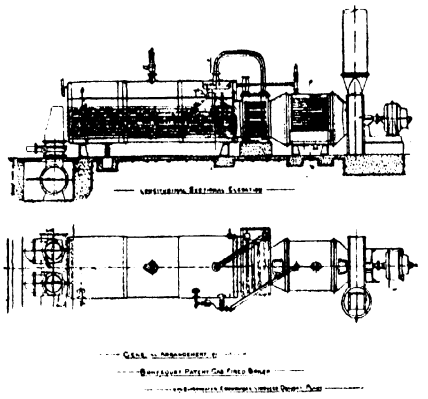


FIG. 9.

is recovered in the feed water heater, the temperature of the gases being reduced to 130° C. in the feed water heater, at which temperature they enter the fan. Such a combined arrangement of boiler, superheater, and feed water heater in one unit has the advantage that it allows of a greatly increased evaporation in the boiler itself per unit of heating surface as compared with the former arrangement of boiler only, and, so far as can be estimated from our experiments, this small boiler would easily evaporate 20,000 lb. water from and at 212° F. per hour when supplied with coke oven gas, and 15,000 lb. from and at 212° F. per hour when supplied with producer gas. In either case the suction would not be more than 9 in. of water, and the overall thermal efficiency would be the same as in the original Skinningrove unit.

As the pressure at which steam is generated in modern central power stations is rapidly increasing it is interesting to note that the boiler shown in Fig. 9 can be made out of ordinary plate for a working pressure of 450 lb. to the sq. in.

Objections sometimes put forward against shell boilers are not applicable to the Bonecourt boiler as, like the shells used in water-tube boilers, they are neither subjected to contact with the hot gases, nor used as part of the heating surface. Moreover, unlike some water-tube boilers, the shell plates are not drilled to accommodate tubes. They have the great advantage over water-tube boilers in that there is no internal pressure tending to burst the tubes. The tubes are floated by the water, and as the water can flow to the heating surface over the whole length of the tubes instead of only at one

end, the boilers can be forced in an extraordinary manner without risk of priming or of burning the tubes out.

In water-tube boilers it is common practice to couple a number of shells in parallel. In the Bonecourt boiler, not only can drums be placed side by side, but also one above the other and yet controlled by a single set of steam fittings. One of the last forms of the boilers recently installed for coke oven

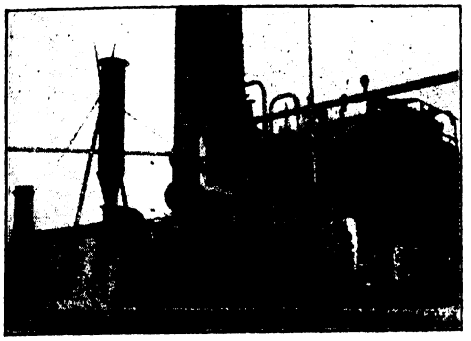


FIG. 10.

gas at a colliery in Cumberland is shown in Fig. 10. From these remarks it will be seen how easily it is to make a Bonecourt multi-drum boiler for almost any output and for any desired pressure and superheat, the space occupied being far less than that of any other boiler. Back-firing is impossible, and there are no large combustion chambers in which dangerous explosions can occur.

Waste Heat Boiler Development.

In addition to the development of surface combustion boilers described in this paper, considerable progress has been made commercially with the installation of waste heat boilers in various parts of the kingdom, for the generation of steam from the hot products of combustion discharged from internal combustion engines and industrial furnaces.

Dr. CHARLES CARPENTER presided at the afternoon session, when Prof. Bone's paper was discussed.

DISCUSSION.

Mr. H. J. PING said that three years ago his firm had put down a Bonecourt boiler; the immediate advantages of it were that they had not to arrange for coal carting nor for the disposal of ash, whilst a big chimney stack was not required. The whole thing was self-contained and all capital expenditure on the items he had mentioned was cut out. In addition there were no stand-by losses worthy of mention such as there would be with a large range of steam boilers, Lancashire, water tube, or Cornish, and as the boiler was lagged the total losses were slight. The furnace which he had installed had five burners and five 6-inch tubes, with solid fireclay packing of the spiral type. There were two or three periods during the day when the load was zero and two or three periods when it was a maximum. The working of the boiler was very simple, the attendant being supplied with instructions based on their knowledge of the working conditions in the factory, showing the number of burners he was to work at each half-hourly period.

Dr. W. R. ORMANDY asked what was the limit of poorness of the gas which it was possible to employ in this boiler and if it had answered to use preheated air when using gas of a very low calorific value, say 100 B.Th.U. He also asked whether in works where producers were installed, having regard to the losses necessarily entailed in running producers, the overall efficiency plus the producer loss would show any advantage over a direct-fired boiler which was run economically, unless the producer was able to use a low grade fuel which could not be employed upon modern mechanical stokers. It was that aspect of affairs which would largely determine whether it would pay to instal this type of boiler. Some 15 years ago Mr. Lester, of Manchester, had made a small model boiler consisting of a copper tube of about ½ in. diameter and 3 ft. long surrounded with a copper tube 1¼ in. diameter. Cold water was fed through the annular space from the bottom and steam taken off at the top, and a mixture of coal gas and air was blown into the top of the smaller inner tube under sufficient pressure to form a long fine jet, the velocity being such that back-firing could not take place. With that an efficiency of 99·2% of the total heat value was obtained and, indeed, the apparatus could be used as a means of measuring the thermal efficiency of the gas comparable in accuracy with the ordinary Boys calorimeter. That scheme did not, however, appear to be capable of being worked out on a large scale.

Prof. BONE said that Dr. Ormandy had asked whether gases of low calorific value could be used. He had already explained that they were working with ammonia recovery producer gas of about 140 B.Th.U., but he presumed Dr. Ormandy referred to low grade blast furnace gas. Very soon after the earliest experiments had been made he had had the opportunity of testing the experimental boiler tubes on blast furnace gas at the Skinningrove works and had found that the surfaces could not be got to glow sufficiently, by feeding in blast furnace gas and air in proper proportions, to induce a very satisfactory surface combustion. The boiler tube was then started with a little coke oven gas from the batteries near by, and as soon as the material was in a sufficient state of glow the mixture of blast furnace gas and air was turned on and the boiler worked satisfactorily. About five minutes was sufficient for that purpose. Once the surface at the front end of the tube was in a satisfactory state of incandescence the process would go on. The question of putting down a boiler for blast furnace gas in preference to a generating plant had been mentioned. In that case the blast furnace gas would have to be so clean that greater efficiency would be obtained by putting it into an internal combustion engine than in any boiler system or even a steam turbine. There were circumstances in which the employment of an internal combustion engine with blast furnace gas was not desirable, in which case there would be no difficulty, if the gas was cleaned—by an electrostatic method preferably—in dealing with it on the same lines as they did with producer gas. With regard to Mr. Lester's experiments, he believed that the amount of gas fed into the tubes was only a few cubic feet an hour, and if he himself were to feed the same quantity of gas through his own tubes at that rate he would be able to get the same efficiency of over 99%.

Mr. KIRKE said that just before the war started he had gone over to Cockerill's works in Belgium and made experiments with blast furnace gas on 6-in. tubes 12 ft. long, but he had had some difficulty with it. An evaporation of 20 lb. per square foot of heating surface was obtained with blast furnace gas, but it was very difficult to burn. He had to start by getting the gas into the tubes at a very slow rate, and when it became properly mixed—he was not working with an explosive mixture—he could speed up very much; provided the combustion were completed before the water-cooled

tube was reached everything went well. Cockerill's had been so satisfied with the demonstration on a single-tube boiler that they had determined to put up a big blast furnace gas-fired boiler and turbine and run it side by side with their big blast furnace gas engines to see which was the best proposition. Just as they had started, however, the war had broken out. He believed, however, that there would be no difficulty in using blast furnace gas, but it would not be possible to use a very long boiler unless the air were pre-heated. Pre-heating of the air would undoubtedly make it so much easier to burn blast furnace gas and for this purpose he would use an air heater of the underfeed stoker make at the exhaust end in order to enable the boiler to be made as long as possible. With regard to the question of the overall efficiency, the boiler efficiency was a little over 90% with a feed water heater, but the producer efficiency was not more than 75 or 80%, so that the combined result was not better than that obtained with a direct fired coal boiler, and the proposition only became interesting if the by-products could be recovered. That necessitated a large scheme, and it would probably only pay to put in a producer with a boiler in a large power scheme where the by-products were recovered. The next point raised was about the explosive mixture and back-firing. When they had first started these boilers they had worked with an explosive mixture and had attempted to pass it through the hole at such a high speed that it could not fire back, but sometimes it would do so. They had then tried to dispense with explosive mixtures and to make it impossible for the charge to back-fire. The air was drawn in by the fan and the mixing of the air and gas took place in the tubes while combustion was going on. The first part of the combustion took place by flame and it was accelerated by the refractory material in the tubes. How much took place by flame and how much by surface combustion he did not know, but it did not matter because the combustion of the gas was complete with approximately the theoretical quantity of air. They had also done a good deal of work in connection with the recovery of waste heat, most of it with gas engine exhausts, because the gas engine had plenty of power to drive the gases through the tube. The chief advantage of the Bonecourt waste heat boiler over the ordinary waste heat boiler was that large and thick tubes could be used which could easily be cleaned on the water side. The amount of water in the boiler, also, was considerably reduced, so that steam was got up much more quickly and condensation of the products in the tubes only took place while the water was getting hot; it was condensation in the tubes while the boiler was getting hot that caused corrosion of the ordinary waste heat boiler tube, so that the objection to the ordinary waste heat boiler was completely eliminated by the Bonecourt boiler. The boiler could also be made so short that it could be got into quite a small space and turned vertically upwards without the efficiency being in any way impaired.

The CHAIRMAN said he thought the authors had proved that a steam boiler could be made an economical appliance and that if it were desired to convert hot water into steam it could be done by the means which had been described, always provided that the gas was obtained under economical conditions. One speaker had said that one of the advantages of the Bonecourt system was that the boiler could be switched on and off very much like a motor, and it had then been pointed out that that was all very well as long as there was an independent supply of gas; but if the supply of gas had to be incorporated with the steam-raising plant then they were face to face with stand-by losses. He thought that the stand-by losses of a producer would not be anything like those in the case of an internal or Babcock fired boiler. In other words there was a much greater control over the production of gas in a producer than by handling the dampers in any of the ordinary forms of boiler.

THE PRODUCTION OF STEAM FROM LOW-GRADE FUEL AND A CHEMICAL WORKS POWER PLANT.

BY P. PARRISH, A.I.C.

The application of a hard and fast rule is impossible when determining the best type of prime mover for a chemical works. Much depends upon the nature of the operations, what these involve in the shape of power and heat, whether the disposition of the chemical plant admits of the power plant being centralised, or whether such plant necessitates the installation of a number of small power units at various points throughout the works.

The major portion of the prime mover at the works under review is required in connection with plant for:—

(1) Disengaging ammonia from ammoniacal liquor, which is treated in continuous columnar stills; the gaseous ammonia being absorbed in such a way as to produce liquor ammonia, ammonium sulphate, sulphite, chloride, and polysulphide.

(2) Promoting the formation of sulphuric acid in the chamber process.

Approximately 1000 tons of gas liquor is treated per day and about 75 tons of chamber acid is made per day. Other chemical processes are conducted but those named are the most important. The several processes involve a variety of chemical and mechanical operations, which may be briefly cited as follows:—Distillation (under pressure and under vacuum), condensation, calcination, concentration, dissolution, crystallisation, lixiviation in vacuum filters, filter-pressing, centrifuging, drying, grinding, disintegrating, screening, elevating, and conveying, etc. Despite these several operations the power load is relatively small compared with the total prime mover required, and constitutes only 18—20% of the aggregate load.

As steam is the best medium for disengaging ammonia from ammoniacal solutions, not only from the point of view of its heat value, but also as regards its carrying effect, it would appear that the choice of a prime mover is for the most part confined to steam.

The chemical works in question are immediately adjacent to the gas works, where large quantities of coal are carbonised, and as the resultant coke has to be graded and screened, there is a quantity of coke breeze immediately at hand.

At one time the disposal of this material presented difficulty, but the progressively increasing price of fuel of late years has compelled attention to its disposal.

The production of steam from low-grade fuel is a matter of fundamental importance. Certainly the problem is not a new one, but it can hardly be said that finality in the matter of efficiency has been reached. Coke breeze is a very indefinite term and may mean almost anything. Some gas engineers describe it as all the material passing through a $\frac{3}{8}$-inch screen. Others would regard such material, or at least that passing a $\frac{1}{4}$-inch screen, as coke dust. Whatever the correct definition of coke breeze may have been, it is certain that any such definition will need to be materially modified to cover the coke breeze supplied during the last two or three years of the European war. Owing to the absence of pickers at the coal belts, the ash content of the coal increased appreciably, and obviously this had

its reflex action on the character of the breeze resulting.

The subjoined table shows the weekly tests of the breeze supplied during the last three months :—

Date	Ash	Moisture
1919	%	%
Jan. 10	20·1	13·6
,, 17	17·7	12·8
,, 24	17·0	16·0
,, 31	27·7	13·8
Feb. 7	21·8	13·7
,, 14	17·1	12·7
,, 21	22·4	14·8
,, 28	21·3	13·1
Mar. 7	23·5	15·5
,, 14	20·2	15·7
,, 21	17·9	13·6
,, 28	24·6	16·0

Average screening tests of such fuel are :—

Percentage passing $\frac{1}{8}$" screen	25·74
,, ,, $\frac{1}{4}$" ,, ...	43·05
,, ,, $\frac{5}{16}$" ,, ...	71·66
,, ,, $\frac{7}{16}$" ,, ...	83·72
Remaining	16·28

It is recorded that more than thirty years ago Messrs. Bryan Donkin and Co. introduced the Perret furnace for the utilisation of this residue. Several other furnaces have since been patented in this connection, chief of which are the Wilton, Victoria, Crosthwaite, and Meldrum.

In all cases the furnaces named are for the most part constituted of a series of cast iron air tubes built up of sections. Each section is provided with serrations, or is so arranged that a section forms a series of perforations with the abutting sections. A blank-end section is provided with each furnace so that the air for combustion of the fuel passes through the several serrations or perforations formed by the various sections when assembled. The air for combustion is delivered through the air tubes under pressure and is induced by the passage of steam usually at boiler pressure through suitable jets or nozzles. In the case of the Crosthwaite furnace these nozzles have an orifice $\frac{3}{16}$ inch in diameter.

Recent improvements in the design of the furnaces appear to have been directed to the number and size of the holes for the admission of the primary air, with minimum dust percolation, to the blast pressure, as well as to the provision of a secondary supply of air, these factors tending to a greater uniformity in the distribution and utilisation of the air.

Some details of the Crosthwaite's patent forced draught air tubes, with which the author has had experience, and the arrangement of bridges are shown in fig. 1.

Coke breeze or dust, whatever is the correct term, possessing the characteristics given, obviously lies in a compact mass, presents considerable resistance, and renders uniform distribution of air at a reasonable pressure next to impossible. Indeed such a fuel bed is typical of the sand lute. Although porous, there is no uniform porosity and such pressures have to be induced by the operation of the steam blast as invariably lead to the introduction of an excess of air beyond that theoretically required for the combustion of the carbonaceous matter in the fuel.

Consideration of fig. 1 will show that the primary air supply is a function of the pressure at which the steam blasts are operated and the resistance caused by the fuel bed. Of course the initial pressure created by the injection of air through the fuel bed is counterbalanced by the suction of the chimney, and the point of equilibrium is usually immediately above the fuel bed.

The secondary air supply is alone controlled by the chimney draught. The correct regulation of the air is a matter of some difficulty and has to be judiciously controlled according to the size and quality of the fuel, the porosity of the fuel bed, and its condition as regards clinker.

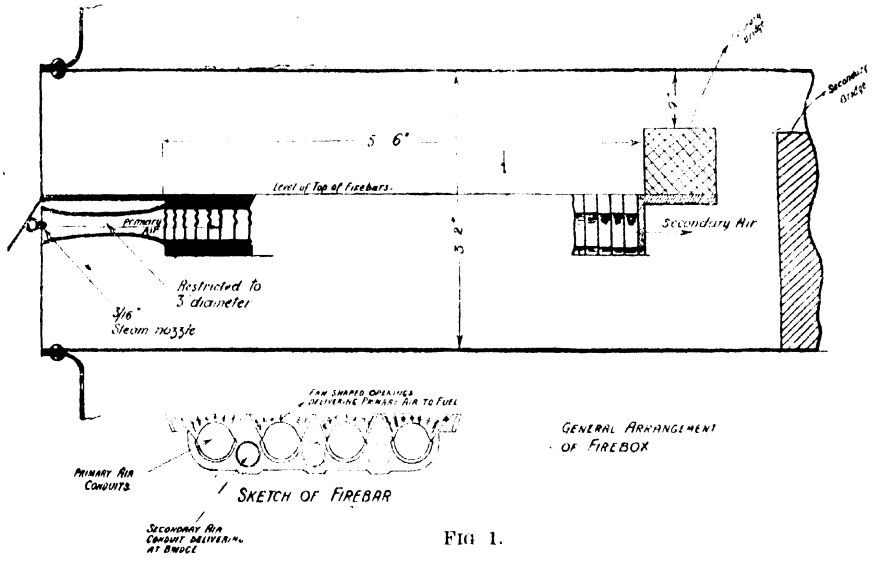


FIG 1.

Many assume that the best results are obtained by admitting such a quantity of primary air as will lead to the formation of carbon monoxide, which can be subsequently burned to carbon dioxide. It has been suggested that this is the best way of ensuring a high CO_2 content in the waste gases.

The author's experience of the combustion of coke breeze in forced-draught furnaces does not confirm this view. Combustion would be very seriously retarded if an attempt were made to restrict the supply of primary air to such proportions as would lead to the formation of carbon monoxide. The resistance offered by the fuel bed is such as to necessitate the introduction of a quantity of primary air sufficient to promote very largely the production of CO_2.

Analyses of the gases above the fuel bed when

the latter is reasonably clean and under full blast show results as high as 16·5% CO_2 and 6·4% of CO. Continuous tests of the waste gases leaving the main flue (*vide* fig. 2) indicate, however, that such a gas composition is not maintained for long, and further that dilution arises. The dilution was traced to the introduction of an excess supply of secondary air due to the imperfect fit of the ash-pit doors and to the absence of adequate provision for adjusting the quantity of secondary air admitted. Steps were immediately taken to remedy these defects in design, with greatly improved results.

The necessity for quick cleaning and re-charging is self-evident. It is important that the air tubes should be kept clean. Fine dust passes through the perforations in the bars and must be removed periodically.

Another important factor contributing to the efficient use of low-grade fuel has reference to the productive capacity of the boilers. The author has had occasion to work boilers with coke breeze under intensive conditions, and it was apparent, during such periods, that the thermal efficiency began to fall; indeed, experience has clearly shown that

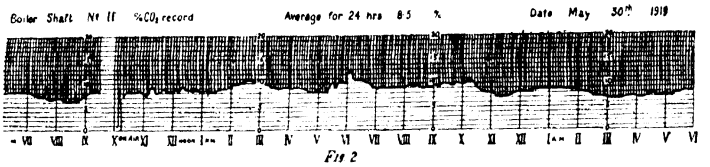
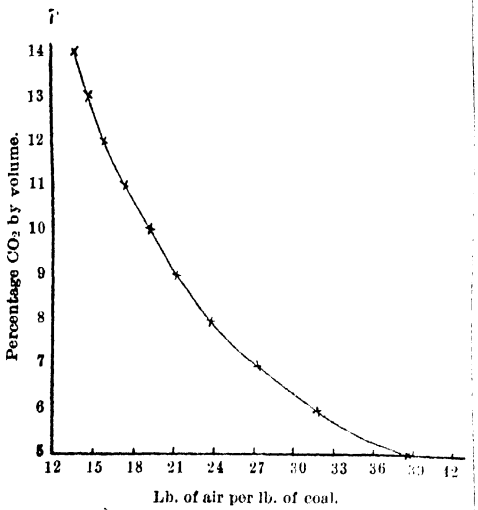


Fig 2

The importance of directing attention to the CO_2 content of the waste gases is made strikingly evident in fig. 3. Experience suggests that the depth of the fuel bed should be about six inches and further that it would be an advantage if the outer primary air ports were capable of adjustment so as to obviate the "blowing" of the fuel bed at points adjacent to the curvature of the boiler. Systematic and judicious clinkering plays an important part in securing efficient results.

It is usual to clinker the fires twice each eight-hour shift, but no irrevocable rule can be imposed. Much depends on the quality of the low-grade fuel. With coke breeze high in ash and moisture content, it is necessary to clinker three times per eight-hour shift. When working a series of nine or more



A Comparison of Air Volume and CO_2 Content in Waste Gases.

Fig. 3.

Lancashire boilers, as is usual at the works in question, it is important that the clinkering operations should be conducted, as far as the quality of the fuel will allow, to a time-table.

If ten boilers are operating and the fuel is of average quality, it is seen that twenty fires have to be cleaned in 240 minutes. This allows twelve minutes per fire. It is usual to clinker and clean the left-hand fires in boilers one to ten in consecutive order, and then proceed in the same order with the clinkering and cleaning of the right-hand fires.

there is a distinct relationship between thermal efficiency and productive capacity. A Lancashire boiler which is capable of evaporating, say, 600 gallons of water per hour with best steam coal is incapable of being worked with coke breeze at a maximum thermal efficiency above a productive capacity of 400 gallons per hour.

It has also been found that the grate, as occasionally installed by the forced-draught specialists, is too long to admit of maximum thermal efficiency. By reducing the length of the grate by about 20% the temperature of the waste gases was reduced from 310° C. to 240° C., a lesser quantity of fuel was consumed, the capacity of the boilers was unimpaired, and the chimney draught was not prejudicially affected. As originally installed the length of the grate merely led to the combustion o extra fuel and accession of the temperature o the waste gase ery little additional heat bein transmitted to t water in the boiler, largely due to the absence dequate surface area for heat transmission.

Adverse critic as been frequently d ct the forced-draug stem of low-grade

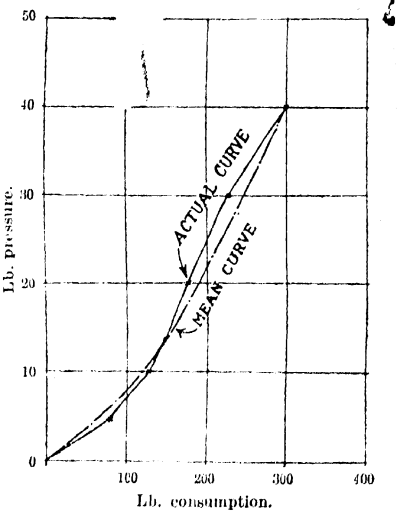


Fig. 4.

bustion by reason of the high consumption of steam in connection with the blasts. Various figures reputed to represent the steam consumptions under the conditions named have been mentioned from time to time. Fig. 4 furnishes data in this connec-

tion based on the discharge of steam at varying pressures. The diagram represents the mean of two distinct determinations.

In one case the steam passing one of the nozzles under varying pressures was condensed to water and measured, as such, at 15° C. The main steam pressure was 80 lb. per sq. in. These results are subjoined :—

Pressure in lb. per sq. in. thrown by the nozzle	Water in gallons condensed per hr.	Water in gallons condensed per hr. per boiler
5	1·0	8·0
10	1·58	12·6
15	1·95	15·6
20	2·16	17·2
30	2·8	22·4
40	3·4	27·2

To confirm the accuracy or otherwise of the above figures, a boiler was isolated and the steam, which was duly measured, was used exclusively for the jets of two other boilers. Results as follows were obtained :—

Main steam pressure	Pressure in lb. per sq. in. thrown by the jet	Consumption of steam per boiler equivalent to
80 lb. per sq. in.	40	29·8 galls. of water
—	20	16·9 ,, ,,

To what extent the steam used in the blasts for inducing the supply of primary air tends to form water gas (a mixture of carbon monoxide and hydrogen) is a matter which is at present under investigation. There are evidences that a portion of the steam so used is dissociated and forms water gas.

Although it is usual to produce blue water gas by an alternate "blow" of air through hot coke in order to bring the fuel bed to a state of incandescence, and then a "run" of steam, undoubtedly, with a continuous steam-saturated, or steam-supersaturated supply of air, the Mond gas producer conditions are reproduced and producer gas is formed.

The importance of frequent and systematic cleaning of the side and bottom flues of the boilers as affecting the question of "drift" and its possible discharge from the chimney shafts cannot be too strongly urged. The entrainment of drift (that is, fine dust and grit) by the products of combustion is a direct function of the velocity of the gases. If the gases in question exceed a speed of 6–8 lineal feet per second then trouble from drift is inevitable. Obviously as the flues begin to accumulate dust, so their cross-sectional areas are gradually reduced with a consequent increase of velocity. If these constrictions of flue areas are coincident with a low CO_2 content in the waste gases, then two potent causes are operating in the creation of the trouble. It has been found necessary to clean the side and bottom flues each six weeks. This work can be effected during week-ends without seriously interfering with the boiler plant.

It was originally thought that the amount of drift could be diminished by eliminating the finer breeze, and it was imagined that simultaneously a better fuel would result. A typical sample of breeze was screened and the various percentages determined. Further, in each gradation the percentage of ash was ascertained by combustion in the usual way, with the following results :—

Size of screen	Remaining on screen	Ash on dry basis
in.	%	%
7/16	19·2	34·10
¼	20·90	31·92
⅛	25·30	26·34
1/16	15·90	21·33
passing 1/16	18·70	24·14

These results are in distinct contradiction to what was surmised. It has generally been assumed that coke fractures by reason of occluded ash agglomerates and that the coke at the surface of the fracture contains a higher ash content than the mass as a whole. The results obtained are certainly not in agreement with this theory, but rather suggest the variation to be due to varying hardness of the coke, probably owing to carbonising conditions. In this case the softer, more friable coke would undoubtedly contain more volatile matter—a condition which is usual in carbonisation. Naturally the ash would vary similarly. The increase of ash content of the screenings smaller than $\frac{1}{16}$ inch is doubtless due to contaminated dirt in this portion of the screenings and the removal of this fine material would be justified, not only from the point of view of the production of a more porous fuel, but also by reason of the possible mitigation of the drift nuisance. The above results were for the most part so extraordinary that careful check tests were applied, but these only afforded confirmation of the above data.

Attempts to increase the porosity of the fuel bed, and to admit of a better control of the air supply to the boilers, thereby reducing the possibility of the formation of drift, by using a proportion of broken coke, say about 50% of the total, have not been attended with the success that was anticipated. True, a more porous fuel bed is secured and the conditions are favourable to the abatement of the drift nuisance, but unfortunately the financial results of the operation of the boiler plant suffer, as the loss due to unburnt clinker is not curtailed, commensurate with the extra expenditure on fuel.

Using 52·9% of broken coke with 47·1% breeze the results were as follows :—

Fuel analysis. Breeze (184·45 tons): moisture, 13·00%; ash, 15·89%. Broken coke (207·75 tons): moisture, 5·20%; ash, 13·73%. Average: moisture, 8·9%; ash, 14·9%; carbon (by difference), 76·2%; calorific value (calc.), 11,000 B.Th.U. per lb.

Volume of softened water, 614,070 galls.
Less water "blown down," 24,030 galls.
Volume of water evaporated, 590,040 galls.
Volume of water per lb. of fuel, 6·7 lb.
Temperature of feed water, 57° C. = 135° F.
Average steam pressure, 100 lb. Abs.
Thermal efficiency, 65·8%.
Loss due to unburnt clinker :
Ash in fuel, 14·9%.
True ash in dry clinker, 92·18%.
Clinker per lb. of fuel, 0·164 lb.
Carbon in dry clinker, 7·82%.
Loss of carbon in 0·164 lb. clinker, 0·013 lb.
Loss of carbon based on 0·762 lb. carbon, 12·5%.

Using breeze exclusively the loss, over a three months' period, due to unburnt clinker was as follows :—

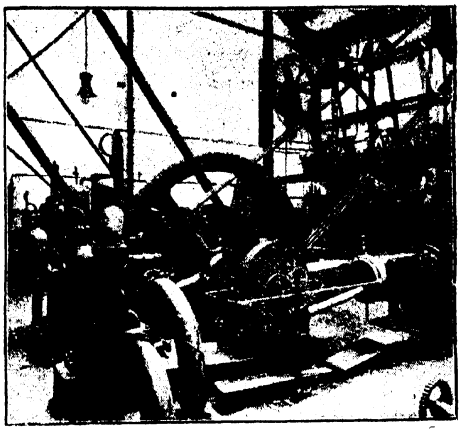
Fuel analysis. Breeze (412·3 tons): moisture, 10·30%; ash, 29·31%; carbon (by difference), 60·39%; calorific value (calc.), 8800 B.Th.U. per lb.

Volume of softened water, 480,010 galls.
Less water "blown down," 17,030 galls.
Volume of water evaporated, 462,980 galls.
Volume of water per lb. of fuel, 5·0 lb.
Temperature of feed water, 55·5° C. = 130° F.
Average steam pressure, 99 lb. Abs.
Thermal efficiency, 61·5%.

Loss due to unburnt clinker:

Ash in fuel, 29·31%.
True ash in dry clinker, 87·50%.
Clinker per lb. of fuel, 0·335 lb.
Carbon in dry clinker, 12·5%.
Loss of carbon in 0·335 lb. clinker, 0·049 lb.
Loss of carbon based on 0·6039 lb. carbon, 20·4%.

Reference to fig. 5, which furnishes comparative costs of raising steam, is interesting. The costs A to H represent published results of several Government factories. In order to render a comparison possible with the results obtained at Phœnix Wharf (the works under review) the cost of coal on the Government plants, instead of being calculated on the original basis of a flat rate of £1 per ton, has been computed on the price at which a similar quality coal could be bought delivered Phœnix Wharf. The price of 13*s.* 6*d.* per ton represents the price at which the low-grade fuel—coke breeze—is



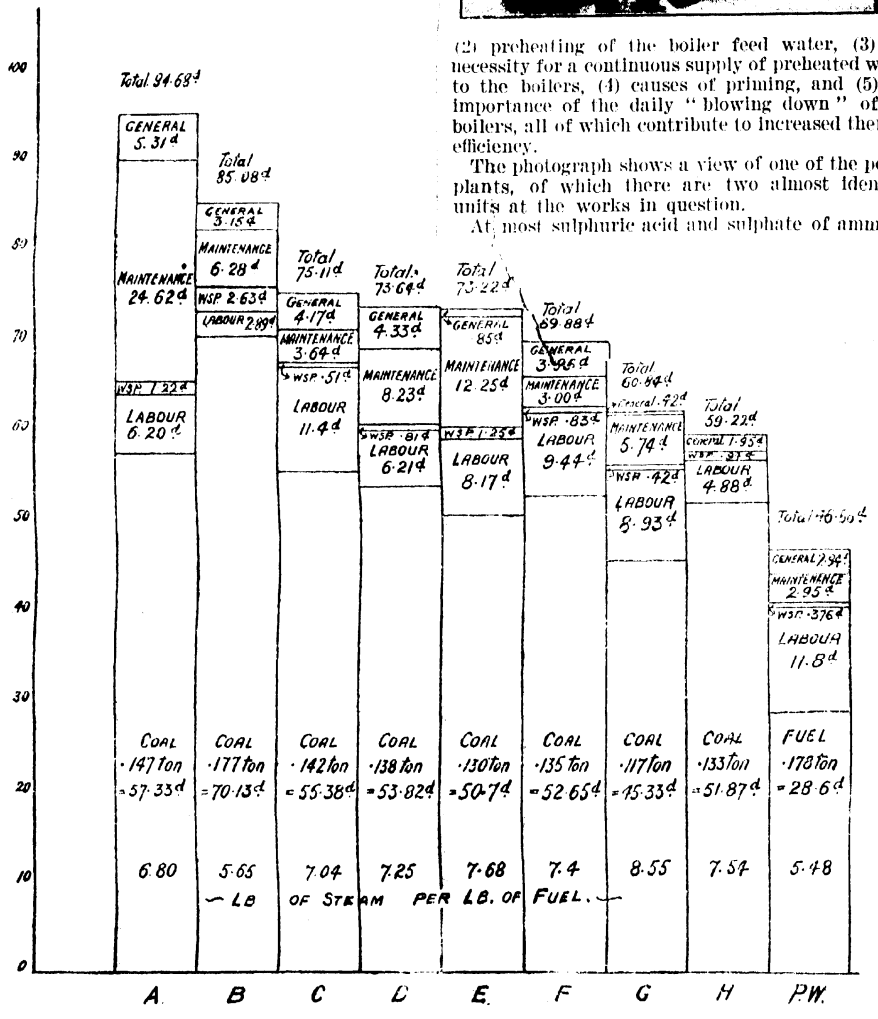


FIG. 5.

purchased from the gas works. In other respects the figures speak for themselves and demonstrate the economy resulting from the combustion of coke breeze, when properly supervised.

It is impossible in the limits of a paper of this character to deal with several other important factors, such as (1) water softening and filtration, (2) preheating of the boiler feed water, (3) the necessity for a continuous supply of preheated water to the boilers, (4) causes of priming, and (5) the importance of the daily "blowing down" of the boilers, all of which contribute to increased thermal efficiency.

The photograph shows a view of one of the power plants, of which there are two almost identical units at the works in question.

At most sulphuric acid and sulphate of ammonia plants there are, for the most part, steam-operated pumps for boiler feed water, cooling water, milk of lime solution, gas liquor, and "devil liquor"; steam-driven air compressors, steam-driven self-contained centrifugals, and small steam-power units for driving the elevators and conveyors and other such plant. Very rarely is any attempt made to

utilise the exhaust steam at these works, and further, the several pumps and small power units are scattered and are usually situated in the midst of operations which are far from clean. These various units are inclined to be neglected, they become somewhat inefficient in operation, and maintenance and running costs are usually high.

The advantages of a centralised plant, as illustrated, are essentially:—

(1) Supervision charges are reduced to a minimum.

(2) Force-feed lubrication can be adopted.

(3) The pumps and other such plant are removed from the sphere of corrosive liquids and gases.

(4) There are minimum heat losses, due to the absence of several separate services.

(5) Economy in capital expenditure.

(6) A marked saving in steam consumption as the aggregate load warrants the installation of a condensing engine.

On the other hand it is conceded that the load at such a chemical works is not altogether a continuous one, but is only partially so, and obviously centralisation under such conditions has some disadvantages.

On the whole, the author strongly favours centralisation of power plant, believing that the loss incurred owing to a moderate load factor is more than counterbalanced by more economical running costs, reduced repairs and maintenance charges, and economy in initial capital expenditure.

It is regretted that the length of this paper precludes a more extended reference to the important aspect of power plant in chemical works.

In conclusion, the author wishes to express his thanks to Dr. Carpenter for his kind permission to publish the various data embodied in this paper. He also wishes to express his thanks to Messrs. W. A. Damon (B.Sc.), F. S. Evans, R. H. B. Lamprey, and O. W. Weight for their assistance in carrying out various tests and for determining the data and preparing the diagrams and charts incorporated in this contribution.

Discussion.

Mr. J. H. West said that the paper called attention to a very valuable and much neglected means of raising steam. It was valuable from the national point of view as using low-grade fuel and he had had some experience about 6 years ago with burning coke breeze under a battery of six Lancashire boilers in a chemical works and he had been able to make comparative tests between that plant and another plant of four Lancashire boilers burning bituminous slack through underfed stokers. The two works had been making the same products, so that the basis of comparison was quite good. From these tests he could fully bear out the figures of cost given by Mr. Parrish, allowing for the great difference, of course, between pre-war prices and those ruling to-day. In his case the coke breeze delivered alongside in barge cost 6*s*. 3*d*. and the coal slack in the other works cost 13*s*. 3*d*. The cost of fuel in producing a ton of steam in the case of the coke breeze was 13*d*., whilst in the case of coal it was 20·5*d*., the cost of labour being 8*d*. and 6*d*. respectively. The great trouble in using breeze was the choking up of the side flues with dust. It was best to clean them out every six weeks. That was sufficiently frequent to keep the velocity of the gases down. Very often the dust in the side flues was 2 ft. thick when they were cleaned. He had also adopted the system of cleaning out one fire of each boiler at a time; with six or more boilers there was a fire door open the whole time because there was a great deal of clinker to be got out. That meant a great deal of cold air getting in and a certain amount of radiation loss in consequence. The author had raised an important point about the primary and secondary air. He had tried reducing the primary air to save steam on the jets, but that was apt to result in incomplete combustion, so that unburnt carbon monoxide might pass on in the main flue and cause explosions by mixing with excess air from other fires. He had got over the difficulty by increasing the primary air to the proper extent. These explosions were particularly liable to happen if any of the fires were banked owing to a temporary decrease in the demand for steam. To sum the matter up, the main advantage of coke breeze was its cheapness for the calorific value. At that time, and he fancied it was so to-day, gas works had very large accumulations of coke breeze which they could not dispose of, but if the demand were to increase largely the price would probably rise. Another disadvantage was the large amount of clinker to be handled and got rid of; in a London works where one had to pay to get rid of the clinker that was rather a serious matter; there would be about three times as much as from coal with 7% ash. The capital cost of a plant for burning coke breeze was 50% more for a given duty than that of a plant burning coal, because the boiler would only evaporate 400 gallons with breeze whereas it would do 600 gallons with coal. Finally, boilers burning breeze could not be forced to any extent if there were an emergency demand for steam.

The Chairman said he took it that the last speaker's remarks related to the use of breeze in the Lancashire type of boiler, and if that was so he quite agreed with what he had said, but it had always seemed to him a barbarous method of steam raising to burn breeze in a Lancashire boiler. With furnaces of the type generally used in large power stations for steam raising—the Babcock or Stirling type—the possibilities were much greater and it had been found—not perhaps with breeze of the lowest grade—but with breeze containing a certain proportion of larger coke, that results could be obtained as regards output from the boiler nearly equal to those obtained when using coal.

Mr. H. M. Ridge said it seemed that the author had used an excess of steam for blowing in his primary air; if that were so it was most undesirable, because not only would there be too much cooling, but, with coke breeze, a considerable proportion of water vapour would pass undecomposed through the incandescent coke, so that heat would be lost at each stage. In the type of boiler illustrated in Fig. 1 with the fire bridge as shown, inter-mixing the secondary air with the gas and probably partially burnt gas from the fire grate, no really efficient result could be obtained in regular practice in his experience. He had found it necessary to interpose division walls and split up the current of gas to cause a more efficient mixing of the secondary air with the gas from the fire grate. The CO_2 diagram (Fig. 2) seemed to show approximately about 9%. At that figure there would be quite an appreciable amount of excess air to be heated, and the efficiency would be considerably increased by reducing that excess air. It would be of great interest if the author were to give not only the exact figures of the grate areas but the quantity of coke and the weights of steam used per square foot of grate area, so that the figures could be compared with other results. Mr. Parrish had raised quite an interesting point about dust being carried forward as drift, and had compared it with mechanical pyrites burners. He

could not agree with the author's figure of the limit to which it was necessary to reduce the gas velocity in mechanical burners. That depended to a very large extent on the design, and working with a much finer material than the ordinary pyrites fines—90% of which, say, would go through a 40-mesh sieve—it was possible to use a higher gas velocity without having an appreciable quantity of dust carried forward.

Dr. W. R. ORMANDY asked whether the experiments described in the paper were carried out on a Lancashire boiler. He presumed they were because the author spoke of the main difficulty in dealing with coke breeze being the deadness with which it lay in the fire grates. That pointed to the need for some form of moving bar and he believed that a fire grate had been made of the moving bar type such as was employed generally in the Babcock boiler, working with induced draught. He had been told that it was possible with coke breeze of ¼-in. mesh to burn from 60 to 80 lb. per square foot per hour. If that were true, then the problem of raising steam would be rather a question of what the boiler could do on the water side rather than on the fire side. With regard to the distribution of ash in the smalls from vertical gas retorts of the Glover-West type, in which steaming was employed, he asked whether the water gas manufacture, which took place in the lower or hot portion of the column of smoke, led to the separation of ash, particularly on the outside of the coke particles; whether in fact the process of steaming would result in the removal of a very considerable portion of the ash. It seemed to him, *à priori*, likely that in an ordinary retort where the mass was being heated by external fire and hot steam was being passed over the coke, there would be a tendency for concentration of the ash on that portion. He did not know whether the coke referred to in these experiments was taken from a vertical retort with steaming, or from horizontal or inclined retorts. With regard to the secondary air it seemed to him that the ideal to be aimed at was the use of air in the primary at such a pressure that the carbon was burnt practically to carbon dioxide with a minimum amount of carbon monoxide and the minimum requirement of secondary air. With regard to the use of wet steam in jets, it was essential to have a standard plug gauge to test the size of the holes because they very rapidly enlarged, and although on a test possibly the amount of steam used in that type of stoker might be only 2½ or 3% of the total steam raised by the boiler, a similar test carried out three weeks or a month later might result in 7 or 8% of it being used.

The CHAIRMAN said that the explosion in the flues arose from the fact that as the fire was banked there was a thick body of fuel, and the small body of air going through was converted into carbon monoxide, so that if there was not an adequate supply of secondary air, or when the fire door was opened, an explosion generally occurred.

Mr. PARRISH, in reply, said that he should not recommend the reduction of primary air except so far as the outer ports were concerned. If the primary air were reduced, the incombustible matter must of necessity increase and an explosive mixture would be formed. The question of the disposal of clinker was one which certainly needed consideration. The clinker arising from the combustion of coke breeze was about 2½ to 3 times the quantity resulting from the ordinary bituminous coal. So far as the extra capital expenditure on the boiler plant was concerned he did not quite agree with the figure mentioned by Mr. West of 50%. Some calculations which he had made revealed the fact that not more than 25% extra capital expenditure was incurred. He agreed with Mr. West as to the difficulty of forcing the plant and therefore there must be sufficient plant available if the load were likely to be variable. In reply to Mr. Ridge, it was impossible to burn breeze unless there was a certain pressure in the primary supply, and the only way to get that was by using certain quantities of steam. Taking the ordinary setting of a Lancashire boiler, continuous tests made at the outlet of the boiler in the drop flue showed that they were getting 14·3% of carbon dioxide between 3 and 4 o'clock; 15% between 4 and 5 o'clock; 13·9% between 5 and 6.30 o'clock; and 16·9% between 6.30 and 8.30; these CO_2 contents were accompanied by 1·4%, 1·1%, 1·1%, and 2·67% of carbon monoxide in the four cases respectively. Dr. Carpenter had suggested that a test which he had given here did not correspond with the figures which are illustrated in Fig. 2, that there was an increase in the CO_2 in the latter case. He had decided to carry out a series of tests right along the boiler flues to ascertain the point at which excess air was being admitted. The type of bar which was supplied by the Crosthwaite firm made quite inadequate provision for closing the door of the ash pit immediately below the forced draught furnaces. It had therefore been closed by improvised means; it had then been found that the CO_2 content gradually increased until the figure he had given was reached.

The CHAIRMAN said that, as far as he could understand it, the diagram in Fig. 2 was put forward as showing the CO_2 content on the main outlet of the boiler setting, and perhaps also the inlet to the main flue, and Fig. 3 showed the composition of the main products of combustion as they left the furnace tube before they were diluted by leakages from the setting.

Mr. PARRISH said that was so. Even though all leaks and chinks in the brickwork had been made perfectly tight the content of CO_2 in the waste gases could not be increased much beyond 10%. He had therefore decided that a determination should be made right through the whole travel of the gases, and although he had not completed that determination he was certain he was getting very efficient combustion of the material and that the probabilities were that unburnt carbon monoxide might possibly account for the somewhat low CO_2 content. The size of the secondary air ports was probably such as to lead to an excess of secondary air for the combustion of any carbon monoxide formed. It seemed as though they were introducing too much secondary air and that that excess, which was a function of the chimney draught, and the size of the holes provided in the forced draught bar, accounted for the low CO_2 content. It had therefore been decided to shut off two of the secondary air ports and the determinations which he had just mentioned were the result of that investigation, *i.e.*, the CO_2 content was brought up at the back end of the flue to 15%, and the carbon monoxide varied between 1·1 and 2·67%. The oxygen under those conditions was only 2%, so it appeared that although the amount of secondary air could be curtailed, it could not be curtailed to the extent that had been anticipated. By careful adjustment of the secondary air ports it was probable that a CO_2 content approaching 14% would be obtained; that would be a very satisfactory result with a low-grade fuel varying in ash content from 15 to 30%.

Mr. H. M. RIDGE said there were two possibilities; he had found them in a parallel case himself. One was that the gas was being cooled too far before secondary air was admitted, so that complete combustion of the carbon monoxide did not take place;

safe transportation by rail. In many cases deterioration of containers during storage has a direct effect upon the safety of subsequent transportation of the package. The mechanical engineer who designs shipping containers must appreciate the stresses that are liable to act on the container during transit, and the loading and bracing of these containers in a freight car must be scientifically planned and executed. The amount of material packed in a container has an important influence also on the design of the container. Finally, the various factors calling for a maximum of strength and endurance must be analysed against the permissible costs. In settling the permissible costs we must consider whether the package is designed for one journey or for continued use. In many cases the expensive package is more economical owing to its long life and continued service.

Interstate Commerce Commission classification.

Dangerous articles other than explosives are classified for transportation purposes by the Interstate Commerce Commission into "Inflammable liquids," "Inflammable solids," "Oxidising materials," "Corrosive liquids," and "Compressed gases." Through the co-operation mentioned above, the Bureau of Explosives and the manufacturing shippers of these materials have during the last eleven or twelve years prepared transportation rules and shipping container specifications which have been adopted by the Interstate Commerce Commission, acting under legislative authority. The rules promulgated by the Commission describe the general types of shipping containers for these various classes of dangerous materials, and also the specific container and packing for many individual articles contained in these classifications. The specifications for shipping containers do not always represent ideal conditions from the safety standpoint, but as a rule they embody the best container commercially practicable and acceptable to the best class of shippers.

Inflammable liquids.

The bulk of shipments of inflammable liquids are shipped in boxed cans, steel barrels or drums, or in tank cars. These liquids commonly have very slight corrosive effects on metal or other containers, and the principal requirement is to get the requisite strength in the construction of the container.

The most dangerous of the inflammable liquids shipped in quantity are casinghead gasoline and liquefied petroleum gas. These liquids are produced by liquefying the condensible vapours in casinghead gas or natural gas, either by compression or absorption. By the compression process especially, a considerable amount of highly volatile material is condensed or dissolved in the liquid product. Some of the more volatile portions are eliminated by means of a "weathering" process, but the final product is far more volatile and dangerous than ordinary refinery gasoline. Such liquids produce internal pressure in their shipping containers. Owing to these pressures, very slight defects in the containers may produce large leakages. It was necessary to devise a test other than the flash test to show the varying degree of hazard involved in handling condensates of this nature. As the special hazard is the high vapour pressure, the test applied to the material is simply a determination of the vapour pressure of the liquid in a closed container filled to 90% capacity at temperatures of 70° and 100° F., respectively, under standard conditions. Material that gives a pressure not exceeding 10 lb. at 100° F. may be shipped in tank cars of the ordinary type, while condensates having pressures above 10 lb. and not exceeding 15 lb. in the summer or 20 lb. in the winter require a special type of tank, which was developed especially for the transportation of this commodity.

Tank cars.

The ordinary tank car was originally designed for the transportation of comparatively less volatile liquids, such as crude oil and kerosene; later, refinery gasolines were satisfactorily shipped in these cars, as comparatively little internal pressures were developed even in hot weather. These tank cars were not designed primarily to stand internal pressures. The shells are sufficiently strong, but the dome cover is not sufficiently tight, the safety vent valves are not of satisfactory design, and the presence of a bottom outlet valve is responsible for many expensive accidents.

The insulated tank car used for the more volatile casinghead condensates is entirely covered with an insulating layer of magnesia or cork about two inches thick, which is in turn covered with sheet iron. The dome cover, instead of screwing directly into the dome ring, is bolted down over the dome opening with ten or twelve bolts around the edges of the cover. By this means direct pressure is placed on the gasket instead of a twisting motion which is obtained with the dome covers which screw into the dome ring. Further, these bolted-on covers cannot be removed until a vent is opened by which all internal pressure is relieved before the dome cover is released. The insulation around the car prevents to a surprising degree the heating of the contents of the car by the heat of the sun and the atmosphere. For this reason the vapour pressures are kept low and there is less loss by evaporation than with the ordinary tank cars.

Very serious accidents have been caused by the use of the tank cars with screw dome covers. In several instances these covers were removed while there was still high pressure in the car. As a result the cover was blown high in the air and a large volume of vapour and hundreds of gallons of liquid were forced up through the dome opening. The vapours were ignited by lights or fires several hundred feet away, causing fires or explosions.

Safety vent valves are necessary on the tank cars of both types, as otherwise if the car were involved in a fire, it would most certainly explode and in that case throw burning gasoline over a wide area, causing rapid spread of fire and probable loss of life. The design of these valves is such that many permit escape of vapour at pressures far below the point at which they are set to operate. The gasoline vapours escaping under these conditions occasionally ignite from outside sources; however, the fires thus caused are comparatively small in extent as they burn only at the safety valve, and are usually extinguished without great difficulty and cause slight damage or loss. The bottom valves on tank cars used for inflammable liquids are a source of hazard, as the outside vent or boot is likely to be damaged or broken off in derailments or accidents, and at the same time the valve becomes unseated, allowing the rapid escape of the contents, which under these circumstances usually ignite almost immediately.

Gasoline frequently contains a small proportion of water, which settles to the bottom of the tank car and frequently works its way past the bottom valve into the outlet pipe. In cold weather this water will freeze and may burst the outlet pipe or unseat the valve. These conditions may be unnoticed until unloading the car is attempted or until the weather becomes warmer, when it frequently happens that a large portion of the contents escapes before the flow can be controlled. Apart from the loss of contents, severe fires and

the second was that trouble might arise through insufficient mixing of the secondary air with the first products of combustion.

Mr. PARRISH said that the temperature of the gases varied according to the state of the fire, and whether clinkering was taking place or not, and he did not think it could be suggested that there was any cooling, because the temperature of the gases just behind the bridge was 617° C., and that temperature was reduced during clinkering to 420°—430°, but then it was immediately raised again to 610°. The temperature was 610° at 8.30 when the fire was in full blast and working well; at 8.45 it was 565°; at 9 o'clock 560°; at 9.15 it was 585° and at 9.30 550°. That was quite a good temperature from a material of the character used, and yet the waste gases were leaving at 200° C. There was some obscure point in connection with the combustion of this low-grade fuel, and he thought it depended upon extreme care in regulating the primary and secondary air. Further, he was certain that water-gas was formed and their determinations had led them to believe that at least 20% of the steam which was used in the blasts went to form water-gas. The combustion of that extra carbon monoxide and hydrogen was a matter which necessitated care in regulating the secondary air supply. Mr. Ridge had also raised the question of gas velocity in relation to the mechanical burners and suggested that there was no necessity to reduce the velocity of the gas to 4 feet per second. In his own experience in connection with mechanical burners he had found that that figure applied very well not only to Norwegian pyrites fines but also to Spanish pyrites fines, and as far as the dust in connection with spent oxide furnaces was concerned, which was lighter, it was necessary to have a lower velocity if it was desired to eliminate the last traces of dust to get a satisfactory Glover tower acid. In reply to Dr. Ormandy, his experiments had been carried out with a Lancashire boiler. He had had an opportunity of inspecting an installation where a moving grate had been adopted for the combustion of coke breeze and where induced draught under a pressure of about 5/8ths water gauge had been used, but the results had not been so satisfactory as his own. Considerable attention had been directed to the wearing of the jets, and he had found that after twelve months the enlargement was very small indeed. It depended upon the material of which the jets were made. His personal view about the scientific combustion of coke breeze was that it should be burned outside Lancashire boilers in a type of producer, and that led to three conditions; a modified type of step grate was required; the producer must be arranged in such a way that there was pre-heating of the low-grade fuel, which was essential; and the step grate should be such that the clinker could be removed almost automatically. Under these conditions he was certain that this material could be burnt to advantage and much more economically than was represented in the figures furnished in the paper.

The CHAIRMAN said that the author had described an economical method of raising steam arising from the fact that the fuel he had used was very low in price. He had really summed up the whole question in his last remarks, *viz.*, that this type of fuel should not be burnt in a Lancashire boiler at all. It should be gasified externally by a producer properly designed for that purpose, and the gas fed into a boiler of some type, such as the Bonecourt. A great deal of coke breeze was being produced all over the country in increasing quantities, because the coke which was now being produced was much more friable than the harder coke produced in the old-fashioned retort settings. There had always been a great scope for a producer which would burn breeze; there certainly was an increasing use for one to-day. That was a problem the solution of which would be of very great value from the point of view of conserving our fuel resources. With regard to one question raised by Dr. Ormandy, he said that the temperature in the lower part of the vertical retort was very low. The retort was made of cast iron, and he could not imagine that there would be any difference in the ash content of the coke at the edge or extremity compared with the centre. He imagined that the coke had been fairly broken up by the time it got to the lower part of the retort, and that the steam really played all round it. Otherwise he did not think the results would have been achieved, at any rate as regards ammonia production, which had been reported from time to time.

A paper by Mr. H. Martin on "Electrical Supply in a Chemical Works" was taken as read.

NOTES ON THE ECONOMIC MANAGEMENT OF SMALL BOILER PLANTS.

BY J. W. HINCHLEY, WH.SC., A.R.S.M., F.I.C.

In many small chemical works where the demand for steam is irregular, and in those factories where steam or power costs are small in comparison with the total cost of production, the steam boiler plant is often neglected, and with the exception of the regular inspection by the boiler insurance company, is left entirely to the stoker.

This habit of mind on the part of the management may be due to several circumstances. A common cause is the limited supply of controlling "brains" or the overloading of those in use, with the result that what can be left alone is left alone. Often the possibilities of saving in other directions are so great as to attract all effort; but generally most managers feel that attention to the boiler plant does not give an adequate return. It is sad to state, however, that personal jealousy and ignorant conceit often preserve a bad state of affairs in the boiler house and other places, when the rest of the factory may be well managed.

During the recent coal difficulties another factor—restriction of supply—has compelled most firms to pay attention to the problem, but success in small plants can only be achieved by educating the stokers and giving them an incentive to economical working. The recent increase in the price of coal will make everybody contemplate change.

It is easy to add accessories to boiler plant and make definite savings, and from a national point of view these are justified by a bare return, but in many cases it is possible, without any addition to the plant, to save the whole of the wages of the stokers by reasoning educational talk and by giving them a material benefit from their more efficient work.

The ordinary equipment usually consists of one or more hand-fired Lancashire or Cornish boilers with chimney draught and a few simple accessories. It is common to find that an injector is relied on for any irregular water feeding, while a pump attached to the main engine deals with the water for the power demand. In the best plants a separate "Worthington" or similar feed pump is provided. Economisers, feed water heaters, and purifiers are not so common.

In many cases an increase in the boiler capacity has become a constant worry and need, when a little education on the part of the stoker would prove that there was ample capacity.

A steam boiler is a "high pressure continuous still," and should be treated as such. The effect of intermittent hand-firing in tending to make the

stoker adopt such discontinuous methods generally, must be resisted if he wishes to secure the highest efficiency.

The systematic chemical and physical examination of the fuel and the flue gases, the latter at different periods in the operation of the boilers, is not a difficult routine matter to establish even in a small chemical works, but unless the results are made intelligible and discussed between the stoker and the chemist no real improvement may be expected. The draught available at each boiler should be considered by the stoker in firing. In those cases where low chimneys are provided (and a 60-foot chimney is occasionally found!) a very thin fire is essential, and its management calls for constant attention on the part of the stoker to get a reasonable amount of coal burnt efficiently.

The effect of heat transmission on the efficiency of boilers is of paramount importance, but the possible enormous variation of the rate of heat transmission is still hardly appreciated.

The outstanding importance of the heat transmission by radiation from the fuel bed should be insisted on. The stoker in firing should destroy as little as possible of the area of the incandescent fuel bed. The length and shape of the firebrick bridge may be increased with advantage both to combustion and heat transmission.

The improvement of heat transmission on the fire side by increasing the velocity of the hot gases is usually not possible with the type of plant we are considering, although the reward is most attractive. The importance of the heat transmission on the water side of the boiler plate has not been adequately recognised in the past.

The simplest experiment will show that the rate of heat transmission (per degree of temperature difference) to boiling water may be as much as four or five times the rate to non-boiling water at the same temperature. The rate of heat transmission depends on the amount of mechanical agitation produced. For the maximum rate of heat transmission the water must be kept boiling vigorously. With very high temperature differences this rate of heat transmission (per degree of temperature difference) falls off again, so that the average rate for a given amount of evaporation is higher under steady boiling conditions than under variable and non-boiling conditions.

In hand-fired boilers the combustion of nearly 4 lb. of coal per hour per square foot of heating surface usually gives the maximum efficiency. Now the equivalent of the combustion of ½ lb. of coal per hour per square foot of heating surface is the maximum rate at which no boiling takes place. It might appear therefore that the non-boiling condition rarely occurs, but where both fuel and water are supplied intermittently, this condition is produced regularly in many factories. It will be obvious, therefore, that the supply of fuel and water to the boiler should be made as continuous as possible to obtain the best conditions of heat transmission.

The formation of scale in the boiler during work has a most serious effect on heat transmission, and may reduce the capacity just before the cleaning period and occasion loss. The use of substances to prevent the formation of adhesive scale is generally advisable even with softened water. One of the latest of these materials, graphite, if used in the highest purity (85% carbon), is extremely effective. After cleaning, the boiler is painted internally with the graphite made into a cream with water, and subsequently about ¾ lb. added per day. In several cases the presence of graphite in the steam system has revealed what was quite unsuspected, bad stoking and priming. The general rule of the good stoker is to keep his fire in constant adjustment to the steam demand, maintaining it in such a condition at the lowest periods so that by fully opening the damper he can obtain, in a few minutes, the maximum rate of combustion on the fire grate. At times of low demand the water level and steam pressure should be kept at their highest points, with the feed-pump working at its lowest rate. An increased demand for steam is shown by a drop in pressure and a fall in the water gauge. The opening of the damper and acceleration of combustion speedily equalises matters, and when the pressure ceases falling the feed-pump is accelerated to maintain the water level. A rise of pressure, on the other hand, would demand the closing of the damper somewhat, followed after some few minutes by a reduction of the speed of the feed-pump. Should the demand for steam over a period be such that in spite of maximum combustion the pressure falls too low for adequate service, some alteration or addition to the plant becomes essential. The grate may be increased in area (generally with reduction in efficiency), or a heat accumulator or a new boiler may be installed.

On the other hand, the particular plant taking the sudden large supply of steam may be controlled to reduce its rate of working for the period of heavy steaming, without any loss.

A continuous feeding pump capable of continuous adjustment is essential to economy. As a rule injectors should be removed. For boiler feeding they are inefficient through being intermittent.

It is obvious that to make this economy permanent it will be necessary to incite the stoker to constant interest, and the best way to do this is to allow him to share the saving he is able to effect by his vigilance. The simplest and only good method consists in measuring and recording the amounts of coal and feed water supplied, and paying the stoker monthly one half of the value of the fuel saved on an agreed basis. In most cases, there are complications such as the return of water to the boiler through closed heating systems, but it is not difficult to devise a scheme which will enable one to give every satisfaction to both parties and secure continuous economy.

Discussion.

The Chairman asked what was the author's objection to the injector.

Prof. Hinchley said that owing to the intermittent action of the injector the pulling of the water often ceased for a short period with a rise in the temperature of the waste gases and there was a consequent loss of efficiency of the boiler during that period.

The Chairman asked if it was not possible to keep an injector working regularly in the same way that a feed pump did.

Prof. Hinchley said it was not. A pump could be kept following the fire.

The Chairman said that whatever might be the disadvantages of the present industrial conditions, we had a much more intelligent workman than was the case 25 years ago. He believed that Prof. Hinchley was right that the more their employees could be interested in the particular work they had in hand, the more efficiently they were likely to carry out their operations. In the carbonising of coal of late years their methods in this respect had changed considerably. The man who had supervised those plants 25 years ago had been a stoker who, perhaps, had known a little more than the average stoker, or perhaps had been more steady and reliable at his work. Apart from that he did not think he had had any other special qualifications, but the man in charge of these plants today could answer intelligently questions with regard to the combustion, the part played by the secondary air, the importance of its regulation, and the importance of the indication of the CO_2 in the waste

gases as being a guide to efficient working. To what extent that state of affairs would be a set-off to the present high wages and general dissatisfaction it was difficult to say, but they could only hope that a great deal of the extra expenditure would be recovered by getting him to do his shorter day's work more intelligently than was the case in the days gone by.

Mr. H. Cheetham, referring to the author's suggestion as to sharing the saving with the stoker, said that in the Lancashire district, where coal was mostly used in the cotton mills, it was a common practice for the stoker in charge of the boilers to get a commission from the coal dealer, and this was an inducement to use more coal rather than less. He did not know how far that system was practised in other industries.

The Chairman said that there again he thought his remarks applied, because the more intelligent they could make a workman and the more self-reliant and independent he was, the less he would rely on these side arrangements for providing him with what he would probably call a living wage. He believed that in the future they would have a better class of man who would scorn to do many of the things which some years ago had been quite common.

The Chairman, in closing the Conference, said that all engaged in the chemical industry realised the increasing importance of chemical engineering. Among the many tasks before them was that of bringing together all those whose practice was mainly engineering and those whose practice was mainly chemical. There was no doubt that the position of the chemical industry was due very largely to the completeness of the collaboration between the engineer and the chemist. The greatest difficulty in the past five years had been in taking the fullest advantage of the large stores of engineering knowledge of the country and in bringing them in towards the chemical industry. That was a work which the Chemical Engineering Group had set out to perform. They had also set a very good example in not attempting to form a separate society or organisation, but in associating themselves with the Society of Chemical Industry. If they were successful—and he believed they would be—it opened up great possibilities with regard to other branches of the chemical industry.

CONFERENCE ON THE PRODUCTION AND CONSUMPTION OF SUGAR WITHIN THE BRITISH EMPIRE.

This Conference was held at the Clothworkers' Hall on July 16th. A full report of the proceedings will be published in the next issue of the Journal.

THE ANNUAL DINNER.

Professor Henry Louis, the President, presided over the Annual Dinner, held at the Savoy Hotel, on Wednesday evening, July 16th, about 250 members and guests being present.

The loyal toasts having been duly honoured, the Rt. Hon. Sir Alfred Mond, Bart., First Commissioner of Works, proposed the toast of "The Society of Chemical Industry." He said that the Society was very near to his heart. His father had been one of its originators, and he himself had for many years been one of its members. He was very glad to know they had such a vigorous and powerful gathering engaged, as he knew they had been during the week, on such important conferences. There had never been a time perhaps when the Society had had more reason to be proud of its existence and of the work it had done for so many years. It was curious that it had required 4½ years of dreadful war to convince this country and its Government of the importance of the chemical industry to the world, and especially to this country. Since the war the importance of the chemical industry had suddenly been recognised, as had also the existence of scientific men and chemists, the importance of invention, and the resources of this country in that direction. Yet what the chemical industry had done during the war was a very small thing compared with what it had done for many years during peace. It was not only a small thing, but, speaking for humanity at large, it was an unimportant thing. What he wanted to emphasise was that they should never allow the non-chemical world to forget or relax its interest in the chemist, the chemical industry, and its future progress. There had never been a time when it was more important to insist with all their vigour on the fact that the progress of the world had rested, rested now, and always would rest on the inventors and scientific inventions. The progress of modern civilisation depended on those men, and it was essential that they should carry out their ideas, and enable the whole world to enjoy the fruits. He heard about capital and he heard about labour, but what did he hear about the men who invented the great processes of the world which had given capital an opportunity and labour the occasion to work? Such men could not be created by States or Governments; either they were there or they were not there. Without their existence, without their work, without inducements encouraging them to work, everything else would become sterile and progress would become impossible. Inventions and management were the two key-notes of industrial progress. In these days of difficulty, when we wanted more production and cheaper production, the only people who could achieve this were those with a knowledge of science and of its application to industry, for these were capable of making improvements and economies. It was a great duty, privilege, and honour to belong to those who were in a position to achieve this absolutely necessary end, and in this respect the members of the Society of Chemical Industry were in a unique position. Chemical industry had given marvellous service during the war. The British chemical industry had demonstrated that it need fear comparison with none in the world, either in resource, energy, or production. Given its opportunity it could rise to every occasion, as it had done. As in war so also he hoped in peace. They could not yet lay down their armour and rest in quiet. It was necessary to re-establish, and more than re-establish the prosperity of former days, to re-animate languishing industry, and unless that could be done we should fall short of reaping the result which we ought to obtain by the sacrifices which had been made during the war. This great Society rightly expected that the memory of those whose victory we were about to celebrate would stimulate us to carry on in peace as in war the research for new ideas with unrivalled energy, great faith, and enormous enthusiasm, and to maintain the position of the Society, and carry it to a greater height than any yet imagined. He had great pleasure in coupling this toast with the name of their eminent President, Professor Henry Louis. The Government owed a great deal to Professor Louis for services rendered during the war, for the researches and expeditions which he had undertaken in order to obtain supplies of raw materials of which we were in sore need. Science,

not merely British science, but International and Allied science, owed a great deal to Professor Louis for the way in which he had combined great tact and skill in bringing together during the war the allied chemists into many important conferences.

Professor HENRY LOUIS said it was an easy task on this occasion to return thanks on behalf of the Society for the toast which Sir Alfred Mond had given. Not only had Dr. Ludwig Mond (the father of Sir Alfred Mond) been one of the founders of this Society, but just 30 years ago he had occupied the position which he (Professor Louis) had the honour of occupying that night. Forty odd years ago Huxley had written in one of his papers to express a hope that in the remote future there should be no member of the Legislature who did not know as much science as an elementary schoolboy. The fact that so eminent a member of the Government as Sir Alfred Mond was at the same time so eminent a scientist should surely go a long way to satisfy Huxley's desire. The Society had now well over 5000 members, and in addition, a good many over a thousand subscribers, so that the total number interested in the Society was not far short of 7000. They might pride themselves on taking high rank among the technical societies of the country. With regard to the work the Society had done during the two years that he had had the honour of presiding over it, there was a good deal that was worthy of note. First of all, on the literary side, as regards their Journal, of which he might say they were entitled to be very proud, they had enlarged and improved it by starting the Review Section. They had published two important Annual Reports, they had published an important monograph on the constitution of coal, and they had compiled statistics and a report as to the Empire's supply of sugar. They had also come into close touch with the Chemical Society in regard to the publication of abstracts, and they had taken a share in promoting the publication of chemical bibliographies in the English language. From a literary point of view that was a very fair record of two years' work under strenuous war-time conditions. In addition they had done a good deal to help forward the scientific side of the chemical industry. They had formed an active and energetic Chemical Engineering Group, and appointed a Committee that was doing excellent work on the standardisation of chemical glassware. They had taken part in conferences dealing with mineral resources and production, and they had been consulted by the Board of Trade with regard to the classification of imports and exports, and were represented on no less than 13 different Boards or Committees. Last, but not least, they had taken an active share in the formation of their own National Federal Council for Pure and Applied Chemistry, and in that capacity they were taking an energetic part in the Inter-Allied Conference in Paris, and in the formation of the Inter-Allied Federation for Pure and Applied Chemistry. The men of science had in this respect shown themselves a little wiser than the politicians. The politicians had started by creating a League of Nations, seeming to forget the not unessential detail of getting concord within their own boundaries. The scientists had taken the opposite course. They were first of all federating themselves as chemists nationally, and, having done that, and smoothed out whatever differences of views and notions there might be among themselves, they were now proceeding to the League of Nations as chemists. Chemists had shown administrative capacity of the very highest order during the war; their work had been essentially that of modernising chemistry. He feared that something of that old secretive spirit of the alchemists had come down to our own days, and that it had taken a cataclysm, like the recent war, to induce them to divulge their secrets to each other, and to pool their energy and resources for the common good. In that all-important work he thought he might fairly claim that the Society of Chemical Industry and its Journal had taken the very front rank. They had disseminated and diffused chemical information, not only throughout the boundaries of their own islands, but throughout the whole world where their Journal circulated. He would say no more regarding the position and work done by their Society, but, what of the chemical industry itself? That industry, as Sir Alfred Mond had truly said, had proved itself over and over again in these strenuous days of war, and in any task that might be put on it in the future it would not fail. The problems of the chemical industry were the problems of industry in general: the problems that faced them on every side were the problems of under-production. He was not afraid of high wages; the wages paid even to-day were little if any higher than they were in the United States before the war, yet nobody would suggest that the United States was then in a moribund condition. There was, however, a difference—the American workman got high wages, but he earned them. There was no minimum wage there. If they paid a man for a day's work he did a day's work. Yet he, personally, looked forward to the future with courage. We were passing through troublous times, but we had passed through troublous times before, and he felt every confidence that the sound common sense of the great mass of the people would before long rise to the occasion. Our scientists had shown that they were equal to the task of showing the way through any difficulty that might arise, and if industry could work and flourish there was no doubt whatever that the Society of Chemical Industry would continue the triumphant march of progress which had marked its whole existence.

Sir WILLIAM POPE proposed the health of "The Delegates of the Inter-Allied Conference of Pure and Applied Chemistry." He said the present meeting of the Society of Chemical Industry was unique, in view of the very large number of distinguished foreign guests they had with them. They owed this fact to the very happy synchronising of the meeting of their Society with a movement that had been on foot for several years for the federation of chemistry in this and in the Allied countries. A very great deal of time, and a very great deal of effort had been spent, not only here, but in France and in America, for the purpose of securing an intimate co-operation in the first place between the chemists in the country, and, afterwards, between the chemists of the country and those of other countries with whom they had collaborated so well during the past five years. What had been started in war had been continued in peace. So much had been effected by joint action during the last few years that they had seen quite clearly that very much might be done in time of peace by intimate collaboration which otherwise might not be possible at all. With respect to the question of the status of the chemists of this country, and he had no doubt the same was true in the countries of their Allies, he remarked that there had appeared a leading article in that day's "Times" dealing with the address which their President had delivered the day before. He ventured to think that five years back there would have been no leading article on that subject. In that article it was stated that the nation required chemistry, and was prepared to pay for it, and that the nation had obtained what it required. He knew a very large number of chemists and others

engaged in chemical manufacture, and he was perfectly sure that they had not enriched themselves as the result of this war. The nation had required chemistry, and it had got it. It was prepared to pay, but when was it going to pay? There were many things that chemists wanted. For example, they must have in this country a home for chemistry; that home should be worthy of their subject, and it must be paid for. He hoped that Sir Alfred Mond, as First Commissioner of Works, would remember that chemistry required treating in an Imperial fashion. Chemistry, if it was to function as it should in the future, must have the treatment that was accorded, say, to the legal profession, or any other profession on an equal footing with themselves. He had to associate this toast with the names of several of their distinguished guests, namely, Professor Moureu, President of the Inter-Allied Council, Dr. R. Lucion, a former President of the Belgian Chemical Society, Dr. F. G. Cottrell, known by so many great technical achievements, and who had latterly done such great service in connection with the manufacture of helium on a large scale in America, and Dr. Severini, as representative of Italian chemistry.

Professor Moureu, speaking in French, said that the Inter-Allied Federation of Associations of Pure and Applied Chemistry had eagerly accepted the invitation of the Society of Chemical Industry. Born at Paris only a few months ago, having as yet made only a few timid steps, it had gladly taken this opportunity of strengthening its vitality, defining its programme, and working out its plan of action. He believed that the meeting would be productive of much valuable result. He recalled the cordiality of their previous meetings in Paris, and said that they had all been eagerly anticipating meeting their British colleagues again, to renew the bonds then tied of mutual sympathy and esteem, and to seek with them the means of drawing from that great victory they had won its most useful results. The success of the Allies had been complete, and chemists had played a large part in achieving that success. He drank to the friendly co-operation of the chemists of the Allied nations, to the success of their work, and to the future of chemistry as a servant of humanity. In the name of the Inter-Allied Federation he drank to the ever-growing prosperity of the Society of Chemical Industry, of which they had had the great honour of being guests.

Dr. Lucion, speaking in French, expressed his great appreciation of the hospitality extended to him. An illustrious teacher under whom he had studied had said that the happiness of mankind was bound up with the facility for producing quickly and cheaply; the great difficulties in the way of rapid and cheap production were firstly those due to nature, which were surmountable, and secondly, those due to men. These latter presented greater problems, but they could be overcome by co-operative effort. Union was strength, and he drank to the union of chemists.

Signor Severini, speaking in Italian, said that it had been a great pleasure to him to take part in the Inter-Allied Conference of Pure and Applied Chemistry. Having brought their work to the present point he hoped and believed that the desired end would be attained. In Italy there was a proverb "Well cut should be well sewn." A sacred union had been formed on the field of battle, where the blood of the Italian had flowed, mingling with that of Englishman, Frenchman, American, and Belgian. There the union had been established, and we must see to it now that union was continued also on the field of material interests. He thanked the great British Society for the cordial welcome it had given its guests, and he drank to its prosperity and the health of its members and of its illustrious President.

Dr. F. G. Cottrell said that during the past few years Americans had learnt to appreciate European problems. He had seen the great ravages that had been worked upon the French frontier, and he was sure that Americans would carry back with them a sense of responsibility for doing their part in reconstruction of those areas. In Italy he had had the opportunity of talking to Italian workers in the chemical industry, particularly in the electrical developments, and he had found problems surprisingly in common with those in California. He had also spent a few weeks with one of the new nations that were looking to the older and more stable nations for guidance. He thought no one belonging to one of the older established nations could pay such a visit without being stirred by a sense of the deep responsibility of having to understand the problems of the new country. The new nations should be helped, not only by industrial and business contact, but by sympathetic human confidence.

The toast of "The Guests" was proposed by Mr. John Gray, President-Elect of the Society of Chemical Industry. He said that on no occasion in his recollection had the reception accorded to the Society exceeded in warmth and cordiality the reception which had been given on that occasion. Not only had the members of the Society rallied to the support of the meeting, but they had the benefit of the attendance of many others who were not perhaps so directly and immediately connected with the chemical industries, but who by their presence and advice had greatly encouraged the Society. The public generally he thought had at last become alive to the fact that the chemical industries of this country were a great national asset, and had come to learn that chemistry was something else than the compounding of pills and liniments. The war, with all its terrible lessons and experiences, had brought home to them the fact that the chemical industries of this country were vital to its very national existence. There were present many guests of eminence in the chemical profession and the chemical industries, and the Society welcomed them because of the interest which they showed in its work. The country was indeed fortunate in possessing such men as the Rt. Hon. Lord Moulton—though he regretted that Lord Moulton was unable to be present. But they had present Sir James Dobbie, Chief Government Chemist, who had recently relinquished the position as President of the Institute of Chemistry, and was now the President of the Chemical Society. They all knew the very great work that he had done in connection with the raising of the status of the chemist. He (the speaker) hoped that the days of the inadequately paid chemist were passed. He believed that in the future we should have chemists taking a very much higher place in the administration of the great businesses of this country. There was also present Mr. W. B. M. Bird, Master of The Worshipful Company of Salters. Not only had the Salters' Company allowed them to use their beautiful hall for their conferences, but they had also placed at the disposal of the Society adequate accommodation for office and headquarters, and in that way had materially helped in carrying out the programme of the meeting. The chemical profession was further indebted to the Salters' Company for having established the Salters' Institute of Chemistry, and for the scholarships which it had founded, by which some of the men whose studies had been interrupted by National Service would be able to continue their careers as students. He believed it was an idea of the City Guilds—the Salters' Company in particular—to link up science much more closely with industry

than had been the case in the past. They all wished success to the scheme, and knowing the able hands in which it was, they knew it would be a success.

Sir James Dobbie, replying to the toast, said that there had never been a time in which it was more important that the most cordial relations should exist between the Society of Chemical Industry and the Chemical Society. The respective functions of the two Societies should be clearly recognised. For the past five years the thoughts and energies of nearly every chemist in the country had been absorbed by practical problems arising out of the war, but now that the great peril to their country was over, they remembered that they were also the inheritors and the custodians of the tradition handed down by the father of English chemistry. Chemistry was not merely the handmaiden of the arts, it was in itself one of the noblest subjects of human study. Even if it had never conferred any material benefit upon mankind, it would still be worthy of the closest study for its great intellectual interest, and for the great part it had played in the unravelling of the mysteries of the universe. At the Jubilee meeting of the Chemical Society, the late Marquis of Salisbury had tried to impress upon his audience the importance of giving attention to the intellectual side of the science, and of not confining themselves merely to the things demanded by the interests and industries of the country, and said that chemistry was a vast amount of solid fact with comparatively little scientific imagination. He (Sir James Dobbie) was not prepared to agree that the gibe had been justified even at the time it was made, and he was certain that if the noble Marquis had been alive today, and were to devote himself, say, to the study of the modern views on the structure of the chemical atom, he would agree that there was no lack of imagination in the chemist of the present day. There was, however, a great danger in the neglect of the pure science of chemistry—if they insisted too frequently upon its practical aspect there was a danger that not only chemistry would suffer, but also the industries which depended on chemistry. The industries depended on science, and if the cultivation of the pure sciences declined so must the progress of the industries decline. Were it not for the patient work carried on in our laboratories—usually without reference to any directly useful purpose to be served—were it not for those investigations, and the vast mass of useful facts which were collected by them, the science on which the industries depended for their progress would eventually be used up. It was incumbent upon those who understood what the relation of science to industry really was, to see that the interests of pure science were not sacrificed to the imaginary interests of applied science. The true relations between the two had been indicated long ago by Bacon. In his ideal state, amongst the classes to whom were entrusted the task of advancing knowledge were those whose duty it was to try new experiments such as they themselves thought fit. These were called Pioneers. There were also those whose duty it was to look into the experiments and to cast about, and to draw from them things of use and practice for man's life and knowledge. These were called Benefactors. The members of the Chemical Society might be considered Pioneers, while those of the Society of Chemical Industry were the Benefactors, and it was only by the most cordial and close collaboration between the two that the richest fruits of science could be garnered for the benefit of the community.

Mr. W. B. M. Bird also responded to the toast. He recalled that the last time he had met the President had been in the neighbourhood of Calcutta, some 20 years ago, when Professor Louis had been inspecting the chances of the satisfactory development of a coal-field there. On his advice, it had been decided to open up that great coal-field, which had proved extraordinarily successful, and was now one of the main factors in making India a great iron and steel producing country. It might be wondered why the Salters' Company should be prominent on such an occasion as this; but in the early days of the war, when they had begun to see what chemistry was doing, they had considered whether a great City Company could not employ its funds in a manner more in consonance with the ideas of its original charter than by the distribution of miscellaneous charity and the giving of great banquets. After considerable investigation they had come to the conclusion that the chemical industry was the one which was originally intended to be promoted, amongst other interests, by the Salters' Company. The Drysalters were, in a sense, the wholesale chemical trade. On the advice of the Committee, aided by consultations with many eminent chemists, it had eventually been decided to form the Salters' Institute of Industrial Chemistry. The object in view was to assist young men who had taken their science degree, and whose circumstances would not permit them to continue the course which they had begun, and for which they had a leaning. At the present moment there were 18 beneficiaries, to each of whom was granted a sum of about £250 per annum towards the cost of continuing his education, in the hope that another three years or so of that training would make him a really useful member of the chemical world. At the start it was obvious that everything depended upon the gentleman whom they might appoint to act as Director, and he believed they would agree that a most excellent choice had been made when Dr. Forster had been appointed to that post. Dr. Forster had thrown himself into the scheme with all energy, knowledge, and enthusiasm, and the first fruits had been beyond expectation. So much was this the case that representatives of many firms were so satisfied that the Salters' Company had taken a right course, that they had come forward voluntarily and asked it on their behalf to administer certain annual funds in the same direction. It was extremely gratifying to observe this evidence of confidence in Dr. Forster and the Worshipful Company of Salters. The view had been taken that it did not matter where the student continued to get his knowledge—he might go to Sheffield, Manchester, Edinburgh, the United States—provided he was doing good work with the funds supplied to him. He did not think anybody realised until this tremendous war came along what chemistry had been to the nation. It was to be hoped that none of us would see another war in our time, but it was quite clear that if there was another in the distant future chemistry would take a leading part in it. It might be that the very efficiency of the chemist might prevent the war taking place. It was sincerely to be hoped that it would.

CONFERENCE ON DYESTUFFS, SYNTHETIC DRUGS AND ASSOCIATED PRODUCTS.

This conference was held at the Salters' Hall on Thursday, July 17, Dr. Alfred Rée in the chair.

THE BRITISH DYESTUFF INDUSTRY.

BY DR. H. LEVINSTEIN, M.SC., F.I.C.

Introduction.

I have been asked to make a few remarks as an introduction to the interesting papers in the "Dyestuffs, Synthetic Drugs, and Associated Products" section, for which a whole day out of the short

space of time available for our meeting has been set aside. This procedure, entirely novel in the history of the Society, shows the importance attached by the Council of the Society to the organic chemical industry, of which the dyestuff industry is the predominating partner.

My one regret is that it is I who am addressing you and not my father, who, had he lived, would undoubtedly have been in my place to-day. Twice President of our Society, it is entirely due to his long and courageous battle for patent law reform that the country was able to have supplies of vital commodities such as indigo and hydrosulphite during the war. To him was due as much as to any one man that our aniline dye industry was kept alive, and I am sure that this Society, of which he was an original member, and for which he worked so assiduously for many years, first as chairman of the Manchester Section and then as a member of the Council, will share my regret.

I shall not give you a panegyric on the war work of the British dye industry, though this was quite remarkable. Such reviews have a tendency to make one complacent and to encourage the fatal notion that we can for the moment relax our efforts.

Nor do I propose to say anything about our present position and future intentions save this:

The industry now operates on a large scale, for the British Dyestuffs Corporation, the principal manufacturer, already employs close on 7000 persons and some 300 academically-trained chemists, exclusively in the manufacture of dyes and auxiliary products, and their works comprise about 1050 acres.

Further large extensions are in preparation both to research laboratories and plant, and I anticipate that before the end of this year the number engaged will be substantially increased, with a corresponding increase of output. The range of products manufactured is being enlarged as quickly as new construction permits. Our immediate object is to manufacture, in the shortest space of time, a range of dyes sufficient to render the country substantially independent of German dyes.

As the Government, who have a substantial holding in the British Dyestuffs Corporation, have in many ways shown their determination to secure a dye industry here, it is important that everybody should thoroughly understand the facts which make a successful dye industry of paramount importance to the State. Mr. Runciman realised this in 1915, and his two successors in office, Sir Albert Stanley and Sir Auckland Geddes, have both been greatly interested in the industry, and have done much to encourage those engaged in it under great difficulty. I propose therefore to deal with those aspects of the dye industry which explain why any British Government may well feel uneasy until we possess a dyestuff industry equivalent to that of Germany.

Reasons why a success of the dye industry is vital to the State.

There are four reasons why the success of the dye industry is vital to the State. I do not give them in their order of importance. There is no order of importance. Each reason is in itself adequate.

(1) *A key industry.* The dye industry is a key industry—an overworked word which now conveys nothing to a good many people. Mr. Runciman gave a clear explanation in stating the reasons for the formation of British Dyes, Ltd., during his tenure of office. (House of Commons, November 27, 1914.)

"Though it is perfectly true that the whole of the textile industry is not dependent upon dyestuffs, we do know that the combined capital of such operations of textile and other industries which require aniline dyes comes to no less than £200,000,000 . . . about 1,000,000 of our employees are either directly or indirectly interested in the adequate supplies of dyestuffs for their main industries."

(House of Commons, February 22, 1915.) "This is not a mere matter of one corner of one industry. It is a matter of vital concern not only for our textile industry, but of a whole group of industries which are dependent upon the use of colours. Wool and cotton are indeed important enough, . . . but there are other industries which, like wool and cotton, are dependent upon the use of dyes and mainly aniline dyes. The lace industry of Nottingham, the silk industry of Macclesfield and elsewhere, the cotton industry, the making of paints, such small things as ink, wallpapers, the colouring of leather goods, the colouring of hats, and I would add, too, the colouring of some foods, they all depend upon an adequate supply of dyestuffs. It may be that some of these industries can dispense altogether with the use of dyes, but the textile industry and some others, like the carpet and linoleum trades, are absolutely dependent upon aniline dyes if they are to succeed."

(On November 27, 1914.) "No one can tell what exactly will be the position after the war is over. Of this I am certain, if we go on being dependent in a large portion of our textile trade, whether cotton or wool, upon supplies which Germany has the power to cut off whenever she pleases, we leave these cotton and wool industries in a state of peril."

It may be said against Mr. Runciman's view that our textile trades did exceedingly well up to the time of the war, though dependent upon Germany for a supply of these products, and that now that the war is over there is not the same necessity for rendering ourselves entirely independent of Germany for the supply of dyestuffs.

That view would be, however, entirely erroneous. It is held by no one who is at all familiar with the methods and history of the big German aniline dye trust, which was created in 1915. The negotiations for the gigantic combine were well advanced in August, 1914, and their conclusion was not, as is generally supposed, due to the war, but the carrying out of a policy long decided upon. Had the war come but a little later the ring would have been closed, and our textile industry would have appreciated an acute difference in the conditions under which they would have received their supplies. To-day this trust, familiarly known as the I.G., is the most powerful weapon possessed by the Germans, for in peace, as in war, it was and is a tool of the German Government.

It is inconceivable that we should voluntarily permit the I.G. to dictate to essential industries the terms on which they should obtain their dyes, that we should leave to the I.G. the power to withhold supplies of useful or even essential commodities or to charge British consumers a higher price than they charge their own textile trades. That, however, would have been the position of this country but for the war, and would have been the situation to-day but for the extraordinary efforts made during the war under the greatest possible difficulties to create a strong dye industry here. If these efforts are not successful, the textile industries are not safe. The real danger of being dependent upon Germany for dyestuffs did not lie in the risk that we might be cut off from supplies in the case of a war with Germany, but that the world monopoly possessed by Germany in dyestuffs was imperceptibly becoming a desperate menace to the freedom of our textile trades. It is of the first importance that this should be universally recognised. It is the main reason, apart from powerful sentimental considerations, which has made the dye

consumer so enthusiastic a supporter of our industry since the war. It was ignorance of this vital fact, because the I.G. was inchoate and still concealed its character, and not indifference to it, which made him appear lethargic in assisting British dye manufacturers before the war.

(2) *National security as a guarantee of peace.* The dye industry is required for national defence as a guarantee of peace. I invite you to consider the war record of the German combine.

During the war the I.G. produced not only all the synthetic ammonia and nitric acid needed for the production of explosives and also vast quantities of explosives, but also, with an unimportant exception, the *whole* of the chemical warfare products used by Germany in the course of the war.

It was entirely due to the I.G. that Germany was able, in spite of the blockade, to carry on the war after the end of 1915. Consider what this means. But for the possession of her dye industry on which the General Staff did not even rely for munitions in 1914, the German resistance would have broken down in little more than a year for lack of nitric acid.

Can anything more clearly prove the military value of the German dye industry and the loss and destruction which it has caused us?

Apart from the production of nitric acid, oleum, and high explosives, the German dyestuff plants are of supreme importance for chemical warfare, because they are extraordinarily adaptable. Practically any organic product can be manufactured in them. This is due partly to standardisation, but chiefly because the plant is often designed not for the manufacture of specific substances, but for the purpose of carrying out specific chemical operations. It was for this reason that most of the poison products used by the Germans were not made in one factory; certain operations were carried out in one factory, other operations could be carried out very conveniently in another plant. Thus in the case of mustard gas, thiodiglycol was prepared at Ludwigshafen, and the mustard gas itself at Leverkusen. The reason for this was that at Ludwigshafen there was already in existence plant which could be used for the manufacture of thiodiglycol.

Where extensions were put down for the manufacture of poison gas the reverse holds good. The extensions for the purpose of war were adaptable for the purpose of peace.

The Germans were, of course, fully conscious of this, and far the greater part of their war expenditure on chemical plant was of a permanent character, and erected with a view to the after-war commercial struggle. The plant erected in Germany for the increased production of mustard gas is now available for the increased production of dyes.

Attached to one of their plants erected during the war, ostensibly solely for the purpose of war, are laboratories which contain a large luxuriously-equipped lecture room, and cost £200,000.

One may sum up the situation in this way.

(1) The production of explosives in blockaded Germany was possible only owing to the Haber process belonging to the I.G., which was greatly developed by them during the war.

(2) Each factory of the I.G. is either an arsenal or a potential arsenal of great size, capable of making great quantities of intermediate products and dyes one day, and 24 hours later capable of being switched on to the manufacture of stupendous quantities of poison gas.

The military value of chemical warfare is little understood owing to the secrecy in which the work has been done, but we must not therefore underrate its importance.

Gas warfare resolved itself into a contest between the development of gas defence (*e.g.* the gas mask) and the discovery of new gases which would penetrate the gas defences. Everything depended upon surprise, and a surprise, to be effective, means the provision of large quantities of material. In our own country, when a new gas had to be made *ad hoc*, plants had in nearly every case to be erected. This involved great delay before the product could be used in the field, and these plants are valueless for peace purposes.

In Germany the I.G. took charge of the whole manufacture, and produced the material for use in the field in a much shorter time. Their plants are of great peace value.

If Germany were to remain the only country possessing such factories she would have every inducement to use them for aggression, for she would have no cause to fear reprisals. She might conceivably be certain in her own mind of affecting a strategic surprise. Therefore the establishment of plants of equal magnitude in this country on a sound basis is one of the first guarantees of peace.

Let me read to you a passage from President Wilson's address to Congress, telegraphed from Paris on May 16th, for, coming from President Wilson, the words have peculiar significance: "The German chemical industry with which we are brought into competition was, and may still be, a thoroughly-knit monopoly capable of exercising competition of a peculiarly insidious and dangerous kind.

"The close relation to the manufacture of dye stuffs on the one hand and explosives and poison gases on the other hand, moreover, has given the aniline dye industry exceptional significance and value. Although the United States will gladly and unhesitatingly join in the programme of any national disarmament, it will nevertheless be a policy of obvious prudence to make certain of the successful maintenance of many strong and well-equipped chemical plants."

The words coming from this source are indeed significant. Yet the danger to America is less than to us by the three thousand miles which separate her from the banks of the Rhine.

I do not agree with what my friend, Sir William Pope, said in his powerful presidential speech to the Chemical Society, on March 27th, 1919, with regard to the production of mustard gas. I say this not for the purpose of controversy, but because it is important that the facts should be correctly appreciated, as they have a bearing on policy and on the question of the importance of the dye industry for national defence. Sir William Pope states that the method of manufacture of mustard gas employed by this country was 30 times as effective as that of the Germans, and the cost in Germany was 30 times as great as that of our product. I am well acquainted with the German method and also with our own, for it was worked out in our laboratories by the head of our Research Department, A. G. Green, F.R.S., based on scientific work communicated to us by Sir William Pope himself. I had a good deal to do with the application of this process to the large scale, and we designed the main features of the great factory at the Edgewood Arsenal at Maryland, U.S.A., where the "Levinstein process" and the "Levinstein Reactor" proved a great success. I may claim to know something of mustard gas, and I am sorry to disagree with the deduction that Sir William Pope draws, *viz.*, that the German chemical service was inefficient, and the scientific chemists under its control incompetent in comparison with ours, whereas, on the other hand, Germany was extremely well served by the skill and perseverance of her chemical manufacturers.

In fact, we now know that the German method of making mustard gas had nothing whatever to do with the scientific chemists under the control of the German chemical service. It was decided by the I.G., and the process they selected was the best

they knew of. If there were any inefficiency, as Sir William Pope says, that inefficiency was on the part of their manufacturers and not on the part of the scientific advisers of the General Staff. I do not think there was any inefficiency. There is nothing technically cumbrous in the German process, nor is there any difficulty about it. Let us be quite frank. Our scientific advisers found this process difficult. If they had come straight to our dye industry we could have shown them how to carry out the reaction on the large scale without any difficulty whatever, exactly in the way the German dye industry carried it out. The fact is, that the production of mustard gas in England on the other hand remained for too long a prerogative of our scientific advisers. What happened? There was certainly no mustard gas produced. The successful manufacture of mustard gas in this country and in America commenced when the British dye industry took it up. We took it up on our own initiative, and mustard gas was produced by us on the large scale six weeks afterwards. In this short space of time a new process—not the German process—was evolved and plant adapted, but the British dye industry was not requested to make mustard gas as it should have been from the beginning.

I do not in any way depreciate the value of the work of our scientific advisers, and I yield to no one in my respect for the achievements of Sir William Pope and his most able and distinguished academic associates. I do regret that he did not recognise that the success of our mustard gas work was due to the co-operation of the dye industry, with their great experience in the manufacture of organic products, with purely academic advisers of the Ministry. The correct inference was drawn by the authorities from these facts, for they became convinced of the unique value of the plants and technical experience of a dyestuff factory for the manufacture of toxic gases. From this point onwards our industry became very intimately associated with the development of Chemical Warfare.

Do not misunderstand my argument. I do not advocate building dye plants for the purpose of making toxic gases. I do say that if the Germans retain their monopoly in dyestuffs, they possess a monopoly in the rapid production of toxic gases, and that, in this event, the world is not safe for peaceful people.

(3) *New industries can only be created by organised research.* Very few people realise to what a small extent new industries arising out of new inventions have been created in England in recent years, in comparison with those created abroad, particularly in Germany. We are apt to regard our commercial supremacy as dependent upon a few well-established staple industries, such as, for instance, the cotton industry, whereas in fact the world moves on and new products and new methods are continually coming in, and that nation which produces the most inventions and the best inventions will, other things being equal, predominate.

Before the development of the scientific industries I think we may fairly claim to have produced more important inventions than our competitors. We are an ingenious and inventive people. To-day only a small proportion emanates from the inhabitants of these islands. Industrial inventions are now, as a rule, not the result of a flash of intuition, but of patient, methodical, and skilled research carried out with big resources on a well-considered plan.

On the whole, that country will produce the most chemical inventions which has the greatest number of trained research chemists. In the fields of discovery, as on the battlefield, numbers will tell. As Pasteur well said, "In the fields of discovery chance always favours the researcher."

There is no industry except the dye industry which can support a large number of organised research chemists. This cannot be more clearly expressed than in the report by Mr. A. Mitchell Palmer, the Allen Property Custodian of the United States (chemical section): "The vital character of that industry (the dyestuff industry) was not due to its financial importance, since the consumption of dyes in the United States at the time of the outbreak of the war did not exceed $25,000,000 a year in cost to the consuming industries, nor to the fact that these dyes were absolute essentials to industries producing perhaps $2,500,000,000 of goods annually, but most of all to the fact that the technical skill and equipment provided by a successful dye industry furnished the means, and almost the sole means, to which every nation must look for advances in the application of chemical science to practical undertakings. No other industry offers a livelihood to any such large numbers of highly-trained scientific chemists, nor any such incentive to continuous and extended research."

The dye industry is thus a key industry in a new sense. It is the key to invention. It is necessary if we are to keep abreast of the world in the development of new industries arising out of chemical discoveries.

The reaction of this on the chemical schools of our universities is of extraordinary importance, because the dye industry can provide a large outlet for highly-trained research chemists. As the dye industry lives by research, new buildings and plants are continually being erected for the manufacture of new products. This entails the employment of more chemists, who, as a rule, are drawn from the research departments, and their replacement by new research students from the Universities. For the first time, young chemists can be assured of a career in industrial research, the most fascinating but elusive and difficult work open to our profession. The bond between organic chemical schools and the dyestuff industry is therefore bound to be a close one. The development of the industry which we plan will give an enormous impetus to the study and research in organic chemistry at academic institutions.

(4) *Political importance of the dyestuff industry.* The German dye industry was the most potent weapon possessed by Germany for peaceful penetration. In America, Mr. Mitchell Palmer shows that the dyestuff sales organisation of the I.G. firms was used by the German Government for espionage both before and during the war. The peaceful penetration of Russia and other foreign countries by Germany was one of the causes which led to the war.

It is not safe for us to permit the Germans to monopolise the up-country business with tins of dyestuffs among the natives of India, and of the East in general, for political reasons. It is our duty to afford an alternative supply of dyestuffs, besides German dyestuffs, to those of our Allies who do not possess an adequate home industry. To secure commercial freedom for our textile trade and that of our Allies is as important as to secure political freedom.

Summary.

These are the four reasons which render the development of our industry so vital in the coming struggle. They may be summed up in the following propositions:—

(1) It would be madness after the close of this terrible war, fought to secure our ideals of political freedom, not to make ourselves economically free from Germany.

(2) It would be folly to leave Germany the sole

possessor of factories, potential arsenals, which, because they were unique in the great war, enabled her to carry on this war for three additional dreadful years.

(3) It is impossible for us to maintain our commercial supremacy if we throw away the one chance of organising the inventive talent of our chemists.

I commend these propositions to all persons if there be any such who question the paramount importance of securing a firm, large, and flourishing dye industry in our country for the protection and development of the vast interests of the Empire. It is, I believe, demonstrable that if Germany retains her predominance in Europe in the dye industry she will ultimately win the war, for though the campaign is gloriously ended, the war is not over nor the victors certain. Though the German military defeat is complete they may yet regain through their dye industry their former ascendancy over Europe.

Germany recognises this fact, and is straining every nerve, using every device, to re-establish her commercial dominance in the dye industry. Her propaganda is to be seen in the press, and not only in the German and neutral press. It is of the utmost consequence that these simple incontrovertible facts with regard to the importance of this industry should be brought thoroughly home to the people of this country.

Conclusion.

It follows from what I have said that enormous responsibility rests upon the chemists of this country, and I think that it is fully appreciated. During the war our chemists rendered good service and made sacrifices and ran risks, as has been handsomely recognised in particular by Mr. Kellaway.

But let us be quite clear on this. The real burden of the war was not borne by chemists, and the victory was not won by chemists or by engineers, but by the indomitable courage and tenacity of our soldiers. The real war work of our chemists lies yet before them, for it rests with chemists to secure in the next few years the opportunities the soldiers won for us, the fruition of which German chemists may yet deny us.

In the final stage of the struggle, in which the clash of arms was but the first round, the chemist's work will be a decisive factor. If the chemist is to take his rightful place as a leader in our industrial order, he must be the first to emerge from the wave of war-weariness and work-weariness which threatens to engulf us.

There is a great opportunity in this for chemists. Let us take it greatly.

The CHAIRMAN said that the report of Mr. Palmer referred to by Dr. Levinstein had actually been written by Mr. J. H. Choate. It was an extremely valuable account of the history of what the Germans had done not merely during the war but prior to the war, in order to establish themselves in America not only as regards industry and commerce but also more particularly in the matter of diplomatic advantages.

DYES AND BRITISH TEXTILES.

BY JAMES MORTON,
GOV. DIRECTOR OF MORTON SUNDOUR FABRICS, LTD.,
AND CHAIRMAN SCOTTISH DYES, LTD.

When I was invited to give some account of what our firm had accomplished with regard to dyes during the past 4½ years, I explained that there was really very little fresh one could contribute of a scientific nature. Inasmuch, however, as our firm had been unique in being not only makers of dyes but users (in fact we had been compelled to become makers because we were users of special dyes that were not likely to be procurable from any other source during the war), I suggested that it might be useful if I made some observations on the present situation, speaking from an inside knowledge, both as a maker and user of dyes for textiles.

Peace has come, and with the reopening of international commerce a situation is about to be created that was not unforeseen by those who ventured into the dye-making industry at the beginning of the war.

It is well to recall the position and attitude in those early days. Users of dyes were left practically stranded for want of colour, especially colours of the best and most complicated types, and we had visions of our vast textile industry being held up. It came as a national shock, and this shock was intensified a hundredfold when it was realised that the very plant which had been making dyes for us in Germany was at once switched on to produce munitions of war. We felt we were being dealt a double blow. It was recognised that here was indeed a true key industry, for not only was it essential to ordinary industry during peace or war, but it contained the vital elements of defence should war ever be forced upon us.

It was the sudden and full realisation of this situation that made us rise to a national necessity. If we made no dyes in this country not only could our whole textile trade be brought to a standstill, but the very fact of relegating the manufacture of dyes to a country that might at any time be hostile deprived us of a weapon that was essential to our national existence.

Small wonder then that all and sundry welcomed the efforts to extend dye-making in this country, and it is well at this stage to recall the enthusiasm and promise of support which it received on all hands.

Users were the first to welcome and encourage the efforts; they were prepared to exercise every patience, and submit to almost any kind of inconvenience in order to foster and develop the new British industry. The Government gave it financial support, and promised all possible priority in supplies of plant and raw materials and made it known that their determined policy was to make this country independent of Germany for its future supply of dyes.

On the faith of this attitude among users, and this declared policy of the Government, much strenuous effort and large capital expenditure have been made by public and private concerns. But the advent of peace and the reopening of international commerce find dye-makers in this country with their house only half built, and not yet ready to meet the demand that will enable users of dyes—the textile and other manufacturers of this country—to compete with foreign manufacturers who have free access to the established German products.

It may be argued that 4½ years has surely been sufficient time to enable British dye-makers to get upsides with the German products, especially when they had available all the German patents and literature to guide them. But it is only those outside the problem that would talk in this way. I can speak for one small field of research from intimate inside knowledge, and I know the tremendous obstacles. German scientific literature is very profuse, but it is often not very illuminating as a guide to desired commercial results. Indeed I sometimes wonder whether quicker results would not be got by ignoring it altogether. At the best it is found that elaborate laboratory tests are necessary for every stage of every colour before anything like a pure product in good yields can be arrived at—this in spite of all the guidance or misguidance to be had from the most exhaustive German descrip-

tions. When it is considered that in order to produce one colour there are often 8 to 10 or 12 stages, and that this elaborate process of research and experiment has to be repeated over the whole range of colours—going into many hundreds—it gives some idea of the problem that has had to be tackled from the scientific side. For it must be remembered, the problem is not simply to produce colour, but to produce a colour of pure quality and in yields sufficiently high to make it a sound commercial product, and one that can compete in these respects with the best pre-war article.

Then it must be remembered that to face this gigantic scientific problem we had, to start with, chemists who were almost entire strangers in this particular province. Moreover, we had to be content, so far as number of chemists was concerned, with what the Government could spare from their numerous activities of war, all requiring the same kind of skill, and this you must recognise was an enormous handicap in the speedy realising of results. It has also to be remembered how almost impossible it was during the whole course of the war to get supplies of plant and raw materials for making such colours as were ready for bulk production. It seems almost a nightmare now—how we had to beg and pray on the door-steps of one Government building after another for a few pounds of lead, a few hundredweights of steel, and how we had to use almost surreptitiously the small amounts of such things as sulphuric acid, oleum, and glycerin necessary for a most modest production of the more essential colours.

There was also the problem of general labour. All the most capable men had gone, and we had to conduct most difficult and exacting chemical processes with elderly, uneducated men, very largely Irish labourers, who in many cases had never seen a thermometer and could not even read.

These and many others were conditions imposed upon us by the necessities of war, and we had to bow to them. The very fact that the pre-war dye-making equipment of Germany gave them such huge advantages in their preparedness for war indicates to what an extent the dye-makers of this country had to draw upon the war requirements of our Government, and how far we had to stand aside till the needs of munitions had been met.

Yet these are elements that must be borne in mind when gauging the progress of dye-making in this country during the past 4½ years, and in deciding on any immediate policy. The wonder is not that we are not equipped to meet the full requirements of the users in this country, but that dye-making has been able to come into existence at all under the mountains of obstacles of war time.

Thus, as we have already mentioned, the coming of peace finds us as dye-makers with our house only half built, and in spite of all the effort and ingenuity, we have frankly to admit that we have not yet reached the point when dye-making in this country can, even approximately, meet the national requirements.

And the question now rises very pointedly—how is the situation to be met, what has to be our national policy? What are we going to do with those hundreds of tons of German colours that will soon be knocking at our gates for admission—colours in many cases that cannot be had here at any price, and in other cases, to be had only at prices many times higher than Germany may be prepared to offer?

It is a very severe test, a severe national test, and it is the problem immediately facing our manufacturing interests and awaiting the immediate solution of our Board of Trade.

For in spite of all our early-war resolutions to use no more colour from Germany no matter almost what should befall us, the peace has somehow brought a tempered attitude. Users are inclined to risk the future of dye-making in this country, to the extent at least of allowing in their own particular requirements. The Government also has to take a wide view of the situation, and, in spite of its desire to foster the making of dyes, cannot afford to ignore the urgency of maintaining our export trade in textiles, both as to quantity and quality.

A glance at comparative figures explains the complex nature of the problem. The total value of dyes used in this country before the war was some £2,000,000 per annum, while the value of textile goods into which these dyes entered was over £200,000,000, a large part of which was for export trade.

The textile trade is therefore, as it were, up in new alarm, and is looking with more than longing eye at these German colours over the wall. For we might as well admit at once the fact that the war-fervour attitude of having no dealings with Germany after the war is already breaking down. The Allies are even now tumbling over each other in Cologne and elsewhere to effect sales of their wares—French, American, and British alike—and it is only folly to think the trading can be on one side only.

If we sell goods to Germany she must pay in manufactured goods of one kind or another. Already our manufacturers have become jealous of their Allies getting into the markets they held in Germany before the war, and it is worth while putting the case of the textile trade clearly before us. Germany's imports of dyes to this country before the war were something like £1,750,000. She also sent textile goods to the extent of £14,500,000. But on the other side, and apart from the value of those dyes to our home and general export trade, Britain sent to Germany alone some £19,000,000 worth of textile manufactures and apparel. She sent cotton yarns to the annual value of £5,000,000 and some 45 to 50 million lb. weight of worsted yarns every year. Thus in the balance, the textile and allied trades in this country were greatly the gainers in their dealings with Germany. And at this new juncture, when there is a fresh setting of the commercial wheel, and when we are faced with new competition in all markets of the world, including the market of Germany, it requires a great deal of national philosophy to expect the textile trade to stand aloof from German dyes wherever they offer advantages over what can be procured in this country. The tendency and temptation is to look to immediate advantages, and again let the future take care of itself.

At this important juncture we are therefore met with three separate interests to satisfy, all necessary for the national well-being, and our problem is whether we can find a solution that will meet all the conditions. The first interest is the maintaining of our supremacy in the textile trade, that trade running into hundreds of millions a year and on which depends the maintenance of hundreds of thousands of British people. It will be generally agreed that no policy can be advocated that would for a single day jeopardise the life of that all-important industry. The second interest is that of dye-making in this country, and its development on lines that will justify the effort and capital already expended, and enable it to stand on its own legs as a sound commercial industry like others in this country. The third interest to satisfy, and one that embraces both the above, and without which neither would be of much value, is national security. For, as is now recognised, the implements of dye-making are very largely the implements of national defence, and to adopt any policy that would discourage the establishment in this country of sound, well-equipped dye works would be laying ourselves open again to that double blow

which came to us with so sudden a shock at the beginning of the late war.

Now how are all these partially conflicting interests to be met? Is it possible to devise a plan that will not fall foul of any of them? There are three obvious policies, and it is worth while briefly to examine how each would operate on the present situation. There is first the opening of the gates free and wide with the fullest opportunity given for Germany to sell and users here to buy at their discretion. Secondly, there is the raising of tariff walls and the indiscriminate boycotting as far as possible of the import of German dyes. Thirdly, there is the method of control of imports—the temporary control of imports—with a temporary subsidy that would give time for the British effort to have a fair run for its life.

Let us see how these would act. To open the gates at this juncture would have the obvious effect of arresting dye-making at its present stage, and administering such a blow that it would probably never be able to stagger on to its legs again. The reasons for this are obvious, and have been already explained. I am a free trader, and am all for the open door under normal conditions. But the conditions of dye-making are extremely abnormal. National necessity and pressure caused undertakings to be set on foot during the war, with the view to making this country self-supporting in regard to dyes. Large capital expenditures extending over years ahead were undertaken by concerns both public and private, undertaken at the instigation of the Government and people of this country, and on the promise of certain conditions, to withdraw which now would be obvious breach of faith. Fortunately there is little likelihood of dye-makers being faced with so disastrous a situation.

On the other hand, it would be equally disastrous to the other interest—that of the textiles—to raise indiscriminate tariffs, and put our manufacturers at so great a disadvantage as compared with our competitors abroad, and the incidence of any tariff that would be effective from the dye-maker's point of view would be almost impossible to foresee. For dye-making in this country is at so many stages of development. In some cases we need no protection, in others the tariff necessary would be so high as to seem ludicrous, and moreover it would defeat its own ends, for the user would be so handicapped as to be put out of the foreign market. Also to encourage dye-makers to look forward to a permanent protection would, in my opinion, have the inevitable effect of slowing down our effort and energies. For we must never be allowed to forget that our success in this, as in other fields of industry, must ultimately depend on our capacity to produce the best article at a lower cost than our competitors.

There remains the third method I indicated —that of a temporary control over the imports of dyes into this country and the granting of a special kind of subsidy by the Government to meet the probationary period. Let us examine this more in detail, and see whether it has in it the means of attaining all our objectives. These objectives are briefly—(*a*) supplying textile manufacturers with dyes of equal quality at the same prices as they can be purchased by competitors abroad; (*b*) giving the necessary time and opportunity for the development of an independent dye-making industry in this country; (*c*) insuring the country for all future time of a valuable weapon of defence in the event of war, while avoiding risk of another collapse of the textile industry.

There has been much discussion as to what should be considered the probationary period, the period necessary for this country to develop a dye industry that would make us practically independent. The past 4½ years, as we have stated, are no proper gauge, but, making due allowances and reckoning on whole-hearted effort and co-operation, I should think the term of 10 years given by the Board of Trade is a reasonable, perhaps an outside, calculation. The problem is therefore how to bridge over this interval.

Here I shall make use of a contribution which I made to the *Times* of January 14 of the present year, with a view to having the proposals more fully ventilated and discussed. It occurred to me that they must have some virtue since they were accepted by the *Times* and afterwards fully approved by the *Manchester Guardian*. Things of course have moved since then, and certain steps have been taken by the Government partly on these lines so far as one can gather, but as the policy of the Government at the present time is difficult to follow, and one does not know what may be in that "locked up box," I think no harm can be done by discussing fully the general proposals then made. My suggestion was that at this juncture there should be formed a temporary Dyes Control Board, which should bring under review the whole of the requirements in dyes of the manufacturers of this country. This Board would form a sort of exchange through which, to begin with, all the dyes, whether home or imported, would pass, and this Board would fix the prices to be charged to the users. But it would be the constant objective of the Board to reduce its activities stage by stage, till at the end of the period of, say, 10 years, it would cease to exist, at least in its capacity of an exchange.

Let us assume such a Board now formed, and that it had ascertained the requirements in the various dyestuffs for the first year. Let us suppose that, after eliminating many items which are only needless varieties of others, the number of colours it had to supply was, say, 1000 in all. The first duty of the Board would be to ascertain which of those colours can be procured in this country, in what quantities and at what prices. They would at the same time learn what prices ruled abroad for corresponding colours. This comparison, let us say, revealed the fact that there are being produced in this country at the present day, say, 100 colours equal in quality and price to the corresponding colours produced abroad. As regards this group of 100 colours, the first duty of the Board would be to announce to manufacturers and dye-makers through the trade journals that these colours are to be given a free market, and that the Board will take no control over them whatever. With quality and price equal it might be expected, after past experiences, that manufacturers would need no inducement to buy from home producers in preference to foreign.

As to the remaining 900 colours, the review would reveal very varied conditions. Some would show home productions to be only slightly dearer than foreign, though equal in quality; some would show much higher in price, yet inferior in quality, while some would not be procurable at all in this country. All these grades would have to be treated separately, and in the manner best suited to bringing every one sooner or later, but as soon as possible, on the free list. Meantime, however, the problem is to be faced of giving the manufacturers now these colours at the same prices as they can be purchased by competitors abroad. This is how they would act.

The Board would buy the production of the home dye-makers at such prices as its members had satisfied themselves showed only a reasonable working profit. Suppose the requirements for a certain colour to be 100 tons a year, the home production to be only 50 tons, and the price 6*s.* per lb. The same colour it may be found can be purchased abroad at, say, 4*s.* per lb. In order that the home

manufacturer may be enabled to procure this colour at the same price as his foreign rival, the policy of the Board would involve its supplying users in this country at 4*s.* per lb. for the whole 100 tons, otherwise they could not compete. The exchange would, therefore, purchase 50 tons from the home producers at 6*s.* per lb. and another 50 tons from abroad at 4*s.* per lb., and hand over the whole 100 tons to users in this country at 4*s.* per lb.

This method spread over a number of colours would of course show a large loss to the Board for the year, but that is the form in which I suggest the Government should give its main help and contribution towards the combined interests of the dye and textile trades. It would preserve the best interests of textiles by assuring an adequate supply of colours sound in quality and competitive in price, while it would give the necessary protection to the struggling dye industry.

Having accepted the situation regarding such a colour as is exemplified above, or such a group of colours, for the first year, investigation would be set on foot as to the causes for the higher price, or it might be the defective quality, of the home product as compared with the foreign article. This would be intimated to the dye-makers, and a certain time allowed them to make good in these particular colours, say one, two or more years, according to the nature of the problems involved; and by the expiry of the period stipulated this colour, or group of colours, would be put on the free list and outside the control of the Board

In this way it might be expected that each year would see a further 100 colours put on the uncontrolled list, and by the end of 10 years the dye-making industry would be expected to be able to stand on its own legs and welcome competition. At any rate, the Board of Trade by this arrangement would have given the industry the opportunity to establish itself; and if in certain instances it transpired that the home supply was inadequate either in quantity or quality, it might prove that the causes were inherent in the nature of things, and not fit cases for further subsidy. Meantime by ensuring to textile manufacturers and other users dyes of good quality at the same prices as are paid by their competitors abroad, the Government would have done all in their power to preserve intact the great textile industry, while the younger industry of dye-making was being nursed into independence.

In working out the plan it would probably be found that by the method of central purchase, and proper control and analysis of products, great economies would be effected. Selling commissions, for example (no small item in the German days), would be largely saved, and by the purchase through one office of such quantities as the Board would place reduced prices might be got, such as would go a long way towards defraying the working costs of the Control Board.

I feel sure that some such scheme will be found necessary if dye-making is to survive the situation that must very shortly face it. As a dye user and manufacturer I know the absolute necessity of having all the colours *now* that will enable us to meet the competition of manufacturers abroad, to whom the whole German palette is available. I know it is impossible to procure all these colours in this country now, and that it will not be possible in some cases for several years to come. On the other hand, I know that many of the colours not just now available are about to be produced in this country, and that already large sums for plant have been expended upon them. It is necessary to take a fair and a balanced view, and adopt a policy that will as far as possible meet the present conditions and be fair to users and makers alike. The plan I have suggested seems to me to attain these objectives. It will cost money, and will need a staff thoroughly interested and well organised, but it is the penalty we have to pay for a past lapse, and our treatment of the problem entirely depends on our determination, and whether we are really serious in our effort to become self-supporting in the dye trade.

Do not let us forget the dilemma we found ourselves in at the beginning of the war, and let us try to recall some of the enthusiasm and will-to-sacrifice that filled us in those early days.

Dye-making in this country, given time and opportunity, can be put on a sound and profitable basis. Given this and a reasonable amount of understanding and co-operation among the dye-makers here, I see no reason why a few years from now should not see us abreast of the best that the Germans are doing; and when we have had that time and opportunity I would be the last to ask for any sort of favour or protection for the industry. We should be game to run the race and take our place according to our ability.

In the meantime I should like to suggest to the Government, in these days of controlling and organising, that a good deal might be done to further the progress of dye-making in this country by some judicious co-ordination of production. I refer chiefly to the production of intermediates. Much needless effort and money have been spent by different firms having had to make the same intermediates, each on a comparatively small scale, whereas by arrangement through the Government and a little co-ordination many of those could have been made at one central place, and made cheaper for all. Take the case of anthraquinone. That is now being made by about five different firms in this country, all probably getting Government grants. I would suggest that here is a case where the Government could easily have stipulated that the plant of one firm should be increased to the extent that it could supply the needs of the country on a controlled price, and so have saved much valuable time and money to the whole dye industry. The same applies to other intermediates, such as phthalic anhydride, salicylic acid, H-acid, and many others wanted in moderate quantities by each firm. It seems only fair if the Government are granting public monies that the public should ask that money is not granted for needless duplicates of plants, if by a little co-ordination that could be avoided.

The same, I would argue, applies to the production of colours. I do not think it desirable from the user's point of view that one firm should for all time have the monopoly in the production of any colours. But for the early period and while the prices to users are under supervision, it would be a sound policy to apportion groups of colours among the various makers and so enable the whole field to be covered in a much shorter space of time.

Perhaps these things appeal to me more because we are comparatively small producers, and we have felt the pinch in having had to wade through all the processes for most of our intermediates single-handed. But I feel sure that from the national point of view the best results will ultimately be attained by making the main intermediates of the colour trade in such a way that they will be available for small makers here to purchase at reasonable prices. After all, colour is a vast field, and there are vast tracts unexplored, and while we shall have to depend for the main supplies on the large companies, such as have risen in this country, there will always be the need and always room for individual effort to develop specialities, for which the larger companies may not have the time or inclination.

It is therefore important, in my opinion, that the Government should try to make available for

ordinary sale the intermediates that form the basis of so much of the potential colour production, so that as many fresh minds and as much individual effort as possible are allowed to operate upon them. This method, it seems to me, suits the peculiar British genius; it is more the British way—we are not so inclined to advance in massed formation as the Germans—and I am sure it would give us our best chance of ultimately outstripping Germany in the dye field.

DISCUSSION.

The CHAIRMAN said he had listened with very great interest to Mr. Morton's paper, which looked at the subject from an entirely different point of view from the other papers. These dealt with the subject from the point of view of the dye maker, but they were extremely grateful to Mr. Morton for having dealt with it from the point of view of the dye user. There were very few dye users in this country who had also had the experience that Mr. Morton had of being a dye maker as well.

Dr. M. O. FORSTER said that Dr. Levinstein's paper was a corrective for the very dangerous and unjustifiable optimism which was growing in the minds of everybody who discussed this question at the present time. He had read a short time ago a statement by a qualified chemist in America to the effect that the American chemists in four years had accomplished what German chemists did in 20 years. That, to his mind, was highly misleading. What American chemists had done in four years was successfully to repeat in the laboratory and in the factory experiments on a small and a large scale which it took German chemists 20 years to elaborate *de novo*, and that was an absolutely different thing. It was because statements of that kind were so frequently made that he welcomed this admirably sound and critical address by Dr. Levinstein. He was very glad that Dr. Levinstein had not been carried away by the absurd optimism which had affected so many people, because Dr. Levinstein was going to be responsible in the future for an enormous national undertaking, in a position in which he would be called upon to guide the chemical destinies of 300, and perhaps in future years more than 300, academic chemists. In a certain sense, he shared with the professors of the universities and colleges the responsibility for the future of the coming generation and even the coming generations of chemists for many decades, and he shared it on a very large scale indeed.

Sir WILLIAM PERKIN agreed with Dr. Levinstein and Dr. Forster that there had been a tendency lately in certain quarters to make the situation stand in a much more favourable light than actually was the case at the present time. Whilst they could congratulate themselves on certain things that had been done, they must also see what an enormous amount of work there was to do. He had long been convinced that an industry like the dye industry required the best chemists that could be got, men of the highest ability. These men had to be trained in the universities and technical schools, and it was therefore most important that the best scientific ability should be concentrated in the universities. He had pleaded for many years that the industries should make use of the scientific brains which were concentrated in the universities, and that was being done now. For instance, in connection with the dye industry there were at some of the universities, such as Oxford, Leeds, and Liverpool, little colonies of men working at problems connected with the dye industry. What had been done in this direction was sufficiently encouraging to lead to the hope that all manufacturers would see to it that the universities were largely used to solve problems of a technical character.

Mr. F. H. CARR said that the important point to be gathered from Dr. Levinstein's paper was that it was of paramount importance that England should be the home of chemistry. England could not be the home of chemistry unless it was the home of industrial chemistry. The universities ought to be able, as Sir William Perkin had pleaded, to maintain a large number of men to carry out that research work which was necessary if England were to be the home of chemistry. That could not be done unless the industry was flourishing and making large profits which would enable it to treat the universities generously. He thought that one of the most important attitudes which the makers of dyes ought to adopt was that the profits which had passed into their hands and which had not passed out again should be utilised as capital for immediate development. The Government was doing all it could to give confidence to that capital and it might be necessary to take risks, but risks must be taken if the standard of effort raised during the war was to be maintained.

Mr. JAMES MORTON said that the fact of having such an army of chemists in this country for the dye trade would also be a stimulus to general invention. It would not only benefit the dye industry; it would quicken the intellect of the whole country and would affect industries quite different from the dye industry, since chemists often made discoveries which proved of value in directions quite different from those in which they were working.

Dr. LEVINSTEIN said that at present he did not propose to criticise the detailed proposals made by Mr. Morton because the Government proposals had now been formulated and it would be necessary to see how the Government policy worked out in practice. Mr. Morton was very much to be congratulated on having had the courage and boldness to enter so successfully upon the manufacture of dyes. In regard to the discussion on his own paper, it was perfectly clear that no one man was going to revolutionise the industry. During the war there had been a great change in the outlook of the universities. They now held themselves far less aloof from industry and they had accomplished extraordinarily fine work during the war, and he looked forward to having great support from them in the future, primarily in supplying the industry with well-taught chemists who had learned how to work rapidly and cleanly and to think. That was the most important function of university training.

The CHAIRMAN congratulated Dr. Levinstein on the fact that he had succeeded in getting together such a large staff of academically trained chemists. Dr. Levinstein had also been very courageous in stating the facts with regard to the situation, and they were particularly grateful to him for doing so. It was a much more pleasant task to tell people that everything was going well and that everything was for the best than to take up the attitude that Dr. Levinstein had adopted. He had great admiration for the scheme Mr. Morton had put forward for dealing with the problems that were going to arise in connection with the dyestuffs of which the country was in need. In many ways the author had brought to bear upon these problems an entirely new aspect. In other respects the scheme which he had put forward was comparable with one that Mr. Young, the official Trustee in Manchester, had suggested early in the war for dealing with the problems that were likely to arise after the war. It was quite conceivable that something of the kind which Mr. Morton had suggested might ultimately be adopted, but there were several respects in which it would be rather difficult to adopt the whole of his proposals. One way in which the Germans might try to defeat

such proposals was by offering to users certain dyes not being made in England at a relatively low price if there were included in the contract other dyes that were being made in this country. He agreed with Mr. Morton that very little had been done during the war to avoid unnecessary duplication of production and of research, but he was afraid that during war time it was inevitable, owing to the great shortage of a number of these products, in consequence of which a number of different firms had started to make them. Also some firms had started making intermediates because those they were able to obtain were not sufficiently pure, so that the resultant dyes were often not of the shade required or were of inferior quality in solubility or other respects. One of the objects of the Association of British Chemical Manufacturers was to prevent that duplication of plant and research referred to by the author. In the past, British chemical manufacturers, like the chemists themselves, had been great individualists, and there had been far too much internal competition at home in various ways. The Association had not accomplished anything like what it was hoped it would do during the time that it had been working, but something had been done in that direction and he had great confidence that a great deal more would be done in the future. A great many of the points that Mr. Morton had raised were of special interest to him because he was one of those who had to deal with licensing the importation of dyestuffs into this country. The work that had to be done was so new and so complex that it was not easy to deal with the problems which had been put before them. When, however, it was difficult to decide whether a particular dye or intermediate should be permitted to be imported or not, he always asked himself the question, "What is it in the best interests of the nation that ought to be done?"; he believed that was the only way in which a proposition of that kind should be dealt with. He thought that before long ways and means would be found to overcome some of the serious difficulties to which Mr. Morton had called attention and which were certain to arise. The Americans had got a kind of treble protection for their dyes. They had first of all a Licensing Committee like our own, but which was much more stringent. Then there was the duty on all imported dyes, and thirdly there was that very important new development known as "Chemical Foundations." Some six months ago the Americans had formed a Syndicate which had bought up all the American patents owned by Germans for a relatively very small sum. In America they had product patents which placed a tremendous advantage in the hands of the United States with regard to the future importation of German patented products, a power which we did not possess in this country. In regard to the question of chemists, whilst he agreed that some of the most brilliant inventions had been made by British chemists, yet in the past we had had an insufficient number of men to carry out the ideas of chemists of the first rank in this country. He thought the situation was going to improve greatly during the next few years. In that connection it was interesting to bear in mind that some of the greatest discoveries that the German chemical manufacturers had made use of during the last 20 or 30 years had been made by chemists who were not of Teutonic origin.

CERTAIN COLOUR-PRODUCING INTERMEDIATES.

BY GILBERT T. MORGAN.

This summary of recent work carried out at the Finsbury Technical College during the past three years illustrates a well-worn theme which should not be forgotten even in the midst of international peace, namely the close relationship between synthetic dyes and military explosives.

Methylation of aromatic amines.

Several methylated bases are employed in colour making and one at least is the basis of a high explosive.

Tetryl, or 2.4.6-trinitrophenylmethylnitramine, is usually prepared by the drastic nitration of dimethylaniline, a process involving oxidation of one of the two methyl groups present in this tertiary base. This operation necessitates the wastage of a considerable amount of nitric acid, and this loss might be avoided by the nitration of monomethylaniline, if this base were obtainable in sufficient amount.

It was previously known that polymerised methyleneaniline, the condensation product of aniline and formaldehyde, yielded on alkaline reduction a certain proportion of methylaniline, but the process presented certain practical difficulties.

An improvement was effected by causing formaldehyde and aniline to interact in the presence of excess of reducing agent so that the nascent methyleneaniline was reduced immediately to methylaniline. The success of this chemical change depends very largely on the thoroughness with which the reagents are mixed together. The machine devised for this purpose is on view at the British Scientific Products Exhibition by the kind permission of the Chemical Warfare Committee.

The reaction was found to be a general one and was applied to the homologues and derivatives of aniline. The three isomeric toluidines were methylated under similar conditions, the optimum result being attained in the case of *p*-toluidine.

The halogen derivatives of aniline were also amenable to this treatment, upwards of 90% of methyl-*p*-chloroaniline being obtained from *p*-chloroaniline. The *ortho*- and *para*-anisidines gave favourable yields of their methyl derivatives.

An extension of the process to α- and β-naphthylamines led to the production of the corresponding monomethylnaphthylamines. The purification of the resulting methylarylamines was, in all the cases examined, greatly facilitated by the use of aqueous zinc chloride, which combines with any unchanged primary base to form a crystalline additive compound of which the aniline compound, $ZnCl_2$, $2C_6H_5NH_2$, is typical. The methylarylamines examined did not yield these additive compounds.

Acyl derivatives of methylarylamines.

The acyl derivatives of the methylarylamines are of technical interest inasmuch as they can be nitrated and reduced successively to yield colour-producing intermediates. A simple example, worked out at Dr. Levinstein's suggestion, will serve to illustrate this point. The formyl and acetyl derivatives of methylaniline give rise to *p*-nitro compounds and these on careful reduction are converted into two new intermediates, *p*-aminomethylformanilide and *p*-aminomethylacetanilide. These new acylated *p*-diamines are diazotisable and their diazo-compounds coupled with aminonaphtholsulphonic acids, such as H and J acid, furnish azo-dyes having useful tinctorial properties.

These examples indicate that experiments initiated to produce improvements in the manufacture of explosives have led to suggestive results in the production of colour intermediates.

Tetryl can, moreover, be prepared by an entirely different process starting from the well-known colour intermediate, chloro-2.4-dinitrobenzene. This compound heated with methylamine hydrochloride in the presence of an alkali such as sodium or calcium hydroxide is converted into 2.4-dinitromethylaniline, the nitration of which yields tetryl.

The practical difficulty of manufacturing the

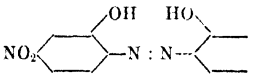
methylamine hydrochloride required has been overcome and this salt can now be procured on a commercial scale. With the aid of this reagent, kindly supplied by Messrs. Claus of Manchester, Mr. F. P. Evans and I have obtained methyl-β-naphthylamine by an alternative method from β-naphthol, so that this hitherto imperfectly studied secondary amine can now be prepared by two alternative methods based on formaldehyde. The acyl and other derivatives of this base are now under examination.

Chlorodinitrobenzene also interacts readily with aqueous or alcoholic ammonia giving rise to 2.4-dinitroaniline, a primary base not hitherto largely used in colour making.

Para-nitrated diazophenols.

2.4-Dinitroaniline is diazotisable only in concentrated acids, and 2.4-dinitrobenzenediazonium salts are only stable in acid solution. In alkaline or even neutral solution they lose the *o*-nitro group and become converted into a soluble variety of 5-nitro-2-diazophenol.

Accordingly when these dinitrobenzenediazonium salts are condensed with a rapidly reacting coupler such as Schäffer salt, a dinitroazo dye is produced, dyeing in orange shades not affected by metallic mordants. When, however, the preliminary change is effected by neutralisation of the acid solution of the dinitrobenzenediazonium salt, the azo-dyes produced by coupling with a phenol or an aminonaphthol are all characterised by having the following skeletal formula :—



Dihydroxyazo dyes having this configuration are very susceptible to the action of metallic salts, becoming mordanted in characteristic colours.

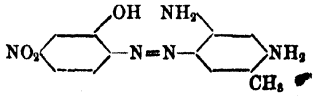
These dyes are to be regarded as illustrations of a larger series, the homologues of 2.4-dinitroaniline yielding others more complicated. Mention may be made of experiments made in collaboration with Mr. E. D. Evens on the naphthalene analogues of dinitroaniline.

2.4-Dinitro-α-naphthylamine can be prepared in three different ways, of which two are realisable under industrial conditions. This base, like 2.4-dinitroaniline, is diazotisable in concentrated sulphuric acid. Dilution with water determines the removal of the *o*-nitro group and, in this case, the precipitation of the internal anhydride of 4-nitro-1-diazo-β-naphthol. This compound couples with the more reactive phenols, notably resorcinol. In conjunction with metallic mordants the resulting dye gives distinctive shades.

The 4-nitronaphthalene-1-diazo-2-oxide loses its diazo group on boiling with alcohol and gives rise to a new nitro-β-naphthol, *viz.*, the 4.2-isomeride, the fourth to be discovered of the seven possible isomerides. 4-Nitro-β-naphthol couples with diazo-compounds like β-naphthol itself, but in most cases the azo-colours produced are quite different from those of the unnitrated naphthol.

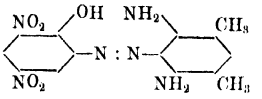
The property of forming lakes with metallic mordants is not confined to azo-dyes containing two hydroxyl groups contiguous to the azo-complex. A pair of hydroxyl and amino groups in this position will bring about the same effect. Metachrome brown is a well-known example of this type.

The 5-nitro-2-diazophenol from 2.4-dinitroaniline gives a similar dye when coupled with 2.4-tolylenediamine



During the war, the demand for toluene led to the isolation of this hydrocarbon from Asiatic petroleum. In this material the toluene is accompanied by the xylenes, the predominant isomeride being *m*-xylene. This hydrocarbon when nitrated and reduced successively yields 4-6-diamino-*m*-xylene, a base which has been examined from the view point of colour production.

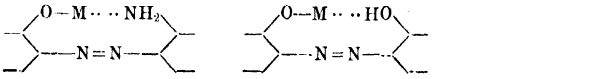
The early evidence as to the coupling powers of this diamine is conflicting. Witt stated (Ber., 1888, 21, 2419) that it did not yield chrysoidines, but in 1902 I showed that it coupled with diazotised aniline, *p*-toluidine, and similar primary bases. These azo-compounds had, however, no value as colouring matters. Recent experiments show that the *o*-diazophenols lead to chromable dyes of which the one from diazotised picramic acid may be cited as a typical example,



giving brown shades by the metachrome process of dyeing.

The lakes produced from *o*-dihydroxyazo- and *o*-aminohydroxyazo-dyes are, on account of their fastness and intensity, substances of great practical utility. They are also of considerable interest from the scientific point of view. The modern conceptions of residual affinity and chemical combination put forward by Werner and others have rendered it possible to give a general explanation of the nature and properties of these mordant dyes.

The metallic atoms implicated in these complexes have in many instances lost their ordinary analytical reactions and the lakes themselves exhibit exceptional colours, sparing solubility, and chemical inertia. These properties are explicable on the assumption that a new cyclic complex has been produced in which the metal, the azo-group, and the two adjacent auxochromic groups take part partly by virtue of principal valency, partly by that of residual affinity.



This explanation applies not only to modern hydroxyazo-dyes but also to the oldest known mordant dyes such as alizarin. The success of Werner's theory in its application to mordant dyes is comparable with that of Kekulé's benzene theory in unravelling the complex constitutions of synthetic substantive dyes. This passing reference to work of theoretical interest may serve as a reminder that continued success in the exploitation of synthetic dyes and other fine chemicals is dependent on an enlightened appreciation of investigations and speculations which are not capable primarily of industrial application.

THE MANUFACTURE OF INTERMEDIATES.

BY E. V. EVANS, F.I.C.

It is stated that a very large proportion of the dyestuffs required for the maintenance of British industry is imported into this country. The creation and rapid development of that great organisation, the British Dyes Corporation, is evidence of the effort being made to render this country independent of external supplies, and the problems surrounding the manufacture of many dyes, especially those used in large quantity, have already been solved. The dye user, however, requires a much larger variety of colours and shades than those obtainable in Great Britain at the present moment, and these demands cannot be

satisfactorily met until the intermediates required are manufactured of a quality equal to that of the pre-war imported product and at a reasonable cost. In fact, the lack of an adequate supply of intermediates is mainly responsible for the present state of affairs.

Intermediates are not only manufactured by the British Dyes Corporation, but also by a number of other chemical undertakings, and during the last three years the author has had the opportunity of meeting at regular intervals practically all these manufacturers. They constitute a special Group of the Association of British Chemical Manufacturers and may be said to represent all British makers of coal tar intermediates and dyes outside the British Dyes Corporation. They have, however, until recently been mainly engaged in the production of munitions, poison gas, and other war necessities and have thus, except in a few instances, been prevented from taking a really important part in the production of dyes. When considered individually most of these undertakings are small compared with the British Dyes Corporation, but in the aggregate they represent an invested capital of some 25 million pounds, and, if their efforts are co-ordinated, form a body admirably suited to deal with the problems of the future. It stands to reason that with so many industrial problems remaining unsolved the value of such a body cannot be ignored, and although the effort already made by the established dye manufacturers is stupendous and most praiseworthy, the national interests will best be served by utilising to the fullest extent the whole of the resources of the chemical industry.

Whatever means may eventually be adopted to develop the whole of the country's resources consideration might advantageously be given to a few of the underlying principles practised by Germany to protect its chemical industry. It is acknowledged that that great octopus of the German chemical industry, the Interessen Gemeinschaft and the Erweiterte Interessen Gemeinschaft, possesses many disabilities. This scheme of selective protection for certain chemical manufacturers would have led to the destruction of the industry had it not been judiciously controlled by a directorate prepared to forego immediate financial returns in order to ensure the establishment of a permanent chemical industry. As an example of the latest developments of this scheme, it is found that one large works obtains a certain product from a distant works of an apparent competitor although it is itself fully equipped to manufacture this same product. This is brought about by the fact that the distant works, owing to its superior geographical position, is able to manufacture the product more efficiently. It is remarkable also to find that a plant at the works of Bayer & Co. is closed down because the market requirement for the product is satisfied by the output of the Badische Anilin und Soda-Fabrik, which is able to manufacture more economically. Here and in many other instances may be seen the effect of co-ordination in the German chemical industry, and it should be emphasised that the industry is self-controlled by a highly technical directorate of chemical manufacturers.

One does not see in Germany twenty firms making salicylic acid or β-naphthol each with an output of 10 cwt. per week. Mass production is the order of the day, and in this lies a great measure of the success that has been attained. The capacity of the β-naphthol plant of Meister, Lucius, und Brüning, Höchst, is eight tons per day. The process has naturally been developed to a high state of efficiency, yet there exists nothing but that which results from a careful study of the process in the laboratory and equally careful production of it on the large scale. The efficiency of the process *qua* process does not appear to exceed that of certain installations operated in this country, but each item of manufacture has been carefully and elaborately studied with the object of producing at a minimum cost a product of the highest degree of purity. Whilst the organisation of the German chemical industry allows a certain amount of healthy competition to exist, the wholly inefficient manufacturer has to be prepared to alter his methods or pay the penalty of inefficiency. This penalty is not the bolstering up of one process by a highly remunerative one, or the utilisation of existing fighting funds or Government monies, but rather the closing down of the plant.

In the manufacture of the intermediates still required in this country processes of a certain degree of complexity are entailed. Moreover many of these products are required in small quantity. It is therefore impossible to imagine that the manufacture of these new intermediates when conducted in a number of small units distributed throughout the kingdom will lead to success. In such cases, in order to pay due regard to the importance of mass production, manufacture must be undertaken only by one or two makers possessing special facilities, for it is no simple matter to displace imported manufactures at the present moment, even with installations of large output, owing to the existing cost of plant and apparatus and the high prices of labour and fuel. Whilst on the one hand great attention must be paid to mass production, it is in the natural order of things that the manufacture of intermediates should not be concentrated in one or two centres, but should be distributed in order to take full advantage of the present resources of the chemical industry. This distribution should be decided by such factors as geographical position, the cost of fuel, of transport, and of labour, and the present fitness of the manufacturer to undertake the work in question, but when the decision is made, plant of considerable output should be installed.

With the close of war chemical manufacturers are left not only with greater experience but with an abundance of plant and material which may be well turned to good account. Whilst one manufacturer is admirably equipped for the production of phenol, cresols, etc., others are more fitted for the production of chlorine derivatives, whilst in those centres where there exists an adequate supply of coal tar products and a sufficiency of inorganic products such as sulphuric acid, ammonia, and its congener, nitric acid, other special facilities are possessed.

A great co-ordination of effort is required and the industry seeks leadership by those who are convinced that there exists such potentiality among the chemical manufacturers who made munitions and poison gases that in the utilisation of their services which they are willing and anxious to give, lies the means to success. Chemical manufacturers have submitted themselves to four years of Governmental control, and although this is not suggested as a means of dealing with the dye problem, it is believed that the chemical manufacturer is in the frame of mind to welcome internal control in the industry.

DISCUSSION.

Prof. A. G. GREEN said that if the author advocated anything like a complete separation of intermediate manufacture from dyestuff manufacture, he could not agree with him. Such an argument left out of account many factors such as that of the close inter-relationship of by-products. For instance, firms making only β-naphthol might not be

able to do anything with the sulphite and would have to sell it, but in large works where a large number of products were being made it was possible to use the by-products of one manufacture as the principal products of another manufacture. In some cases of intermediates, which were used in comparatively small quantities, separate manufacture might be an advantage, but such things as β-naphthol and Cleve acid, which Mr. Evans had specifically mentioned, which were not small things but very big things, should essentially be made by the dye manufacturer himself.

Mr. F. H. Carr was rather surprised to hear Mr. Evans' reference to geographical distribution. It seemed to him that anyone coming home from that wonderful centre of distribution, the Rhine, could not but see the enormous advantages of that river to their chemical industries, because it brought each unit of the concern into immediate proximity with the other, even although they might be 20 or 30 miles apart. In England it was desirable, if it were possible, to develop the idea of consolidation of industries in the same way, making use of the best equivalent we had, *viz.*, the Mersey or the Manchester Ship Canal; he thought there was the strongest possible argument that the geographical distribution of the chemical industries should be in that district.

Mr. Arthur Green said he could not agree that the secret of the success of the chemical works in Germany was their geographical position; it was more due to the fact that they manufactured everything for themselves. If the manufacture of these intermediates were distributed over the whole of the United Kingdom the cost of manufacture would necessarily be greater than if the dyestuff maker manufactured them for himself, if only on account of the cost of transportation.

Dr. J. C. Cain thought they were rather apt to generalise on this question. Mr. Evans did not propose that all intermediates should be made in an intermediates works, but that certain intermediates should be produced in the dye manufacturing works and certain others in separate works. It had rather been conveyed that the German dyeworks made all their own intermediate products, whereas it was a fact that one works alone concentrated on salicylic acid. Before the war von Heyden's had been the only firm making salicylic acid, and there were other similar cases to that. On the other hand, there were intermediates such as *m*-phenylenediamine which could be made in the dyeworks to better advantage than in a separate works.

Prof. H. E. Armstrong said he gathered from the last paragraph in the paper that the great lesson which the author had learned on the Rhine, and which he wished to urge upon them here, was that they must get together and organise. The important thing to consider was what chemists were going to do in the future. The development of the chemical industry in Germany had commercialised and ruined the majority of the German laboratories by persuading them that it was desirable to make money out of chemistry. What he was most anxious to see avoided in this country was any socialisation of our scientific work through Government grants. The Government had instituted a system which was bound to commercialise our science, if we were not careful, by putting a money bait before academic students. When he had been in Leipzig there had been free intercourse among the students, and their training had been identical. They had communicated one to the other what they had learned, and taught one another. A few years afterwards the staff had been subsidised by the manufacturers, and instead of the students being free to talk about their work they had been put under a pledge of secrecy, which had had a most serious influence. He did not want to see that condition introduced here, and yet the Government was giving grants on condition that reports of the work should not be published without consulting them. He had the greatest respect for what had been done at Dr. Levinstein's works under the most difficult conditions, but he had even more respect for the work done by Mr. Morton, because he had started without previous experience, without a brick laid, and had developed his particular small branch of the industry in a very remarkable way. If we were to secure an economic success which would make it possible for the industry to develop, a great co-ordination of effort was required. Mr. Evans had said that the industry sought leadership. In his opinion an industry which sought leadership was doomed. One great enterprise had been started under Government, but it would only be a real success when it got entirely free from Government control. How were they going to secure that leadership? That was the great problem of the future. If they could secure it within a few years they might do something; if not they would not do anything. It must be done very soon. There was a lot of ability in the country, but it had not been directed to the chemical industry, and it would not be under present conditions any more than it had been in the past. They wanted men of *savoir faire* and commercial ability, as well as scientific ability, for this purpose. In the early part of the paper the author said "Whatever means may eventually be adopted to develop the whole of the country's resources, consideration might advantageously be given to a few of the underlying principles practised by Germany to protect its chemical industry." Germany had never thought of protecting her industry until she had got it. We did not want to protect our industry; we had to get it first. Much had been said about the advance of the industry, but he would like to know whether the different dyestuff users were satisfied not merely with the range but with the quality of the goods they were getting. The Germans had in the past supplied articles of high quality and uniform quality. Were we doing that? Much more serious competition was coming from America than from Germany. The Americans were far ahead of us from the point of view of organisation. It was essential that we should have at the Board of Trade people who understood the business they had to deal with.

Mr. Evans, in reply, said that his instructions from those who sent him to Germany were to write a paper in which matters could be read between the lines, and nothing more was given. He could not deal in detail with the questions that had been raised. He could not tell them whether β-naphthol could be made at Huddersfield or on the Mersey, or where it could be made. He left that to the existing dye manufacturers. What he had to tell them was that he had seen in Germany the best organisation ready to send material over here at the earliest opportunity. Before going to Germany he had spent three years with a number of manufacturers in this country who had been disorganised for want of someone to pull their forces together, and his paper really was a plea for leadership inside the industry.

Prof. Perkin said he had been most keenly interested practically all his life in endeavouring to bring the universities and the industries closer together. No chemical laboratory nowadays could exist or flourish unless it was in connection with the industry. Chemical laboratories were very expensive in regard to appliances and buildings as well as the staff, and unless it was in contact with the industry and got much of its material and apparatus free, and unless it had a Government grant, the laboratory could not exist.

It had been calculated in Manchester that the University lost about £70 a year on every advanced student. Another thing was that they must hold out to the man who was studying chemistry a hope that he would get some kind of remuneration later on, *i.e.*, money must enter into the calculations of every student. He must ultimately see his way to get a decent salary after the labour he had put into his education, and in this respect he did not agree with Prof. Armstrong, because he thought there must necessarily be a certain amount of commercialism about every university. It was impossible to get rid of it. With regard to contact between the University and the works, he looked upon it that the type of research that was required by a works, especially an organic chemical works, was practically the same as that which was carried out in the University laboratory. There were many problems which presented themselves to the chemical manufacturer which could perfectly well be solved, and best solved, at the University.

Patent Law.

Prof. A. G. Green said that he wished to raise a point in connection with our patent law policy. A new patent law was being considered by the Government, and the Society had been asked, among others, to make suggestions with regard to amendments in the present law. The enormous assistance which the industry had received during the war from German patents was well known. The Germans were especially aware of the fact that they had, by means of their own patents, assisted us tremendously. That must necessarily cause them to change their policy in the future, and he was credibly informed that they did intend to change it. In future, in his opinion, they would take out no patents with the exception of those in which the process was indicated by an examination of the end product. They would not take any patents for intermediates where it could not be told from an examination of the end product how it was made, and they would not take any patents for improved processes. That must influence our policy, because if we continued to take out patents in the same way as we had before, we should be placing ourselves at a hopeless disadvantage. Moreover, we should have no possible means of bringing home infringement. A product might be sold on the English market which was made by a process patented here, but it would be impossible to decide definitely by examination what method was adopted. There then came the difficult question that if we did not protect our inventions, how could we establish prior use? It would seem that two courses were open; either to amend the patent law so that a process might at the discretion of the Board of Trade be kept secret for a certain number of years; or to keep the process secret. To keep a process secret indefinitely tended to prevent further progress, and, also, how were they to establish prior use? The question of prior use was one which lawyers did not seem able to decide upon. What was prior use and how could it be established? If a process were worked out in the laboratory and a few hundred grammes made of the product but it was not manufactured, and somebody else took a patent for that process independently, could they bring forward their laboratory books to show that they had made the substance; could they establish prior use and upset the patent? He was informed by patent solicitors that we had not in this country a similar law to that which existed in Germany. In Germany, if a patent were taken out and another man said he had worked the same thing before, and proved it conclusively, the patentee could take no action against him; but the patent remained good to the rest of the world. In this country he was informed that a patent was either valid or it was invalid. If it was invalid against one person it was invalid against the world. If one man showed that he had used that invention before the subsequent patent was invalidated. It did not seem quite clear how they could establish prior use if a process were kept secret. Everyone was more or less agreed that if a process was only put into operation in the laboratory it was only in the nature of an experiment, and it could not be looked upon as a commercial working; but it was not quite clear, even if a process was put into commercial work—*i.e.*, that the products were sold, as long as they were sold secretly and as long as the product did not show on the face of it how it was made—that prior use could be established. Therefore, as things stood at present, if the inventor kept the process secret he was very doubtful whether he was safe. An independent inventor who also patented it might possibly prevent him working his own invention. On the other hand, if he patented it he might be giving away his invention to the world. He thought it would be very useful to consider the question and prepare in advance for the new position which was certain to arise.

The Chairman said that Prof. Green had raised some important and difficult questions, which should be discussed more fully than the present occasion allowed, in order that some proposition might be brought forward before the new patent law was finally drafted.

SYNTHETIC DRUGS.

By Francis H. Carr.

Although synthetic organic, pharmaceutical, and photographic chemicals were not until recently manufactured on any significant scale in this country, the achievements of British chemists during the past four years indicate clearly that there is no reason why we must revert to the former state of affairs. It is scarcely necessary to add that we shall have failed to fulfil a national duty if England ever again becomes dependent upon foreign sources for the supply of medicinal chemicals and is thus placed in the precarious position in which she stood at the outbreak of war.

The industrial applications of synthetic chemical processes are too difficult and intricate to be quickly established. They require men with an intimate knowledge and a long experience of detail. Even the cleverest and most intuitive chemists can only discover by the method of trial and error the best plant and conditions for working many processes on the large scale. Five years ago we were most appallingly behind in this department of chemical manufacture, and had the war broken out a decade later its result might have been disastrously different, so quickly were we losing ground. The position to-day is more hopeful and stimulating, for we have gained much invaluable experience and, above all, well-founded confidence in ourselves. Nevertheless these manufactures were carried out during war time in such abnormal and, in most respects, disadvantageous circumstances that the conditions in England at the present moment are in essential respects less favourable than those which obtain elsewhere. High prices have enabled us to continue during the war to manufacture many of these chemicals under less favourable conditions than those existing abroad. All inefficiencies must now be steadily eliminated and we are able confidently to predict that, given proper opportunities, this will be achieved.

The fine chemical industry is one peculiarly suited to this country. As Lord Moulton so forcibly pointed out in his speech at the opening of the

British Scientific Products Exhibition the other day: "We English people have nothing to fear as regards our abilities. We have got the power of research and invention and the power of patient devotion to a particular end we have chosen, and we have got the power of acting together on the largest possible scale, as the war has proved; all that is necessary is that we should be roused to the necessity of doing it." Through her consolidated and splendidly organised chemical industry Germany at one time bade fair to dominate the world. If we are not to be dominated by Germany or any other nation we must have a strong, comprehensive, unified chemical industry. Such an industry must necessarily embrace all the important branches of chemical manufacture, including that concerned with pharmaceutical chemicals. Those who have followed the rapid advances of biochemistry during the past decade can foresee great achievements now pending. It is clearly to be discerned that the powers of the synthetic chemist will find no limit. The day is probably not far distant when we shall be able to manufacture organic substances which control and modify the physiological changes affecting all the functions of the cells and organs of the body. The application of such compounds for nutritive, curative, or destructive purposes will render them of paramount importance. This will endow countries in which they are manufactured with great powers not possessed by those who have neglected to develop the synthetic chemical industry. The value of synthetic organic chemicals in combating disease has already made the industry one of extreme importance, and its importance is becoming rapidly greater. One can readily imagine that stricken countries may some day be driven to dependence on chemical synthesis even for their nutriment.

In its commercial aspects the manufacture of pharmaceutical chemicals is an important branch of chemical industry, for it utilises the same intermediates as are employed in the dye trade, whilst it also constitutes an outlet for by-products which are not of use in the colour industry. The manufacture of purified organic chemicals is the work of very highly skilled operatives, though it does not involve a large proportion of labour for a given value of product. We require in England industries which provide occupation for such skilled and well-paid workers, and, as the education of English people develops, this need will become greater. We shall need more and more occupation for the many young men with a taste and aptitude for chemistry who are continually coming forward from our secondary schools. I personally am convinced that, given time and patient training, this country will produce a class of skilled chemical workers second to none in the world. As for chemists, the record of British chemical research shows our adequacy in this respect.

More need not be said as to the necessity of retaining this branch of fine chemical manufacture. The Association of British Chemical Manufacturers has successfully argued that it is a key industry which should be protected, at least temporarily, and the Board of Trade, by a recent Order in Council, has restricted the importation of foreign-made fine chemicals to those for which a licence is given by a specially appointed committee. This protection is needed in spite of the proved ability and the potentiality to which I have referred, because we have not arrived at conditions comparable with those existing abroad, but it can be predicted that such State interference will on no account be allowed to continue if it can be shown to harbour inefficiency. On the contrary, we must be so efficient that we shall be able successfully to compete for foreign markets, the home market, as will be explained in a moment, being too small. The action of the Board of Trade affords a period of time to enable us to set in order a house which was turned topsy-turvy by war, and I wish particularly to direct discussion to those steps which can now be taken for this purpose. Unless reformation is commenced at once, we shall have to face a very serious loss of the fruits of the energy and capital which have been effectively expended during the war.

Let us consider first the nature of the competition we have to meet, next our own present conditions, and lastly what changes can be made.

Now pharmaceutical chemicals may be considered in four classes:—

1. Inorganic and simple substances, such as hydrobromic acid, glycerophosphates, chloroform, bismuth, magnesium, lithium and potassium salts, etc.

2. Naturally occurring substances, such as atropine, pilocarpine, eserine, emetine, aloin, strychnine, podophyllin, salicin.

3. Synthetic chemicals more recently discovered, for which there is relatively small demand. Most of these have been patented or are protected by trade names, such as adalin, novocaine, salvarsan, and pyramidon (of Meister, Lucius), aristol, heroine, lycetol, salophene (Bayer), bromipin, dionine (Merck), keroform, collargol, creosotol (Von Heyden), and so on.

4. Synthetic chemicals not protected by patents, for which a big demand has been created, such as antipyrine, aspirin, urotropine, phenacetin, sulphonal, veronal, phenolphthalein, sodium salicylate, saccharin, chloral hydrate, and guaiacol.

It is in regard to synthetic drugs of the fourth class that conditions abroad are at present so much more favourable than at home, and, as these represent by far the largest volume of trade, my remarks have most bearing upon the problem of their successful manufacture. In making these chemicals the cost of primary materials, such, for instance, as caustic soda, chlorine, zinc, acetic acid, and alcohol, is of much significance, and the intermediate products and by-products being intimately connected with the requirements of the dye trade, Germany secures a great advantage by combining their manufacture with that of dyes. The strength of this combination is particularly significant in the manufacture of these pharmaceutical chemicals, because the quantity of them needed for the whole world's requirements is limited and overproduction is readily reached. The world requirements of phenacetin, for instance, one of the most important of the synthetic drugs, probably amount to less than 10 tons per week—a quantity which could conveniently be made in two or three factories.

The German works producing pharmaceuticals of this type have stinted no capital outlay in perfecting and completing most elaborate plants; experience has been carefully husbanded and brought forward, and this accumulated knowledge represents an advantage which is most difficult to overtake. Substances such as phenacetin have been made by the Bayer Company since 1882; they have thus thirty-seven years of accumulated knowledge in perfecting their process. They make the chlorine, the nitric acid, the benzene, and the acetic acid which enter into its composition, and the by-products are employed in making dyes, guaiacol, chinosol, etc. By the complete internal organisation of their chemical trade the German chemical manufacturers are enabled to allocate particular manufactures to that works in which they can most suitably and efficiently be produced. Nor must we for one moment imagine that the German chemical industry will emerge from this war weakened in any important respect, either in equipment or in the determination of its leaders to maintain its old supremacy. Adverse labour conditions may affect it for a while, but they will doubtless soon be overcome. The plant in the

German factories has been beautifully preserved and greatly added to, for in Germany the manufacture of explosives and poison gases was mainly entrusted to the large dye-making concerns which also make most of the pharmaceutical chemicals of this class. The immense strength of these firms lies in their complete internal organisation in one body known as the Interessengemeinschaft. This big combination embodies in itself sufficient economies to enable it to compete on almost any basis with an unorganised body of manufacturers, whilst we must recognise that the men who built the German chemical industry will be doughty opponents, quite apart from this immense advantage in organisation with which they start. There are weaknesses and shortcomings in the German organisation, but we have to reckon with competitors who will be willing and able to overcome all such deficiencies. What resources and potentialities have we to set against the proved ability and power of this great German organisation, with reasonable prospect of success? The substances in class 4, with which we are mainly concerned, are all or nearly all manufactured in this country, by a considerable number of firms working independently and on a relatively small scale. In many cases, if not all, the processes are completely efficient, and the quality of the products is equal to or better than that of the pre-war German articles. The unavoidable economic inefficiency of this small-scale production, however, constitutes a handicap that is decisively overwhelming. Duplication of chemical and engineering staff, waste of by-products, or the necessity of disposing of them at less than their value (because the quantity is insufficient to recover alone), disproportionate maintenance and power charges, are existent drawbacks which for economical working must be overcome; moreover, even if we were to avoid this overlapping, the quantity of these chemicals required for the home market alone is not sufficient in most cases to give the mass production required. For instance, the home requirement of phenazone is but about 5 cwt. per week, of phenacetin about 15 cwt. and of hexamine about 10 cwt. It is therefore useless to depend on high prices in a home market secured by a protective tariff if we wish to build up an industry comparable in importance with that of Germany. We need a large share in the foreign markets, and it cannot be fairly claimed that on the whole we are at present in a condition to secure it.

Organisation among the firms engaged in other branches of chemical industry has made great progress, but in regard to synthetic chemicals much remains to be done. It is imperatively necessary, by making agreements or by other means, to prevent useless overlapping, to capitalise each manufacture so that its engineering equipment is of the best, to establish an intimate financial connection between the making of the primary, intermediate, and finished products involved, and, lastly, to achieve, where needed, technical co-operation.

It may be impossible to deal at one time with the substances enumerated, but attention should be given first to those substances required in largest quantity. Let me select salicylic acid as an example to illustrate the present position of affairs. There are in England about twenty firms making between them less than 10 tons per week of this substance—an amount which might conveniently be produced under the supervision of two or three chemists. Thus we have twenty or more chemists expending time and thought in a diffused manner to much less effect than if three good men were intensively concentrated on the same problem, and probably in no one factory has it been deemed desirable to expend the amount of capital required to make a plant perfect as regards labour-saving devices, efficiency of yield, and so forth. Moreover, salicylic acid can only efficiently be produced where the phenol, caustic soda, and carbon dioxide are available at the lowest cost. Compare with this its manufacture in the German Bayer Works. There carbon dioxide is a by-product from the neutralisation of sulphonation mixtures with chalk, caustic soda may be regarded for the moment as a by-product from the chlorine employed in the chlorination of benzene, and the phenol, which is made synthetically by another firm in the I.G., is made with similar economies in regard to primary materials. Only by the manufacture being undertaken here as in Germany on the requisite scale by two or three corporations can we obtain equal advantages for the manufacture of synthetic drugs of this class. This statement requires no elaboration, as it does not admit of contradiction. Such an undertaking is distasteful at first sight and involves sinking our individualities in a national effort. The old-established fine chemical firms in this country possess indispensable assets which are, apart from the above-mentioned considerations, needed for this business. They control selling organisations which cover the whole of the home market and, to a certain extent, the markets abroad. They possess invaluable technical knowledge and experience of refining these pharmaceutical chemicals to the necessary degree of purity and are well equipped for making the substances enumerated in classes 1 and 2, though in these cases great advantages could be obtained by making agreements to avoid overlapping. An attempt on the part of, say, the dye manufacturers to cut them out would result in a most deplorable national waste. It is most important, therefore, that interests should be reconciled, and we may now discuss how this can best be done. Let us consider two proposals. (1) That a large group of the present makers should close down their plants and combine in a united effort, (2) That one or more of the large makers of dye intermediates should manufacture these synthetics and supply them in both crude and purified state, as desired, solely to a group of the present manufacturers, who could, if they chose, purify the crude products and thereby continue to supply branded material of the quality and specification for which they have established a reputation.

The former plan would possess many of the advantages of co-operative effort, but would be subject to the disadvantage that if such an amalgamation produced its own intermediates the scale would still be small compared with that on which the dye producer makes the same substances, and should it not do so it would not purchase them as cheaply as the intermediate maker would produce them; but this plan has a greater difficulty in that the various firms combining would need to sell goods of identical price and quality, which it is feared would be unsuited to businesses which are concerned with branded articles of special quality. The second proposal would possess the advantages of large-scale production and technical co-operation, yet would allow the firms so desiring to purify their own finished products and thus to maintain their separately acquired reputation. To adopt such an arrangement, progressively dealing with the substances enumerated in class 4, would be a step towards a more complete and coherent combination of interests which might follow. The principle could be applied to those organic chemicals which are made by a number of firms on a scale smaller than will keep a well-engineered plant in full operation, and it chiefly concerns cases where technical achievement is approaching finality. It may be argued that the individual effort which is necessarily the first stage in the process must be carried on until the principle of the survival of the fittest has proceeded to its logical conclusion.

To adopt in its entirety such a policy would in all probability result in the sacrifice of the great achievements of the past five years, for our competitors abroad already possess a good lead. It is an unequal race in which we are engaged, and every advantage in point of time must be utilised.

In the manufacture of many pharmaceutical chemicals there remains room for individual achievement, and any satisfactory organisation of the industry must secure the fullest and freest scope for such effort. If the more important fine chemical manufacturing firms were to combine in the manner indicated to make the substances to which I have referred, they would make larger profits out of them and so have more money to utilise in individual developments and research. In this way, by fostering enterprise and research, pharmaceutical manufacturers would take a more active part in introducing those specialities referred to above in class 3. Side by side with concerted arrangements by these firms for the production of staple lines should develop co-operative purchase of raw material; in all other respects free and honourable competition might continue. Mistrust which now exists would be slowly dissipated by working together in this way. Such business arrangements must, of course, be the spontaneous outcome of individual firms and cannot be directed by trade associations, still less by the Government.

Nevertheless it is the duty of a Government giving protection to an industry of this kind to watch the trade in order to ensure that the protection is being utilised to national advantage and not merely being employed for private gain. It is necessary for those engaged in the industry to eliminate in every way duplication of effort and overlapping by making agreements and arrangements with others who are engaged on the same work; and this is a point on which I particularly wish to invite discussion and suggestion.

This section of chemical industry is to-day afforded an opportunity which probably will not recur. We are being morally tested as to our strength and national spirit. Time and opportunity are passing rapidly. In 1915 we were told to "carry on," but that precept comes much more appropriately to-day.

We need to conserve every dyne of our energy and to apply it in the right direction. Until we arrive finally at a coherent and interconnected chemical industry we shall not have reached our goal. In the meantime each of us must contribute his utmost effort with all the intelligence, enthusiasm, and good-will that he can command, subordinating, wherever possible, personal interests to that of national good.

DISCUSSION.

Captain L. M. NASH, of the Department of Industries and Manufactures, Board of Trade, said that he was present as the representative of the Board of Trade. The prohibition of imports had been designed to protect those new industries built up under difficult war conditions, and it depended on how British manufacturers used the term of grace in the prohibition, as to whether they were merely postponing the death of these industries or whether they were going to be firmly established here. He agreed strongly with Mr. Carr that unless they realised that the time had come for working along co-operative lines they were merely postponing the death of these industries. Economy of production could only be secured by working on a large scale, and therefore he earnestly hoped that something would be done on the lines suggested by Mr. Carr. He had no doubt that many of these new chemicals were already satisfactory as regards quality, but he believed that in other cases the standard of purity was not yet such as had been reached before the war with imported chemicals. He hoped the industry would give full attention not only to maintaining the pre-war standard but to improving it, so that when these new industries were no longer Government protected and supported, they would be able to maintain their position in the world. If the prohibition were used as a means of enabling the manufacturers to increase their profits then the manufacturers would have entirely failed to grasp the true value of the prohibition. The manner in which this prohibition was used would doubtless be taken into account by the Government when they formulated their future trade policy. Finally, he said that he had been a member of the Society for 20 years, and now he found himself at the Board of Trade. If any manufacturer wanted to go to the Board of Trade about any matter he would be only too pleased to extend to him a cordial welcome and a sympathetic hearing and to do everything in his power to help the industry.

Dr. LEVINSTEIN said it was very much to be welcomed that a representative of the Board of Trade, speaking to them as a member of the Society, should assure them that the Board of Trade took an interest in everything they did and offer to give a sympathetic hearing to anything that might be put before it. He did not know that there was any change in our national life during the past five years which was comparable with the change of attitude which was now being experienced from that Department. Mr. Carr had put forward a perfectly clear and specific claim for organisation of the industry in which it appeared that the dye industry played a great part in the scheme. He himself said that as regards the dye industry they would welcome any constructive proposals which might be put forward in which they could participate to the advantage of the country in the development of the fine chemical and pharmaceutical industry. He was rather inclined to deprecate the general statements in which they were told to organise, as if any person did not know that organisation was one of the prime needs of commerce at any time. There was a great difference between telling people to organise and thinking out and creating a satisfactory organisation. Organisation did not consist in combining together in one rotten concern all the firms that had attempted, successfully or unsuccessfully, to manufacture fine chemicals and dyes during the war. If that point were fully appreciated by the gentlemen who talked to the industry about organisation it might be possible to come more quickly to that kind of decision which they all desired. He thought Mr. Carr's paper indicated that as regards fine chemicals the industry was capable of producing without an Association that leadership which other members of the Association of British Chemical Manufacturers deplored the lack of. He also agreed with Mr. Carr that such amalgamations or such working arrangements and proposals must come from the industry and not from trade associations. He pointed out that the great power of the I.G., and its danger to this country as a competitor, lay in the fact that all its members pooled their profits. Any real organisation in our present industrial system meant that the various people who organised would have a common financial interest in their respective undertakings. Without that kind of organisation there was no real organisation. The I.G. controlled the manufacture of heavy chemicals, fertilisers, fine chemicals, and pharmaceutical products, and the profits of all the undertakings were pooled, each firm getting a *pro rata* portion of the total profits of the I.G., irrespective of the source. It was that which rendered the I.G. such a powerful and potent weapon in the hands of the German Government.

Mr. D. Lloyd Howard emphasised what Mr. Carr had said with regard to the fine chemical and the great synthetic firms not endeavouring to work for the survival of the fittest but working in co-operation. He was convinced that it would pay, say, the old fine chemical firms who before the war had not been much engaged in synthetics, but in other branches of medicinal chemicals, in which branches they had held their own sufficiently well against the Germans, to combine and instead of each one making their own salicylic acid, say, to buy it from the producing company in the comparatively small quantities required for medicinal purposes, or else to buy the whole of the refined product, and in consideration of that to place at the disposal of the larger firms the world-wide selling organisation which the old pharmaceutical and fine chemical makers possessed. He recognised the weight of Dr. Levinstein's observation that it was quite easy to talk of organisation, but very difficult to come forward with a concrete thought-out scheme. No concrete thought-out scheme could come from a Government Department. If the great producers of synthetic chemicals on a large scale were willing to work with the manufacturers of pharmaceutical chemicals—not all of them were synthetic or even organic—some valuable co-operation might result.

The following two papers were taken as read:—

THE RAW MATERIALS OF PHOTOGRAPHIC PLATE AND PAPER MANUFACTURE.

BY W. R. INNES.

Since photography is partly a luxury trade, it was generally anticipated that the outbreak of war would lead to a greatly decreased demand for photographic products. Such, however, was not the case; even in the early days business was very brisk whilst at a later stage Government requirements were so great that it was not possible fully to satisfy the demands of ordinary customers.

Most of the materials used increased greatly in price—silver nitrate at the armistice was double the pre-war price and has since advanced still further. The quality remained excellent, only three samples containing an appreciable amount of harmful impurity having been met with.

Bromides of satisfactory quality could be obtained throughout the war. Prices varied between wide limits, but the salts could generally be obtained at from 6*s.* to 10*s.* per pound; the price in 1914 being 1*s.* 6*d.* Most samples were stated to be of American manufacture.

Good quality gelatins of English and Swiss manufacture were obtainable. Some batches were considerably more acid than in normal times, and a certain number hardened up less readily than was desirable. Prices rose 250—300%.

The shortage of glass of photographic quality was one of the greatest difficulties met with. A considerable quantity used to be obtained from Belgium, the remainder being of English make. Belgian glass, in diminished quantity, continued to come into this country during the earlier years of the war. When shortage of labour became serious, supplies fell off and manufacturers were forced to clean and recoat old negatives.

No photographic raw paper or card was made in this country before the war. Germany, Belgium, and France supplied practically the whole of the raw paper, whilst the baryta coating was almost all carried out in Belgium or Germany. The papers of best quality were neutral, free from metallic particles, strong and well sized, whilst the baryta coating was neutral, hard, and yet tough and the paper was free from mechanical faults.

During the war several firms in England and France commenced the manufacture of photographic raw paper and card. Considering the difficulties of manufacture in factories not specially built for the purpose, considerable advances were made in several directions, but there are still a number of serious faults to be eliminated. Perhaps the most serious are acidity, and the presence of microscopic particles of iron and bronze. The particle becomes surrounded by a halo of sulphate owing to the action of the acid, and since ferric and cupric salts are desensitisers of photographic emulsion, a white spot is formed on development of the exposed paper. If the particle is sufficiently near the emulsion, a black centre may be formed by the reducing action of the metal, or of the ferrous or cuprous salt in its immediate vicinity. Under certain conditions not readily defined, the whole spot may be black. The emulsion is partly protected by the baryta coating, and the effect of the metal can be further minimised by suitable methods of emulsion making. Another fault, which is fairly common, is softness of the paper; the problem of sizing does not seem to be satisfactorily solved. Other faults are of a purely mechanical nature, though some of them are probably connected with the sizing. The principal of these are inferior joins, tears, creases, and lines. In the baryta coating, brittleness, excessive acidity, rough surface, brush marks, and hairs were sometimes met with. The prices of paper and card have increased approximately $2\frac{1}{2}$ times, but the increase in cost of manufacture due to this item was considerably greater than this owing to the increased waste.

Of substances used in smaller quantity than those already dealt with, the supply of glycerin was completely stopped early in 1918, whilst the supply of spirit was restricted. Satisfactory substitutes for both substances were found, and it was not found necessary to use spirit from the date of the restriction.

The supply of dyes for various purposes offered some difficulties. The most serious shortage was that of the panchromatising dyes derived from substituted quinolines. These dyes were solely of German manufacture. They have been successfully replaced by the much superior dyes discovered by Sir William Pope.

The most unsatisfactory chemical of war-time make was chrome alum. All samples examined, except those specially prepared, were impure and badly crystallised.

THE ORGANISED PREPARATION OF LABORATORY CHEMICALS.

BY DR. M. O. FORSTER, F.R.S.

The resumption of normal activities by the universities and colleges will bring into prominence the pressing need of some organisation fulfilling the functions of Kahlbaum, Schuchardt, Merck, and Schimmel. At the moment, this need is somewhat obscured by the immense demands on the energy of the teaching staffs made by the unusual number of students requiring pre-graduate training, but among the minor needs of the reconstruction period this will sooner or later become one of the most urgent. It has already been recognised, but it seems to resemble the weather as described by Mark Twain, when he said that everybody grumbles about it, but nothing gets done.

All research chemists are aware of the substantial value represented by access to a wide selection of chemical specimens; it not only economises time, but what is much more important, though less obvious, it saves ideas. It is like sound milk for skimpy babies. Researches are born in the

study, and optimistic researchers will say that only one in twenty of their ideas reaches practical shape; investigators of gloomier outlook quote 1%. Striking a mean at one in fifty, it follows that in order successfully to develop one basic idea, an average of at least fifty preliminary experiments must be made. Many of the materials for these fifty experiments are not to be found in even the best-equipped laboratories, and if they are not readily obtainable elsewhere some of the fifty experiments, including perhaps the one potentially successful experiment, will not be made; whence the idea-saving service of the above-mentioned firms.

Laudable attempts to meet the need are being made by certain manufacturers in this country, and I am not suggesting that these should be in any sense superseded; but they require to be amplified and co-ordinated. The field is too vast to be covered immediately by any one enterprise, or perhaps it would be more accurate to say that, as a commercial speculation, it offers too little profit and requires too much detailed organisation to attract a manufacturing company large enough to cover it. Nevertheless, it is just such a company, with an ample technical staff, and capital resources sufficiently generous to justify foregoing a satisfactory profit on this department for some years, which would best be fitted to correlate and complete the work of others.

Schuchardt's list comprised upwards of 7000 separate items, and Kahlbaum's about 5000. No other commercial unit is approaching this, or could approach it in ten years, but I can imagine Explosives Trades, Ltd., or the British Dyestuffs Corporation, establishing a branch of their organisation to deal with the subject on lines which may be roughly sketched as follows.

A census would first be made of those materials which are being produced already by separate firms, with whom arrangements would be made for their continuance, as affiliated members of the organisation, to manufacture those products, and others allied to them, for which they were best fitted by their particular resources. This would reveal the deficit, dividing itself roughly into two classes, (*i*) Bulk materials obtainable from different factories in commercial form but requiring purification before distribution, and (*ii*) Materials not made systematically in this country. The former would be purchased from the factories in question, and would frequently constitute the starting-materials for members of class (*ii*). The latter would be prepared by the staff of the Central Organisation, or better, be divided between that staff and the university laboratories under an arrangement by which advanced students, directed by the teaching staff, would convert specified raw materials into products required by the Organisation.

It is undeniable that such an enterprise would be unremunerative at first, because it involves the skilled manipulation of a very large number of very small quantities, and because a considerable proportion of capital would be locked up in stock for uncertain periods, often very protracted. It is therefore necessary to indicate the commercially compensating factors.

I believe that these would develop in several directions. In the first place, successive generations of newly-trained chemists would grow accustomed to inquiring for British products and, let us hope, to satisfying their needs from domestic sources of supply. At the same time, at least a proportion of the advanced students, while still at college, would be faced with the necessity of working economically, and would gain that regard for material, time, and apparatus which they often lack on entering a factory, being in this respect a source of loss instead of profit to their employers. Then it would sometimes happen that a by-product in the bulk preparation of a commercial article could be utilised for the purpose of the retail enterprise, and a demand for this by-product would have the effect of diminishing the cost of the article itself, or of improving the methods of purification. This aspect of the work, thus brought immediately to the notice of the colleges, would stimulate attempts to devise novel and profitable ways of utilising by-products, because it would focus attention upon them to an extent not hitherto approached. Finally, the least easily measurable, but probably the most valuable result commercially would be the cultivation of ideas preserved from destruction following malnutrition. This cannot fail to bring profit ultimately to the chemical manufacturer, who, when enlightened, regards ideas as one of his raw materials. The chemical industry is perpetually applying the principles of chemical change to a variety of natural products, which are thus converted into other materials required by manufacturers or the public. Any new or newly-applied change which shortens the circuit of operations, or which utilises materials hitherto unutilised, is a potential source of profit to the manufacturer, and I am convinced that, for the reasons indicated and for others which will doubtless suggest themselves to people of wider experience, the organised preparation of laboratory chemicals in this country will ultimately compensate the domestic chemical industry for any loss which it might thereby sustain in the initial stages of the enterprise.

CONFERENCE ON THE CHROME TANNING INDUSTRY.

On Thursday, July 17, a Conference on the chrome tanning industry was held at the Goldsmiths' Hall, Mr. Francis H. Briggs, President of the Federation of Curriers, Light Leather Tanners, and Dressers, in the chair.

The CHAIRMAN said that from the national standpoint the subject of chrome tanning was one of profound interest. It was to be deplored that this important process had been so neglected, the more so when one remembered that our Empire controlled the greater portion of the raw material. The annual output of hides in India was now in the neighbourhood of 12 millions, and whilst the largest proportion some 20 years ago had been treated in this country, mostly by vegetable tanning, yet, in 1913, 80% of these hides had been dealt with by the Central Powers, and mostly made into chrome leather, but a very large proportion of the chrome leather had found its way back to London. India exported some 21 million goatskins annually, but only 2 millions of that number were dealt with in the United Kingdom, and in the year 1913 a large part of that 2 millions had been re-exported to our neighbours, because we were unable to deal with it. Further, of that 2 millions of Indian goatskins, between 30 and 40% had been tanned, dressed, and made into glacé kid, to be imported into England for the use of the public. This was a very sad state of affairs, and he could not help thinking that a great deal of it was due to the world of science. Austrians, Germans, and especially the Americans, had carefully fostered this process of tanning, but we had neglected it to a large extent. The object of the present Conference was to hear addresses which would help us to foster this process, and so take our right place among the nations of the world. It was the duty of every leather producer to utilise these raw materials that the Empire supplied. The present state of affairs was a national disgrace.

THE DEVELOPMENT OF THE CHROME TANNING INDUSTRY IN THE UNITED STATES OF AMERICA.

BY DOUGLAS MC CANDLISH, M.SC.

As the United States has been so closely associated with the chrome tanning industry since its inception, it seems appropriate, in considering the subject as a whole, that special consideration be given to the part taken by that country in originating and developing what is a comparatively new method of tanning. It is not surprising to find that the chrome process was favourably received in the States, for its outstanding feature, that of producing a serviceable leather in considerably less time than it could be produced by prevailing methods of tanning, appealed strongly to the Americans' inborn desire for speed. The time necessary for tanning by either the vegetable or chrome process is governed by several factors, such as the thickness of the skins, the kind and condition of the tanning liquor, etc., but it may be said that whilst the older system of vat tannage with vegetable materials required weeks or months, chrome tannage may be completed in as many hours as the former process required days.

The commercial employment of chromium compounds as tanning materials in America commenced about 1884, when Augustus Schultz of New York was granted a United States patent for what he described as "An improved process for the tawing of hides and skins." Schultz was born in Germany in 1834 and moved to America in early youth. He was not a tanner, but whilst employed as chemist to a New York dyestuff agency was asked by a friend if it were possible to produce a leather that would not cause corset steels to rust, as ordinary alum tawed leathers did. His investigations resulted in the production of a leather of the desired quality, and the method suggested is now universally known as the "two-bath process." In this method of tanning, the skin is impregnated with chromic acid, which is readily absorbed by the skin fibres in the first bath. The chromic acid is subsequently reduced in a second bath to a basic chromium salt, which is the actual tanning agent. A mixture of sodium or potassium bichromate with hydrochloric or sulphuric acid is used for the first bath, and a mixture of sodium thiosulphate with either of these acids constitutes the second or reducing bath.

The practical application of the process presented many difficulties, and whilst these were gradually overcome, fairly large fortunes are known to have been lost by the American pioneers in the chrome tanning industry. Many attempts were made to circumvent the patent specifications, and various substitutes were suggested to replace the thiosulphate and acid bath. However, none were as satisfactory as the latter, and they did not find extended application.

Several years before Schultz patented his method, Professor Knapp in Germany had described a process for making chrome leather by the use of basic chromium chloride solution, made by dissolving precipitated chromic hydroxide in hydrochloric acid and rendering the solution basic with sodium carbonate. He wrongly stated that the leather so produced was no more resistant to water than ordinary alum-tanned leather, a mistake difficult to understand, as Knapp was ordinarily a painstaking worker. As a matter of fact, whilst alum-tanned leather will dry hard and horny after treatment with cold water, on account of the unstable nature of alum tannage, chrome leather tanned by the method suggested by Knapp withstands the action of boiling water without any apparent sign of injury. Martin Dennis, of Newark, N.J., evidently became aware of the possibilities of this method, and in 1893 was granted a patent for a basic chrome tanning liquor which closely resembled Knapp's basic solution. By means of such a liquor, properly prepared hides and skins may be converted into very satisfactory leather, and as the tannage is completed in one solution, this system is known as the "one-bath," as distinct from Schultz's "two-bath" process. Although the ultimate tanning agent in both processes is the same, *i.e.*, a basic chromium salt, there is one essential difference between the methods. In the two-bath process finely-divided sulphur, liberated from the thiosulphate-acid solution in the second bath, is deposited in and upon the fibres of the leather, giving a certain characteristic softness not readily obtained by the one-bath tannage.

The processes described form the foundation upon which the chrome tanning industry of the United States has been built. Whilst the advantages and disadvantages of chrome and vegetable tanned leathers have been the subject of many controversies, the fact remains that so far as upper leather is concerned, the former has largely supplanted the latter during the past twenty years in the United States as well as in this country.

Before considering the development of the industry, a brief outline of the operations preceding and following the actual tanning of light leather is necessary.

The raw skins are first washed with water or soaked in dilute sodium sulphide solution, the treatment varying with the method of preservation of the skins. They are then subjected to the action of a weak alkaline solution which loosens the hair roots sufficiently to allow the hair to be rubbed off the skin with a suitable dull-edged unhairing tool. As milk of lime has been universally used for this operation, it is commonly known as the "liming" process. The lime left in the skin is removed by washing with water, dilute acids being sometimes used to facilitate its removal, and the stock is then puered or bated in a fermenting infusion of dog or pigeon manure. The skins are now ready for tanning. When this is completed, the leather is neutralised with a weak alkali, washed, dyed, and fat-liquored, the latter operation supplying the necessary lubricant to the fibres in the form of an oil emulsion. The leather is dried, softened by mechanical means, and finished by one of a great variety of methods according to the particular purpose for which the leather is intended.

It is by the gradual improvement of the various processes described, rather than by any revolutionary changes, that progress has been made in the chrome leather industry in the United States, and an attempt will be made to describe a few of the more important advances in American practice.

Considerable changes have taken place in the methods of depilating. The use of sodium sulphide, either alone or in conjunction with lime, has entirely supplanted the use of milk of lime as the medium for loosening the hair. Not only is the time required for the operation shortened considerably, but, what is more important, the hide substance is conserved and a better grade of chrome leather results. Some tanners find it profitable, for certain classes of leather, to use sodium sulphide of such concentration that it dissolves the hair from the hide. The destruction of the hair, itself a valuable by-product, may appear at first sight to be uneconomical, but a process has been patented and is in operation in connection with at least one tannery, for the recovery of the dissolved nitrogenous matter for fertilising purposes. The sulphide solution containing an accumulation of dissolved hair from several lots of hides is acidified, and the liberated insoluble amino compounds are found to contain a sufficient proportion of nitrogen

to make the process profitable, at least when war-time prices for fertiliser prevailed. It seems reasonable to expect that nitre-cake might be satisfactorily substituted for sulphuric acid, and the process made more profitable.

The old system of puering or bating with animal excrements has been almost entirely superseded by methods having none of the objectionable features of the old methods. The most successful artificial bates are those prepared on lines suggested by the researches of J. T. Wood, the active principle of these being trypsin, obtained from the pancreas of cattle. Although numerous previous attempts had been made to prepare substitutes which would satisfactorily replace dog manure for puering goatskins, the most difficult class of skins to puer, none but the class described have produced the desired results.

The actual tanning processes have been greatly improved. In the one-bath system, a better understanding of the necessary relationship between the basicity of the liquor and the condition of the raw pelt has helped to do away with a great deal of the uncertainty which existed in the earlier days. In this connection American chemists are doing good work in elucidating the problems of chrome tanning. As an indication of the interest in the scientific side of the industry, a well-known firm of tanners recently showed a commendable spirit by placing a considerable sum of money at the disposal of an American University for the purpose of investigating certain fundamental principles of the chrome tanning process, and the results of the research are to be published for the benefit of the trade as a whole.

The fat-liquoring of leather was formerly carried out with emulsions of animal and vegetable oils in soap solution. Mineral oils have been looked upon with disfavour not only because they were used as adulterants of the more expensive oils mentioned, but because they did not give satisfactory emulsions with soap solution. A development which may have far-reaching effect is the utilisation of mineral oils for fat-liquoring purposes in conjunction with sulphonated animal, vegetable, or fish oils, which are excellent emulsifying media and possess lubricating properties themselves.

A noteworthy addition to the mordants available for use upon chrome leather previous to dyeing with aniline colours was made a few years ago. An extract prepared from osage orange wood, introduced under the name of Aurantine, has found successful application as a substitute for fustic extract. The yellow colouring matter of the extract is readily absorbed by chrome leather and this preparation will probably be more extensively used when it is better known.

In the finishing operations, considerable ingenuity has been exercised in devising means of overcoming defects in the skins and improving the appearance of the leather. A process for finishing coloured chrome leather which fairly effectively covers irregularities arising from uneven colour adsorption in the dyebath, and tends to give a desirable even appearance, employs what are known as pigment finishes. These consist of very finely ground earth colours suspended in suitable gum or resin solutions, and can be applied in the same way as ordinary finishes. If the skin defects are very prominent, it may be necessary to buff the grain lightly on an emery or carborundum wheel to obtain an even bottom on which to apply the finish. The finishes are so constituted, and have such good covering property, that it is not always easy to decide without the aid of a microscope if the grain has actually been buffed.

Steady improvement in the quality of chrome leather has been made by the American tanner as the principles underlying the process have been better understood, and he has earned and maintained a well-deserved reputation for the character of his goods. Certain grades of American glazed kid, for example, are recognised as standard articles and great care is exercised by the producers to maintain the uniformity and excellence of their products. Formerly black glazed kid was the sole product of the majority of goatskin tanneries, but in recent years, either to satisfy the demands of ladies' fashions or to create them, there has been a large output of coloured goatskins in a great variety of very delicate shades. For the production of these leathers it is necessary to have raw skins of the very highest grade, free from natural and acquired defects. As several glazed kid tanneries in the Philadelphia district are each capable of producing over 1600 dozen finished goatskins daily, it will be understood that it is possible to select a reasonable number of high-grade skins for the purpose mentioned. Large-scale operation is not confined to the class of leather mentioned, as very large tanneries are engaged in the production of calf and side leathers.

The Chicago packers, who control a large portion of the raw hides and skins of the country, have recently entered the chrome tanning business, and this may eventually lead to a still greater development of the industry of the future.

Whilst progress has been made in the technique of leather manufacture, great advances have also been made in labour-saving machinery. On account of the high cost of labour, the American tanner has always been on the alert to obtain such machinery, and its design and manufacture have offered a good field for the engineer. It seems safe to assert that tanning machinery is developed to a greater extent in America than in any other country.

One must admire and respect the initiative, courage, and business ability of the American chrome tanners who founded and developed this most important industry. However, the industry cannot be regarded as exclusively American, as some of the most important advances have been made through the adoption of European ideas. It is well known that traditions and time-honoured customs do not appeal strongly to the average American merely on account of their extreme age. This may be considered an asset where the manufacture of chrome leather is concerned, as it enabled the tanner to forsake methods which, though successfully applied to vegetable tanning throughout the centuries, may be totally unsuitable for chrome leather, and he has prospered by being progressive.

THE CHROME TANNING INDUSTRY IN GREAT BRITAIN.

BY M. C. LAMB.

The first attempt at the conversion of prepared hide into leather by a process of mineral tanning is generally credited to Professor F. L. Knapp, who obtained patent rights for the use of normal or basic salts of chromium, iron, manganese, etc., in combination with fatty acids for the purpose. Although in its original form this process was not applied commercially, owing to the fact that Knapp regarded his discovery as being applicable to the employment of iron salts rather than chrome salts and devoted his energies chiefly to the commercial application of these, the credit for the discovery of the fact that a basic salt of chromium possesses tanning properties is undoubtedly his.

The patent of Christian Heinzerling of 1878 was the first process of mineral-tanning to be applied on a commercial scale. Heinzerling's method consisted of the application of a mixture of potash

alum and potassium bichromate and the subsequent treatment of the hide with albuminous matter such as blood. About 1880, the Eglinton Chemical Co. of Glasgow acquired the right of granting licences to work Heinzerling's process in this country and commenced the manufacture of leather on a small scale at their Exhibition Tannery, Glebe Street, Glasgow. The process was worked only with a very limited degree of success. The chromic acid was very imperfectly reduced by the hide substance, and proteins and fats were used for subsequently impregnating the "leather," for the purpose of rendering it more water-resistant.

During the period when the Eglinton Chrome Tannery Co. were endeavouring to pioneer this process, Professor J. J. Hummel, of the Yorkshire College, Leeds, was consulted with a view to devising a process for fixing the chrome salt on the fibre. After some experimenting, he suggested a method then used in the chrome-mordanting of wool and cotton, of applying chromic acid to the prepared hide and subsequently reducing this by treatment with sodium bisulphite or thiosulphate. Samples of leather were actually produced by this process, but for some reason, unknown to the author, the method was not worked on a commercial scale, though it anticipated the method patented by Augustus Schultz in America in 1884. Schultz's process was the first successful method practised on a large commercial scale for the manufacture of pure-chrome tanned leather, and with minor modifications is the process now being worked in this country for the tanning of goatskins for glacé kid.

In 1893, Martin Dennis took out patent rights in America for the use of a basic chromium chloride solution for tanning. The Martin Dennis process as regards the preparation of the chrome tanning liquor is very similar to that originally advocated by Knapp. This process was the commercial pioneer of the now common method of chrome tanning by what is termed the "single-bath" process, depending upon the utilisation of a basic chromium sulphate or a basic chromium chloride solution.

The methods of Schultz and Martin Dennis were brought to the notice of the British leather trade by Professor H. R. Procter, who when visiting the Chicago Exhibition of 1895 had an opportunity of seeing the Schultz process being worked by Messrs. Burk Bros. and Robert Foederer, of Philadelphia. The process of Martin Dennis was also being experimented with by several American chrome tanners. These two methods of chrome tanning were brought directly under the notice of the members of the Leeds Leather Trades' Association at a public lecture given by Professor Procter on his return, and excited considerable interest. Several of the more important light leather manufacturers of Great Britain, seeing possibilities in this new tannage, commenced experimenting. The earliest of these were Messrs. J. J. Flitch & Sons, Leeds, who were rapidly followed by other manufacturers, amongst whom may be mentioned Messrs. R. Fawsitt & Sons, and East, Kinsey & East, of Bermondsey, and Ward & Co., of Worcester. These firms, who had previously been engaged in the manufacture of calf kid by the alum process, found that their experience in the preparation of the goods for the manufacture of leather by this older mineral tannage enabled them to make rapid headway as compared with the firms who were only familiar with the vegetable tanning process.

The patents of Schultz and Martin Dennis having both been anticipated in Great Britain, no attempt was made by the holders of these patents to contest the right of the British tanner to manufacture without payment of royalties. Considerable difficulties were experienced by the early pioneers of chrome tanning, and much valuable raw material was wasted by reason of an imperfect knowledge of the chemistry of the process and the lack of knowledge how to prepare the pelt suitably before tanning. To those firms who had been chiefly interested in vegetable tanning the method of Martin Dennis appealed the more strongly of the two processes, owing to the fact that it was worked on somewhat similar lines to vegetable tanning, the prepared pelt being placed in a weak solution of the basic chromium chloride or chromium sulphate, and the strength of the solution being increased as the tannage progressed.

The progress of the application of this "single-bath" method of chrome tanning became more rapid after the publications of Procter in 1897 and 1898, in which he advocated, in the first place, the reduction of an acidified solution of potassium bichromate by organic reducing agents, *e.g.* glucose, sugar, etc., following on somewhat similar lines to the method described by Hummel in the account of chromium mordants in his book entitled "The Dyeing of Textile Fabrics"; and a still more simple method of making a basic chrome liquor by the addition of an alkaline carbonate to a solution of chrome alum. This salt, which was obtainable in large quantities as a by-product in the manufacture of alizarin from anthracene, having very little commercial application, was available at a very low price. The liquor was more simply prepared than that patented by Martin Dennis and was more uniform than that obtained by the reduction of chromic acid with organic reducing agents. In consequence, this method of preparing chrome liquors was almost universally adopted and continued to be used up to 1914, when owing to the difficulty of obtaining chrome alum, tanners had of necessity to revert to the manufacture of chrome liquors by the reduction of chromic acid by reducing agents, glucose, farina, and starch being employed until the use of these materials was prohibited, when sodium bisulphite, sodium thiosulphate, and sulphurous acid were pressed into service.

The process of chrome tanning is, apparently, dependent upon the impregnating and covering of each individual fibre with a coating of a basic chromium salt or oxide, thus preventing the fibres subsequently adhering when the leather is dried, and at the same time so protecting the fibres that the leather is capable of withstanding the action of boiling water and other hydrolysing agents.

The principle of tanning by mineral agents consists, according to Stiasny, in the formation through hydrolysis of a colloidal basic constituent, which must possess a certain power of membranous diffusion to be of any practical tanning value.

One of the obstacles to progress in the manufacture of chrome leather in the early days of its introduction was the uncertainty which existed as to the chemical reactions which were involved. The reactions in the double-bath process of chrome tanning are complicated.

Eitner, in about 1905, after studying this process, proved that under certain conditions the reaction between the chromic acid and the acidified thiosulphate resulted in the production of a basic chromium sulphate, as shown by the following equation:—

$$K_2Cr_2O_7+6HCl+3Na_2S_2O_3 \rightleftarrows 2KCl+4NaCl+Na_2SO_4+2Cr(OH)SO_4+2H_2O+3S$$

which is confirmatory of the statement that the tannage is due to the production of a basic salt.

In the tannage of hides for "box" leather, calf, etc., the single-bath process is universal in this country, and it is generally considered that a

basicity between 85 and 95 (Cr : SO_4 = 52 : 85–95) is most suitable.

The method of carrying out the tannage is extremely simple. The goods are placed, preferably, in a drum with sufficient water to make a comfortable float. The pelts having been weighed are introduced, and the liquor is added in small quantities during the rotation of the drum in the earlier stages. The total quantity of liquor necessary, in terms of chromic acid, is between 3% and 4% on the pelt weight of goods processed, and this should be added in not less than four portions, as the tannage proceeds. The addition of 5% of either common salt or sodium sulphate is advisable. The goods are satisfactorily processed when it is found on making a test that the resulting leather will withstand immersion in boiling water without being detrimentally affected. The usual length of time required is about 6 hours, but in the case of thick goods, it is sometimes advisable to keep the goods in the solution for a longer period.

The double-bath process is used exclusively upon goatskins for glacé kid. The goods are drummed in a solution of 3–4% chromic acid and 3—4% salt, until thoroughly impregnated, and are then transferred to a solution of sodium thiosulphate, using 15—20%, acidified with 5—7% of sulphuric acid, and drummed until the chromic acid is completely reduced to basic chromium sulphate, as indicated by the colour of the leather.

It will be understood from what has been said that the difference between the single-bath process and the double-bath process (Schultz's) is that in the first mentioned the tannage is produced by the direct application of a basic salt to the pelt, whereas in the latter case the basic salt is produced on the hide fibres.

Sulphur, resulting from the decomposition of the sodium thiosulphate in the second bath of the double-bath process, is deposited in the interstices between the fibres in a colloidal form and acts as a lubricant to the fibres themselves, imparting a more supple feel to the leather. This deposition of sulphur is important from the point of view that it has been found that leather with a large sulphur content is capable of withstanding higher temperatures than leather containing smaller quantities. In certain instances it has been found advantageous to increase the sulphur deposit, particularly where the leather is to be used for motor tyres and is to be subjected to the operation of vulcanisation in conjunction with indiarubber.

The treatment of chrome leather after tanning consists in neutralising the acid liberated during the tanning process, removing the soluble salts from the leather, and, in the case of leather intended for boot uppers, fancy purposes, etc., the dyeing and fat-liquoring operations.

The common method for neutralisation is by the use of borax or alkali carbonates. Blacks are usually dyed by the use of logwood in conjunction with direct cotton dyestuffs, or acid and basic coal tar colouring matters, in which latter case the dyestuffs are applied after treatment with the logwood mordant.

In the dyeing of coloured leathers, the leather is usually mordanted with a vegetable dyewood or tanning mordant, *e.g.* gambier, fustic extract, etc., and then subsequently dyed either with basic coal tar colours or, what are generally preferred, acid wool colours.

The operation of fat-liquoring, which has for its object the lubrication of the fibres of the leather with a view to rendering it more soft and supple, consists of impregnating the leather with a dilute oil and soap emulsion. This consists, generally, of a mixture of either vegetable or animal oil in conjunction with soap, the latter being used chiefly as an emulsifying agent. The soap ingredient of the fat-liquor has, for the last two or three years, been largely replaced by sulphonated animal, vegetable, and mineral oils. The sulphonated oil acts as a carrier for the animal and vegetable oils in conjunction with which it is used, thereby effecting more complete penetration of the emulsion through the fibres and resulting in a better nourished and softer leather.

A few further special points of importance showing the progress that has been made in the manufacture of chrome leather in Great Britain may be mentioned.

It was found that, in the original formula of Schultz, consisting of 5% of potassium bichromate and 2½% commercial hydrochloric acid, only about two-thirds of the total quantity of bichromate is converted into chromic acid, and the unconverted bichromate is not absorbed and subsequently reduced. Considerable economy was effected by the use of a sufficient amount of acid in the first bath to effect the almost complete conversion of the bichromate into chromic acid. The quantities of thiosulphate (10%) and hydrochloric acid (5%) recommended by Schultz were found to be insufficient, and were materially increased.

Whereas it was customary a few years ago to use a fresh solution of thiosulphate and acid for each pack of goods, it is now more general to use a standing bath; this has resulted in considerable economy and it is generally conceded that the finished leather is improved.

During the past few years great attention has been drawn to the importance of the degree of basicity of the chrome liquor when processing goods by the single-bath method, and to the necessity for adjustment of this for the particular class of goods being tanned.

The influence of the degree of basicity upon the resulting leather will be better understood when it is pointed out that, whereas the normal salt is only absorbed to a very small extent by the pelt, a basic solution is readily absorbed, and consequently the more basic the solution the greater will be the deposition of chromium hydroxide on the fibres. When the chrome liquor is too basic, the tannage will be extremely slow, there will be a considerable liability of the production of "drawn grain," and a liability of overtanning the grain surface with the consequent tendency to produce a brittle, "cracky," grained leather.

It has been found advisable to commence the tannage with a more acid liquor and to complete with a more basic liquor, and in this respect the process is comparable with the vegetable tanning process.

The chrome leather industry in Great Britain has attained very considerable importance. Whereas, prior to 1900, the bulk of the leather manufactured for the purpose of boot uppers was of vegetable origin, practically the whole of the leather used in the manufacture of the better quality boot uppers is now of pure chrome tannage. Chrome leather was used to the extent of 20% in the manufacture of boots for the Army during the recent campaign. Its behaviour on active service was all that could be desired, and the only reason why a much larger amount was not employed was on account of the lack of tanning facilities.

Chrome-tanned sole leather is being made in very large quantities, and whilst there is still a considerable amount of public prejudice to be overcome and also this method of manufacture is not applicable to the tanning of sole leather from all classes of hides, it would appear probable that this method of tanning will further extend, as the wearing properties of chrome leather are greatly in advance of those of leather tanned with vegetable products,

and the tanning process only occupies about one-fiftieth of the time necessary in the latter case.

It is somewhat curious that this method of tanning sole leather has not been practised to any very large extent in America. One of the earliest objections to the employment of chrome leather for soleing boots, *viz.* the liability to cause slipping when in wear, particularly on wet pavements, has been almost entirely overcome by impregnating the leather with hard waxes. This has the effect of still further waterproofing the leather and also enables it to pick up small particles of grit, and thus minimise the defect just mentioned.

This paper would be incomplete without reference to the very important industry which has arisen from the chrome tanning process, *viz.* the manufacture of semi-chrome leather. This leather is prepared by first removing a portion of the original vegetable tannage from an already tanned leather by means of a weak alkaline solution, and afterwards re-tanning with a basic chromium sulphate solution or a basic chromium chloride solution; the dyeing, fat-liquoring, and finishing operations are almost identical with those practised on real chrome leather.

In the early part of 1898, when American box calf made by the chrome process was exported to this country in large quantities and tanners of calf kid and others were engaged in experimenting in the manufacture of chrome calf, there was a consequent decline in the popularity of curried leathers, and the shoe leather currier, who had been primarily engaged in the dressing of vegetable tanned calf-skins for boot-upper leather, began to fear that chrome tanning might eventually supplant the leather that he was then producing and that the major part of his vocation would be taken from him.

Experiments were made by several British firms in the direction of re-tanning vegetable tanned leather, with the object of imparting to it certain characteristics of chrome leather, and eventually a result was obtained which was sufficiently satisfactory for the process to be generally adopted by the majority of leather dressers catering for the boot-upper leather trade. It was found that this leather, no doubt due to the presence of the tanning mordant, was capable of absorbing a greater amount of chromic oxide than was commonly found to be present in a pure chrome tanned leather. Properly prepared, this leather has certain chrome characteristics as regards softness and ability to withstand the action of boiling water without becoming damaged. This process of manufacture has been used on a very considerable scale, particularly in connection with the manufacture of brown-coloured calf and black side leather.

This method of manufacture is only common to Great Britain and France. So far as the author is aware it has not been employed to any extent in other countries. This is most probably accounted for by the fact that in America and Germany, unlike Great Britain and France, the manufacture of leather is carried through in one works from hair to finish, whereas in the two latter mentioned countries it is quite common practice for the manufacture to be divided, the tanner handing his product over to a currier or leather dresser to complete the manufacture.

The manufacture of semi-chrome leather is also particularly applicable to employment upon the large quantities of half-tanned vegetable leather imported from India, which is capable of being finished into a substitute for real chrome leather.

In conclusion, the author would like to make reference to, and express the great obligation of this branch of the leather industry to Professor Henry R. Procter, who has, since the inception of this form of mineral tannage, been associated with the methods of analytical control universally adopted by chemists specialising in this industry, and who is thus to a very considerable extent responsible for the scientific advancement of this method of producing leather.

DISCUSSION.

The CHAIRMAN asked Professor McCandlish if, when he spoke of leather produced in 24 hours, he really meant produced in an 8-hour working day.

Professor MCCANDLISH replied that he meant that the output was per working day, which he believed in that district was ordinarily about 18 hours. In one case the output was 1000 dozen skins per 10-hour day.

Mr. GRANT HOOPER said that it seemed desirable to consider whether or not we had been following on altogether the right lines. The great success which the industry had experienced in Germany had probably been very largely due to the combination of trade bodies into large organisations, and was it not something of a reproach to us in England that we had preferred to continue our individual career rather than combine into larger organisations, through which alone we could expect to get the full advantage of scientific assistance? A comparatively large manufacturer might still be disinclined to incur the very considerable expense that a sufficient amount of entirely satisfactory scientific assistance would cost. But as soon as a large organisation existed, the best knowledge could be obtained, and a proper staff employed. The backwardness of the English tanning industry was no reproach to the chemist, because, as had been indicated by both authors, the progress that had been made in the industry was entirely due to chemists.

The CHAIRMAN said that we were possibly commencing to do now what we ought to have done 10 or 20 years ago. Many firms were now spending up to £5000 a year in research work connected with chrome tanning. He hoped and believed that the old ultra-conservative spirit was dead. As to whether it was necessary to combine on a large scale was a question for the various firms concerned. He believed that the trade was now alive to the value of applied science.

Mr. RICHARDSON asked whether, in the opinion of Professor McCandlish, it was a commercial possibility for a business man to produce successfully in a moderately large way in competition with the great combine. Many tanners had their old family businesses, which they looked on with great pride, and they did not wish to lose their personality. In the past they had moved very slowly, but there was no doubt they were moving faster now. To-day they had the advantage of being able to call in the expert and take his advice.

Professor MCCANDLISH gave an instance of a practical tanner who had succeeded in building up a very large business in America from a small beginning, without introducing outside capital. That firm was now spending money on research at the rate of considerably more than £10,000 a year. He did not feel in a position to answer the question whether a small English tanner could compete with the American tanner, but he should say that the chances were that he could do so. The chrome leather and glacé kid produced by the small English tannery was equal in quality to American, and why the article was not produced in a larger quantity here was something for the tanner to answer and not the chemist.

Mr. F. INNES said that if the tanners of to-day had been taught science when they were at school, there would have been more hope of chemists getting earlier into the trade. He asked Professor McCandlish if the firm he had mentioned was representative of the industry as a whole, or was it

an exceptional case? If tanners were to increase their production they must make far more use than they did now of the scientific men.

Dr. SAGE, speaking of the training of the younger men, said that experience had shown that those men did best and learnt most who had had a practical apprenticeship in the trade they were going to follow before they went in for a scientific training. The boy should be turned loose in the factory and then he would have a taste for his particular work, and would know what he wanted to learn when he went to college. Many were being helped in that way by the Leathersellers' Institute, but he did not think that that opportunity was available to enough young men at the present time.

The CHAIRMAN said that it must be recognised that there had not been sufficient co-ordination between science men and the trade. The Leathersellers' Company was quite alive to the position and awake to the necessity of co-operation.

Professor MCCANDLISH said that he thought the employment of chemists by American tanners was general, although the example he had given ought not perhaps to be considered an average. Taken as a whole, American tanners were making more use of the chemist than English tanners had done in the past. The chemist must have a practical knowledge of the leather industry if he was to be really useful in the tannery.

Mr. LAMB said that at the Leathersellers' Technical College they had generally adopted the principle that it was a wrong procedure for the boy to be sent straight from school to the Technical College, and they had always advised parents in that sense. The right procedure was to give 12 months' practical training before the boy was sent to the College. By that means the lad assimilated some knowledge of the industry of which he was to be taught the principles, and was better able to grasp the scientific facts placed before him. There were two classes of individuals to be trained, the chemist who wished to specialise in leather manufacture, and the youth who was subsequently to become a foreman or assistant manager, and, ultimately, to take over a managerial position in the works. The training of these two should be considered entirely separately. The chemist should go through the university training as a chemist before he considered the technicalities of the industry and specialised in leather trades chemistry. Whether he should go into the industry before going to Leeds University or the Leathersellers' College was a matter of debate; but there was no doubt that if he were eventually to take an administrative position and be armed with a scientific knowledge of the industry, he should have his practical training before he got his scientific training.

Professor MCCANDLISH said that at the Leeds University the prospective student was usually advised to seek practical experience before entering on a course of specialisation in leather chemistry. The University of Leeds awarded degrees in technology, and for a man to obtain a science degree in the leather department it was necessary to take a three or four years' course, of which the first year or two was spent entirely in the study of chemistry, mathematics, physics, and so on. Not until the last two years did he specialise in leather chemistry in particular. At Leeds, in the past, it had been more the aim to fit the training to a man seeking to become qualified as a leather chemist, rather than to the man seeking an administrative position. At the same time, results had shown that a properly trained chemist, if he acquired practical experience, did make a good administrator. That was true, not only in the leather industry, but in other branches of chemistry. If the respective entries for the Leathersellers' College and the Leather Department at Leeds were to be taken as a guide, they certainly proved that the British tanner had awakened to the possibilities of applying science to industry. Both institutions had their capacity entirely filled for the coming session, and had a long waiting list of men who wished to be admitted.

Mr. CHALLIS spoke of the difficulty there had been in obtaining the chromium chemicals during the war, and asked if that difficulty still existed, and what was the prospect in the future. A little before the war they had had difficulty in getting licences to permit the export of sodium chromate from the United States into Canada, and it had been discovered that Canada exported 20,000 tons a year of the raw material to make that substance, which they could not get back. He also asked as to the possibilities of the Pyro Tan process rivalling chrome tanning in the future.

Mr. RICHARDSON said that he had found Pyro Tan leather unsatisfactory.

The CHAIRMAN said that the Pyro Tan process was more or less in its infancy. There was no likelihood of its replacing chrome tanning.

Mr. WOODROFFE said that there was a variety of reasons why the chrome tanning industry had not made more progress in this country. The tanner was very conservative, and had not a great deal of enterprise. The chemist also had his faults. There was no co-ordination between the two. What he believed was lacking in the tanning industry was that there were no process chemists, and until we could get some process chemists, or some tanners in the trade who could tan and also understand the language of the chemist, we should not make progress. He believed we could make as good leather of all kinds in this country as in any other country. Another difficulty at the present time was the lack of machinery. It seemed impossible to get it. Then, what was wanted to make the tanning industry, and, especially, the chrome tanning industry progress in this country, was more co-operation between the tanner and the chemist, and also with the other trades.

The CHAIRMAN said that the key-note of the discussion had been that everybody, whether chemist, scientist, master, or tanner, desired a greater co-operation in the future than there had been in the past. That was the key-note of success. It had been illustrated by reference to the unity of the nations in fighting the terrible war just concluded, and, as we had succeeded by co-operation then, so should we now succeed in peace. He had no fear for the future. The unfortunate thing, as he had already remarked, was that we had started so late.

Dr. SAGE said that the application of chrome tanning to pigskin had not been mentioned. There were many uses to which pigskins might be put.

Professor MCCANDLISH said that a successful chemist in a tannery first of all must have the necessary knowledge of the work which he was about to undertake—as complete a knowledge as possible. Second to that he must be a diplomat, because the points mentioned by Mr. Woodroffe were probably true in every tannery where the employer knew possibly very little about chemistry, and the foreman knew nothing. As a pioneer leather chemist in the North of England, he (the speaker) knew some of the difficulties encountered by a chemist going into such a factory. He had to overcome the prejudice of the foreman, and at the same time produce results satisfactory to the employer. He had omitted all reference to the tariff question in his remarks, but the American chrome tanning industry had been built up behind a tariff which had remained in force

for a great number of years, and only in recent years had been taken off. He had been in America at the time when chrome leather had been put on the free list. The removal of the tariff had adversely affected the American industry, and the German leather was coming in in large quantities. The English tanner had had a real difficulty in having to compete with the cheap labour of Germany on the one hand, and the highly organised production of America on the other. These had been severe difficulties to face in an open market.

Dr. KEANE said that many interesting points had been raised in the discussion, including the problem as to whether it was best for a man to go to his college before he entered the works, or *vice versâ*. There were great advantages in both directions, and it seemed that with the right man it did not matter very much which way he went. Another point had been as to the lack of appreciation of the chemist by the manufacturer, and the lack of appreciation of the manufacturer by the chemist, and the lack of encouragement of research on all sides. It was the same in other industries. He thought everybody was pretty much to blame. We must all make up our minds to pull together better in the future than in the past. The war had shown what could be effected by co-operation; in a National reconstruction we had to carry into science and industry the co-operation we had followed during the war.

CONFERENCE ON RECENT DEVELOPMENTS IN THE FERMENTATION INDUSTRIES.

In the afternoon of Thursday, July 17th, a Conference on Recent Developments in the Fermentation Industries was held at the Goldsmiths' Hall, the chair being taken by Sir James J. Dobbie.

The CHAIRMAN, after touching upon the early history of fermented beverages, recalled the statement, which was probably substantially true, that no nation or tribe had been discovered which did not use a fermented beverage of some kind. China and Japan produced saké from rice, India and tropical Africa had fermented palm juice, the Zulu and other South African tribes made beer from maize and millet, while in Central Asia and the Russian steppes fermented milk or koumiss was in general use. The vast extent of the fermentation industry engaged in the manufacture of these alcoholic beverages might be gathered by a perusal of the official returns of our own and other European countries, the United States, and the principal British dependencies. From these it appeared that the average annual production of wine was about 4500 million gallons, requiring for its manufacture over 30 million tons of grapes. Of beer over 6000 million gallons was produced, requiring from five to six million tons of grain. Spirit amounting to over 450 million gallons of pure alcohol consumed about 5,000,000 tons of potatoes, over 4,000,000 tons of grain, and about 2,000,000 tons of molasses, syrups, and grapes. These figures referred only to the fermented liquors subject to fiscal control in the countries mentioned, and if those produced in other countries, such as India, China, and Japan, were included, the totals would be greatly increased. Notwithstanding the enormous production of these fermented liquors it was curious that their manufacture, even in the most civilised countries, still largely followed the empirical methods of thousands of years ago. It was only in quite recent times, mainly owing to the work of Pasteur and his successors, that the chemical and biological factors involved in the processes employed had begun to be understood, and, as yet, only a small portion of the wine and beer produced was manufactured under efficient scientific control. It was more than a thousand years since the alchemists had succeeded in extracting spirit or alcohol in a comparatively dilute form from wine, and the use of alcohol except for medicinal or drinking purposes was quite a recent development. The invention of the Coffey still and similar fractionating apparatus had made possible the production on a commercial scale of alcohol of sufficient concentration to permit of its use for lighting, heating, solvent, and many other important industrial purposes. The yeast industry was naturally closely bound up with the production of alcohol, which, indeed, was in many cases only a by-product of yeast manufacture. During the war the quantity of yeast produced from a given quantity of grain had been doubled without any considerable loss in the amount of alcohol produced. Incidentally it might be noted that the cost of industrial alcohol had been reduced by about one half owing to the concurrent production of yeast. Ethyl alcohol might now be produced from such compounds as ethylene and acetylene or even from its elements; but so far these processes had not proved successful on a manufacturing scale, and the time still seemed far distant when the production of alcohol would cease to be the principal fermentation industry. The manufacture of other important commercial products, such as acetic acid, dependent on fermentation methods, had only quite recently been subjected to control on scientific principles, and the range of the "fermentation industries" would be extended as the result of research. Before the war the manufacture of butyl alcohol had excited much interest in connection with the production of artificial rubber, and, under the stimulus of war, the manufacture of acetone had become a national concern of the first importance.

THE MANUFACTURE OF ACETONE.

BY COL. SIR FREDERIC NATHAN.

Professor Louis in his presidential address referred to the work done during the war in connection with the production of acetone, and I propose to give a very brief historical retrospect and to mention one of the new processes which realised considerable supplies. I will leave Mr. Amos Gill, who is much better qualified than I am, to deal with the bacteriological aspects of the manufacture of acetone by fermentation.

The British Service explosive, cordite, is a gelatinised mixture of nitrocellulose and nitroglycerin with a percentage of mineral jelly; the solvent used for gelatinising the earlier varieties of cordite is acetone.

Before the war the main sources of acetone were the United States and Austria, in which countries it was produced from acetate of lime made by treating acetic acid with lime. Acetic acid itself is obtained by the destructive distillation of hard woods in iron retorts.

Austria ceased to be a source of acetone when war broke out and the United States became the only source of supply, the quantity produced in this country being practically negligible as compared with the large and rapidly increasing requirements of this solvent for the manufacture of cordite, and later on for aeroplane dope.

Steps were therefore taken to augment the American output from acetate of lime, and in addition a contract was placed with a firm who adopted a process for making acetone from vinegar, but although the process proved a success up to a point the yield was poor and the price was very high, and it was eventually abandoned.

Two other methods of producing acetone formed the subject of much experimental work. Both were catalytic processes; in one alcohol and in the other

calcium carbide were the raw materials employed. The former process, suggested by Dr. Perkin, was worked out by Messrs. Joseph Crosfield & Sons, of Warrington; the latter process was the result of experiments conducted at the McGill University of Montreal, and was worked by the Canada Electro Products Co., of Montreal, the calcium carbide being supplied by the Shawinigan Water and Power Co. Acetone was successfully produced by both these firms, but when the requirements of acetic acid for aeronautical purposes became very large it was necessary to stop the process, which was a three-stage one, at the second or acetic acid stage to provide the necessary quantities.

Yet another process for the manufacture of acetone is that known as the Weizmann process. In the spring of 1915 Dr. C. Weizmann, of Manchester University, brought to the notice of the Admiralty his laboratory experiments on the production of acetone by bacterial fermentation from maize or other substances containing starch. The process was generally similar to one which had been in operation on a small scale at the factory of the Synthetic Products Co. at King's Lynn since early in 1912, but in this case potatoes were the raw material employed and the bacteria were those of Prof. Fernbach. Unfortunately many difficulties were encountered in working the process at King's Lynn on a manufacturing scale and very little acetone was produced.

Steps were taken to carry out large-scale experiments on the Weizmann process, for which purpose semi-manufacturing scale plant was fitted up at Messrs. J. & W. Nicholson's Distillery at Bromley-at-Bow, and at the same time arrangements were made to carry on research work under Dr. Weizmann at the Lister Institute.

The Lister Institute research work and the experiments at Messrs. Nicholson's Distillery, which were conducted on a gradually increasing scale, proved that the process, if carried on under proper conditions, would produce acetone on a manufacturing scale, and it was decided by the Admiralty to erect a plant at the Royal Naval Cordite Factory for the production of acetone by this process. The factory was duly completed and acetone was made very satisfactorily so long as raw materials were available; damaged rice was mainly used.

It was also decided by the Ministry of Munitions to adapt some of the spirit distilleries for the process, and three in London and three in Scotland were selected. The distilleries at Bromley-at-Bow and at Ardgowan, near Greenock, were the first to be completed, and the difficulties encountered at the start were being successfully overcome when it became necessary, owing to the shortage of grain, to abandon the manufacture of acetone by this process at the distilleries.

The failure of the Synthetic Products Co. to produce acetone in any quantity from potatoes resulted in their King's Lynn factory being taken over by the Ministry of Munitions and led to the substitution of grain for potatoes and to the use of the Weizmann bacteria. These changes had good results and a satisfactory output was obtained. The factory, however, was a small one and manufacture from grain was stopped early in 1918 as by that time the acetone requirements were of less importance than the conservation of grain for food purposes.

The use of horse chestnuts having been suggested as a source of acetone in view of the fact that they contain a considerable proportion of starch, experiments were carried out at the Lister Institute which indicated the probability of horse chestnuts being suitable for the purpose. Arrangements were therefore made to collect horse chestnuts during the autumn of 1917. When a start was made with them at King's Lynn on a factory scale, the difficulties attendant on their use became apparent, but these difficulties were in a fair way of being got over when it was decided to close down the factory.

It was, however, established that for the successful fermentation of horse chestnuts the following conditions are essential:—(1) The nuts must be of good quality; (2) they should be dried to a moisture content of not less than 1%; (3) they should be ground to as fine a meal as possible; (4) the meal should be as free from husk as possible.

The manufacture of acetone by the Weizmann process attained the greatest success at the factory of British Acetones, Toronto, Ltd., in Canada.

During the early part of 1916 the directors of Messrs. Gooderham and Worts' Distillery and of the General Distilling Co., of Toronto, generously offered to place their plants at the disposal of the Ministry of Munitions for the production of chemicals during the war. The plants were inspected by officials of the Imperial Munitions Board of Canada, and seemed to offer most of the necessary apparatus for the successful carrying out of the Weizmann process on a large scale. An engineer, a chemist, and a bacteriologist, who was specially trained at the Lister Institute, were sent out from England to organise and carry out the work from the technical side. Colonel Gooderham and his son placed their services at the disposal of the Ministry and acted throughout as manager and assistant manager respectively; the success which was attained was in great measure due to them. The plant started to work in January 1917 and continued in operation until the signing of the armistice. At the start there were nine fermenting vessels, each of 30,000 gallons capacity; seven more were added in the early part of 1917 and six more in 1918, making 22 in all, and an output of nearly 200 long tons a month was reached.

In view of the large requirements of solvents generally, due to the increase in the output of aeroplanes, steps were taken towards the end of 1917 to provide additional supplies of acetone in the United States. With this object Colonel Gooderham visited America, and in due course reported to the British War Mission on the advantages of the plant of the Commercial Distilling Co. at Terre Haute, Indiana, for conversion for the manufacture of acetone by the Weizmann process. As a result the plant was purchased early in 1918 and converted into an acetone factory. In the spring of 1918 it was decided by the United States authorities to acquire another distillery for the same purpose, and that of the Majestic Distilling Co., also at Terre Haute, was purchased and its conversion started. The Commercial Distilling Co.'s plant commenced production in May 1918, that of the Majestic Distilling Co. in November 1918.

In the fermentation of maize or other substances containing starch by the Weizmann process, acetone and butyl alcohol are produced in the proportions of approximately one part of acetone to two of butyl alcohol.

As butyl alcohol had only a restricted use both for war and industrial purposes, experiments were started by Dr. Weizmann in order to develop a process for converting normal butyl alcohol into methyl-ethyl-ketone which, in the pure state, is equally suitable as acetone for the manufacture of cordite. The process, which was a catalytic one, was worked out on a laboratory scale and promised to give good yields. An experimental plant was erected at Toronto early in 1917, and as a result of the operation of this plant a suitable type of large scale catalyser was evolved. Samples

of methyl-ethyl-ketone were made to enable tests to be carried out with it in the manufacture of cordite. The results of these tests being quite satisfactory it was decided to erect a large scale plant at Toronto which, however, only commenced successful operation just before the signing of the armistice.

The results obtained during the war, especially in Canada and the United States, have proved that acetone can be produced successfully on a large manufacturing scale by the fermentation of substances containing starch. The process cannot, however, be considered as a commercial one likely of being capable of competing with the production of acetone by the destructive distillation of wood, because of the relatively high cost of the raw material and the fact that the production of every part of acetone involves the production of two parts of butyl alcohol having very little value for industrial purposes, at all events at the present time.

THE ACETONE FERMENTATION PROCESS AND ITS TECHNICAL APPLICATION.

BY AMOS GILL, B.SC., A.I.C.

The micro-organism used by Dr. C. Weizmann for the production of acetone and butyl alcohol from cereals containing starch is a bacillus of the long rod type, which is stained readily with carbol fuchsin, but only lightly with methylene blue.

Spore formation takes place by slight expansion of the organism in the centre and consequent transparency, the final spore being oval in shape, with only the envelope taking the stain. Spore formation takes place at an early stage when conditions are unsuitable, and in a young culture the presence of a considerable number of sporing forms is regarded as a bad sign. In a vigorous culture spore formation will not take place much before the lapse of 20—24 hours.

The cultivation of the bacillus in the laboratory does not entail any special conditions other than those usual to bacteriological work. Growth occurs readily in various liquid media, that which was used most frequently being 5% maize mash. Many attempts have been made to produce a suitable solid medium. It was possible to rear colonies on a solid medium made up by adding 2% of agar to partially fermented maize mash. This, however, was not always successful, a good deal depending upon the condition of the maize mash, especially with regard to acidity. The most suitable mash for this purpose was one which had been fermenting about 10 or 12 hours and had reached such an acidity that 1·0—1·2 c.c. *N*/10 sodium hydroxide was required to neutralise 10 c.c. of the mash. At the factory in Toronto, A. E. Gooderham has produced a medium which he says gives excellent results with the Weizmann culture. The recipe is as follows: To 1000 c.c. of wort of sp. gr. 1·008 add 1% of gelatin, 1% of calcium carbonate, and 2% agar. Heat gently, filter, sterilise, and make up into tubes. Use for shake cultures, and in making dilutions use an old culture containing spores. Vegetative forms will not grow on this medium, but spores give rise to large colonies of healthy bacilli in 48 hours. Attempts to prepare plate cultures with this medium have been unsuccessful.

The application of the process on a factory scale presents many interesting points, and a few notes on the general methods employed may be of interest.

The first important point is the preparation of a regular supply of good culture for the factory. In practice samples of about 10 c.c. were taken from cultures which were known to be in good and vigorous condition and were put into thinner constricted tubes and allowed to sporulate. The tube was then drawn out to a capillary just above the cotton wool, evacuated, and sealed off. In case tubes of spores have to be carried from place to place it is convenient to seal off at the constriction, so that there is no cotton wool plug. This is rather inconvenient when opening the tubes. An alternative method of keeping spores is to put them down on to the sterilised sand (freed from lime, iron, and carbonates by boiling with hydrochloric acid and washing till neutral). About 2 c.c. of liquor containing spores is dropped on to the sand in a sterile test tube and the plug replaced. The sand is then dried *in vacuo*, the tube being sealed when the sand is completely dry. This method has the advantage of preserving the spores in a dry state and thus eliminating the possibility of decay of the cell wall through contact with the acetone and butyl alcohol in the liquor. Spores are supposed to keep indefinitely on sand; but this statement must be taken with a certain amount of reserve, since it is not more than 3 years since the method was introduced. With reference to the preservation of spores in their own liquid, I have raised a culture which gave satisfactory results, both in the laboratory and in the factory, from a tube which had been kept for eighteen months.

In starting up a culture for the factory, 2—5 c.c. of liquor containing spores was inoculated after pasteurisation into about 100 c.c. of sterilised 5% maize mash. In case of sand cultures, the whole contents of one small tube were used. The tube was placed in a desiccator, which was evacuated and then put into an incubator kept at 37° C. The preparation of the sterile maize mash required considerable care owing to the tendency to form cakes or balls of maize meal, which might contain an unsterile core. The most reliable method was to mash the maize with warm water until there were no lumps, bring to the boil in an open vessel, and then "tube out" and sterilise for 2 hours at 2 atmospheres pressure. The mash must be well stirred during the "tubing out" operation in order to secure an even distribution of the maize skin, which contains the proteins and is necessary for fermentation. With glass apparatus and comparatively small amounts, 2 hours at 1 atmosphere, or 1 hour at 20 lb. will probably yield a sterile mash, but on the large scale 2 hours at 30 lb. was found to give the best results and this was adopted throughout the process for the sake of uniformity.

The object of pasteurising the liquid containing the spores is to kill the vegetative forms, which would immediately germinate but give rise to a weak culture. Vegetative forms have been known to persist for as long as six months, although at the end of that time they were very unhealthy in appearance.

Signs of germination usually appear after about 24 hours and the mash is generally fermenting vigorously by the end of 48 hours from the time of inoculation with spores. At this stage the culture generally has an irregular appearance and contains many "involution" forms, which, however, disappear on carrying over the culture.

The method used for "carrying over" was to remove about 1 c.c. from a vigorously fermenting culture tube and inoculate this into another tube containing about 100 c.c. of sterile mash, the inoculant being introduced at the bottom of the tube. The contents of the tube are then incubated, preferably in a vacuum, since the B.Y. is essentially an anaëroble bacillus. After a further 24 hours have elapsed the culture is again ready for carrying over.

After 24 hours the organisms should be uniform in length and staining power, and will have arranged themselves in groups of four or five,

parallel lengthwise. These groups are formed by the organisms dividing and slipping past each other. In the earlier stages of the fermentation many chains of organisms, end to end, are found. The presence of chains after about 24 hours is a sign of a sluggish fermentation, caused by lack of motility on the part of the bacilli. In a 24-hour culture there should also be a few spores, or sporulating forms, but the presence of a large number is a sign of bad physical conditions, and this will probably be confirmed by determination of the acidity of the mash. A normal culture at 24 hours should require about 4·0—4·5 c.c. of $N/10$ sodium hydroxide to neutralise 10 c.c. of the mash. I shall refer to this acidity later.

The presence of organisms which differ in thickness from the normal bacillus is to be regarded with suspicion. We have found that in many cases the normal organisms show great variation in length, but only in rare cases do they vary in thickness. Incubation at higher than normal temperatures produces swollen forms, but in these cases the whole culture is affected. In the first generation or two from the spore tube, it is common to find "involution" forms—swollen and distorted in shape, but these usually disappear after the culture has been carried over two or three times. If not, the culture is rejected.

Assuming a culture to be normal in general and microscopic appearance and acidity, one tube containing a hundred c.c. of this is used for the inoculation of a 3-gallon pail. The design of a suitable pail for anaërobic culture work under sterile conditions is a difficult matter, and one which would prove perfectly satisfactory in use has not yet appeared. The pails in use at King's Lynn were easily handled, but had several disadvantages. The pails were made of aluminium and the mash was introduced through an opening in the top, which was closed by a 2-inch screw plug. One tube reached to the bottom of the pail, and the other ended just below the surface. A rubber tube closed by a screw clip was affixed to the longer tube during the sterilisation, while an open rubber tube on the shorter served to let out the steam. An air filter was inserted in this rubber tube when the pail was taken out of the autoclave, and as it cooled down sterile air was drawn into the space at the top of the pail. In inoculating a seed tank from the pail the culture was drawn into the former by reason of the diminished pressure above the mash. There were several disadvantages with this pail. (1) There was no thermometer pocket, so that the temperature of the mash in the middle of the pail was never known definitely. (2) In inoculating the pail from a tube, the 2-inch plug had to be removed and the inoculant poured in. The pail was then shaken in order to mix the inoculant with the mash. This was open to two objections, *viz.*, that there was considerable risk of infection in inoculating the pail, and that on shaking the mash and inoculant together, some aeration of the mash took place, which has been shown to be detrimental to the fermentation. (3) The 2-inch plug-hole, while large enough to permit of infection entering during inoculation, sometimes prevented the thorough cleaning of the pail. (4) The inlet tube was liable to become choked during the inoculation of the seed tank and often caused trouble.

In spite of these objections the pail gave more satisfactory results than others which were tried. At the distilleries a 1-gallon pail was in use. The whole top of this lifted off, and there was considerable difficulty in keeping the joint air-tight and so avoiding infection.

A. Appleyard, of King's Lynn, designed a pail which was very good from a theoretical point of view, but in practice it was most difficult to manipulate. It was spherical in shape and was fitted with a pressure gauge, gas outlet, and an outlet to be used for inoculation. A thermometer pocket was also provided. The advantages claimed for this pail were (1) being spherical, it could be cleaned easily and there would be no corners in which pieces of maize might lodge and perhaps cause infection; (2) the inoculant could be drawn in under vacuum, and as the fermentation proceeded a certain pressure could be maintained on the pail. This would be a decided help in the inoculation of the seed pot. (3) Anaërobic conditions would be maintained.

The main difficulty was on account of the narrow bore of the inoculating tube, and in practice this invariably became choked. It should be possible to make alterations to the tubes so as to overcome this difficulty and the advantage of maintaining anaërobic conditions would be a decided one.

In the technical application of the process, the question of the pail culture is one which needs careful consideration—as this is the last stage of laboratory development. In all factories in which the process has been worked special care has been taken in securing sterility in the pails, as infection at this point is most serious. As a matter of factory routine it is useful to blow steam at intervals through the pails (after cleaning them). This is not absolutely necessary, but it is an extra precaution, which costs very little, and certainly does no harm.

A 24-hour pail culture is used for the inoculation of a seed tank. At the King's Lynn factory the seed tanks were steel vessels, with no enamel lining. The use of these vessels successfully exploded the idea that the organism would not work satisfactorily in contact with iron. The Bub vessels introduced into some of the factories were made of aluminium, and were certainly easy to clean and keep clean, but a 900-gallon aluminium vessel, unless made of very stout material, cannot be sterilised at high pressure, and in any case is costly. Steel vessels which would withstand 15 or 20 lb. pressure could be thoroughly sterilised and also had the advantage of withstanding a vacuum, so that when the mash entered it was not necessary to provide elaborate arrangements for filtering air into the tanks. Even though the air were thoroughly filtered in such cases, there was the disadvantage of aeration of the mash, which was proved to be detrimental to the fermentation. Again, the charging of a seed tank under vacuum makes the inoculation from a pail an easy matter, all that is necessary being to connect the tube and open the valve.

The preparation of the mash for the seed tanks was carried out as follows: 56 stones of finely ground maize was mashed with warm water and run into a cooker and the volume made up to 1300 gallons. The mash was stirred all the time and steam was passed in until the boiling point was reached, a tap being open at the top to allow air to escape. This mash was kept at the boiling point for an hour, to ensure that all the starch granules were broken and also that all air had been driven out of the vessel. The pressure was then raised to 30 lb. and this was maintained for 2 hours. The final volume of the mash was approximately 1600 gallons; it was divided equally between two seed tanks, being blown into them by steam pressure, and cooled to 37° C. on the way. The cooler is an important part of the system, and from the point of view of fermentation must satisfy three conditions. (1) The sterility of the mash must be preserved. (2) The temperature required by the organism must be easily attained. (3) The cooler must respond quickly when slight changes in the temperature of the stream of mash are desired.

The cooling system in use at King's Lynn was

simple in design, but very effective and had the great advantage of being easily sterilised. The coolers were upright coils of copper pipe 2 inches in diameter. Mash was blown in at the bottom of these and passed out at the top, and a stream of water flowed over them. Steam at high pressure could be blown through the whole length of pipe line and cooler. This was always done before the coolers were used, and if at any time they were to be in continuous use, it was done at intervals of about 4 hours. In this case it had the advantage of clearing the cooler of mash which might be clinging to the sides; the time taken for this was soon regained owing to the increased cooling power. The coolers for the large fermentation tanks were exactly similar.

Before charging a seed tank with mash it was sterilised by steam at 15—20 lb. pressure for 2 hours, and a current of steam passed through all valves and cocks. All valves and cocks should be examined carefully after each fermentation, as slight leaks in these, especially at the seed tank stage of the process, may cause much trouble through the entrance of infecting organisms.

The contents of a seed tank were inoculated with one pail of culture—this having been previously examined for acidity and for infection and general state of the culture. At various factories different amounts of inoculant were used. We found that 3 gallons was sufficient to use on an 800-gallon seed tank, and that the seed would be fit for use about 16 hours afterwards.

The mash for the fermenting tanks was made in the same way as that for the seed tanks, but was usually prepared so as to contain about 6% of maize. The fermenting vessels were of 3000 gallons charge capacity, and the cookers used supplied two tanks with mash at one charging. The cooking and sterilisation of this 6000 gallons of mash was a problem requiring careful handling.

There are three essentials for a good cooker: (1) the stirring arrangement must be good; (2) the steam inlets must be well distributed; (3) an accurate pressure gauge or thermometer should be fitted. With these conditions satisfied, the mash can be thoroughly cooked and sterilised, but with any one of them missing the result is uncertain.

The mash was blown over from the cookers to the fermenting tanks, through coolers similar to those in use for the seed tanks.

The question of the amount of inoculant to be used has been the cause of much argument. Some workers assert that a system could be evolved whereby seed is fed by the mash rather than the mash fed by seed, and by this means claim to effect economy in time by effecting quicker fermentations. Others say that the smaller the amount of inoculant the better, arguing that, by introducing large quantities of inoculant, considerable amounts of acetone and butyl alcohol are introduced, and these have a retarding action on the fermentation. My experience at King's Lynn went to show that the best results were obtained by the use of 200 gallons of seed on a 3000-gallon fermenting vessel—or about 6¼% of inoculant. A normal fermentation was completed in 30 to 36 hours, the end of the fermentation being decided by the cessation of gas evolution. At King's Lynn fermentations were rarely complete in less than 28 hours, but the Canadian workers claim to have completed large numbers in 24 to 27 hours.

The maize mash before inoculation usually has an acidity such that 0·3—0·5 c.c. of *N*/10 sodium hydroxide is required to neutralise 10 c.c. of the mash. After the fermentation begins the acidity of the mash rises gradually to a maximum of 4·0—4·5 c.c. and then begins to fall, the final acidity usually being in the region of 2 c.c. During the fermentation a mixture of approximately equal volumes of carbon dioxide and hydrogen is evolved; the maximum gas evolution is reached some time after the maximum acidity. A sign of a good fermentation is the sudden fall in gas evolution. From a 3000-gallon fermentation tank the total amount of gas evolved during one fermentation is about 9000 cub. ft., and at its maximum about 800 cub. ft. per hour would be evolved. This corresponds roughly with the results of the Canadian workers, who calculate on about 5 cub. ft. per lb. of maize used.

On completion of the fermentation the liquor was immediately sent over to the still—a double column continuous still by Blair, Campbell, and McLean of Glasgow. The still was fed from a wash storage tank. The object was to get the wash out of this tank fairly quickly, as experiment has shown that after transference to the storage tank there was a loss of acetone—partly due to evaporation, but more particularly owing to the decomposition of the acetone and the increase of the acidity of the wash.

So much may be said to be a general description of the process work, without much reference to the difficulties which arose during the working. These I propose to deal with now.

A great source of trouble and anxiety in the earlier days of the process was the repeated sluggishness of the fermentation. This phenomenon appears after 4 or 5 generations in culture tubes, even when using perfectly pure cultures and growing under anaërobic conditions. Many disintegrating forms but very few spores are visible in the slides, and in the factory the fermentations require almost twice the normal time. Several methods were tried to avoid this difficulty. Different media were employed at intervals of one or two generations. The one which I found to give the best results as regards re-invigoration of the culture was a mash made up to the strength of 5% total solids, consisting of a mixture of 90% of flaked or ground rice and 10% of oatmeal. Cultures grown on this medium had a very pleasing appearance, the organisms being straight, sharply defined, and in typical groups, and by carrying over for one or two generations on this medium the culture was certainly improved. Chiefly, however, it was possible to preserve strongly fermenting cultures by discarding tubes at intervals and starting from an old culture containing spores, usually from three to six weeks old. This was done about twice a week. In two generations, starting from such a spore culture, a vigorous, rapidly fermenting culture is obtained.

The question of suitable pails for this type of work was discussed earlier. Aluminium pails were used in most of the factories, but in Canada satisfactory results were obtained with copper vessels. A distinct advantage in a pail would be a suitable arrangement for withdrawing a sample of the culture without exposing the rest of the contents to infection. In factory work a slide of the pail culture, with a record of the acidity, should be kept until the completion of the fermentations for which that pail is responsible. As a rule the purity of the culture is always maintained up to this stage, because everything has been done in the laboratory under more or less ideal conditions, and it was only on very rare occasions that infection was found before the seed tank stage.

Throughout the account of the process I have tried to emphasise the necessity for working under sterile conditions. This is admitted by all workers on the process to be a most important point, and experience shows that the success of the process depends almost entirely on the sterility of the conditions under which it is worked.

In factory working the infecting organisms fall into two classes: (1) Those which enter with air through leaky glands, valves, or cocks; (2) those which are present in the raw material and are not

exterminated during the sterilisation process. With regard to the first class, it may be said that after being used two or three times all valves and cocks can be regarded as leaky, even though it only be to a slight extent, and it seems to be impossible to erect a large-scale plant which can be guaranteed absolutely gas-tight, so that the danger of air infection is always with us. The best guard against this is to work the positive system. When not in use all pipe lines are kept under a positive steam pressure. This ensures the pipe line being kept sterile, and if there is any leak steam will come out and so prevent the entrance of infection. For the first two or three hours of the fermentation in the tanks at King's Lynn there was a possibility of air entering, because the inoculation was carried out under vacuum. All valves and cocks connecting to the open were covered with cotton wool soaked in formalin, so that any air which entered would be cleared of bacteria in the passage through this filter. After the fermentation begins a slight gas pressure is kept on the tanks, and this effectively guards against any leaks.

Air infection may also occur when the tank is opened for cleaning. Theoretically speaking, as long as the culture is kept pure any number of fermentations may follow each other in one tank, without opening for cleaning, but in practice it is found that after two or three successive fermentations the solid matter which remains clogs up the outlet pipes, and time is lost. It is therefore advisable to have the tanks opened and thoroughly cleaned after every second fermentation. This opportunity is also taken for a thorough examination of all the valves and cocks, which are repacked or replaced as required. Particular care must be taken to keep the manhole joint in good condition. We found that vulcanised asbestos joints gave the best results, the manhole being finally tightened when the tank was under steam pressure. After being opened the tank was sterilised for 2 hours with steam at 15 to 20 lb. pressure. Some workers are inclined to consider this excessive, but I think it is as well to regard the extra sterilisation as a matter of insurance, and if there is an error it is best to err on the safe side.

With regard to the second class of infection, namely, organisms present in the raw material, the only guard against this is efficient sterilisation of the mash, and this depends upon the state of the raw material and the type of cooker in use. To begin with the grain should be thoroughly mashed with warm water. No attempt is made at this stage to sterilise the mash, but the object is to effect a thorough mixing so as to prevent balling or caking of the meal. I mentioned earlier what I consider to be the essentials of an efficient cooker. The actual cooking of the mash, as distinct from the sterilisation, is an important point. A mash may be brought rapidly up to a high pressure and kept at that till it is perfectly sterile and yet may not yield the best results. Mash which is overcooked or burnt does not provide a suitable medium for the organism. The quick cooking of maize mash tends to increase the acidity of the mash, and high initial acidity is not favourable to good fermentation. At one time it was considered that maize mash with an acidity of more than 1·0 c.c. $N/10$ sodium hydroxide to neutralise 10 c.c. would prevent fermentation, but although I do not agree with this, I know that sluggish fermentations usually result.

For this reason the mash should be raised to the required pressure carefully, and the steam should be introduced at several points, stirring going on the whole time. In practice we found that sterilisation for 2 hours at 30 lb. was sufficient to produce a sterile mash. With other raw materials the best time and pressure must be found by experiment. For example, it would be impossible to sterilise wort at this pressure without caramelising the sugars. Again, in the sterilisation of a mash made from horse-chestnut meal it was not advisable to use such a high pressure unless the meal could be guaranteed free from bark. In this case at higher pressures poisonous matter from the bark was extracted and taken into solution, and so produced bad physical conditions.

In practice it was found useful to take samples in sterile flasks of mash before inoculation. These were incubated and examined if any sign of infection appeared in the fermenting tank.

Usually the first sign of infection, or of an unsuccessful fermentation, was the abnormal acidity of the fermenting mash. After a little experience we could tell by the odour of the mash whether a fermentation was proceeding normally or not. If a sample smelt sour, the acidity was determined and a microscopical examination made. If a vessel was only slightly infected there was hope that it might produce some acetone and butyl alcohol, but a badly infected tank rarely recovered, and usually the acidity would rise steadily and practically no "oil" was produced. An attempt was made to diagnose the infection, and from the type of organism it could be generally settled whether the trouble was caused by unsterile mash or entrance of unsterile air.

Organisms present in the raw material usually gave rise to strongly acid fermentations, particularly lactic acid fermentation. Certain coccus infections from the air produced no acid, but since they multiplied rapidly in the maize mash it may be assumed that they were starch devourers, and so the full value was not obtained from the material by our own organism.

The diagnosis of infection in a sample from a seed tank required considerable experience. It was usual, in examining a sample from a seed tank before its use as inoculant, to note the gas evolution and acidity. These, except when cocci such as those just mentioned were present, usually gave some guide. A stained slide was made, carbol fuchsin being used chiefly. In most cases a second slide, stained with methylene blue, was also prepared and examined. It was inadvisable to stain too deeply, since certain common infections took the carbol fuchsin stain very readily and, on examination, these showed up as deeply stained organisms, while the normal were stained ordinarily. In a 16-hour culture it is usual to find a large number of short organisms. These were regarded suspiciously at first, but we found that usually they were young B.Y.

A seed tank culture was rejected if there was any definite infection present, or if in the opinion of the man who examined it the culture did not appear vigorous enough to carry through a successful fermentation. Thus it will be seen that in a properly organised factory the supply of seed should always be greater than the maximum requirement, so as to allow of the choice of the best and the rejection of seed which, although not definitely unhealthy or infected, might break down in the fermentation tank.

When infection is discovered in any seed vessel or fermentation tank it must be got rid of at the earliest moment, according to the circumstances. Its cause should be investigated and steps taken to prevent a recurrence of the trouble. Vessels which have contained infected mash should be thoroughly cleaned and given extra sterilisation.

In the technical application of a bacteriological process such as this efficient scientific control throughout is necessary. The raw material should be examined for bacteria, and chemically for starch and nitrogen. The latter is most important.

Several of the early failures at the distilleries were due to the fact that the grains were not put into the wort, and as a result the organism suffered from nitrogen starvation. A similar state was arrived at upon one occasion at King's Lynn. Upon investigation it was found that the millers, in order to produce a fine meal, were extracting the maize skin containing the proteins. The fact that the organism can only assimilate the nitrogen in the form of protein was demonstrated at Bromley by Dr. H. B. Hutchinson and P. K. Standring. A method had been tried by which the wort was to be neutralised by lime after sterilisation. The lime was added by error before sterilisation, and in the boiling with lime the proteins were broken down, and although nitrogen was still present in the peptones formed the organism could not assimilate it, and would not ferment the wort. Examination of slides showed no infection, but the appearance of the organism was exactly similar to that noticed in cases of proved nitrogen starvation.

From the general examination of the raw material the method of cooking must be decided upon. For example, Egyptian maize is very easily cooked and very good results are obtained owing to complete extraction of the starch in cooking. On the other hand River Plate maize requires very careful cooking. The sudden change from White African maize to Plate maize was the cause of several failures. It was finally discovered that in order to use River Plate maize successfully it must be very finely ground and carefully cooked with a longer boiling period than ordinary maize, and if possible a slightly larger amount of inoculant should be given. With horse-chestnut meal a good many experimental cookings were carried out. As mentioned earlier, sterilisation of the mash at high pressure extracted tannin and acid matter from the bark, which to a certain extent poisoned the medium. In the laboratory sterility could be attained by cooking at 10 lb. pressure for 2 hours, but in the factory we had to raise the pressure to 15 lb. Later, great difficulty was experienced because many of the nuts were in bad and decayed condition, and moulds were growing upon the exposed parts. To a certain extent these difficulties were anticipated after examination of the nuts as they arrived.

Since the raw material may vary considerably, both in the whole and ground state, it is most desirable in a process of this type to have the milling done under control of the factory staff. If not, the meal supplies should conform to a given standard of fineness, and each batch should be analysed before being used.

With regard to the scientific control of the process work, the first part, namely, the inoculation of culture tubes and pails was always carried out by a qualified chemist, who also supervised the preparation of the mash for these vessels. He also inoculated the seed tanks, and examined and passed all cultures before they were used. There was always a chemist in charge of the process, and apart from the definite routine work he made arrangements at his own discretion in case of difficulties arising.

For example, the fermentation tanks were charged in a definite rotation and emptied in the same order as a rule. Sometimes, however, there would be sluggish fermentations, which did not finish according to the scheduled time. In this case it was a question whether to hold up the following tanks and preserve the rotation, or to wait until they finished. A microscopical examination of a slide and determination of the acidity of the mash or distillation of a small sample for acetone and butyl alcohol content would give a fair indication of whether the fermentation was nearing completion or not. Also the amount of fermented liquor in the still storage tank was taken into consideration, because with a continuous still it was inadvisable to stop it and re-start frequently. Such questions as this also involve the consideration of cost—whether it will be cheaper to lose the extra amount of product, or to keep the factory waiting for it. This question of cost also arises in connection with the large scale distillation of liquor with a low content of "oil." If a fermentation has been unsuccessful, and has only produced a small quantity of acetone and butyl alcohol, it is probably more economical to send the whole lot to waste, since attempts at distillation usually upset the temperature regulation of the still, and at best can only produce a small amount of the required product.

So far I have not dealt with the question of a suitable arrangement of plant for this process except to mention that it must be one in which sterile conditions can be maintained. At H.M. Factory, King's Lynn, we were fortunate in having a plant which was, in many respects, ideal—but during the working many improvements suggested themselves. Probably the weakest point was the battery of cookers which were not designed for the raw materials used by us. In setting up a battery of cookers for this process four main points must be considered: (1) the charging of the cookers, (2) the actual cooking and sterilisation process, (3) the discharging arrangement, (4) the fermentation capacity of the factory.

(1) The best method of getting the mash into the cookers is to mash it on the floor above and allow it to run into the cooker. Methods of mashing and pumping into the cooker have met with little success, since most pumps do not seem to work well with uncooked maize. It is advisable to use open pipes as far as possible because at this stage there is no attempt to sterilise, and in case of any stoppage or block it can be easily rectified.

(2) The fittings on the cooker should be such as to enable the operator to have complete and accurate control throughout the cooking. In making up the volume of mash, due allowance must be made for condensation of steam during the cooking, so that the final volume of mash is of the required strength. The cooker should be made of material capable of withstanding a normal working pressure of 30 lb. per square inch, and should be fitted with a safety valve. It is advisable to have this as high above the mash as possible, since particles of maize are apt to get into it and cause steam leakage or premature blowing off. This remark also applies to the pipe leading to the pressure gauge; a small tap in this pipe is an advantage, so that any mash which may have been carried up into the pipe may be let out. The gauge itself should be fitted to a rigid standard, in order to be free from the effects of vibration. The steam inlets should be well distributed at the base of the cooker, and for the cooking I think it is best to use saturated steam at a somewhat higher pressure than that required. Above all, a good stirring arrangement must be fitted; it must be carefully designed so as to carry the weight continuously for fairly long periods. If the steam inlets are sloped, the stirrer should drive in the opposite direction, or there will be a tendency to form a core of undisturbed mash. An additional safeguard is a thermometer, so that the actual temperature of the mash may be recorded, as well as the pressure. A sample cock is also a necessity, since it is advisable to incubate sterile samples of the mash as control experiments.

(3) The best method of discharging the contents of the cooker is by the introduction of top steam so as to keep up the pressure. The use of pumps for this part of the process would involve extra risk of infection, and there is also a tendency for the grains to stop the action of the pump. The actual discharge pipe would lead from the bottom of the cooker to the coolers. An arrangement must be

made by which steam can be blown through this pipe either from the fermenting tank end or from the cooker end. The main object of this is to sterilise the line, but it is also a great advantage to have steam at both ends in case of a blockage in the mash line during charging. The capacity of the cooker and the rate at which the mash can be cooled must be taken into consideration in fixing the size of the discharge pipe. At King's Lynn we had two 2-inch discharge pipes leading from each cooker, through separate coolers. Two tanks were charged simultaneously, each receiving approximately 3000 gallons of 6% maize mash, which was cooled on the way to 37° C. The time taken was about 1 hour 50 minutes.

(4) With regard to the relation between the capacity of the cookers and the fermenting capacity of the works, I maintain that the tanks should never be kept waiting for mash, and therefore the cooking capacity should be greater than the maximum requirements of the fermentation department. It is also advisable to have one spare cooker, so that the cookers may be cleaned and repaired when required without disturbing the working of the process. If at any point tanks are waiting for mash this means a longer interval between two consecutive brews completing fermentation. There are consequently two periods during which the workers in this section have practically nothing to do. In addition, with a continuous still, such as we had, in a long interval there is a possibility of the distiller waiting for fermented mash, which involves slowing down the rate of distillation and re-arrangement of the temperature regulation.

The type of cooler to be used depends to a certain extent on the nature of the water supply. If it is necessary to use clean, fresh water there should be some arrangement by which the water coming from the coolers may be used in some other department, *e.g.*, for mashing the maize or for boiler feed. In this case coolers of the Moreton type would probably be used. Their main disadvantage is the number of joints and bends, which militate against the preservation of sterility. At King's Lynn we were fortunate in having the factory by the dock side, and were allowed to pump water free, provided that the drain from the coolers was kept clean and the water was allowed to run back into the dock. The coolers were upright copper coils, 2 inches in diameter, and gave very satisfactory results; these I think are best where water is very cheap. The coolers, being in the direct line from the cookers to the fermentation tanks, are sterilised at the same time as the pipe line by blowing steam through them.

The fermentation tanks should be housed in a building which is free from draughts and in which an equable temperature can be maintained, or considerable difficulty will be experienced in maintaining the temperature of the fermenting mash during the winter months. The tanks at King's Lynn were of steel, with glass enamel lining. They were of approximately 3000 gallons charge capacity, and were capable of withstanding 15 lb. pressure and 26 in. vacuum. They were very fine vessels for the process, being easily cleaned and sterilised. For general use steel vessels of 8000 to 10,000 gallons capacity would probably be more economical, provided they could be sterilised. Vessels of this size would not be so large as to be unmanageable, nor yet too small for economical working. Every fermentation tank should be fitted with an efficient stirring arrangement, which serves two purposes. (1) The mash can be kept at a uniform temperature during the charging of the tank. (2) After the fermentation has been proceeding for about 12 hours, frequent stirring for short intervals speeds it up considerably, and also breaks the "head" of débris which rises to the top of the liquid. In some cases a good deal of unused starch is carried up into the "head," especially in a vigorous fermentation, and if it is not brought down again the yield suffers accordingly.

A temperature recorder or indicator is necessary in the fermentation tank. If ordinary thermometers are used they should be read at definite times, the readings to be marked on a chart hung by the side of the tank. In the factory at Toronto continuous recording thermometers were fitted to tanks, and gave readings of the temperature of the mash in the centre of the tanks. It is advisable also to take samples from bib cocks at various heights and take the temperatures with ordinary thermometers. These temperatures usually vary slightly from the centre thermometer reading, because the sample is necessarily drawn from the side of the tank, the temperature of which is affected by radiation and proximity of other tanks under steam. If the stirring arrangement is good there is little difference in temperature between samples drawn at various heights.

The tanks will be fed with sterile mash by a pipe line leading from the coolers. I mentioned earlier that it is an advantage to have an arrangement for blowing steam back through this line from the tank house end. A certain economy in piping may be effected by utilising the same pipe line as is used for mash for bringing in steam for sterilising purposes, but in this case care must be taken to have cocks in the line so that each tank can be isolated from the others on the same line.

The total length of pipe line from the cooker to the fermentation tank should be as short as possible, and it is best to have it free from sharp elbow bends, where pieces of mash might get stuck and gradually block up the passage. The pipe line should be carefully examined at frequent intervals, particularly at the bends. Although the acidity of the mash which traverses this line is rarely more than 0·8 c.c., the action on wrought iron piping is very marked, and as soon as a section begins to get thin it is best to have it replaced. A useful precaution is to keep spare lengths, with bends, ready made up.

The fermenting capacity of a plant determines the output, and other factors are arranged in relation to this.

The completely fermented mash is conveyed to the stills for separation of the product, after a sample has been taken to the laboratory for an oil estimation. Owing to the extreme volatility of acetone, great care must be taken at this point, and it is difficult to avoid some loss. At King's Lynn the still was fed from a liquor storage tank, and in the early days of the process the fermented liquor was blown to this tank by applying steam at the top of the fermenting vessel. While the greater portion of the liquor remained at its original temperature, the last runnings were considerably heated, with consequent loss of acetone by evaporation. Later, centrifugal pumps were installed in the pipe line leading from the fermenting tanks to the storage tank. The arrangements made for disposal of the fermented liquor depend to a certain extent on the type of still used. In the acetone process the continuous type of still gave satisfactory results, but the acetone produced was not capable of satisfying the Government specification without re-distillation. This, however, would be the case with any other still dealing with fermented liquor containing a mixture of acetone and butyl alcohol. With a continuous still some form of storage tank is necessary in order to counteract irregularities in the completion of fermentations. It is not possible to avoid these completely, since the fermentation is dependent upon a living organism.

The storage tank or tanks should be closed vessels, to prevent evaporation of the products, and

may take the form of a series of "finishers." The yield of acetone has been found to be 95% at from 80 to 85% of the time occupied until the yield ceases, and there is reason to believe that no foreign bacteria can compete with the B.Y. at this stage. Hence it would be possible to withdraw the fermenting liquor at a point before the full yield of acetone is obtained, and if transferred to a closed tank under fairly clean, but not sterile, conditions, the fermentation would complete normally. A series of these tanks might be used as an intermediate stage between the fermentation tanks and the still.

The still chosen should be capable of dealing with slightly more than the maximum output from the fermenters, so that there will be no need at any time to rush the distillation.

There are yet two points to be considered in the relation of one section of the plant to another—the boiler capacity and the seed capacity. Again, both depend on the fermentation capacity.

The amount of seed produced each day should be more than is required. In case of doubtful or infected seed, there will then be a margin and a choice of other seed. Should all the seed tanks turn out well (as is generally the case if the laboratory work is satisfactory), there will be nothing lost, as the unused seed tanks may be allowed to ferment through and go to the stills, or their contents blown into tanks of similar age. In inoculating a fermentation tank from a seed tank it is very useful to be able to apply accumulated fermentation gas pressure. For this reason a seed tank is closed an hour or two before it is used for inoculation purposes, and so allowed to accumulate gas pressure. The method of connection from a seed tank to the various large tanks presents some difficulty in the choice of an ideal method. At King's Lynn lengths of reinforced rubber hose were used. These would withstand a certain amount of steam sterilising and the joints were sprayed with formalin. I think it would be possible to design an all-iron pipe system, without rubber or other flexible connections, which could be thoroughly sterilised and need not have the ends open to the air at any time.

In considering the boiler capacity, the great point to bear in mind is that a large reserve of steam must always be kept. In the ideal factory I think there should be three separate and distinct steam supplies, one to feed the still (since here it is advantageous to have a regular supply of steam at constant pressure), one to feed the cookers (as a rule here the supply is intermittent, a large quantity being required when a cooker is being raised to pressure), and one for sterilising pipe lines and tanks, both seed tanks and fermentation vessels. As steam-driven pumps or engines would probably be working continuously, they could be supplied from the same system as supplies the still.

When steam for all parts of the factory is being drawn from the same source, the stoker should be instructed in the general working of the process, and should be warned when there is likely to be a sudden call on his steam supply, or otherwise the whole process may be held up.

In this process there is still abundant scope for investigation, both academic and practical. During the war it was a case of concentration on output rather than a close investigation of the various causes of the phenomena which occurred.

From the point of view of academic research, there is yet to be settled the question of exactly what happens during the fermentation. Briefly, the present knowledge is as follows:—When the fermentation begins, gas, consisting of approximately equal volumes of carbon dioxide and hydrogen, is evolved, and the acidity of the mash, as shown by titration against *N*/10 sodium hydroxide solution, begins to rise, until a maximum is reached. At this stage 10 c.c. of the fermenting mash is neutralised by 4·0 to 5·0 c.c. of the alkali. Up to this point no acetone or butyl alcohol is formed, but as the acidity falls the oil content of the mash increases; when fermentation ceases and no further gas is evolved nor any more acetone and butyl alcohol, the acidity is not completely destroyed, the final acidity of the mash being usually in the vicinity of 2·0 c.c. of alkali—considerably higher than the initial acidity of the mash.

It is probable that the maximum acidity is produced by a mixture of acids rather than by a single one, because it cannot be completely neutralised by the addition of milk of lime, and the question arises as to whether some interaction takes place between these acids, the proteins, and the starch present. It is not yet clear what part is played by the actual bacteria and what part by the enzymes present. Certainly the reactions are of a complex nature, but if thoroughly investigated the knowledge gained might be of considerable utility in the working of the process. I think the starting point in this work would be the identification of the acids formed during the early part of the fermentation.

Another question which requires investigation is the loss of acetone and butyl alcohol after the completion of the fermentation, if the mash is kept even for a comparatively short time. This was suggested by the loss sustained in the storage tank for fermented liquor at King's Lynn. I did not think that the loss could be wholly accounted for by evaporation, although unfortunately the tank was to a certain extent open. I found on investigation that there was a distinct increase in acidity of the liquor while waiting for distillation. This may, of course, have been produced by the entrance of acid-forming bacteria from the air, or on the other hand it may have been produced chemically by the interaction of the various products, with consequent breakdown of the acetone and butyl alcohol.

From the purely practical point of view the chief field for investigation is the utilisation of the waste products. In a maize mash fermentation there is a solid residue of approximately 13% of the total maize used. This has a very high oil content, since during the fermentation the maize oil is untouched. The albuminoid content is also fairly high, because all the nitrogen present is not used up by the bacilli during fermentation. The carbohydrate content is small—in fact in a successful fermentation the whole of the carbohydrate should be used up. The chief disadvantage here is the cost involved in recovering this residue in the dry state. As it comes from the still there is probably about 1 cwt. of solid matter in every 1500 gallons of liquor. At King's Lynn this was run into settling pits and the supernatant liquor run off. The residue in a wet state was sold to farmers locally at 30*s.* per ton, for mixing with other foods. This was purely a war-time price, owing to the high prices of other foods and also the difficulty in obtaining them, and it is probable that farmers would not be prepared to pay the same price now. Another objection to this method of recovery from open pits is the change in the state of the material due to atmospheric conditions. In the winter the settling pits were frequently frozen over, and in the summer they produced offensive odours due to the decay of the vegetable matter and the secondary fermentations, which are encouraged in the warm weather. If it were desired to use it as a cattle food the most feasible plan seems to be to filter it immediately on leaving the stills, and to dry the solid matter. This could then be mixed with some other material comparatively rich in carbohydrate but poor in fat and protein.

An alternative method of dealing with the waste

product is to attempt to reduce the amount of residue. Obviously the protein present in maize is in considerable excess of the amount required for fermentation, and it should be possible to remove some as bran, and sell this, or if some cheap form of starch or starch solution were available, this could be used in making up the mash, and so help to utilise all the available nitrogen.

Another problem for the technical investigators is the utilisation of the waste gases produced. A small amount of acetone vapour is carried out with the waste gases, particularly when the fermentation is at the vigorous stage and there is considerable "foaming" or "frothing." The amount of gas being approximately 5 cub. ft. per lb. of maize used (or perhaps slightly less), a factory consuming 100 tons of maize per week would produce over a million cubic feet of gas per week. The first suggestion usually offered is to burn the gases under the boilers and so save fuel. Apart from the risk of explosion and the expense incurred in putting up the necessary plant, it was found at the factory in Toronto that the saving would only be about 1%.

Another suggestion is to use the waste gases in a gas engine. Here again, for obvious reasons, the engine must be at a long distance from either the fermenting house or the stills, or there would be considerable risk, and if so placed the gas engine could not be used.

If the fermentation factory were near a works using large quantities of hydrogen for fat hardening processes some arrangement might be devised whereby the carbon dioxide could be separated, possibly by cooling and compressing, and the hydrogen liberated in a pure state.

Other investigations should be directed at increased yields or economy in working. In this direction some workers favour a continuous fermentation system, and I understand that some time ago an experimental plant was constructed at Toronto, but I have not heard what results were obtained.

Another point is the disposal of the butyl alcohol. There is in existence a process, patented by the Synthetic Products Company, for the conversion of this into synthetic rubber, but they have their own source of supply for butyl alcohol. During the war the butyl alcohol produced (containing about 90% actual butyl alcohol) was in fair demand for patent cookers and as a methylated spirit substitute, but now that spirit is again on the market this outlet for the butyl alcohol is closed. Research has been done, and plant erected for the conversion of butyl alcohol into methyl ethyl ketone under the patent of Dr. Weizmann and Mr. D. A. Legg has given satisfactory results.

The working of this process in this country is always carried out under the disadvantage of the comparatively high price of raw material. The only available materials in Britain are potatoes and horse-chestnuts. Both have disadvantages. The pick of the potato crop is used for human consumption and the buyer of large quantities of the surplus is open to incur considerable losses through the potatoes decaying. With regard to horse-chestnuts, I do not think this is a commercial possibility in peace-time. The difficulties in connection with the collection and transfer to a given depot are enormous. In addition the drying and grinding present some difficulty, and even when all this is surmounted the medium is not an ideal one for the growth of the B.Y. organism.

In foreign countries the raw material can be grown cheaply and bought on the spot. For example, in India unpolished rice might be used. This gives better results, weight for weight, than maize owing to the higher starch content. Millet is also available there in large quantities. With this raw material there might be some difficulty owing to the large amount of natural oil present, but the excess could probably be pressed out. Laboratory experiments have given promising results.

Again, the experience at Toronto has upheld the belief that it is best to work the process where a continuous supply of fresh grain is available. Considering that the total weight of finished product is not more than 24% of the grain used, it follows that even if costs of running the factory were approximately the same as in this country the saving in freight would be very considerable.

It therefore seems that the future of the Weizmann process lies abroad, rather than at home, although from the pure research point of view much might be attained in the laboratories at home.

In conclusion I wish to express my thanks to Sir Frederic Nathan, K.B.E., for permission to contribute this paper.

Discussion.

Prof. A. Fernbach said that it appeared to be admitted in this country as well as abroad that he was the discoverer of the fermentation process by which acetone and butyl alcohol were obtained as early as 1910 from starchy raw material and other carbohydrates. The process was generally referred to as "Fernbach's process." Many misleading and incorrect statements had, however, been published which he (the speaker) wished to correct. It was in his own laboratory that Dr. Weizmann had been taught in 1910 and 1911 how acetone and butyl alcohol were produced in the fermentation of maize or other substances containing starch in the proportions approximately of one part of acetone to two of butyl alcohol. These facts were in close relation with the question of the raw material employed in the Fernbach process; a question concerning which incorrect statements had been made; as early as 1911 fermentations had been successfully carried out on maize, potatoes, and glucose at an experimental factory in this country; and it was therefore misleading to say that the processes used by the Synthetic Products Company had never employed anything but potatoes. He had also been surprised to read the following sentence in the paper by Mr. Speakman previously referred to: "It was due to the diligent and original work of Fernbach that advantage was taken of what had long been known to students of general bacteriology, namely, that certain species or strains of one species of organism are able to decompose carbohydrates with the production of acetone and various alcohols and acids." It was true that at the time of his (Prof. Fernbach's) work one process of fermentation had been known in which small amounts of acetone were produced, and others in which butyl alcohol was obtained, but no process had been known in which acetone and butyl alcohol were obtained simultaneously in one fermentation. Mr. Speakman had also stated that out of a total of 3458 fermenters inoculated, each holding 21,000 galls., none was discharged into the drain and not distilled. This statement was decidedly misleading to anyone who had had no bacteriological training, as it might be understood to mean that none of these numerous tanks had been infected; whereas, no bacteriologist would claim to be able to perform a series of more than 3000 pure cultures without any case of infection. Sir Frederic Nathan was to a certain extent correct when he mentioned that potatoes had been the raw material used by the Synthetic Products Company at King's Lynn, but it should have been added that potatoes had at that time been the cheapest raw material available in England. He (Professor Fernbach) could support Sir Frederic Nathan's view that the Weizmann process and the Fernbach process were generally similar; he would even go further and say that

from what had been published the processes were identical. It would have been very interesting to know on what evidence was based the assertion that the bacteria were different. It might be wondered why the points now mentioned had not been published earlier; but when asked in 1916 to read a paper on the production of acetone by fermentation before the London Section of this Society, his doing so had been formally vetoed by British Government officials, and he had been compelled therefore to bow to this decision. In Mr. Gill's paper the plant that had been in work at King's Lynn was described at length and finally reported to be an ideal one. It would perhaps have been desirable to say what parts of the plant erected by his (Prof. Fernbach's) friends had been maintained and what parts had to be altered? The successes of the so-called Weizmann process dated from the time that the King's Lynn factory was taken over by the Government after having been worked with complete success by the Synthetic Products Co. in so far as fermentation operations were concerned. The failure to produce acetone in any quantity mentioned by Sir Frederic Nathan had been entirely due to incomplete and inadequate plant for distillation; and immediately this defect had been remedied the plant had been worked at its full output with complete success by the staff of the Synthetic Products Co. The reasons for this success, and for those which Mr. Gill had reported in his paper, had been mainly that the King's Lynn factory had possessed a plant which had been specially designed for the working of the process. As regarded the working of the process in French factories, he said that he had been approached by two large distilling firms, one having its works in France and the other in Indo-China; each of these possessed a plant which could without any great alteration be employed for the manufacture of acetone. These plants had been employed in the first years of the war, and previously to the war, for the manufacture of "silent" spirit by the "Amylo" process. The experience gathered by these manufacturers in the production of pure alcoholic fermentations had greatly helped them in obtaining success in the manufacture of acetone. The Indo-China works had unfortunately been compelled to stop after a few weeks of successful working, owing to the impossibility of shipping their goods to France. But the works in France had been manufacturing acetone continuously since 1917, and had only recently been stopped through lack of raw material. The fermenting tanks, which had an average capacity of from 16,000 to 18,000 galls., were charged with a mash containing about 8% of maize or rice, which was inoculated with a pure culture contained in a two-litre flask. The average duration of fermentation had been 40 to 42 hours. Experience had taught in this process exactly what they had known as regards alcohol manufacture, namely, that the most perfectly erected lines of pipes did not always avoid infection, and that it was best to dispense with the seed tank, and to seed the fermenting tank direct with a pure culture prepared in the laboratory.

Mr. E. Grant Hooper said he was sure there was nobody in England who denied to Prof. Fernbach the credit of having been the first to produce butyl alcohol and acetone by a fermentation process. Probably Sir Frederic Nathan and Mr. Gill would say that the reason why the process had been referred to as the "Weizmann process" was because Dr. Weizmann had been placed in charge of the production, and they could only speak of the products under his actual operation. It would be interesting to know a little more as to the exact cost. Could it under the most favourable conditions ever compete with acetone derived from, say, the destructive distillation of wood? It appeared at first rather remarkable that the production of acetone from acetic acid obtained by alcoholic fermentation should not have been successful. It seemed a little difficult to understand that it should not have been possible to produce acetone by the acid process at a cheaper rate than had been the case with this process. He gathered that the residue in this particular process amounted to 13% solid. It was stated that practically no carbohydrate remained. No starch remained, but he wondered whether any dextrinous substance was present; he took it that it was not wholly albuminous matter which remained. It was remarkable that an organism could exist in the presence of acetone and butyl alcohol, substances normally most inimical to almost all forms of life.

The Hon. F. R. Henley said he had had some experience in 1918 with the fermentation of horse-chestnuts. He had found it impossible to carry through fermentation with horse-chestnut meal unless it were completely free from husk, and that was in practice impossible. It was impossible to get the husk down to such a percentage that the fermentation would proceed properly, but it had been found possible to effect fermentation when the husk was partially removed and the horse-chestnut meal mixed with an equal quantity of rice or maize. Under these conditions he and his associates had carried through about a dozen fermentations quite successfully, though the fermentation proceeded a good deal more slowly than with the cereals alone. Another raw material used had been acorns. They had fermented quantities up to 2 cwt. of acorns in the same way as with horse-chestnuts; but in that case he believed the tannin interfered with the fermentation, though with a mixture of 40% of acorns and 60% of rice or maize the result had been fairly normal. The last speaker had raised the point about the quantity of acetone and butyl alcohol present in the fermenting liquid, thinking it remarkable that bacteria could live in the presence of these substances. But the extreme dilution of the liquid must be realised. The mash contained 6% or 7% of grain, and only about 7% of that was converted into acetone and 14% converted into butyl alcohol; so that, when the fermentation was finished, there was only 1·4% of butyl alcohol and 0·6% of acetone—a very small quantity. Little had been said about by-products. He and those who worked with him had had opportunities of following the nature of the gases produced, as they had had plant for separating them. They had found that a solution of soda under pressure produced a very efficient separation, so that they got hydrogen sufficiently pure to be used by the plumbers. He believed it could have been made sufficiently pure for airship work by a final washing with caustic alkali. One interesting point that had not been touched upon was the course of the chemical reactions which took place during fermentation. As Mr. Gill had explained, the acidity of the mash gradually rose as the fermentation progressed. In their experience in the factory the acidity rose steadily for the first 12 hours of fermentation, and then fell steadily until a minimum was reached, which was maintained to the end. If that acidity were neutralised as it was formed the salts of two acids were produced—butyric and acetic acid.

Col. Goodeham said that in Toronto they had started with a 5% mash and had gradually worked it up to at least 10%. They had obtained their best results at 10%. The sluggishness of the fermentation was due to using the ferment too soon after it had been put aside for future use. With regard to the inoculating system, they had used the aluminium pails that Mr. Gill spoke of, and nearly all their failures had been traced back to those pails. They had then made a battery of small inoculators that would hold about 5 galls., and

provided a pipe connection from this on to the inoculators and then on to the seed tanks. Every pipe in their works, from the time it was empty until it was used again, was under steam pressure. They had found that it did not increase the yield or give any advantage to cook the grain at anything between 15 lb. and 60 lb., but with pressures above 60 lb. better results were obtained. What the reason of this was he could not say. Four fermenters were used and each was filled in turn; that only took a few hours, but it gave the ferment in the first fermenter a chance to start; after that, they did not have to reject any batches. Of course some fermenters were contaminated to a certain extent, but they did not run the product into the sewer unless the yield of acetone was below 60% of the normal.

Dr. REILLY said that during several fermentations at the Royal Naval College Factory they had attempted to separate the acids which were formed. Butyric and acetic acids were not the only acids produced; there was also a small quantity of another organic acid which they had not succeeded in identifying. The acids were formed at first in the proportion of four parts of acetic acid to one of butyric acid. After a few hours the proportion of butyric to acetic acid increased, until more butyric acid than acetic acid was produced. Then, as fermentation proceeded, the proportion of acetic acid again rose. There was a rising curve of acidity for a certain number of hours, and afterwards it fell off; as it fell off, acetic acid was added to bring it up to the maximum again. It appeared that the bacteria or enzymes were actually able to reduce the acetic acidity in considerable quantities. The percentage of acetone was increased by the addition of acetic acid. If acetic acid were made by an ordinary fermentation process, for example, by souring cheap wines, the dilute solution could be pumped directly into the fermentation vat for conversion into acetone. In that way the yield of acetone was increased about 10½% and the butyric acid production was normal. He doubted whether in peace time such a process would have an economic value.

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THE EMPLOYMENT OF MICRO-ORGANISMS IN THE SERVICE OF INDUSTRIAL CHEMISTRY. A PLEA FOR A NATIONAL INSTITUTE OF INDUSTRIAL MICRO-BIOLOGY.

BY A. CHASTON CHAPMAN.

When I was invited to contribute to this Conference a paper dealing with the employment of micro-organisms in the service of chemical industry, my first impulse was to decline, on the ground that it would be quite impossible to deal adequately with even a small branch of so wide and complex a subject within the limits of an ordinary scientific communication.

A little reflection, however, sufficed to show that if the temptation to wander too far afield were resolutely resisted, there were one or two aspects of the matter of special importance at the present moment which might very usefully be brought before an audience such as this.

It is, I think, abundantly clear that, during the period of reconstruction on which we are now entering, it will be necessary for this country to strain every nerve to meet foreign competition, and to become as far as possible self-supporting.

It is a truism that the wealth of a country depends on its productiveness and, for far too many years and in far too many cases, we have been content to act merely as agents when we should have been manufacturers. The war has, I think, brought home to us the folly of such a course, and it behoves us to see that we never again become as dependent as we have been on other countries for so many of our vital necessities.

As a branch of chemical industry, industrial micro-biology has not received, in this country, the amount of attention to which its importance entitles it; and in this paper I propose to refer merely by way of example to one or two of what may be called (for want of a better term) the fermentation industries, which have been very seriously neglected in this country, and which it should now be our duty to establish firmly on British soil.

Of all branches of chemical science none, perhaps, has made greater progress during comparatively recent years than that sub-division of organic chemistry to which the term *biochemistry* is now generally applied. Including, as it does, within its purview a study of the chemical constitution of a vast number of naturally occurring compounds, their genetic relationships, their modes of production, and the various transformations which they undergo in the living organism, it will be obvious that the problems concerned are not merely of intense interest, but are frequently of the very highest importance in their relation to chemical industry.

Whilst any attempt to divide chemical processes and chemical products into *vital* and *non-vital*—that is, to assume some special "vital force" operating in living organisms—would be without scientific justification and could scarcely fail to act as a serious obstacle to progress, yet it cannot be denied that, in the great majority of biochemical syntheses and transformations, we are confronted with chemical modes of activity of which, at present, we have but the dimmest conception. When we consider the wonderful synthetic processes accomplished by the leaves of plants under the stimulus of light, the formation of starch or of protein in the growing plant, the conversion of carbohydrates into fat in the animal organism or by some of the microscopic fungi, or any of the numerous instances of enzyme action, and compare the ease and completeness with which these complex transformations are effected at ordinary temperatures with the drastic, clumsy and often wasteful syntheses of the organic laboratory, we must realise how far we are still from understanding nature's methods, and how much we have to learn before we can hope to imitate them.

To quote from the late Professor Meldola: "When we can transform sugar into alcohol in the laboratory at ordinary temperatures by the action of a synthesised nitrogenous organic compound; when we can convert glucose into citric acid in the same way that *Citromyces* can effect this transformation; when we can build up heptane, or cymene, or styrene, or when we can produce the naphthalene or anthracene complex in the laboratory by the interaction of organic compounds at ordinary temperatures, then may the chemist proclaim with confidence that there is no longer any mystery in vital chemistry."

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It is true that we are beginning to understand something of the nature of enzyme action and that

many of the changes—particularly those involved in hydrolysis—can be readily brought about by what may be termed, in this connection, "artificial" laboratory methods. It has to be remembered, however, that there are still a great many important natural processes coming under this heading—such, for example, as alcoholic fermentation—which cannot be successfully imitated, and for these we are still dependent on the living organism.

Thus, to take two instances: whilst alcohol and lactic acid can be prepared synthetically, as the result of various purely chemical processes, those processes are at present so costly and so imperfect as to be useless for technical purposes, and we are therefore largely dependent on what may be termed biological methods for the production of those important substances on a commercial scale.

Whether, with the growth of chemical knowledge, the services of the living organism will be ultimately dispensed with, or whether—as I think more probable—those services will be more largely utilised in industrial chemistry, only the future can show. It is sufficient for our present purpose that a number of very important industries are more or less completely dependent upon the activities of certain lowly organisms, and that a very thorough knowledge of the nature of those organisms and of the influence of environment on their chemical activities is essential to efficient and successful factory work.

This brings me to a point to which I wish in this communication to direct special and serious attention, *viz.* the very inadequate provision made in this country for systematic instruction in industrial micro-biology, and for the study of the innumerable problems on which it bears. In connection with brewing and distilling an immense amount of work has been, and is being done, but the minor fermentation industries have been left very largely to take their chance, and to what extent we have been losers by this carelessness and neglect, a reference to one or two industries will show. Let us consider, for example, the manufacture of lactic acid.

Although it had been known since the time of Scheele that lactic acid can be prepared from milk sugar, the production of this acid on an industrial scale dates back no more than thirty or forty years. It was in the early days prepared in somewhat considerable quantities in this country and in America and for a number of years, so far as I can ascertain, little or none was made in Germany. Up to about twenty years ago the Germans seem to have relied almost entirely on the imported product, and I think I am right in saying that a not inappreciable quantity was actually obtained from this country. With the greatly extended commercial use of lactic acid, particularly in the dyeing and tanning industries, the need for new sources of supply became great. To meet this many factories were established, especially in Germany, and at the outbreak of war that country had become a large producer, one firm alone making over 600 tons per annum. Reliable statistical information in regard to the production and importation of lactic acid and its salts is scarcely obtainable, but I am informed on good authority that in 1912 we imported from Germany 513 tons, and that in the following year this had risen to 750 tons. It is clear, therefore, that not only were we not able to supply our own requirements, but that we were importing from our former customer, Germany, about one-half of the total quantity we needed and the bulk of the remainder chiefly from France, Italy, America, and Holland. It is not easy to arrive at an exact estimate of the amount of lactic acid used in this country, but I think it may be taken that at the outbreak of war it was something approaching 1500 tons per annum, and of this only a very small proportion was being made here. It may, of course, be said that these quantities, after all, are not great, and that as compared with many industrial products, the money value involved is very small. This is, of course, quite true, but it has to be borne in mind that lactic acid is only one of the biochemical industries to which my paper has reference, and that I am merely using it as an illustration of the general principle that unless we are content to allow our industries to pass into the hands of our competitors, we must spare no effort to raise those industries—great and small—to such a condition of technical perfection that our position as manufacturers is absolutely unchallengeable.

I need scarcely remind you that lactic acid is manufactured on the large scale by the bacterial decomposition of various carbohydrates. According to the usual text-book equations, one molecule of milk sugar first undergoes hydrolysis and then yields 4 molecules of lactic acid, whilst 1 molecule of dextrose similarly gives rise to 2 molecules of the acid. That the reactions involved are not by any means as simple as these equations would appear to indicate is, of course, obvious, but the important fact from the technical point of view is that through the agency of selected micro-organisms, or more probably through the agency of the enzymes which they elaborate, a yield which falls not very far short of that indicated by the above equations can, under favourable conditions, be obtained. The actual process of manufacture roughly comprises five steps:—(*a*) The preparation of the sugar solution in a condition suitable for fermentation, (*b*) the bacterial fermentation of this solution under suitable conditions in the presence of an excess of finely-divided calcium carbonate and the production of calcium lactate, (*c*) the decomposition of the calcium lactate with sulphuric acid, (*d*) the filtration and washing of the calcium sulphate resulting from the preceding operation, and (*e*) the concentration of the lactic acid to the required strength.

It is not within the scope of this paper to describe in detail the manufacture of lactic acid, and I may, therefore, omit all reference to the nature of the plant and to the many precautions which have to be taken if an acid of good quality is to be produced. My object is, rather, to show that no matter how good the plant may be, how carefully all the purely chemical operations may have been carried out, or with what success the various engineering difficulties may have been surmounted, the success or failure of the manufacture depends on the selection of the right organism and on a precise knowledge of the conditions under which that organism is capable of doing its best work. The production of lactic acid from carbohydrates is, in fact, a general property of a large number of bacteria, but of these only a comparatively small number are capable of industrial application. This fact brings us face to face with the first difficulty and one upon the proper solution of which successful working very largely depends. I refer, of course, to the selection of the organism to be employed. It is clear that the intending manufacturer may adopt one of two courses. He may himself take steps to isolate in some way or other an organism capable of giving him the results he requires, or he may endeavour to procure the necessary culture from someone else. In the first case it is obvious that he must be possessed of considerable knowledge, not merely of bacteriological technique, but also of the life history, general characters, and probable habitat of the various lactic bacteria. He must, obviously, be prepared to devote a considerable amount of time to this preliminary work, and even then it is by no means certain that he will obtain the organism which is capable of giving him the result he requires—that is to say, the maximum yield of lactic acid in the minimum time. The alternative to this uncertain and difficult method of

proceeding is to obtain the required organism from some person or institution. This is a point with which I propose to deal more fully a little later, but it will perhaps suffice to say here that any one intending to commence the manufacture of lactic acid in this country would find it very difficult, except perhaps as a personal favour, to obtain a pure culture of a carefully selected lactic bacterium, together with full instructions as to the precise fermentation conditions to be observed in order to get the best results. This last point is one of considerable importance, since for every organism there is a particular set of conditions, the observance of which is absolutely essential to successful working. It is necessary, for example, to know what soluble form of nitrogen should be supplied and in what quantities, what temperature should be maintained, what amount of aeration, if any, should be adopted, and what steps should be taken to prevent the acidity from rising beyond the point at which the activity of the organism becomes inhibited. It will, I think, be clear that the acquisition of this knowledge often involves a series of scientific investigations such as could only be carried out successfully in a laboratory or institution devoted to that particular kind of work. Although a vast amount of study has been devoted to the bacteria producing lactic acid, and although there are several organisms that have acquired industrial fame owing to their activity, it is not by any means certain that still more active bacteria may not yet be discovered. In support of this I may, perhaps, mention that in the course of a somewhat prolonged investigation I myself succeeded a few years ago in isolating a lactic acid bacterium which gave not only a rather higher yield, but worked very much more rapidly than the most vigorous organism which had previously been obtained. From what I have said it will, I think, be clear that if lactic acid is to be manufactured successfully and to be sold profitably at a competitive price, it is essential that steps should be taken to secure in the first place the right organism, secondly to grow it under the most favourable conditions and finally to maintain it in a state of biological purity. I may say, without fear of contradiction, that these conditions of success, whilst well recognised by our manufacturers, are by no means universally observed. A good deal of lactic acid is, in fact, being turned out in a very haphazard manner, the quality being poor and the cost of production unnecessarily high.

If the conditions of the lactic acid industry are by no means as satisfactory as they should be, the conditions under which butyric acid is manufactured are very much worse. Much less work has been devoted to a study of the various bacteria producing butyric acid and to the determination of the conditions under which they exert their maximum activity. It is not too much to say that the majority of the manufacturers of butyric acid very rarely have any precise knowledge of the organisms they are employing, and as a result the yield of butyric acid is often very low and its quality poor.

Even in the important and ancient vinegar industry the same want of precise knowledge obtains. Each manufacturer has in process of time produced a certain variety of organism which appears to answer his purpose, but of the life history of which he is usually profoundly ignorant and which he takes no special pains to obtain or to preserve even in an approximately pure condition. There can, I think, be very little doubt that a careful study of the acetic acid bacteria with special reference to their industrial properties would be productive of great benefit to the vinegar industry. Not only is it probable that different species, if used in pure culture for acetification would give vinegars of different flavour, but it is also tolerably certain that particular organisms might be found to be especially suited for use in certain types of apparatus, and that the working losses which are so serious in many vinegar factories might be very considerably reduced.

I might refer to many other industries depending on the activities of micro-organisms, but I have perhaps said enough to show that even in the case of industries which have been in existence for a considerable time, the empiricist is still far too much in evidence. This, I think, is largely due to the fact that facilities are wanting for the proper training of workers in the biochemical industries, and that there are no means by which such workers can keep in touch with modern views and modern developments.

There is not, in fact, in this country, nor (so far as I am aware) in the British Dominions, any institution devoted to a subject which is admittedly of such enormous technological importance.

Assuming such an institution to come into existence it may be useful to consider for a few moments what ground its activities might cover and what functions it might perform.

In the case of brewing and distilling, we are dealing with two very ancient industries, in which scientific investigation had, perforce, to follow for a considerable time in the footsteps of practical experience. In those industries the practical man knew what results he required and, as a rule, how those results could best be obtained, and it was left for the scientific man merely to supply the explanation. Even in these ancient industries, however, a point was reached at which further progress was impossible without highly specialised scientific investigation, and what Pasteur, Hansen, and many others have done in this field of inquiry is too well known to need any further reference here.

In the case of the wine industry, however, very much less scientific work has been done, and, at the present time, there is in my view an enormous future for the systematic investigation of the wine-making industry, from the biological side.

In the dairy industry, and particularly in connection with cheese-making; in agriculture; in bread-making and the pressed yeast industry; in tanning, in the treatment of sewage, and in the study of certain plant diseases, to mention only some of the fields in which micro-organisms play an overwhelmingly important part, the scope for investigation is almost unlimited.

The first, and perhaps the most important, object of the Institute which I have in my mind would be to provide for the systematic prosecution of original research, in connection with the above industries, and in fact with any industry in which micro-organisms or enzymes play an important part.

That a great deal of very valuable work of this kind has been done in this country is well known to all who are familiar with the subject, but the institutions in which this has been done are scattered, and there can be no doubt that far better results would be obtained if the many closely related problems connected with the activity of micro-organisms and of enzymes could be studied in a single institution adequately provided with all the necessary appliances and specimens, and where the various workers in these closely-associated fields would have the opportunity of discussing their problems with one another.

In the next place, the Institute would serve as a centre for the specialised training of men intending to devote themselves to the teaching of microbiology and biochemistry in our Universities and Technical Schools, and also for the practical instruction of factory managers and other technical employés engaged in the various biological industries.

I am, of course, aware that a good deal of work in this direction is being done in existing institu-

tions, but there is an absolute want of co-ordination, accompanied by overlapping and waste of energy, and, above all, there is the important fact that the men engaged in teaching these subjects, although possessing the highest academical qualifications, are frequently wanting in the necessary practical experience and knowledge. There is, moreover, very frequently a great scarcity of the living specimens necessary for experimental laboratory work.

It would not, for example, be at all easy to name any existing institution in this country in which the science and technology of the manufacture of, say, vinegar, lactic acid, or butyric acid could be taught in such a way as to provide a proper and adequate equipment for a man desirous of devoting himself to any one of those industries.

What I may perhaps describe as the chemical and chemical engineering sides of the subject are, of course, provided for, but for the teaching of the much more important biological side, the provision at present existing is imperfect and entirely inadequate.

A further function which the proposed Institute might fulfil would be that of providing breweries, distilleries, and other factories with any required organisms in pure culture and in sufficiently large quantities for industrial purposes. The technical manager of any factory in which biological processes are employed would find it a very great convenience to be able to obtain at any required moment a working quantity of the particular organism on which his operation depended. At the present time scarcely any such facilities exist in this country. In France the want is to some extent met by the *Service des Levures* of the Pasteur Institute, which is in the habit of supplying brewers, distillers, wine growers, cider manufacturers, and lactic acid makers with the necessary cultures, and in addition to this there are several private institutions, covering more or less the same ground. In Germany the work is done by the Institute for Fermentation Industries, and in one or two other countries there are more or less well-known private establishments such as Jörgensen's Laboratory in Copenhagen.

Then again, the Institute would serve to house as complete a collection of industrial micro-organisms in pure culture as could be got together. No such collection exists in Great Britain, and scientific workers, industrialists, and others are compelled to apply to their friends on the chance that someone may happen to have a specimen of the organism required, or to endeavour to obtain it from the Centralstelle für Pilzkulturen in Amsterdam, or (before the war) from the Fermentation Institute in Berlin, from Kral of Prague, or from some other foreign public or private institution. The time and trouble involved in a quest such as this will be well remembered by those who have been compelled to undertake it. As one who happens to possess a fairly large collection of living saccharomycetes and allied organisms in pure culture, I can myself bear witness to the frequency with which these organisms are required and to the difficulty of obtaining them conveniently. It must be remembered that these cultures are to the micro-biologist what pure chemicals are to the research chemist, and it is surely not too much to ask that one set at least of these important living specimens and reagents should be at the service of biological workers and others in this country. I have reason to believe that the demand on the part of British and Colonial workers alone is not inconsiderable, and it would most certainly increase if the supply were readily forthcoming. I am aware that the labour involved in maintaining such a collection as I am indicating would be considerable, but it is of the routine kind, necessitating the employment of merely a well-trained laboratory attendant working under the supervision of the keeper of the collection. The Institute would further serve as a central biochemical library. At the present time there is happily a proposal to form one large library devoted to chemical literature, and there is a very general feeling that all overlapping and unnecessary multiplication should be avoided. With this policy of concentration I am in the fullest agreement, but I think that it will be generally admitted by all who know that the literature of the subject with which I am dealing is of a very highly specialised character, and that many of the most important volumes and some of the periodical journals are not, as a matter of fact, readily obtainable in any of our existing libraries. On this point I speak as one who has on more than one occasion experienced the difficulty of obtaining access to works for which the general demand is small, and which are too costly and too highly specialised to appeal to the majority of the members of the Library Committees of our scientific societies. Finally—and this would possibly not be one of the least important of its functions—the proposed Institute would serve as a central home for British micro-biological science, and as the institution to which all workers in this field of natural knowledge in every part of our Dominions would apply for information, to which they could send rare specimens for identification or for investigation, and to which they could, subject to proper safeguards in the matter of priority, communicate any discovery of importance. The subject in its botanical aspects is not one with which I can claim anything more than a very limited acquaintance, but in our Colonies and overseas Dominions there must be many occasions on which mycologists —official and otherwise—would experience the advantage of such an institution, and whilst obtaining information themselves might render great national service by contributing to our knowledge of the nature of many fungoid plant diseases. As an example of this side of the Institute's functions reference may be made to the so-called "mineral yeast" which was manufactured in considerable quantities in Germany during the war and used for human food purposes. From statements published during the war in the German technical press, it appeared that one of the Professors of the Institut für Gärungsgewerbe in Berlin received in the early part of 1916 from a pupil of his on the Eastern Front a small specimen of a growth found on the stumps of certain trees in that district. After considerable investigation it was found that the growth contained an organism which exhibited some very interesting features. Thus, not only did it produce under certain conditions considerable proportions of fat, but it also had the property of building up crude protein from ammonium salts (without any form of organic nitrogen) in the presence of phosphoric acid and traces of compounds of potassium and magnesium. Inasmuch as ammonium salts could be obtained readily from the air, and since the carbohydrates resulting from the acid hydrolysis of wood could be used as a source of carbon, it was clear that this organism rendered it possible in the short space of 36 hours to build up fat and protein from such comparatively cheap raw materials as ammonium phosphate and the acid conversion products of sawdust. This organism is not a true yeast—that is to say, it does not belong to the genus saccharomyces and it does not produce alcohol. As the result of the numerous statements appearing in the German technical press, Mr. Fred. Wissler, Chairman of the Marmite Food Extract Co., Ltd., interested himself in this matter and a product was obtained from which, after some considerable difficulty, an organism was isolated, which if not identical with the German "mineral yeast," possessed very similar properties. The conditions essential for the growth of this yeast were minutely studied, and it was produced on a large

experimental scale. By a special process the Marmite Food Extract Company found it possible to prepare from it a food extract closely resembling extract of meat in its chemical and physical properties, and so one had placed in one's hands the possibility of manufacturing, through the agency of this microscopic organism, and in the course of a few days, a food extract closely resembling meat extract from such materials as glucose or converted sawdust, ammonium phosphate, and traces of certain other mineral salts. I mention this merely to show how important at times it might be to have a central institution to which interesting biological specimens from various parts of the world might be sent for examination and study.

I am well aware of the excellent work in the domain of industrial micro-biology which is being done in a number of isolated institutions such as the Lister Institute in this country, in one or two well-known American colleges, in the Pasteur Institute in Paris, in the Institute for Fermentation Industries in Berlin, in the Carlsberg Laboratory in Copenhagen, and in some others which it is not necessary to specify. Each of these institutions, however, deals with this immense subject in certain of its aspects only, and as compared with the scheme which I am advocating, they suffer from the great disadvantage that there is no co-ordination and that consequently a combined attack on any of the big problems which are calling for solution is rendered very difficult, if not impossible. I might refer to still other advantages attaching to a central institution, but I think I have said enough for my purpose. I desire to make it clear that I do not lay claim to any originality, since the idea which I am putting forward is one which must have presented itself to many working biologists, and is similar to one advocated some years ago by Paul Lindner of the Institute for Fermentation Industries in Berlin. It need scarcely be said that the institute Lindner advocated would have had its home in Germany, and I think it behoves us in this country to take steps to establish on British soil an institution which, although primarily intended to meet the needs of British workers, might ultimately receive the support of many of our American and Continental allied colleagues. If my paper should be the means of provoking discussion, and should bring the establishment of such an institution a little nearer, I shall feel myself amply repaid for the labour involved in its preparation.

Discussion.

Mr. Wm. B. Brierley, speaking as a microbiologist, recalled the fact that at the Newcastle meeting of the British Association, in a discussion on the organisation and future progress of the science of microbiology, he had contributed a paper to that symposium in which he and others had suggested the formation of an Imperial Bureau of Microbiology, the details of which were very closely paralleled in Mr. Chaston Chapman's proposal. To their great disappointment the Government had not taken up the proposition in its fullest aspect; they had certainly created an Imperial Bureau at Kew, but had not had the industrial microbiologist in mind. Last November the Pathological Laboratory at Kew had been transferred to the Rothamsted Experimental Station at Harpenden. An Institute of Microbiology had been set up there, and it was proposed to establish a laboratory where pure cultures might be obtained and supplied to those who wanted them. That laboratory was about to be inaugurated, and he asked help from those who were interested in pure cultures of micro-organisms. At that laboratory they would have to confine themselves to those organisms which were pathogenic to plants, and more commonly found in agriculture; they hoped later to extend their activities so as to include those micro-organisms which were of use in industrial purposes, and, possibly, finally, to include a good many of those which were pathogenic to man. It was impossible to separate the aspects of the pure culture laboratory into those which had an industrial application and those which had an agricultural application; that was also true of the research done in such an institution. The application of the activities of micro-organisms to industry was very largely dependent upon our knowledge of their physiological activities. It would be quite feasible by a slight extension of the pure culture laboratory at Rothamsted to satisfy the demands for some time of industrial chemists and other branches for the supply of micro-organisms. Finally, he drew attention to the Association of Applied Biologists, where chemists might meet the bulk of those workers in this country who were interested in the economic aspect of biology, and it was possible that the Society of Chemical Industry might at some time have joint meetings with that Association. It would be well if there were more co-ordination between the economic biologists and the industrial chemists of this country. If such an institute as Mr. Chapman had suggested was put on foot, he (the speaker) was sure that the biologists of this country would give it the most cordial welcome.

Mr. F. J. Lloyd said that this country was probably the only country of any importance where there was no bacteriological society. The use of such a research institute as suggested was not only for the supply of those organisms which were desirable. He had found that one of the greatest difficulties met with in practice was to find the source of organisms which were not desirable, and such an institute would prove of immense value to industry in this direction. He had also found considerable difficulty in carrying on pure cultures for any length of time. In some industries pure cultures were wanted frequently, but in many cases, such as that of the fermentation of fruit, the season lasted only a very short time, and any pure cultures that were required would have to be kept, say, 9 months, in order to be utilised the next season. This difficulty had been experienced not only by himself, but also abroad; and it had been found necessary to place those institutes where pure cultures were manufactured on a large scale at high altitudes to prevent contamination. But the difficulty of obtaining and retaining pure cultures was very great, and in that way the institution proposed would be of immense value. He suggested that those interested should combine to form an association, start research work, and keep before themselves Mr. Chapman's ideal.

The Chairman said that he thought Mr. Chapman had made out a very strong case, and they all hoped that his paper would bear fruit. He (the Chairman) thought that Mr. Lloyd's suggestion was an extremely good one, and he could see no reason why an association with the objects in view that Mr. Chapman had put before them should not be formed in connection with the Department of Scientific and Industrial Research.

On Thursday evening a soirée was held at the British Scientific Products Exhibition, Westminster.

The meeting concluded on Friday, July 18th, with an excursion to Windsor and Cookham. At Windsor members were given the opportunity of visiting St. George's Chapel, the Albert Memorial Chapel, and the Terrace and Round Tower of the Castle. After luncheon, the party was taken from Windsor by steam launch to Cookham, and thence to Tanlow, returning to town by train.

Annual Meeting.

CONFERENCE ON THE PRODUCTION AND CONSUMPTION OF SUGAR WITHIN THE BRITISH EMPIRE.

Held at Clothworkers' Hall, Mincing Lane, E.C., on Wednesday, July 16th, 1919.

The Earl of Denbigh presided over the Conference during the morning from 11 A.M. to 1 P.M., after which it adjourned.

The Worshipful Master of the Clothworkers' Company, Mr. W. Withers Moore, formally welcomed the assembly, remarking that it was always a pleasure to his Company to lend their Hall to further such objects as those of the Society of Chemical Industry. Their Hall seemed a suitable place for such a meeting as the present, because grouped around it were the offices of traders who were very much interested in the success of the Society. The capture of the tea trade had been accomplished by a comparatively few young Englishmen and Scotchmen in the space of about twenty years. In the early seventies there was no tea produced in Ceylon at all, and only about ten per cent. of what was now grown in India. The dislocation of the sugar beet industry on the Continent owing to the war, gave the opportunity of capturing a great deal of this trade for our Empire, and he had no doubt that the Society would assist to bring about this desideratum.

Dr. Charles A. Keane said that, as Chairman of the London Section of the Society, he would like to express on behalf of the assembly their very sincere appreciation of the hospitality they were enjoying from the Worshipful Company of Clothworkers. They felt it a great privilege to hold their meeting in one of those great halls associated with so much tradition and achievement, and to do what they could to bring science into touch with industry and commerce. Many gatherings of this kind had been held amid more academic surroundings, but it had been felt by the London Section that it would be an excellent departure if they were able to meet amidst the activity associated with a business centre.

The Earl of Denbigh after thanking the Committee for having done him the honour of asking him to take the Chair, said that he had only received the proof of the preliminary report of the Committee the previous night, and he had had very little opportunity of looking into it. He saw, however, that the Society had given a great deal of attention to the question of the development of the sugar beet industry in this country, with which subject he had been associated for many years. Commenting on the ignorance of the general public in regard to sugar, it was no exaggeration, he said, that most people believed that the sugar they consumed was made from sugar cane. He had met agriculturalists in the country who did not even know that sugar was produced from beet at all, yet on the Continent before the war, something like 8,000,000 tons of sugar was produced from this source per annum. In Germany there was a highly developed sugar industry, and everybody knew how to handle it; the agriculturalist knew how to grow the beet and to transport it to the factory, and the factory knew how to manufacture the sugar, and get it to market, whilst in England everybody was ignorant of these things. In these circumstances it was impossible for the farmer in this country, with his uninstructed labour, to grow beet as cheaply and efficiently as the Continental farmer. Consequently it was absolutely necessary, in order to attract the farmer, to guarantee him a price for his roots considerably above the market price on the Continent, and that of course meant that the British factory had to pay more for its material. He did not want to raise questions of protection, but John Stuart Mill had laid it down that in the case of a new industry, it was quite legitimate that it should have assistance for a number of years until it was well established. At the present time, he thought he might rightly claim that a change in feeling had taken place which had resulted in Government assistance being given towards a factory which he hoped was going to be put up at Kelham, Nottinghamshire; this might well be the beginning of a sugar industry in this country. He noticed that it was stated in the report that information on the comparative yields of sugar beets, mangolds, and swedes was of no value to the sugar problem. Whilst that was true, he would point out that such experiments had been carried out in order to meet the objections of the farmer who wanted to know what crop the sugar beet would displace, and whether sugar beets would pay him better than mangolds or turnips. He (the speaker) quite admitted that with mangolds and turnips they got a much better crop in weight, but they did not go for weight in growing sugar beet, but for quantity of sugar. If they got 12 tons of sugar beets containing a high percentage of sugar, it was very likely of considerably more value to the farmer than 30 or 40 tons of low-grade sugar beets. It gave him great pleasure to be present, and he sincerely hoped that the Society of Chemical Industry would do all it could to spread the light, and continue the good work of helping to develop the Empire's resources.

He would now ask the Chairman of the Committee, Mr. Arthur R. Ling, to present the Report.

PRELIMINARY REPORT OF THE EMPIRE SUGAR SUPPLY (TECHNICAL) COMMITTEE.

Introductory.

Early in 1917 a suggestion was made to one of us, then the Chairman of the London Section of the Society, by Professor H. E. Armstrong, that it would be useful to obtain the latest statistics from the different parts of the British Empire of the production and consumption of sugar, as well as of the possibilities of extending its production, with the view of ascertaining whether the Empire could be made self supporting, at least, as regards this commodity. No time was lost in forming a Committee, consisting of members of the Society and certain co-opted members from outside. Sanction to co-opt these outside members was obtained from the Committee of the London Section, and the project subsequently received the assent of the Council. The members were so selected as to include representatives of producers and users of sugar in the overseas parts of the British Empire, refiners, confectioners, preserve manufacturers, and makers of brewing sugars.

The terms of reference were as follows:—

1. To prepare an account of the pre-war sugar position as regards (a) Production, its amount and nature; (b) Consumption, its amount and nature; and (c) The quantity, nature, and source of the sugar imported or exported by each unit of the British Empire.

2. To ascertain the economic sugar producing possibilities of each unit of the British Empire.

3. To report on the most likely localities for increased supply, as well as on the kinds of sugar required by the various consumers throughout the Empire.

4. To make such technical suggestions as may appear of use to the development of the industry.

The names of the members of the Committee are as follows:—Mr. Arthur R. Ling, F.I.C. (Chairman of the Committee), Mr. Julian L. Baker, F.I.C., Sir George Beilby, F.I.C., F.R.S., Mr. R. F. Blair, Prof. M. J. R. Dunstan, M.A. (Oxon), F.I.C., F.R.S.E., Sir Richard Garton, F.I.C., Mr. T. H. P. Heriot, F.C.S., Dr. C. A. Keane, F.I.C. (Chairman of the London Section of the Society), Mr. J. W. Macdonald, Mr. Hugh Main, Mr. W. Martineau, Mr. G. Mathieson, Dr. S. Miall (Hon. Secretary *ex officio*), Mr. J. P. Ogilvie, Mr. C. Sandbach Parker, Mr. J. Pickering, Mr. R. Robertson, Mr. F. I. Scard, F.I.C., Mr. Louis Souchon, Dr. L. T. Thorne, F.I.C., Mr. A. J. Yorke.

The Committee having been formed, the following Schedules of Questions were addressed to the Dominions, Colonies, Dependencies, and Protectorates of the British Empire. Form A was sent to those parts of the Empire which produce sugar, and Form B to those who do not at present produce sugar.

FORM A.

1. What is the present acreage, production and consumption of sugar in ———?

2. What were the pre-war exports of sugar (if any) from ——? What description of product is exported, and to what countries?

3. What is the source of the present sugar production in ——— cane, beet, maple, or palm?

4. What yield of sugar producing material is obtained per acre? What is the average percentage of sugar in such material, and what is the present yield of actual sugar obtained per acre? What are the various kinds of sugar produced?

5. What refining and other sugar using trades are there in ———, and what class of sugar do they respectively require?

6. What description of sugar is required by the general public in ———?

7. What scientific establishments are there existent or available for technical training in connection with the sugar industry of ———?

8. If sugar is imported, from what country or countries does it come, and in what form?

9. What area of suitable land has ——— for the extension of the sugar industry, and in what time, and under what conditions of transport etc. could it be made available? What is the position of the labour supply in relation to such extension?

10. Are there in ——— any special economic considerations which tend to influence the cost of production either adversely or favourably?

FORM B.

1. What was the pre-war consumption of sugar in ———?

2. What are the sources and descriptions of the sugar imported?

3. What refining and other sugar using trades has ———?

4. What description of sugar is required—
(a) by the general public, and
(b) by the refiners and sugar using traders?

5. What area of land has ——— suitable for sugar cultivation, and in what time, and under what conditions of labour, transport, etc., could it be made available if a sugar industry were established?

6. What scientific establishments are there in ——— which would be available for technical training if a sugar industry were established?

7. What are the economic or other considerations which have hitherto prevented the establishment of a sugar industry in ———?

The report which we have now to present must be regarded as being of a preliminary character, and we hope to publish at a later date, a much fuller document, giving complete details of all the information collected.

We feel that it will not be invidious if we mention that in the early stages of this enquiry, when the whole scheme had to be arranged, no one of us was more active than Mr. F. I. Scard, who unfortunately for some time past has been too ill to continue his participation in the work. Mr. Scard it was, in fact, who first suggested the formation of a Committee for the purpose in view, and his collaboration was all the more valuable on account of his long association with the production of sugar in the West Indies.

Sugar, the sucrose or saccharose of the chemist, is very widely disseminated in the vegetable kingdom. In a great many plants it represents the most important carbohydrate reserve substance. Originally consumed as a condiment, or even as a medicine, it has become during the last few centuries one of the most important articles of dietary among civilised nations. The United Kingdom, which next to the United States is the largest sugar-consuming country in the world, consumes sugar in different forms at the rate of more than 90 lb. per capita per annum.

The chief sources of supply of sugar are the sugar cane, *Saccharum officinarum*, one of the graminiæ or grasses, and the sugar beet, *Beta vulgaris*. Among other plants of less importance as sources of sugar supply may be mentioned certain species of palm, as well as the maple, and the sorghum.

The earliest recorded production of sugar is from the sugar cane in India, to which country many writers believe the sugar cane to be indigenous. Others have pointed out, however, that one kind of cane found in Java is a species, and not a variety of the native Indian cane, so that it may have been indigenous to more than one part of the East.

In the Antharva Veda, one of the sacred books of the Hindus, mention is made of sugar cane, whilst writers at the time of Alexander the Great refer to a reed growing in India which produces honey without the aid of bees. In the early centuries of the Christian era sugar production (from cane) was carried on in Persia and Egypt, and at the time of the crusades extensive sugar plantations existed in Tripoli, Mesopotamia, Palestine, Syria, etc. In 1150 Spain had a flourishing sugar industry, and 75,000 acres of land was cultivated with sugar cane.

The Arabs and Chinese introduced the sugar cane into Tunis, Morocco, Gambia, Madagascar, Siam, Sunda Islands, the Philippines, Formosa, and Japan. After Constantinople was taken by the Turks in 1453, much of the prosperity of the sugar industry in the Near East and the Mediterranean came to an end. In the fifteenth century, the Portuguese established a sugar industry in Madeira, Azores, Cape de Verde Islands, etc., whilst towards the close of the same century the Spanish commenced sugar cultivation in the Canary Islands.

After the discovery of America, the sugar cane was introduced into the various parts of the islands and mainland suitable for its production. It is stated that the sugar cane was introduced into the West Indies in 1493 on the second voyage of Columbus. The pioneers were the Spanish, Portuguese, Dutch, and later the English and French. Sugar cane is now cultivated in the tropical and sub-tropical parts of Asia, Africa, America, and Polynesia. In Europe Spain is the only country which cultivates cane, and sugar to the extent of between 6000 and 7000 tons is now manufactured from it annually in that country.

The sugar cane is grown from cuttings, and the plant attains maturity at the end of 15—18 months, when it is cut and dealt with in the factory. The stubble is left in the ground, and ultimately produces shoots, called ratoons. These are in turn cut, and produce second ratoons, and so on. The ratoon crop is not so rich in sugar as the original cane. However, fresh cuttings are only planted in periods of from 2—7 or more years according to the richness of the soil.

Much work is now being done in attempting to improve the cane by growing it from seeds produced by cross fertilising different varieties. Here difficulties are encountered, for some varieties do not flower at all, whilst in others the pollen of the anthers is found to be infertile.* However, success has attended these experiments in different parts of the world, and it has been found possible in many instances to breed cane suitable to a given locality.

The sugar cane as now cultivated under the most favourable conditions gives a crop of 30—40 tons per acre, and sometimes more, and has a sugar content of 11—16 per cent. Taking a yield of cane of 35 tons per acre, and an extraction of sugar of 12 per cent., this would mean a production of sugar of 4·2 tons per acre. We have heard of as much as 7½ tons per acre having been obtained in isolated instances.

The history of beetroot sugar dates from 1747 when Marggraf, a German chemist, demonstrated the possibility of extracting sugar from beet. Some 50 years later a Frenchman named Archard, who was a refugee in Germany, continued this work, and at the commencement of the nineteenth century the first beet sugar factory was started in Silesia. It had a capacity for dealing with about 500 tons of roots per annum, which might have produced 25—30 tons of sugar. The industry was fostered by Napoleon the First, who thought thereby to cripple England's colonial sugar trade. In 1811 he ordered 80,000 acres to be planted with beet. The industry flagged somewhat after the wars, but it was taken up by Germany as well as by France, and in 1860 the production of beet sugar was 250,000 tons. In 1871 France produced 284,000 tons, and Germany 186,000 tons of sugar, whilst in 1884 the German production reached 1,000,000 tons, whilst the French production had dropped to 265,000 tons.

Coming to more recent times, in 1913, the world's production of beetroot sugar was 8,758,900 tons, or 46·96 per cent. of the total sugar production from cane and beet together. Of this Germany produced 2,718,000 tons. The cane production at the same time was 9,894,200 tons. The remarkable success met with in Germany in improving the sugar content of the roots by selection and manuring may be judged by the fact that at the commencement of the industry the roots probably contained not more than 6—8 per cent. of sugar, whilst the sugar content had steadily improved until the roots of the 1909 harvest contained an average of 17·63 per cent. of sugar. Of this over 90 per cent. would be secured by modern methods.

It will be seen that the sugar content of beets is higher than that of cane, but the crop is a lighter one. On an average under the best conditions, about 12 tons of beets can be grown to the acre, so that the yield of sugar seldom reaches 2 tons per acre, and is generally a little below it.

The late Mr. George Martineau in his booklet "Sugar. Cane and beet," p. 17, makes the following pertinent remarks on the comparative yields of sugar from cane and beet:—

> "It is curious to think that this humble root" (the beet), "weighing only 2 lb. should now be giving to the world as much sugar every year as the lordly sugar cane, and that the beetroot factory should actually extract a greater percentage of sugar from the little root than the cane factory wins from the rich cane. But it must not be forgotten that, under favourable circumstances, the cane can produce twice as much sugar to the acre as the beetroot. Which will win the race?"

The British Empire, according to the last returns, had about 3,500,000 acres under sugar, mostly cane, yet the total production from this was less than that of Germany and Austria-Hungary combined, which countries could not have had as much as half that number of acres under beet. Obviously, in view of what we have stated as to the potentialities of sugar production from cane and beet respectively, there must be something wrong with our methods, and this will become apparent when we consider the data we have obtained in detail.

Let us bear in mind that the British Empire exceeds all other States in the production of sugar, and the United Kingdom occupies the second place, coming next to the United States, as an importer of sugar. It is of particular significance in connection with this last-named fact that prior to the war more than 96 per cent. of the sugar imported into the United Kingdom came from foreign countries, and by far the greater portion of the imported sugar (80 per cent.) was European beet sugar. In fact before the war the importation of raw cane sugar was restricted to the demands of those industries which found raw beet sugar unsuitable for their requirements. See diagrams on pp. 301 and 302 T.

As regards the consumption of sugar per capita per annum of the important countries before the war, the United Kingdom comes first with 95 lb., whilst the United States is second on the list with 89 lb., Germany 49 lb., and France 48 lb.

Since the outbreak of hostilities the production of sugar from beet has dropped from 47 per cent. to 29 per cent. of the world's total supply. On the other hand, the production of the British Empire has increased from 3,275,500 tons in 1913-14 to 4,394,100 tons in 1917-18 (or 34·1 per cent.), whilst the total production of sugar throughout the world, which was 18,653,100 tons in 1913-14, was in 1917-18 17,556,400 tons. The countries showing the largest increases are India, Cuba, and Java.

There is no doubt that the importance of the race now being run is fully recognised in all parts of the British Empire, and the granting of Imperial preference should help our sugar industry, but it must not be forgotten that all such measures without efforts on the technical side will be unavailing. It is our special object to insist on this point and to indicate where, and in what directions, reforms and improvements are most needed. Let us not forget, however, that time presses. Our late enemies are eagerly watching all we are doing, and unless we make the necessary improvements within the next year or two we shall again be left behind in the race for supremacy.

* These circumstances preclude that systematic work which has been so successful with other members of the grasses, notably the ordinary cereals, where, guided by Mendel's law of inheritance, hybrids have been produced having certain desired properties.

EUROPE.

1. *Possibilities of a Beet Sugar Industry in the United Kingdom.*

In the International Sugar Journal, 1914, **16**, 510—515, a writer signing himself "Home Counties" states that the first beet sugar factory in England was founded by the late Mr. James Marriage, an account of which is published in the Quarterly Magazine and Review for 1832.

It seems that about this time several young men from Essex, members of the Society of Friends, visited France in order to qualify themselves for establishing a beet sugar factory in this country. They made several visits, and inspected many works of the kind, engaging into their service ultimately two Frenchmen who understood the process. A company was then formed, and factories were erected at Ulting, upon the line of the Chelmer Navigation, near Hoe Mill, in the vicinity of Maldon. These buildings, with the apparatus, cost Messrs. Marriage, Reed, and Marriage about £2000, and were equipped on the most modern principles, the metal used in pans and other utensils being chiefly copper, and the heat conveyed in every department by steam. It appears that the factory stopped through lack of capital.

Desultory experiments were made on the culture of sugar beet in England and Ireland from the year just mentioned onwards to 1870, the year in which Mr. James Duncan started a sugar factory at Lavenham in Suffolk, which was at work for about nine years. Duncan's idea was that of extracting beetroot juice, clarifying it, and concentrating it, to enable it to be carried to the refinery at Clyde Wharf, Victoria Docks. He never obtained more than 8000 tons of beets per annum, and he found it impossible to continue work unless he had a guarantee of 20,000 tons per annum. This not being forthcoming the factory closed down in 1878.

We may here remark that one of the great difficulties of establishing a beet sugar industry in this country is lack of co-operation between the agriculturalist and the sugar manufacturer. Without such co-operation no regular supply of roots can be guaranteed. Unless he has some interest in the factory, the farmer as soon as he experiences a bad crop becomes disheartened, and either discontinues the cultivation of beets altogether, or limits the supply. Obviously for its successful working a factory must be run up to its full capacity.

Among the numerous experiments that have been made in more recent years on the cultivation of sugar beets in this country, must be mentioned in the first place those of Dr. G. Schack-Sommer. These experiments were undertaken between the years 1889 and 1895 (see this J., 1890, 153; 1891, 318; 1893, 233; 1894, 213; Farmer's Magazine, 1890, p. 306). They demonstrated that roots equal in sugar content and purity to the best obtained at the time on the Continent could be grown in the United Kingdom.

Within recent years, the problem came again to the fore, and it was taken up by the British Sugar Beet Council in 1910, over which the Earl of Denbigh at first presided, and subsequently Major Courthope, M.P. In 1911 the National Sugar Beet Association was formed under the chairmanship of the Earl of Denbigh, and some fresh trials were made, the agricultural aspect of the problem being placed under the control of Mr. R. N. Dowling. A report was issued showing comparative experiments on the cultivation of sugar beets, mangolds, and swedes in various parts of the country.

Mr. Dowling's results so far as sugar beets cultivated in the West and East of England are concerned are given in the following tables.

One of us (A. R. Ling) has a record of the investigation of averages of 375 samples of sugar beets, grown in different parts of the United Kingdom. In these the average weights of the roots and of the leaves have been determined, the percentage of sugar in the roots and juice, and the coefficient of purity of the juice, *i.e.* the percentage of sugar in the dry substance therein. The results show that the roots are in composition and purity superior to the average grown on the Continent. (For some of these results compare A. R. Ling, this Journal, 1912, 31, 452.) There is, however, another most important factor from the sugar producer's point of view, and in this respect the majority of our home-grown roots are defective. Some of them are globose in form, some are bifurcated, whilst many of them contain huge fangs and tails, and not a few have green crowns. But the shape is the point we have

The Average Returns for the West of England.

Area	Average weight per acre of topped and washed sugar beet	Average weight of roots	Average per cent. sugar in roots	Average purity
Gloucestershire	tons cwt. qr.	lb. oz.		
*Gloucester area ...	11 3 0 (28 growers)	16¼	18·2	92·5
†Bristol area	11 10 0 (19 growers)	15½	18·0	91·5
‡Chepstow and Lydney areas	12 7 0	15	17·9	91·8
Average for County ...	11 8 1 (54 growers)	15½	18·0	91·9

* The farms are situated in the neighbourhood of Tewkesbury, Dymock (near Ross), Gloucester, and Stroud. The soils include the thin Cotswold brash loams, the wet clay loams of the Severn Valley, the fertile loams near Evesham, the brashy loams to the north-west of Tewkesbury, and the friable red sandy loams of Dymock and Newent.

† The farms in this area include the red loams of the Old Red Sandstone, the brash loams of the carboniferous system, the heavy clays overlying the coal measures, the oolitic limestone of the Cotswolds, and the low-lying stiff land of the Severn Valley.

‡ This area includes the well-known red friable loams of Lydney and the heavier and brashy loams round Chepstow.

Area	Average weight per acre of topped and washed sugar beet	Average weight of roots	Average per cent. sugar in roots	Average purity
Somersetshire	tns. cwt. qrs.	lb. oz.		
*Taunton and Bridgwater districts, and a few near Bristol	14 0 0 (22 growers)	15	18·0	92·9
†*North Devon* Bideford area	11 16 3 (9 growers)	1 3½	17·9	92·3
‡*South Wales*	15 0 0 (6 growers)	1 0	18·4	91·3
Total averages for 100 growers—West of England	12 6 2	1 0½	18·0	92·0

* The soils in this area vary considerably, and include the stiff clay loams near Highbridge, the red sandy loams and deep loams near Bridgwater, the good friable loams near Ilminster, the brashy loams near Yeovil, the red brash sandy loams near Taunton, and the brashy carboniferous loams of the Mendips.

† The farms covered a large area, including chiefly the somewhat thin brashy loams of the Culm measures, and a few on the heavier and deeper drift loams of the valleys.

‡ This area comprises a variety of soils between Newport and Port Talbot, near Swansea, and includes some heavy, light and brashy loams.

to deal with at the moment, and this is, in the majority of instances, so faulty that it would be difficult, if not impossible, to deal with many of them in the sugar factory.

The defects to which we have referred could be corrected if better attention were given to agricultural conditions. Deep ploughing and earthing-up of the crowns are not necessary in cultivating mangolds. The latter may be allowed to grow without much attention, and it matters not if the crowns protrude above the surface of the soil and become green. The object is to obtain a more or less complete cattle food, in which there is a fairly even balance between the different constituents. Not so in the selected variety of the same plant, the sugar beet. Here the main object is to obtain the maximum production of sugar and the minimum of other substances. In other words, to obtain the maximum sugar content and a high purity of juice. Sugar beets should seldom exceed an average weight of two pounds if the best results are to be obtained. Mangolds, on the other hand, frequently run to four and even seven pounds in weight. Their sugar content is, however, lower (from 3 to 5%), and the purity of the juice from 55 to 65.

Naturally mangolds will yield a larger crop than sugar beet. Mangolds are, however, useless for anything but stock raising, and the farmer who grows them must perforce become a stock raiser. It would not pay him to send them long journeys, besides which the quantity required is limited, for a mixed diet, something besides mangolds, is needed by stock. We contend, therefore, that comparative agricultural experiments on the yields of mangolds and sugar beets are sheer waste of time *qua* the sugar problem. Further, until greater attention is bestowed on the culture of sugar beets to meet the needs of the sugar producer we cannot assert that sugar beets can be grown in the United Kingdom equal to those furnished on the Continent. Deep ploughing is of course possible in this country, but as this has not been carried out hitherto the subsoil may for some considerable time exercise a deleterious effect on the roots.

It is well recognised that the cultivation of sugar beet is one of the most useful rotations, and since it is necessary to cultivate it deeper than other roots for the reason given above nothing cleans ground or prepares it for other crops better than sugar beet. It has been stated that the sugar beet crop in Germany occupies less than 2 per cent. of the cultivated ground, but the present high efficiency of agriculture in that country would not have been attained without it. Apart, therefore, from the establishment of a sugar industry in the United Kingdom, sugar beet cultivation would undoubtedly exercise a far-reaching effect on the general agriculture of the country.

The Average Returns for the East of England.

Area	Average weight per acre of topped and washed sugar beet	Average weight of roots	Average per cent. sugar in roots	Average purity
	tns.cwt.qrs.	oz.		
Suffolk				
The Elvedon Estate (Lord Iveagh) ...	5 14 1	9½	17·9	94·2
18 in. drills	7 2 3	9	17·3	87·4
15 ,, ,, (A)	8 7 0	9	16·9	89·6
18 ,, ,, (B)	8 1 1	9	16·9	89·6
15 ,, ,, (F)	9 17 0			
16 ,, ,, (G)	8 7 0	8	17·1	91·3
18 ,, ,, (H)	8 11 1			
21 ,, ,, (I)	9 14 1			
	5 5 3	8	17·1	91·3
†Ipswich and Snape areas	9 19 2 (12growers)	15	18·3	92·0
‡Norfolk, Fakenham District, and the Norfolk Farmers' Experimental Station	11 19 2 (2 growers)	14½	17·5	94·0

* Field A.: 22 acres subsoiled, 2 acres manurial trials, 1 acre not subsoiled, 1 acre mangolds, 1 acre swedes = 27 acres.

The soil is of a very light sandy nature—in fact, almost a "blowy sand" with very little humus.

London dung was applied in the spring and dressings of mineral manures. The crop on this field suffered in consequence of the hoeing getting "in front" of the hoers.

Field B.: 13 acres subsoiled; 3 not subsoiled; ¼ acre trials for distance between rows and ¼ acre seeding trials = 17 acres.

The soil is of a similar nature to A., but with more "humus," deeper tilth, and better condition. No farmyard manure. Mineral manures as required. The hoeing was done to time and influenced the yield considerably. Plot 1 had 10 cwt. lime per acre during the winter, better-shaped roots and more healthy top.

Field C.: 5 acres of almost derelict sterile blowy sand. No dung applied but dressed with mineral manures.

† This area is made up by 12 growers, each growing 5 acres, and includes soils of a blowy-sand nature at Snape, light and sometimes very gravely-glacial drift loams around Ipswich, and the heavy Boulder Clay bordering the Ipswich and Bury St. Edmunds valley.

‡ The soils tried consisted of fairly stiff gravel loams.

Area	Average weight per acre of topped and washed sugar beet	Average weight of roots	Average per cent. sugar in roots	Average purity
	tns. cwt. qrs.	lb. oz.		
Lincs.				
Wragby and Horncastle	8 18 2 (5 growers)	12	17·6	89·2
†*Bedfordshire*				
His Grace the Duke of Bedford	(A) 17 not subsoiled 14 8 2 (A) 17 subsoiled			
Woburn	11 8 2 (B) 14½ not subsoiled 16 8 2 (B) 14½ subsoiled			
	11 7 0 (C) 21 not subsoiled 14 7 0 (C) 21 subsoiled 11 0 0	14½	17·5	92·1
‡*Warwickshire*				
Rt. Hon. The Earl of Denbigh (NewnhamPaddox)	10 8 3	11	18·9	95·5
§*Berkshire*				
Capt. Morrison (Pangbourne)	12 7 0	13½	17·9	94·2
‖*Shropshire*				
Harper Adams, Agric. College	13 14 3	1 3½	18·3	90·0

* These trials were organised to test the Boulder Clay soils, which are somewhat extensive. The better-class silt and fenlands and the upland barley soils had been tried when it was proposed to have a factory at Sleaford.

† Twenty acres were grown in one field on His Grace the Duke of Bedford's estate near Woburn, the soil being a deep friable loam. It is interesting to note that subsoiling has been detrimental.

‡ The soil tried was a stiff clay loam.

§ Twelve acres were grown on a thin calcareous loam with flints, situated on a hill-top.

‖ Five acres were grown on stiffish loam.

2. *The Isle of Man.*

This island is under separate parliamentary administration from that of the United Kingdom. It possesses no sugar industry, but the annual consumption of sugar may be placed at about 700 tons. Possibly some land might be available for sugar beet culture.

3. *The Channel Islands.*

The annual consumption of sugar in these islands may be estimated at about 3000 tons. The land is

already under so many different crops that it is scarcely likely that any would be available for sugar beet.

4. *Malta.*

The pre-war consumption of sugar in the island was 4944 tons, about 4/5ths of which consisted of crushed sugar imported from Austria-Hungary, the remainder being granulated and cubes, principally imported from the United Kingdom and Germany.

There are no sugar refineries, and the other trades employing sugar are limited to confectionery.

Asia.

1. *The Indian Empire.*

India was at one time the largest producer of sugar of any country in the world, but so far as statistics show at the present time it occupies second place in the list, Cuba coming first. However, it must not be forgotten that statistics in British India are by no means complete, whilst those of the native States are still less so, consequently much of the sugar which is produced and consumed by the natives is unrecorded.

The annual production of sugar in India in 1915 was 2,600,000 tons from cane, and about 500,000 tons from palm. This sugar was the soft variety made by the natives under the name of gur (Sanscrit gud) or jaggery for their own consumption. In 1917—18 the yield of cane gur had increased to 3,311,000 tons, but in the year following it had dropped to 2,337,000 tons owing to deficient rainfall, more especially in Northern India.

The annual consumption of sugar in India in 1905 was 3,750,000 tons, including palm sugar, which left a deficit of 750,000 tons, which was made up by the importation of white sugar from Java, Mauritius, and other countries. The imports of white sugar into India in 1913 amounted to over 800,000 tons, some of which came from Germany and Austria-Hungary.

The consumption of sugar in India is on an average just below 17 lb. per capita per annum. Large quantities of cane, however, are in addition chewed by the natives, and do not therefore appear in the statistics. The sugar consumed by the natives is exclusively the soft variety above referred to.

The area under sugar cane and sugar-yielding palms for the season 1916—17 was estimated to be as follows:—

Sugar cane	... ...	2,437,000 acres.
Palms	... ...	175,000 ,,

For the following year the acreage for cane is given as 2,837,000.

The cane was estimated to produce 2,626,000 tons of gur, and the palms 400,000 tons of gur, a yield of 1·08 tons and 2·28 tons per acre respectively. These figures have, however, little significance so far as our object is concerned, for the present small holdings will have to be converted into centralised estates if any real improvements are to be effected in India as regards increasing the yield and quality of the sugar.

The exports of sugar from India for the three years prior to the war were as follows:—

	1911–12 Cwts.	1912–13 Cwts.	1913–14 Cwts.
Sugar 16 Dutch standard and above ...	25,388	32,214	30,568
Sugar 15 Dutch standard and below ...	175,895	287,853	161,269
Confectionery	—	83	93
	201,283	320,150	191,930
	Tons 10,064	Tons 16,007½	Tons 9,596½

The average yield of cane per acre differs in various parts of India. In the Northern Provinces, including United Provinces, Punjab, Bihar and Orissa, Bengal, and Assam, which together constitute 91·6 per cent. of the total sugar-growing area of India, where for the most part thin canes are grown, the average yield of sugar in the current year was only 0·72 ton per acre. On the other hand, in the Southern Provinces, Madras, Bombay, and Sind, situated in the tropics, where thick canes are grown, the average yield of sugar was 1·95 tons per acre.

In considering the sugar problem in India we have in the first place to bear in mind that the sugar is produced by the natives on small holdings, by very primitive methods. The juice is expressed by bullock-driven mills, by which at most 50 per cent. of the sugar is extracted, the remainder being left in the bagasse which is used as fuel. Then again, the juice is evaporated in open pans so that in this way much of the sugar is destroyed, amounting sometimes to another half (see Reports by Mr. William Hulme and Mr. P. Sanghal, 1918).

On the other hand, we have been informed by Mr. J. McKenna, Agricultural Adviser to the Government of India, that in the Bombay Presidency in the area under canals, where cane is specialised, the yield of Pundia cane which is generally grown is as high as 40 tons per acre; this being due to heavy applications of manure and to irrigation. These yields are possible owing to the district, and no criterion can be drawn from them as regards the rest of India. With such a yield of cane, however, and assuming that the variety cultivated was the best suited to the district, it should be possible with modern methods of extraction and manufacture to obtain 4 tons and upwards of sugar per acre.

It should here be mentioned that in India wild boars, jackals, mice, white ants, and borers, beetles and grasshoppers do much damage to the cane crops, besides a host of parasitic fungi.

In some correspondence between Mr. Kelavkar and one of us (J. W. Macdonald) in 1916, Mr. Kelavkar draws attention to the facts given by Mr. McKenna. He is strongly of opinion that if some firm of standing such as Messrs. Henry Tate and Sons in England, would start a factory in India, the money for the scheme would be subscribed at once, and the Government would find every facility.

It must not be forgotten, however, that the native desires a soft, luscious sugar of the character of the gur which is now produced by such primitive and wasteful methods. Bearing this in mind one of us (J. W. Macdonald) made the following recommendations in a letter replying to Mr. Kelavkar:—

"I would recommend an up-to-date factory to produce a good class *first quality* raw sugar for export to England, and a *second quality* for local consumption, making it as near as possible to the sugar now favoured. The second quality would be made from the syrup coming from the centrifugals which would spin the first quality, but owing to careful manufacture it would be really better than the crude sugar now produced direct from the cane juice. The syrup would be concentrated in the vacuum pans, but not boiled to grain. It would be boiled to string-proof only, *i.e.* thick, with say 10—12% water, and then run off into cooling tanks, and allowed to crystallise slowly. It would be finally spun in the centrifugals so as to produce a *soft low sugar* containing a large amount of molasses, and would be very sweet, and pleasant to eat. It would be a *clean, wholesome product.* The more molasses left in it, the cheaper it could be sold, and the less molasses there would be to sell as such. The production of India at present is 2,600,000 tons, but I am sure the same canes with careful manufacture would produce another million tons or more, as the waste must be very great.

"What we want over here is good, dry crystal sugar, loose grain (not solid) made from the juice, and packed in strong 2 cwt. bags. The colour should not be spoiled by mixing low products with first boiling. These low products should be sold separately, and there is a boundless market in India for them, particularly if care be taken in their manufacture to keep them clean and wholesome. If the first qualities be made to a standard colour, and analysis, and be free crystalline sugars (not solid), and be packed in good 2 cwt. bags, I am sure they would command a leading position in the English market, particularly as they would be Empire sugars."

The most feasible means of extending the sugar industry in India appears to be the establishment of central factories in which all interested in the manufacture co-operate, and are bound by legal contract to assist one another. The factories must be fitted with up-to-date power mills, vacuum evaporating plant, and other modern machinery. This would naturally necessitate considerable organisation and research, and the outlay of much capital. The Indian sugar industry greatly needs capital to extend it. Mr. Wynne Sayer is of opinion that the capital necessary for the development should be forthcoming in view of the assistance available from Government sugar experts, which has made it possible to overcome many obstacles which formerly obstructed progress.

We may point out that for several years past experiments have been carried out by Dr. C. A. Barber on the growth of seedling canes, and many thousands of new plants have been raised in this way.

In Southern India gur is made from various species of palm, and as already mentioned the sugar so made amounts to something like half a million tons per annum, the principal sources being the wild date (*Phœnix sylvestris*), fan palm (*Borassus flabelliform*), and the coconut palm (*Cocos nucifera*).

Mr. H. E. Annett has studied the production of sugar from palm, and has published several papers on the subject. It appears that 2·3 tons of gur can be obtained per acre of palms, so that this source of sugar supply is one of importance.*

Sugar beets have been grown experimentally in the Punjab, the North-West Provinces, and Kashmir, but we have up to the present received no information regarding these crops.

As will have been seen from the above there are in India several scientific men of high standing who are continually prosecuting valuable research work in connection with the sugar industry. We are of opinion, however, that considering the magnitude of the problem of the possible extension of the sugar industry in India, there would appear to be a lack of co-ordination among these workers, and we believe that the immediate future calls for the establishment of a large number of experimental stations, together with more scientific workers. Only by such means can a secure foundation for the establishment of a sugar industry in this vast Empire be secured. The problems awaiting solution consist not only in the selection of suitable canes for various districts, but also in combating numerous pests, and for this purpose the services of zoologists and cryptogamic botanists are needed.

That the sugar problem is worthy of serious attention follows from the fact, as we have seen above, that there are vast additional areas awaiting cultivation, whilst there is also a plentiful supply of the necessary labour.

* Mr. Annett states that 350 trees could conveniently be grown per acre and that the yield would then be equal to 1·4 tons of gur.

2. *Ceylon.*

The average importation of sugar into Ceylon for the years 1911-16 inclusive was about 20,000 tons. It included jaggery from British India, unrefined sugar from British India and the Straits Settlements, refined sugar from the United Kingdom and various British Colonies, as well as from Austria-Hungary, Belgium, China, and Germany.

The kinds of sugar required are palmyra and coconut jaggery for the natives, and white sugar for the European residents.

There is one sugar house in Jaffna for the production and refining of palmyra jaggery.

Much of the lands under tank cultivation in the Northern and North Central Provinces, and river lands in the North-West Provinces could be made available for the cultivation of sugar cane, but some imported labour would be required, and the climate is somewhat unhealthy at times.

There is a technical institute in Colombo, but there are no real facilities at the present time for training in practical sugar making.

Cane was grown at one time in the Southern Province in one district, but the land was gradually planted with rubber as this was found to be more profitable. There was, however, a good demand for the sugar produced. Cane grows freely, and yields large crops, but the percentage of sugar is said to have been unsatisfactory in some cases. Attempts are being made to encourage the growth of sugar cane where soil and climate are favourable, as well as to manufacture an improved jaggery which could be easily refined at a central factory.

Sugar cane may be found growing all over the Colony. It is usually grown in small patches or even as isolated plants near to dwelling-houses of the villages, and is used for chewing.

The Excise Commissioner reports that the Ceylon Sugar Refineries, Ltd., which is now in liquidation, imported from India all the jaggery used in producing refined sugar. The company also made use of, though on a very limited scale, palmyra toddy obtained locally, but was barely able to get 10,000 gallons of toddy per day, even during the middle of the palmyra tapping season, and the quantity of refined sugar manufactured from raw material locally obtained was almost negligible.

The total acreage under palmyra cultivation in the Jaffna district is about 36,959 acres. There are also numerous kitul trees growing wild over most of the lower hills and foothills, but they are so widely scattered that the collection of the sap, and manufacture of jaggery or sugar therefrom on a large scale would be very expensive. With regard to coconut toddy as a sugar producing juice, since the copra industry will in all probability rapidly develop now the war is over, it cannot be expected that toddy will be available at a low cost. The tendency will be to allow the nuts to form, and to discontinue tapping the trees.

With regard to the future development of sugar cultivation in Ceylon, it may be said that fully two-thirds of the island receives less than 75 inches of rain per annum, and the cultivation could only be carried out in the dry area with irrigation, especially when it is remembered that the greater part of the rainfall falls within the months of the north-east monsoon season.

3. *Hong Kong.*

The pre-war consumption of sugar in Hong Kong was 20,000 tons per annum, imported from Java as white and brown sugar, and molasses, from Formosa as brown sugar, and molasses, and from the Philippine Islands as brown sugar.

There are two sugar refineries, the Taikoo Sugar Refining Co., Ltd., and the China Sugar Refining

Co., Ltd., besides ginger and fruit preserving factories, and samshu and soy factories.

The general public consume refined sugar, Java plantation white and brown sugar.

The climate of Hong Kong is not so suitable for sugar cultivation as that of British possessions nearer the Equator, and the area available is small.

Hong Kong University could be made available for scientific instruction, but there is no other provision at present.

4. *British North Borneo.*

At the present time only about 20 acres are under sugar cane cultivation, producing about 50 tons per annum. The consumption of sugar is from 900 to 1000 tons per annum. The bulk of the sugar comes from Java, and is chiefly the white plantation variety.

There are at least 10,000 acres of land in Cowie Harbour, Tawau district, which could be used for sugar cultivation. The time in which the land could be made available, however, depends on capital, organisation, and labour. All areas are at present jungle land, and would first have to be cleared. Chinese and Javanese labour would be necessary, and could easily be obtained.

5. *Sarawak.*

Only a small quantity of sugar from the Nipa palm is produced for home consumption, but the yield has never been determined. The imported sugar, amounting to about 1000 tons per annum, is chiefly soft Java of low grade.

The cultivation of sugar cane was attempted some years ago, but the land then put under cultivation was unsuitable, and the percentage of sugar insufficient to make it commercially profitable. There may, however, be land suitable for the crop. Transport would be by small boats to main rivers, where, if prices justified it, loading could be effected to launch or steamer.

6. *Straits Settlements.*

The sugar industry in these Settlements was formerly of much more importance than it is now, as it has been slowly but steadily supplanted by the cultivation of rubber.

The following table gives the pre-war exports of sugar from Singapore:—

	Sugar tons	Sugar candy tons	Jaggery tons	Molasses tons
1910 ...	29,167	7,271	3	217
1911 ...	29,040	795	39	247
1912 ...	61,698	11,207	0·5	681
1913 ...	53,150	10,574	nil	445
1914 ...	37,754	7,309	nil	289

In 1916, 2316 tons of sugar were imported into Malacca. Sugar has never been cultivated in this Settlement.

The consumption of sugar in Penang in 1916 was 12,140 tons, and the pre-war exports were as follows:—

	Sugar tons	Sugar candy tons	Jaggery tons	Molasses tons
1910 ...	11,018	32	0·2	727
1911 ...	8,140	35	3·75	898
1912 ...	7,398	77	13	920
1913 ...	5,950	380	11	452
1914 ...	4,924	29	1·5	292

There is no land in Penang or Province Wellesley available or suitable for the extension of the sugar industry.

7. *Cyprus.*

Up to the middle of the sixteenth century, Cyprus was one of the principal producers of cane sugar in the Levant, but no attempt has been made in recent years to revive the industry. It is believed, however, that beet could be grown successfully in the island, and within the last year or so inquiries have been made from two different sources as to whether the Government could grant monopolies for the manufacture in the island of sugar (*a*) from beet, and (*b*) from the caroub bean.

Africa.

1. *Egypt.*

The portion of the country in which sugar cane is cultivated is the valley of the Nile, from Cairo to Assouan, near the Sudanese frontier, but without irrigation the cultivation of sugar cane would be impossible. The crop has fluctuated very much during recent years.

The total amount of cane used for sugar in 1915—16 was the produce of 54,400 acres, and the total production of sugar during this period was 99,973 tons, or 1·83 tons per acre.

During the five years ended 1916, the average yield of sugar cane per acre was 30·8 tons, and the average percentage of sugar extracted during this period was 10·12 per cent., or 3·12 tons per acre.

The estimated consumption of sugar in the same season as shown by the excess of production and imports over exports was 78,629 tons thus:—

Production	99,973 tons.
Imports	7,474 ,,
	107,447 ,,
Exports	28,818 ,,
Consumption	78,629 ,,

There are several factories in Egypt belonging to the Société Générale, and the main object of the industry is refining, the raw sugars being produced in the best form suitable for that purpose. There are jam factories, which have extended since the war, also factories making liqueurs, lemonade, syrups, and numerous pastries. There are also some native factories producing sweetmeats of all descriptions. The kind of sugar generally required by these trades is refined granulated.

The types of sugar imported are raw and refined, the importing countries being Austria before the war (for consumption), Java, and other countries of the Far East (for refining).

At present there is no suitable land available for the extension of the sugar industry, but should the remaining basins of Upper Egypt be converted to perennial irrigation, a considerable area will be available.

2. *Sudan.*

We have received no information from Sudan, but it appears to us that with irrigation there should be a possibility of establishing a sugar industry.

3. *Mauritius.*

The area under sugar cane for the production of sugar has increased from 63,570 acres in 1893 to 152,000 acres at the present time.

The average production of sugar for the last five years has been 252,000 tons, out of which 5904 tons are used for local consumption, the balance being exported.

The number of factories in Mauritius has decreased from 104 to 55 from the year 1892 to 1917, but on the other hand the tendency has been to centralise the industry, so that the total capacity is much greater than it was formerly.

Sugar cane is cultivated by two distinct classes

of planters, (*a*) the estates with or without factories, from which a yield of 2 tons per acre is obtained, and (*b*) the small planters, almost exclusively Indians, who obtain a yield of 1 ton per acre or less.

The description of sugar manufactured is 94 per cent. of plantation white sugar, and 6 per cent. of low grade sugar.

There are no refineries or other sugar-using trades in the island.

There is attached to the Department of Agriculture a School of Agriculture, where every year a certain number of students are admitted, and they then follow the three years' course of instruction leading to the diploma of the Department. Students are also admitted in the Laboratories of Sugar and Manure Factories, where under the guidance of the Chemist they study agricultural chemistry and sugar technology. After a certain stage they present themselves first to a preliminary and then to a final examination as enacted by a Bill, No. 20 of 1915 (local Government), the promoter of this valuable step having been The Société des Chimistes. The Board of examiners is appointed by the Governor, and is composed of the Director of Agriculture, the Professor of Chemistry of the Royal College, and two members of the Société des Chimistes.

Practically the whole of the lands in Mauritius which are suitable for cane cultivation are at present under that crop. There is a certain area in the drier districts of the island which might be available for cane cultivation provided that an adequate supply of irrigation water could be obtained for application thereto. A limiting factor to extensions of area lies in the labour supply, which is decreasing in amount, largely owing to the very marked extension of small planters' cultivation which has taken place in recent years, this kind of cultivation now representing 45 per cent. of the whole. Greatly increased yields might in many cases be anticipated as a result of the adoption of improved agricultural methods by the small planters. Moreover, the existing scarcity of labour is probably capable of being overcome to a considerable extent by the introduction of labour-saving devices both in field and factory, and it may be regarded as highly probable that the adoption of such measures would lead to considerable increases in output in a short space of time, as the small planters only obtain 9½ tons of cane per acre, as compared with 20 tons from the larger estates.

No sugar is imported into Mauritius.

4. *British East African Protectorate and Uganda.*

The area of the British East African Protectorate is approximately 200,000 sq. miles, and that of the Uganda Protectorate 109,119 sq. miles. From information we have received the sugar cane is grown by natives in small patches over a wide range for sucking and for conversion into an intoxicating drink known as tembo. In various parts of the Protectorates small mills of the Chattanooga type are established for crushing sugar canes. The juice is boiled in open pans until it is converted into a common form of muscovado sugar, known as jaggery, which is in considerable demand by natives.

The imports of sugar rose from 1622 tons in 1910 to 4490 tons in 1914, and the average for the five years prior to the war was 3900 tons. The average annual exports do not exceed 50 tons, and it is reasonable to deduct this quantity from each year's imports to arrive at the consumption of the Protectorates. Refined white sugar forms the bulk of the quantity imported, whilst a negligible quantity of sugar candy and unrefined sugar is also included in the figures given.

With regard to the possible expansion of sugar production in British East Africa, the Chief of the Economic Plants Division has estimated that there are from 250,000 to 300,000 acres suitable for sugar cane, the greater part of which is in the Tana River Valley. In the hotter parts of the Protectorate sugar canes from the time the cuttings are planted mature in 14—16 months, but in the sub-tropical parts a somewhat longer time is needed. In the coast belt, outside labour would have to be obtained. Sugar canes are cultivated experimentally at the Government farms at Kibos, Kabate, and Mazeres, and although no attempt has yet been made to manufacture sugar, analyses have proved that the canes compare most favourably with those grown in recognised sugar growing countries. Want of capital to establish the cultivation and in particular the erection of factories is the chief reason why sugar production has not been taken up by the Protectorate.

As regards Uganda Protectorate, it is estimated that 1937 acres are cultivated with sugar cane by natives, the canes being eaten when newly cut. The imports of sugar and molasses in 1916—17 from Java amounted to 256 tons, the description required being white crystallised. The exports of jaggery to British East Africa in 1916—17 were 26 tons. There are no sugar refineries in the Protectorate, but at the present time the agricultural development has been confined to a few crops only.

5. *Zanzibar and Pemba Protectorates.*

The area of Zanzibar is 640 sq. miles, and of Pemba 380 sq. miles. There was formerly a sugar industry when these districts were under the rule of the Sultan of Muscat and Zanzibar, but it collapsed in the "sixties" when slavery was abolished. Plantation owners then turned their attention to coconuts, finding also the labour was insufficient for keeping up their clove plantations.

About 1100 tons of sugar per annum are imported into Zanzibar from Java, Mauritius, and Portuguese East Africa.

It is impossible to introduce any new agricultural industry of importance without injury to the clove and copra industries unless some satisfactory organisation of all the labour elements of the Protectorates can be brought about.

6. *Union of South Africa.*

At the present time the production of sugar in South Africa is exclusively from cane, and is restricted to Natal, although we are given to understand that the industry has potentialities in other parts of the Union, notably on the low Veld of the eastern Transvaal.

In the season 1916—17, 63,000 acres were under cane, the output being 114,500 tons of sugar, or 1·82 tons per acre. The normal consumption of sugar is 120,000 tons annually.

There were no pre-war exports of sugar oversea, but small quantities were exported to the Belgian Congo, and to Portuguese East Africa.

About 13,000 tons is consumed per annum for manufacturing purposes. Jam and preserve manufacturers mostly prefer large grain, and jam crystals; sweet and confectionery manufacturers prefer best quality refined sugar, but they use a small proportion of unrefined "whites" for their cheap sweets. The class of sugar required for general consumption is best fine grain, but the capacity of the two Natal refineries is nothing like sufficient to supply the demand. The quality next in demand is unrefined plantation sugar. There is also a fair sale for large grain, moist yellow crystals, and for fine grain yellow.

Prior to the war, Mauritius competed with Natal for the Cape Colony trade, but during recent years the importation of Mozambique white sugar into the Transvaal has grown considerably.

The abolition of Indian immigration, with the increasing competition for labourers, and the Mozambique Treaty have adversely influenced the economic conditions. There is a steady repatriation of Indians going on, and that description of labour is becoming very difficult to obtain.

7. *North and South Rhodesia.*

The total imports of sugar in 1912 were 2613 tons, and the consumption 935 tons. The sugar was imported from Mauritius, the United Kingdom, Germany, Austria-Hungary, etc.

Experiments have been conducted on the possibility of cultivating sugar beet at the Experimental Station, Salisbury, but it has been found that to produce a profitable crop without irrigation would call for a very high standard of farming.

In the Kafue valley there are areas in which sugar cane might be cultivated, but it is doubtful whether climatic conditions would be suitable.

8. *Nyasaland Protectorate.*

In 1913—14, 189 tons of sugar were imported from the United Kingdom, South Africa, India, and Mauritius. The kind demanded is granulated sugar.

The sugar cane grows all over the Protectorate, and is used by the natives.

There are not less than 100,000 acres, principally along the Shiré River, and on Lake Nyasa, which might be put under sugar cane, but it would take four or five years for development. Labour supply since the termination of the war is plentiful and cheap, and with adequate transport facilities by connecting the existing railway with Beira and Lake Nyasa, the sugar industry could be established.

There is a Governmental Department of Agriculture at Zomba.

9. *Basutoland Territory.*

The climate of this territory is unsuitable for the cultivation of sugar cane. About 364 tons of sugar is imported annually, almost entirely from Natal. The kind of sugar demanded is No. 1 refined, and best raw whites.

10. *Bechuanaland Protectorate.*

The country of this Protectorate is essentially pastoral, and no sugar is cultivated in the Protectorate. It is estimated that the consumption of sugar by the white population would be quite 400 tons annually.

11. *Swaziland Protectorate.*

No sugar is grown, pastoral pursuits being followed more than agricultural. About 250 tons of sugar is imported annually to meet the requirements of the white population.

12. *Somaliland.*

This country is not an agricultural one, and no land is suitable for sugar growing. The natives would militate against the successful establishment of the sugar industry. In the eight years from 1909 to 1917, the average quantity of sugar imported was about 100 tons.

13. *Gold Coast.*

The average annual importation of sugar in the four years 1910—13 was 2000 tons, and the consumption is now on the increase. Of this Germany supplied 1140 tons, and the United Kingdom 870 tons, both refined. The comparative sparseness of the population, and the fact that the majority of the agricultural population is composed of peasant proprietors who have found even the unexacting labour required by the production of cacao too severe a strain upon their energies, are the principal factors against the establishment of a sugar industry in the Gold Coast, whilst European supervision is more expensive in West Africa than in any other part of the tropics.

The Governor and Commander-in-Chief of the Colony regards sugar cultivation as quite unsuited to the natives in their present state of development. Sugar cane is, however, grown in small patches practically all over the Colony for chewing, and it appears to grow very successfully.

14. *Sierra Leone.*

The quantity of sugar consumed in Sierra Leone in 1913 was 624 tons imported from the United Kingdom, Germany, and U.S. America. It consisted of granulated, moist, brown, cube or loaf.

All the low-lying lands, not swamps, and alluvial soils are admirably adapted for the cultivation of sugar cane, the estimated area being from 4000 to 7000 sq. miles. Labour is scarce, the population being about 48 to the square mile, but this difficulty could be overcome.

The Agricultural Department is competent to advise on the production of cane, and the technical side of the industry from a chemical standpoint, as one of the officers had two years' experience in connection with the sugar industry as a chemist attached to the Imperial Department of Agriculture for the West Indies.

15. *Gambia.*

The average annual consumption of sugar in the years 1912—14 inclusive was 350 tons, imported from France, Germany, the United Kingdom, and America.

Sugar cane could not be grown without irrigation owing to the long drought, and the swampy lands are unsuitable for it.

16. *Nigeria.*

The imports of sugar into the Protectorate for the three years prior to the war were 1911, 1050 tons; 1912, 1350 tons; and 1913, 1950 tons.

Granulated sugar is now imported, but almost all the imports before the war were beet sugar in cubes. There is a prejudice against brown sugar amongst the natives. Large quantities of honey are used by them in place of sugar.

The cultivation of sugar cane is impracticable in the Northern Provinces without the aid of irrigation, but where natural facilities for irrigation exist, such as a perennial stream, or spring, the cultivation of sugar cane is practised throughout the country up to an altitude of 2500 feet.

The native cane is of moderate height and thickness. The juice appears to be rich in sugar, but has not been subjected to analysis.

The only chance of success in the cultivation of cane would be in the river flats of the Niger or Benue. Here suitable sites for very large plantations could no doubt be found. Irrigation would have to be employed.

The supply of fuel, either wood or local coal, would not be a difficult matter, and there is also a plentiful supply of unskilled labour.

No draught animals could be kept, as they would be susceptible to disease, but conditions appear to be favourable for steam traction which, on a large scale, would probably prove far more economical.

In the event of preferential treatment being given to Colonial cane sugar, the possibilities of Nigeria as a source of supply are well worthy of the most careful inquiry.

In the Southern Provinces there are vast acres of land in the vicinity of rivers and creeks admirably adapted for sugar growing under irrigation. The people in all these areas are engaged in the palm oil and kernel industry, and it is therefore doubtful whether labourers would be obtainable in large number.

17. *Seychelles.*

No sugar is at present cultivated in these islands, but the consumption in the year preceding the war was about 340 tons. The inhabitants have been accustomed to white sugar for nearly a century. A small quantity of sugar is used for bacca adulteration (a fermented beverage for local use), and also to make sweets.

Including the marshes, which would have to be drained, and the steep hill sides which are not too much worn out by erosion, there are in the Mahe group about 5000 acres, mostly of the second-class soil, which could be put under cultivation. There would be no difficulty about transport and labour, but much depends on the good will of the inhabitants among whom the land is extremely subdivided. As the cultivation of sugar cane is well known to most of them they would soon supply, say in about three years, the requirements of a small factory.

Sugar was manufactured in the Colony about 50 years ago, but it appears that a rum distillery was attached to each factory, and unavoidable difficulties arose with the fiscal authorities. Owing to this, and the lack of technical assistance, the distilleries had to close.

At present 50 acres of sugar cane are grown for the manufacture of bacca. Canes grow well in the Colony, especially in the marshy land, but the soil is rocky, and an average of 5—10 tons per acre only is obtained.

The climate is very suitable.

At the Botanical Station there is a small laboratory in which the chemical control of a sugar house can be learnt so long as the curator in charge is a sugar chemist.

AMERICA.

1. *British West Indies.*

The agricultural industries of these valuable and productive islands were allowed to languish up to about twenty years ago, and had it not been for the timely aid of the British Government, who recognised the position at the time just referred to, disaster would have overtaken them.

Each local Government maintains a local Department of Agriculture. In October 1898, the Imperial Government established an Imperial Department of Agriculture, which acts in an advisory capacity on agricultural matters to all the Governments of the West Indies, and exercises a detailed supervision in respect of certain of them which do not possess the full complement of scientific officers. The headquarters is in Barbados.

During the first ten years of the existence of the Imperial Department of Agriculture very large financial assistance was given to each of the West Indian Colonies in order to enable them to develop and carry on the work of the local Departments of Agriculture under the supervision of the Imperial Commissioner of Agriculture.

The Government gave a sum of £250,000 for the relief of the sugar industry during the period immediately preceding the coming into effect of the Brussels Convention. A portion of this grant was used to encourage the formation of a pioneer sugar factory in Antigua, and as the outcome of this Gunthorpe's Sugar Factory was erected and operated on co-operative lines; this was the means of solving many of the problems incident to central factory working. As a direct consequence of the successful working of this factory a similar factory was shortly afterwards established at St. Kitts, and the central factory movement in Barbados and Trinidad was greatly stimulated.

The following is a general outline of the position of the West India Islands as regards sugar production:—

Barbados, with an area of about 166 sq. miles, mainly depends on the sugar industry, and produced in 1917—18 65,000 tons whilst the following crop is estimated at 80,000 tons. Trinidad, with an area of 1974 sq. miles, and Tobago, with an area of 114 sq. miles, produce sugar and cacao. The production of sugar is some 50,000 tons per annum. Of the Leeward Islands, Antigua has an area of 108 sq. miles, and produces from 10,000 to 15,000 tons of sugar annually. St. Kitts has an area of 68 sq. miles. The chief industries are sugar and cotton. It produces from 10,000 to 15,000 tons of sugar per annum. Nevis, with an area of 50 sq. miles, produces for the most part cotton, with only a small quantity of sugar. Montserrat has an area of 32 sq. miles. It produces very little sugar, the chief industries being cotton and limes. Dominica has an area of 291 sq. miles, and does not produce any appreciable quantity of sugar, the cultivation of limes being an important industry. The Virgin Islands belonging to Great Britain have an area of 58 sq. miles, but no sugar is produced. Of the Windward Islands, St. Lucia has an area of 233 sq. miles. Its main industries are cacao and limes. About 6000 tons of sugar are produced annually. St. Vincent has an area of about 150 sq. miles. The main industries are cotton, arrowroot, cacao, and a small quantity of sugar, about 500 tons annually. Grenada and the Grenadines occupy about 133 sq. miles. The chief industries are cacao, rubber, cotton, and coffee. Sugar production is quite a minor industry. Jamaica is the largest of the British West India Islands, having an area of 4450 sq. miles. The principal industries are rum, bananas, coconuts, cacao, coffee, and pimento. The amount of sugar produced varies from 30,000 to 40,000 tons per annum.

a. Barbados.

About 30,000 acres is under sugar cane in this island, and about 5000 tons of sugar are consumed annually. The canes contain about 14% of sugar, and the yield per acre averages 1·4 tons.

The average exportation of sugar for the three years 1913—1916 was 38,236 tons. There were also exported 9,017,358 gallons of molasses. In 1917 the exports were 34,770 tons of sugar crystals, 17,190 tons of muscovado sugar, and 9,400,196 gallons of molasses. The exports were to Great Britain, Canada, the United States, Newfoundland, Bermuda, British West Indies, Holland, British Guiana, Bahamas, Denmark, and Brazil.

At the Department of Agriculture a large number of new varieties of canes are raised from seed, and their cultivation is carried out in comparison with the standard canes, until it is ascertained whether they are better than those under cultivation. Experiments are also conducted to ascertain the manurial requirement of the sugar canes. These have been instituted 25 years.

Practically all the land suitable for cane cultivation is used for that purpose. It is worthy of note that owing to the population of Barbados being about 1124 persons to the square mile, the cost of all labour is lower than in most of the British West Indian Colonies.

b. Trinidad and Tobago.

The area under sugar cane is between 55,000 and 60,000 acres. The average production and consump-

tion of sugar in the Colony for the five years 1912—1916 was :—

Production, 52,361 tons; consumption, 8551 tons.

The principal exports were to the United Kingdom, British North America, and the United States. The description of sugar exported was chiefly vacuum pan with a smaller quantity of muscovado. Some refined sugar was also exported. An average of 475 tons of refined sugar was imported during the five years 1912—1916, and also a small quantity of raw sugar. This sugar came principally from the United Kingdom, British Guiana, United States, Holland, and up to 1914 from Germany.

The yield of sugar cane on the estates is from 12 to 25 tons per acre, whilst from farmers the yield is 8 to 12 tons per acre. It takes from 10 to 17 tons of cane to produce a ton of sugar according to the efficiency of the factory, the quality of the juice, etc. The canes contain from 9 to 16 per cent. of sucrose.

There are no refineries or other trades using sugar in the Colony.

The lower classes of the population prefer muscovado sugar, but the vacuum pan (96 crystals and yellow crystals) is generally used. A comparatively small quantity of refined sugar is consumed in the Colony.

There are no scientific establishments available for technical training in connection with the sugar industry available in the Colony, but some interesting results have been published by the local Department of Agriculture on the cultivation of seedling canes. Plots of from more than one acre to one-tenth of an acre have been sown, and comparisons made against Bourbon cane with the new varieties from seedlings, the plant canes and first ratoons and in one series also the second ratoons, being tested. Nearly all the new varieties show an increased yield of sugar over Bourbon cane, whilst in not a few cases the improvement is more than one ton per acre.

An influential committee presided over by Professor Carmody, Director of Agriculture, has reported on the possible extension of the sugar industry in the Colony. They draw attention to the substitution of canes by other more profitable crops, *e.g.* coconuts, and to a less extent, cacao. They refer to the attention that is being paid to the selection of cane plants, and to improved methods of cultivation. They are of opinion, however, that no material extension of the sugar industry is to be expected under present conditions, and that a continuation of immigration on the scale of the last few years is necessary for the maintenance of the normal output. To increase the working capacity of factories, and to provide additional encouragement to farmers, fresh capital is necessary, and this would not be forthcoming without a guarantee that prices of sugar would be higher than during recent years. These conclusions were arrived at, however, before the British Government granted Colonial preference.

c. Leeward Islands.

These include Antigua, Montserrat, St. Kitts, Nevis, Anguilla, Dominica, and the Virgin Islands.

The total area under sugar cultivation in 1916 in Antigua, St. Kitts, Nevis, and Montserrat amounted to 32,200 acres, Antigua heading the list with 16,000 acres, about 10,000 of which were reaped.

The exports from these islands in 1916 were 26,993 of crystals, and 8058 tons of muscovado. The estimated annual consumption in these islands was 1,550 tons.

The average yield of cane in Antigua and St. Kitts may be taken as 20 tons per acre, and in Nevis as 10 tons per acre. The sugar in the cane averages 13—14 per cent. A certain quantity of sugar is imported from the United States of America.

Dominica and the Virgin Islands produce very little sugar, and no returns are available.

d. Windward Islands.

The Windward Islands include St. Lucia, St. Vincent, and Grenada. The islands are mountainous, and of volcanic origin, and quite recently there has been a violent eruption in St. Vincent. The climate is damp and hot, and the rainfall amounts to 80—100 inches. The islands not only suffer from volcanic eruptions and earthquakes, but also from hurricanes. The hurricane of 1897 and the eruption of 1902 destroyed much of the land under cultivation of sugar in St. Vincent, and since that time the sugar production has practically ceased.

The chief sugar producing island is St. Lucia. The average exports from this island during the six years 1910—1916 inclusive were 4526 tons, whilst the consumption of sugar in the island may be estimated at 1300 tons.

The exports of sugar from St. Vincent show a steady increase in output in 1917—1918, but it is doubtful whether this will be maintained owing to the attention being given to cotton. The sugar exported in 1916 was twice the amount of 1915. The average for the two years 1916 and 1917 was 544 tons. We have no information as to where this sugar was sent.

The average annual consumption may be estimated at 1200 tons.

Grenada produces about 450 tons of sugar annually, and its consumption is 1575 tons.

A certain quantity of sugar is imported from Barbados, Trinidad, and St. Vincent, as well as refined sugar from the United States of America and the United Kingdom.

There are about 6000 acres which might be made available for sugar growing.

e. Jamaica.

The production of sugar in this island is subject to fluctuations. In 1892 it was 23,654 tons, in 1901, 16,083 tons, and in 1911, 19,414 tons.

The acreage under sugar cane in 1916 was 33,830 acres, of which 10,107 acres of cane were grown by small settlers, who make a crude description of molasses sugar for local consumption, no return being made of the quantity; 21,620 acres on the estates making sugar by steam, water, or cattle power are returned as in cane for the crop completed on August 31, 1916. The quantity of sugar produced was 32,196 tons, and of rum 18,406 gallons.

Plants maturing in 15 months yield 30—40 tons of cane according to weather, efficiency, etc. Data as to the percentage of sugar in the canes are only available on two estates in the district of Vere, where the percentage of sugar in the crops for 1910, 1911 and 1917 was between 13 and 14. The present yield of sugar is 1·45 tons per acre, and 85 gallons of rum. There are no refineries or other trades employing sugar in the island.

The Agricultural Department gives a course in distilling occasionally, and the head of this Department is a chemist, besides which a mycologist and an entomologist are employed, whose services are at the disposal of the public for advice.

There are about 117,700 acres adjacent to the railway line, or to river navigable by boats, or within 3 to 8 miles of shipping ports, which should be available for extension of the sugar industry. The land, however, is in private ownership, and it would no doubt take some time to induce the owners to invest in machinery and plant canes.

There are a great number of labourers scattered over the country whose time is only partially occu-

pied in casual labour or growing their own food stuffs.

Three new sugar factories have been provided for in St. Catherine, and many projects for sugar developments are being actively considered as soon as machinery is again procurable.

f. Bahama Islands.

These islands are not suitable for the cultivation of sugar cane, as the soil is not rich enough. About 900 tons of sugar were imported in 1913, mostly from the United Kingdom and United States.

g. Bermuda.

The average annual consumption for the three years 1911—13 inclusive was 859 tons, imported from the following countries:—United States 588 tons, West Indies 214 tons, and the United Kingdom 57 tons.

There is no sugar industry in Bermuda, and there is no land suitable for the cultivation of sugar cane.

2. *British Honduras.*

About 600 acres are at present under cane, producing about 600 tons annually, nearly all of which is consumed locally.

About 50 tons of muscovado and centrifugal sugar were exported annually before the war.

The land is unfertilised, unploughed, and practically uncultivated, and the canes are allowed to ratoon for about ten to twenty years before being replanted.

Before the war refined and unrefined sugar came from the United States, and a small quantity from the United Kingdom. Since the war imports are mostly from Guatemala.

We have no information regarding the consumption of sugar in this Colony.

3. *British Guiana.*

The estimated area under sugar cane is 78,000 acres, with a production of 120,000 tons of sugar per annum, the consumption being 8500 tons.

The annual pre-war exports for the seven years 1907—13 were 99,412 tons of sugar, 3,258,200 proof gallons of rum, 180,000 gallons of molasses, and 7820 tons of molasses as cattle food.

The yield of cane is 10 to 60 tons per acre, according to the soil, variety, and seasons, with a content of sugar of 10—14 per cent.

The sugar required by the general public is white, yellow, vacuum pan sugar, and syrup sugar from yellow crystals. A small quantity of white refined sugar is imported from Canada and the United States.

No scientific establishments are so far available for technical training in connection with the sugar industry, but the larger and more efficient sugar plantations are themselves under technical control.

Given an ample supply of labour, and of manure, efficient tillage, and economical scientific manufacture, the production of the sugar estates might be increased to 250,000 tons of sugar per annum. There are at least 450,000 acres of land suitable for the cultivation of sugar cane in districts in which it has been grown, whilst nearly 1,000,000 acres of land are available in the north-western sections of the Colony, where sugar cane cultivation has hitherto not been attempted.

The land is very fertile, and very favourable meteorological conditions exist, but there are difficulties in regard to labour supply, and the mechanical tillage owing to the nature and lay of the soils, and heavy costs of draining the land.

4. *Canada.*

The total refined sugar consumed in Canada during 1916 was 258,711 tons, made mostly from imported raw sugar, including 4464 tons imported as such.

The exports of sugar are very variable. In 1915 they amounted to 5·6 tons, in 1916 to 280·93 tons, and in 1917 to 2579·83 tons.

The imports also vary very much, thus:—

Refined sugar, and sugar above No. 16 Dutch standard in colour.

	1913 tons	1914 tons	1915 tons	1916 tons	1917 tons
British Empire	8,421	4,251	2,248	903	902
Foreign Countries	506	44	163	28	253

Sugar of lower quality, including drainings and concrete.

	1913 tons	1914 tons	1915 tons	1916 tons	1917 tons
British Empire	130,156	111,761	166,177	140,569	201,637
Foreign Countries	124,693	182,176	126,078	125,889	124,900

The home production of Canada is from sugar beet, and there is a large amount of land suitable for its extension.

The quantities of refined sugar manufactured from Canadian grown beets during the five years 1911—15 inclusive were as follows:—1911, 9522 tons; 1912, 11,996 tons; 1913, 11,673 tons; 1914, 13,979 tons; 1915, 17,641 tons.

The public of Canada demand principally granulated sugar in normal times, but since the war yellow sugar has been used. The confectioners and biscuit manufacturers use granulated and yellow sugar, and chocolate and cocoa manufacturers use granulated only. Syrup and molasses blenders use raw cane sugar, and molasses, also refiners' syrups, and black strop.

There are no special technical schools for instruction in the sugar industry, but technical instruction of a general character may be obtained from several technical schools, and chemical and engineering departments of the Canadian Universities.

In regard to possible extension, we have been informed that the labour conditions are uncertain at the present time, and before any capital investment can be warranted, careful preparation of a well organised field co-operation will be necessary.

5. *Newfoundland.*

The pre-war consumption of sugar in Newfoundland was an average of 5920 tons per annum. It consisted chiefly of white granulated and cube sugar from the United States, United Kingdom, and Canada. Brown sugar was also imported from the West Indies.

The local consumption is not sufficient to warrant refineries being established.

The climate prevents the growth of sugar cane or sugar beet.

6. *Falkland Islands.*

No returns have been received from the Falkland Islands, and the sub-antarctic climate prevents the possibility of a sugar industry.

POLYNESIA.

1. *Commonwealth of Australia.*

The area devoted to the cultivation of sugar cane in Australia is a narrow strip of land along the eastern coast of Queensland, with the three northern counties of New South Wales. Queensland is the largest sugar producing State in the Commonwealth. In the year 1912, Queensland had 141,652 acres under cane, the yield from 78,142 acres crushed being 994,212 tons, equal to 12·72 tons per acre, whilst the quantity of sugar produced was 113,060 tons, equal to 1·45 tons per acre. In the same year New South Wales harvested 6137 acres

of cane, out of a total area of 14,283 acres, the yield of cane being 140,014 tons, equal to 22·81 tons per acre. The sugar content of the cane averaged 16,723 tons, equal to 2·72 tons per acre.

It should be pointed out that as the sugar cane requires 18 months to mature, the total area under cane for any one year really includes the cane for two successive harvest seasons.

Beet is cultivated in Victoria, the area under this crop in 1912 being 752 acres, which yielded 3974 tons of roots, equal to 5·3 tons per acre, and 477 tons of sugar, equal to 0·64 ton per acre.

The average consumption of sugar per head of population in Australia is estimated at 127·6 lb. for the decade 1905—1915.

a. Queensland.

According to information we have received, the average yield of sugar cane is 12·72 tons per acre, and the yield of sugar 1·45 tons per acre.

There are in Queensland two sugar refineries employing 423 hands, one juice mill employing 55 hands, and 43 sugar mills employing 4165 hands.

There are two experimental stations at Mackay and Bundaberg, whilst experimental plots have been established in various cane growing centres.

Some 30 cwt. of cane sugar was imported from Java, Mauritius, and Fiji in 1915.

That there is still room for further expansion in Queensland in regard to sugar growing is conclusively demonstrated by the fact that there is not enough sugar produced in the Commonwealth to satisfy local requirements.

In 1900 black labour was abolished, and in order to encourage the employment of white labour, the Federal Parliament passed legislation providing for the payment of bounty on a sliding scale on all cane grown by white labour. An import duty was also imposed on all foreign sugar brought into the Commonwealth. The excise and bounty were abolished in 1913.

b. New South Wales.

The total area under harvested cane in 1916 was 6030 acres, and the quantity of sugar produced was 19,148 tons, equal to 3·18 tons per acre.

The only portion of the State suitable for the growth of sugar cane is the coastal areas from the Clarence River northward, and during recent years the area devoted to it for sugar purposes has contracted considerably. This has been brought about chiefly by labour troubles, and dissatisfaction with the prices paid for cane. On the Tweed River the banana is ousting the cane on the hills, the cost of carriage to the deep water frontage, in conjunction with the cutters' demands, rendering profitable production of sugar cane impracticable.

c. Victoria.

The annual consumption of sugar in the State is approximately 75,000 to 80,000 tons, and the major portion is obtained from Queensland, and some of the Pacific islands.

About 1200 acres under beet in 1916—17 produced 1650 tons of sugar, equal to 1·375 tons per acre, the production of roots being 12 tons per acre.

There is more than sufficient land in Victoria to render the State self-supporting as regards sugar by increasing the area under beet, and we assume that with further development Victoria could become a sugar exporting State.

The environment of the one beet sugar factory has not been ideal, and only in recent years has sufficient beet become available to run it at a profit. The industry has not yet become sufficiently well established to command appreciation, but a promising interest is now developing favourably. Labour is also said to be scarce.

d. South Australia.

The pre-war consumption of sugar is unknown. No sugar is produced in the State, but the sources of supply are chiefly from other Australian States.

The climate is unsuitable for sugar cultivation.

e. Western Australia.

The consumption of sugar for the year ended June 30, 1918, was 12,400 tons of cane sugar, derived chiefly from Queensland, New South Wales, and Fiji.

Sugar beet could be grown in the South-West Division over a large area, but economic conditions do not permit it to be cultivated with profit to the grower, the chief of these being the cost of labour.

f. Tasmania.

No sugar is produced in Tasmania, but there are large areas over which beet can be grown. The present supply is derived principally from Queensland and New South Wales.

2. *New Zealand.*

The consumption of sugar in New Zealand for the year 1915 was 66,645 tons.

Raw sugar is imported from Fiji, whilst practically all the refined sugar comes from Australia.

There is one sugar refinery requiring raw sugar, whilst there are numerous jam, biscuit, and confectionery works, and breweries, requiring refined sugar.

No coloured labour is available. This has, up to the present, prevented the establishment of a sugar industry.

3. *Fiji.*

This group of islands, with an area of about 7068 sq. miles, has 50,000 acres devoted to sugar cane cultivation. The annual production of raw sugar varies from 85,000 to 120,000 tons.

The consumption of sugar in Fiji is estimated at 2000 tons per annum.

The raw sugar exported to New Zealand and Australia in 1913 was 95,000 tons, and in 1914, 92,000 tons.

The average yield of sugar cane is 18 tons per acre, and the average sugar extracted from the cane is 2·25 tons per acre.

There are no refineries in Fiji, nor are there any other trades employing sugar.

There are no scientific establishments in Fiji available for technical training in connection with the sugar industry, but the largest sugar-producing company has facilities for training its own employees.

As regards the area of land suitable for the extension of the sugar industry, there are 39,000 acres in nine different localities, varying from 1000 acre to 12,000 acre blocks, which could be made available if land could be obtained from Fijian claimants. Light railways are required for the transport of the crop to the mill. The position of the labour supply is not very favourable; indentured labour from India, formerly the only labour supply for all cane estates, has been abolished, and no adequate arrangements have been made for replacing it.

The freights to and from the United Kingdom, Australia, and New Zealand are very high.

4. *Other Pacific Islands.*

a. British Solomon Islands.

The consumption of sugar is about 80 tons annually, and consists of refined white sugar for Europeans, and coarse brown sugar for the natives. The sugar is imported from New Zealand and Australia.

About 100,000 acres on the Island of Guadalcanal could be used for sugar cane cultivation, but most of the other islands are too mountainous. Approximately altogether 120,000 to 130,000 acres should be available.

It would be necessary to erect mills, tramways, bridges, wharves, etc., and the clearing of the land, which would be costly, would have to be undertaken.

The scarcity of the labour supply, and the prevailing high freights, would act adversely on the establishment of a sugar industry. On the other hand, the compactness of the flat lands on Guadalcanal, and their large area, would be much in its favour.

b. Gilbert and Ellice Islands.

No canes are grown at the present time in these islands. It is considered that the poor soil of these coral atolls would be unsuitable.

Sugar is imported from Australia and America, white sugar being used by Europeans, and brown sugar by the natives.

The annual consumption is about 550 tons.

c. Fanning and Washington Islands.

No sugar is grown in these islands, and the reports we have received show that they are not suitable.

The annual consumption appears to be under 40 tons.

d. Tonga or Friendly Islands.

No sugar is produced, and the average annual consumption during the past five years was 120 tons, imported as refined sugar for the most part from New Zealand.

No land is available at the present time for sugar production.

e. New Hebrides Group.

Refined sugar is imported from Australia, New Zealand, and New Caledonia. During 1917 this amounted to about 130 tons.

There is land in the group of islands which is considered suitable for the cultivation of sugar cane, but no estimate can be given of the available area.

The Committee wish to express their thanks to the various officials who have supplied them with the information forming the basis of this Report.

For the statistics they are largely indebted to the publications of Messrs. Willett and Gray, J. W. de Silva, and Otto Licht.

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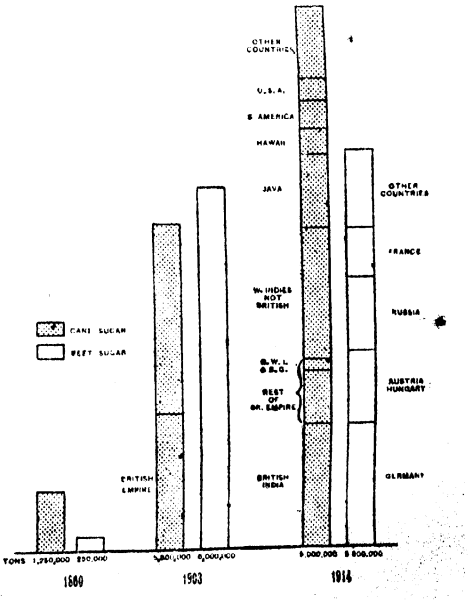
"Sugar Cane in South Africa," 1913.

"Sugar Beet Industry of Canada," 1909.

"Sugar Beets," by C. A. Zacitz and A. W. Mason, Ontario Agricultural College, West India Committee Circular.

After the reading of the Report, the Chairman requested Mr. J. W. Macdonald to explain the statistical tables.

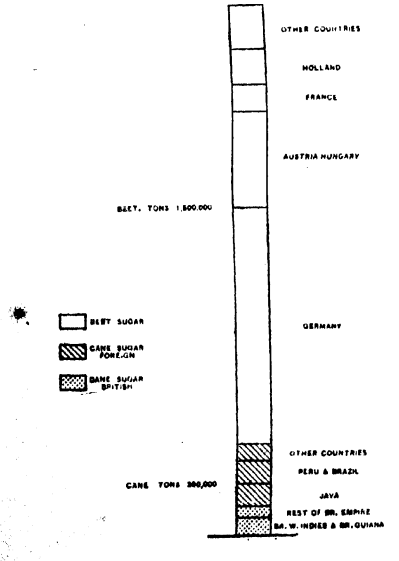
Mr. J. W. Macdonald said that he was sorry he had not had time to write a paper on the subject; it deserved a paper on the different aspects of information they had received from the Colonies. The reason they had gone into the question was because during the war there had been a cry that the Empire should be self-supporting so far as sugar was concerned. They had written to all the Colonies and Dependencies for any information they could get; the Report they were now issuing was only a preliminary one—the full Report would be produced later. The great thing disclosed in the present Report was that the Empire was consuming, so far as he could gather from the returns, about 6¼ million tons of sugar. At the present time, the Empire production was about 3¾ million tons, though, about two years ago, when the Indian crop, which was usually about 2½ million tons, had increased for one year to about 3½ million tons, the Empire production had been about 4½ million tons. It had now fallen back to the smaller figure. Deducting the 3,859,330 tons produced from the 6,222,030 tons consumed, there was a shortage of 2,362,700 tons. Where was that to be produced in order that the Empire might be self-supporting in sugar? He had some tables, which had not yet been published,



The World's Production of Sugar.

Diagram drawn up by Mr. W. G. Freeman, B.Sc., A.R.C.S., F.L.S., Assistant Director of Agriculture, Trinidad and Tobago, and published in the Bulletin of the Department of Agriculture Trinidad and Tobago, 1918, Vol. 14.

dividing the Empire's production of sugar into groups. There was the Australian Group whose sugar came chiefly from Queensland and Fiji. Their production was about 425,900 tons, and their consumption 395,120 tons; so, practically, they had only got a surplus of 30,780 tons to export. That was to say Australia and Fiji would feed themselves, New Zealand, and all the Pacific Islands—which all used a little sugar that had to be sent from somewhere. Australia itself was not an exporting country, but Fiji was producing 100,000 tons and consuming only 2000 tons. The Australian Group of producers had not a very large amount available for export, and the natural increase of population in Australia would presently take up that small surplus. The next group to be considered was the Indian Group. This included (besides India) Ceylon, Hong Kong, North Borneo, Sarawak, and the Straits Settlements (Singapore, Malacca and Penang). The only one among those countries that produced sugar, if we except Singapore and Penang, the productions of which were comparatively insignificant, was India, and there the normal production was about 2½ to 2¾ million tons. The others, with the exceptions mentioned, were consuming countries. In the whole group there was a shortage of about 840,000 tons made up, at present, chiefly from Mauritius and Java. They wanted the Indian Empire to be producing its sugar rather than getting it from Java, and this naturally pointed to some place in the East making the deficit up, so as to save freight and expenses. That place would appear to be India, but how was India to go about it. Re-organisation was wanted, and the matter was being dealt with by the Indian Government. Ceylon and Hong Kong between them consumed about 50,000 tons; they had to get it from somewhere, and it should be from some part of the Empire in preference. The next group was the West Indian Group and Canada. That included Demerara, Barbados, Trinidad, Tobago, Antigua, St. Kitts, the Windward Islands, the Leeward Islands, Jamaica, Bahamas, Bermuda, British Honduras and Canada. That group produced



The Sources of Supply of Sugar to the United Kingdom in 1914.

Diagram drawn up by Mr. W. G. Freeman, B.Sc., A.R.C.S., F.L.S., Assistant Director of Agriculture, Trinidad and Tobago, and published in the Bulletin of the Department of Agriculture, Trinidad and Tobago, 1915, Vol. 14.

DATES OF REAPING THE WORLD'S SUGAR CROPS.

—	—	1917–18 Crops
		Tons
U.S.A. (beet) ...	July to Jan.	682,867
Mauritius	August to Jan.	225,466*
Réunion	,, ,,	50,000
European (beet) ...	Sept. to Jan.	4,287,923
Venezuela	Oct. to Dec.	15,000
Canada (beet) ...	,, ,,	11,250*
Demerara	Oct. to Dec. and May to June	114,007*
Louisiana	Oct. to Jan.	217,199
Texas	,, ,,	2,009
Surinam	,, ,,	10,009
Ecuador	Oct. to Feb.	8,000
Peru	,, ,,	265,000
Brazil	,, ,,	148,958
		6,037,688
		* 350,723 (British)
Formosa	Nov. to June	397,618
Philippines	,, ,,	216,260
Hawaiian Islands ...	Nov. to July	515,035
India	Dec. to May	3,229,000*
Cuba	Dec. to June	3,446,083
Hayti	,, ,,(1918-19)	18,000
Mexico	,, ,,	40,000
Spain (cane) ...	,, ,,	6,000
Porto Rico	Jan. to June	405,174
St. Croix	,, ,,	5,400
Trinidad	,, ,,	45,256*
Barbados	,, ,,	65,230*
Jamaica	,, ,,	34,300*
Other British West Indies	,, ,,	16,745*
San Domingo ...	,, ,,	145,000
Central America ...	,, ,,	25,000
Egypt	,, ,,	79,450*
Martinique	Jan. to July	20,881
Guadeloupe	,, ,,	28,000
Antigua	Feb. to July	9,409*
St. Kitts	Feb. to August	8,846*
		8,756,687
		* 3,488,236 (British)
Natal	May to Oct.	106,250*
Mozambique ...	,, ,,	50,000
Argentine	May to Nov.	126,171
Java	,, ,,	1,791,064
Australia	June to Nov.	325,900*
Fiji	,, ,,	70,800*
		2,470,185
	Total ...	17,264,560 * 502,950 (British)

341,930 tons. With the exception of Canada, they consumed very little; but Canada consumed all that she herself produced and took the surplus of all the others. The consumption of the whole group was 294,720 tons per annum, and the natural expansion of consumption would before long absorb the small surplus of 47,000 tons. Practically the Australian and American Groups were self-supporting, whilst the Indian Group was short by 840,000 tons. The other group of the Empire was the African Group. That included Mauritius, Natal, Egypt, Nigeria, the Seychelles, Rhodesia, Nyasaland, Basutoland, Bechuanaland, Swaziland, Somaliland, the Gold Coast, Sierra Leone, Gambia, British East Africa, Uganda, and Zanzibar. That group produced 466,500 tons of sugar and consumed 252,920, so there was a surplus of 213,580 tons. But that surplus was only in Mauritius, for the producing parts were simply Mauritius, Natal and Egypt. Egypt consumed all she produced, Mauritius had a surplus, as she produced over 250,000 tons and only used about 6000 tons. The surplus of the whole group was due to this Colony alone. That surplus went to India, and when it had gone there, there was still a shortage in the Indian Group of fully 600,000 tons. Finally, the United Kingdom itself produced

BRITISH EMPIRE PRODUCTION AND CONSUMPTION OF SUGAR.

—	Production	Consumption
Australia ...	325,900	325,550
Fiji	100,000*	2,000
New Zealand ...	—	66,650
Solomon Islands	—	80
Gilbert Islands ...	—	590
Tonga Islands ...	—	120
New Hebrides ...	—	130
	425,900	395,120 = 30,780 surplus.†

* Exporting country.
† This is wanted for local increase in consumption.

India	2,625,000	3,400,000
Ceylon	—	28,000
Hong Kong ...	—	20,000
North Borneo ...	—	1,000
Sarawak ...	—	1,000
Straits Settlements	—	1,000
Singapore ...	—	1,000
Malacca	—	2,140
Penang	—	12,140
Cyprus	—	1,540
	2,625,000	3,467,820 = 842,820 shortage.

Demerara ...	120,000*	8,500
Barbados ...	65,230*	5,000
Trinidad & Tobago	64,230*	8,350
Antigua	9,410*	—
St. Kitts ...	8,850*	1,550
Windward Islands	5,520	—
Leeward & other Islands ...	16,750*	4,080
Jamaica ...	34,300	6,220
Bahamas ...	—	900
Bermuda ...	—	860
Brit. Honduras	—	550
Canada	17,640	258,710
	341,930	294,720 = 47,210 surplus.†

* Exporting country.
† Wanted for increase in Canadian consumption.

Mauritius ...	252,000*	5,900
Natal	114,500	120,000
Egypt	100,000	113,780
Nigeria	—	1,950
Seychelles Islands	—	340
Rhodesia ...	—	840
Nyasaland ...	—	190
Basutoland ...	—	365
Bechuanaland ...	—	400
Swaziland ...	—	260
Somaliland ...	—	100
Gold Coast ...	—	2,000
Sierra Leone ...	—	625
Gambia ...	—	350
Brit. E. Africa ...	—	4,500
Uganda ...	—	230
Zanzibar ...	—	1,100
	466,500	252,920 = 213,580 surplus.†

* Exporting country. † Wanted by India.

United Kingdom (pre-war) ...	—	1,811,450 = 1,811,450 shortage
Total Production	3,859,330	6,222,030 Empire consumption.
		3,859,330 Empire production
		2,362,700 Empire shortage.

N.B.—Since the above tables were printed it has been found that the consumptions of the following countries have been inadvertently omitted. Newfoundland 5000 tons (after Canada). Malta 4945 tons, Isle of Man 700 tons, Channel Islands 8000 tons (after the United Kingdom).

nothing and consumed between 1,800,000 and 1,900,000 tons raw and refined sugars. Surveying the whole Empire, practically we were short of sugar in the Indian Group and the United Kingdom. Where was that to come from? A lot had been said about the West Indies. He was a West Indian himself, and had great sympathy with that part of the Empire; but he was also a sugar refiner and had to consider where he could get his sugar cheapest and best. No doubt some of them had seen a pamphlet issued by the West Indian Committee, stating that the West Indian Group could produce all that the Empire wanted; because Demerara could produce 2½ million tons, which was exactly the amount the Empire was short of to-day. It might be true that Demerara could and would produce it if the settlements were there, but what a long time it would take to wait for that! If they waited for that we should be flooded with foreign sugar long before Demerara was ready to supply. What they wanted to do was to get sugar where it could be got best and quickest and where labour was to be had and other natural conditions were favourable. Leaving out Demerara, there was not very much to be got from the rest of the West Indies. Barbados was supposed to produce 51,000 tons and was actually producing 65,000 tons. Trinidad was supposed to produce 60,000 tons and was producing 64,000 tons. Trinidad was getting to the top of her sugar production, and had rival industries, such as cocoa and oil, which took away somewhat from the inducement to produce sugar. The Windward and Leeward Islands now produced 40,000 tons and the West Indian circular said they might produce 67,000 tons; but that 27,000 tons was only a drop in the ocean compared with what was wanted, so there was only a problematical prospective amount from Demerara to help us. Jamaica was now producing as much as the West Indian circular said she could. He (the speaker) believed there was a possibility of her producing a great deal more, but it would take time. Canada might go ahead. She produced 18,000 tons of beet sugar at present and

SUGAR PRODUCTION IN ALLIED COUNTRIES.

Entered war	1913–14	1917–18
Serbia, 28 July, 1914 ..	6,500	—
Russia, 1 Aug., 1914	1,750,000	1,100,000
Belgium, 2 Aug., 1914 ..	230,000	120,000
France, 3 Aug., 1914, & colonies	914,430	338,000
Great Britain, 4 Aug., 1914 „	3,286,420	4,347,900
Montenegro, 4 Aug., 1914 ..	—	—
Japan, 23 Aug., 1914, & colony	204,000	397,620
Italy, May, 1915	328,330	100,000
Albania, Jan., 1916	—	—
Portugal, March, 1916, colony	34,000	50,000
Rumania, Aug., 1916 ..	34,760	—
U.S.A., 6 April, 1917, & colonies	2,030,360	2,080,985
Cuba, 7 April, 1917	2,597,730	3,446,085
Panama, 10 April, 1917 ..	—	—
Greece, 30 June, 1917 ..	—	—
Siam, 22 July, 1917	—	—
Liberia, 8 Aug., 1917 ..	—	—
China, 16 Aug., 1917 ..	—	—
Brazil, 27 Oct., 1917 ..	203,395	148,960
Central America—		
Guatemala, 24 April, 1918		
Costa Rica, 27 April, 1918	22,000	25,000
Nicaragua, 8 May, 1918		
Honduras, 19 July, 1918		
Hayti, 15 July, 1918	—	18,000
	11,641,925	12,172,550
Diplomatic relations severed—		
Bolivia	—	—
Santo Domingo	105,780	145,000
Peru	176,670	265,000
Uruguay	—	—
Ecuador	—	8,000
	282,450	418,000
	11,924,375	12,590,550

wanted 200,000 tons; but the conditions in Canada were not very satisfactory. They could not go ahead very much, because the beet did not yield anything like enough sugar to cover all the high expenses of that country unless there was very heavy protection. All this brought him back to India as a most important factor in this question. He believed the difficulties there were very great; the land was held by small people, each of whom worked his own little plot and produced his own sugar for his own consumption. But in one way or another the Indian peasantry wasted two-thirds or three-quarters of the sugar that the land might produce; they were satisfied with this result, and it was difficult to move them. He (the speaker) thought that the Indian Government should try, in the interests of India and the Empire, to educate its people into more satisfactory and less wasteful methods of making sugar. That also would take time, but he believed that in the canal districts of India, particularly in the Bombay Presidency, there were very great possibilities. Large factories could be put up on the spot. He was told they could get there 40 to 45 tons of cane per acre, as against 12 tons of beetroots in Europe. It was only possible for beet to compete with cane because it had the benefit of science in every department of the industry, which cane sugar, so far, had not, except in certain countries like Java and Hawaii. In those countries scientific methods had been adopted thoroughly, and they provided an object lesson to us as to what could be done with cane. Great things were possible in India if there were earnestness in the work and ample capital. He was told there was as much as 6½ to 7½ tons of sugar per acre in the cane actually grown in the canal districts of Bombay. That was what was being got in Java and Hawaii. It would take a long time for India to get much of such production, but the trouble about the other parts of the Empire that wanted to make sugar was that they really had not the people to put on the land to get the results they were aiming for. Queensland, for instance, had only one person per square mile, and Demerara 3½ persons—and of these a half were imported Indians—whereas British India itself had 224 people to the square mile. The sugar could be grown there, the labour was there, the cane made its own fuel, and there was available land; so it seemed to him that India was the place from which to get more sugar quickest. There was room in every Colony for an expansion of sugar production, but if we were to make up this shortage of 2½ million tons we had to be quick in making a good start; for all this was going to take time. The thing that concerned him most was the enormous cost of the factories. In pre-war times a factory would cost about a third of what it would cost to build to-day, and, unless there were to be big profits, guarded by protection, or preference, or something else, until these big capital costs were reduced materially, he did not think many people would care to risk their money in it. That would put the power of expansion rather with the countries that had gone ahead already, such as Cuba and Java. These could add a bit to factories already built, and the rest of the factory would not have cost them the high price of a new factory. He thought we ought to go where the people were. In India the present process was extremely wasteful, and that was where it was so hopeful if we could get the people to see the advantages of working in better ways. For instance, they did not get the proper yield from the land; their agricultural methods were old-fashioned. They did not use the right cane in many places, they did not crush all the juice out of the cane, and they did not manufacture the sugar properly. So the loss was terrible and the possibilities enormous. He would like people to think this subject over. In most of the

SUGAR PRODUCTION IN NEUTRAL COUNTRIES.

—	1913–14	1917–18
Mexico	130,000	40,000
Colon	—	—
Venezuela	3,000	15,000
Paraguay	—	—
Chile	—	—
Argentine	280,320	126,170
Morocco	—	—
Abyssinia	—	—
Spain	173,230	140,955
Switzerland	4,625	4,000
Holland	230,000	200,000
Borneo	—	—
Dutch New Guinea	—	—
Java	1,345,230	1,791,065
Sumatra	—	—
Surinam (Dutch Guiana)	14,000	10,010
Denmark	145,700	115,000
Sweden	136,770	125,000
Norway	—	—
San Salvador	—	—
Arabia	—	—
Persia	—	—
Afghanistan	—	—
	2,462,875	2,567,200

SUGAR PRODUCTION IN ENEMY COUNTRIES.

—	1913–14	1917–18
Germany	2,738,000	1,547,935
Austria-Hungary	1,710,000	750,000*
Turkey	—	—
Bulgaria	7,800	11,000
	4,455,800	2,308,935

* In future part of Austrian production must be included with Allies' sugar because the Czecho-Slovaks became Allies during the war. A large portion of the Austrian sugar crop was grown in Bohemia, of which Prague is the capital, Bohemia being the principal portion of Czecho-Slovakia.

BEET SUGAR PRODUCTION IN TONS AND PERCENTAGE OF TOTAL SUGAR PRODUCTION.

—	1913–14		1914–15		1915–16		1916–17		1917–18	
	tons	%	tons	%	tons	%	tons	%	tons	%
Germany	2,718,000	14·37	2,600,000	14·14	1,512,000	9·10	1,550,000	9·09	1,565,400	8·92
Austria	1,688,300	9·05	1,602,300	8·72	939,000	5·65	944,000	5·53	670,000	3·82
France	781,000	4·19	336,600	1·83	150,700	0·91	207,000	1·21	225,000	1·28
Belgium	229,000	1·23	204,000	1·11	113,100	0·68	135,000	0·79	130,000	1·74
Holland	231,400	1·24	302,500	1·65	242,800	1·46	269,200	1·58	200,000	1·14
Russia	1,688,000	9·05	1,977,600	10·76	1,671,000	10·06	1,325,000	7·77	1,100,000	6·27
Sweden	137,200	0·74	154,100	0·80	127,300	0·77	118,000	0·70	131,000	0·94
Denmark	145,700	0·78	153,000	0·83	125,200	0·75	113,800	0·66	120,000	0·68
Italy	305,600	1·64	150,200	0·82	150,400	0·91	140,000	0·82	100,000	0·57
Spain	169,400	0·91	77,700	0·42	103,100	0·62	125,100	0·73	115,000	0·66
U.S.A.	655,300	3·51	646,300	3·52	779,800	4·70	734,600	4·31	682,200	3·89
Canada	10,000	0·05	12,500	0·07	17,600	0·11	12,500	0·07	11,300	0·06
	8,783,900	46·96	8,216,800	44·71	5,932,000	35·73	5,873,200	33·86	5,050,600	28·87

countries that we were getting sugar from now, the yields were not so satisfactory as to encourage one to develop in those places if his statements about India were true. Hawaii produced a large amount of sugar; that was because they developed the industry well and extracted practically all the juice. He believed the cane contained from 13½ to 14½% of sugar, and they got it nearly all; so that Hawaii got 5 tons of sugar per acre, whereas Trinidad only got from 1 to 1¾ tons, Jamaica 1½ tons, and Antigua 2¼ tons. From Barbados 97% of the exports were from the sugar cane as sugar, rum and molasses. It practically lived on the cane and was the most thickly populated place on the face of the earth—having about 1125 people to the square mile—they did that on not more than 1½ tons of sugar per acre. He believed that labour there was cheap, but if they could get 5 tons to the acre what a difference it would make to that island! As to India, the bulk of the sugar grown there was grown in the north, where they got a thin cane and only got 1 ton of sugar to the acre. In the south, where a thicker cane was grown, they got, with their primitive methods, 2 tons to the acre; but, with better cane and better methods, instead of 2 they would get 4 or 5. Queensland only got 1½ tons per acre, Fiji 2¼. Mauritius was highly successful with 2, Natal got 2½ to 3, Egypt 1¾ and British Honduras 1 ton per acre. Such yields did not encourage the putting of a lot of money down. In these days, as factories were going to cost a lot, we wanted to put the factories where the conditions would give the biggest return. A place was wanted with plenty of labour, plenty of water, and good cane at hand. He was very much afraid that beet in this country could not compete with cane under those conditions; although it might make a small amount of the sugar we wanted, he did not see how we could spare the land to produce the 2 million tons of sugar that we were actually importing before the war. If we spared all that land for sugar we should have to import more wheat or more beef. On balance he did not know that we should be really better off. Of course India might be considered, in time of war, as the wrong place to depend on getting sugar from. We were shut off from Java largely during the war, and had to depend on Cuba because we could get the sugar from there in half the time and with half the ships. If we were at war again, to depend on India might be a mistake. The nearest tropical place in the Empire was the west coast of Africa, which was not very much farther off than the Baltic. It might be considered the wiser thing, therefore, if we could not produce a substantial amount of sugar at home, that we should grow cane on the west coast of Africa, and preferably in Nigeria; that would take a long time also, and West Africa was not a very healthy place to live in. All the same, the alternative deserves consideration. Everything pointed to

CANE SUGAR PRODUCTION IN TONS, WITH PERCENTAGE OF TOTAL SUGAR PRODUCTION.

—	1913–14		1914–15		1915–16		1916–17		1917–18	
	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%
Louisiana	261,300		216,700		122,800		271,300		217,500	
Texas	7,000		3,500		1,000		6,300		2,000	
Porto Rico	325,000		308,200		431,300		448,600		413,200	
Hawaii	550,000		577,200		529,900		575,500		510,000	
Cuba	2,597,700		2,592,700	14·14	3,007,900	18·11	3,023,700	17·73	3,350,000	19·53
St. Croix	5,800		4,500		14,800		7,800		7,500	
Philippines	225,000		243,000		332,200		210,000		273,300	
Total	3,972,700	21·30	3,945,800	21·47	4,439,900	26·73	4,543,200	26·64	4,773,500	27·19
St. Domingo	105,800		108,500		126,100		130,200		145,000	
Mexico	130,000		110,000		65,000		50,000		35,000	
Central America	22,000		22,000		35,000		25,000		25,000	
Total	257,800	1·38	240,300	1·31	226,100	1·36	205,200	1·20	205,000	1·17
Trinidad	47,300		49,100		64,200		70,900		45,200	
Barbados	33,400		32,600		65,000		55,000		55,000	
Jamaica	15,600		15,100		15,100		28,300		30,000	
Other W. Indies	24,000		24,000		35,400		30,000		35,000	
British Guiana	103,800		113,600		116,200		101,700		120,000	
British India	2,291,500	12·29	2,460,600	13·39	2,634,000	15·86	2,728,000	15·99	3,229,000	18·39
Queensland & N.S.W.	225,000		246,400		159,700		192,800		340,900	
Fiji	100,000		102,000		90,000		100,000		100,000	
Egypt	69,400		75,200		99,000		101,800		100,000	
Mauritius	249,800		—		215,500		209,200		224,000	
Natal	85,700		91,600		115,500		114,600		115,000	
British Colonies	3,275,500	17·56	3,487,900	18·97	3,609,600	21·73	3,732,300	21·88	4,394,100	25·03
Martinique	38,700		40,000		39,900		34,400		35,000	
Guadaloupe	38,900		40,000		34,100		36,200		35,000	
Reunion	35,800		39,300		45,000		42,200		50,000	
French Colonies	114,400	0·61	119,300	0·65	119,000	0·72	112,800	0·66	120,000	0·68
Dutch Guiana	14,000		12,000		13,000		15,000		15,000	
Java	1,345,200		1,303,000		1,198,600		1,596,200		1,791,100	
Dutch Colonies	1,359,200	7·29	1,315,300	7·15	1,211,600	7·30	1,611,200	9·45	1,806,100	10·29
Venezuela	3,000		3,000		7,000		15,000		15,000	
Ecuador	—		—		7,600		7,000		8,000	
Peru	176,700		175,000		250,000		276,000		265,000	
Argentine	280,300		330,000		149,300		84,100		88,100	
Brazil	203,400		240,000		194,000		300,000		375,000	
South America	663,400	3·56	748,000	4·07	607,900	3·66	682,100	4·00	751,000	4·28
Formosa	204,000	1·09	262,000	1·43	405,200	2·44	436,000	2·56	490,000	2·28
Mozambique	34,000		40,000		50,000		55,000		60,000	
Spain	13,200		7,400		6,400		6,000		6,000	
Total	9,894,200	53·04	10,155,700	55·29	10,675,700	64·28	11,383,800	66·74	12,505,800	71·03

India as being the place to consider first. It was the best place to operate from quickly, while letting all the other places expand as much as they could. Sugar did not seem a thing that in normal times could stand a very long freight. It might pay to grow sugar with a poor yield in a country that was near to you rather than in another where the yield was large but where there was a big freight to pay; and, consequently, outlying places might be able to grow sugar for their own wants despite poor yields because ships could not bring sugar cheaply to these distant places from a better and cheaper sugar country. But where sugar could be produced most cheaply it could be put on board ship and so be able to stand a higher freight, which might easily be the case of India.

WORLD'S SUGAR PRODUCTION

(arranged in Empires and Countries according to their importance).

—	1917–18 Tons
British Empire production—	
India	3,229,000
Australia	325,900
Mauritius	225,466
Demerara	120,000
Natal	106,250
Egypt	79,450
Fiji Islands	70,800
Barbados	65,230
Trinidad	45,256
Jamaica	34,300
Canada (beet)	11,250
Antigua	9,409
St. Kitts	8,846
Other British West India Islands	16,745
British	4,347,902
Cuba	3,446,083
United States—	
U.S.A. (beet)	632,867
Hawaiian Islands	515,035
Porto Rico	405,174
Philippine Islands	253,000
Louisiana	217,499
St. Croix	5,400
Texas	2,009
American	2,080,984
Holland—	
Java	1,791,064
Holland (beet)	200,000
Surinam	10,009
Dutch	2,001,073
Germany (beet)	1,547,935
Russia (beet)	1,100,000
Austria-Hungary (beet)	750,000
Japan-Formosa	397,618
France—	
French (beet)	220,000
Réunion	50,000
Martinique	40,000
Guadeloupe	28,000
French	338,000
Peru	265,000
Brazil	148,958
San Domingo	145,000
Argentina	126,171
Belgium (beet)	120,000
Spain (beet) 134,955	140,955
,, (cane) 6,000	
Sweden (beet)	125,000
Denmark (beet)	115,000
Italy (beet)	100,000
Mozambique-Portuguese	50,000
Mexico	40,000
Central America	25,000
Hayti	18,000
Venezuela	15,000
Bulgaria (beet)	11,000
Ecuador	5,000
Switzerland (beet)	4,000

Discussion.

Sir Francis Watts (Imperial Commissioner of Agriculture for the West Indies) said that he was very largely interested in the sugar industry. He had seen the sugar industry of certain Colonies go down almost to the point of extinction, when those who were concerned were agitating themselves as to what other industry they could substitute to make a living. Since then he had seen the industry in a state of great prosperity as the result of the necessities of this country. We in this country had created that condition for ourselves and had done it deliberately. We had nearly killed the West Indian sugar industry; had we killed it entirely our necessities to-day would have been even greater than they are. He saw the following reference to the British West Indies in the Report just presented to the meeting:—"The agricultural industries of these valuable and productive islands were allowed to languish up to about 20 years ago, and had it not been for the timely aid of the British Government, who recognised the position at the time just referred to, disaster would have overtaken them." It seemed to him that it would have been more fair to say that the disaster had been created by this country, which only stepped in as a last resort in order to prevent what would have been a national disgrace. Those who were interested in sugar knew that we had received sugar in this country from hostile countries—then hostile in intent, and since openly hostile to a degree which shook this nation to its very foundations—and that that hostility had been manifested in sugar for many years, with the deliberate intention of endeavouring to get hold of and control the sugar industry of the world, and to use the shortage of sugar as a war measure to starve this country into submission, which it very nearly did. We had at times bought sugar from £2 to £3, or possibly £4, a ton below the cost of production. We had done that deliberately and gloried in it; saying we intended to buy the sugar from Germany and Austria, and that if they were so foolish as to give this country £2,000,000 a year by supplying sugar below the cost of production, we should be extremely unwise not to take advantage of that fact. We had taken advantage of it, and were now paying millions where we had saved pounds. We were paying for it to-day and were not yet out of the wood. Mr. Macdonald, who had just spoken, included Indian sugar in the sugar produced within the Empire; this was quite correct, but while it swelled enormously the return of Empire-grown sugar it must be remembered that India imported rather than exported sugar, and it was a very open question whether India could be induced to produce so much sugar as to supply her own needs, apart from the question of having a surplus for export to the Mother Country. Coming to the question which concerned this country, we found that nearly 2 million tons of sugar had to be found annually in order to satisfy its needs. How was that sugar to be produced within the British Empire? India might be left out for the moment, it was an importing country; Australia, Fiji, and New Zealand might be left out; they were not exporting countries, so far as this country is concerned, but a group supplying their own needs. Canada was an importing country. What remained? Where were we going to get Empire sugar now from British tropical countries? There were but few left that still produced sugar. Why? Because the condition of the sugar industry had been such that no people would venture to put money and machinery into the parts of the British Empire where sugar could be produced. So we were left relatively destitute. Whether we could by a vigorous effort, well thought out in this country, produce Empire sugar, rested with the

politician. From the very beginning sugar had been the sport of politics, and those countries which had built up their sugar industries into a powerful position had done so on a political basis, while this country had destroyed its sugar industry on a political basis. That was where we stood to-day, and what were we going to do which might induce people to venture money into new countries for new sugar? He doubted whether we could, or would, do anything. When those who were interested in sugar in the tropics pleaded for a better consideration of sugar, they were told they were pleading for their own interests and the opportunity of making more money. He did not wish to cloud the issue by talking of sugar vaguely from the Imperial point of view, but wished to concentrate attention on sources of supply for Great Britain. If Australia, Canada and other places were left alone, they looked after themselves very well as regards supplying themselves with sugar. They were not in the same position as the Mother Country. Australia had a heavy protective tariff on sugar; Canada had countervailing duties and anti-dumping clauses in her tariff Acts. Her supply from the West Indies was comparatively safe. It was this country which was dependent on outsiders. If we were to produce Empire sugar, if we were to open up new areas in sugar-producing countries, either we had to do it by the expansion of the existing industries, or we had to make new ventures with new land and new capital. The survey which had been made that morning showed that British Colonies producing sugar, even if they expanded their existing interests very considerably, would make little impression on the amount of sugar to be supplied to this country. The present British West Indian and British Guiana productions only supplied the Canadian need, so that if these supplies were diverted to Great Britain, some other source of supply had to be found for Canada. The British West Indian production, with which he was more particularly concerned, could be increased; but it could not be increased to a degree which would make any very appreciable impression upon the quantity wanted in this country. It had been said that British Guiana could produce 2 million tons of sugar, but, as a matter of fact, British Guiana would not produce anything like that. It produced to-day 120,000 to 130,000 tons of sugar, and it would need a very considerable effort even to double that. It was a country of 95,000 square miles, much of it forest, much of it unexplored, and it was not wise to talk of the 95,000 square miles of country producing sugar; because there were no facilities. There was no opening up of land and no labour to do it. British Guiana could double her output in a short time if the labour position could be adjusted. The whole question depended on labour; given the labour, capital might come and an increased output of sugar would follow. Further north, Trinidad was developing its sugar industry, and he believed that under the stimulus of high prices it might double its present production. This was only some 60,000 tons; so that doubling that would not go far towards meeting this country's requirements.

WORLD'S SUGAR PRODUCTION

(arranged according to Continents).

—		Before the war 1913–14	After war 1917–18
		Tons	Tons
North America—			
Louisiana	U.S.A.	261,337	217,499
Texas [1]	„	7,000	2,009
Porto Rico	„	325,000	405,174
Hawaiian Islands	„	550,925	515,035
St. Croix (West Indies)	„	5,800	5,400
Cuba		2,597,732	3,446,083
Trinidad	British	47,251	45,256
Barbados	„	33,267	65,230
Jamaica	„	15,583	34,300
Antigua	„	—	9,409
St. Kitts	„	—	8,846
Other British W.I.	„	24,000	16,745
Martinique	French	38,730	40,000
Guadeloupe	„	39,920	28,000
San Domingo		105,780	145,000
Hayti		—	18,000*
Mexico		130,000	40,000
Central America		22,000	25,000
U.S.A. (beet)	U.S.A.	655,298	682,867
Canada (beet)	British	10,007	11,250
South America—			
Demerara	British	101,725	120,000
Surinam	Dutch	14,000	10,009
Venezuela		3,000	15,000
Ecuador		—	8,000
Peru		176,670	265,000
Argentina		280,320	126,171
Brazil		203,395	148,958
Total in America		5,648,740	6,454,241
Asia—			
British India	British	2,291,500	3,229,000
Java	Dutch	1,345,230	1,791,064
Formosa	Japanese	204,000	397,618
Philippine Islands	U.S.A.	225,000	253,000
Total in Asia		4,065,730	5,670,682
Australasia—			
Australia	British	255,000	325,900
Fiji Islands	„	100,000	70,800
Total in Australia		355,000	396,700
Africa—			
Egypt	British	69,370	79,450
Mauritius	„	249,800	225,466
Réunion	French	35,780	50,000
Natal	British	85,715	106,250
Mozambique	Portuguese	34,000	50,000
Total in Africa		474,665	511,166
Europe—			
Germany (beet)		2,738,000	1,547,935
Austria-Hungary (beet)		1,710,000	750,000
France (beet)		800,000	220,000
Belgium (beet)		230,000	120,000
Holland (beet)		230,000	200,000
Russia and Poland (beet)		1,750,000	1,100,000
Other Countries (beet)		796,700	500,000
Spain (cane)		13,231	6,000
Total in Europe		8,267,931	4,443,935
World's production		18,812,066	17,476,724

[1] 1915–16.

CONSUMPTION OF SUGAR PER CAPITA.

Country	Population 1914–15	1912–13	1913–14	1914–15
		lb.	lb.	lb.
Germany	68,000,000	49·26	45·13	74·95*
Austria-Hungary	52,300,000	28·14	29·17	37·38
France	39,610,000	43·47	43·85	39·01
Russia	136,210,000	24·31	25·43	29·26
Belgium	7,500,000	39·20	36·08	42·79
Holland	6,230,000	40·90	50·09	53·44
Sweden	5,645,000	57·09	57·73	60·48
Norway	2,430,000	45·83	46·64	60·37
Denmark	2,770,000	98·16	95·57	93·48
Italy	34,750,000	11·05	11·68	10·45
Spain	19,720,000	15·62	14·19	15·91
Roumania	7,605,000	8·89	9·26	17·12
Finland	3,155,000	32·54	32·65	32·54
England	46,600,000	95·52	93·37	89·69
Bulgaria	4,950,000	7·83	9·61	9·94
Greece	4,270,000	11·57	7·68	8·99
Servia	4,500,000	9·33	10·03	4·60
Turkey	21,650,000	19·84	21·93	20·35
Portugal	5,990,000	13·57	14·70	13·69
Switzerland	3,850,000	77·24	73·55	74·31
All Europe, average	477,735,000	36·61	36·83	41·73
United States	101,577,000	85·04	89·14	88·04

* The large increase in the German consumption is probably temporary, as owing to the war exports were stopped and sugar was taken into consumption to replace fats and other foods.

Barbados could produce practically but little more sugar: the island was tilled from end to end, there was not a neglected foot in it: with 1100 people to the square mile, it was a hive of industry and practically producing all it could. The other islands were the Leeward and Windward Islands, which, in the aggregate, only produced about as much as Barbados or Trinidad. If their production was doubled, that would add greatly to the prosperity of their inhabitants, but it would not be very important from the point of view of supplying sugar to this country. The only island left unconsidered in the West Indies was Jamaica, which at the present moment was only producing some 50,000 tons of sugar. With a little effort it might produce 100,000 tons of sugar and with an extensive effort 200,000 tons. Mr. Macdonald had raised the point whether it would be prudent in Jamaica to substitute sugar for another industry, but another 50,000 tons of sugar could be grown in Jamaica without diminishing any other industry whatever. It might be possible to grow the 200,000 tons of sugar by alternating with other industries, and, perhaps, to some extent benefiting them. Jamaica depended very largely on the banana crop. This was very uncertain, as all fruit crops were. The plant was liable to damage by wind storms, which, because of the destruction they caused, might be called hurricanes; for it frequently happened that a man would lose his whole crop by a wind which was of not much more force than one of our ordinary winter gales. The banana planter had to be content with years of loss and years of high profit; and it would be an advantage to him if he could alternate sugar with the bananas. It would be excellent for both industries, for the alternation of sugar with bananas would lead to cleaning up of various insect pests and fungus diseases which troubled the different crops. He believed that both would benefit and would be increased in output. He looked to Jamaica as the principal place in the British West Indies for a material increase in Imperial sugar. The other islands and British Guiana would increase, but he doubted if the effort would be very material when judged on the basis of British needs and requirements. Our immediate shortage had to be made good without delay, and it would, he anticipated, be made good by non-British countries. There was no good disguising the matter; we could not start a sugar industry in 6 months. In matters of sugar the unit of time was 3 years. Therefore, as we were going to consume sugar in this country, we were going to buy much of it from non-British countries. We were going to buy foreign sugar because British sugar would not be there to buy—Cuba, San Domingo, and Java would be the great suppliers. Moreover, these were producing their sugar on capital charges of about half of what the capital charges would be for new ventures. Therefore, unless there was some measure of assurance given to those who wanted to produce British sugar, they would be ousted by foreign sugar—not coming from enemy countries but from neutral ones—before the Empire sugar came into existence; because of the fact that capital was already invested in sugar enterprises in those countries, and it would be a mere natural expansion, whereas with us, it would be a question of finding new capital and new lands, under conditions which, at the moment, were most disadvantageous. It would cost from £2 to £3 a ton of output more to-day to equip a new British sugar enterprise than to develop a Cuban, Porto Rican, or San Domingan one; and unless something was done here to give stability to the industry, we should not see much additional Empire-grown sugar. He might be told that it was under discussion now, and probably would be acceptable to this country, to give preferential treatment to British-grown sugar by remission of duties to the extent of £3 or £4 a ton. That meant that British-grown sugar coming in to-day or next year would receive preferential treatment to the extent of £3 or £4. Therefore it was estimated that the British

IMPORTS OF SUGAR INTO THE UNITED KINGDOM.

(Board of Trade Returns.)

—	Year ended 31 Dec., 1913	Year ended 31 Dec., 1918
Imported into U.K.—Refined Sugar.	Tons	Tons
From—		
Russia	2,939·8	·05
Germany	465,453·2	—
Netherlands	178,566·6	6,002·75
Belgium	49,764·4	—
France	26,571·8	12·0
Austria-Hungary	198,063·85	—
Java	—	492·95
U.S.A.	—	5,276·1
Argentine Republic	—	82·75
Other Foreign Countries	894·85	—
Other Foreign Countries in Europe	—	·65
Other Foreign Countries not in Europe	—	165·75
Mauritius	—	4,170·65
Channel Islands	—	·05
Gibraltar	—	9·45
Egypt	—	2·1
Cape and Natal	—	108·25
India	—	424·90
Ceylon	—	163·1
Hong Kong	—	1,032·9
Australia	—	403·05
New Zealand	—	337·25
Canada	—	559·6
British West India Isles	—	2,303·7
Demerara	—	3·35
British Dominions	290·25	—
	922,544·75	21,551·35
Foreign	922,254·5	12,033·0
British	290·25	9,518·35
Imported—Raw Sugar.		
From—		
Germany	472,026·0	0·6
Netherlands	11,207·7	7,691·2
Belgium	2,466·15	—
France	17·9	—
Austria-Hungary	160,858·45	—
Java	98·95	186,192·7
Cuba	224,227·3	823,900·7
Dutch Guiana (Surinam)	4,606	3,011·55
Hayti and San Domingo	9,412·45	—
Mexico	4,134·25	—
Peru	27,486·75	41,695·9
Brazil	5,132·75	8,325·1
Portuguese East Africa	—	1,980·8
U.S.A.	—	3·45
Costa Rica	—	336·15
Venezuela	—	575·8
Chili	—	2·1
Argentine	—	·7
Other Foreign Countries	53,310.55	—
Mauritius	20,075	94,417·55
British India	3,850·25	41·7
British West India Isles, British Guiana and British Honduras	47,735·6	59,490·75*
Cape and Natal	—	3·25
Ceylon	—	6·0
Demerara	—	56,423·1
Other British Dominions	68·6	—
	1,046,714·65	1,284,099·10
Foreign	974,995·2	1,073,716·75
British	71,729·45	210,382·35
Total Imports—		
Foreign	1,897,239·7	1,085,749·75
British	72,019·7	219,900·7
	1,969,259·4	1,305,650·45
Imported, refined, consumed	899,326·8	43,897·75
Imported, raw, consumed direct	116,942·15	158,229·5
British refined, consumed	715,660·85	738,142·2
Total consumption	1,731,929·80	940,269·45

* British West Indies only.

producer would get that much advantage in the price of sugar. But it was not quite certain that he would. The working out of preferential treatment in other things was often obscure, and it appeared that the preference which was supposed to go to the producer often stuck midway and did not reach him. Even with the present stress and need he (the speaker) did not look for more than three-quarters of the preference to find its way to the producer. If it did, to what extent would it stimulate the investment of new capital? Probably to a very moderate extent. He believed the intention of granting that preference was to stimulate investment; but for a preference to stimulate investment in a business whose unit of time was 3 years, there must be some assurance that the benefit would extend over at least 10 or 15 years. No man would invest in a sugar enterprise because for the next 2 or 3 years he might make large profits and for the next 10 or 15 years a bare margin. The amount of capital to be invested for new sugar enterprises was enormous; to put up a modern sugar factory making 10,000 tons of sugar a year, with the railways and everything else necessary, would cost £400,000, or £40 per ton of output. It could not be suggested that one should provide less than 10% for interest and sinking fund—6% for interest and 4% for sinking fund—therefore there would be a dead overhead charge of £4 a ton, even assuming that the factory could be worked every year up to the capacity designed; an assumption which was not always realised. If the factory worked to only half this capacity, owing to drought, accident, or other trouble, there would be an overhead charge of £8 a ton. That was what the investor was faced with. If this preference was capable of being assured for a considerable period of time, people would invest and there would be British sugar. If it were not assured, this market would get most of its requisite supply of 1½ to 2 million tons from benevolently disposed but none the less foreign competitors.

Dr. J. A. VOELCKER said that experiments to test the respective yields of mangolds, swedes and beets were all-important to the agriculturist; because, after all, these things resolved themselves into a question of which crop paid best. In the past, agricultural experiments had shown thoroughly that England possessed a climate which enabled the sugar beet to grow well. It had also been shown that by careful cultivation more of the kind of roots that the manufacturer wished to have could be produced. But when all was said and done what the agriculturist wanted to know was what it would cost him to grow the particular kind of root that the sugar manufacturer wanted; and this resolved itself into a matter of comparison as to whether he could grow that small acreage of sugar beet and get a better profit thereby than by growing his ordinary crop of mangolds. Whether you would get a big crop or a small one was a question of experiment, as was also the matter of manuring, and the percentage of sugar to be obtained from the beets. There were other questions united with these which were of extreme importance when considering the whole question of sugar beet growing. There was the fact that by sugar growing we produced another and very important food supply for cattle—a subject of enormous importance at a time like this. Had we the residue from sugar beet factories to keep our cattle on, as they had in Germany, a very great difficulty would be partly solved for us. Further, there was the great question of the larger employment of agricultural labour and of the land—the possibility of doing as they did in Germany and France, having a large population on the land occupied in growing sugar beet. The main question was a political one—what was going to be the agricultural policy of our Government in the future? Were we going to aim more and more at being a self-supporting country, or were we to be supplied by other countries—our Colonies and elsewhere—and depend on the Navy to protect our shores? That was, to his mind, the main problem. He had lived in India, and he agreed with Mr. Macdonald that that country was capable of producing a much larger quantity of sugar than was now the case. There was great waste there in the production, manufacture and further preparation of sugar, and there should be a larger outturn; but, after all, why should we look entirely even to India when we had the possibility of having in our own land such a grand source of supply of sugar as we had in sugar beet cultivation? As to the suggestion made by Mr. Macdonald, that we had not land enough in this country; if the farmer found it paid him better to grow a sugar beet crop, he would be quite ready to give up to it some of the land on which he grew corn and other crops at a considerable loss. If we had the sugar beet industry fostered by the Government there would be more food for stock as well as more sugar for the people.

The CHAIRMAN said that he agreed with Dr. Voelcker. It was very necessary to carry out these comparative experiments in order to induce the British farmer to alter his methods, and, at the same time, we had got to make him understand that growing beet for sugar was a proposition to be looked at in a different way from that of growing mangolds and swedes for cattle feeding purposes. Another matter that he thought ought to be called attention to had been brought to his mind by a remark made by Mr. Macdonald, who had pointed out that the population per sq. mile was in the United Kingdom 374, in Germany 311 and in France 193. With our dense population we had to remember how much wheat area we could sacrifice. But he believed that with beet cultivation it was not a question of growing less wheat but more wheat. He remembered going to the Magdeburg district in Germany and staying there two or three days about three or four years before the war. He had looked into this question then, and had been assured that their wheat production would go down about 10% if they gave up growing sugar beet. The question they had to solve in this country was whether it would not be more profitable to have less grass land and more arable land. A great deal of land had been allowed to lapse into inferior grass in bad times, and the question was whether that land could not be made profitable by working in beet cultivation—having more land under the plough and a considerable proportion of that sugar beet. He believed it was largely a question of labour and enterprise on the part of our agricultural community. A few months ago he was at Cologne, and had taken the opportunity of going over a large sugar factory treating about 12,000 tons of roots per year. The manager had shown him round, and he (the Chairman) had asked the manager what he thought about the production of beet sugar in England. The reply had been, "You will never produce beet sugar in England. Your people will never take the trouble to learn."

Mr. ARTHUR R. LING proposed a vote of thanks to the Chairman, which was heartily accorded, and the Conference adjourned until the afternoon.

When the Conference reassembled the Chair was taken by Mr. J. W. Macdonald.

Mr. HAMEL SMITH said that about 18 months ago he had published a little pamphlet entitled "The High Price of Sugar," which was based mainly on the question of production in India. Dr. Barber had written to him on the subject

several times, and the essence of his remarks had been that up to the present India had been a producer of gur, not sugar. Dr. Barber had been striving to get a sugar industry started. He (the speaker) thought that it was not a question of area but one of handling the canes and avoiding the present losses. It seemed that with proper methods India could add another 2 million tons of sugar to her annual output. The trouble was that the native stuck to his gur and did not want to make sugar, but from reports he had read during the last 4 or 5 years, it appeared that the sugar was there, but those who handled the canes wasted 50% of the sugar.

Mr. SANDBACH PARKER said he was mainly interested in British Guiana. He knew the possibilities there were immense, as had been shown in the Report, and as had been previously shown in the Report issued by the West Indian Committee some years ago. But there were very great difficulties. First of all there was no labour now. Labour could be got when security for the industry was finally established and the country was proved to be as attractive for sugar growing as any other part of the Empire. In considering the development of the production of sugar in the British Empire it should be remembered there was an immense expansion to be made; there were immense possibilities in those parts of the Empire where sugar was indigenous, and it was a matter of obtaining the other necessary conditions. The primary natural conditions were a good and ample labour supply, a good and ample water supply and the requisite soil. We knew sugar was indigenous almost throughout the tropical belt of the British Empire so we had the land suitable to grow sugar. With regard to the remarks that had been made as to the extraction of the sugar from the cane, it was largely a matter of the amount of capital that you were prepared, and that it was economically sound to put into the manufacture of sugar. In tropical regions the value of the land was, as a rule, very small. The question of what you got out of the land varied considerably with the cost of the supplies—the manures and so on—that you had to put in in order to get a good yield. In British Guiana they were suffering severely from a great falling off in yield, partly due to a very severe drought last year, but also very largely due to the fact that their supplies of manures had been almost completely cut off for three years. The sugar part of the country had been in cultivation for the best part of 100 years, so sugar could not be produced without fertilisers. As concerned the extraction of the sugar from the juice that came out of the cane, in India they got a very small return, but it had to be borne in mind that the larger return depended chiefly on the capital that was invested in machinery. In Hawaii they got a very large return because they had had for over 20 years free entry into the United States, and had a protection of some £8 to £9 per ton in that way. Therefore they could with confidence invest in the very latest and most modern machinery for extracting the very last unit of sugar out of the cane and out of the juice in the cane. But this did not pay in other countries. As long as there were quantities of virgin land capable of producing a crop, although of a low yield per acre, it was a matter of calculation whether it would pay a company or a government to invest the large sums which would be required at the present time in machinery and manures for intensive cultivation. In Cuba intensive cultivation was not carried on. The bulk of the Cuban crop, which averaged 2¼ tons or less to the acre, was grown without manure at all. It had been maintained at that level by wonderful virgin soil which had been coming into cultivation. What had been done there was to put up the very finest machinery for the extraction of the maximum of sugar from the cane. Compared with Hawaii, the best properties in Cuba yielded less than half or even no more than a quarter as much per acre. In British Guiana they got a yield in normal years of 1¼ to 2 tons, but the best estates there had got and maintained over a series of years a production of 2¼ tons per acre. That was done largely by good factory production. There were in British Guiana factories of which he would not say that they were second to none; but, considering the conditions under which they had been working for the last fifty years, they were astonishingly good and bore very favourable comparison with any factory production in the world. But in British Guiana they had a by-product of considerable value —that was rum. They were often criticised for not being up to date in the extraction of sugar from the cane, but it would never pay them to get the very high recovery of sugar from the juice obtained in Hawaii where there was no by-product. Conditions varied in different countries, what we had to consider in the development of the Empire in future was where we should get the best value for the capital invested in the industry. This might be in Africa where land was cheap and labour plentiful. In a small place, like Barbados, if labour was plentiful it might pay to cultivate fairly intensively, but you could not lay down a rule and say that because in Hawaii they average 4 or 5 tons to the acre, therefore it was going to be economically sound to endeavour to get that throughout the British Empire. He agreed, however, with Mr. Macdonald that in India sugar was not manufactured in a very economical way. What the difficulties were in bringing it up to a modern system he was not sufficiently acquainted with in India to know. But if you choose to put the money into the cultivation of the soil and the factories it should be possible to improve the yield to something like 2 tons to the acre, and more in some places with adequate irrigation. But it was no use laying down a hard-and-fast rule. All he could say about British Guiana was that a very small proportion of the land eminently suitable for the production of cane sugar in that country was under cane sugar to-day. The reason it was impossible to go ahead there was because they had no labour available, and the supply from India had been cut off for 4 years entirely. They had to replace that labour by making arrangements for getting labour under free conditions into the Colony, and he was satisfied that if that Colony was shown to be likely to give the best results agriculturally in the production of sugar it would be to the interests of the Imperial Government to assist in getting the labour necessary to make that development. But, obviously, it could not go so quickly as in India, where the sugar industry was already established on a very large scale. In India they had the land under sugar cultivation. They were there getting a very bad return. They could improve that return by the application of modern methods and fertilisers, and by erecting modern factories. These were mainly matters of money, and Mr. Macdonald was probably right when he said that the quickest way to begin the development of the British Empire production of sugar was in India itself; but India was not likely to be in a position to export sugar to this country for some considerable time, because they had themselves to import 500,000 to 800,000 tons of sugar for their own consumption. It would take some years to double the production in India, which would probably be necessary in order to allow any large portion to be exported to the refiners of this country.

Sir ALFRED CHATTERTON said that he would first remind the audience that 50 or 60 years ago India

had exported sugar largely to London. Towards the end of the "fifties" that had fallen off, and, since the beginning of this century, the demand in India for sugar, owing to the growing wealth of the country, had increased largely, and any estimates that were made as to the future production of India and the possibilities of exporting sugar, had to take account of the fact that there were 315 million people in the country, and that their consumption of sugar per head was comparatively small, and was likely to grow very rapidly. There was no doubt whatever that it would be possible very largely to increase the yield of sugar from the land already cultivated in India, and to bring a considerable area of new land under cultivation, but with the economic conditions which now existed in that country it was hardly likely that within any reasonable period there would be a surplus of sugar available for export. Of course it was all to the good that India should not go on to the markets of the world for 800,000 or 1 million tons of sugar per year, so it would ease the situation a great deal if we could bring about a large expansion in the production of sugar. It had been mentioned that the yield of sugar from the cultivation was very small, which fact was largely due to bad cultivation and bad methods of extracting the sugar from the cane after it was grown. He had himself seen in a good year large areas of sugar cane in good condition allowed to rot and finally to be burnt on the ground, because the power available for crushing the cane was not sufficient, and at the present moment there was no possibility whatever of any extension of sugar cane cultivation, unless it was accompanied by the introduction of mechanical appliances for dealing with the cane. It took a pair of bullocks about three weeks or a month to crush the cane growing on an acre of land, and there were already more than 3 million acres of land under cultivation. That was really the crux of the situation, that before anything could be done very largely to increase the yield of sugar they must introduce mechanical appliances. This was being done, though not on a very large scale at present, but a good deal of experimental work had been got through, and the course that should be pursued in regard to these matters was pretty clear. The difficulty that the ryot had was the lack of cattle power, and that was the reason why there was no expansion of sugar cane growing. With his cattle he extracted about two-thirds of the juice he might extract, and produced usually an inferior kind of jaggery which would not keep. The result was that he did not get the benefit he might get from sugar cane cultivation. When circumstances were favourable it was probably the most profitable crop he could grow, but usually circumstances were not favourable, so the area under cane cultivation at the present time tended to diminish, owing to the increased value of other crops. Very large areas in Bengal had been thrown out of sugar cultivation because of the increased rates which had been obtained for paddy and jute. That had to be borne in mind, for the ryot was a very keen man in estimating the exact value of the crops to be got from his land, and he changed from one to the other as circumstances dictated. Most of the jaggery that was made by the ryot came on the market all at one time, and the dealers who took over the crop bought it comparatively cheaply, and had to dispose of it fairly quickly. The result was that there were violent fluctuations every year in the price of jaggery. At the time of the crop going on the market it was very cheap, but later in the year the price rose very rapidly. If the ryot could obtain anything like the average price for the year it would be a much more profitable crop to him than it was. To get over this difficulty methods of manufacture were necessary which would produce a better quality of jaggery, a jaggery which would keep better. If the jaggery could be kept in store for any length of time it would be possible for the banks and other people interested in money matters to finance it, so the sooner the quality of the jaggery was improved, the sooner the ryot would make more profit and be able to extend the area which came under cultivation. There was no prospect whatever at the present time of any very large increase in the number of sugar manufacturing plants. The growth of cane over the country was very diffused. There was scarcely any part of the country that did not grow cane, but there were very few parts where you found 5 per cent. of the area under that cultivation. The result was that it was impracticable except in a few areas to bring cane to the mill; the difficulties in transport were too great. To achieve any large result they had to go through an intermediate stage. They had to encourage the ryot to grow cane and find the mechanical means to use it. They were using comparatively small power driven mills, worked with oil engines or suction gas, and these mills yielded 25 per cent. more juice than the country mills. The mill was set up by the Government; the ryot brought his cane to the mill, and it was made into jaggery. This was returned to him, and he paid a certain percentage of the price obtained for the jaggery to the Government for running the mill. In this way the ryot was encouraged to put under cultivation an increasing area of cane every year. In consequence of the growing of cane there would be a concentration into areas where water was available, and some day it would be possible to substitute for those small mills much larger mills in which to make the sugar.

Professor CARMODY said that he had been connected with Trinidad for a great number of years. The sugar position was fairly clearly represented in the report that had been prepared, and he was sure that a great deal of benefit would result from the compilation that had been made by this Society, which he wished to congratulate for going outside what might be considered the ordinary province of a scientific society. One point he would mention was that of the source of sugar. He could not very clearly understand why such serious efforts should be made in this country to obtain sugar from beet. He could quite understand it if we had no tropical possessions, or if we had no tropical possessions in which the cane sugar industry was already established. But there was this fact that it was firmly established. It had remained in existence in spite of the severest, most unfair, and most strangling competition that any industry had ever had to face. In spite of all, the cane sugar industry of the British Empire was still alive. He took it that it was the intention of this Society to find some means of producing within the Empire the 2½ million tons of sugar required, and that it was immaterial whether that sugar was produced from cane or from beet; and having an established cane sugar industry within the Empire it seemed to him that any expenditure that we might incur would be most profitably incurred in furthering the improvements in the cultivation and manufacture of cane sugar. If they took the case of beet, he need not mention that beet sugar up to a certain state of refinement was an unsaleable product, whereas the negro in the field, or the East Indian labourer, sucked the raw cane juice, and throve on it. When they made their sugar up to 98 or 99 per cent. he was quite satisfied in his own mind that it was a better product than the same quality of sugar derived from beet. He thought the efforts being made to establish a beet sugar industry, taking into account the difficulties to be met with from farmers, the great difficulties of the last 10

years, and seeing that our agriculture was not in need of a beet sugar industry—for the agricultural industries of this country were thoroughly productive at the present time—he would say that if we were going to expend money in research for sugar production, it should be expended in the British Colonies where cane was produced, and where we had no trouble but to go on and improve, rather than in this country where we had great obstacles to face, and perhaps would continue to have for the next 25 years. The manufacturers of high grade sugars in the Colonies did not want to produce a sugar of higher than 98½ per cent. polarisation. Otherwise they came in for a slightly increased rate in the sugar duty. In their best factories they had no difficulty in producing a sugar of 98½ per cent. purity, and that sugar would come into direct consumption without refining, for which reason the manufacturer would obtain a somewhat higher price for it. But, in order to reduce the duty to a small extent, the manufacturer was required to produce a sugar of about 96 per cent., and if he made a mistake and produced a sugar of 98 per cent. he mixed that with an inferior sugar to bring it down to the scale of 96 per cent. That reduced the market value of the sugar, because when sugars were mixed the colour was not uniform. Such sugar had to be sold to the refiner and had to be refined. After their war experiences it might be that in some cases people had become accustomed to eat any kind of sugar, but before the war it would have been regarded as inferior. There was no doubt whatever that in some parts of the Empire where the production of sugar was small at the present time, it would be possible to develop the industry, but the West Indies could not be developed rapidly. They could be developed slowly, but the question of labour was a very serious problem there. A deputation, he believed, had arrived in this country from British Guiana for the purpose of influencing, if possible, the Government to return to some system of immigration which would help the labour problem in British Guiana. That problem was a serious one in nearly all the West India Islands, although in Trinidad they had got over it to a certain extent. At the time when they were hardest pressed by the bounty system, and sugar estates were disappearing one by one, they had found the only way of keeping their heads above water was to introduce a system of cane farming, by which the farmers were encouraged to grow canes and sell them to the manufacturers. Estate owners could not possibly grow canes at the price paid to the farmers, and there was the further advantage, if there was a loss, that it was divided among a great number, and did not fall entirely on one estate. When the losses, which were of frequent occurrence in those years, fell upon a single estate, it meant bankruptcy. That had been avoided by the system of cane farming, and that was a system which might be extended to other countries. The cane farmer felt to a certain extent an independent man. He was his own master. He sold his canes to the nearest factory, or any other factory which gave him a higher price, and it had been found fairly satisfactory in Antigua and St. Kitts that a carefully managed central factory, working in conjunction with cane farmers, could be worked at a reasonable profit. The sugar factories there were only established about 10 years ago, and in both islands were in a satisfactory condition. With regard to India, in order to improve the cultivation and manufacture there, capital and machinery must be available to improve matters, which constituted a difficult problem, but he agreed with Mr. Macdonald that India was the place where we were likely to produce results much earlier than in any other part of the Empire. In many parts of the Empire—in Queensland, the West Indies, Demerara, Mauritius, and elsewhere—they had practical men, not only with experience in the field but in the factory also, who would be able to take charge of those small establishments in India, and carry them through during the first 10 years of struggle for existence. By that time larger machinery would probably be introduced, and capital would be available. There was no question of labour, and the great needs were capital, machinery, and scientific assistance. The question of haulage was a very serious matter, and would have to be taken into consideration. He understood the report before the Conference was only a preliminary one, but he congratulated the Society upon having entered this fresh field, and he hoped that some parts of the Report would be reconsidered before being finally published. Some statements in it were misleading to one who had no knowledge of the industry. He might mention the point where the yield of sugar in Hawaii was given as 7 or 8 tons to the acre. That might mean two years' cultivation, and cultivation under irrigation of the most elaborate kind, and, if that was so, the yield was 4 tons to the acre; not very different from what was produced in the West India Islands, where they produce 2½ to 3 tons fairly regularly. Another yield was given in Demerara as from 10 to 60 tons to the acre of cane. He would like further inquiries to be made into that to ascertain whether that 60 tons was from an experimental plot.

The CHAIRMAN said that he thought it meant the first crop from virgin land. The 10 tons was probably from exhausted land.

Professor CARMODY said that for average yield you had to take into account, not only the planting, but the ratoon crop. He had known ratooning in Venezuela to go on for about 50 years. The land was so rich that they never thought of replanting again in the lifetime of the owner. As regards the yield from the acreage point of view, there was one other point he would like the Committee to consider, and that was that the acreage under canes was not always the acreage under cultivation. That was the trouble, for you could not get data that were comparable on account of that. Sometimes you got the total acreage of the estate when probably 20 per cent. was in fallow.

Mr. LING, referring to a point raised by Professor Carmody, said that no other compound had been submitted to such numerous and far-reaching physical tests as sucrose, whether derived from sugar cane or beet, and, when refined to the extent it was by refiners, not only was there no doubt that the sugar from the two sources was identical, but there was no recognisable impurity in either.

Dr. L. T. THORNE said that he was not a sugar producer, but he had had a good deal to do with the refining and using of sugars produced in the various countries, and he could certainly very strongly endorse what had been said about cane sugars produced in the Empire. He thought that, due to the work of the Committee, we might look forward to producing within the Empire all the sugar that was wanted, and we might hope to produce it within a comparatively short time if we put our backs into the matter. He agreed with some of the other speakers that in this instance the country nearest at hand for our purpose was India. He thought that there we might find immense scope for improvement and for a very rapid increase in the amount of sugar made, and that we should endeavour to induce alike private individuals and the Government to go very seriously and very strenuously into the question. But he thought with Mr. Sandbach Parker that we should not in any way neglect the other Colonies, and that probably British Guiana was the one that next after India deserved our

immediate attention, and we must not let that wait until after we had had all our resources exercised on India for some time. British Guiana would probably take longer than India to make its great increase in production, but if we left it in the background now and did not pay attention to it, that would mean still further delay. Production as well as cultivation for production of sugar in India was undoubtedly very lax and inefficient; but, whilst giving a great deal of energy to both these matters in that country, we should strongly give our attention to the other Colonies. Then British Guiana would come on and help provide the increasing quantities required as consumption went on. Undoubtedly, as Mr. Sandbach Parker had said, while India might be capable, if properly handled, of producing another 2 million tons, it would very soon be wanting to use that 2 million tons itself. But there was very large scope in British Guiana and the West Indies for an improvement in sugar production, without harming other agricultural interests there, and the increased production from those countries ought to arrive in time to supply other parts of the Empire by the time India was consuming the whole of its enlarged production. If we paid attention to India first, whilst keeping at the same time our attention on British Guiana, Trinidad and the West Indies generally—but not giving, he thought, very much attention to the Australasian districts—we should then be able to look forward with a great deal of hope to keeping abreast of the growing requirements of the British Empire, although of course we should probably want half as much again as we were counting upon now.

Mr. WILLIAM MARTINEAU said that he would like to endorse what Mr. Ling had said with regard to the comparison of beet and cane sugar. As a refiner, he would like to say that, in his opinion, thoroughly refined beet sugar was quite as pure as an equally refined cane sugar; he would go further and say that in the refined state no one could tell the difference. Although it was easier to refine beet than cane, he hoped he would never have to refine beet again, for he did not want to see German or Austrian beet here again, either in the form of refined or raw sugar. Of all raw cane sugars, he preferred Colonial to either Cuban or Javan. Colonial raw sugar was easier to refine and gave better results. He would like to say a word about "research." Planters, refiners and manufacturers, who used sugar as a raw material, all realised the importance of research. He did not himself pretend to be an advanced chemist, though he knew a little of sugar technology. A movement had been started in England some two years ago to form a Sugar Research Association; the movement was set on foot by a small committee of people connected with the Sugar Section of the British Empire Producers' Organisation. The movement had gone on slowly but steadily and thoroughly, and only about six weeks ago it actually came into being as The British Empire Sugar Research Association. The Association had the backing of thirteen powerful Empire sugar trade associations, consisting of Colonial sugar planters from India, South Africa, the West Indies, Australia, and Mauritius, and the infant English Beet Sugar Association, sugar refiners of London, Liverpool, and Greenock, and manufacturers who used sugar as one of their principal raw materials. These manufacturers were represented by the Food Manufacturers' Federation, the Manufacturing Confectioners' Alliance, the Brewers' Society, and the National Union of Mineral Water Manufacturers. The Research Association also had the support of the Royal Technical College, Glasgow, the Wye Agricultural College, the Chamber of Agriculture, Mauritius, and last, but not least, the Society of Chemical Industry. The supporters of this new movement represented millions of capital and thousands of firms. Its memorandum and articles of association and prospectus had all been passed by the Government Department and the Board of Trade, and were duly registered, as already stated, about six weeks ago. It was hoped that this Research Association would help to bring the Empire back to the position it held about 60 years ago, when the Empire did practically the whole of the sugar trade of the world. The aim of the Association was to establish, in co-operation with the Government Department of Scientific and Industrial Research, an Empire scheme for the scientific investigation, either by its own officers, or by the Universities, Technical Schools and other institutions, of problems arising in the sugar industry, and to encourage and improve the technical education of persons who were or might be engaged in the industry. He expressed a hope that the Society of Chemical Industry would authorise the Committee to allow their valuable Report to be at the disposal of the Sugar Research Association for their use and reference. He also stated that the Research Association would shortly have the *personnel*, the money, and he hoped the brains, to carry into effect the technical suggestions mentioned in the Report.

The CHAIRMAN said that he would refer to one or two questions. One gentleman had asked about beet root. In all the returns the Committee had got in, only two countries had referred to beet root; these were Victoria and Canada, and neither of them gave a very rosy account of their work. In Victoria, in 1912, they only got 5·3 tons of root, equivalent to about a third of a ton of sugar per acre. At another time they got 12 tons of root, or one and a third tons of sugar to the acre. From Canada the report was that they were cultivating from 14,000 to 18,000 acres in Ontario, and that there was a large amount of suitable land available. But the conditions were not economically favourable for the extension of factories without assistance from the Government; and it was reported that one factory had closed because some fiscal facilities that had been given by the Government had been withdrawn. He was afraid the Report would not help them much on beet root, they would have to lean on cane. Personally, he thought cane was the best reed and would always beat the beet. Mr. Sandbach Parker had reminded them that India would not help very much because she would herself absorb all the increased sugar she produced. But India was now a very considerable competitor for sugar with the rest of the world, and, if she made more, a lot would be liberated that now went there from other parts of the Empire. For instance, Mauritius produced 200,000 or 300,000 tons a year, and practically all of it went to India in normal times. It would help us very much if we could get that here. Another point was that fuel was very important in beet sugar making, but cane supplied its own fuel.

Mr. MARTINEAU said that the use of the bagasse was important in reducing the cost of production; it provided fuel not only for power but also for heat to evaporate the juice. He did not quite understand Professor Carmody's reference to some protection that the refiners had in connection with the 98% sugar. What the refiners wanted was good sugar, from 96% to 98%, of good grain and colour, and with not an immoderate amount of reducing sugar. It should be packed cool so that it did not turn into a solid mass. Those were the things refiners had had to put up with in the case of Cuban sugar, and they felt very wroth about the way they had been treated by Cuba during the war. The Cubans had saved themselves a few pence per hundredweight, but it had cost the refiners shillings per hundredweight to put things right.

Professor CARMODY explained that a manufacturer might produce a sugar of about 98% suitable for going into direct consumption, in which case he would get a better price than if it went to the refiner. But, in order that the refiner might get the sugar at 96, he mixed his 98 with 94, and that spoiled it for market. He had to pass it through the refiner, but there was no necessity to refine 98½% white crystal.

The CHAIRMAN said that that depended on the purpose to which the sugar was put. Such sugar would do for coffee or cocoa, but the acids and bacilli in it would curdle milk. A reference had been made to scarcity of labour in Trinidad, but he thought that island had eighty people to the square mile.

Professor CARMODY said that there was a big cacao industry to be provided for. They had had to import labour, and owing to the cessation of immigration had had to resort to other means. Out of their total population of 300,000, the East Indians numbered 150,000.

The CHAIRMAN said that this was the more reason to go to India where the people were, if you wished to establish the industry quickly, rather than take them from India, out of their natural conditions. Sugar we must have, because we were buying 2½ million tons from foreign people. We were doing that now, and had been doing it for a long time past. Nearly all the reports the Committee had received complained of the scarcity of labour; that was the reason why the industry did not develop—scarcity of labour and high freights. He thought India would meet those conditions. Undoubtedly India would in time use the sugar she produced, because she was only using 17 lb. per head now. He did not think there would ever be a glut of sugar, for as production increased consumption in the lower countries would also increase.

Canadian Section.

Meeting held at Ottawa on March 20th, 1919.

PROF. E. G. R. ARDAGH IN THE CHAIR.

POTASH RECOVERY AT CEMENT PLANTS.

BY DR. ALFRED W. G. WILSON.

Potash salts have not been produced in Canada on a commercial scale. We are now saving or producing a small amount of potash-bearing materials which are being utilised in the fertiliser industry, but the total amount available is not equal to our own needs. Prior to the war we imported all the compounds of potash required by our industries, chiefly from Germany, minor importations coming from Great Britain and the United States. Both these countries, however, and nearly all other countries of the world, also derived their principal supplies of the primary salts from Germany.

The average annual cash value of all potash salts imported during the five-year period 1910 to 1914 (ending March 31st), on the basis of import data published by the Department of Customs, was $503,702. This includes an amount of $155,243 given as the import value of certain potash salts which are used chiefly in the fertiliser industry for food production. The other salts imported were utilised by other Canadian industries, chiefly in the recovery of gold and silver, in glass making, in tanning, and in certain chemical manufacturing processes including soaps.

The total weight of potash salts available for fertilisers averaged 8,773,664 lb., during each year of the five-year period prior to the war. The classification adopted by the Department of Customs fails to take cognisance of the market basis on which these salts are sold, and it is impossible to estimate the actual potash content of the various salts imported. These are all lumped together in the published statistics, regardless of composition or of commercial value. It is probable that Canada at present consumes only about 1200 tons of potash (K_2O) per annum in fertilisers.

It is unnecessary to discuss the importance of suitable potash salts for utilisation in manufacturing mixed fertilisers. Food production not only cannot be maintained, but it will show a very marked decline if these salts are not available as plant food. In the future, in addition to other constituents of plant foods, we shall require much larger quantities of potash salts to maintain grain production in the West. The rapid decline in the acre yield of many areas in Manitoba is due largely to the removal and export, over a term of years, of important solid chemicals, chiefly potash salts and phosphates, and to the failure to replace these losses. In brief, it may be stated that potash salts are absolutely essential to food production, and an independent home source of supply seems desirable in the national interest.

At the present time fifteen cement plants in the United States have installed or are installing potash recovery equipment. In those plants where the equipment was installed two years or more ago, their principal business during the last year of the war was potash recovery, the cement produced being rather of the nature of a by-product. Several plants paid for their entire installation within the first year of operating, and many of them appear confident of their ability to continue in operation under normal conditions.

The total output of all potash materials in the United States in 1917 was 126,577 short tons, which contained 32,366 tons of pure potash (K_2O), or 26·4%. This was more than three times the production in the previous year. The production in 1918 has been almost 53,000 tons of pure potash. The total requirements of the United States are said to be about 240,000 tons.

In 1917 about 45% of the total production of potash was derived from brines, about 10% from kelp, nearly 9% from charred molasses residues, and about 5% from cement mills. Cement mill production of potash in 1918 was equivalent to 1429 tons of pure potassium oxide.

In Canada there are two important potential sources of potash supply—the cement mills and the blast furnaces. The latter source has not yet been investigated, although one steel plant reports a high potash content in the dust from the stoves. In the United States three steel plants are said to be recovering potash from their flue gases experimentally. It is reported that in England a large quantity is being recovered from blast-furnace gases, and that eventually this will probably be sufficient to provide for home requirements at least.*

Mr. Shirley Barr, an engineer in the employment of the Canada Cement Company, Montreal, and the author were privileged to inspect, in detail, twelve out of the fifteen installations in the United States. The three plants omitted were under construction, and the equipment for the most part duplicates that seen elsewhere. This paper is based upon the results of this investigation.

It does not appear that any attempts were made to recover the soluble potash from the stack dust

* Compare Board of Trade Journal, Sept. 5, 1918, p. 303.

of cement plants prior to the war. Standard practice consisted in returning this dust to the mix whenever it was collected.

In the manufacture of Portland cement it is necessary to reduce both the raw materials and the finished clinker to a fine state of division by grinding. As a natural result much dust escapes into the atmosphere in the vicinity of these plants, either from the mill buildings or through the stacks. In some localities this dust is found to be a nuisance. In certain areas in California where orange and lemon groves predominate it was claimed that escaping cement mill dust was injurious to the groves. In Southern California certain orange growers instituted suits against the cement plants and eventually succeeded in having them enjoined by the courts to prevent the escape of dust, if their operations were to be continued. These plants are located near Riverside and near Colton. The California Portland Cement Company at Colton attempted to eliminate the dust nuisance by installing large dust chambers into which the flue gases were led. The Riverside Portland Cement Company at Riverside interested themselves in the electrical precipitation methods, which were then being developed by Dr. F. G. Cottrell. The results of their experiments have finally led to the great development that has taken place within the last few years in the art of dust collecting by electrical precipitation. Soon after the installation of the Cottrell system for collecting dust at Riverside it was noticed that this dust carried a rather high percentage of potash salts. When the supplies of European potash were cut off by the war this dust became a saleable article. The amount of soluble potash present in the dust as recovered is not very large and the desirability of producing soluble potash salts in a more concentrated form was quickly evident. Experiments were instituted by Huber and Reath at the Riverside plant and they succeeded in developing a satisfactory process.*

The first installation at an American cement plant, erected primarily for the purpose of recovering the potash salts, is that of the Security Cement and Lime Company at Security, Md., not far from Hagerstown. This company installed the Cottrell system in 1916, and have since carried out a good many experiments. Their operations have been very successful and much of the information that is available to cement manufacturers in America has been made public through the several articles published by their manager, Mr. John J. Porter. Much additional information has also been supplied through the Western Precipitation Company, of Los Angeles, which controls the patent rights of this system of precipitation.

During the last two years there have been developed in the Western States several systems for the recovery of the potash-bearing dust which use some form of water spray for cleaning the gases. These systems have been designed in the attempt to develop a process that will show a higher efficiency than that hitherto obtained by electrical precipitation alone, as applied to this purpose.

At the present time 19 cement plants are known to have installed equipment for the purpose of preventing the escape of flue dust. Seventeen of these plants were erected, or are in course of construction, for the purpose of recovering the potash in the dust. One of the remaining two disposes of its flue dust as a potash fertiliser to local trade during certain seasons of the year. The other installation is for dust collection only. In the United States there are nine electrical precipitation installations in cement plants. There is also one in Norway, one in Sweden, one in Spain, and one in Japan. There are six cement plants in the United States using five different systems of water spraying for the recovery of the flue dust.

In average practice it is found that about 608 lb. of dry raw mix are required to produce one barrel, or 380 lb. of cement. In Canada, 546 lb. of dry raw mix produces one barrel, or 350 lb. of cement. About 100 lb. of coal having a heating value of 13,500 B.Th.U. is required to burn this material. Where petroleum is used as fuel about 9·4 gallons, having a heating value of 18,800 B.Th.U. per lb., is required.

There are two principal methods of cement manufacture, usually termed the dry process and the wet process. As the name indicates, in the dry process the raw mix is fed direct to the kilns in a dry state as it comes from the pulverisers. In the wet process the raw mix is ground with water to form a slurry. Slurry as fed to the kilns contains about 38 to 45% of water, which must first be evaporated before the burning process can begin. It is obvious that owing to the presence of this large quantity of water the temperature of the escaping flue gases, where the wet process is in use, will be lower than in the dry process.

The temperature of the stack gases as they leave the kilns is usually about 800° C. in the dry process and 150° C. in the wet. The maximum temperature in the zone of greatest heat is about 1430° C. occasionally slightly higher. The temperature of the clinker at the point of discharge is usually about 700° C.

As regards the by-products which are available in cement mill practice approximately 13% of the total heat generated is carried out of the kiln with the clinker. Occasionally a portion of this heat is used for preheating the air supply. About 45% of the heat is carried out of the kiln by the dust-laden flue gases and approximately 10% or more is lost by radiation. In ordinary practice about 480 lb. of carbon dioxide per barrel of cement escapes with the flue gases, slightly less than one-half of this being derived from the limestone in the cement mix. The quantity of potassium salts carried out with the flue dust and gases varies in ordinary practice from 2 to about 7 lb. per barrel of cement. Sodium and lithium oxides are liberated in association with potassium oxide, and volatile salts of these metals are also found in the flue dust and gases.

The salts of the alkali metals which are found in the flue gases and dust are derived from alkali silicates present in the raw materials used in the cement manufacture. The greater portion of these is usually found in the clay or shale used in making the raw mix. Small amounts may be derived from the limestone or from the ash of the coal used for fuel.

Analysis of the raw mix from Canadian plants shows a variation in potash content between 0·50 and 1·04%. In the process of burning, the potash-carrying silicates are decomposed at the high temperature, probably owing to reactions with the lime. There are present in the kiln gases carbon dioxide, sulphur dioxide, and possibly other compounds. Consequently the formation of a number of different alkali salts is possible. The potassium salt which occurs in the largest amount is the sulphate. The thiosulphate, sulphide, and carbonate also occur. Under certain conditions the odour of hydrogen sulphide can be noted in the escaping gases and elementary sulphur has been found on the walls of some of the treaters. The corresponding salts of sodium and lithium probably also occur.

Where petroleum is used as fuel it has been found that a greater proportion of the potassium salts in the recovered dust is soluble than where the fuel used was coal. Further investigation showed

* "Potash from Cement at the Riverside Portland Cement Company." Met. and Chem. Eng., June 15, 1917, pp. 761–5.

that it was probable that in the latter case the silica from the coal ash combined with the alkali salts to form a silicate which was insoluble in cold water, but which was slowly soluble in hot water or in weak acid solution.

Cement mill dust recovery.

The methods employed for the recovery of the potash constituents volatilised in the process of cement manufacture all depend upon the fact that these constituents are carried into and through the stack with the escaping flue gases. The problem therefore became one of cleaning these gases, recovering the solid products, and separating the potash salts from the less desirable residues. Two general methods have been developed, the one for cleaning the dry gases, the other in which the gases are cleaned by a system of water sprays.* During the course of development of the electrical precipitation process it was found that a large proportion of the volatilised potash salts was in such a condition that it was not easily removed from the gases. The development of the water spray systems on the one hand, and of the electrical water film treater on the other, marks further steps in the progress that has been made in attempts to increase the efficiency of potash collection methods.

Dry-cleaning methods.—Two types of equipment are in use, one the expansion chamber, which is supplemented by a series of auxiliary chambers in which water sprays are located, and the other electrical precipitation by the Cottrell system. This latter method may be further subdivided on the basis of the type of treater used.

(*a*) *Expansion chamber system.*—The expansion chamber system was first introduced by Mr. T. J. Fleming at the plant of the California Portland Cement Company near Colton. The following description of the dust-collecting system is based on an article published by W. C. Hanna.† This installation consists of two very large rectangular chambers connected with the cement kiln stacks by long flues. Exhaust fans are used at the ends of the flues close to the expansion chamber. The draught for the kilns and dryer is maintained by the suction of these fans. The fans discharge into large dry settling chambers immediately adjacent. The area of the cross-section of these chambers is so large in comparison with the area of the cross-section of the flues that the velocity of the gases, and consequently their carrying power, is very greatly reduced. All the coarse dust and some of the fine dust settles. This dust is collected in a series of receptacles in different parts of the chamber, from which screw conveyors deliver it to a central common conveyor, which in turn carries it to the dust-treating plant or back to the cement mill. Beyond the dry dust settling chamber is another chamber which is subdivided by apron walls in such a way that all the escaping gases pass upwards and downwards seven times before reaching the outer air. During each of these seven passes they are subjected to the action of a fine water spray which effectively removes the finer material that did not settle in the dry chamber. The liquors from these spray chambers are passed through a series of conical settlers to remove the dust, the liquor being returned to circulation or filtered and treated for the recovery of its potash content when it reaches the desired strength.

(*b*) *Electrical precipitation.*—The principles applied for the removal of solid particles from the flue gases in the Cottrell system of electrical precipitation have been very frequently discussed since its first introduction in 1910. In the application of the Cottrell system to the precipitation of cement mill flue dust two principal types of electrical treaters have been developed. In the one the operations are carried on so that the dust is recovered in a dry state. In the second type the dust is recovered as a sludge and the soluble portion has for the most part gone into solution in the water.

With respect to those treaters in which the dust is recovered dry there are two kinds, usually termed the "plate" treater and the "pipe" treater. An electrical treater of the plate type was the first developed for use in the cement business, and the Riverside plant is the only one in which they have been installed. There are eight installations in America, two in Scandinavia, one in Spain, and one in Japan, using the pipe type of treater.

In the plate type of treater a number of specially constructed collecting electrodes are arranged parallel, in a vertical position, and spaced at equal intervals, the whole being housed within a suitable chamber. In the treater at Riverside each plate consists of an angle-iron frame on which a heavy metal screening has been stretched. Between each pair of electrodes is suspended a series of parallel vertical wires, suitably spaced, which act as discharge electrodes. The frame to which these wires are attached is insulated from the rest of the treater and is connected with the negative terminal of a rectifier. The plates of the treater and the positive terminal of the rectifier are both grounded. The treater housing is so constructed that the effluent gases from the flues pass between the plates of the treater in a horizontal direction.

A single unit of the pipe type of treater consists of a vertical pipe made of sheet steel, usually about 12 inches diameter and 18 feet long. The high tension discharge electrode consists of a single wire suspended vertically along the axial line of the pipe. The walls of the pipe act as the collecting electrode. The number of pipes in a treater unit vary according to circumstances from 80 to 240.

In operation, the gases to be cleaned enter the treater at the top, pass downward through the several pipes, which constitute the unit, and are discharged into a common flue below. Occasionally, the path of the gases is reversed, being from bottom to top, instead of top to bottom. A special hopper bottom is provided below the treater unit to receive the dust. This hopper usually discharges from below either continuously to a conveyor, or intermittently to cars, barrows, or a sacking plant.

When in operation the greater portion of the dust is deposited on the surface of the collecting electrodes. At stated intervals the stream of gases is interrupted, the gases being diverted to another treater, and the accumulated dust is shaken from the sides of the collecting electrodes, vibrations being generated by striking the pipes with suitably suspended knockers. The discharge electrodes are also shaken to free them from any dust which may have collected upon them.

In practice, a battery of two or more unit treaters is generally employed, in order that the current of gases discharged through the flues may not be interrupted.

(*c*) *Water film treater.*—The discovery that a considerable portion of the volatilised potash salts remained in the gases after the heavier dust particles had been removed made it necessary to institute experiments to develop some type of treater which would recover as much of this potash as possible. The film type of treater was devised for this purpose. This treater is so designed that a thin film of water is maintained in constant flow down the faces of the collecting electrodes. In the form which was installed first at Security each unit consists of 8 sections. Each section consists of a vertical cell about 14 inches wide, 18 feet long;

* It is not considered necessary to discuss the bag house system of dust collecting in connection with cement mill practice.

† "The Fleming Dust-Collecting System," Met. and Chem. Eng., Sept. 15, 1915, p. 609.

and about 20 feet high. The walls between the sections are about 8 inches thick, the whole unit being a concrete monolith. A water trough is provided at the top of the treater and is so constructed that each section is completely encircled. The circulating liquid is conducted to the trough through suitable pipes from which it overflows down the walls of the cell. It is kept in circulation by a centrifugal pump. When the treater is in operation water is discharged from the troughs over each of the four walls of the section so that a thin film covers the whole surface. The circulating liquid is collected in a chamber below the treater and after suitable treatment to remove the sludge which may have collected it returns to the pump. The wires for carrying the high tension current are suspended from a frame connected with the negative pole of the rectifier. In each section of the treater the high tension wires are suspended along the median plane, equi-spaced with respect to each other, and with respect to the adjacent walls. In operation the gases are admitted at the bottom of the treater and pass out through the top.

The second type of water film treater combines the features of the dry plate treater and the sectional water film treater. The median walls of the sections are retained and suitable equipment is provided to discharge a uniform water film over the whole of their working surface. No end walls are provided on the sections. The wires carrying the high tension current are suspended along the median plane between the section walls. The stream of gases enters at one side of the treater and is discharged at the other.

A dry treater of the plate type as already noted was first installed in the plant of the Riverside Portland Cement Company at Riverside, California, to treat the flue gases from ten kilns. More recently a pipe treater was installed to take care of the effluent gases from an installation of two additional kilns. Pipe type dry treaters have also been installed at all the other cement mills but one using this system. A water film treater of the open section kind in which the gases enter and are discharged laterally has been installed in the plant of the Newaygo Portland Cement Company, Newaygo, Michigan.

Combinations of these two types of electrical treater operating in series are also being tried out experimentally. At Security the hot gases as they come from the kilns are first cooled by the admission of a certain quantity of air and are then conducted through the pipe treater where the greater portion of the dust particles are removed. From this treater they are conducted to the water film treater for final treatment before discharge into the atmosphere. In the plant of the Clinchfield Portland Cement Company at Kingsport, Tenn., it is proposed to treat the gases in much the same way as at Security. The pipe treater has already been installed, but the water film treater which is to be of the plate type with side adits and exits has not yet been erected.

Spray systems.

The following classification has been evolved for convenience in describing the various spray systems for cleaning the gases to recover the potash salts by the use of sprays and circulating solutions.

In the simplest type sprays are introduced directly into the flues and a special chamber is provided in which the escaping vapours are trapped by means of special tile suitably arranged in towers. A coke tower or a quartz tower could be used for the same purpose. In another type flue spraying is followed by a special condenser in which a portion of the water vapour is recovered, containing more or less of potash salts in solution, and incidentally the waste heat available from the condensation of the vapour is used for the evaporation of a portion of the saline liquors. The second group of spray systems employ special chambers in which the flue gases are subjected to treatment with sprays. Usually the chambers are arranged in series, the gases being subjected to treatment in three or four units, arranged in series, one after the other, before they escape. One type of spray chamber has been evolved in which the escaping gases after saturation with water are filtered through specially designed filter beds made of "excelsior."

Supplementary operations.—It is only under certain particularly favourable conditions that it is possible to market the flue dust containing the potash salts in the form in which it is collected through any one of the several types of the preliminary operations described above. It is usually necessary to subject the collected dust to some supplementary treatment for the purpose of concentrating the potash salts. It is obvious that these operations must be carried on in harmony with the other operations of the plant. Moreover, the flue gases from the cement kilns, escaping where the dry process is in use, are capable of supplying a considerable quantity of heat which can be recovered for utilisation if the proper equipment is provided. About 45% of the heat generated by the combustion of the fuel is lost through the flue gases.

A portion of the waste heat can be recovered through the installation of water tube boilers and preheaters. This is being done at the Cementon (New York) plant of the Alpha Portland Cement Company, where an electrical treater of the pipe type is in operation. A similar installation is in operation at Nazareth at the plant of the Dexter Portland Cement Company. In both cases the boiler equipment is installed close to the kilns and a high speed fan has been placed in the system between the waste heat recovery equipment and the electrical treater.

The waste heat in the flue gases can also be utilised for the purpose of evaporating the water from the saline solutions which are circulated in the spray systems or which are specially prepared in the dry recovery systems. Where waste heat is used for evaporating purposes special pans are sometimes placed over the top of the flues or they may be so constructed that the bottom projects downward into the flue.

Saline solutions are prepared in the plants where dry dust is collected by mixing the dust with water at a suitable temperature, usually about 85° C. The digestion operations are carried on in special tanks and when completed the liquors are drawn over into settling tanks where the solids are permitted to settle and the liquor is removed in a suitable manner. In the water spray systems occasionally some of the dry dust which collects in the flue between the kilns and the first spray chamber is subjected to digestion treatment in hot water. After settling the liquor is drawn off and joins the liquor from the spray system. In both cases the liquors to be evaporated, after final treatment in settling tanks, are passed through a filter, both Oliver and American filters being used for this purpose. It has been found that a liquor containing about 3½% of soluble potash salts is the most satisfactory for the spray systems. If the percentage of potash salts present is permitted to become much higher than this a proportion of the salt is likely to remain in the spray chamber. In plants where there is no liquor circulating system for spraying purposes and where the only liquors to be treated are those made through the treatment of the dry dust the soluble potash content of the liquor may be somewhat higher. After filtration the liquors are collected in storage tanks, from whence they are conducted to the evaporating pans.

The final stages of the evaporation operation are sometimes carried on in separate equipment with an independent source of heat. In some cases direct-fired pans are used for this purpose, in other cases specially constructed evaporators are utilised, to which the heat is supplied by the use of steam coils and a special boiler. In the latter case crystallising pans are also used.

Costs of potash recovery.

It is obvious that the cost of the installation will vary according to local conditions, the type of construction employed, and the particular process selected. With the exception of the installations at Riverside and Colton, California, the several plants mentioned in previous paragraphs were built under war time conditions, and were to a considerable extent experimental. The costs of construction and development in pioneer work naturally were higher than they would be under normal conditions.

Equipment costs.—A complete potash recovery plant using the dry electrical precipitation method would probably cost about $30.00 per barrel of daily cement capacity if constructed largely of reinforced concrete or concrete and tile brick. If all steel construction the cost would be about double. A water film treater would cost in the neighbourhood of $25.00 per barrel of daily cement capacity.

A complete potash recovery plant using one of the water spray systems would cost from $30.00 to about $50.00 per barrel of daily cement capacity. The efficiency of this type of apparatus is higher and the cost of the plant on the basis of the potash recovered would therefore be lower.

A leaching and evaporating plant to produce concentrated salts for shipping would cost in the neighbourhood of $25,000 if designed to treat the dry dust from a 3000-barrel mill. If this plant were designed and constructed in connection with a treater where saline solutions are circulated as part of the system for recovering the potash, the cost of such additional equipment as would then be required would be less.

In designing a potash recovery plant it is to be noted further that normally about 45% of the heat generated by the combustion of the fuel used is lost with the flue gases and dust. Under favourable circumstances a portion of this heat can be converted into power by the use of water tube boilers, superheaters, and preheaters. The heat can also be utilised to evaporate the excess liquor from saline solutions. It would therefore seem to be expedient to design by-product recovery equipment in such a way as to utilise the waste heat as well as to recover the potash in a form most suitable for merchandising.

Operating costs.—The operating cost at the plant of the Security Cement and Lime Company in 1917 is given by John J. Porter, the manager, as follows* :—

Labour ...	$27.00 per day =	$0.0090 per brl. clinker.	
Power ...	25.00 ,, ,, =	0.0083	,, ,,
Repairs ...	8.00 ,, ,, =	0.0027	,, ,,
Laboratory	120.00 pr. mth. =	0.0014	,, ,,
Cost of salt addition ...	...	0.0220	,, ,,
Total ...		$0.0434	,, ,,

The capacity of this plant is 3000 barrels per day.

R. K. Meade has published the following estimates for a 3000-barrel plant using a dry electrical treater† :—

Labour and superintendence	$25.00 per day.
Power at 1 c. per kw.h. ...	13.00 ,,
Repairs	10.00 ,,
	$48.00 ,,

The addition of salt to the mix is stated to represent an additional cost of $70.00 or $0·025 per barrel of capacity. The production of concentrated salts would entail an additional expenditure of $8—$10 per day for labour, and $15—$25 for power and evaporating excess water. The latter expense can be reduced or eliminated by utilisation of waste heat from the kilns.

Meade thus estimates the cost of operating a wet treater, applicable either to the water film electrical precipitator or to a spray system :—

Labour	$35.00 per day.
Power at 1 c. per kw.h. ...	25.00 ,,
Repairs	5.00 ,,
Fuel for evaporation	15.00 ,,
	$80.00 ,,

If salt is added the additional expense would be $70·00 per day, or 0·025 c. per barrel of capacity.

In estimating the costs of production for any given cement plant the potash recovery plant should be credited with the value of the leached dust returned to the raw mix as slurry, and with the saving of coal that is almost sure to result with the installation of fans whereby the draught on the kilns and the cement burning can be more closely regulated. Porter‡ states that at Security the fuel consumption for 5 months in 1916, before the installation of the potash plant, averaged 96·4 lb. of coal per barrel, while for 5 months in 1917, with the potash plant, it averaged 87·0 lb. per barrel.

It might also be well to draw attention to the fact that the installation of potash recovery equipment does not involve any changes in the process of cement manufacture and does not injure the product. On the contrary the maintenance of more uniform burning conditions in the kilns under forced draught is likely to result in a more uniform product.

While this paper deals primarily with the subject of potash recovery, attention may also be turned to certain other directions in which economies can be effected.

Cement mill dust is very frequently a cause of trouble with the owners of adjacent properties, particularly in agricultural districts. It is also injurious to the workers in the mills. Anything that can be done to reduce the dust nuisance is therefore advantageous both to the mill owner, to his employees, and to his neighbours. All recovered dust can be returned to the cement mix. Its value represents a credit for the recovery plant, while the cost of recovery is a legitimate charge against cement manufacture in those mills where it is compulsory to prevent the escape of dust.

Fuel is one of the principal items of cost in operating a cement plant, and power costs are of equal importance. Many Canadian cement mills utilise imported fuels. It, therefore, appears desirable to reduce fuel costs to a minimum by utilising the heat produced by fuel combustion as completely as possible. Those cement mills which are operating on the dry burning process may find it materially to their advantage to install waste heat recovery equipment for the purpose of reducing their power costs.

Potash recovery, fuel economy, elimination of the dust nuisance, reduction of power costs, and more complete utilisation of waste heat, with the consequent reduction of coal consumption and coal imports, are all closely related problems that merit careful study.

* "The Recovery of Potash as a By-product in the Manufacture of Portland Cement," American Fertilizer, Aug. 31, 1918, pp. 58–72.

† "Potash as a By-product of Cement Industry," Rock Products, Sept. 25, 1918, p. 25.

‡ Cement World, Chicago, Sept., 1917.

Sydney Section.

Meeting held on May 26th, 1919.

MR. B. J. SMART IN THE CHAIR.

NOTE ON A PAPUAN NATURAL PETROLEUM.

BY JOHN READ, M.A., PH.D., AND MARGARET MARY WILLIAMS, B.SC.

The investigation of which a summary is here given was carried out in 1916. Publication was deferred for the time being, in the hope that larger supplies of the material would become available for examination, but this expectation has not yet been realised. Owing to the small amount of material, many of the operations could not be carried out in duplicate; and for the same reason a thorough fractionation of the oil was impracticable: these limitations should be borne in mind in considering the appended numerical data.

FIRST SAMPLE.

The first sample (Vailala Oilfield, Papua) possessed a light brownish-yellow colour with a bluish fluorescence, and readily yielded water-white material on distillation. The smell was in no way unpleasant, and resembled closely that of kerosene. The amount of suspended matter was minimal. Neither the crude oil nor the colourless distillates responded to the indophenin reaction or to tests for nitrogen or sulphur. The oil suffered no appreciable loss on shaking with dilute acid or alkali. In its general characteristics it is thus very similar to Borneo petroleum. The specific gravity of the crude oil was 0·796 at 18·75° C.

Fractional distillation.

The crude oil (1000 grms.) was distilled from a long-necked round-bottomed flask, through an ordinary condenser, up to 170° C. The resulting distillate, or "170° run" (370 grms.), was then fractionally distilled from a similar flask connected with a 4-pear still-head, the total height of the condensing column being 58 cm., the diameter of the bulbs 2·5 cm., and the rate of distillation 2 drops per second. Particulars of the fractionation are summarised below:—

Temperature	Weight of fraction. grms.	Weight percentage of "170° run"	Weight percentage of crude oil	Specific gravity
To 170° C.	370	100	37·0	0·744 at 19·5°
60°– 90°	60·9	16·5	6·1	0·707 at 19·5°
90°–120°	174·4	47·1	17·4	0·744 at 20°
120°–150°	75·8	20·5	7·6	0·760 at 21°
above 150°	41·5	11·2	4·2	0·788 at 19·5°
—	352·6	95·3	35·3	—

The remainder of the sample (1500 grms.) was distilled in a similar manner, up to 180°, and the resulting "180° run" was fractionally distilled in the manner adopted in the first experiment.

The results demonstrated that it is immaterial, as far as the first two fractions are concerned, whether the "straight run" is cut at 170° or 180°; in the latter case, however, an appreciably higher yield of the third fraction (120°—150°) is obtained. The unusually high proportion of light oils is in agreement with the low specific gravity of the crude material.

Nitration of fractions.

The distillates only decolorised bromine water after several hours' contact: it was therefore concluded that the oil contains saturated hydrocarbons, possibly in admixture with aromatic hydrocarbons, and this was confirmed by a preliminary nitration test. Accordingly, the several fractions were submitted to a systematic series of nitration experiments, the mixture of oil and nitrating acid being mechanically stirred during the process, and the temperature kept below 25° C. until no further heat was developed. The mixture was eventually heated gradually to 40° and then allowed to cool, with continuous stirring, in order to complete the nitration.

(*a*) When treated in this way, the first fraction (60°—90° C.) yielded two layers, the upper of which was separated, washed with dilute sodium carbonate solution and water, dried, and distilled from a bath of boiling water. The residual, pale-yellow oily nitro-product was weighed, as was also the distillate of unaltered hydrocarbons. Owing to the volatility of the latter, the content of aromatic hydrocarbons could not be obtained by difference, and the values quoted below are calculated on the assumption that the nitro-product represents pure mononitrobenzene.

The high value obtained in the first experiment may be due to the use of an appreciable excess of nitrating mixture and the consequent formation of higher nitro-compounds.

About one-half of the mixed yields from the two experiments distilled over between 200° and 210°, and on further nitration gave a hard, pale yellow, crystalline product with a dry setting-point of 63° C. The higher-boiling portion of the original nitro-product appeared to contain nitrotoluenes.

The high specific gravity of the residual hydrocarbons points to the presence of naphthenes in association with paraffin hydrocarbons. A similar peculiarity is presented by Borneo petroleum.

(*b*) The product obtained by nitrating the second fraction (90°—120°) settled into three layers. The bottom layer of spent acid was run off, and the other layers mixed and washed with dilute sodium carbonate solution, followed by water, after which the dried unchanged hydrocarbons were distilled from the nitro-product. The results of three experiments are tabulated on page 320 T. The weight-percentages of aromatic hydrocarbons were calculated (1) by difference, and (2) as toluene, assuming the nitro-product to consist of mononitrotoluenes.

Fraction 60°—90°.

Weight taken	Weight of nitro-product	Percentage of benzene (wt.)			Unaltered hydrocarbons		
		In fraction 60°–90°	In "170° run"	In crude oil	Weight	Percentage	Specific gravity
40 grs.	4·4 grs.	7·0	1·16	0·43	29·5 grs.	73·8	0·710 at 19·5°
109 „	7·84 „	4·6	0·76	0·28	90·8 „	83·3	0·709 at 19·5°

Fraction 90°—120°.

Weight taken	Weight of nitro-product	Percentage of toluene (wt.)		Unaltered hydrocarbons		
		By difference	From wt. of nitro-product	Weight	Percentage	Specific gravity
40 grs.	7·0 grs.	12·5	11·8	35·0 grs.	87·5	0·741 at 17·5°
120 ,,	17·9 ,,	13·3	10·0	104·0 ,,	86·7	0·747 at 17°
120 ,,	18·0 ,,	12·5	10·1	105·0 ,,	87·5	0·747 at 17°
		Mean = 11·7.				

The first determination was carried out with material from the "170° run," the second and third with material from the "180° run": the results indicate that no appreciable difference in composition exists between the second fractions yielded by these two runs.

The mean value, 11·7% corresponds to 5·5% of the "170° run," 4·5% of the "180° run," and 2·0% of the crude oil. The high specific gravity of the residual hydrocarbons is again noticeable.

On further nitration, the oily nitro-product gave a pale-yellow, hard crystalline solid with wet and dry setting-points of 60° and 65° C. respectively.

(*c*) The third fraction (120°—150°) behaved very similarly to the second when nitrated. In this case, after separating the two upper layers from the spent acid, the nitro-product was extracted from the residual hydrocarbons by shaking out with concentrated sulphuric acid. 60 grms. of the fraction gave 51·9 grms. of washed and dried residual hydrocarbons, having after redistillation the sp. gr. 0·766 at 19·15°. The weight-percentage of aromatic hydrocarbons, obtained by difference, was 13·5% in the fraction, corresponding to 1% in the crude oil. Further nitration gave a light-yellow, crystalline product, which remained solid in contact with boiling water.

(*d*) The fourth fraction (above 150°) when submitted to similar treatment gave 13·3% by weight of aromatic hydrocarbons, estimated by difference, or 0·6% in the crude oil. The residual hydrocarbons, after washing and redistillation, possessed a specific gravity of 0·768 at 19°. When nitrated further, the sulphuric acid extract of the nitro-product yielded a yellow, pasty mass, in which solid crystalline particles were discernible.

SECOND SAMPLE.

The second sample (No. 5 bore, Government Oilfield, Upoia, Papua) had sp. gr. 0·7965 at 22°, and proved to be practically identical in all respects with the first sample.

Fractional distillation.

The crude oil was first distilled to 180° from an ordinary distilling flask, in the manner adopted for the first sample. The yield of "180° run" was 44·65%, sp. gr. 0·755 at 22·25° C. The "180° run" was next fractionally distilled through an 8-pear still-head, lagged with Posidonia fibre; the diameter of the bulbs was 2·5 cm., the total height of the condensing column 102 cm., and the rate of distillation 2 drops per second. The results obtained are given below:—

Fractionation of the "180° run."

Temperature	Weight percentage of "180° run"	Weight percentage of crude oil	Specific gravity
60°–90°	11·2	5·0	0·715 at 24°
90°–120°	37·2	16·6	0·744 at 24·5°
120°–150°	31·3	14·0	0·7615 at 25°
above 150°	17·9	8·0	0·7905 at 24°

In a second experiment the percentages of the four fractions obtained were 11·8, 37·4, 27·8, and 21·3.

(*b*) Weight taken, 875 grams.

Nitration of fractions.

(*a*) Two portions of 80 grms. of the first fraction (60°—90°) were nitrated in the manner described above; the results indicated that the fractions contained (*a*) 5·2, (*b*) 4·5% of benzene, and (*a*) 84·4, (*b*) 81·9% of unaltered hydrocarbons. Taking the above results in conjunction with those obtained for the first sample of the oil, it appears that the fraction of b.pt. 60°—90° contains about 5% of aromatic hydrocarbons. Further, the main aromatic component is probably benzene.

(*b*) Two portions of 160 grms. of the second fraction (90°—120°), upon nitration in the manner already described for this fraction, gave the following results: Toluene, (*a*) 13·75, (*b*) 14·1%; unaltered hydrocarbons, (*a*) 86·25, (*b*) 85·9%. A review of the whole of the results obtained for this fraction indicates the aromatic content to be approximately 12%.

It is evident from the above data that by redistilling the "170° run" through a fractionating column up to 120° C., it is possible to produce, in a ready manner, a fraction containing about 10% of aromatic hydrocarbons, these being essentially benzene and toluene. Such a possibility lends considerable interest to the oil as a source of aromatic compounds.

An examination of the higher-boiling fractions of this oil is at present in progress, and a further examination—as far as the available material allows—of the lower-boiling fractions described in this communication is also contemplated.

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Communications.

THE FORMATION OF SOLID ISO-OLEIC ACIDS BY THE HYDROGENATION OF ORDINARY LIQUID OLEIC ACID.

BY CHARLES WATSON MOORE, D.SC., PH.D., F.I.C.

Oleic acid, in the form of its glyceride, occurs in almost all vegetable and animal oils, and in an impure form has been known for many years.

The researches of Baruch (Ber., 1904, 173), N. and A. Saytzeff (J. prakt. Chem., 1905, 422), and Harries (Annalen, 1910, 358) have shown that the formula $CH_3(CH_2)_{13}.CH:CH.CH_2.COOH$ put forward by Saytzeff (Ber., 1894, Ref. 577) as representing the constitution of oleic acid is untenable, and have established the formula $CH_3(CH_2)_7.CH:CH.(CH_2)_7.COOH$ as best representing the constitution of the acid.

The first solid form of oleic acid, elaidic acid, was discovered by Boudet in 1832 (cp. Lauenet,

Ann. Chim. et Phys., 66, 149) and is easily prepared by the action of nitrous acid on ordinary oleic acid. Elaidic acid crystallises in colourless plates, m.pt. 44·5° C. (cp. H. Meyer, Annalen, 1840, 35, 182, and Farnsteiner, Z. Unters. Nahr. Genussm., 1899, 5). When elaidic acid is heated with sulphurous acid it is partly converted into ordinary oleic acid. Harries (*loc. cit.*) has shown that it behaves towards ozone in a manner similar to oleic acid.

It is now generally accepted that oleic acid and elaidic acid are stereometrical isomerides and stand towards each other in the same relationship as do fumaric and maleic acids so that their structural formulæ may be written as follows:

$$\begin{array}{ll} CH_3(CH_2)_7CH & CH_3(CH_2)_7.CH \\ \quad\quad\quad\

gave the same ratio of liquid oleic acid to solid "iso-oleic acid" on partial hydrogenation as did a preparation obtained with a nickel catalyst at 180° C.

A partial explanation of the isomerisation of oleic acid is offered by the investigations of Drs. E. F. Armstrong and T. P. Hilditch, some of whose results have already been communicated to the Royal Society. These authors have shown that "the mechanism of catalytic hydrogenation in the solid-liquid state depends on the primary formation of an unstable complex or intermediate compound between nickel and the unsaturated organic compound."

The transference of hydrogen from one compound to another has also been considered by these investigators and is regarded as evidence that there is in certain cases an association between a saturated compound and the catalyst which may decompose in the right to left direction, as shown below:—

$$R.CH:CH.R' + Ni + H_2 \rightleftarrows [(R.CH:CH.R', Ni, H_2) \rightleftarrows (R.CH_2.CH_2.R', Ni)] \rightleftarrows R.CH_2.CH_2.R' + Ni.$$

From this it is clear that the "association" of nickel and nascent ethyl stearate may decompose in such a way that the hydrogen atoms are partly removed from a position other than the 9 : 10 position, so that an apparent migration of the ethylenic linking occurs and an isomeric oleic acid is formed.

According to this scheme the formation of "iso-oleic acid" could only occur during the actual hydrogenation of oleic acid, as has been shown to be the case.

Another explanation of the migration of the double bond has also been considered. It was thought that this might be due to the presence of traces of moisture, acting as shown below, but the hydrogenation of thoroughly dried and moist oils gave the same results:—

$$(a)\ R.CH:CH.CH_2.CH_2.R + H_2O = R.CH_2.CH(OH).CH_2.CH_2.R$$

$$(b)\ R.CH_2.CH(OH).CHH.CH_2R = R.CH_2.CH:CH.CH_2.R + H_2O.$$

As stated above, the formation of "iso-oleic acid" is coincident with the hydrogenation of oleic acid, and so far as is known its production only occurs during the actual hydrogenation of oleic acid. Thus, when an ester of oleic acid is heated in presence of an active nickel or palladium catalyst, and hydrogen is *not* passed through the mixture, no change occurs. Further, it has been observed that although oleic acid, or rather its ethyl ester, is a component of a mixture of esters one of whose constituents other than the ethyl oleate is undergoing hydrogenation, yet no ethyl iso-oleate will be formed. Thus a mixture of ethyl oleate and ethyl linolenate on partial hydrogenation would yield practically no "ethyl iso-oleate," for the hydrogen would be completely taken up by the highly unsaturated ethyl linolenate and practically no hydrogenation of the ethyl oleate would occur.

Experimental.

Preparation of pure oleic acid.

The oleic acid employed in this investigation was obtained from olive oil. Olive oil consists of the glycerides of palmitic, oleic, and linolic acids, but of these the glyceride of oleic acid forms the chief constituent. The published results of several examinations of the fatty acids of olive oil show that these consist of approximately 9% of palmitic acid, 10% of linolic acid, and 81% of oleic acid.

In view of the many possible isomers of oleic acid the question naturally arises as to whether the oleic acid of olive oil is identical with the oleic acid occurring in the great number of other vegetable and animal fats and oils with which we are acquainted. In this connection it may be stated that the author has prepared the corresponding dihydroxystearic acids from the oleic acids of cotton-seed oil, palm oil, tallow, olive oil, and linseed oil, and has found that in all cases the dihydroxy acids so obtained are identical. Further, the publications of the Wellcome Research Laboratories record the preparation of the dihydroxystearic acids from more than a score of samples of oleic acid obtained from the leaves, fruits, and barks of various plants, and in all cases these agree in melting point (132°—133° C.) with the dihydroxystearic acid obtained from the oleic acids of the above-mentioned oils.

The oleic acid of olive oil may, therefore, be regarded as identical with the oleic acid most generally distributed in nature.

[Note.—It is of interest in this connection to record the occurrence of an isomeric liquid oleic acid which was isolated by the author from a sample of South Sea whale oil. This oleic acid was carefully purified by crystallising its lithium salt from dilute alcohol (see below). It possessed an iodine value of 89·5 and in almost all respects resembled ordinary oleic acid. On oxidation, however, it yielded a dihydroxystearic acid crystallising in well-defined needles, m.pt. 124°—125° C. The saponification equivalent was 317 (calc. for $C_{18}H_{34}O_2(OH)_2$, 316). A determination of its "hydroxyl value" gave the following result:—"Saponification value" of the original acid, 176·6; of the acetylated acid, 524·8; hydroxyl value, 348·2. This corresponds to an (OH) content of 10·5% ($C_{18}H_{34}O_2(OH)_2$ requires 10·7%).]

Several methods have been suggested for the preparation of pure oleic acid, but of these only two will be mentioned, *viz.* those of Gottlieb (Annalen, 1846, 36) and Farnsteiner (Z. Unters. Nahr. Genussm., 1898, 390). In both cases the liquid and solid fatty acids are separated by the well-known method of Gusserow (Annalen, 1828, 153) and Varrentrapp (Annalen, 1840, 197). The liquid acids so obtained are converted into their barium salts and these are purified by crystallisation from alcohol (Gottlieb) or wet benzene (Farnsteiner). On decomposing the barium salts with hydrochloric acid fairly pure oleic acid is obtained. The author has found, however, that the lithium salt of oleic acid crystallises better than the barium salt and is more readily purified. The use of divalent metals for the separation of univalent acids is to be deprecated owing to the possibility of double salts being formed, such as, in this case, barium oleo-linolate.

The following method has been found to give a very pure oleic acid:—100 grms. of the liquid acids of olive oil, separated from the palmitic acid by the Gusserow-Varrentrapp method (*loc. cit.*), was dissolved in 250 c.c. of absolute alcohol and to this solution was added 250 c.c. of an aqueous solution of lithium hydroxide sufficient just to neutralise the acids. On standing a beautifully crystalline precipitate of lithium oleate separated, which was collected on a filter and after washing with dilute alcohol was decomposed with hydrochloric acid. The oleic acid so obtained was distilled under diminished pressure, when it formed a colourless, odourless liquid possessing an iodine value of 89·5 and a saponification equivalent of 283 ($C_{18}H_{34}O_2$ requires 284; the theoretical iodine value of oleic acid is 90·0).

Estimation of iso-oleic acid, liquid oleic acid, and stearic acid in a mixture.

On partially hydrogenating a quantity of ethyl oleate a mixture of ethyl stearate, ethyl oleate, and ethyl iso-oleate is obtained. The determination of the percentage composition of such a mixture is not a simple matter, but the following method has been

found to give results which, if not strictly accurate, are a very close approximation to the truth and are certainly close enough for purposes of comparison.

A quantity of the mixture of hydrogenated esters was saponified by boiling with alcoholic potash, and from the resulting potassium salts the corresponding lead salts were prepared by the addition of lead acetate. These lead salts were then digested with ether for the separation of their corresponding solid and liquid acid constituents (Gusserow-Varrentrapp *loc. cit.*). The Gusserow-Varrentrapp method for the separation of solid and liquid fatty acids depends upon the fact that while the lead salts of the solid acids are insoluble in cold ether those of the liquid acids are soluble. This method does not yield strictly accurate results, for while it is comparatively easy to obtain the liquid acids free from solid acids, the converse is not the case. (One point in connection with this process which appears to have been overlooked is the possibility of the formation of salts such as lead oleo-stearate which would probably be partly soluble in ether.)

It has been found, however, that the method is improved by observing the following modifications:—

1. The ether employed should be as anhydrous as possible, as this tends to minimise the formation of emulsions which are sometimes very difficult to filter.

2. The ethereal solution of the lead salts of the liquid acids should be allowed to remain at 0°—5° C. overnight, when small quantities of the solid-acid lead salts, especially lead iso-oleate, will be precipitated and can be removed and united with the lead salts of the solid acids obtained by the first ether digestion. The lead salts are then decomposed by means of hydrochloric acid and the solid and liquid acids isolated.

The liquid acids so obtained will be found to consist in this case of practically pure oleic acid, but the solid acids will show a more or less considerable "iodine value." Now the "iodine value" indicates the percentage of iodine chloride absorbed by a fat expressed in terms of iodine, and is a measure of the proportion of unsaturated fatty acids present in the mixture. Since "iso-oleic acid" has a molecular weight of 282 and absorbs two atoms of iodine its iodine value is 90, so that the determination of the iodine value of the solid acids is a comparatively accurate indication of the amount of "iso-oleic acid" present. Since liquid oleic acid has also an iodine value of 90 and this acid is not completely removed by the Gusserow-Varrentrapp process, the following means were employed to remove the last traces of this compound. The solid acids, obtained as above described, were dissolved in a large volume of 70% alcohol and allowed to stand overnight. The crystalline precipitate of stearic and "iso-oleic acids" which separated was collected on a filter and the filtrate was kept at 0°—5° C. for at least 12 hours, when a further precipitation occurred. This was collected and united with the first precipitate. The alcoholic mother liquors were boiled to expel the alcohol and the fatty acids so separated were once more submitted to the Gusserow-Varrentrapp process, when further small quantities of solid and liquid fatty acids were obtained which were united with those obtained as above described. The iodine value of the solid fatty acids was then determined, and from this value the amount of "iso-oleic acid" present was readily calculated.

Effect of the temperature of hydrogenation on the formation of "iso-oleic acid."

In the following table the results of hydrogenating an ester of oleic acid at different temperatures are recorded. The catalyst employed in all cases was nickel.

Temperature °C.	Fall in iodine value	Percentage of "iso-oleic acid"
		%
140	26	22·0
185	29	36·0
240	24	42·0

Meters recording the entering and issuing hydrogen were employed, and from the reading of these the hydrogenation could be stopped when the desired fall in iodine value had taken place.

Effect of different catalysts on the formation of "iso-oleic acid."

According to Lewkowitsch (*loc. cit.*) the employment of copper as a catalyst results in a greater formation of "iso-oleic acid" than does that of nickel. No experiments were made with copper, but the following results show that this is certainly true of palladium.

Catalyst	Temperature of hydrogenation	Fall in iodine value	Percentage of "iso-oleic acid"
	°C.		%
Nickel ...	180	15	21·5
Palladium ...	180	19	49·0

Hydrogenation of an anhydrous and an ordinary olive oil.

These experiments were made to ascertain the effect, if any, of moisture on the formation of "iso-oleic acid" by the hydrogenation of oleic acid. Olive oil was employed instead of an ester of pure oleic acid.

In the first case the olive oil was very thoroughly dried by heating at 100° C. under diminished pressure while a current of dry carbon dioxide was passed through it. Special precautions were also taken to ensure that the catalyst and hydrogen employed were as anhydrous as possible.

In the second case an ordinary olive oil containing about 0·25% of water was employed and the hydrogen was passed through water before entering the hydrogenating apparatus.

The results of these experiments are recorded below.

	Fall in iodine value	Percentage of "iso-oleic acid"
		%
Dry oil	35	32·5
Moist oil	29	36·0

Moisture would, therefore, appear to have no bearing on the formation of "iso-oleic acid."

"Iso-oleic acid" is only formed during the actual hydrogenation of oleic acid.

It was desired to ascertain whether the formation of "iso-oleic acid" was due to contact with an active catalyst metal producing molecular rearrangement without *apparent* chemical change, as in the preparation of elaidic acid from oleic acid by the action of nitrous acid, or whether its formation was dependent upon the actual hydrogenation of the liquid oleic acid.

Experiments in which ethyl oleate was heated with an active nickel catalyst without the passage of hydrogen through the mixture showed conclusively that no "iso-oleic acid" was formed. In these experiments, however, the catalyst was not playing its full part, as no hydrogenation was taking

place. Now it has been shown by the researches of Dr. T. P. Hilditch and the author that if a mixture of a highly unsaturated fatty acid and an acid of the $C_nH_{2n-8}O_2$ series (such as oleic acid) is partially hydrogenated almost all the hydrogen will be absorbed by the highly unsaturated acid; so that while actual hydrogenation will be taking place the oleic acid will only be in contact with an active hydrogenating catalyst but will not be itself hydrogenated. A mixture was accordingly made of 75 grms. of ethyl oleate and 75 grms. of the ethyl ester of an acid isolated from whale oil by the author, which acid belonged to the $C_nH_{2n-8}O_2$ series. The iodine value of the mixture was reduced by 55 and the products examined for "iso-oleic acid" when only 4·5 grms. of a mixture of solid acids, possessing an iodine value of 34, was obtained. This would correspond to only about 1·5 grms. of "iso-oleic acid," and as the above described selective hydrogenation is not entirely selective this would indicate that the "iso-oleic acid" was formed by the hydrogenation of the ethyl oleate, as the remaining 3 grms. of solid acid was stearic acid. "Iso-oleic acid" is, therefore, only formed during the actual hydrogenation of oleic acid.

Determination of the equilibrium ratio established between oleic and "iso-oleic acid" on hydrogenation.

As above stated, when the iodine value of oleic acid, or rather that of one of its esters, has been reduced by 30 by means of hydrogenation a definite ratio of approximately 10 :15 is established between the liquid and "iso-oleic acids." In the experiments recorded below a nickel catalyst was employed, and the hydrogenation was effected at the same temperature in all cases.

Fall in iodine value	Ratio of oleic acid to "iso-oleic acid" in the hydrogenated mixture
15·0	10 : 4
29·0	10 : 14·6
30·0	10 : 15·3
46·0	10 : 16·0
63·5	10 : 14·2

This arrival at constant ratio is very striking, and the results of the second and third experiments show the accuracy of the analytical method employed.

That the liquid oleic acid remaining after hydrogenation was identical with the original oleic acid was shown by the fact that on oxidation it yielded a dihydroxystearic acid, m.pt. 132° C., identical with that formed by the oxidation of the oleic acid of olive oil.

Preparation and properties of pure "iso-oleic acid."

By a "pure iso-oleic acid" is meant a preparation free from liquid oleic acid and saturated acids such as stearic or palmitic acids. Practically all the liquid oleic acid is removed by submitting the mixture of fatty acids to the Gusserow-Varrentrapp process (see above), and on subsequently recrystallising the solid acids from 70% alcohol the last traces are removed. The solid acids so obtained are then submitted to a prolonged fractional crystallisation, first from 90% and subsequently from 70% alcohol, when the more sparingly soluble stearic acid is removed, and an "iso-oleic acid" having an iodine value of 88 is obtained.

By this means "iso-oleic acid" can be separated from stearic acid but not from palmitic acid or other lower homologue, so that if a "pure iso-oleic acid" is required it is necessary to employ pure oleic acid itself and not an oil, such as olive oil, which contains palmitic acid.

"Iso-oleic acid" crystallises in glistening plates melting indefinitely between 34° and 36° C. It is very soluble in all ordinary solvents with the exception of dilute alcohol. With bromine it combines very readily, forming a liquid dibromostearic acid which is reduced by means of zinc and alcoholic hydrogen chloride yielding "iso-oleic acid." On hydrogenation it yields normal stearic acid, but on partial hydrogenation a mixture of stearic acid, liquid oleic acid, and unchanged "iso-oleic acid" is obtained.

Determination of the equilibrium ratio established between "iso-oleic acid" and oleic acid on hydrogenation.

As above recorded, "iso-oleic acid" yields both stearic acid and liquid oleic acid on partial hydrogenation.

With the endeavour to determine the equilibrium ratio, if any, which exists between "iso-oleic acid" and liquid oleic acid on hydrogenating the former, the following experiments were conducted. Two preparations of iso-oleic acid (or rather its ethyl ester) were employed for this purpose, the first, designated (A), being one which had been obtained by mixing the products of the above recorded experiments carried out with the different catalysts at varying temperatures, while the second preparation, designated (B), was obtained by hydrogenating ethyl oleate at 180° C., using a nickel catalyst. Both products possessed the same melting point (34°—36° C.), and on hydrogenation gave almost identical results, as is shown below :—

Preparation	Fall in iodine value	Ratio of oleic acid to "iso-oleic acid" in the hydrogenated mixture.
A	30	10 : 23·3
B	34	10 : 24·0
B	51	10 : 22·7

It follows from the above that on hydrogenating a quantity of ethyl iso-oleate until a fall of 30 has occurred in the iodine value a definite ratio exists between the "iso-oleic acid" and the liquid oleic acid in the hydrogenated mixture.

This liquid oleic acid yielded on oxidation a dihydroxystearic acid of m.pt. 132° C., so that it was identical with the oleic acid of olive oil.

Oxidation of "iso-oleic acid" by means of ozone.

As stated above, the different equilibrium ratios found to subsist between liquid oleic acid and "iso-oleic acid" on hydrogenating liquid oleic acid or "iso-oleic acid" indicate that "iso-oleic acid" is a mixture of substances, one (or more) of the constituents of which is capable of reverting to liquid oleic acid on hydrogenation. This view receives support from an investigation which was conducted with the endeavour to determine the position of the ethylenic linking in "iso-oleic acid" by the method of Harries (*loc. cit.*).

The method of Harries consists essentially in treating an unsaturated acid with ozone, when an ozonide is formed, which on decomposition yields an aldehyde and a dicarboxylic acid, rupture taking place at the double bond shown below :—

$$R(CH_2)_x.CH : CH.(CH_2)_{x_1}COOH \rightarrow$$
$$R(CH_2)_x.CH : CH.(CH_2)_{x_1}.COOH. \rightarrow (CH_2)_x.$$
$$\dot{O}.\dot{O}.\dot{O}$$
$$R(CH_2)_x.CHO + HO.CO.(CH_2)_{x_1}COOH.$$

It is self-evident that if the number of carbon atoms in the aldehyde and the dicarboxylic acid

respectively be determined the position of the ethylenic linkage will be known.

On treating "iso-oleic acid" in the manner above described a dicarboxylic acid possessing the empirical formula $C_{10}H_{18}O_4$ was obtained. The melting point of this acid was, however, very indefinite, lying between 80° and 100° C., whereas the acid of this formula should melt at 133° C. This product is, therefore, a mixture, and the simplest assumption is that it consists of equal parts of the dicarboxylic acids represented by the formulæ $C_8H_{14}O_4$ (m.pt. 106° C.) and $C_{11}H_{20}O_4$ (m.pt. 114° C.) respectively.

The examination of the aldehydes formed supported this conclusion, for although analysis indicated the formula $C_8H_{16}O$, the presence of nonylic aldehyde was proved by the isolation of its semicarbazone.

"Iso-oleic acid" consists, therefore, of a mixture of isomerides, one of which would appear to be elaidic acid, while the other (or others) is present owing to the migration of the ethylenic linkage.

Hydrogenation of ethyl elaidate.

The conclusion that elaidic acid is present in "iso-oleic acid" receives strong support from the fact that on partially hydrogenating a quantity of ethyl elaidate liquid oleic acid is formed.

A quantity of ethyl elaidate was hydrogenated until its iodine value had fallen from 82 to 50. On examination the hydrogenation products were found to consist of the following acids: Stearic acid, 45 grms.; "iso-oleic acid," 25 grms.; liquid oleic acid, 26 grms. Elaidic acid would, therefore, appear to be the constituent of "iso-oleic acid" which partially reverts to liquid oleic acid on hydrogenation.

My thanks are due to Drs. E. F. Armstrong and T. P. Hilditch for the interest they have shown in this investigation.

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Warrington.

THE DETERMINATION OF NITROBENZENE IN COMMERCIAL NITROBENZOLS.

BY CHARLES SIMPSON AND WILLIAM JACOB JONES.

Introduction.

At the present time it is usual to judge a nitrobenzol by its specific gravity and by the results of a distillation under fixed conditions. These tests are but rough guides, for the dinitrobenzenes, the mononitrotoluenes, and benzene counteract with regard to density, and, further, the boiling point of *o*-nitrotoluene is not greatly removed from that of nitrobenzene.

The determination of nitrobenzene in commercial nitrobenzols by methods depending on reduction to aniline (Altmann, J. prakt. Chem. 1901, [2], **63**, 370; Knecht and Hibbert, Ber., 1903, **36**, 1554) fails owing to the fact that the chief impurities are themselves nitro-compounds. Moreover, these methods are lengthy and laborious, and are not comparable in accuracy with the method to be described.

The present method depends on the relation between the freezing point and the percentage of nitrobenzene. The freezing point of the sample is determined and the corresponding percentage of nitrobenzene is then either calculated by means of a given equation or read off from a graph. A determination takes only five minutes to complete.

Method.

To the nitrobenzol, placed in a test-tube, are added two drops of water, and the contents of the test-tube are well shaken to ensure saturation. The test-tube is then placed inside a slightly wider test-tube which is supported vertically in melting ice. In the inner tube stand a thermometer and a copper-wire stirrer. The thermometer used should be graduated in fifths or in tenths of a degree, and be standardised between 0° and 6° C. Failing a certified thermometer, one may be corrected for the purpose by means of melting ice (0°) and of freezing, wet, purified nitrobenzene (5·22° C.) prepared as hereinafter described. During the determination the stirring should be at the rate of about one up-and-down movement per second. The thread of mercury in the thermometer will first fall and then suddenly rise. The highest point then attained is to be taken as the freezing point of the sample. In order to minimise the effect of lag, the thermometer should be tapped with the finger before a reading is taken.

Purification of nitrobenzene.

Nitrobenzol which contained 99·7% of nitrobenzene was re-distilled, and the distillate partly frozen. The crystals were mechanically separated from the mother liquor and allowed to melt. This process of alternate freezing and melting was repeated until the freezing points of three successive products, determined as described later, remained constant. The purified nitrobenzene thus obtained was found to be free from nitrothiophens. After saturation with water it froze at 5·22° C. on the international gas-thermometer scale. After careful drying it froze at 5·70° C. on the same scale. These figures confirm those given by Hansen (Z. physikal. Chem., 1904, **48**, 593.)

Freezing points of nitrobenzene mixtures.

Mixtures containing nitrobenzene and the substances which are commonly associated with it in commercial nitrobenzols were prepared, and their freezing points, after saturation with water, were determined. The substances were carefully purified beforehand. Table I., which shows the results, gives the percentage by weight of nitrobenzene present for various freezing points, each of the indicated impurities being present alone. Thus a mixture containing 95% of nitrobenzene and 5% of *m*-dinitrobenzene, after saturation with water, freezes at 2·90° C.

TABLE I.

Weight % of nitrobenzene	Freezing points of binary mixtures of nitrobenzene with						
	Paraffin	CS_2	C_6H_6	$mC_6H_4(NO_2)_2$	C_7H_8	$oC_7H_7NO_2$	$pC_7H_7NO_2$
100	5·22	5·22	5·22	5·22	5·22	5·22	5·22
99	4·53	4·30	4·34	4·78	4·45	4·74	4·67
98	3·85	3·43	3·48	4·35	3·69	4·25	4·14
97	3·20	2·60	2·66	3·90	3·05	3·71	3·59
96	2·62	1·92	1·90	3·42	2·43	3·18	3·06
95	2·05	1·23	1·14	2·90	1·78	2·62	2·52
94	1·53	0·53	0·34	2·41	1·11	2·07	2·00
93	1·03	−0·17	−0·46	1·94	0·44	1·55	1·48
92	0·54	−0·89	−1·26	1·47	−0·24	1·04	0·95
91	0·04	−1·61	−2·08	1·02	−0·94	0·52	0·36
90	−0·46	−2·36	−2·90	0·55	−1·64	0·00	−0·22

Application.

Benzols used for nitration contain as impurities toluene, aliphatic hydrocarbons, thiophen, and carbon bisulphide. Of these, under the conditions of nitration, paraffins and carbon bisulphide remain

practically unaltered. Unsaturated aliphatic hydrocarbons and thiophen are almost completely destroyed, and the products dissolve in the acids. Practically the whole of the toluene is converted into mononitrotoluenes, in the proportion of two parts of *ortho-* to one part of *para*-nitrotoluene. Unless the amount of toluene in the original benzol is large, it may be assumed that no free toluene is left in the product of nitration.

For the sake of illustration we will assume that the benzol used for nitration is of fair quality, and that it contains per cent. by weight benzene 97·5, toluene 1·0, thiophen 0·5, aliphatic hydrocarbons (mainly paraffins) 0·8, and carbon bisulphide 0·2. On nitration under the usual conditions about 95 of the benzene will form nitrobenzene, about 2 will form dinitrobenzene, whilst about 0·5 will remain unchanged. Normally the amount of actually recovered nitrobenzene will not represent 95% of the original benzol, but it will approach this figure if due allowance be made for losses during the nitration. Thus assuming the normal nitration of a benzol of the given composition and no losses by volatilisation we can prepare Table II.

Taking now the impurities present in the nitrobenzols to be in the proportions found in Table II., and using the results of Table I. we are enabled to draw up Table III.

Where the original benzol differs considerably in composition from that here assumed, or where the conditions of nitration are very different from those here assumed, similar tables to the above, but applicable to the altered conditions, may be constructed on the lines indicated.

For all ordinary purposes the following equations, derived from the foregoing figures, will give the percentage of nitrobenzene, where t° C. denotes the freezing point of the nitrobenzol, saturated with water, and x the percentage by weight of nitrobenzene in the nitrobenzol.

(1) For the crude product of nitration, after washing with water to remove acids $x = 90{\cdot}2 + 1{\cdot}87\ t$.

(2) For the crude product after removal of unnitrated benzene etc. by steam-distillation $x = 89{\cdot}0 + 2{\cdot}11\ t$.

(3) For distilled nitrobenzol $x = 90{\cdot}0 + 1{\cdot}91\ t$.

The present method is applicable to samples inferior to the above by simply mixing a known weight or volume of the sample with a suitable amount of purified nitrobenzene so that the freezing point of the mixture is above 0° C.

TABLE II.

Composition of product per 100 parts by weight of the original benzol.

Constituents	Parts by weight		
	Crude product of nitration after washing to remove acids	Crude product of nitration after washing and removal of unnitrated benzene etc. by steam distillation	Distilled nitrobenzo
Unnitrated benzene ...	0·5	0·0	0·0
Paraffin	0·8	0·0	0·0
Carbon bisulphide ...	0·2	0·0	0·0
Nitrobenzene	149·8	149·8	149·8
m-Dinitrobenzene ...	4·3	4·3	0·0
o-Nitrotoluene ...	1·0	1·0	1·0
p-Nitrotoluene ...	0·5	0·5	0·0
Total	157·1	155·6	150·8

TABLE III.

Percentage by weight of nitrobenzene in the nitrobenzol	100	99	98	97	96	95	94	93	92	91	90
					Freezing point °C						
(1) Crude product of nitration	5·22	4·69	4·17	3·66	3·13	2·60	2·06	1·50	0·94	0·38	-0·18
(2) Crude product of nitration after removal of unnitrated benzene etc. by steam-distillation	5·22	4·76	4·30	3·86	3·39	2·92	2·41	1·88	1·40	0·92	0·44
(3) Distilled nitrobenzol	5·22	4·74	4·25	3·71	3·18	2·62	2·07	1·55	1·04	0·52	0·00

Chemical Department,
The University, Manchester.

Annual Meeting.

*PRODUCTION OF STEAM FROM LOW-GRADE FUEL.

BY P. PARRISH.

(This J., 1919, 234 T.)

WRITTEN CONTRIBUTIONS TO DISCUSSION.

Mr. F. M. POTTER:—

Reference is made to the best grate area, but I have not gathered figures which would enable one to calculate the author's practice for fuel consumption per unit of grate area and equivalent evaporation from and at 212° F. per sq. ft. heating surface. Based on my present information, I would suggest that good practice is obtained with coke breeze where the varying boiler load requires a fuel consumption of 25—30 lb. per sq. ft. grate area, the grate area for a 30 ft. × 8 ft. 6 in. hand-fired Lancashire boiler being reduced to 30 sq. ft. This gives a mean evaporation at 64% efficiency of 5300 lb. of water per hour to 60 lb. gauge pressure, or 5900 lb. from and at 212° F. for the 30 ft. × 8 ft. 6 in. boiler (fuel 10,500 B.Th.U. per lb., feed water 130° F.). The evaporation from and at 212° F. is 6·2 lb. per sq. ft. heating surface, and the ratio of heating surface to grate area is thus 950 : 30 = 31·6 : 1.

With the Wilton furnace, tests show a steam consumption by the jets of 3·7% of the total production.

Has the author calculated the possible value of economisers on a plant using a low-grade coke fuel? The saving effected, as compared with a similar unit on a coal-fired plant, is less, but figuring on a minimum 7% efficiency with a cost per tube installed, including accessories and setting, of £6, seventy-two 9 ft. × 4⅛ in. tubes per boiler, a rough calculation gives an annual saving on the fuel bill alone equivalent to 20% on the capital expenditure. On the credit side must also be added saving in wear and tear of boilers, value of steadier steam production under varying load, and reduced labour in that one boiler in a battery of 9 could be closed down. The maintenance of a comparatively high feed water temperature by a circulator would be necessary to prevent excessive condensation from the flue gases with consequent corrosion.

Nicol (Electrician, January 24, 1919) publishes figures for the boiler range of the London Hydraulic Power Co., using coal slack and coke on the sandwich system. Burning 30·6 lb. of fuel per sq. ft. of grate area with an equivalent evaporation from and at 212° F. of 5·22 lb. per sq. ft. heating surface, he obtains a boiler efficiency of 69·9% increased to 79·96% by the economiser.

With the Wilton furnace practically the whole of the air is passed through the fuel bed, a low secondary air supply being admitted through parts in the firedoor.

Mr. NORMAN SWINDIN:—

Those who have had experience with the burning of coke breeze and gasworks refuse in furnaces of the Wilton type can agree with the general terms of the paper. Yet notwithstanding the success of the methods employed, the direct firing of mere refuse (for the coke breeze supplied to a gasworks boiler is nothing else) in expensive boilers appears to be entirely wrong. I have experience of a range of about 30 boilers fitted with the Wilton furnace, and I can confirm the fears expressed in the paper that at times the furnace becomes a gas producer and the downtake to the bottom flue a most excellent furnace. Moreover, explosions often take place in the back flues. The steam jets increase in size till they become mere openings for steam, and the firemen pile up their fires so that all the conditions for producer-gas making are present. This seems to point to the pressure gas producer as the instrument of combustion. Though at the moment it is difficult to recover ammonia from coke in a gas producer, extended use of this method of gasification would give the necessary experience. The supply of producer-gas of 140 B.Th.U. to a gasworks' chemical works would serve to fire boilers for direct steam and also to run the gas engines. It is surprising how much good, clean, expensive gas is still used to run gas engines. The gasworks do not seem to be able to get away from pure coal gas.

Mr. PARRISH supplemented his paper with the following remarks:—

The suction at the shaft was ¼ in. water gauge, at the main flue ⅛ in., and the secondary air ports were under $\frac{3}{16}$ in. suction. The pressure in the primary air conduits was ¼ in. and the products of combustion were in a state of equilibrium immediately above and adjacent to the secondary bridge.

The term "coal" used in fig. 3 (p. 236 T) implied a content of 0·855 lb. of carbon. It was on this basis that the lb. of air per lb. of coal were calculated.

Regarding the consumption of steam in connection with the blasts, further determinations have been made with nozzles having an orifice ¼ in. diam. These determinations are indicated in fig. 6. The consumption of steam has been correlated with the evaporation of water, and fig. 7 (p. 328 T) furnishes these data.

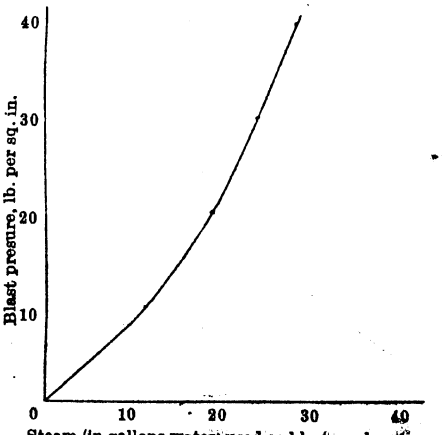
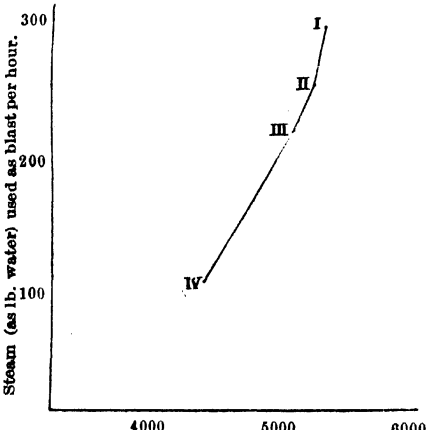


FIG. 6.

Experience of the operation of mechanical pyrites fines and spent oxide burners, which give rise to the formation of considerable dust, suggests that three conditions should be complied with if the dust is to be effectively arrested. In the first place it is essential to secure a wide disparity between the specific gravity of the dust particles and the gases in which these are suspended, and this can only be effected by insulating the flues and dust chambers, so as to prevent the dissipation of heat, thereby ensuring attenuated, or specifically light, gases. Separation of the dust particles under these conditions is facilitated. In the second place it is important that the dust chamber should be arranged in such a way that the direction of the flow of the gases is diverted at right angles at as many points as possible. Thirdly, the velocity of the

gases should not exceed four lineal feet per second. It might be advantageous to interpose a dust chamber, designed on the above lines, between the main flue and the chimney stack in order effectually to overcome the nuisance arising from drift.

The Lancashire boilers referred to in the paper are each 27 ft. × 8 ft. with varying grate areas. It has been found that 26 sq. ft. of grate area per boiler affords the best results, and this is the standard to be uniformly adopted throughout the whole installation. The evaporation from and at 100° C. is 430 gallons of water per hour during ordinary working, and the evapora-



I. 40 lb. sq. in. pressure, 5·1%
II. 30 ,, ,, 4·7%
III. 20 ,, ,, 4·6%
IV. 10 ,, ,, 3·11%

Chart showing steam consumption on blasts in relation to gallons of water evaporated per hour.

FIG. 7.

tion of water per pound of fuel during the last three months has been 5·48 lb. This is equivalent to a consumption of fuel of 30 lb. per sq. ft. of grate area. As regards fuel consumption per unit of grate area in relation to heating surface per sq. ft. based on an evaporation from and at 100° C., the figures are 855 : 30 = 28·5 : 1. Calculations as to the possible value of economisers on a plant using a "low-grade coke" are misleading in the absence of full details as to the characteristics of this particular fuel. The porosity and degree of fineness of the fuel play an important part in this connection. The wisdom of adopting economisers in conjunction with boiler installations using coke breeze is doubtful. It is feared that dislocation of the normal operation of the scrapers of the economiser would ensue, unless an efficient dust chamber for arresting drift and flue dust were provided. The provision of a dust chamber would increase the capital outlay and augment radiation losses, and, having regard to these factors and the initial capital cost of the economiser tubes, the author would hesitate to recommend the adoption of such additional plant. In giving expression to the latter view the author is not oblivious of the advantages of economisers when coupled to boiler installations using a suitable quality of fuel. Several years' experience of the working of the Wilton forced draught furnace leads the author to the view that the adoption of some suitable provision for the admission of a readily controllable supply of preheated secondary air would be distinctly advantageous, as compared with the introduction of a cold supply of secondary air through the perforations of the door as obtains at present.

Newcastle Section.

Meeting held at Newcastle on April 9th, 1919.

DR. J. T. DUNN IN THE CHAIR.

DETERMINATION OF OXYGEN AND NITROGEN IN ELECTRIC WELD METAL.

BY J. H. PATERSON AND H. BLAIR.

Within recent years rapid progress has been made with a method of welding steel and iron, in which the operation is effected by means of the heat derived from an electric arc. In one of the most promising modifications of this method, the work to be operated on is made one pole of the arc, and a piece of iron wire held in a special holder is made the other pole. On striking the arc, the iron wire melts and falls on the fused surface of the work, making, under the proper conditions, an excellent junction. The metal thus deposited in the weld has unfortunately been found to be faulty in its mechanical properties, being wanting in toughness and ductility, and numerous modifications of the process have been devised to produce weld metal which shall be free from these defects. These modifications consist, in practically all cases, in wrapping the wire or electrode with some material which melts with the electrode and floats on the top of the weld metal, thus protecting it from atmospheric oxidation, and by retarding the rate of cooling, producing a better crystalline structure. In some cases a deoxidiser, such as aluminium or magnesium, is applied to the wire electrode between the metal and the coating. Practically every conceivable fluxing material has been patented as a suitable coating for electrodes.

As the supposed benefits of these flux-covered electrodes are based on very unconvincing mechanical tests only, it was felt that a thorough investigation of the composition and properties of weld metal was necessary before the advantages or disadvantages of the various fluxes could be decided upon. The following account deals with the methods found necessary for determining the quantities of oxygen and nitrogen which are always present in weld metal, no matter what process has been used.

Determination of nitrogen.—The accurate determination of this element in iron and steel has been the subject of much investigation and discussion, although the methods advocated by Braune [1] in 1906 have not been much improved upon. In commenting on the titration method of estimating nitrogen as ammonia, De Osa [2] suggested that some of the nitrogen might be converted into oxygen compounds instead of into ammonia when dissolving the metal in acid. He proposed therefore that, after the ordinary ammonia distillation, zinc should be added to the distillation flask and the operation repeated. Tschischewski [3] objects to this on the ground that the zinc reduces nitrogen compounds contained in the acid used for dissolving the metal.

As in all welds oxygen and nitrogen exist in comparatively large quantities, and probably, to a certain extent, in combination with one another, the possibility of missing some of this nitrogen becomes very great. The authors have found that by carrying out the distillation with a zinc-copper couple in the alkaline liquid, about 40% more of ammonia is obtained than when it is dispensed with. Any ammonia obtained by the reduction of nitrogen

[1] Jernkontorets Annalen, 1906.
[2] Rev. Met., 1906, 493.
[3] J. Iron & Steel Inst., 1915, Vol. 2.

compounds in the hydrochloric acid is of course allowed for by carrying out comparative blank distillations with the reagents employed in the actual process. The determination is made in the following manner:—2·5 grms. of the sample is dissolved in cold hydrochloric acid and then digested on a hot plate till any black residue which may be visible has disappeared. The solution is then neutralised with caustic potash, and a measured excess (about 3 grms.) added. One or two pieces of zinc which have been coated with copper and carefully washed are then added and the mixture distilled, over a large naked flame, into *N*/20 sulphuric acid. The mixture boils freely and shows no tendency to bump or splash. The partially neutralised acid is titrated back with *N*/50 potassium hydroxide, using methyl orange as indicator. A comparative blank experiment is made from time to time, using pure iron turnings which have been strongly heated for some time in a current of hydrogen, and which may be assumed to be free from nitrogen.

Determination of oxygen.—The determination of small quantities of oxygen in steel by passing carefully purified hydrogen over heated drillings of the sample is recognised as being perfectly accurate and the method calls for no special comment. In dealing with steel containing both oxygen and nitrogen, however, it was felt that error might be introduced through some of the nitrogen being reduced to ammonia and being absorbed by the phosphorus pentoxide tubes. An experiment was consequently performed in which hydrogen, carefully purified as described below, was passed over a quantity of drillings of weld metal heated to 850° C. in a silica tube. Appreciable quantities of ammonia were produced, especially at the beginning of the experiment. In all determinations of oxygen, therefore, the ammonia thus formed must be estimated and deducted from the total increase in weight of the absorption tube in order to obtain the true weight of water formed. This is accomplished by placing between the combustion tube and the absorption tube a small guard tube, containing about 3 grms. of phosphorus pentoxide held in place by two plugs of glass wool. This tube is weighed along with the absorption tube both before and after the experiment. It is then detached and the contents washed into a distillation flask, made alkaline with caustic potash, and the ammonia determined by the distillation method. An alternative and accurate method is to place a fresh quantity of drillings in the combustion tube and to absorb the ammonia formed in *N*/50 sulphuric acid, determining the amount produced by back titration. The former method is to be preferred, however, as it gives the nitrogen figure for the sample in which the oxygen is determined. The details of the actual method are as follows:—Electrolytic hydrogen is passed through a tower filled with soda-lime and a wash-bottle containing strong sulphuric acid. From thence it is carried into a silica tube filled with fine iron borings and heated to bright redness in a tube furnace. Here any trace of oxygen contained in the gas is reduced to water. The gas then passes through two U-tubes, the first containing glass wool saturated with strong sulphuric acid, and the second phosphorus pentoxide. The purified gas is then passed into the reaction tube. Both silica tubes are closed with rubber stoppers, which are protected from the heat of the centre of the tube by plugs of asbestos ignited in hydrogen.

Before carrying out a determination the apparatus is swept free of air and then both tubes heated up to the full temperature for about 90 minutes in a slow stream of hydrogen. If the absorption bulbs are now attached they should show no appreciable gain in weight after the gas has passed for an hour longer. The reaction tube is then cooled and the dry drillings quickly introduced in a silica boat. From 3 to 5 grms. was the quantity usually employed in the experiments. The tube is heated again to 850° C. and the removal of the oxygen is complete in 30 minutes. The ammonia absorbed by the guard tube is determined as previously described, and the quantity deducted from the total increase in weight of the U-tube.

It has been found very difficult in practice to get strictly concordant results from the same samples. Investigation showed that if any given sample of drillings be separated into three portions, *viz.*, coarse drillings, fine drillings, and powder, each portion differs greatly in oxygen content from the others. Thus a sample of weld metal gave the following oxygen figures on analysis:—Coarse drillings, 0·075%; fine drillings, 0·190%; dust, 0·680%; complete sample, 0·342%.

It is evident from the microscopic examination of electric welds that there are considerable quantities of non-metallic inclusions in every weld, particularly when a flux-covered wire is used. Analyses of some large slag inclusions from a flux-coated electrode show that they contain 6—6·5% of oxygen, which is removed as water when the material is heated in hydrogen. Inclusions consisting of iron oxide particles contain, of course, still larger quantities.

It follows, therefore, that no matter how the samples are taken, the quantity of oxygen found must include a certain amount which will have little or no effect on the mechanical properties of the metal. Chemical analysis must therefore always be supplemented by microscopic examination of the sample.

Analysis of weld metals.

In order to determine the effect of the composition of the electrode on the oxygen and nitrogen contents of the weld metal, welds were made under as nearly as possible identical conditions with six different steel wires of the following composition:—

Electrode	Carbon	Manganese	Silicon	Nickel
	%	%	%	%
A	0·103	0·681	0·03	—
B	0·06	0·56	0·045	0·086
C	0·120	0·60	0·05	—
D	0·112	0·244	0·053	—
E	0·059	0·016	—	—
F	0·057	0·605	0·045	—

The weld metal was laid on the surface of a flat plate and, after cooling, the surface was ground off and the samples taken for analysis. It is important to note that weld metal laid in a groove (the usual condition when making a weld) contains less oxygen than metal laid on a flat plate. This is to be attributed to the difference in the surface areas exposed to atmospheric oxidation.

The percentage of oxygen in a weld made with any one kind of electrode has been shown by one of the authors [4] to decrease rapidly as the current strength is increased and hence as the rate of deposition of the metal is increased. It is therefore interesting to note that under similar conditions of current density the more rapidly melting electrodes (as shown by the quantity K) produce a weld metal with more oxygen in it than those which deposit slowly. A notable exception, however, is electrode F, which shows the fastest speed and contains the least oxygen, a condition possibly brought about by its high carbon content. A probable explanation of this fact is that the fastest electrodes have the lowest melting points and hence remain

[4] J. H. Paterson, Ass. of Eng. & Ship Draughtsmen, Feb., 1919.

Electrode	Type	Arc voltage = A	Current strength in amperes = C	Grms. of metal melted per minute = G	$K = \frac{G}{A \times C}$	Percentage composition of weld: O_2	Total N_2	N_2 given off with O_2	C
A	Bare	25·20	101	30·3	0·0133	0·37	0·10	0·054	—
B	,, ...	21·50	105	30·0	0·0132	0·37	0·11	0·041	—
C	,, ...	19·5	107	20·3	0·0115	0·32	0·135	0·018	—
D	,, ...	18·5	107	23·0	0·0110	0·275	0·10	0·044	0·04
E	,, ...	20·5	107·5	21·6	0·0101	0·266	0·125	0·048	nil
F	,, ...	26·0	99	35·0	0·0136	0·145	0·10	0·021	0·15
A	Coated with CaCO	18	109	20·0	0·0102	0·264	0·11	0·042	—
B	,,	18	108	19·5	0·0100	0·238	0·114	0·031	—
C	,,	33·5	78	23·0	0·00884	0·214	0·08	0·013	—
D	,,	17·5	107	16·2	0·0086	0·141	0·106	0·039	0·045
E	,,	18	114	15·3	0·0075	0·753	0·120	0·035	nil
F	,,	15	123	18·3	0·0100	0·131	0·081	0·038	0·16

liquid and capable of absorbing atmospheric oxygen for the longest periods.

The high percentage of nitrogen contained in the weld metal and the comparative uniformity of the amount is of great interest. It is a generally accepted fact that molten iron is practically unacted upon by atmospheric nitrogen, and when it is remembered that the maximum time that the weld metal remains molten is about thirty seconds it will be understood that the reaction which does take place must be a powerful one. Andrew,[5] by heating iron for long periods in an atmosphere of nitrogen at very high pressures, succeeded in producing alloys containing 0·3% of nitrogen, but the conditions in the case of weld metal are not at all comparable.

In 1911, R. J. Strutt [6] found that under the influence of a high-tension discharge, nitrogen became chemically active and would rapidly combine with metals such as sodium, magnesium, and calcium at ordinary temperatures. Numerous workers have since investigated the phenomena connected with active nitrogen, and among others Koenig and Elod [7] showed that it could be produced when nitrogen was drawn through a direct-current arc. These investigators also showed that a highly active form of oxygen was produced in the direct-current arc, differing from ozone. It is probable, therefore, that the high percentage of nitrogen found in all weld metal is due directly to the exposure of the metal, while molten, to active nitrogen produced by the arc.

The conditions under which the nitrogen exists in the weld metal are of the greatest interest, but much further work requires to be done before dogmatic explanations can be given. When weld metal is heated (as already explained) to about 850° C. in a current of dry hydrogen a proportion of the nitrogen is given off almost immediately, some as ammonia, and some apparently as uncombined nitrogen. Thus a weld metal containing 0·095% of total nitrogen when heated for thirty minutes in hydrogen gave off 30·5% of the element as ammonia and the residue on analysis still contained 23·1% showing that 46·4% had escaped as uncombined nitrogen.

A weld metal containing 0·081% of nitrogen was heated in hydrogen for thirty minutes, when it gave off 46·9% of its nitrogen as ammonia. On heating for 20 hours longer it gave off 7·4% more as ammonia. The residue still contained 17·3% of the nitrogen. The difference of 28·4% of the nitrogen must therefore have been given off as uncombined nitrogen. It is not unreasonable to suppose that the nitrogen exists in the metal in two forms, one form intimately related to the oxygen content, and the other as a solid solution of iron nitride.

[5] J. H. Andrew, *J. Iron & Steel Inst.*, 1913, Vol. 86.
[6] R. J. Strutt, *Proc. Royal Soc.*, 1911, A 85.
[7] Koenig & Elod, *Ber.*, 1914, 47.

New York Section.

Meeting held at Chemists' Club on May 23rd, 1919.

MR. C. E. SHOLES IN THE CHAIR.

SHIPPING CONTAINERS.

BY C. P. BEISTLE.

This paper deals with the origin and present status of the efforts of the Bureau of Explosives to promote safety in the transportation of dangerous articles through improvement of shipping containers. The Traffic Department in prescribing freight rates stated in a very general way the type of container that would be acceptable for different classes of freight. It was not practicable to go into much detail in prescribing these containers. The absence of detailed specifications made it possible for shippers to present and have their shipments accepted at the freight stations, in almost any type of container. The active competition between railroads made it difficult, if not impossible, to apply restrictions which would result in the refusal of improperly packed freight. Loss and damage occurred as a natural result and the railroads bore the financial burden. What this burden amounts to at the present time is shown in the Annual Reports on the Statistics of Railways in the United States. In the analysis of operating expenses under item "Loss and damage, freight," the following figures are given:—

Year ending June 30th	Carrier	Loss and damage, freight	Per cent. of total operating expenses
1916*	Class I., II., III.	$22,738,893	1·029
1915	I., II., III.	29,942,828	1·461
1914	I., II. ...	33,671,219	1·555
1913	I., II. ...	30,885,454	1·451
1912	I., II. ...	24,639,852	1·237

* Latest available.

NOTE.—Class I. carriers are those having annual operating revenues above $1,000,000. In 1916 Class I. carriers operated over 230,500 miles and Class II. operated over 18,000 miles of railroad in the United States.

The materials classed as dangerous by the Regulations of the Interstate Commerce Commission, and causing the heaviest losses during the year 1918, as shown by Annual Report of the Chief Inspector of the Bureau of Explosives, were as follows:—

Gasoline, causing	101	fires and a loss of		$881,000
Alcohol,	,, 39	,,	,,	145,000
Nitric acid,	,, 158	,,	,,	108,000
Matches,	,, 39	,,	,,	51,000
Liquefied petroleum gas,	,, 2	,,	,,	45,000
Nitrate of soda,	,, 5	,,	,,	28,000
Crude oil,	,, 11	,,	,,	26,000

Policy of Bureau of Explosives.

The aim of this policy, established when the Bureau began its work in 1907, was to form a partnership with the shipper for the purpose of promoting safety in the transportation of his product. The principal object of this partnership was to impress upon the shipper his share of responsibility for this promotion of safety, and to give him corresponding opportunity to meet that responsibility. By this plan he had a voice in framing specifications to govern the design and construction of his shipping container, as well as the rules to govern both the carrier and the shipper in marking, describing, and handling these shipments during transit. On account of the greater danger involved, work was directed first toward the transportation of explosives. The containers used for this purpose were wooden boxes for high explosives and metal kegs for black powder. An exhaustive series of tests was planned and carried out at the Altoona yards of the Pennsylvania Railroad. Packages containing sand and loaded in freight cars were subjected to various degrees of rough treatment to represent the shocks liable to occur in railway operation. When a freight car travelling at five miles per hour is allowed to strike a solid train of loaded freight cars at rest, the force tending to produce a movement of lading along the floor of the car amounts to not less than five pounds for each pound in the weight of the package. For example, 240 boxes of high explosives weighing 58 lb. each, develop under these circumstances a tendency towards relative movement which can be stopped only by a force equal to 5 × 58 × 240, or 69,600 lb.

After a careful study, plans for loading and bracing these explosive packages in cars were worked out in detail and published in B. E. Pamphlet No. 6A, which illustrates by drawings and photographs the best loading and bracing methods. The wooden boxes and metal kegs in use at that time for these shipments were subjected to careful tests to ascertain their resistance to end and side pressures. These resistances were strengthened as much as was possible under the conditions that had to be met. As a final result of this standardisation work we have been able to reduce the property loss due to the annual shipment during normal times of about six hundred million pounds of explosives, to an average of about $30,000 a year. This loss during 1907, the first year covered by statistics, amount to $500,000. During the same year fifty-two people were killed and eighty injured by explosions in transit. These figures have been reduced so that it is now exceptional when a life is sacrificed by the transportation of explosives throughout the United States and Canada.

Our invitation to manufacturing shippers of dangerous articles throughout the United States to co-operate with us in this important work has met with most generous response. Where these shippers were already organised for other purposes into societies or associations, the full weight of the influence of these associations has been thrown into this work. In many cases organisations were effected where they had not previously existed, the principal object being to have representatives available to meet at any time representatives of the Bureau of Explosives to discuss the problems requiring solution. In no case has this co-operation been more generous or effective than in the case of the Executive Committee of the Manufacturing Chemists' Association, under the chairmanship of Mr. Henry Howard of Boston.

We have made very satisfactory progress in standardising the shipment of explosives. The natural benefits to be expected from such standardisation are referred to in the following quotation from the Annual Report of the Chief Inspector for the year 1918:

"Our military program, adopted early in 1918, called for a production in one year of about two billion pounds of explosives for military use, and for the production of poisonous liquids and gases at a maximum rate of about 200 tons per day. The actual production attained under this program cannot be stated at this time, but it is known that for most of the year preceding the signing of the armistice, the monthly production of military explosives exceeded eighty million pounds, or more than two thousand carloads of 40,000 pounds each per day. These explosives moved to the loading plants where each carload of explosives produced not less than five carloads of explosive projectiles. Allowing ten days for the average movement to destination, and considering less-than-carload shipments as well as carload shipments, a conservative estimate shows that the railroads of the United States during the busy months of 1918 had at all times not less than fifty thousand cars in transit on Government business and bearing the explosive placard. This was in addition to the average of five thousand cars in transit to meet the normal commercial demand, and our estimate does not include the cars bearing military explosives in Canada. In meeting this abnormal demand only 11 accidents of all kinds occurred in the transportation of explosives during 1918, only four persons were injured, only one life was lost; and the total property loss was only $33,238. Of these results the only one chargeable to war material was the loss of one life, which occurred in Canada.

"This excellent record is due, primarily, to the general use of standard packages and of standard methods of loading, blocking, and bracing the packages in cars. Such standardisation is secured more readily for explosives than for many of the other classes of dangerous articles on account of the relatively small number of shippers of explosives, and their very general appreciation of the necessity for strict compliance with the regulations. The record should be an object lesson to shippers of other dangerous articles and to operating officials of railroads. These other losses can and should be reduced by the same attention to construction of containers, loading of packages, and handling of cars. The efforts of the Bureau of Explosives must be reinforced, however, by stronger measures if progress in this direction is to be accelerated."

Efficiency in shipping containers: A problem in mechanical and chemical engineering.

The problem of securing safe transportation involves numerous factors. The nature of the material to be shipped must be considered with respect to the results liable to follow from leakage from shipping containers. In some cases only the loss of the material is involved, while in others disastrous fires involving the loss of much additional property may result, either by the effect of the exposure of leaking material to air and moisture, or by ignition of inflammable material. In some cases the material shipped is liable to act chemically on the container. The nature of the material shipped and the design and construction of the container must be considered also from the standpoint of safe storage of the article, as well as

Summary of reported accidents involving shipping container failures causing fires, personal injuries, or property loss occurring in the transportation of dangerous articles other than explosives for a period of five years ending December 31st, 1918.

Name of article	Tank cars				Metal drums or barrels				Carboys				Wooden barrels and kegs				Cylinders				Cans, bottles, jugs, etc., in wooden boxes or barrels			
	No. accidents	Persons killed	Persons injured	Property loss	No. accidents	Persons killed	Persons injured	Property loss	No. accidents	Persons killed	Injured	Property loss	No. accidents	Persons killed	Persons injured	Property loss	No. accidents	Persons killed	Persons injured	Property loss	No. accidents	Persons killed	Persons injured	Property loss
Acetone	...	...	...	...	13	...	...	$1,638	1	...	...	$287	...	...	...	...	...	...	...	...	2	...	...	$36
Acid, hydrochloric	9	...	...	$737	...	...	...	...	674	...	1	13,007	...	...	...	...	...	...	...	...	32	...	...	168
Acid, hydrofluoric	...	...	...	...	...	...	...	...	22	...	3	271	28	...	1	$2,425	...	...	...	...	1	...	1	1
Acid, hydrofluosilicic	...	...	...	...	...	...	...	...	...	...	...	...	14	...	...	477	...	...	...	...	...	...	...	...
Acid, nitric	...	...	...	...	...	...	...	...	468	...	13	384,491	...	...	...	...	...	...	...	...	52	...	...	216,620
Acid, sulphuric	14	...	9	2,548	39	...	1	11,289	1016	...	30	27,261	2	...	...	13	...	...	...	...	64	...	11	1,169
Alcohol	5	...	...	32,660	3	...	...	5,670	2	...	...	33	71	...	8	162,386	...	...	...	...	47	...	...	2,556
Batteries, storage (charged with acid)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15	...	...	1,180
Benzol	9	...	...	8,029	1	...	...	38	...	...	...	...	1	...	...	4	...	...	...	...	1	...	...	1
Benzine	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26	...	...	21,613
Carbon bisulphide	...	...	...	...	3	...	...	1,675	...	...	...	...	...	...	...	...	...	...	...	...	14	...	...	88
Cologne spirits (alcohol)	...	...	...	...	...	...	...	...	...	...	...	...	23	...	...	13,250	...	...	...	...	3	...	...	10
Electrolyte	...	...	...	...	...	...	...	...	98	...	1	2,635	...	...	...	...	...	...	...	...	3	...	...	13
Ether	...	...	...	...	5	...	...	81	...	...	...	...	...	...	...	...	...	...	...	...	7	...	...	43
Gas, compressed acetylene	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	15	1	8	$15,878	...	...	...	...
Gas, compressed carbonic acid	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	181	...	7	1,074	...	...	...	...
Gasoline	76	3	16	142,705	68	...	1	5,851	...	...	...	...	5	...	3	1,246	...	...	...	...	33	...	...	207
Naphtha	6	...	...	2,514	1	...	...	1	...	...	...	...	3	...	...	1,514	...	...	...	...	...	...	...	...
Paint	...	...	...	...	4	...	...	105	...	...	...	...	20	...	...	464	...	...	...	...	31	...	...	161
Shellac, varnish	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	34	...	...	...	...	15	...	...	57
Toluol	14	...	...	14,068	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Turpentine	...	...	...	...	...	...	...	...	...	...	...	...	7	...	...	6,493	...	...	...	...	17	...	...	5,118
Totals	133	3	25	203,261	137	0	2	26,348	2281	0	48	427,985	176	0	12	188,306	196	1	15	16,952	363	0	12	249,043

Total no. accidents, 3286, each involving from 1 to 150 individual containers (see nature of failures under each type of container).

Total no. persons killed, 4.

Total no. persons injured, 91.

Total amount of property loss, $1,111,895.

Losses include fire, containers and contents, damages to other cargo and property.

Note.—This summary does not include the many listed dangerous articles which have been involved in less than 10 accidents each during the past five years.

Tank car failures consist of:

Leaking plates, seams, rivets, outlet valve, discharge pipe and outlet valve cap, not caused by collision or derailment.

Leaks resulting from the formation of ice in outlet valve, discharge pipe, or cap.

Leaks resulting from damage to outlet valve, pipe, or cap (due to collision, derailment, or rough handling).

Drum failures consist of:

Leaking bungs, vent-holes, seams, and ruptures due to corrosion.

Bursting due to internal pressure.

Rough handling.

Carboy failures consist of:

Inefficient stoppering.

Insufficient cushioning.

Improper loading, bracing, or blocking, etc.

Breakage due to causes unknown.

Breakage due to rough handling.

Wooden barrel and keg failures consist of:

Leaking staves, heads, bungs.

Bursting of heads.

Collapsing due to loose hoops, sprung staves, etc.

Rough handling or improper loading, blocking, or bracing.

Cylinder failures consist of:

Broken valves.

Leaking valves.

Bursting of safety discs.

Explosions due to defective welding, dropping of cylinder, increase of internal pressure (from exposure to direct sunlight, hot steam pipes, fire) or dissociation of acetylene gas.

Failures of above-mentioned containers consist of:

Inefficient stoppering or closure of interior packages.

Improper packing or cushioning.

Insufficient packing or cushioning.

Leaks due to improperly driven nails, rust spots, or defective seams (resulting from brittle or poor solder).

Improper loading, bracing, etc.

explosions have occurred from this cause. While from the standpoint of safety the bottom valves on tank cars are undesirable, it appears impracticable to eliminate them, owing to various commercial considerations.

Steel barrels and drums.

The specification steel drum required for inflammable liquids serves the purpose admirably; failures in this container generally result from too long service, porous bungs, or improper gaskets. Ordinary cast-iron bungs are often sufficiently porous or flawed to permit leakage through the metal. This is more noticeable with light and volatile liquids, such as gasoline or ether. The remedy is to use steel bungs, or to subject all cast-iron ones to severe tests for porosity before use.

Difficulties with these metal drums may be divided into three classes: first, poor welding; second, closing devices; and third, corrosion and rough handling. Poor welding can ordinarily be controlled by the most careful supervision of the manufacture. An air test of 15 lb. is prescribed for each package, but small holes may be covered with scale or closed by oxide so that leakage will develop after use. Such a test made before each shipment, especially if the package is hammered with a wooden mallet along the chime and side weld, would eliminate practically all chance of leakage due to defective welding. The apparatus and test would not be very expensive and would probably pay in the case of a large shipper, for the railroads are fast coming to the conclusion that claims on leaking packages should not be paid unless injury actually occurs in transit. A small shipper can get fair results by laying the package on its side after filling, and allowing it to remain for several hours and examining for leakage while hammering with a wooden mallet along the chime and side weld. Repairing of leaks by soldering does not pay in the long run and should not be allowed. They should be welded.

The efficiency of closing devices can be easily controlled by the purchaser, even if the manufacturer is careless. All that is necessary is a careful and intelligent inspection of packages upon receipt, and the use of a new gasket at each shipment. Bungs when screwed in about three-quarters of the distance should show a fairly close fit in the threads, otherwise they will soon strip. The thread in the bung-hole should have at least five complete threads and that on the bung should be sufficiently long to engage in all of the five threads in the bung-hole. Cast-iron bungs should never be accepted. Bungs should screw up to an even bearing when gaskets are removed. Gaskets should be at least $\frac{1}{16}$ in. thick by $\frac{1}{2}$ in. wide.

The use of a proper gasket is essential to tight closure of drums. The material from which the gaskets are made must be chosen with regard to the material to be shipped and also to the physical qualities, such as hardness, durability, and elasticity. Satisfactory gaskets may be made from numerous materials, such as hard fibre, leather, rubberised asbestos, etc. One of the principal causes of failures in gaskets is the fact that they are used too often. It would probably be a safe rule to require that no gasket should be used more than once.

Wooden barrels.

The transportation of dangerous articles in wooden barrels and kegs will always result in accidents, especially in connection with the lighter inflammable liquids and the more dangerous inflammable solids. The troubles lie principally in the inherent liability to leakage of barrels of the tight variety and sifting of contents through cracks in slack barrels.

The shipment of alcohol in wooden barrels has resulted in comparatively large losses. In addition to the original weakness of the package, these accidents are due to shippers using second-hand barrels without properly re-coopering them, or barrels which do not come up to the standards prescribed. Faulty methods of loading may also contribute to the losses, since these packages are especially susceptible to damage through shock.

For new barrels the user is urged to require the manufacturer to certify that his product complies with the specifications and to mark them to show such compliance. This responsibility placed upon the manufacturer of the package will secure some improvement. For second-hand barrels only the most careful re-coopering should be allowed and care should also be taken that only those barrels complying with the specifications on original manufacture should be used for the dangerous articles.

The shipment of potassium permanganate, the chlorates, and similar articles in slack barrels and kegs is also giving some trouble. If these accidents continue it will probably be necessary to limit these articles to metal containers. The present container, the slack barrel, is dangerous even after the contents are removed and there have been some fires caused by their use as second-hand packages for other articles.

Failures of shipping containers for inflammable liquids have often been due to overloading the container and the expansion due to rise in temperature. To determine the safe limit it is necessary to know the co-efficient of expansion of the liquid and the maximum temperature range to which it may be subjected in transit or storage. The maximum temperatures to which shipments may be subjected in transit is probably about 110° F. in this section, while in the south-west it is approximately 120° F. Generally the more volatile and lighter liquids have the higher expansion co-efficient. Gasoline has a much higher co-efficient of expansion than kerosene and heavier oils, and the amount of free space in the container sufficient for such shipments is quite inadequate for gasolines, especially those of higher specific gravity.

Inflammable solids.

The principal requirement for shipping containers of inflammable solids is the exclusion of air or moisture. Contact with air causes spontaneous oxidation with many of these substances, and often with sufficient degree to cause ignition. The degree of activity varies with these materials and the attendant hazard of exposure to air is in proportion to this activity. Phosphorus, metallic sodium, fused sodium sulphide, cobalt resinate, and matches are included in the class of "inflammable solids."

The shipping containers for phosphorus commonly consist of sealed tin cans containing the phosphorus submerged in water; these cans are shipped in wooden boxes. This type of container has been satisfactory in direct shipment from factory to consumer. Where the material has been subjected to long storage before shipment, trouble has been caused by the slow rusting of the tin cans, allowing the escape of the water, the entrance of air, and in some cases the actual ignition of the phosphorus. It will be necessary to modify the specification of this container either by having a much heavier coating of tin on the tin can, or by requiring that the outer wooden box be provided with a hermetically sealed metallic lining. The latter will probably be the safer, since no matter how secure the single inner package is, it is liable to be burst by the freezing of the water in cold weather.

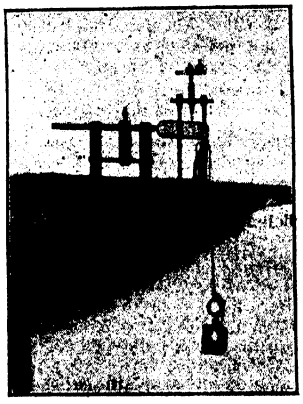
Metallic sodium has caused very little trouble in shipments, owing to the fact that the shipping container is practically satisfactory. Large shipments are commonly made in the form of bricks or

ingots packed in heavy steel drums tightly closed. Smaller shipments are packed in hermetically sealed tin cans, packed in boxes, also immersed in oil in glass bottles surrounded by tin cans, the entire inner package being placed in a wooden box. Carload shipments are also made with the sodium cast solid in sheet-iron drums, such as used for caustic soda. This package, while satisfactory for inter-plant shipments in solid carloads, is not permissible in L.C.L. shipments, or for general use.

Fused sodium sulphide is required to be shipped in tight iron drums, as when in wooden barrels it is liable to spontaneous heating and ignition, particularly in hot and damp weather. Crystallised sodium sulphide is more hazardous.

"Strike anywhere" matches, while not liable to ignition owing to exposure to air, require a tight package for the reason that if the matches are accidentally ignited in a tight package, the fire is almost immediately smothered for lack of air. The present shipping containers for matches are wooden or fibre-board boxes. These containers quite generally smother any fire started in the matches. However, if the outer package is defective or is broken by rough handling, any fire started is likely to spread throughout the package and to adjacent packages.

The ordinary strike-anywhere match is extremely sensitive to friction. It is in fact more readily ignited by friction than any commercial or military explosive. Decrease of the losses in transportation may be sought either by the use of a shipping container more nearly air-tight, such as a metal-lined wooden box, or by noticeably decreasing the sensitiveness of the matches themselves. In order to determine the relative sensitiveness of the matches a special friction test apparatus has been designed and put into use.



In this apparatus an alundum cylinder, 3 inches long and 1¼ inches in diameter, is held in a horizontal position on a slide moving in a direction parallel to its axis. The slide and cylinder are moved forward 2 inches by the pull of a 500-grm. weight falling through a distance of 6 inches. The match to be tested is held so that the match head touches the top surface of the cylinder, and the match stick is vertical. The match is held in a socket which can give an adjustable pressure of from 10 to 200 grms. on the match head. The test is made to determine the least pressure which will cause ignition of the match head during the 2-inch movement.

Oxidising materials.

Materials classed as "oxidising materials" for transportation purposes include sodium peroxide, barium peroxide, potassium permanganate, potassium chlorate, and others of less activity and hazard. Sodium peroxide is inherently the most hazardous of these compounds, but, owing to the effectiveness of the containers—tight steel drums or tight tins packed in wooden barrels or boxes—very little difficulty has been experienced in shipments. Barium peroxide formerly caused numerous fires, accompanied by heavy losses. At that time shipments were made in heavy and apparently tight wooden barrels. The barium peroxide was in the form of a fine but heavy powder. This powder in small quantities worked through the joints in the barrel, and it was found that friction of this powder between dry wooden surfaces readily produced fire. As a result of this investigation steel containers were required for shipments, and since this type of container has been used no fires have been reported in these shipments. The loss of the steamer "Volturno" by fire some six years ago is believed to have been caused by the ignition of barium peroxide shipped in wooden barrels.

Potassium permanganate and potassium chlorate are now shipped in wooden barrels or kegs. This practice is not entirely satisfactory, for there is a chance of fires being caused by friction if the contents escape from the package. Also if the chlorate gets in a fire it occasionally causes quite severe explosions. A series of explosions of chlorate occurred in connection with a warehouse fire in Jersey City about eighteen months ago. An unexpected risk pertaining to wooden containers for chlorates has recently been noted. Fires have been caused by shipments of metal and hardware in second-hand chlorate kegs. The inner surface of these kegs was slightly encrusted and impregnated with sodium chlorate. The friction of the metal pieces against the chlorate-impregnated surface started the fires. Immediate discovery and control of two fires disclosed definitely the cause. It is quite possible that other fires have been caused in this manner, and that the cause was never determined.

Corrosive liquids.

The shipping containers used for corrosive liquids consist principally of tank cars, steel drums, glass carboys, and glass bottles. For sulphuric acid and mixed nitrating acid the tank car is very satisfactory and the steel drum reasonably so. The glass carboy at its best is a fragile package. Sulphuric acid of 92 to 96% strength has but slight effect on iron or steel, but oleum has a much more marked effect, not uniform over the surface, but causing irregular pitting. This may be due to local impurities in the metal, but it is quite pronounced in the grade of steel used in making steel drums. Owing to the proposed development of air nitric acid plants, it is desired to ship strong nitric acid in tank cars with the minimum mixture of sulphuric acid which will serve to protect the steel from undue corrosion. So far as is known, the least amount of sulphuric acid which has been successfully used for this purpose has been approximately 15% by weight of the total mixed acid. The corrosion of the steel depends not only on the amount of sulphuric acid, but also on the amount of water in the mixture. Investigations on this subject are still incomplete. The shipment of nitric acid has been the cause of heavy losses, not only of acid but also of equipment. These shipments must necessarily be made in glass carboys.

While the glass is not affected by the acid, frequent fires have occurred owing to the breakage of the carboys. The glass carboy of the usual capacity, about 12 gallons, is extremely fragile, and even with the best available packing there is considerable breakage due to the shocks caused by shifting and coupling of cars, or by train movement. The

regulations require that no material, such as hay, straw, or similar combustible material should be used as packing for nitric acid carboys. The packings most used are mineral wool, and the so-called "Stahl" packing, which consists of four grooved vertical wooden strips whose elasticity serves as the cushioning agent. While both of these packings are safer than hay for nitric acid carboys, nevertheless numerous fires have occurred in shipments in both types of these carboys.

It is desirable that a carboy box for nitric acid should have a metal or other liner that will hold the acid after the carboy is broken, and not permit it to come in contact with the wooden boxes, or the wooden floor and lining of the car. As yet such a shipping container has not been developed to a commercial stage.

In the development of the carboy and its container it was necessary to determine accurately the resistance of the various combinations to severe stresses. In railroad transportation observation has shown that packages receive their greatest stresses in a direction parallel to the length of the car. These stresses are due to coupling, switching, and sudden stops in train operation. The straight-sided carboy now in use is naturally more resistant to vertical stresses than to lateral ones, hence the freight car and the carboy make a combination in which the greatest stress comes on the weakest part of the carboy. As far as possible the packing serves to overcome this inherent weakness of the package.

Boxed carboys filled to the shoulder with water are tested to destruction by both vertical and lateral impact. The vertical impact is obtained by dropping the carboy on the bottom on a concrete floor. The lateral impact is obtained by suspending the carboy so as to act as the weight on a fourteen-foot pendulum. The carboy strikes laterally against a vertical wall just beyond the bottom point of swing. The amount of impact is determined by the vertical component of the arc through which the carboy swings. In making this test it is necessary that the carboy be swung so that the face of the box is exactly parallel to the vertical wall, otherwise the box will not strike squarely and the test will be misleading.

Considerable difficulty has been caused at times by the bursting of nitric acid carboys from internal pressure, due to expansion of the acid by heat or decomposition by light. Experiments showed that with tightly closed bottles of nitric acid filled to 90% of capacity, and exposed to direct sunlight, a pressure of 17 lb. per square inch developed in three days. A considerably lower pressure was produced by diffused daylight, and practically none in the absence of light. These tests showed the necessity for venting nitric acid carboys, especially where ground glass stoppers were used for chemically pure acid. Work is also being carried on in the development of porous stoppers for commercial acids which will permit the escape of vapours produced in transit.

Until recently carboys were commonly closed by a loosely fitting earthen stopper held more or less securely in place by clay, plaster of Paris, and burlap. These stoppers were generally in fair condition when loaded in car, but by the vibration and shocks of transportation they worked loose and in many cases jarred completely out of the necks of the carboys. This condition caused splashing of the acid from the carboys, which in some cases caused fire or injury to employees, and always caused rapid deterioration of the carboy boxes, the car floor, and lining.

Boxed carboys for the transportation of inflammable liquids and acids are a prolific source of trouble. Probably for nitric acid it will be necessary to adopt eventually a metal-lined box to retain the acid in case of accident. For ordinary acids, however, it is believed that careful attention to cushioning, closing devices, and repair will largely eliminate accidents due to the package.

Poor and insufficient cushioning cannot be cheap in the long run. It will cause accidents and will increase repair. The cushioning material should be 1½ to 2 inches in thickness all around the carboy and should be carefully put in. A thin cushioning will give insufficient protection and will quickly wear through by the constant rubbing of the carboy, while one full of lumps will cause the pressures to be brought on small areas of the carboy and cause breakage. A 1-inch thickness does not give space for proper packing or sufficient cushioning.

The use of elastic wooden strips for cushioning decreases initial costs, but has not proved successful from the standpoint of safety and final costs. Great care must be taken in manufacture and assembly, the elasticity of the wood is liable to be quickly destroyed by acid or acid fumes, and finally the repair and readjustment costs are certain to be high unless efficiency is neglected. I believe that some improvement will be obtained if packages cushioned with elastic wooden strips are used only where reshipment will not occur.

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Fires have been occasionally caused by the use of organic packing, such as sawdust, around bottles and jugs of bromine. This packing was improved later by saturating the packing with the so-called "bittern water," but still fires occurred at times, and it was finally required that bromine bottles or jugs should be packed in entirely incombustible packing.

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The shipment of miscellaneous goods packed in boxes, and including dangerous articles, has always been difficult to regulate. A small amount of dangerous articles may start just as bad a fire as a large amount.

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Acetylene cylinders have presented a peculiarly different problem in design and construction, because of the property of acetylene under certain conditions to dissociate with explosive violence when compressed to a pressure above two atmospheres. It can readily be liquefied, but in this condition is almost as dangerous as nitroglycerin. Experience has shown that the only safe way to store and ship compressed acetylene is in solution in acetone, which in turn is held in a porous filling mass in a steel cylinder. Asbestos blocks or other porous materials are used for the purpose. This mass must have a porosity of not more than 80% and must have no large voids in which an explosive reaction may start. The mass must be of sufficiently fine texture to be safe, and sufficiently rigid and durable to prevent sagging away from the walls of the cylinder, even after long use and severe handling.

In addition to the usual hydrostatic tests, the filled and charged cylinders are tested as to liability to explosive dissociation of contents and bursting of the cylinders. The tests commonly applied are, first, placing a charged cylinder in fire and observing whether gas escapes quietly by the safety vents or bursts the cylinder. Second, placing on a cylinder a charge of dynamite sufficiently heavy to make a deep dent in the side wall, and yet not sufficient to break the wall. Third, burning a hole through the wall of the cylinder with a charge of thermit.

Shipping container specifications, as indicated, have been gradually developed to their present state. They are neither complete nor perfected; they do not always represent the best possible container because they must be made within certain limiting costs to be available for commercial use. They represent the joint results of the experience of shippers of the commodities, manufacturers of the shipping containers, and of the carriers, plus thorough study of all the conditions. Additional specifications are being prepared from time to time as needed, and modifications and improvements are made in those previously drawn up. Further knowledge of the materials to be shipped, and improvements in materials and manufacturing processes, will suggest future developments and improvements in shipping containers.

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The liners, as a rule, have an elasticity of about 33⅓%, so that the burden of strain is transferred to the outside container of burlap, cotton, or, in the case of barrels, wood.

In cases where, because of weight, the single burlap package is unsatisfactory, "Arksafe" elastic linings, as they are called, have been found satisfactory—*e.g.*, for packing sugar, flour, salt, coffee, chemicals, dyestuffs, etc.

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Within the last two years a machine has been developed for the production of a shaped, bilged keg and barrel of paper, and another, somewhat similar, for the manufacture of square, rectangular, or odd-shaped paper boxes. In the barrel process the paper is obtained in a strip, say 6 inches wide, wound into a large roll, which is passed through an apparatus in which one side is coated with an adhesive, and at the same time it is slit into two 3-inch strips. The two strips are attached to mandrels, which, after they have revolved a sufficient number of times, are caused to separate, as well as to revolve, so that the two ends of the package are made first and then the rest of the cylindrical package. When the package is of the proper length the mandrels cease to separate, the knife used for slitting the strip "kicks out," and the full 6-inch strip comes down and wraps as many times as desired around the middle for a rolling hoop or reinforcing band. About 20 seconds is required to make a barrel of the size used for flour.

By the process described a keg or barrel can be made of any size and thickness. Any grade of paper can be used, but the ordinary cheap grades, such as chip board or screenings, are suitable.

A factory for the commercial production of these packages has been in operation in Brooklyn for several months. The box machine, mentioned above, has passed the development stage, and is to be placed on the market very shortly.

Sydney Section.

Meeting held on May 26th, 1919.

MR. B. J. SMART IN THE CHAIR.

NOTE ON EXPLOSIONS IN COAL MINES.

BY GEORGE HARKER, D.SC.

From time to time references appear to certain proposals made by J. Harger for the prevention of mine explosions by the reduction of the oxygen in the mine atmosphere by diluting it with flue-gas to such an extent that explosions could not take place.

Attention has again been recently drawn to this matter in a paper by T. F. E. Rhead ("Residual and Extinctive Atmospheres of Flames," this J., 1918, 277 T) wherein Harger's proposals are commented upon and in which it is considered that his limit for the proposed reduction of the oxygen to 17% is not sufficiently low. Having had some experience with the application of flue-gas for the prevention of fire (see "Fire-Extinction and Disinfection in Ships and other Enclosed Spaces," Seventh Int. Cong. Appl. Chem., 1910, also "The Use of Flue-gas for Fire-Extinction and Fumigation," this J., 1915, 157) I would point out that it would be necessary to purify the flue-gas from any contained carbon monoxide before it could be safely breathed by human beings. Flue-gas containing 0·1—0·3% carbon monoxide is successfully applied to the destruction of rats in enclosed spaces, death generally ensuing in ten to fifteen minutes.

But even if a sufficiently pure flue-gas could be supplied containing only carbon dioxide, oxygen, and nitrogen, would it not be impossible for men to do continued work in an atmosphere in which the oxygen had been reduced to 17%? In all probability the output of coal per man would be very seriously reduced, while the men would perform their work under most distressing conditions. Experiments of Dr. J. S. Haldane have shown that human beings can live for a short time in air in which the oxygen has been reduced to as low as 12%, but that in such an atmosphere the breathing is exceedingly laboured. We must conclude therefore that, although men could exist in an atmosphere containing 17% of oxygen or less, it would be impossible for them to do hard work.

However, the question arises as to whether it would not be practicable to localise explosions and prevent them spreading by separating the different parts of the mine workings by local concentrations of inert gas across which the explosive wave could not pass. If experiment showed that a layer of inert gas, say a few yards in thickness, would be sufficient to prevent an explosion from travelling further, it might be possible to place explosion breaks at different points in the mine and at the same time permit traffic to pass through them without harmful results.

DISCUSSION.

Professor C. E. FAWSITT said that although the flue-gases might be purified from carbon monoxide, a gas containing 17% oxygen, 4% carbon dioxide, 78% nitrogen, and 1% argon would probably be quite unsuitable for a man to work in. It was true that in towns at a height of say 6000 feet the partial pressure of the oxygen was reduced to a point such that the amount of oxygen breathed was as low as would correspond to 17% oxygen in ordinary air at N.T.P., but there was no carbon dioxide in such air. It might be possible to work in an atmosphere of 17% oxygen and 83% nitrogen and argon, but not in 17% oxygen, 4% carbon dioxide, and 79% nitrogen and argon.

Mr. B. J. SMART thought that as the explosion was transmitted by a detonating process the interposition of a layer of inert gas might not be sufficient to prevent the explosive wave from progressing further.

Dr. HARKER in reply said that even on high mountains the proportion of oxygen to other gases in the atmosphere was always 21%, whereas if the oxygen were reduced to 17% and diluted with an inert gas, a different ratio of oxygen to other gases was set up. The inhibiting action of a layer of inert gas could be determined by experiment.

EXPLOSIONS IN COAL MINES.

NOTE BY J. S. HALDANE, M.D., F.R.S.

In connection with Dr. Harker's note and the very pertinent comments by Professor Fawsitt I may perhaps point out certain reasons why, except in limited spaces sealed off on account of fire, no attempts have hitherto been made to prevent explosions or spontaneous fires in coal mines by reducing the oxygen percentage of the air.

Although an ordinary flame is extinguished by air in which the proportion of oxygen is reduced by withdrawal of oxygen to about 17·5%, there is still enough of oxygen left to produce a violently explosive mixture when a sufficient proportion of methane is added to the extinctive atmosphere. This was experimentally shown in 1895 by Sir William Atkinson and myself. To render the air safe from gas explosions the oxygen percentage would need to be reduced below 14. If this were done by adding flue-gas, even free from CO, there would be about 6% of CO_2 present, which would cause the severest panting, headache, etc. Even with 3% of CO_2 the panting on exertion would be intolerable. If the CO_2 were removed the reduced oxygen percentage would still cause great reduction of working power, and the group of symptoms (due to oxygen deficiency) known as "mountain sickness." The quantity of flue-gas needed to carry off the firedamp

etc. from the workings and keep them cool would be enormous. There is in reality not the smallest chance of this method ever being adopted for preventing explosions. To prevent spontaneous combustion of coal a far greater reduction of the oxygen percentage would be needed.

Although great colliery explosions are often originated by explosions of gas, it is now well known that their extension over great lengths of road-way is due to the coal-dust being blown into the air and ignited. Practically speaking, therefore, all the serious colliery explosions are coal-dust explosions. As a result of observations of the points at which coal-dust explosions died out, Sir William Garforth came to the conclusion that when mixed with sufficient stone-dust the coal-dust on the roads was rendered inexplosive. When this point was tested in the experiments made first at Altofts Colliery, and later at the Eskmeals Experimental Station shortly before the war, it was found that when as much as an equal part by weight of shale-dust was present along with the coal-dust the mixture could not be ignited by either a gas-explosion or a flaming explosive. A good deal of stone-dust is naturally present along with the coal-dust lying along the roads in coal mines—often sufficient to prevent the propagation of explosions. Where the proportion is insufficient it is easy to add sufficient shale-dust to make propagation impossible; and this plan has already been introduced extensively. There now appears to be no doubt that it is by far the most effective, as well as the cheapest, method of preventing the propagation of explosions; and no valid objections to it have appeared, whereas there are the most serious objections to the alternative, and far more expensive, plan of watering the dust. The shale-dust is just as harmless to the lungs as coal-dust is. By shale-dusting the roads, maintaining a thoroughly adequate ventilation, using good safety-lamps, and taking certain other precautions, the risks from explosions are reduced almost to a vanishing-point. But without stone-dusting or something equally effective there is always the chance of such a cause as the ignition of a little gas by a spontaneous fire, or a mistake in blasting, initiating an extensive explosion.

Even if it were practicable to prevent explosions by reducing the oxygen percentage in the air of coal mines, the object in doing so would be far more easily attained by shale-dusting.

Yorkshire Section.

NOTE ON A PECULIAR CASE OF CORROSION BY ELECTRICAL LEAKAGE.

BY W. STEWART PATTERSON.

The following case of corrosion occurred at the rear of an ordinary double-pole electrical fuse board. This latter was fastened to a brick wall in the basement of a building supplied by the network of the Barrow-in-Furness Corporation Electricity Department at a voltage of 220, direct current, on the three-wire system.

After being in use for some 4 years, a fire occurred at the back of the board owing to the insulation being eaten away. The whole of the wall behind, and in the immediate vicinity around the board was found to be covered with a greyish deposit, whilst the brick constituting this part had become soft and crumbly to a depth of at least 1 inch. The negative pole of the board was slightly covered with the deposit, whilst the positive pole, which was at earth potential, was free from deposit.

The deposit on the wall resembled moist caustic soda in appearance, and contained NaOH 5·56, Na_2CO_3 60·51, H_2O 33·93%.

Analyses of the bricks which had been softened and corroded taken from immediately behind the board, and from the wall 3 or 4 feet to the left of the area covered with deposit, showed that the former contained 12·0% of alkalis as Na_2CO_3, whilst the latter contained 2·9% as Na_2O (calculated on the material dried at 100° C.). Samples of mortar were also taken from positions identical with those from which the brick samples were taken; the sample from behind the board was found to be contaminated with bituminous compounds from the corroded cable. The dried sample from the position 4 feet to the left of the board contained 2·4% of alkalis as Na_2O. Such quantities of alkalis are believed to be not uncommon in ordinary red brick, nor is it unlikely that sodium chloride corresponding to 2·4% of Na_2O should be present in the sand from which the mortar was compounded, especially as the latter was in all probability derived from the sea front.

Presumably moisture penetrates into the brick and so forms a leakage path from the live pole of the fuse board to earth, this leakage in turn setting up an electrolytic action upon the brick, removing the sodium compounds present, depositing them on the negative pole of the system, which in this case appears to be at the point where the leakage leaves the board and passes to the wall, where they are decomposed electrolytically.

It is not apparent whether the disintegration of the brick is brought about by the removal of the alkalis or by the action of the caustic soda carried into the brick by the moist leakage path from the negative pole; possibly it is due to a combination of both actions.

There is every reason to believe that under suitable conditions secondary reactions may take place within the deposit itself due to electrolysis, with the formation of a bead of metallic sodium or potassium, and an instance is on record where this has actually occurred.

An examination of several cases of this type of corrosion which have occurred in the same locality shows that they are exclusively confined to basements of buildings or places where the fuse boards are situated in moisture laden atmospheres. No case is known where, other conditions being the same, this particular type of action has occurred in a dry position.

Coating the back of the board with insulating materials does not prevent the formation of the deposit, since the moist surface of the board to which the poles are attached acts as a conductor for the leakage, and the action occurs along the edges instead of at the rear of the board.

In conclusion the author desires to thank Mr. J. Heslop, of the Electricity Department, Barrow Corporation, for bringing the matter to his notice, and Messrs. Vickers, Ltd., Barrow, for permission to carry out the above analyses in their laboratory.

Communications.

AGEING EXPERIMENTS ON VULCANISED PLANTATION PARA RUBBER.

BY CAPTAIN B. J. EATON, F.I.C., AND F. W. F. DAY.

PART I.

Preliminary investigations.

The results contained in this communication are derived from preliminary investigations carried out to ascertain the changes which take place in

vulcanised rubber on storing, *i.e.*, the phenomena connected with ageing.

As a guide to a systematic examination of such phenomena it was considered advisable in the first instance to experiment on samples of rubber which had been considerably over-vulcanised, since the changes would be emphasised in such samples and would be accelerated. For the preliminary investigations, four samples of rubber were selected, Ref. Nos. 244 A 7, A 8, C 9, and C 10. (NOTE.—A 7 denotes sample A cured for 7 hours at 140° C., C 9 denotes sample C cured at a similar temperature for 9 hours etc.)

Samples of "slab" rubber (*i.e.*, coagulum matured for at least 6 days before machining to crêpe) (244 A) and crêpe rubber (244 C) were selected for the tests; the samples were prepared under comparable conditions and mixings containing 10% of sulphur and 90% of rubber were prepared as usual.

In the experiments to be described here, two sets of samples were investigated viz. crumbed (*i.e.*, ground to coarse particles) and original test pieces or uncrumbed specimens. The object of breaking up samples into coarse particles was to accelerate any changes which might take place due to atmospheric influence, since such changes would be affected by the amount of exposed surface of the rubber. The crumbed samples were stored in specimen tubes loosely packed and closed with a nickel cap. The amount of combined sulphur was determined at intervals with the results shown in Table I.

In addition to the results given in this table, which show actual decrease in combined sulphur content with ageing, the combined sulphur content of another crumbed sample, viz.: 244 A 24 (*i.e.*, cured for 24 hours) was found to have dropped from 10·0% to 8·8% during one month's storage, while an uncrumbed sample 244 A 9 dropped during a period of 6 months from 10·0% to 9·0%.

It was discovered, however, that no useful deductions could be drawn from these figures owing to the remarkable increase in weight which occurred in the crumbed samples after storage, *i.e.*, on ageing. Unfortunately these large increases in weight had not been followed up in these preliminary experiments. The following results, however (see Table II.), are instructive and indicate also that much over-cured samples would give even greater increases over similar periods.

In this experiment 2-grm. samples of crumbed rubber, 244 A 1¾ and 244 B 2¼, were left in watch-glasses and weighed at intervals.

TABLE II.

Date 1916–1917	244 A 1¾ (over-cured slab)		244 B 2¼ (under-cured sheet)	
	Weight	Increase	Weight	Increase
	Grms.	%	Grms.	%
December 21 ...	2·00	0·0	2·00	0·0
January 19 ...	2·01	0·5	2·01	0·5
February 8 ...	2·05	2·5	2·02	1·0
May 5	2·30	15·0	2·07	3·5
July 26	2·48	24·0	2·13	6·5
September 5 ...	2·59	29·5	2·18	9·0
November 2 ...	2·56	28·0	2·18	9·0

From these results it would appear that the maximum increase in weight is reached in about 9 months. Before proceeding to a more detailed investigation of ageing phenomena, it was considered desirable to examine the 9 months' old crumbed samples, of which details are given in Table I. Samples 244 A 7, A 8, and C 9 were investigated, with the results shown in Table III.

As it was practically certain that the increases in weight were due to oxidation, it was thought probable that substances soluble in water might be present, and to test this, the samples were extracted with boiling water and the percentage of extract (by difference), the percentage of sulphur in the form of sulphate or sulphuric acid in the aqueous extract, and the total acidity of the

TABLE I.

Ref. no.	Boiling water extraction				Subsequent acetone extraction				
	Extract (by difference)	Residue	Soluble sulphate and H_2SO_4 (as sulphur)	Total acidity, H_2SO_4 (as sulphur)	Extract (by difference)	Residue	Soluble sulphur	Combined sulphur (by combustion)	Total sulphur
244	%	%	%	%	%	%	%	%	%
A 7	26·2	73·8	0·92	2·08	19·6	80·4	Aq. 0·92 Ac. 1·37	4·13	6·42
A 8	22·9	77·1	0·94	2·11	22·3	77·7	Aq. 0·94 Ac. 1·36	4·32	6·62
C 9	3·4	96·6	0·75	1·69	36·8	63·2	Aq. 0·75 Ac. 1·43	5·06	7·24

Aq. = Aqueous extract. Ac. = Acetone extract.

TABLE III.

Ref. no.	Uncrumbed sample. Total sulphur	Crumbed samples				
		Original total sulphur	Combined sulphur after storing for			
			Nil	2·3 months	5·4 months	8·4 months
	%	%	%	%	%	%
244 A 7	10·17	10·10	9·56	4·81	3·74	4·13
A 8	10·26	10·06	9·82	4·55	3·92	4·32
C 9	9·86	10·00	9·48	5·33	4·63	5·06
C 10	10·06	10·01	9·63	6·47	4·76	—
Mean	10·09	10·04	—	—	—	—

NOTE.—Complete sulphur analyses and tensile properties of these samples were published in this Journal, 1917, 36, 18.

extract as sulphuric acid were determined as sulphur. The extraction with water was followed by extraction with acetone in order to obtain the free sulphur content and the additional matter extractable by acetone.

It will be seen from the above results that a remarkable percentage of matter extractable by water has been formed during the ageing of the very over-cured samples 244 A 7 and A 8 and a smaller quantity in the less over-cured sample 244 C 9. The amount of sulphur present as sulphates in the aqueous extract is also marked. Further, the acetone extract contains substances other than the sulphur and the resin which would be present in the original raw rubber (which ordinarily amounts to 2·3%). Here again, however, no further deductions can be drawn from the results, since the increases in weight of the above samples, after the period of storage, had not been determined. It will be seen later that some of these increases are in the neighbourhood of 40%, which would bring the total sulphur content of the samples, calculated on original weight, up to about 9%, which still indicates an actual loss of sulphur on ageing.

Present investigation.

Scheme of experiment.—As a result of the preliminary experiments given above it was decided to trace the changes, due to ageing, in the combined sulphur content, and the aqueous and acetone extracts, after making allowances for the oxidation or other changes in weight. For this purpose, two sets of about 10 grms. of crumbed rubbers were stored in specimen tubes as before. The first set was used to provide samples for analysis at different periods, while the second set was weighed at intervals, but not otherwise disturbed. (Before analysis the contents of the tube were thoroughly mixed.) In addition, 2-grm. samples of each crumbed rubber were left on watchglasses and also weighed at intervals, as it was thought that ageing (as indicated by increase in weight) would proceed more rapidly in the case of crumbs exposed to the air and under different conditions from those packed in closed tubes. Further, 8-grm. discs about 5 mm. thick and 44 mm. in diameter were also exposed in small basins. The basins were used in order to retain any sulphur exuding on the surface due to the well-known "blooming" of vulcanised rubber.

Increase in weight on storage.

For this experiment the following samples were selected:—Ref. No. 358 S_2—A ¼, A ½, A 3, and A 9; 358 S_2—B 2, B 2¾, B 6, and B 9. The figures given after the letters indicate the period of vulcanisation in hours given to the sample (thus 358 S_2 A ¼ represents sample 358 S_2 A cured for ¼ hour). The samples 358 S_2 A (optimum time of cure indicated by tensile curve=1½ hours; vide Bulletin No. 27, "The preparation and vulcanisation of plantation Para rubber," published by the Agricultural Department, F.M.S., 1918, and previous papers in this Journal) were derived from "slab" rubber, and the samples 358 S_2 B were from ordinary crêpe samples from the same bulked latex. The coagulant was acetic acid (1:1066 on the latex). The latex was diluted to contain approximately 1·5 lb. of dry rubber per gallon.

Table IV. Columns 1, 2, and 3 give the percentage increases in weight, in the case of crumbed samples stored in tubes, crumbed samples stored in watchglasses, and disc samples stored in small basins respectively. In the case of the disc samples, weighings were made also in the case of samples A 1, A 1½, A 6, B 2, B 2¾, B 2¾, B 3, and B 8½, but the figures are not produced, in order to save space, since they gave values intermediate, as expected, for the intermediate cures.

TABLE IV.

Percentage increase in weight on ageing samples of crumbed vulcanised rubber, Ref. no. 358 S_2.

No. 1. Tube-stored.
No. 2. Watchglass-stored.
No. 3. Disc samples on watchglasses.

—	A 9			A 3			A 1½			A ½			B 9			B 6			B 2¾			B 2		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1917																								
Oct. 11	0·0	0·0		0·0	0·0		0·0	0·0		0·0	0·0		0·0	0·0		0·0	0·0		0·0	0·0		0·0	0·0	
„ 17	0·3	0·3		0·1	0·2		0·0	0·2		0·0	0·1		0·2	0·4		0·1	0·1		0·0	0·0		0·0	0·0	
„ 25	2·8	3·3		0·3	0·4		0·2	0·2					1·2	2·4		0·4	0·5		0·1	0·1		0·1		
Nov. 1	8·4	14·0		0·7	1·3		0·3	—					3·9	8·9		0·7	2·2		0·4					
„ 10	13·5	14·1	Nil	—	—	Nil	0·5	—	Nil	Nil		Nil	7·3	9·1	Nil	—	—	Nil	0·05		Nil			Nil
„ 12	14·3	14·4	0·1	1·8	1·5	0·1	0·05	0·2		0·1	0·1		7·9	9·7		1·8	2·5					0·1	0·0	
„ 22	17·4	16·7		4·2	4·2		0·06	0·2					11·0	12·6		3·6	4·4							
Dec. 10	20·4	18·6	0·4	13·0	13·8	0·4	0·1	0·2					15·2	15·5	0·2	7·5	8·4							
„ 17	21·3	19·3		16·3	16·9		0·2	0·2					16·4	16·6		9·5	10·4							
„ 24	22·1	19·7		19·2	18·6		0·2	0·2					17·3	17·0		11·6	12·3							
1918																								
Jan. 3	23·7	20·5	0·6	22·7	20·6	0·6	0·3	0·2		0·2	0·2		18·5	17·6	0·3	15·2	14·9	0·5	0·2	0·3		0·2	0·2	
„ 16	25·2	20·6		26·2	21·4		0·3	0·3		0·2	0·2		19·6	18·0		18·8	16·8		0·3	0·3		0·2	0·2	
„ 30	26·6	20·7	0·6	29·7	21·8	0·8	0·3	0·3	0·1	0·2	0·2		20·7	18·0	0·4	21·5	17·8	0·6	0·3	0·3		0·2	0·2	
Feb. 13	28·3	20·6	0·5	33·7	24·3	0·9	0·5	0·3	0·1	0·2	0·5		21·8	18·1	0·3	24·1	18·4	0·8	0·4	0·4		0·3	0·2	
Mar. 8	32·0	22·2	0·7	36·7	26·9	1·2	0·9	1·1	0·3	0·3	0·6		24·2	19·5	0·5	28·8	21·3	0·6	0·6	0·7	0·1	0·3	0·9	0·1
May 21	36·4	23·6	0·7	38·3	26·9	1·3	1·3	2·2	0·3	0·3	0·6		26·3	20·5	0·5	33·7	22·9	0·8	1·0	1·5	0·2	0·4	1·1	0·1
June 11	37·6	23·6	0·7	38·7	27·4	1·3	2·0	2·8	0·3	0·3	0·6	0·1	28·6	20·9	0·6	35·6	23·1	0·9	1·3	3·0	0·2	0·5	1·1	0·1
July 24	39·4	25·0	0·8	39·4	29·8	1·4	3·6	6·0	0·5	0·5	0·7	0·2	31·7	22·0	0·7	37·7	24·0	1·1	2·3	4·7	0·4	0·7	1·6	0·2

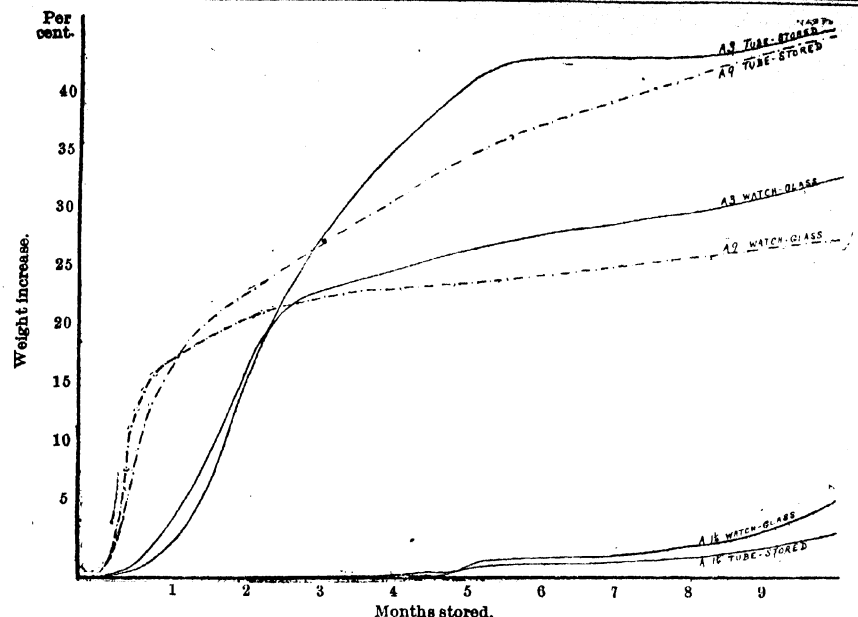


Diagram 1. 358 S2. Slab. 1hr. 20m.

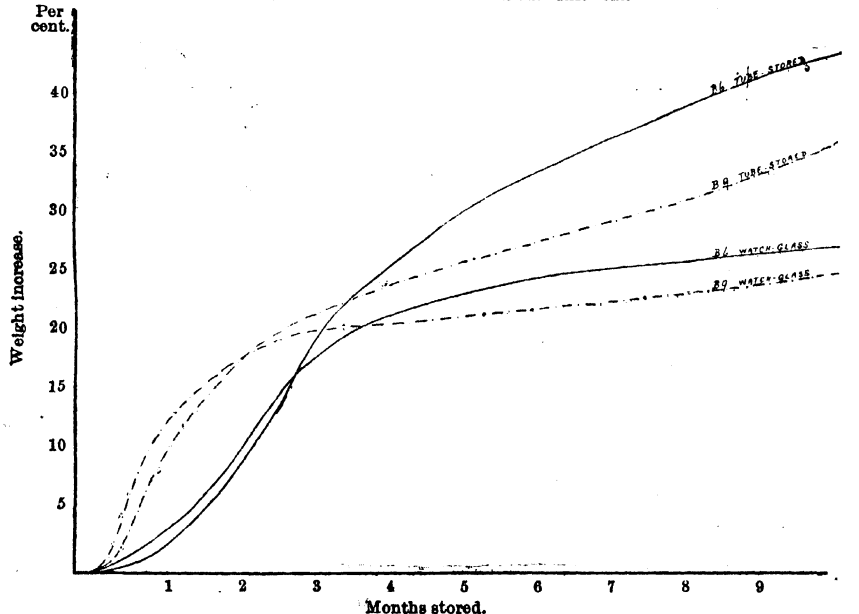


Diagram 1A. 358 S2. Crêpe. 1hr. 50m.

These increases in weight were plotted as graphs, as shown in diagrams 1 (slab) and 1A (crêpe) which illustrate the relative changes of weight very clearly.

Reference to these diagrams shows that, during the first ten days, a slow increase in weight takes place in all the samples, after which period the factors favouring a rapid increase are (*a*) overcuring of the rubber, (*b*) freedom from complete exposure to the air. The most rapid increase is shown by the most overcured sample (A 9) exposed on a watchglass.

A similar relationship holds good between the tube-stored and watchglass-stored samples for each pair of samples, the greatest difference between pairs occurring in the case of B 9 and the least in the case of A 3. In every instance, however, the increases in weight of the tube-stored samples overtake those of the watchglass-stored samples after periods varying from 1 to 2½ months, the period increasing according as the initial increase or slope of the curve is less steep, *i.e.*, according as the overcuring of the sample is less; *i.e.*, a slightly overcured sample does not reach this point till the later period. Thus, the curves for A 9 intersect after 35 days, B 9 after 66 days, A 3 after 68 days, and B 6 after 81 days.

The type of curve for each pair, up to the point

of intersection, appears to be more or less constant and the difference between the A and B curves is very slight, as is apparent by comparing the two diagrams. Excessive overcuring appears to be the principal factor affecting the type of curve, the curves for the very overcured samples, A 9 and B 9, being all convex to the ordinate, while the A 3 and B 6 curves are both concave. After the point of intersection is reached each pair of curves continues to diverge at a slope greater than that of their original incidence. Anomalies now begin to occur. Sample A 3 (tube-stored) diverges quickly, by maintaining its upward slope, while the remainder begin slowly and progressively to flatten out, *i.e.*, tend to become horizontal and parallel to the abscissa. At the end of 5½ months, the graph of A 3 (tube-stored) has become almost flat, a stage which is not reached by the remaining tube-stored samples till nearly 12 months.

In the case of watchglass-stored samples a quite different result is obtained, the graphs of these samples tending to become horizontal after about 4 months and to show every tendency to keep below the tube-stored samples for an indefinite period.

It seems clear that the explanation lies in the fact that while increases in weight are proceeding uniformly in both sets of samples, a loss of weight is proceeding *pari passu* in the freely exposed samples, which leads to an apparent retarded increase. It has already been shown (Table III) that there is an actual loss of total sulphur, and further experiments, to be described, place the fact beyond doubt that the ageing of rubber involves very complex changes, which have not yet received investigation. Among these changes is the ascertained fact that the percentage of sulphur in the overcured rubbers, after decreasing for some months, subsequently increases, which may be regarded as conclusive of complex change.

Of the four samples investigated above, it is noteworthy that sample A 3 has given the greatest increases in weight (in the case of watchglass, tube-stored, and disc samples) in spite of the fact that sample A 9 has been given three times as long a cure. Overcuring beyond a certain point therefore ceases to increase the capacity of a rubber to gain weight during storage, after the early ageing period is passed, and in view of the fact that sample B 6 presents a similar case with reference to sample B 9, it can be assumed that such excessive overcuring does actually decrease the capacity of ageing as measured by weight increase.

Combined sulphur content.

These samples were also stored and periodically analysed for combined sulphur content by the method already described (this Journal, 1917, 16).

The results of these analyses are given in Table V and the graphs, which are given in Diagram II, illustrate even more clearly the extraordinary rise in sulphur content which takes place after 6—9 months, thus confirming the work carried out during 1916—1917 already referred to in this paper.

Only the much overcured crumbed samples show combined sulphur content changes on ageing. Normally cured samples do not show much variation in this respect, although some changes can be traced. These changes are, however, small and irregular.

It will be noted from the remarks at the foot of Table V. that conclusive evidence of the loss of sulphur as volatile sulphide was obtained accidentally in the case of the acetone-extracted residues of sample B 6, although, in the case of the other samples, such loss was not observed. It was noticed generally that the colour changes of the samples of stored crumbs which took place were greatest in those portions of the samples in contact with the sides of the tubes, *i.e.*, the portions

TABLE V.

Direct acetone extractions.

(Sulphur percentages worked back to original crumbed weights before ageing.)

358 Ss	October 11, 1917			October 27, 1917			November 10, 1917			November 22, 1917			January 5, 1918			June 18, 1918		
	Combined	Soluble	Total	Combined	Soluble	Total	Combined	Soluble	Total	Combined (average)	Soluble	Total	Combined (average)	Soluble	Total	Combined (average)	Soluble (apportioned)	Total
	Group average :— 9·89					Group average :— 9·86												Group average :— 9·37
A 9	9·80	0·09		8·12	1·83		4·95[a]	3·58	8·53	4·60[2]	5·14	9·74	5·83[2]	3·87	9·70	5·413	3·33	
A 3	7·97	1·92		7·99	1·96					7·80[4]	1·93	9·73	7·94[2]	2·64	10·58	6·352	2·39	
A 11	6·42	5·47														4·262	5·74	
A 12	2·42	7·49														2·232	7·77	
B 6	10·00	0·00																
B 3	8·08	1·81		9·21	0·74		7·14	2·93	10·07	6·30[4]	3·48	9·79	6·33[2]	3·45	9·78	6·006	2·74	
B 12	3·83	6·06		8·12	1·83					7·80[2]	1·89	9·69	7·80[2]	2·30	10·19	6·158	2·50	
B 9	2·60	7·29														4·102	5·90	
																2·962	7·04	

(a) Percentages in heavy type are actual estimations; others are "difference" estimations.
(b) Small numbers thus :—$4·60^4$ indicate the number of estimations from which average was obtained.
(c) Difference between individual analyses is less than 0·2% except in case of June 18, B 6 (5·93 and 6·38. Av. = 6·15).
(d) The acetone-extracted residue of 22/11/17. B 6 when stored in glass stoppered weighing bottle (lead glass) deposited a metallic film (PbS) on the ground portions of the glass. The other samples did not show this peculiarity. Throughout sample B 6 has given irregular figures.
* This figure is obviously wrong; the figure for soluble, namely 3·58, is correct.

exposed to light. The central portion or core of the tube-stored crumbs appeared to be unaffected in the undercured samples; the overcured samples, however, broke down to a powder. Probably therefore, if given sufficient time, the full ageing effects (*i.e.*, 40% increase in weight) would develop in all the samples.

On examining the curves of the two very overcured samples A 9 and B 9 in Diagram II. a minimum sulphur content is found after rather more than 1 month, *i.e.*, at about the period of intersection of the curves for weight increase (Diagram I.). The sulphur content changes in sample A 3 are small compared to those in samples A 9 and B 9, and it would appear therefore that the large variations of weight in the case of sample A 3 are not closely correlated to the variations in sulphur content or alternatively that the correlation is obscured by other factors. It is evident that very complex changes are proceeding in which the loss of sulphur compounds at one time exceeds, proportionately, the loss of other constituents; it is also clear that at a later stage the conditions are reversed, leading to an increase in sulphur

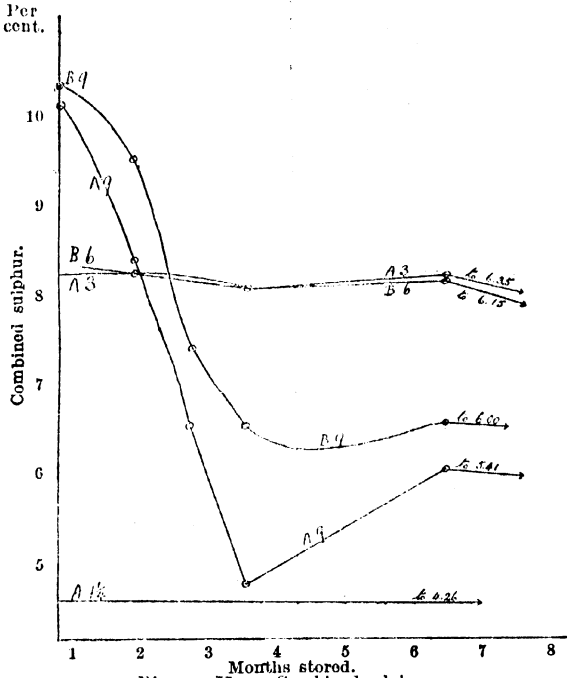


Diagram II. Combined sulphur.

TABLE VI.

Ref. no.	Boiling water extraction: Extract (by difference)	Boiling water extraction: Residue	Boiling water extraction: Sulphur derived from extract as: Total acidity as H_2SO_4	Boiling water extraction: Sulphur derived from extract as: Total sulphur by fusion	Subsequent acetone extraction: Extract (by difference)	Subsequent acetone extraction: Residue	Direct acetone extraction: Extract (by difference)	Direct acetone extraction: Residue	Direct acetone extraction: Sulphur obtained from extract as: Total acidity as H_2SO_4	Direct acetone extraction: Sulphur obtained from extract as: Total sulphur by fusion	Date of commencing extraction
	%	%	%	%	%	%	%	%	%	%	
All samples	—	—	less than 0·02	—	—	—	—	—	—	—	11.10.17
A 9	—	—	less than 0·02	—	—	—	—	—	—	—	4.11.17
B 9	—	—	—	—	—	—	53·6	46·4	—	3·58	10.11.17
A 9	—	—	—	—	—	—	28·0	72·0	—	2·93	
B 9	1·8	98·2	0·29	0·14	24·3	75·7*	57·3	42·7	—	5·14	
A 9	1·6	98·4	0·29	0·14	16·5	83·5*	38·8	61·2	—	3·49	
B 9	—	101·3	0·06	0·16	12·6	87·4*	12·5	87·5	—	1·80	22.11.17
B 6	—	—	less than 0·02	—	—	—	12·6	87·4	—	1·93	
A 3	—	—	—	—	—	—	43·5	56·5	—	3·87	
A 9	—	—	—	—	—	—	40·5	59·5	—	3·45	
B 9	—	—	—	—	—	—	25·0	75·0	—	2·30	5.1.18
B 6	—	—	—	—	—	—	27·5	72·5	—	2·64	
A 3	—	—	—	—	—	—	—	—	—	3·33	
A 9	23·4	76·6	2·68	0·45	—	—	—	—	—	2·74	
B 9	17·8	82·2	2·21	0·39	—	—	—	—	—	2·59	18.6.18
B 6	21·9	78·1	2·56	0·63	—	—	—	—	—	2·39	
A 3	26·7	73·3	3·03	0·66	—	—	—	—	—		

* These three figures rose to 76·2, 84·3 and 91·9 respectively after keeping for six weeks.

NOTE.—All percentages worked on actual weight of Aged crumb taken.

content. Further, throughout the whole period of change a steady gain in weight, due presumably to oxidation, is taking place.

Aqueous and acetone extracts.

(Sulphur extracted by the boiling solvents.)

The crumbed samples, after various ageing periods, were treated for 6—8 hours in a Soxhlet apparatus with boiling water, followed, after drying, by acetone extraction, with the results shown in Table VI.

Some idea of the changes in the portions soluble in water and in acetone can be obtained, but close analysis of the results is impossible, owing to the weight increases, and it is not possible to eliminate the effect of these changes. Fresh crumbs contained no water-soluble acid or sulphur, and only a trace of any water-soluble constituent.

After about 1 month, the two very over-cured samples began to develop a water-soluble acidity but even the total aqueous extract was well under 2%; after a period of 9 months, however, the water-soluble extract rose to 25% and the acidity to 2·5—3%, calculated as sulphur, and the actual sulphur washed out to about 0·5%. Contrary to what might have been anticipated, samples A 9 and B 9 gave smaller extracts than samples A 3 and B 6. The acetone extract is very large in the case of samples A 9 and B 9 while the under-cured samples show much smaller figures; after 9 months the acetone extract of sample A 9 decreases, an irregularity which is correlated with the rise in combined sulphur content. These results show that complex changes are occurring, which it is not possible to examine more closely at this stage of our work.

On referring to Table III. it will be seen that the 9 months old sample of the crumbed crêpe rubber (244 C 9) showed only 3·4% of water-soluble extract, compared with 17·8% for a similarly cured crêpe sample (358 S_2 B 9) in the present experiments. Other factors are therefore involved which at present lack explanation.

Part II.

Uncrumbed vulcanised rubber stored for 14 months.

Further experiments were carried out on two types of mixings, using samples of slab and crêpe rubbers. One mixing contained the usual percentage of sulphur employed in nearly all of our vulcanisation experiments, viz. 10% calculated on the rubber-sulphur mixing, and the other contained 4·75% of sulphur calculated on the rubber-sulphur mixing.

10% Mixing Ref. No. 333 A (slab) and 333 B (crêpe).

4·75% Mixing Ref. No. 333 A^1 (slab) and 333 B^1 (crêpe).

The tensile curves (continuous lines), as obtained on the Schopper-Dalen rubber testing machine, are shown in Diagram III. and IIIa. respectively, and the combined sulphur content figures calculated on the mixing in all cases, as in previous samples, are given in Table VII.

The samples were again tested mechanically after 14 months and tensile curves for the repeated tests are shown in Diagrams III. and IIIa. No good purpose is shown by giving the figures, the changes being more clearly illustrated by the curves. It will be observed in the case of the 10% sulphur samples, that the shift of the curve is equivalent to about an additional ½-hour cure and, in the case of the 4·75% sulphur samples, the shift is equivalent to a 2 hours' extra cure. In the latter case, however, it should be noted that a large increase of curing gives only a small shift of the curve.

Table VII.

Combined sulphur, %

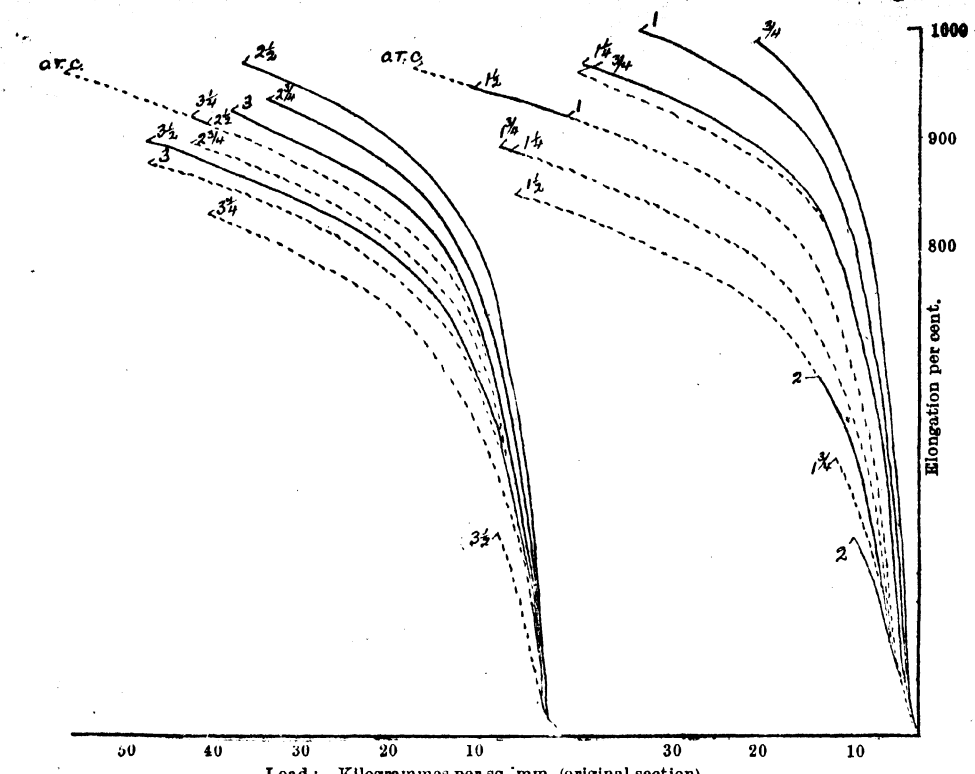
Ref. no. 333		June, 1917	July, 1918	Increase
A	½	2·81	3·04	0·23
	1	3·19	3·34	0·15
	1½	3·83	4·16	0·33
	1¾	4·46	4·66	0·20
	1¾	5·30	5·62	0·32
	2	5·69	6·14	0·45
B	2½	2·72	3·04	0·32
	2¾	2·83	3·20	0·37
	3	3·14	3·36	0·22
	3½	3·53	4·20	0·67
	3½	3·83	4·40	0·57
A^1	2	3·22	3·52	0·30
	3	4·20	4·46	0·26
	4	4·29	4·68	0·39
	5	4·84	4·82	—
	7	4·87	4·72	—
B^1	2½	1·54	1·92	0·38
	3	1·81	2·12	0·31
	4	2·54	2·80	0·26
	5	2·89	3·16	0·27
	7	3·97	4·26	0·29

On examining Table VII. it will be observed that there is an increase in combined sulphur content in nearly every case, after storing the samples for 14 months, but the increase is not as great as is indicated by the shift in the tensile curves, assuming the new curves had been obtained from freshly cured samples. The increases are generally greater for the more over-cured samples, although, when the combined content approximates to the total sulphur content, it is obvious that such increases cannot be great. In these experiments ageing effects were accelerated by crumbing the vulcanised specimens, so that any changes occurring in the rubber during the period of experiment would probably be comparable with those which would occur over a much longer period under normal conditions.

In this connection it is interesting to recall the statement made by de Vries that "the percentage of combined sulphur is quite independent of the state of cure expressed by the position of the stress-strain curve and that it is possible to bring the rubber to the 'correct' or any other chosen standard cure (as judged by the curve) with other and quite arbitrary coefficients of vulcanisation." He subjected a much under-cured rubber (2·85% of combined sulphur) to a temperature of 70° C. for 11 × 6 hours without affecting the sulphur content while affecting to a marked extent the mechanical properties of the vulcanised rubber, as indicated by the tensile curve. The results given above, which were carried out at normal temperature (about 30° C.), may be of a different order. The increases in combined sulphur content found by us, while small, can, in view of the method of estimation employed, be accepted as definite. It is possible that other methods of estimation have failed to detect such small but important increases. The results, however, show that the changes occurring in vulcanised samples on storage are complex and, from several points of view, require further investigation which must necessarily be prolonged.

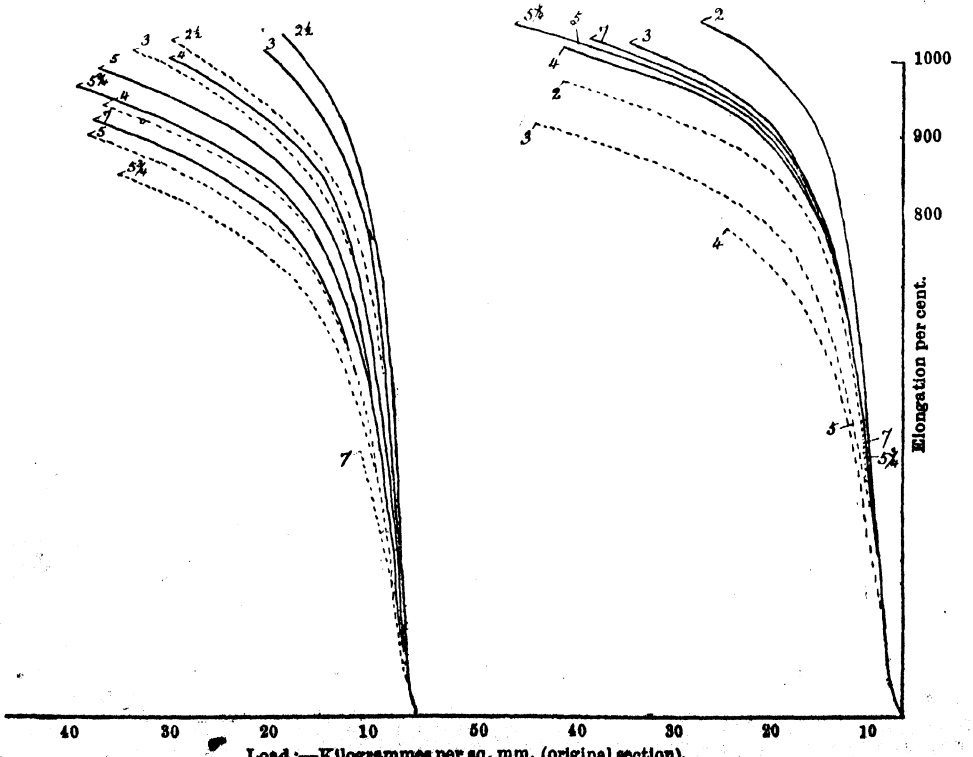
Conclusions.

At the present stage of these investigations, which had unfortunately to be interrupted at this point, it is not possible to draw any very definite conclusions, since the changes taking place in vulcanised rubber on ageing are obviously complex. It is considered desirable, however, to place the results on record as the literature on this subject does not appear to contain any results similar to those shown here, in respect of (1) the large increases in weight on storage, (2) the formation of a large aqueous extract in the samples, (3) the



Load :—Kilogrammes per sq. mm. (original section).
333B (crêpe). 333A (slab).

Diagram III. Tensile changes. 10 % sulphur.



Load :—Kilogrammes per sq. mm. (original section).
333 B[1] (crêpe). 331 A[1] (slab).

Diagram IIIA. Tensile changes. 4½ % sulphur.

conversion of the sulphur to a large extent into aqueous soluble compounds.

NOTE.—This work was carried out and completed to this stage while the authors were working together in the chemical laboratories of the Department of Agriculture, F.M.S.

Experimental Vulcanising and Chemical Laboratory,
Agricultural Department,
Federated Malay States.

STUDIES IN VULCANIZATION.
A. THE RUBBER STRESS/STRAIN CURVE.

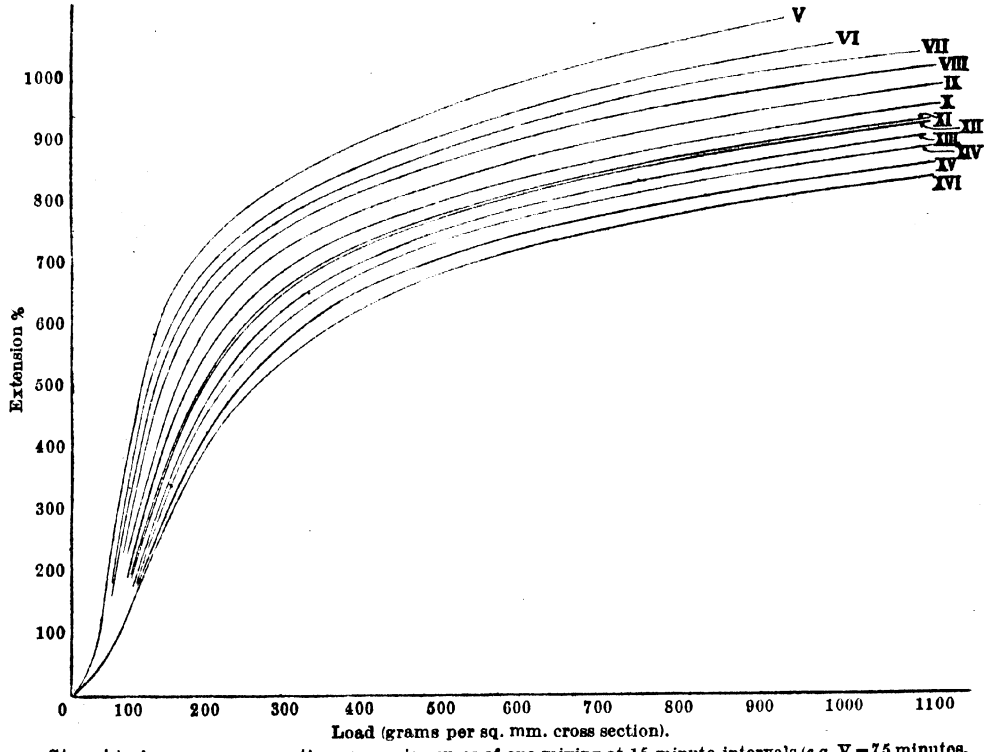
BY P. SCHIDROWITZ AND H. A. GOLDSBROUGH.

In a preliminary paper on this subject by one of us,[1] read at the Rubber Congress held in June/July 1914, it was stated that we hoped shortly to publish full details thereon. Although certain specific points [2] have been briefly dealt with since then, our original intention has up to the present remained unfulfilled, and it is our purpose in this and succeeding papers to carry out the programme mapped out at the date mentioned. From time to time various authors [3] have referred to or complained of the fact that our promise in this regard has not been carried out. We think it only fair to ourselves, therefore, to point out that very shortly after the preliminary communication was read war broke out, and our activities both as regards routine and research were diverted into channels which were of more immediate importance. Further, one of us (Goldsbrough) was, from early in 1915 to quite recently, engaged on active service.

Nature of stress/strain curve.

(By E. Hatschek and H. A. Goldsbrough.)

An examination was made of the practicability of obtaining a single expression for the stress/strain curves of a series of cures [4] of the same mixing. The general form of such curves is now well known, but as the scale to which hitherto published curves have been drawn [5] does not, in our opinion, sufficiently emphasise the load factor for rubber-sulphur mixings,[6] we append fig. 1, which illustrates a series of cures carried out by the method employed by Schidrowitz and Goldsbrough and drawn to the scale employed by them. In this connection, and in order that the following discussion on the mathematical solution of the curves, of the nature of "type," etc., may be more readily understood, we consider it desirable to restate, briefly, the following characteristics of progressive cures of the same rubber-sulphur mixing, as first set forth by Schidrowitz.



Stress/strain curves representing successive cures of one mixing at 15-minute intervals (*e.g.* V = 75 minutes, VI = 90 minutes etc.) in steam at 286° F.
(Part of a series from 15 minutes to 6¾ hours.)

FIG. 1.

[1] P. Schidrowitz, "Variability." The Rubber Industry, 1914, pp. 212 *et seq.*

[2] India-Rubber J., 1916, 41, 505; *ibid.* 1916, 42, 615.

[3] *E.g.*, de Vries and Hellendoorn. This J., 1919, 927; Eaton and Grantham, Agric. Bull., F.M.S., No. 27, p. 46.

[4] As explained elsewhere (*cf.* Schidrowitz and Goldsbrough, India-Rubber J., *loc. cit.*), the mixing employed by them in their fundamental experiments consisted of 100 parts rubber to 8 of sulphur, cured for periods varying from 15 to 405 minutes at 286° F. in moulds in live steam.

[5] For illustrations of series of cures of this same mixing *cf.* Eaton and Grantham, this J., 1915, 989-999.

[6] Hitherto published curves have almost invariably been traced by means of the Schopper autographic drum recorder. This apparatus, in the case of "pure," *i.e.* rubber-sulphur, mixings, yields a very upright form of curve; as a result the extremely important features of the latter part of the curve are not readily discernible. This, no doubt, accounts for the fact that Eaton and Grantham failed to perceive the "type" differences which are one of the chief characteristics of plantation rubber. (*Cf.* Schidrowitz, The Rubber Industry, *loc. cit.*; India-Rubber J., *loc. cit.*; and Eaton and Grantham, Agric. Bull., F.M.S., *loc. cit.*).

(1) The process of vulcanization is physically and mechanically of a definitely progressive character, and its progress can be accurately represented graphically by a series of stress/strain curves.

(2) The state of cure of a given mixing of any rubber at any given time (assuming standard conditions) is graphically expressed by the form and position of the corresponding stress/strain curve. The stress/strain curves representing progressive cures bear a certain mathematical relationship to one another for any one rubber, and a relationship exists between the series of curves representing progressive cures of any one rubber and the series of curves representing progressive cures of any other rubber.

(3) As curing proceeds the curves come further down the paper in regular fashion, and do not intersect at any point.

(4) At a part of the curve not far from the point of inflection the curves become parallel to one another. That is to say, the rate of stretch decreases with increasing loads, *and is independent of the state of cure.*

The above characteristics for a single set of cures may be readily gathered from fig. 1.

An examination of the curves showed that, without doubt, they belong to the conchoid family, and it was found that a conchoid corresponding closely to the rubber curve could be expressed, referred to Cartesian co-ordinates, as follows:

$$y = a - b \sin \alpha$$
$$x = n\,(a.\ \cot \alpha - b \cos \alpha).$$

Now the rubber curve is derived from the parent conchoid by plotting the ordinates against a constant fraction (n) of the corresponding abscissa, and the co-ordinates of the rubber curve are therefore:

$$y = a - b \sin \alpha$$
$$x = n\,(a \cot \alpha - b.\cos \alpha).$$

Practical interpretation of the curve.

(By Schidrowitz and Goldsbrough.)

The interpretation of the terms in the above expressions may be obtained from the following considerations:—

(1) a represents, as stated, the distance between the pole of the curve and the asymptote.

(2) n is a constant in the expression $x = nx'$ in which x is the load at any point on the stress/strain curve and x' is a corresponding point on the parent conchoid.

(3) $a.n$ is a constant for any given set of curves.

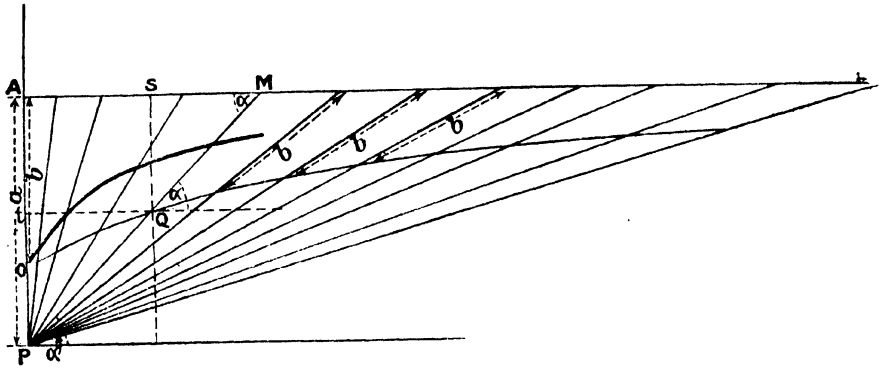
(4) n represents the increase of stretch per increment of load, or in other words slope or "*type.*"

(5) Hence a/an or $1/n$ is the degree of stretch or distensibility.

(6) It follows that a represents a quality which is the inverse of stretch capacity, *i.e.*, toughness or tenacity.

(7) b represents the limit of extension.

In every set of curves (*i.e.* progressive cures of the same mixing) there must be a specific curve in which $a = b$. It follows (*cf.* 7 and 8 above) that this specific curve represents a theoretically ideal balance of properties. The curve in question is the one which we term the *correct or perfect cure.* Evidence as to the mechanical properties of various rubbers cured to the correct curve will be found in Tables III. and IV.



Derivation of rubber stress/strain curve from parent conchoid.

FIG. 2.

Fig. 2 illustrates the relationship between the rubber curve and the parent conchoid, as follows:

a = distance between the pole P and the asymptote A B;

b = distance between the origin of the curve (O) and the asymptote A B.

The conchoid curve is plotted in the well-known manner through points representing equal distances from the asymptote (b) on the radii-vectores emanating from P.

Taking any point Q on the curve, then,

$$y = Pt = PA - At = a - (Q.M.\ \sin \alpha)$$
$$= a - (b \sin \alpha)$$

Taking (for the solution of x) the same point Q, we have:

$$x = AS = AM - SM$$

and, as $\frac{AM}{a} = \cot \alpha$, $AM = a.\ \cot \alpha$,

$$x = a.\ \cot \alpha - SM.$$

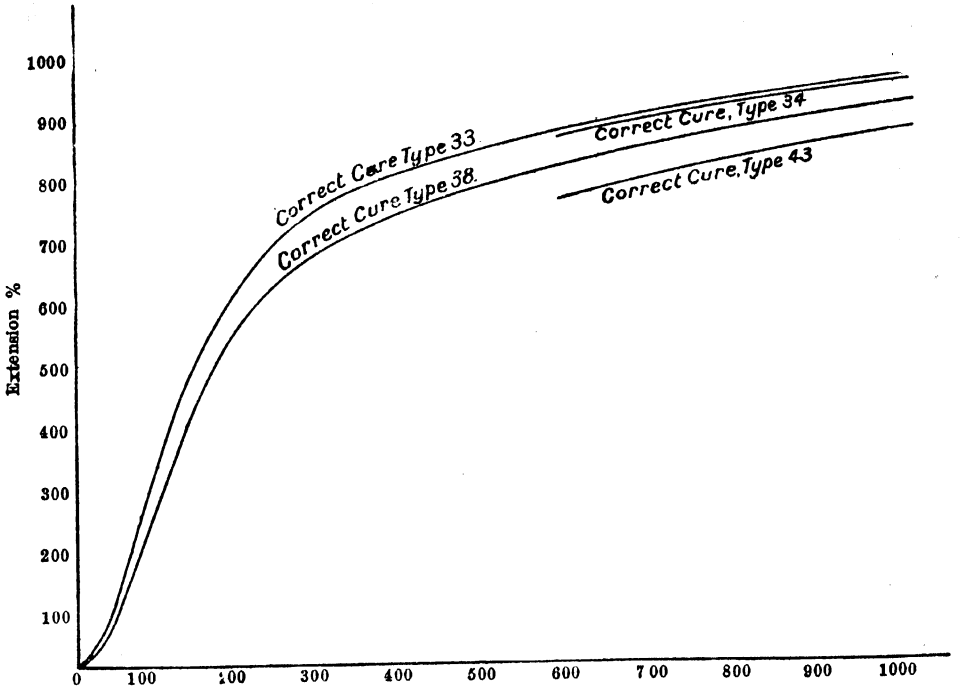
Now, as $\frac{SM}{QM} = \cos \alpha$,

$$SM = QM \cos \alpha$$
$$= b \cos \alpha,$$

and $x = a \cot \alpha - b \cos \alpha$.

It is remarkable that $a.n$ (*i.e., slope or type*) which obviously represents a fundamentally important quality of a rubber is a constant for any rubber, theoretically from the point of inflection upwards and, actually, as found experimentally, from a point not far removed from the latter. Expressed in other terms, this means that after the initial stage of stretching, equal increments of load produce equal elongations *whatever the state of cure.* Experimental evidence as to the invariability of "type" in any set of cures will be found below.

It has been found by solving the correct cure curves by the method of trial and error that all correct cure curves are derived from a parent conchoid in which b (and, therefore also a) = 10·5 (*cf.* fig. 3). It is apparent from fig. 2 that the parent conchoid meets the asymptote at infinity, and the same, necessarily, applies to the derived rubber curve. Hence it follows that we are justified



Stress/strain curves representing correct cures for types 33, 34, 38, and 43.

For Type 33 : $a.n = 2{\cdot}10$; $n = \frac{1}{5}$; $a = b = 10{\cdot}5$.

,, ,, 34 ; $a.n = 2{\cdot}27$; $n = \frac{1}{4{\cdot}6}$ $a = b = 10{\cdot}5$.

,, ,, 38 : $a.n = 2{\cdot}88$; $n = \frac{1}{3{\cdot}65}$; $a = b = 10{\cdot}5$.

,, ,, 43 : $a.n = 3{\cdot}68$; $n = \frac{1}{2{\cdot}85}$; $a = b = 10{\cdot}5$

FIG. 3.

in concluding that all *correct cures* of a standard mixing consisting of 100 parts of rubber to 8 parts of sulphur (whatever the nature of the rubber, provided it is *Hevea*) meet at a point for which the co-ordinates are $y = 10{\cdot}5$, $x = \infty$ (that is an extension of 11·5 times the original length is the limit of distensibility).

Method of determining "correct cure."

From the above it will readily be inferred that to obtain the correct cure it is necessary to determine a, b, and n; in other words it is essential to determine (1) type and (2) the particular curve in any set in which $a = b$ (*cf.* fig. 3).

Type.

In practice the determination of $a.n$ ("type") by means of the expressions corresponding to the co-ordinates (*cf.* above) is obviously inconvenient, and, as stated in a previous note,† taking advantage of the fact that "type" represents increase of stretch per increment of load, we determine the property by measuring the increase in elongation corresponding to two suitable points on the load co-ordinate as follows :

$$Type \text{ (conventional)} = \frac{E_1 - E}{2.5}$$

where E = extension % at 600 grms. per sq. mm. and E_1 is that at 1040 grms.

† India-Rubber J., 1910, 41, 464.

The extensions corresponding to the loads stated for various types for the correct cure in each case were found to be as follows :

TABLE I.

Types 33 to 45.

"Correct" cure extensions at 600 grms. and 1040 grms. per sq. mm. (Mixing 100 of rubber to 8 of sulphur.)

Type	Extension % at 600 grms. per sq. mm.	Extension % at 1040 grms. per sq. mm.	$E_1 - E$
33	826*	908†	82
34	815	900	85
35	805	892	87
36	794	884	90
37	783	875	92
38	772	867	95
39	761	859	98
40	750	850	100
41	740	842	102
42	729	834	105
43	718	825	107
44	707	817	110
45	697	809	112

* 9·26 times original length.
† 10·08 ,, ,, ,,

A glance at the above table and at fig. 3 will reveal a fact which is of fundamental importance, namely that the lower (or better) the type figure (*i.e.* the more rapid the decrease in extension with increasing tension *towards the end of the curve*), the less rapid is the decrease in the initial portion. In other words, a curve representing a rubber A

which is flatter[8] in type than rubber B, will lie for the whole of its course *above* the latter at the correct cure (*i.e.* where $a=b$). As confirmation in this connection it is interesting to note that de Vries and Hellendoorn,[9] in a paper from the Central Rubber Station at Buitenzorg (which has adopted our method of determining "type"), found that "the maximum of tensile strength is found higher on the paper the flatter (smaller) the 'slope,' that is the better the type or quality as determined by this property." These authors found a range of variation in different grades of plantation rubbers of 36 to 53.

The same authors in a previous paper[10] found that "the permanent set for our standard state of cure shows a close relationship with the property called 'type' by Schidrowitz. . . As the 'type' in ordinary routine testing of raw rubber can be determined in the same operation as tensile strength, a separate test for permanent set—when using the above-named mixture of rubber and sulphur only—is superfluous for ordinary samples; only in the case of rubber prepared by special methods a deviation from the above given relationship may occur and lead to important conclusions."

A consideration of the above will demonstrate the fallacy of measuring the quality of a rubber by the resistance to stretch method, which consists in determining the load necessary to produce a given extension at a single point, and assumes that the greater the load the better the rubber. For rubbers of different *types*, the reverse is actually the case. Further, it is obvious that the application of this method for determining state of cure, as suggested,[11] may give fallacious results.

Non-variation of type.

Table II. illustrates the non-variability of type (*i.e.* constancy of *a.n* or absence of effect on this quality due to variation of the curing time). The figures given are merely examples of many hundreds of results, all of the same general order. The figures under "Type (experimental)" were obtained by direct reading from the Schopper apparatus, those under "Type (from curve)" by careful drawing of the curve on the basis of all the apparatus readings from a small load up to the break. The rubbers which we have examined in this connection comprise many examples of all the better-known plantation grades.

Effect of experimental conditions.

A number of experiments were made with a view to ascertaining whether various experimental factors, likely to vary somewhat in practical working, had any effect on type. It was found, however, that, if we except the effect of excessive heating[12] in the case of certain mixings, none of the usual variables have any noticeable influence. The following brief data in this regard are, we think, worth recording.

1. *Effect of mixing by different operators and machines.* A batch of rubber was divided, and one part (*a*) was put through a works machine and mixed by an operator unknown to us; the remainder (*b*) was mixed by us on the laboratory mill. Both sets were then cured by us with the following results:

	a	*b*
Curing time (hours)	3½	3½
Type	39	39
Breaking strain (lb.)	1711	1718
Elongation at break	9·96	10·02

[8] Over the part of the curve which is *typical*, *i.e.* independent of the state of cure.
[9] This J., 1919, 927.
[10] This J., 1917, 1261.
[11] *Cf.* G. D. Kratz and A. H. Flower, India-Rubber J., 1919, 47, 873 *et seq.*
[12] Schidrowitz and Goldsbrough, India-Rubber J., 1919, 47, 269.

TABLE II.

Non-variation of type.

Absence of effect due to duration (time) of cure.

Rubber no.	Time of vulcanisation	Type (experimental)		Type (from curve)	
	Hours	E1–E	Type	E1–E	Type
95	1½	82·4	33·00	82·5	33·0
95	2	81·0	32·40	82·5	33·0
95	2½	82·4	33·00	82·5	33·0
95	2½	85·0	34·00	82·5	33·0
90	3½	77·0	30·80	77·5	31·0
90	4	80·0	32·00	77·5	31·0
90	4½	77·0	30·80	77·5	31·0
92	1½	87·0	35·00	87·5	35·0
92	1½	88·4	35·40	87·5	35·0
92	2	84·4	34·00	87·5	35·0
92	2½	88·3	35·40	87·5	35·0
93	1½	82·40	33·00	82·5	33·0
93	2	81·20	32·50	82·5	33·0
93	2½	82·40	33·00	82·5	33·0
93	2½	82·20	32·90	82·5	33·0
331	2	89·00	36·00		
331	3	89·00	36·00		
332	2	94·00	37·66		
332	3	93·00	37·33		
333	2½	92·00	37·00		
333	3	92·00	37·00		
336	2½	86·00	34·50		
336	3	86·00	34·50		
335	1½	93·00	37·30		
335	2	92·00	37·00		
335	3	93·00	37·30		
337	1½	86·00	34·50		
337	2½	85·00	34·00		
337	3	85·00	34·00		
338	2½	84·00	33·66		
338	3	82·00	33·00		
842a	1½	82·00	33·00		
842a	2½	81·00	32·66		
342	2½	90·00	36·00		
342	3	90·00	36·00		
347	3	86·00	34·50		
347	3½	87·00	35·00		
352	2½	83·00	33·33		
352	3½	84·00	33·66		

2. *Curing in different vulcanisers.* A batch of rubber mixed on standard lines was cured in separate vulcanisers, with the following results:

	Vulcaniser 1	Vulcaniser 2
Correct cure (hours)	2½ to 2⅝	2½
Type	35	35
Breaking strain (lb.)	2040	2156
Elongation at break	10·45	10·60

3. *Method of heating.* (*a*) Four samples were cured in different moulds in an electrically heated vulcaniser for 2¾ hours, and the products examined in the usual way. In each case the type was found equal to 34.

(*b*) Four cures of the same mixing were made at 2¾, 3¼, 3½, and 3¾ hours, and of these two were in steam, two in the electrically heated apparatus. In each case an examination of the product yielded a type of 36.

4. *Effect of overworking.* We have elsewhere[13] dealt with the general effect of overworking, and so far as type is concerned we may be content to state here that cures, partly on normally masticated material, partly on grossly overworked dough, partly on normally and partly on overmixed batches, were cured at 2, 2¼, 2½, 3, and 3½ hours, and in every case an examination of the product showed that the type was, as nearly as possible, 33. Fig. 4 reproduces some of the curves obtained in this series.

5. *Effect of varying "rest" or "storage."* We have elsewhere (*loc. cit.*) given details regarding mixings made up, cured, and tested with the following variations:

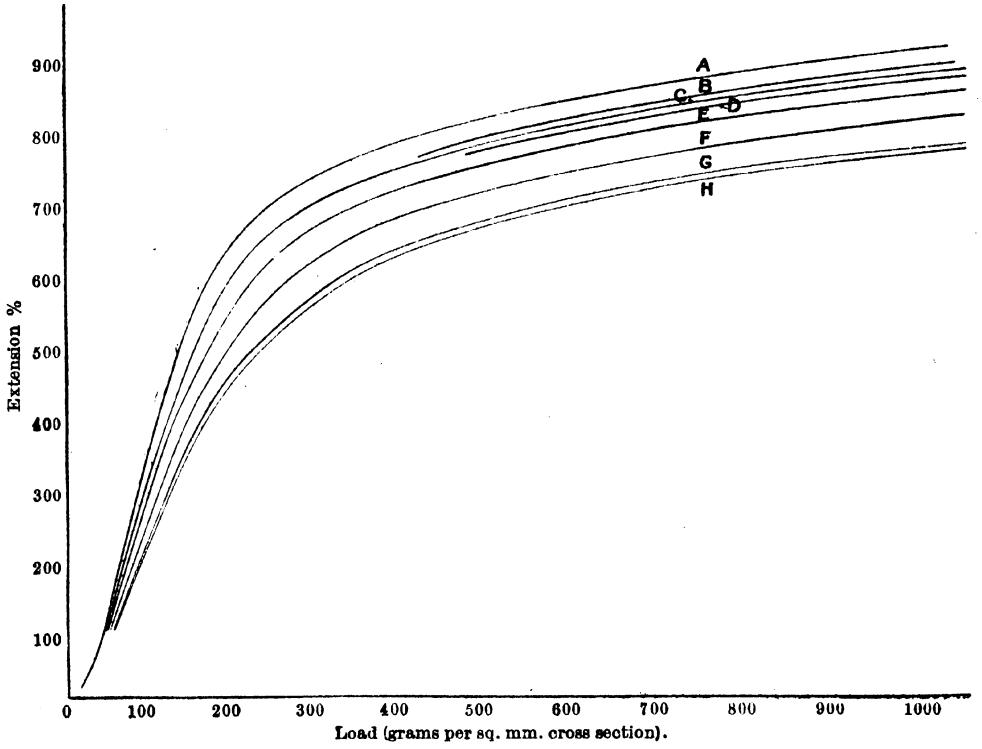
Interval between mixing and curing, from ½ hr. to 168 hrs.
" " curing and testing, " ½ " " 72 "
Curing " " " " " 2 " " 2½ "

[13] India-Rubber J., 1918, 55, 615.

In each case the type was found equal to 37. Similarly, various cures of the same mixing varying from 1¾ to 8 hours were stored for 15 months, and in the case of another set various rubbers, ranging as regards correct cure from 1 to 3 hours, were stored for 8 months. In no case was any measurable difference of type observed.

The "correct" cure.

We have (above) shown that the curve in any series of cures which we select as the "correct" cure possesses certain attributes which represent (theoretically) an ideal balance of properties; it is the curve in which $a = b$, that is to say the toughness or tenacity equals the limit of extension. It is obvious that, for purposes of comparative evaluation of crude rubber, a certain *definite* curing standard must be selected. Various suggestions in this respect have been made; thus de Vries and Hellendoorn [14] have in this connection dealt with maximum breaking strain, and Eaton and Grantham [15] have proposed as a standard that cure (which they call the "optimum" cure) which gives the highest figures for the "tensile product" (*i.e.* breaking strain×elongation at break). In so far, however, as it is desired to ascertain comparative *rate of cure* and *type*, such standards are open to serious objections. Firstly, owing to the fortuitous character of the "break"—as the result of minute mechanical imperfections, of slight differences in mixing, moulding, etc.—a considerable number of test pieces in each case must be tested in order to eliminate accidental factors. Secondly, the maximum "break" is very frequently on the (technically) "over-cured" side, and by no means easy to pick out. The most serious objection, however, is that which applies to the "optimum" method. According to our experience there is, on both sides of the "correct cure," but particularly on the over-cured side, a region in which the tensile product is very similar for a number of cures; that is to say, it may, in practice, be impossible to decide as to which cure, over a range of perhaps an hour or more (according to our standard methods), actually represents the "optimum." We have elsewhere [16] published some figures illustrative of these points. It follows, therefore, that there is a great and undeniable advantage in a method which not only indicates quite clearly which curve represents the "correct" or standard cure but which, in addition, in the case of a cure which is not correct, indicates quite clearly what the correct cure should be.



Stress/strain curves illustrating effect of overworking and overmixing.

I. Normal mastication and mixing (15 minutes in all): A = 2 hour cure; C = 2¼ hour cure; E = 2½ hour cure; G = 3¼ hour cure (correct cure).

II. Overworked rubber (35" mastication plus 5" mixing): B = 2½ hour cure (correct cure about 2¾ to 3 hours).

III. Over-mixed rubber (10" mastication plus 30" mixing): D = 2 hour cure; F = 2½ hour cure; H = 3 hour cure (correct cure about 2¼ hours).

FIG. 4.

The figures in Table III. show, we believe, that the curve (according to type) which is correct according to our method, not only possesses a theoretically ideal balance of properties, but obviously corresponds in every case to a cure possessing excellent mechanical properties compared with other cures of the same series.

With a view to affording a comparison we set forth in Table III. our own figures for the various cures made, indicating the cure which corresponds to the "correct cure," and also the

[14] This J., 1919, 91 T *et seq.*
[15] *Loc. cit.*
[16] India-Rubber J., 1916, 52, 615.

cures which give the best results according to the maximum breaking strain, and "optimum" methods.

TABLE III.

Cures of various standard mixings for different periods (hours) showing:

Type, break-strain, and elongation at break of various cures, the "correct cure," maximum breaking strain cure, and "optimum cure."

No. 87 (*Type* 38)

	1½ h.	2 h.	"Correct cure" (hrs.)	Max.: break (hrs.)	"Optimum cure" (hrs.)
*B.S.	1494	**2188**	2	2	2
E.	10·70	**10·39**			

No. 88 (*Type* 33)

	2 h.	2½ h.	2½ h. (a)	2½ h. (b)	3 h.	2½	2½	2½
B.S.	1900	**2252**	2463	2356	2255			
E.	10·88	**10·74**	10·26	10·25	10·24			

No. 89 (*Type* 33)

	2 h.	2½ h.	2½ h.	2½ h.	3 h.	2½	3½	2½
B.S.	1691	1912	**2094**	2338	2462			
E.	10·96	10·78	**10·60**	10·07	19·92			

No. 90 (*Type* 31)

	2 h.	3½ h.	4 h.	4½ h.	4	4½	4
B.S.	No break (about 1400)	1727	No break (2400)	2419			
E.	11·36	10·82	**10·98**	10·68			

No. 92 (*Type* 36)

	1½ h.	1½ h.	2 h.	2½ h.	1½	2	2
B.S.	2057	**2100**	2302	2226			
E.	10·77	**10·43**	10·42	10·00			

No. 93 (*Type* 37)

	1½ h.	2 h.	2½ h.	2	2	2
B.S.	1928	**2110**	2012			
E.	10·32	**10·35**	9·84			

No. 94 (*Type* 37)

	2 h.	2½ h.	2½	2½	2½
B.S.	2072	**2388**			
E.	10·65	**10·56**			

No. 95 (*Type* 33)

	1½ h.	2 h.	2½ h.	2½ h.	1½	2½	1½
B.S.	**2289**	2222	2386	2111			
E.	**10·78**	10·53	10·20	9·56			

No. T.D.

	1½ h.	2 h.	1½	1½	1½
B.S.	1706	1610			
E.	**10·23**	9·56			

No. J. (*Type* 35)

	1½ h.	2 h.	2 h. 5"	2 h. 5"	2 h. 5"	2 h. 5"
B.S.	1593	1778	**1805**			
E.	10·66	9·96	9·96			

No. K. (*Type* 35)

	2 h.	2 h.	2½ h.	2½ h.	2½	2½	2½ & 2½ almost =
B.S.	Obviously under-cured	1496	**1682**	1750			
E.		10·14	**10·06**	9·58			

No. A.S.F. 13 (*Type* 36)

	1½ h.	1½ h.	2 h.	1½	1½	1½
B.S.	**2343**	2454	2330			
E.	10·5	10·26	9·81			

No. C. (48) *S.*

	1½ h.	1½ h.	2 h.	1½	1½	1½
B.S.	1629	**1900**	1660			
E.	10·92	**10·4**	10·2			

No. 64 (*Type* 38)

	2 h.	2½ h.	2½ h.	2½ h.	2½	2½	2½
B.S.	1058	1295	1414	**1650**			
E.	9·77	1098	1050	**1020**			

No. 66 (*Type* 43)

	1½ h.	2 h.	2½ h.	2	2½	2½
B.S.	1960	**2048**	2282			
E.	**10·92**	**10·76**	10·24			

No. 67 (*Type* 37)

	2 h.	2½ h.	2½ h.	2½	2½	2½
B.S.	1746	**1868**	1775			
E.	10·04	**10·34**	9·38			

No. 69 (*Type* 41)

	2½ h.	2½ h.	3 h.	3	2½	2½
B.S.	1093	1425	**1460**			
E.	11·02	10·92	**10·6**[illegible]			

No. 75 (*Type* 38)

	2 h.	2½ h.	2h.25"	2h. 35"	2h.25"	2h.35"	2h.35"
B.S.	1079	1672	**2106**	2281			
E.	10·54	11·20	**10·60**	10·35			

	2 h.	3 h.	"Correct cure" (hrs.)	Max.: break (hrs.)	"Optimum cure" (hrs.)
	No. W. 331 (*Type* 36)				
B.S.	**1688**	2120	2	3	3
E.	**10·10**	9·4			
	No. W. 332 (*Type* 37/8)				
B.S.	**1947**	2058	2	3	3
E.	**10·3**	9·27			
	No. W. 333 (*Type* 37)				
	2½ h.	3 h.	2½	2½	2½
B.S.	**1770**	1730			
E.	**10·10**	9·62			
	No. W. 336 (*Type* 34½)				
	2½ h.	3 h.	2½	2½	2½
B.S.	**2188**	2072			
E.	**10·53**	9·64			
	No. W. 335 (*Type* 37)				
	1½ h.	2 h.	3 h.	2	3	3
B.S.	1680	**1484**	3072			
E.	10·54	**9·83**	8·78			
	No. W. 338					
	2½ h.	3 h.	2½	3	3
B.S.	**2000**	2184			
E.	**10·85**	10·29			
	No. 841a (*Type* 33)				
	1 h.	1½ h.	1	1	1
B.S.	**2016**	1960			
E.	**10·66**	10·30			
	No. 842a (*Type* 33)				
	1½ h.	2½ h.	1½	1½	1½
B.S.	**2160**	2083			
E.	**10·75**	9·54			
	No. W. 340				
	2 h.	2½ h.	3 h.	2½	3	3
B.S.	1331	**1770**	2116			
E.	10·38	**9·98**	9·72			
	No. W. 341					
	2 h.	2½ h.	3 h.	2½	3	3
B.S.	1500	**1800**	1960			
E.	10·60	**10·09**	9·74			
	No. W. 342					
	2 h.	2½ h.	3 h.	2½	3	3
B.S.	1520	**1568**	1876			
E.	10·91	**9·96**	9·49			

In Table IV. (below) some examples are given of "correct cures" obtained on the basis of a single preliminary cure. The rubbers, as in the other series, consisted of various plantation grades (smoked sheet, pale crêpe, brown crêpe, and scrap). Some rubbers of an experimental type are also included.

TABLE IV.

Examples of "correct cures," obtained on basis of one preliminary cure.

(Preliminary cure in each case = 2 hours except where otherwise stated.)

Number	Preliminary cure figures B.S.	E.	Time	"Correct cure" figures B.S.	E.
P.	1,592	9·95	1 hr.	1,786	10·03
M.	1,288	9·86	2½ ,,	1,554	9·85
F.	1,521	10·94	3 ,,	1,850	10·28
F. 1	581	10·78	4 ,,	1,960	10·68
,, 2	798	10·46	3½ ,,	1,260	10·12
,, 3	840	10·35	3½ ,,	1,094	10·08
N.	1,484	11·34	2½ ,,	1,515	10·72
F. 4	1,219	11·00	3 h. 5"	1,886	10·40
,, 5	1,204	11·00	3 hrs.	1,313	9·82
31 A. VIII. ...	2,380	9·81	1½ ,,	2,345	10·50
31 S. VII.	1,341	9·33	1½ ,,	1,554	9·86
36 S. VII.	1,198	11·2	2½ ,,	1,642	10·57
77 S. XI.	476	10·0	3½ ,,	1,700	10·40
79 S. XI.	460	9·58	3½ ,,	1,850	10·50
C. 48	1,660	10·2	1½ ,,	1,900	10·40
38 S.X.	1,262	10·48	3 ,,	1,579	10·20
W. 332 (3 h.) ...	2,058	9·27	2 ,,	1,947	10·30
W. 333 (3 h.) ...	1,730	9·62	2½ ,,	1,770	10·10
W. 336 (3 h.) ...	2,072	9·64	2½ ,,	2,188	10·53
W. 338 (3 h.) ...	2,184	10·20	2½ ,,	2,000	10·85
842a (2½ h.) ...	2,083	9·54	1½ ,,	2,160	10·75
841a (1½ h.) ...	1,960	10·30	1 ,,	2,016	10·68
W. 344 (2½ h.) ...	1,477	9·8	3½ ,,	1,540	9·55
W. 352 (3½ h.) ...	2,140	9·95	2½ ,,	1,880	10·45
W. 354 (2½ h.) ...	1,568	10·80	2½ ,,	1,946	10·36

NOTE.—B.S. = Breaking strain (lb. per sq. inch). E. = Elongation at breaking (taking original length = 1).

* B.S. = Breaking strain in lb. per sq. inch; E. = Elongation at break, taking the original length as = 1. The "correct cure" figures are shown in black.

THE EVAPORATION OF CONCENTRATED AND SATURATED SOLUTIONS OF AMMONIUM NITRATE, VAPOUR PRESSURES, HEATS OF SOLUTION, AND HYDROLYSIS.

BY E. B. R. PRIDEAUX, M.A., D.SC., F.I.C., AND R. M. CAVEN, D.SC., F.I.C.

The information obtainable from the vapour pressures of concentrated and saturated solutions affects the design of evaporating plant in two principal ways. Firstly the values of the vapour pressures are related to the velocity of dehydration of the solutions. Secondly, from the pressures, by the well-known thermodynamic relation, the heats of evaporation can be calculated, only approximately it is true, but with a sufficient accuracy to serve as a working guide in processes in which so many other heat factors are as yet not accurately defined. In the case of ammonium nitrate the consequences of hydrolysis are important, and the second part of our paper deals with these—the loss of ammonia and the corrosion of iron vessels.

Experimental.

The pressures of the solutions were measured directly against a mercury manometer with mirror scale. This was known to be an accurate one, and we also calibrated it with a cathetometer against a half-metre Cambridge Scientific Instrument Company standard which was kindly lent by Dr. Shaw, of the Department of Metrology, University College, Nottingham. The manometric height was equal to the sum of the readings on the two sides, and when the tensimeter side was completely evacuated this was equal to the barometric height. The differences between the barometric readings at the time and the manometric reading give the pressures of solutions in mm. of mercury. The whole apparatus was tested with pure water and found to give readings which agreed with the tables within 1 mm. of mercury.

The tensimeter was of the type described by Johnston (Z. physikal. Chem., 1908, **62**, 330). It was connected with the pump and manometer by a system of taps and drying tubes. The tensimeter part was immersed in a well-stirred beaker thermostat having the usual gas regulation and containing a concentrated solution of calcium chloride. This type of tensimeter is convenient from many points of view. It can be made to requirement by anyone with a slight knowledge of glass-blowing. The chief care that must be taken is to keep to the proper relative lengths of the different parts and to bend these round in such a way that the tensimeter does not need an inconveniently large beaker to hold it. The solid is introduced in a finely ground and dry state with, in the case of the unsaturated solutions, rather more than the calculated amount of water. Since water is inevitably lost during evacuation such solutions were analysed after the experiment. Saturated solutions should of course contain less than the amount of water calculated to dissolve the salt at the highest temperature. Readings were taken about every 5° upwards from 40° C., the temperatures being kept constant until the pressures also became constant; and also at about the same temperatures when the thermostat was cooling. The solutions can often be stirred by boiling them under a slightly reduced pressure, and the pressure may also be increased at will, and thus the equilibrium pressures may be approached from both sides. The solutions sometimes required mechanical shaking, especially those which were unsaturated and at the higher temperatures. The experimental results are given in Tables I., II., III., and the pressures at regular temperature intervals taken from the smoothed curves are given in Table IV.

Experimental vapour pressures.

TABLE I. 47·8 % *solution.*

t =	42·2°	51·4°	60·8°	71·2°	79·6°	82·2°	90·8°	98·2°
p =	52	78	123	194	276	295	410	532

(to nearest mm.)

TABLE II. 60·4 % *solution.*

t =	40°	48·2°	61·2°	66·0°	71·2°	80·4°	86·0°	90·2°	94·1°
p =	42	62	108	134	176	258·5	309·2	383·5	424

TABLE III. *Saturated solution.*

t =	40·1°	41·0°	43·0°	49·8°	54·5°	56·2°	61·3°	68·0°
p =	29·8	32·0	37·3	43·9	51·2	53·8	67·0	84·0
t =	70·4°	70·6°	74·7°	80·9°	81·2°	87·6°	89·8°	90·0°
p =	93·0	94·8	110	121·7	124·4	137·8	143·7	145·5
t =	92·0°	98·0°	103·4°					
p =	152·0	166·4	177·4					

TABLE IV. *Pressures at regular temperature intervals in cm. of mercury from the smoothed curves.*

t	p 47·8 % solution	p 60·4 % solution	p saturated solution
40	4·6	4·3	2·9
45	5·8	5·4	3·6
50	7·4	6·6	4·4
60	12·0	10·3	6·4
70	18·6	16·4	9·2
80	27·6	25·1	12·2
90	40·7	38·2	14·8
95	48·2	45·2	16·0

Even in such concentrated solutions as 60%, which is about saturated at ordinary temperature, the pressure still rises rapidly with rise of temperature. Consequently the evaporation will proceed much more rapidly if carried out at higher temperatures. As the concentration increases the pressures are lower and increase less rapidly with temperature, until the curve for saturated solutions is reached, on which the pressures are low, only 17 cm. of mercury even at 100°. A solution saturated at room temperature will, if raised to 100°, give an initial pressure of about 51 cm. which will soon fall to 17 cm.

The latent heats.

The heats of evaporation were then obtained by means of the equation—

$$Q = T(v_2 - v_1)\frac{dp}{dt}.$$

The values of dp/dt were calculated in two ways: (1) Tangents were drawn to the curves omitting those parts at which the curvature was altering too rapidly. (2) Equations to the curves were calculated, by the kind offices of Professor Piaggio, and these were differentiated. The values of dp/dt (2) calculated by this method at the extreme low temperature ends of the curve are less accurate than in the main portion and have been omitted. The formulæ connecting p (in mm.) and t (° C.) are—

48% solution $p = 336{\cdot}5 - 12{\cdot}845t + 0{\cdot}15116t^2$.

60·4% ,, $p = 231{\cdot}2 - 9{\cdot}666t + 0{\cdot}125t^2$.

Saturated solution

$p = 16 - 0{\cdot}8275t + 0{\cdot}01525t^2 - 0{\cdot}0_3 6875t^3$.

The corresponding values of dp/dt are—

48% solution $dp/dt = -12{\cdot}845 + 0{\cdot}30232t$.

60·4% ,, $dp/dt = -9{\cdot}666 + 0{\cdot}25t$.

Saturated solution

$dp/dt = -0{\cdot}8275 + 0{\cdot}0305t - 0{\cdot}0_2 0625t^2$.

The specific volumes v_2 of the steam have been obtained from the tables and are those calculated from the Linde equation

$$pv = 0{\cdot}5962T - p\,(1 + 0{\cdot}001_2 p)\left(\frac{1508 \times 10^6}{T^3} - 0{\cdot}0836\right).$$

in which p is in lb. per sq. inch, v in cubic feet per lb., and T is the absolute temperature on the Fahrenheit scale.

The values of p are taken from the experimental curve, multiplied by the conversion factor, and substituted in the above equation, giving the values of v which must then be converted into c.c. per gram. The products $T(v_2-v_1)dp/dt$, in which T is absolute temperature Centigrade, v_2 and v_1 specific volumes of steam and water in c.c. per gram, and dp/dt in cm. of mercury at ° C., when multiplied by the conversion factor $0{\cdot}0_2277$ give Q, the latent heats in calories per gram (or kilocalories per kilogram) of water evaporated. Q_1 refers to $\frac{dp}{dt}$ (1) from the graph and Q_2 to $\frac{dp}{dt}$ (2) from the equation.

TABLE V. 47·8 % solution dp/dt in cm. of mercury per 1° C. and Q in kilocalories per kilogram immediately above.

t			dp/dt (1) graphic	dp/dt (2) formula	Q_1	Q_2
40	...	...	—	—	—	—
45	...	...	0·275	0·275	459	459
50	...	...	0·36	0·37	486	499
60	...	...	0·56	0·53	495	468
70	...	...	0·755	0·83	459	501
80	...	...	1·08	1·13	465	486
90	...	...	1·50	1·44	462	443
95	...	...	1·50	1·59	462	424

TABLE VI.— 60·4 % *solution.*

40	...	...	—	—	—	—
45	...	...	0·23	0·158	413	283
50	...	...	0·29	0·283	439	429
60	...	...	0·50	0·53	515	549
70	...	...	0·71	0·78	486	537
80	...	...	1·07	1·03	507	476
90	...	...	1·37	1·28	449	421
95	...	...	1·45	1·41	413	410

TABLE VII.— *Saturated solution.*

40	...	...	0·115	—	372	—
45	...	...	0·15	0·125	404	337
50	...	...	0·175	0·18	397	409
60	...	...	0·245	0·26	444	462
70	...	...	0·30	0·30	367	367
80	...	...	0·275	0·29	269	283
90	...	...	—	0·25	210	—
95	...	...	—	0·21	170	—

The latent heats of the unsaturated solutions are probably about 450 to 500 calories, *i.e.*, at least 50 calories lower than that of water at the same temperature. They appear to reach a maximum at some temperature between 60° and 70° C. The maximum is more pronounced in the case of the saturated solution and also occurs at about 60°. At that temperature the latent heat is about 400 to 450 calories and rapidly falls to less than 200 cal. at 100°. The latent heats of saturated solutions of those salts of which the solubilities increase continuously with rise of temperature will in general become zero when the pressures of saturated vapour reach a maximum and therefore $dp/dt=0$, and thereafter will become negative (*i.e.*, evaporation of water with precipitation of salt evolves heat) as the vapour pressures fall to zero.

If the assumption is made that the same equation for saturated solutions holds good up to this temperature, and it is used to calculate the temperature of zero latent heat, this is found to be 112° C. From the general trend of the curve it would appear to be somewhat higher.

Hydrolysis of ammonium nitrate and its reaction upon iron and aluminium.

It is reported that much ammonia is lost during the evaporation of ammonium nitrate solutions; the following experiments were performed to discover whether such loss is due mainly to the original hydrolysis of the salt or rather to the continual reaction between the hydrolytic nitric acid and the metal of the containers.

I.—Hydrolysis in glass.

A modification of the method of E. G. Hill (J. Chem. Soc., 1906, **89**, 1277) was employed, a litre of purified air being drawn through a solution of 40 grms. recrystallised ammonium nitrate in 10 c.c. of water heated in the water bath to 92°—94° C. and then through ammonia-free water contained in two cylinders placed in series. The water was afterwards Nesslerised. The first cylinder contained 0·04 mgrm. NH_3, the second none. In two subsequent experiments the air was drawn directly through diluted Nessler solution and the amounts of ammonia found were 0·03 and 0·035 mgrm. NH_3 per litre of air.

In a further experiment with fresh material two litres of air was drawn through the solution during 2½ hours, and the amount of ammonia found was 0·06 mgrm. per litre of air.

II.—Hydrolysis in presence of iron.

(*a*) The above experiment was repeated in presence of fine iron wire. Much rusting of the iron was observed, and 2·25 mgrms. NH_3 was found per litre of air drawn through, *i.e.*, 37·5 times as much as in the absence of iron.

(*b*) *Cast iron borings* were employed, 2 grms. of iron being placed with 20 grms. of ammonium nitrate and 10 c.c. of water in the glass flask. The iron was observed to rust when the solution was heated before air was drawn through it. In two experiments 5 mgrms. and 6 mgrms. NH_3 were carried over per litre of air, and ammonia could be smelt in the flask.

(*c*) *Distillation in steam* in presence of iron borings. In this case atmospheric oxidation of iron was almost eliminated. 1 grm. of iron borings was heated in a flask with 20 grms. ammonium nitrate and a little water, and steam was blown through the mixture. 100 c.c. of the distillate contained 136 mgrms. of NH_3; the residual liquid in the flask measured 60 c.c., and, after being acidified subsequent to the removal of the metallic iron, contained ferrous and ferric iron.

(*d*) *Evaporation in an iron crucible.* 5 grms. ammonium nitrate was dissolved in 10 c.c. of water, and the solution evaporated to dryness in an iron crucible on the water bath. The solution when hot attacked the iron, inducing rapid rusting; bubbles of gas were evolved (? oxides of nitrogen) and ammonia could be smelt. The solution formed on adding water after evaporation to dryness contained ferrous as well as ferric iron, and there was a black deposit on the crucible.

III.—Hydrolysis in presence of aluminium.

Since aluminium has no appreciable action on dilute nitric acid, it was anticipated that ammonium nitrate solution might be evaporated in an aluminium container without serious loss.

(*a*) 1 grm. of aluminium turnings was heated in a flask with 20 grms. of ammonium nitrate and 10 c.c. water, whilst air was drawn through. 1 litre of air carried over 0·2 mgrm. NH_3. This was more ammonia than appeared when the solution was heated in contact with glass alone, but was only about one-twenty-fifth the amount which escaped under similar conditions when iron was present.

(*b*) The solution was distilled with steam in presence of aluminium turnings. 100 c.c. of the distillate contained 2·7 mgrms. NH_3, or about one-fiftieth the amount which was found when a similar experiment was performed in presence of iron.

(*c*) *Evaporation in presence of aluminium.* 5·810 grms. of purified and dried ammonium nitrate was

dissolved in water in a small aluminium saucepan, and the solution evaporated to dryness. The salt was again dissolved in water and re-evaporated in glass, 5·800 grms. being thus recovered. The surface of the aluminium remained quite unaffected.

Conclusions.

(1) The hydrolysis of ammonium nitrate which occurs when an aqueous solution of this salt is evaporated in an acid-resisting vessel is very small and the loss is consequently inappreciable.

(2) There is considerable loss of ammonia when ammonium nitrate solution is evaporated in contact with iron, accompanied by corrosion of the iron and consequent pollution of the residual salt. This is due to interaction between the iron and the hydrolytic nitric acid, with concomitant loss of ammonia.

(3) The substitution of aluminium for iron as the material of the containing vessel almost entirely obviates loss of ammonia because of the inertness of this metal towards nitric acid.

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NOTE ON THE YIELD OF MINERAL OIL FROM CERTAIN LOW-GRADE COALS (SHALES).

BY S. ROY ILLINGWORTH, B.SC.(LOND.), A.R.C.S., F.I.C.

The yield of mineral oil from certain low-grade coals mined at the Old Roundwood Collieries, Wakefield, was investigated by the author in 1909 through the courtesy of Mr. Stanley Nettlefold.

The material dealt with occurs in the Adwalton Stone Coal, a lenticular deposit of local character situated between Bradford and Wakefield in the West Riding of Yorkshire. The seams are in the Middle Coal Measures, and lie about a hundred yards above the Silkstone Coal.

The samples experimented upon were mine-samples taken from "roof to floor" of the seam; the bulk sample thus obtained was quartered down to the requisite size for investigation. Each sample was distilled in a horizontal iron retort, of 8 inches circular cross section, mounted in a brick-work setting heated by a coke fire. The charge distilled weighed 56 lb., leaving three to four inches clearance between the top of the charge and the retort. An internal temperature of 650°—700° C. was maintained throughout each experiment. The gaseous products evolved were passed through a series of air coolers seven feet high, built up of one-inch iron pipe, the gas being finally scrubbed in a five-foot tower, packed with coke, down which a stream of creosote oil was allowed to flow.

The crude oil from the air-coolers was mixed; a litre sample was then distilled by direct heat in an iron still fitted with a swan neck, wet steam being introduced into the oil as soon as the kerosene fraction had passed over. The whole of the distillate was collected together, the distillation being carried on until the distillate dropping from the condenser solidified to a yellow mass, *i.e.*, until chrysene commenced to pass over. This once-run oil was washed with the following reagents in the order given: (*a*) 25% solution of caustic soda, (*b*) water, (*c*) concentrated sulphuric acid equal to 5% of the oil by weight, (*d*) water. These various washings were carried out at 40° C.; between each washing operation the mixture was allowed to stand for two hours before separating the reagent used. The washed oil was then fractionated into naphtha, a kerosene distillate of sp. gr. 0·810, and heavy residue. The heavy oil was cooled to 0° C. and pressed in a screw press to expel the lubricating oil from the crystalline wax.

The naphtha fraction was redistilled, that portion boiling above 160° C. was added to the kerosene, which in turn was also redistilled to a bulk gravity of 0·810 and a flash point 78° F., and the residue was added to the oil expressed from the wax. These redistilled fractions were finally washed with 2% by weight of 92% sulphuric acid, water, and dilute caustic soda, in the order named.

The creosote oil from the scrubbers was distilled with wet steam, the light naphtha separated from the water and added to the refined naphtha obtained from the crude oil.

Two coals exhibited commercial possibilities in so far as they behaved in a satisfactory manner in the retort and gave average yields of refined products. Particulars of these coals are as follows:—

	Hubb	Shell-band
Moisture	0·90	0·88
Volatile matter (900° C.) ...	34·92	22·03
Fixed carbon	19·93	24·95
Ash	44·25	52·30
Nitrogen	0·84	0·82
Sulphur	1·71	0·94
Crude oil, per ton in galls. ...	34	18
Sp. gr. crude oil	0·891	0·902
Ammonium sulphate, lb. per ton	10·2	9·3

Refined products.

% by volume on the crude oil.

	Hubb	Shell-band
Naphtha	6·8	3·75
Kerosene	34·8	32·25
Heavy oil	30·00	21·40
Wax (scale)	4·00	9·10
Loss to acid	16·0	22·50
Loss to soda	2·6	6·0
Naphtha from scrubbers (galls. per ton of shale) ...	2·1	1·3

AN ELECTROLYTIC HYDROGEN GENERATOR FOR THE LABORATORY.

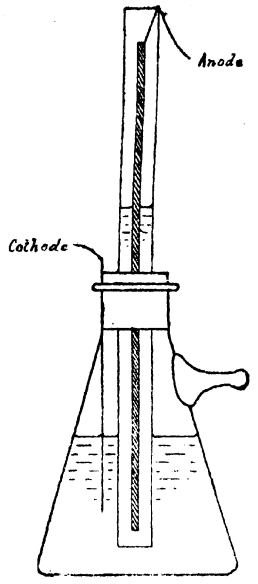
BY L. D. WILLIAMS.

This generator is a small-scale cell suitable for use as a substitute for the familiar Kipp's apparatus, over which it possesses the advantages of supplying very pure hydrogen and requiring much less attention. For example, a battery of five such cells has been used by the author for six months with no further attention than occasionally supplying distilled water.

The probable impurities in the hydrogen are hydrogen sulphide, oxygen, water vapour, and spray from the electrolyte. These may be removed by passing through sodium hydroxide solution and over heated copper, and then drying with solid sodium hydroxide or soda-lime. Hydrogen so purified is quite suitable for reductions by Sabatier and Senderens' method, which is a very severe test of the purity.

Oxygen containing ozone may be obtained by either reversing the current through the cell or else by closing the mouth of the anode tube and providing a delivery tube. The oxygen may be purified by passing through sodium hydroxide, over well heated copper oxide, and then drying with concentrated sulphuric acid or other suitable desiccating agent.

As shown in the accompanying diagram the cell consists of a filter flask of 250 c.c. capacity fitted



with a cork carrying a straight tube, 30 cm. long, which should be as wide as the diameter of the cork will allow, or about 1·5 cm. The anode is a strip sheet of lead, 25 cm. long, the lower end as wide as possible while the remainder is about 1 cm. wide. The upper end is soldered to a copper lead which supports this electrode so that its lower end is 1 cm. above the bottom of the tube. The cathode is a strip of lead foil thin enough to pass between the cork and the neck of the flask without causing any leakage. It should not be lower than the bottom of the anode tube and may be very conveniently wrapped around this. The electrolyte consists of 20% sulphuric acid and should nearly fill the flask when the exit is open.

In use a cell will produce 7 c.c. of hydrogen per ampère per minute and half this quantity of oxygen. The normal load for a cell is 2 ampères, but twice this amount may be used if necessary, although the electrolyte boils after a time unless the cell is cooled externally. When overloaded the anode disintegrates slowly, forming a deposit of lead peroxide. At the normal load a potential difference of 6 volts is required, a rather high figure, corresponding to an efficiency of less than 50%, but of no material importance in small installations run from direct-current lighting circuits.

Experience shows that the ideal plant for a small laboratory consists of 10 cells run normally at 1 ampère, a variable resistance to handle up to 3 ampères, an ammeter, and purifying apparatus.

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Communications.

THE THERMAL CONDUCTIVITIES OF INSULATORS IN RELATION TO THE LAGGING OF STEAM PIPES.

BY R. THOMAS, M.SC., A.I.C.

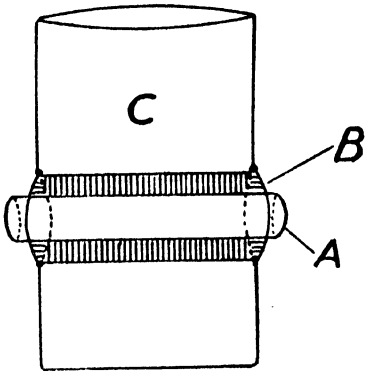
THERE appears in many cases to be a considerable variation in the published results of the values of the thermal conductivities of badly conducting materials. This is probably due to a variety of causes, such as the condition in which the material is employed, particularly the tightness or otherwise of the packing, the presence or absence of moisture, and to some extent, no doubt, the method by which the conductivity is determined, in addition, of course, to the slight variation due to the temperature. When this is considered in relation to the loss of heat from steam pipes, it is necessary in order to obtain a reliable estimate of these losses to know accurately the value of the thermal conductivity of the lagging material, otherwise an enormous number of actual determinations of the heat losses becomes necessary, with pipes of varying diameters and varying thickness of insulator and with steam at different temperatures. The method generally employed by engineers is to determine the amount of steam condensed in a pipe covered with a certain thickness of the insulator under consideration, and in the case of superheated steam to determine the fall in temperature along the pipe.

A determination of the conductivity of the lagging material is considerably simpler and capable of greater accuracy. Knowing the conductivity and also the emissivity of the radiating surface, it is quite easy to calculate the heat losses from a furnace or a steam pipe of any diameter with any thickness of lagging and with any temperature of the steam inside, to obtain which in a direct manner would involve an enormous number of experiments.

Various methods have been employed for determining thermal conductivities. The earlier determinations by Forbes, Peclet, Meyer, and others did not lead to very reliable results. The methods employed by these observers are reviewed by Lees,* who points out the sources of error involved. Using Lodge's "divided bar" method, Lees (*loc. cit.*) determined the conductivities of crystals and other bad conductors. The principle of this method is to determine the fall in temperature along a bar heated at one end and cooled at the other, the bar being divided half-way between the two ends by a plane perpendicular to its axis. The fall in temperature is compared when: (1) the divided ends are together; (2) a disc of the crystal or other body is interposed between the divided ends.

It appeared to the author that a simpler method, and one in which the conditions complied more nearly with those under which the material is employed in works for lagging, might be of interest, inasmuch as the physical condition, as already mentioned, has a considerable influence on the results obtained. Accordingly, determinations of the thermal conductivities of the more commonly employed insulators have been carried out, and the results obtained have been utilised to calculate the heat losses from steam pipes as outlined above. The method of experiment was as follows:—

C is a copper can of about 8 cm. diameter and 10 cm. in height. Two holes of one inch diameter were drilled opposite one another a little below the centre. Two rubber stoppers carrying a thin copper tube, B, of internal diameter 19 mm., were inserted in the holes. Another thin copper tube, A, of external diameter 12·2 mm., was placed coaxially inside the wider tube and kept in position with rubber stoppers. The space between the two tubes was filled with the material of which the conductivity was desired, care being taken when comparing different insulators to pack the space as far as possible to the same degree of tightness.



Superheated steam at a known temperature was passed through the inner tube, and the rise in temperature of a known weight of water in the calorimeter was determined during a definite interval of time. The usual precautions were observed to avoid radiation correction, C being initially as many degrees below the temperature of the surroundings as it ultimately attained above it. The calorimeter was also protected by asbestos from external heating by steam issuing from A being blown back upon it. It will be seen from the dimensions of the tubes that the quantity of insulator employed was quite small, so that its total heat capacity was small. The steam was passed through for a few minutes before actual measurements of the temperature of the water were carried out, so as to attain a steady flow across the insulator.

We have in the usual way in the case of a cylinder:—

$$Q = -2\ \pi\ lrkt\ \frac{d\theta}{dr}$$

Whence $\log.\frac{r_1}{r} = \frac{2\pi lkt\ (\theta - \theta_1)}{(W+w)\ (\theta_2 - \theta_0)}$

where the letters have the usual significance, *i.e.*; r_1 = external radius of the insulating material and therefore the internal radius of the outer copper tube; r = internal radius of the insulator and therefore the external radius of the inner copper tube; l = length of the insulating material, equivalent in this case to the length of the outer copper tube in contact with the water in the calorimeter; t = time; θ = temperature of the steam; θ_1 = outside temperature, *i.e.*, the mean temperature of the water in the calorimeter. W = weight of water in the calorimeter; w = water equivalent of the calorimeter and its accessories; θ_2 = final and θ_0 = initial temperature of the water in the calorimeter.

The following results were obtained, time being reckoned in seconds and temperatures in degrees centigrade:—

Substance.	θ	θ_1	θ_2	θ_0	W.	w.	t.	k. (c.g.s. units).
1. Magnesia ..	294	18·1	22·8	13·5	357	14	660	$0{\cdot}19\times10^{-3}$
,, ..	340	19·4	24·8	14·0	358	14	660	$0{\cdot}18\times10^{-3}$
2. Kieselguhr .	190	19·1	23·2	15·0	326	14	780	$0{\cdot}24\times10^{-3}$
,, ..	240	20·0	25·0	15·0	340	14	540	$0{\cdot}25\times10^{-3}$
,, ..	230	21·2	28·0	14·4	300	14	900	$0{\cdot}22\times10^{-3}$
3. Ignited	240	15·9	18·6	13·2	320	14	420	$0{\cdot}18\times10^{-3}$
kieselguhr	270	21·6	28·5	15·2	336	14	900	$0{\cdot}20\times10^{-3}$
4. Asbestos	305	20·1	25·2	15·1	370	14	400	$0{\cdot}34\times10^{-3}$
fibre ..	305	20·7	28·5	13·0	368	14	540	$0{\cdot}36\times10^{-3}$
5. Slag wool ..	320	21·2	27·1	15·3	381	14	600	$0{\cdot}26\times10^{-3}$
..	310	19·7	25·5	13·8	352	14	480	$0{\cdot}29\times10^{-3}$

n

* Trans. Royal Soc., 1892, A., 183, 480 *et seq.*

Arranging in the order of their efficiencies as insulators ($1/k$), taking magnesia as 100, we get:—

Substance.	$k \times 10^{-3}$.	Insulating capacity
Magnesia	0·185	100
Kieselguhr (ignited) ..	0·190	97
" (ordinary) ..	0·230	80
Slag wool	0·275	67
Asbestos fibre	0·350	53

Thus, of the materials examined, magnesia is the best insulator, although ignited kieselguhr is practically as good. Asbestos fibre, which is very commonly employed, is only half as efficient.

Gard* recommends "magnesia covering," a composition containing 85% of magnesium carbonate and 15% of asbestos fibre, as one of the most efficient materials on the market for use in lagging boiler plant and steam pipes.

Reverting now to the original heat equation:—

$$Q = -2\pi r l k t \frac{d\theta}{dr}$$

or its integral

$$\log \frac{r_1}{r} = \frac{2\pi lkt}{Q}(\theta - \theta_1) = \frac{2\pi lk}{Q_1}(\theta - \theta_1)$$

When we consider steam pipes and furnaces the quantity Q_1, $\left(\frac{Q}{t}\right)$ is the amount of heat lost per second by radiation from the surface, r the radius of the pipe, r_1–r the thickness of insulator, θ the temperature inside the pipe, and θ_1 the temperature of the radiating surface.

$$Q_1 = 2\pi r_1 lq.$$

q being the amount of heat radiated from unit area of the radiating surface in unit time when its temperature is θ_1.

Hence by substitution:—

$$r_1 \log_e \frac{r_1}{r} = \frac{k}{q}(\theta - \theta_1)$$

Knowing k and q, the heat losses from a pipe or furnace of any radius, with any thickness of insulator and any value of θ, can be calculated from the above equation; q can, of course, be readily found by any of the usual methods for determining emissivity, and from the laws of cooling.

It is evident from the above equation that the greater portion of the heat saved by lagging is saved by a comparatively small thickness of insulator, and that only with an infinite thickness of insulator is it possible to conserve the heat completely. It also follows that when the radius of the pipe is large, a greater proportion of the heat is saved with the same thickness of insulator than when the radius is small. The information given in engineering text-books as to the relation between the amount of heat saved and the thickness of the insulator is generally very vague, and is, as a rule, made without reference to the diameter of the steam pipes. Hausbrand†, in dealing with this subject, says: "The coating (of insulator) should not be too thick or the surface is unduly increased: a larger and cooler surface may easily lose more heat than a smaller or hotter surface," from which one would infer that there is a certain limit to the thickness of insulating material beyond which the heat lost begins to increase with further thickness. In other words, one would, if this statement is correct, find that the curve connecting the heat lost with the thickness of the insulator passes through a minimum. Such, however, is not the case, but the curve does, under a certain condition, pass through a maximum. This is true when the radius of the tube lagged is below a certain limiting value, in which case lagging will lead to a greater loss of heat unless the thickness of the insulator is disproportionately great. This point is of some importance, as steam pipes which are in common use fall in this category with certain classes of insulators.

In order to find the magnitude of this minimum value of the radius, use is made in the following deduction of Newton's law of cooling as a first approximation when the temperature of the radiating surface is not too high above the surroundings. It will be shown in the sequel that the results so derived are in substantial agreement with results calculated from actual experimental determinations of the loss of heat from various surfaces by Peclet and others.

We have, as before:—

$$\log \frac{r_1}{r} = \frac{2\pi lk}{Q_1}(\theta - \theta_1) \qquad \text{(i)}$$

$$Q_1 = 2\pi r_1 l K \theta_1 \quad \text{(Newton's law)} \qquad \text{(ii)}$$

K being the "emissivity" or the quantity of heat radiated per unit area in unit time with unit temperature excess over the surroundings.

Substituting (ii) in (i) we get:

$$\log \frac{r_1}{r} = \frac{k}{K r_1 \theta_1}(\theta - \theta_1)$$

$$\text{or } \frac{1}{\theta_1} = \frac{1}{\theta}\left(1 + \frac{K r_1}{k} \log \frac{r_1}{r}\right) \qquad \text{(iii)}$$

Differentiating (iii) we get:—

$$\frac{1}{\theta_1^2} \cdot \frac{d\theta_1}{dr_1} = \frac{1}{\theta} \cdot \frac{K}{k}\left(1 + \log \frac{r_1}{r}\right) \qquad \text{(iv)}$$

From (ii) by differentiation:—

$$\frac{dQ_1}{dr_1} = 2\pi lk\left(r_1 \frac{d\theta_1}{dr_1} + \theta_1\right)$$

If there is a maximum or minimum in the curve, then at this point:—

$$\frac{dQ_1}{dr_1} = 0 \quad i.e., \quad r_1 \frac{d\theta_1}{dr_1} + \theta_1 = 0$$

$$\therefore \frac{d\theta_1}{dr_1} = -\frac{\theta_1}{r_1} \qquad \text{(v)}$$

Substituting (v) in (iv) we obtain:—

$$\frac{1}{\theta_1} = \frac{K r_1}{k} \cdot \frac{1}{\theta}\left(1 + \log \frac{r_1}{r}\right) \qquad \text{(vi)}$$

but (iii) is universally true, *i.e.*, $\frac{1}{\theta_1} = \frac{1}{\theta}\left(1 + \frac{K r_1}{k} \log \frac{r_1}{r}\right)$.

Hence at the point at which a maximum or minimum occurs.

$$\frac{K r_1}{k} = 1 \text{ or } r_1 = \frac{k}{K} \qquad \text{(vii)}$$

To evaluate this, we may take the case of asbestos, for which, as mentioned in the earlier part of this paper, k was found to be $0{\cdot}36 \times 10^{-3}$ c.g.s. unit, K was determined in a manner to be described and was found to be $0{\cdot}29 \times 10^{-3}$ c.g.s. unit, hence for asbestos $r_1 = 1{\cdot}25$ cm. Since $r_1 = 1{\cdot}25$ cm. it is obvious that r must be less than this figure, *i.e.*, the existence of a maximum or minimum with asbestos is only possible when the radius of the pipe is less than 1·25 cm. Further mathematical investigation shows this to be a maximum and not a minimum. In Figures I. and II. are shown the heat losses from pipes of 1 cm. and 2 cm. diameter, lagged with varying thicknesses of asbestos, nd with steam at 100° C. inside. Porter* deduced a similar result in the case of a hot wire. He established the relation:—

$$\theta_a = \frac{H}{2}\left(\frac{1}{be} + \frac{1}{k} \log \frac{b}{a}\right)$$

θ_a being the temperature of the wire, H the quantity of heat supplied per unit length, k the conductivity and e the emissivity of the lagging material, b the outer radius and a the radius of the wire.

* This Journal, 1919, 97A.

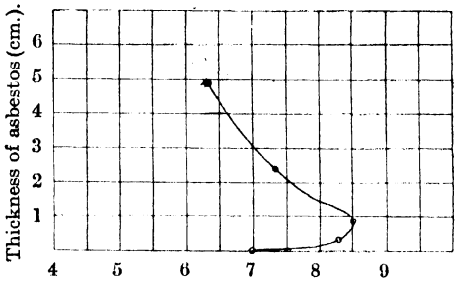
† "Evaporating, Condensing and Cooling Apparatus," p. 205.

* Phil. Mag., 1910, II., 512.

By differentiation, keeping H constant, he obtained:—

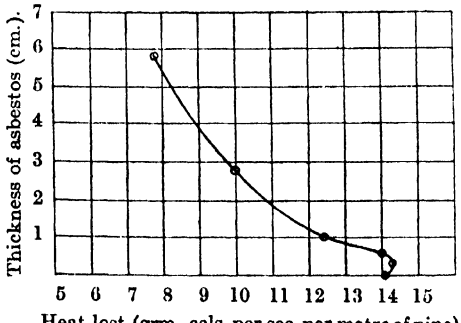
$$\frac{d\theta_a}{db} = \frac{H}{2}\left(-\frac{1}{b^2 e} + \frac{1}{kb}\right)$$

from which it follows that the temperature of the wire (θ_a) is increased if b is greater than $k+e$, while if b is less, the effect is reversed. It is surprising that Porter's result has not been more widely quoted in engineering text books. The reason for this is probably due to the fact that in applying this result to a narrow tube lagged with asbestos paper*, the particular sample of asbestos employed by them (Porter and Martin) had such an exceptionally low conductivity that what they term the "critical radius" is in this case only 0·5 cm., which is, as they point out, below engineering dimensions. The asbestos paper employed by Lees† in his conductivity determinations had $k=0{\cdot}00057$, which is much of the same order as that of the asbestos material generally supplied for lagging. This will bring the "critical radius" well within the limits of pipes used in engineering practice. The value found in the first part of this paper for asbestos fibre was 0·00036, giving, as already mentioned, a limiting value for the tube radius of 1·25 cm. A ¾-in. pipe ($r=1{\cdot}0$ cm.) is lower than this, and such steam pipes are often employed. Very extensive measurements of the heat losses from different radiating surfaces at various temperatures have been made by Peclet and others‡. Making use of these results and taking the value found for the emissivity (K) of asbestos, *i.e.* 0·00029, the corresponding values for θ_1, Q_1, and r_1 in equation (i.) above have been found and the curves shown in Figures I. to V. constructed.



Heat lost (grm.-cals. per sec. per metre length of pipe).
Diameter of pipe = 1 cm.

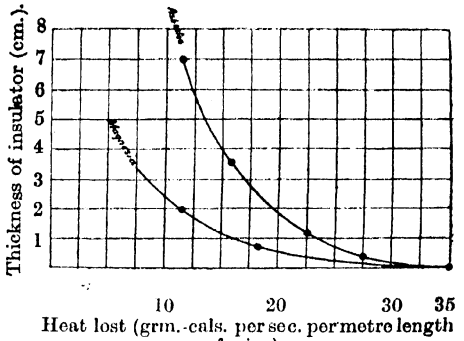
Figure 1.



Heat lost (grm.-cals. per sec. per metre of pipe).
Diameter of pipe = 2 cm.

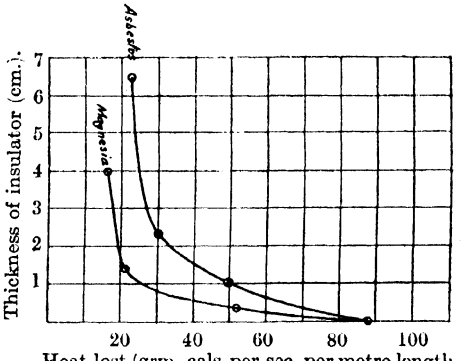
Figure 2.

* Porter and Martin, *loc. cit.*, p. 520.
† Lees, *loc. cit.*
‡ See Hausbrand, "Evaporating, Cooling and Condensing Apparatus."



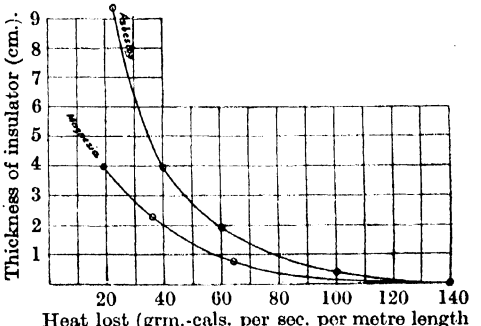
Heat lost (grm.-cals. per sec. per metre length of pipe).
Diameter of pipe = 5 cm. Steam temp., 100° C.

Figure 3 (Tables 1 and 2).



Heat lost (grm.-cals. per sec. per metre length of pipe).
Diameter of pipe = 5 cm. Steam temp., 180° C.

Figure 4 (Tables 3 and 4).



Heat lost (grm.-cals. per sec. per metre length of pipe).
Diameter of pipe = 20 cm. Steam temp., 100° C.

Figure 5 (Tables 5 and 6).

Figure I. shows the existence of the maximum heat loss referred to above, *i.e.* the initial increase of the heat losses with lagging, in a very marked manner. It will be noticed that in this case it takes a thickness of 3 cm. of asbestos to bring down the heat lost to the value it would have with the naked pipe. In Figure II. the maximum is still visible, but it is evident that the diameter of the pipe is just at the limiting value. Nevertheless, a thickness of 6 cm. of asbestos is necessary to save just 40% of the heat lost from the naked pipe.

Since k and K vary with the temperature, the limiting value of the radius also varies with the temperature of the steam inside the pipe. The

variation is such that as the steam temperature increases, the critical radius diminishes. Nevertheless, with steam up to 160° C. the general conclusion can be drawn that a ¾-in. pipe will lose more heat when lagged with asbestos than when naked unless the thickness of the insulator is disproportionately great. Even then the efficiency of heat saving is small.

With substances of very low conductivity—magnesia, kieselguhr, etc.—since with the same class of surface the value of the emissivity does not vary much, the value of the critical radius will be proportionately lower, and is, in fact, below that of pipes employed in engineering. In general, therefore, asbestos and other inferior insulators should not be employed for lagging pipes of diameter of about 1 in. and under. Such pipes should either be left unlagged or, better still, lagged with a very good insulator, such as magnesia. When we consider 2-in. (r=2·5 cm.) and 8-in. (r=10 cm.) pipes, although they are well above the limiting radius, the great advantage of using a good insulator, over an inferior material, is readily seen from Figures III. to V. and Tables I. to VI.

In the following tables H is the heat lost per second (in grm.-calories) from one metre length of pipe, θ_1 is the temperature of the surface of the insulator, and r_1-r is its thickness in cm. Temperature of surroundings is taken as 20° C.

Diameter of pipe=5 cm. (=2 in.). Steam temp.=100° C.

I. (Asbestos).				% Heat	II. (Magnesia).				% Heat
r_1.	r_1-r.	θ_1.	H.	saved.	r_1.	r_1-r.	θ_1.	H.	saved
2·5	0	100°	35	0	2·5	0	100°	35	0
2·9	0·4	80°	27·3	23	3·2	0·7	60°	18	49
3.75	1·25	60°	22·4	37	4·5	2·0	40°	11·8	66
6·0	3·5	40°	15·8	55					
9·6	7·1	30°	11·5	68					

Diameter of pipe=5 cm. (=2 in.) Steam temp.=180° C.

III. (Asbestos).				% Heat	IV. (Magnesia).				% Heat
r_1.	r_1-r.	θ_1.	H.	saved.	r_1.	r_1-r.	θ_1.	H.	saved.
2·5	0	180°	88	0	2·5	0	180°	88	0
3·5	1·0	100°	50	43	3·05	0·55	100°	43	51
4·75	2·25	60°	29	67	3·75	1·25	60°	21	75
9·0	6·5	40°	23	74	6·5	4·0	40°	17	81

Diameter of pipe=20 cm. (=8 in.) Steam temp.=100° C.

V. (Asbestos).				% Heat	VI. (Magnesia).				% Heat
r_1.	r_1-r.	θ_1.	H.	saved.	r_1.	r_1-r.	θ_1.	H.	saved.
10·0	0	100°	141	0	10·0	0	100°	141	0
10·5	0·5	80°	99	30	10·75	0·75	60°	64	55
11·4	1·4	60°	68	52	12·4	2·4	40°	32	78
14·3	4·3	40°	38	73	15·0	5·0	30°	19	86
19·4	9·4	30°	23	83					

It will be seen from the above tables that the higher the steam temperature the greater is the percentage of heat saved with a given thickness of insulator, although, of course, the actual heat loss is greater. Further, a given thickness of insulator conserves a greater proportion of the heat the greater the diameter of the pipe, and finally the major proportion of the heat saved is saved by a comparatively small thickness of the insulator—with the exception, of course, of pipes whose radius is below the critical value. Thus, from Table III., while 2·25 cm. of asbestos saves 67%, a further 4·25 cm. only increases this to 74%. From Table VI. it will be seen that a thickness of 2 in. of magnesia round an 8-in. pipe saves as much as 86% of the heat. Any number of similar tables can be constructed from the data given in this paper, and the amount of heat saved can be easily read from them, for a pipe of any radius, carrying steam at various temperatures and lagged with through a hickness of different insulators.

of the tube rmining the emissivity, any of the usual in which ca ay be employed. As a general rule with heat unless es of this nature, it is in the neighbour-disproportio 03 c.g.s. uni . It is to a slight extent on the shape and diameter. To any uncertainties due to these causes, determinations were carried out using a portion of a 2-in. steam pipe which was thinly coated with the material to be investigated. The latter was applied in the form of paste with water and then dried, when an extremely thin coating was left on the tube. The tube was closed at the bottom, filled with water, oil, or other suitable liquid, and the rate of cooling determined, the liquid being stirred by means of a stirrer passing through a cork at the top. The emissivity, K, is given from the relation:

$$2\pi rlK(\theta-\theta_0)dt = -(ms+m_1s_1)d\theta$$

Whence:

$$\log\frac{\theta-\theta_0}{\theta_1-\theta_0} = \frac{2\pi rlKt}{ms+m_1s_1}$$

θ being the initial temperature of the liquid, θ_1 the final temperature at time t, θ_0 the temperature of the surroundings, m and m_1 the weight of liquid and metal respectively, and s and s_1 their respective specific heats.

For asbestos the value found was 0·000290 c.g.s. unit. Porter (*loc. cit.*) found the value of 0·000275 for asbestos paper by determining the rate of cooling of a thinly coated bar, the temperatures being read by the thermoelectric potentiometer method.

Summary and Conclusions.

1. The thermal conductivities of the more commonly employed insulators have been determined under conditions as similar as possible to those under which they are used for lagging steam pipes and furnaces.

2. The results so obtained have been utilised to determine the heat losses. Tables and curves are given showing the effect of the thickness of the insulator on the heat lost in the case of magnesia and asbestos, with a steam temperature of 100° and 180° C., for 2-in. and 8-in. pipes.

3. Steam pipes of ¾ to 1 in. diameter should not in general be lagged with insulators whose conductivity exceeds $0{\cdot}3\times10^{-3}$ c.g.s. unit. With an inferior insulator, such pipes will lose more heat when lagged unless the thickness of the lagging is disproportionately great. In order to effect any appreciable heat saving with such pipes a substance of the magnesia or kieselguhr class (k=0·00018) should be used as insulator.

4. With pipes of moderate dimensions from 85 to 90% of the heat can be saved with 1½—2 in. of magnesia, whereas 3—4 in. of asbestos is necessary to effect the same saving.

In conclusion the author desires to express his indebtedness to Messrs. Lever Bros., Ltd., for permission to publish these results.

Research Laboratories, Port Sunlight.

A NEW POTASH SUPPLY.

BY E. G. BRYANT, B.A., B.SC.

It has long been known that saltpetre (potassium nitrate) occurs in the mountains of various parts of South Africa. Some of the deposits are only large enough to provide the neighbouring farmers with saltpetre for bacon curing and so forth, whilst others have been at times reckoned of economical importance. The source of the saltpetre has been ascribed both popularly and officially to the "dassies" or rockrabbits—the conies of the Bible—which abound in the rocky districts of Southern Africa, and deposit their excrement in particular spots. This substance is not only very rich in nitrogen, but in a dry atmosphere gradually changes into a some-

* This Journ

† "Evapor

what sticky black mass like pitch, and having very little odour; "klip-suit," as it is called, is supposed to have medicinal properties, and is a recognised drug in all parts of South Africa. If the rocks on which the excrement is deposited contain a base, such as lime or potash, it is quite conceivable that nitrification sets in and nitrates are formed. The "dassie" theory of the formation of saltpetre is not only possible, but in many cases very probable. The largest and best known nitre bed is that at Prieska on the Orange River, in the north-west of Cape Colony; another deposit in the Transvaal was large enough to supply the old Boer Republican Government with saltpetre for making gunpowder. About 1895 a small company was formed to work the Prieska beds. Dr. Marloth, who investigated the deposits on behalf of the Cape Government, considered they were only superficial incrustations and gave the dassies credit for the whole. At the same time he suggested that further prospecting should be carried out in the mountains as well as in their neighbourhood. About four years ago the attention of the British Government was drawn to this possible source of potash and of nitrate; the official sent to investigate appears to have been considerably impressed with what he saw, but his report led to no tangible result.

Last year Johannesburg people amalgamated various small interests, enlarged their scope, and formed the S.A. Nitrate and Potash Corporation, which is now in active operation, its capital being large enough to construct any works that may be necessary. The Corporation also possesses extensive deposits of pyrites, and aspires to make Prieska the centre of a great chemical and fertiliser industry. Mr. V. Grindley Ferris, Consulting Engineer to the Consolidated Goldfields of S.A., examined a portion of the district, roughly 33 miles long by 6 wide, and reported saltpetre in amounts from 3 to 30% on every farm visited. One sample taken, from the face of a tunnel 35 feet in from the mouth, gave 7·7% of potassium nitrate over 5 feet of face. Mr. W. T. Hallimond reported that the available tonnage on the farms examined was far in excess of that required to warrant the outlay on any works which might be required for the treatment of nitrates to meet the demand in South Africa, and for an unlimited export trade as well.

The nitrate deposits occur in the Griquatown beds of the Transvaal geological system; they extend from just south of the Orange River northwards to the Kalahari Desert, and then eastwards into the Transvaal from Zeerust to Pietersburg (in the Transvaal they are usually termed the Pretoria beds). Their full extent to the west and north is unknown, as they are covered by immense deposits of sand and of volcanic matter; their thickness is from 2000 to 3000 feet. No undoubted fossils have ever been found in them, though certain markings resembling the doubtful fossil algæ of the Cambrian period are known; their geological horizon is thus undecided, but is certainly palæozoic, possibly pre-Cambrian. The Griquatown beds are divided by Dr. Rogers and other South African geologists into three groups: the Upper or Ongeluk volcanic, consisting of basic lavas; the Middle, mainly of banded ironstone shales; and the Lower, of shales, limestones, and conglomerates. The middle portion is the most important, both on account of its greater thickness and from the fact that it contains numerous layers of blue and yellow amphibole, commercially known as crocidolite and blue asbestos; it is also in this portion of the series that the nitrate deposits occur. The shales are of several varieties, either fairly thick, banded and unchangeable (jasper), or thinner and cemented together into a compact blue-black mass by magnetite, or again brown and brittle, lying loosely packed on one another like a heap of tiles. The strata are wonderfully regular and the dip in most places is slight.

Where the shales have become hardened and silicified, or where asbestos and magnetite are present, there is little or no evidence of saltpetre, but in the softer and more powdery layers deposits of powdery crystals lying between the layers or crystalline masses are found on the shales themselves. Occasionally large masses, more or less pure, and up to 5—10 lb. in weight, are found filling cracks and fissures, or lying at the base of the strata. The thinner and more decomposed the shales are, the richer usually in nitrate they are. That the potash is a primary constituent of the rock appears certain, and experiment has proved that, in some cases at any rate, there is a residue of potash. The process of nitrification is obviously a secondary one.

A large number of assays and analyses show soluble contents usually varying from 3 to 10%. The main constituent is always potassium nitrate, with smaller (often insignificant) quantities of calcium and magnesium nitrates, also a little chloride and sulphate; the very small amount of sodium salts usually present is remarkable. Typical analyses gave:—

	1. %	2. %	3. %	4. %	5. %
Potassium nitrate ...	24·3	14·67	5·95	1·2	25·88
Calcium nitrate ...	0·30	—	—	—	—
Potassium sulphate...	—	10·77	—	—	—
Sodium nitrate ...	—	22·47	—	1·4	1·10
Sodium chloride ...	—	0·90	1·10	—	0·20
Magnesium nitrate ...	—	—	2·34	—	—

When it is remembered that these shale beds cover an area of some hundreds of square miles, that the thickness of the nitrate layers is not less than 10 feet and often extends to two or three times that amount, and that the nitrate contents are at least 3% of the weight of the shales, the magnitude of the deposit becomes apparent. The shales lie in most places nearly horizontal, and could easily be reached from the surface, but the Orange River and its tributaries have carved out hundreds of miles of valleys with nearly perpendicular cliffs on both sides, on the faces of which the saltpetre shales are exposed many feet in thickness, so that the material can be quarried out in the open. Owing to the heavy overburden in some localities, adits and tunnels will have to be driven in and the roof supported. Even should the nitrate layer prove to be merely a few feet in thickness (this has been the expert view in the past, and is still so, to some extent), the deposits would still be of great economic importance. Now that it is definitely ascertained that saltpetre can be obtained from 400 ft. in, the Prieska potash supply may prove to be the largest in the world.

The method of extracting the saltpetre, which has been practised locally for many years on a small scale, is to dig around the bases of the krantzes or cliffs, and in any hollows formed by the wearing away of the softer shales, and thus obtain lumps of crude nitrate, from 50 to as much as 90% pure. These lumps of native saltpetre are sometimes pure white and composed of masses of fibrous crystals; they may weigh several pounds. The material is boiled in water in an iron pot and stirred for four or five hours. The earthy matter is removed with a spade and a strong solution is obtained which will crystallise on very slight cooling. The dark brown liquid is poured into flat trays and allowed to stand overnight. In the morning the crystals are drained, slightly washed, and dried; they are often of remarkable purity. The mother liquor is diluted with water and used again with fresh supplies of material. As the liquid becomes more saturated with impurities the saltpetre crystals

gathered become smaller and brownish coloured. The mother liquor, when very dark and thick, contains some 20% of potassium nitrate, and about the same amount of calcium nitrate, together with sodium chloride, calcium sulphate, and sometimes magnesium nitrate. As much as £50 per ton has been obtained for saltpetre made in the above manner.

When the saltpetre boom occurred about 1895, one or two companies erected quite elaborate plants with tanks, boilers, and so forth, but they confined their attention to the soil and débris at the foot of the cliffs, never attacking the shales themselves. Their efforts ended in failure, and some of the tanks and pumps are still to be seen on various farms in the district.

It is estimated that a small profit can be made from shales containing as little as 3% of nitrates, even should the price of saltpetre fall as low as £20—£25 per ton. The treatment proposed consists mainly in leaching the material broken up to a suitable size with hot water and evaporating the solution to crystallising point by solar heat, or by artificial means, or by both combined.

NOTE ON THE DEHYDRATION OF FORMIC ACID SOLUTIONS.

BY D. C. JONES, M.SC.

Phosphoric anhydride is in general use as a dehydrating agent for the lower fatty acids with the exception of formic acid. It is known to attack acetic and propionic acids to a slight degree with the production of anhydride, but in the case of formic acid this decomposition has been believed to be so great as to preclude the use of phosphoric anhydride altogether (Ewins, J. Chem. Soc., 1914, **105**, 350; Garner, Saxton, and Parker, Amer. Chem. J., 1911, **46**, 236). Schmidt (Z. physikal. Chem., 1891, **7**, 446), however, dehydrated formic acid with phosphoric anhydride and finally distilled from it at ordinary pressure, producing a highly concentrated acid; but he gives no details as to the extent of decomposition produced.

In the investigation described in this paper it has been found that phosphoric anhydride may be used very successfully to produce a high yield of very concentrated formic acid.

The method adopted was the gradual addition to the acid solution of the quantity of anhydride required to form orthophosphoric acid with the free water present, the mixture being continually shaken in a cooling mixture of ice and water. The formic acid was then distilled off under a pressure of 15—18·4 mm. of mercury, great care being used to condense efficiently owing to the low boiling point of the acid under these pressures (*vide infra*, vapour pressure curves). When the proportion of phosphoric anhydride recommended above was used slight decomposition occurred. Greater decomposition followed the use of greater proportions of the reagent, while if considerably less than this proportion was used no decomposition was evident, and the whole of the formic acid was recovered. A few examples from the experimental results obtained are given:—

No. of expt.	Strength of formic acid.	Theor. P_4O_{10} for ortho-acid.	Weight of P_4O_{10} used.	Strength of acid obtained.	Yield.	Press. of distillation.
	%	grms.	grms.	%	%	mm.
A.	82·7	9·1	5	92	100	18·4
B.	86·7	7·1	7·1	99	84*	16·5
C.	95·5	5·1	6·0	99·5	84*	16·5
D.	98·3	2·0	2·0	99·5	90·5	17·4

* Comparatively low yield due to inefficient condensation of formic acid under so low a pressure.

The value of fractional distillation under ordinary and diminished pressure for the concentration of aqueous formic acid solutions will now be considered.

The concentration of dilute solutions of this acid by distillation under ordinary pressures is limited by the formation of a mixture of constant boiling point (Roscoe, Trans. Chem. Soc., 1862, 270) containing 77% of acid by weight and boiling at 107·1° C. The boiling points under ordinary atmospheric pressure of pure formic acid and of the mixture of constant boiling point are so close together that the separation of anhydrous acid from a solution more concentrated than 77% is extremely tedious with an ordinary laboratory still-head. The hygroscopic nature of highly concentrated formic acid increases the difficulty.

One or two results obtained from distillation through an 8-bulb pear still-head, taking ordinary simple precautions against access of moisture, are given below:—

No. of expt.	Orig. m.pt. of formic acid.	Quantity & m.pt of 1st fract.	Quantity & m.pt.of 2nd fract.	Quantity & m.pt. of 3rd fract.	Residue.	Loss.
E.	7·3°	37·3% 8·1°	32% 7·0°	21·4% 7·6°	8%	1·3%
F.	7·97°	38·6% 8·25°	38·6% 8·2°	17·2% 7·8°	4·3%	1·3%
G.	−8·8°	10·0% 3·2°	48·9% 1·7°	31·5% Below −8°	—	—

An examination of the vapour pressure curves of formic acid and water showed, however, that the vapour pressure of the acid, like those of the other fatty acids, does not decrease as fast with decrease of temperature as does that of water. Thus, at a pressure of 30 mm. of mercury the difference in boiling point between pure water and pure formic acid reaches 11° C., whereas at 760 mm. the boiling points only differ by a few tenths of a degree. The most recent value gives the boiling point of pure formic acid as 100·4° C. at 760 mm. (Ewins, *loc. cit.*) It is evident, therefore, that whether a mixture of constant boiling point is formed at these low pressures or not, fractional distillation under diminished pressure should give much better results than under ordinary pressures.

The kind of result obtained may be seen from an experiment in which a specimen of the same formic acid as used in expt. G (above) was distilled under a pressure of 43 mm. of mercury. The two results are compared:—

No. of expt.	Original m.pt. of formic acid.	External pressure.	Quantity of 1st fraction.	M.pt. of 1st fraction.	Quantity of 2nd fraction.	M.pt. of 2nd fraction.
G.	−8·8° = 88·5%	760 mm.	10%	3·2° = 97·2%	48·96%	1·7° = 96·4%
H.	−8·8° = 88·5%	43 mm.	31·8%	7·3° = 99·5%	40·9%	−3·2° = 92%

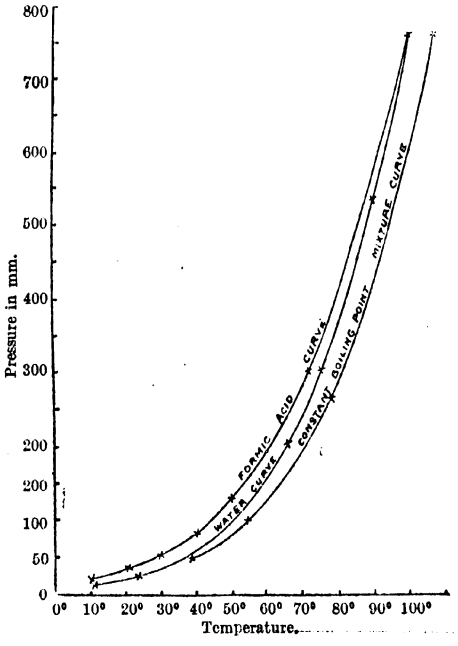
It is seen that expt. H gives 31·8% of the total acid as a 99·5% solution, while in expt. G even the first 10% fraction gives only a 97·2% solution.

An examination of the behaviour of aqueous formic acid solutions under various low pressures soon demonstrated the existence of mixtures of constant boiling point; the following experimental results were obtained:—

Press. in mm.	43	97	262	740*	1830*
B. pt. of mixtures of constant b. pt.	38° C.	54° C.	77° C.	107·1°C.	135° C.
Composition of mixtures of constant b.pt.	60·9%	69·1%	72·9%	77%	83%

* These two results are taken from Roscoe's paper (*loc. cit.*).

The above experimental results do not pretend to any great accuracy, the experiments being in the nature of rough preliminary trials, but they show that as the pressure is decreased the composition of the mixture of constant boiling point rapidly changes in the direction of a greater percentage of water. The relations between boiling point and pressure in the cases of pure water, pure formic acid and the mixture of constant boiling point are shown on the diagram, Schmidt's (*loc. cit.*) results being used for the formic acid curve.



The results shown in the curves afford an explanation of the efficiency of distillation under diminished pressure in producing concentrated solutions of formic acid from solutions containing a greater percentage of acid than the mixture of constant boiling point at that pressure. It is also apparent from the graph that at low pressures it becomes far more difficult to separate the mixture of constant boiling point from the excess water of dilute solutions. Thus, to concentrate a very dilute formic acid solution, distillation under ordinary pressure with an efficient still-head would give a residue of practically 77% acid. The formation of this mixture of constant boiling point prevents any further concentration by distillation at ordinary pressures; but if the pressure be now sufficiently reduced, a further separation into very concentrated formic acid and the more dilute mixture of constant boiling point corresponding to the lower pressure takes place.

Conclusions.—Practically anhydrous formic acid can be obtained very conveniently, and in high yield, from aqueous solution by (1) the use of phosphoric anhydride under conditions described above, (2) fractional distillation under variable external pressure. For all formic acid solutions above 77% strength the phosphoric anhydride method would yield quickest and best results. For more dilute solutions distillation under ordinary pressure through an efficient still-head, followed by the phosphoric anhydride method, would be the best procedure.

I wish to acknowledge the helpful criticism and encouragement given me during the progress of this research by Prof. K. J. P. Orton.

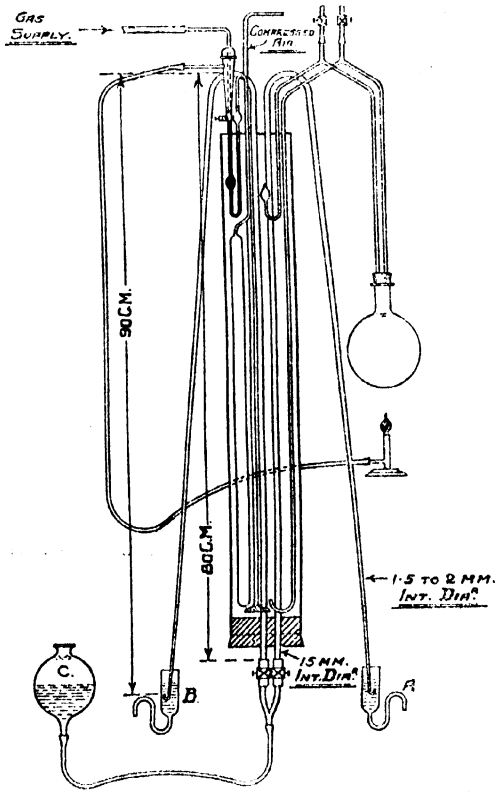
University College, N. Wales, Bangor.

IMPROVED APPARATUS FOR THE ESTIMATION OF VAPOUR PRESSURES.

BY ALLAN MORTON, M.SC.

Considerable difficulty having arisen in the use of stopcocks with organic liquids which dissolve the lubricants generally employed, a vapour pressure apparatus without taps was devised (see figure).

Two capillary tubes were fused to the top of the barometer tubes and bent downwards, the ends



dipping into two mercury reservoirs, A and B. The mercury in the whole apparatus was dried by treatment with concentrated sulphuric acid, and the excess of acid displaced from the barometer tubes by raising the reservoir, C, and forcing the acid over into A and B. The acid was removed from the surface of the mercury in A and B

by pipetting off and finally eliminating the last traces by means of filter-paper. This treatment with sulphuric acid was continued until, on breaking the mercury columns at the head of the tubes by lowering the reservoir, C, the following conditions for a true vacuum were found to be satisfied:—(1.) the mercury stood at the same level in the two tubes; (2.) the distance between the common level and the level of the mercury in the reservoir was equal to the barometric height at the time of the experiment. The liquid to be tested was introduced into A, the screw clip on the left hand tube closed, the vessel, A, depressed till the end of the capillary was immersed only in the liquid under test and the reservoir, C, raised until the mercury was running down the capillary. Then C was quickly lowered until the mercury column broke, when the test liquid in A was sucked up the capillary into the barometer tube. A sufficient quantity having entered the barometer tube, A was raised so as to immerse the capillary tube in mercury. The reservoir, C, was depressed well below the level of A and the sample in the barometer tube allowed to remain under vacuum for some time at the temperature of the experiment. Uniform temperature conditions were ensured by surrounding the tubes with a water-jacket fitted with a constant temperature regulating apparatus and stirred by means of compressed air. Bubbles of air were given off from the sample under treatment, and on raising C these were forced back into A and escaped through the mercury seal. The reservoir, C, was again lowered, the left-hand clip opened, and the difference in levels in the two tubes measured by means of a cathetometer. The reservoir, C, was still further lowered and the difference in the levels measured at a point considerably lower in the tubes.

If these two differences were not the same the vapour and air in the sample were again forced into A and this repeated until concordant results were obtained at different levels in the barometer tubes.

I have to thank Messrs. Nobel's Explosives Co., Ltd., for permission to publish the description of this apparatus, which was made and used in their research laboratories at Ardeer.

THE ESSENTIAL OIL DISTILLED FROM JUNIPERUS PROCERA GROWN AT NAIROBI, BRITISH EAST AFRICA.

BY A. F. MACCULLOCH, M.A., B.SC., A.I.C.

Wood of *Juniperus procera*, in the form of fine shavings, was subjected to steam distillation; 2% of oil was obtained, having the odour of cedar wood and the following characters: sp. gr. 0·987 at 15·5° C.; α_D^{20} (1 dcm. tube) = −16°; $n_D^{26} = 1{\cdot}480$. The oil is miscible in all proportions with alcohol of 90% or over, and soluble in 70% alcohol in the proportion of 1 in 60 (compare Schimmel's Report, 1911, p. 105).

The amount of cedrol or "cedar camphor" present in the oil was found to depend on the interval between the time when the wood was disintegrated and the time when it was distilled. If the disintegrated wood had been exposed for some weeks to a hot sun the oil obtained on distillation cooled to a mass of cedrol crystals. If the disintegrated wood were not exposed to the sun and were distilled a few days after being disintegrated, the oil was found to contain 38% of cedrol. It is the result of an examination of such an oil which is given above.

The cedrol isolated was in the form of long, white needle-shaped crystals, m. pt. 75·5° C.

Newcastle Section.

Meeting held at Bolbec Hall on December 18th, 1918.

PROF. P. PHILLIPS BEDSON IN THE CHAIR.

NOTES ON THE WET EXTRACTION OF COPPER

BY D. W. JONES.

In the wet extraction process for the recovery of copper from cupreous pyrites, the cinders are mixed with from 10 to 15% of salt, ground and calcined; the calcined ore is leached, silver and gold precipitated from the liquor as iodides, and copper recovered in the metallic form by precipitation with scrap iron.

Grinding.—The "grist" of the ground ore and salt must be carefully controlled; fine grinding will ensure better extraction, but there are limits to the degree of fineness permissible, as serious trouble, due to slow and partial percolation, accompanied by bad drainage, will be encountered in the subsequent leaching if a certain proportion of "grit" is not present.

A washed ore having the following percentages of "grist" will be found advantageous:

	%	Copper content %.
Left on ¼ in. sieve* ..	11	0·14
,, 1/16 in. ,, ..	14	0·10
,, 1/30 in. ,, ..	8	0·09
,, 1/60 in. ,, ..	7	0·05
Passed 1/60 in. ,, ..	60	0·03 Average 0·058 %

* This grade should just fail to pass ¼ in sieve.

Roll mills of the Cornish type and ball mills equipped with sieves of various sizes are used to secure the most desirable "grist."

Rock salt has been found more economical than fine salt, due to a smaller loss by volatilisation and to the fact that when the larger particles become heated, decrepitation occurs, bringing about better distribution throughout the charge.

As received from the acid manufacturer, pyrites cinders may contain, besides copper, small amounts of silver, gold, selenium, cobalt, nickel, antimony, and bismuth, and a larger amount of arsenic, whilst the percentages of lead and zinc may exceed that of the copper present.

The amount of unburnt sulphur present varies considerably, differences amounting to several per cent. being found. Uniformity of working is best secured by working to the average sulphur content of the whole batch.

Calcining in hand furnaces.—By calcination in hand-worked, coal-fired muffle furnaces having provision for the passage and condensation of gases evolved separately from those of combustion, there is obtained as the main product an ore containing soluble compounds of metals present, iron excepted. The by-products are (a) flue dust, which may contain copper and gold in profitable quantities; (b) condensed gases from which copper, gold, and silver are recovered.

According to Schnabel and Louis' "Handbook of Metallurgy," the sulphur must not exceed 1½ times the equivalent of the copper present, otherwise too much salt would be consumed and the calcination take too long.

If too high a temperature is employed insoluble cupric oxide is formed; iron is lost by conversion into soluble ferric chloride; and, according to Plattner, gold chloride is formed below red heat, and at a red heat it is converted into metallic gold.

That the sulphur content is the determining factor in gold extraction is illustrated by the following data.

Two ores were calcined in a muffle furnace for 9 hours, the weight of the charge being 4 tons in each case. The composition of the ores was as follows:—

	No. 1.	No. 2.
Total sulphur ..	2·85% ..	5·93%
Total copper ..	3·18% ..	1·27%
Iron as Fe_2O_3 ..	86·85% ..	85·67%
Gold, per ton ..	20 grs. ..	1 dwt. 4 grs.
Silver, per ton ..	1oz. 1dwt. 0gr.	1oz. 8dwt. 14grs

An examination of evolved gases throughout the "period" showed that in the case of No. 1 evolution of chlorine occurred uninterruptedly for 7 hours, in the case of No. 2 for but 1½ hours. On drawing No. 2 sulphurous acid was in evidence, but after spreading over a fairly large area chlorine was again noticeable after the lapse of one hour.

The introduction of mechanical furnaces made profitable the working of low-grade ore previously leached without calcination. These furnaces are of the multiple-hearth, producer-fired continuous type, and among them may be mentioned the MacDougall, Wedge, and Ramen-Beskow furnaces. These latter are chiefly in favour for calcination of cupreous cinders in this country, 31 being in use at the present time.

Labour saving and decreased coal and salt consumption are the distinguishing features of mechanical furnaces. The consumption of fuel in a muffle furnace, using a low-grade fuel, is 25% on the ore treated. With a Ramen-Beskow furnace, using a good-class fuel at probably twice the price, the consumption per ton of ore calcined should not exceed 4%. It is not claimed for this furnace that a high gold recovery is possible, but the extraction of silver and copper is satisfactory.

The Ramen-Beskow is a five-hearth furnace, the hearths being circular. Ore enters the first hearth at the centre and is brought towards the circumference by rabbles fixed in arms depending from a shaft extending from the top of the furnace. The heating is effected by gas firing, and is only applied on the top hearth. The discharge of ore from hearth No. 1 is at the circumference, from No. 2 at the centre, and so alternately until the final discharge. By inserting a plough in an arm, the accumulations on the hearth may be removed without seriously interfering with the output; certain ores have a tendency to flux, causing these accretions.

The power for driving a furnace is supplied by a 4 h.p. motor. Combustion gases are withdrawn by a flue leading from No. 1 hearth, and gases evolved during calcination by three flues leading from No. 2 hearth. Air for combustion is admitted through ports in each hearth.

The temperature of ore leaving the first hearth should be 500° C., vacuum in flue 0·015 in. of water. In hearth No. 2 the vacuum in flue should be 0·09 in. of water. Under these conditions no unburnt sulphur will be found beyond hearth No. 3, and ore will be discharged free from noxious vapours and dust. The ideal ore is that which is fresh from the burner and contains about 4·5% sulphur. If the sulphur content is too low, it will be necessary to add unburnt pyrites to supply sulphur for initial ignition; if too high decreased output will result.

In normal working the time occupied by the charge in passing through this type of furnace is 4 hours, during which time it is in slow but constant motion.

Leaching.—Leaching is conducted in wooden tanks (lined with firebrick, using an acid-proof jointing), total capacity 15 tons per tank, output of washed ore 11 tons. At the bottom of the tank are filters composed of graded pebbles supported on perforated tiles, or, if gold recovery is a consideration, coarse heather is substituted for pebbles.

The liquor obtained contains metals soluble in water and dilute acid (condensed from previous operation). The by-products consist of (c) iron ore, containing up to 65·5% Fe; (d) the deposit from below filter, which may contain up to 40% lead and 4 oz. gold per ton; and (e) the bottom layer of ore attached to heather, which may contain 10% lead and 2 oz. gold per ton. The gold values in the case of the last two apply to ores of class No. 1 only. The following results may be expected from leaching ores 1 and 2:—

Liquor.	No. 1.	No. 2.
Silver, grs. per gallon	1·95	2·72
Gold, % on silver	1·937	0·084
Average sp. gr. of strong liquor	1·26	1·205
Average temperature of strong liquor	46° C	73° C
Permanganate required to oxidise 1 litre	0·40 grms.	6·96 grms.

Washed ore.	No. 1.	No. 2.
Insoluble copper	0·08%	0·10%
Total sulphur	0·29%	0·53%
Gold, per ton	9·5 grs.	21 grs.
Silver, per ton	4dwt. 0 grs.	7dwt. 11grs.
Extraction of gold	52·5%	25·0%
,, silver	80·95%	73·43%
,, copper	97·46%	92·13%

These extraction figures are calculated on quantities contained in the ore as received, after calcination and leaching; the actual recovery of gold is referred to later.

The operation of leaching is conducted on the cyclic system, six tanks, or preferably twelve in pairs, forming the complete number. In such a system one-third of the total number as dry tanks should be kept either empty, washed ready for emptying, or filled and ready for wetting, otherwise difficulty arises in disposing of liquor of varying strength and acidity, and maintaining a high concentration in the final product. A liquor of 50° Tw. (sp. gr. 1·25) is considered a satisfactory concentration. To arrive at this figure weak solutions from washing operations are used for the initial flooding of dry ore.

It is not advisable to use liquor stronger than 23° Tw. (sp. gr. 1·115) for the first wetting of ore. If denser liquor is employed, crystallisation is set up in the mass, resulting in imperfect percolation.

Condenser acid is employed to assist solution of insoluble cupric oxide, and is always passed through three tanks or pairs in order to neutralise the liquor before the next process. Its use introduces impurities (volatilisation products) and causes a marked increase of these in the copper, besides entailing increased scrap iron consumption. With good calcination a large plant has been worked successfully for one month, during which time no acid was applied.

Another essential is an abundant supply of water at a temperature not below 87° C. For obvious reasons tidal waters possess advantages over fresh water.

In some systems each tank is equipped with a pump to transfer liquor in any direction; in others liquor is run off at the bottom of the tanks. The method is claimed to produce a washed ore uniform, but as the moisture content by this system is always about 20%, and the simple run-off system will achieve this, there is no advantage in such an installation.

The plant necessary for leaching a given quantity of ore calcined in a hand-worked muffle furnace may be gathered from the fact that 46 hours is about the total time occupied from filling to refilling when dealing with the above-mentioned quantity per tank. Under similar conditions it will be necessary to provide plant on a basis of 70 hours for leaching ore calcined in mechanical furnaces.

Claudet's silver extraction process.—Silver extraction by Claudet's process effects a recovery of 96% of the silver, with a loss of 15—33% of iodine. It furnishes a silver mud containing 20—50% Ag, up to 0·16% Au (51 oz. per ton), up to 55% Pb, and 2% Zn. A poor silver mud contains 0·8—1·8% Ag and Au up to 5 oz. per ton. The by-product (f) is the deposit obtained on cooling and settling the liquor, which may carry up to 47% Pb, 10 oz. Au, and 40 oz. Ag per ton.

It is necessary in practice to provide storage room which will allow cooling to 37° C. By this means most of the lead sulphate present can be separated by settling. This separation would otherwise take place after the addition of iodide, with formation in part of lead iodide, and would result in a silver mud of much lower silver value.

Standard iodine solution (0·18% iodine) is added to the liquor, which is stirred, allowed to settle in lead-lined tanks for 48 hours, and then run off to within 6 in. of the tank floor, and the tank refilled until a sufficient quantity of silver iodide is obtained to warrant collection. The silver iodide is washed free from copper (when hot salt water is used for washing, 2000 gallons of liquor at 2·5 grs. Ag per gallon can be de-silverised by the washings) and decomposed by scrap zinc, very light galvanised scrap iron, or sodium sulphide, with regeneration of zinc iodide and sodium iodide respectively. Silver mud should not contain more than 0·05% or iodine. Economy in this process is effected by the careful use of iodide. An excess of iodide is necessary for even the incomplete precipitation of silver. For No. 1 ore (as above) the excess of iodide required would be 7·5% on the calculated figure, and for No. 2, 25—35%.

In each case desilverised liquor should not contain more than 0·08 grain Ag per gallon.

Before precipitation of the copper, a considerable recovery of silver iodide is possible by filtration. Sand or sawdust to a depth of 20 in. laid on top of graded pebbles will effect this.

The distribution of gold during copper extraction is as follows:—

	No. 1 ore %	No. 2 ore %
In flue dust	2·5	0·6
In condenser acid	18·0	3·1
In condenser coke	1·5	0·2
In deposits obtained on leaching	19·5	18·6
In silver residues	9·5	0·7
Unaccounted for	1·5	2·4
Left in iron ore	47·5	75·0

Regarded in the light that to be profitable by-products should contain 1 oz. of gold per ton with small silver value, the actual recovery is from 51·0% down to as little as 4·0%.

Thus in the treatment of auriferous ores of high sulphur content, quantities of residues are produced which contain, say, ½ oz. of gold per ton, and iron ore in large quantities containing 21 grs. of gold per ton, from which no recovery is practised.

Copper precipitation.—The product of this process is metallic copper as sludge, and the by-product

(g) a liquor which will contain iron, and may contain zinc, nickel, cobalt, sodium chloride and sulphate.

Precipitation of copper by means of scrap iron is generally carried out in circular tanks. More rapid and better precipitation is obtained by heating and agitation by injected steam and air; circular tanks facilitate these processes.

It is usual to fill a tank about twelve times before collecting the copper. Scrap is renewed daily. The time occupied in precipitation is 4½ hours for fillings 1 to 3, increasing till the twelfth filling requires 7 hours. The yield of copper per filling is 3—5 cwt. The waste liquor carries 1 gr. of copper per gall. Scrap iron is separated from sludge by wet sifting. The copper will contain deleterious impurities derived from raw material, of which arsenic is usually greatly in preponderance. Impurity may also be introduced in the scrap.

By-products.—(a) Flue dust obtained in calcining is washed until 0·4 % of copper remains, if profitable (as in the case of that derived from No. 1 class ore), and sold or smelted with other by-products containing gold, silver, and lead to produce bullion.

(b) Condenser acid, which may contain 15 grs. Cu per gall., is first treated to recover gold and silver; if 3 % of copper present in acid be precipitated as sulphide this will carry down practically all the gold; after settling and filtering, copper is precipitated by iron. If coke is used as condenser packing, recovery of gold is possible from this source.

(c) Iron ore is either sold direct to the steel smelter or briquetted and burnt in kilns. In this form it is an acceptable product, containing only negligible quantities of phosphorus, arsenic and sulphur, and has an iron content of about 64 %.

(d) (e) (f) Deposits collected during leaching are only considered profitable when they contain over 1 oz. of gold per ton, and lead sufficient to make smelting simple. Their silver value is usually very low.

(g) Waste liquors, after silver and copper precipitation, when allowed to run to rivers, represent an enormous waste of metals and sodium salts.

In some liquors zinc is present in excess of copper (that is, before precipitation of copper), cobalt to the extent of 15 grs. per gall, nickel 4 grains per gall., iron ½ lb. per gall.; as at least 150 galls. and frequently 200 galls. of liquor is produced per ton of ore, the question of recovery will well repay attention.

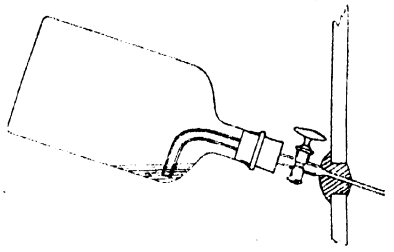
Communications.

A METHOD FOR THE ANALYSIS OF NITROUS GASES AND ITS APPLICATION TO THE STUDY OF TOWERS FOR THE ABSORPTION OF SUCH GASES.

BY A. GEAKE AND F. J. SQUIRE.

The following method was devised for the analysis of the gases in a system of absorption towers used in connection with a plant for the denitration of nitroglycerin spent acid. The gases consisted of a mixture of nitric oxide and peroxide, carbon monoxide and dioxide, oxygen, and nitrogen. The object was not only to analyse the gases throughout the system, but also to determine the weight of each of the constituent gases passing through each tower in a given time, in order to estimate the work done by the individual towers.

Each sample of gas was drawn in a bottle of known capacity, fitted with a glass tap, as shown in Fig. 1. The size of the bottle was such that the

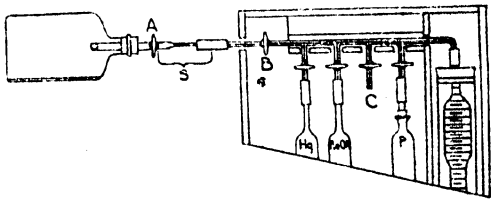


Method of drawing sample.
Fig. 1.

sample contained about 0·3 grm. of oxides of nitrogen. The tap had a bore of 2 to 3 mm. diameter. The outer portion of the tap tube was drawn off to about this same internal diameter, and was 3 inches in length; the tube inside the bottle was bent so that the end nearly touched the wall of the bottle. The bottle was charged with 25 c.c. of $N/2$ permanganate and 1 c.c. of concentrated sulphuric acid, the tap inserted, and the apparatus evacuated as completely as possible with a Geryk pump. It was tested for gas tightness. To draw the sample, the end of the tap tube was inserted in the sampling hole and the bottle so turned that the bent end of the tube dipped below the surface of the permanganate. The tap was then opened for about one second, closed, and the bottle thoroughly shaken. The rush of the gas through the permanganate threw this up as a spray, thus giving intimate contact and ensuring rapid absorption of the oxides of nitrogen. If more than a few seconds was allowed to elapse before the absorption was complete, appreciable oxidation of nitric oxide by the oxygen gas in the sample took place, and an incorrect result was thus obtained. It was essential that unchanged permanganate should remain after shaking, otherwise absorption of nitric oxide might have been incomplete.

Estimation of carbon dioxide, oxygen, and nitrogen.

The next operation was the measurement of the volume of residual gas in the sample at atmospheric pressure. This could not be calculated from the capacity of the bottle and the weights of nitric oxide and peroxide absorbed, because when



Method of measuring the volume of unabsorbed gases.
Fig. 2.

drawing the sample the tap was not opened for long enough to fill the bottle completely at atmospheric pressure, and some assumption as to the density of nitrogen peroxide would have to be made to avoid direct measurement of the volume of residual gas. For this purpose the tap tube was connected to an Orsat apparatus (see Fig. 2), the burette and levelling bulb of which were filled with mercury. The tap, B, was first opened and the air from the dead space, S, drawn into the burette.

After closing B, this air was forced out through C. A and B were then opened, and the levelling bulb adjusted so that the mercury in the burette stood at the zero mark (*i.e.*, at the bottom); A and B were then closed, the gas in the burette brought to atmospheric pressure, and its volume, v, noted. Then if V = volume of bottle, v' = volume of permanganate and sulphuric acid, and V' = volume of residual gas in bottle at atmospheric pressure, the volume of the burette being 100 c.c.,

$$V' = \frac{v}{100}(V - v' + 100) \text{ c.c.}$$

The temperature of the bottle was observed from a thermometer hung beside it.

The sample in the Orsat apparatus was used for the estimation of carbon dioxide (by sodium hydroxide) and oxygen (by phosphorus). If its volume was inconveniently small it was first forced into an absorption pipette full of mercury, a second portion drawn from the sample bottle, and the two combined. From the results of the analysis the weights of carbon dioxide, oxygen, and nitrogen in the sample were calculated. A correction was added to the weight of carbon dioxide for the amount dissolved by the permanganate solution; this amounted to approximately

$$\frac{v'}{V - v'} \times \text{wt. of carbon dioxide found,}$$

since at the atmospheric temperature and pressure water dissolves about its own volume of carbon dioxide. The residue in the Orsat apparatus after absorption of carbon dioxide and oxygen was considered in calculations as pure nitrogen; actually it contained carbon monoxide, but as this is inactive and has the same density as nitrogen its presence was unimportant.

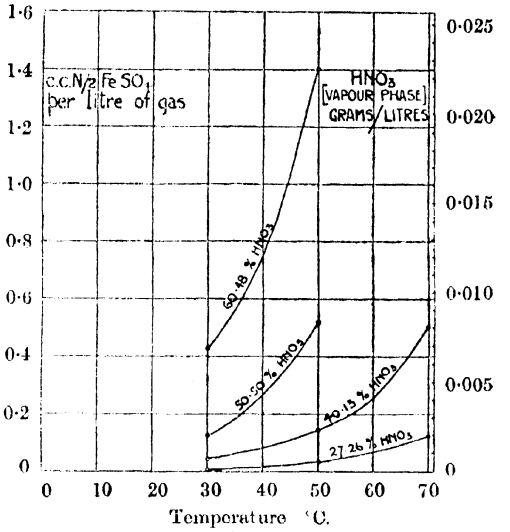
Estimation of nitric oxide and peroxide.

Air was then admitted to the sample bottle and the permanganate solution titrated with $N/2$ ferrous sulphate until colourless. In practice a slight excess of ferrous sulphate was added to effect complete solution of any precipitate, and the end-point reached by back titration with $N/2$ permanganate. The volume of $N/2$ permanganate reduced by the sample of gas was thus obtained.

The total combined nitrogen in the gas was then estimated in this solution by the method of Bowman and Scott[1]. After the addition of a large volume of concentrated sulphuric acid, the solution was titrated with $N/2$ ferrous sulphate until a brown colour appeared. At this stage the whole of the nitric acid formed by the oxidation of the gases with permanganate had been reduced to nitrous anhydride, and a slight excess of ferrous sulphate had produced a brown colour owing to further reduction to nitric oxide.

The solution from the first titration, the volume of which was known, was transferred to a litre flask, and sufficient concentrated sulphuric acid added, with cooling, to ensure that at the end of the second titration the acid would be 80% by volume. A portion of the acid was used to wash out the sample bottle. $N/2$ ferrous sulphate was then slowly run in until the brown colour persisted, the temperature being kept below 50° C. Any considerable deviation from 80% caused an increase in the volume of ferrous sulphate required. Before carrying out a series of estimations the $N/2$ ferrous sulphate was standardised both against $N/2$ permanganate and $N/2$ sodium nitrate (1 c.c. = 0·0035 grm. nitrogen). It was found that the ferrous sulphate was always about 3% weaker with respect to the latter titration. The standardisation against $N/2$ permanganate was used for the first titration and that against $N/2$ sodium nitrate for the second; it was then not necessary to subtract 0·2 c.c. from the second titre, as recommended by Bowman and Scott.[1]

If K = c.c. $N/2$ permanganate reduced by the gas (from first titration), and N = c.c. $N/2$ ferrous sulphate required in second titration, then wt. NO_2 in sample = 0·00575 (3N − 2K) grm., and wt. NO in sample = 0·00375 (2K − N) grm. In most cases a small correction was necessary on account of the nitric acid vapour entering the sample bottle together with the nitric oxide and peroxide. The amount of this was calculated from the vapour pressure of a nitric acid solution of the strength of the circulating acid, and the corresponding volume of $N/2$ ferrous sulphate deducted from the titre found in the second titration. The values of these corrections are shown graphically in Fig. 3 for 1 litre of gas.



Curves showing the correction for the vapour pressure of nitric acid per litre of gas.

Fig 3

Calculation of results.

In applying this method of analysis to the estimation of the weights of nitrous gases absorbed by the individual towers of the series, gas samples were taken simultaneously from the gas exit of each tower. The calculation of the analytical results to volumes at the temperature of the plant would have been a complicated process, since it would have been necessary to take account of the vapour tensions of the circulating acid and of the variations of the degree of dissociation of N_2O_4 with changes of temperature and of partial pressure; neglect of either of these would have led to considerable error. Further, the volumes, when obtained, would not have been directly comparable with plant tonnage. It was therefore found preferable to make all calculations in weights, the most convenient unit being lb. per hour. In order to calculate the analytical results to weights of the constituent gases passing through the plant it was necessary to know the velocity of the gases at each sampling point. This velocity could not be assumed to be everywhere the same, since nitric oxide and peroxide and oxygen were being absorbed, and air was being admitted through air lifts. Velocity measurements with an anemometer are liable to an

[1] Bowman & Scott, J. Ind. Eng. Chem., 1915, 7, 769; this J., 1915, 1008. See also Scott, "Standard Methods of Chemical Analysis," p. 515 (Crosby Lockwood & Son, 1917).

[1] *Loc. cit.*

error of 10%. In comparing estimations at two points there might, therefore, have been an error of 20%, especially as the densities of the gases were somewhat uncertain. Such an error in the weights of oxides of nitrogen entering and leaving a tower would have been sufficient in most cases to mask entirely the absorption in the tower. Velocity measurements at each sampling point would not, therefore, have given reliable results. It was found best to measure the gas velocity at one point only and to calculate the velocity at the other sampling points on the assumption that the weight of carbon dioxide* passing each point in a given time was the same. For the later towers of the system, where the absorption of oxygen was small, and where but little air was admitted, the volume percentage of carbon dioxide in the residual gases, after removal of oxides of nitrogen, was found to be approximately constant. The amount of carbon dioxide was also found to be constant over moderate intervals of time. The only probable sources of loss or gain of carbon dioxide in the gases of the absorption system were solution in the circulating acid, and oxidation of carbon monoxide to dioxide by nitric acid. The loss of carbon dioxide on account of solution was calculated on the assumption that its solubility in dilute nitric acid was the same as in water; it was found that the loss would not exceed 0·25% of the total carbon dioxide, and was thus negligible. Oxidation of carbon monoxide to dioxide is stated by Treadwell and Stokes† to be brought about by fuming nitric acid. The ratio vol. % CO_2 : vol. % CO was therefore determined in the gases before and after the absorption system. This ratio was found to be constant, showing that no appreciable oxidation of carbon monoxide took place. The velocity at one sampling point was measured with a calibrated anemometer of the Pitôt tube type, and the manometer reading calculated directly to lb. of gas passing through the main per hour by the formula

$$W = 215{\cdot}5\ Kr^2\sqrt{Hd},$$

where W = wt. of gas passing through main in lb. per hour, K = correction factor of anemometer, r = radius of main in inches, H = manometer reading in inches of ether of sp. gr. 0·72, and d = density of the gas in grms. per litre. This equation is a modification of the usual formula for such a manometer, viz., $V = \sqrt{2gh}$.

To calculate W it was necessary to know the density of the gas at the point where the measurement was made. This point was, therefore, chosen at or near the exit of the series of towers, the gas there being both cool and dilute. In this case there was but little error in assuming that the gas had the same density as air at the same temperature and pressure, especially as it was only the square root of the density that entered into the calculation. From the value of W the weight of carbon dioxide passing per hour through any part of the plant was calculated from the equation:—

$$W_{CO_2} = w_{CO_2} \times W\ w$$

where W_{CO_2} = required weight of CO_2 in lb. per hour, w_{CO_2} = weight of CO_2 in the gas sample drawn from the point where the velocity estimation was made, and w = total weight of the gas sample.

Here w is the sum of the weights of the constituent gases found in the sample and the weight of vapour in the sample. This latter could be assumed without considerable error to be equal to the weight of an equal volume of saturated water vapour under similar conditions.

As stated above, W_{CO_2} was assumed to be the same throughout a series of towers. The weights of the other gases passing each sampling point were then calculated from the analysis of the corresponding gas sample by the equation:—

$$\text{Required weight} = W_{CO_2} \times \frac{\text{wt. of required gas found in sample.}}{\text{wt. of } O_2 \text{ found in sample.}}$$

The weight in lb. of each gas leaving each tower per hour was thus obtained. Any error in determining W_{CO_2} (due to anemometer errors) affected the total weight of gases passing through the towers, but did not affect the comparison between the weights of each gas leaving each tower of the series.

In conclusion the authors wish to express their gratitude to the Superintendent of H.M. Factory, Gretna, for permission to publish this work.

THE ESTIMATION OF CYANOGEN COMPOUNDS IN CONCENTRATED AMMONIA LIQUOR. PART II.—THE ESTIMATION OF THIOCARBONATE.

BY PERCY EDWIN SPIELMANN, PH.D., B.SC., F.I.C., AND HENRY WOOD.

In a previous communication (this J., 1919, 38, 43 T) we described a colorimetric method for the estimation of the cyanogen compounds occurring in concentrated ammonia liquor, based on the depth of colour obtained after their successive conversion into ferric thiocyanate. The method has now been extended to include the determination of thiocarbonate, which is usually present and which is of importance, inasmuch as it is converted into thiocyanate in the ordinary conditions of storage.

The problem centres round the establishment of conditions in which cyanide and thiocarbonate can separately be converted quantitatively into thiocyanate, for estimation in this form. These conditions have been found to coincide fairly closely with those anticipated by Linder in his studies of ammonium thiocarbonate (Alkali Inspector's Report, 1918; this J., 1919, 716 A).

Conversion of ammonium cyanide into thiocyanate by digestion with polysulphide.

Linder has pointed out that this change does not take place as readily as is usually supposed when concentrated ammonia is present (above Report, pp. 53 and 72), and that the solution of the cyanide must be warmed at 30°—35° C. for half an hour with an excess of ammonium polysulphide. This we have confirmed, as is shown by the following figures, which prove also that thiocarbonate is not changed in these conditions. The thiocarbonate solution was made up as described by Linder (above Report, p. 58, exp. 9a), and its strength was estimated by the maximum quantity of thiocyanate obtained from it. Ammonium cyanide present was equivalent to 0·0137% thiocyanate. (All percentages are wt./vol.)

	Thiocyanate found %
1. Cyanide and thiocarbonate present: insufficient excess of polysulphide	0·0054
2. Cyanide and thiocarbonate present: insufficient excess of polysulphide	0·0074
3. Cyanide only present: insufficient excess of polysulphide	0·0105
4. As in 1 and 2: excess of polysulphide ..	0·0137

Conversion of thiocarbonate into thiocyanate.

Experiments were made to determine the lowest temperature at which the reaction would take place with a reasonable velocity, and digestion for 45 minutes at 70°—75° C. was finally adopted.

* In the towers under observation, carbon dioxide formed about 5% by volume of the gases remaining after the absorption of oxides of nitrogen, and it was, therefore, readily estimated.

† Ber., 1888, 21, 3131.

(1) Thiocarbonate sol.: 10 c.c. = 0·0068% thiocyanate; thiocyanate sol., $N/10$, 1 c.c. = 0·0076% thiocyanate; 0·880 ammonia, 10 c.c. After digestion, as above, 0·015% thiocyanate was found, of which 0·015—0·0076=0·0074% consists of thiocyanate formed from the thiocarbonate. Usually the result is a little low rather than high.

(2) Thiocarbonate sol.: 10 c.c. = 0·004% thiocyanate; thiocyanate sol., $N/10$, 1 c.c. = 0·0076%; potassium cyanide sol., 1 c.c. = 0·0137%. After digestion 0·0115% thiocyanate was found, of which 0·0115–0·0076 = 0·0039% consists of thiocyanate formed from the thiocarbonate. (Any free alkali in the cyanide solution was neutralised before it was used.)

These two sets of experiments show conclusively that digestion for 45 minutes at 70°—75° C. will convert thiocarbonate completely into thiocyanate without affecting cyanide, and that polysulphide at 30°—35° C. will convert cyanide to thiocyanate in half an hour without attacking thiocarbonate.

A shortening of the procedure (in absence of ferrocyanide) was attempted by boiling down the mixture of substances instead of digesting it, but this was found to be undesirable, on account of the cyanide being attacked to a certain extent.

Ferrocyanide is not affected by digestion under the prescribed conditions, as was found by Linder at 80°—85° C. (*loc. cit.*, p. 61).

The method was tested on an artificial ammoniacal liquor of the following composition: Thiocarbonate solution, 20 c.c. = 0·185% thiocyanate; ammonium thiocyanate sol., 4 c.c. = 0·0304%; potassium cyanide sol., 4 c.c. = 0·0274%; ammonium ferrocyanide sol. (1 c.c. = 0·001042 grm.), 10 c.c.; ammonia, 0·880, 62 c.c.; hydrogen sulphide (introduced in thiocarbonate sol.) 2·65%. The procedure was that described in our previous paper (this J., 1919, 43 T; *q.v.*), with the modifications here recommended:—

Separate quantities of 25 c.c. of liquor are taken for each estimation.

(A) *For thiocyanate as such.* The liquid should be kept as cold as possible during acidification, *e.g.*, by pieces of ice floating in the liquid.

(B) *For cyanide and thiocyanate.* The liquid is digested at 30° C. for half an hour, with excess—2 c.c.—of ammonium polysulphide.

(C) *For thiocarbonate and thiocyanate.* The liquid was diluted with 15 c.c. of water, 10 c.c. of strong ammonia added, and digested at 75° C. for 45 minutes.

Example.—Found: 0·216% thiocyanate. Theory: from thiocarbonate, 0·1850; from thiocyanate, 0·0304; total, 0·2154.

(D) *For ferrocyanide.* This was determined from the "blue" obtained in experiments (A) and (C) above.

In the titrations for ammonia and hydrogen sulphide (the latter with copper sulphate—found 2·67%) the end-points were bad, which may account for similar troubles in estimating these substances in commercial samples.

On acidifying the solution after digestion precipitated sulphur often obscures the red colour formed by the addition of iron alum. It is then necessary to add a decided excess of iron alum, warm to about 40° C., whereby the solution becomes clear, and filter off the precipitated sulphur compounds. If after polysulphide treatment large quantities of slimy sulphur are precipitated and much hydrogen sulphide is evolved, it is preferable to remove most of the sulphur by a preliminary shaking with lead carbonate.

Linder, and Colman and Yeoman (this J., 1918, 37, 319 T) emphasize the necessity of excluding air from the reacting substances, and it has been suggested that a slow stream of coal gas should play on the surface of the liquid. In the present experiments it was found sufficient that the conical flasks employed should be provided with loose stoppers, below which the vapours and evolved gases acted as sufficient protection from atmospheric oxygen.

Removal of thiocarbonate.—In the method of analysis described in our two papers the removal of thiocarbonate is not necessary, but some experiments were made to find how this could be effected. The action of lead carbonate in presence of ammonia is not complete (Linder), nor is that of bismuth carbonate. If, however, the filtrate from the lead carbonate treatment be shaken with zinc carbonate, the whole of the thiocarbonate is removed without affecting the thiocyanate, which remains in solution as a zinc salt (Williams, "Cyanogen Compounds"). On boiling the ammonia from the filtrate zinc oxide separates and is easily filtered off, preferably with the aid of the pump. The preliminary treatment with lead carbonate avoids the production of an excessive amount of zinc sulphide.

CELLULOSE ACETATE.

BY EDWARD C. WORDEN.

No one familiar with the subject will controvert the fact that the supremacy of the air in the late conflict has been intimately connected with the question of the quality and supply of cellulose acetate, for, although many other materials have been proposed from time to time for coating and preserving the fabric of aeroplane wings to impart to them the necessary property of tautness, resiliency, and waterproofing, none has passed beyond the experimental stage; and the wings of the aircraft used by England, France, Italy, and the United States—both observation and fighting 'planes—have been coated with dope made from this cellulose ester.

In the above-mentioned four countries at the outbreak of the war, with perhaps the exception of a firm at Lyons, France, and a company near Boston, Mass., producing relatively small amounts for artificial silk making, there were no firms engaged in the manufacture of cellulose acetate uninterruptedly in commercial quantities, the world's supply of this commodity being furnished by the Société Chimique des Usines du Rhône, at Lyons, the Cellonite Co., of the Brothers Dreyfus in Basle, the Bayer Co., at Leverkusen, and the Cellulose Products Co., near Boston, Mass.

The outbreak of hostilities soon disclosed the momentous importance of the speedy conquest of the air, and impressed upon the respective countries the fact that prudence demanded that immediate and active steps be taken to ensure within their borders independent and adequate sources of supply of cellulose acetate.

The French Government, after a minute and protracted investigation, came to the conclusion that it was not wise to depend solely upon the then producing firm for their supply of cellulose acetate, and entered into negotiations with the Dreyfus interests whereby a plant for cellulose acetate manufacture and synthetic acetic acid production was laid down at Rouen, of a projected productive capacity ample to meet the entire demands of the programme of the Section Aeronautique.

In Italy the military representatives of the Government entered into an arrangement whereby the Dreyfus Brothers erected a plant at Milan of cellulose acetate capacity sufficient for their projected aeroplane programme, and with a comfortable margin of safety.

England at first relied upon shipments of cellulose acetate from Basle and from Lyons, but partly due to increasing difficulty in overland transportation in France, and also to the submarine menace, coupled with the fact that the war appeared likely-

to be of long duration, and also as the culmination of an exhaustive investigation of existing available sources of cellulose acetate supply, entered into arrangements with the Dreyfus interests, the result being the formation of the British Cellulose and Chemical Manufacturing Company and the erection of a plant at Spondon, near Derby. This factory was designed on a basis of ample production of cellulose acetate and solvents therefor, including a complete synthetic acid works and units for the manufacture of acetic anhydride.

Notwithstanding the many delays incidental to building construction in the critical period through which the country was passing, this firm, from the commencement of production, supplied all the cellulose acetate required in England in carrying out her extensive Air Service programme, and at the time of the signing of the Armistice the Government surplus of cellulose acetate accumulated, it is understood, amounted to several hundred tons. The English standards for clarity, ash, solubility, and viscosity of cellulose acetate intended for aeroplane dope are rigorous.

When the United States entered the conflict the only company which had regularly been manufacturing cellulose acetate was the Cellulose Products Co., which produced small quantities of fibrous cellulose acetate made by esterifying cellulose (usually cotton) in the presence of a petroleum non-solvent, whereby the cellulose during acetation did not pass into solution in the esterifying medium. The Bureau of Aircraft Production, however, used no fibrous cellulose acetate for coating aeroplane wings.

By virtue of being large manufacturers of nitrocellulose for photographic purposes, the Eastman Kodak Co., of Rochester, N.Y., undertook the preparation of cellulose acetate under Government contract, but the Bureau of Aircraft Production, alert to the fact that an accident in this factory might seriously handicap the proper carrying out of their extensive aircraft programme, sought for an alternative source of manufacture of this ester in a factory to be preferably located within its border.

Their deliberations resulted in a mission being dispatched to England in April, 1917, to investigate and report upon the situation of this commodity there, the result being that a contract was entered into with the Dreyfus interests, resulting in the formation of the American Cellulose and Chemical Manufacturing Co., which commenced the erection of a factory at Cumberland, Maryland, for the fulfilment of a Government contract for several million pounds of cellulose acetate. The Chemical Company of America, under the direction of Dr. Samuel Iserman, also produced cellulose acetate under Government contract at their Springfield, N.J., works.

Therefore the Entente countries depended for their supplies of cellulose acetate upon a Dreyfus factory located in each of the four countries, augmented by the output of the parent company in Switzerland, in addition to the sources previously mentioned. Tentative arrangements were entered into between the respective Governments, whereby in case the necessity should arise, the Dreyfus English factory should be allowed to send cellulose acetate to the United States.

Inasmuch as the success of the Allied aeroplane programme as a whole has depended in a large measure upon the output of the various factories operating under the processes of the Brothers Dreyfus—Doctors Henry and Camille—it may be of interest to examine somewhat in detail, from a chemical viewpoint, the reasons which probably actuated the technical advisers of the four Governments, independently and at different times, to select the same source for cellulose acetate manufacture, and to enquire into the basic principles differentiating the Dreyfus processes as a whole from the ideas of those who have preceded and succeeded them in this art.

The history of carbohydrate acetation goes back to the original experiments of Schützenberger in 1865, and, for purposes of discussion herein, may be said to fall conveniently into three clearly-defined transitional stages as follows:—

(1) The academic period. Schützenberger to Cross and Bevan, 1865—1894.

(2) The period 1894—1911, the most important advances being the Miles patents.

(3) The period 1911 to date, the most important advance being the Dreyfus patents.

The academic period. In addition to the work of Schützenberger,[1] alone and in conjunction with Naudin[2] (1865—1870), are to be included the researches of Girard, Liebermann and Hoermann, Erwigs and Koenigs, and Cross and Bevan. Apparently all these investigations were approached from the theoretical and non-utilitarian point of view, and one would not suspect from a perusal of these investigations as a whole that the subject possessed any practical interest or might lead to results of commercial utility. Each repeated the work of his predecessor, eliminated some of the errors and pointed out many of the inconsistencies, broadened the scope of the investigation, and carried the sum total of knowledge a step further; but the researches were carried on in an obscurely co-ordinated and entirely empirical manner, and without any evidence of a well-defined attempt to lay down broad generalisations as the outcome of quantitative experimentation.

All the acetations of Schützenberger involved profound and far-reaching decomposition of the cellulose, in some instances going so far as the formation of water-soluble esters (sugars). Girard[3] laid down many principles of value, frequently referred to in questions of novelty and priority of conception in subsequent patent litigation. He confined his work entirely to the esterification of hydrocellulose, the product, therefore, being worthless for commercial purposes.

Liebermann and Hoermann,[4] by the use of anhydrous sodium acetate, were able to esterify in open containers and thereby diminished the amount of objectionable by-products formed. Franchimont[5] laid the foundation for a distinct improvement when he commenced experiments upon the use of sulphuric acid to replace the sodium acetate previously employed, but beyond describing methods of procedure, he evidently failed to grasp the fact that his work embraced great possibilities.

In 1889 appeared the information which Erwigs and Koenigs had accumulated on the subject incidental to their investigation of the acetation of quinic acid and some of the sugars.[6] Cross and Bevan,[7] in a series of carefully conducted quantitative experiments, sought to mollify the destructive action of sulphuric acid by the substitution of zinc chloride, and although the purified ester gave upon saponification acetic acid equivalent to a yield of triacetate of but 62% based on a C_6 cellulose molecule, yet many of the inferences which they drew at that time have since received general acceptation.

The period 1894 *to* 1911, *containing Miles' patents.* A continuation of the work led to a patent being granted to Cross and Bevan in 1894,[8] this being the first patent granted for the manufacture of cellulose acetate. It discloses a method for obtaining this ester in commercial quantities by the action of zinc acetate and acetyl chloride upon cellulose hydrate, the patentees suggesting possible uses for this material in pharmacy and surgery as a substitute for collodion. Weber[9] replaced zinc acetate by the corresponding magnesium salt, and

predicted that the new product would soon become a rival of celluloid. Widespread interest was now aroused.

Thiele and Skraup in 1898[10] studied the limit of dilution of sulphuric acid in acetation, it being by this time clearly recognised that this acid exerted a powerful detrimental effect upon cellulose. Vignon and Guerin[11] tried to acetate at the boiling point of acetic anhydride, and of course failed to obtain useful products. Bardy[12] reviewed the state of the art in 1900 but contributed nothing new.

Up to the time of the appearance of the Miles patents, two lines of endeavour are evident. One was concerned with determining what form of modified cellulose was most suitable (" suitable " in this instance being synonymous with " easy ") for acetation, while the other group was occupied in attempting to replace, or rather render innocuous, the powerful action of sulphuric acid as a component in the acetating bath. For this purpose there were proposed among many others the following: phosphoric,[13] hydrochloric,[14] phenolsulphonic,[15] ethylsulphuric,[16] sulphoricinoleic,[17] and sulphinic and sulphonic acids,[18] nitrosyl sulphate,[19] ammonium bisulphate,[20] sodium acetate,[21] nitric acid from nitrates,[22] dimethyl sulphate,[23] aniline bisulphate,[24] and alkylaminesulphonic acid salts.[25] As the result, to-day sulphuric acid is universally employed for this purpose.

All the cellulose acetates produced up to this time were of but little commercial value, not only because they lacked tensile strength, flexibility, and tenuity, but also on account of the fact that they were only soluble in expensive solvents. This is the point in this art analogous to the nitrocellulose industry in the early 'eighties of the past century, when the subject was only advanced by the discovery of a new solvent or improved ways of applying those already known. All acetation methods up to this time required as a preliminary that the cellulose should undergo some preparatory treatment which involved expense and decreased the desirable qualities of the finished product.

The most important advance in this period 1894—1911 is to be attributed to the Miles inventions, especially the patent of 1905.[26] Miles had already taken out a patent in 1900[27] for cellulose acetate which marked an important advance on the earlier patents, but in this case also the ester produced was, like those which had been prepared previously, only soluble in expensive toxic solvents such as chloroform and tetrachloroethane, and hence, from a practical point of view, the use was necessarily limited. In 1905, however, a patent was granted to Miles for a process of partial hydration, to which the chloroform-soluble acetated cellulose known up to that time was subjected, whereby an ester was formed probably by the progressive withdrawal of acetyl from the acetated cellulose, this ester being sharply distinguished from all previous products of this kind by dissolving in cheaper solvents such as acetone.

Miles acetated unmodified cellulose with acetic acid, acetic anhydride, and a catalyst such as sulphuric acid, obtaining first a substantially non-hydrated cellulose acetate, soluble in chloroform, insoluble in acetone, and closely approximating to the normal triacetate; by successive hydration this gradually lost the solubility in chloroform, the hydration process being preferably interrupted at the point where the solubility in chloroform merges into that nuance of insolubility represented by plasticity in warm chloroform. During this progressive increase in chloroform-insolubility phase there is developed a solubility in acetone. Hydration beyond this stage causes the incipient plasticity in chloroform to pass to a complete insolubility, while at the same time the cellulose acetate becomes wholly soluble in acetone containing more and more water. This point should be clear, that co-incidental with the stage of plasticity in warm chloroform comes complete solubility in substantially anhydrous acetone. In general it may be said that in proportion to the amount of water required to be added to the acetone to insure complete insolubility, so do the strength and value of the film decrease.

From the date of issue of the Miles patent (1905) to 1911 no observations of equal merit appeared as indicated by the patents issued. Mork,[28] for instance, hydrated the chloroform-soluble acetated cellulose by the aid of alkalis under the name of " saponification "; Bayer and Co.[29] precipitated the non-hydrated cellulose acetate by water and hydrolysed the product after dissolving again in acetic acid—a very tedious process, and, in fact, only a modification of the Miles principal patent. Danzer[30] obtained water for partial hydration by the addition of alcohol to the esterifying bath, and thereupon formed ethyl acetate and eliminated water in so doing.

All the cellulose acetates prepared up to this time, however, had the disadvantage of giving more or less brittle celluloid, mainly on account of their relatively low viscosity, primarily as the result of too much depolymerisation of the cellulose complex.

Period of 1911 *and after.* The foregoing, therefore, are the salient points in the development of cellulose acetate up to the time of the application for the first Dreyfus patent (July 5, 1911), which described methods for the preparation of the highly viscous cellulose acetates. At this time the older methods for the preparation of the chloroform-soluble acetates for film formation and textile coatings had given way to the acetone-soluble, partially hydrated modifications on account of the fact that acetone was easily obtainable and a comparatively inexpensive, non-toxic solvent, and also to the fact that the films of the acetone-soluble cellulose acetate were superior to those deposited from chloroform.

Due to the multiplicity of the Dreyfus patents in this field,[31] covering as they do the entire range of cellulose acetate manufacture, including the solvents, a comprehensive analysis of the meritorious points contained therein requires a careful study of these patents as a series. The first Dreyfus patent issued disclosed a distinct departure from the existing art, in that it is clearly shown that viscosity, high tensile strength, and elasticity are complementary. The highly viscous cellulose acetates comprehended in the Dreyfus patents are obtainable by acetating cellulose under conditions which give as a preliminary or initial product an acetated cellulose insoluble in chloroform but soluble in alcohol-chloroform, and at the same time dissolving in acetone—a product which previously had not been described.

It must be understood that the quality of cellulose acetate required for the manufacture of dope for the coating of aeroplane wings is quite different from that for the manufacture of artificial filaments, photographic films, and celluloids. In general, it is a fact that the preparation of cellulose acetate intended for use as films is more exacting than that intended for dope, for in the former the elements of high viscosity and clarity enter, which are of relatively minor importance in the preparation of dope. Furthermore, whereas strength is of paramount importance in the plastic industry, as well as high solubility, relative tautness is of more moment in aeroplane dope.

Just as in the older and more thoroughly investigated cellulose nitrate art, so it is to-day well established that the highly viscous cellulose esters are much tougher and more elastic. Dreyfus has developed—as disclosed in his patent applications—a series of principles underlying the manufacture of cellulose acetate, and covering various applica-

tions to which the cellulose nitrates have heretofore been almost exclusively applied, the keynote of originality running through these patents, as it is disclosed to the author, being that by minimising depolymerisation or degradation of the original cellulose by controllable factors, he has been enabled to produce a series of esters of pre-determined viscosity and strength, and of acceptable solubility in commercial solvents and solvent combinations. On account of the conservation of solvents, cellulose acetate used in aeroplane dope was prepared of much lower viscosity than that preferred for acetate plastics.

Much confusion has appeared in the minds of some in respect to the phenomenon of viscosity as applied to a cellulose acetate in solution. In testing a series of these esters prepared in the same manner, it will be noted that as the viscosity increases, the strength of the film and its elasticity show corresponding improvement—not always in a quantitatively increasing ratio, because it is almost impossible so to control the varying factors in an esterifying process under ordinary conditions of experimentation, that successive acetations can be carried out under strictly comparable conditions. But if a low viscosity acetate is obtained, the film cast therefrom will be brittle and of low tenuity. Conversely, if the esterification be conducted in such a manner that esters insoluble in chloroform but soluble in acetone and in acetic acid are first formed, as first disclosed by the Dreyfus patents, then there result, upon application of partial hydration ("ripening"), esters of high viscosity and great strength, suppleness, and wearing qualities.

In the determination of the viscosity of cellulose ester solutions, erroneous results may readily be obtained owing to a portion of the ester remaining in a state of colloidal suspension, removable by high centrifugal action or careful filtration, as distinguished from true solution. The lack of concordance in discussions on solubility and viscosity, which is to be found in the technical literature, may be traced to insufficient appreciation of the above.

There exists, therefore, what one may term a "true," as well as a "false" or "misleading" viscosity, in respect to cellulose acetate in solution. In order to make this more clear by example, assume that an acetation of cellulose is carried out by methods giving by direct acetation on the one hand a cellulose acetate soluble in chloroform, insoluble in acetone, and having a lower viscosity, and, on the other hand, an acetated celluloso, insoluble in chloroform, soluble in acetone and in alcohol-chloroform, characterised by a relatively higher viscosity. In the first method an ester is obtained soluble in chloroform and in acetic acid, but insoluble in acetone, while in the second instance an ester is formed which is insoluble in chloroform, but soluble in alcohol-chloroform, in acetone, and in acetic acid, and is at the same time highly viscous.

Let the products of both processes be exposed to the well-known ripening process called by Miles "partial hydration." The results of Dreyfus indicate that this reaction may proceed without any water, *i.e.*, when the free anhydride has only been converted into acetic acid. It may be rather an intramolecular change in the ester induced by a partial degradation or depolymerisation of the molecule. However, if both materials be examined just before ripening, it will be found that the product of the first process (subsequently called "A" herein) will be soluble in chloroform, while the product of higher viscosity produced by means of the second process (hereafter called "B") will be insoluble in chloroform, but soluble in alcohol-chloroform and in acetone, both being soluble in acetic acid as evidenced by the fact that they passed into solution in the acetating mixture.

By now interrupting the acetation reaction by changing the acetic anhydride into acetic acid, after a period of time, the length of which is governed by a number of factors, changes in solubility of both products appear. "A" reaches a point where it becomes soluble in alcohol-benzene, while at the same time maintaining the original solubility in chloroform. "B" has likewise become soluble in alcohol-benzene, while its deportment towards chloroform is a complete reversal from insolubility to solubility—that is to say, a solubility in chloroform not obtained by a process of acetation.

At this point it may be mentioned that, according to the description in the Dreyfus patents, the reaction may be so manipulated that the product never becomes soluble in chloroform, remaining soluble in alcohol-chloroform. At the transition point of alcohol-benzene solubility and chloroform solubility the products from both processes dissolve in acetone, the "B" product being already soluble in acetone, while the "A" product acquires that solubility by virtue of the ripening process to which it was submitted.

Should "A" and "B" be precipitated at this point, washed till neutral, dried, and dissolved in portions of the same simple solvent, then a correct comparison of the viscosity will result, and such viscosity determinations are a trustworthy criterion of the tensile strength and tenuity of the acetate for the formation of plastics or films.

If, on the other hand, the product of lower viscosity, "A," be allowed to ripen further until it has lost its solubility in alcohol-benzene, while still remaining soluble in acetone, there would then be presented an example in comparing this product with "B" above of two acetone-soluble, partially hydrated cellulose acetates, which, when dissolved in acetone, would give false or misleading viscosity comparisons as indicating the probable value of the acetate and its suitability for a given purpose. The results obtained would be misleading, although both were soluble in acetone.

But let the ripening process be carried a step further with both under similar conditions. When "A" becomes soluble in alcohol-benzene, but plastic in chloroform (either cold or warm), and still soluble in acetone—it being remembered that this solubility in acetone was developed as the result of ripening, and did not exist from the beginning (the ripening of "B" having meanwhile been progressing under identically similar conditions), the more viscous cellulose acetate will have reached a stage where it is still soluble in alcohol-benzene, but its solubility in chloroform has been succeeded by an insolubility, while it is still soluble in alcohol-chloroform. Under these conditions a true comparison of the two products becomes possible, and may lead to valuable results. Note that "B" has changed from a chloroform-insoluble to a chloroform-soluble ester and back again to insolubility, and cannot again by any means be made to dissolve in pure chloroform.

However, if "B" is ripened to a further stage where it becomes insoluble in alcohol-benzene or in chloroform, not completely soluble in substantially anhydrous acetone, but completely soluble in acetone containing some water, then in making viscosity comparisons against "A," which would be soluble in acetone and in alcohol-benzene, and plastic or insoluble in chloroform, deductions based on viscosity determinations would be erroneous and to the disadvantage of "B," which is the opposite to the example previously cited.

The above are a few of the indications of the trend of development in cellulose acetate manufacture as expanded by H. Dreyfus from the broad

point of view of the correlation of solubility and viscosity, and its bearing upon questions of tensile strength (wearing qualities) of organic esters of cellulose. The work has opened up an entirely new field with practically unlimited potentialities.

It will be remembered that until 1910 or 1911, in order to prepare commercially an acceptable cellulose acetate, it was considered essential that the product obtained by direct acetation should approximate in composition to a triacetate and be soluble in chloroform This opinion, however, has been radically modified as the result of the Dreyfus patents, for it has therein been shown how little real value is to be attached to the acetic acid content of a cellulose of primary esterification, and in what manner the properties of the finished product are modifiable in numerous ways by manipulative skill in the acetation.

As has been mentioned, one of the primary features developed in the Dreyfus inventions has been a reversal of the opinion formerly held that the directly acetated cellulose must be first soluble in chloroform, rather than so to conduct the primary acetation that an ester results which is insoluble in chloroform and soluble in alcohol-chloroform. This question has been investigated this year independently by Miles, who has corroborated the differences in solubility between the products as made by his U.S. Patent 838,350 previously cited and those of Dreyfus previously referred to.

A large number of other patents have been issued during this period of relatively minor importance in comparison to the advances of Miles and of Dreyfus. In general—apart from the question of possible patent circumlocution—they propose other condensing agents and modifications of the then known methods, and while it cannot be denied that they represent additions to knowledge, apparently they do not possess the basic merit of the work of the two investigators mentioned above.

(1) Comptes rend., 1865, **61**, 485; abst. Bull. Soc. Chim., 1866, (2), **5**, 291; Zeits. Chem., 1866, **9**, 16; Chem. Centr., 1865, **10**, 1036; J. prakt. Chem., 1866, **97**, 250; J. Pharm. Chem., 1865, **4**, II., 376; Jahr. Chem., 1865, 504; Ber., 1869 **1**, 163, 556.

(2) Comptes rend., 1869, **68**, 814; abst. Chem. Centr.,1869, 681; Zeits. Chem., **12**, 264; Bull. Soc. Chim., 1868, (2), **10**, 178; 1869, (2), **12**, 107, 204; Jahr. Chem., 1869, 750. See also Schnetzenberger, Ann. Chim. Phys., 1870, (4), **21**, 235; abst. Chem. Centr., 1871, 568: Ann., 1871, **160**, 74; J. Chem. Soc., 1872, **25**, 266; Chem. Centr., 1871, 740.

(3) Comptes rend., 1875, **81**, 1105; abst. Ber., 1876, **9**, 65; Jahr. Chem., 1875, 786; Chem. Centr., 1876, 83; J. Chem. Soc., 1876, **30**, i., 676; Chem. News, 1875, **33**, 10. Ann. Chim. Phys., 1876, (5), **9**, 116; abst. Chem. Centr., 1877, 6. Comptes rend., 1879, **89**, 170; abst. Jahr. Chem., 1879, 1116. Comptes rend., 1879, **88**, 1322; abst. Ber., 1879, **12**, 2085, 2158; Jahr. Chem., 1879, 835; Jour. de Pharm., 1879, **30**, 348; J. Chem. Soc., 1879, **36**, 379. Ann. Chim. Phys., 1881, (5), **24**, 337; abst. Ber., 1881, **14**, 2834; Jahr. Chem., 1881, II., 985; J. Chem. Soc., 1882, **42**, 378. Comptes rend., 1879, **89**, 170; abst. J. Chem. Soc., 1879, **36**, 911; Bull. Soc. d'Encourag., (3), **8**, No. 91; Chem. News, 1881, **44**, 216.

(4) Ber., 1878, **11**, 1618; abst. J. Chem. Soc., 1879, **36**, 271; Bull. Soc. Chim., 1879, **32**, 338; Jahr. Chem., 1878, 92; Chem. Centr., 1878, 710.

(5) Rec. Trav. Chim., 1899, (2), **18**, 465, 472; abst. J. Chem. Soc., **1900**, **78**, i., 141; Jahr. Chem., 1899, 1289. Rec. Trav. Chim., **1883**, **2**, 241; abst. Jahr. Chem., 1883, 1366; Chem. Centr., **1884**, **60**. Comptes rend., 1879, **89**, 711; abst. J. Chem. Soc., 1880, **38**, **159**; Chem. Centr., 1879, 771; Ber., 1879, **12**, 1938. Comptes **rend.**, **1881**, **92**, 1054; abst. Chem. Centr., 1881, 422; Jahr. **Chem.**, **1881**, **859**; J. Chem. Soc., 1881, **39**, 716; Ber., 1881, **14**, **1284**. **Comptes** rend., 1881, **92**, 1053; abst. Chem. Centr., **1881**, **424**; **Jahr.** Chem., 1881, 985; J. Chem. Soc., 1881, **40**, 709; Ber., **1881**, **14**, 1290.

(6) Ber., **1889**, **22**, **1457**, 1464, 2207; 1890, **23**, 672; abst. **this J.**, **1889**, **8**, 718, 723, 994: 1890, **9**, 637; Jahr. Chem., 1889, 1692, 2041; 1890, 2132; J. Chem. Soc., 1889, 952, 991, 1131; **1890**, **58**, 732; Chem. Centr., 1889, 251, 260, 748; 1890, 757.

(7) Chem. News, **1889**, **60**, 163, 254; abst. Chem. Centr., 1889, **60**, II., 790; 1890, **61**, 21; Jahr. Chem., 1889, 2066; 1890, 2152. J. Chem. Soc., 1890, **57**, 2; abst. Chem. Centr., 1890, I., 390; Amateur Phot., 1890, **30**, 146; Tech. Repert., 1889, 45.

(8) Eng. Pat. 9676, 1894; abst. this J., 1895. **14**, 987; Chem. Centr., **1896**, I., 465.

(9) Z. angew. Chem., 1899, **12**, 97; abst. Chem. News, 1899, **80**, 247; Jahr. Chem., 1899, 1280; Wagn., **1899**, **45**, 1065; Chem. Centr., **1899**, **70**, 337.

(10) Ber., **1898**, **31**, 1247; abst. J. Chem. Soc., **1899**, **76**, i., 469; Chem. Centr., **1898**, II., 31; Jahr. Chem., **1898**, 2010; Bull. Soc. Chim., **1898**, (3), **20**, 596.

(11) Monatsh., **1898**, **19**, 458; abst. J. Chem. Soc., **1899**, **76** i., 112; Bull. Soc. Chim., 1898, (3), **20**, 806; Jahr. Chem., 1898 1123; this J., **1898**, **17**, 895. Ber., **1899**, **32**, 2413; abst. J. Chem Soc., **1899**, **76**, i., 852; this J., **1899**, **18**, **941**; Chem. Centr. **1899**, II, 2140; Jahr. Chem., 1899, 1288; Bull. Soc. Chim. 1900, (3), **24**, 619; Annuario Soc. Chim., 1899, 27. Ber., **1901**, **34**, 1115; abst. Bull. Soc. Chim., 1902, (3), **28**, 817; Jahr. Chem., 1901, 878; Chem. Centr., 1901, **72**, I, 1197; J. Chem. Soc., **1901**, **80**, i., 370.

(12) Bull. Soc. Encour., 1900, (5), **5**, 321.

(13) Eng. Pat. 4886, 1902; abst. this J., 1903, **22**, 315. Fr. Pat. 316,500. 1901; abst. this J., 1902, **21**, 719; Mon. Sci., 1903, (4), **59**, 53. Aust. Pat. 17456, 1902, D.R. Anm. L-15737.

(14) Eng. Pat. 24,067, 1906; abst. this J., 1907, **26**, 1213; Fr. Pat. 371,447, 1906; abst. this J., 1907, **26**, 340; Mon. Sci., 1908, (4), **68**, 79; Chem. Tech. Rep., 1907, **31**, 149.

(15) U.S. Pat. 709,922, 1902; abst. this J., 1902, **21**, 1345. Eng. Pat. 20,660, 1902; abst. this J., 1903, **22**, 1011. Fr. Pat. 324,862, 1902; abst. this J., 1903, **22**, 646; Mon. Sci., 1904, (4), **60**, 43.

(16) Eng. Pat. 2026, 1907; abst. this J., 1907, **26**, 353. Fr. Pat. 369,123,1906; abst. this J., 1907. **26**, 91; Mon. Sci., 1908, (4), **68**, 28. D.R. Pat. 180,666, 1905; abst. Z. angew. Chem., 1907, **20**, 1786; Mon. Sci., 1909, (4), **70**, 77.

(17) Eng. Pat. 27,102, 1909; abst. this J., 1911 **30**, 19; Chem. Tech. Rep., 1911. **35**, 59. Fr. Pat. 409,405, 1909; abst. this J., 1910, **29**, 751.

(18) U.S. Pat. 1,090,074, 1914; abst. this J., 1914, **33**, 349; Chem. Abs., 1914, **8**, 1667.

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Birmingham Section.

Meeting held on October 23, 1919.

DR. R. S. MORRELL IN THE CHAIR.

SOME CHEMICAL ASPECTS OF THE POTASH INDUSTRY IN GREAT BRITAIN.

BY E. C. ROSSITER, F.I.C., A.C.G.I., AND CYRIL S. DINGLEY, A.I.C.

The importance of a home supply of potash is second only to that of the supply of combined nitrogen both as regards agriculture and industry. In the case of combined nitrogen the supply can be obtained from synthetic processes, from by-product recovery, and from natural deposits. In the case of potash the last two sources only are possible.

In this country potash occurs as a by-product in considerable quantities in the blast furnaces, the cement industry, and the wool-washing industry. This paper contains the results we have so far obtained from an examination of the possible production from the blast furnaces of England and Wales.

The information is by no means complete, as can be readily understood when it is stated that in 1917 there were some 240 blast furnaces in blast in England and Wales, and the preliminary examination of each furnace for possible potash production takes some seven days more or less. We have, however, after some three years' work, arrived at a stage when certain conclusions can be drawn as to the probable extent of potash production from this source.

It may be here stated that unless certain modifications are made in the routine of blast furnace management, namely, the simple addition of salt to the furnace charge combined with an adequate means of cleaning the furnace gases, it is very improbable that sufficient potash can be obtained to make a potash industry worth while. For, as will be shown, the greater portion of the potash charged into the furnace is carried into the slag; and the collection of the dust from the stoves and boilers will provide only a small portion of the potash requirements of the country, and then only of a very variable and inferior quality.

Our information is arranged under the following heads:—

(1) The sources of the potash in the furnace charge.
(2) The potash contents of the flue dust obtained from the flues, stoves, and boiler settings of blast furnaces, which is a small amount, is variable in composition, and usually of low potash content.
(3) The distribution of the potash in the blast furnace products.
(4) The increased volatilisation due to the addition of salt to the furnace charge.
(5) Some analytical notes on the estimation of potash carried by the furnace gases.

Source of the potash in the furnace charge.

An examination of materials used in the manufacture of pig-iron has shown, as was to be expected, that the chief source of the potash is the iron ore. In the accompanying tables is given the percentage of potash stated as KCl and of soda stated as NaCl in representative samples of iron ores from various localities, and also of limestones and cokes. Although these tables do not contain a complete survey of all the ores and other materials used in British blast furnaces, they furnish sufficient data to permit of accurate conclusions being drawn.

It is evident that the limestones and cokes do not, as a rule, contain much more than 0·1% of potash stated as KCl or about 3·5 lb. per ton of pig-iron made, but occasionally as much as 13–14 lb. per ton of pig is found in these constituents of the furnace charge.

The ores are arranged in groups according to the locality of the mines; the average content of potash in descending order of magnitude in these groups is as follows:—

Ores		%	%	%
Ferro-manganese	(7 samp.)	0·526	K_2O.=0·833 KCl,	0·067 NaCl
Northamptonshire	(37 ,,)	0·420	K_2O.=0·666 KCl,	0·524 NaCl
Cleveland ..	(13 ,,)	0·360	K_2O.=0·571 KCl,	0·709 NaCl
North Lincolnshire	(12 ,,)	0·258	K_2O.=0·568 KCl,	0·520 NaCl
Oxfordshire ..	(4 ,,)	0·305	K_2O.=0·48 KCl,	0·425 NaCl
Foreign	(22 ,,)	0·158	K_2O.=0·25 KCl,	0·47 NaCl
N.W. Coast ..	(18 ,,)	0·153	K_2O.=0·242 KCl,	0·399 NaCl

TABLE I.

FERRO-MANGANESE ORES.

	Name of mine.	Potash as KCl, %	Soda as NaCl %.
1.	Indian Central Prov. ..	1·16	0·79
2.	Indian-Nagpur	1·07	0·83
3.	Indian	0·93	0·87
4.	Indian-Kutchee	0·71	0·59
5.	Indian-Nagpur	0·51	0·44
6.	Gold Coast	0·81	0·79
7.	West African	0·64	0·36
	Average (7 samples) ..	0·833	0·667

TABLE II.

NORTHAMPTONSHIRE ORES.

	Name of mine.	Potash as KCl, %	Soda as NaCl, %
1.	Finedon	1·20	0·90
2.	,, ...	0·46	0·29
3.	,, ...	0·49	0·31
4.	Glendon	1·29	0·41
5.	,, ...	0·24	0·46
6.	Stamford	1·20	0·76
7.	,, ...	1·25	0·52
8.	Uppingham	1·17	0·53
9.	,, ...	1·00	0·35
10.	Leadenham	1·11	0·49
11.	Irthlingboro'	0·89	0·66
12.	Market Overton	0·87	0·43
13.	,, ,, ...	0·69	0·41
14.	Long Hill ,, ...	0·84	1·16
15.	Buckminster	0·84	1·11
16.	Hullswell	0·84	1·01
17.	Gretton	0·78	1·12
18.	Gayton Wood	0·64	0·38
19.	Maunsell No. 2	0·64	0·41
20.	,, No. 4	0·63	0·42
21.	,, No. 3	0·61	0·44
22.	Capt. Maunsell	0·61	0·62
23.	Dalkeith	0·65	0·37
24.	Kettering Glebe No. 1 ..	0·61	0·49
25.	,, No. 2 ..	0·48	0·42
26.	Booth's No. 3 ..	0·61	0·34
27.	,, No. 4 ..	0·31	0·29
28.	Miss Cole	0·40	0·46
29.	Oddfellowes	0·48	0·37
30.	Thorpe Glebe No. 2 ..	0·46	0·39
31.	Rockingham	0·41	0·61
32.	Hunters Close	0·40	0·55
33.	Weldon and Corby ..	0·32	0·53
34.	Deen Pit	0·31	0·39
35.	Unknown	0·23	0·22
36.	Byfield	0·23	0·32
37.	Blisworth	0·22	0·46
	Average (37 samples) ..	0·666	0·524

In the case of two mines, the adjacent strata to the ore bed have been sampled. At Messrs. Lysaght's mine at Scunthorpe the adjacent sand contains 1·50% KCl and 0·50% NaCl, and at the

Loftus mine in the Cleveland District the top shale contains 1·81% KCl and 2·29% NaCl, the bottom shale 1·07% KCl and 1·48 NaCl, and the Dogger 2·04% KCl and 1·91% NaCl. These figures are, of course, not taken in the average potash content of the ore; they show that a clean ore is likely to contain less potash than ore not clean, and generally it would appear that the best iron ores, *i.e.*, those used in the hæmatite furnaces, mostly of foreign origin, contain less potash than inferior ores.

Taking the above average potash contents and the average weight of ores used per ton of pig-iron—namely, ferro-manganese ores 39 cwt., Northamptonshire ores 51¼ cwt., Cleveland ores 72 cwt., North Lincolnshire ores 77 cwt., foreign ores 35½ cwt., N.W. Coast ores 39 cwt., the potential potash production per ton of pig-iron for each variety of ore is as follows:—Ferro-manganese ores 37 lb. KCl; Northamptonshire 38½ lb.; Cleveland 46 lb.; North Lincolnshire 49 lb.; foreign 10 lb.; N.W. Coast 10¼ lb. KCl. These figures, calculated from the average potash content of the ore samples, vary very considerably for different works and even for the same works at different periods, and an inspection of the individual potash contents of the ores shows that such variation is likely. However, notwithstanding these variations, a comparison of the calculated amount of potash going into a furnace with the amount coming out, that is, the amount found in the slag and the gas, shows in most cases a very fair agreement.

Table III.

Cleveland ores.

Name of mine.	Potash as KCl, %	Soda as NaCl, %
1. Grinkle	0·69	0·76
2. Belmont	0·87	0·88
3. Loftus S. Drift	0·80	0·85
4. Loftus	0·44	0·66
5. Loftus N. Drift	0·35	0·35
6. Kilton	0·78	1·02
7. Boulby	0·69	0·91
8. Whitcliffe	0·68	0·87
9. Lumpsey	0·61	1·14
10. North Skelton	0·55	0·90
11. South Skelton	0·51	0·84
12. Skelton	0·31	0·48
13. Park Pit	0·32	0·43
14. Eston	0·20	0·25
Average (14 samples)	0·571	0·739
Shal in Cleveland stone	1·75	1·25
Loftus top shale	1·81	2·20
Loftus bottom shale	1·07	1·48
Loftus Dogger	2·04	1·91

Table IV.

North Lincolnshire ores.

Name of mine.	Potash as KCl, %	Soda as NaCl, %
1. Frodingham pink stone	0·97	0·78
2. Chatterton	0·87	0·68
3. Sheepbridge	0·76	0·55
4. Lord St. Oswald	0·69	0·50 (Average 4 samples)
5. Frodingham blue stone	0·68	0·57
6. Redbourne Hill	0·82	0·38
7. Winn's	0·31	0·54
8. Lysaght's	0·24	0·42 (Average 3 samples)
Average (13 samples)	0·568	0·520
Lysaght's mines (sand)	1·50	0·50 (Average 3 samples)

Table V.

Oxfordshire ores.

Name of mine.	Potash as KCl, %	Soda as NaCl, %
Sydenham (2 samples)	0·41	0·40
Astrop (2 samples)	0·55	0·45
Average (4 samples)	0·48	0·425

Table VI.

Foreign ores.

Name of mine.	Potash as KCl, %	Soda as NaCl, %
1. Alquife	0·73	0·37
2. Villericos	0·68	0·97
3. San Miguel	0·57	0·58
4. Rubio	0·41	0·54
5. Sopressa Rubio	0·29	0·46
6. Cartagena	0·35	0·80
7. Tafna (N. Africa)	0·35	0·60
8. Calera	0·29	0·46
9. Franco Belge	0·28	0·37
10. Breira	0·28	0·37
11. Martinez	0·26	0·34
12 Garrucha	0·21	0·49
13. Beni Himmel	0·21	0·29
14. Zaccar	0·17	0·33
15. Roulna	0·15	0·30
16. Aurora	0·14	0·61
17. Beni Telkai	0·14	0·21
18. Djerissa	Trace	0·40
19. Temezrit	Trace	0·40
20. Obregon	Trace	0·45
21. Porman	Trace	0·25
22. Tharsis briquettes	Trace	0·85
Average (22 samples)	0·25	0·47

Table VII.

N.W. coast ores.

Name of mine.	Potash as KCl, %	Soda as NaCl, %
1. Cavendish Royalty	0·52	0·58
2. Burlington	0·43	0·47
3. Roanhead	0·38	0·42
4. Californian No. 1	0·37	0·53
5. Cleaton Winder	0·37	0·48
6. Stirlings	0·31	0·49
7. Ulleoats	0·29	0·36
8. Lonsdale	0·28	0·37
9. Stainton	0·23	0·32
10. Hodbarrow	0·21	0·39
11. Buccleuch	0·20	0·45
12. Washed Park	0·20	0·30
13. Oxen Close	0·20	0·30
14. Pennington	0·17	0·38
15. Wyndham	0·15	0·25
16. Newton Yariside	Trace	0·40
17. Anti Cross	Trace	0·35
18. Park fine jigged	Trace	0·35
Average (18 samples)	0·212	0·399

Table VIII.

Limestone.

Name of mine.	Potash as KCl, %	Soda as NaCl, %
1. Marsden	0·40	0·65
2. Clitheroe	0·34	0·41
3. Fulwell	0·26	0·49
4. Dyserth	0·20	0·36
5. Stainton	0·14	0·31
6. Tuthill	Trace	0·45
7. Yariside	Trace	0·40
8. Buxton	Trace	0·40
9. Bishop Middleham	Trace	0·35
10. Leyburn	Trace	0·35
11. Hopton Wood	Trace	0·35
12. High Peak dolomite	Trace	0·35
13. Bold Adventure	Trace	0·25
Average (13 samples)	0·103	0·393

TABLE IX.

COKE.

Locality.	Potash as KCl, %	Soda as NaCl, %
1. South Yorks	0·42	0·55
2. South Yorks	0·33	0·32
3. South Yorks, Lancs, and North Staffs	0·22	0·33
4. N.E. Lancs and W. Yorks ..	Trace	0·40
5. Saltley	0·29	0·51
6. Bridgwater	0·18	0·37
7. Not known	0·17	0·48
8. Not known	0·17	0·33
9. Durham	0·20	0·45
10. Durham	Trace	0·35
Average (10 samples) ..	0·098	0·409

The flue dusts obtained from the flues, stoves, and boiler settings of blast furnaces.

Some hundreds of analyses have been made to determine the potash contents of various flue dusts from blast furnaces. These dusts, provided they contain sufficient potash, and have been burnt in stoves or under boilers, can be used without further preparation in agriculture, and are therefore valuable as a source of potash. They vary considerably as regards their potash content even when obtained from the same works.

The heavy dust, *i.e.*, that obtained from the downcomer, heavy dust catcher, and the flues adjacent to the furnace, contains little potash, which numerous analyses have shown to vary from a slight trace to 2·05% of potash stated as KCl.

The dust from the stoves and boiler settings is usually valuable, and in Table X. are given a few typical analyses. From these figures it is seen that the soluble potash varies from 3% K_2SO_4 with 4% KCl in the same sample to 30·5% K_2SO_4; the potash insoluble in water varies from 3·6—11·4% stated as KCl, and the soluble impurities, namely—sodium and calcium sulphates and chlorides, also vary greatly.

The following analysis may be taken as a fair sample of the dust obtained from the stoves of an ordinary blast furnace where no cleaning plant is installed:—K_2SO_4, 10·01% KCl, 1·60; NaCl, 1·14; $CaCl_2$, 1·18. Total soluble in water, 13·93%; SiO_2, 26·49; Fe_2O_3 and Al_2O_3, 37·46; CaO, 9·69; MgO, 1·98; PbO, 0·69; ZnO, 2·30; K_2O, 4·83; Na_2O, 0·55; CO_2, 1·98%.

collected indicate about 12 cwt. of this dust per 100 tons of iron, or, on the average test of the above samples, about 2¼ lb. of potassium chloride per ton iron; this is less than 10% of the potash contained in the furnace charge. It is therefore evident that the systematic collection of this dust will provide only a very minute proportion of our potash requirements, and owing to the low potash content of many of the samples it will be suitable only for local use in agriculture.

Distribution of the potash in the products of the blast furnace.

The potash charged into the blast furnace comes out either in the slag or in the gas. In the slag it probably occurs combined with silicates, and in the gas as a very fine fume, which, after cooling, may contain the potassium as carbonate, bicarbonate, formate, cyanide, thiocyanate, sulphate, and chloride, with small quantities of bromides and iodides. It usually contains a very constant quantity of chloride with varying quantities of carbonate and a smaller quantity of cyanides. It varies considerably for each works. This fume is so fine that a sample of the gas, if drawn into a hot aspirator, shows no signs of settling after remaining for several hours.

In those works which do not clean their gas most of the potash carried in the gas eventually escapes up the chimney after the gas is burnt at the boilers and stoves, and is evident in the white fume issuing. A small proportion is deposited with the heavy dust collected in the dust catcher and the first portion of the gas main, and a larger proportion (but less than 10%) is deposited in the stoves and boiler flues, where, after the gas has been burnt, it is present as a mixture of sulphate and chloride. As previously stated, the quantities obtained in these various positions have not been carefully estimated. The few figures which we have collected indicate about two tons of heavy dust and 12 cwt. of boiler and stove dust per 100 tons of iron. This distribution of the potash has been determined in America by Wysor (Amer. Inst. Min. Eng., Feb., 1917, and Met. and Chem. Eng., **16**, 205; see this J., 1917, 327).

For the manufacture of potassium salts only that portion of the potash which is carried by the gas is available, unless the small quantities of stove dust are collected for this purpose, and therefore when considering the distribution of potash it is of the first importance to determine the quantities of potash present in the gas and in the slag at every

TABLE X.

DUST FROM STOVES AND BOILER SETTINGS.

	Soluble in water.						Alkalis insoluble in water.	
	K_2SO_4	KCl	Na_2SO_4	NaCl	$CaSO_4$	$CaCl_2$	As KCl	NaCl
	%	%	%	%	%	%	%	%
Bottom of chimney	26·95	—	4·71	0·22	—	1·43	5·03	1·63
Stove dust ..	9·65	—	1·60	—	2·08	0·22	6·50	2·09
Boiler ,, ..	30·58	—	2·89	3·27	—	—	9·37	2·40
Stove ,, ..	12·18	—	0·75	0·85	—	—	5·80	1·85
Boiler ,, ..	26·61	—	4·43	—	1·29	1·07	7·23	4·31
Boiler ,, ..	13·66	—	2·26	2·35	—	3·04	3·60	1·20
Stove ,, ..	26·70	—	4·44	0·19	—	—	4·86	3·57
Stove ,, ..	9·07	—	2·07	—	—	3·12	11·40	1·94
Stove ,, ..	9·34	4·73	—	2·64	—	2·89	4·58	1·14
Boiler ,, ..	18·76	—	10·83	0·37	—	4·23	Not estimated	
Stove ,, ..	2·93	3·92	—	4·66	—	2·77	,,	,,
Average ..	16·94	0·79						

We have not been able to estimate carefully the quantity of dust from the stoves and boilers per ton of iron made. The few figures which we have

blast furnace. In Table XI, these figures are given for 34 furnaces, the potash being given as KCl, and it is clearly seen what a comparatively small pro-

portion of the potash is present in the gas under ordinary conditions of blast furnace practice. In this table the furnaces are arranged in groups according to the type of ore used, and this naturally groups them more or less according to the type of iron produced. Moreover, the relative distribution of the potash in the gas and slag is very similar for each of the furnaces in the same group.

Taking the average figures for each group, it is seen that the greater the quantity of potash present in the ores the greater is the proportion remaining in the slag. Also, it is quite evident that unless a large proportion of the potash remaining in the slag can be transferred to the gas, a sufficient quantity of potash to make a potash industry worth while will not be available. The results of our experiments in this direction are discussed in the following section of this paper, where it is shown that by the simple addition of salt to the furnace charge a larger proportion of the potash is transferred from the slag to the gas (Eng. Pat. 112,338 of 1917). This process has been described by K. M. Chance (this J., 1918, 222 T).

The figures for the ferro-manganese furnaces are specially to be noted; here the whole of the potash is volatilised into the gas under normal working conditions, and a large proportion is obtained as carbonate.

The figures in Table XI. give a means of checking the calculations of the available potash made in the previous section of the paper from the potash contents of the ores used, and a very fair agreement is found. This comparison is seen in the following table:—

	Lb. KCl per ton of iron calculated from—	
	the ores.	the furnace product.
Northamptonshire ores	38½ lb.	50·6 lb.
Cleveland ores	46 lb.	52·6 lb.
North Lincolnshire ores	49 lb.	42·4 lb.
Foreign ores	10 lb.	14·8 lb.

The potash calculated from the furnace products, *i.e.*, that in the gas and the slag, contains also that introduced by the coke and limestone used, on the average about 4 lb. per ton of iron.

The quantities of potash indicated by the preceding figures as present in British blast furnaces must be taken as the basis from which the potentially available potash is calculated, until further investigation has provided a better average. It is therefore necessary to discuss any likely sources of error. The figures for the potash in the ores are in many cases calculated from analyses of what may be called the official samples of ores, representing the ore used over considerable periods, and these should be substantially correct.

When the potash obtained in the furnace products is estimated and compared with the potash charged into the furnace some undetermined factors come in. Without a supply of labour and supervision much greater than has, up to the present, been available, it is impossible accurately to weigh and sample the ores, coke, and limestone charged into the furnace. We know that the potash content of the ore varies considerably in each district, so that reliable figures will be obtained only by taking the average over long periods.

The quantity of slag produced by a furnace is not weighed, and the weight taken for these calculations is that estimated by the furnace managers. The gas produced cannot be accurately measured in its dirty condition, and is calculated from the average quantity of coke used, one ton of coke being assumed to give 150,000 cub. ft.

It is therefore surprising that the quantity of available potash, as calculated from the ores used, does not differ from the quantity calculated from the furnace products in a greater degree. In fact, the two calculations are sufficiently near for all practical purposes.

TABLE XI.

DISTRIBUTION OF POTASH IN THE GAS AND SLAG OF BLAST FURNACES.

Type of iron produced.	Potash as lb. KCl per ton iron.				Ores principally used.	Proportion of base to silica in slag. $\frac{CaO+MgO}{SiO_2}$.
	In gas.	In slag.	% in gas.	% in slag.		
Hæmatite ..	5·5	9·5	36·7	63·3	Foreign	1·47
,, ..	3·1	6·2	33·4	66·6	,,	1·52
,, ..	8·6	11·0	43·9	56·1	,,	1·32
,, ..	4·9	6·2	44·2	55·8	,,	1·60
,, ..	8·6	10·8	44·4	55·6	,,	—
Average.	6·1	8·7	40·5	59·5		
Special hæmatite	14·5	4·6	75·9	24·1	West Coast & Foreign	1·63
,, ,, ..	9·0	3·8	70·4	29·6	,,	1·56
Hæmatite ,, ..	6·8	5·5	55·3	44·7	,,	1·43
,, ..	7·4	10·5	41·4	58·6	,,	1·42
Special hæmatite	10·2	5·8	63·6	36·4	West Coast	1·59
Average	9·6	6·0	61·3	38·7		
Forge & foundry	20·1	19·8	50·4	49·6	Northants.	—
,, ,,	29·3	7·8	79·0	21·0	,,	1·50
,, ,,	12·0	49·0	19·7	80·3	,,	1·47
,, ,,	16·1	48·3	25·0	75·0	,,	1·36
Average	19·4	31·2	36·0	64·0		
Basic	27·0	37·0	42·2	57·8	N. Lincoln	1·42
,, ...	5·9	24·4	19·4	80·6	,,	1·52
,, ...	5·9	37·6	13·6	86·4	,,	1·44
,, ...	10·3	20·5	33·5	66·5	,,	1·50
Average	12·5	29·9	27·2	72·8		
Cleveland ..	9·1	40·3	18·5	81·5	Cleveland	1·56
,, ..	6·0	26·9	18·3	81·7	,,	1·56
,, ..	4·8	65·9	6·8	93·2	,,	1·15
,, ..	3·6	43·3	7·7	92·3	,,	1·30
,, ..	12·3	58·1	17·5	82·5	,,	1·25
,, ..	10·3	41·6	19·9	80·1	,,	1·47
,, ..	3·0	31·9	8·6	91·4	,,	1·47
,, ..	9·0	54·6	14·2	85·8	,,	1·31
Average	7·3	45·3	13·8	86·2		
Hæmatite & basic	7·5	13·8	35·3	64·7	Foreign & Northants	1·47
Basic	10·3	33·6	23·5	76·5	N. Lincs. & Northants.	1·47
,, ...	7·1	21·2	25·1	74·9	N. Staffs & Northants.	3·10
,, ...	8·7	24·9	25·9	74·1	Oxford & Northants.	1·62
,, ...	2·4	23·8	9·2	90·8	Oxford.	1·20
Average	7·2	23·5	23·8	76·2		

	Lb. per ton of metal.				
	In gas.			In slag.	
	K_2CO_3	KCl.	Na_2CO_3	as KCl.	
Ferro-manganese	64·6	38	10·8	None.	1·66
,,	58·5	12	22·0	2	1·58
,,	58·8	13·4	14·7	2	1·58
Average	60·6	21·1	17·8	1·3	
Spiegeleisen ..	22·2	7·4	9·0	Trace.	1·58

This agreement is not shown in the case of furnaces making ferro-manganese, where the potash calculated from the gas is considerably more, and in one case double that calculated from the furnace charge. This requires further investigation, and at present we can only suggest that at these furnaces potash is being deposited in the stoves whilst they are heating up, and being blown from there into the furnace by the hot blast and so going round and round. This may be happening

also at other furnaces, although the figures do not show it except in one case.

In Table XII. is given a more detailed account of the comparison of the potash charged into the furnace with that coming out. The results are from seven furnaces. At the North Lincolnshire Iron Co. daily analyses were made of the gas and slag from two furnaces for eleven weeks and the weights of ore and coke recorded as accurately as possible. In No. 2 furnace 20% less and in No. 4 furnace 10·4% less potash was found in the furnace products than that calculated in the materials charged. During the period when salt was added to these furnaces the two calculations agreed to within 0·5%.

TABLE XII.

COMPARISON OF THE CALCULATED QUANTITY OF POTASH IN THE CHARGE WITH THAT FOUND IN THE GAS AND SLAG.

Works.	Date.	Lb. per ton iron. Potash contents (as KCl) of charge to furnace.		Potash contents (as KCl) of products from furnace.	
North Lincs. Iron Co. No. 2 Furnace	Aug., 1916, 5 weeks.	Ore .. 59·2 Coke .. 12·8		Gas .. 26·8 Slag .. 29·9	
		Total ..	72·0		56·7
„	Sept., 4 weeks.	Ore .. 59·2 Coke .. 12·6		Gas .. 30·4 Slag .. 25·6	
		Total ..	71·8		56·0
„	Oct., 2 weeks.	Ore .. 58·9 Coke .. 13·0		Gas .. 31·5 Slag .. 26·8	
		Total ..	71·9		58·3
No. 4 Furnace	Aug., 1916, 5 weeks.	Ore .. 60·1 Coke .. 12·8		Gas .. 29·0 Slag .. 33·1	
		Total ..	72·9		62·1
„	Sept., 4 weeks.	Ore .. 61·0 Coke .. 13·5		Gas .. 31·5 Slag .. 36·8	
		Total ..	74·5		68·3
„	Oct., 2 weeks.	Ore .. 58·9 Coke .. 12·8		Gas .. 36·7 Slag .. 29·0	
		Total ..	71·7		65·7
Northampton-shire Works.	Sept., 1918, 6 days.	Ore .. 20·0 Coke .. 8·3 Limestone 2·5		Gas .. 20·1 Slag .. 19·8	
		Total ..	39·8		39·9
Cleveland Iron Works.	Oct., 1918, 4 days.	Ore .. 36·9 Coke .. 5·9 Limestone 3·5		Gas .. 9·1 Slag .. 40·3	
		Total ..	46·3		49·4
Cleveland Iron Works.	Nov., 1917, 17 days.	Ore .. 46·2 Coke .. 5·1 Limestone 0		Gas .. 12·3 Slag .. 58·1	
		Total ..	51·3		70·4
Ferro-manganese Works	Oct., 1918, 4 days.	Ore .. 39·6 Coke .. 11·8 Limestone 3·0		Gas .. 107·7 Slag .. None	
		Total ..	54·4		107·7
„	Dec., 1917, 4 days.	Ore .. 34·9 Coke .. 9·8 Limestone 2·2		Gas .. 74·2 Slag .. 2·0	
		Total ..	46·9		76·2

In the case of a Northamptonshire furnace and of a Cleveland furnace, the agreement was as good as could be desired; a second Cleveland furnace, however, gave 40% more potash in the furnace products than was calculated as in the furnace charge. This difference may be due to potash going round and round, and another possible explanation is that unselected ore was being used, the shale and dogger adjacent to the ore containing from 1·07 to 2·04% KCl, whereas the average ore contained only 0·57% KCl.

Finally, the results from the furnaces making ferro-manganese show the wide difference previously mentioned as occurring in the two methods of calculation for these furnaces.

The increased volatilisation of potash due to the addition of salt to the blast furnace charge.

In the paper by Mr. Kenneth Chance, entitled "The Prospects of Founding a Potash Industry in this Country" (this J., 1918, 222 T), is an account of experiments which were made with the object of volatilising a large proportion of the potash. These experiments were made at the North Lincolnshire Iron Co.'s works, and at first an attempt was made to increase the volatilisation of the potash by the addition of more lime and then by also increasing the temperature of the furnace. As stated in that paper, only inconclusive results were obtained as regards the volatilisation of the potash; but it appeared that the increased cost of the coke was more than sufficient to make such alterations to the normal working of the furnaces unprofitable. A detailed description of these experiments is unnecessary, because about twelve months after completing them, when furnaces making ferro-manganese were examined, it was found that in these furnaces working with a highly basic slag and at a higher temperature the whole of the potash was volatilised, showing that a highly basic charge furnaced at high temperatures will volatilise all the potash.

The reason for adding salt to the furnace charge is also discussed in Mr. Chance's paper; briefly, it was found that the gas from the furnaces working at the North Lincolnshire Iron Co.'s works always contained a fairly constant quantity of potassium chloride, about 8 lb. per ton of iron, whereas the potassium carbonate was varying from 3 to about 35 lb. per ton of iron. This quantity of chloride was fairly constant for all the furnaces at four works on the North Lincolnshire iron ore bed, and varied from 6 to 9 lb. per ton of iron. In the case of furnaces using other ores such constant figures were not obtained. At four works using Northamptonshire ores the chloride in the gas varied from 10 to 22 lb. per ton or iron, and in the case of furnaces using Cleveland ores a still wider variation was found, from 6 to 24 lb. per ton of iron. The charge in many of these furnaces using Cleveland ores contains an excess of chlorides, so that dust carried by the gas is often not alkaline, and, besides containing potassium and sodium chlorides, also contains calcium, iron, and aluminium chlorides. For example, the chlorides carried by the gas were found, in the case of six furnaces using Cleveland ores, to be as follows:—

LB. PER TON IRON.

KCl.	NaCl	Ca, Fe, and Al chlorides.
12·3	7·5	8
9·1	4	4·5
6·0	1	0
10·3	3·5	3
9·0	4	0
4·8	2·7	4

Notwithstanding this excess of chlorides, when salt was added to a Cleveland furnace, a considerable increase was obtained in the quantity of potash volatilised. Up to the present the effect of the addition of salt to the furnace charge has only been examined at five works, and the results are given in Table XIII. The potash volatilised into the gas has been at least doubled, and in the case of a furnace

at Palmer's Shipbuilding and Iron Co.'s works increased nearly five times, namely, from 4·8 lb. to 22·3 lb. per ton iron.

The effect of adding salt to the furnace charge has been studied since February, 1917, and the results are at present far from being complete. In experiments of this type it is several years before conclusive results are obtained, because it is impossible sufficiently to control the conditions in the furnace, in respect to variations in the potash content of the charge, the proportion of bases to silica in the slag, the temperature and the regular working of the furnace; and, as far as our experiments have gone at present, there are differences at different works which we are unable to explain.

Result of addition of salt to the furnaces at the North Lincolnshire Iron Works.

At North Lincolnshire Iron Works the iron produced is principally basic. Salt has been added to these furnaces for a longer period and more continuously than at any other works. The preliminary experiments were made here, and a good deal of necessary experience gained. Turning to the results in Table XIII., which contains the results from the commencement, it is seen that the addition of an average of 41·4 lb. of salt per ton of iron has resulted in an increase from 27·0 lb. to 56·7 lb. of potash stated as KCl volatilised into the gas. During part of the time to which these figures relate, more salt was added than was necessary, since we were then experimenting to determine the most advantageous quantity. For some considerable time 25 lb. of salt per ton of iron has been added, and has resulted in the amount of potash in the gas being raised from 27·0 lb. to 52·6 lb. (as KCl), or a trifle over 1 lb KCl for each pound of salt used. It is probable that 25 lb. of salt is not sufficient, and this quantity is being gradually increased. The table shows no correspondence between the amount of salt added and the amount of potash in the gas, owing to the variation in the amount of potash in the furnace charge and the impossibility of continually adjusting the quantity of salt to this variation—a state of affairs which will always exist, necessitating an average adjustment of the quantity of salt over long periods.

The effect on the potash in the slag is an average reduction from 1·10% to 0·48% KCl, but many of the slags contained as little as 0·20%, the variation being due to the impossibility of adjusting the quantity of salt as explained above. However, the figures indicate that the greater the quantity of salt added the less potash will remain in the slag, and individual results show this very clearly, but we have not considered it advisable to give these, as the paper is already overburdened with figures.

The effect of adding salt on the composition of the flue dust is seen in the following analyses:—

FLUE DUST.

	No salt; %.	25 lb. salt per ton of Iron; %.
KCN	5·00	0·97
K_2CO_3	5·35	—
$KHCO_3$	18·70	—
KSCN	0·15	—
K_2SO_4	1·19	0·25
$KHCO_3$	3·66	—
KCl	11·11	54·89
Na_2CO_3	2·70	4·24
NaCl	—	5·32
Insol. in water	51·25	31·09

The alkalis and cyanides are much reduced, the chlorides correspondingly increased, and an increase has occurred in the proportion of sodium salts, which is, however, not serious.

The addition of salt at Messrs. Lysaght's works, Scunthorpe.

At Messrs. Lysaght's works the iron produced is basic. The management of this works could only allow experiments to be made with salt on one of their furnaces which was just about to be blown out, as they were disinclined to risk much interference with their production of iron by any possible action of the salt. We may here state that the use of salt has up to the present disclosed no adverse results as regards the manufacture of pig-iron. Unfortunately, owing to the condition of the furnace the experiments were occasionally interrupted. The addition of an average of 34 lb. of salt per ton of iron increased the volatilised potash from 5.9 lb. to 18·2 lb., at the same time the alkalis disappeared from the gas, and chlorides of calcium, iron, and aluminium were found. The potash in the slag increased from 0·66% to 0·79% KCl. This may have been due to an increase in the potash in the furnace charge, but probably also to the fact that the furnace was worn out and portions of the furnace lining were being carried down with the charge.

The results are very inconclusive. Our opinion is that a substantial increase in the potash volatilised occurred due to the addition of salt, but further investigation is required, more especially as this furnace was working similar ores to the North Lincolnshire furnaces, where very satisfactory results are being obtained.

The addition of salt at Ebbw Vale Victoria Furnaces.

At Ebbw Vale the iron produced is hæmatite. The investigations were over a much shorter period, and the figure for the potash in the gas under normal conditions was an average of tests made during occasional periods of a week or so at a time. This was 5·5 lb. KCl per ton of iron. On the addition of salt for various experimental periods the potash in the gas was increased to an average of 13·9 lb. At times more than the necessary calculated quantity was added for the purpose of ascertaining the effect. The average quantity used was 12 lb. of salt per ton of iron. As only 13·9 lb. KCl was in the gas during the period, it will be seen that the yield of potash per lb. of salt was not as good as at North Lincs., as the increase was only 8·4 lb. KCl, or 1 lb. KCl for 1·43 lb. NaCl used. The result is not as good as we have reason to believe it might have been, because the ores used at these furnaces were from different foreign ports and the supplies due to shipping difficulties were usually short; therefore the ores could not be mixed as desired to ensure a regular burden on the furnace, but had to be used as received. It can easily be understood, therefore, that the potash in the furnace charge was a constantly varying factor, and that it was impossible properly to adjust the quantity of salt necessary to release the potash.

It is interesting to note that during one experiment in October, 1917, a criticism was put forward that the addition of salt to the furnace had little effect in increasing the amount of potash in the gas, but merely changed the potash which already existed there as alkali into chloride. In order to solve this point tests were made contemporaneously on two furnaces over a period of five days, one using salt at the rate of 10 lb. per ton of iron and the other using no salt. The results were: With salt, 11·5 lb. KCl per ton iron in gas; without salt, 1·96 lb. As the conditions were nearly, though not quite, identical in other respects, these may be taken as a fair indication of the result of adding salt. The potash content of the ores used varied from 0·14% to 0·38% KCl. The potash in the slag was reduced from 0·73% to 0·47% KCl, wide variations occurring in the slags obtained whilst salt was being used, as in the case of the North

Lincolnshire Iron Co.'s furnace, and for similar reasons.

The very considerable effect which the salt had on the composition of the dust collected in the gas-cleaning plant is seen from the following analyses:—

FLUE DUST.

No salt added.		12 lb. salt per ton of iron.	
	%		%
H_2O	4·77	H_2O	3·16
KCl	11·95	KCl	32·05
K_2SO_4	0·45	NaCl	11·65
$K_2S_2O_3$	0·81	$CaCl_2$	3·07
Na_2CO_3	1·00	$FeCl_3$	1·15
NaCl	2·20		
Soluble in water	21·18	Soluble in water	51·08
PbS	4·60	PbS	
Fe_2O_3, Al_2O_3	13·63	Fe_2O_3, Al_2O_3	45·8
CaO	30·49	CaO	
MgO	8·17	MgO	
SiO_2	16·28	SiO_2	
K_2O	4·10	K_2O	1·8
Na_2O	1·45	Na_2O	0·9
C and Prussian blue	Trace		
	99·90		99·58

Therefore, by the addition of salt a poor flue dust containing 13% of potassium salts is replaced by one containing 32% KCl, and the insoluble potash is greatly reduced. Experiments at these works are shortly to be resumed under more favourable conditions.

The addition of salt at Messrs. Palmer's Shipbuilding and Iron Co.

At Messrs. Palmer's Shipbuilding and Iron Co., Ltd., furnaces making basic iron, hæmatite iron, and Cleveland iron have been experimented with. The results are seen in the following table:—

POTASH AS KCl PER TON IRON IN THE GAS WITH AND WITHOUT SALT.

Hæmatite furnace.		Basic iron furnace.		Cleveland iron furnace.	
Lb. salt used.	Lb. KCl in gas.	Lb. salt used	Lb. KCl in gas.	Lb. salt used.	Lb. KCl in gas.
15	12·4	40	29·1	25	18·4
20	16·1	45	25·2	40	16·6
18	21·3	40	21·3	30	22·0
11	17·5	40	26·2	35	27·0
11	16.1	35	24·0	40	27·1
5	12·4	35	13·3	45	29·0
10	15·2	30	15·6	37	25·2
—	—	30	16·8	40	27·2
—	—	—	—	30	16·2
Average . 13 Lb. KCl in gas without salt	16·0 / 7·2	37	21·5 / 6·9	37	23·2 / 4·7

In all three cases a large increase has occurred in the potash volatilised into the gas.

The hæmatite furnace, using only foreign ores containing a small percentage of potash has, on the average, given an increase of 9 lb. KCl for 13 lb. of salt, and during the last four periods, when the salt was more advantageously adjusted, an increase of 8·1 lb. KCl for 9·2 lb. of salt. When the salt is properly adjusted there is every prospect that 1 lb. of KCl will be obtained for every pound of salt used.

The basic iron furnace using 55–70% Cleveland ore mixed with foreign ores has, on the average, given an increase of 14·6 lb. KCl. per 37 lb. of salt, or 1 lb. KCl for each 2½ lb. of salt used.

The Cleveland iron furnace using 94% Cleveland ore has, on the average, given an increase of 18·5 lb. KCl per 37 lb. of salt, or 1 lb. KCl for each 2 lb. of salt used. In both these furnaces the result is very similar. A substantial increase in the potash volatilised into the gas is obtained, but the potash in the slag cannot on the average be reduced to less than 1·0% KCl; that is, the greater portion of the potash remains in the slag. A larger quantity of salt will reduce the potash in the slag, although up to the present we have never obtained a satisfactory reduction; but with this larger quantity of salt the proportion of sodium chloride volatilised into the gas is so high that the separation of the sodium and potassium salts at the potash works is rendered more costly.

We believe this retardation of the action of salt in furnaces using Cleveland ores to be due to the low ratio of lime and magnesia to silica in the slags from these furnaces. Before salt is added the fume carried by the gas is neutral, and contains chlorides of calcium, iron, and aluminium, so that there is already present more than sufficient hydrochloric acid to combine with the potassium which is volatilised, but the low working temperature of the furnace may also retard the volatilisation of the potash.

The effect of adding salt on the dust collected in the cleaning plant is very marked, as is seen in the following analyses, which show the composition of the dust collected from the mixed gas from all these furnaces:—

No salt.			Salt added.			
KCl	..	11·32%	H_2O	..	1·21%	Soluble in water
K_2CO_3	..	3·90%	KCl	..	26·20%	
Na_2CO_3	..	5·34%	NaCl	..	11·10%	
			$CaCl_2$	..	2·19%	
			$AlCl_3$	..	0·55%	
		20·56%				41·34
			SiO_2	..	13·30%	
			PbS	..	10·32%	
			ZnO	..	3·22%	
			Al_2O_3 & Fe_2O_3		10·38%	
			$CaCO_3$	..	12·01%	
			CaO	..	4·10%	
			MgO	..	3.50%	
			K_2O	..	0·58%	
			Na_2O	..	1·26%	
					100·01	

The addition of salt has replaced a comparatively poor dust containing 15% of potash salt by one containing 26% KCl, which is the same effect as was observed at Ebbw Vale.

When the results obtained by the use of salt at these four works are compared, those at the North Lincolnshire Iron Co. differ considerably from the others as regards the percentage of alkali salts in the dust with and without salt. The flue dust at these works, before the addition of salt, contained a very high percentage of alkali salts. On the addition of salt the percentage of alkali salts in the flue dust is increased only moderately. Apparently the dust before the addition of salt carried almost as much alkali salts as it was able, the increased volatilisation of alkali salts resulting in a large increase in the amount of dust carried by the gas. Both at Palmer's Shipbuilding and Iron Co.'s works and at Ebbw Vale the dust before the addition of salt contained a low percentage of alkali salts, and on adding salt this percentage was greatly increased to a figure which, although lower than that obtained at the North Lincolnshire Iron Co.'s works, is of the same order. At all furnaces which are provided with an adequate gas-cleaning plant the potash is removed without incurring any extra cost, except that for the salt added. It is therefore quite worth while to add salt for the pur-

pose of collecting the comparatively small quantity of potash which will then be volatilised from hæmatite furnaces using foreign or North-West Coast ores, as the percentage of potash contained in the collected dust is comparatively high in the case of those hæmatite furnaces to which salt has been added.

TABLE XIII.

SALT EXPERIMENTS.

Date.	Lb. salt per ton iron.	Potash as lb. KCl per ton iron.		Distribution of KCl.	
		In gas.	In slag.	% in gas.	% in slag.
NORTH LINCOLNSHIRE IRON CO. N. LINCS. ORE. BASIC.					
1917.					
Feb. 2–14 ..	56	57·8	19·5	74·7	25·2
„ 15–20 ..	56	73·6	13·1	84·9	15·1
„ 21–Mar. 3 ..	50	54·2	12·7	81·0	19·0
Mar. 4–15 ..	46	48·3	13·1	78·7	21·3
„ 10–16 ..	28	61·2	20·5	74·9	25·1
„ 18–28 ..	34	57·8	16·4	77·9	22·1
28–Apr. 3 ..	36	48·1	13·1	78·6	21·4
1919.					
Feb. 26–27 ..	25	52·6	20·5	72·1	27·9
Average ..	41·4	56·7	16·1	77·9	22·1
LYSAGHT'S WORKS. N. LINCS. ORE. BASIC.					
1917.					
Mar. 10–18 ..	34	15·4	24·4	38·7	61·3
„ 19–Apr. 4 ..	30	17·4	34·0	33·8	66·2
Apr. 13–20 ..	30	13·7	30·6	31·0	69·0
„ 23–May 8 ..	40	21·2	29·2	42·1	57·4
May 14–June 7 ..	35	23·2	27·7	45·6	54·4
Average ..	34	18·2	29·2	38·3	61·7
EBBW VALE (VICTORIA FURNACES) FOREIGN ORE.					
1917.					
Sept. 28–Oct. 4 ..	10	12·7	4·2	75·2	24·8
Oct. 10–13 ..	16	14·9	10·4	58·9	41·1
„ 14–17 ..	11	13·0	5·0	72·2	27·8
1918.					
Feb. 23–27 ..	12	14.8	4.7	75.9	24.1
Average ..	12	13.9	6·1	70.6	29·4
PALMER'S (JARROW). CLEVELAND ORE.					
Apr. 28–30 ..	35	21·8	48·3	31·1	68·9
May 7–11 ..	40	16·5	47·3	25·9	74·1
„ 23–31 ..	30	22·3	39·6	36·0	64·0
June 10–17 ..	35	28·6	32·6	46·0	54·0
„ 20–July 4 ..	42	22·2	27·9	44·3	55·7
Average ..	36	22·3	39·3	36·7	63·3
PALMER'S (JARROW). FOREIGN ORE. HÆMATITE.					
1918.					
Apr. 18–25 ..	15	16·8	4·8	77·1	22·9
May 8–10 ..	15	12·5	2·3	84·5	15·5
„ 13–20 ..	20	16·1	3·6	81·7	18·3
Average ..	17	14·9	3·6	81·1	18·9
PALMER'S. CLEVELAND ORE. BASIC.					
1917.					
Aug. 27–28 ..	20	16·0	34·2	31·9	68·1

Analytical methods.

The difficulty of obtaining an average sample of the gas issuing from a blast furnace presented a grave problem at the commencement of this investigation. Ordinary methods of taking samples of gas by means of comparatively small glass apparatus were useless. The large quantity of dust and steam carried by the gas necessitates special apparatus, and, owing to considerable variations taking place from hour to hour, it is necessary to take a continuous sample over several hours. We find that a reliable test can be obtained by passing from 20–100 cub. ft. of the gas through the apparatus, allowing this quantity to pass in from 8 to 24 hours. The larger the quantity and the longer the duration of the test the more reliable is the result. In order that a representative sample may be obtained it is necessary to choose a straight portion of the gas main, so that the gas is fairly free from eddies, and to take the sample from a point about one-third of the diameter of the main from the circumference. This point must not be too near to the furnace, because then the apparatus may quickly become choked with the heavy dust; nor must it be so far away that any appreciable quantity of the light dust has settled. We find that about 20–30 yds. from the furnace is usually a good point to choose, but experience alone enables the operator to choose the point, and very often, owing to the arrangement of the gas mains, the operator is obliged to select a point which is not altogether suitable.

The apparatus which we have used with success for some considerable time consists of a thin-walled iron tube, A, ¾ in. diam., about 3 ft. long, closed at one end, and with a ¾-in. hole in the side near the closed end. This tube is placed in the gas main so that the ¾-in. hole is facing in the same direction as the gas current. A joint is made at D by putting fireclay round the tube and into the outer wall of the gas main.

The open end of the tube is fitted with a rubber bung, enabling connection to be made with the glass funnel, B. This funnel is charged with three separate wads of cotton-wool, previously dried before a fire so as to make the fibres separate; a catch-bottle, C, is provided before the gas goes to the meter. The gas is drawn through the apparatus by suction, which can be provided by any suitable means. If an aspirator is used it should contain not less than 5 cub. ft. After the gas has been drawn through the apparatus for a sufficient time the apparatus is washed out with water, the solution filtered, made up to bulk, and analysed by the ordinary methods. We have always determined the potassium salt by precipitation as potassium platinic chloride.

This sampling work has to be carried out in the open, often in a very exposed place, and it is necessary to see that the apparatus is securely held in place. We have more than once had the apparatus, including the gas meter, carried away in a storm.

Conclusion.

From the results obtained by the addition of salt to those few furnaces to which it has been added up to the present, we can conclude that in the case of furnaces using North Lincolnshire ores about 80% of the potash will be volatilised into the gas, and be therefore recoverable by the use of adequate gas-cleaning plant; the hæmatite furnaces will also yield about 80% of the potash, and the furnaces using Cleveland ores about 33% of the potash contained in the furnace charge.

If we assume that the Northamptonshire and N.W. Coast ores will yield 80% of the potash, as we may fairly do from the information we have gained about these ores, the remaining home ores 33% of the potash and the coke used 50% of the potash contained in these materials, we can from the Home Office report of the quantities of ores and coke used in British blast furnaces in 1917 calculate the potential production of potash from this source.

The figures are as follows:—

Variety of ore.	Tons used.	Tons KCl. contained	% recovery expected.	Tons.
Leicester Northants Lincolnshire	6,441,937	39,630	80	31,704
N.W. Coast	1,261,002	3,052	80	2,442
Cleveland	4,851,802	27,704	33	9,234
Other home ores	2,290,993	6,873	33	2,291
Foreign ores	6,189,633	15,474	80	12,379
Coke	10,485,239	10,485	50	5,242
Total KCl		103,218	Total KCl recoverable	63,292

A potash industry obtaining raw material from the blast furnaces of England and Wales will therefore be able to provide potassium salt equivalent to some 63,000 tons of potassium chloride per annum, on the exceedingly conservative figures upon which we have based this calculation.

In this table we have not taken into account the potash now going to waste in the manufacture of ferro-manganese, we have made no allowance for the substitution of home ores for foreign ores, which is so rapidly developing, nor have we calculated upon any improvement in the recovery of potash from furnaces using Cleveland ores, although the margin for improvement is very large. If these factors are taken into consideration we are of the opinion that a conservative estimate of the potash which can be recovered from the blast furnaces of England and Wales may be taken at 80,000 tons per annum as KCl, equivalent to some 50,000 tons of potash expressed as K_2O. This potential output from this source alone may be taken as approximately double the pre-war consumption of this country.

We are indebted to the Directors of the British Cyanides and the British Potash Companies for permission to publish these results, to Mr. Kenneth Chance for kindly reading the paper and for advice, to the management of numerous blast furnace works for valuable assistance whilst we were making investigations at their furnaces, and to Mr. P. H. Sanders who has done a large proportion of the analytical work.

DISCUSSION.

The CHAIRMAN asked if the durability of the linings of the furnace were affected by the addition of salt.

DR. SLATER PRICE raised the question whether the potash recovered would be able to compete with the foreign product.

MR. H. SILVESTER said that furnace owners would welcome information as to a cheap gas cleaning apparatus. Furnace gas must be clean if it was to be used in gas engines.

MR. DINGLEY, in reply to the Chairman, said that so far as they had been able to discover no injury of this kind was occasioned.

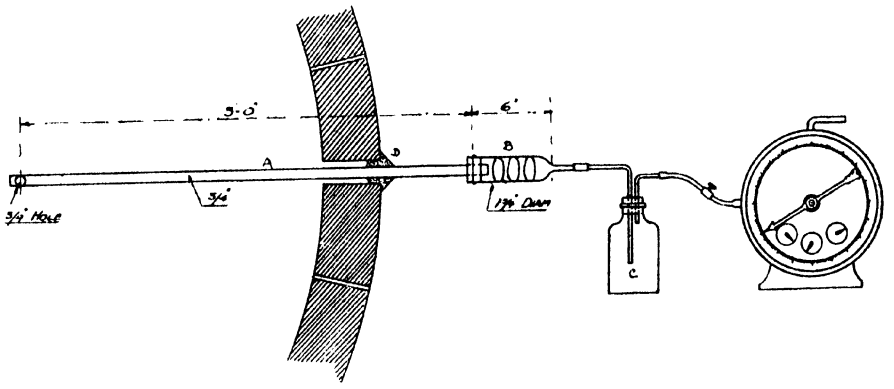
MR. ROSSITER, in reply, said that a substantial amount of potash was made every week at Oldbury from the blast furnaces. He emphasized the fact that after the necessary apparatus had been provided, the extra recovery of potash was obtained without any expense except that of the salt added.

ERRATA.

METHOD FOR THE ANALYSIS OF NITROUS GASES. By A. Geake and F. J. Squire (this J., Oct. 31, 1919, 367—369 T).

PAGE 369 T, col. 1, last equation, for "W w" read "W/w."

Page 369 T, col. 2, in the denominator of the equation, for "O_2" read "CO_2."



London Section.

Meeting held at Burlington House on November 3, 1919.

MR. JULIAN L. BAKER IN THE CHAIR.

BLACK-LEAD PENCILS AND THEIR PIGMENTS IN WRITING.

BY C. AINSWORTH MITCHELL, M.A., F.I.C.

On several occasions during the past few years specimens of pencil writing have been submitted to me for examination. At first I accepted as correct the statement of Dennstedt and Voigtländer (Baumert's Lehrb. Gerichtlichen Chemie, 1906, II., 71) that it is not possible to differentiate between the writing done with different pencils, but subsequently I found that the problem was by no means hopeless, and that under favourable conditions the pigments may be distinguished on paper.

Cognate with this question was an investigation which I made for a firm of pencil manufacturers as to the suitability of certain kinds of graphite for black-lead pencils; and, as is so often the case with work of this kind, I found that the literature on the subject was exceedingly scanty, and that it was necessary to discover for myself the reasons underlying changes in the manufacturing processes in the evolution of the industry.

Early metal pencils.—Prior to the discovery of graphite, pencils were composed of metallic lead or alloys of lead which were cast into a suitable shape and wrapped in paper holders. Pencils of this type continued in common use until late in the eighteenth century, and are not entirely extinct at

the present day. One composition used for such pencils was Arcet's mixture, consisting of 5 parts of lead, 2 parts of tin, and 8 parts of bismuth. Another alloy, known as Rose's mixture, consisted of 1 part of lead, 1 part of tin, and 2 parts of bismuth. About $\frac{1}{16}$ part of mercury was sometimes added to make these mixtures softer to use. Carlier's metal pencils, which were in common use in Germany, consisted of 70 parts of lead, 30 parts of bismuth, and about 8 parts of mercury.

Graphite was discovered at Borrowdale about 1560, and from that time until the latter half of the nineteenth century the black pencils used all over Europe were derived from the Cumberland mine. The graphite was simply sawn into thin veneers with a wedge-shape edge, which was glued into a square groove in the wood and then sawn off flat with the surface, and the upper segment of wood was glued down on this.

A proof that this was the method in use in the 16th century and incidentally of the antiquity of English black-lead pencils is afforded by the description and illustration of a pencil in Gesner's book, *De Rerum Fossilium Lapidum et Gemmarum Genere*, 1565, Vol. II., p. 105. Fig. 1, I., shows the graphite cut into the wedge, and II. a complete pencil. In the text Gesner states that in his opinion the material was an artificial kind of lead, which some described as "English antimony."

A fuller description of the properties and uses of graphite is given by Cæsalpinus (*De Metallicis Libri Tres*, Paris, 1602, Cap. VII., p. 186), where it is mentioned that it was known as "Flemish stone," owing to its being imported to the Continent by way of Belgium, and that in Germany it was termed "bismuth," and regarded as a mixture fused with antimony for producing characters on paper. It was left for Scheele in 1779 to demonstrate the true nature of graphite.

The graphite from which the early pencils were made was chosen, according to its grade of hardness and blackness, for making the different types of pencils. According to Ure (1823) it was sometimes boiled in oil before being sawn up, with the object of obtaining a product which would give a softer and more uniform marking. In other pencil works the graphite was heated in luted crucibles to harden the pigment.

About the year 1840 the Borrowdale mine, which at first was only worked for a few weeks in the year, but later more continuously, showed signs of exhaustion, and various methods of utilising the graphite dust in the works were tried. The most successful of these was Brockedon's process (Eng. Pat. 9977, 1843), according to which the finely-sifted graphite was subjected to a pressure of about 5000 tons per sq. in., while air was simultaneously exhausted from the press. This yielded compact blocks of graphite, which could be sawn up in the same way as the natural graphite. Specimens of Brockedon's compressed graphite may be seen in the Geological Museum, and the tests I have made with them show that it was an excellent substitute for the natural product.

This method was used by several English manufacturers, and it was not until 1869 that the Cumberland graphite was finally exhausted, and that composite pencils came into general use.

In 1761 Faber's works were established in Nüremberg, and mixtures of powdered graphite with sulphur, resins, gums, and other ingredients were used for pencil pigments, but the modern process of pencil manufacture originated in 1795 with Conté of Paris.

Conté's process consisted in mixing finely-elutriated clay and graphite into a paste, which was forced through small openings in a cylinder so as to produce circular threads of pigment. These were dried, heated in a covered crucible, and glued into the grooves in the wooden holder. The hardness of the pencil depended upon the proportion of clay and the degree of baking. This process was introduced into this country early in the nineteenth century, and overlapped the older process, which continued to be the principal one. A further development was the incorporation of wax with the pigment, and for this purpose apparatus was devised in which the melted wax was introduced into the material after creation of a partial vacuum. Incorporation of the pigment with wax dates back to about the year 1840. Various other additions, such as lampblack, sulphur, and resin, have from time to time been incorporated ith the graphite composition, and the pigments in some of the cheaper grades of pencils, such as No. 21 in the list below, consist largely of lampblack.

Graphites for pencil making.—The original Cumberland graphite acquired a deserved reputation for softness and tone, and some of the early pencils which I have had the opportunity of trying can hardly be equalled by any of the best products of to-day. Analyses of typical specimens of Borrowdale and Pennsylvanian graphite made in 1825 by Vanuxem (Thomson's Ann. Phil., 1826, II, 104) gave the following results:—

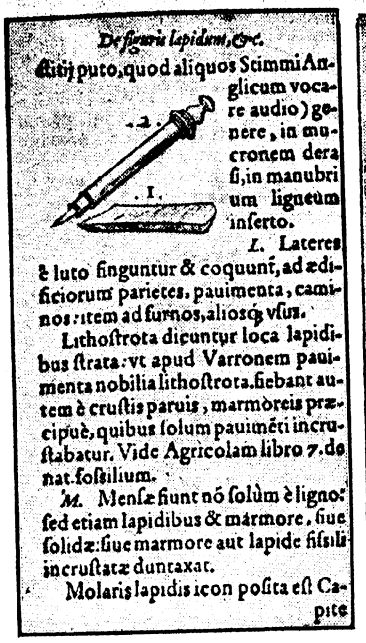
Graphite.	Carbon.	Water.	Residue left on ignition.	Silica.	Alumina.	Oxides of iron and manganese.	Loss.
	%	%	%	%	%	%	%
Borrowdale graphite	88·37	1·23	10·4	5·10	1·00	3·60	0·70
Do. do. impure ..	61·27	5·33	33·4	10·10	3·20	20·00	0·10
Pennsylvanian graphite	94·40	0·60	5·0	2·60	1·40	1·40	1·00

Nickel and chromium were also found in Borrowdale graphite, whilst Brande detected the presence of titanium.

For some of the specimens of graphite which I have analysed I am indebted to the Curator of the Geological Museum, to Messrs. Acheson, and to Mr. Birkbeck, the former proprietor of the Greta Pencil Works at Keswick, who has also very kindly given me trustworthy information as to the methods used in his works. In the following table of the results of my analyses I also give the microscopical appearance of the marks made by the graphite on paper.

In judging as to the suitability of graphite for pencil making the chemical points to which attention will be directed are: (1) The proportion of carbon; (2) the amount of silicates; and (3) the iron. It is interesting to note that the Borrowdale graphite (No. 2) used for making pencils in 1850 was much purer than that used subsequently (No. 1), which was both low in carbon and high in iron. The Swedish graphite (No. 5) is of still poorer quality, although it contains less iron.

It is not only the amount of carbon, but also its physical nature which is of importance, and a microscopical examination of the marks made by the graphite on paper shows why certain specimens of Borrowdale graphite, relatively poor in carbon, give better results than specimens of more crystalline graphite containing more carbon.



De figuris Lapidum, &c.

ſtitij puto, quod aliquos Scimmi Anglicum vocare audio) genere, in mucronem dera ſi, in manubri um ligneum inſerto.

L. Lateres è luto finguntur & coquunt, ad ædificiorum parietes, pauimenta, camino: item ad furnos, alioſq; vſus.

Lithoſtrota dicuntur loca lapidibus ſtrata: vt apud Varronem pauimenta nobilia lithoſtrota. fiebant autem è cruſtis paruis, marmoreis præcipuè, quibus ſolum pauimẽti incruſtabatur. Vide Agricolam libro 7. de nat. foſſilium.

M. Menſæ fiunt nó ſolùm è ligno: ſed etiam lapidibus & marmore, ſiue ſolidæ: ſiue marmore aut lapide fiſſili incruſtatæ duntaxat.

Molaris lapidis icon poſita eſt Capite

FIG. I.

P. 105, Vol. II. "De Rerum Fossilium Lapidum et Gemmarum Genere," by Conrad Gesner, 1565. (1) Wedge of graphite. (2) Complete pencil.



FIG. II.

Mark made by Borrowdale graphite used for pencil making in 1851. Now in Geological Museum. × 20.

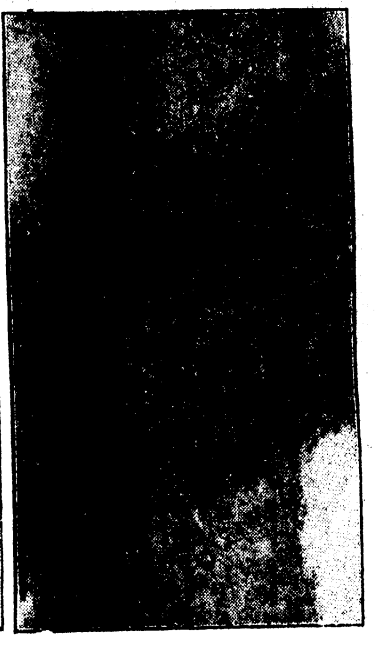


FIG. III.

Marks made with Faber's pencil. Striations show sequence of lines. × 20.

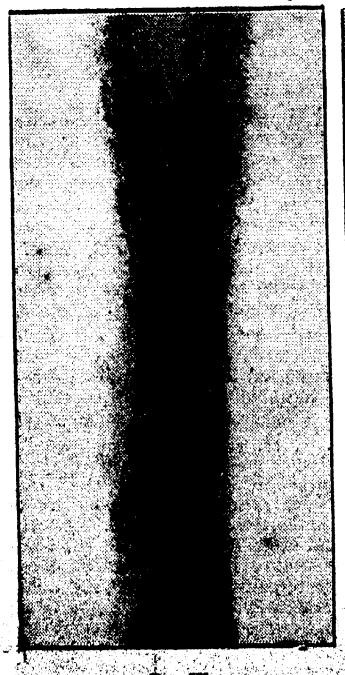


FIG. IV.

Marks made with Acheson graphite pencil. Striations show sequence of lines. × 20.

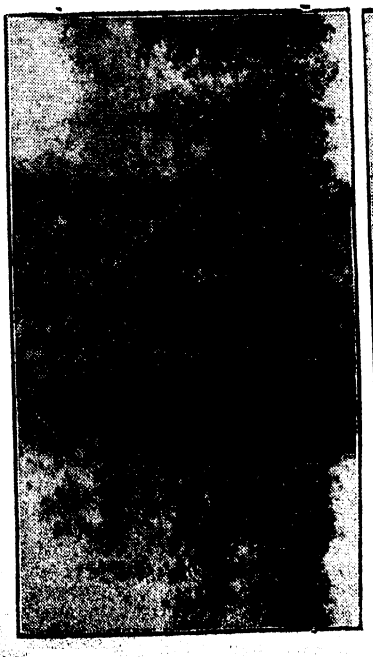


FIG. V.

Carbon copy. Shows absence of striations. × 20.



FIG. VI.

Line in drawing of 1851. Typical of old pencil markings. × 20.

In the microscopical examination both vertical and horizontal lines should be examined with a 1 in. objective and with a strong side light. Under these conditions it will be noticed that in the case of Borrowdale graphite the vertical lines show relatively few straight striations, and that when these occur in the heavier strokes they are disjointed and irregular. The fibres of the paper are frequently brilliantly lit up. The Siberian graphite, No. 8, was much richer in tone than, for example, the Ceylon graphite (No. 4), which contained much might be mistaken for those made by a modern pencil of poor quality.

Fig. 2 shows the appearance of the marking made by Borrowdale graphite as cut for pencils in 1851. (Ex. 54.)

Analysis of pencil pigments.—The methods which I have found most suitable for analysing pencil pigments are the following: (1) The loss on heating the finely powdered pigment in a platinum basin at a constant temperature of 200°—210° C. may be due to water, wax, sulphur, etc. In the case of

	Analysis of graphites.				Microscopical appearance of markings.
	Carbon.	Ash.	Silicates.	Iron and alumina. *	
	%	%	%	%	
1. Borrowdale crude graphite (Banks & Co.)	52·99	47·01	37·68	10·26	Irregular deposit of pigment. Irregular striations, many following fibres of paper. Few straight lines.
2. Borrowdale graphite used in 1850 for pencil making (Geol. Museum, Ex. 54.)	90·33	9·67	7·03	1·08	Irregular disjointed striations, some brilliantly lit up. In lighter strokes irregular striæ following the fibres.
3. Borrowdale graphite	90·73	19·27	11·44	3·31	Black pigment deposit. Fibres of paper lit up, but few straight striations visible. Type of graphite common in old pencil writing and drawings.
4. Ceylon graphite	92·78	7·22	3·90	2·45	Black pigment deposit. Irregular silvery branching striations. Groups of straight disjointed striæ. Brilliantly lit up in places.
5. Swedish graphite	43·84	56·16	44·09	7·61	Greyish pigment irregularly distributed. Numerous groups of disjointed straight striæ, lit up in places.
6. Greenland graphite made into pencils for King of Denmark (Geol. Museum)	79·63	20·37	15·30	4·03	Rich black pigment covered with brilliant branching striæ. Effect of silvery sheen. Fibres of paper lit up.
7. Canadian graphite	93·21	6·79	3·82	0·27	Black pigment on sepia grounding. Heavy strokes fairly free from striations. Here and there broad silvery streaks.
8. Siberian graphite. (Geol. Museum. Ex. 33).	77·45	22·55	17·41	0·12	Rich black pigment showing fibrous shimmer. Fine irregular disjointed striations.
9. Acheson's graphite for pencil making (powder)	99·83	0·17	—	faint trace	
10. Do. for electrodes (solid)	96·80	3·20	—	trace	Uniform silvery shimmer composed of points reflecting the light.

*In these and subsequent analyses the iron and alumina were precipitated together and were not separated. The proportion of alumina present was generally very small. The extraction with hydrochloric acid was continued until the residue gave only the faintest coloration with ferrocyanide.

more carbon. The sample of compressed Acheson graphite (No. 10) produced markings with microscopical characteristics very similar to those given by Brockedon's compressed graphite, and the uniform structure of the brilliant branching striations was clearly distinguishable from the markings of ordinary graphite. The sample of powdered graphite (No. 9) was particularly pure. In spite of the high percentage of graphite, however, the black tone was not so rich as that of the finest specimens of old Cumberland graphite. Owing to the kindness of the Curator of the Geological Museum I was able to examine under the microscope the marks made by all the specimens of graphite in the museum.

A pencil made from Canadian graphite (No. 3986) produced markings with numerous brilliant striations, irregularly disposed, and frequently forming light patches at the edges. Graphite from Huasco, Chile (No. 7630), showed a grey pigment, with small light patches and pronounced light striations at the edge. Brockedon's compressed graphite (Ex. 57) showed silvery dashes and lines all over the field, with a fairly uniform shimmer. To some extent the appearance resembled that produced by a 6 B Koh-i-Noor pencil.

Cornish graphite (Ex. 30) appeared very similar to Ceylon graphite on paper, but showed fewer irregular striations. Graphite from Upper California (Ex. 45) showed series of parallel striations in excess of the dark pigment, and the markings

samples containing lampblack some of the carbon derived from that source is also burned at that temperature. In test experiments, however, with mixtures of graphite and lampblack it was necessary to raise the temperature to 305°—310° C. to remove the whole of the lampblack.

(2) The covered basin was then strongly heated over a Bunsen flame until the residue became constant in weight, and the loss was taken as representing the graphitic carbon.

(3) Silicates were determined by extracting the ash with boiling hydrochloric acid until free from iron, and iron, alumina, etc., were determined gravimetrically in the acid extract.

Composition of pigments in old pencils.—Mr. Birkbeck and Mr. T. H. Court have very kindly put at my disposal specimens of old pencils, three at least of which probably date back to the latter part of the eighteenth century, whilst the others are typical of the square-leaded pencils which were made in Cumberland some 70 years ago. The composition of the pigments in these pencils shows several points of interest. The following table gives the analytical results.

The pigment in pencil No. 1 burned with a blue flame and contained a large amount of sulphur, whilst Nos. 2 and 3 contained much less. These pencils are interesting as early specimens of composition pencils. They were hard and produced scratchy writing, which under the microscope

Pigments in old pencils.

Pencil.	Loss at 200°-210°C.	Graphite carbon.	Ash.	Silicates (insol. in HCl).	Iron oxide and alumina.	Remarks.
	%	%	%	%	%	
1. In Nairne's box of instruments, about 1780	46·12	41·17	12·71	10·06	2·52	Sulphur present.
2. Do. do. ..	7·87	44·10	48·03	29·77	large amount.	Do.
3. Do. (Ackermann) ..	23·32	65·09	11·30	8·71	1·72	Do.
4. Pure Cumberland lead. Banks & Co. (BB)	22·80	51·92	25·28	9·09	12·81	(Ether extract 14·91 %)
5. Pure Cumberland lead. Banks & Co. (HB)	2·82	44·21	52·97	40·43	0·57	Slight fumes.

showed irregular striations and interrupted lines, with patches brilliantly lit up.

Pencils Nos. 4 and 5 resembled many modern pencils in containing pigments which emitted white fumes when moderately heated. On extracting No. 4 with ether I separated 9·39% of a white camphor-like substance, with an odour of cedar oil. Mr. Birkbeck assures me that in their works no wax had ever been used with the pencil pigment, and that in this case the graphite had been cut direct from the block. It would therefore appear probable that during the 70 years between the making of the pencil and my first cutting of it the cedar oil in the wood had been absorbed by the graphite and converted into the solid cedrol. Extraction of the powdered pigment with ether yielded 14·91% of a solid wax-like substance with an odour of cedar oil. This crystallised in needles and melted at 51° C.

Composition of modern pencil pigments.—In view of the fact that the modern process of making pencils originated with Conté, the following analyses of the pigments in one series of pencils now made by that firm is worth studying.

No. 0 was the softest in the series, and No. 5 the hardest. With the exception of No. 2 there is a decrease in the proportion of carbon and an increase in the total mineral matter and silicates throughout the series. No. 5 was remarkable for containing a notable proportion of titanium, the oxidised hydrochloric acid extract of the ash being bright yellow after removal of the iron.

Composition of pigments in Conté's pencils. Series 1020.

Pencil no.	Graphitic carbon.	Loss at 200°—210°C. Wax, etc.	Loss at 200°—210°C. Ash.	Silicates.	Iron oxide with traces of Al_2O_3.	Remarks.
	%	%	%	%	%	
0	60·28	12·85	26·87	23·70	2·07	Puce-coloured ash.
1	55·43	17·71	26·86	16·54	5·93	Do.
2	57·63	13·76	28·61	25·61	1·90	Do.
3	50·80	10·60	38·60	34·95	0·28	Do.
4	48·52	12·21	39·27	34·98	3·79	Do.
5	36·06	8·41	55·53	36·29	5·35	Do. Titanium present.

The following results were obtained in the analysis of typical British, American, German, Austrian, and Japanese pencils. For some of these specimens I have to thank several manufacturers, and in particular Messrs. Acheson, Messrs. Banks, Messrs. Rowney, and Messrs. Wolff and Sons.

In these results the carbon, as before, was estimated by deducting the sum of the ash and the loss at 200°—210° C. from the original weight. Where lampblack was present, as, for example, in the carpenter's pencil (21), the loss in the first ignition also included a considerable proportion of the carbon derived from that source. To this cause must also be attributed the low carbon results in

Composition of pigments in typical modern pencils.

	Carbon.	Loss at 210°C. Wax.	Ash.	Silicates.	Iron oxide and soluble alumina.	
	%	%	%	%	%	
1. American Pencil Co. Dessin No. 2	58·18	7·33	34·49	22·01	2·29	White fumes.
2. Acheson's graphite No. 385 = HB ..	57·85	—	42·11	38·83	1·74	No white fumes. White ash.
3. Acheson's graphite No. 205 (between BB and BBB)	64·00	13·23	22·77	21·84	0·66	No white fumes.
4. Acheson's graphite No. 515 = HH	34·25	1·20	65·75	63·59	—	No white fumes.
5. Banks & Co. "Crisdall" = HB ..	47·87	4·10	48·03	44·28	2·83	Slight white fumes.
6. Dixon's American graphite HB ..	65·55	13·05	31·40	29·82	0·24	White fumes.
7. Eagle Pencil Co. Orloff B ..	57.39	19·20	23·41	21·83	0·62	Pink ash.
8. Do. do. BBB ..	55·30	22·32	22·30	—	—	Do.
9. Faber hard pencil	57·19	5·26	37·55	32·42	1·99	No white fumes. Red ash.
10. Faber soft crayon pencil	22·28	1·49	76·23	63·49	6·62	No fumes. Buff ash.
11. Faber compressed solid pencil 3409 .	62·50	—	37·50	32·04	1·81	No fumes. Brick red ash.
12. Faber solid pencil	63·95	0·65	35·40	26·22	4·91	Do. do.
13. Hardmuth Koh-i-Noor 2B.. ..	54·60	15·4	30·00	20·30	1·52	Dense fumes. Grey ash.
14. Hardmuth Koh-i-Noor 4B.. ..	47·15	21·2	31·65	15·49	2·72	Dense fumes. Pink ash.
15. Hardmuth Koh-i-Noor 6B.. ..	16·56	43·0	40·44	32·16	3·30	Dense fumes. Ether extract 12·21%
16. Japanese pencil HB	43·29	1·85	54·86	52·15	2·57	Yellow ash.
17. Müller F.	45·89	9·10	45·00	37·28	5·06	White fumes. Dark brown ash.
18. Rowney B No. 800	64·89	6·09	29·02	23·78	4·87	Yellow ash.
19. Rowney BB	65·72	7·81	26·47	22·92	2·18	White fumes.
20. Rowney indelible correspondence ..	29·06	19·94	51·00	43·40	1·45	Dense fumes.
21. Spear carpenter's pencil	49·12	0·4	50·48	33·97	6·10	Yellow ash.
22. Staedtler B	58·74	12·84	28·42	24·42	2·31	White fumes. Pink ash.
23. Staedtler HH	58·72	4·00	37·28	26·86	2·54	Slight fumes. Pink ash.
24. Wolff HB	29·85	8·17	61·98	47·00	7·86	White fumes.
25. Wolff BBB	62·01	11·34	26·65	21·36	3·12	White fumes. Yellow ash.
26. Wolff HH	54·04	16.38	29·58	27·66	8·92	White fumes. Yellow grey ash.
27. Wolff indelible	29·19	28·00	42·81	40·40	2·40	Dense fumes. Grey ash.

No. 10 and No. 15. The readiness with which the carbon was burned away afforded an indication of the presence of lampblack.

The loss at 200°—210° C. may thus include moisture, volatile oil absorbed from the wood, wax or resin, and lampblack.

As a rule, on ignition the powdered pigment emitted dense white fumes when added wax was present, but the pigments in pencils, such as No. 5, free from extraneous wax or the like may also emit fumes with an odour of cedar oil.

The ash in the third column includes both the added clay and the silicious constituents of the original graphite, and it is not possible to distinguish between these. The colour of the ash in these specimens ranged from greyish-white, through yellow and pink, to deep red and brown, according to the proportion and composition of the iron compounds present. These are factors of importance for distinguishing between the writing done with different kinds of pencils.

It will be noticed that there is no general agreement between pencils of the same grade made by different manufacturers. Thus, the HB pencils contained from about 30 to 65% of graphitic carbon, and the HH pencils from 34 to 58%.

On the other hand, in several cases the different grades of the same manufacturer frequently show a tendency to contain approximately the same proportion of graphitic carbon, whilst the differences are due to variations in the other constituents. Examples of this are to be seen in Nos. 7 and 8, 11 and 12, 18 and 19, and 22 and 23.

Differentiation of pencil pigments in writing.

From a consideration of the foregoing results it is obvious that the material for differentiating between pencil pigments in writing is much more scanty than in the case of writing inks (Analyst, 1908, 33, 80) or of copying ink pencils (Analyst, 1917, 42, 3). The colour, or, rather, the depth of tone, is only occasionally of use, for generally it is possible by varying the pressure to make the mark from a hard pencil resemble that from a soft one. In exceptional cases, however, as when one of the pencils contained lampblack, the microscopical appearance of the writing may be distinctly different from that produced by a soft graphite pencil.

The silver striations.—It has already been mentioned that if the marks made by pure graphite be examined under the microscope in a vertical position, with the light at right angles, irregular silvery strokes or broken striations may be seen, although in the case of the old pure Cumberland graphite such markings are the exception. These interrupted striæ are most pronounced at places which appear lustrous to the naked eye. In the modern pencil pigments, in which clay is incorporated with the graphite the fine silicious particles in the mixture are finely distributed and appear in the pigment on paper as fine beaded striations, which are parallel and uniform throughout the line (Fig. 3).

The irregular lighting up of patches and interrupted masses of striæ which occur in natural graphite are not, so far as my experience goes, to be found in modern pencil writing. In the case of the latter it is possible to follow the bead-like striations from end to end of the line, and this affords the means of determining which of two crossing lines in pencil writing was made first. (Fig. 4.) Similar striations are also present in the writing done with copying ink pencils, being produced by the fine particles of clay in the pigment, but the irregular distribution of the patches of dyestuff over the line renders it impossible to determine which line is uppermost. The same remark applies to ink-writing crossing pencil-writing. It is not possible to state with certainty which line is uppermost. The absence of striations in the lines affords a certain means of distinguishing between pencil-writing and carbon copies (Fig. 5). Differences may sometimes be observed in the form of the striations in the lines made by different kinds of pencils, especially those made by different manufacturers. For example, in the case of the Koh-i-Noor pencil 6B (No. 15) the striations are plainly visible in the heavy strokes, but are nearly invisible in the lighter strokes, and the irregular lighting up of the striations recalls the appearance seen in some forms of natural graphite.

In the case of Wolff's indelible pencil (No. 27) the regular striations are masked by the pigment and are only faintly visible in the heaviest lines; whereas in the marks produced by Rowney's indelible pencil (No. 20) fine regular striations are readily visible even in light strokes.

Again, Faber's pencil (No. 9) produces lines with broad bands of beaded striations, which are readily distinguishable from the fine striations in lines made by Rowney's B pencil (No. 18).

These variations appear to be due both to the proportion of silicates and to their fineness. The commonest types of pencil, such as No. 21, show abundance of coarse striations.

Differentiation of old and modern pencil writing.—In order to confirm what appeared to be a characteristic difference between the writing done with old pencils of natural graphite and modern pencils containing clay, I examined all the early specimens of writing and marks made by myself with early pencils to which I could gain access, and I am greatly indebted to the Director of the Science Department, South Kensington Museum, for permission to examine the old pencils in early scientific and drawing instruments exhibited there. In no instance did I obtain the uniform bead-like striations with graphite pencils, but as a general rule lines with the appearance shown in Fig. 6, which represents part of a line in a drawing of 1831. Striations are the exception in old writing, but the fibres of the paper are frequently lit up by adherent particles of graphite. I then asked Mr. Gilson, of the MSS. Department of the British Museum, for his assistance, and I take this opportunity of thanking him for all the trouble he took to find early specimens of pencil writing for me. Before examining these MSS. I studied any literature I could find bearing on the subject. The most definite statements I could find were in a curious book by C. T. Schönemann, termed "Versuch eines Systems der Diplomatik," which was published in 1818 in Leipzig. This deals with the methods of examining the old documents preserved in the libraries in Germany and incidentally with the occurrence of pencil writing.

It is stated (Vol. I., p. 515) that codices of the 8th to 9th centuries show vertical parallel lines made with a stylus; that in the 11th century documents first signs of black lead pencil appear, and that from the 12th century onwards such marks are of common occurrence. In Vol. II. (p. 108) it is asserted that lines in black lead (Reisblei) had been drawn on the Codex Berengarii Turonensis of eleventh or twelfth century, which was in the Wolfenbüttel library. Now, as blacklead was not known until the sixteenth century, it is obvious that Schönemann mistook markings in ordinary lead for graphite.

Under the microscope the two can be readily distinguished. Ordinary lead and some alloys, at all events, of lead show a series of irregularly distributed patches uniformly lit up, and each patch is marked with regular striations.

The earliest pencil writings which Mr. Gilson was able to discover dated back to the beginning of the sixteenth century, and were drawings of coats of arms in "Stowe's Arms of Ancient Nobilitie." One of these was of doubtful compos-

tion; the drawings in another MSS. of Stowe (1686) had the appearance of graphite, whilst another (1691) was undoubtedly in metallic lead.

Other MSS. of the eighteenth and early nineteenth century were undoubtedly in graphite and showed few striations. The pencil writing in Hogarth's note book (47e) is in a particularly rich graphite.

Various drawings made by Flaxman on the backs of envelopes in the early nineteenth century show all the characteristics of good graphite. It is interesting to note, however, that a card written to Flaxman by the painter Epinat, of Lyons, between 1805 and 1814, shows the characteristic fine silver striations of modern composition pencils.

Most of the MSS. in the British Museum have been fixed with a shellac wash, but if a good light is used this does not materially affect the visibility of striations.

Chemical differentiation of modern pencil writings.

The analyses given above show that the most distinctive difference between the pencil pigments in writing will usually be found in the iron present as an impurity in the original graphite or in the clay. It has been pointed out that the iron compounds are present in different forms of combination and vary in their solubility in acids, and on these facts a means of differentiation may often be based.

Sensitiveness of tests for iron.

Dennstedt and Voigtländer (*loc. cit.*) assert that the amount of impurities in pencil writing is insufficient for chemical differentiation. To determine the sensitiveness of the various tests for iron I made standard solutions of ferrous ammonium sulphate in water and of pure metallic iron in hydrochloric acid, and diluted these with water until the point when they no longer gave a visible reaction with the different reagents. In this way the following results were obtained:—

		Limit for amount of iron detected.
Ferrous ammonium sulphate	Potassium ferricyanide	1 in 18,500
Do.	Gallic acid	1 in 66,450
Ferric ammonium sulphate containing free nitric acid	Potassium ferrocyanide	1 in 37,100
Iron in HCl.	Do.	1 in 56,000
Ferrous ammonium sulphate + HNO_3	Potassium thiocyanate	1 in 12,366

In the light of these results I chose potassium ferrocyanide as the most suitable reagent, and applied it to the writing after treatment with a drop of 80% acetic acid or of strong nitric acid.

Pronounced differences could thus be seen in the behaviour of the writing done with different pencils. For example, marks made with Faber's pencil (No. 9) when treated with nitric acid and potassium ferrocyanide immediately gave an emerald green drop, rapidly darkening to deep bluish green. With acetic acid and the reagent a green stain was immediately produced, and after about three hours the spot was pale bluish green, with a narrow dark bluish green zone.

Hardmuth's Koh-i-Noor 6B (No. 15) gave only a very faint reaction with acetic acid and ferrocyanide, whilst with nitric acid and the reagent the colour was pale green.

Again, Muller's F pencil (No. 17) contained much more iron than Faber's pencil (No. 9), but the reactions with ferrocyanide were much less intense. Acheson's graphite pencil (No. 2) gave only the faintest reaction for iron in writing. Naturally, a blank test should also be applied to the papers on which the writing has been done, and the parallel tests should be applied both to heavy and light strokes.

Titanium in sufficient quantity to give a distinct reaction is rare in pencils, but in the case of Conté's No. 5 pencil the amount of titanium was sufficient to give a bright yellow coloration on treating the writing with hydrochloric acid and hydrogen peroxide.

Certain pencil pigments contain a considerable proportion of chlorides, and this fact enables the writing done with them to be distinguished from other pencil writing. The test is best applied as a drop reaction, as follows:—A drop of dilute nitric acid is applied to the pencil writing, and silver nitrate is then introduced into the drop, which should retain its globular condition throughout the test. The presence of chlorides is shown by the drop becoming turbid. By this test the writing done with the American pencil (No. 1) could be distinguished from that given by the Acheson pencils or Faber's pencils. Soluble sulphates are rarely present in pencil pigments, but a drop test with barium chloride and nitric acid may be applied.

In doubtful cases confirmatory evidence is sometimes obtainable by a test with dilute nitric acid, which will remove the pigment rapidly from some pencil writing, whilst it has little effect upon others. This difference in behaviour appears to be due to the wax in some pigments repelling the acid. I attempted to use osmic acid as a differentiating test, but the results were inconclusive, for although the reduction was effected more rapidly in some cases than in others, the paper itself had some reducing action.

Discussion.

Prof. J. W. Hinchley said whilst he was appreciative of Mr. Mitchell's exhaustive researches into the subject of the origin of pencil making, he thought he had fallen into one or two errors. For instance, in fig. 1 object No. 2 was not a pencil but a scriber, by means of which the strip was split on insertion in the groove in the wood. The prepared blocks of graphite were 2¼ in. square by 1 in. thick, and were sawn into strips $\frac{1}{16}$th inch wide. Three of these were placed in the groove of the wood, and thus with a ¼ in. blank end the pencil 7 in. long was produced. The author might have made reference to the English workers of that period when methods were devised for producing graphite blocks from graphite powder. He believed that in Queen Street, at Wolff's old factory, there was still the old Bramah press which had been used to compress these blocks. The pressure used was 200 tons on the 2¼ in. square block, not 5000 tons per square inch. A method of using antimony sulphide as a binder for graphite had also been devised and used very successfully for many years for cheap pencils. If Mr. Mitchell had known more of the technical side of pencil manufacture it would have helped him a great deal in getting over some of his analytical difficulties. The wax used for the graphite at that period was spermaceti; the feel on the paper given by this was the best, but its high price prevented its use now. The modern pencil was far superior to that made in the middle of the last century by the Conté process, or the Hardmuth process, for Hardmuth claimed to have invented the same process three years later (in 1798). On account of the poor grinding processes of those days the pencils made could not equal those made from Borrowdale graphite, and he did not know of any maker now who produced a pencil that could compare with the old-fashioned Borrowdale graphite pencil un-

touched, as it was, by any process except that of nature. The question of producing a solid slip for a modern pencil was a physical question of extrusion and called for very careful consideration. It would be very interesting to take sections of lead pencils and note the actual relation of the inside of the lead to the outside of the lead. The process of drying to produce a first-class lead took about a month; it could not be done in less than a fortnight without risk of failure. If the drying was too rapid the inner portion became porous and resulted in pencils with rotten points. That had been a common fault of English pencils before the war, and it was also the fault of some of them to-day. The grinding operations that were carried out to-day were the finest that had ever been done. The grinding surfaces were trued up as accurately as in any engineering operation, and the graphite mixture of the finest pencils to-day was generally ground for at least eight days; the total period of manufacture was from four to six months, and necessitated fifty or sixty operations. That would give a notion of what was involved in making high-class pencils.

Dr. W. R. Ormandy said that the marks of the scratches to which the author referred were due to the fine silica in the clay. The ball clays of the South of England were nearest to the pure clay substances of any of the known clays, much purer in that respect than even washed China clay, and consequently these clays were exported and used for the manufacture of pencils abroad. In washing China clay it was possible by using 97 tons of water to 3 tons of clay to get rid of the greater portion of the silicious matter and the mica, but even then a considerable amount of silicious matter remained, and no one had ever attempted to wash ball clay on a large scale for the simple reason that the very fine particles of silica were almost as fine as the clay substance itself, and no ordinary system of settling or washing by elutriation would remove this. B. Schwerin had discovered that by mixing clay and water and adding a small amount of chemical, generally an alkali, which would act as a dispersive medium, it was possible to retain the clay particles in suspension, whereas the silicious particles did not acquire to the same extent the Brownian movement, and in consequence could be separated; it was thus possible to remove from very pure China clay some 5 or 7% of silicious and micacious matter which could not be washed out by any of the ordinary processes, whilst in the case of ball clay it was possible to remove 3 or 4% of silicious matter which, though exceedingly fine considered from the ordinary standard, was still exceedingly coarse as compared with the clay substance itself. He had found in one of the clay pits of East Prussia a clay mixed with pyrites which was of such a low quality that it was only used for making drain-pipes, but by blunging this clay with a small amount of electrolyte and collecting the clay on the anode in an electrical arrangement, it had been possible to separate the clay so completely from the other matter that the material which had previously been considered worth only 6s. per ton had been sold for 300 marks per ton to the pencil-makers of Germany. It had the added advantage that the dispersed clay substance, carrying a fairly heavy electro-negative charge, had the power of adsorbing dyes to a degree unequalled by any of the ordinary or natural clays, since the negative clay particle was made more negative by adsorbing the dispersive chemical employed, and thus had the property of picking up electro-positive dyes. If clay were used for admixture with graphite or blackening material for pencils, it was to-day possible to obtain from any ordinary clay a material so fine and so free from crystalline silica that no ingredient carried forward by the clay would be capable of giving the fine scratches which were shown on the microscope. If natural graphite contained silicious material it was quite possible that the scratches might be due to the working up and grinding of the silicious material contained in the graphite itself. If, on the other hand, artificial graphite or lampblack were used, it was quite possible that the scratches which were going to be, or had been in the past, so useful as a means of distinguishing one make of pencil from another would not be applicable as a method of differentiation.

Prof. Hinchley said that artificial graphite was almost out of the question as a pencil-making graphite owing to its high price. He did not know of any artificial graphite which had a future as a pencil-making substance.

Mr. Mitchell, in reply, said he was ignorant of the methods used in pencil manufacture to-day. His information had been derived entirely from Mr. Birkbeck of the Greta Pencil Works, who had told him that in a great many cases those works did not embody all the modern processes. He himself had been more concerned with the result produced by the pencil on the paper than with the manufacture of the pencil. Nevertheless, many of the points raised by Prof. Hinchley were of great interest. With regard to the question of English workers, he had to derive his information largely from Messrs. Bankes & Co., and they would not be in touch with what was being done in London. As far as he could make out, Brockedon's process for compressing graphite was used by various other people in various forms. The figure of 5000 tons pressure per square inch had been printed in two or three places, *i.e.*, in the account of the process in the official catalogue of the Great Exhibition of 1851. He had challenged the figure, but had found it in another reference also. With regard to wax, he believed that in many of the processes the wax was forced in after the pigment had been made.

Prof. Hinchley said that was so.

Mr. Mitchell said it was forced in under a vacuum, and that must to some extent affect the composition of the pigment. It would not necessarily be uniformly distributed all the way through. As to the unsuitability of artificial graphite for pencil-making, he had had specimens from Messrs. Acheson, and, whether they were unsuitable or not, the pencils themselves were very suitable. It would be very interesting to carry out the suggestion of distinguishing between the inside and the outside of the pigment, particularly in view of the fact of the wax being forced in. With regard to Dr. Ormandy's remarks as to the clays, it was quite possible, he should say, that even after the clay had been purified from the silicious material and then blended with graphite, there would still be certain particles which would be a little harder than the graphite itself. In any case, he did not think that a graphite absolutely free from silicious material would be obtained, and so long as there were silicious particles, however finely the graphite was powdered, the fine regular striations which were characteristic of the modern pencil would result.

Addenda.

In the original exhibit of the method of pencil manufacture which was sent by Messrs. Bankes & Co., to the Great Exhibition of 1851, and is now to be seen in the Geological Museum in Jermyn Street, the insertion of the wedge of graphite into the groove in the wood is shown as one of the stages in the process.

With regard to Brockedon's process, the pressure is not given in the original patent. It seems not improbable that in the description of the exhibit

in the official catalogue of the Great Exhibition of 1851 (Vol. I., p. 128) the word "tons" is a misprint for "lb.," and that the error has been copied into other books (*e.g.*, "Der Vollständige Schreibmaterialist," Weimar, 1854, p. 218).

Gesner's original text (pp. 104—105) clearly shows that his Fig. No. 2 was intended to represent a pencil: "Stylus inferus depictus ad scribendum factus est plumbi cujusdam (factitii puto, quod aliquos stimmi anglicum vocare audio) genere, in mucronem derasi, in manubrium ligneum inserto."

A CLIP FOR PREVENTING RUBBER CONNECTIONS FROM SLIPPING OFF GLASS AND METAL TUBING AND FOR ATTACHING PRESSURE PUMPS TO TAPS.

BY CHARLES A. KEANE, D.SC., AND G. PATCHIN, A.R.S.M.

This clip has been designed to secure a satisfactory means of preventing rubber connections from slipping off glass and metal tubing when in use with many forms of scientific apparatus and fittings. It entirely replaces the use of wire for securing such connections, and is applicable to a great variety of apparatus employed in ordinary laboratory work.

The clip is easily and quickly adjusted, it does not wear or cut the rubber tubing, and it possesses sufficient play to be adaptable to any slight variations in the size of the connections concerned. It accordingly overcomes the annoyance so generally experienced of rubber connections slipping during the course of experiments.

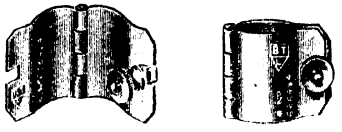


Fig. 1.

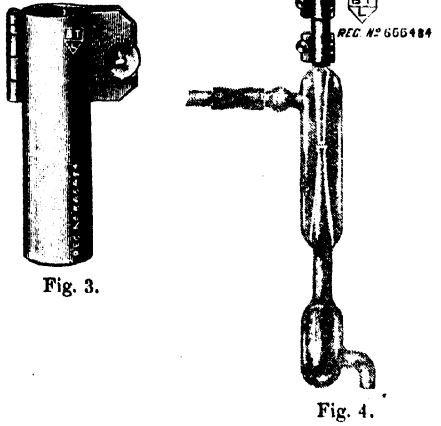


Fig. 3.

Fig. 4.

The general design of the clip is shown open and closed in Fig. 1, and in use with a Hempel gas burette and pipette in Fig. 2. Of the other many forms of apparatus in which it has been found useful the following may be instanced:—Gas samplers, connections between wash-bottles, combustion apparatus, Bunsen burners, burettes, and vessels for the absorption and collection of gases, such as are used in the estimation of ammonia, in Kjeldahl estimations, and in the estimation of nitrogen by Dumas' method. The clip has also been found quite reliable for securing the connections in apparatus in which mercury is employed as a confining liquid such as nitrometers. In all cases of butt-joints a single clip replaces two wired attachments.

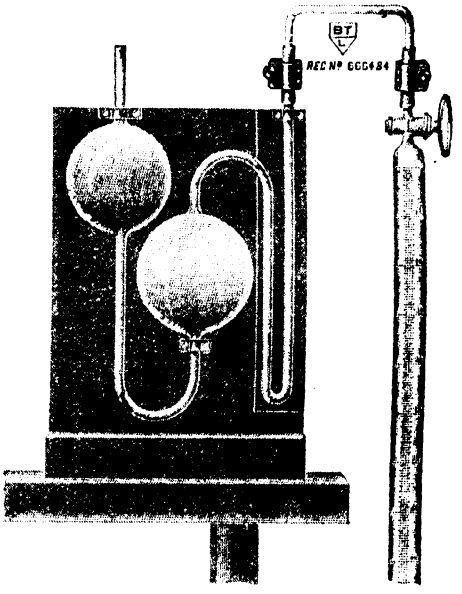


Fig. 2.

To secure the attachment of pressure pumps to taps use is made of two clips, one of which is provided with a sleeve, as shown in Fig. 3.

For use, the tap and pump are first connected by ordinary rubber tubing, the sleeve-clip is then fixed over the rubber attached to the pump, and the simple clip over the portion attached to the tap. The simple clip should slightly overlap the top of the sleeve.

The attachment prevents the swelling of the rubber when the pump is in use, and obviates the need of thick pressure tubing or of canvas-lined tubing for such connections.

An ordinary filter-pump held in position by the clips is shown in Fig. 4. The ease of attachment and facility of removal are obvious advantages over the methods usually employed.

In some cases the expanded part of the glass at the top of filter-pumps is too wide in relation to the adjacent portion for the clip to be satisfactorily attached, but this difficulty is easily overcome by softening and drawing out this portion of the pump. We have found that when the clip is employed the bulb end of the pump can quite well be dispensed with.

The clips have been made for us by Messrs. Baird & Tatlock as the "K-P clip" in 4 sizes, which are adaptable to connections of from ¼ in. to ¾ in. diameter.

Yorkshire Section.

Meeting held at Leeds on November 3, 1919.

MR. W. MCD. MACKEY IN THE CHAIR.

THE CHANGE OF REFRACTIVE INDICES OF FIXED OILS WITH TEMPERATURE.

BY C. HAROLD WRIGHT, M.A. (CANTAB.), F.I.C., AGRICULTURAL CHEMIST, FIJI.

It is well known that the refractive indices of fixed oils vary with temperature, a rise in temperature being accompanied by a decrease in refractive index. Up to the present (so far as I am aware) the law governing the change of refractive index with change of temperature has not been investigated. In order to calculate the refractive index of an oil at one temperature from its value at some other temperature the difference in the refractive index for 1° C. has been determined (see Tolman and Munson, J. Amer. Chem. Soc., 1902, 24, 754; Harvey, this J., 1905, 24, 717; and Harvey and Wilkie, Chem. and Drugg., 1910, 76, 442).

A number of formulæ connecting the refractive index (n) of a substance with its density (d) have been proposed. Of these the simplest and probably on the whole the best is that of Gladstone and Dale, *viz.*, $(n-1)/d$=constant. Landolt tested this formula at different temperatures and found that it held very closely not only for pure substances, but also for mixtures. H. R. Procter (this J., 1898, 17, 1021) determined the refractive indices and densities of many fixed oils at 15° and 60° C., and showed that $(n-1)/d$ is very approximately a constant for each of these oils. Hence if n and n' are the refractive indices of a liquid at t° and t'° C., and d and d' are the densities of the same liquid at the same temperatures, then

$$\frac{n-1}{d} = \frac{n'-1}{d'} \quad .. \quad .. \quad (i)$$

Mendeléef (Ann. Chim. Phys., 1884, [6], 2, 271) has shown that the expansion of a liquid when heated can be expressed by the equation

$$V = \frac{V_0}{1-kt}$$

where V and V_0 are the volumes of a liquid at t° and 0° C. respectively, and k is the modulus of expansion. If d and d_0 are the densities of a liquid at t° and 0° C. respectively, then since the density of a liquid is inversely proportional to its volume

$$d = d_0\,(1-kt).$$

I have shown (this J., 1907, 26, 513; 1916, 35, 457) that the values of the modulus of expansion of all oils, fats, and waxes are approximately the same, and for 16 fixed oils examined the mean value of k is 0·0007. Hence by adopting this value for k the specific gravity of any fixed oil at 15·5° C. can be calculated from its specific gravity at any other temperature. If in (i) we replace d by $d_0\,(1-kt)$ and d' by $d_0\,(1-kt')$, we have

$$\frac{n-1}{d_0(1-kt)} = \frac{n'-1}{d_0(1-kt')}, \text{ or}$$

$$\frac{n-1}{1-kt} = \frac{n'-1}{1-kt'} \quad .. \quad .. \quad .. \quad (ii)$$

$$\text{Hence } k = \frac{n-n'}{(n-1)t'-(n'-1)t} \quad .. \quad .. \quad (iii)$$

It is thus possible to calculate the numerical values of k for fixed oils if the refractive indices of a number of such oils are determined at any two temperatures.* In this way I have calculated the numerical values of k from the refractive indices of 20 fixed oils at 15° and 60° C. determined by Procter (*loc. cit.*). The following are the values obtained:—

Oil.	No. of samples.	k (average).
Castor	6	0·00071
Raw linseed (old)	1	0·00075
,, (new)	1	0·00070
,, (blown), 48 hrs. at 100° C.	1	0·00074
Cod liver (Möller's)	1	0·00072
,, medical	3	0·00073
,, medical, blown 48 hrs.	1	0·00072
Coast cod	4	0·00080
Whale	4	0·00073
Seal, pale	1	0·00076
Shark liver	1	0·00075
Mixed fish	4	0·00077
Cottonseed	1	0·00076
Arachis	4	0·00078
Maize	3	0·00074
Sesamé	1	0·00077
Olive	4	0·00079
Rape	4	0·00074
Neatsfoot	–	0·00079
Sperm	–	0·00078†

I have also calculated the values of k for 6 other fixed oils from determinations made by Messrs. T. F. Harvey, F.I.C., and Albert Tompkin, A.I.C. These results have been communicated to me privately, and I take this opportunity of offering these gentlemen my thanks for kindly giving me these figures. The results are given in the following table:—

TABLE I.

Oil.	Refractive Index.	Temp., °C.	k
Cod liver	1·4821	10·6	0·00077
	1·4748	30·1	
Linseed	1·4835	10·1	0·00078
	1·4783	23·8	
Castor	1·4819	10·8	0·00077
	1·4775	22·5	
Rape	1·4764	10·1	0·00076
	1·4696	28·8	
Olive	1·4722	10·5	0·00077
	1·4673	23·9	
Sperm	1·4683	10·7	0·00078
	1·4638	23·0	
		Mean	0·00077

It will thus be seen that in the case of fixed oils the value of k varies from 0·00070 to 0·00080, and is approximately constant. The mean value of the modulus of expansion of the 20 oils examined by Procter is 0·00075, and of the 6 oils examined by Harvey and Tompkin 0·00077. The mean of the modulus of expansion of these 26 oils is 0·000756.‡ This differs slightly from the mean value of the modulus of expansion of 16 fixed oils published previously (this J., 1907, 26, 513), which was 0·000693. This value, which I called the *approximate* modulus of expansion (m), was calculated from the specific gravities determined in the ordinary way, *i.e.*, the weight of oil held by a specific gravity bottle at any temperature t° C. is divided by the weight of water held by the same bottle at 15·5° C. The value thus obtained, as explained at p. 514 (*loc. cit.*), is not the true specific gravity at t° C. (water at 15·5° C.=1), because the volume of the specific gravity bottle varies with temperature, and therefore the weights of water held by the bottle at t° and 15·5° C. are not the same.

* It should be observed that equation (ii) is a general equation which applies to all liquids. I hope to consider the refractive indices of essential oils in a later paper soon.

†Maximum, 0·00080; minimum, 0·00070.

‡ It will be seen from (iii) that

$$n-n' = k\,[(n-1)t'-(n'-1)t].$$

$$\text{Hence the difference for 1° C.} = \frac{n-n'}{t'-t} = k\left[\frac{(n-1)t'-(n-1)t}{t'-t}\right]$$

This is not a constant. The numerical value of the expression within the bracket is about 0·5, hence the difference for 1° C. = $k/2$ approx.

The value of k for refractive indices can be taken as 0·00076 for purpose of calculation. Hence equation (ii) becomes

$$\frac{n-1}{1-0{\cdot}00076t} = \frac{n'-1}{1-0{\cdot}00076t'} \quad .. \quad .. \quad (iv)$$

$$\text{or } n' = (n-1) \times \frac{(1-0{\cdot}00076t')}{(1-0{\cdot}00076t)} + 1 \quad .. \quad (v)$$

It is thus possible to calculate the refractive index of a fixed oil at any temperature from the refractive index of the same oil at any other temperature. At present there is no agreement as to the temperature at which the refractive indices of oils should be stated. Many observations are given at 20° C., but others are given at 15°, 15·5°, 30°, 40°, 50°, 60°, etc., and so far there has been no means of correlating these results. Dr. J. Lewkowitsch (*Oils, Fats, and Waxes*, Vol. I., 1909, 257) thought that "it is advisable to adopt 40° C. as the standard temperature. Most oils and fats are liquid at 40° C., and only in exceptional cases, such as beeswax, is a higher temperature required." This temperature, which is generally adopted in the case of butter and lard, is adopted in the new (1914) edition of the British Pharmacopœia for fixed oils and fats. Whilst 20° is a convenient temperature for liquid oils, it is obviously impossible in the case of solid fats, and it seems absurd to have one standard temperature for fats and another for oils, which only differ in their melting points. I would therefore recommend 40° C. as the temperature at which the refractive indices of all oils and fats should be stated. Determinations made at other temperatures will not be wasted, because from them the values at 40° C. can always be calculated.

Substituting 40 for t' in equation (v) we get

$$n_{40} = (n-1) \times \frac{1-40 \times 0{\cdot}00076}{1-0{\cdot}00076t} + 1$$

$$\text{or } n_{40} = (n-1) \times \frac{0{\cdot}9696}{1-0{\cdot}00076t} + 1$$

To simplify the calculation I have worked out the numerical value of the factor

$$\frac{0{\cdot}9696}{1-0{\cdot}00076t}$$

for 15°, 15·5°, 20°, each degree from 25° to 55°, 60°, 65°, and 70° C. The results are given in Table II. Hence n_{40} can be calculated from the refractive index determined at any other temperature by subtracting 1 from the refractive index and multiplying the difference by the factor opposite the temperature at which the determination was made, and then adding 1 to the product so obtained.

TABLE II.

Temperature. °C.	Factor.	Temperature. °C.	Factor.
15	0·98078	40	1·00000
15·5	0·98116	41	1·00078
20	0·98457	42	1·00157
25	0·98838	43	1·00236
26	0·98914	44	1·00314
27	0·98991	45	1·00393
28	0·99068	46	1·00472
29	0·99145	47	1·00552
30	0·99222	48	1·00631
31	0·99299	49	1·00710
32	0·99377	50	1·00790
33	0·99454	51	1·00870
34	0·99532	52	1·00950
35	0·99610	53	1·01030
36	0·99687	54	1·01110
37	0·99765	55	1·01190
38	0·99843	60	1·01593
39	0·99922	65	1·02000
40	1·00000	70	1·02408

Procter (*loc. cit.*) determined the refractive indices of olive oil and oleic acid at various temperatures between 15° and 60° C. By using the factors in Table II I have calculated for each observation (except those at 40°) the refractive indices at 40° C. Thus the refractive index of olive oil at 30° is 1·4657. The factor at this temperature is 0·99222. Therefore the refractive index at 40° is $1+0{\cdot}99222 \times 0{\cdot}4657 = 1{\cdot}4621$. The results are given in Table III.

TABLE III.

Temperature. °C.	Refractive index.	Refr. index at 40° C. (calculated).	Difference.
	Olive oil.		
15	1·4718	1·4627	−0·0008
20	1·4691	1·4691	0·0000
30	1·4657	1·4621	−0·0002
40	1·4619	—	—
50	1·4584	1·4620	−0·0001
60	1·4543	1·4615	+ 0·0004
	Oleic acid.		
15	1·4638	1·4540	−0·0003
20	1·4620	1·4549	− 0·0003
25	1·4603	1·4549	−0·0003
30	1·4585	1·4549	−0·0003
35	1·4566	1·4548	−0·0002
40	1·4546	—	—
45	1·4528	1·4546	0·0000
50	1·4509	1·4545	+ 0·0001
60	1·4471	1·4542	+ 0·0004

It will be noticed that the greatest difference between the observed and calculated refractive indices is 0·0008, but these differences are far less when the temperatures at which the observations are made are not far from 40° C.; in many cases the differences are the same as the error in a single observation. In determining the refractive index with an Abbé refractometer it is very difficult, if not impossible, to maintain the prisms at 40° C. whilst an observation is being made. On the other hand it is often quite easy to obtain a steady temperature somewhere near 40°. In the tropics this presents no difficulty since the temperature of the tap water is about 28°—30° C. I would therefore recommend that the observation should be taken at a steady temperature, and from the result the refractive index at 40° C. can be calculated as described above. By thus having more time to take an observation, and if necessary to repeat it, it is probable that the refractive index at 40° C. will be obtained with greater accuracy than it would be if an attempt were made to determine it at 40° C. exactly. If the steady temperature is not a whole degree the factor for the intermediate temperature can be found by the method of differences. An example will make the calculation clear. Harvey found that the refractive index of rape oil at 28·8° C. was 1·4696. The difference between the factors at 28° and 29° is 0·00077. Therefore the factor at $28{\cdot}8° = 0{\cdot}99068 + 0{\cdot}8 \times 0{\cdot}00077 = 0{\cdot}99068 + 0{\cdot}00062 = 0{\cdot}99130$. Hence the refractive index at 40° C. $= 1 + 0{\cdot}99130 \times 0{\cdot}4696 = 1{\cdot}4655$.

A glance at the second volume of Lewkowitsch's *Oils, Fats, and Waxes* will show the state of confusion of the recorded values of the refractive indices. Thus, Strohmer determined refractive indices at 15°, Tolman and Munson at 15·5°, Harvey at 20°, and Thoerner at 60°, and so on. So far it has not been possible to correlate these recorded observations and so determine their relative value. But it is now possible to calculate the refractive indices at 40° from the recorded values at other temperatures, and when this is done it is very satisfactory to find that in most cases the recorded values agree very well amongst themselves. Thus the following values of the refractive indices of linseed oil have been recorded:—1·4835 at 15° (Strohmer), 1·4800—1·4812 at 20° (Harvey), and 1·4660 at 60° (Thoerner). When the refractive indices at 40° are calculated from these observations the following values are obtained:—1·4742, 1·4725—1·4737, and 1·4734. These values fall within the limits given in the B.P., 1914, *viz.*, 1·4725—1·4748. Again, for almond oil the following values have been recorded:—1·4728 at 15·5° (Tolman and Munson), 1·4701—1·4712 at 20° (Harvey), and 1·4555 at 60° (Thoerner). From these results the calcu-

lated refractive indices at 40° are:—1·4639, 1·4628—1·4639, 1·4627, and thus agree very closely with the limits given in the B.P., *viz.*, 1·4624—1·4640. On the other hand, the recorded values for turtle oil are 1·4677 at 30° (Zdarek) and 1·4665 at 50° (Sage). The calculated values at 40° are 1·4641 and 1·4702, which differ considerably and are thus subject to some doubt.

Communications.

MOISTURE IN BLAST-FURNACE COKE.

BY WILLIAM H. GEORGE.

During the war period the presence of widely varying and often excessive quantities of moisture in blast-furnace coke prepared in the various types of by-product coke oven has frequently been a source of trouble to the metallurgist.

Variation.—The variation in moisture between such wide limits as 5 and 20%, or even 25%, in exceptional cases, is not conducive to the regular working of the blast furnace. It is common practice to charge a fixed weight of fuel, and to vary the burden according to the heat requirements of the furnace, the "available carbon" or calorific value of the coke being assumed to be practically constant. It is seldom, if ever, practicable to determine the percentage of moisture in each wagon-load of coke used, and, moreover, the results obtained would only be of doubtful value, as the coke would probably before use be indiscriminately mixed in various coke bunkers according to the chance position of the trucks in the sidings. It is therefore clear that this variation, on account of the impracticability of determining its amount, introduces an additional element of uncertainty in blast-furnace practice, and leads to waste of fuel. W. C. Gillhausen,* taking 1·263 tons of coke, containing 11·54% ash and 11·72% moisture, as necessary for the production, under ordinary conditions of working, of 1 ton of basic pig-iron, finds that the extra consumption of coke per 100 tons of pig-iron is 450 kilos. for every additional 1% of moisture. A variation of about one-half cwt. (25 kilos.) of coke per ton of pig-iron is sufficient to change the quality of the iron one grade.

Excessive moisture.—The amount of moisture in the raw ores used is more or less beyond control, that in the fuel is not so. The oven-coke production in 1918 was 13,301,548 tons. After deduction of 635,000 tons for export, and 20% for beehive oven coke, we have approximately 10,000,000 tons left for use in blast-furnaces. Assuming a 10% moisture content in this coke, 1,000,000 tons of water is needlessly carried about the country and introduced into blast-furnaces.

Exhaustive investigations of the influence of moisture on the crushing strength of coke (see A. Wagener; Ferrum, 1913, **10**, 321—336, 353—369) show that the strength of coke saturated with water up to 22·4% is diminished by 14%, as compared with dry coke. J. Boiteux (L'Echo de l'Industrie; Colliery Guardian, **92**, 512) finds that with a coke containing 10% of water the loss due to handling averages 5%, and that such a coke will yield 8 to 10% of coke dust.

Complaints of excessive moisture content by users of by-product oven coke are by no means novel. J. H. Darby in 1898 (J. Iron and Steel Inst., **53**, 44; this J., 1898, 748) stated that he "has seen contracts for retort coke carried out where it was undertaken that the water and ash added together should not exceed 12%, and where for months together no deducting was made for excessive percentage; 9—10% of ash is a fair average for good coke, so very little room is left for water." He considered 2% of moisture in retort coke "a fair allowance if the coke was carefully watered." In the discussion on the paper, C. Wood, presumably a user of the coke, said he found it to contain, generally speaking, from 12 to 15% of moisture. "He had seen the coke arrive at the furnaces with the water actually dripping out of the bottom of the trucks. He had once dried nearly a whole truck, and found it threw off 17% of water." This case may be taken as typical of the differences which occur between coke makers and coke users. In this particular case, makers and some users assert 2—3½% of moisture, other users, 12—15%. It is therefore clear that before complaints are made every possible care must be taken to ensure that the results of analysis are not only accurate, but are representative.

Sampling.—By far the most fruitful source of error lies in the sampling, which is frequently left to persons who have no intrinsic interest in the work. The literature on the subject, in nearly every case, assumes that a sample has been obtained, and more careful consideration is given to such points as crushing, drying-temperature, etc. The following appear to be the only two exceptions. A. Wagener (*loc. cit.*) recommends the taking of two forkfuls from the bottom of the wagon and one from the top, and one from the bottom and two from the top, of each alternate wagon, coloured glasses being worn by the sampler so as to make all coke appear of uniform colour, and to prevent the selection of pieces according to their good appearance or otherwise. The sample so obtained is crushed to egg-size, walnut-size, and pea-size, with careful mixing and quartering after each crushing. H. Brearley and F. Ibbotson ("Analysis of Steel Works Materials") recommend that at least 20 pieces be taken from each wagon, and that the sample be crushed on an iron plate to hazel-nut size, and one-quarter of the bulk to pea-size, with careful mixing and quartering after each crushing. The final sample is crushed in an iron mortar to pass through a sieve of 60 meshes to the lineal inch.

The first method would not appear to be free from objection for general use, as the sample is selected from those portions of the wagon which are usually the least representative. Coke at the top of the wagon, on account of its exposure to the weather, suffers loss from evaporation, or gain from wetting by rain, whilst there is a tendency for breeze (the wettest portion of the coke) to collect at the bottom of the wagon during transit. In addition, the sample is selected from only three places in the wagon. The second method is not given in sufficient detail to be helpful.

It is doubtful if a representative sample can ever be obtained from the top only of a wagon. Where the wagon is unloaded from a side door by shovel, directly into barrows or skips, the sample is best obtained when the wagon is from one-third to one-half empty, when it will usually be found that the method of unloading exposes two complete sections from top to bottom of the wagon, on right and left of the door. It is necessary to make a mental estimate of the proportion of small and of large coke present and to try to preserve the same proportions in the sample. The author obtained and analysed separately samples of the small and the large coke from a number of wagons under the conditions previously given. In each case the sample of small was selected from that portion of the coke which would pass through a one-inch sieve. The sample of large was selected from the remainder of the coke. The first sample was well mixed, and 1000 grms. was weighed in a porcelain dish, and

* See Wagener, Ferrum, 1913, **10**.

dried at 150°—200° C. The second sample, after rapidly crushing to a similar size, was similarly treated. The results obtained and given in table I. show that the percentage of moisture in the small coke may be from 2 to 8 times that in the large. The small letters after the sample numbers refer to the brand of coke; the same letter is used for the same brand throughout the table:—

TABLE I.

Sample no.	A. % Moisture in large coke.	B. % Moisture in small coke.	Ratio B/A.
1a	18·0	21·8	1·2
2b	9·3	13·4	1·4
3c	9·1	13·7	1·5
4a	14·6	21·8	1·5
5d	5·8	9·2	1·6
6c	11·8	19·1	1·6
7f	10·1	17·3	1·7
8g	12·3	21·3	1·7
9a	12·6	24·5	1·9
10c	5·8	11·4	2·0
11c	8·8	20·1	2·3
12h	4·6	12·0	2·6
14c	6·4	17·4	2·7
14h	7·1	19·8	2·8
15d	4·0	12·7	3·2
16d	3·6	12·6	3·5
17f	4·7	18·5	3·9
18i	4·3	18·0	4·2
19j	1·4	6·7	4·8
20g	1·6	12·0	7·5
21b	1·6	15·2	9·5

The distribution of moisture in the lumps was also examined as follows. During the unloading of a wagon a lump was obtained from the centre. With chisel and hammer, portions about 1½ in. thick were rapidly chipped off the outside of the lump, and were at once placed in a dried and weighed glass jar fitted with a screw top. The remainder of the lump was then broken up, and portions from the centre were similarly treated. The jars and their contents were then weighed and dried. Typical results, which are given in table II., show that the outer layer of a lump may contain ten times as much water as the inner portion. The lumps were taken from different wagons on different occasions, and in each of the cases 5—8 the whole of the outer portion and the whole of the inner portion of the lump were dried:—

TABLE II.

Sample no.	A. % moisture in outer 1½-in. layer of lump.	B. % moisture in centre of lump.	Ratio A/B.	Average % moisture in whole lump.
1	3·4	0·3	11·3	—
2	10·0	1·0	10·0	—
3	19·3	2·5	7·7	—
4	28·2	4·2	6·7	—
5	7·1	1·38	5·1	4·6
6	15·0	4·25	3·5	11·4
7	10·5	5·0	2·1	9·7
8	18·6	9·4	2·0	18·5
9	24·0	12·7	1·9	—

Table I. emphasises the necessity of preserving in the sample the same proportion of large and small as in the wagon. Table II. shows that care must be taken in selecting portions from lumps. Very considerable error would, for instance, be introduced by conscientiously chipping off small portions from a large number of lumps, in the hope of obtaining a representative sample.

It is well in sampling to take samples from points at regular distances apart, and it is helpful to place mentally some simple arrangement of straight lines over the section of coke, and to select pieces at each of the points of intersection of the lines. It would appear advisable, on account of the uncertainty of weather effects, to avoid sampling the coke at the top of the wagon to a depth of about 1 foot. This procedure, which by avoiding one portion of the wagon, will not give a strictly representative sample, is only fair if complaint of excessive moisture content is likely to be made. Care should also be taken to avoid sampling just after a fall of coke in the wagon. Lumps should be broken through the centre before any portion is taken for the sample.

Weight of sample.—The weight of the original sample taken will depend on the amount of coke which it is taken to represent, and also on the degree of accuracy desired in the result. The most accurate result would, of course, be obtained by drying the whole wagon, a distinctly cumbersome procedure. When the sample has to be crushed by hand, the weight taken is often too small. For routine work a sample weighing about 14 lb. and consisting of about 20 lumps or portions will usually be found convenient and sufficiently accurate. We may adopt as a general principle that the addition or removal of the largest lump in the sample, no matter how wet or dry the lump may be, should not seriously affect the result. For example, let us suppose that from a wagon of coke containing 16% of small, a sample weighing about 14 lb. has been obtained as described above. We may take it that each of the 20 portions will contain 300 grms. of dry coke, and that the sample will consist of three portions of small (average moisture content 16%) and 17 portions of large (average moisture content 8%). The average moisture of such a sample would be 9·296%. If one lump of the large had been omitted, the average moisture content would be 9·363%, whilst if one portion of small had been omitted, it would be 8·913%. Further calculation shows that the average moisture content of the wagon of coke would be 9·28%. It will be noted that the ratio of the percentage of moisture in the small coke, compared with that in the large coke, has, in this particular case, been taken as 2, but reference to table I. will show that it may reach as high a figure as 9·5. A few calculations similar to the foregoing, but with different numerical data, will show the impracticability of obtaining results, representative of the whole wagon, to 0·1%. The author suggests that for routine work, results be reported to the nearest 1%. This would be fully as accurate as the sampling would justify, and as would be of any service in works practice. If, in cases where the analysis of the sample yields a result involving 0·5%, the result be given to the nearest *odd* integer, the error due to the addition or subtraction of 0·5% will, in dealing with a large number of samples, be minimised.

Crushing.—It is desirable that the sample be crushed as quickly as possible, in order to avoid appreciable error due to drying. A. Wagener (*loc. cit.*) found that saturated lump coke containing 16—20% of water lost 4% of water whilst being crushed and put through a sieve of 4 mm. meshes. Coke containing 9% of water lost from 1 to 2% under similar conditions. The weight of the sample should be reduced by quartering, and not by removing insufficiently crushed lumps by the use of a sieve. Before quartering, the well-mixed heap can be conveniently spread out by a spiral stirring motion of a brush handle. The only justification for the use of a sieve is to test the degree of fineness of the sample, but any advantage so obtained is more than counterbalanced by the disadvantage of the unavoidable extra drying which the sample undergoes during the sifting. In the preparation of a sample of very wet coke, on a day when the relative humidity is low, the error is considerable. There is a second objection to the use of a sieve by some samplers. Where the sampler's duty is to

prepare, by hand crushing, an ultimate sample of about 300 grms. of 64-mesh. coke, there is a tendency, at least on some occasions, for his conscience to be satisfied, if he merely crushes the coke for as short a time as will yield just about the desired 300 grms. and no more. Obviously the whole of the sample should be crushed to pass through the sieve. The author has found that in wet coke the portions of 64-mesh coke first obtained contain 2% more moisture than the remainder of the sample, the wettest, and therefore the softest (and usually the outermost), portions of the lumps being of course the most easily broken. With further crushing this effect is lost, even before the greater part of the sample has been well crushed, as the smaller coke, offering a larger drying surface, loses moisture more quickly than the larger coke. In fact it will frequently be found that the 64-mesh coke is slightly drier than that remaining on the sieve, always provided that the sample, during preparation, has been spread out for a considerable time on the crushing plate. The ultimate degree of fineness of the sample, and the amount dried for the determination of water, will be fixed by similar considerations to those given in the previous paragraph. Previous to drying, if the sample be stored in a glass jar fitted with a tightly fitting screw-top or cork, there will be no important loss.

Determination of moisture.—The determination of moisture in the prepared sample, involving as it does no chemical reactions, is by far the easiest portion of the work. Almost all text-books give one method to be used for both coal and coke, thus neglecting the fact that coke is of much less delicate chemical constitution than coal. A method giving accurate results with coal will, of course, give accurate results with coke samples, but the restrictions of temperature, duration of heating, etc., necessary in dealing with coal, are quite unnecessary with coke. For coke samples, an American committee (Trans. Amer. Foundrymen's Assoc., 1912, xxl., 143) would restrict the drying temperature to 104°—107° C., Thörner (Stahl und Eisen, 1888, 8, 589) chooses 105°—110° C., whilst Brearley and Ibbotson (*loc. cit.*) choose 110°—120° C. Reference should be made to the work of A. C. Fieldner and W. A. Selvig (U.S. Bureau of Mines, Tech. Paper 148), which deals with the determination of moisture in the prepared sample. Their conclusions, based on experimental evidence, may be briefly summarised here. Temperature, time, humidity of drying atmosphere, and fineness of sample may be varied over a considerable range without appreciably affecting the results. The maximum variation in the percentage of moisture produced by oven temperatures ranging from 105° to 200° C. was 0·3%. Coke may be dried to "constant weight" without any gain in weight, due to oxidation taking place. Circulation in the oven of dried air, as is required for coal analysis, is unnecessary in dealing with coke. Moisture content can be quickly determined to within ±0·5% by simply heating a large sample of lump coke at 100°—200° C. to constant weight.

Usually in works practice a fairly small sample (20—150 grms.) is dried by heating in a suitable oven. If advantage be taken of the fifth conclusion of Fieldner and Selvig (*loc. cit.*), there will be much saving of labour and avoidance of congestion in the sample-house. The bucket, containing the lump sample, just as it has been obtained from the wagon, would be weighed and placed in a warm box or chamber, such as might be constructed on or by the side of the boilers of a blast-furnace plant. The drying may be accelerated by passing air, conveniently obtained from the blowing-engines and dried and warmed if convenient, through the chamber or even through the individual buckets if these are of suitable construction.

For special cases more accurate results will b obtained by passing dried air, nitrogen, or hydrc gen over the gently heated coke and absorbing th moisture in a weighed drying tube. Graefe (Braun kohle, 1906, 581—583) applied the method of distil lation in dealing with brown coal and other fuels Details of suitable apparatus will be found mor recently (see this J., 1918, 488 A). A weighec quantity of the coke is heated with petroleum spirit, and the distillation products are condensec in graduated apparatus, the water sinking to the lower graduated portion. Maurice (Comptes Rend. Mens. Soc. Ind. Min., 1899, 144—165) describes a rapid approximate method which he applied to washed coal to be used for coking purposes. A portion of the sample is shaken with twice its weight of calcium chloride solution (sp. gr. 1·4), the altered specific gravity of the solution after filtration is determined, and the percentage of moisture in the sample obtained by calculation, or by reference to tables.

Absorption of moisture.—The maximum possible moisture content as indicated by the total amount of water which coke is capable of absorbing when immersed in water, varies with the porosity of the coke. G. D. Cochrane (J. Iron and Steel Inst., 1918, i., 146) gives the following figures: for hard coke 30·49% (absorbed by dry coke), for soft coke 39·26%, and for very soft coke 51·00%.

Effect of weather.—Calculation will frequently show that the effect of rain alone is insufficient to account for excessive moisture content. A wagon 17 feet long, 7½ feet wide, and 5¼ feet deep is designed to carry 12 tons of coke. The area of the top of such a wagon is 127·5 sq. ft., and the weight of one inch of rain over this area is 664 lb. If we assume the 12 tons of coke to be dry, then the percentage of moisture in the coke, after one inch of rain has fallen on it, will be 2·4. There would be no experimental difficulties to hinder actual measurements of the weather effects, as wagons of coke can be weighed on an ordinary weigh-bridge to within 28 lb., and records of the weather conditions are always available.

A. Hüssener (J. Iron and Steel Inst., 1895, i., 329), in comparing two kinds of coke, mentions that Hüssener coke containing 2·515% of moisture was found to contain 4·5% after 2 days of rainy weather, and that Otto-Hoffman coke containing 5·139% was under the same conditions found to contain 9·5%. The conditions are not, however, given in sufficient detail to enable the figures to be applied to other cases, and no other figures appear to exist in the literature of the subject.

In conclusion, the author wishes to thank Messrs. The North Lincolnshire Iron Co., Ltd., for permission to publish the results.

North Lincolnshire Iron Works, Scunthorpe.

VEGETABLE DECOLORISING CARBONS.

BY A. B. BRADLEY.

Factors which govern the decolorising effect.

During recent years a number of highly active decolorising vegetable carbons have appeared on the market for use in sugar refineries and other industries requiring an efficient decolorising and clarifying agent. That such carbons should, in the near future, tend to replace bone and other animal charcoals may be seen from the fact that in most examples so far introduced the decolorising effect is anything from 10 to 30 times that of animal charcoal, weight for weight. Among this class of carbons may be mentioned Eponite, Littoral, Norit, Filchar, Flandrac, Carboraffin, etc., the inventors or investigators of some of which seem to make extravagant claims for their products, and many conflicting reports and articles have appeared in various technical journals in consequence. It is

not intended to deal here with the manufacturing side of vegetable decolorising carbons, much of which is secret (some information can be obtained on referring to a recent paper by F. W. Zerban in the International Sugar Journal of June, 1919, p. 284; see this J., 1919, 527 A), but to show as briefly as possible to what extent such factors as temperature, concentration of solution, time of contact, percentage of carbon added, and size of the grain of carbon, etc., influence the percentage of colour absorbed from sugar solutions.

Pellet* has made a study of the various decolorising carbons, taking Eponite as a standard. He gives the carbons in the following order of merit—Eponite, Littoral, Flandrac, Flaming, etc., etc. It will be seen later on that, unless he took the same sized particles of each of these carbons for comparison their relative merits may be largely due to difference in size and not to increased activity of the carbon. It is possible to take a decolorising carbon and by simply sifting and selecting a particular grade of the sample to produce a decolorising effect much better than that given by the original sample, and very much better than that obtained with other fractions of the same sample, weight for weight. Most vegetable decolorising carbons appear in the form of black, glistening, fairly coarse powders, consisting of a mass of many-sized particles. For the purpose of these experiments "Norit" was selected, and a bulk sample was first boiled with distilled water and washed until no soluble extract was obtained in the filtrate, and then dried in a steam oven. Raw Barbados and raw Mozambique sugars were used for the decolorising tests, bulk solutions being prepared of 50% strength. Weighed samples were taken for treatment, so that in all experiments in each set the same amounts of colour and other removable matters were dealt with.

Size of carbon particles.—As it was first of all noticed that the decolorising carbon contained fairly coarse particles as well as extremely fine dust, it was thought interesting to grade a fair bulk to obtain its percentage composition as regards size of particle. Silk flour sieves were used for this.

Having obtained fair-sized samples of each of the different grades, decolorising experiments were made to see what differences would be produced by treating sugar solutions with 5% of each of the different grades. In these tests 5 grms. of carbon and 200 grms. of the prepared syrup were just brought to the boil and filtered through a 2½in. Buchner funnel, a pump suction equal to a pull of 20in. of mercury being maintained during filtration, and tintometer readings were taken with the filtrates. The percentages of the different grades of carbon obtained and the percentages of colour removed by each are shown in the following table:

	Silk sieve mesh.	Carbon left as residue on sieve. %	Percentage of colour &c., absorbed. (5% of carbon used)
1.	20 per linear inch ..	0·45	Not estimated.
2.	28 " " ..	0·41	"
3.	38 " " ..	0·45	29·06
4.	48 " " ..	4·04	41·51
5.	60 " " ..	7·30	65·00
6.	72 " " ..	12·80	76·20
7.	84 " " ..	7·01	80·00
8.	94 " " ..	6·06	80·60
9.	106 " " ..	6·43	81·00
10.	124 " " ..	4·60	81·62
11.	Passes through 124-mesh ..	49·20	Not estimated.
12.	Original Norit ..	..	71·80

The fraction 49·2% which passes through the 124-mesh sieve is not uniform in size, but is capable of further grading by such means as fractional settling out in water, etc. No separation such as this was undertaken. The above figures do not represent any definite standard composition for the carbon used, variation occurring in almost every bag, at any rate in individual batches. It is quite certain also that variations take place in the raw material and general treatment employed in the production of these carbons, thereby giving variable results after manufacture.

In the case of Nos. 1 and 2 the colour absorption readings were not taken on account of the muddy appearance of the filtrates, the surface presented by 5% of these two grades being insufficient to absorb and hold back all the gummy matters, etc., contained in the syrup. No. 11 also was not estimated, as this fraction, being in itself a mixture, would not give a comparable reading.

The times taken for filtration are interesting, although they may not be strictly correct on account of the difficulty experienced in maintaining the mixtures at about 95° C. over the long periods of time taken for filtration. They were as follows: No. 2, 72 mins.; No. 4, 34; No. 5, 28; No. 6, 18; No. 8, 7; No. 9, 4½; No. 10, 4½; No. 11, 6 mins. These figures, taken for what they are worth, would seem to demonstrate that in the first four cases the excessive times taken are due to the settling of the non-absorbed gummy matters, etc., on the filter paper, thus forming a less permeable layer.

The time required by No. 11 indicates that, after a certain limit of fineness is reached, the particles of carbon pack down so tightly on to the filter paper that they form a less porous surface for the syrup. It has been the author's experience in practice that bulk batches of fine decolorising carbon (that is to say, very old carbon reduced to great fineness by constant use) take longer to filter off in the presses, ton per ton, than carbon of normal size. Rough experiments indicated that the extremely fine carbon obtained by precipitating all but the finest particles in water takes very much longer to filter on a laboratory scale than the figure obtained with No. 11. When the decolorising results are plotted as a curve, it is clear that, up to a certain limit of size (84- or 94-mesh), the percentage of colour removed increases quite rapidly as the carbon decreases in size of grain, whereas after about 94-mesh the increased efficiency is relatively small. This will also demonstrate that any two carbons made up of grains of variable size in different proportions will behave in the same manner, and, therefore, the claims made for increased efficiency of any one carbon over another, if used weight for weight, may be partly due to the size of carbon grain and not entirely to greater activity of the carbon.

Percentage of carbon employed.—The next set of experiments was made to test the effect of increasing percentages of decolorising carbon on the amount of colour removed from sugar solutions. The original ungraded Norit was used for these experiments, and increasing percentages from 0·5% up to 7·0% were added to equal weights of the prepared solution and treated as described above. The percentages of colour absorbed were:—

Carbon added %.	Colour absorbed %	Carbon added %.	Colour absorbed %
0·5 ..	36·5	4·0 ..	85·5
1·0 ..	62·5	4·5 ..	86·0
1·5 ..	70·0	5·0 ..	86·2
2·0 ..	75·4	5·5 ..	87·0
2·5 ..	79·0	6·0 ..	87·0
3·0 ..	82·7	6·5 ..	87·8
3·5 ..	84·5	7·0 ..	88·0

It will be noticed that the first 1% of carbon removes 62·5% of the total colour, whereas the second only removes an additional 12·9% and the last 1% of carbon only absorbs 1% of additional colour. This, in the author's opinion, would seem to indicate that the greater proportion of colouring matter is in a crude colloid state, of considerable molecular dimensions, and is therefore the more easily removed, whereas the last traces, being

much nearer a true solution, are more difficult to absorb.

A number of experiments have been made in which sugar solutions were treated with small percentages of carbon (say, 2·5%), and nitrogenous substances such as casein etc., added in very small proportions to the clear filtrates, which were then boiled. After treatment with an additional 2·5% of carbon, the final results were found in all cases to be better than when the solution was treated with 5% of carbon in one boiling, and filtering without the addition of the nitrogenous substances. This would seem to indicate that when the less dispersed colloid colouring matters have been removed, the finer or more soluble particles can be agglomerated (probably adsorbed) by colloid substances added, such as casein or gelatin, and thus removed to a fair extent. Further experiments are to be carried out to endeavour to throw more light on this problem.

It may be stated here that when using from 0·5% up to 2·5% of carbon in the above treatments filtration was extremely slow, becoming more rapid up to 5% and very much more so when 7% of carbon was used. The filtrates also up to the 3% treatment were not absolutely bright, whereas from 5% onwards perfectly bright solutions were obtained.

Temperature.—The effect of temperature was next considered. For these experiments equal weights of 50% syrup were agitated with 5% of carbon (calculated on the sugar solids) for one minute and then filtered. For temperatures of 80° to 100° C. the solutions were agitated under a reflux condenser. The percentages of colour removed were found to be as follows:—

Temperature of treatment.	Colour absorbed %.	Temperature of treatment.	Colour absorbed %.
20° C.	54·60	70° C.	70·13
30° C.	60·80	80° C.	71·11
40° C.	64·50	90° C.	71·60
50° C.	67·20	100° C.	71·95
60° C.	69·72		

Thus up to 70° C. the increasing percentage of colour removed for each 10° C. is somewhat marked, whereas from this point up to 100° C. the additional colour absorbed is very small. To the sugar refiner this should be useful, as it allows an economy to be effected in steam or fuel used for heating the syrups, and incidentally there is less production of invert sugar at the lower temperature also.

Following on from this experiment, a large batch of sugar was boiled with 5% of carbon under a reflux condenser, and samples were taken after each 5 minutes' boiling for 1 hour. The percentages of colour absorbed were as follows:—

Time of boiling.	Colour absorbed %.	Time of boiling.	Colour absorbed %.
Just boiled.	78·21	35 minutes	81·03
5 minutes	78·45	40 ,,	81·09
10 ,,	78·96	45 ,,	81·87
15 ,,	79·38	50 ,,	82·23
20 ,,	79·96	55 ,,	82·93
25 ,,	80·48	60 ,,	83·52
30 ,,	80·71		

The results show that, even after agitating and boiling for 1 hour, the gain in decolorising effect is only 5·31% above the original figure (78·21%).

Concentration of sugar solutions.—Experiments were now made to test the effect of the concentration of sugar on the amount of colour absorbed. For these experiments a bulk solution (50%) of dark Mozambique sugar was made, and for the first experiment 20 grms. of this syrup was diluted to 100 c.c. and treated with 5% of carbon (calculated on the sugar solids). Then, for the rest of this series, 10, 15, 20, 25, 30, up to 60 grms. of pure white crystal sugar was added respectively to each 20 grms. of syrup dissolved, and this was made up to the original 100 c.c. and treated with the same amount of carbon as used in the first experiment. In this way all conditions were made equal except for the increased concentration. The following decolorising values were obtained:—

White sugar added.	Colour absorbed %.	White sugar added.	Colour absorbed %.
Nil	50·0	30%	21·91
10%	46·75	40%	19·96
15%	43·62	50%	17·82
20%	38·32	60%	16·10
25%	32·03		

These results show that increased concentration, up to a total sugar content of 40% of sugar, brings down the decolorising efficiency quite rapidly, whereas above this figure to a total sugar content of 70% the loss of efficiency is not nearly so marked. Experience has proved that when dealing with very dark and impure sugars, such as dark Mozambique or Ilo-Ilo, in bulk, very much better decolorising results are obtained if the syrups under treatment are rendered as dilute as is permissible.

Degree of acidity of the sugar syrup.—It is a well-established fact that decolorising carbon (animal or vegetable) gives greater efficiency with sugar solutions of an acid reaction than with neutral or, in the case of raw beet sugars, alkaline syrups. As only an extremely low degree of acidity is permissible if the resulting syrups are to be crystallised or if they are to be transformed into a dry powdery mass, it was deemed advisable to see what decolorising efficiency could be looked for, as against the decolorisation of syrups which are required of an acid nature for the production of "golden syrup," treacles, fondant creams, jams, or the like, which in their finished state must contain a certain amount of invert sugar.

For these experiments a bulk syrup containing 50% of raw sugar was made, which, after titrating a weighed quantity, was rendered just neutral with the calculated quantity of sodium bicarbonate; 100 grms. of this solution was then diluted to 200 c.c. and treated with 5% of carbon (calculated on the sugar solids). Then to successive lots of 100 grms. from 0·5 to 20 c.c. of $N/10$ sulphuric acid was added, the solution made up to 200 c.c. bulk, and treated as above with 5% of carbon. The percentage decolorising effects obtained were:—

Amount of acid added.	Colour absorbed %.	Amount of acid added.	Colour absorbed %.
Nil	76·2	5·0 c.c.	83·4
0·5 c.c	77·1	6·0 c.c.	84·8
1·0 c.c.	78·0	8·0 c.c.	87·1
2·0 c.c.	79·4	10·0 c.c.	89·6
3·0 c.c.	80·8	15·0 c.c.	92·6
4·0 c.c.	82·1	20·0 c.c.	95·0

The increase in decolorising efficiency is thus practically proportional to the degree of acidity, the slight deviation from a straight line relationship being probably due to the formation of a little colouring matter (caramel) while the syrups of high acidity were being heated.

Nature of acid used.—Experiments were made to see if different acids, both organic and inorganic, had differing effects on the decolorising power of carbon, if they presented in the sugar syrups the same degree of acidity. A bulk solution of cane syrup (50%) was neutralised, and sufficient of each of the acids was added to give an acidity equivalent to 1 c.c. of $N/10$ sodium hydroxide in 100 grms. of the syrup. The following acids were used: Sulphuric, hydrochloric, nitric, phosphoric, acetic, tartaric, citric, oxalic, lactic. After treatment with 5% of carbon, little or no difference was found in the resulting filtrates; several were slightly brighter than others, this being the only marked difference.

From a sugar refiner's point of view this is extremely interesting when compared with the inverting rate of the same acids, as given by Ostwald (J. prakt. Chem., 29, 385); these rates are as follows, the acids being in the order given above: 100·0, 100·0, 53·6, 6·49, 18·57, 6·50, 1·72, 1·07, 0·40.

The publication of these results was thought advisable from the fact that they form the basis of a more elaborate research, now in progress, which it is hoped to communicate in the near future.

In conclusion, my thanks are due to Messrs. Peek, Frean and Co., in whose laboratories this work was carried out.

London Section.

REPORT OF REFRACTOMETRY COMMITTEE.

The terms of reference were:—"To report on the steps which should be taken in order to standardise the application of the refractometer to industrial and scientific purposes."

The Committee proceeded in the first place to ascertain the usual practice followed in refractometric measurements for technical and commercial purposes, more especially as regards the temperature at which the measurements are made. The facts elucidated in this preliminary enquiry may be summarised as follows:—

1. In the case of essential oils, from data which are available, temperatures given vary from 10° to 40° C., but the largest number of published figures, especially those of Schimmel, are for 20° C.

2. For fatty oils, the majority of figures are recorded at 15°, 20°, 25°, and 40° respectively, and in the case of solid fats more figures are given at 40° than at any other temperature. The practice of recording determinations both for liquid and solid fats at 40° appears to be on the increase. It should be observed, however, that 40° is too low in certain cases to permit determinations to be made.

3. In the case of sugar solutions the temperature of 20° has been generally adopted for temperate countries and 28° for the tropics for the Abbe refractometer.

4. For the dipping refractometer the tables published are for 17·5° C., the temperature at which the Zeiss instrument was standardised.

5. The recommendations of an International Conference, held in Paris in June, 1910, were that:—"Measurements be expressed as refractive indices with reference to air for the spectrum line D and at a temperature of 25°, but at a temperature of 40° for fats.

"When, however, it is impossible to work at 25° or 40° as mentioned above, the refractive index may be taken at another temperature, T, but this must be designated by the expression, Refractive index T."

(The same conference recommended that polarimetric measurements should be made at 20° C.)

Attention was directed to the possible error arising from the fact that in actual practice refractometers are used at temperatures different from those for which the graduation of the scale is strictly valid. From the information before the Committee, however, it appears that in the case of the Abbe or butter refractometer, at a point 20° different from the temperature at which the instrument was standardised, the error in the reading arising from this cause does not amount to more than 2 units in the fourth decimal place of the refractive index.

In view of the wide and growing application of the refractometer for technical and analytical purposes, the Committee holds the opinion that it is desirable to secure uniform practice as far as possible in regard to the temperature at which refractometric measurements are made. Since the risk of imperfect thermal control increases with the difference between the working temperature and the air temperature, it is clearly desirable to choose for the general working temperature a point which may be taken as an average temperature for non-tropical countries. The Committee would suggest 30° C. as such a point, and that temperatures should be suitable for the practicable determination by the refractometer not only of sugar in solution, but also of other dissolved substances, such as glycerol and alcohol. This choice would also have the advantage that it is the temperature at which most refractometers are standardised. In the opinion of the Committee the temperature of 25° proposed by the International Conference held at Paris in 1910 is too high.

The temperature of 20° obviously cannot be taken as a universal standard in refractometric practice, for, on the one hand, fats cannot be examined at ordinary temperatures, and, on the other hand, the air temperatures in tropical countries will generally be above 20° C. The Committee recognises the exceptional circumstances of these two cases and considers, in view especially of the practice already widely adopted, that 40° C. is the best standard temperature for the refractometric investigation of fats, and that refractometric measurements in tropical countries should be made as far as possible at 28° C.

The Committee, while expressing its view as above, recognises that nothing like uniformity in refractometric practice can possibly be secured unless the question has been thoroughly considered by a much more representative body, preferably international in character. The Committee would urge, therefore, that the Committee of the London Section, supposing it to approve generally of the present report, should initiate a movement for the standardisation of refractometric practice. The question would no doubt be brought primarily to the notice of the Council of the Society of Chemical Industry.

Members of Committee: Prof. J. C. Philip (Chairman), Dr. T. M. Lowry, Messrs. E. R. Bolton, A. R. Ling, T. Macara, J. S. G. Thomas; H. Main (Secretary).

Communications.

NOTE ON THE DE-ARSENICATION OF SULPHURIC ACID BY HYDROGEN SULPHIDE.

BY T. S. MOORE.

According to the published information, the strength of sulphuric acid submitted to de-arsenication by hydrogen sulphide must not exceed 110°Tw (64·26% H_2SO_4), and is in many works much less than this, down to 100° Tw. (59·7% H_2SO_4). The experiments described in this paper were undertaken at a time when the demand for arsenic-free C.O.V. was very large and when all unnecessary concentration had to be avoided on account of shortage of plant, to find out whether more concentrated acid, particularly Glover tower acid of about 147° Tw. (80% H_2SO_4) could be de-arsenicated without prohibitive loss of sulphuric acid by reduction.

The experiments were carried out at the temperature of the laboratory. Hydrogen sulphide at the rate of one bubble a second was passed through 200 grms. of the acid under examination, and the product filtered through asbestos in three separate portions:—(1) Without any special precaution, (2) with hydrogen sulphide passing through the liquid while filtering, and (3) without precaution, after the liquid and precipitated arsenious sulphide had remained together for one or two days.

In de-arsenicating arsenical C.O.V. (95% H_2SO_4, 0·15% As_2O_3, 0·11% As_2O_3) it was found (1) that the process was slow, taking 2½ hours in laboratory apparatus; (2) that excessive reduction of sulphuric acid occurred, the strength of the resulting

acid being 91·8%; (3) that if filtration from the arsenic trisulphide is carried out immediately after the precipitation the arsenic content is 2 to 3 parts As_2O_3 per million, but that the arsenic content is higher the longer the filtration is delayed; and (4) that if hydrogen sulphide is passed through the liquid during filtration the arsenic content falls to less than 1 part As_2O_3 per million. Further, under the conditions last mentioned, the acid coming through the filter is perfectly clear, but soon becomes cloudy owing to the precipitation of sulphur, which shows that the rate of oxidation of hydrogen sulphide by strong sulphuric acid is not large enough to prevent the accumulation in solution of an appreciable quantity of the gas.

With arsenical C.O.V. diluted to contain approximately 80% of sulphuric acid it was found: (1) That the rate of reduction of the sulphuric acid is quite small (Original acid contained 79·7% H_2SO_4. After one hour's treatment with hydrogen sulphide, the acid contained 79·4% H_2SO_4. After two hours' treatment it contained 77·8% H_2SO_4); (2) that acid filtered immediately after one hour's treatment contained 1 part As_2O_3 per million, and the arsenic content was not diminished by passing hydrogen sulphide during filtration; (3) that when filtration was delayed for days the arsenic content had risen only to 1·5 parts As_2O_3 per million. Two days after the acid has been filtered it still smells of hydrogen sulphide, which shows that the rate of reaction between hydrogen sulphide and 80% sulphuric acid is small.

The behaviour of 70% acid resembles that of 80%, the chief differences being that (1) de-arsenication is slightly more rapid, (2) filtration of the arsenic trisulphide may be delayed several days without any serious increase of the arsenic content, and (3) there is even less reduction of sulphuric acid.

Finally, an experiment with Glover tower acid of unusually high arsenic content was carried out, in which hydrogen sulphide in fine bubbles was passed through 500 grms. of the acid contained in a bottle fixed on a shaking machine. One hour's treatment with hydrogen sulphide proved insufficient for this acid, and in a second experiment treatment was continued for 1¾ hours. Part of the product was filtered immediately and part after two days. The results of analysis were:—

	Before treatment.	After immediate filtration.	After standing two days.
H_2SO_4	77·1%	77·1%	77·1%
N_2O_3	0·18	None	None
As_2O_3	0·29	Between 0·6 and 1 part in 10^6.	2 parts in 10^6.
As_2O_3	1·58	None	None

These figures need some comment, for as they stand they give the impression that there is no loss of sulphuric acid. The following calculation shows that de-arsenication should actually cause an increase of the sulphuric acid content. The reactions proceeding are:—

$$N_2O_3+H_2S=H_2O+2NO+S;$$
$$As_2O_3+3H_2S=As_2S_3+3H_2O;$$
$$As_2O_5+5H_2S=As_2S_3+5H_2O+2S.$$

Thus, apart from absorption of water from the atmosphere and from reduction of sulphuric acid, 100 grms. of the original acid containing

77·1 grms.	H_2SO_4	should give, with H_2S	77·1 grms.	H_2SO_4
0·18 ,,	N_2O_3		0·05 ,,	H_2O
0·29 ,,	As_2O_3		0·08 ,,	,,
1·58 ,,	As_2O		0·63 ,,	,,
20·85 ,,	H_2O		20·85 ,,	,,

i.e., 100 grms. of acid should become 98·71 grms. after de-arsenication, so that the strength of the sulphuric acid in the de-arsenicated product should be $\frac{100\times77\cdot1}{98\cdot71}=78\cdot1\%$. Since it was found to be 77·1, there is an apparent loss of 1·3% of the sulphuric acid originally present. This figure cannot be taken as accurate, for absorption of water may have occurred, and, further, it is not possible in small experiments to estimate the yield of de-arsenicated acid at all exactly. But it can be taken that the loss of sulphuric acid by reduction is less than 1·3% of the original sulphuric acid. The loss could certainly be diminished by (*a*) using a more efficient apparatus for mixing the gas with the acid, (*b*) stopping the treatment before the de-arsenication had gone so far as the point reached in the experiment, and (*c*) using a Glover tower acid of more normal arsenic content, for all these conditions would diminish the duration of treatment.

From these experiments it is clear that for practically complete de-arsenication of acid of any strength up to 95% the only essential condition is that the acid after treatment must contain dissolved hydrogen sulphide, and so long as this condition is fulfilled the acid can stand in contact with the arsenious sulphide without any serious increase of arsenic content. As soon as the hydrogen sulphide has been destroyed the acid takes up arsenic again at a rate depending upon its strength.

E. Schmidt (Arch. Pharm., 1917, 255, 45) states that although water, alcohol, and dilute solutions of hydrochloric acid cause appreciable decomposition of arsenious sulphide, such decomposition is prevented by the presence of small quantities of hydrogen sulphide. The above experiments show that hydrogen sulphide has a similar effect, even in the presence of strong sulphuric acid.

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THE EFFECT OF COOLING BURNER GASES ON THE CATALYTIC ACTION OF PLATINUM IN SULPHURIC ACID CONTACT PLANTS.

BY P. PARRISH, A.I.C.

In a recent contribution bearing the above title (this J., May 31, 1919, 133 T), by S. T. T. Geary, the author shows an intelligent appreciation of the theoretical principles and considerations underlying the union of sulphur dioxide and oxygen in the presence of a platinum catalyst, as well as the conditions regulating equilibrium. Consideration of the contribution suggests that the author started out with the intention of proving a studied theoretical factor calculated to promote increased efficiency of conversion, and it would be ungenerous to suggest that he had failed to afford adequate proof. The value of the investigation would have been enhanced had the author furnished evidence or data to support the statement that "the conditions on both units were the same with the exception of the exit temperatures" during the investigation period.

Several factors affect efficient conversion, *e.g.*, (1) Maintenance of a specific content of SO_3 in the gases entering the converter. (2) Uniformity of the SO_2 content of the gases. (3) The presence or absence of inhibiting substances. (4) The presence of or freedom from sulphuric acid mist. (5) Maintenance of a uniform inlet temperature to the first platinum layer. (6) Velocity of the reaction; in other words, the intensivity, or otherwise, of the operation of the plant. Having regard to these factors, it is to be imagined that the desirability of correlating and incorporating data on such points, along with the particulars embodied in the contribution, would have occurred to the author as obvious. It is not unreasonable to assume, in the absence of data to the contrary, that other contributory causes, operating concurrently with the specific condition of control outlined, tended to promote increased efficiency.

In support of the above view, the writer ventures to direct attention to the chart (reproduced below) showing plottings of various temperature conditions, etc., taken on an oleum plant at the works of which he has charge.

Mr. Geary's results demonstrate that maximum conversion is attained when an exit temperature of 470° C. is maintained. According to the author's experience in the working of a Grillo plant, maximum conversion (94·75%) is attained when a temperature of 425° C. is maintained. A temperature of 460° C. results in decreased efficiency (viz. 92·7%). In the latter case, however, inhibiting substances—chlorine or chlorine compounds—due to the presence of sodium chloride in the sulphur, were operating slightly but continuously, rendering the maintenance of uniform temperatures at the inlets to the various layers next to impossible.

Evidently the plant with which Mr. Geary was connected when he carried out the investigation in question was a Mannheim type, where the converter is somewhat obsolete in design.

The converters provided in connection with most Grillo oleum plants are arranged in such a way that the incoming SO_2 etc. gases ascend an external tortuous annulus, in which such gases are preheated by the SO_3 etc. gases descending the internal part of the converter. In order to facilitate the maintenance of a definite outlet temperature, it is possible to by-pass the preheater and to introduce a certain percentage of cold SO_2 etc. gases direct to the inlet of the converter.

COMPOSITION OF RECTIFIED PETROLEUM SPIRIT FROM TOLUOL-PETROLEUM SPIRIT RUNNINGS OF ASIATIC PETROLEUM.

BY H. G. EVANS.

The object of this investigation was to determine the approximate composition of the petroleum spirit in the toluol-petroleum spirit runnings from Asiatic petroleum. For this purpose the distillation was conducted in three stages in three types of column:—*Stage* 1: Young's 12-bulb-pear-column. *Stage* 2: A 75 cm. glass column of 2·5 cm. internal diameter packed with lead balls, of diameter 5 mm. approx., throughout its length, except for a short plug of iron-wire gauze at the foot of the column to prevent lead balls from passing down. *Stage* 3: A 75 cm. glass column similar to 2, but having a copper-gauze plug 10 cm. in length at the foot of the column and the remaining space occupied first by 30 cm. of small steel balls about 2 mm. in diameter and then 35 cm. of larger steel balls of about 4 mm. diameter. In each stage the distillation was regulated by suitable lagging so as to take place at a constant rate not exceeding 7 c.c. per min. in columns 1 and 2, and 4 c.c. per min. in column 3.

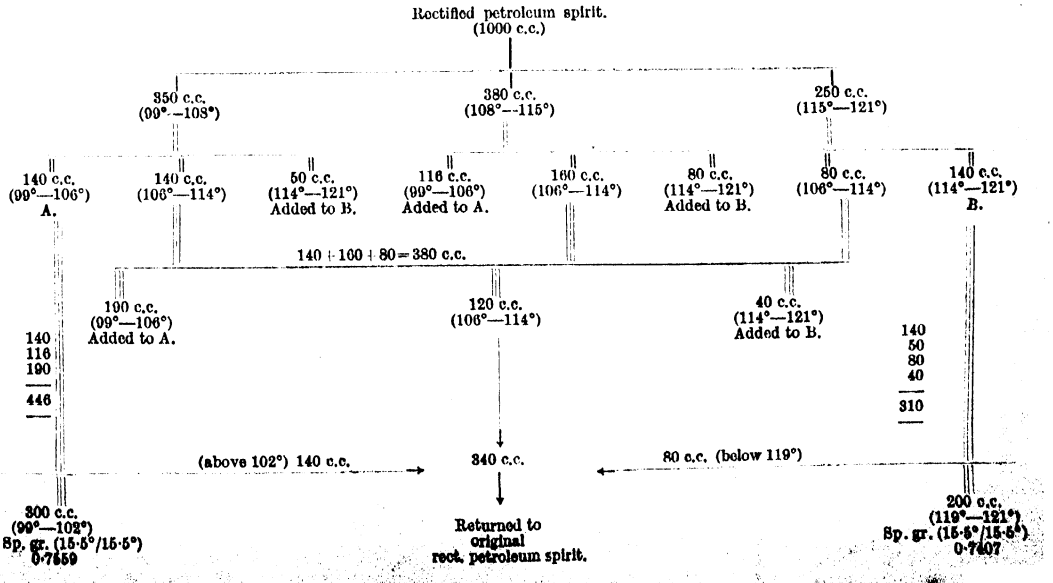
It was found that the fractionating power of the column employed in Stage 3 considerably exceeded that of the other two types. The following record of a test on 500 c.c. of the original rectified petroleum spirit will serve to illustrate this:—

Temp., °C.	Column 2, c.c. per 1° C.	Column 3, c.c. per 1° C.
100—101	16	25
101—102	14	47
102—103	66	66
103—106	20	28
106—110	12	6
110—112	10	2
112—114	14	11
114—115	24	12
115—116	34	12
116—118	56	55
118—120	40	46

It will be observed that in column 2 the intermediate runnings (106°—115°) were approximately 24% of the total volume employed, whereas in column 3 these were reduced to 12% of the total. If this result could be obtained on direct distillation of the original rectified petroleum spirit in one stage only, there is good reason to suppose a fairly complete fractionation to occur when the two columns are employed in succession.

This process was maintained constantly for a period of eight hours per day for upwards of three weeks, and the proportion between the two main fractions remained practically constant. The column employed in each stage is indicated by the number of lines in the diagram, thus III represents column 3.

Scheme of fractionation process.



The sp. grs. of the final distillates were repeatedly taken by means of a delicate pyknometer of less than 1·5 c.c. capacity, and only very slight

variations affecting the fourth decimal place occurred. This variation was not due to experimental error, as it was found possible to repeat any determination with certainty to the fourth figure.

Rectified petroleum spirit thus consists of two main fractions, the first distilling over between 100° C. and 102° C. and constituting 60% of the whole, and the second between 119° and 121° C., forming 40% of the whole. It was found impossible to separate either of these main fractions further into their constituents, no indication of fractionation being observed even with most careful distillation. The specific gravity and boiling point range of the first fraction approximated to those of normal heptane and hexahydrotoluene, and this fraction may be regarded as a mixture of these two hydrocarbons. Similarly the second fraction may be regarded as a mixture of normal octane and hexahydroxylenes (*o*, *m*, and *p*).

The boiling points of these four constituents are variously given as follows:—Normal heptane, 97°—100·5° C.; hexahydrotoluene, 101°—103°; normal octane 121°—125·5°; hexahydroxylene, *m* (70%) 119·5°—121°; *o* (10%), 126°; *p* (20%), 120°.

The specific gravities finally selected for the four constituents, after an exhaustive examination of existing literature, and corrected to 15·5°/15·5° C. in each case, were as follows:—Normal heptane, 0·68800 (Thorpe, J. Chem. Soc., 1880, **37**, 215; Francis and Young, J. Chem. Soc., 1898, **73**, 921). Hexahydrotoluene, 0·77330 (Sabatier, Comptes rend., 1901, **132**, 1254—1257; Kijner, J. Russ. Phys. Chem. Soc., **31**, 1035). Normal octane, 0·70648 (Thorpe, J. Chem. Soc., 1880, **37**, 217). Hexahydroxylene (70% *m*, 20% *p*, 10% *o*), 0·77797 (Sabatier, *loc. cit.*; Markownikow, Ber., **30**, 1213).

The observed sp. gr. of the fraction 100°—102° C. was 0·7559, and that of the fraction 119°—121° was 0·7407.

Assuming that no contraction occurs on mixing the respective paraffins and naphthenes, these sp. grs. would indicate the following compositions:—*Fraction*, 100°—102°: n-Heptane 20·4, hexahydrotoluene 79·6%. *Fraction*, 119°—121°: n-Octone 52·3, hexahydroxylene 47·7%. Thus, taking the first fraction to be 60% of the original petroleum spirit and the second fraction 40%, the composition for the original rectified petroleum spirit would be:—n-Heptane 12·2, hexahydrotoluene 47·8, n-octane 20·9, hexahydroxylene 19·1%.

In the above analysis the constituents boiling below 100° C. and above 123° C. are included in the respective fractions, but as the amount of these in no case exceeded 2% of the total, it is improbable that lower and higher homologues were present in any appreciable quantities.

As a check on the above results the sp. gr. of a mixture of these four constituents in the above proportions was worked out. Theoretically, assuming the sp. grs. of the separate constituents as given above, this mixture would have the sp. gr. 0·7498. Actually the sp. gr. of the original rectified petroleum spirit at 15·5°/15·5° is 0·7493. This result would appear to justify the assumption that no contraction occurs on mixing paraffins and naphthenes.

THE ESTIMATION OF PARAFFINS AND UNSATURATED COMPOUNDS IN COMMERCIAL TOLUOLS.

BY H. G. EVANS.

Estimation of Paraffins.

In an investigation to find a method of estimating accurately and rapidly the amount of paraffin spirit in ordinary commercial and Government contract toluols two processes were tried, viz., the sulphonation method and the specific gravity method.

Sulphonation method.

The first experiments were carried out with acids ranging from 20% oleum to 97% sulphuric acid. No special amount of acid and toluol, or fixed ratio between the two, was maintained. The results obtained for paraffins as percentage of toluol were accordingly quite inconsistent. Moreover, with oleum of 20%, 9%, and 4% free SO_3, no coherent results could be obtained even with fixed ratios and similar periods of shaking and standing. It is very difficult when using oleum to govern the reaction temperature. The use of oleum was therefore abandoned and 99%, 98%, or 97% sulphuric acid tried.

The measuring apparatus employed consisted of a 350 c.c. separating funnel, the neck of which was fitted with a graduated tube reading to 0·01 c.c., and communicating, through a length of pressure tubing attached to the run-off tube, with a mercury reservoir, such as a nitrometer bulb. The reaction mixture can thus be displaced upwards, on opening the tap of the funnel, until the paraffins occupy a portion of the graduated tube. When cold, the volume of paraffins can be read off with precision. This form of apparatus also possesses the advantage that the paraffins can be brought down again into the separating funnel and agitated with more acid in order to ascertain whether sulphonation has been complete or not.

Consistent results were obtained with 99% and 98% sulphuric acid, employing a fixed ratio of acid to toluene and keeping all the conditions constant as far as possible; 97% acid was of little use, as in many cases, even after repeated and prolonged shaking, the sulphonation was incomplete.

The 98% acid gives complete sulphonation in 15 mins., using 3 vols. of acid to 1 of toluol and agitating gently by hand in such a manner that the vessel does not become uncomfortably warm. Accordingly 98% sulphuric acid (prepared by adding 100 grms. of 20% oleum to 400 grms. of concentrated sulphuric acid, 96·4% H_2SO_4) was adopted for all experiments.

The exact conditions for sulphonation as employed for the synthetic mixtures, and therefore to be followed in dealing with ordinary samples, were as follows:—Approx. 50 c.c. of toluol was measured accurately (within 0·5 c.c. of the stated quantity) by pouring it slowly upon 150 c.c. of 98% sulphuric acid contained in a 250 c.c. stoppered and graduated cylinder. The cylinder was then shaken gently until fairly warm (not more than 45° C.), occasionally releasing the pressure. After standing for about 5 mins., it was shaken vigorously for 3 or 4 mins. to complete the sulphonation. The contents were then transferred to the measuring apparatus, the last drops rinsed in with 50 c.c. of sulphuric acid, and the graduated tube replaced. The mixture was then displaced upwards by means of the mercury in the reservoir until its surface occupied the neck of the separating funnel, and allowed to remain so until quite cold (from 2—3 hrs., depending on external conditions). The paraffins were then displaced upwards into the graduated tube and read off after standing a few minutes. The volume of paraffins was calculated as a percentage of the toluol taken, a correction of 0·60% being added to allow for solubility (see below).

If no separation of paraffins occurs, a known amount of paraffin may be added before sulphonating, or the sample may be mixed in suitable proportions with another sample of known paraffin content.

The reaction mixture from numerous sulphonation tests and also from the sulphonation of four Winchester quarts of commercial toluol after re-

moval of paraffins by separation, was poured into about one-fourth of its volume of water in large porcelain basins. Crystals of *p*-toluenesulphonic acid (together with the sulphonic acids of benzene, xylene, and thiotolenes if present) separated; these were drained free from mother-liquor and washed with a little concentrated sulphuric acid. About 1000 grms. of crystals was heated with an equal weight of concentrated sulphuric acid to 120° C. Steam was then passed in and the temperature allowed to rise to 190° C., during which time a considerable yield (70—100 c.c.) of toluene, nearly pure, distilled over. The oil in the distillate was separated and washed with 10% soda solution several times, and then with with distilled water. The pure spirit was dried over calcium chloride and distilled. The boiling-point was 110·2°—110·4° C. and the sj. gr. at 15·5° C. 0·87137—0·87142. The accepted figure for pure toluene at 15·5° /15·5° C. appears to be 0·87193 (Beilstein). The toluene thus obtained shows the indophenine reaction with isatin, but is sufficiently pure for the purposes required here, and should be practically free from paraffins.

The paraffins obtained from the above sulphonations by separation, and after further treatment with 4 % oleum, washing, and drying, distilled over completely between 117° and 125° C., chiefly at 121° C. About 100 c.c. was obtained, of sp. gr. 0·73539 at 15·5° C. A sample obtained previously gave 0·7423 at 15·5° C., but the former is an average value.

A number of synthetic mixtures were made of the almost pure toluene and pure paraffin spirit in order to estimate the correction for solubility of the latter in the reaction mixture after sulphonation, with the following results:—

No. of test.	% Paraffins present.	% Paraffins recorded.	Correction necessary.
1	0·700	0·10	0·60
2	1·000	0·40	0·60
3	1·000	0·44	0·56
4	2·000	1·40	0·60
5	2·000	1·35	0·65
6	1·960	1·38	0·58
7	2·000	1·40	0·60
8	2·940	2·34	0·60
9	3·000	2·40	0·60
10	3·920	3·30	0·62
11	4·900	4·28	0·62
			Mean 0·60

Specific gravity method.

All specific gravities were obtained by means of a very small pyknometer of about 2 c.c. capacity. The advantages of this apparatus are great accuracy and speed of adjustment and no loss on expansion when weighing. The liquid also rapidly assumes the temperature of the bath in which it is placed to come to the standard temperature, 15·5° C.

The portion of the toluol unaffected by 98% sulphuric acid was considered to be the "paraffins" for the purpose of the present work. It would of course include naphthenes and possibly a trace of carbon bisulphide, but for all practical purposes may be regarded as "paraffins." The sp. gr. of these paraffins (aggregate samples obtained from many different specimens of toluol) was 0·73539. It would be useless to employ this figure, however, in calculating the percentage of paraffin in the mixture. The amount of paraffins so calculated is invariably too high, since other substances are present with lower specific gravities than pure toluene, which also tend to lower the sp. gr. of the toluol. As the amount of these other substances was found to be dependent on the amount of paraffins present, it was possible to arrive at a factor by which the sp. gr. of the paraffins themselves should be multiplied in order to estimate the total lowering of the specific gravity associated with the presence of a given quantity of paraffins. As a mean of 20 determinations it was found that to obtain the correct lowering of the sp. gr. due to known amounts of paraffins present, it was necessary to multiply the sp. gr. of paraffins given above by 0·979. In other words, for the purposes of calculation, the sp. gr. of paraffins must be regarded as $0{\cdot}73539 \times 0{\cdot}979 = 0{\cdot}7208$ (see note below). Thus, in one sample of sp. gr. 0·86920, the actual amount of paraffins present (found by sulphonation method) was 1·480%; the amount calculated from sp. gr. 0·73539 was 1·631%, while that calculated from the sp. gr. corrected as shown was 1·470%. This gives a very fair agreement for paraffins calculated and observed. In the accompanying table of results (see below) it will be noticed that in six cases out of twenty there is equally good agreement (even for toluol containing as much as 4·9% of paraffins). The remaining 14 cases fall within the limits of experimental error, and the average of all the 20 cases calculated agrees within 0·007% with the average amount of paraffin actually present.

It would thus appear that in commercial toluols the presence of 1% of paraffins by vol. is associated with a lowering of sp. gr. amounting to 0·00151, whereas in a synthetic mixture with pure toluene and 1% of the same paraffins, the lowering of sp. gr. is only 0·00136.

Comparison table of % of paraffin recorded in toluol by the sulphonation and sp. gr. methods.

No. of test.	Sp. gr. 15·5°/15·5°C.	Paraffins calculated from sp. grs.		Paraffins present by sulphonation method. %
		Uncorrected. %	Corrected. %	
1	0·86939	1·491	1·343	1·853
2	0·86909	1·712	1·541	1·720
3	0·86933	1·538	1·385	1·500
4	0·86824	2·339	2·103	2·300
5	0·86902	1·765	1·590	1·800
6	0·86920	1·631	1·470	1·480
7	0·86920	1·631	1·470	1·520
8	0·87124	0·132	0·119	0·020
9	0·86858	2·092	1·879	1·980
10	0·86885	1·890	1·700	1·560
11	0·86980	1·190	1·072	0·860
12	0·86998	1·058	0·954	1·060
13	0·86692	3·310	2·980	2·680
14	0·86848	2·161	1·945	1·720
15	0·86800	2·515	2·263	2·160
16	0·86945	1·448	1·304	1·320
17	0·86909	1·712	1·542	1·640
18	0·86816	2·398	2·160	2·240
19	0·86391	5·520	4·975	4·900
20	0·86826	2·322	2·092	2·120
	Mean	1·992	1·804	1·797

NOTE.—To understand the full significance of this "assumed specific gravity" for the paraffins, viz.: 0·7208, the connection between it and the specific gravities of toluene, unsaturated compounds, and paraffins was worked out in the following manner:—

Let S_t, S_u, and S_p be the sp. grs. of toluene, unsaturated compounds, and paraffins respectively. Also P_p and P_u the percentages by volume of paraffins and unsaturated compounds respectively.

Then if we imagine a *single* liquid impurity, sp. gr. S_x, which, if present in commercial toluol to the extent P_p, would depress the sp. gr. by the same amount as the two existing impurities combined, we get for the calculated sp. gr. of the mixture:—

$$[(100 - P_p)S_t + P_pS_x] \div 100,$$

but the actual mixture has the sp. gr.

$$[(100 - P_u - P_p)S_t + P_uS_u + P_pS_p] \div 100.$$

Equating these quantities we get:—

$$S_x = S_p - (S_t - S_u)\ P_u/P_p.$$

It would thus appear that, knowing S_x to be 0·7208 from these experiments, we have only to find another equation involving S_u and P_u in order to arrive at the sp. gr. and percentage by volume of the unsaturated compounds.

For the completion of this work see later.

The average amount of paraffins was thus 1·797% by volume, and the greatest error by the specific gravity method was 0·300%. In order to obtain even this degree of accuracy it is necessary to know the sp. gr. within 0·00045 of the true value, this being the error in sp. gr. corresponding to 0·300% of paraffins. Further, since the sp. gr. changes by 0·00095 per 1° C., this amount of error will be introduced if the temperature exceeds the standard 15·5° C. by as much as 0·5° C. It therefore becomes obvious that unless very special precautions are taken in the sp. gr. determination, the latter is of no use whatever in determining the paraffin content of toluols.

The figures given in the following table show that the sp. gr. of a mixture of paraffins and toluene (almost pure) can be calculated from the separate sp. grs. of the constituents for small quantities of paraffins present:—

No. of test.	% Paraffins in mixture.	Sp. gr. calculated.	Sp. gr. observed.
1	1·00	0·87007	0·87010
2	2·00	0·86879	0·86890
3	3·00	0·86748	0·86740

The sp. gr. of paraffins employed in these tests was 0·74230 at 15·5° C., and that of the toluene 0·87137.

These results indicate that errors due to expansion on mixing paraffins and pure toluene are smaller than the experimental errors involved in determining the sp. grs.

The two methods outlined above are both more rapid and more accurate than any previously suggested. These earlier methods have entailed long and careful distillations, either fractional or direct, "cutting" at certain specified temperatures (depending on the barometric pressure), and followed by the determination of the specific gravity of one or more fractions so obtained.

The sulphonation method has repeatedly been mentioned, without any correction for solubility; except in one case (Lunge and Keane; Tech. Meth. Chem. Anal., vol. ii. 799) in which the paraffins are recovered from the reaction mixture by dilution of the acid with an equal weight of ice, followed by boiling-out until 50 c.c. of water has distilled over in addition to the paraffins previously left in solution. For a quick method the last-named would be of little use, and it is doubtful whether an accurate result could be obtained by it in any case.

In the present method by sulphonation a different correction would be required for a different range of paraffin content, *e.g.*, 5—10%, in the toluol. There is, however, only a slight tendency for the correction to change in the case of toluols containing less than 5% of paraffins. This tendency appears to suggest a somewhat higher correction, possibly 0·62—0·63% for a higher range such as 5—10% paraffin content.

Estimation of unsaturated compounds.

In attempting to find a reliable comparative method of estimating unsaturated compounds, the following were tried:—

(1) Shaking 10 c.c. of toluol for 3 mins. with 50 c.c. of $N/10$ permanganate solution in presence of acid, destroying the remaining permanganate by potassium iodide and titrating the iodine liberated with $N/10$ thiosulphate. Although the test was carried out as nearly as possible under standard conditions, it was found impossible to obtain consistent results.

(2) Washing with R.O.V. and 90% sulphuric acid, with subsequent water and alkali washes. The diminution in volume as recorded in a 100 c.c. burette, however, was so small that accurate results could not be obtained. With R.O.V. a considerable amount of sulphonation occurs. An attempt to estimate the unsaturated compounds gravimetrically by this method also proved fruitless owing to the apparently insuperable difficulty in drying the toluol again after washing.

(3) Titration with $N/10$ bromide-bromate solution in presence of sulphuric acid (this proved to be the simplest and certainly most reliable method). 10 c.c. of the sample was placed in a small stoppered bottle, and 20 c.c. of dilute sulphuric acid (1:5) added. The bromide-bromate solution (prepared by dissolving 9·9167 grms. of potassium bromide and 2·7833 grms. of potassium bromate in distilled water and making up to one litre) was then run in until after 5 mins. shaking the colour of bromine persisted in the toluene layer. The sample was then set aside for 10 mins., and if the colour still persisted was considered to be saturated, and the reading of the burette taken.

It was found that on an average 10 c.c. of toluol required 9·58 c.c. of the $N/10$ bromide-bromate solution.

Paraffins were estimated by the sulphonation method described in the first part of this paper.

From experiments on 22 samples of toluols from widely different sources the following data were obtained:—Average sp. gr. (15·5°/15·5° C.), 0·868567; average paraffin content, 1·891%; average sp. gr. of paraffins, 0·7354. Therefore, since the sp. gr. of pure toluene at 15·5° C. is 0·87142, it may be concluded that a mixture of toluene and 1·891% of paraffins *only* would have a sp. gr. of 0·868848. The difference between this 0·868848 and the observed sp. gr. of 0·868567, *i.e.*, 0·000281, represents the lowering of sp. gr. due to unsaturated compounds present.

Now, the lowering of sp. gr. of pure toluene due to 1·891% of paraffins of sp. gr. 0·7354 is given by 0·87142 − 0·868848 = 0·002572.

The following equation therefore holds:—

$$\frac{\text{Lowering by paraffins}}{\text{Lowering by unsaturated compounds}} = \frac{0{\cdot}002572}{0{\cdot}000281} = \frac{1{\cdot}891 \times 0{\cdot}7354}{p \times s}$$

in which p = percentage of unsaturated compounds present, and s = sp. gr. of unsaturated compounds.

A second equation involving p and s can be derived from the observed average sp. gr. of the toluol:—

$$(100 - 1{\cdot}891 - p) \times 0{\cdot}87142 + (1{\cdot}891 \times 0{\cdot}7354) + ps = 0{\cdot}868567 \times 100$$

By solving these two equations for p and s:

$$p = 0{\cdot}2068\%$$
$$s = 0{\cdot}7378$$

The second equation employed above is, in fact, the same equation as the one mentioned in the first part of this paper.

The value of S_x can be ascertained now from the further work which has been done, including a rather wider range of samples.

Employing the above values for S_u and P_u and the new averages for S_p and P_p (0·7354 and 1·891% respectively) we get:—

$$S_x = 0{\cdot}7354 - (0{\cdot}87142 - 0{\cdot}7378)\ \frac{0{\cdot}2068}{1{\cdot}891} = 0{\cdot}7208.$$

This is exactly the same as the previous value, which was employed in a purely empirical manner

as a means of determining the content of paraffins present from the observed sp. gr. of any toluol.

The average absorption of $N/10$ bromide-bromate solution, under the standard conditions described, being known (see above), it follows that for every 1 c.c. of bromide-bromate solution absorbed by a particular sample the amount of unsaturated compounds present = 0·2068 ÷ 9·58 = 0·021158%, and the corresponding lowering of the sp. gr. to be expected = 0·000281 ÷ 9·58 = 0·0000293.

The amounts of unsaturated compounds present can be very easily and quickly estimated by this method and a graph drawn to facilitate reading of results.

The chief sources of error are (1) inaccuracy of sp. gr. determinations, (2) slight variations in the nature of unsaturated compounds or paraffins present. The error due to (1) would be far the greater, since a change in the temperature of 0·2° C. introduces a change in sp. gr. equal to 0·00022. The fact that the results agree so closely goes to prove that the error due to (2) must, therefore, be entirely negligible.

Examination of a large number of samples showed that no direct connection exists between the amount of paraffins and unsaturated compounds, although in many cases a rough proportionality was found. This fact does not concern the present method of estimating unsaturated compounds. In the estimation of paraffins, however, the specific gravity method previously described can still only be regarded as an approximation. In this, the merging of the paraffins and unsaturated bodies into one single liquid impurity which, if present to the same extent as the paraffins only can be regarded as having a specific gravity of 0·7208, can only be said to be justified as an *average* computation. The amount of error would usually be less than 0·2% of the amount of toluol.

Thus the retention of the sp. gr. method for estimation of paraffins is quite justified as a first approximation, but should be supported finally by a determination by the sulphonation method.

The titration method for the estimation of unsaturated compounds, together with the sulphonation method for paraffins, completes the analysis of toluol. The amount of pure toluene can, of course, be arrived at by difference.

By the aid of graphs provided for each experiment the amount of paraffins and unsaturated compounds can be estimated and read off in rather less than 3 hours from the receipt of sample.

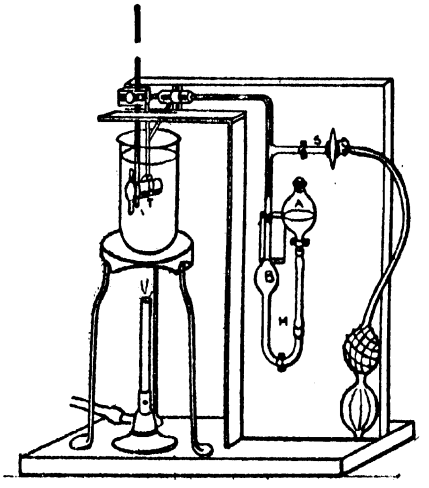
The actual time required in manipulation should not exceed 25 or 30 mins., and a large number of samples could be treated concurrently.

DETERMINATION OF THE SOFTENING POINT OF ASPHALTUM AND OTHER PLASTIC SUBSTANCES.

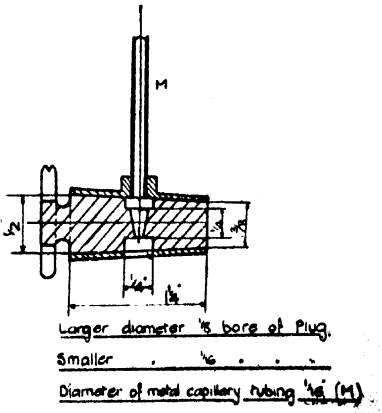
BY D. F. TWISS AND E. A. MURPHY.

Substances of the asphaltum type are employed widely in chemical industry under various names, such as gilsonite, grahamite, pitch, elaterite, albertite, bitumen, "mineral rubber," and "hydrocarbon," and as the differences in chemical composition are relatively slight, physical tests become of correspondingly greater importance.

The absence of any definite point of fusion renders all the so-called melting-point methods of examination really methods for the comparison of the tendency to soften with rise of temperature. Probably the method most commonly applied is that of G. Krämer and C. Sarnow, in which a core of the bituminous material in a glass tube is submitted to the pressure of a drop of mercury of definite weight and the temperature is measured at which the mercury forces its way through the material; details of other well-known methods have been given recently by L. M. Proctor (Chem. Met. Eng., 1919, 21, 81). The Krämer-Sarnow method is probably the most satisfactory, but possesses some disadvantages; for the introduction into the tube the bituminous material has to be rendered fluid by heat and the subsequent shrinkage during cooling causes an uncertainty as to the actual dimensions of the resulting bituminous core; the mercury and the bituminous material fall into the surrounding heating bath, and although this is not serious as long as water is the heating medium, it is obviously undesirable when, as occurs frequently, the temperature of softening necessitates the use of a less volatile heating medium such as glycerin; the "flowing" capacity of a bitumen is probably not represented entirely by the ease with which a core of the material is forced from a cylindrical tube.



For the avoidance of the above disadvantages we have found the arrangement represented in the diagram (figure 1) very convenient. The apparatus consists of a U-tube, M, one arm of which is connected by capillary tubing with a gun-metal tap, T. The central plug of this tap, which forms the most important part of the apparatus, has a



conical or tapered bore ¼ inch in length and ⅛ and 1/16 inch in diameter respectively at the two ends; the bore is terminated at each end by a flat groove (see figure 2) to which its axis is perpendicular; the

capillary metal tube of the tap is connected with the glass capillary by means of a well sealed metal sleeve.

To perform a test the sample of bituminous material and the clean plug of tap T are warmed in a steam oven for about 10 minutes so that the material becomes somewhat plastic; a piece of the softened material is then pressed into the wider end of the bore of the warm tap plug, as expeditiously as possible, with a small spatula, until the bore is filled throughout and a little extrudes from the other end; the tap plug is then allowed to cool and the excess of material removed carefully so as to leave the exposed surfaces of the material flush with the metal at the end of the bore. The plug is then refitted into its seating in the barrel, being previously lubricated if necessary with a smear of glycerin; from the principle of the test it is essential that the narrower end of the bore should face downwards and be directly above the free opening of the barrel of the tap. Sufficient mercury is present in the U-tube to reach approximately to the equator of the bulb, A, when the pressure is the same in each limb. Air is then forced gently through the tap, S, until the U-tube, acting as a manometer, indicates an excess internal pressure of 1½ inches of mercury between the two limbs. The tap, S, is then closed, when, if the apparatus is properly fitted, the internal pressure remains constant. On warming the medium in the bath, with the usual precautions, a temperature is finally attained at which the air pressure is sufficient to cause the complete extrusion of the core of bituminous material through the narrower end of the bore of the tap plug: the attainment of this temperature is indicated sharply by the sudden rise of the level of the mercury above B, and the reading of the thermometer is recorded as the softening point of the material.

The flat grooves cut at the two ends of the tapered bore of the plug of the tap, T, not only facilitate the filling of the bitumen and enable a considerable degree of accuracy in fixing the length of the bituminous core, but also, at the narrower end, provide a convenient space to receive the extruded bitumen so that the subsequent removal of the plug from the barrel is possible without difficulty.

The bulbs, A (diameter approximately 1¼ in.) and B (diameter approximately ¾ in.), are so arranged that any expansion of the air enclosed between T and B, due to heat received from the bath despite the interposed screen, causes no appreciable alteration in the difference between the mercury levels. The pressure, therefore, is practically constant until the extrusion of the bitumen at the end of the determination. For a second test it is merely necessary to remove the plug of tap, T, and to clean it with a camel-hair brush (or a piece of filter paper) moistened with carbon bisulphide; the apparatus can therefore be kept fitted up ready for immediate use. Any gradual discoloration of the heating medium is of no consequence to the performance of the test. The construction of the tap, T, in metal facilitates the transference of heat to the central core of bitumen and so reduces the "lag" of its temperature behind that recorded by the thermometer. For the heating medium in the bath, glycerin is generally convenient. As the commercial products of the asphalt type have generally been already well mixed when in a fluid condition, the smallness of the sample tested is not detrimental.

The results obtained with the apparatus described above are generally higher than those obtained with the Krämer-Sarnow method, and the essential difference between the two methods of testing the softening is reflected in the fact that, although both methods give concordant results, we have found the difference between the results of the two methods for various materials to range from 5° to 30° C.

In the following table is given the range of the readings obtained with various commercial samples which were tested repeatedly with the described apparatus and by the Krämer-Sarnow method; the first four samples were probably of gilsonite, whilst the fifth was of a coal-tar pitch.

Sample.	Softening points.	
	Above extrusion method.	Krämer-Sarnow method.
1.	155°—157° C.	138°—140° C
2.	145°—147° C.	127°—129° C.
3.	146°—147° C.	124°—126° C.
4.	179°—181° C.	148°—150° C.
5.	94°— 95° C.	87°— 88° C.

It is evident that the apparatus which we have described above will also be of very considerable utility for the comparison of the softening points of other materials, such as guttapercha, balata, etc., which exhibit a similar gradual softening when heated. The relative behaviour of various grades of guttapercha and balata towards heat is of great importance for some purposes. On account of the lack of adhesion between glass and gutta the Krämer-Sarnow method is not satisfactorily applicable, whereas our experiments using the method described above have given clear indication of its trustworthiness for this additional purpose. The significance of the test is manifest from the fact that although consistent results are obtainable with various commercial samples, the softening temperature observed ranged from 101° C., for a sample of washed raw balata, to 190° C., for a commercial sample of so-called "pure gutta." It is essential, however, that the portions used for the test should previously be rendered air-free and dry. In making these experiments the same "head" of mercury was used as was mentioned earlier for asphalt materials, but in the comparative examination of balatas or guttas it might be advisable in some cases to apply a greater pressure.

London Section.

Meeting held at Burlington House on Dec. 1, 1919.

MR. JULIAN L. BAKER IN THE CHAIR.

THE INFLUENCE OF IMPURITIES IN LEAD ON ITS BEHAVIOUR WHEN HEATED WITH CONCENTRATED SULPHURIC ACID.

BY C. E. BARRS, A.I.C.

During the war many thousands of tons of lead (sheet, pipe, etc.) have been used for various purposes in the chemical industry. In view of this, and of the many different purposes for which lead of a suitable composition may be utilised, and in the absence of any special literature on the subject, it was thought that the results of the following investigation carried out some time ago by the author might prove useful to sulphuric acid manufacturers and other users of lead for chemical purposes.

Two brands of lead, supplied for chemical use, proved to be very different in their power of resistance to the solvent action of concentrated sulphuric acid. When a small portion of each was heated with concentrated acid it was noticed that whilst one brand (A) was rapidly attacked by the acid at about 250° C., the other (B) resisted the attack until a temperature of 296° C. was reached. A chemical analysis of each brand gave the following results:—

	A %	B %
Copper	0·002	0·021
Bismuth	Trace	0·005
Silver	0·001	0·002
Arsenic	0·001	Trace
Antimony	0·009	0·003
Iron	0·005	0·004
Manganese	Trace	0·001
Zinc	0·001	0·001
Lead (by difference)	99·981	99·963

It will readily be seen from the above that the impurity which differs most is the copper, and a further series of tests made on lead from various sources showed that those in which copper was the predominating impurity were most resistant when heated with sulphuric acid. The following are two typical examples:—

	C %	D %
Copper	0·017	0·017
Bismuth	0·004	0·001
Silver	0·002	0·002
Arsenic	Trace	0·001
Antimony	Trace	0·301
Iron	0·003	0·003
Manganese	0·001	0·001
Zinc	0·001	Trace
Lead (by difference)	99·972	99·674
Attacked by sulphuric acid (i.e. action vigorous) at	300°C.	260°C.

Lead of the same composition as that shown in analysis "A" was then alloyed separately with approximately 0·2% of each of the following metals:—Copper, bismuth, arsenic, antimony, zinc, tin, and silver, and also with tellurium and sulphur. Small portions of each were then heated with concentrated sulphuric acid with the results tabulated below:—

	First action	Action vigorous
Lead alone (A)	150° C.	220°C.
Do. plus 0·2% copper	210°	315°
Do. Do. bismuth	70°	135°
Do. Do. arsenic	213°	260°
Do. Do. antimony	150°	220°
Do. Do. zinc	160°	200°
Do. Do. tin	156°	232°
Do. Do. silver	200°	302°
Do. Do. tellurium	100°	316°
Do. Do. sulphur	142°	236°

The temperature of the "first action" was taken when a continuous stream of bubbles was seen to rise from the metal or alloy. The final temperature, "action vigorous," was noted when excessive frothing of the acid took place, and although the heat was removed at this point it was noticed with those metals or alloys attacked at the lower temperature that the action still continued very vigorously for some time afterwards, whilst with the copper and tellurium alloys the action soon ceased when the heat was removed.

The metal was heated with the concentrated acid in a beaker on a small asbestos mat protected from draughts, the vessel being covered with a piece of thin sheet lead having a hole in the centre. The thermometer, suspended by means of a cork, was passed through the sheet lead so that the bulb was quite close to the metal or alloy under treatment.

It seems fairly obvious from these experiments that a small percentage of copper acts beneficially, and makes the lead more resistant to the solvent action of the acid.

Subsequent research into the matter has shown that by subjecting the lead to refining heat treatment in order still further to eliminate impurities it is possible to obtain a metal which will resist attack up to 280° C. In other words, an increase in the purity of the lead renders it more resistant to attack by acid. It has, however, been found desirable in most cases to add a small percentage of copper (0·02—0·05%) to ensure obtaining the maximum resistance.

In conclusion my thanks are due to Messrs. Locke, Lancaster and W. W. and R. Johnson and Sons, in whose laboratory some portion of this work was done, and also to Mr. H. C. Lancaster for much useful guidance, and to Messrs. Daniel C. Griffith and Co., in whose laboratories the final operations were completed.

Discussion.

Mr. H. M. Ridge asked whether the author could account for the fact that lead containing bismuth or silver generally suffered more rapid attack at higher temperatures than lead which was practically free from those metals. He considered that these two elements played an important part in the chemical attack of lead. The metals for which the author had given figures were dissimilar; one contained 0·021% of copper and the other only 0·002%, and, of course, their behaviour was not by any means identical.

Mr. H. W. Rowell said it was usual to demand Pattinsonised lead for work in sulphuric acid plants, and the main difference between this lead and the lead for which figures were given by the author was in the zinc content. A small percentage of zinc would cause a much more rapid action of sulphuric acid on lead than any other impurity. It did not appear that the silver content was deleterious, because Pattinsonised lead usually contained more silver. The author's results were comparable with the case of concentrated sulphuric acid heated in a lead pan. He thought that lead containing a large amount of copper in a sulphuric chamber where the acid was comparatively weak would not last so long as a chamber made of pure lead. The purer the lead was the longer it would last, particularly in chamber work, and suitable lead could be made by the Parkes process.

Mr. Lancaster pointed out that if more than 0·2% of copper were introduced into a pure lead it gave rise to commercial difficulties. He could not agree with Mr. Ridge's remarks with regard to the effect of silver; he thought that other authorities bore out Mr. Barr's contention, namely, that a small quantity of silver protects lead. Mr. Ridge doubtless was bearing in mind that a low

content of silver was an indication of good refining of the lead, and in this respect there was something in his remark, but, given two specimens of lead of equal purity, silver undoubtedly had a protective action against the effects of strong sulphuric acid at high temperatures. One reason why Pattinsonised lead was popular was because it invariably contained a much larger percentage of copper than lead produced by the Parkes process, for the reason that in extracting silver from lead bullion zinc was added and had a greater affinity for the copper than any other metal. It was, nevertheless, a mistake, as the author had said, to assume that because the lead was Parkes lead it was bad for chemical chambers, or equally to assume that because the lead had been made by the Pattinson or Rozan process it was suitable for chemical chambers. The science of the metal was very much better understood than it had been in the past, and the manufacturers of sheet lead were producing lead to-day containing only a small trace of copper, which would stand up to 310°—315° C. in strong sulphuric acid. There was little doubt in his mind that the purer the lead the more it would resist the action of acid, and there was equally little doubt, too, that copper acted as a "dope" against certain impurities. This statement was borne out fully by experiments which he had made in producing electrolytic lead, *i.e.*, a product of 99·998% purity that would withstand the action of sulphuric acid without any addition of copper up to fully 310° C.

The Author, in reply, said that the analyses and tests which he had given in the paper were not the only ones that had been made; they were merely typical examples. Many others had been carried out in which the compositions, with the exception of the copper contents, were very similar, but always with the same difference in the power of resisting acid. With regard to Mr. Rowell's remarks concerning the Pattinson process *versus* the Parkes process, that had been so in the past, but lead made by the Parkes process was now subjected to a treatment which purified it still further and so rendered it equal to Pattinsonised lead, and on that point he thought that those who stipulated for Pattinsonised lead were mistaken. Subsequent investigation had also shown that this purification treatment still further eliminated the zinc. In some processes in which, perhaps, the lead had to be handled more drastically it was necessary to have a lead which was harder. In that case it was hardened with antimony, and, of course, the same high temperatures were not applied. Copper was not necessary if the lead was very pure, but the addition of 0·02–0·05% of copper gave greater security against attack by acid.

Manchester Section.

Meeting held at Grand Hotel, on Friday, November 7, 1919.

MR. JOHN ALLAN IN THE CHAIR.

THE ESTIMATION OF *p*-PHENYLENEDIAMINE.

BY T. CALLAN, M.SC., PH.D., AND JAS. A. RUSSELL HENDERSON, D.SC.

The usual methods of estimating monoamines and *m*-diamines, *viz.*, the titration of the former with sodium nitrite in acid solution to form a diazonium compound, and the titration of the latter by means of a standard solution of a diazo compound such as diazobenzene, p-nitrodiazobenzene, or diazo-*m*-xylene, cannot be applied to *p*-diamines. The following methods have previously been suggested for the determination of *p*-phenylenediamine. Walther's method (*Erfahrungen eines Betriebsleiter*) depends on the oxidation of the *p*-phenylenediamine in presence of aniline by titration with potassium bichromate to form an indamine. The method gives fairly accurate results, but has the serious defect that oxidation is readily affected by changes of temperature, dilution, speed of addition of bichromate, etc., and also that the aniline itself is slowly oxidised.

Meldola and Evans (Proc. Chem. Soc., 1889, **5**, 115) proposed to determine the ammonia evolved on oxidising *p*-phenylenediamine with bichromate.

Green and Johnson (Ber., 1913, **46**, 3772) showed that when *p*-phenylenediamine was oxidised with lead peroxide in sulphuric acid solution and the excess of lead peroxide destroyed with oxalic acid, the resulting benzoquinone determined by adding potassium iodide and titrating with $N/10$ sodium thiosulphate solution, was equivalent in three experiments to 95·5%, 95·2%, and 95·4% of the *p*-phenylenediamine taken, about 5% of the diamine being apparently destroyed by further oxidation.

Heiduschka and Goldstein (Arch. Pharm., 1916, **254**, 584–625) devised a method based on the conversion of *p*-phenylenediamine into benzoquinone dichloroimide, $C_6H_2(NCl)_2$, by the action of a solution of calcium hypochlorite, a reaction first discovered by Krause (Ber., 1879, **12**, 49), who showed also that the quinone dichloroimide formed could be estimated by reduction with stannous chloride. Heiduschka and Goldstein found that 93—95% of the *p*-phenylenediamine is precipitated as benzoquinone dichloroimide. Corrections due to incomplete precipitation and to the solubility of the product in alcohol must, however, be applied.

Having occasion to make a considerable number of analyses of *p*-phenylenediamine generally in aqueous solution, the authors considered the methods mentioned to be unsuitable and sought for other methods.

The first method tried depends on the formation of the diacetyl derivative, which is practically insoluble in water. The results obtained depended largely on the relative amounts of acetic anhydride and sodium acetate employed. The most concordant results were obtained by using only a slight excess of acetic anhydride together with a large excess of sodium acetate and neutralising the solution exactly with dilute caustic soda before filtering; even by this procedure, however, the results were consistently low, varying from 95·97% to 96·64% of the amount of pure *p*-phenylenediamine taken.

A few experiments were made using benzoyl chloride in an endeavour to prepare the dibenzoyl derivative quantitatively, but these indicated that the method afforded no likelihood of success. Effront (Ber., 1904, **37**, 4290—4295) devised a method of estimating ammonia, amines, etc., based on oxidation with calcium hypochlorite followed by addition of excess of sodium arsenite and titration with standard iodine solution, using starch as indicator. This method, applied to *p*-phenylenediamine gave very promising results in our hands. It depends, like the method of Heiduschka and Goldstein, on the formation of benzoquinone dichloroimide. The results obtained were, however, consistently low both in the case of *p*-phenylenediamine and hydrolysed *p*-aminoacetanilide, only 90% to 95% of the amount of *p*-phenylenediamine actually present being found. The end-point using starch was very indistinct, and it was difficult to obtain concordant results.

It was observed, however, that if sodium carbonate be employed in place of sodium hydroxide the precipitate of benzoquinone dichloroimide is formed very rapidly, precipitation being complete in two or three minutes. It was found further that the dichloroimide had no action whatever on starch-iodide test-papers in alkaline solution, and this was made the basis of a method which was found to be extremely rapid and to give very accurate results. On the addition of *p*-phenylenediamine to a solution of hypochlorite containing sodium carbonate, the amount of hypochlorite (or available chlorine) removed from the solution is proportionate to the amount of *p*-phenylenediamine present in accordance with the equation:

$$C_6H_4(NH_2)_2+6Cl=C_6H_4(NCl)_2+4HCl,$$

the amount of available chlorine so removed being readily determined by means of standard sodium arsenite solution.

The following method of procedure was found to be most suitable. A stock of solution of sodium hypochlorite is prepared by diluting about 50 c.c. of commercial sodium hypochlorite solution containing about 12–15% of available chlorine to 1000 c.c., and 50 c.c. of this solution is accurately titrated with $N/10$ sodium arsenite, using starch-iodide paper as indicator. 100 c.c. of the hypochlorite solution is diluted with about an equal volume of cold water, about 1 grm. of sodium carbonate is added, and 10 c.c. of the solution to be determined, containing about 2–6% *p*-phenylenediamine dissolved in slight excess of hydrochloric acid, is added slowly, with stirring. The mixture should then give a strong reaction with starch-iodide paper, otherwise the experiment must be repeated, using either less *p*-phenylenediamine solution or a larger amount of hypochlorite solution. On the addition of the *p*-phenylenediamine solution the benzoquinone dichloroimide is rapidly precipitated as an almost white substance. The turbid solution is then titrated, without filtration, with $N/10$ sodium arsenite solution, using starch-iodide paper as external indicator, the end-point being very sharply indicated by the disappearance of the blue colour on spotting out on to the indicator paper. At the end of the titration the solution should still be distinctly alkaline. The total time of the titration is only a few minutes. The difference in the volume of $N/10$ arsenite solution required for the titration of the sodium hypochlorite itself and for the solution of hypochlorite plus diamine is equivalent to the amount of active chlorine removed from the solution as benzoquinone dichloroimide, each c.c. of $N/10$ arsenite solution corresponding therefore to 0·0018 grm. of *p*-phenylenediamine.

Very concordant results are readily obtained by this method; thus a sample of freshly distilled *p*-phenylenediamine of m.pt. 142°, which was probably not quite pure, gave 99·45%, 99·57%, 99·67%, and 99·42% in experiments made by different workers and using solutions of hypochlorite of varying strength.

As a check on the method a sample of *p*-aminoacetanilide was carefully recrystallised from water and the product titrated in acid solution against a carefully-standardised solution of sodium nitrite, using starch-iodide papers as indicator. After two crystallisations the product tested 99·55% by this method. A weighed amount of the substance was then hydrolysed by boiling with dilute hydrochloric acid and the resulting solution of *p*-phenylenediamine titrated by the method described, sufficient sodium carbonate being added to neutralise the acid employed for the hydrolysis. Calculating from the amount of diamine found, the strength of the *p*-aminoacetanilide employed was 99·60% and 99·50% in consecutive experiments, as compared with 99·55% by sodium nitrite.

The method further can be utilised for the determination of *p*-nitraniline, which readily yields *p*-phenylenediamine on reduction. A pure sample of *p*-nitraniline, m.pt. 147° C., prepared by recrystallisation of the commercial article from alcohol, on titration in acid solution with $N/2$ sodium nitrite solution tested 100%. 1·7500 grm. was reduced to *p*-phenylenediamine by the cautious addition of zinc dust and dilute hydrochloric acid, the solution filtered from excess of zinc dust, etc., almost neutralised with sodium carbonate and made up to 500 c.c. 50 c.c. of the reduced solution was added to 50 c.c. of a sodium hypochlorite solution which had been previously found to be equivalent to 110·6 c.c. of $N/10$ sodium arsenite and to which 5 grms. of sodium carbonate had been added, and the solution titrated with $N/10$ arsenite, the precipitated zinc carbonate being neglected. In three consecutive experiments 34·65 c.c., 34·60 c.c., and 34·60 c.c. of $N/10$ arsenite were required to combine with the excess of hypochlorite, hence chlorine equivalent to 76·0 c.c. of $N/10$ arsenite had been absorbed, equivalent to 0·1368 grm. of *p*-phenylenediamine or 0·17474 grm. of *p*-nitraniline, or 99·9%. The method of analysis used for *p*-phenylenediamine was tried also with naphthylene-1.4-diamine. This substance was prepared in the form of hydrochloride by diazotising sulphanilic acid, coupling with α-naphthylamine, and reducing the azo dyestuff with sodium sulphide according to the method described by A. Cobenzl (Chem.-Zeit., 1915, **39**, 859–860).

As in the case of *p*-phenylenediamine, a quinone dichloroimide was readily precipitated, but, unlike the former diamine, the results obtained were somewhat low, being only 98% to 99% of the naphthylenediamine taken. This is most probably due to the dichloroimide derived from naphthylenediamine being slightly soluble. As is stated later, the the method fails where the chloroimide is soluble.

This method of analysis has been further extended to *p*-aminodiphenylamine. It was found that this substance also reacted quantitatively with hypochlorite in alkaline solution according to the equation—

$$NH_2C_6H_4NH.C_6H_4+4Cl=ClN:C_6H_4:N.C_6H_4+3HCl,$$

each molecule of *p*-aminodiphenylamine requiring 4 atoms of chlorine to form a monochloroimide. The method of analysis is precisely the same as for *p*-phenylenediamine except that it is necessary to use a considerable excess of sodium carbonate. A sample of pure distilled *p*-aminodiphenylamine tested by this method gave 99·9%, 99·7%, and 99·9%.

The introduction of a sulphonic group into the molecule was found, in all cases tried, to cause the resulting chloroimide to be largely or completely soluble, and in all such cases the method as described for phenylenediamine fails. Thus it was found that *p*-phenylenediamine-*o*-sulphonic acid and naphthylene-1.4-diaminesulphonic acid and substances such as *p*-aminophenol, all of which give soluble chloroimides, cannot be analysed by our method.

Powell (Analyst, 1919, **44**, 22–25) has recently published a method for the analysis of such substances as *p*-aminophenol which give soluble chloroimides, which depends on the reaction between sodium hypochlorite and the *p*-compound in *acid* solution. An excess of sodium hypochlorite is added to the *p*-substituted compound in acid solution and the solution then briskly aerated to drive off all chlorine not combined as quinone chloroimide, the chlorine in the latter being then determined by adding potassium iodide and titrating with $N/10$ sodium thiosulphate. This method in our hands also gave very satisfactory results with *p*-aminophenol, but applied to *p*-phenylenediamine gave low results, the end-point being very indefinite. It was hoped that Powell's method could be applied to the sulphonic acid derivatives of *p*-phenylenediamine

and naphthylene-1.4-diamine, which are technically important, and with which the method above described for *p*-phenylenediamine fails owing to the solubility of the chloroimides, but our experiments in this direction have so far only yielded moderately satisfactory results.

Finally, we may mention that the method described for *p*-phenylenediamine can also be applied to *p*-diamines of the nature of benzidine. Experiments in these directions are at present in progress.

In conclusion we desire to express our thanks to Messrs. The British Dyestuffs Corporation (Blackley), in whose Central Analytical Laboratory the work was carried out, for permission to publish the results of this investigation.

Discussion.

Dr. J. J. Bloch enquired what happened when an ortho-diamine was present.

Dr. Craig asked what would be the effect of using hypobromite instead of hypochlorite.

Mr. Heywood asked whether research had been made with respect to the curious colour reactions which took place.

Dr. Callan, in reply, said he was not yet able to state what would be the effect of the presence of ortho-diamines. Experiments on this point were, however, in progress. Hypobromite had not been tried; it would probably act similarly to hypochlorite. With regard to colour reactions, in the space of about two minutes the solution passed through a remarkable series of colour changes, with the final precipitation of the chloroimide as a white substance providing a sufficient quantity of hypochlorite had been used. The quantity recommended was quite sufficient to give a white quinonedichloroimide as a final product. No experiments had been made to ascertain the nature of the intermediate substances, to the formation of which the various colour changes were probably due.

THE ESTIMATION OF SULPHATES IN THE PRESENCE OF ORGANIC SULPHONIC ACIDS.

BY T. CALLAN, M.SC., PH.D., JAS. A. RUSSELL HENDERSON, D.SC., AND R. BARTON.

The authors have had occasion to make a considerable number of analyses of intermediates used in the manufacture of dyestuffs, which involved the determination of the amount of sulphate in presence of various sulphonic acids. This sulphate arises from the excess of sulphuric acid used in the sulphonation of hydrocarbons, such as benzene, naphthalene, etc., and their nitro, amino, and hydroxy derivatives, and is generally present as sodium or calcium sulphate. We have been unable to find in the literature any special reference relating to the estimation of sulphate in the presence of organic sulphonic acids; and as the estimation may probably be seriously affected by two distinct and opposing factors, *viz.*, (1) the formation of sparingly soluble barium sulphonates which may be thrown down concomitantly with barium sulphate, and (2) the solubility of barium sulphate in solutions of sulphonic acids, we have investigated the problem of estimating sulphuric acid under such conditions. This was the more necessary as the solubility of barium sulphate in concentrated solutions of organic sulphonic acids is generally regarded as being very appreciable.

The procedure adopted was first to study the conditions of precipitation of barium sulphate in different concentrations in presence of various sulphonic acids by means of barium chloride. Two distinct methods of precipitation were employed:—(1) Hot precipitation with a slight excess of barium chloride in the usual way. (2) The cold precipitation or dilution method (Allen and Bishop; 8th Internat. Cong. Appl. Chem.), in which barium chloride solution is slowly added to the cold, faintly acid solution, considerably diluted. Allen and Bishop recommend the use of a Gooch crucible with a layer of asbestos fibre as a filter; but we have found that filtration through a good filter paper is quite as rapid, and gives equally good results. Precipitating the sulphate as benzidine sulphate by the method suggested by Raschig (Z. anal. Chem., 1903, **42**, 617 and 818) was tried as an alternative method, but the objections surmised as being possible with barium sulphate were highly accentuated in this method, very sparingly soluble benzidine sulphonates being readily formed on the one hand, whilst on the other hand benzidine sulphate was found to be appreciably soluble in solutions of many sulphonic acids. This method was therefore discarded after a few preliminary experiments. We may mention that instead of estimating the precipitated benzidine sulphate by titration with standard alkali, it may be equally well determined by titration with standard nitrite solution.

Finally we turned our attention to volumetric methods of estimating sulphates. Several such methods are to be found in the literature. Thus Roemer (Z. anal. Chem., 1910, **49**, 490—492) made use of standard solutions of barium chloride and potassium bichromate, the excess of bichromate being estimated by titration with ferrous sulphate or iodometrically (cf. North; Amer. J. Pharm., 1914, **86**, 249—256). Repiton (Monit. Scient., 1910, **20**, 382—384) uses a similar process, but determines the excess of chromate by means of a standard solution of stannous chloride. Finch (Chem.-Zeit., 1912, **36**, 782—783) estimates sulphates by adding excess of standard lead acetate solution. Howden (Chem. News, 1918, **117**, 383) describes a volumetric method for estimating soluble sulphates based on their decomposition by barium carbonate. Vansteenberger and Bauzil (Ann. Chim. Anal., 1918, **23**, 210—214) add excess of standard barium chloride solution to an acidified solution of the sulphate, boil and filter. The excess of barium in the filtrate is precipitated as carbonate, which is then collected, washed, and titrated with standard acid in the presence of methyl orange. Rivett (Chem. News, 1919, **118**, 253—254) acts upon soluble sulphates with barium oxalate, and titrates the soluble oxalate formed by means of potassium permanganate.

The method which we have used is as follows:—A quantity of the substance containing equivalent to 0·15—0·2 grm. of anhydrous sodium sulphate is dissolved in water. If the solution is acid it is rendered faintly alkaline by the cautious addition of ammonia (containing a little calcium chloride to precipitate any carbonate, which is filtered off) and boiled till the escaping vapours no longer turn red litmus blue. 20 c.c. of $N/4$ barium chloride is added, and the heating continued for a few minutes. The excess of barium chloride is then titrated with $N/4$ potassium chromate, using starch-iodide paper as indicator, the end-point being determined by allowing a drop of the solution to fall on the test paper so that the barium chromate remains concentrated in one spot whilst the clear solution spreads around it. A drop of very dilute hydrochloric acid is then spotted on to the paper so that the acid runs into the clear rim of the first spot. A blue colour develops when excess of soluble chromate is present, due to the liberation of iodine and the action of this on the starch. The blue colour takes from ten to fifteen seconds to develop. An immediate production of a blue colour indicates that a considerable excess of chromate has been added. The end-point may also be shown by the production of a green colour when a drop of the solution is spotted into a spot of a freshly prepared solution of *p*-phenylenediamine containing a crystal of aniline hydrochloride. The starch-iodide paper

was found to give a sharper end-point, and in the experiments described this indicator has been used. The solutions of barium chloride and potassium chromate were standardised against one another with the aid of this indicator, the potassium chromate being first standardised against $N/10$ thiosulphate after adding potassium iodide, care being taken to note that the titre of the solution against thiosulphate is based on the oxidising value which is proportionate to, but not identical with, the precipitating value for barium salts.

From our results we conclude (1) that there is little danger of barium sulphate being contaminated with co-precipitated barium sulphonates when precipitated from solutions containing organic sulphonic acids under the conditions generally employed in analytical work. Naphthalene-β-monosulphonic acid appears, however, to behave exceptionally in this respect except when the dilution method of Allen and Bishop is employed. (2) That barium sulphate is not appreciably soluble in dilute solutions of organic sulphonic acids. (3) That sulphuric acid can be rapidly determined with considerable accuracy in such materials by the volumetric method above suggested.

Experimental.—The sulphonates chosen for this investigation were such as could be easily obtained pure either by crystallisation or otherwise. Many other sulphonates than those given as examples were used, and similar results were obtained. None of the sulphonates used gave any precipitates with barium chloride either by the hot precipitation method or by the dilution method.

The sulphate used was pure sodium sulphate dissolved in distilled water to give a solution containing 1·97% of anhydrous sodium sulphate. This sulphate solution was carefully weighed out and not measured, so as to avoid errors due to pipetting.

The following table shows the results obtained in this way, using mixtures of sodium sulphate and various sulphonic acids typical of different classes of such substances

Sulphonic acid	None	A		B		C		D		E		F	
Sodium sulphate	Found %	Added %	Found %	Added %	Found %	Added %	Found %	Added %	Found %	Added %	Found %	Added %	Found %
Hot pptn. method	1·97	8·99	9·07	11·65	11·71	11·60	11·65	9·39	9·40	11·67	11·67	11·66	12·20
	1·97	9·01	9·05	11·65	11·72	11·60	11·64	9·00	9·03	11·60	11·58	11·66	12·29
Dilution method ..	1·98	9·00	9·02	11·65	11·60	11·66	11·67	8·98	9·00	11·62	11·66	11·67	11·77
of Allen & Bishop.	1·96	9·01	9·03	11·65	11·57	11·70	11·71	9·01	9·03	11·67	11·70	11·70	11·77
Volumetric method	1·97	4·72	4·76	6·16	6.20	6·52	6·55	4·67	4·66	6·22	6·25	6·08	6·80
	1·97	4·73	4·76	6·22	6·25	6·16	6·25	4·68	4·68	6·19	6·17	6·02	6·52
Benzidine pptn. ..	1·97	Ppte. with		Ppte. with		Ppte. with		——		——		Ppte. with	
	1·97	sulphonic Acid		sulphonic Acid		sulphonic Acid						sulphonic acid	

A. Naphthalene-1,5-disulphonic acid. B. 2-Naphthylamine-6,8-disulphonic acid. C. *p*-Nitrochlorobenzene-*o*-sulphonic acid. D. Naphthionic acid. E. Sulphanilic acid. F. Naphthalene-2-sulphonic acid.

In conclusion we desire to express our thanks to Messrs. The British Dyestuffs Corporation (Blackley), Limited, in whose Central Analytical Laboratory the work was done, for permission to publish the results of this investigation.

DISCUSSION.

Dr. T. J. I. CRAIG said that he found it was a good plan to make potassium bichromate itself a standard, after purifying it by repeated crystallisation.

Mr. HEYWOOD said that he had been called upon to estimate small quantities of sulphuric acid and sulphates in the presence of sulphonic acids of the anthraquinone series. He confirmed Dr. Callan's results in the case of the anthraquinone acids with the slight exception that the barium sulphonates of the acids were very sparingly soluble in water. He had found it necessary to have a considerable dilution even with a hot precipitation, and frequently it was necessary to wash several times by decantation, using dilute hydrochloric acid. He agreed with Dr. Callan that there was very little adsorption of sulphonic acid and holding up of barium sulphate by sulphonic acids. From the point of view of atomic weight determinations no doubt there was a slight influence, but from a practical point of view one could get out 99·9% of the sulphuric acid added.

Mr. J. R. HANNAY asked if the method had been tried with respect to sulphonated complete dyes. He had in mind chiefly cases of colour lakes to a number of which perhaps the method would not be applicable. It was important to know whether there were classes of dyestuffs to which the method could be applied, as many of them were diluted with sulphates.

Dr. CALLAN, in reply, said that the fact that lake formations were possible with barium salts had been the reason why the experiments described in the paper had been instituted, as the co-precipitation of barium sulphonate with barium sulphate might be likened to the formation of an "invisible" lake. Dyestuffs which formed such lakes with barium sulphate could not be analysed by the method described. In regard to Mr. Heywood's enquiry, in all cases where any contamination of barium sulphate was suspected both the ordinary method and the dilution method of Allen and Bishop could be tried side by side, and any precipitation of barium sulphonate would then be detected by the discrepancy between the results of the two methods. This difference had not been noticed in intermediates and derivatives of the benzene and naphthalene series as Mr. Heywood had observed in the anthraquinone series. It was necessary to use a neutral potassium chromate solution, and although this could be prepared from a standard solution of potassium bichromate, it was just as convenient to prepare a solution of neutral potassium chromate and standardise this by any of the usual methods.

Communication.

THE PRODUCTION OF NORMAL BUTYL ALCOHOL AND ACETONE BY FERMENTATION OF HORSE-CHESTNUTS.

BY AMOS GILL, B.SC., A.I.C.

It has been stated that unless horse-chestnuts are completely freed from husk it is impossible to carry through a successful fermentation by the n-butyl alcohol and acetone process (Henley, this J., 1919, 281 T).

At H.M. Factory, King's Lynn, a considerable number of experiments were carried out with horse-

chestnuts as a raw material, and successful fermentations were obtained, both in the laboratory and on the large scale. In the latter case a considerable amount of husk was removed, but at no time could the meal be said to be completely freed from husk.

Auld (this J., 1913, 173) gives the proportion of kernel to husk in fresh horse-chestnuts as 85·5% kernel to 14·5% husk. The chestnuts received varied considerably. In the properly-matured nuts this standard was reached, and in some cases the percentage of husk was no more than 12·5%; but large numbers of immature nuts were received in which the percentage of husk was as high as 25%.

The outstanding features of most of the experiments on horse-chestnuts were:—(1) The long period for completion of fermentation; (2) frothing both during fermentation and distillation; (3) the unhealthy appearance of the bacteria.

Probably all these are due to the presence of æsculin or æsculic acid, a bitter, saponin-like substance which is present in horse-chestnuts (Rousset, Les Matières Grasses, 1913, 6, 2980—1; this J., 1913, 243). While a fermentation on maize mash can be completed in 30—36 hours, the fermentations on horse-chestnut mash were rarely completed in less than 72 hours. This is explicable from the microscopical appearance of the bacteria during fermentation on this medium. The bacteria were only faintly motile, and stained slides revealed the presence of chains of organisms, even as long as 50 hours after inoculation. This occurrence of chain formation when the fermentation ought to be well advanced is a sure sign of sluggishness. The bacteria were also inclined to be swollen, and there was a tendency to early spore formation, showing that the medium was not suitable for their growth.

The bitter principle may be removed by extraction with ethyl alcohol or butyl alcohol, or by soaking overnight in water and bringing to the boil (Auld; this J., 1913, 173). The method of extracting with butyl alcohol was tried by the author on a laboratory scale. The extracted meal was quite sweet, and a mash made up from this meal fermented normally in less than 40 hours. The appearance of the bacteria was quite as good as on maize mashes.

When a certain amount of husk was present better results were obtained by sterilising the mash at lower pressures than were customary with maize meal. The theory advanced in explanation of this was that at higher pressures more tannin was obtained in solution, and this militated against the action of the organism.

The results given below are taken as typical of many experiments. The chestnuts used in these fermentations contained kernels 87·5%, containing 42% of moisture; husk 12·5%, containing 36% of moisture.

Kernels alone.—3 litres of 8% mash made from dry kernel meal. Sterilised for 1 hour at 10 lb. pressure. Inoculant, 3%. Incubation period, 72 hours. Yield of mixed oil,* 61 c.c.=20·3% on kernel meal.

Kernels and husk.—The whole chestnuts were minced and dried at 45°—50° C. 210 grms. of meal obtained by milling this (equivalent to 184 grms. of dry kernels) made up to 3 litres of mash. Sterilised for 1 hour at 10 lb. Inoculant, 6%. Incubation period, 72 hours. Yield of mixed oil 44·5 c.c.=17% on dry meal, or 19·4% on dry kernels.

Kernels and husk plus malt.—300 grms. meal (equal to 262·5 grms. of dry kernels) as used in the last experiment was made up with water to 3 litres. This was treated with 30 grms. of ground malt for 1½ hours at 60°—65° C. Sterilised for 1 hour at 10 lb. pressure. Inoculant, 6%. Incubation period, 48 hours. Yield of mixed oil, 74 c.c. Deducting 7·5 c.c for malt, leaves 66·5 from chestnut meal, which is equivalent to 17·7% on dry meal, or 20·2% on dry kernels.

Kernels and husk plus maize.—150 grms. of dried kernels and husk and 150 grms. of maize meal were mashed separately, boiled, and mixed. The whole was made up to 3 litres and sterilised for 1 hour at 15 lb. pressure. Inoculant, 6%. Incubation period, 60 hours. Oil yield, 77 c.c. Deducting 45 c.c. for maize, this leaves 32 c.c. from the chestnut meal, which is equivalent to 17·1% on the dry meal, or 19·5% on the dry kernels.

The results show that fermentation is possible in the presence of the natural amount of husk. French workers claim to have effected successful fermentations on a large scale with the natural amount of husk present, but in factory experiments at King's Lynn we were not able to confirm this or our own laboratory results with the full amount of husk present. This was due to the difficulties in the way of efficient sterilisation of large quantities of mash. Higher pressures were used in order to effect more complete sterilisation, and as a result the final mash contained a large amount of bitter matter. Milling machinery which removed about 80% of the husk was installed, and the resulting meal was successfully fermented.

For factory work the main points to be noted are:—The nuts should be carefully picked, bad ones being thrown out. Drying should not be carried out above 70° C. As much of the husk as possible should be removed. The presence of an excessive quantity of husk retards fermentation, and the husk itself produces no acetone or butyl alcohol. Saccharification of the starch with malt seems to be a distinct advantage. It is advisable to use a slightly larger amount of inoculant than in the case of maize mash. The yield of mixed oil from horse-chestnut meal is about 18—20%, compared with 24% from maize meal.

* Mixed oil consists of acetone and n-butyl alcohol in the proportion of 1 : 2.

I.—GENERAL; PLANT; MACHINERY.

Patents.

Rod mills for crushing ores and the like. K. P. Lund, Sulitjelma, Norway. Eng. Pat. 113,097, 28.1.18. (Appl. 1646/18.) Int. Conv., 31.1.17.

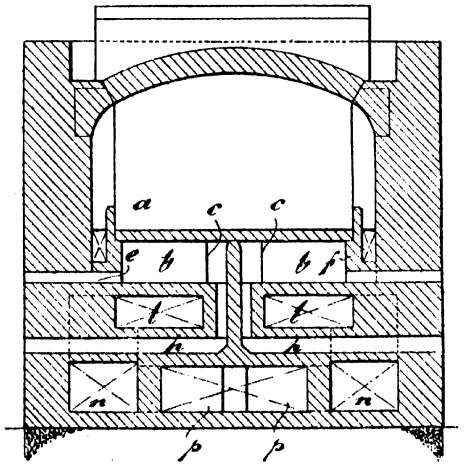
In a crushing mill of the type comprising a truncated conical drum, carrying loose crushing bars, the bars are also made of truncated conical shape with the smaller ends turned in the direction of the flow of material through the mill. The heavy ends are thus utilised for crushing the large-sized ore fed into the mill. The bars taper less than the casing, the difference in taper being such that during the operation of the mill, the axes of the crushing bars, if projected, would meet approximately at the apex of the conical casing.—C. A. K.

Furnaces [*; Rotary* ——]. A. M. Aubert, Billancourt, France. Eng. Pat. 115,840, 3.5.18. (Appl. 7473/18.) Int. Conv., 12.5.17.

The two parts of a rotating furnace which move relatively to one another are separated longitudinally by a comparatively large gap across which the flame passes without admixture of air from one part to the other. The flame may be observed through the gap and any liquefied material may escape without obstructing the relative movement of the two parts. The mouth of the part into which the flame passes across the gap may be made conical, or its section may be of larger diameter to ensure any required proportion of air being drawn in.—W. F. F.

Furnaces. A. Smallwood, London. Eng. Pat. 120,259, 2.11.17. (Appl. 15,974/17.)

A furnace, *a*, heated by gaseous or liquid fuel, is provided with a number of transverse chambers, *b*, below it on both sides, and each chamber is divided into three compartments by vertical partitions, *c*, extending from the outer end nearly to the inner end as shown. The ports, *e*, receive the hot products from Bunsen burners, and lead into the central compartments of the chambers, *b*. The hot gases then pass through the two side compartments



of each chamber, *b*, to the passages, *f*, and thence into the furnace, *a*. Secondary air is supplied to the partly burnt gases by the passages, *h*, leading to the inner ends of the chambers, *b*. The waste gases from the furnace, *a*, pass downwards by passages at one end into the longitudinal flues, *l*, and thence from the further ends of these into longitudinal flues, *n*, and finally back again through the flues, *p*, to the outlet. The secondary air in the pasages, *h*, is thereby preheated. The temperature in the furnace, *a*, may be regulated by providing outlets communicating directly with the stack. —W. F. F.

Furnaces. H. Batchelor, Boston, Mass., U.S.A. Eng. Pat. 120,522, 17.5.18. (Appl. 8285/18.)

An air compressor driven by an electric motor delivers air to a reservoir and thence through a pipe in the top of the furnace. The pipe then branches into two parts which feed the preheated air to two rotary fans mounted on the same shaft, and carrying between them a rotary feeding device at the bottom of a hopper containing powdered fuel. The fuel is thus fed continuously into a mixing chamber to which the air also passes, and the mixture then enters the bottom of the combustion chamber of the furnace. An adjustable friction device is provided on the shaft carrying the feeding device so as to vary its speed and consequently the proportions of fuel and air delivered. The device may be graduated to regulate the proportions according to the amount of carbon and hydrogen in the fuel. The mixture of fuel and air impinges on an incandescent mass of broken refractory material in the combustion chamber to ensure complete combustion.—W. F. F.

Furnaces and other apparatus; Means for controlling the temperature in ——. N. H. Freeman, Chesham, Bucks. Eng. Pat. 120,590, 21.8.17. (Appl. 12,020/17.)

An air vessel in the furnace is connected to a vessel containing mercury so that the expansion of the air drives the mercury up a small tube. This tube swivels on a horizontal trunnion in the mercury vessel, provided with openings so that the tube communicates with the mercury when at any angle to the vertical. The extent of movement of mercury along the tube, and consequently the sensitiveness of the instrument, is increased according as the angle of the tube to the horizontal diminishes. An adjustable wire is inserted into the open end of the tube so that at a predetermined temperature in the furnace the mercury makes contact with the wire and completes an electric circuit. The current operates a relay which controls a valve or damper in the gas supply pipe to the furnace.—W. F. F.

Muffle furnaces. T. W. S. Hutchins, Middlewich, Cheshire. Eng. Pat. 120,633, 17.11.17. (Appl. 16,965/17.)

Six muffles are arranged in a circle around a gas producer. Valves are provided so that each muffle chamber may be connected with the adjacent chambers, or with a passage leading from the producer. Valves are also provided controlling air inlets to the muffle chambers and also outlets to the flue. One muffle at a time is opened for discharging and recharging, and the muffle chamber diametrically opposite is placed in communication with the producer. The air supply for this chamber passes through the two muffle chambers on one side, the air valves and communicating valves being opened, so as to preheat the air, and the hot burnt gases are passed through the two chambers on the other side, to the flue, to heat these chambers on the regenerative principle. The connections are then adjusted so that an adjoining muffle may be discharged and recharged, the opposite muffle heated, and the chambers on either side used for preheating the air and receiving the burnt gases respectively.—W. F. F.

Fire-proofing processes and compositions. S. A. Walton, London. Eng. Pat. 120,421, 6.11.17. (Appl. 16,190/17.)

THE double borate precipitated by mixing boiling solutions of zinc and aluminium sulphates with borax is suspended in a colloidal medium, such as gelatin, in the proportion of 1 part of the double borate to 9 parts of a hot gelatin solution containing 4 oz. of gelatin and 12 oz. of ammonium chloride per gallon, at 90° C., and to 8 parts of the finished solution 1 part of borax is preferably added. The resulting fluid is applied in one or more coats as a fireproof glaze, for instance, to the structures of aeroplanes.—J. F. B.

Dehydrating; Apparatus for ——. M. F. Mangelsdorff, Union Hill, N.J., U.S.A. Eng. Pat. 120,501, 21.2.18. (Appl. 3144/18.)

THE material to be dried is fed into the higher end of a cylinder kept in approximately uniform rotation and set with its axis at a slight inclination to the horizontal. A current of hot air is introduced at the lower end of the cylinder. Longitudinal blades are attached to the inner surface of the cylinder and serve to stir up the mass in its passage through the cylinder. The longitudinal troughs into which the cylinder is divided by the blades are subdivided into pockets by annular discs. Centrally within the cylinder is suspended a longitudinal structure similarly divided up by discs and blades, which rotates with the outer cylinder and serves to break the fall of the material and to promote further agitation. The parts of this inner member are formed of wire cloth or perforated material. Dehydration is slow at first, so that materials such as vegetables do not suffer rupture of the cell walls, and the cell contents are preserved uninjured. The dehydrated material is delivered through a shoot near the lower end of the cylinder on to a travelling belt.
—J. S. G. T.

Centrifugal dryer; Continuous ——. W. F. Downing, jun., St. Clair, and C. L. Weil, Port Huron, Assignors to Diamond Crystal Salt Co., St. Clair, Mich. U.S. Pat. 1,259,727, 19.3.18. Appl., 22.6.17.

A DRUM is mounted on a central, vertical, hollow shaft, which is suspended from a spherical bearing so that the drum can rotate about its true centre of gravity. The material is fed through openings in the hollow shaft into the upper end of the drum; the separated liquid passes through the permeable wall of the drum, and the solids are moved downwards by a worm mounted on a sleeve encircling the shaft. The apparatus is suitable for drying salt and similar materials.

Drying material; Apparatus for ——. B. R. Andrews, Braintree, Mass. Reissue 14,528, 8.10.18, of U.S. Pat. 1,268,535. Appl., 31.10.18.

A CURRENT of air and the material to be dried pass through a drying tunnel in opposite directions. The dried material is finally delivered into a chamber communicating with the discharge end of the tunnel. By means of sprays and heating devices, the humidity and temperature of the air at various points of the tunnel are independently controlled. By means of a fan the pressure in the discharge chamber is maintained approximately equal to that at the discharge end of the tunnel.
—J. S. G. T.

Tunnel-dryer. G. H. Benjamin, New York. U.S. Pat. 1,280,642, 8.10.18. Appl., 8.1.18.

THE drying kiln is surrounded by a casing, and means are provided for circulating air through transverse valve-controlled passages extending from the bottom upwards round the kiln, then over the material in the kiln, and downwards to the bottom of the kiln. Heating means are provided in the air passages.—W. F. F.

Emulsifier and clarifier. J. W. Davies, Reading, Mass. U.S. Pat. 1,279,287, 17.9.18. Appl., 23.4.17.

A ROTARY cylindrical chamber is provided with outlet passages in the containing wall, the outlet units extending into the chamber, and taking the liquor from points away from the periphery of the chamber. The outlets are provided with emulsifying nozzles and with deflecting plates to prevent direct flow of the liquid into the nozzles.—C. A. K.

Separating suspended solids from liquids; Apparatus for ——. F. L. Waterman, Endicott, N.Y. U.S. Pat. 1,279,949, 24.9.18. Appl., 25.7.17.

A RETICULATED metal cylinder is provided with reinforcing bands which support it on grooved rollers so that it can be rotated. The cylinder is provided inside with longitudinal radial wings. The liquid separated from the material fed into the cylinder escapes through the wall of the latter, and the solids are discharged by a conveyor mounted on a carriage which travels on a fixed support extending into the cylinder.

Evaporator. G. H. Benjamin, New York. U.S. Pat. 1,280,641, 8.10.18. Appl., 27.6.17.

A CASING is divided into two superposed chambers by a diaphragm, and each chamber contains a heating unit consisting of horizontal headers connected by vertical tubes. Each heating unit is attached to a removable door at one side of the chamber so that it may be removed bodily, and the heating units are connected in series by external pipes. Each vertical tube is flattened at intervals along its length, the flattened portions being alternately at right angles to one another along the length of the tube.—W. F. F.

Condenser. J. Buhr, Norwood, Ohio. U.S. Pat. 1,280,656, 8.10.18. Appl., 9.1.15.

A CONDENSER coil is contained in a vessel through which a continuous current of cooling medium is maintained. The coil surrounds a central chamber out of communication both with the coil and the outer vessel. Liquid is delivered into the central chamber by a pipe reaching to the bottom, the exit pipe being at the top of the chamber. A number of baffles are contained in the central chamber and serve to retain any sediment and to make better contact between the liquid and the sides of the chamber.—J. S. G. T.

Gravel or other materials; Machine for washing ——. R. W. Dull, La Grange, Ill., Assignor to The Raymond W. Dull Co., Chicago, Ill. U.S. Pat. 1,280,688, 8.10.18. Appl., 18.9.14.

THE gravel or other material is fed in at one end of a horizontal rotating cylinder containing the washing liquid, and means are provided on the cylinder to lift the material on to fixed shelves from which it overflows on to a lower series of shelves and is thereby moved axially along the cylinder. The lower shelves are carried by a support suspended from the support of the upper shelves in such a way that the lower shelves may be moved axially to vary the rate at which the material is moved through the cylinder.—W. F. F.

Refrigeration apparatus. G. A. Kramer, New York, Assignor to The Frigidor Corporation. U.S. Pat. 1,280,765, 8.10.18. Appl., 12.2.15.

A REFRIGERATING apparatus of the evaporation type comprises a refrigerating coil and a condenser, with a compressor to withdraw vapour from the refrigerating coil and force it into the condenser. The collecting receptacle of the condenser is connected, by a pipe dipping into the liquid, to a chamber containing a float valve, and this chamber is connected to the refrigerator. The condensed liquid is thereby automatically transferred to the float-valve chamber, and heavy impurities are retained in the collecting receptacle of the condenser. The compressor is mounted on a movable support below the refrigerator, and a detachable connection is provided between the compressor and the refrigerating coil.—W. F. F.

Refrigerating machines; Compression ——. H. Grasso and J. Rettschnick, s'Hertogenbosch, Holland. Ger. Pat. 308,209, 13.10.15.

IN order to lower the final temperature in the compressor, a portion of the refrigerating liquid is withdrawn from the circuit before expansion and introduced into the compression cylinder, during the compression period, by means of a pump or the like interposed between the regulating valve and the condenser or after-cooler.

Gas-dryer. C. A. Pfanstiehl, Highland Park, Ill., Assignor to Pfanstiehl Co., Inc., North Chicago, Ill. U.S. Pat. 1,281,064, 8.10.18. Appl., 24.7.16.

THE dryer comprises a long slender iron tube set vertically and containing calcium chloride. The gas enters near the lower end. The tube is furnished with observation windows, one at the bottom and one at the top, and a removable drip-pan is provided below the level of the gas inlet.

—J. S. G. T.

Dust collector. F. A. Wegner, Silver Creek, N.Y. U.S. Pat. 1,281,238, 8.10.18. Appl., 22.4.16.

A DUST collector comprises a separating chamber with inlet opening and discharge openings for dust and air. An auxiliary dust chamber situated above the separating chamber is enclosed within a tubular guard, and a tube leads from the auxiliary chamber to a point near the lower end of the separating chamber. A portion of the air is returned by means of this tube from the auxiliary chamber to the separating chamber, and is discharged in a downward direction. The end of this tube is furnished with an extensible section.—J. S. G. T.

Extraction of substances; Apparatus for the continuous ——. L. Melzer, Kgl. Weinberge, Bohemia. Ger. Pat. 305,919, 10.7.17.

THE extraction vessel proper consists of a cylinder mounted to rotate about a vertical axis and divided into compartments by radial partitions. Above and below the extraction vessel are fixed chambers, the lower one of which serves as a steam boiler. The joints between the cylinder and the fixed chambers are sealed by cylindrical or conical rings, provided with passages so that in certain positions the cylinder communicates with the upper or lower fixed chamber. When the material in one of the compartments is completely extracted, the cylinder is rotated so that this compartment communicates with the lower chamber, and steam is blown through the material. Whilst this compartment is being steamed, others may be filled or emptied, so that the operation of the apparatus is practically continuous.

Leaching process. P. Meyer, Berlin-Johannisthal. Ger. Pat. 308,285, 20.4.17.

THE material to be leached is brought in contact, in countercurrent, at different places in a circuit successively with the solvent and a washing liquid; the latter after use is added to the circulating solvent.—W. R. S.

Cooling tower. G. Politz, Breslau. Ger. Pat. 308,290, 22.1.15.

WITHIN the tower are horizontal series of inclined plates spaced apart and extending over the whole cross-section of the tower. The lower ends of the plates are bent upwards to form collecting gutters which, however, do not extend to the ends of the plates, so that comparatively wide gaps are left free for the ascending current of air. Spaced a short distance above the surface of the plates are baffles to catch any rebounding water and direct it into the collecting gutters. The upper portions of the plates are preferably more steeply inclined than the lower portions.

Cooling apparatus [for air or gases]. E. Jeenicke, Dortmund. Ger. Pat. 308,621, 14.11.17.

AIR or other gas is cooled by means of a rotating drum provided with spirals which form channels between the drum and a surrounding air-tight casing for the passage of the gas. The drum has hollow axles for the introduction of the cooling water, and these may be of the same diameter as the drum, or may be constricted at either end to an extent corresponding to the depth of the water to be kept in the drum for keeping its walls wet.—C. A. M.

Non-conducting material. Eng. Pat. 120,691. *See* IX.

Dry-kiln. U.S. Pat. 1,281,212. *See* IX.

Desiccating apparatus. U.S. Pat. 1,259,890. *See* XIXA.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Methane and air; Inflammation of mixtures of —— in a closed vessel. R. V. Wheeler. Chem. Soc. Trans., 1918, **113**, 840—859.

THE phenomena associated with the inflammation of mixtures of methane and air have been examined. The mixtures were contained in closed spherical vessels fitted so as to permit of ignition at the centre. Comparative observations were made in vessels of about four and sixteen litres capacity respectively, the principal data obtained being the various pressures developed, the rates of development of pressure, and the speeds of propagation of flame. For mixtures containing from 7·5 to 12·5% of methane the maximum pressures recorded were the same in the two vessels, and in such mixtures the propagation of the flame appears to follow regular concentric spherical surfaces in such manner that the flame reaches the walls of the vessel simultaneously at all points. In consequence, the inflammation of the mixture is complete before cooling by conduction of the walls comes into play. On the other hand, with mixtures which contain less than 7·5 or more than 12·5% of methane, the more slowly moving flame reaches the bottom of the vessel later than it reaches the top, the difference in time varying with the composition of the mixture. For such mixtures, cooling by conduc-

tion begins before complete inflammation and before the maximum pressure is attained. The curves obtained by plotting the recorded pressure against time appear to indicate three distinct stages in the inflammation process. The first stage, in which the pressure increases with the time in a linear manner, corresponds with the propagation of flame within the sphere. The third stage, in which the pressure falls, represents the cooling of the products of combustion, and the second stage, in which the pressure remains constant for some little time, probably represents a balance between the cooling effect of the walls and the effect of the equalisation of temperature differences within the gaseous mass. When a rapidly revolving fan is introduced into the explosion vessel, the horizontal portion of the pressure curve is no longer obtained and the maximum pressure recorded is higher than in a corresponding experiment made without the mechanical mixer. There is a close correspondence between the time taken for the flame to reach the top of the explosion vessel and the time recorded for the development of the maximum pressure, although the first appearance of the pressure effect is considerably later than the time of ignition.—H. M. D.

Tar as fuel oil for Diesel engines. O. Schertel. J. Gasbeleucht., 1918, **61**, 493—495.

Heated filtered tar has been used with complete success for three years as fuel for two 100-H.P. Diesel engines worked alternately. Paraffin oil, when available, was used as ignition oil, but on occasion tar was used alone. When paraffin oil became no longer available, gas oil and heavy petroleum were used as ignition oils. It was then found to be advantageous to run on tar-oil for 5 to 10 minutes at starting, a procedure unnecessary with paraffin oil. The tar had a calorific value of about 8700 cals., and 337 grms. of tar with 20 grms. of ignition oil were required to produce 1 H.P.-hour. The cost of running with the usual oil of calorific value about 10,000 cals. would have been 2½ times as great. The cylinders and piston rings remained bright and clean throughout. The crude tar was run into large storage tanks where it was kept heated by hot-water pipes, and where water and solid matter separated. It was then pumped up to a high-level tank holding sufficient for one day's working (about 500 kilos.). Here also the tar was kept heated and a further separation of water took place. Thence the tar ran by gravity through two gravel filters, the grain-size in the first filter being 3 to 5 mm., and in the second 1 to 2 mm., and from these through a meter and a regulator to a heater where the temperature was raised to about 60° C. Preheating of the tar to this temperature was found to be necessary to ensure complete combustion. Two pairs of filters were used alternately in periods of about 3 weeks, during which time about 10,000 kilos. of tar passed through. A steady flow of tar through the filters was obtained by fitting to the outlet from the fine filter an open vertical pipe in which the filtered tar ascended when the feed to the engine was interrupted by the regulator. The heating of the tar and of the water for the pipes in the tanks was accomplished by the exhaust gases from the engine.—T. St.

Petroleum oils and their products; "Degree of mercuration" of crude —— for the control of the refinery processes. J. Tausz. Petroleum, 1918, **13**, 649—654. Z. angew. Chem., 1918, **31**, Ref., 336.

The crude oil or distillate is shaken with a methyl-alcoholic solution of mercuric acetate, the liberated acetic acid being then estimated by titration; the number of c.c. of *N*/1 potassium hydroxide necessary to neutralise the acetic acid liberated by 100 c.c. of oil is designated "the degree of mercuration," and provides a measure of the undesirable constituents, such as unsaturated hydrocarbons, sulphur compounds, asphaltic and resinous compounds, and phenols which react with mercuric acetate with formation of mercury compounds and liberation of acetic acid (see this J., 1918, 554A).
—D. F. T.

Lubricating oils; Testing ——. R. Dubrisay. Ann. Falsif., 1918, **11**, 309—310.

Replying to Nicolardot and Masson (this J., 1918, 499A) the author states that his instrument (this J., 1917, 1123) is not intended for determining the viscosity of oils; it may, however, be used for rapidly determining differences of fluidity of oils.
—W. P. S.

Combustion in furnaces. Escher. *See* X.

Trade effluents. Wilson. *See* XIXB.

Patents.

Coke; Apparatus for the manufacture of ——. F. J. Slyver, Edmonton, Queensland. Eng. Pat. 113,091, 9.1.18. (Appl. 531/18.) Int. Conv., 2.2.17.

An open-ended arched oven is provided with rails extending through it on which a wheeled truck carrying the charge of coal is conveyed into the oven. The sides and bottom of the truck are made double-walled, with suitable openings to allow air to circulate, and the truck is of the same length as the oven, so that its end wall forms part of the closure of the oven, the remaining spaces above and below being closed by doors and sealed. When the coking is finished, the truck is run out of the oven and discharged. One of the side walls of the truck is hinged to facilitate discharge. Air for combustion is admitted through adjustable openings in the upper end doors, and the gaseous products are withdrawn from the top of the oven.—W. F. F.

Retorts for the continuous carbonisation of coal and the like; Vertical ——. S. Glover, St. Helens, J. West, Southport, and W. Wild, Blackpool. Eng. Pat. 120,458. (Appls. 17,103, 20.11.17, and 7586, 6.5.18.)

Steam under pressure is passed through a tubular superheater at the base of the waste gas chimney of the vertical retort bed, and then through pipes in the waste gas circulating flues at the top of the setting. The steam then passes down through vertical passages in a partition in the vertical flue through which the hot gases from the combustion chambers of the retort bed pass upwards. The highly superheated steam then passes into the retorts to generate water-gas. In horizontal or inclined retorts such as those described in Eng. Pat. 113,981 (this J., 1918, 233A) the steam is admitted into the retort beneath the hot coke which is being discharged, and the retort is maintained full of incandescent fuel, so that the steam must pass through it to the gas outlet at the charging end.
—W. F. F.

Gas-making retort. Ehrhardt und Sehmer G.m.b.H. in liquidation, Saarbrücken. Ger. Pat. 308,252, 31.10.16.

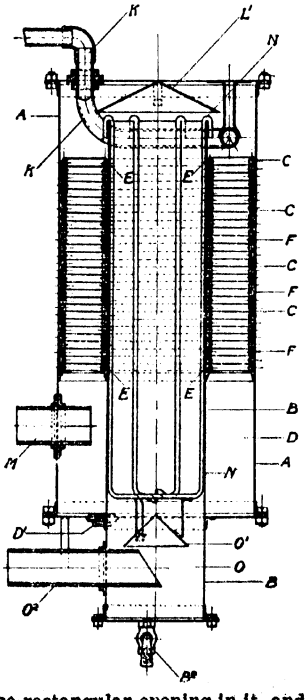
A retort of increasing cross-section from the top downwards, which serves also as a feed tube for a gas producer and is heated by the hot gas from the latter, is provided with a conical hollow core so that the thickness of the column of fuel is approximately the same throughout the retort. The hollow core may be used as gas-outlet pipe.

Gas producers. D. J. Smith, London. Eng. Pat. 120,599, 18.10.17. (Appl. 15,089/17.)

A VERTICAL cylindrical producer chamber is provided with a superposed boiler, and air is drawn over the water in the boiler by the suction of a gas engine. The air and water vapour pass into the ash-pan of the producer and then upwards through the fire, which is kept shallow to avoid slow distillation. The producer gas passes from the combustion chamber through a gas cooler in which the cooling water is the boiler feed water, and then through a scrubber such as that described in Eng. Pat. 120,684 (following) to the engine. The boiler is provided with an overflow from which the surplus water passes to an annular trough in the ash-pan. A transverse shaft in the ash-pan is continuously rotated by the engine and carries a series of cams which are adapted to oscillate one end of the firebars progressively from one side of the grate to the other, thus agitating the fire. The other ends of the firebars are pivoted on a fixed spindle. The same shaft also operates the boiler feed pump through a crank of adjustable length. The fuel is fed into the producer from a hopper above by a worm conveyor, and the ash is discharged from the ash-pan by a rotary valve, all these devices being driven from the same shaft through adjustable cranks, and consequently at proportional speeds. The air inlet to the boiler is provided with a throttle-valve which is connected to the throttle-valve of the engine, so that the pressure in the boiler is reduced and more steam is generated and supplied to the fire when there is an increased demand for gas.—W. F. F.

Scrubbers, cleansers and coolers for [producer] gas. D. J. Smith, London. Eng. Pat. 120,684, 18.10.17. (Appl. 2832/18.)

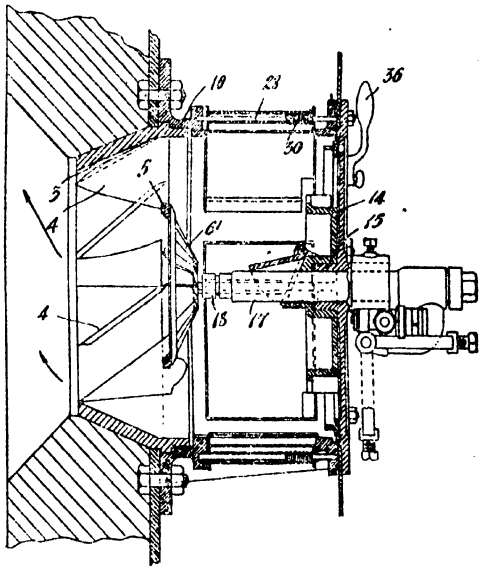
THE annular space between two concentric cylinders, A, B, is provided with superposed annular discs, C, separated by rubber rings, E, F. Each



disc has one rectangular opening in it, and the discs are arranged so that these openings are alternately at opposite ends of a diameter. The washing water is sprayed on to the discs by a circular perforated pipe, K, and trickles downwards over the annular discs in a zigzag path. The gas to be treated enters by the pipe, M, traverses the water film in countercurrent, passes under the hood, L^1, and then downwards through a wire basket, N, filled with pieces of coke. The gas is then deflected outwards by the cone, O^1, to separate the solid particles, and is finally discharged through the pipe, O^2. Sludge and tar are removed from the chamber, D, through the outlet, D^1, and from the chamber, O, through the outlet, B^2.—W. F. F.

Oil burning apparatus. Babcock and Wilcox, Ltd., London. From The Babcock and Wilcox Co., New York. Eng. Pat. 120,489, 23.1.18. (Appl. 1323/18.)

THE front of the furnace is provided with a conical mixing chamber, 3, having substantially triangular blades, 4, normal to the conical surface, and at an angle of about 60° to the front plate of the furnace. A central ring, 5, carries a number of inclined blades, 6^1, as described in Eng. Pat. 27,672 of 1911 (this J., 1912, 1021) to give the air a whirling motion, or a flat deflecting plate as described in



Eng. Pat. 18,712 of 1911 (this J., 1912, 864) may be used. A cylinder, 10, is attached to the furnace front and its closing plate, 14, is provided with a hub, 15, to carry the burner, 17. The outlet, 18, of the burner is close to the air-deflecting blades, 6^1. The cylinder, 10, is provided with large air openings on its cylindrical face, which are controlled by similarly shaped curved plates or doors pivoted on the pins, 28, and normally kept in their open positions by the springs, 30. The doors may be partly or wholly closed by a cam mechanism operated by the hand lever, 36.—W. F. F.

Viscous mineral oils or mineral oil distillation residues; Conversion of —— into less viscous hydrocarbons of approximately the same specific gravity. Allgem. Ges. für Chem. Ind., Berlin. Ger. Pat. 308,197, 30.6.15.

THE viscous oil is heated for a short time at 360°—420° C. under 4—6 atmospheres pressure; by this treatment it is possible to effect an alteration in the molecular condition of the material whilst restraining any further thermal decomposition.—D. F. T.

Coal-gas; Extraction and recovery of vaporous and gaseous constituents from ——. R. Lessing, London. U.S. Pat. 1,281,597, 15.10.18. Appl., 8.10.15.

SEE Eng. Pat. 10,022 of 1915; this J., 1916, 883.

Hydrocarbon oils; Apparatus for vaporising ——. C. B. Forward, Urbana, Ohio, U.S.A. Eng. Pat. 120,626, 15.11.17. (Appl. 16,822/17.)

SEE U.S. Pat. 1,255,149 of 1918; this J., 1918, 200A.

Petroleum oils; Process and apparatus for converting ——. M. J. Trumble, Los Angeles, Cal., Assignor to Shell Co. of California, San Francisco, Cal. U.S. Pat. 1,281,884, 15.10.18. Appl., 19.7.15.

SEE Eng. Pat. 15,084 of 1915; this J., 1916, 1210.

Ammoniacal liquor. Eng. Pat. 120,596. *See* VII.

Asphalt-like composition. U.S. Pat. 1,279,918. *See* IX.

Combustible gases. Eng. Pat. 120,661. *See* XXIII.

Viscosimeter. U.S. Pat. 1,281,042. *See* XXIII.

Gas analysis. Ger. Pat. 308,005. *See* XXIII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

PATENTS.

Tungsten filaments; Treatment of ——. C. T. Fuller, Nutley, N.J., Assignor to General Electric Co. U.S. Pat. 1,280,704, 8.10.18. Appl., 13.4.14.

TUNGSTEN wire which has been drawn by the usual methods, and which is to be later subjected to a temperature substantially higher than that of red heat, is heated to at least a red heat in an oxidising atmosphere in order to improve its mechanical properties.—T. H. B.

Incinerating kelp. U.S. Pat. 1,282,708. *See* VII.

III.—TAR AND TAR PRODUCTS.

Tar in Diesel engines. Schertel. *See* IIA.

PATENTS.

Distillation of benzol homologues; Classifying apparatus for use in the ——. F. Tschuby, Fairfield, Ala. U.S. Pat. 1,282,324, 22.10.18. Appl., 5.7.17.

THE apparatus consists of a dephlegmator, a rectifying column through which the condensed liquor from the dephlegmator passes, and a tubular heater through which the condensed liquor from the rectifying column passes. The tubes of the heater project a short distance beyond the bottom of the rectifying column to cause the liquid to flow through in thin films, the arrangement being such that only the homologue desired passes down through the heater, lower boiling homologues being vaporised and passing upwards through the rectifying column to mix with the products passed by the dephlegmator, maintaining the required vapour pressure therein. The liquid passing through the heater passes into an insulated header and thence into a cooler.

—L. A. C.

[Naphthalene] sulphonic acids; Separation and purification of ——. J. E. Southcombe and R. M. Downie, Birkenhead. Eng. Pat. 120,405, 7.9.17. (Appl. 12,839/17.)

INSTEAD of neutralising the product obtained by the sulphonation of naphthalene completely with lime, it is partially neutralised with sodium carbonate or sodium hydroxide, and lime is then added to the boiling solution until a filtered test portion gives a heavy precipitate of calcium carbonate on addition of sodium carbonate. Calcium sulphate is then removed by filtration, and the lime in the filtrate removed by precipitation with sodium carbonate and subsequent filtration. The filtrate contains the sodium naphthalenesulphonates. If desired, the sodium carbonate (or hydroxide) and lime may be added in quantities corresponding to the sulphonic acids and the free sulphuric acid respectively.

—L. A. C.

Rubber composition. U.S. Pat. 1,282,505. *See* XIV.

IV.—COLOURING MATTERS AND DYES.

Methyl Violet as sensitiser. Yoshida. *See* XXI.

PATENTS.

Dyes [from peat]; Production of ——. A. M. Hart, Croydon, Surrey. Eng. Pat. 120,588, 13.8.17. (Appl. 11,625/17.)

DRIED and powdered peat is treated with sulphuric and nitric acids, either in succession, or together, and the solution filtered. The "acid filtrate" so obtained, diluted with water, may be used alone as a dye-bath, or may be "diazotised" with sodium nitrite, and used in conjunction with a grounding bath of, *e.g.*, β-naphthol, or a metallic mordant, *e.g.*, potassium ferrocyanide, and, if desired, a developing bath of, *e.g.*, naphthylamine. Alternatively the "acid filtrate" may be neutralised with sodium carbonate, or the like, and allowed to crystallise, a solution of the crystals being used as before. The bath may be used also for treating cotton previous to dyeing with colours which are not readily applied to that fibre, *e.g.*, cochineal.

—L. A. C.

Disazo colouring matters and process of making the same. A. E. Gessler, Staten Island, N.Y. U.S. Pat. 1,281,938, 15.10.18. Appl., 20.12.17.

A DISAZO dyestuff is prepared by coupling the tetrazo derivative of di-*p*-aminoditolyl with 2,6-naphtholmonosulphonic acid, and converting the product into its copper salt. The colouring matter so formed is insoluble in water, oil, and benzene, cannot be sublimed, and gives a greenish-blue colour with concentrated sulphuric acid.

—L. A. C.

Ortho[hydr]oxyazo dyestuffs; Substantive —— and process of making same. E. Anderwert, H. Fritzsche, and H. Schobel, Assignors to Society of Chem. Ind. in Basle, Switzerland. U.S. Pats. 1,282,354, 1,282,355, and 1,282,356, 22.10.18. Appl., 6.10 and 7.10.15 and 26.4.17.

SEE Eng. Pat. 12,250 of 1915; this J., 1916, 1008.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cotton; Constituents of raw ——. E. Knecht and W. Hall. J. Soc. Dyers and Col., 1918, **34**, 220—224.

THE systematic series of consecutive extractions described previously (this J., 1911, 813, 1007) was repeated under comparative conditions with 2-ply 60's American and Egyptian yarns. The results previously recorded were confirmed, except for unimportant quantitative differences. Both the alcoholic and aqueous extracts were extremely rich in mineral matter, a considerable proportion of which consisted of potassium salts. On dialysis of the aqueous extract, it was separated into a diffusible portion extremely hygroscopic and very rich in potassium salts, and a residue which on evaporation yielded a non-hygroscopic brittle resinous substance. Nitrogen determinations were carried out on the yarns after each treatment; the benzene, alcohol, and water extracted only 14·1—16·7% of the total nitrogenous matter. Experiments on the removal of nitrogenous matter from raw cotton in a single treatment showed that boiling at atmospheric pressure for 6 hours with 2% caustic soda solution removed 78—80% of the total nitrogen; boiling with lime for 12 hours removed 37·5%, but this was increased by subsequent souring to 53·1%; hot soaping removed only 17·5%. Further experiments, in imitation of the industrial process, boiling under 35 lb. pressure per sq. in., showed with a yarn containing originally 0·248% of nitrogen, the following results, representing the proportion of nitrogen remaining in the yarn after each stage (orlginal=100):—After lime boil, 54%; after sour, 40·5%; after caustic boil, 27·1%; after sour, 26·8%; after bleach liquor, 6·7%; after sour, 5·8%. A preliminary examination has been made of the various extracts. The lime extract gave a gelatinous precipitate with alcohol, free from nitrogen and corresponding with pectic acid. The portion soluble in alcohol gave two brown resinous substances of different solubilities, containing 9·1 and 9·6% of nitrogen respectively; these are described as colouring matters. There was also a small quantity of fatty acid. The total substance extracted from the cotton by the lime boil was 2·1%, which included the greater portion of the mineral constitutents of the cotton. The first hydrochloric acid extract (lime sour) contained mainly a fatty acid corresponding apparently with stearic acid, together with a dark-coloured wax, m.pt. 77°—80° C.; there was also a small quantity of brown resinous substance similar to that present in the lime extract. The caustic soda extract yielded a brown residue fairly rich in nitrogen and phosphoric acid. The solid residue yielded a further quantity of the brown colouring matter soluble in alcohol; the matter insoluble in alcohol gave the general reactions of protein. On acidification of the soda extract a dark-coloured protein, containing 18·75% of nitrogen, was isolated. From this extract were obtained also a black, brittle, shining mass, soluble in ammonia and containing 9·6% of nitrogen, and a mixture of pectic acid and colouring matter. The total substance extracted from the cotton by the above three main treatments was about 4%. The hygroscopic moisture of the raw cotton was 7·36% and that of the scoured and bleached cotton 6·14%.—J. F. B.

Cotton cellulose: structure and constitution. C. F. Cross and E. J. Bevan. J. Soc. Dyers and Col., 1918, **34**, 215—218.

A SPECIMEN of powdered cotton produced by the stamping action of the finishing "beetles" when working for a prolonged time on the same area of cloth has been submitted to chemical and physical examination. The dimensions of the cellulose particles were similar to those of starch granules but without the organised structure. The particles were inert towards polarised light, in sharp contrast to the original cotton fibres. The elementary composition calculated on the dry ash-free substance corresponded accurately with the formula, $C_6H_{10}O_5$, and the hygroscopic moisture under ordinary atmospheric conditions was normal, namely 5—6%. On treatment with caustic soda lye of 17·5% strength, the cotton powder gave indications of a profound modification, showing 40—56% of the soluble forms of cellulose (β- and γ-celluloses), a large and variable proportion of which was re-precipitated on acidification. The product recovered after treatment with the alkali showed considerable resistance to acetylation with the aid of sulphuric acid as catalyst. The cotton powder is characterised by a particularly low specific volume (0·635), or high density, as compared with normal cotton. The specific volume changes with rise of temperature, showing a minimum value at 35° C. and a maximum at 77° C. Above this temperature a sharp loss of volume occurs, accompanied by a visible hydration effect; the suspended cellulose, previously in the form of a fine powder, changes to a flocculent curd, but the phenomenon is reversible and the cellulose resumes its original appearance on cooling. The authors discuss the analogies between this modified cellulose and starch which, after drying at 100° C., also shows a rapid loss of volume in water at the gelatinisation point.—J. F. B.

Wool; Some effects of moist and dry heat on ——. A. Woodmansey. J. Soc. Dyers and Col., 1918, **34**, 227—230.

IN the conditioning of wool the removal of hygroscopic moisture is considered complete after heating the wool at 100° C. for 40 minutes, provided the ventilation is sufficient. At 150° C. a gradual small loss of matter other than water takes place. The tensile strength increases on drying and decreases on damping, and the tensile elongation varies in the inverse sense. On boiling with water a partial solution of wool substance occurs, with liberation of small quantities of ammonia and hydrogen sulphide. Wool damped with cold water recovers most of its original strength on re-drying, but wool boiled with water for one hour suffers a permanent loss of strength. Heating with water at 130° C. completely disintegrates the wool. On the other hand, wool in the dry state suffers only a moderate loss of strength on heating at very much higher temperatures, *e.g.* 150°—200° C. The effect of dry heating on wool is a function of the time of heating. When the temperature is raised gradually the first signs of darkening appear at about 145° C. When heated for 3 hours at 150° C., the scorched wool still shows the scale markings but the surface is covered with longitudinal striations. Wool heated at 175° C. for 3¼ hours does not re-absorb the normal amount of moisture; its absorption capacity for sulphuric acid is also diminished. On heating in a current of air, ammonia is evolved, a larger quantity in the moist condition than in the dry. Heated wool becomes acid, partly on account of the oxidation of the sulphur to sulphuric acid and partly on account of the loss of ammonia. The decomposition of wool under the influence of heat may take place with the formation of an amide which in presence of moisture undergoes hydrolysis, forming an acid and ammonia. The dyeing properties of scorched wool are analogous to those of faded wool, as is also its increased solubility in alkalis and in water. From a neutral bath of an acid dyestuff, scorched wool takes a deeper shade than unheated wool, presumably on account of its acid character; with an acid bath there is little

difference between heated and unheated wool, though the unheated wool gives brighter shades. With basic dyes there is little difference in depth, but the heated wool is duller and redder. In none of the changes which wool undergoes on heating is there any sharp critical temperature; the changes take place gradually and a long time at a lower temperature is equivalent to a shorter time at a higher temperature.—J. F. B.

Trade effluents. Wilson. *See* XIXB.

PATENTS.

Paper pulp [from papyrus]; Production of ——. H. H. Spicer, London. From J. Wells, Cairo, Egypt. Eng. Pat. 120,086, 24.10.17. (Appl. 15,467/17.)

PAPYRUS is thoroughly dried and matured, for instance, by storage for one year, and then crushed between rollers; the crushed material is boiled for 4—8 hours in open pans with water and 25—30% of its weight of lime, and treated mechanically for the separation of the fibres. Sudan papyrus yields about 36% of fibre. Alternatively, the inner fibre and pith alone may be treated by this process.
—J. F. B.

Paper-making machines [suction couch rolls]. L. M. Blyth, Leith. Eng. Pat. 120,147, 5.1.18. (Appl. 298/18.)

A SUCTION couch roll is composed of a central solid roller and an outer perforated cylinder, which is supported concentric with the solid roller by means of intermediate rollers, which revolve in bearings on the end frames. The central roller and outer cylinder are positively driven in opposite directions, and the intermediate rollers revolve by frictional contact with the driven parts of the apparatus. In the area of the cylinder which is covered by the web of paper, three of the intermediate rollers are covered with rubber to make air-tight contact with the central roller and the perforated cylinder, so that this portion of the space between the central roller and the outer cylinder is divided into two vacuum chambers. The ends of these chambers are closed by end-pieces with air-tight packing joints which are continuously flooded with water, and means are provided for shifting the end-pieces towards or away from each other to accommodate varying widths of paper.—J. F. B.

[Paper] machine [suction-boxes]; Fourdrinier ——. W. A. Murray and C. E. Putnam, Chisholm, Me. U.S. Pat. 1,280,524, 1.10.18. Appl., 14.5.18.

IN a Fourdrinier machine, several suction-boxes are coupled together and the whole set is connected with a mechanism for imparting to it a unitary reciprocating movement in the direction of the travel of the wire.—J. F. B.

Porous vessels [of paper or cardboard]; Rendering —— impervious to the fluid they are intended to contain. G. H. Hadfield, Mitcham, and A. E. Bawtree, Sutton, Surrey. Eng. Pat. 120,410, 4.10.17. (Appl. 14,383/17.)

IN making the joint between the sides and ends of the vessel, one or both of the surfaces to be united are previously coated with a composition similar to that which is to be used for making the porous portions impervious, and the parts are joined before the composition has dried. The vessel, consisting, for instance, of a paper or cardboard tube with metal caps or rings at the ends, is then mounted on a revolving support, and a little of the melted composition is poured in. The vessel is rotated on a horizontal axis at a sufficiently high speed to cause the centrifugal force to overcome the effect of gravity on the portions of the fluid which for the time being are vertically above the axis of rotation. In order to obtain a uniform coating, it is essential that any error in the centreing of the vessel should be less than the thickness of the film. The distribution of the fluid may be assisted by the application of a brush to the interior of the rotating vessel.—J. F. B.

Porous material [e.g., fibre-board]; Method of filling and indurating —— and the product thereof. W. V. Lander, Newton, Mass., Assignor to General Indurating Corporation. U.S. Pat. 1,278,943, 17.9.18. Appl., 8.11.15.

THE pores of the material, *e.g.* fibre-board, are filled with a mixture of resin and petroleum residue (in which the quantity of resin is at least equal to that of the petroleum residue), dissolved in a volatile carrier, such as petroleum spirit. After impregnation the surface of the impregnated material is bathed in the vapour of the solvent and the material is then indurated by evaporation.
—J. F. B.

Fibre-board; Water- and fire-resisting —— and process of manufacture. A. L. Clapp, Marblehead, Assignor to The Metalite Co., Amesbury, Mass. U.S. Pat. 1,280,400, 1.10.18. Appl., 27.4.16. Renewed 3.12.17.

VEGETABLE material is treated with a solution of caustic alkali so as partly to dissolve the material. The dissolved matter and the residue are mixed with fibrous cellulose in water and beaten to a finely divided state. The dissolved matter in the stock is then precipitated by a metallic salt and the resulting pulp is formed into sheets.—J. F. B.

Brake-lining and method for preparing the same. W. D. Pardoe, Assignor to Thermoid Rubber Co., Trenton, N.J. U.S. Pat. 1,277,108, 27.8.18. Appl., 16.3.17.

A FABRIC is passed through a solution containing asphalt, preferably gilsonite, mixed with lead oxide, sulphur, and an oxidation accelerator, *e.g.*, hexamethylenetetramine, and is then subjected to a pressure of 150 lb. per sq. in. and a temperature of 300°—400° F. (150°—205° C.) to vulcanise the impregnating material. The product is practically uninflammable, has an unusually high coefficient of friction and good wearing qualities, and does not become sticky under working conditions.

Plastic composition [ethylcellulose] and method of making the same. P. C. Seel, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pat. 1,281,080, 8.10.18. Appl., 7.2.18.

A CELLULOSE ether, such as ethyl cellulose, is mixed with a chlorine substitution product of a carbocyclic compound, such as naphthalene, in chloroform and alcohol.—J. F. B.

Cellulose-containing materials; Process for treating —— and recovering substances used therein. O. G. Stage, Three Rivers, Quebec. U.S. Pat. 1,279,604, 24.9.18. Appl., 14.3.18.

PART of the " black liquor " is withdrawn from the digester after its digestive action is completed and is replaced by weak liquor. The pulp in the digester is washed with this weak liquor, and the liquor is preserved at the temperature and pressure of the digestion.—J. F. B.

Celluloid-like substance and process of making the same. S. Satow, Sendai, Japan. U.S. Pat. 1,280,862, 8.10.18. Appl., 30.12.16.

VEGETABLE proteins are hydrolysed, and the hydrolysed product is glutinised to form a plastic and elastic mass. A substance resembling celluloid is made with hydrolysed proteins, a viscous material, a fibrous material, and a reducing agent.—J. F. B.

Waterproofing fibrous material; Process for ——. P. F. Bovard, Winona, Minn. U.S. Pat. 1,280,954, 8.10.18. Appl., 4.6.17.

THE material is immersed in a solution of saponified linseed oil and casein until the fibres are thoroughly saturated; the excess moisture is then removed by squeezing, and the material is immersed in a solution of an aluminium compound, and finally dried.—J. F. B.

Cellulose; Apparatus for the manufacture of ——. E. Schauffelberger, London. U.S. Pat. 1,282,635, 22.10.18. Appl., 25.5.17.

SEE Eng. Pat. 113,494 of 1917; this J., 1918, 203A.

Fireproofing. Eng. Pat. 120,421. *See* I.

Asphalt-like composition. U.S. Pat. 1,279,918. *See* IX.

Insulating material. U.S. Pat. 1,281,097. *See* IX.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

"Dry dyeing" process; Use of acid colours in the ——. M. Fort. J. Soc. Dyers and Col., 1918, **34**, 226—227.

THE remarkable penetrating powers of carbolic acid and allied phenols when applied to animal fibres and their solvent properties towards many acid dyestuffs have led to the development of a process of "dry" dyeing of woollen and other fabrics. Commercial cresol, b.pt. 190°—200° C., has been found to be the cheapest and most satisfactory solvent. The presence of a small quantity of water, *e.g.* 5% on the weight of the cresol, is necessary. The cresol or other phenol cannot be employed directly on account of its shrinking action on wool. Shrinkage is accompanied by an increase in the tensile strength and elongation of the yarn, but there is a pronounced development of scales and increased felting properties. The shrinking action of the cresol may be prevented by diluting the cresol solution of the dyestuff with a neutral solvent such as petroleum spirit, naphtha, or nitrobenzene. Solvent naphtha boiling above 100° C. is the diluent most generally useful and permits the use of heated dyebaths. The addition of formic acid increases the solvent power of the cresol for acid dyestuffs. A typical dyebath for blue shades is made by dissolving 0·1 part of Patent Blue Superior in 0·5 part of water, 0·5 of formic acid, and 10 parts of cresol. These are mixed in the order named, and the solution is diluted with solvent naphtha to 100 parts. Dyeing is performed at 50°—80° C. for from 5 to 30 minutes. Yellow shades are dyed with Naphthol Yellow S, red with Crystal Ponceau or Crystal Scarlet, black with Nerol B. The dyed goods are squeezed or centrifuged, rinsed thoroughly in petroleum spirit or naphtha to which 5% of cresol is added, and passed through the ordinary dry-cleaning process to complete the removal of the cresol.—J. F. B.

Effects of heat on wool. Woodmansey. *See* V.

Trade effluents. Wilson. *See* XIX B.

PATENTS.

Dyeing machines. H. M. Dudley, Philadelphia, Pa. U.S. Pats. (A) 1,280,185, (B) 1,280,186, (C) 1,280,187, (D) 1,280,188, (E) 1,280,189, and (F) 1,280,190, 1.10.18. Appl., (A) 13.3.17, (B) 1.6.17, (C) 19.9.17, (D) 24.9.17, (E) 24.9.17, (F) 29.10.17.

(A) THE dyeing receptacle contains a series of adjustable, parallel, foraminous plates spaced from each other and having oppositely disposed pyramidal members. At each end of the receptacle is a chamber, abutting thereon and capable of being moved outwards free from the dyeing receptacle. Each of these chambers contains a series of divergent elements and is connected with a pump capable of circulating liquid through the chambers and through the foraminous plates and the dyeing receptacle. Means are provided for revolving the receptacle and for removing it from between the end chambers. (B) The receptacle is divided into a series of superposed fibre chambers with unperforated sides, each chamber having a fixed foraminous bottom with members extending upwards and a movable foraminous top with members extending downwards, and the fibre is compressed within the chambers by the downward movement of the tops. A central unperforated member extends through the receptacle and the fibre chambers surround it; a liquid chamber is situated beneath the series of fibre chambers and there is a second liquid chamber containing unperforated members diverging upwards beneath the first one. (C) In the receptacle is situated a reel with a foraminous cylindrical body having members extending outwards and unperforated flanges, which can be revolved within the receptacle. The reel is adapted to receive a number of strips of fabric wound thereon, successive rolls of fabric being separated by a series of extensible members sliding over the outer face of the cylinder and closing holes which are not covered by the rolls of fabric, so that the whole of the liquid forced through the machine impinges on the inner face of the fabric rolls. An adjustable foraminous cover having members extending inwards is wrapped around the fabric rolls, and the cylinder is connected at both ends with sources of liquid supply. (D) In a machine similar to that last described, a series of removable conduits is arranged around the exterior of the fabric roll and connected to a common liquid supply, and another set of conduits is arranged inside the cylinder and connected with another liquid supply. The sets of conduits are revolved with the cylinder, and liquid is passed through them and through the fabric in either direction. (E) A machine of the type described under (B), is provided with liquid-distributing arrangements diverging inwards, below the bottom plates, and similar distributing means above the top plates; oppositely extended convergent members are situated centrally of the series of fibre chambers, extending above the top plates and below the bottom plates so as to produce a divergence of the liquid column. A removable cover is fitted to the receptacle, and both the top and the bottom of the apparatus are connected with a pump circulating liquid in either direction. (F) Each of the series of fibre chambers in the receptacle has two fixed foraminous bottom plates spaced apart and two movable top plates spaced apart; the receptacle is provided with a bottom portion containing baffle-plates and a top portion containing baffle-plates, each of these portions being connected with a source of supply of liquid which can be circulated in either

direction. In all the different types of machine described, small exterior testing devices similar to the respective types of large machines are attached to each fibre chamber or dyeing receptacle, and the liquid is circulated through the larger and smaller devices simultaneously, the small device being capable of being shut off for examination without interrupting the flow of liquid through the larger device.—J. F. B.

Dyeing apparatus. A. Rudler, Oxford Furnace, N.J. U.S. Pat. 1,282,633, 22.10.18. Appl., 13.4.18.

THE yarn or the like to be dyed is supported on needles mounted in holders which slide in adjustable slotted racks carried by a frame. The frame is mounted to revolve about another frame, which can be moved vertically into and out of the dye-vat.

Di- and triarylmethane dyestuffs; Preparation of fast vats from ——. H. Wieland, Munich. Ger. Pat. 308,298, 1.9.16.

DI- and triarylmethane dyestuffs are reduced with hydrosulphite in alkaline solution, giving reduction products which have all the properties of vat dyestuffs and are oxidised rapidly on the fibre by the action of the air. The leuco-derivatives form a class of compounds which have the SO_2Na group attached to the methane carbon atom, possibly with SC linking or perhaps in the form of OSONa. It is suggested that the two SO_2Na residues of the hydrosulphite become attached to the quinonoid system of the dyestuff and that one of the two groups is then split off as sulphite.—J. F. B.

Cotton fabrics or yarns; Printing of [coloured discharge effects on] ——. The Calico Printers' Association, Ltd., Manchester, F. Ashton, and G. Nelson, Hyde. Eng. Pat. 120,152, 19.1.18. (Appl. 1137/18.)

A SULPHUR or vat dyestuff with a suitable reducing agent is printed on or under a metallic mordant together with sodium citrate, tartrate, or lactate adapted to discharge the mordant in the printed areas when the goods are subsequently steamed and finally dyed with a mordant dyestuff. The vat or sulphur dyestuff, together with the citrate discharge, may be printed on goods previously prepared with β-naphthol and a metallic mordant, and a diazo salt may be incorporated with the printing mixture or printed separately; or alternatively, the cloth may be prepared with a metallic mordant, then with Aniline Black mixture, and finally printed as before, steamed, and dyed with a mordant dyestuff.—J. F. B.

Gums for the production of thickenings suitable for calico and other textile printing and finishing; Treatment of insoluble, natural ——. The Calico Printers' Association, Ltd., Manchester, J. B. Fothergill, and G. W. Wilson, Dinting Vale, Derby. Eng. Pat. 120,183, 22.6.18. (Appl. 10,299/18.)

KARAYA gum and other insoluble gums of the East Indian and Persian type are converted into a soluble form by treating with a solution of sodium or potassium peroxide, percarbonate, persulphate, or persilicate, and the solution is subsequently neutralised and bleached if necessary. Example: 160 lb. of powdered karaya gum is stirred into 40 galls. of water containing 8 oz. of sodium peroxide; after 1½ hour, a solution of 9 oz. of sodium peroxide in 5 galls. of water is added, and the liquid is heated and boiled for 3½ hours, cooled, neutralised with hydrochloric acid, diluted to 80 galls., and clarified. When used for textile finishing the solution of gum may be bleached with hypochlorites.—J. F. B.

Dyes [from peat]. Eng. Pat. 120,588. *See* IV.

Composition for building. U.S. Pat. 1,279,119. *See* IX.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitrogen; Fixation of atmospheric —— as cyanide. Y. Morimoto. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, **21**, 881—898.

FROM the results of a study of Bucher's method (this J., 1917, 451) of fixing atmospheric nitrogen by passing the gas through a mixture of iron powder, charcoal powder, and sodium carbonate in an electrically heated tube the following conclusions have been drawn: (1) Iron powder is an effective catalyst. (2) The yield of sodium cyanide depends upon the proportions of the materials, the temperature, and the duration of the heating, the latter depending upon the velocity of the current of nitrogen. (3) A suitable ratio for the raw materials, iron, charcoal, and sodium carbonate, is 2 : 2 : 1 or 2 : 2 : 1·35. (4) From 820° to 950° C. is a suitable temperature. Under these conditions it is possible to obtain 75% of the theoretical yield of sodium cyanide in a horizontal furnace. The use of yellow and red iron oxides (containing about 40% of silica) as a catalyst, was unsuccessful, possibly owing to the formation of soluble sodium silicate. —C. A. M.

Sodium peroxide; Determination of active oxygen in ——. J. Milbauer. J. prakt. Chem., 1918, **98**, 1—8.

METHODS depending on the liberation of hydrogen peroxide by water, followed by titration with potassium permanganate, and on the treatment of sodium peroxide with potassium iodide and potassium bicarbonate and titration of the liberated iodine with sodium arsenite give low results, whilst measurement of the oxygen liberated by water in the presence of cobalt nitrate gives high results. The following processes yield accurate results: (1) Water (100 c.c.) is mixed with concentrated sulphuric acid (5 c.c.) and chemically pure boric acid (5 grms.); sodium peroxide (0·5 grm.) is added gradually to the mixture which is kept briskly shaken, and the liberated hydrogen peroxide is titrated with potassium permanganate. The low results given by the older permanganate method are to be attributed to the catalytic decomposition of a portion of the hydrogen peroxide by the manganese sulphate formed during the titration. (2) Sodium peroxide is introduced gradually into a solution of potassium iodide (2 grms.) in dilute sulphuric acid (1 in 20; 200 c.c.); the iodine is titrated with standard sodium thiosulphate. The results agree with those obtained by the permanganate method. (3) Sodium peroxide (0·2—0·3 grm.) is mixed with about 10 c.c. of copper sulphate solution (0·05%) in a small flask connected to a nitrometer; the flask is shaken, and decomposition is completed within a minute, when the liberated oxygen is measured. The gas evolved contains about 0·32% of carbon dioxide and 0·08% of hydrogen. With cobalt nitrate as catalyst, the results are invariably high; the author considers that this may indicate the presence of an oxide higher than the peroxide. The action of the atmosphere on sodium peroxide has also been investigated; moisture appears to be more active than carbon dioxide in causing decomposition.—H. W.

Barium dioxide; Decomposition of —— and the reactivity of the resulting barium oxide. J. A. Hedvall. Z. anorg. Chem., 1918, **104**, 163—168.

THE decomposition of barium peroxide into barium oxide and oxygen is an endothermic reaction and its course can be readily followed by recording the heating curve. The arrest point in the curve is at 795° C., this being the temperature at which the vapour pressure of the evolved oxygen is equal to one atmosphere. In presence of catalysts, such as copper oxide, the decomposition starts at a much lower temperature and is continued over a considerable range. In presence of silica, especially amorphous silica, the reaction becomes exothermic, as shown by the heating curve. The heat evolution is attributed to the formation of a barium silicate, owing to the great reactivity of the barium oxide at the moment of formation. (See also J. Chem. Soc., Jan., 1919.)—E. H. R.

Alkali iodides; Action of chlorine on ——. W. N. Rae. Chem. Soc. Trans., 1918, **113**, 880—884.

WHEN the carefully dried iodides of the alkali metals are subjected to the action of a current of dry chlorine the gas is absorbed with the formation of compounds of the type, $MICl_4$. The curves obtained by plotting the increase in weight against time afford no evidence of the formation of the intermediate compound, $MICl_3$. The rate of absorption of the chlorine bears no obvious relation to the stability of the resulting compound, but comparison is rendered difficult by the fact that traces of water increase the rate. In the case of lithium iodide, the experiments were made with the crystalline hydrate $LiI,3H_2O$, but the same proportion of chlorine was found to be absorbed as in the case of the anhydrous iodides.—H. M. D.

Cupric hydroxide; Solubility of —— in sodium hydroxide and potassium hydroxide. Justin-Mueller. Comptes rend., 1918, **167**, 779—780.

AN aqueous solution of sodium hydroxide having sp. gr. 1·345—1·370 (37°—39° B.) or of potassium hydroxide having sp. gr. 1·453—1·498 (45°—48° B.) will just dissolve 0·78 grm. of cupric hydroxide in 100 c.c., giving a bright blue solution which does not give a precipitate when boiled direct or after dilution. If a more dilute alkali solution be used to dissolve the cupric hydroxide, a solution is obtained which is not stable when further diluted and subsequently boiled.—W. G.

Zinc chloride; Dissolving —— and several suggested solvents. J. C. and B. L. DeG. Peacock. Amer. J. Pharm., 1918, **90**, 706—717.

THE formation of zinc oxychloride when zinc chloride is dissolved in water is accompanied by the liberation of hydrochloric acid; the addition of boric acid or ammonium chloride prevents this decomposition of the zinc salt. Camphor water dissolves a small quantity of zinc chloride, yielding a clear solution, but the solution becomes turbid when the quantity of the salt exceeds 10 grains per oz.—W. P. S.

Antimonic acids and antimonates. G. Jander. Kolloid Zeits., 1918, **23**, 122—144.

THE properties of th antimonic acids vary according to the method of preparation and previous treatment. Soluble tri- and tetra-antimonic acids are hydrosols of low stability. The difference between the various antimonic acids is only that due to difference in the size of the particles. Ortho-, pyro-, and meta-antimonic acids are not capable of existing in the free state. The amorphous and gum-like antimonates are produced by the adsorption of alkali hydroxide from dilute solution and do not constitute true salts. Concentrated solutions of alkalis dissolve antimonic acids, and on careful evaporation at low temperatures definite antimonates may be crystallised out. In this way the salt, $1{\cdot}71K_2O,Sb_2O_5,8H_2O$ has been obtained. (See also J. Chem. Soc., Jan., 1919.)
—J. F. S.

Rare earths. VIII. Separation of yttrium and erbium; the ratio $Er_2O_3:2ErCl_3$. E. Wichers, B. S. Hopkins, and C. W. Balke. J. Amer. Chem. Soc., 1918, **40**, 1615—1619.

THE nitrate fusion method is very efficient for separating erbium and yttrium and is much better than any of the newer methods, although the cobalticyanide and the nitrite precipitation methods (this J., 1916, 736, 925, 1259) are both good, the latter being the more practicable and efficient. Erbium oxide prepared by igniting the oxalate always contains carbon dioxide and consequently may not serve as the basis of the atomic weight determination of erbium. (See also J. Chem. Soc., Jan., 1919.)—J. F. S.

Scandium from a Brazilian source. C. James. J. Amer. Chem. Soc., 1918, **40**, 1674.

BRAZILIAN zirconia is shown to yield residues which contain notable quantities of scandium fluoride.
—J. F. S.

Hydrosols; Influence of filtration on ——. T. Malarski. Kolloid Zeits., 1918, **23**, 113—122.

THE effect of filtration on positive colloids like ferric hydroxide and negative colloids like silver, when the latter have had their velocity in an electric field reduced by the addition of electrolytes, is to reduce the velocity of migration in an electric field and to increase the stability of the sols. The experiments were made with filters of paper, fat-free cotton, sand, and glass wool. (See also J. Chem. Soc., Jan., 1919.)—J. F. S.

Carbon monoxide, carbon dioxide, sulphur dioxide, and free sulphur; Equilibrium between ——. J. B. Ferguson. J. Amer. Chem. Soc., 1918, **40**, 1626—1644.

CARBON monoxide and sulphur dioxide react at temperatures between 1000° C. and 1200° C. to form carbon dioxide and free sulphur, with possibly traces of carbon oxysulphide in those mixtures which are rich in carbon monoxide. The equilibrium constants for these temperatures have been determined. (See also J. Chem. Soc., Jan., 1919.)
—J. F. S.

Carbon dioxide factories; Separation of potassium sulphate from the potash liquors of —— and process for preventing the formation of this salt. E. Luhmann. Z. ges. Kohlensäureind., 1917, **23**, 471—472, 483—486. Z. angew. Chem., 1918, **31**, Ref., 331.

THE potash liquors employed in carbon dioxide factories accumulate impurities, the chief of which is potassium sulphate, derived from sulphur dioxide present in the gas. In course of time the accumulation of sulphate becomes sufficiently large to interfere with the efficiency of the liquor and obstructions may occur in the plant through the crystallisation of the sulphate in the cooler portions. The sulphate may be removed by evaporating the liquor, but it is far better to avoid its formation. This may be done by passing the gas through a scrubbing tower packed with limestone.

If the scrubbing is performed by a weak solution of sodium carbonate instead of water, the removal of the sulphur dioxide is more complete, or if soda is not available, a suspension of chalk may be used.—J. F. B.

Sulphur in ores. Paul. *See* X.

Potassium bichromate. McCrosky. *See* XXIII.

PATENTS.

Ammonia; Distillation and recovery of —— from ammoniacal liquor and apparatus therefor. G. Wilton, London. Eng. Pat. 120,596, 11.10.17. (Appl. 14,745/17.)

HOT spent liquor from ammonia stills, which contains a small residual proportion of ammonia, is led from the still through an intermittent automatic valve into a horizontal container which is maintained under reduced pressure, and may, if desired, be heated, *e.g.* by steam coils. The spent liquor is withdrawn continuously from the receiver through a trapped outlet. The ammonia passes through an outlet pipe into the bottom of a reflux condenser and concentrator, the lower part of which contains superposed trays and hoods similar to those of a fractionating column, the upper part containing a number of vertical tubes cooled by water. Condensed liquor flows back to the container through a trapped pipe, and uncondensed vapour passes out of the top of the condenser and through a water-cooled coil condenser. The ammonia liquor condensed therein flows down a long fall pipe into a receiver, and is of better quality than that obtained from the stills. A vacuum pump is connected with the ammonia receiver, but the effect of the condensers and fall pipe may be sufficient to maintain the required reduced pressure throughout the apparatus. If desired, less steam may be employed in the liquor stills, leaving more ammonia in the spent liquor to be recovered by the above means.—L. A. C.

Oxalates; Process for manufacturing ——. L. W. Andrews, Chicago, Ill. U.S. Pats. (A) 1,280,622, (B) 1,281,117, and (C) 1,281,118, 8.10.18. Appls., (A and B) 8.5 and (C) 5.6.15.

ALKALI oxalates are manufactured by heating alkali formates together with a relatively small amount of (A) a polybasic alkali phosphate, (B) the trisodium salt of an oxy-acid of arsenic, or (C) a trialkali aluminate.—L. A. C.

Alunogene, halotrichite, [natural alum], or the like; Art of treating ——. M. Barnett and L. Burgess, New York. U.S. Pat. 1,280,636, 8.10.18. Appl., 13.7.17.

THE soluble portion of alunogene, halotrichite, or natural alum is extracted and a solution of ammonium sulphate is added to the liquor, ammonium alum crystallising out, and iron sulphate remaining in solution. The ammonium alum is dissolved in water and the solution treated with ammonia, with the formation of aluminium hydroxide (which is removed and dried) and ammonium sulphate. Iron is precipitated as iron hydroxide from the original mother liquor by the addition of ammonia; the precipitate is removed and ammonium sulphate recovered from the solution.—L. A. C.

Aluminous materials of high silica content; Method of treating ——. C. M. Hall, Niagara Falls, N.Y.; A. V. Davis, Pittsburgh, Pa., and H. H. Johnson, Cleveland, Ohio, Exors. U.S. Pat. 1,282,222, 22.10.18. Appl., 25.11.14.

A MIXTURE of aluminous material and common salt in the proportion of about 4 mols. of salt to 1 mol. of alumina is heated to 1600°—1700° F. (about 870°—925° C.) for about 4 hours in the presence of steam. Hydrochloric acid is generated and the residue is mixed with soda and lime and heated to 1300°—1400° F. (about 705°—760° C.) for 2—3 hours. The soluble sodium aluminate produced is separated from calcium silicate by leaching.—L. A. C.

Alunite; Utilisation of ——. R. Moldenke, Watchung, N.J. U.S. Pat. 1,282,273, 22.10.18. Appl., 1.5.18.

ALUNITE is digested with sufficient concentrated sulphuric acid to form a pasty mass, in a closed vessel at ordinary pressure and at a temperature at which free evolution of vapours takes place. The mixture is then allowed to settle, and excess sulphuric acid removed. The solid matter is dissolved and allowed to crystallise, and then calcined in an atmosphere of sulphur dioxide and oxygen to produce sulphuric acid and alumina.—L. A. C.

Permanganates; [Electrolytic] process of making ——. M. Shoeld, Assignor to Armour Fertilizing Works, Chicago, Ill. U.S. Pat. 1,281,085, 8.10.18. Appl., 14.6.17.

SODIUM manganate is converted into sodium permanganate by electrolysis in presence of an alkali salt other than a manganate, and potassium permanganate formed by the addition of a potassium salt to the solution.—L. A. C.

Calcium cyanamide; Process of making —— and by-products from phosphate rock. E. W. Haslup, Bronxville, N.Y., Assignor to Haslup and Peacock, New York. U.S. Pat. 1,281,363, 15.10.18. Appl., 15.12.17.

A MIXTURE of phosphate rock with an excess of carbon is heated to about 1200° C. in a current of producer gas to drive off phosphorus and produce calcium oxide in the residue; the temperature is then raised to about 1500° C., the current of gas being continued, resulting in the formation of calcium cyanamide. Phosphorus pentoxide is prepared as a by-product by burning the phosphorus and oxides of phosphorus produced during the first part of the reaction.—L. A. C.

Alkali metal [sodium] cyanide and process of producing same. H. P. Eastman, Niagara Falls, Ont., Assignor to The American Cyanamid Co., New York. U.S. Pat. 1,282,395, 22.10.18. Appl., 10.3.17.

THE necessary amount of calcium cyanamide to form the required cyanide, together with calcium carbide, is added to molten sodium chloride, and the mass maintained above 900° C. until the reaction is complete. Above 1100° C. the reaction is more rapid.—L. A. C.

Kelp and like materials; Apparatus for incinerating ——. S. R. Oppenheim, Keeler, Cal. U.S. Pat. 1,282,708, 22.10.18. Appl., 7.6.17.

A FURNACE for incinerating or charring kelp or like material is provided with a long horizontal combustion chamber with an ash-pit below. The combustion chamber is fitted with charging doors at

the top and firing doors in its side, and the ash-pit is trough-shaped and provided with a longitudinal conveyor by means of which the ash or char is moved along the trough and discharged. A gas outlet conduit has valved communication with the combustion chamber and with the ash-pit, whereby gases may be drawn directly from the chamber or from the ash-pit to cause a down draught through the material on the grate. The gas outlet is inclined downwards from the ash-pit to a washing apparatus for the gas, and an exhaust fan is provided to draw the gases through the conduit.

—L. A. C.

Flue-dust; Leaching —— [*to recover potassium salts*]. W. G. Henshaw, San Francisco, and F. W. Huber and F. F. Reath, Riverside, Cal., U.S.A. Eng. Pat. 111,845, 14.11.17. (Appl. 16,741/17.) Int. Conv., 2.12.16.

See U.S. Pat. 1,220,989 of 1917; this J., 1917, 503.

Centrifugal dryer. U.S. Pat. 1,259,727. *See* I.

Composition for building. U.S. Pat. 1,279,119. *See* IX.

VIII.—GLASS; CERAMICS.

Optical glass melts: Formation of seed in ——. A. E. Williams. J. Amer. Ceram. Soc., 1918, **1**, 134—140.

The formation of "seeds" or bubbles in glass is attributed to: (i) stirring the glass at too low a temperature, (ii) cooling the pot, without rapidly chilling the bottom (a conical layer of "seedy" glass extending upwards from the bottom of the pot is formed), (iii) raising one end of the pot above the bottom of the furnace ("seeds" appear in the other end), or (iv) evolution of gases during the slow cooling of the glass, particularly between 1200° and 700° C. Stirring during rapid cooling does not produce "seeds." The bubbles were found to contain a small quantity of carbon dioxide; the gas in them may be either a dissociation product or evolved from solution as the glass cools.—A. B. S.

Glass; Relation between the physical properties and chemical composition of ——. *VIII. Molecular compounds.* E. W. Tillotson, jun. J. Amer. Ceram. Soc., 1918, **1**, 76—93.

The graph representing the variation of the refractive index or sp. gr. of a glass with the composition consists of one or more straight lines; if there is more than one line the points of intersection indicate the composition of molecular compounds. Glasses composed of mixtures of albite and anorthite give a single line graph, and therefore appear to contain no new compound. The graphs of mixtures of calcium and magnesium orthosilicates form three straight lines, intersecting at two points, indicating the formation of two compounds, $CaMg_3(SiO_3)_4$ and $Ca_4Mg(SiO_3)_5$. No indication is given of the formation of diopside, $CaMg(SiO_3)_2$—the only double silicate which crystallises out of these mixtures. Graphs showing the relation of the refractive index to the composition of glasses of the system Na_2O—BaO—SiO_2 were plotted. With binary mixtures, the lines intersected at points corresponding to the compounds Na_2O,SiO_2 and $BaO,2SiO_2$. With ternary mixtures the compounds $Na_2O,BaO,3SiO_2$, and $Na_2O,BaO,4SiO_2$ were indicated. The glasses corresponding to these compounds devitrify readily. The graphs for the system Na_2O—CaO—SiO_2 indicated the existence of only one ternary compound, $2Na_2O,3CaO,7SiO_2$. A typical alkali-glass corresponding to $12Na_2O,3CaO,45SiO_2$ is therefore considered to be a solution of 1 mol. of $2Na_2O,3CaO,7SiO_2$, 10 mols. of $Na_2O,2SiO_2$, and 18 mols. of SiO_2. A high-melting lime glass corresponding to $Na_2O,CaO,6SiO_2$ is considered to be a solution of 1 mol. of $2Na_2O,3CaO,7SiO_2$, 1 mol. of $Na_2O,2SiO_2$, and 9 mols. of SiO_2. In the discussion, E. D. Tillyer pointed out that a hyperbolic curve fits the experimental results equally as well as intersecting straight lines, and that such a curve does not indicate the formation of any of the suggested compounds.—A. B. S.

Glassware; Effect of heat on chemical ——. R. G. Sherwood. J. Amer. Chem. Soc., 1918, **40**, 1645—1653.

When glass is heated there are two distinct kinds of gaseous evolution, *viz.*, that resulting from adsorbed material, which is readily removed at temperatures below 300° C., and that resulting from a decomposition of the glass itself. The latter effect becomes important at 400° C. for the softer glasses and at 500° C. for the harder glasses. The most important constituent of the decomposition products (water, carbon dioxide and monoxide, hydrogen, nitrogen) is water, which constitutes practically the only product at temperatures near the softening point of glass. In regard to the use of glass vessels in experimental work, it is shown that if a hard glass which has been annealed, say at 600° C. for 2 hours, be subsequently heated, there is practically no evolution other than that of adsorbed gas until after the previous annealing temperature has been passed. (See also J. Chem. Soc., Jan., 1919.)—J. F. S.

Alabaster glass: history and composition. A. Silverman. J. Amer. Ceram. Soc., 1918, **1**, 247—261.

Alabaster glass is semi-opaque, and diffuses light transmitted through it without altering its colour, whereas opal glass alters the colour of the transmitted light. This effect is probably due to sulphates and chlorides acting as ionised electrolytes in the molten glass and precipitating various colloidal suspensions which would otherwise cause opalescence. Fluorides and aluminium compounds produce opalescence until sufficient quantities of sulphates or chlorides are introduced. Barium compounds increase the whiteness of the glass. Cryolite does the same up to a certain concentration, but in excess of this its action diminishes and finally disappears. Calcium phosphate, magnesium silicate, stannic oxide, arsenious oxide, zirconium oxide, and titanium oxide are also used for producing alabaster effects. A summary of the chief papers and a bibliography are given.—A. B. S.

Clays; Effect of electrolytes on some properties of ——. H. G. Schurecht. J. Amer. Ceram. Soc., 1918, **1**, 201—216.

The cross-breaking strength of dry clays may be increased by the addition of 0·8—3% of the following electrolytes to the plastic clay, the first-named being the most effective: sodium hydroxide, sodium silicate, sodium carbonate, tannic acid, and calcium hydroxide. Small percentages of sulphuric acid decrease the strength of Kentucky ball clay. The addition of caustic soda, sodium silicate, or sodium carbonate adversely affects the moulding of the bodies, and the ware cracks more easily when drying. Calcium hydroxide and tannic acid do not affect the moulding. Sulphuric acid up to 2% improves the moulding properties of the bodies, but is harmful in larger proportions. The addition of

alkali to ball clay blackens it and lowers the percentage of water necessary for the development of plasticity. The addition of 1—2% of alkalis reduces the shrinkage of mixtures of equal parts of clay and flint, except when Georgia kaolin is used. Small quantities of sulphuric acid increase the shrinkage and large ones reduce it. Tannic acid and calcium hydroxide increase the shrinkage. The addition of alkalis and acids increases the density of dry mixtures. Up to 1% of calcium hydroxide increases the density, but larger amounts reduce it. Alkalis reduce the porosity and acids increase it, but calcium hydroxide always increases it. Small percentages (below 0·8%) of caustic soda reduce the burning shrinkage at cone 01 (1080° C.), but larger quantities increase it. At cone 8 (1250° C.) the electrolytes previously mentioned increase the strength of the pieces burned and in the same order of effectiveness, with the exception of calcium hydroxide, the action of which was not examined.—A. B. S.

Clays; Bonding strengths of —— between normal (atmospheric) temperature and red heat. C. W. Saxe and O. S. Buckner. J. Amer. Ceram. Soc., 1918, **1**, 113—133.

VARIOUS clays were mixed with three times their weight of alundum of No. 60-mesh, made into briquettes, dried under various conditions, and their tensile strengths at various temperatures determined. The strength of a clay which has been dried to constant weight at 110° C. is only a rough measure of its strength under manufacturing conditions, and does not afford a practical means of distinguishing similar clays with regard to their behaviour in commercial dryers. Clays which have not been completely dried show great dissimilarities in their affinity for water. The presence of a small proportion of water causes some clays to lose far more strength than others. The strength of hot clays between 110° C. and red heat is lower (for the first 200°—300° C.) than the strength of the same clays after thorough dehydration at 110° C. followed by subsequent cooling. During dehydration the strength of clays either increases or remains constant, independent of the temperature. Generally, the clays which are strongest after drying at 55° C. and then cooling, are also strongest at temperatures between 110° C. and 25° C., so that their strength under the former condition is a rough measure of that under the latter. No relation has been observed between the tensile strength and the loss of weight on drying the clays or their porosity.—A. B. S.

Terra-cotta bodies; Use of furnace slag as grog in architectural ——. R. H. Minton. J. Amer. Ceram. Soc., 1918, **1**, 185—200.

ARCHITECTURAL terra-cotta is very liable to a form of cracking known as "dunting." The author attributes this to the use of grog of an unsuitable character. The substitution of granulated acid furnace slag for grog in suitable proportions offers no exceptional difficulty; it costs about half as much as sagger grog, is lighter in weight, and abundant supplies are available. Bodies made of slag offered greater resistance to repeated "freezing" and to the sodium sulphate test. Only acid slags can be used, as the free lime in basic slags would cause disintegration of the terra-cotta. Metallic iron in the slag causes trouble, but it may probably be removed by a magnetic separation. It is suggested that the use of slag may prevent terra-cotta from "dunting." In the discussion, E. C. Hill suggested that the sodium sulphate test used by the author would not produce the fine hair cracks characteristic of dunting and that this defect may be avoided by suitably controlling the nature, size, and proportion of the grog used, and by cooling very slowly below 650° C.—A. B. S.

Terra-cotta; Polychrome decoration of —— with soluble metallic salts. H. Wilson. J. Amer. Ceram. Soc., 1918, **1**, 353—366.

THE colour is applied to the glazed terra-cotta in the form of a solution of a soluble salt in water or in a mixture of glycerin and alcohol, a suitable dye being added so that the painted areas may show distinctly. As some chlorides and sulphates attack the carbonate in the glaze, it is often preferable to use nitrates or acetates. The painted ware is set in ordinary terra-cotta kilns and burned to cone 6—7. Good blues are produced in this way with cobalt sulphate, using 0·5—30 grms. per 100 c.c. of water. In glazes containing zinc oxide, good "tans" and browns are obtained with chromium salts. The greens from chromium salts in zinc-free glazes are unreliable. Good greens are obtained with uranium nitrate 6 grms., cobalt sulphate 1—3 grms., alcohol 10 c.c., and glycerin 10 c.c. Uniform light pinks are produced with tin chloride 20 grms., saturated solution of chromium acetate in alcohol 16 c.c., glycerin 10 c.c., and alcohol 9 c.c. Fair browns are made with manganese sulphate 10 grms., alcohol 10 c.c., and glycerin 10 c.c. More dilute solutions produce good grays. Nickel sulphate produces light purple and gray with some glazes and brown with others. Iron chloride gives variable red-browns. Cobalt sulphate and iron chloride in the ratio 5 : 6 to 1 : 10 gives violet and blue-grays. The following colours may be used on an ordinary white slip but do not develop so brightly as in glazes. Strong solutions of uranium salts give gray-brown colours. Uranium and cobalt salts give blues and green-blacks. Iron salts give buffs and red-browns. Manganese gives grays, browns, and blacks. Rutile and glycerin gives good light buffs and buff-browns. Copper sulphate gives shades ranging from light green-grays to black. Nickel gives good browns. The method is in regular use on a large scale in one works.—A. B. S.

Tunnel kiln; The Zwermann —— and its operation. C. H. Zwermann. J. Amer. Ceram. Soc., 1918, **1**, 262—266.

AN oil-fired tunnel kiln, 352 ft. long, 6 ft. 4 in. wide, and 6 ft. 6 in. high from the top of the trucks to the arch, contains 19 tanks (each 7 ft. 7½ in. long) in the preheating zone, 8 in the firing zone, and 18 in the cooling zone. The chief features of the oven are a fan to create the draught, a second fan to draw cold air through the hollow arch and side walls of the cooling zone of the kiln and then through the ware to be dried and preheated, and a pressure blower which forces air through recuperators in the side walls of the cooling zone and thence to the oil-burners. The interior of the tunnel is free, the spaces between the goods on two successive trucks serving as combustion chambers.—A. B. S.

Porcelain; Use of dense solutions in determining the structure of ——. H. Spurrier. J. Amer. Ceram. Soc., 1918, **1**, 287—290.

PORCELAINS may be graded by immersing the sample first in a dense solution of acid nitrate of mercury diluted so as just to float a properly-fired piece and to allow an underfired piece to sink, and afterwards in a similar solution diluted so as to allow a properly-fired piece to sink and an overfired piece to float. After immersion the sample may be washed with water, any yellow deposit which may occur being removed with a little acetic acid. The glaze is usually too thin to affect the accuracy of the method.—A. B. S.

[Salt] glaze reduction; Phenomena in ——. H. B. Henderson. J. Amer. Ceram. Soc., 1918, 1, 148—159.

SAMPLES of salt-glazed sewer pipes examined under the microscope all contained brown to black crystalline hexagonal plates, amber-coloured when separated and viewed by transmitted light, and resembling the ferric oxide in aventurine glaze. The crystals were attracted by a magnet and were 0·0026 to 0·017 mm. in diameter. The glazes contained about 0·01% of carbon, and the author regards the presence of carbon as essential for formation of the crystals. The colour of "flashed" brick only occurs on those faces exposed to the flame. On reburning "flashed" bricks in a normal or oxidising kiln atmosphere, the "flash" disappears. The "flashed" portions all contained similar hexagonal plates, the number of which increased progressively in samples drawn during the cooling. Reducing conditions are necessary for inducing the formation of the crystals, but the crystallisation continues under oxidising cooling conditions following the production of superficial fusion. In producing "flashed" bricks the ware is first subjected to reducing conditions, but if these are continued to the end the surface of the bricks is merely blackened. If, however, an oxidising period follows the reducing one, surface fusion commences, and if the reduction and oxidation are continued alternately and are followed by slow cooling the crystals are formed. The intense colour is probably an optical effect due to several modifications of crystals containing or consisting of iron oxide. The "fire flashed" colour and that of salt glaze are not, however, due to iron alone. In the subsequent discussion, C. F. Binns suggested that the formation under reducing conditions of ferrous silicate, which could afterwards be oxidised to ferric silicate, explained all the observed phenomena.—A. B. S.

Green glaze; A cobalt-uranium —— for terra-cotta. H. Wilson. J. Amer. Ceram. Soc., 1918, 1, 238—246.

A GREEN glaze of deeper shade than is produced from chromium compounds was prepared by adding 3% of cobalt sulphate and 6% of uranium oxide to a matt glaze with the formula, 0·261 K_2O, 0·306 CaO, 0·294 ZnO, 0·083 BaO, 0·057 MgO, 0·384 Al_2O_3, 2·08 SiO_2, which matures at cone 3—7 in a commercial kiln. The use of an ordinary cobalt stain instead of the sulphate produced a mottled glaze. This was absent when a bright glaze with the formula, 0·238 K_2O, 0·354 CaO, 0·210 ZnO, 0·144 BaO, 0·055 MgO, 0·428 Al_2O_3, 2·90 SiO_2, maturing at cone 4—7, was substituted for the matt glaze. In the discussion R. H. Minton stated that the addition of a little rutile prevents the irregularity in colour.—A. B. S.

Frits [for enamels]; Effect of the degree of "smelting" on the properties of ——. E. P. Poste and B. A. Rice. J. Amer. Ceram. Soc., 1918, 1, 221—237.

THE materials to be fritted were placed in a preheated tilting furnace and the time required for the mixture to be uniformly fused was taken as unity. Samples were withdrawn after the following unit times: 1, 1½, 2, 2½, 3, and 3½ and designated A—F respectively. Although fluorspar was an ingredient of the original mixture, none of the frit contained any fluorine. The percentage of silica in the frit increased rapidly at first and more gradually on prolonged heating; that of the soda and boric oxide diminished somewhat less rapidly; the alumina, lime, and potash remained fairly constant. At point B (double unit time of heating) the composition of the batch closely resembled the theoretical composition of the frit, but on further heating the composition changed considerably from that anticipated, the silica showing an increase, the soda and boric oxide a large, and the lime and alumina a slight, reduction owing to volatilisation. These changes produce an objectionable rise in the maturing point of the glaze, but favourably increase its range of deformation. The computed coefficient of expansion of the frit drops rapidly during the heating until 4 unit time is reached, after which it remains constant on further heating, but is then so low as to induce "shivering" or "flaking." Prolonged heating increases the resistance of the frit to acid, but also makes it much more brittle. In the discussion, it was pointed out that the results were vitiated by the authors rejecting the harder portions of frit and only using the finest of the ground material.
—A. B. S.

Enamels for cast iron; Ground-coat ——. H. F. Staley. J. Amer. Ceram. Soc., 1918, 1, 99—112.

A SATISFACTORY, glassy ground-coat should melt at a dull red heat, should be able to dissolve any oxides or foreign matter on the surface of the metal, and to flow into the minute pores of the metal so as to produce a good bond; it should not blister or volatilise at the temperature used in enamelling. Such ground-coat enamels are chiefly made by fritting a mixture of flint or sand, felspar, borax, red lead, and sodium nitrate. The borax is used to dissolve iron and other oxides; lead oxide produces fluid enamels of great strength. Cobalt oxide and other substances are sometimes added to increase the adhesion, but they are of doubtful value. Clay is invariably added to the ground frit to facilitate the suspension of the particles in water. Its action is improved by the addition of magnesium sulphate or chloride, which reduces the excessive alkalinity of the frit, and also forms a flocculent precipitate of magnesium hydroxide. Ammonium carbonate or borax may be used in place of the magnesium salt. The addition of a sulphate is undesirable, but the small proportions of magnesium sulphate generally used appear to be harmless. Magnesium oxide and carbonate and calcium hydroxide and carbonate are objectionable, as they do not melt in the enamel and their subsequent hydration may cause spalling. The comparative fusibilities of enamels may be roughly calculated from their composition by reducing the batch weight to 1000 lb. (melted) and comparing the "flint equivalents" or the number of pounds of flint which would have been used if flint had been the only refractory ingredient of the enamel, assuming that 100 parts of felspar may be replaced by 66·66 parts of flint or 40 parts of clay. Recipes for five typical ground-coat enamels are given as follows: (1) Flint 675, borax 390, sodium nitrate 35, red lead 52·5, cobalt oxide 3, clay 60 parts. (2) Flint 680, borax 170, sodium nitrate 50, red lead 170, cobalt oxide 0·85, clay 51. (3) Sand 275, potash felspar 435, borax 375, red lead 41, clay 57, cobalt oxide 3. (4) Sand 685, borax 325, sodium nitrate 30, red lead 85, cobalt oxide 2·7, clay 48, magnesium carbonate 3. (5) Sand 200, felspar 200, borax 390, sodium nitrate 30, red lead 100, magnesium carbonate 10, clay 325, cobalt oxide 1 part.—A. B. S.

Silica bricks; Laboratory testing of ——. R. J. Montgomery and L. R. Office. J. Amer. Ceram. Soc., 1918, 1, 338—352.

CHEMICAL analysis assists in determining the purity of the raw material but is of doubtful value for control purposes. Silica bricks which contain less than 2% of lime will have a weak bond; those containing more lime will not be highly refractory.

Alumina should not exceed 1·5%, as, in the form of clay, it is the most active of all the fluxing impurities. Iron has little effect on the refractoriness of silica bricks under oxidising conditions, but should not exceed 1·5%. The high colouring power of iron compounds has led to their importance being exaggerated. The deformation or refractoriness test is difficult, owing to the high viscosity of the softened material. The best silica bricks will not soften below cone 32; bricks made from chert or sand rock soften at cone 31—32. When a whole silica brick is maintained on end in a laboratory furnace for 24 hours at about 1600° C. it will usually soften and deform; the same brick will apparently withstand a higher temperature in an industrial furnace, but this is due to the fact that only the face of the brick is exposed to the full heat of the furnace, and the brick does not attain the maximum temperature throughout. The load test recommended by the Amer. Soc. of Testing Materials (25 lb. per sq. in. at a temperature of 1500° C.) is of doubtful value except in testing new materials; failures are usually due to a shearing or rupture of the bond and not to lack of refractoriness. Under normal conditions, silica bricks under a load of 25 lb. per sq in. expand slowly up to about 200° C., very rapidly from 200° to 280° C., very slowly from 280° to 500° C., and then more rapidly until all further expansion ceases. Fireclay bricks, on the contrary, show an expansion more nearly proportional to the temperature, when heated under load. The cold crushing strength of silica bricks varies from 900 to 3700 lb. per sq. in., the average being 1800—2800 lb. per sq. in. The apparent sp. gr. of a 20-grm. sample after boiling 1 hour in water is useful to indicate underburning. The sp. gr. of well-burned silica bricks is about 2·42; that of under-burned about 2·36. Little use can be made of a determination of the porosity. In this discussion A. A. Klein stated that the proportions of quartz, cristobalite, and tridymite present are best ascertained by determining the sp. gr. of the brick.—A. B. S.

Plasticity of clays and limes. Kirkpatrick and Orange. *See* IX.

Balsam problem. French. *See* XXIII.

PATENTS.

Glass; Process and apparatus for controlling the outflow of —— from melting tanks. W. J. Miller, Swissvale, Pa., U.S.A. Eng. Pat. 112,947, 24.1.18. (Appl. 1284/18.) Int. Conv., 25.1.17.

THE flow of glass from the discharge port of a melting tank between intermittent shearing operations is controlled and any surplus of glass is returned to the tank by a blast of air applied to the outer end of the discharge port. By this means, the chilled end or scar of surplus glass is re-melted. The introduction of air-bubbles into the molten glass is prevented by diminishing the pressure of the air as the glass becomes more fluid, and therefore flows more readily, the pressure being adjusted so that it is only just sufficient to return the glass to the tank and support it clear of the shears.—A. B. S.

Muffle leer [lehr]. H. M. Thompson, Washington, Pa. U.S. Pat. 1,281,713, 15.10.18. Appl., 1.6.18.

THE lehr chamber has a flat roof and floor, both built up of tiles. Over the front end of the lehr chamber is a muffle chamber and behind this and separated from it by a dividing wall is a regenerator chamber. Flues beneath the floor of the lehr chamber communicate at their receiving ends with the muffle chamber and at their discharge ends with the regenerator chamber by way of flues in the side walls. Fuel gas and air are preheated by passing through pipes which extend through the regenerator chamber and discharge through passages in the dividing wall into the muffle chamber.

Refractory substances, artificial slate, and the like; Manufacture of ——. G. Marsh, London. Eng. Pat. 120,471, 3.12.17. (Appl. 17,893/17.)

REFRACTORY substances are made by mixing ground furnace slag, slate waste, infusorial earth, sand, flint, or ballast with Portland, Roman, or hydraulic cement to which plumbago may be added. Artificial slate is similarly made from slate dust, broken slate waste, crushed marble, granite, or the like with cement. In each case the dry materials are worked into a mortar by the addition of a solution of casein, blood, glue, gelatin, or other protein matter, with or without the addition of an alkali silicate, borax, boric acid, or ammonia. Suitable proportions for a refractory material are 100 lb. of water, 2 lb. of casein, 4 lb. of sodium silicate, and ¼ lb. of boric acid. For artificial slate 100 lb. of water, 8 lb. of casein, 2 lb. of sodium silicate, and ½ lb. of borax may be used. The articles are cast or moulded under pressure and afterwards hardened in air or steam.—A. B. S.

Refractory material and process of making the same. H. A. Kennedy, Clearfield, Pa., U.S.A. Eng. Pat. 111,853, 26.11.17. (Appl. 17,454/17.) Int. Conv., 28.11.16.

SEE U.S. Pat. 1,238,020 of 1917; this J., 1917, 1095.

Coating process. U.S. Pat. 1,281,262. *See* X.

IX.—BUILDING MATERIALS.

[Plasticity] of clays and limes; Tests of —— by the Bureau of Standards plasticimeter. F. A. Kirkpatrick and W. B. Orange. J. Amer. Ceram. Soc., 1918, 1, 170—184.

EMLEY'S plasticimeter (this J., 1918, 514 A) may be used satisfactorily for distinguishing finishing from non-finishing hydrated limes and their relative behaviour when spread on absorbent surfaces. Mixtures of lime and 25% of gypsum, containing 48% of water, when made into a paste, gave a higher plasticity figure than other lime pastes. Tests made with clays which had been passed through a 100-mesh sieve showed similar results to those with lime, though the results were not comparable owing to different weights being used on the pendulum of the apparatus.—A. B. S.

PATENTS.

Non-conducting material. R. Illemann and J. A. Montgomerie, Glasgow. Eng. Pat. 120,691, 6.3.18. (Appl. 3901/18.)

ONE part, by measure, of calcined gypsum is gradually introduced into about six parts of water, and the mixture agitated until a plastic spongy mass is produced. The material may either be moulded into blocks of any suitable shape and dried, or may be applied direct to a boiler or other surface. On drying, a highly porous mass of gypsum is produced forming a very efficient insulator. If desired, a small proportion of slaked lime and/or sodium silicate may be added to the gypsum to neutralise any free acid; also, mineral or vegetable fibre may be added to strengthen the material.
—L. A. C.

Timber-preserving composition. L. A. Cretsinger and J. A. Workman, Cleveland, Ohio. U.S. Pat. 1,276,725, 27.8.18. Appl., 20.11.16.

Holes are bored in the wood at suitable distances apart, and a mixture of sodium chloride (16 parts), arsenic trioxide (6 parts), and mercuric chloride (1 part) is introduced into the holes, which are then plugged, and the wood is left until it becomes impregnated with the preservative mixture.

Composition of matter for building and structural purposes. W. U. Jury, Shamokin, Pa. U.S. Pat. 1,279,119, 17.9.18. Appl., 10.6.18.

A composition which is specially suitable for the floors of dyehouses and for acid vats consists of Portland cement, hydrated lime, liquid soap, and "sand" and "tailings" obtained from the clinker from anthracite coal.

Asphalt-like composition [for making roofing felt] and process of making the same. W. Savage, Philadelphia, Pa. U.S. Pat. 1,279,918, 24.9.18. Appl., 4.8.17.

Spent fullers' earth from the refining of fatty oils is mixed with an asphalt-like material; the mixture may be subjected to an oil-hardening process, *e.g.*, by heating it to 300°—700° F. (150°—370° C.) or by blowing air through the hot mass, or it may be mixed with sulphur and vulcanised. The product is specially suitable for the manufacture of roofing felt from paper or the like.

Insulating material; Thermotic —— and process for making the same. J. K. Toles, San Francisco, Cal., Assignor to Union Fibre Co., Winona, Minn. U.S. Pat. 1,281,097, 8.10.18. Appl., 10.1.16.

Insulating felt is made by reducing and partially purifying rice straw by cooking it in a weak alkaline solution, washing the resulting fibre, and mixing it with "uncooked vegetable tissue." The mixture is floated over a drain-screen, to form sheets of the desired size and thickness.—A. B. S.

Dry-kiln [for timber]. F. W. Rubin, Indianapolis, Ind. U.S. Pat. 1,281,212, 8.10.18. Appl., 5.3.18.

Stacks of timber are arranged with suitable passages through them. A current of air is passed through the stack, and the direction of the air current can be reversed. Jets of steam can be directed into the passage-ways, and a draught of steam or heated air can be produced throughout the whole of the stack.—J. S. G. T.

Oxy [chloride] salt [cement] composition and process of making the same. C. Catlett, Staunton, Va. U.S. Pat. 1,282,188, 22.10.18. Appl., 9.5.18.

A mixture of commercial quicklime and sufficient calcium chloride to ensure chemical combination of all of the latter is caused to react in the presence of moisture, and the resultant oxychloride composition is allowed to set and become "relatively dry by the heat of hydration," and is then powdered.—L. A. C.

Fireproofing. Eng. Pat. 120,421. *See* I.

Washing gravel. U.S. Pat. 1,280,688. *See* I.

Artificial slate. Eng. Pat. 120,471. *See* VIII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Magnetic iron alloys. Ber. Phys.-Techn. Reichsanstalt, 1917. Stahl u. Eisen, 1918, **38**, 1043.

In experiments made with a view to substitute chromium-steel for tungsten-steel, it was found that in the case of bar magnets of chromium-steel left undisturbed for 1 year the alteration of the magnetic moment in the best specimens amounted to only 0·1—0·3% and was within the limits of experimental error in nearly all the specimens examined during the latter half of the year. Suitable chromium-steels form an almost completely satisfactory substitute for tungsten-steel magnets, but the "efficiency" as measured by the product of the remanence and coercive force is not quite so high in the case of the best chromium-steels as in that of the best tungsten-steels.

Steel; Microstructure of hypo-eutectoid ——. E. Atkinson. J. Roy. Micros. Soc., 1918, 265—274.

Tensile tests made on the segregated portion of a rail and on a normal part of the same material gave the following results:

	Segregated	Normal
Max. stress, tons per sq. in. ...	48·2	44·5
Reduction of area, %	24·5	40·5
Elongation, %	16	24

The melting points of manganese and iron sulphides are given as 1620° C. and 950° C. and these sulphides thus freeze out as the first and last components respectively of the steel. Manganese sulphide occurs ultimately in globular form, and iron sulphide as intercrystalline films.—F. C. Th.

Manganese ores; Blast furnace treatment of low-grade ——. R. Cordes. Stahl u. Eisen, 1917, **37**, 494—497. Rev. Mét., 1918, **15**, Extr., 310—312.

Owing to the increasing shortage of manganese, low-grade carbonate ores from the Siegerland district are now used. The material is hand-picked, or concentrated by an electromagnetic process; the value of the concentrate as a source of manganese is the smaller the higher its silica content. In smelting for pig-iron containing 3·5—4% Mn, the slag normally takes up 3% Mn, hence the manganese content of the metal decreases as the quantity of slag increases. Ore of the best quality assays SiO_2 10, Fe 48, and Mn 9%; ores containing more than 30% SiO_2 must be concentrated.

—W. R. S.

Aluminium; Impurities in and purification of commercial ——. Ber. Physik.-Techn. Reichsanstalt, 1917. Stahl u. Eisen, 1918, **38**, 1044—1045.

The impurities in 4 samples of commercial metal varied from 0·4 to 2%, chiefly iron and silicon, with lesser amounts of carbon and traces of sulphur, phosphorus, and nitrogen. The analytical methods for determining the impurities are as yet imperfect. The bulk of the aluminium may be eliminated as chloride by saturating the acid solution with hydrogen chloride. The purification of the commercial metal is difficult: silicon may be largely removed by fusion with nitre, but not the iron. The bulk of the latter can be dissolved by digesting the metal with 2% hydrochloric acid: borings containing 1% Fe gave 60% of purified metal with less than 0·1% Fe.—W. R. S.

Yttrium mixed metal; Preparation and properties of ——. J. F. G. Hicks. J. Amer. Chem. Soc., 1918, **40**, 1619—1626.

Yttrium mixed metal in the form of powder has been prepared: (1) by the action of sodium on a

mixture of the anhydrous chlorides of the mixed yttrium earths in a vacuum at 1100° C., (2) by the electrolysis of the molten chlorides in a protected graphite crucible, using a carbon anode, and (3) by the electrolysis of a solution of the mixed oxides in fused cryolite. The last-named method is less efficient than the others. The first method affords a means of obtaining yttrium mixed metal of relatively high purity on a large scale. Reduction is effected in iron or nickel boats placed in seamless steel tubes, which are exhausted to 3—1 mm. and then introduced into a muffle previously heated to 1100° C. Yttrium chloride is lost in considerable quantities in all processes owing to its volatility at the working temperatures. The powdered metal has been sintered in a vacuum electric furnace, but the resulting mass easily disintegrates. The product has a mean "atomic weight" of 120 and contains 94·05—95·70% of metal, which corresponds to 37·5% of yttrium. It burns in the air at a dull red heat with a very bright light and yields a brown oxide. It is slowly oxidised by moist air at ordinary temperatures. It glows when heated in hydrogen, nitrogen, or carbon dioxide. It is readily attacked by water and does not amalgamate with mercury. It is pyrophoric but not so strongly as the alloy of cerium mixed metal and iron. The anhydrous chloride can be prepared on the large scale by heating the hydrated salt with ammonium chloride, whereby five of the six molecules of water are expelled, and then heating in a current of hydrogen chloride to expel the last molecule.—J. F. S.

Combustion; Economics of —— in metallurgical operations. M. Escher. Stahl u. Eisen, 1918, **38**, 977—982.

The dissociation temperature of carbon dioxide in presence of incandescent carbon, the temperature at which carbon and oxygen combine to carbon monoxide, is 1300°—1400° C. under practical conditions. It is the highest temperature obtainable by combustion of carbon monoxide (producer-gas), above which the monoxide and oxygen co-exist uncombined; but combination takes place as soon as the temperature falls below the dissociation point. Higher temperatures are attained by the combustion of carbon, hydrogen, or hydrocarbons. In open-hearth furnaces fired with producer-gas, in which the charge melts at about 1300° C., carbon monoxide does not contribute to the raising of the temperature beyond that point, and after this temperature is reached combustion of the carbon monoxide takes place only in the regenerators; only the hydrogen and hydrocarbons present in the producer-gas are of value for raising the temperature further, hence the volume of gas blown in must be increased. The most economical manner of working would consist in melting down the metal with producer-gas and finishing the charge with a gas rich in hydrocarbons. In cupola furnaces, the oxygen-carbon monoxide mixture is formed at the tuyères, and combination to carbon dioxide takes place higher up in the shaft in contact with the cooler charge. Where 1300°—1400° C. has to be exceeded in foundry work, the most economical appliance would be a cupola with an upper and lower set of tuyères. The iron would be melted down in the zone above the upper tuyères; in the lower part, where the furnace works as a gas-producer, the molten metal would become superheated.—W. R. S.

Sulphur; The value of —— in ores, with special reference to blende-roasting contracts. R. Paul. Metall u. Erz, 1918, **15**, 371—386.

In high-grade sulphides (*e.g.*, pyrites), sulphur has a positive value, while the contrary is the case with medium and low-grade sulphide ores. Hence there must be an intermediate grade where the value of the sulphur balances the cost of roasting. The following values of one unit (10 kilos.) of sulphur in Spanish pyrites are arrived at by a series of calculations from contract data: In 40% pyrites, M.0·1975—0·3075; 45%, M.0·213—0·320; 50%, M.0·226—0·331; and in 55% pyrites, M.0·2360—0·3395. The roasting charge per unit of sulphur in blende is calculated from actual contracts at M.0·30—0·40 in ores containing 20% S; with increasing sulphur content the curves tend towards the zero line; but in only a few cases do the curves pass through the zero line indicating that the sulphur has a positive value. By calculating the cost and profits of sulphuric acid manufacture, the value of the sulphur in blende works out as follows (marks per unit):

15% S −1·07955	35% S −0·13765
20% ,, −0·66747	40% ,, −0·04934
25% ,, −0·42022	45% ,, +0·01933
30% ,, −0·25386	50% ,, +0·07428

The lower value of sulphur in blende as compared with pyrites is due chiefly to the higher working-cost, as blende must be dead-roasted, while pyrites is less thoroughly calcined with a view to a large output in acid. According to the contracts at present in vogue, the roasting charge paid to acid works is too small for low-grade blende, but too high for the higher grades.—W. R. S.

Enamels for cast-iron. Staley. *See* VIII.

PATENTS.

Metals [iron]; Anti-rust treatment of ——. W. C. A. Mate, Garstang, Lancs. Eng. Pat. 120,619, 14.11.17. (Appl. 16,687/17.)

The articles to be treated (*e.g.* shell noses) are heated to about 200°—300° F. (93°—149° C.), out of contact with sulphurous or other deleterious fumes, and then immersed in boiling linseed oil, drained, and cooled.—W. E. F. P.

Alloy steel. C. H. Wills, Detroit, Mich. U.S. Pat. 1,278,082, 3.9.18. Appl., 9.6.17.

Molybdenum is added to the other ingredients of the steel to obtain a product which can be readily worked and has a tensile strength ranging from about 120,000 to 270,000 lb., and an elastic limit of 100,000 to 225,000 lb. Steel with these characteristics may contain substantially 0·2 to 0·35% carbon, 0·3 to 0·125% manganese, chromium in relatively large traces up to 1·2%, silicon from 0·15 to 0·35%, and molybdenum up to 1%.

—C. A. M.

Steel; Manufacture of ——. S. S. Wales, Pittsburgh, Pa. U.S. Pat. 1,282,660, 22.10.18. Appl., 3.8.17.

Solid scrap is charged into an electric furnace, and molten metal is added to form a coherent heated mass, which is then melted and refined to the desired composition.—T. H. B.

Chrome-steel for magnets; Process for hardening ——. Stahlwerke R. Lindenberg A.-G., Remscheid-Hasten. Ger. Pat. 308,291, 8.9.16.

The finished pieces, used in the preparation of magnets, are brought to a temperature just below the critical point, then heated as quickly as possible to the hardening temperature above that point, and quenched in water.—W. R. S.

Ferromanganese; Production of —— from low-grade manganiferous slag. H. Thaler, Herdorf. Ger. Pat. 307,393, 7.3.16.

THE slag is fused in a non-oxidising atmosphere in an electric furnace containing molten iron. Carbon is added to reduce the manganous oxide, and lime to increase the basicity of the slag and decompose manganese sulphide. The process is specially applicable to manganiferous blast-furnace slags having a basicity of 1—0·8.—W. R. S.

Puddling furnaces and process for making wrought iron. J. S. Withers, London. From P. F. Charles, E. F. Broderick, and E. A. Kirby, Girard, Ohio, U.S.A. Eng. Pat. 120,400, 6.9.16. (Appl. 12,632/16.)

PIG iron is melted in a continuously rotating furnace and "boiled" until graining of the metal occurs. The furnace is then transferred to a stationary balling furnace, and tilted to discharge its contents into the latter, in which puddling is completed by manual labour. Two boiling furnaces may be working in conjunction with one balling furnace, and the latter may be provided with a movable door in the crown to facilitate the transference of the partially treated metal. Mechanical means for operation are provided.
—C. A. K.

Furnaces; Heating, annealing, welding, and like ——. E. J. W. Richards, Glasgow, and W. Kane, Port Talbot. Eng. Pat. 120,469, 3.12.17. (Appl. 17,844/17.)

FLUE gases from a furnace are caused to pass along a flue situated under the bed of the furnace and then through a downtake flue to the chimney. Air for combustion is conveyed through a flue separated from, and at a lower level than, that conveying the flue gases. The air duct is connected with an uptake flue in the side wall of an adjacent gas producer, and the air and gas for combustion meet in a mixing chamber prior to entering the furnace proper.—C. A. K.

Tempering ovens or furnaces. P. Carlisle and A. W. Harbord, Sheffield. Eng. Pat. 120,530, 4.7.18. (Appl. 10,957/18.)

A TEMPERING oven designed to utilise the heat contained in flue gases is provided with a grid on which articles to be tempered are placed. The hot gases enter the chamber below a perforated distributing plate which is fixed under the grid, and after passing around the material for treatment, leave by means of a flue provided with a damper to control the passage of the gases through the chamber.—C. A. K.

Furnaces for roasting ores and the like. E. Cortese, Alexandria, Egypt. Eng. Pat. 120,654, 3.12.17. (Appl. 17,892/17.)

IN a furnace having an inclined roasting chamber through which the charge descends by gravity, the inclination of the upper portion of the chamber is greater than that of the lower portion, and the two parts are connected by a section having a parabolic or cycloidal profile. The charge is stirred, and its descent controlled, by means of vertical baffles; and the furnace is provided with water jets for hydrating the material, and with an adjustable discharge door for regulating the duration of the roasting process.—W. E. F. P.

Blast furnace use; Method of desiccating air for ——. L. Goldmerstein (now L. Cammen), New York. U.S. Pat. 1,282,680, 22.10.18. Appl., 11.12.16.

AIR is passed through a nearly saturated solution of calcium chloride at a temperature of 16° F. (−9° C.), the solution being circulated so as to include the passing air in its path of travel. The solution is then denuded of absorbed moisture, cooled, and circulated again.—T. H. B.

Aluminium alloy, and process of making same. L. S. Gardner, Detroit, Mich. U.S. Pat. 1,280,706, 8.10.18. Appl., 11.1.18.

AN alloy of aluminium, manganese bronze, and zinc is first made and is then melted with tin and aluminium; the approximate composition of the final alloy is Al 78, Cu 4, Sn 10, Zn 8, Mn 0·05 part.
—T. H. B.

Metal [lead]; Reinforced ——. Manufacture of pipes. C. M. Wales and C. Baskerville, New York, Assignors to The Metalco Co., Mount Vernon, N.Y. U.S. Pats. (A) 1,280,908 and (B) 1,280,909, 8.10.18. Appl., 5.2.16.

(A) FERROUS wire gauze, netting, or perforated sheet is dipped into a molten alloy of lead and antimony, the coating thus obtained serving as a binder between the netting and a covering of lead or lead alloy applied subsequently. (B) Pipes are made of a ferrous reinforcing member to which is secured a continuous sheet of lead by means of a binder of lead-antimony alloy.—T. H. B.

Ores; Process of concentrating ——. T. A. Janney, Garfield, and C. M. Nokes, Salt Lake City, Utah. U.S. Pat. 1,281,018, 8.10.18. Appl., 28.7.17.

THE ground ore is mixed with water and the pulp is treated successively with a solution of gilsonite in oil, another oil with greater frothing power than the first, and an acid reagent, after which it is aerated to concentrate the metalliferous particles.—T. H. B.

Flotation process for concentrating ores. Hernadthaler Ung. Elseniudustrie A.-G., Budapest. Ger. Pat. 308,063, 5.10.16.

THE pulp mixed with oil and a current of air are circulated in the same direction in a chamber provided with an overflow for the froth carrying the values to be recovered.—W. R. S.

Zinc; Process of recovering ——. F. Laist, Assignor to Anaconda Copper Mining Co., Anaconda, Mont. U.S. Pats. (A) 1,281,031 and (B) 1,281,032, 8.10.18. Appl., 29.1.18.

(A) Zinc is recovered from a siliceous calcine by leaching with an acid liquor, neutralising to precipitate silica, and separating the zinc-bearing solution from the insoluble matter. The latter is dehydrated and any zinc present is recovered by leaching the residue, the solution being used for leaching a fresh charge of calcine. (B) After leaching and precipitating the silica as in (A), the insoluble matter is separated and repulped with water and the resulting dilute solution of zinc separated. The two zinc-bearing solutions thus obtained are electrolysed separately, using insoluble anodes, to recover the zinc.—T. H. B.

Zinc; Furnace for refining ——. W. Nestmann, Cöln-Kalk. Ger. Pat. 308,156, 27.9.17.

THE floor of the furnace slopes towards a lateral taphole leading into a well where the lead separates out; in this well is a float by means of which the taphole is automatically opened or closed according to the density of the metal in the well.
—W. R. S.

Coating metals, alloys, or other materials with protective coats of metals or alloys; Process of ——. F. A. Vaughn, Milwaukee, Wis. U.S. Pat. 1,281,108, 8.10.18. Appl., 5.10.17.

A PLASTIC binding material, acting as an electrolytic insulating material (*e.g.*, a solution of alkali silicate), is applied to the metal to be coated, and while the binding material is still plastic, it is coated by means of a spray of molten metal and subsequently hardened by exposure to carbon dioxide.—C. A. K.

Coating a transparent article with precious metal [*gold*]. F. O. Andres, San Francisco, Cal. U.S. Pat. 1,281,262, 15.10.18. Appl., 21.9.15.

A METALLIC deposit to which gold will adhere is applied to the surface of the article, and on this base is poured a solution containing gold chloride, potassium carbonate, and sugar, and the gold allowed to deposit without the application of heat. After removal of excess of the solution, the deposited film is toned with a mixture of a silver solution and copper nitrate.—T. H. B.

Metals; Apparatus for protecting from oxidation volatilised —— used in coating processes. Neufeldt und Kuhnke, Kiel. Ger. Pat. 307,849, 31.1.15. Int. Conv., 11.8.14. Addition to Ger. Pat. 284,991.

THE metallic vapour passes into a receiver with an exit at the bottom, into which a stream of an inert gas has previously been passed, the air being thereby displaced. The gases issue from the top or bottom and pass through a layer of liquid. The chamber, which contains the articles to be coated, is thus trapped and the entry of fresh air prevented.—W. G.

Precipitating materials [*metals*] *from solutions; Process of and apparatus for* ——. T. B. Crowe, Victor, Colo., Assignor to Merrill Metallurgical Co., San Francisco, Cal. U.S. Pat. 1,281,249, 8.10.18. Appl., 3.7.16.

ANY gas which may interfere with the precipitation is removed. After precipitation, the mixture of precipitate and liquid is transferred to a filter without contact with the air. (See also this J., 1918, 626A.)—J. S. G. T.

Tungsten; Production of ductile ——. C. A. Pfanstiehl, Waukegan, Ill., Assignor to Pfanstiehl Co., Inc., North Chicago, Ill. U.S. Pat. 1,282,122, 22.10.18. Appl., 12.7.15.

FINELY powdered tungsten is compressed to an ingot having a sp. gr. greater than 15·5, and the ingot is placed on a cradle of ductile tungsten, through which an electric current is passed, in an atmosphere of hydrogen, to heat the cradle and weld the ingot.—T. H. B.

Molybdenum or alloys thereof; Process of obtaining ——. J. A. Holladay, Assignor to Electro Metallurgical Co., Niagara Falls, N.Y. U.S. Pat. 1,281,961, 15.10.18. Appl., 29.6.18.

WULFENITE concentrate or similar material is smelted to eliminate lead and produce a soluble molybdate slag, which is leached with a dilute solution of a calcium salt. From the resulting solution molybdenum is precipitated as calcium molybdate.—T. H. B.

Rod mills for ores. Eng. Pat. 118,097. *See* I.

XI.—ELECTRO-CHEMISTRY.

PATENTS.

Electric cells and batteries. R. S. Baxter, Tayport, Fife. Eng. Pat. 120,689, 5.3.18. (Appl. 3840/18.)

IN electric cells or batteries of the kind described in Eng. Pat. 103,020 (this J., 1917, 295), the negative element is formed of carbon or carbonaceous material to which a layer of sulphur or of carbon impregnated with molten sulphur is attached.

—W. E. F. P.

[*Electrical*] *conductors; Process of making moulded* ——. S. Trood, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,281,716, 15.10.18. Appl., 3.10.13.

FINELY-DIVIDED metal, *e.g.* copper, is amalgamated, the amalgam is mixed with lubricating material, *e.g.* finely-divided carbon, and the mixture is subjected to heat and pressure to remove practically all of the mercury.

Carbon electrodes; Manufacture of ——. S. E. Sieurin, Höganäs, Sweden. U.S. Pat. 1,282,475, 22.10.18. Appl., 16.10.17.

SEE Eng. Pat. 119,164 of 1917; this J., 1918, 706A. The product is crushed, mixed with a binding material, such as coal tar, heated, and pressed into a suitable form.

Electrolytic gas generators. I. H. Levin, Newark, N.J., U.S.A. Eng. Pat. 111,483, 13.11.17. (Appl. 16,645/17.) Int. Conv., 18.11.16.

SEE U.S. Pat. 1,219,966 of 1917; this J., 1917, 511.

Electric furnace. J. O. Boving, London. U.S. Pat. 1,281,280, 15.10.18. Appl., 4.9.17.

SEE Eng. Pat. 109,465 of 1916; this J., 1917, 1183.

XII.—FATS; OILS; WAXES.

Oils; Negative catalysts in the hydrogenation of ——. S. Ueno. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, 21, 898—939.

THE term "ratio number of hydrogenation" indicates the degree of hydrogenation of oils, $r = x \div a$, where r represents the ratio number, x the difference between the iodine values before and after hydrogenation, and a the original iodine value. A comparison between the values of r and r' (the latter indicating the ratio number of a "blank" hydrogenation) shows whether a given substance acts as a negative catalyst or not. It was found that hydrogenation by means of a nickel catalyst was retarded by the soaps of potassium, sodium, lithium, magnesium, barium, beryllium, iron, chromium, zinc, cadmium, lead, mercury, bismuth, tin, uranium, and gold, whilst the soaps of calcium, strontium, aluminium, cerium, nickel, manganese, copper, silver, vanadium, thorium, and platinum had no effect upon the catalytic action. Nickel acetate, butyrate, stearate, lactate, oxalate, and succinate had also no influence on the catalytic hydrogenation. Copper hydroxide, ammonium molybdate, boric acid, arsenious acid, hydrochloric acid, and potassium hydroxide had a strong restrictive effect, zinc oxide and aluminium silicate had a slighter effect, and tungstic acid was almost inert. Fatty acids such as acetic, lauric, stearic, and oleic acids had no influence on the catalytic action, but glycollic and lactic acids, hydroxystearic acids, oxalic, succinic, and fumaric acids, and

hydroxy acids such as malic, citric, and tartaric acids, acted as negative catalysts. Sodium taurocholate had a restrictive influence, whilst nucleic acid had no effect. Powdered metals (not reduced by hydrogen) such as nickel, tin, zirconium, aluminium, and copper had no pronounced injurious effect, but iron, zinc, lead, and mercury acted as poisons. Sulphur, selenium, tellurium, and red phosphorus acted as negative catalysts, but the presence of a small amount of oxygen in the hydrogen had not a pronounced effect. Proteins, blood albumin, blood fibrin, and gelatin had a restrictive influence, but hæmoglobin was inert. Glycerol and lecithin had a pronounced action, but cholesterol and squalene had no effect. Carbohydrates such as sucrose, dextrose, mannitol, and starch behaved as negative catalysts, but glycogen had no influence. Alkaloids such as morphine and strychnine were pronounced poisons, as were also potassium cyanide, amygdalin, and the gaseous and liquid products of the dry distillation of herring oil.—C. A. M.

Oils; Velocity of the hydrogenation of ——. S. Ueno. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, **21**, 749—762.

THE velocity of the hydrogenation of fatty oils by means of a nickel catalyst may be expressed by the equation of a reaction of the first order :—

$$k=\frac{1}{t}l_n\frac{a}{a-x}.$$

—C. A. M.

Seed oil of Amorpha fruticosa. H. Nakatogawa. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, **21**, 781—782.

THE seeds of the leguminous plant, *Amorpha fruticosa* (Manchuria), yielded 8·7% of a brownish-yellow oil with weak drying properties. It had the following characters :—Sp. gr. (15°/4° C.), 0·9426; acid value, 7·06; saponif. value, 182·5; iodine value (Wijs), 133·71; and $n_D^{20}=1·4845$.—C. A. M.

Soap solutions; Hydrolysis of —— measured by the rate of catalysis of nitrosotriacetonamine. J. W. McBain and T. R. Bolam. Chem. Soc. Trans., 1918, **113**, 825—832.

THE velocity measurements show that the alkalinity of solutions of sodium and potassium palmitate is very slight, the concentration of the hydroxyl ion being of the order of *N*/1000. This result agrees with that obtained in a previous investigation of the alkalinity by the electromotive force method. The observed concentration of the hydroxyl ion is quite insufficient to account for the electrical conductivity of soap solutions and precludes the widely held opinion that such solutions contain appreciable amounts of free fatty acid. All such fatty acid must be present in the form of acid soap, the formation of which may be due to chemical combination or to adsorption of the free acid. The alkalinity of the soap solutions decreases with falling temperature. (See also this J., 1918, 249 T.)—H. M. D.

PATENTS.

Cottonseed meats; Treatment of ——. C. O. Phillips, New York. U.S. Pats. (A) 1,278,073, (B) 1,278,075, and (C) 1,278,076, 3.9.18. Appl., (A) 21.8.17, (B) and (C) 10.7.18.

(A) CRUSHED decorticated cottonseed is intimately mixed with a small amount (about 3 galls. per ton) of a dilute solution (about $\frac{1}{10}$lb. per gall.) of sodium bicarbonate or other alkali carbonate, the mixture cooked, and the oil expressed. (B) A dilute solution of sodium carbonate (about 2½ oz. of the crystalline salt, $Na_2CO_3,10H_2O$, per gall.) is used for the admixture. (C) A dilute solution of lime water or milk of lime (containing about 5% of calcium oxide) is used instead of alkali carbonates.—C. A. M.

Soaps containing insoluble metallic compounds; Preparation of ——. K. Endriss, Stuttgart, and H. Schuster, Lendsiedel. Ger. Pat. 307,581, 19.7.16.

WITH the object of obtaining products of increased detergent power and of saving fatty acids, the materials are mixed, before or during the manufacture of the soap, with considerable quantities of soluble metallic salts, such as those of magnesium, aluminium, and zinc, which are able to react with alkali to form insoluble compounds of weak basic character, and these salts are completely or partially decomposed with alkali. For washing and textile soaps the proportion of metallic salts should not be materially less than 10%, and for toilet soaps not materially less than 5%, calculated on the amount of fatty acids. The finished soap should contain little free alkali, preferably not more than 1 to 2% of the amount of fatty acids. —C. A. M.

Detergents containing ammonia; Preparation of —— from ammonium salts. A. Heckt, Kiel. Ger. Pat. 308,078, 3.5.17.

A DILUTE aqueous solution of sodium silicate is incorporated with an aqueous solution of ammonium chloride or carbonate to obtain a paste-like product. The addition of oxalic acid to either constituent promotes the formation of a paste, and increases the detergent power of the preparation. Quillaia bark extract, saponin, or the like may also be added to cause frothing.—C. A. M.

Soap substitute. J. Perl und Co. G.m.b.H., Berlin-Tempelhof. Ger. Pat. 308,609, 3.6.16.

MAGNESIA cement made by a hot method froths like soap and has frictional detergent properties. It is conveniently prepared from light magnesia, and before hardening is incorporated with magnesium carbonate, barium sulphate, kaolin, or other finely powdered substances.—C. A. M.

Asphalt-like composition. U.S. Pat. 1,279,918. *See* IX.

Animal substances. Ger. Pat. 308,152. *See* XV.

Treating cocoa, etc. Eng. Pat. 120,178. *See* XIXA.

Viscosimeter. U.S. Pat. 1,281,042. *See* XXIII.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Essential oil of Pinus thumbergii (Japanese oil of turpentine). Y. Shinosaki. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, **21**, 763—774.

TURPENTINE from the Japanese pine, *Pinus thumbergii*, Parl., locally known as *kuromatsu* or *o-matsu*, consisted of 22·92% of essential oil and 73·36% of colophony, with 3·61% of moisture and 0·21% impurities. The essential oil, which was separated by distillation with steam, had the following characters: Sp. gr. at 15°/4° C., 0·8740; $n_D^{20}=1·4738$; $\alpha_D=-19·17$; and acid value, 0·53. It was soluble in 8 vols. of 90% alcohol and 28 vols. of 80% alcohol. About 80% of the oil distilled between 154° and 160° C., and about 4% between 160° and 252° C. The fraction (15%) distilling

above 252° C. had sp. gr. 0·9244, n_D^{20}=1·4993; and α_D=+36·25. By fractional distillation *in vacuo* three main fractions were obtained, *viz.* (1) about 73% of the original oil consisting of α-pinene; (2) a fraction containing camphene; and (3) a liquid tricyclic sesquiterpene boiling at 105°—106° C. (2 mm.), and having sp. gr. 0·9370 at 15° C.; n_D^{20}= 1·5055; and α_D=+43·5°.—C. A. M.

PATENTS.

Colour. F. J. Baumgardner, Assignor to W. Hoyt and A. J. Hudson, Cleveland. U.S. Pat. 1,276,861, 27.8.18. Appl., 6.11.16.

FINELY-GROUND oyster shells are claimed as an efficient substitute for aluminium hydroxide as a base on which to precipitate aniline dyestuffs for the manufacture of pigments. For the production of a given tint less colour is required when oyster shells are used as a base than when aluminium hydroxide is employed.

Coloration method. B. D. Avis, Clarksburg, W.Va. U.S. Pat. 1,277,172, 27.8.18. Appl., 8.1.18.

AN improvement of the process described in U.S. Pat. 933,522 (this J., 1909, 1049). The surface to be coloured is coated with an ammoniacal solution of dimercuric ammonium nitrate or an alcoholic alkaline solution of a double mercury-alkali salt, and the double salt is precipitated by evaporation of the ammonia or alcohol respectively. Glass, porcelain, metal, wood, paper, etc. can be coloured by this method. The transparency of glass is not destroyed by the coloration.

Varnish and process of making the same. S. Satow, Sendai, Japan. U.S. Pat. 1,280,861, 8.10.18. Appl., 25.11.16.

VEGETABLE proteins are "glutinised" by an agent such as a dilute acid, a phenol is added as an antiseptic, and the product is employed for the preparation of a varnish, *e.g.* by emulsifying a solution of the gelatinised proteins.—J. F. B.

Luting composition and method of producing the same. S. Tamari, Tokyo, Japan. U.S. Pat. 1,281,702, 15.10.18. Appl., 19.1.17.

SEE Eng. Pat. 107,370 of 1917; this J., 1918, 188 A.

Ink; Writing ——. M. Shinozaki, Nihombashi-ku, Japan. U.S. Pat. 1,282,302, 22.10.18. Appl., 5.6.17.

SEE Eng. Pat. 117,117 of 1917; this J., 1918, 554 A.

Disazo colour. U.S. Pat. 1,281,938. *See* IV.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Viscosity of plantation ——, *its relation to the properties after vulcanisation and its significance in rubber testing.* O. de Vries. Comm. Central Rubber Stat., Buitzenzorg, Java, 1918, No. 9, 51 pages.

FROM a consideration of numerous tests made as part of the routine work of the Rubber Station, the conclusion is drawn that there exists no close relationship between the viscosity of a rubber and its tensile strength, rate of vulcanisation, or resistance to stretching at high elongations (*i.e.* "slope").—D. F. T.

Rubber; Influence of "rustiness" on the inner qualities of sheet ——. O. de Vries and H. J. Hellendoorn, Comm. Central Rubber Stat., Buitzenzorg, Java, 1918, No. 10, 1—12.

"RUSTINESS" arises from the action of aëroble micro-organisms on the serum of the rubber with intermediate formation of a jelly-like substance which does not consist of protein matter; it can be avoided by rapid surface-drying. "Rustiness" merely consists of a dry superficial film. No deterioration of the inner qualities of the sheet rubber could be detected other than the slight differences arising from the circumstances under which "rustiness" is produced.—D. F. T.

Rubber; Influence of heat on the inner qualities of ——. O. de Vries and H. J. Hellendoorn. Comm. Central Rubber Stat., Buitzenzorg, Java, 1918, No. 10, 13—34.

LATEX coagulated by heat gives a rubber of low viscosity and greatly increased rate of vulcanisation, but the tensile strength and "slope" are unaltered. Freshly rolled crêpe or sheet is unaffected by being soaked in water at 40° C. for 15 minutes, but with rise in the temperature the viscosity and, to a less degree, the rate of vulcanisation, and even the tensile strength exhibit a decrease. If coagulum becomes heated during rolling the viscosity undergoes a reduction, but the other properties are relatively little affected, whilst freshly rolled sheet when dried at 40°—50° C. gives exactly the same résult as air-dried rubber, although at 60° C. a decrease is observed in rate of cure and in viscosity. Dry rubber when heated at 70°—100° C. undergoes a reduction in viscosity and tensile strength, but the rate of vulcanisation and "slope" are unaltered; the effect of heat in this case is considerably increased by the occurrence of oxidation.—D. F. T.

PATENTS.

Vulcanising process. C. E. Andrews, Assignor to The Walker Chemical Co., Pittsburgh, Pa. U.S. Pat. 1,280,940, 8.10.18. Appl., 27.2.18.

A VULCANISED rubber compound is obtained by heating the raw material together with sulphur and aminocymene.—D. F. T.

Rubber composition and method of producing the same. J. M. Weiss, New York, Assignor to The Barrett Co. U.S. Pat. 1,282,505, 22.10.18. Appl., 16.5.18.

A LIGHT-COLOURED, semi-solid to solid bitumen obtained by the destructive distillation of coal-tar pitch is mixed with the vulcanisable ingredient of the composition to be vulcanised, and the product subjected to vulcanisation.—L. A. C.

XV.—LEATHER; BONE; HORN; GLUE.

Jellies [gelatin]; Diffusion of electrolytes into ——. *I. Relationship between the distance of diffusion and the concentration.* O. von Fürth and F. Bubanović. Biochem. Zeits., 1918, **90**, 265—287.

FROM the study of the diffusion of chlorides into gelatin jellies containing silver nitrate, the relationship found was $d=mt^{\frac{1}{2}}k^n$, when d=diffusion distance in time t, k=concentration, and m and n are constants. (See also J. Chem. Soc., Jan., 1919.)

—S. B. S.

PATENTS.

Animal substances; Apparatus for the treatment of —— [*for recovery of glue and fat*]. H. Goslar, Aix la Chapelle. Ger. Pat. 308,152, 5.9.16.

THE apparatus comprises an extractor and a fat separator, the latter consisting of two superposed chambers connected by tubes for the equalisation of the pressure and the transference of the glue solution from the upper to the lower. The bottom of the extractor is convex internally and is heated most strongly at the centre, it may be double-walled and heated by steam, or heating may be effected by solid fuel, in which case the base may be fitted with a metal plate thickened at the centre. —D. F. T.

Tanning. R. Bohn, O. Bally, and H. Wolff, Mannheim, Assignors to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,281,494, 15.10.18. Appl., 30.12.16.

SEE Eng. Pat. 116,935 of 1917; this J., 1918, 521 A.

XVI.—SOILS; FERTILISERS.

Superphosphates; Rational preparation of ——. A. Aita. Annali Chim. Appl., 1918, **10**, 45—103.

Determination of free phosphoric acid and water.—In the system—phosphoric acid—calcium oxide—water—there is normally a solid phase consisting of mono- and dicalcium phosphates, and a liquid phase consisting not only of phosphoric acid and water (compare Pratolongo, this J., 1916, 1073), but also of monocalcium phosphate. The proportions of free phosphoric acid and dicalcium phosphate in the mixture depend upon the quantity of water which goes to form part of the liquid phase. For determining free phosphoric acid under these conditions aqueous solvents, alcohol, and ordinary ether are unsuitable since they have a hydrolytic action on the monocalcium phosphate. The use of anhydrous ether for the extraction of the free phosphoric acid prevents this hydrolysis, and reduces or eliminates the risk of removing part of the water of crystallisation of the solid constituents:—Two grms. of the superphosphate is extracted with anhydrous ether, the filtrate evaporated, and the residue dried in an oven at 40° C. The residue left after the treatment with ether is also dried at 40° C., then weighed and placed in a desiccator over sulphuric acid until again constant in weight. The first loss in weight gives the amount of water in the liquid phase (after taking into account the free phosphoric acid), and the second loss in weight gives the water of crystallisation of the solid constituents. In the case of superphosphates prepared from phosphorites the proportion of free phosphoric acid diminishes during storage. *Superphosphates of normal and abnormal composition.*—From experimental data the following conclusions have been drawn:—(1) The characteristic physico-mechanical properties of superphosphates depend upon the proportions of free phosphoric acid and water, considered together. (2) The content of water depends upon the concentration of the sulphuric acid used, whilst the content of free phosphoric acid depends on the relative proportions of the interacting substances and is independent of the temperature. Commercial superphosphates may be classified into two groups—normal and abnormal. To the first group belong bone superphosphates and mineral superphosphates prepared by rational methods; to the second group belong most commercial mineral superphosphates. In products of normal composition the amount of water should not exceed 10 to 12%, whilst the free phosphoric acid should not exceed 1 to 2% (as P_2O_5), corresponding to 5 to 10% of the total soluble P_2O_5. The presence of dicalcium phosphate is a criterion of normal composition. The fraction of phosphoric anhydride combined with the calcium in this form should be equivalent to that present as free phosphoric acid. In the case of bone superphosphates, which are prepared with a deficiency of sulphuric acid, this relationship between the free phosphoric acid and dicalcium phosphate is not found, owing to the fact that the tricalcium phosphate was not originally completely converted into monocalcium phosphate, but remained to a large extent in the form of dicalcium phosphate. The remainder of the soluble phosphoric anhydride is present as monocalcium phosphate. Mono- and dicalcium phosphates are mainly present in the hydrated form, whilst the calcium sulphate is present in the form of plaster of Paris rather than as anhydrite. The hydrated forms of these salts are produced by secondary reactions, at all events in the case of mineral superphosphates. Superphosphates of abnormal or defective constitution show a high proportion (over 12%) of water in the liquid phase, and contain more than 2% of free phosphoric acid (as P_2O_5), exceeding 10% of the total soluble P_2O_5. They contain little or no dicalcium phosphate, and the anhydrous forms of the salts mono- and dicalcium phosphate and calcium sulphate predominate or are exclusively present. They show defective physico-mechanical properties varying with the proportions of water and free phosphoric acid, and are sometimes so pasty that they cannot be distributed. *Rational conditions of preparation.*—It is necessary to limit the proportions of water and free phosphoric acid. The evaporation of the water in the mass during the reaction varies directly with concentration and temperature of the acid, the temperature of the reaction, and the nature and chemical composition of the phosphorite. A high temperature of the acid is objectionable, since it promotes too rapid evaporation before the mass has become uniformly and completely mixed, and it is preferable to keep the temperature between 20° and 30° C. It is essential that the mixture should be kept in a paste-like form for a sufficient length of time, so that it can be uniformly distributed in the reaction chamber. The concentration of the acid to be used varies with the nature of the mineral phosphate and the moisture it contains. As a general rule acid of 51° B. (sp. gr. 1·600) is suitable for hard and lumpy phosphates, and acid of 55° to 56° B. (sp. gr. 1·615 to 1·635) for friable phosphates. The quantity of sulphuric acid required may be calculated from the composition of the mineral, the following table showing the coefficients for the principal components with different concentrations of acid:—

Sulphuric acid, °B.	53	54	55	56
Tricalcium phosphate	1·14	1·11	1·09	1·07
Calcium carbonate	1·46	1·43	1·40	1·37
Iron oxide (½), aluminium oxide (½)	3·34	3·25	3·20	3·12
Unestimated	0·12	0·11	0·10	0·09

The duration of the mixing should be kept strictly to the time required for complete and uniform admixture (*e.g.* about 15 to 20 secs.). The conversion of the phosphoric acid into soluble forms depends on various factors such as the nature of the phosphorite, its hardness and structure, its calcium carbonate content, the process of grinding, and the proportion of fine powder to granular matter. By the modern systems of grinding, superphosphates are prepared leaving at most 0·2 to 0·3% of insoluble phosphoric anhydride, whereas at one time this portion exceeded 1%. On the other hand, excessive fineness of the meal tends to cause undesirable

physico-mechanical conditions in the final product. Hard phosphorites yield products containing more free phosphoric acid than those obtained from friable phosphorites. This is due to the influence of the finer meal produced and the different structure of the grains upon the reaction. Hence in the case of hard and lumpy phosphorites it is advisable not to grind the material too fine. Official (Italian) method of examining superphosphates.—The official method which consists essentially in extracting the product with water, and digesting the residue with ammonium citrate solution, is inaccurate, since extraction with water causes more or less hydrolysis of the monocalcium phosphate according to the amount of free phosphoric acid in the sample. *Artificial drying of superphosphates.*—Hot and cold systems of drying superphosphates are employed. In the former the product is exposed to hot air at 80° to 150° C. for a definite time in suitable apparatus (revolving drums, etc.). The removal of water modifies the relationship between the three forms of phosphoric anhydride compounds, but in a different way for normal and abnormal superphosphates. In the case of normal products it also reduces the amount of free phosphoric acid, which will have reacted with a corresponding quantity of dicalcium phosphate to form monocalcium phosphate, thus improving the physico-mechanical condition of the product. In the case of abnormal products, however, containing excessive free phosphoric acid, the removal of water is slow and expensive, and there is much less reduction of free phosphoric acid owing to the deficiency or absence of dicalcium phosphate, so that the free phosphoric acid may even be relatively higher after the removal of water. The physico-mechanical properties of such products are not improved, and may even be deteriorated by the process. The second method of drying is to add inert absorbent material such as infusorial earth to absorb part of the water, or substances which will react with the excess of free phosphoric acid such as bone-ash or friable phosphates. (See also J. Chem. Soc., Jan., 1919.)—C. A. M.

PATENTS.

Fertiliser and insecticide. G. Truffaut, Versailles, France. Eng. Pat. 120,288, 3.12.17. (Appl. 17,900/17.)

THE fertiliser is a mixture of 40% of calcium sulphide, 20% of calcium sulphate, 20% of calcium phosphate, and 20% of heavy tar oils freed from bases and phenols. It acts as a partial steriliser of the soil and stimulates the formation of ammonia.—J. H. J.

Fertiliser materials; Process of making ——. P. H. Carter, Savannah, Ga. U.S. Pat. 1,279,838, 24.9.18. Appl., 1.7.16. Renewed 17.7.18.

NITRE-CAKE is subjected to the action of tricalcium phosphate (*e.g.*, phosphate rock) in the presence of water, and the product is allowed to act on "fertiliser stick" until the mass has dried and hardened.—J. H. J.

Fertiliser for seeds and plants; Physiological ——. N. A. Barbieri, Rome. U.S. Pat. 1,282,170, 22.10.18. Appl., 11.3.18.

SEE Eng. Pat. 110,338 of 1917; this J., 1917, 1244.

Calcium cyanamide. U.S. Pat. 1,281,363. *See* VII.

Fertiliser. Ger. Pat. 307,575. *See* XIXA.

XVII.—SUGARS; STARCHES; GUMS.

Sugar; Measures taken in Java to prevent deterioration of stored ——. L. G. L. Steuerwald. Archief Suikerind. Ned.-Indië, 1918, **26**, 879. Int. Sugar J., 1918, **20**, 543—546.

THE effect of the conditions of warehousing sugar upon its keeping qualities has been studied in Java, where about 1,000,000 tons of the 1917 crop was stored during the rainy season of 1917—18 in buildings of varying construction. Stores with roofs constructed of tiles gave the worst results. Somewhat better results were obtained in stores with glass roofs, provided with windows; but corrugated iron, on account of its heat conducting property, proved even better. For the floors of the stores, sand proved unsatisfactory; and earthenware or tile floors, and also those of brick laid in cement, allowed moisture readily to pass upwards through them. It is concluded that to obtain the best results impermeable floors of asphalt or concrete should be used, the roofs and walls should be of corrugated iron, the bags should be piled on wooden blocks, *e.g.*, railway sleepers, covered with a thatchwork of bamboo or rattan, permitting circulation of air beneath and between them, and a slow current of dry and moderately warm air should be conducted through the whole length of the building.—J. P. O.

Dextrin; Preparation of ——. M. Yano. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, **21**, 865—881.

DEXTRIN prepared by the following method is a suitable substitute for gum arabic, although not so adhesive. Ten parts of dilute nitric acid (5 parts of acid of sp. gr. 1·40, and 95 parts of water) is mixed with 100 parts of sweet-potato starch, and the resulting paste is dried at about 50° C., and then heated for about an hour at about 150° C. in a lacquered zinc pan in an iron heating box.—C. A. M.

PATENTS.

Sugar liquors; Treating ——. G. W. S. Simpson, London, and R. F. Lyle, Greenock. Eng. Pat. 120,055, 24.7.17. (Appl. 10,629/17.)

SPHAGNUM or other moss is boiled in alkali, washed, and filled into vertical leaf filter-frames which are suspended in a tank into which the sugar liquor to be filtered is passed. The moss is retained in position by coarse wire screens which are covered with a cloth of open texture to retain slimy and coarse impurities. The sugar solution in the tank is drawn through the filters by a vacuum pump and when, owing to accumulation of impurities on the filters, the rate of filtration becomes too slow, the cloth is removed to be washed and a clean cloth inserted. When the moss requires to be cleaned, hot water is admitted to the tank and drawn through for a short time. Instead of a leaf filter, the moss may be placed on a rotary drum covered by an endless cloth. Radial pipes conduct the sugar solution to axial channels in the drum. A vacuum pump draws the liquid through the drum. As the drum revolves, the cloth leaves the drum above the level of the liquid and passes over a small roller in a washing tank, where it is sprayed with hot water before returning to the drum. The sugar liquor comes through the filter freed from suspended matter and is ready to be decolorised.—J. H. J.

Adhesive; Preparation of a non-drying ——. H. Küchle, Darmstadt. Ger. Pat. 308,754, 16.2.17.

THE process described in Ger. Pat. 297,186 (this J., 1917, 895) is modified, in that the mixture of yeast

and molasses, or other saccharine material, is allowed to ferment in acid, neutral, or alkaline condition, either before or during concentration *in vacuo*. The fermentation is mainly at the expense of the yeast proteins, the molasses being relatively unchanged.—C. A. M.

Treating gums. Eng. Pat. 120,183. *See* VI.

Fodder from beet. Ger. Pat. 307,575. *See* XIXA.

XVIII.—FERMENTATION INDUSTRIES.

Wines; Damaged —— [Vins tournés.] L. Roos. Ann. Falsif., 1918, **11**, 300—308.

The alteration of wine by bacteria, producing *vin tourné*, may take place quite suddenly and for no apparent reason; the wine becomes turbid, a sediment forms, the colour is changed, and the volatile acids increase in quantity. The latter change is due to the decomposition of the tartaric acid, which is, apparently, converted into tartronic, lactic, acetic, and propionic acids and carbon dioxide. Wine which is badly attacked may be quite free from tartaric acid. The amount of tartaric acid present cannot therefore be used as a basis for the detection of added water in the wine. As a rule, the altered wine contains abnormally large quantities of mineral matter, particularly of potassium, since further amounts of potassium bitartrate are dissolved from the walls of the cask as the decomposition of the already dissolved tartrate proceeds. It is only when the total ash, its alkalinity, and the total potassium are all unusually low that watering is indicated.—W. P. S.

Diastase, peroxydase, and catalase; Relationship between ——. H. Maggi. Helv. Chim. Acta, 1918, **1**, 433—451.

The simultaneous presence of peroxydase and catalase activity in many enzymes has been attributed by Woker (Ber., 1917, **50**, 679) to the presence of an aldehyde group which unites with hydrogen peroxide to yield a secondary peroxide, R.CH(OH).O.OH, which has more powerful oxidising properties than hydrogen peroxide itself and which can also react with excess of the latter to yield oxygen. The possibility of the aldehyde group being able to exert diastatic action in addition to peroxidising and catalytic action has been examined; it is suggested that the mechanism would consist in the alternate addition (to form a hydrate) and elimination of water. The action of mixtures of starch and formaldehyde was studied by the capillarity method; the presence of dextrins was detected by means of iodine and of sugar by Fehling's solution. The results show that the behaviour of formaldehyde towards starch closely resembles that of diastase. One considerable difference, the recurrence of the blue colour with the lapse of time in the case of mixtures of formaldehyde and starch, appears to be due to the formation of unstable iodine derivatives of formaldehyde or of the achroodextrins, which gradually eliminate iodine. The necessary conditions are the presence of unchanged starch and a substance capable of liberating iodine; if these conditions are fulfilled, elimination of achroodextrins will restore the blue colour to the solution.—H. W.

Patent.

Culture media. Ger. Pat. 307,881. *See* XX.

XIXA.—FOODS.

Milk; Determination of lactose in —— after the milk has been heated with addition of sodium bicarbonate. C. Porcher and A. Bonis. Ann. Falsif., 1918, **11**, 295—299.

When milk is heated with the addition of sodium bicarbonate, the lactose undergoes decomposition. At 80°—90° C. the change is but slight, but at 120° C. it is very marked. The change appears to be due to the conversion of part of the lactose into a lævo-rotatory sugar, since the polarisation falls whilst the reducing power is only slightly reduced. For instance, a milk containing 4·61% of lactose was treated with 2 grms. of sodium bicarbonate per litre and pasteurised at 80°—90° C.; it then showed 4·43% of lactose by reduction and 4·36% by the polarimeter. On heating this alkalised milk at 120° C. for 1 hr., the lactose found by reduction was 4·07% and by the polarimeter 2·16%.—W. P. S.

Fruit juices; Use of hydrofluoric acid for preserving ——. A. Beythien and P. Pannwitz. Z. Unters. Nahr. Genussm., 1918, **36**, 116—119.

Hydrofluoric acid and soluble fluorides have distinctly poisonous properties, and the use of the acid as a preservative for fruit juices is dangerous to health. The added hydrofluoric acid cannot be removed completely by the addition of calcium carbonate in quantity slightly larger than that required by theory, and if more than this quantity of calcium carbonate is added, the quality of the fruit juice is affected.—W. P. S.

Baking powder; Determination of carbon dioxide and carbonate in ——. G. Rupp and E. Wohnlich. Z. Unters. Nahr. Genussm., 1918, **36**, 101—110.

To ascertain the available carbon dioxide and excess sodium bicarbonate in a baking powder, determinations are made of the total carbon dioxide and the amount remaining after a portion of the sample has been boiled with water for 30 mins.; the difference between the two determinations gives the available carbon dioxide. In the case of baking powders containing calcium carbonate in addition to sodium bicarbonate, the mixture, after boiling, must be filtered and the carbon dioxide determined both in the insoluble portion and in the filtrate. All the determinations are made in a Keissler-Erdmann carbon dioxide apparatus.—W. P. S.

Patents.

Foodstuffs for human beings, cattle and other animals or birds, and manufacture thereof. E. Makin, Manchester. Eng. Pat. 120,166, 22.3.18. (Appl. 5060/18.)

Heather, grasses, and other plants are added to distillery meal or other meal, spent hops, and a seasoning liquid or essence. The plants form 30% of the mixture, and the hops 15%. The mass is pulped, cooked by superheated steam, hot air, or direct heat, and reduced to powder or cake form.

—J. H. J.

Cocoa and the waste products of chocolate manufacture; Processes for treating ——. E. de Grousseau and A. Vlcougne, Clichy, France. Eng. Pat. 120,178, 4.6.18. (Appl. 9224/18.) Int. Conv., 10.4.18.

Theobromine, caffeine, and fat are extracted from cocoa or the waste products from the manufacture of chocolate by the use of a special solvent consisting of ethane tetrachloride, 750—900 parts, phenol, 100—250 parts, concentrated ammonia, 15—25 parts,

and water 75—85 parts. The material to be treated is macerated with the solvent in a jacketed vessel at 60°—70° C. and then extracted by continuous circulation for an hour. The solvent is run off and the material is washed with ethane tetrachloride. The solvent and washings are distilled *in vacuo*, the ammonia, ethane tetrachloride, and most of the phenol being collected separately. The residue is transferred to another vacuum still provided with means for the introduction of steam, in which the remainder of the phenol is distilled off. A solvent of fat, such as petroleum ether, is admitted, and allowed to dissolve the fat, after which the solvent is decanted off. The residue is treated with alkali which dissolves the theobromine and tannin, and the caffeine is obtained by filtration. Carbon dioxide is passed into the alkaline solution to precipitate the theobromine, which is filtered off and dried.
—J. H. J.

Beverage; Food —— and process of producing same. J. L. Kellogg and B. Kazmann, Battle Creek, Mich., U.S.A. Eng. Pats. (A) 120,121 and (B) 120,279, 15.11.17. (Appls. 16,828 and 16,830/17.)

(A) Starchy material, such as wheat, rye, etc., free from sugar and malt, is ground and made into a dough, which is submitted to steam at 15 lb. pressure for 2½ hours, to dextrinise the starch. The mass is then dried, powdered, roasted, and extracted with water in a percolator. The extract is evaporated and dried *in vacuo*, and then ground to a powder or into scales. The product is readily soluble in boiling water and forms a substitute for coffee. (B) The process is the same as the preceding, but with the addition of crushed malt or extract of malt to the starchy material. The high temperature of the dextrinisation process stops the action of the enzyme before maltose is produced.—J. H. J.

Desiccating apparatus. J. C. MacLachlan, Chicago, Ill. U.S. Pat. 1,259,890, 19.3.18. Appl., 7.1.15.

The apparatus is intended for drying food products, such as milk, eggs, etc., and especially for carrying out the process described in U.S. Pat. 850,306. The liquid to be desiccated is sprayed by an atomiser into the upper part of a receptacle, into which heated air is also introduced. The liquid is thus immediately dehydrated, and the atomised solids fall into hopper-shaped containers in the lower, enlarged part of the receptacle. The vertical side walls of these containers are in the form of screens covered with canvas or the like, which retains the fine solids but allows air to pass. Below the containers is an exhaust pipe to remove the air. The deposited solids are removed from the containers by worm conveyors, and beaters are provided to clear the canvas or the like when this becomes clogged.

Calcium-casein compound; Process for separation of —— from milk. P. Hoering, Berlin. Ger. Pat. 305,953, 4.9.15.

The compound is precipitated by means of methyl alcohol instead of with the ethyl alcohol usually employed. The product precipitated with ethyl alcohol quickly loses its solubility when left in contact with the mother liquor or on treatment with stronger alcohol, but this change is prevented or very greatly retarded by use of methyl alcohol.

Fodder or fertiliser; Preparation of a —— from raw beet-juice. H. Claassen, Dormagen. Ger. Pat. 307,575, 22.6.15.

The juice is treated at the ordinary temperature with just sufficient lime to precipitate the non-sugar compounds, the precipitate is filtered off, freed from juice, and dried. It contains no free lime or calcium carbonate. It has a high food value by reason of the albumin and pectin bodies and organic acids it contains and the calcium phosphate also present is a bone-forming substance. It may be used as a supplement to foods poor in albumin and phosphates.
—W. G.

XIXB.—WATER PURIFICATION; SANITATION.

Effluents; Purification of trade —— to make them fit for re-use. H. M. Wilson. J. Textile Inst., 1918, 9, 103—105.

Instances are given of processes in which the reuse of trade effluents is in operation. At collieries where coal is washed, the wash-water is treated to recover the fine coal, the water being afterwards used anew. At paper works, the water from the paper machines is treated for the recovery of the pulp which is returned to the machines, whilst the water is re-used. In wool-scouring, fresh water is used for the final rinsing and is passed to the second washer and then to the first washer, after which it is treated for recovery of grease. In piece-scouring, the water used for the first scour is treated for grease recovery; the water from the second and third scour is fit to be used in the first scour. In dyeing, the dirty waters from the vats are discharged into one set of drains, while the cooling and rinsing waters are kept separate and re-used. The first washings which contain considerable amounts of dye are received in a vat, through which fresh goods are passed in order to exhaust the colour from the washings as much as possible; the water is then used to make up the fresh dye solution.
—J. H. J.

Patents.

Water; Filtration of ——. F. P. Candy, Cheam, Surrey. Eng. Pat. 120,595, 11.10.17. (Appl. 14,691/17.)

A rapid mechanical filter is provided with a filter bed about 6 ft. in diam., which contains about half-way down suitable means for collecting and discharging the filtered water. The water to be filtered is supplied to both the top and bottom of the bed, the upper part of which thus filters downwards and the lower part upwards, the working pressure on the surface of the upper bed being greater than that on the surface of the lower bed. Means are also provided for washing the filter bed by forcing water under pressure through it from below.—C. A. M.

Liquids, particularly water; Process for removing gases from ——. A. Holle, Düsseldorf. Ger. Pat. 308,288, 21.7.16.

The liquid is passed at a moderate temperature (about 40° C.) over a series of "corrosion" plates, *i.e.* plates of soft wrought iron or zinc. The apparatus consists of a large container in which the plates are situated in a slightly inclined position, spaced parallel to each other and attached alternately to the top and the bottom of the container, so that the liquid is forced to take a zig-zag path between them. Gas-collecting chambers are formed along the top of the container between alternate pairs of plates, and these chambers communicate with a "header" pipe connecting the gas chambers with an ejector operated by steam from a heating coil inside the container. Alternatively the container may be directly connected with a condenser, a pipe being built into the lower portion of the condenser with a cut-off valve

reaching below the level of the water, so that only the gas-collecting chambers are connected through pipe branches with the vacuum of the condenser.
—J. F. B.

Disinfectant. A. A. Wells, Montclair, N.J. U.S. Pat. 1,280,602, 1.10.18. Appl., 12.11.17.

A DISINFECTANT is made from chlorobenzol, 1400 c.c., phenol crystals, 320 grms., and carbon tetrachloride, 200 c.c., incorporated with a small amount of paraffin wax sufficient to retard evaporation.
—J. H. J.

Insecticide. Eng. Pat. 120,288. *See* XVI.

Culture media. Ger. Pat. 307,831. *See* XX.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Morphine; Determination of —— in complex substances. I. Revision of the analytical reactions employed. A. Tingle. Amer. J. Pharm., 1918, **90**, 689—706.

THE author has investigated the acidimetric and iodometric methods and the iodo-acidimetric method for the estimation of morphine, and the action of various substances on the precipitation of the alkaloid. Morphine is extracted completely by a mixture of chloroform, 2, and alcohol, 1 vol. Alcohol should not be present in the solution when it is desired to precipitate the morphine by means of ammonia or by the addition of ammonium chloride to the alkaline solution. Morphine is not dissolved completely by barium hydroxide solution in the presence of lead acetate. Sulphuric and acetic acids act sufficiently rapidly on morphine to vitiate analytical processes in which they are used, but hydrochloric and salicylic acids do not.—W. P. S.

Oleander leaves; Amount of substances having a digitalis-like action in —— and the manner of their natural occurrence. W. Straub. Arch. Exp. Pathol. u. Pharmakol., 1918, **82**, 327. Chem.-Zelt., 1918, **42**, Rep., 186.

OLEANDER leaves contain about two and a half times as much active principles as digitalis leaves. The active substances are entirely soluble in water, also the crystalline glucosides which, in the pure form, are only very difficultly soluble. Aqueous and alcoholic extracts are quite stable. The absorption of an extract containing the total glucosides is as good as that of the crystallised oleandrin, which is nearly equal to gitalin in this respect. In addition to the active glucosides oleander leaves, like digitalis leaves, contain a considerable amount of a glucoside which gives a green colour reaction with iron salts; this is probably a phenol-glucoside, but in any case not a true tannin body. This substance, probably in proportion to its amount, determines the proportion of the difficultly soluble active glucosides obtained from the plant by aqueous extraction in the presence of the easily soluble glucosides.—W. G.

Proteinogenous amines. I. Synthesis of β-iminazolylethylamine (histamine). K. K. Kressler and M. T. Hanke. J. Amer. Chem. Soc., 1918, **40**, 1716—1726.

THE method followed is based on that of Pyman (this J., 1911, 646, 923) but several additions and improvements are recorded, among which are the use of sodium thiocyanate instead of the potassium salt in the preparation of 2-thiol-(4 or 5)-aminomethylglyoxaline, the use of the hydrochloride of the latter instead of the free base for conversion into (4 or 5)-hydroxymethylglyoxaline picrate, and the use of boiling benzene instead of ether as solvent in converting the picrate into hydrochloride. In the final reduction of cyanomethylglyoxaline to histamine, the procedure adopted differed considerably from that described by Pyman, and a yield of 165 grms. of histamine dichloride was obtained from 4530 grms. of citric acid.—H. W.

Neosalvarsan; Adulteration of ——. L. P. J. Palet. Ann. Falsif., 1918, **11**, 299—300.

A SAMPLE examined by the author was quite free from arsenic and consisted mainly of sodium sulphate coloured with picric acid; other samples consisted of sodium sulphate and chloride or starch coloured with picric acid.—W. P. S.

Aromatic compounds [phloroglucinol]; New method of synthesising —— from aliphatic compounds. T. Komninos. Comptes rend., 1918, **167**, 781—783.

MALONYL chloride and acetone readily react in the presence of marble chips to give phloroglucinol and a compound, $CH_3.CO.CH_2.CO.CH_2.COCl$, which when boiled with water and more marble is in its turn converted into phloroglucinol.—W. G.

Essential oil of Amorpha fruticosa. Y. Shinosaki and K. Hoshino. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, **21**, 774—781.

THE fruit of *Amorpha fruticosa* (Manchuria) contains about 1·1% of an essential oil. The oil is yellow, has an odour recalling that of *Piper nigrum*, and is optically inactive. A sample had sp. gr. 0·9125 at 15° C., $n_D^{20}=1·5032$; acid value, nil; and saponif. value after acetylation 40·51; soluble in 10 vols. of 90% alcohol. When distilled under reduced pressure (4 mm.) it gave the following fractions: From 95° to 110° C., 0·5; 110°—115° C., 7·8; 115°—120° C., 47·9; 120°—125° C., 22·6; and 125°—138° C., 5·7%. The third and fourth fractions consisted chiefly of cadinene and another sesquiterpene, whilst the last fraction contained a considerable quantity of a sesquiterpene alcohol (m.pt. about 118° C.). The oil also contained a small amount of an aldehyde or ketone forming a crystalline bisulphite compound.—C. A. M.

Dissolving zinc chloride. Peacock. *See* VII.

Pinus thunbergii oil. Shinosaki. *See* XIII.

PATENTS.

[Hydr]oxy-alkyl ethers of p-acetoaminophenol or substitution products thereof; Manufacture of ——. J. Tchernlac, London. Eng. Pat. 120,081, 23.10.17. (Appl. 15,395/17.)

HYDROXYALKYL ethers of *p*-acetoaminophenol are prepared by causing an alkylene or hydroxyalkylene monohalogen hydrin to react in an aqueous medium with *p*-acetoaminophenol or a substitution product thereof, in presence of a substance capable of fixing the free hydrogen halide which is formed. Example: 151 parts of the acetoaminophenol is dissolved, with cooling, in an exactly equivalent quantity of 2*N*-caustic soda solution, 81 parts of ethylene chlorohydrin is added, and the mixture is heated at 60°—70° C. for 8 hours; the β-hydroxyethyl ether of *p*-acetoaminophenol separates as an oil which crystallises on cooling.—J. F. B.

Ethyl alcohol from acetaldehyde; Manufacture of ——. A. G. Bloxam, London. From Elektrizitätswerk Lonza, Gampel, Switzerland. Eng. Pat. 120,163, 16.3.18. (Appl. 4684/18.)

In the manufacture of ethyl alcohol from acetaldehyde by the action of hydrogen in presence of a catalyst, the use of a relatively small excess of hydrogen gives a product of objectionable odour and rich in aldehyde. This difficulty is avoided by the use of a very large excess of hydrogen, preferably by a system of circulation, the alcohol being condensed by cooling the vapours and the excess of hydrogen returned to the reaction vessel. By the circulation of 30 times the theoretical quantity of hydrogen, the quantity of gas is sufficient to absorb and conduct away the heat of the reaction, and the temperature of the reaction chamber is maintained within the most favourable limits, *viz.* between 100° and 180° C.—J. F. B.

Analgesic body [*anilides of α-bromodiethylacetic acid*] *and process of making.* L. Thorp, Cincinnati, Ohio. U.S. Pat. 1,279,942, 24.9.18. Appl., 21.3.18.

Anilide derivatives of α-bromodiethylacetic acid are prepared by treating an arylamine, such as *p*-phenetidine, with an acyl halide of α-bromodiethylacetic acid. These anilides possess analgesic and sedative properties and are colourless, crystalline compounds, slightly soluble in water, and having a somewhat bitter taste. The *p*-phenetidide melts at 54° C.—J. F. B.

Bromolecithalbumin and bromolecithin; Preparation of ——. P. Bergell, Berlin-Wilmersdorf. Ger. Pat. 307,490, 5.3.14.

Lecithalbumin is brominated in an anhydrous, inert organic solvent by the addition of bromine. The resulting bromolecithalbumin can be converted into bromolecithin by the usual methods for the conversion of lecithalbumin into lecithin. The resulting bromolecithin is much purer than the bromolecithins prepared up to the present from lecithin itself, which is liable to decomposition by oxidation.—W. G.

Bacteriological culture media and liquids; Preparation of ——. O. Kammann, Hamburg. Ger. Pat. 307,831, 9.4.16.

Peptone prepared from yeast and dried is used. This peptone is obtained as a yellowish-white powder, easily soluble in water. The method is of importance for bacteriological-diagnostic purposes and for the preparation of vaccines.—W. G.

Cystin and its derivatives; Preparation of water-soluble compounds of ——. B. Stuber, Freiburg. Ger. Pat. 307,858, 12.12.16.

When insoluble or sparingly soluble compounds of cystin and its derivatives with mercury, mercuric chloride, and silver are dissolved in solutions of sodium chloride, sodium bromide, sodium thiocyanate, or lithium chloride, and to the solution acetone, ethyl or methyl alcohol, or ether is added in excess, a precipitate is obtained, which is filtered off and dried in a vacuum. The derivatives thus prepared are soluble and possess disinfecting properties and can be used for injections or taken internally to combat typhus or other infectious diseases which have their seat in the liver.—W. G.

Mercury-amino-compounds and complex salts of the same; Preparation of ——. Schwelz. Serum- und Impfinstitut, Berne, Switzerland. Ger. Pat. 307,893, 13.7.16.

By the action of one or more molecules of a mercury salt on 1-phenyl-2.3-dimethyl-4-sulphamino-5-pyrazolone, only the nitrogen reacts with the mercury salt, the sulpho-group remaining intact. The new compounds possess strong bactericidal and spirillocidal properties and should find use in therapy.—W. G.

Tannic acid derivatives; Preparation of compounds of —— with lime. Knoll und Co., Ludwigshafen. Ger. Pat. 308,047, 6.2.15.

By treating acylated tannic acids, such as acetyltannins and formylacetyltannins, or other tannic acid derivatives such as formaldehyde-tannic acid, hexamethylenetetraminetannin, and tanninthymolmethane, with calcium compounds, grey to brown powders, insoluble in water and alcohol, are obtained, valuable for the treatment of dysentery. —D. F. T.

Opium; Production of solutions of the total alkaloids of ——. A. Stephan, Wiesbaden. Ger. Pat. 308,151, 27.6.15.

An aqueous solution of glycerophosphoric acid is used instead of hydrochloric acid for the extraction of the total alkaloids from opium: on account of the nature of the acid it can be used in considerable excess and the deleterious influence of the alkali of the glass thereby avoided.—D. F. T.

Guaiacol; Method for the production of ——. E. H. Zollinger, Zürich, Switzerland, and H. Roehling, Milwaukee, Wis. U.S. Pat. 1,281,662, 15.10.18. Appl., 6.1.17.

See Ger. Pat. 305,281 of 1916; this J., 1918, 487 A.

Treating cocoa, etc. Eng. Pat. 120,178. *See* XIX A.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Methyl-Violet as a red sensitiser of the photographic plate. U. Yoshida. Mem. Coll. Sci., Kyoto Imp. Univ., 1918, **3**, 69—71.

Photographic plates were sensitised by bathing for 5 mins. in a 1 : 20,000 solution of Methyl Violet in 50% alcohol, with the addition of 5% of ammonia, the bath being cooled by melting ice. The maximum of the conferred sensitiveness was at 640 $\mu\mu$, but no better result was obtained than is given by the Wratten panchromatic plate. Bathing an orthochromatic plate in this solution gave a plate sensitive to almost all colours down to about 660 $\mu\mu$, with a definite minimum in the green at 530 $\mu\mu$.—B. V. S.

Light-sensitive films; Law of blackening of ——. F. Halla and A. Schuller. Z. physik. Chem., 1918, **93**, 173—182.

Mathematical relationships between the time of exposure to light and depth of darkening of a light-sensitive film are deduced. These relationships are also extended to the case where the film lies on a reflecting base. The peculiarities observed in the darkening curves cannot be explained by the scattering of light.—J. F. S.

Diffusion into gelatin. Von Fürth and Bubanović. *See* XV.

Balsam problem. French. *See* XXIII.

PATENT.

Colour photography. Hess-Ives Corporation, Assignees of F. E. Ives, Philadelphia, Pa., U.S.A. Eng. Pat. 112,769, 12.11.17. (Appl. 16,572/17.) Int. Conv., 15.1.17.

SEE U.S. Pat. 1,268,847 of 1918; this J., 1918, 607A.

XXII.—EXPLOSIVES; MATCHES.

PATENT.

Nitrated cellulose; Apparatus for drowning, washing, and conveying ——. J. D. Flack, New York. U.S. Pat. 1,280,981, 8.10.18. Appl., 9.2.16.

AN elongated shallow trough containing wash water is provided with a stationary false bottom, the ends of which are spaced from the ends of the trough. A screen, forming a continuation of the false bottom, is fitted at the discharge end. The nitrated cellulose is fed into the water above the false bottom at the inlet end, and is immersed, washed, and worked along by a paddle to the discharge end, where it is retained by the screen. The water passes through the screen and returns to the inlet end below the false bottom.—T. St.

XXIII.—ANALYSIS.

Balsam problem [in optical instruments]. J. W. French. Trans. Opt. Soc., 1918, **19**, 143—163.

THE cementing together of the various parts of an optical system by means of Canada balsam is the commonest method of assembling the parts and has advantages over the other three methods described, namely mechanical fixing with air spaces between contiguous faces, optical contact between faces with or without a seal of cement round the edge, and the Parker and Halliday method of heating with surfaces in optical contact up to welding point. The method, however, is not without objection owing to the possibility of "starring" of the balsam and separation of the parts in course of time or as a result of shock, and of distortion of the surfaces sufficient to cause defects of definition. Mastic, colophony, copal, balsam of Tolu, and fish glue have also been used as cements; the advantage of one cement as compared with another lies rather in its physical properties, such as working temperature, hardness of setting, brittleness when set, and contraction with setting than in the exact refractive index or degree of dispersion. The contraction of the cement on drying or setting, which if excessive produces "starring" or distortion or both, is very small with Canada balsam, slightly less with colophony, while with "zapon" (celluloid in amyl acetate and acetone) it is several hundredfold greater. The examination of a number of old cemented optical parts showed that the hardening of the balsam extends only 1 to 4 mm. from the edge, the centre being almost uniformly soft; where melted balsam had been used for cementing, the outer ring was found to be very brittle and not directly adherent to the glass itself but separated from it by a thin oily film. A number of illustrations of various defects, "starring," and separation are given, chiefly defects produced by long-continued baking of the balsam. In the subsequent discussion the addition of castor oil or cedarwood oil, up to about 4%, to reduce the brittleness of the dried balsam and consequent tendency to "starring," was advocated.—B. V. S.

Thermo-couples. Ber. Physik.-Techn. Reichsanstalt, 1917. Stahl u. Eisen, 1918, **38**, 1044.

FROM tests with various base-metal thermo-couples the following conclusions are drawn: Thermo-couples with one element of iron (constantan-iron, nickel-iron) should not be used above 800° C. Couples having a free thin nickel wire should not be used for long periods at temperatures above 1100° C. in contact with air, and will in future only be tested up to this temperature by the Reichsanstalt. Couples formed by 3 mm. wires of nickel and nickel-chromium respectively may, however, be used up to 1200° C. Nickel-carbon couples consisting of nickel wire passing through a concentric carbon tube and thus protected against oxidation may be used for a considerable time at 1200°C., and for short periods at 1250° C.

Dialysers made from colloidal membranes. L. Berczeller. Biochem. Zeits., 1918, **90**, 302—304.

THE author discusses the adsorption of iodine by collodium membranes and the alterations of the permeability of the membranes according to whether they are treated with water when the organic solvent is still in them or when they are nearly free therefrom. (See also J. Chem. Soc., Jan., 1919.)—S. B. S.

Potassium bichromate; Oxidising action of —— as compared with that of pure iodine. C. R. McCrosky. J. Amer. Chem. Soc., 1918, **40**, 1662—1674.

IT is shown that in iodometric determinations potassium bichromate always liberates more iodine than the theoretical quantity from hydriodic acid. This excess of iodine may be reduced but not entirely removed by expelling dissolved air from the solutions, by drying and fusing the bichromate in the absence of air, and by recrystallising it repeatedly to remove oxidising impurities. It is also shown that the excess iodine is in no way due to the catalytic action of chromium chloride.

—J. F. S.

Calcium; Gravimetric determination of —— and the separation of calcium from magnesium. L. W. Winkler. Z. angew. Chem., 1918, **31**, 187—188, 203, 214—216.

CALCIUM is best precipitated as oxalate by acidifying the neutral solution with acetic acid, adding an excess of ammonium chloride, and treating the boiling solution with ammonium oxalate. After 24 hours, the precipitate is collected, washed, dried at 100° C., and weighed. It may be ignited to oxide before being weighed, but this is not recommended, especially if the solution contained sulphate. In such case, the calcium oxalate always contains calcium sulphate, but this contamination does not affect the weight of the calcium oxalate as the two salts have about the same molecular weight. Potassium salts and chromates do not interfere with the determination, but the results are too high when sodium salts are present. Calcium may also be precipitated as carbonate, provided that ammonium salts and chromates are not present in the solution. To separate calcium from magnesium, 100 c.c. of the solution, containing not more than 0·1 grm. of calcium or 0·05 grm. of magnesium, is treated with 3 grms. of ammonium chloride and 10 c.c. of *N*/1 acetic acid, boiled, and 20 c.c. of 2·5% ammonium oxalate solution is added. After 18 hrs., the calcium oxalate is collected and weighed, and the magnesium in the filtrate is precipitated as ammonium magnesium phosphate and weighed as such.—W. P. S.

Lipoids; Micro-estimation of —— by titration. I. Bang. Biochem. Zeits., 1918, **91**, 86—103.

The fats are oxidised by potassium chromate solution at ordinary temperature in presence of excess of sulphuric acid. Excess of the chromate is then estimated by the addition of potassium iodide and titration of the liberated iodine by thiosulphate solution. The fat (from blood, etc.) is separated by extraction with benzene, a little alkali is added (to emulsify the fat) and then the solvent is distilled off. Cholesterol can be estimated in the same manner, and the same factor can be employed in making the calculations; this factor is determined empirically, as under the conditions of experiment employed the oxidation is not complete. When cholesterol is present with fats, the determination of both constituents can be made by precipitation of the cholesterol by digitonin which is insoluble in benzene. Methods are also given for the estimation of the cholesterol esters in the presence of fats, and a preliminary account is given of the methods of estimating the lipoids. (See also J. Chem. Soc., Jan., 1919.)—S. B. S.

Petroleum oils. Tausz. *See* IIA.

Lubricating oils. Dubrisay. *See* IIA.

Sodium peroxide. Milbauer. *See* VII.

Silica bricks. Montgomery and Office. *See* VIII.

Plasticity of clays. Kirkpatrick and Orange. *See* IX.

Superphosphates. Aita. *See* XVI

Baking powder. Rupp and Wohnlich. *See* XIXA.

Determination of morphine. Tingle. *See* XX.

PATENTS.

Hydrometers. P. Stevenson, Edinburgh. Eng. Pat. 120,659, 15.12.17. (Appl. 18,686/17.)

A hydrometer of the type comprising a closed bulb containing ballast, connected to a graduated stem, is provided with a tube of smaller diameter than the stem extending down through it and through the bulb. This tube is open at the top and bottom, and is sealed into the bottom of the bulb so as to be open to the liquid which thus rises in the tube to the level of the external liquid. The sensitiveness of the instrument is thereby increased without decreasing the diameter of the stem and the legibility of the graduations.—W. F. F.

Combustible gases or vapour in the atmosphere; Appliance for giving a warning of the presence of ——. A. and L. D. Williams, and The Thames Trading Co., Ltd., London. Eng. Pat. 120,661, 28.12.17. (Appl. 19,168/17.)

An electrically conducting rod of fusible metal, such as tin, is surrounded by a solid cylinder of non-conducting material impregnated or coated with finely-divided platinum. An electric heating coil is wound on the cylinder to warm it and maintain the platinum in active condition so that surface combustion of the combustible gases in the surrounding atmosphere takes place. If the temperature becomes sufficiently high due to excess of combustible gas, the central rod fuses, and the breaking of the circuit operates an alarm. The fusible rod may be maintained in tension by a spring at each end, the springs being connected in series with the heating coil, a battery, and the electromagnet of an electric bell. When the circuit is broken by the fusion of the rod, the magnet is de-energised, and the hammer falls back and completes a shunt circuit forming the normal circuit of the bell, which thus continues to ring. In a modification, the breaking of the fusible rod releases a cam which is rotated by a clock spring and operates a bell mechanically. In another modification the impregnated cylinder or disc is dispensed with and the fusible rod is placed transversely across a vertical tube through which the air passes upwards. An independent electric heating coil is placed in the tube below the fusible rod and causes combustion of the gas. When the temperature is sufficiently high, the rod is fused and an alarm is operated. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 3644 of 1882, 6364 of 1911, 15,094 of 1915, and 110,439; this J., 1916, 1273; 1917, 1248.)—W. F. F.

Gas analysis by absorption with solid substances; Apparatus for ——. H. Strache, Vienna, and K. Kling, Lemberg. Ger. Pat. 308,005, 8.11.16.

The apparatus consists essentially of a small cylindrical pump, in which there is a definite volume enclosed between the two extreme positions of the piston. The two ends of the cylinder are connected by tubes with a nine-way tap by means of which the cylinder may be connected as required with the gas inlet, the absorption chamber, the outer air, and a manometer. The absorption vessel is a large tubulated jar.—W. G.

Viscosimeter. R. F. MacMichael, Auburn, Wash. U.S. Pat. 1,281,042, 8.10.18. Appl., 5.10.14.

A vessel containing the liquid to be tested is supported on a platform which carries a footstep bearing and is continuously rotated. A horizontal disc is suspended in the liquid by a torsion wire, the upper end of which is looped and supported by a pair of grooved pins carried by a vertical standard. The torsion wire is enclosed in a vertical tube which is attached to the disc at the bottom and to an indicating dial at the top. The viscosity is measured by the angular rotation of the disc as indicated by the dial. The support for the vessel contains an electrical heating coil to vary and control the temperature of the liquid. (See also this J., 1915, 1226.)—W. F. F.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Acton. Apparatus for separating solid particles from liquids. 21,756. Dec. 30.

Alexander (United Filters Corpn.). Continuous vacuum filters. 21,759. Dec. 30.

Boland. Drying process. 21,927. Dec. 31.

Fenton and Vivian. Rotary kilns, and means for heating same. 21,470. Dec. 21.

Francart. Method of operating furnaces, kilns, ovens, etc. 21,322. Dec. 19.

Francart. Tunnel furnaces, kilns, ovens, etc. 21,323—21,326. Dec. 19.

Francart. 21,327. *See* VIII.

Furness. Filter plate for filtering acids etc. 20,917. Dec. 16.

Graham and Honeywood. Crushing or grinding machinery. 21,279. Dec. 19.
Hardinge. Grinding mills. 21,553. Dec. 23.
Hughes. Carrying out certain chemical reactions and physical actions. 21,452. Dec. 21.
Jennings. Grinding machines. 21,102. Dec. 17.
Johansson. Separators. 21,062. Dec. 17.
Kilburn (Sulzer Frères). Condensing or evaporating apparatus. 21,204. Dec. 19.
Mason. Filter press plates. 21,231. Dec. 19.
Rivett. Grinding machines. 21,076. Dec. 17.
Shaw. Apparatus for evaporating or concentrating liquids. 21,286. Dec. 19.
Thatcher. Diaphragms, etc., for separating two liquids. 21,799. Dec. 30.
Wade (Lindbergh). 21,462. *See* VII.
Webster. Filter presses. 21,057. Dec. 17.

COMPLETE SPECIFICATIONS ACCEPTED.

8926 (1917). Bradley. *See* XI
18,870 (1917). Menzies. Apparatus for use in treating liquids with gases. (121,521.) Dec. 31.
19,209 (1917). Laurie. Drying solid substances precipitated from solutions in water or other liquids. (121,372.) Dec. 30.
2178 (1918). Maxwell. Dehydrating vegetable, textile, and other substances. (121,394.) Dec. 30.
6357 (1918). Adt Co. Drying apparatus. (117,603.) Dec. 30.

14,943, 14,944, and 14,947 (1918). Bradley. *See* XI.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Abrahams and Bamber. Generation of producer gas. 21,539. Dec. 23.
Ballinghall and Dempster. 20,941. *See* VII.
Christopher. Distilling, carbonising, or gasifying coal, carbonaceous material, oil shales, etc. 21,724. Dec. 30.
Colman and Yeoman. Extraction and recovery of carbon bisulphide. 21,389. Dec. 20.
Crush. Gas-producing plant. 21,021. Dec. 17.
Davidson. Preparation of damp peat for manufacture of producer gas. 21,502. Dec. 23.
Davies. Carbonising fuel by vertical coke ovens etc. 21,239. Dec. 19.
Eastick and Eastick. 20,971. *See* XVII.
Francart. 21,327. *See* VIII.
Gonville. Fuel. 21,378. Dec. 20.
Hewitt Construction Synd., and Whitcher. Appliances for steaming gas retorts. 21,637. Dec. 24.
Ionides. Gaseous combustion. 21,314. Dec. 19.
Lea. Briquetting peat. 21,540. Dec. 23.
Remfry. Retorts for distilling shale etc. 21,819. Dec. 30.
Tinker. Production of petrol. 21,289. Dec. 19.
Tinker. Fuel oils. 21,588. Dec. 24.
Topp. Elimination of water from peat etc. 21,881. Dec. 31.

COMPLETE SPECIFICATIONS ACCEPTED.

14,997 (1917). Oil Extractors, Ltd., and Lamplough. Coal-distilling apparatus. (121,496.) Dec. 31.
18,249 (1917). Nelson. Gas-producers. (112,128.) Dec. 30.
18,653 (1917). Ellis, Foster, and Ellis-Foster Co. Making lighter from heavier petroleum oils. (121,356.) Dec. 30.
18,815 (1917). Grocott. Furnaces for the generation and combustion of producer gas. (121,516.) Dec. 31.
19,245 (1917). Twynam. Production of artificial fuel and utilisation of peat (121,373.) Dec. 30.

III.—TAR AND TAR PRODUCTS.

APPLICATION.

Matthews and Strange. 21,402. *See* XX.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

Ehrhardt and Merriman. Manufacture of afterchroming azo dyestuffs. 21,445. Dec. 21.
Holliday and Law. Production of colouring matters of anthraquinone series. 21,340 and 21,341. Dec. 20.

COMPLETE SPECIFICATION ACCEPTED.

18,484 (1917). Angel (Angel). Manufacture of compounds to be used as colouring matters or in the manufacture of colouring matters. (121,347.) Dec. 30.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Charlesworth. Machines for drying hanks of yarn. 21,255. Dec. 19.
Jamieson. Paper manufacture. 21,748. Dec. 30.
Pellerin. Manufacture of filaments from hydrated cellulose. 21,084. Dec. 17. (Fr., 20.11.13.)
Puttaert and Puttaert. Manufacture of pulp and paper from garbage. 20,972. Dec. 16.
Rawlins. Treatment or preparation of paper etc. 21,421. Dec. 21.
Skinner. Pulps and fibres for paper-making etc. 21,790. Dec. 30.
Stockton. Purifying cottonseed hull fibre. 21,906. Dec. 31.

COMPLETE SPECIFICATIONS ACCEPTED.

17,920 (1917). Croll. Manufacture of waterproof paper. (121,318.) Dec. 30.
2178 (1918). Maxwell. *See* I.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATION.

Lord and Lord. Machines for dyeing, washing, scouring, sizing, bleaching, and mercerising yarn in hank form. 21,864. Dec. 31.

COMPLETE SPECIFICATION ACCEPTED.

1941 (1918). Longthorne, and Leather, Ltd. Textile fibre printing processes. (121,390.) Dec. 30.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Ashcroft. 21,595. *See* X.
Ballinghall and Dempster. Process relating to reducing operations in hydrogen-making plants. 20,941. Dec. 16.
Brightmore. Apparatus for fixing atmospheric nitrogen. 21,318. Dec. 19.
Furness. 20,917. *See* I.
Grauel. Recovery of potassium from potassium-bearing silicates. 21,808. Dec. 30.
Norske Aktieselskab for Elektrokemisk Industri. Production of alumina poor in iron. 21,659. Dec. 24. (Norway, 8.4.18.)
Soc. Industrielle de Produits Chimiques. Conversion of alkaline monochromates into bichromates. 21,503. Dec. 23. (Fr., 5.1.18.)
Wade (Lindbergh). Recovering salts from mother liquors. 21,462. Dec. 21.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Adair. Drying china clay. 20,912. Dec. 16.

Donald. Manufacture of refractory materials such as bricks, blocks, etc., used in construction of furnaces, etc. 21,038. Dec. 17.

Francart. 21,322—21,326. *See* I.

Francart. Drying bricks, tiles, pottery, peat, etc. 21,327. Dec. 19.

Marks (Kohler Co.). Manufacture of enamelled ware. 21,557. Dec. 23.

Sankey. Manufacture of firebricks, blocks, tiles, retorts, etc. 21,315. Dec. 19.

Shaw, Shaw, and Shaw. Furnaces for melting glass etc. 21,443. Dec. 21.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Donald. 21,038. *See* VIII.

Francart. 21,327. *See* VIII.

Gronroos. Production of hard flooring or insulating slabs. 21,264. Dec. 19. (Denmark, 19.3.18.)

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Annable and Janson. Treatment of ores, etc., containing scheelite. 21,924. Dec. 31.

Ashcroft. Production of magnesium or magnesium alloys and magnesium chlorate or alkali chlorate. 21,395. Dec. 20.

Bloxam (Stabilimenti Blak-Ing. A. Pouchain). Metallurgical furnaces. 21,542. Dec. 23.

Dresden. Soldering metals. 21,514. Dec. 23.

Griggs. Open-hearth furnaces. 21,550. Dec. 23.

Jackson, Lancaster, Rogers, and Walter. Treatment of tinned scrap. 21,520. Dec. 23.

Janson. Ore-roasting furnaces etc. 21,171. Dec. 18.

Soc. Anon. de Commentry Fourchambault et Decazeville. Alloys containing iron, nickel, and chromium. 21,068—21,070. Dec. 17. (Fr., 19, 20, and 21.12.17.)

Stein et Cie. Charging steel-melting etc. furnaces. 21,794. Dec. 30. (Fr., 12.9.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

13,131 (1917). Edser, Tucker, and Minerals Separation, Ltd. Concentration of ores. (121,303.) Dec. 30.

16,512 (1917). Dickson and Nicklen. Manufacture of steel. (121,311.) Dec. 30.

7650 (1918). Grondal. Mechanical roasting-furnace. (115,639.) Dec. 31.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Campbell. Electric furnaces. 21,541. Dec. 23.

Fenton. Electric furnaces. 21,831. Dec. 30.

Joel. Electric accumulators. 20,988. Dec. 16.

Magini. Electric arc furnaces. 21,894. Dec. 31. (Italy, 31.12.17.)

Waring and Waring. Electric furnaces. 21,863. Dec. 31.

COMPLETE SPECIFICATIONS ACCEPTED.

8926 (1917) Bradley. Electrical treatment of gases. (107,389.) Dec. 30.

16,261 (1917) and 4529 (1918). Leitner. Electric accumulators. (121,309.) Dec. 30.

3883 (1918). Turner and Walker. Regulating electrodes of electric furnaces. (121,409.) Dec. 30.

6563 (1918). Watson and Co., Greaves, and Etchells. Electric furnaces. (121,563.) Dec. 31.

14,943, 14,944, and 14,947 (1918). Bradley. Electrical treatment of gases. (119,236, 119,237, and 119,238.) Dec. 30.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Donnenberg and Jacobson. Soap. 21,603. Dec. 24.

Engel. Oil-extraction apparatus. 21,410. Dec. 20.

Lane. Apparatus for hydrogenising oils etc. 21,895. Dec. 31.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Damard Lacquer Co. Phenol-formaldehyde condensation products. 21,352. Dec. 20.

Ivinson and Roberts. Anticorrosive paint or composition. 21,504. Dec. 23.

Kenton. Writing composition. 21,438. Dec. 21.

Ponton, Ponton, and Ponton. Manufacturing physical radiant colours. 21,343. Dec. 20.

COMPLETE SPECIFICATIONS ACCEPTED.

18,619 (1917). Sperr and Darrin. Manufacture of paint or varnish. (118,079.) Dec. 30.

988 (1918). British Thomson-Houston Co. (General Electric Co.). Manufacture and application of japan. (121,533.) Dec. 31.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATION.

Stenhouse. Adhesive compound and process of making same. 21,838. Dec. 30.

COMPLETE SPECIFICATIONS ACCEPTED.

18,183 (1917). Cock and Williams. Method of tanning. (121,325.) Dec. 30.

16,968 (1918). Blanc. Process of tanning and manufacture of tanning liquors. (120,049.) Dec. 30.

XVII.—SUGARS; STARCHES; GUMS.

APPLICATIONS.

Eastick and Eastick. Manufacture of decolorising vegetable carbon. 20,971. Dec. 16.

Martin. Manufacture of lactose or milk sugar. 21,833. Dec. 30.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Banks. Treatment of cereals etc. 20,943. Dec. 16.

Prescott. Preserving food by means of carbon monoxide etc. 21,618. Dec. 24.

Puttaert. 20,972. *See* V.

COMPLETE SPECIFICATIONS ACCEPTED.

18,635 (1917). Oxley. Food product. (121,355.) Dec. 30.

2178 (1918). Maxwell. *See* I.

3776 (1918). Goodwin. Treatment of semolina. (121,408.) Dec. 30.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Arellano. Medicament. 21,578. Dec. 23.

Matthews and Strange. Separating derivatives of *o*- and *p*-toluenesulphonic acids and manufacturing saccharin. 21,402. Dec. 20.

New Oxydol Products, Ltd., and Ramsay. Pharmaceutical preparations. 21,297. Dec. 19.

I.—GENERAL; PLANT; MACHINERY.

Colloid chemistry and its industrial application. F. G. Donnan and others. Rep. Brit. Assoc., 1917, 20—105.

THE first report of a committee appointed to compile information regarding the advances made in capillary and colloid chemistry with special reference to industrial processes. The report includes the following articles:—(1) Viscosity of colloids, 3 *pp.*, E. Hatschek. (2) Colloid chemistry of tanning, 15 *pp.*, H. R. Procter. (3) General review and bibliography of dyeing, 19 *pp.*, P. E. King. (4) Colloid chemistry in the fermentation industries, 3 *pp.*, A. J. Brown. (5) Rubber, 5 *pp.*, H. P. Stevens. (6) Colloid chemistry of starch, gums, hemicelluloses, albumin, casein, gluten, and gelatin, 32 *pp.*, H. B. Stocks. (7) Colloids in the setting and hardening of cements, 4 *pp.*, C. H. Desch. (8) Nitrocellulose explosives from the standpoint of colloidal chemistry, 2 *pp.*, E. R. Chrystall. (9) Celluloid from the standpoint of colloidal chemistry, 2 *pp.*, E. R. Chrystall. Very full bibliographies are included.—J. F. S.

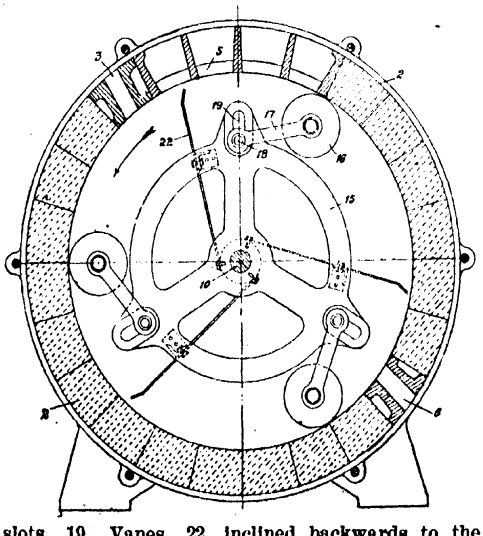
PATENTS.

Grinding mills. A. Schär, Flawil, Switzerland. Eng. Pat. 115,424, 13.4.18. (Appl. 6305/18.) Int. Conv., 3.5.17.

THE material is ground between two vertical plates, one fixed and the other moving up and down in guides so arranged that the two plates are successively divergent upwards, parallel, and then divergent downwards, as the movable plate passes from its highest to its lowest position. The material is thereby received, crushed, and discharged.—W. F. F.

Grinding machines. F. W. Lyon and A. Ross, Liverpool. Eng. Pat. 121,206, 22.12.17. (Appl. 18,999/17.)

MATERIAL to be ground is fed by an opening, 3, into the grinding cylinder, 2, having a rotating cage, 15, provided with radial slots, 19. The grinding rollers, 16, are carried by links, 17, the ends, 18, of which may be pivoted at any point in the



slots, 19. Vanes, 22, inclined backwards to the direction of rotation, are also attached to the cage, 15. The ground material is discharged through a grid, 5, occupying from one quarter to one third of the circumference of the cylinder, and a reduced pressure is maintained in the discharge conduit above the grid. Air is admitted by the opening, 6, and the width of the grid, 5, in relation to the distance between the vanes, 22, is such that the air passes through to the outlet periodically, so that heavier material may fall back from the discharge conduit into the grinding cylinder. The shaft, 10, is mounted in bearings which are carried by short vertical spindles free to slide vertically. Any accumulation of material in the bottom of the grinding cylinder will thus cause the shaft to lift, and this movement may be used to regulate, through suitable mechanism, the supply of material to the machine.—W. F. F.

Crusher and pulveriser. P. S. Knittel, Assignor to American Pulverizer Co., St. Louis, Mo. U.S. Pat. 1,282,239, 22.10.18. Appl., 2.1.18.

THREE radial carrier members are keyed to a horizontal rotating shaft at intervals, and each is provided with a circular aperture near its edge which registers with the apertures in the others, so that a parallel revolving spindle may be carried by them. The portions of the spindle between the carriers are eccentric with respect to the remainder of the spindle, and hollow cylindrical beaters of considerably larger internal diameter are mounted on these eccentric portions. The revolving spindle may be secured in any angular position in its carriers by means of set screws.—W. F. F.

Precipitation; Apparatus for ——. D. C. Walker, Anaconda, Mont. U.S. Pat. 1,281,443, 15.10.18. Appl., 14.3.16. Renewed 24.8.18.

A SERIES of cylindrical precipitation tanks having conical bottoms are arranged at successively lower levels so that liquid can overflow from one to the next. A corresponding number of closed conical settling tanks provided with spraying devices are arranged all at the same level below the precipitating tanks. The precipitating tanks are each provided with perforated containers for the precipitant and with a screen below the container. The tanks are connected by a system of pipes and valves so that the liquid may flow from the precipitating tanks to the settling tanks, where the precipitate is deposited and subsequently discharged. The liquid may also be made to flow by hydrostatic pressure from the upper part of one settling tank to the top of the next precipitating tank, or the liquid flowing from the bottom of one precipitating tank may be diverted into the upflow pipe from its own settling tank and so pass direct to the next precipitating tank.
—W. H. C.

Subdivided solid materials; Apparatus for subjecting —— to the action of a current of gases. E. B. Kirby, St. Louis, Mo. U.S. Pat. 1,281,585, 15.10.18. Appl., 21.7.14.

THE receptacle containing the material is provided with a number of perforated hollow vertical partitions. Alternate partitions are connected to the supply and discharge pipes for the gas, so that the gas flows from one partition to the next through a uniform thickness of material. Means are provided for charging the solid material at the top and discharging the finished product at the bottom without tilting the receptacle. The perforations in the partitions are at such a depth in the material that gas is prevented from escaping upwards, and the wall of the receptacle adjacent to the charging opening is inclined so as to prevent the material from being lifted out by gas pressure below.
—W. F. F.

Emulsions; Process and apparatus for dehydrating ——. F. W. Harris, Los Angeles, Cal. U.S. Pat. 1,281,952, 15.10.18. Appl., 4.4.17.

A PAIR of electrodes are immersed in the emulsion and brought sufficiently close to one another to cause "water chains" to be formed between them, and allow heavy short-circuit currents to flow. The electrodes are then separated to interrupt the short-circuit currents.—W. F. F.

Filter-press plate. J. E. Hagstrom, Brooklyn, N.Y., Assignor to The Independent Filter Press Co., Inc., New York. U.S. Pat. 1,282,144, 22.10.18. Appl., 26.1.18.

A FILTER-PRESS plate comprises a rigid frame carrying a grooved "field" which is movable within the frame.—T. St.

Filtering apparatus. A. R. Peck, Los Angeles, Cal. U.S. Pat. 1,282,280, 22.10.8. Appl., 28.8.16.

A FILTER-LEAF is formed with a flattened tubular rim having a slot into which the marginal portion of a wire screen fits. The tubular rim is provided with spacing lugs, with upper and lower outlets, and with a pet-cock.—W. H. C.

Pump for acids. H. Tobler, Hackensack, N.J. U.S. Pat. 1,282,145, 22.10.18. Appl., 23.4.18.

Two cylinders having similarly arranged inlets and outlets are each provided with an internal flexible tube connecting the inlet and outlet. The inlets are connected with a pipe supplying the liquid to be pumped and the outlets with a discharge pipe. The cylinders are connected respectively with the opposite ends of a third cylinder provided with a reciprocating piston which alternately forces water or other suitable liquid into and withdraws it from the cylinders containing the flexible tubes. The flexible tubes are consequently alternately contracted and expanded, and the acid liquid is discharged through the outlet connected with the contracted tube and a fresh quantity drawn in through the inlet connected with the expanded tube.—W. H. C.

Furnace; Regenerative ——. A. L. Stevens, Chicago, Ill. U.S. Pat. 1,282,649, 22.10.18. Appl., 25.9.16.

THE combustion chamber of a regenerative furnace is provided with fuel-supply pipes connected to sets of burners which are used alternately, and each pipe is connected to a valve chamber having a diaphragm with an opening which may be closed by a revolving damper valve. The valves are operated in succession by Geneva movements which are timed so that a closed valve is opened only after an appreciable time subsequent to the closing of an open valve.—W. F. F.

Liquids and powdered material; Process for mixing ——. Akt.-Ges. Siegener Dynamitfabrik, Fürde. Ger. Pat. 308,783, 11.3.16.

THE materials to be mixed, in the course of their upward and downward movement through the apparatus, are also moved in a horizontal direction from the circumference to the centre and *vice versa* in order to ensure a thorough mixing. The apparatus consists of a vertical cylindrical container with a conical bottom; a pair of tubes with projecting arms are suspended side by side within the cylinder and rotated in opposite directions through a certain angle. The vertical distance between the arms in the upper part of the vessel is smaller than that between those in the lower portion in order to break up any lumps. Inside the tubes are worm conveyors, and the shafts of the tubes and the worm conveyors are carried on bearings situated above and outside the vessel. The tubes are driven by eccentrics and the worm-shafts by rope pulleys from the same counter-shaft. Above the uppermost arms, the two tubes are pierced with several outlets, above which the worm shaft carries a screw which forces the material downwards.—J. F. B.

Lead linings for accumulator boxes, cistern boxes, and the like; Method of and apparatus for manufacturing ——. W. G. and J. W. Claughton, Manchester. Eng. Pat. 121,383, 17.1.18. (Appl. 945/18.)

Drying apparatus. The John B. Adt Co., Assignees of J. B. Adt, Baltimore, Md., U.S.A. Eng. Pat. 117,603, 15.4.18. (Appl. 6357/18.) Int. Conv., 17.7.17.

SEE U.S. Pat. 1,255,843 of 1918; this J., 1918, 197 A.

Dry kiln. H. Hunter, Indianapolis, Ind., U.S.A. Eng. Pat. 120,809, 14.12.17. (Appl. 18,626/17.)

SEE U.S. Pat. 1,254,142 of 1918; this J., 1918, 197 A.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coke breeze; Briquetting of ——. Kayser. J. Gasbeleucht., 1918, **61**, 541—547, 556—558.

COKE breeze requires from 9 to 10% of pitch as binding material for briquetting purposes. In the "Koxit" process, patented by Alexander, part of the pitch is replaced by a cheaper fluid binding material consisting of oil-gas tar and vertical-retort tar in about equal parts. The mixture of coke, pitch, and liquid binding medium is heated with superheated steam and pressed into egg-shaped briquettes. In a series of trials, the moisture content of the coke breeze varied from 9·3% to 19·9%. The softening point of the pitch was 83° C. A satisfactory briquette was obtained by the addition of about 5% pitch and from 0·8 to 1% of the liquid binding material. The air-dried briquettes contained about 3·5—4·5% of water and yielded about 14—16% ash. The calorific value was 6400—6600 cals. The quantity of water taken up when the briquettes were stored under water for 7—8 days ranged from 13 to 18·6%, as compared with 11·9% by brown coal briquettes under similar conditions. The loss of weight after transport by rail, unloading, and storing for 6 months was in three tests with large quantities (3200, 3250, and 7200 kilos.) 4·1, 6·3, and 4·3% respectively. For preference the pitch should have a softening point between 60° C. and 75° C. For steam-raising purposes, an addition of from 20 to 25% of coal dust is in general necessary to secure efficient combustion. The briquettes do not crumble when burnt and this is due to the coking of the fluid binding material during the combustion. This coking effect is increased by the use of liquid binding materials capable of acting as solvents for the pitch, and of such materials, vertical retort and chamber oven tars and oils, such as anthracene oil, are found particularly suitable. Very viscous binding material is not suitable, as by its use air is entrapped in the pores of the coke breeze and the briquette on subsequent combustion crumbles owing to the expansion of the entrapped air. A process has been patented whereby this effect is reduced by adding the liquid binding material under reduced atmospheric pressure. The

total cost of manufacture including establishment charges, cost of material and labour, since the commencement of the war has amounted to M.7·67 per ton. The sale price, determined by the relative calorific values of the respective fuels, is about 14 to 15% lower than that of coke.
—J. S. G. T.

Methane. W. Malisoff and G. Egloff. J. Phys. Chem., 1918, **22**, 529—575.

THIS paper contains a summary from all sources of the investigations which have been carried out on methane, under the following headings: physical constants; specific properties; gas properties; industrial application of physical characteristics; combustion and explosion; solubility in various solvents; occlusion; industrial reactions of methane including oxidation, halogenation, carbides from methane, cyanide formation; synthesis and decomposition of methane by chemical, catalytic, and electrical methods; sources and supply of methane. It is pointed out that the consumption of natural gas in America in 1917 reached the figure of 900,000,000,000 cub. ft., this gas averaging 78·2% methane. The great importance of further research on the gas is emphasised and a list of 53 different problems requiring investigation is given.—E. H. R.

Acetylene condensations; Pyrogenic —. V. R. and W. Meyer. Ber., 1918, **51**, 1571—1587.

CONTINUING the previous investigation (Ber., 1917, **50**, 422) the authors have detected *o*-xylene, mesitylene, ψ-cumene, and indene, but not durene or isodurene in the tar obtained by the pyrogenic condensation of acetylene. α-Thiotolene has been found in the condensation product of the acetylene-methane-hydrogen sulphide mixture, and thionaphthene in that of the acetylene-hydrogen sulphide mixture. The velocity of the gaseous mixture through the three ovens (at 550° C., 630° C., and 850°—900° C. respectively) is of importance. When the rate is 70—90 litres per hour the hydrocarbons of high boiling-point are formed in larger quantities than at faster rates (about 120 litres per hour), at which the formation of the more easily volatile substances predominates. The formation of aniline from benzene vapour and ammonia at 550°—700° C. has been observed. (See also J. Chem. Soc., Feb., 1919.)—C. S.

Acid tars [from petroleum refining]; Oily constituents of —. S. Gaslorowski and G. von Kozicki. Bergbau u. Hütte, 1918, **4**, 181—182. Z. angew. Chem., 1918, **31**, Ref., 354.

AN oil of sp. gr. 0·9685 at 18° C., setting pt. −19° C., flash point (Martens-Pensky) 86° C., and viscosity (Engler) 2·2° at 20° C. has been obtained by steam distillation of the acid tar produced by diluting with water the waste acid of petroleum refining. The oil was completely soluble in liquid sulphur dioxide, a proof that the chief function of the sulphuric acid in petroleum refining is to remove unsaturated compounds. Different fractions of the oil separated by vacuum distillation showed no variation in specific gravity. No nitro-derivative could be prepared from the distillate obtained by destructive distillation of the oil, showing that further unsaturated compounds are formed during the decomposition.—L. A. C.

Sulphur in spent oxide. **Twisselmann.** ***See*** **VII.**

PATENTS.

Burners; Gaseous or liquid fuel —. Alldays and Onions Pneumatic Engineering Co., Ltd., and A. Nicholson, Birmingham. Eng. Pat. 120,770, 21.11.17. (Appl. 17,139/17.)

A GASEOUS or liquid fuel burner is provided with a central fuel supply tube, tapering internally, and tapering or cylindrical externally, at the nozzle end. The flow of fuel is regulated by an axial needle valve. Air is supplied through a concentric outer tube also having a converging nozzle, surrounding the fuel nozzle. The nozzle portion is screwed on to the body portion so as to be adjustable axially to regulate the air, and helical vanes may be provided in the nozzle to give the air a whirling motion. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 12,060 of 1898; this J., 1899, 478.)—W. F. F.

Fuel; Motor —. J. Penhale, Johannesburg. Eng. Pat. 120,792, 3.12.17. (Appl. 17,858/17.)

A FUEL for internal combustion engines consists of alcohol substantially saturated with acetylene, and containing about 1% of acrolein.—W. F. F.

Fuel. L. le W. Hamon, Dublin. Eng. Pat. 121,102, 20.8.18. (Appl. 13,533/18.)

THE fuel consists of liguite, peat, sud, leaf-mould, or shale 50—60%, cellulose 15—20%, silica 12·5—15%, pitch or tar or their residues, or oil residues 20—25%, and alkali 2·5—5%. In a modification, graphite, carbon, anthracite, or coal dust, coke breeze, slag, cinders, or culm, 15—20%, may be added, and the proportions of cellulose and silica reduced, and in another modification, clay ironstone, blackband, iron-sand, manganese ore, or iron oxide, 1—2%, may also be added. The mixture may be briquetted, and may be converted into smokeless fuel by distillation in a retort.—W. F. F.

Gas-producers or other chambers; Apparatus for feeding fuel or other material to —. F. Thuman, Westminster. Eng. Pat. 120,853, 4.5.18. (Appl. 7532/18.)

A REFRACTORY "sounder" rests on the surface of the fuel-bed and is connected at its upper end to a movable section or spout in the inclined channel which feeds the fuel into the distributing hopper. If the fuel bed rises above a predetermined height, the movable section is raised and the fuel supply automatically reduced or cut off. In a modification a "sounder" carried by a lever arm works through a slot in the side of the producer and is connected to the feed-spout.—T. F. E. R.

Coal-gas; Method and means for generating — *in retorts.* J. and S. Walster, Sheffield. Eng. Pat. 121,146, 24.5.18. (Appl. 15,445/17.)

COAL-DUST is violently agitated, by means of paddles rotated in a suitable chamber, so as to form a cloud or "fog," which is drawn through an off-take pipe by the suction of a gas reservoir or internal combustion engine into a heated retort, where it is immediately gasified. The retort may be heated externally either electrically or by means of oil or gas burners, the gas being supplied from the retort. The exhaust heat from an internal combustion engine may constitute an auxiliary supply for heating the retort.—T. F. E. R.

Producer-gas plants. H. W. Bamber, London. Eng. Pat. 121,161, 30.11.17. (Appl. 17,740/17.)

THE water supplied to the producer for generating steam passes through a regulating device which is

interconnected with the gas-egress valve of the producer or throttle-valve of the engine. The water supply is thus automatically regulated in direct proportion to the amount of gas required for the engine. By an analogous arrangement the water can be supplied to the producer from a float chamber of the carburettor type, the water feed to this chamber from an overhead tank being controlled by a valve which is interconnected with the gas-egress valve of the producer and thereby automatically regulated.—T. F. E. R.

Gas; Process of producing —. B. F. McKee, Arma, Kans. U.S. Pat. 1,282,445, 22.10.18. Appl., 12.12.17.

Gas is generated by feeding carbonaceous material to a rotating vessel having a pair of electrodes embedded in the material, the solid residue being discharged continuously at the bottom.—W. F. F.

Gas; Cooling, cleansing, and filtering devices for —. D. J. Smith, Loudon. Eng. Pat. 121,177, 5.12.17. (Appl. 17,982/17.)

Crude suction-producer gas or the like is passed in a zig-zag path through a water-jacketed cooling chamber, issuing from which it impinges on to projecting ribs and then proceeds through a nest or group of tubes, for further cooling, and then through tubes containing wire gauze filters which remove dust and tarry matter. The cooling jacket may be made to supply hot feed water for boiler purposes. Rubber cushions are provided to allow for unequal expansion of the concentric tubes forming the cooler.—T. F. E. R.

[*Shale*] *oil extracting and refining apparatus.* E. T. Erickson, Salt Lake City, Utah, Assignor to Rainbow Petroleum Products Co. U.S. Pat. 1,281,320, 15.10.18. Appl., 15.4.18.

Crushed oil-bearing shale is passed through narrow metal retorts heated in a furnace. The retorts are spaced at the ends and sides from the walls of the furnace. Perforated pipes are disposed longitudinally in the retorts and are connected in groups by discharge pipes. The pipes leading from the perforated pipes are controlled by valves. —T. St.

Gasoline; Method of manufacturing —. J. B. Weir, New York. U.S. Pat. 1,282,338, 22.10.18. Appl., 11.4.18.

Gasoline is extracted from natural gas by compression and cooling, and the partially denuded gas is passed through an absorbent hydrocarbon liquid. The derived products are blended and after a portion of the more volatile constituents has been driven off, the product is ready for use as gasoline. The more volatile constituents thus removed are absorbed by a hydrocarbon liquid heavier than gasoline, and this product is used as the absorbent through which is passed the gas remaining after the initial treatment of fresh quantities of natural gas.—T. St.

Lubricants; Process of treating used —. J. O. Handy, Assignor to Pittsburgh Testing Laboratory, Pittsburgh, Pa. U.S. Pats. (A) 1,281,354 and (B) 1,281,355, 15.10.18. Appl., 23.5 and 5.7.17.

(A) Used lubricating oil is clarified, dissolved in a hydrocarbon solvent, and solid suspended matter removed. The solution is decolorised by adsorption, and treated successively with an alkali and an acid. The acid is allowed to separate, the solution neutralised and washed, and finally the solvent is removed by distillation. (B) The decolorised solution obtained as described under (A) is treated with caustic alkali, washed, and the solvent distilled off.—T. St.

Lubricating oil; Substitute for —. Farbw. vorm. Meister, Lucius und Brüning. Ger. Pat. 308,385, 3.10.15.

Anhydroformaldehyde derivatives of toluidine or xylidine, or mixtures of the same, liquid at ordinary temperatures, may be used for lubricating purposes.—L. A. C.

Peat; Raising and drying —. T. E. Doyle, Dublin. Eng. Pat. 120,850, 23.4.18. (Appl. 6801/18.)

Briquetting [*coal, etc.*]; *Method of* — *and the product.* E. R. Sutcliffe, Leigh, Assignor to Pure Coal Briquettes, Ltd., Cardiff. U.S. Pat. 1,283,354, 29.10.18. Appl., 27.3.15.

See Eng. Pat. 5019 of 1915; this J., 1916, 592.

Coke-ovens; Converting beehive — *into by-product ovens.* B. Zwillinger, New York. Eng. Pat. 121,085, 17.6.18. (Appl. 9977/18.)

See U.S. Pat. 1,269,895 of 1918; this J., 1918, 538A.

Petroleum oils; Process for making lighter from heavier —. C. Ellis, N. L. Foster, and Ellis-Foster Co., Montclair, N.J., U.S.A. Eng. Pat. 121,356, 15.12.17. (Appl. 18,653/17.)

See U.S. Pat. 1,249,278 of 1917; this J., 1918, 49A.

Distillation. Eng. Pat. 120,854. *See* IIB.

Gas-analysing apparatus. U.S. Pat. 1,281,729. *See* XXIII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Patents.

Distillation; Process of fractional or destructive —. C. Turner, Irlam, Lancs. Eng. Pat. 120,854, 23.11.17. (Appl. 8011/18.)

Liquids such as crude hydrocarbon oils are subjected to fractional or destructive distillation under varying pressures. The pressure is raised by keeping the vessel closed, and then rapidly lowered by opening the vessel. The heating of the vessel is continuous except for the cooling which may occur when the vessel is opened.—W. F. F.

Electrode; Arc-lamp —. I. Ladoff, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,281,796, 15.10.18. Appl., 20.6.14.

An electrode, capable of producing a relatively steady arc, is composed of titanium oxide mixed with a uranium compound.—B. N.

Decolorising carbon. **Eng. Pat. 121,035.** ***See*** **XVII.**

III.—TAR AND TAR PRODUCTS.

Phenol and alkaline liquors; Miscibility of ——. R. Dubrisay, Tripier, and Toquet. Comptes rend., 1918, **167**, 1036—1038.

A DEFINITE weight of phenol was added to a solution of caustic soda of known strength, and the mixture was heated until solution was effected. On cooling and stirring the solution, a cloudiness forms at a certain temperature, corresponding with the equilibrium point. The coefficient of miscibility was found to increase with increasing concentration of the sodium hydroxide solution from *N*/20 to *N*/3, the temperature at which the opalescence appears being gradually lowered from 32·9° C. to 11·8° C. The behaviour of the alkaline-earth bases corresponds with that of the alkalis. Acids and strongly acid salts diminish the miscibility of phenol with water, as also do alkali carbonates, a contrary result to expectations based on the consideration of the hydrolysis of the alkali carbonates.
—C. A. K.

Acetylene condensations. Meyer. *See* IIA.

Arsenotungstic and arsenotungstomolybdic reagents. Guglialmelli. *See* XX.

Differentiating naphthols. Palet. *See* XX.

PATENTS.

4.4'-Diamino-2.2'.5.5'-tetramethyltriphenylmethane; Manufacture of ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 308,785, 9.7.16.

COMMERCIAL xylidine is treated with more than the theoretical amount of benzaldehyde in the presence of acids. The yield of the triphenylmethane-derivative is about 15% of the weight of xylidine.
—L. A. C.

Lubricating oil substitute. Ger. Pat. 308,385. *See* IIA.

Distillation. Eng. Pat. 120,854. *See* IIB.

Paint [from pitch]. Eng. Pat. 118,079. *See* XIII.

Disinfectant. U.S. Pat. 1,282,062. *See* XIXB.

IV.—COLOURING MATTERS AND DYES.

Indole and indigotin groups; Derivatives of —— substituted at the nitrogen atom. A. Albert. Annalen, 1918, **416**, 240—278.

1-HYDROXY-3-BENZOYLOXY-2-THIO-OXINDOLE (Ber., 1916 **49**, 1382) only reacts in the thio-form in forming the acetyl derivative. In other reactions it behaves as a thiol. Thus with phenylhydrazine it forms 3-benzoyloxy-2-thioloxindole-1-phenylhydrazone hydrate, $C_6H_5.NH.N(OH)\diagdown\!\!\diagup C_6H_4\diagdown\!\!\diagup C(SH)\!=\!CH.O.CO.C_6H_5$.

This substance loses its sulphur very easily, *N*/2-sodium hydroxide converting it into 1.1'-bisphenylhydrazinoindigotin, red plates decomposing at 237°—240° C. The latter, which appears capable of reacting also in the tautomeric enolic form, is not a vat dye. It undergoes extensive decomposition on reduction but from it can be prepared indigotin-1.1'-imide, $C_{16}H_8O_2N_2$, violet plates decomposing at 185° C., which is a true vat-dye, the yellow solution obtained by its reduction by alkaline sodium hydrosulphite regenerating the imine by exposure to air. (See also J. Chem. Soc., Feb., 1919.)—C. S.

PATENTS.

Formaldehyde and primary aromatic amines; Manufacture of condensation products of —— [*for the production of azo-dyes*]. A. M. Nastukoff and P. M. Croneberg, Moscow. Ger. Pat. 308,839, 25.12.13.

PRIMARY aromatic amines are treated with formaldehyde, preferably in slight excess, and dilute aqueous mineral acids, such as sulphuric or hydrochloric acid, and heated to the boiling point. Theoretical yields are obtained of pure amino-bases free from oxygen and resin and having definite constant melting points. These bases can be diazotised and azo-dyestuffs can be developed on the fibre giving red, claret, khaki, or yellow shades of excellent fastness to washing, alkalis, and acids.—J. F. B.

β-Anthrimides [vat dyestuffs]; Manufacture of ——. Farbw. vorm. Meister, Lucius, und Brüning. Ger. Pat. 308,666, 27.8.16.

THE reaction products of β-diazoanthraquinones with ammonia are heated in solvents of high boiling point, with or without the addition of condensing agents. Instead of these derivatives the products of the action of cold alcoholic ammonia on β-diazoanthraquinones, which apparently are analogous to bis-diazobenzeneamide, may be employed. β-Anthrimides are valuable vat-dyestuffs.
—J. F. B.

Azo dyestuffs; Production of ——. H. Levinstein, Manchester. U.S. Pat. 1,283,231, 29.10.18. Appl., 14.2.16.

SEE Eng. Pat. 5341 of 1915; this J., 1916, 630.

Mercury derivatives of phthaleins. Ger. Pat. 308,335. *See* XX.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Sulphite pulp from spruce; Effect of varying certain cooking conditions in the production of ——. S. E. Lunak. U.S. Dept. Agric. Bull. 620. Pulp and Paper Mag., 1918, **16**, 815—818, 837—838, 863—864, 889—892.

COMPARATIVE trials were made in an experimental digester, the following factors being kept constant throughout: quantity of spruce chips, 74·2 lb. dry weight; condition of chips, air-dry; quantity of acid liquor, 63 galls.; time to reach 100° C., 2 hours; time to reach maximum temperature, 3 hours. The digester was heated by a closed steam coil, and the pressure was not relieved during the digestion. To determine the end of the digestion process, comparative estimations of the colour of the spent liquor were made, using as standard a coffee extract, clarified by egg-albumin and preserved with formaldehyde. The pulp was blown off, washed 5 or 6 times in the drainer, pressed to about 30% dry weight, passed through a shredder, weighed, and sampled. The main portion was opened out in a beater, diluted, and pumped over a strainer with slots of 0·009 in. in order to determine the weight of screenings. The screened pulp was drained and a portion taken for bleaching trials, while the remainder was brushed out in a beater and made into paper for

colour and strength tests. At a maximum digestion temperature of 135° C. and a constant concentration of 5% of total SO_2, the quantity of combined SO_2 was varied from 0·3 to 2·09%. The results showed that below a certain limit (about 1%) of combined SO_2 digestion was incomplete; the spent liquor darkened without a corresponding digestion effect, the percentage of screenings and the consumption of bleach increased and the colour of the pulp was inferior. On the other hand, increasing the percentage of combined SO_2 beyond 1% had practically no influence on the quality of the pulp, but there was a slight increase in the yield of screened pulp owing to the more thorough digestion. A lower percentage of combined SO_2, however, gave a quicker digestion. Keeping the ratio of free SO_2 to combined SO_2 constant at 4 : 1, it was found that an increase in the total SO_2 gave a more rapid digestion. The percentage of screenings and colour of the pulp began to be influenced unfavourably when the percentage of total SO_2 was decreased below 5%. Increasing the total SO_2 gave a decreased consumption of bleaching powder. With a standard liquor containing 5% of total and 1% of combined SO_2, lowering the temperature of digestion had a beneficial effect on the yield of pulp, the percentage of screenings, the strength of the pulp, and the consumption of bleach; thus all the advantages connected with a milder treatment were obtained; no influence on the colour of the pulp was observed. On the other hand, the time of digestion was greatly prolonged at the lower temperature, 25 hours being required at 110° C. as compared with 5 hours at 146° C., but the longer time permitted a more uniform action and gave a well digested pulp comparatively free from "shives."—J. F. B.

"Sulphite acid" [for wood pulp manufacture]; Analysis of ——. P. Klason. Swedish Pulp and Paper Engineers' Assoc. Pulp and Paper Mag., 1918, **16**, 1015—1018, 1037—1039.

The composition of the fresh acid sulphite liquor is expressed in terms of "free" and "combined" SO_2, as ascertained by iodometric and acidimetric titrations performed either on the same sample (Holm's method) or on separate portions (Winkler's method). The analysis of the exhausted or partially exhausted liquor in the control of the digestion process is complicated by the presence of SO_2 in a loosely combined or reversible form, which affects the alkali titration in the same manner as the half-bound SO_2 (calcium bisulphite) but does not appear as a sulphite until it has been treated with excess of alkali. It is proposed therefore to supplement either of the above methods by a second iodine titration made after treating the liquor with excess of alkali and re-acidifying. The three titrations then afford data from which may be calculated the completely free SO_2, the half-bound SO_2, which indicates the available SO_2 capable of combining with lignin, and the loosely combined SO_2. The last-mentioned form of SO_2, which becomes active after treatment with caustic alkali, reacts more slowly with calcium and barium hydroxides and still more slowly with ammonia. It does not react at all in the cold with calcium carbonate, but to a small extent on heating. It is impossible, therefore, to neutralise a spent sulphite liquor with calcium carbonate alone, because the "reversible" SO_2 exercises an acidity equivalent to half its value. On neutralising carefully with lime the decomposition of this form of combination can be observed by the reappearance of acidity after the first neutral point has been reached, until a stable point of neutrality is obtained. Another obstacle to direct neutralisation is the hydrolytic dissociation of the normal calcium sulphite as it is first formed, the hydroxyl ions thus liberated establishing the apparent neutral point before true equilibrium is reached. As the precipitate becomes stable, the hydroxyl ions disappear and the liquor turns acid. In the first iodine titration only the free and half-bound SO_2 are determined, but these being removed the "reversible" SO_2 comes into play to a slight extent, and it is found that the blue colour indicating the end point is not permanent. The principal error in the analytical methods for controlling the digestion liquor is that due to organic acids which make the alkali titration too high; consequently, as the organic acids accumulate towards the end of the digestion, low results are obtained for the *half-bound* (available) SO_2 and high results for the completely free SO_2. The error in the alkali titration cannot very well exceed 0·2 c.c. *N*/10 for 1 c.c. of liquor and is greatest in the case of spent liquors. Towards the end of the digestion, the value for the available, *i.e.*, half-bound SO_2 may sink to zero or become negative; in that case the digestion is completed by means of the fully free SO_2, and the calcium lignosulphonates will not be fully saturated with calcium. In such a case it is probable that the loosely combined sulphite comes into play and furnishes calcium to assist in the dissolving process. The Mitscherlich test with ammonia is useful in a qualitative sense; the quantity of the precipitate does not depend on the quantity of calcium but on that of the SO_2, nevertheless when the quantity of precipitate ceases to decrease, no more dissolving action can take place, and if this point occurs before digestion is complete it indicates an original deficiency of calcium. The author does not accept Oman's proposals in connection with this test (this J., 1916, 172, 832), and states that "black" charges are not caused by an excess of free SO_2, which can be very high without danger, provided sufficient calcium bisulphite is present to combine with all the unsaturated components of the lignin.—J. F. B.

Wood cellulose as fodder. Schwalbe. *See* XIXA.

Water softening. Chambers. *See* XIXB.

Nitration of cellulose. Hervé. *See* XXII.

PATENTS.

Fibrous materials; Drying machine for ——. F. G. Sargent, Westford, Assignor to C. G. Sargent Sons Corporation, Graniteville, Mass. U.S. Pat. 1,281,667, 15.10.18. Appl., 20.12.17.

The drying machine comprises a casing in which are situated means for supporting the stock to be dried. Air is drawn from the outside by means of intake fans, which deliver it into the casing and through the stock. The air is heated immediately it is drawn in, and means are provided for exhausting the air from the casing. An interior casing or passage is located in position to receive the air as it passes through the stock and direct it back to the intake fans, and means are provided for controlling the passage of air through the interior casing.—J. F. B.

Paper; Method of utilising old —— for the purpose of producing new paper. J. A. van den Knapp, Sellingen, and B. J. Bartelds, Apeldoorn, Holland. Eng. Pat. 111,860, 7.12.17. (Appl. 18,181/17.) Int. Conv., 7.12.16.

Waste printed paper is cleaned, reduced to a pulp, mixed with cold water in a beating engine, and washed therein by means of a drum washer. When the paper is completely pulped and most of the ink removed, the stuff is mixed with soap solution

in the proportion of 250 grms. of soap per 100 kilos. of dry pulp. It is then fed into boiling tubs wider at the top than at the bottom in which are suspended a certain number of open steam pipes, inside which are situated water pipes with perforated orifices at the bottom of the tub. The mixture is boiled for half an hour and the fibres are allowed to settle; the grease and dirt collect at the top and are removed by an overflow when steam and water together are introduced at the bottom of the tub. The admission of hot water is repeated intermittently until the pulp is completely cleansed. (Compare Eng. Pat. 13,269 of 1902; this J., 1903, 646.)—J. F. B.

Paper pulp; Tub-beaters for ——. C. W. Unkle and T. D. Grilley, Baltimore, Ohio, U.S.A. Eng. Pat. 116,695, 9.5.18. (Appl. 7783/18.) Int. Conv., 15.6.17.

In a beating engine the roll is enclosed by a hood having a flattened portion at the side opposite the backfall. The flattened portion of the hood is perforated and a series of plates having sharp edges is reciprocated by means of a rod across the perforations in the flat portion, so that when the perforations become clogged the protruding particles of paper pulp are cut away and the holes are cleared. During the beating of the pulp, the fibres are thrown by the centrifugal action of the roll against the perforated flattened portion of the hood and the finer, fully beaten fibres pass through the holes, while the coarser particles are returned to the roll. The finely beaten stuff is collected in a gutter extending across the beater and is discharged into a receptacle outside.—J. F. B.

Sea-tang; Method of obtaining paper pulp and fibrous material from ——. V. Frydensberg, Tidsvildeleje, Denmark. Eng. Pat. 120,761, 19.11.17. (Appl. 17,008/17.)

Fresh, moist sea-tang is bleached by exposure to chlorine or preferably by spreading it out in layers or heaps and sprinkling with bleaching powder and a little acid, or else by steeping in dilute bleach liquor. The bleached or unbleached sea-tang is dried in the air and then reduced by crushing, rubbing, tearing, or carding to a fibrous mass which may be used for the manufacture of paper or for strengthening plaster, stucco, etc.—J. F. B.

[Cardboard] tubes; Coating the interior surfaces of ——. G. H. Hadfield, Mitcham, and A. E. Bawtree, Sutton, Surrey. Eng. Pat. 120,934, 26.11.17. (Appl. 8921/17.)

In treating the interior surface of a tube with a colloid in order to render it impervious, the material of the tube is treated at any stage of its manufacture with a hardening agent before the colloid is applied. For instance, a cardboard tube made from paper which is impregnated with alum is coated by means of a revolving brush with a hot 10% solution of gelatin.—J. F. B.

Paper; Process of coating ——. C. M. Gage, jun., East Pepperell, Mass. U.S. Pat. 1,282,564, 22.10.18. Appl., 12.11.15.

A main coating of the finishing material is first applied to the paper, and the material is forced into the pores of the paper and spread evenly over the surface by appropriate means; it is then partially dried by blasts of air, and the partially dried coated surface of the paper is passed over a smooth roll which revolves at the same surface speed as the speed at which the paper moves forward. The coated face of the paper is pressed lightly against the roll to eliminate any wavy formation resulting from the partial drying, and a second coating of the same material as the first coating is then sprayed on to the coated face of the partially dried paper, which is afterwards dried in the usual way.—J. F. B.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Mordant dyestuffs in calico printing. H. Pomeranz. Monatsschr. Text.-Ind., 1918, **33**, 30—31, 38, 45—46, Z. angew. Chem., 1918, **31**, Ref., 350.

The author discusses the manner of the fixation of acid mordant dyestuffs in calico-printing, particularly of alizarin. The formation of the colour-lake on the fibre under the action of steaming is the result of a mutual reaction between the fibre, mordant, and dyestuff, leading to the production of a colloidal colouring matter, which in itself has the property of dyeing the fibre but which does so still better through the part played in its formation by the colloidal alumina deposited in the fibre. According to Liebermann's researches, no stoichiometrical relations exist between dyestuff and mordant. The oil exists both as a constituent of the colour-lake and in a peculiar form of direct combination with the cotton. Before the appearance of Turkey-red oil, the author employed oil in the printing colour for goods not prepared with oil. He used ricinoleic acid emulsified with saponin and the colour was thickened with starch and gum, the starch being gelatinised by heating together with the oil and gum. The portion of the oil mordant intended to enter into combination with the colour-lake was added to the printing colour in the form of calcium ricinoleate.

—J. F. B.

Water softening. Chambers. *See* XIXB.

Patents.

Textile materials; Process for the production of foam baths for treating ——. P. Schmid, Basle, Switzerland. U.S. Pat. 1,281,670, 15.10.18. Appl., 27.11.17.

Alkalis and "wastes of common trees" are added to the liquid which is to be transformed into foam, and the mixture is boiled.—J. F. B.

Sericin soap [for silk dyeing]; Manufacture of a substitute for ——. P. Schmid, Basle, Switzerland. U.S. Pat. 1,284,152, 5.11.18. Appl., 15.2.18.

See Ger. Pat. 305,239 of 1917; this J., 1918, 464A.

Condensation products [for azo dyes]. Ger. Pat. 308,839. *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Potash [from lakes] in Nebraska. J. M. Lilteras. Chem. and Met. Eng., 1918, **19**, 633—634.

The present field on which pumping operations are carried out extends over an area of about 330 sq. miles. It has been proved by the continuous pumping of certain lakes that the potash supply of Western Nebraska is not inexhaustible, as the density of the water falls after a certain length of time. If the lakes however are allowed to "rest" the density of the water increases and in rare cases may attain the original value. As the small lakes are scattered, the brine is conveyed

to a central station, and evaporated in Devine or triple-effect Swenson evaporators. Difficulty has been experienced in drying the salts and the most successful plant consists of a cylindrical shell, 30—45 ft. long and 4—6 ft. in diameter. The concentrated brine is sprayed into the upper end of the cylinder and travels towards the heated end, loose rollers and baffles preventing any adherence of the dried salts. The gases and dust pass from the cool end of the dyer through a dust-collecting chamber and thence to a chimney. Nebraska is now producing about 450 tons of salts daily with an average potash content of 25% K_2O.
—C. A. K.

Potassium salts; Carnot's method for the estimation of ——. C. E. Spegazzini. Anal. Soc. Quím. Argentina, 1918, **6**, 196—209.

Analyses according to the original method of Carnot (Comptes rend., 1878, No. 7) for the precipitation of potassium bismuth thiosulphate gave results in every case much too high. The method as modified by Grandeau and by Fresenius also gave high results. It is essential in the preparation of bismuth chloride solution from the subnitrate to give particular attention to the acidity and temperature of the resulting solution, the optimum acidity being determined by precipitation of a In the case of potassium chloride good results were known quantity of potassium from *N*/10 solution. obtained only with pure dilute solutions (*N*/10—*N*/1). Nitrate solutions also gave good results, but with sulphate solutions the results were much too low. With mixtures of potassium chloride with calcium chloride, magnesium chloride, or sodium chloride the method is satisfactory only when the potassium salt is in excess.—W. S. M.

Carbon dioxide in carbonates; Determination of ——. D. D. Van Slyke. J. Biol. Chem., 1918, **36**, 351—354.

The carbonate is placed in a test-tube which is inserted into a suction flask containing a known volume of *N*/10 barium hydroxide solution. The flask is closed by a rubber stopper carrying a dropping funnel the bottom of which is arranged to dip into the test-tube. The flask is evacuated, excess of acid is allowed to drop into the test-tube, and after agitation by rotation for about 3 minutes (two hours in the case of animal tissues such as bones, pulverised but not ashed), all the carbon dioxide will be found to have passed from the inner tube into the barium hydroxide. The precipitated barium carbonate is filtered off, and the excess of barium hydroxide in the filtrate determined by titration with *N*/10 hydrochloric acid, using phenolphthalein as indicator. The method appears to be applicable to all carbonates, soluble or insoluble, in the absence of acids, such as hydrogen sulphide, which are highly volatile from aqueous solution. (See further J. Chem. Soc., Feb., 1919.)—H. W. B.

Bisulphites of sodium and calcium; Apparatus for the manufacture of pure ——. H. J. Paoli. Anal. Soc. Quím. Argentina, 1918, **6**, 121—128.

The process is based on the action of excess of sulphur dioxide on wet crystals of sodium carbonate, $Na_2CO_3,10H_2O$. The sulphur dioxide is generated in a sulphur burner of simple construction of which drawings to scale of two alternative types are given. The gas passes through several layers of wet carbonate crystals supported at different levels in a reaction tower. The liquor drawn off from the bottom of this tower is a solution of sodium bisulphite of 30° B. (sp gr. 1·262). The gases then pass to a second tower packed with earthenware cylinders down which flows a saturated solution of sodium carbonate. The liquor from the bottom of this tower is elevated to the top, and the circulation is maintained until a pure bisulphite solution can be drawn off. A scale drawing of the plant is given.—W. S. M.

Aluminium hydroxide; Solubility of ——. E. H. Archibald and Y. Habasian. Trans. Roy. Soc. Canada, 1917-18, [iii], **11**, 1—6.

Aluminium hydroxide is appreciably soluble in solutions of ammonia, thus a *N*/10 solution of ammonia dissolves 0·240 grm. of $Al(OH)_3$ per litre at 20° C. The solubility increases with increasing concentration of ammonia to a maximum which is reached at *N*/2 (0·450 grm. per litre). The presence of ammonium nitrate decreases the solubility, the decrease being greater the larger the concentration of ammonium nitrate and the higher the temperature. Potassium nitrate increases the solubility to a marked degree. In the quantitative estimation of aluminium only a small excess of ammonia should be used, and the precipitate should be washed with a 10% solution of ammonium nitrate. (See J. Chem. Soc., Feb., 1919.)—J. F. S.

Magnesium ammonium phosphate and magnesium pyrophosphate; Some properties of ——. Z. Karaoglanow and P. Dimitrow. Z. anal. Chem., 1918, **57**, 353—371.

The conversion of magnesium ammonium phosphate into magnesium pyrophosphate may or may not be accompanied by the phenomenon of incandescence, depending upon the conditions under which the magnesium ammonium phosphate is precipitated. The product will not incandesce if precipitated slowly at the boil, but will do so if formed quickly or at lower temperatures. It has been found that incandescence never takes place if all traces of organic matter are carefully excluded from the precipitate. The properties of magnesium pyrophosphate depend upon whether it is formed with or without incandescence. If incandescence occurs, the product is hard and lava-like, and grey to black in colour, whilst if there is no incandescence, it is amorphous, loose in texture, and quite white. (See also J. Chem. Soc., Feb., 1919.)
—E. H. R.

Ammonium chloroplatinate, bromoplatinate, and chloroiridate; Solubility of —— and the separation of platinum and iridium. E. H. Archibald and J. W. Kern. Trans. Roy. Soc. Canada, 1917—18, [iii], **11**, 7—16.

The solubility of ammonium chloroplatinate, bromoplatinate, and chloroiridate in water increases continuously with the temperature, the two first salts being approximately ten times as soluble at 100° C. as at 0° C. Ammonium chloroiridate is several times more soluble than the chloroplatinate under the conditions of precipitation; a separation of platinum and iridium can be obtained, therefore, by the precipitation of the ammonium chloroplatinate. The solubility of all three salts in solutions of their corresponding halide salt is very small. Ammonium chloroplatinate is appreciably less soluble than the potassium salt. (See also J. Chem. Soc., Feb., 1919.)—J. F. S.

Spent oxide; Determination of the free sulphur content of ——. N. T. Twisselmann. Chem.-Zeit., 1918, **42**, 588. (See also this J., 1918, 336T, 690A.)

Five grms. of the finely powdered material is extracted for 1·5 hr. with carbon bisulphide, the

solvent is then distilled from the extract, the residue of impure sulphur dried at 100° C., and weighed. The residue is then dissolved in carbon bisulphide, the solution filtered, the filtrate evaporated, the residue dried at 100° C., weighed, and ground to a fine powder; 0·5 grm. of this powder is ignited in a porcelain crucible until all sulphur has volatilised, and the non-volatile residue is weighed and its weight deducted from that of the impure sulphur.—W. P. S.

Flowers of sulphur and sublimed sulphur. Noyer. Caoutchouc et Gutta-Percha, 1918, **15**, 9661—9663.

THE conflicting descriptions given by different writers of the product obtained by condensing sulphur vapour in refining chambers have led the author to make a careful examination of the material so obtained. The deposit on the floor of the condensing chamber consists of a number of stratified layers corresponding to the number of times the retort has been charged. The deposit is not homogeneous, and four different varieties may be distinguished. The first or utricular variety consists of globules of varying size formed by condensation of the hot vapour in the cold chamber. This is followed as the chamber becomes hotter by a variety having a crystalline appearance, a conglomerate of globules and crystals. The third variety is a light, friable, spongy mass, mainly crystalline, and the fourth forms hard compact masses in the neighbourhood of the mouth of the retort. The different commercial varieties are obtained by sifting the product. Good "flowers of sulphur" should contain a maximum of sulphur insoluble in carbon bisulphide. Commercial products examined by the author contained from 13 to 33% of insoluble sulphur, whilst a sample of the pure "utricular" form direct from the condensing chamber contained a maximum of 37% of insoluble sulphur, which on long keeping diminished to 33%. It is suggested that the term "flowers of sulphur" should be reserved for samples containing a minimum of 33% of sulphur insoluble in carbon bisulphide. Other samples should be sold as "sublimed sulphur" containing a stated percentage of "flowers" based on the proportion of insoluble sulphur present.—E. H. R.

Estimating sulphate ion. Howden. *See* XXIII.

PATENTS.

Calcium cyanamide; Method of making ——. G. E. Cox, Niagara Falls, N.Y., Assignor to American Cyanamid Co., New York. U.S. Pat. 1,282,381, 22.10.18. Appl., 3.12.17.

A PERFORATED container is inserted into a furnace and is then charged with a finely divided carbide. The temperature of the mass is raised sufficiently in the presence of nitrogen to bring about the formation of calcium cyanamide.—J. H. J.

Cyanides; Process of preventing the decomposition of molten ——. H. Freeman, Niagara Falls, Ontario, Assignor to American Cyanamid Co., New York. U.S. Pat. 1,282,405, 22.10.18. Appl., 20.4.18.

A MIXTURE of sodium chloride and "lime nitrogen" (crude calcium cyanamide) is fused in an electric furnace, and the mixture tapped from the furnace and rapidly cooled to a temperature below redness. The product, in the form of thin flakes, contains more than 30% of sodium cyanide, mixed with calcium chloride, sodium chloride, and lime.

—W. F. F.

Pumps for acids. **U.S. Pat. 1,282,145.** ***See*** **I.**

VIII.—GLASS; CERAMICS.

Glazes on zinc retorts. Mühlhaeuser. *See* X.

PATENTS.

Glass; Drawing ——. A. E. Spinasse, Mount Vernon, Ohio, U.S.A. Eng. Pat. 114,819, 26.11.17. (Appl. 17,474/17.) Int. Conv., 12.4.17.

THE end of a hollow metal bait or blow-pipe is heated to about 200°—480° C., and is then lubricated with rosin, tallow oil, wax, powdered lime, magnesia, or the like to prevent the glass adhering to it, dipped into the molten glass, and withdrawn in the customary manner. Alternatively, a hollow bowl-shaped bait may be lubricated as above, filled with glass, and air under pressure introduced into the bait before withdrawing it. By keeping the glass out of direct contact with the warm bait, the former remains plastic, is less liable to crack, and its surface is under less tension than usual. A bait with its end constructed in sections may be used.

—A. B. S.

Oil-fired glory-hole and like furnaces. Burdons, Ltd., and W. M. Burdon, Bellshill, Lanark. Eng. Pat. 121,100, 9.8.18. (Appl. 12,956/18.)

A FURNACE for use in glass bottle manufacture is heated by oil supplied through a Burdon burner into the central firing chamber, the gases then escaping at right-angles to chambers at each side of the furnace. From these chambers the gases pass upward around the glory-holes through restricted flues and again at right-angles to a central outlet flue and to a recuperator in which they heat the air required for the combustion of the oil. Glassware in the glory-holes does not come into contact with the products of combustion.—A. B. S.

Clay; Treatment of ——. W. Feldenheimer, London. Eng. Pat. 121,191, 6.12.17. (Appl. 18,116/17.)

CRUDE china clay is suspended in water to which has been added a deflocculator such as sodium carbonate or tannic acid. The coarser impurities are allowed to settle out and the liquid is transferred to another vessel and a flocculator, such as alum or sulphuric acid, is added sufficiently slowly to cause coagulation but not rapid settling. The material settles to form two layers, the upper being clay and the lower foreign matter; these are separated in any convenient manner. The clay may be deflocculated as described and afterwards coagulated by the addition of a strong solution of the deflocculating agent. The colour of the product may be improved by adding ultramarine to the suspended clay prior to its coagulation.—A. B. S.

Kilns or ovens for pottery, tiles, and other ware. J. S. Maddock, Newcastle, and W. E. Maddock, Wolstanton, Staffs. Eng. Pat. 121,198, 13.12.17. (Appl. 18,463/17.)

THE kiln consists of a renewable vertical shaft or chamber surrounded by a combustion chamber and a series of annular flues and air passages, the whole being surrounded by a permanent structure of non-conducting material. The combustion chamber is situated about midway of the height of the kiln, and the fire or flames from it pass around the central chamber and through the annular flues to the chimney. Cold air is blown by a fan into a space surrounding the top of the central chamber and travels down through an outer pipe and then spirally upwards through the annular air passages into the combustion chamber. The goods are carried on projecting shelves which are supported on a vertically movable table of refrac-

tory material or on an expansible ring at the bottom of the kiln. In order to place more goods in the kiln the lowest shelf is supported on the expansible ring, the table is then lowered, a new loaded shelf is placed on the table, and the latter is raised until it supports the whole of the goods in the kiln. The expansible ring is opened and the table is raised still further so as to cause the fresh goods to enter the kiln. Simultaneously a set of finished goods is raised above the top of the kiln and may be removed. In this manner each shelf with the goods thereon rises step-wise through the preheating, firing, and cooling zones of the kiln. As the combustion occurs in the central chamber or shaft of the kiln, no saggers are needed to protect the goods.—A. B. S.

IX.—BUILDING MATERIALS.

PATENT.

Road surfacing material, and process of producing and laying the same. G. Ross, Kansas City, Mo., U.S.A. Eng. Pat. 120,961, 26.11.17. (Appl. 17,427/17.)

SEE U.S. Pat. 1,252,722 of 1918; this J., 1918, 151 A.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron; Electrolytic deposition of —— from organic solvents. E. H. Archibald and L. A. Piguet. Trans. Roy. Soc. Canada, 1917—18, [iii], **11**, 107—112.

SOLUTIONS of ferric chloride in acetone, ethyl alcohol-acetone, and water-acetone on electrolysis deposit the whole of the iron. In the case of acetone and acetone-water solutions the iron is free from carbon. At low voltages the iron is deposited in the metallic condition but as the voltage rises it is obtained as an adherent red deposit. From acetone-alcohol solutions the iron although completely deposited is contaminated with carbon. From acetone-water solutions of ferrous sulphate the iron can be completely deposited, but the deposit contains a considerable amount of carbon.—J. F. S.

Iron and steel; Oberhoffer's etching reagent for the detection of areas high in phosphorus in ——. K. Harnecker and E. Rassow. Stahl u. Eisen, 1918, **38**, 1079—1080.

THE modification of Stead's reagent due to Oberhoffer (Stahl u. Eisen, 1916, 798—9) reveals clearly high- and low-phosphorus areas. Bauer's statement that the reagent produces a negative of the copper-ammonium chloride etching is confirmed. Etched with the Oberhoffer reagent the low-phosphorus primary dendrites of a steel casting appear dark against the higher-phosphorus background when the illumination is vertical, a negative of this being obtained when the light falls obliquely. A soft iron bar with a high-phosphorus core etched with Oberhoffer's reagent shows a perfect negative of the same section etched with copper-ammonium chloride, the illumination being vertical in both cases.—F. C. Th.

Steel; Magnetic permeability of ——. F. P. Fahy. Chem. and Met. Eng., 1918, **19**, 247—250.

THE magnetic characteristics of iron and steel are increasingly important in the construction of electrical machinery. At the present time particular attention is being given to research work on permanent magnet material to meet the increased demand for magneto construction, and on the substitution of chromium for tungsten as the principal alloying element. Material for this class of work is practically always used in the heat-treated condition, and sometimes is also subjected to a thermal or mechanical ageing process. Both the "residual" induction and the "coercive force" must be determined in order properly to determine the quality of the material examined. In an open circuit, such as a magneto, the poles of the magnet exert a demagnetising influence and reduce the induction, which is then termed "remanent induction." Magnetic data furnish valuable information as to the structure and characteristics of magnetic materials and supplement the use of the microscope and chemical tests. Burrows (Bull. Bureau of Standards, **13**, 207; Sci. Paper No. 272) has shown the wide changes in magnetic properties during heat treatment. The development of apparatus for the magnetic analysis of materials has been backward, and the difficulty in obtaining accurate measurements of the magnetising force is increased by the presence of joints, for which compensating adjustments have to be made. Most of the available permeameters are inaccurate and cannot be relied upon even for comparative determinations, except when the specimens are practically of the same kind.—C. A. K.

Gold amalgams. N. Parravano. Atti R. Accad. Lincei, 1918, **27**, ii, 168—170.

THE results of experiments on the distillation of mercury on to gold and on the evaporation of mercury in a current of hydrogen lead to the conclusion that gold amalgams contain at least two compounds, Au_2Hg_3 and Au_3Hg. (Compare J. Chem. Soc., Feb., 1919.)—T. H. P.

Zinc retorts; Glazes on ——. O. Mühlhaeuser. Metall und Erz, 1918, **15**, 393—395.

WHEN zinc distilling furnaces are heated with coal rich in iron, the volatile matter and dust from the fuel may attack the retorts and interior of the furnace, forming glaze-like materials which eventually collect into drops. If the glaze falls from one retort on to a lower one it may cause extensive erosion. Analyses of several "glazes" are given. Their composition varies with the fuel and the conditions in the furnace. The "glazing" of the retorts is advantageous, as it restricts loss due to diffusion of zinc vapour through the wall of the retort; hence natural gas and Mond gas appear to be undesirable fuels, because their freedom from flue-dust precludes the formation of "glazes." These gases might be utilised, however, if a suitable artificially prepared glaze could be applied to the retorts.—A. B. S.

Zinc; Electrolytic precipitation of ——. D. McIntosh. Trans. Roy. Soc. Canada, 1917—18, [iii], **11**, 113—119.

THE following conditions must be observed for the best results in the electrolytic deposition of zinc from solutions of the sulphate. (1) The solution must be absolutely clear and free from colloids. (2) The iron content should be low, and arsenic, antimony, copper, cobalt, nickel, and in general metals more electropositive than zinc must be absent. (3) The solution, particularly in tanks containing large amounts of acid, should be cold. The zinc is deposited in a semi-passivé form; but when it begins to dissolve solution cannot be stopped in any simple way. (4) The zinc concentration should be as high as possible (6—7%) and no attempt should be made to electrolyse solutions

containing less than 1·5—2·0% of zinc. (5) With the ordinary cascade system the optimum current density is 25—30 ampères per sq. foot.—J. F. S.

Copper; Influence of antimony on the mechanical properties of ——. W. Stahl. Metall u. Erz, 1918, **15**, 395—396.

The presence of 0·3—0·4% of antimony in pure copper increases the hardness and general value of the metal. Admixture of 0·15% of nickel and 0·15% of antimony also increases the hardness and quality of the metal provided that any flakes of oxide formed are removed by careful "poling" during the refining of the copper. In copper alloys containing more than 2% Ni, antimony is harmful. It is also harmful in copper containing manganese. In smelting copper containing 0·05% Bi, sufficient antimony should be added to convert the bismuth into an antimonate. In the presence of lead, antimony acts detrimentally on copper, unless the lead is present as antimonate.—A. B. S.

Alloys [brass]; Comparison of internal strains of —— after quenching and after cold drawing. A. Portevin. Comptes rend., 1918, **167**, 1033—1036.

The internal strains produced by the rapid cooling of metal cylinders have been previously studied (this J., 1918, 704 A), and the same method was utilised in the determination of strains produced in the cold drawing of metals. The hard surface of quenched steels prevented determinations on that material, and comparisons were made on an ordinary brass. The exterior of the quenched bar is in a state of compression, successive inner layers showing a gradual reduction in compression, until a condition of longitudinal strain is found, which increases to a maximum at the centre of the bar. The cold-drawn metal showed surface cracks and was readily fractured by small bending stresses. The strains were found to be the inverse of those of the quenched bar, the exterior being in a state of tension. An almost exactly similar curve was obtained but of inverse character. It has been found possible to reverse the sense of the stresses by quenching a drawn bar, and after a preliminary quenching, a greater amount of drawing can be performed than on the unquenched metal.—C. A. K.

Nickel; New method for determining the allotropic transformation of ——. Jänecke. Z. angew. Chem., 1918, **31**, 229.

Allotropic changes in metals are accompanied by a change in the rate of expansion, but this is so small as to be difficult to detect. The following method allowed the change to be observed over short as well as long intervals of time. A nickel cylinder 45 cm. high was inserted in a low-power press (3000 kilos.) used for tensile and compressive strength tests, and heated by means of a resistance furnace; the variation in length produced a movement of the upper movable plate of the press and was registered on a scale indicating movements as small as 0·007 mm. The transformation temperature of nickel was found to be 347°—350° C.; the expansion graph consists of two straight lines, that above the transformation temperature being more steeply inclined.—W. R. S.

Aluminium and its light alloys. P. D. Merica. Chem. and Met. Eng., 1918, **19**, 135—140, 200—202, 329—335, 587—592, 635—640.

A résumé of the production, uses, and properties of the metal and its light alloys. About one-third of the total production of aluminium is utilised in the motor industry. The microstructure of aluminium is simple, consisting of crystals in which grains of the iron-aluminium compound, $FeAl_3$, and of silicon, are formed; the metal undergoes no thermal or other transformation in the solid state. It is stated that sea-water has less action on aluminium than on iron, steel, or copper. Protection against corrosion by electroplating is questionable, as the coatings do not adhere satisfactorily, and all the metals used are electro-negative to aluminium. The application of a paint or varnish is a more promising solution. For castings an alloy of aluminium with copper, zinc, or other metal is usually employed, and care must be exercised, as above 800° C. porous castings result from the absorption of gases by the molten metal. Aluminium may be readily rolled, drawn, or hammered, with subsequent annealing. When worked cold, the tensile strength is increased and the ductility reduced, but the original properties may be restored by annealing at 300°—500° C. A compound, $CuAl_2$, is formed with the copper, the eutectic mixture at 545° C. containing 32% Cu. The tensile strength increases with increase in copper, but the alloys are subject to severe corrosion in sea-water. Magnesium-aluminium alloys are too brittle for rolling if the magnesium exceeds 6%. This series of alloys (magnalium) is lighter than aluminum, but has never become commercially important for rolling purposes. Aluminium-manganese-copper alloys have similar properties to the aluminium-copper series and are, in common with all aluminium alloys, less resistant to corrosion than the pure metal. Alloys with nickel, and with nickel and copper, show a high ductility, but are not sufficiently strong for structural shapes. Corrosion is rapid, particularly in dilute organic acids. It has been found possible to draw aluminium-zinc alloys containing as much as 26% Zn, but excessive work upon the alloy, or increase in temperature, impairs the tensile strength. Schirmeister (this J., 1916, 894) has observed that most metals form compounds with aluminium, the solubility of the compounds in the pure metal being generally almost zero. The prominent exceptions are zinc, copper, and magnesium. The light alloys of these metals contain only small quantities of the added metal, as with increasing amounts the alloys rapidly become brittle. The light alloys are usually heterogeneous, crystals of the aluminium compound occurring in a ground mass of almost pure aluminium. In commercial practice aluminium-copper or aluminium-zinc-copper alloys have been most largely used for castings, while for forging purposes, "duralumin" (Wilm, this J., 1911, 692) is the best. The general practice in casting follows that employed for brass, and a low casting temperature is favoured. Two of the most largely used alloys are "No. 12," containing 8% Cu, and "No. 31" (Zn 15%, Cu 3%, Al 82%). Rolling and forging alloys contain less of the hardening metal and may be instanced by the alloy containing 1—2% Cu and 1% Mn. "Duralumin" is probably the best known of all the light alloys of aluminium, and alone has the feature that the mechanical properties may be improved greatly by heat treatment. The composition is given as Cu 3·5—5·5%, Mg 0·5%, Mn 0·5—0·8%, aluminium, balance. It can be readily rolled and forged, and its physical properties are improved by the application of mechanical work to it. When hardened by quenching, duralumin is remarkably resistant to corrosion. A comparison of the density and mechanical properties shows that weight for weight the aluminium light alloys are as strong as the best steels and for the same strength give greater rigidity.—C. A. K.

Metals used in aeroplane construction; Metallography and heat treatment of ——. F. Grotts. Chem. and Met. Eng., 1918, **19**, 121—128, 191—196, 241—247, 315—319, 583—586.

Aeroplane construction involves the use of aluminium, copper, bronze, brass, cast iron, and steel,

of which the latter, in the form of carbon or alloy steel, is the most important. An outline of the methods employed in heat treatment and metallographic examination is given, the results of such examination showing that irregularities in low-carbon steel are very common, and are due to strains set up in the metal by bending or welding without subsequent proper annealing. The principal defects found in medium-carbon steel are pipes and slag inclusions; variation in crystal size and brittleness caused by pickling are minor defects. Cable wire and springs made from high-carbon steel often show fine cracks after quenching. A steel containing 0·55% C and 0·85% Mn is recommended for shock-resisting properties. For high tensile strength chrome-nickel steel is employed, as it possesses greater hardening and wearing power than carbon steels, and a double process of quenching is suggested to avoid surface cracking. Inclusions of manganese sulphide and silicate are common, and lead to lines of weakness in the metal. Piston pins and connecting rods are made from chrome-vanadium steel, which has a very fine tough structure when properly heat-treated. Manganese sulphide inclusions and seams containing oxide particles surrounded by partially decarburised metal often occur. Nickel steel is extensively used for bolts, nuts, and other parts subject to shock, as the ferrite increases in strength with the solution of nickel, but it is very susceptible to oxidation during treatment, and is subject to piping and slag inclusions. Chromium steel is of particular value by reason of its non-corrosive properties, and vanadium steel is good for parts which are fabricated by punching. Tungsten steel is made into exhaust valves and cutting tools owing to its property of retaining its hardness even at a dull red heat. Copper is chiefly used in the form of sheets and tubing and is subject during use to bending by vibration. Straining of the metal by hammering is liable to induce cracks. Bronze, gun-metal, Monel metal, and brass often suffer from faulty brazing, the metal being overheated or "gassed." A brass containing 78—82% Cu was found to make the strongest joint, and the best brazing was obtained with standard brazing material, using an acetylene torch. All the joints tested were weaker than the tubing itself, but the brazed joints were stronger than similar welded joints. Heat treatment greatly strengthened the brazed or welded junctions.—C. A. K.

Flotation apparatus; Design and operation of ——. A. W. Fahrenwald. Chem. and Met. Eng., 1918, 19, 77—82, 129—134.

Machines in which the mineral sought is recovered by forming a froth or foam may be classified into:—(1) Straight mechanical frothing machines, (2) mechanical-air frothing machines, (3) pneumatic frothing machines, (4) gravity frothing machines. In the first type, agitation is entirely produced by mechanical stirrers, the pulp travelling from one section (spitzkasten) to another and the froth being collected from the surface. Concentrate is taken from the first few spitzkasten, the remainder yielding "middling," which may be returned to the head of the machine. In the second class, in addition to mechanical agitation, air under pressure is admitted to the pulp conduits and aids in lifting the mineral matter. The top of the agitating compartment is closed, and the current of air assists in the removal of the froth. In one type of machine no partitions are used; the froth collects over the whole surface and flows off both sides into receivers. Pneumatic frothing depends wholly on emulsification by air, which may start in the tube mill or in the mixer. The agitating chamber is usually fitted with a porous bottom through which air at about 5 lb. pressure is forced, a uniform water level being maintained throughout the operation. Cells may be worked either in series or in parallel, though when working on a heavily mineralised ore, the series arrangement is advantageous. The Cole-Bergman machine is fitted with a grate through which air for emulsification is forced, this form of distributor replacing the carborundum porous medium of another type. The tailings in the first chamber fall through the grate into a chamber underneath, from which they are forced through a "goose-neck" pipe into the second chamber, and finally the tailings are ejected from the compartment underneath the last emulsifying compartment. The cells are of rectangular shape, and the froth from each cell overflows on four sides into a common launder. The "Inspiration" flotation machine is divided into two compartments, each 24 ft. by 8 ft. 6 in. Each compartment is subdivided into eight sections, from each of which the froth overflows into a side-launder, the tailings passing under the dividing baffle-plate from one section to the next. Although considerable attention has been given recently to gravity flotation machines, the general success of this type is doubtful on account of insufficient agitation. When the froth is produced mechanically it carries a heavier charge of mineral than when produced by atomised air, and persists for a considerable time. The difference between the two froths apparently consists in the percentages of air and moisture, as compared with the amount of solids. Pneumatic aeration gives a slightly better separation on the finer slimes and requires less power and labour than mechanical machines.—C. A. K.

Estimation of mercury. Piña de Rubies. *See* XXIII.

Patents.

Steel; Furnace for the heat-treatment of ——. W. R. Bennett, Elmwood, Conn., U.S.A. Eng. Pat. 118,598, 18.6.18. (Appl. 10,026/18.) Int. Conv., 16.8.17.

Three superimposed chambers, preferably of cylindrical shape, are heated by the products of combustion of fuel gas or oil, burning in a combustion chamber which forms the bottom section of the furnace. The hot gases travel through the two lower chambers, but the uppermost chamber, which is used for the final tempering of the metal, is heated only by heat conducted through the metal base of the section. A narrow space may be left between the second and third chambers, through which air may be drawn in order to regulate the temperature in the tempering chamber.—C. A. K.

Furnaces for annealing or heat-treating. W. N. Best, Brooklyn, N.Y. U.S. Pat. 1,281,489, 15.10.18. Appl., 14.6.18.

A central furnace chamber has passageways on both sides, along which flames are delivered from two burners fixed at opposite ends. The passageways communicate with the furnace chamber by a series of ports in the dividing walls; the ports are graduated in size, the largest opening being adjacent to the burner mouth. The flue gases leave through openings in the bed of the furnace and are conducted through a central flue extending lengthwise under the furnace bottom.—C. A. K.

Malleable iron castings; Production of ——. F. Perry, and Industrial Inventions, Ltd., Tipton. Eng. Pat. 121,074, 26.4.18. (Appl. 7049/18.)

The metal casting is heated in a current of Mond, blast-furnace, or other gas, in which carbon dioxide, which is capable of removing carbon from iron, is associated with hydrogen, the latter preventing oxidation of the iron. The presence of

such a proportion of carbon monoxide as to prevent the reduction of the carbon dioxide at the working temperature, is preferred, and the gas should be purified from sulphur and hydrocarbons. "White-heart" castings are produced at a temperature between 800° C. and 950° C., a steady current of gas being passed until the desired degree of carburisation is effected; for "black-heart" castings a lower temperature (700° C.—800° C.) is preferred, with only sufficient gas to prevent the ingress of extraneous air or flue gas. The treated metal should be cooled in an atmosphere of the gas used. The sulphur content of iron is reduced if the annealing temperature is above 850° C.

—C. A. K.

Concentration of ores [by flotation]; Apparatus for the ——. Minerals Separation, Ltd., Assignees of Minerals Separation and De Bavay's Processes Australia Proprietary, Ltd., Melbourne. Eng. Pat. 112,019, 4.12.17. (Appl. 17,973/17.) Int. Conv., 5.12.16.

In a modification of Eng. Pat. 10,666 of 1915 (this J., 1916, 930) the flow of pulp from one section of the flotation apparatus to a section at a lower level is controlled by an "equalising feed box," a constant level being maintained by means of an adjustable overflow plate. An inclined baffle is arranged in the separating chamber to divert the froth towards the higher exit. Air is admitted to the discharge pipes connecting the overflow outlet of one box with a box lower in the series by inlets in the pipe, in conjunction with an injector nozzle.—C. A. K.

Plating [tinning] sheet metal; Process and machine for ——. C. C. Roberts, Ansonia, Conn., U.S.A. Eng. Pat. 112,125, 26.11.17. (Appl. 17,452/17.) Int. Conv., 16.12.16.

Sheet metal after being passed through cleaning rolls, and preferably between heating rolls, prior to entering the tinning bath, is drawn under a guide-shoe (or a rotary guide-drum) immersed in the molten coating metal. If it is required to coat the sheet on one side only, clamping collars operate on the edge of the sheet and prevent the liquid metal penetrating between the guide-shoe and the metal sheet. The concave face of the guide-shoe is heated by a burner in order to increase the temperature of that portion of the sheet metal in contact with the liquid coating metal.—C. A. K.

Welding; Method of electric ——. T. E. Murray, jun., Brooklyn, N.Y. U.S. Pats. (A) 1,281,636 and (B) 1,281,637, 15.10.18. Appl., 6.2.18.

(A) Two different metals to be welded are subjected to a current of extremely high amperage for a very brief space of time, thereby producing molecular dissociation at each of the opposing faces of the bodies of metal "and an intermingling of the dissociated molecules, whereby said bodies are caused to form an integral body without solution of continuity, a part of said body being composed of a mixture or alloy of the materials of the two original bodies." (B) In electrically welding two bodies, with a contact area of which the length is greater than the width, the bodies are subjected to a high amperage current of brief duration, thus forming a body of a strength equal to that of an unwelded body of like material and dimensions; the amperage of the current is greater than that necessary to accomplish the same result in welding two bodies of identical material, when the length and width of the contact area are equal.—B. N.

Platinum and similar metals; Process for the extraction of —— from their sands and ores. R. Thayer, Philadelphia, Pa. U.S. Pats. (A) 1,281,878 and (B) 1,281,879, 15.10.18. Appl., 5.3.18 and 1.9.17.

(A) For the recovery of platinum and allied metals from granular silicious ore, an alkaline solution is caused to diffuse through the mass, and the metal is "volatilised" by heating the wetted charge in a closed receptacle. (B) Heated chlorine gas is conducted through a mass of the metal-bearing sand, and the gas current is then passed through a solvent for the compound formed. The residue is leached to remove any unvolatilised compound of the metal, and the metal is subsequently recovered from the solutions obtained.

—C. A. K.

Alloy; Noble-metal ——. G. H. Dufour, Oak Park, Ill., Assignor to Marshall Field and Co., Chicago, Ill. U.S. Pat. 1,282,055, 22.10.18. Appl., 15.4.18.

An alloy having a permanent appearance similar to that of platinum, is composed of about 74% of gold, 21·5% of palladium, and 4·5% of platinum.

—B. N.

Copper ores; Process of leaching ——. A. W. Hahn, El Paso, Tex. U.S. Pat. 1,282,415, 22.10.18. Appl., 9.1.15.

An acid leaching solution is passed through a series of tanks containing ore until it becomes neutral, and is then passed through a fresh charge of ore, whereby ferric iron is precipitated. The solution thus freed from ferric iron is acidified, electrolysed, and returned to the tanks. The first tank of the series is cut out at intervals, and a tank with fresh ore added at the other end of the series.

—T. St.

Metals; Process of and apparatus for extracting —— from ores. F. L. Antisell, Perth Amboy, N.J. U.S. Pat. 1,282,521, 22.10.18. Appl., 7.1.15.

Metalliferous materials (*e.g.*, copper ores) are leached with a solution saturated with the impurities present in the material but capable of dissolving the metal to be recovered. A portion of the solution saturated after contact with the ore is electrolysed, and the metal recovered, the electrolysed solution being transferred to the leaching system again, thus completing a cycle.—C. A. K.

Apparatus for precipitation. U.S. Pat. 1,281,443. *See* I.

Steel melting and other furnaces; Gas and air reversing valves for ——. E. J. W. Richards, Glasgow, and W. Kane, Port Talbot. Eng. Pat. 121,316, 3.12.17. (Appl. 17,843/17.)

Copper ores; Treatment of ——. A. A. Lockwood, Forest Hill. U.S. Pat. 1,282,892, 29.10.18. Appl., 20.1.17.

See Eng. Pat. 105,772 of 1916; this J., 1917, 654.

Zinc; Electrolytic recovery of ——. G. H. Clevenger, Palo Alto, Cal., Assignor to H. W. Gepp, Melbourne, Victoria. U.S. Pat. 1,283,078, 29.10.18. Appl., 7.5.17.

See Eng. Pat. 115,847 of 1918; this J., 1918, 659A.

Gold and silver; Obtainment of —— from their ores. A. A. Lockwood, Forest Hill. U.S. Pat. 1,283,236, 29.10.18. Appl., 8.3.18.

See Eng. Pat. 112,876 of 1917; this J., 1918, 154A.

XI.—ELECTRO-CHEMISTRY.

PATENTS.

Depolariser; Electric battery ——. M. E. Holmes, Lakewood, Ohio. Assignor to National Carbon Co., Inc. U.S. Pat. 1,281,372, 15.10.18. Appl., 21.2.18.

A DEPOLARISER for primary batteries is composed of molybdenum trioxide combined with a basic oxide, *e.g.*, ammonium phosphomolybdate.—B. N.

[*Electric*] *battery fluids; Recovery of* ——. S. H. Shelb, Assignor to H. and H. C. Frochling, Richmond, Va. U.S. Pat. 1,281,857, 15.10.18. Appl., 30.11.17.

THE used alkaline electrolyte of primary batteries is maintained quiescent in a drum until the oils have risen to the surface. The fluid is then run from the bottom of the drum into a receiver, and subjected to the action of an electric current to separate the zinc.—B. N.

Electric battery. R. W. Erwin, Fremont, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,282,057, 22.10.18. Appl., 30.11.15.

A NEGATIVE element, for a primary battery with alkaline electrolyte, is composed of a mixture of copper oxide and sulphur.—B. N.

[*Electric*] *furnace.* E. F. Collins, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,281,521, 15.10.18. Appl., 10.11.17.

THE furnace comprises a number of superimposed sections, each of which is composed of a wall of refractory material, within a metal casing, and inner and outer frameworks, the outer one supporting the furnace structure. The inner one is formed of tie rods, connected to annular metal end plates, and supports for electric heaters are attached to the tie rods, spaced from the inner wall of the furnace. The inner framework in each section is relatively movable with respect to the outer supporting framework, and the clearance space permits longitudinal adjustments due to the thermal expansion and contraction of the inner framework. The resistance heaters, mounted on the supports, are supplied with current by conductors passing through the wall.—B. N.

Electric furnaces; Mechanism for regulating the electrodes of ——. V. F. Turner, Rotherham, and J. Walker, Sheffield. Eng. Pat. 121,409, 6.3.18. (Appl. 3883/18.)

Dehydrating emulsions. U.S. Pat. 1,281,952. *See* I.

Producing gas. U.S. Pat. 1,282,445. *See* IIA.

XII.—FATS; OILS; WAXES.

Glycerol residues from Reichert-Meissl determinations; Utilisation [*recovery*] *of* ——. A. E. Parkes. Analyst, 1918, **43**, 408—409.

THE residues in the distillation flask are collected, solid fatty acids are separated, the liquid is neutralised with solid calcium hydroxide, boiled, filtered, the filtrate concentrated to one-half of its volume, and 50% sodium hydroxide solution added to bring the alkalinity of the solution to the desired strength for subsequent use. Duplicate determinations with this recovered glycerol-sodium hydroxide and with fresh glycerol-sodium hydroxide gave identical results.—W. P. S.

Salmon oil. Bailey and Johnson. *See* XIXA.

PATENTS.

Catalyst [*for hydrogenating oils*]. A. Schwarcman, Assignor to Kellogg Products, Inc., Buffalo, N.Y. U.S. Pats. (A) 1,282,296 and (B) 1,282,297, 22.10.18. Appl., 7.5.18.

A CATALYST for hardening oils consists of (A) finely ground roasted quartz and fullers' earth or (B) poreless amorphous native silica of a fineness between 300- and 400-mesh (such as occurs in asbestos deposits), impregnated with finely divided reduced or colloidal nickel.—W. H. C.

Oily materials; Process of purifying ——. Superior Oil and Process Co., and W. P. Schuck, Portland, Oreg., U.S.A. Eng. Pat. 120,820, 31.12.17. (Appl. 19,305/17.)

SEE U.S. Pat. 1,260,072 of 1918; this J., 1918, 312A.

Soaps and cleansing agents for use in laundries. Escejay Co., Cincinnati, Ohio, Assignees of M. Spazier, Los Angeles, Cal., U.S.A. Eng. Pat. 113,086, 3.12.17. (Appl. 17,886/17.) Int. Conv., 27.1.17.

SEE U.S. Pats. 1,241,043 and 1,241,044 of 1917; this J., 1917, 1185.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Oil varnishes; Determination of volatile "thinners" in ——. A. de Waele. Analyst, 1918, **43**, 408.

THE use of a mixture of benzene, 3, and alcohol, 1 part, is recommended in place of the acetone employed for the removal of water in the steam distillation process described previously (this J., 1917, 603). Twenty c.c. of the benzene-alcohol mixture is sufficient to remove all the water from the most gummy residues.—W. P. S.

Guaiacum resin. Schroeter and others. *See* XX.

PATENTS.

Paint or varnish; Manufacture of —— [*from pitch*]. F. W. Sperr, jun., Oakmont, and M. Darrin, Wilkinsburg, Pa., U.S.A. Eng. Pat. 118,079, 14.12.17. (Appl. 18,619/17.) Int. Conv., 10.8.17.

A PAINT or varnish is obtained by dissolving hot coal-tar or water-gas-tar pitch in a suitable solvent containing compounds of the coumarone-indene group, *e.g.* "solvent naphtha." The coumarone-indene products may be polymerised before, simultaneously with, or after dissolving the pitch by blowing in steam or air at 160° C. or employing a suitable catalyst, *e.g.* aluminium chloride. Other paint materials such as thinners, pigments, driers, etc., may be added to the composition.—A. de W.

Printers' inks and colouring-matter and procedure whereby the same are producible. L. E. Barton, Niagara Falls, N.Y., and H. A. Gardner, Washington, D.C., Assignors to The Titanium Alloy Manufacturing Co., New York. U.S. Pat. 1,283,455, 5.11.18. Appl., 28.11.17.

A COLOURING matter suitable for printing-inks consists of pigment, organic colouring-matter, and titanic oxide coalesced with sulphate particles.

—A. de W.

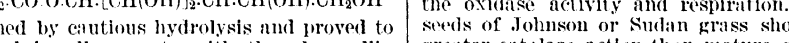
Paraphenylenediamine substance and process relating thereto. T. A. Edison, West Orange, N.J. U.S. Pat. 1,283,706, 5.11.18. Appl., 2.10.16.

p-PHENYLENEDIAMINE is added to the usual ingredients which react on heating to form a hardened phenolic condensation product.—A. de W.

XV.—LEATHER; BONE; HORN; GLUE.

Tannin and similar substances; Synthesis of ——. V. E. Fischer and M. Bergmann. Ber., 1918, **51**, 1760—1804.

PREVIOUS attempts to prepare pentadigalloylglucose (this J., 1912, 503, 1043; 1913, 500; 1915, 672) did not lead to the desired result owing to the unfavourable properties of the carbomethoxy-compounds. Recently, however, it has been found possible to prepare the penta-acetyl derivatives of *m*- and *p*-digallic acids and the corresponding chlorides in the crystalline state (Fischer, Bergmann, and Lipschitz, Ber., 1918, **51**, 45); from these, the penta-(penta-acetyldigalloyl)-glucoses have now been prepared which, when hydrolysed by sodium acetate in aqueous acetone solution, yield the corresponding pentadigalloylglucoses. Penta-(*m*-digalloyl)-β-glucose is shown to be remarkably similar to Chinese tannin both in chemical and physical properties and in its specific rotation in organic media; the only point of difference noted is in the specific rotation in aqueous solution. Since, however, the solutions are colloidal in character and their optical activity is known to be greatly influenced by small factors, the authors do not consider the discrepancy to be necessarily fundamental. The chemistry of the pentagalloylglucoses has been further studied (compare Fischer and Freudenberg, this J., 1915, 672) and, through the triacetylgalloyl derivatives, it has now been found possible to isolate products which consist almost uniformly of the pentagalloyl derivatives of α- and β-glucose respectively. 2.3.5.6-Tetra-acetylglucose readily condenses with acyl chlorides in the presence of quinoline and, on subsequent removal of the acetyl groups, 1-acylglucoses are obtained, these being the first monoacyl-glucoses to which a definite structure can be assigned. The reaction has been studied in the cases of benzoyl, acetylsalicoyl, and, more particularly, triacetylgalloyl chlorides. From the 1-triacetylgalloyl-tetra-acetylglucose produced in the latter instance, 1-galloyl-β-glucose,



was obtained by cautious hydrolysis and proved to be identical in all respects with the glucogallin isolated by Gilson (Bull. Acad. roy. med. Belg., 1902, [4], **16**, 827) from Chinese rhubarb. (See also J. Chem Soc., Feb., 1919.)—H. W.

β-Glucosidogallic acid; Structure of ——. E. Fischer and M. Bergmann. Ber., 1918, **51**, 1804—1808.

THE work of Fischer and Strauss (this J., 1903, 99) has led to the supposition that β-glucosidogallic acid contains the sugar residue attached to the *p*-hydroxyl group of gallic acid; this hypothesis is now confirmed by its conversion into glucosyringic acid (Mauthner, J. prakt. Chem., 1910, **82**, 271). The latter acid melts at about 225° C. (decomp.) when moderately rapidly heated and has $[\alpha]_D^{16} = -18{\cdot}18°$ (as sodium salt) in aqueous solution. (Compare J. Chem. Soc., Feb., 1919.)—H. W.

XVI.—SOILS; FERTILISERS.

Lime; Determination of the value of agricultural ——. S. D. Conner. J. Ind. Eng. Chem., 1918, **10**, 996—999.

RESULTS of pot-culture experiments showed that the value of agricultural lime was proportional to its acid-neutralising power, rather than to its content of calcium oxide, magnesium oxide, or carbon dioxide. The neutralising power is determined by boiling 1 grm. of the powdered sample with 6 c.c. of 4*N* hydrochloric acid and 75 c.c. of water, for 15 mins., and titrating the excess of acid with *N*/2 sodium hydroxide solution, using phenolphthalein as indicator. The results are expressed in terms of per cent. of calcium carbonate; some magnesites and dolomites show a calcium carbonate equivalent of over 100%.—W. P. S.

Potash [in fertilisers]; Sources of error incident to the Lindo-Gladding method for the determination of ——. T. E. Keitt and H. E. Shiver. J. Ind. Eng. Chem., 1918, **10**, 994—996.

IN the Lindo-Gladding method errors are introduced due to the bulk of the precipitate formed on addition of ammonia and ammonium oxalate, and to occlusion of potash in the precipitate; the two errors are partially compensating. The occluded potash cannot be extracted by washing the precipitate with hot water, but may be separated to a certain extent by dissolving the precipitate in hydrochloric acid, diluting the solution, and re-precipitating with ammonia and ammonium oxalate. Both iron and calcium phosphates, when precipitated with ammonia, occlude potash, and the occlusion is greater when the two are present together.—W. P. S.

Catalase and oxidase content of seeds in relation to their dormancy, age, vitality, and respiration. W. Crocker and G. T. Harrington. J. Agric. Res., 1918, **15**, 137—174.

THE catalase activity of seeds may be measured by determining the volume of oxygen liberated from an excess of hydrogen peroxide solution, provided that the solution is first made neutral to phenolphthalein by the addition of *N*/10 sodium hydroxide. Various factors were found to affect the catalase activity of seeds. Thus, excessive pulverisation of the seeds, storing the powdered seeds in a desiccator, or drying seeds which had been in a germinator reduced their catalase activity. In the case of wheat the catalase activity of the embryo was found to be 28—29 times that of the endosperm, this relation being paralleled by the oxidase activity and respiration. Immature seeds of Johnson or Sudan grass showed a much greater catalase action than mature seeds, but the relative oxidase action differed with these two grasses. The physiologically inactive organs (sterile florets and caryopsis scales) showed only a small fraction of the catalase activity of the caryopses, whereas the oxidases were as active in the non-living as in the living organs. Retention in a germinator, not furnishing conditions suitable for germination, greatly reduced the catalase activity and the respiratory intensity of Johnson grass seeds, the effect on the oxidase activity being in the same direction but much less marked. In dry peach seeds the optimum temperature for after-ripening is apparently the optimum for catalase increase, whereas oxidase activity decreases with after-ripening, although autocoloration of the ground seed mass on exposure to air increases. During germination of grass seeds the catalase activity and respiratory intensity rise rapidly, but there is no rise in oxidase activity.

In certain seeds, such as those of Johnson grass, there is a close correlation between catalase activity and respiratory intensity but no correlation between these two factors and the vitality of the seeds or the vigour of the resulting seedlings. A general survey of the results indicates that no general conclusions can be drawn as to the catalase behaviour in all seeds, but it seems evident that seeds can be separated into several physiological types, for each of which more or less general conclusions can be drawn. Catalase activity of seeds seems to parallel physiological behaviour much more generally than does oxidase activity.—W. G.

Potash in Nebraska. Lliteras. *See* VII.

Waste water from sugar recovery. Skudrna. *See* XVII.

Effect of hydrocyanic acid on larvæ. Sasscer and Sanford. *See* XIXB.

PATENTS.

Phosphates; Treatment of ——. E. C. Soper, Chattanooga, Tenn., Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pat. 1,281,681, 15.10.18. Appl., 19.12.13.

AN insoluble phosphate is converted into a citrate-soluble form by mixing it with water and an alkali salt to form a semi-fluid mass. This is made to flow in a thin layer on to a highly heated surface whereby it is quickly deprived of moisture and given a porous form. The porous material is calcined.—J. H. J.

Fertiliser; Process of making phospho-potassic ——. A. F. Delacourt, Assignor to Soc. Anon. Italiana Gio. Ansaldo and Co., Genoa, Italy. U.S. Pat. 1,282,385, 22.10.18. Appl., 5.6.18.

TRICALCIUM phosphate, a silicate rock containing potash, and free silica are heated together to 1000°—1100° C.—J. H. J.

Superphosphate; Process for disintegrating and storing ——. J. Lütjens and W. Ludewig, Hanover. Ger Pat. 308,619, 15.2.17.

THE material coming from the reaction chamber is powdered by a movable disintegrating device, which is caused to travel while in operation, so that the ground phosphate is uniformly distributed in a thin layer over a large storage area. This layer cools rapidly, so that, if after 12—24 hours, another charge of powdered superphosphate is spread on the top of it, there is no danger of the first charge caking together.—J. F. B.

Stable manure and fluids; Process for increasing the fertiliser value of ——. A. Stutzer, Godesberg. Ger. Pat. 308,658, 25.12.17.

CALCIUM chloride, preferably in the form of a solution, is spread about in the stables, in the floor-channels and on the manure, in the proportion of about 25 parts of dry calcium chloride to 1000 of stable fluids. The ammonium carbonate which is formed by the decomposition of the urea is thereby converted into ammonium chloride and losses of volatile ammonia are avoided.—J. F. B.

Fertilisers; Manufacture of ——. Badische Anilin und Soda Fabrik. Ger. Pat. 308,659, 30.1.17.

UREA is mixed with superphosphates and at the same time or subsequently an earthy, sandy, or carbonaceous material is added. The finely powdered mixture is thus preserved in a pulverulent condition suitable for spreading, owing to the absorption of excess moisture and the fixation of the acid.—J. F. B.

Calcium cyanamide. U.S. Pat. 1,282,381. *See* VII.

XVII.—SUGARS; STARCHES; GUMS.

Sugar; Seeding method of graining ——. H. E. Zitkowski. Amer. Inst. Chem. Eng., June, 1918. J. Ind. Eng. Chem., 1918, 10, 992—994.

THE method at present used for producing "granulated" crystals is as follows:—The syrup is concentrated *in vacuo* under the usual conditions until it is slightly supersaturated; at this point a quantity of sugar dust or powdered sugar, varying from 0·5 qt. to 2 qts. per 1000 cub. ft. of vacuum pan capacity, is introduced by aspiration. The syrup is then boiled vigorously for some minutes and the evaporation is continued until that density is reached usually obtained by the older methods of "graining." From this point the ordinary procedure is followed. The essential difference between the two methods is that in the older process the crystallising nuclei are formed by highly supersaturating the solution, whilst in the new process they are introduced ready made. The sugar powder used should pass a 100-mesh sieve.—W. P. S.

Raffinose; Influence of —— on the determination of sucrose in beet molasses by different methods. [*Determination of raffinose.*] H. Pellet. Bull. Assoc. Chim. Sucr., 1917, 35, 16—30, 106—115. (See also this J., 1917, 153, 935.)

AFTER pointing out sources of error in earlier methods of determining raffinose, the author gives full working details of procedure for applying Hudson and Harding's method (this J., 1915, 1065) to beet molasses. A saccharimetric normal solution (2 or 3 litres) of the molasses is made, with sufficient basic lead acetate for clarification, and filtered. The lead is precipitated from an aliquot part of the filtrate by addition of a solution of sulphurous acid of sp. gr. 1·038—1·040; usually 10 c.c. per 100 c.c. of molasses solution is sufficient. The filtered liquid is completely neutralised with powdered calcium carbonate and again filtered. The liquid thus prepared may be subjected to the action of the two yeasts in various ways, but the author prefers to take eight portions of 100 c.c. each in eight separate flasks. Four of these, and an additional one containing only 100 c.c. of water, are treated each with 10 c.c. of top-fermentation yeast suspension, and the other four, besides an additional one containing 100 c.c. of water, are treated with 10 c.c. of bottom-fermentation yeast suspension. To prepare the top-fermentation yeast, 100 grms. of pressed bakers' yeast is ground in a mortar with 6·6 grms. of powdered sodium salicylate until it forms a homogeneous paste. This paste (which can be kept indefinitely), mixed with an equal volume of water, constitutes the suspension referred to above, and a similar one, is prepared from bottom-fermentation beer yeast in the same way. After addition of 2 drops of glacial acetic acid to each of the ten flasks, these are closed and kept either at the ordinary temperature or in a bath at 55° C. To ascertain the rotations finally attained in presence of the top- and bottom-fermentation yeasts respectively, the four flasks of each series are withdrawn for polarisation, one by one, after successive periods of 2 hours or 24 hours, accord-

ing as the inversions are carried out at 55° C. or at the ordinary temperature. When the practical identity of two consecutive readings shows that the final rotation has been attained, the latter is corrected for the rotation of the corresponding yeast extract in the fifth flask. In polarising the contents of a flask, 50 c.c. of the liquid is treated with 1 c.c. of 30% normal lead acetate solution, made up to 100 c.c., shaken with 2 grms. of a mixture of decolorising charcoal and kieselguhr, and filtered, all readings being taken in a jacketed tube at the same temperature. With a polarimeter based on a normal weight of 26 grms., and a 200 mm. tube, a difference of 1° Ventzke between the final corrected rotations in presence of the top- and bottom-fermentation yeasts respectively indicates 0·351 grm. of anhydrous raffinose per 100 c.c of the liquid. The method gave correct results with an artificial mixture of sucrose and raffinose; it indicated the presence of 0·8—1·5% of raffinose in samples of beet molasses, and the absence of raffinose in cane molasses. With raw beet sugars and beet molasses the method, usually but not invariably, gives higher results than that based on the Clerget process.—J. H. L.

Cane molasses; Composition of ——. H. Pellet. Bull. Assoc. Chim. Sucr., 1917, **35**, 118—129.

A CRITICAL discussion of the data furnished by commonly employed methods of analysing cane molasses, and suggestions (largely based on the author's own work, see this J., 1901, 754; 1914, 35; 1917, 467) for greater accuracy and for a more complete analysis involving the separate return of sucrose, dextrose, lævulose, glutose, and mannose. —J. H. L.

Molasses; Separation of sugar from —— by the saccharate process. C. J. Leonis. Sugar, 1918, **20**, 15—17, 56—57.

IN extracting the sugar remaining in the final molasses obtained in beet factories in the United States, it is the practice to dilute the product with wash-water to a suitable sucrose content, and add milk of lime at 35° Brix at the rate of 18 parts of calcium oxide per 100 of sucrose present, that is, sufficient to form the mono- and some di-saccharate. To precipitate the insoluble tri-saccharate, powdered lime is then gradually added in a cooler at 12°—13° C. (preferably under pressure), taking care not to allow the temperature to rise above 14° C.; the addition is stopped when the density of the filtered solution corresponds to 6·5° Brix. The liquor is passed into a filter-press; the cake is washed with water containing a little milk of lime, discharged from the presses, diluted with a little "sweet-water," and finally sent to the carbonatators, where the saccharate is decomposed, the recovered sugar being united with that in the juice undergoing clarification.—J. P. O.

Waste water; Utilisation of the —— resulting from the saccharate process of recovering sugar from molasses. A. W. Skudrna. Sugar, 1918, **20**, 220—221.

WASTE water from the saccharate cake in the recovery of sugar from final beet molasses (see preceding abstract) contains about 0·5% of potash and 0·1% of nitrogen. Up to 1400 tons of this waste water may be produced daily, and it is now the custom at one of the Colorado factories to pump it during the campaign over the autumn-ploughed land, and to follow this application with a beet crop. Appreciable increases in the beet tonnage and other crop yields have resulted.—J. P. O.

Horse-chestnuts; Utilisation of —— [for preparation of starch, etc.]. A. Heiduschka. Pharm. Zentralh., 1918, **59**, 291—293.

MACERATION before or after fermentation, or after treatment with sodium carbonate solution, presented mechanical difficulties in the separation of starch from horse-chestnuts, but the following method was found to be practicable. The air-dried meal (containing about 91% of dry substance) is made into a paste with 1% sodium sulphite solution and, after an hour or so, the paste is mixed with water, and the starch washed through a fine sieve. The yield is about 40% of starch. The wash-water contains dextrins, dextrose, proteins, oils, etc., and may be utilised in the distillery, or mixed with the insoluble portion of the chestnuts, or with other foodstuffs, and used as a fodder.—W. P. S.

Tannin and similar substances. Fischer and Bergmann. *See* XV.

Fumaric acid fermentation. Wehmer. *See* XVIII.

Determining lactose. Hildt. *See* XIXA.

PATENTS.

[*Sugar beet;*] *Extraction of juice from vegetable substances* [——]. J. I. Thornycroft, Bembridge, Isle of Wight. Eng. Pat. 120,448, 12.11.17. (Appl. 16,587/17.)

AN apparatus for continuous counter-current diffusion, particularly adapted to beet sugar extraction, consists of a tall cylindrical jacketed diffuser, having a conical lower portion connected with a vertical feed cylinder of smaller diameter below it. Fresh beet slices are introduced into the feed cylinder through a lateral valve pipe, and a piston movable vertically in the cylinder forces them upwards into the diffuser through a lift valve which normally closes the top of the cylinder. The exhausted slices are discharged from the top of the diffuser, where also the water or fresh syrup enters. The walls of the diffuser at its lower end are perforated, to enable the saturated juice to escape into an annular casing whence it is discharged through valved pipes. A cylinder with piston, connected with these valved pipes, enables the juice to be forced back at intervals into the diffuser to clear the perforations of obstructing matters, and may also serve to introduce juice into the feed cylinder to displace any air therein before the contents of the cylinder are discharged into the diffuser. The diffuser may be provided at one or more points, at different heights, with inlets for water or juice, and these may be associated with means for circulating water or juice transversely through the material in the diffuser; *e.g.* two casings covering perforated openings on opposite sides of the diffuser may communicate externally through a rotary pump.—J. H. L.

Carbon; Process of manufacturing decolorising ——. T. Hayashi, and Kwanto Sanso Kabushiki Kaisha, Tokyo, Japan. Eng. Pat. 121,035, 11.2.18. (Appl. 2445/18.)

SAWDUST, chaff, or other vegetable organic matter, finely chopped and disintegrated, is soaked with a large quantity of a solution of monocalcium phosphate and afterwards sprinkled with a solution of ammonia. The material is dried and carbonised by roasting in a reverberatory furnace or muffle oven, and the calcium pyrophosphate is dissolved out of the charcoal produced by steeping in a solution of phosphoric acid.—J. F. B.

XVIII.—FERMENTATION INDUSTRIES.

Fumaric acid [; Production of —— by] fermentation of sugar. C. Wehmer. Ber., 1918, **51**, 1663—1668.

Aspergillus fumaricus easily ferments relatively large quantities of sugar yielding fumaric acid and a little citric acid. Oxygen is necessary and, for continuous fermentation, calcium carbonate. Thus by the fermentation of 20 grms. of sugar (20% solution) by 2·87 grms. (dry weight) of *Aspergillus fumaricus* in presence of calcium carbonate, 15 grms. of the latter is converted into about 33 grms. of calcium salts consisting chiefly of the sparingly soluble normal calcium fumarate but containing also varying quantities of the easily soluble acid fumarate, about 4% of calcium citrate, and the calcium salt of another, unidentified acid. The sugar is fermented completely and 60—70% of it is converted into acids. The optimum temperature for the growth of the organism is about 22° C. and the maximum about 30° C., but the formation of acid may take place above 30° C.—C. S.

Invertase solutions; Simple method of preparing very active ——. H. Colin. Bull. Assoc. Chim. Sucr., 1917, **35**, 84—88.

A SUSPENSION of yeast in water, *e.g.* 25 grms. in 150 c.c., is left to undergo putrefaction. The invertase activity of the liquid increases from day to day and attains its maximum when the reaction has become acid to litmus but neutral to methyl orange and *p*-nitrophenol. By filtering at this stage, in presence of kieselguhr, a clear extract may be obtained which, if treated with toluene and shaken from time to time, will retain its activity for years. Bakers' yeast gives the palest and clearest extracts, though not the most active. Extracts prepared in this way will invert 20 times their volume of 5% sucrose solution in about an hour at 50° C., without themselves affecting the optical rotation of the liquid. They do not produce any alcohol.—J. H. L.

Sodium carbonate as antiseptic in the fermentation industries. Bettinger and Delavalle. Bull. Assoc. Chim. Sucr., 1917, **35**, 135—139.

SODIUM carbonate solutions are largely employed in distilleries for washing air used for rousing fermentations and stimulating the growth of saccharifying Mucors, where on account of the robust character of the organisms perfectly sterile air is not essential. Experiments described showed that the germicidal power of sodium carbonate, even in 15—20% solutions, is very feeble, spores of certain organisms surviving 10 days' contact with such solutions. For the sterilisation of air, therefore, sodium carbonate solution is scarcely more effective as a washing agent than water alone.
—J. H. L.

Corozo or vegetable ivory; Manufacture of alcohol from ——. G. Mezzadroli. Boll. Chim. Farm., 1918, **57**, 361—362.

THE seeds of *Phytelephas macrocarpa, Palma dum*, and other plants, known as corozo or vegetable ivory, contain a large amount of mannocellulose, which, when boiled with dilute mineral acids, is hydrolysed, with the formation of mannose. This sugar is fermentable by the yeast of saké, but the fermentation is too slow for industrial conditions. Much better results were obtained by means of selected wild yeasts occurring on fruits from Perugia, the solutions of mannose derived from corozo being completely fermented by these. These yeasts also ferment sucrose, dextrose, and maltose. In practice the saccharification product, which should contain about 25% of total solids, is nearly neutralised, the acidity being left at 0·1%, and is treated with 150 grms. of sodium phosphate and 50 to 100 grms. of ammonium sulphate per hl., and pitched with the yeast in the same way as in the fermentation of molasses. The fermentation proceeds regularly and is complete in 48 hours, and distillation of the fermented product yields 4 to 6% of pure alcohol. Each 100 kilos. of corozo, or of the waste from the factories where buttons are made from the vegetable ivory, yields from 10 to 15 litres of alcohol. The waste fragments from the Italian factories yield from 20 to 30% of mannose when hydrolysed with acids. Mould fungi of the type of *Mucor Rouxii* will also effect the decomposition of the mannocellulose of waste vegetable ivory, but a higher temperature and pressure and a longer time are required than when mineral acids are used.—C. A. M.

Utilising horse-chestnuts. Heiduschka. *See* XVII.

XIXA.—FOODS.

Flour; Determination of the moisture content of ——. F. T. Shutt and P. J. Moloney. Trans. Roy. Soc. Canada, 1917-18, [iii], **11**, 101—106.

THE lower results obtained by heating flour to constant weight in an air oven at 100° C. as compared with those from drying in a vacuum oven at the same temperature are not due to oxidation of the flour but rather to incomplete drying. Drying flour for 5 hours at 100° C. in a vacuum possesses the following advantages over drying in an air oven at the same temperature to constant weight:—(1) It gives results nearer the absolute moisture content of the flour; (2) duplicate analyses show a closer agreement, and (3) the results are obtained in a much shorter drying period. (Compare this J., 1918, 263 T.)—J. F. S.

Milk; Hygienic control of ——. A. Verda and A. Kirchensteins. Schweiz. Apoth.-Zeit., 1917, **55**, 665—668, 677—681, 689—692, 705—708. Z. angew. Chem., 1918, **31**, Ref., 348.

THE Tromsdorf test is the only one which gives positive indications in the case of acute udder inflammation. The sediment from the centrifuges should always be examined microscopically and bacteriologically. The detection of a large number of leucocytes and phagocytes calls for an inspection in the stalls, followed by a bacteriological examination of the milk of the suspected cows. All cows set aside for the production of milk for infants and invalids must not only be injected with tuberculin, but the milk from each cow and, if necessary, from each individual teat should be tested biologically. It is essential that a maximum specification be fixed for the number of germs present both in special milk and ordinary milk. The microscopic examination of the centrifuge sediment affords an approximate estimation of the number of germs in the milk.—J. F. B.

Milk; Behaviour of various substances as preservatives of ——. H. Mohorčič. Arch. Hyg., 1917, **86**, 254. Chem.-Zeit., 1918, **42**, Rep., 189.

WHILST the addition of sodium salicylate, sodium benzoate, benzoic acid, boric acid, borax, sodium carbonate, or formaldehyde retards the formation of acid in milk, so much acid is formed eventually that the milk curdles. Frequently, a higher acidity is necessary to curdle preserved milk than is required to curdle untreated milk.—W. P. S.

Lactose [in milk]; Determination of ——. E. Hildt. Comptes rend., 1918, 167, 756—759.

MILK samples, especially those preserved with bichromate, often contain their lactose partially hydrolysed. In such cases the sugar can be determined by cupric reduction after hydrolysis has been rendered complete, provided the reducing power of the hydrolytic products is known. The use of mineral acids for hydrolysis is liable to result in partial destruction of galactose. Good results have, however, been obtained with various sulphonic acids, including those described by Twitchell (this J., 1900, 251). At a concentration of 1%, benzene- or phenol-sulphonic acid, used in the form of sodium or barium salt in presence of an equivalent quantity of sulphuric acid, completely hydrolyses 0·5% solutions of lactose in 4 hours at 100° C., and longer heating produces no further change in reducing power. Lactose in milk serum, however, is hydrolysed more slowly than in pure solutions. The author found that 10 c.c. of "cupro-potassic" solution which, employed at ebullition, corresponded with 0·0495 grm. of invert sugar, corresponded also with 0·0708 grm. of lactose hydrate or 0·0506 grm. of lactose hydrolysed by the sulphonic acids mentioned above. Whilst the solid residue from decomposed milk (*lait altéré*), dried *in vacuo* at the ordinary temperature, corresponds in weight fairly well with the sum of the constituents of the milk determined separately, the residue dried at 100° C. weighs considerably less, owing to destruction of sugar at the higher temperature. This destruction is attributed to interaction of the sugar with proteolytic products formed in the decomposing milk (cp. Maillard, this J., 1912, 144). The interaction probably takes place in two stages, the first of which proceeds at the ordinary temperature and involves evolution of carbon dioxide but no darkening of colour. The second stage, which requires a higher temperature, results in loss of water and the formation of dark-coloured products.—J. H. L.

Butyrometers; Graduation of Gerber ——. H. D. Richmond. Analyst, 1918, 43, 405—407.

THE author discusses a paper by Day and Grimes (this J., 1918, 278A) and points out certain slight differences between the figures recorded by them and those found by himself. The figure adopted by the standardising authorities (one division = 0·125 c.c.) is the mean of those found by the author and by Day and Grimes and is a satisfactory one for use in standardising Gerber butyrometers.

—W. P. S.

Chlorine in foods; Determination of —— without incineration. A. Weltzel. Arbeit. Kaiserl. Ges.-Amt, 1917, 50, 397. Chem.-Zeit., 1918, 42, Rep., 170.

THE substance, *e.g.*, meat, bread, dog biscuits, etc., is finely divided and heated at 100° C. under a reflux condenser for 30 mins. with nitric acid (sp. gr. 1·15); water is then added and the mixture boiled for a further 15 mins.; after cooling, a measured excess of standardised silver nitrate solution is added, the mixture filtered, and the excess of silver titrated with thiocyanate solution in an aliquot portion of the filtrate. In the case of salted fish, the substance must be heated with 10% potassium hydroxide solution, the mixture then diluted to a definite volume, and a portion boiled for 30 mins. with the addition of nitric acid and an excess of silver nitrate solution, and the excess of silver titrated as described.—W. P. S.

Salmon oil; Determination of the hexabromide and iodine values of —— as a means of identifying the species of canned salmon. H. S. Bailey and J. M. Johnson. J. Ind. Eng. Chem., 1918, 10, 999—1001.

THE following results were obtained with oils from canned salmon of different species:—

——	Iodine value	Hexabromide value
Red, Sockeye or Blueback (*Oncorhyncus nerka*)...	140·72–148·10	32·61–37·35
Chinook, King or Spring (*O. tschawytscha*) ...	126·62–134·48	23·86–31·06
Medium Red, Coho or Silverside (*O. kisutch*)	152·51–166·40	43·07–50·31
Humpback or Pink (*O. gorbuscha*)...	153·58	40·17
Chum or Dog (*O. keta*)	133·10–147·75	27·59–35·53

From three to six samples of each kind were examined. The expressed oils had practically the same values as the oils extracted with ether. An acetic acid solution of bromine was used as the brominating agent in the determination of the hexabromide value.—W. P. S.

Kafirin; Hydrolysis of ——. D. B. Jones and C. O. Johns. J. Biol. Chem., 1918, 36, 323—334.

KAFIRIN, the alcohol-soluble protein of kafir, closely resembles the alcohol-soluble protein of maize, zein, in its composition. It contains large quantities of leucine and glutamic acid and is free from glycine. It differs from zein in containing a trace of tryptophan.—H. W. B.

Tyrosine in proteins; Determination of ——. C. O. Johns and D. B. Jones. J. Biol. Chem., 1918, 36, 319—322.

TYROSINE can be estimated in proteins after hydrolysis with hydrochloric acid by means of the colorimetric method of Folin and Denis (J. Biol. Chem., 1912, 12, 245).—H. W. B.

Straw; Feeding experiments with digested ——. G. Fingerling. Landw. Versuchsstat., 1918, 92, 1—56. Z. angew. Chem., 1918, 31, Ref., 347.

THE digestion of straw without pressure yields a fodder having a starch-value ranging between 45 and 75% of that of the dry, digested straw, according to the quantity of caustic soda used for the digestion and the manner of steaming. The small amount of protein in the digested straw is unassimilable, and this circumstance must be taken into account when making up the fodders. A good cooking effect can be obtained by the use of sodium sulphide or other reagents. Cooked straw is readily accepted and tolerated by the animals after they have become accustomed to it. The assimilation of completely digested straw (so-called straw pulp) by ruminants is not increased by grinding the pulp.

—J. F. B.

Wood cellulose as fodder in Sweden. C. G. Schwalbe. Papier-Zeit., 1918, 43, 318. Z. angew. Chem., 1918, 31, Ref., 347.

FEEDING trials have been made with wood cellulose, previously treated with small quantities of acid, in order to make it tender and destroy the felting capacity of the fibres. The experiments showed a very high digestibility but a tendency to give rise to kidney irritation. The unfavourable results may be explained by the various forms in which wood cellulose is prepared for fodder. The author points

out that if the chemical treatment is not carried out correctly, undesirable side reactions may occur, with the formation of small quantities of methyl alcohol, formaldehyde, formic acid, or acetic acid, which are not in themselves injurious to the cattle but yet may lower the digestibility of the fodder. —J. F. B.

Utilising horse-chestnuts. Heiduschka. *See* XVII.

Yerba mate. Guglialmelli and Estrella. *See* XX.

PATENTS.

Margarine; Manufacture of —. H. Norton, Liverpool. Eng. Pat. 120,836, 28.2.18. (Appl. 3609/18.)

ABOUT 40 parts of edible oil and 10 parts of hard fat are heated together to the melting point of the fat and churned with about 2 parts of uncoagulated egg albumin dissolved in 8 parts of water heated to the same temperature as the fat but below the coagulation point of the albumin. The product is pressed to extract surplus water, and colouring and flavouring matters are added.—J. H. J.

"Ripening" or "souring" milk or cream for use in the manufacture of butter, margarine and the like; Tanks or containers for —. C. Revis and E. R. Bolton, London, and C. Downs and R. A. Bellwood, Kingston-upon-Hull. Eng. Pat. 121,033, 6.2.18. (Appl. 2123/18.)

THE milk to be soured is placed in a jacketed tank of tinned copper supplied with hot and cold water. In the tank is a series of pipes in parallel or in coils, the inlet and outlet being upright pipes bent over the upper edge of the ends of the tank. These upright pipes are carried in blocks which slide in perpendicular guides standing on the top of the tank. The blocks are connected to cranks worked from a shaft underneath the tank, which causes the series of pipes to be moved up and down in the tank; or, the raising and lowering may be done by a hydraulic ram arrangement. By these means the milk is kept in slow movement and each portion is brought successively to the surface for aeration. A current of brine may be passed through the pipes for cooling purposes. Covers are provided for the tank which can be raised and turned back mechanically.—J. H. J.

Milk and other liquids; Process and apparatus for preserving and sterilising —. A. F. Spencer, Margate. Eng. Pat. 120,963, 26.11.17. (Appl. 17,442/17.)

THE apparatus consists of two sterilising cylinders connected to one or more bottles for the sterilised liquid. Before use the whole apparatus is sterilised by passing heated air at 300° F. (about 150° C.) through it, and is then cooled. Milk is poured into one of the sterilising cylinders, which is maintained at 160° F. (about 70° C.) for 15 mins. by a gas jet, or by passing sterilised air cooled to 160° F. through it. During this period the milk is gently stirred by blades and is under a slight pressure from the air enclosed between the liquid level and the top of the cylinder. By this pressure the milk is transferred to the second sterilising cylinder, where the process is repeated. The milk is then passed through a cooler into the bottoms of the receiving bottles, which are closed at the top, until they are nearly full, when a tap on the entry pipe of each bottle is closed.—J. H. J.

Soya beans; Process of producing liquid food from —. A. B. Moses, Seattle, Wash. U.S. Pat. 1,281,411, 15.10.18. Appl., 27.12.17.

SOYA beans are disintegrated and allowed to stand with water until the nutritious matters are dissolved; then the mass is heated, and is afterwards cooled and strained. The residue is subjected to mechanical pressure and the expressed liquid is added to the strained liquid.—J. H. J.

Food product and process of making same. F. E. Pierson, Gravity, Iowa. U.S. Pat. 1,281,828, 15.10.18. Appl., 27.4.18.

CORN (maize), from which the hulls have been removed, is immersed in acetic acid, drained, and frozen. Afterwards, the moisture is evaporated from the corn.—J. H. J.

Bread; Method of treating —. H. J. Lueders, Assignor to F. Treuleben, Washington, D.C. U.S. Pat. 1,282,251, 22.10.18. Appl., 22.11.17.

BREAD, after baking, is cooled and is then sterilised by subjecting the crust to a temperature between 140° and 600° F. (60°—315° C.) in order to destroy moulds.—J. H. J.

Curing meats; Process of —. A. C. Legg, Birmingham, Ala., U.S.A. Eng. Pat. 120,964, 26.11.17. (Appl. 17,458/17.)

SEE U.S. Pat. 1,250,934 of 1917; this J., 1918, 164A.

XIXB.—WATER PURIFICATION; SANITATION.

Water softening. P. E. King. J. Soc. Dyers and Col., 1918, **34**, 240—243.

A REVIEW of processes of softening water is given. In the Gaillet and Huet, or Stanhope continuous process, clear saturated lime water is made by passing a definite proportion of the water to be treated through milk of lime at the bottom of a saturator, a clear saturated solution being discharged at the top. This is added to the hard water together with sodium carbonate solution, and the mixture passes up a clarifying tower with diaphragms fixed to alternate sides to remove the precipitated solids. Plants operating with saturated lime water are becoming obsolete, as 10—25% of the hard water has to be passed through the lime saturator. The Lassen and Hjort is an efficient method in which the water is measured by a tipper in the treatment tank, the tipping action also regulating the addition of milk of lime and sodium carbonate. The precipitated solids settle out and the effluent is passed through a wood wool filter. In the Paterson "Osilameter Bye-pass" method a proportion of the water is by-passed through a tipper; the main stream of water drives a water-wheel which works agitators in the chemical tank; the agitators are provided with cups which fill the reagent measuring bucket which is overturned by the action of the tipper. The Archbutt and Deeley process is discontinuous and the softened water is carbonated to neutralise alkalinity and prevent subsequent deposition. In the Permutit process there is no precipitate produced and the water is reduced to zero hardness. When this process is used after a lime-soda process, certain disadvantages are found to occur, in that free lime passing through permutite produces caustic soda, which gradually dissolves the material. Moreover, sodium carbonate in passing through permutite containing calcium-permutite, produces calcium carbonate which turns the softened water opalescent. Free

alkali in softened water always causes a subsequent deposition of calcium carbonate, a process hastened by contact with permutite, which thus becomes contaminated with calcium carbonate and ultimately inactive.—J. H. J.

Water softening [in the textile industry]. E. V. Chambers. J. Soc. Dyers and Col., 1918, **34**, 243—246.

A REVIEW is given of the plant used in water softening processes in the textile industry. Continuous processes of softening have received more attention than intermittent processes, mainly because the plant occupies less room and requires less attention. In the intermittent system, working on a four hours' cycle, a plant to deal with 5000 galls. of water per hr. requires a total tank capacity of 40,000 galls.; whereas in the continuous system the corresponding tank capacity is only 15,000 galls. In a good continuous plant a total hardness of 26° can be reduced to 2·5°, without imparting any appreciable alkalinity to the treated water, at a cost of about 2½*d.* per 1000 galls. In the textile districts, the rivers usually have a hardness of about 10°, and this can be dealt with satisfactorily by one of the lime-soda processes. The oil and suspended matter in the river water are carried down along with the precipitate produced, or can be deposited by the simultaneous addition of a little crude aluminium sulphate. A good deal of the water used in the textile industries can be used over again if properly purified. Waste water from piece-scouring processes is passed through a screen to remove fibre and then treated with sufficient sulphuric acid to decompose soap and separate grease. The fatty acids and grease are retained on filters. The water is then neutralised with sodium carbonate and stored for re-use. It has a total hardness of 4·5° and is clear and colourless. The cost is 2*d.* per 1000 galls.—J. H. J.

Hydrocyanic acid gas; Effect of —— under vacuum conditions on subterranean larvæ. E. R. Sasscer and H. L. Sanford. J. Agric. Res., 1918, **15**, 133—136.

THE effectiveness of hydrogen cyanide vapour under the conditions of the vacuum process in destroying subterranean larvæ, *e.g.* in the balls of earth enclosing the roots of imported nursery plants, is influenced by the water content of the soil. Vacuum fumigation with hydrogen cyanide at a concentration exceeding the equivalent of 1 oz. of sodium cyanide per 100 cub. ft. of space with an exposure of 1½ hours is not recommended for plants in foliage, and as all larvæ in soaked soil were not killed with concentrations of sodium cyanide varying from ¼—3 oz. per 100 cub. ft., fumigation of imported nursery stock at the port of entry with a dose which will not injure the plants is not an effective preventive against the introduction and establishment of subterranean pests. Apart from the tests with soaked soil, the best results were obtained when the plants were exposed to the gas first at a vacuum of 15 in., and then for 1½ hours under normal atmospheric conditions.—W. G.

PATENTS.

Filters [for water]. J. Wilson, London. Eng. Pat. 120,867, 9.8.18. (Appl. 12,966/18.)

A FILTER designed for upward filtration is provided with a dome with serrated edges in the space beneath the filtering medium, the top of the dome being connected with the top of the tank by a tube. The water to be filtered is led into the dome and passes through the serrations, while any air escapes by the tube in the top of the dome. After passing through the filtering medium, the water leaves the filter by a pipe near the top. In cleaning the filter, a valve in a wide pipe in the bottom of the filter under the dome is opened, which causes the water standing in the filter to pass through the medium as a flush. More water is then admitted to the space beneath the material and allowed to fill the filter. The valve beneath the dome is opened again and the filter allowed to become only partly empty, while at the same time air is drawn into the space beneath the medium through a special pipe. More water is again admitted to the space beneath the medium, which causes the imprisoned air to be driven out through the medium, thus agitating it.
—J. H. J.

Water and other liquids; Apparatus for purifying ——. J. Wilson, London. Eng. Pat. 121,180, 5.12.17. (Appl. 18,044/17.) Addition to Eng. Pat. 7029, 21.3.11.

AN improved apparatus is described for carrying out the process of purifying water described in a previous patent (this J., 1912, 200), in which milk of lime is added to the water by means of cups. The improvement consists in using two oscillating buckets, one of which actuates the cups for adding the reagent, whilst the other actuates the stirrer for the reagent. Means are provided for reducing the supply of water to the latter bucket when the flow through the apparatus increases above a determined volume.—J. H. J.

Air-diffusing apparatus. C. H. Nordell, Milwaukee, Wis. U.S. Pat. 1,281,816, 15.10.18. Appl., 12.5.17.

A PORTION of the tank containing the liquid to be aerated is recessed, the recess having a concave bottom, and an arch of the same curvature as the bottom, made of diffusing blocks, placed edge to edge, is supported a little away above the bottom. The air is admitted between the bottom and the blocks.—J. H. J.

Antiseptics, disinfectants and the like [zinc tribromophenolate]. B. Abrahamsen, Trondhjem, Norway. Eng. Pat. 117,072, 4.6.18. (Appl. 9207/18.) Int. Conv., 28.6.17.

A DISINFECTANT for wounds is claimed, consisting of the zinc salt of tribromophenol with or without zinc hydroxide, prepared by precipitating a neutral or alkaline solution of a soluble salt of tribromophenol with a soluble zinc salt. It has not the cauterising action of tribromophenol itself, and is better adapted than the bismuth salt ("Xeroform") to the preparation of antiseptic gauze, as it forms a gelatinous mass with alcohol.—J. H. L.

Disinfectant; Solidified soluble coal-tar-derivative ——. A. Franck-Phillipson, Chicago, Ill. U.S. Pat. 1,282,062, 22.10.18. Appl., 15.3.18.

TAR oil is mixed with fat and with sufficient alkali to neutralise the free acids of the tar oil and saponify or partly saponify the fat. The mass is solidified, and is capable of producing a stable emulsion with water.—J. H. J.

Softening and purifying water, metering fluids, or the like; Apparatus for ——. G. J. Gibbs, Preston. Eng. Pat. 120,752, 27.10.17. (Appl. 15,663/17.)

Water or sewage; Apparatus for purifying ——. C. E. Wallace, Tompkinsville, and M. F. Tiernan, New York, U.S. Pat. 1,283,993, 5.11.18. Appl., 26.3.15.

SEE Eng. Pat. 113,105 of 1916; this J., 1918, 191 A.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Morphine in complex products; Determination of ——. *II. Mixtures containing morphine as a simple salt.* A. Tingle. Amer. J. Pharm., 1918, **90**, 788—795. (See this J., 1919, 27 A).

To determine morphine in pills, powders, etc., 6 grms. of the sample is mixed with 2 grms. of calcium carbonate and 20 c.c. of water and warmed until a uniform paste is obtained; 60 c.c. of cold saturated barium hydroxide solution is then added, and, after 30 mins., the mixture is filtered. (The insoluble portion should be dissolved in hydrochloric acid, warmed, filtered, and the filtrate tested for meconic acid with ferric chloride: the presence of meconic acid indicates that the morphine is in the form of opium, in which case the method is not applicable.) Fifty c.c. of the filtrate is treated, drop by drop, with dilute sulphuric acid, to precipitate the barium, then diluted to 55 c.c., and filtered. Fifty c.c. of the filtrate is rendered just alkaline (to litmus paper) with sodium hydroxide solution, then acidified slightly with hydrochloric acid, and evaporated to a volume of not more than 5 c.c.; this residual liquid is transferred to a separating funnel with about 10 c.c. of water, 25 c.c. of a mixture of chloroform and alcohol (2 : 1) is added, followed by a quantity of saturated sodium bicarbonate sufficient to render the mixture just alkaline. After shaking, the chloroform layer is drawn off, and the extraction repeated four times. The united chloroform extracts are evaporated, and the residue titrated with *N*/10 sulphuric acid, using lacmoid or cochineal as indicator. Each c.c. of *N*/10 acid is equivalent to 0·0300 grm. of morphine.
—W. P. S.

Quinine; Detection of ——. H. Salomon. Ber. deuts. pharm. Ges., 1918, **28**, 273—275.

The fluorescence produced when a quinine solution is treated with dilute sulphuric acid is a very sensitive test and will detect 1 part of the alkaloid in 100,000 parts of solution. A less sensitive test (1 in 10,000) consists in treating the quinine with chlorine and then with ammonia, a green coloration being produced (thalleloquin reaction). It is recommended that bromine be used in place of chlorine in this test; the bromine-water must be added cautiously until the solution is just coloured yellow and a drop of ammonia then introduced. Another reagent for quinine recommended by Giemsa and Halberkann (Deuts. Med. Wochenschr., 1917, Nr. 48) consists of potassium iodide 10, mercuric chloride 2·7, water 200, and glacial acetic acid 2·5 grms.; this gives a turbidity with a solution containing 1 part of quinine in 200,000 parts. To detect quinine in urine, the alkaloid should first be extracted with ether.—W. P. S.

Alkaloids of the betel nut. K. Freudenberg. Ber., 1918, **51**, 1668—1682.

The author shows by direct comparison and in other ways that guvacine is 1.2.5.6-tetrahydropyridine-3-carboxylic acid (Freudenberg, this J., 1918, 560 A) and not 1.2.5.6-tetrahydropyridine-4-carboxylic acid (Hess and Leibbrandt, this J., 1918, 559 A; see also J. Chem. Soc., Feb., 1919).—C. S.

Digitalis leaves of different origin; Active glucosides of ——. E. Meyer. Arch. exp. Path. u. Pharm., 1917, **81**, 261. Chem.-Zeit., 1918, **42**, Rep., 190.

First and second year digitalis (*D. purpurea*) leaves contain the same amount of glucosides, and the latter cannot be extracted from the leaves with the use of less water than twenty-five times the weight of the leaves. The concentration of active glucosides (gitalin and digitalein) in the aqueous extract is never greater than 1 to 3020. The active glucosides cannot be extracted directly from the leaves by means of chloroform, since the gitalin is present in a form insoluble in this solvent; gitalin may also become insoluble in chloroform when the aqueous extract is dried. The following process may be used for concentrating the active principles:— 20 c.c. of the cold water extract is concentrated *in vacuo* over sulphuric acid to a volume of 3 c.c., the residue is treated with dry sodium carbonate, and shaken with 50 c.c. of chloroform: anhydrous sodium sulphate is then added in quantity sufficient to combine with all the water present. The chloroform solution is separated, the residue washed with chloroform, the united extracts evaporated *in vacuo* at 30° C., and the residue then treated with a small quantity of water and again heated at 30° C. *in vacuo* to remove the last traces of chloroform.—W. P. S.

Digitalis substances. XXXVIII. H. Kiliani. Ber., 1918, **51**, 1613—1639.

A record of some neutral and acid substances obtained by the oxidation or reduction of digitogenic acid, gitogenic acid, digitoxigenin, and digitaligenin. The sugar syrup previously obtained (this J., 1916, 615) could not be made to crystallise because the sugars in the syrup, which had been prepared in an alcoholic medium, were present chiefly in the form of ethylglucosides. After a second hydrolysis with hydrochloric acid a partial crystallisation was effected and *d*-galactose obtained by inoculation; dextrose, identified as *d*-gluconic acid, and apparently a third sugar, a ketose, were also present. (See also J. Chem. Soc., Feb., 1919.)
—C. S.

Yerba mate; Testing the purity of ——. L. Guglialmelli and C. G. Estrella. Anal. Soc. Quím. Argentina, 1918, **6**, 136—150.

The method proposed by Sabattini (this J., 1918, 221 A) is based on the reduction of ferric chloride by the caffeine contained in the mate. The authors show that discordant results are obtained with the same sample of mate owing to the different degrees of hydrolysis of the ferric chloride solutions used. Their experiments show further that in the conditions specified caffeine exerts no reducing action on ferric chloride and that in any case there is a reaction between the ferric salt and such substances as resorcinol, catechol, etc., which are also present in the mate.—W. S. M.

Pyramidone (dimethylaminoantipyrine); New and delicate reaction of —— and its differentiation from antipyrine. L. P. J. Palet. Anal. Soc. Quím. Argentina, 1918, **6**, 151—155.

The author finds that an acid solution of pyramidone treated with a few drops of an acid solution of potassium ferricyanide and ferric chloride gives an intense blue coloration and precipitate of Prussian blue. The test is very delicate. With antipyrine a blood-red colour is obtained with the same reagent. This colour is converted into a pale yellow by the addition of a few drops of hydrochloric acid. The test is therefore carried out in hydrochloric acid solution, which permits the blue due to the presence of pyramidone in a mixture to emerge. In this way 0·01 part of pyramidone may be detected in one part of antipyrine. Phenacetin, acetanilide, acetylsalicylic acid, exalgin (methylacetanilide), and caffeine give no reaction with the reagent.
—W. S. M.

Alkaloids, glucosides, and other vegetable principles; Reaction of the "ferri-ferric" reagent with ——. L. P. J. Palet. Anal. Soc. Quím. Argentina, 1918, **6**, 156—158.

An extension of the application of a mixed solution of potassium ferricyanide and ferric chloride (see preceding abstract) to the characterisation of alkaloids, glucosides, and other substances of vegetable origin. Of 102 substances of this kind tested, 42 gave a positive reaction, *i.e.*, a more or less intense blue coloration.—W. S. M.

Enzymic reagents; Use of ——. *II. Detection of pyramidone and the differentiation of the naphthols.* L. P. J. Palet. Anal. Soc. Quím. Argentina, 1918, **6**, 250—257.

If some small pieces of the root of alfalfa, which contains oxidases and peroxidases, be added to a solution of pyramidone, a violet-blue colour is produced on the root fibres on standing. The addition of hydrogen peroxide accelerates the appearance of, but does not intensify, the colour. The further addition of α-naphthol immediately produces an intense wine-red colour characteristically different from that produced by β-naphthol. This constitutes a delicate test for the presence of small quantities of α-naphthol in β-naphthol.—W. S. M.

Guaiacum resin; Constitution of substances from ——. G. Schroeter, L. Lichtenstadt, and D. Irineu. Ber., 1918, **51**, 1587—1613.

Among the products obtained by the dry distillation of guaiacum resin are two substances of unknown constitution, pyroguaiacin and guaiene. The latter is now proved to be 2.3-dimethylnaphthalene by its synthesis. Pyroguaiacin is almost certainly 6 - hydroxy - 7 - methoxy-2.3-dimethylnaphthalene. Guaiaretic acid, extracted from guaiacum resin by ether, has the formula $C_{20}H_{24}O_4$, not $C_{20}H_{26}O_4$ as stated by Herzig and Schiff (this J., 1898, 267, 600). It is optically active, $[\alpha]_D = -94°$ in alcohol, and unsaturated. Herzig and Schiff's norguaiaretic acid is proved to be norhydroguaiaretic acid. Hydroguaiaretic acid methyl ether is most probably αδ-diveratryl-βγ-dimethylbutane, $[.CH(CH_3).CH_2.C_6H_3(OCH_3)_2]_2$, and guaiaretic acid methyl ether has the formula $C_6H_3(OCH_3)_2.CH:C(CH_3).CH(CH_3).CH_2.C_6H_3(OCH_3)_2$. The synthesis of 1.2-dimethylnaphthalene, b.pt. 139°—140° C. at 15 mm., is described. (See also J. Chem. Soc., Feb., 1919.)—C. S.

Saccharin tablets; Examination of ——. H. D. Richmond, S. Royce, and C. A. Hill. Analyst, 1918, **43**, 402—404.

A modification of a method described previously (this J., 1918, 246 T) is recommended since the presence of theobroma emulsion or similar substance containing soap causes excessive frothing when the tablets are boiled with alkali solution. The alkalinity of the tablets is determined by boiling one tablet with an excess of *N*/10 sulphuric acid and titrating the excess of acid with *N*/10 sodium hydroxide solution, using phenolphthalein as indicator. Let the alkalinity equal *x* c.c. of *N*/10 acid. Twenty tablets are then weighed, treated with 25 c.c. plus *x* c.c. of 4*N* sulphuric acid, the mixture diluted to 50 c.c., and boiled under a reflux condenser for 1·5 hr.; 20 c.c. of 7·5*N* sodium hydroxide solution is added together with a little powdered pumice, the ammonia is distilled into 20 c.c. of *N*/5 acid, and the excess of acid then titrated, using methyl-red as indicator. The result is calculated as percentage of *o*-benzoylsulphonimide by multiplying by 1·831. If the tablets do not dissolve completely in water, the insoluble portion should be collected on a filter and ignited; it will probably be talc.—W. P. S.

Uramino-acids; Method for the identification of certain —— in the presence of amino-acids and of urea. A. Rohde. J. Biol. Chem., 1918, **36**, 467—474.

The urea is first destroyed by urease and the uramino-acid then extracted from the acidified solution by ethyl acetate. It is shown that amino-acids are not excreted from the body in conjugation with urea, as has been previously suggested, but in the free state. (See further J. Chem. Soc., Feb., 1919.)—H. W. B.

Arsenotungstic and arsenotungstomolybdic complexes as reagents for phenolic amines. L. Guglialmelli. Anal. Soc. Quim. Argentina, 1918, **6**, 185—195.

Reagents prepared by boiling solutions of sodium tungstate with arsenic acid, and a mixture of sodium tungstate and molybdate with arsenic acid, until concentrated hydrochloric acid no longer produces a precipitate, have been shown to give a delicate colour reaction with phenols and some purine derivatives. The same reaction, *i.e.*, an intense blue colour, is given by phenolic amines. The author has investigated a large number of substances of this class, also nitro-, sulphonic, and hydroxy-derivatives of these. Positive results were given with the first reagent with hydroxylamine and hydrazine and their derivatives of the types, RNH—NH_2, NHR—NHR, NHR—OH, and also with compounds containing the same groups separated from each other but united directly to a benzene, naphthalene, purine, or pyrazolone nucleus. The second reagent reacts with substances containing the same groups and in addition with substances containing one NH_2 group, *e.g.*, aniline.—W. S. M.

Chloroform; Detection of hydrogen chloride in ——. D. Vorländer. Ber. deuts. Pharm. Ges., 1918, **28**, 385—388.

Ten c.c. of the chloroform is treated with a minute particle (about 0·01 mgrm.) of *p*-dimethylaminoazobenzene; if free hydrogen chloride is present a violet-red coloration is obtained, otherwise the solution remains yellow. An excess of the indicator must be avoided, since the yellow colour may mask a feeble coloration given by a mere trace of the acid. In doubtful cases, it is advisable to treat a further quantity of the chloroform with a few drops of the first portion containing the indicator. This method is more sensitive and reliable than the usual way of testing chloroform by shaking with water and then testing with litmus, as there is risk of gradual decomposition of the chloroform in presence of water. Carbon dioxide and anhydrous formic and acetic acids do not give a red coloration with *p*-dimethylaminoazobenzene in chloroform solution. —W. P. S.

Oil of cassia; Constituents of ——. F. D. Dodge. J. Ind. Eng. Chem., 1918, **10**, 1005—1006.

Including constituents known previously (see this J., 1916, 139) oil of cassia is now found to contain:—cinnamaldehyde (75 to 90%), cinnamyl acetate, phenyl propylacetate (?), methyl *o*-coumaraldehyde, salicylaldehyde (0·1 to 0·2%), coumarin, benzoic acid, salicylic acid, an unidentified liquid acid, benzaldehyde, and methylsalicylaldehyde. (See also J. Chem. Soc., Feb., 1919.)—W. P. S.

Carvacrol; Study of the conditions essential for the commercial manufacture of ——. A. W. Hickson and R. H. McKee. J. Ind. Eng. Chem., 1918, **10**, 982—992.

A process for the manufacture of carvacrol from cymene is described in detail; spruce turpentine is

used as the source of the cymene. Cymenesulphonic acid is made by agitating spruce turpentine with its own volume of sulphuric acid (66° B., sp. gr. 1·84) for 4 hrs. at 90° to 100° C. in a cast-iron vessel. The excess of acid is then neutralised by addition of ground limestone, and calcium sulphate is removed by filtration. The filtrate is treated with soda ash and the resulting sodium cymenesulphonate solution, after removal of the calcium carbonate, is concentrated and dried in a vacuum evaporator. The dry sodium cymenesulphonate is mixed with one-half of its weight of 76% sodium hydroxide and fused for 6 hrs. at 350°—370° C. in a cast-iron vessel provided with a cover and water-cooled condenser. The fused mass is then poured into a minimum quantity of cold water, the solution neutralised with sulphuric acid (40° B., sp. gr. 1·384), and the liberated carvacrol separated from the liquid by steam distillation or extraction with benzene; in the latter case the benzene is recovered by distillation. The carvacrol is re-distilled; it is a clear yellowish oil, b. pt. 232° C. The total cost, based on a 60% yield, is estimated to be about 60 cents per lb.—W. P. S.

Tannin and similar substances. Fischer and Bergmann. *See* XV.

β-Glucosidogallic acid. Fischer and Bergmann. *See* XV.

Fumaric acid fermentation. Wehmer. *See* XVIII.

Potassium in blood. Clausen. *See* XXIII.

Estimation of mercury. Piña de Rubles. *See* XXIII.

PATENTS.

Acetic anhydride; Process of making ——. H. Dreyfus, Basle, Switzerland. U.S. Pat. 1,283,115, 29.10.18. Appl., 18.1.16.

SEE Eng. Pat. 17,920 of 1915; this J., 1917, 162. The sulphuric anhydride may be replaced by a mixture of sulphuric acid and anhydride containing 50—70% of free anhydride.

Phthaleins and similar compounds; Manufacture of mercury derivatives of ——. Saccharin-Fabr. Akt.-Ges. vorm. Fahlberg, List, und Co., Magdeburg. Ger. Pat. 308,335, 28.11.14.

BY heating neutral solutions of alkali salts of phthaleins, succineins, sacchareins, etc. with a large excess of a mercury salt (mercuric chloride), readily filtered, crystalline mercury compounds may be obtained which can be washed free of mercuric chloride with hot water and are not readily decomposed, even with hot ammonium sulphide. Fluorescein may be removed from the products by washing with alcohol or acetone. Bromo- and iodo-derivatives of phthaleins are readily converted into mercury compounds by this method.—L. A. C.

Calcium halides and starch; Dry preparations containing ——. E. Ritsert, Frankfort. Ger. Pat. 308,616, 16.9.15.

APPROXIMATELY equal weights of calcium halide and starch are mixed at the ordinary temperature with sufficient water to form a paste which sets to a solid without the application of heat.—L. A. C.

Antiseptics. Eng. Pat. 117,072. *See* XIXB.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Mordant dye process; A new photographic ——. F. E. Ives. Communication from Hess-Ives Laboratories. Brit. J. Phot., 1919, **66**, Col. Suppl., 1.

AN ordinary silver image is treated in a mixed potassium ferricyanide-chromic acid solution, a convenient strength being one part of each compound to 160 parts of water. This converts the silver image to a transparent yellow image, which is a silver salt containing also chromium but the exact composition of which has not yet been determined. The plate is then washed to remove all excess of chromic acid; the washing process is shortened, and the subsequent staining improved if a weak solution of sodium bicarbonate is used, but excessive treatment in this bath weakens the image. This transparent silver image acts more powerfully than previously described mordanting images such as the transparent silver iodide of Traube or the copper ferrocyanide image of Ives and Crabtree, suitable dyes being Safranine, Malachite Green, and Auramine. In a short historical introduction to the paper it is noted that the priority for the copper mordanting process described in the author's Eng. Pat. 113,617 of 1918 (this J., 1918, 607 A) belongs to Crabtree (see Brit. J. Phot., 1918, 357—359).
—B. V. S.

PATENT.

Celluloid or like material; Coating films of —— with sensitised photographic emulsion. N. L. Scott, Ashtead, Surrey. Eng. Pat. 121,054, 19.3.18. (Appl. 4817/18.)

IN the coating of celluloid film any unevenness in its surface during coating or setting, such as that produced by buckling, causes unevenness in the thickness of the coating even if this has been initially quite uniform, by running of the emulsion from the ridges to the hollows. This is prevented by damping the back of the film and then pressing it by means of a spring roller into close contact with the surface of a large smooth revolving drum on which it remains during coating and setting, contact being maintained by atmospheric pressure. The revolving drum is chilled internally to produce quick setting.—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Cellulose; Nitration of —— and determination of nitrogen in guncotton. A. Hervé. Monit. Scient., 1918, **62**, 241—245.

COMPARATIVE nitrations of cotton showed definitely that as the percentage of water in the nitrating mixture was increased, the percentage of nitrogen in the pyroxylin decreased. On the other hand, a variation in the percentage of nitric acid in the nitrating mixture, within fairly wide limits, had very little influence on the percentage of nitrogen in the product and the effect was not regular. On comparing the composition of the baths before and after nitration, it was found that the quantity of nitric acid removed was always slightly greater than the equivalent of the percentage fixed in the nitrocellulose. It is concluded that, although in the manufacture of soluble pyroxylin the effect of small variations in the percentage of nitrogen is not of vital importance, in the manufacture of guncotton such variations have a very considerable influence on the ballistic power, and the control of the percentage of water in the nitrating mixture requires the most urgent attention. The regeneration of old

nitrating baths by the addition of sulphuric and nitric acids is performed on the basis of analyses of samples taken from large reservoirs in which the acids are mixed by the agitation of compressed air. Analyses have shown, however, that homogeneity in composition is not always easily obtained by this method of mixing, even when agitation is prolonged for several hours, and substantial variations have been found in the percentage of nitrogen in the nitrated cotton produced with acid taken from different parts of the tank. The author has made a careful examination of Crum's method for the determination of nitrogen in nitrocelluloses, using the Lunge nitrometer. To obtain consistent results it is absolutely necessary to verify that the reaction with the mercury has been complete, by shaking again after the volume has been accurately read off. Generally, two vigorous shakings are sufficient, and there is no alteration in volume after a third, but if a change is noted the operation must be repeated until the result is constant. One of the principal causes of divergent results is inattention to the solubility of nitric oxide in sulphuric acid. This gas is only insoluble in sulphuric acid of 85% concentration; its solubility in stronger acid becomes very sensible and reaches 0·035 c.c. per c.c. of acid in the case of 94% sulphuric acid. It is possible to arrange matters so that the acid in the tube, after dissolving the nitrocellulose in 96% acid, has a final concentration of 85%.—J. F. B.

Estimation of mercury. Piña de Rubies. *See* XXIII.

PATENTS.

Explosive. P. E. Haynes and H. E. Thompson, Buffalo, N.Y., Assignors to The Linde Air Products Co., Cleveland, Ohio. U.S. Pat. 1,282,229, 22.10.18. Appl., 8.3.18.

THE explosive contains carbonised balsa wood and liquid ozone.—T. St.

Explosive. C. E. Griffing, Assignor to W. H. Kennedy, Los Angeles, Cal. U.S. Pat. 1,282,413, 22.10.18. Appl., 31.5.17. Renewed 18.3.18.

THE explosive consists of powdered potassium chlorate 50, white granulated sugar 49, potassium permanganate 0·33, powdered white sulphur 0·33, and talcum powder 0·33%.—T. St.

XXIII.—ANALYSIS.

Permanganate solutions; Arsenite titrations of ——. A. Bose. Chem. News, 1918, **117**, 369—370.

IBBOTSON has shown (this J., 1918, 268A) that sodium arsenite solution has an abnormally high reducing value when used for the titration of permanganate in the presence of nitric acid. The author records results of experiments which show that the nitric acid is not the cause of the abnormal reaction. Ibbotson considers that the cause is the formation of manganic compounds, but this does not seem possible. It may be that some complicated reactions take place during the titration, as up to this point titration with ferrous ammonium sulphate shows that all the manganese is present as permanganate.—W. P. S.

Sulphate ion; Volumetric estimation of the ——. R. Howden. Chem. News, 1918, **117**, 383.

A RAPID volumetric method for the estimation of the sulphate ion is based on the decomposition of alkali sulphate by barium carbonate, generating alkali carbonate which can be estimated by titration. The sulphate solution is made exactly neutral to methyl orange and is then shaken with excess of pure precipitated barium carbonate in presence of phenolphthalein. *N*/10 hydrochloric acid is then run in until the red colour is discharged through the formation of bicarbonate, the solution is filtered and titrated, using methyl orange as indicator. The results obtained are only approximately correct, generally about 2% too low, from the figures quoted.—E. H. R.

Potassium in blood; Method for the estimation of ——. S. W. Clausen. J. Biol. Chem., 1918, **36**, 479—484.

THE blood is oxidised by boiling with nitric and sulphuric acids and the potassium then precipitated by sodium cobaltinitrite. The precipitate is collected, decomposed by sodium hydroxide, and the nitrites then estimated by titration in acid solution with permanganate at 70° C. By this method, the amount of potassium in 1 c.c. of blood can be accurately estimated. (See further J. Chem. Soc., Feb., 1919.)—H. W. B.

Mercury; Exact and rapid method for the estimation of —— in the majority of its compounds. S. Piña de Rubies. Anal. Fis. Quím, 1918, **16**, 661—689.

THE method is a combination of the Rose-Finkener and Eschka processes, combining the accuracy of the former with the rapidity of the latter. As applied to the analysis of mercury minerals, it is as follows: The mineral is mixed intimately with fine iron powder and heated in a porcelain crucible into which is closely fitted as a cover a small crucible of gold or silver for the condensation of the volatilised mercury. The cooling of the upper crucible is effected by means of a small rubber bladder distended by a stream of cold water. The crucible with the condensed mercury is washed with alcohol and the weight of the mercury film determined. The results obtained by this procedure showed a maximum error of 0·07%. In the case of more volatile compounds of mercury, organic and inorganic, anhydrous potassium carbonate and barium peroxide, either separately or mixed, are substituted for the iron powder. When the substance to be analysed contains much moisture, *e.g.*, a solution, a weighed quantity is evaporated to dryness in the porcelain crucible after the addition of sodium sulphide, and the mercury is determined as before. The method is applicable without special modification to the analysis of mercury fulminate and fulminate mixtures.—W. S. M.

Halogens in organic compounds; Determination of —— by catalytic reduction. M. Busch. Z. angew. Chem., 1918, **1**, 232.

IN the catalytic reduction of organic halogen compounds by means of palladium, hydrazine (which is decomposed by the catalyst into nitrogen and hydrogen) may be substituted with advantage for a current of purified hydrogen (this J., 1916, 709). 0·2 grm. of the organic compound is dissolved in 40—50 c.c. of alcohol; 2 grms. of palladinised calcium carbonate or barium sulphate, 2·5 c.c. of 50% caustic potash, and 10 drops of hydrazine hydrate are added. The liquid is boiled under a reflux condenser for half an hour, after which the bulk of the alcohol is expelled by heating. The catalyst is filtered off, and the halogen determined in the filtrate.—W. R. S.

***Nitrogen; Folin's direct nesslerisation method for the determination of* ——.** L. Langstroth. J. Biol. Chem., 1918, **36**, 377—380.

Two slight modifications of the Folin and Denis method (this J., 1916, 1133) are described in detail. —H. W. B.

Phosphorus; Quantitative determination of —— by the nephelometric method. E. B. Meigs. J. Biol. Chem., 1918, **36**, 335—346.

THE nephelometric method furnishes accurate results only when the prescribed procedure is strictly followed (compare Kober and Egerer, this J., 1915, 1170).—H. W. B.

***Gas analysis; Bubbler for* ——.** O. D. Burke. Chem. News, 1918, **117**, 368—369.

THE bubbler consists of a flask closed with a cork carrying an inlet and an outlet tube for the gas. The lower end of the inlet tube is drawn out to a fine capillary and a second tube is sealed on to the side of the tube and bent round under the end of the capillary where it is flattened and the upper surface ground. The capillary point is made to fit tightly on the ground surface. The incoming gas is thus broken up into a number of very small bubbles. The apparatus is suitable for determining sulphur dioxide in gases by absorption in iodine solution. —W. P. S.

Analysis of "sulphite acid." Klason. *See* V.

Potassium salts. Spegazzini. *See* VII.

Carbon dioxide in carbonates. Van Slyke. See VII.

Sulphur in spent oxide. Twisselmann. *See* VII.

Aluminium hydroxide. Archibald and Habasian. *See* VII.

Magnesium ammonium phosphate and pyrophosphate. Karaoglanow and Dimitrow. *See* VII.

Separating platinum and iridium. Archibald and Kern. *See* VII.

Glycerol residues from Reichert-Meissl tests. Parkes. *See* XII.

Oil varnishes. De Waele. *See* XIII.

Agricultural lime. Conner. *See* XVI.

Potash [in fertilisers]. Keitt and Shiver. *See* XVI.

Raffinose. Pellet. *See* XVII.

Moisture in flour. Shutt and Moloney. *See* XIXA.

Milk control. Verda and Kirchensteins. *See* XIXA.

Determining lactose. Hildt. *See* XIXA.

Graduating butyrometers. Richmond. *See* XIXA.

Chlorine in foods. Weitzel. *See* XIXA.

Salmon oil. Bailey and Johnson. *See* XIXA.

Tyrosine in proteins. Johns and Jones. *See* XIXA.

Morphine in complex products. Tingle. *See* XX.

Detecting quinine. Salomon. *See* XX.

Pyramidone reaction. Palet. *See* XX.

Alkaloids, glucosides, etc. Palet. *See* XX.

Yerba mate. Guglialmelli and Estrella. *See* XX.

Saccharin tablets. Richmond and others. *See* XX.

Pyramidone and naphthols. Palet. *See* XX.

Uramino-acids. Rohde. *See* XX.

Hydrogen chloride in chloroform. Vorländer. *See* XX.

Arsenotungstic and arsenotungstomolybdic reagents. Guglialmelli. *See* XX.

Nitrogen in guncotton. Hervé. *See* XXII.

PATENT.

Gas-analysing apparatus. N. H. Wener, Assignor to Svenska Aktiebolaget Mono, Stockholm. U.S. Pat. 1,281,729, 15.10.18. Appl., 2.8.18.

A GAS-ANALYSING apparatus in which the gas is subjected to mechanical or chemical action before or after absorption and in which the movements of the gas are effected by a rising and falling liquid, is provided with an adjustable obstruction in the piping, of such form that the gas or liquid is obstructed when flowing in one direction but not in the opposite direction.—W. F. F.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Burris. Filters. 158. Jan. 2.

Fidler and Maxwell. Gas, coal, or oil fired continuous kilns of tunnel and car type. 392. Jan. 6.

Fidler and Maxwell. Gas or coal fired continuous kilns and dryers of tunnel and car type. 393. Jan. 6.

Naaml. Vennootsch. Vereen. Nederlandsche Rubberfabrieken. Filtering apparatus. 115. Jan. 2. (Holland, 25.1.18.)

Reid. Treating exhaust steam for use for heating, evaporating, or drying purposes. 20. Jan. 2.

Schuck. Production of nickel catalyser. 353. Jan. 6. (U.S., 9.1.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

17,740 (1916). Walker and Walker. Fractional distillation of liquids. (121,748.) Jan. 15.

14,410 (1917). Brettell and Adamson. Refrigerating systems and apparatus. (121,615.) Jan. 8.

15,824 (1917). Hinchley, Harper, and Power-Gas Corporation. Expressing liquid from materials. (121,759.) Jan. 15.

19,348 (1917). Wade (Davis). Refrigerating machines. (121,642.) Jan. 8.

2904 (1918). Curtis. *See* VII.

10,589 (1918). Wallwin. Gas-heated furnaces or muffles. (121,917.) Jan. 15.

17,277 (1918). Bradley. *See* XI.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Ballingall and Dempster. 195. *See* VII.

Blakeley. Troughs for washing, coal, coke, etc. 554. Jan. 8.

Broadhead. Manufacture of gas. 55. Jan. 2. (Australia, 7.1.18.)

Dayton Metal Products Co. Fuel for internal-combustion engines. 371. Jan. 6. (U.S., 7.1.18.)
Jefferies. Apparatus for producing gas. 359. Jan. 6.
Marriott. Rock asphalt. 742. Jan 10.
Pace. Apparatus for making air gas. 707. Jan. 10.
Player and others. 192. *See* X.
Poore. Destructive distillation of wood, woody fibre, etc. 812. Jan. 11.
Rector. Fuel-producing devices. 372. Jan. 6. (U.S., 9.10.17.)
Schofield. Means for burning powdered fuel. 104. Jan. 2.
Swinburne. Low temperature destructive distillation. 261. Jan. 4.
Whitaker and Yeadon. System of low temperature carbonisation. 257. Jan. 4.

COMPLETE SPECIFICATIONS ACCEPTED.

12,433 (1917). Smith. Briquets, and method of making same. (111,285.) Jan. 15.
13,560 (1917). Pease. *See* VII.
2878 (1918). Simpson and Moorhouse. Carbonisation and distillation of coal and other carbonaceous materials by electricity. (121,854.) Jan. 15.

III.—TAR AND TAR PRODUCTS.

COMPLETE SPECIFICATION ACCEPTED.

47 (1918). Westwood. Distillation of tar and the like. (121,804.) Jan. 15.

IV.—COLOURING MATTERS AND DYES.

APPLICATION.

Hill. Black colouring-matter, and process for dyeing animal fibres or fabrics. 330. Jan. 6.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

COMPLETE SPECIFICATION ACCEPTED.

2258 (1918). Bramson. Utilising dead leaves as stock for making paper pulp. (121,847.) Jan. 15.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Heymann. Dyeing. 798. Jan. 11.
Hill. 330. *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Armour Fertilizer Works. Production of aluminium nitride. 365. Jan. 6. (U.S., 28.1.18.)
Ballingall and Dempster. Apparatus for manufacture of hydrogen. 195. Jan. 3.
Dawson. Manufacture of sulphuric acid. 265. Jan. 4.
Dutt and Dutt. Manufacture of manganese dioxide and manganates. 834. Jan. 11.
Edison Swan Electric Co., and Percival. Production of argon. 693. Jan. 9.
Elektrizitätswerk Lonza. Manufacture of mercuric oxide. 388. Jan. 6. (Switzerland, 7.1.18.)
Jackson (Air Reduction Co.). Production and extraction of cyanides. 381. Jan. 6.
Soc. Industrielle de Produits Chimiques. Transforming free or combined ammonia mixed with inert gases or steam into ammonium sulphate or into concentrated and pure ammonia gas. 395. Jan. 6.

COMPLETE SPECIFICATIONS ACCEPTED.

13,560 and 13,608 (1917). Pease. Extraction of ammonia from gases and vapours and production of nitrogen compounds. (121,754.) Jan. 15.
15,581 (1917). Craig, and Spence and Sons. Manufacture of chromium and iron compounds. (121,617.) Jan. 8.
19,139 (1917). Tiniolo. Manufacture of nitric acid. (121,635.) Jan. 8.
2904 (1918). Curtis. Composition for making lining of acid pots etc. (121,855.) Jan. 15.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Adair. Drying china clay. 526. Jan. 8.
Haddan (Corning Glass Works). Borosilicate glass for use as filter to produce daylight effects. 674. Jan. 9.
Haddan (Corning Glass Works). Potash glass for use as filter to produce daylight effects. 675. Jan. 9.
Reeves and Tucker. Separation of molten glass etc. from mass. 53 and 54. Jan. 2. (U.S., 10.4.16.)

IX.—BUILDING MATERIALS.

APPLICATIONS.

Akerman. Cement kilns. 285. Jan. 4.
Allender, Badder, and Burrows. Compositions for, and production of, waterproof cements and mortars. 180. Jan. 3.
Field. Materials for rendering cement damp-proof. 686. Jan. 9.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

British Thomson-Houston Co. (General Electric Co.). Treatment of metals. 113. Jan. 2
British Thomson-Houston Co. (General Electric Co.). Metals and their manufacture. 212. Jan. 3.
Coles. Apparatus for electrodeposition of iron. 721. Jan. 10.
Coles. Means for coating articles with zinc. 722. Jan. 10.
Fuller, and Fuller Engineering Co. Steel-smelting furnaces. 278. Jan. 4.
Player, and Sterling Metals, Ltd. Crucible and like furnaces heated by liquid fuel. 192. Jan. 3.
Schuck. 353. *See* I.
Waring and Waring. Open-hearth furnaces. 532. Jan. 8.
Weyman. Cleaning blast-furnace gases. 781. Jan. 10.
Wilson. Treatment of arsenious and other ores. 243. Jan. 3.
Worrall. Hard metal alloys. 374. Jan. 6.

COMPLETE SPECIFICATIONS ACCEPTED.

19,057 (1917). Parkinson Stove Co., and Thompson. Protection of iron and steel surfaces. (121,781.) Jan. 15.
19,220 (1917). Armstrong, Whitworth and Co., Trevelyan, and Rowden. Production of steel from scrap. (121,785.) Jan. 15.
3420 (1918). Humbert. Process of making iron and steel in electric furnaces. (121,674.) Jan. 8.
4633 (1918). Industrie- en Mijnbouw-Mij. Titan. Smelting titaniferous iron materials. (114,309.) Jan. 15.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Antonoff. Electric batteries. 668. Jan. 9.

Armour Fertilizer Works. Electric furnaces. 364. Jan. 6. (U.S., 28.1.18.)

Coles. 721. *See* X.

Fawcett and Hoyle. Electric furnaces. 222. Jan. 3.

Hatfield. Primary batteries. 355 and 356. Jan. 6.

Hatfield. Primary cell. 357. Jan. 6

Johnson (Commercial Truck Co.). Electric batteries. 466. Jan. 7.

Soc. Electro-Métallurgique Française. Manufacture of carbon electric conductors. 390. Jan. 6. (Fr., 26.1.18.)

Twist. Electric accumulators. 43. Jan. 2.

COMPLETE SPECIFICATIONS ACCEPTED.

2878 (1918). Simpson and Moorhouse. *See* II.

3420 (1918). Humbert. *See* X.

17,277 (1918). Bradley. Electrical treatment of gases. (120,573.) Jan. 8.

XII.—FATS; OILS; WAXES.

APPLICATION.

Schuck. 353. *See* I.

COMPLETE SPECIFICATION ACCEPTED.

13,091 (1918). De Bruyn. Imparting a definite flavour and aroma to edible oils and fats. (121,711.) Jan. 8.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Bowles, and Titanine, Ltd. Manufacture of varnishes or dopes. 467. Jan. 7.

Cleghorn, and Gayner Pneumatic Co. Production of materials for coating substances to protect them or render them non-porous. 758. Jan. 10.

Flakes Aktieselskabet, Schou, and Wingen. Manufacture of painting, priming, etc. compositions. 290. Jan. 4.

Kohler. Producing colophony of high quality from old natural resin or conifers. 369. Jan. 6. (Sweden, 15.1.18.)

MacFarlane and Muller. Manufacture of luminous paint. 468. Jan. 7.

COMPLETE SPECIFICATIONS ACCEPTED.

18,891 (1917). Craven, and Yorkshire Dyeware and Chemical Co. Manufacture of linoleum. (121,777.) Jan. 15.

9746 (1918). Naaml. Vennootsch. Nederlandsche Maatsch. *See* XIV.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATIONS.

Gaisman and Rosenbaum. Vulcanising natural and artificial caoutchouc etc. 704. Jan. 10.

Iddon. Rubber mixing, grinding, sheeting, etc. mills. 5. Jan. 2.

Jackson (American Rubber Co.). Vulcanising rubber goods. 384. Jan. 6.

Van Raap. Regenerating vulcanised rubber. 227. Jan. 3. (Holland, 8.1.18.)

COMPLETE SPECIFICATION ACCEPTED.

9746 (1918). Naaml. Vennootsch. Nederlandsche Maatsch. tot Exploitatie van Optimiet Fabrieken. Manufacture of a product substituting ebonite, bakelite, etc. (118,270.) Jan. 8.

XVI.—SOILS; FERTILISERS.

APPLICATION.

Furse. Manufacture of manure from house and other refuse. 663. Jan. 9.

XVII.—SUGARS; STARCHES; GUMS.

APPLICATION.

Boidin and Effront. Treatment of residues containing carbohydrates. 131. Jan. 2. (Fr., 17.1.18.)

XVIII.—FERMENTATION INDUSTRIES.

APPLICATION.

Pascal. Manufacture of ethyl alcohol etc. 224. Jan. 3. (Fr., 16.1.18.)

COMPLETE SPECIFICATION ACCEPTED.

19,326 (1917). Barbet et Fils et Cie. Apparatus for rectifying phlegms, wines, or fermented musts. (121,797.) Jan. 15.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Callimachi. Manufacture of flour from potatoes. 662. Jan. 9.

Hucks. Flavouring mineral waters etc. 68. Jan. 2.

COMPLETE SPECIFICATIONS ACCEPTED.

585 (1918). Hamilton and Quirk. Sterilising cereals, nuts, seeds, etc. (121,650.) Jan. 8.

7300 (1918). Graham. Bread and other food products and process of producing same. (116,272.) Jan. 15.

13,091 (1918). De Bruyn. *See* XII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATION.

Soc. Chim. des Usines du Rhône. Preparation of primary alcohols. 217. Jan. 3. (Fr., 22.1.18.)

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

COMPLETE SPECIFICATION ACCEPTED.

18,648 (1917). Pedersen. Production of coloured photographic views. (121,776.) Jan. 15.

XXII.—EXPLOSIVES; MATCHES

APPLICATIONS.

Gardner, Hargreaves, and Robural and Ammonite. Explosives. 820. Jan. 11.

Nobels Explosives Co., Lowndes, Rintoul, and Weir. Explosives. 746. Jan. 10.

XXIII.—ANALYSIS.

APPLICATION.

Ommanney. Instrument for facilitating calculation depending on relations between pressures, densities, temperatures, and percentage composition of gases, and recording observations of these quantities. 484. Jan. 7.

I.—GENERAL; PLANT; MACHINERY.

PATENTS.

Gases; Electrical treatment of ——. L. Bradley, East Orange, N.J., U.S.A. Eng. Pats. (A) 107,389, (B) 119,236, (C) 119,237, and (D) 119,238, 21.6.17. (Appls. 8296/17 and 14,943, 14,944, and 14,947/18.) Int. Conv., 21.6.16.

(A) GASES are subjected to a silent discharge from a powerful current in a number of treater tubes or ducts, which act as collecting electrodes for the deposited particles of dust, a wire chain, or the like, arranged along the axis of the tube, acting as the discharge electrode. The gases are led to and from the treater ducts by main ducts, or common headers, arranged at the entrance and exit parts of the treater tubes. In order to control or maintain a uniform draught through the treater ducts, a localised frictional resistance is interposed in the flow of the gases, *e.g.*, by making the inlet or outlet (but not both) of each treater duct smaller in cross-sectional area than the duct itself. An increased velocity through any one duct will result in greater friction in the constricting means, thus tending to equalise the velocity in the different treater ducts. The heat of the gas may be maintained and the temperature kept uniform by providing suitable insulation or by interchange of heat. (B) The conductivity of the gas may be maintained by supplying water vapour to it, the spray or steam wetting the particles of dust. (C) The treater ducts are square or rectangular in cross-section, and are divided by partitions. (D) The velocity is equalised in the different treater ducts by passing the gases in a downward direction to maintain a down draught, so that any tendency to inequality of flow (by reason of inequality of temperature) will be resisted by a tendency to an upward draught. The gases may be afterwards passed in an upward direction through one or more ducts to separate the finer particles.—B. N.

Separation of suspended particles from gaseous bodies; Electrical ——. H. A. Burns, Finchley. Eng. Pat. 120,994, 11.12.17. (Appl. 18,349/17.)

IN apparatus for the electrical precipitation of suspended particles from gases, the insulators are mounted in chambers separated from that in which the dust-separating devices are mounted, and the connection between the chambers is constricted so as to hinder the dust from passing into the insulator chambers. A current of cleaned air or gas is passed into the insulator chambers at a slightly higher pressure than that obtaining in the dust chambers and is heated so that it may not deposit moisture on the insulators.—W. H. C.

Ball mill and sifting device. C. Candlot, Paris. Eng. Pat. 115,224, 13.12.17. (Appl. 18,460/17.) Int. Conv., 26.4.17.

A BALL mill is divided into two compartments separated by a sifting device. In the first compartment the preliminary grinding is effected and the material passes to the sifting device, which consists of superposed plane screens arranged in the form of a cone and shielded from the action of the balls. The fine material passes through to the finishing compartment and the insufficiently ground portion is returned to the first compartment.—W. H. C.

Pebble or ball mill. C. H. Stave, Thornton, Ill. U.S. Pat. 1,283,589, 5.11.18. Appl., 4.3.18.

A CYLINDRICAL pebble or ball mill is clamped into a frame so that the axis of the cylinder is oblique to the axis about which the frame is rotated.

—W. H. C.

Crusher. W. A. Kraemer, Chicago, Ill. U.S. Pat. 1,282,870, 29.10.18. Appl., 28.1.18.

MATERIAL to be crushed is fed from a hopper through an aperture in a fixed crushing plate. A bar of prismatic cross-section is arranged parallel to, and with an edge facing the crushing plate, and means are provided for moving the bar parallel to the plate. This bar carries a crushing plate formed of an angle bar longer than the aperture in the fixed plate, and mounted on the supporting bar so as to overlap the two faces the meeting edge of which faces the fixed plate. Dowel pins carried by the supporting bar project loosely through apertures in the angle bar, and springs are interposed between the supporting bar and each web of the crushing bar. The crushing bar is mounted to oscillate about an axis between the supporting bar and the fixed plate.—W. F. F.

Drying chambers. O. H. Abbott, London. Eng. Pat. 120,635, 21.11.17. (Appl. 17,190/17.)

THE drying chamber is placed over a gas-heated furnace and is provided with a double bottom, through which the hot gases from the furnace pass in a tortuous path formed by vertical baffle-plates. Air enters the drying chamber at the bottom, and passes in the same direction as the gas through a horizontal compartment also provided with vertical baffles, just above the double bottom, whereby the air is heated. The air is then delivered into a vertical conduit at one side of the chamber, the remainder of the chamber being filled with superposed perforated drying trays, slightly inclined to the horizontal and spaced apart. The hot gases pass upwards to the exit flue through a vertical pipe in the vertical air conduit, to increase the air draught, and the conduit is also provided with horizontal baffles extending towards the tray shelves but leaving a space which decreases progressively from the bottom upwards. The hot air is thereby caused to circulate over and through the trays and is finally discharged through a pipe surrounding the waste gas flue.—W. F. F.

Drying, conditioning, and regulating the moisture content of hygroscopic materials; Method of and apparatus for ——. W. H. Carrier, and Carrier Engineering Corporation, New York. Eng. Pat. 121,080, 21.5.18. (Appl. 8464/18.)

THE materials to be treated are supported within a chamber and air is caused to circulate around and through them. In order to maintain the circulating air in the desired condition of temperature and humidity, a regulated portion of fresh air of the requisite temperature and humidity is introduced into the chamber through nozzles at one side. The jets of air are so adjusted that any desired proportion of the circulating air which is about to be discharged through the exhaust ports can be withdrawn, mixed with fresh air, and recirculated over the material in the chamber. The temperature and humidity of the air to be introduced are regulated by a system of thermostats and hygrostats which control the heating and drying or humidifying arrangements.—W. H. C.

Drying of solid substances [e.g., pigments] precipitated from solution in water or other liquids. A. P. Laurie, Edinburgh. Eng. Pat. 121,372, 29.12.17. (Appl. 19,209/17.)

THE liquid containing the solid in suspension is exposed to a low temperature in order to freeze the liquid. The mass is then thawed and after draining away as much liquid as possible the residue is dried in the usual way. Precipitated pigments treated in the above manner dry to a powder and not into cakes or lumps.—W. H. C.

Dehydrating vegetable, textile, and other substances; Methods of and apparatus for ——. J. G. Maxwell, London. Eng. Pat. 121,394, 6.2.18. (Appl. 2178/18.)

THE material to be dried is heated for a short time in a rotary or other apparatus to between 400° and 600° F. (about 200°—315° C.) in a quiescent atmosphere, and then the drying is completed by a current of air at a temperature below the boiling point of water.—W. H. C.

Dehydrating vegetable and other substances; Method and apparatus for ——. G. H. Benjamin, New York. U.S. Pat. 1,284,218, 12.11.18. Appl., 7.6.18.

THE material to be dehydrated is subjected to the action of radiant heat for a sufficient time to induce exudation of the contained moisture, and at intervals to the action of heated air currents. The material is supported in V-shaped containers formed of a reticulate material, and the radiant heat is supplied by electric lamps placed in proximity to the containers.—J. H. P.

Dryer. O. C. McCormick, Cleveland, Ohio. U.S. Pat. 1,283,242, 29.10.18. Appl., 12.3.18.

THE material to be dried is charged into carriers supported on an endless sprocket chain which passes over sprocket wheels mounted on a frame within a drying chamber. The chain with the charged carriers travels in a zig-zag path through the chamber from the charging door at one end to the discharging door at the other end and then returns the empty carriers to the charging door. —W. H. C.

Conveyor and its application for drying, mixing, screening, and other processes. W. R. Bates, Cricklewood, and H. R. L. Walker, London. Eng. Pat. 120,764, 20.11.17. (Appl. 17,064/17.)

A HORIZONTAL cylinder mounted on friction wheels is divided into a number of compartments by cross partitions or discs mounted on an axial shaft. The partitions are mounted either at right angles or inclined to the axis of the cylinder and each has a sector or quadrant cut away and is provided with a flange. The materials to be treated are fed into one end of the cylinder by a screw conveyor. When the central shaft is still and the cylinder is rotated the materials are agitated but are not moved forward, but when both the shaft and the cylinder are in motion the materials are transferred from compartment to compartment. Gaseous or liquid treating agents may be passed through the cylinder in the opposite direction to that taken by the materials.—W. H. C.

Fractional distillation of mixtures of liquids which are not miscible with water [e.g., light tar oil etc.]; Apparatus for ——. A. Goyvaerts, P. Becquevort, and H. E. Bossut, London. Eng. Pat. 120,940, 27.8.17. (Appl. 12,291/17.)

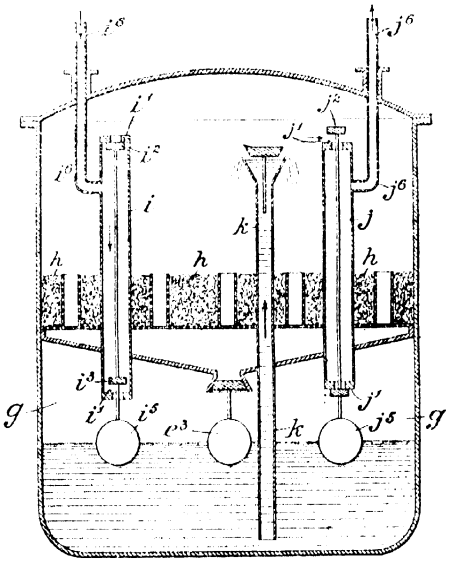
THE mixture of liquids is fed continuously from an overhead tank into the first of a series of stills. Open steam is supplied to this still and a mixture of steam and vapour passes over to the next still in the series. Here the vapour of the constituent with the highest boiling point and some of the steam condense, while the vapours of the constituents of lower boiling point and the uncondensed steam pass on to the next still. The vapours from the last still of the series pass through a condenser. The level of the liquid in the stills is kept constant by drawing off from each a portion of the liquid condensed therein. It is claimed that by one distillation in this apparatus there can be recovered from crude benzol four fractions consisting of commercial benzol (from the condenser), commercial toluol from still No. 3, a mixture of xylenes, cymene, and crude naphtha, of b.pt. 135°—190° C., from still No. 2, and creosote oil from still No. 1.—W. H. C.

Steam heating of ovens and the like. F. O. Bynoe, London. Eng. Pat. 121,001, 13.12.17. (Appl. 18,504/17.)

THE heating is effected by grids of "Field tubes" attached to inlet and outlet headers. Steam at high temperature but low pressure is passed into the inner tubes and returns along the annular space between the two tubes. The inlet header has a flange on one side provided with perforations into which the inner tubes are fixed. The outlet header has flanges on both sides. The outer tubes are fastened into a set of holes in the flange on one side of the header and the inner tubes pass through holes in the flange on the other side and into the outer tubes. The two headers are bolted together to form a steam-tight joint.—W. H. C.

Extractors, dyeing machines, or the like. British Dyes, Ltd., J. Turner, and T. P. K. Crosland, Huddersfield. Eng. Pat. 121,199, 13.12.17. (Appl. 18,464/17.)

THE liquid in the lower chamber being at the level shown in the figure, air or steam is passed through the pipes, i^6, i, and the valve, i^1, i^2, into the space, g, and forces the liquid up the pipe, k, into the upper chamber, the air in which escapes through j^1, j^2, j, and j^6. So long as the bottom of the



pipe, k, is sealed by the liquid the pressure keeps the valves in the position shown, but as soon as it is unsealed the valves are reversed and the air or steam enters the upper compartment through the valves, i^1, i^2, and forces the liquid through the material, h, into the lower compartment, the air in which escapes through the valves, j^1, j^2, and the pipes, j, j^6. When the liquid has again collected in the lower chamber the floats, i^5, e^3, and j^5, rise and reverse the valves, and the process is repeated.—W. H. C.

Extracting solids; Process of ——. E. E. Howson, Salt Lake City, Utah. U.S. Pat. 1,284,346, 12.11.18. Appl., 5.10.17.

THE material to be extracted held in suspension in a liquid is delivered successively to a series of filters subjected to an intermittent jarring action (see following abstract). The liquid is drawn off and a submerging liquid delivered successively to the filters from which the liquid has been removed and a "mixing and stirring fluid" is admitted to the material, this fluid being afterwards allowed to escape.—J. H. P.

Filtering device. E. E. Howson, Salt Lake City, Utah. U.S. Pat. 1,284,347, 12.11.18. Appl., 5.10.17.

A NUMBER of filters are disposed round a common axis and stationary relative to it. The material to be filtered is supplied to the filters successively and the latter can be tilted to discharge the residue on to a carrier mounted to revolve about the axis and below the filters. Means are provided for shaking the filters whilst they are being tilted.
—J. H. P.

Gold, sand, coal and other minerals; Apparatus for screening and washing ——. R. W. Pleasance, Manor Park, Essex. Eng. Pat. 121,512, 17.12.17. (Appl. 18,744/17.) Addition to Eng. Pat. 28,675, 12.12.12.

IN screening and washing apparatus of the type described in the prior patent (this J., 1913, 1017), the hopper containing the material is provided with a perforated bottom and sides, and water is supplied from a sprinkler over the hopper. The material is washed on to a series of oppositely inclined perforated screens, alternately coarse and fine, arranged in a vertical casing. The material is graded by the coarse screens, which are progressively finer, and the dirt is washed through the fine screens and removed. The water passing through the hopper is carried by pipes to the top of the second and third screens.—W. F. F.

Grading or sizing of materials of all kinds; Method of and apparatus for the ——. C. Q. Payne, New York. U.S. Pat. 1,283,284, 29.10.18. Appl., 6.12.16. Renewed 3.11.17.

MATERIAL composed of particles of different sizes is charged in a thin sheet upon a flexible endless belt the upper surface of which is inclined transversely at a progressively increasing angle so as to form a helicoidal surface between its end supports. The belt is moved longitudinally so as to carry the material at a high speed into zones of gradually increasing transverse inclination. The material is discharged, in gradually decreasing sizes, transversely to the motion of the material, the different sized particles being separately collected.—B. N.

Liquids [e.g., water]; Apparatus for use in treating —— with gases. S. H. Menzies, London. Eng. Pat. 121,521, 19.12.17. (Appl. 18,870/17.)

A CYLINDER of liquefied gas (*e.g.*, chlorine) is connected with a measuring vessel consisting of a plunger working in a sleeve, the working space being adjustable to contain the particular quantity of gas desired. The gas is measured under the vapour pressure of the liquefied gas in the cylinder. The measuring vessel is connected by an outlet tube with an absorbing vessel holding a measured volume of the liquid (*e.g.*, water) to be charged with the gas. Valves placed on the inlet and outlet tubes of the measuring vessel are linked together, so that one is opened and the other closed by the same movement; or, the inlet and outlet of the measuring vessel may be controlled by two needle valves. The solution of the gas obtained in the absorption vessel may be used as a strong solution for adding to a larger volume of liquid to obtain a dilute solution of definite strength.—J. H. J.

Gas; Apparatus for applying —— to fluids. C. F. Wallace, New York, and M. F. Tiernan, New Rochelle, N.Y. U.S. Pat. 1,285,496, 19.11.18. Appl., 28.3.17.

FLUID under pressure is delivered into a mixing chamber provided with a siphon, which draws off a portion of the fluid whenever the level rises to a certain point. A source of gas is connected to the mixing chamber by a passage provided with a valve, which is opened by the negative pressure established by the siphoning off of the fluid.

Refrigerating apparatus. Ransomes and Rapier, Ltd., and R. J. Cracknell, London. Eng. Pat. 121,522, 19.12.17. (Appl. 18,875/17.)

Two closed cylindrical casings are mounted a short distance apart on the same horizontal shaft, and one of them contains a rotary compressor, preferably of the type in which a rotor with channels on its periphery rotates within a drum containing liquid, *e.g.*, mercury, the drum rotating freely on bearings carried by eccentrics mounted on the shaft. A weight is connected to the eccentrics to hold them stationary during the rotation of the rotor and casing. The driving shaft is hollow and serves to convey the compressed gas to the other rotating casing which acts as a condenser. The liquefied gas collects in a layer around the periphery of this casing, and a pipe parallel to the shaft connects the two casings. The ends of the pipe are turned radially outwards and terminate near the peripheries of the casings. The flow of liquid from one casing to the other thus depends on the relative pressures in them. The compressor and condenser casings dip into brine and cooling water respectively, contained in suitable vessels, the brine being used for refrigerating purposes.
—W. F. F.

Pump; Internal-combustion ——. C. A. Clark, Syracuse, N.Y., Assignor to Humphrey Gas Pump Co. U.S. Pat. 1,282,757, 29.10.18. Appl., 7.12.15.

IN an internal combustion pump having a reciprocating column of liquid, the combustion chamber contains a reciprocating piston carried by a hollow plunger which divides the space above the piston into a central and an annular space, both separated from the combustion space by the piston. Gas and air are drawn through valves into the central and annular spaces respectively when the piston descends, and then pass through valves in the piston into the combustion chamber below when the piston ascends. The gas and air are then mixed, compressed, and ignited. The gas and air are thus kept separate from one another and from the hot burnt products of the previous charge until they are ready for mixing and ignition. Means may also be provided whereby air may be added to the gas in the central space.—W. F. F.

Evaporator. A. Harvey, Greenwich, Conn. U.S. Pat. 1,282,825, 29.10.18. Appl., 22.10.15.

AN evaporator comprises a number of chambers each provided with a separate air inlet. The air supply to each inlet is heated in a separate heater, so that the temperature of the air supplied to each chamber may be adjusted independently.—W. H. G.

Evaporator. J. A. Meroney, Assignor to Nupro Evaporator Co., San Francisco. U.S. Pat. 1,283,254, 29.10.18. Appl., 21.3.17.

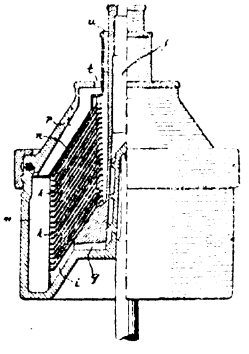
The apparatus consists of an oven containing independent superposed sets of trays which can be introduced from opposite ends of the oven. An open space is left between the adjacent ends of the two sets of trays, and a central suction apparatus at the top of the oven draws filtered air upwards through the open space; discharge passages leading from the fan return the air through filters to opposite sides of the oven bottom. Fan blowers above each series of trays force a portion of the heated air downward through the trays.—W. R. S.

Furnace; Regenerating ——. C. E. Duncan, Johnstown, Pa. U.S. Pat. 1,283,117, 29.10.18. Appl., 10.2.17.

The checker-work of a regenerating chamber for furnaces is built up in several sections, spaced apart so as to form vertical passages between adjacent sections extending through the checker-work down to the underlying flues.—J. F. B.

Separator; Centrifugal ——. F. S. Snyder, Poughkeepsie, N.Y., Assignor to The De Laval Separator Co., New York. U.S. Pat. 1,283,343, 29.10.18. Appl., 31.8.17.

Liquid having a heavy slimy constituent is fed by the central tube, *f*, and passages, *g*, *i*, to the annular space, *m*, in a rotating bowl. The central portion of the bowl is occupied by a number of superposed perforated conical plates, *k*, dividing the liquid into thin layers. A non-perforated plate,



n, partly conical and partly cylindrical, is mounted above the perforated plates so as to leave only a narrow space between its outer rim and the inner wall of the bowl. The lighter constituents pass upwards between the conical plates and are discharged at the outlet, *u*, while the heavier material passes upwards through the space, *p*, to its discharge outlet, *t*. Radial wings are provided in the spaces, *g*, *i*, *m*, and *p*.—W. F. F.

Separator; Centrifugal ——. A. M. Mark and B. H. McElvain, Denver, Colo. U.S. Pat. 1,283,846, 5.11.18. Appl., 18.2.16.

Material to be separated is fed through a vertical pipe on to a conical distributor supported in a rotary separating-pan with its apex in the mouth of the pipe, which just projects through the cover of the pan. The distributor is arranged centrally in, and just above the base of the pan. The side wall of the pan is flared outwards from the bottom, and a spiral riffle is arranged around the inner face of the wall. The heavier separated material is thus guided to a discharge opening immediately below the upper end of the riffle, the opening being protected so as to prevent the material from passing beyond it. The solid material falls into a discharge shoot, and another shoot is provided for the lighter material which overflows the upper edge of the pan.—W. F. F.

Filtering apparatus. O. J. Salisbury, Assignor to United Filters Corporation, Salt Lake City, Utah. U.S. Pat. 1,283,925, 5.11.18. Appl., 3.3.17.

A hollow horizontal rotating shaft, extending through a tank containing the liquid to be filtered, carries transverse hollow filtering discs which have their lower portions immersed in the liquid. The interior of each filtering element is connected to a suction device through the hollow shaft, and stationary scrapers are arranged above the liquid to detach deposited material from the discs. Vertical rotating spiral conveyors are arranged between the discs to remove the solid material, and are driven by bevel gearing from a single shaft arranged horizontally above the tank.—W. F. F.

Retort; Continuous rotary ——. P. S. Shoaff, Long Beach, Cal. U.S. Pat. 1,284,479, 12.11.18. Appl., 21.9.16.

A rotary retort is inclined downwards towards the burner end of the furnace chamber. The interior of the retort has no communication with the furnace chamber. A stack leads from the top of the chamber at the burner end. Baffle-walls are fixed in the chamber in such a manner that the flame and heating gases pass along the bottom of the retort, then around both sides and over it to the stack. The material to be treated is fed at the upper end and withdrawn from the lower end of the retort.—J. H. P.

Kilns; Apparatus for utilising the waste heat and increasing the circulation of the air during the drying and burning processes in ——. T. B. Sullivan, Kansas City, Mo. U.S. Pat. 1,284,943, 12.11.18. Appl., 12.12.17.

The air supply for the furnace of a kiln is preheated by passing it through a pipe which enters the smoke stack below the level of the grate, and passes upwards through the stack. The pipe continues outwards through the stack and finally discharges into the furnace near the grate.—W. F. F.

Sublimation apparatus. J. D. Sartakoff, New York. U.S. Pat. 1,284,787, 12.11.18. Appl., 13.4.17.

The apparatus comprises a horizontal rotary drum provided with a central perforated pipe through which a gaseous heating agent is introduced so as to maintain the temperature of the whole chamber substantially constant. Solid material is fed into one end of the drum and a number of lifting buckets attached to the inner wall of the drum elevate and dump the material within the drum. Baffle plates are mounted on the perforated pipe, and the vapours and gases pass through a tapering exit into a condensing chamber.—J. H. P.

Refrigerating machines. H. Wade, London. From D. I. Davis, Chicago, Ill., U.S.A. Eng. Pat. 121,642, 31.12.17. (Appl. 19,348/17.)

See U.S. Pat. 1,280,101 of 1918; this J., 1918, 757 A.

Corrosive liquids or substances; Apparatus for manufacturing, storing, treating, or transporting ——. I. Wolf, London. U.S. Pat. 1,285,537, 19.11.18. Appl., 23.2.18.

See Eng. Pat. 113,992 of 1917; this J., 1918, 229 A.

Gas washer. U.S. Pat. 1,283,763. *See* IIA.

Conveying and absorbing gases. U.S. Pat. 1,282,799. *See* VII.

Optical pyrometry. U.S. Pat. 1,282,967. *See* XXIII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Oxidation and ignition of ——. R. V. Wheeler. Chem. Soc. Trans., 1918, 113, 945—955.

In a series of experiments in which air or oxygen was circulated in a closed system through a column of powdered, freshly won coal heated in a constant-temperature oven, the rate of disappearance of oxygen being measured by the fall in pressure, results have been obtained which, in general, agree with those recorded by previous investigators. The occluded gases which can be removed from a sample of coal by exhaustion at 100° C. contain a large proportion of the oxides of carbon if the coal has been previously "weathered" either naturally or artificially, and in this respect differ from the gases which are removed from newly won coal. Comparative experiments, in which the gases were removed at 15° C. and at 100° C., show that although some oxygen is occluded by coal and can be removed at the ordinary temperature by physical means, the major portion of the oxygen retained by the weathered coal only makes its appearance in the form of oxides of carbon when the temperature of the coal is raised. The results suggest that the first step in the oxidation of coal is the formation of an addition compound or complex of oxygen with one or more of the substances present in the coal. Incidentally it has been found that the quantity of gas removed from a weathered coal by exhaustion at 100° C. is considerably increased when the coal has been "weathered" by contact with air dried over calcium chloride. In order to determine what relationship, if any, there is between the chemical composition of a coal and its ignition temperature, a number of coals were tested by heating finely powdered and sifted samples in tubes embedded in a sand bath the temperature of which could be slowly raised by electrical heating, a current of air being drawn through the column of coal at constant speed. Thermometers embedded in the coal and in the sand respectively were read at frequent intervals. Two temperature-time curves were thus obtained and it was found that these curves intersected at a certain temperature. This temperature is regarded for comparative purposes as the "ignition temperature." The results obtained with samples of coals containing different quantities of oxygen show clearly that the most highly oxygenated coals are those which have the lowest "ignition temperature" and are therefore most liable to self-heating. It is probable that such highly oxygenated coals contain considerable quantities of substances, the molecular structure of which approximates closely to that of carbon. The reaction responsible for the self-heating is supposed to consist in the attachment of oxygen to molecules of this type.—H. M. D.

Ammonia recovery [from coke-oven gas]; Effects of ——. T. B. Smith. Midland Coke Oven Managers' Assoc., Dec. 21, 1918. Gas J., 1918, 144, 161—162.

The effects of the direct and indirect processes for the recovery of ammonia from coke-oven gas on the other by-products are compared. In the direct method a thicker tar is produced and more light oils pass to the benzol plant, which consequently has to perform more work. The intermediate dephlegmation fractions of the crude benzol still or the crude benzol itself contain 7 to 10% of phenolic bodies which the author recommends should be recovered. In the direct process, naphthalene causes serious trouble in the condensing plant following the ammonia absorber and a suitable solvent must be employed. The effluent from these condensers differs considerably from that of the usual ammonia stills, a typical analysis showing: free ammonia, 0·0184%; fixed ammonia, 0·0061; total ammonia, 0·0245; carbonic acid, 0·0088; hydrochloric acid, 0·0010; hydrocyanic acid, 0·0135; hydrogen sulphide, 0·0115; sulphur as sulphates, 0·0012; sulphur as thiocyanate, 0·0025; total sulphur, 0·0148; phenols, 0·1947%. Such an effluent can be used for coke quenching without seriously affecting the appearance of the coke. The hydrocyanic acid in the gas may be recovered by Buch's process prior to the gas entering the ammonia absorber, but the author points out that a much purer product would result if the recovery were made after the gas had passed the absorber. If, however, no attempt is made at recovery a considerable proportion is taken out at the benzol absorbers and evolved again at the vapour pipe of the crude benzol still. The pink colour frequently met with in ammonium sulphate from the direct process is due to the presence of traces of ferric thiocyanate.—T. F. E. R.

Liquid fuels. A. Guiselin. Mem. et Compt. rend. Trav. Soc. Ing. Civils de France, Oct., 1918, 453—548.

The author discusses the subject of liquid fuels with special reference to the needs of France. The paper includes sections on the production of fuel oils from bituminous shales, coal tar, coal waste, lignite, peat, etc., and on the use of alcohol as fuel.

Calorimetric lag. Calorimetric precision. Calorimetric methods. White. *See* XXIII.

PATENTS.

Fuel; Production of artificial —— and utilization of peat. T. Twynam, Redcar. Eng. Pat. 121,373, 31.12.17. (Appl. 19,245/17.)

Wet or partially air-dried peat is intimately mixed by grinding, with about one-eighth of its weight of dry pitch and coke dust, or small coal, to give a product when dry approximating in composition to coal. The moist mixture is either briquetted or flattened into pieces of suitable thickness and dried by means of waste steam.—T. F. E. R.

Fuel briquette. C. H. Smith, Short Hills, N.J., Assignor to International Coal Products Corporation, Richmond, Va. U.S. Pat. 1,284,939, 12.11.18. Appl., 18.7.18.

A fuel briquette is composed of finely-divided, partly carbonised coal, and pitch in such proportions that the total amount of volatile hydrocarbon is about 11—17%.—W. F. F.

Coal-washings; Settling apparatus for ——. E. G. Burks and N. Hayes, Ensley, Ala. U.S. Pat. 1,284,586, 12.11.18. Appl., 26.1.16. Renewed, 25.4.18.

The settling tank of a coal-washing apparatus is constructed with a sloping bottom formed by four sloping sides. A well is provided at the bottom, formed by the downward extension of an opposite pair of sloping walls, the other pair of walls of the

well being vertical. The tank is divided into three compartments by two vertical partitions, each partition being formed of spaced perforated walls enclosing a layer of granulated material. The coal and dirty water are delivered into the central compartment, and the water is filtered through the partitions into the side compartments and withdrawn from them. An inclined endless elevator has its lower end projecting into and closely fitting into the well. (See also U.S. Pat. 1,201,143; this J., 1916, 1209.)—W. F. F.

Coking pitch. R. A. Lee, Brooklyn, N.Y., Assignor to The Barrett Co., New York. U.S. Pat. 1,283,229, 29.10.18. Appl., 28.4.17.

Coke is produced from pitch or a similar hydrocarbon liquid by heating it under several atmospheres pressure to a temperature in excess of the boiling point of a substantial portion of its constituents, say 600° F. (315° C.). By suddenly reducing the pressure to atmospheric, and without the application of further heat, vapours are evolved and a residue of coke remains.—T. F. E. R.

Coked products; Method of making low density ——. H. Rodman, Edgewood, Pa., Assignor to Rodman Chemical Co. U.S. Pat. 1,283,310, 29.10.18. Appl., 7.2.17.

Coking material or a mixture containing such is made into pellets or fragments and suddenly raised to a coking temperature.—T. F. E. R.

Gas-producer. L. Nelson, Wellington, N.Z. Eng. Pat. 112,128, 8.12.17. (Appl. 18,249/17.) Int. Conv., 8.12.16.

The apparatus consists of a down-draught producer with scrubbers, contained in a compact shell, for use in conjunction with marine engines. Air supplied by a fan or drawn in by the suction of the engine passes into a perforated distributing pipe in the upper part of the producer, and downwards through the incandescent fuel. The gas passes down through the grate of the producer, then under a partition into the scrubbers. After passing up one scrubber and down the other, it proceeds to the engine. The scrubbers are packed with small coke or pumice and water is sprayed in at the top and passes off at the bottom to the ashpit. Clinker is extracted from the producer by operating the sliding grate.—T. F. E. R.

Gas-producer. H. C. Perdue, Valparaiso, Ind., Assignor to Morgan Construction Co., Worcester, Mass. U.S. Pat. 1,284,138, 5.11.18. Appl., 1.6.14.

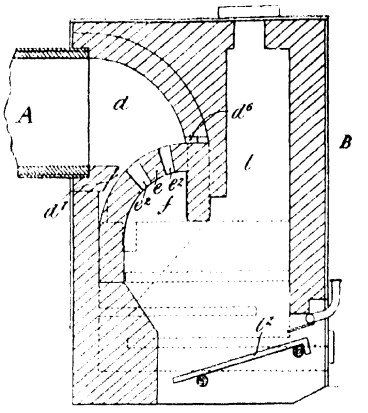
In a gas producer having a rotary section carrying the fuel, a stationary member is arranged to rest on the fuel surface to keep the surface even. This member may be adjusted about an axis eccentric to the axis of the producer so as to vary its position on the fuel bed and thus vary the accumulation of fuel towards or away from the centre of the fuel bed. Means are also provided to adjust the position of the fixed member axially to correspond with variations of level of the fuel bed.—W. F. F.

Gas-producer. E. A. W. Jefferies, Assignor to Morgan Construction Co., Worcester, Mass. U.S. Pat. 1,284,694, 12.11.18. Appl., 23.1.15.

The rotating body of the producer is fed with fuel from a hopper above placed excentrically to the axis of rotation. From the top of the producer depends a swinging member which levels the fuel and at a determined height puts into motion a weighted lever which automatically shuts off or controls the supply of fuel. The weighted lever can be disconnected from the swinging member for hand operation. In an alternative arrangement the fuel-feeding device rotates excentrically and the producer body remains stationary.—T. F. E. R.

Producer-gas; Furnaces for the generation and combustion of ——. F. J. Grocott, Birmingham. Eng. Pat. 121,516, 19.12.17. (Appl. 18,815/17.)

The producer is provided with a vertical shaft, *l*, down which the fuel is fed and at the bottom of which are the fire-bars, l^2. The producer-gas rises into a collecting chamber, *f*, and then passes through



nostrils, c^2, in the concave roof, *c*, into a combustion chamber, *d*. Secondary air, preheated by passage through zig-zag channels in the furnace structure, is also led into this chamber from ports, d^6, d^7, close to the nostrils. The producer-gas is burned and the hot products pass into the boiler flue through a short piece of pipe, A, lined with fire-bricks.—T. F. E. R.

Gas washing and collecting apparatus. H. Hermansen, Baybridge, Assignor to The Sandusky Cement Co., Cleveland, Ohio. U.S. Pat. 1,283,763, 5.11.18. Appl., 28.12.16.

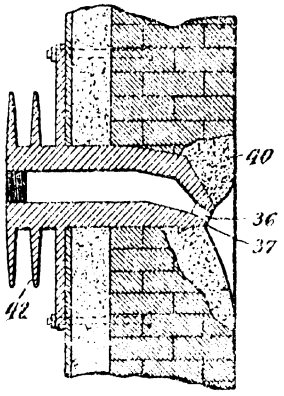
The washing chamber is divided by a horizontal partition into two compartments. Gas is supplied to the top compartment by a central pipe and passes into the lower compartment through an annular series of pipes depending from the partition. In each pipe the gas is subjected to a small spray of washing fluid supplied by vertical pipes from outside the chamber. The fluid and gas pass together into a separator tank, after which the gas passes forward and the fluid is re-circulated to the sprays by means of a pump.—T. F. E. R.

Liquid fuel; Apparatus for burning ——. R. E. Griffith, Chicago, Ill. U.S. Pat. 1,284,657, 12.11.18. Appl., 1.3.15.

A mixing chamber and an air chamber are separated by a perforated wall, and liquid fuel and air are drawn into the mixing chamber at the inner side of the perforated wall. The fuel is heated by a steam pipe passing through the fuel pipe, and connected with an apertured tube leading from the mixing chamber. The flow of steam draws the air and fuel into the mixing chamber and the mixture of fuel, air, and steam then passes through the apertured tube to the combustion chamber. The products of combustion pass through a flue enclosing the supply pipe for the combustible mixture. —W. F. F.

***Burning explosive mixtures; Apparatus for* ——.** Surface Combustion Co., Long Island City, N.Y., Assignees of G. E. Richardson, New York, W. B. Eddison, Irvington, N.Y., and H. L. Read, New York. Eng. Pat. 112,011, 1.11.17. (Appl. 15,938/17.) Int. Conv., 23.11.16.

FURNACES heated by the burning of explosive gaseous mixtures are provided with a special nozzle (see fig.) for introducing the mixture. This nozzle is made of a good heat conductor, *e.g.* cast iron, and tapers to the short discharge passage, 36, which has parallel sides. The gaseous mixture issues in a slanting downward direction, and im-



pinges on a granular bed of refractory material, where it spreads out and is burned. The mixture is supplied at a pressure such that it enters the furnace at a rate greater than its rate of flame propagation. The nozzle is almost completely protected from the heat by refractory cement, 40, but to prevent the incandescent cement coming into contact with the issuing stream a small area, 37, of the nozzle is left exposed and by conducting heat away prevents the issuing gas being raised to its ignition point and thus prevents the phenomenon of "back creeping" which the otherwise gradual heating up of the nozzle would cause. Heat-dissipating fins are fixed at 42, or the nozzle may be water-cooled.—T. F. E. R.

Hydrocarbon oils; Method of and apparatus for treating ——. E. A. Johnson, Woodhaven, and W. Snodgrass, Brooklyn, N.Y. U.S. Pat. 1,283,202, 29.10.18. Appl., 17.1.17.

A NUMBER of parallel stills are placed in the combustion chamber of a furnace, each still consisting of an upper and a lower section connected by a number of vertical tubes. Oil is passed upwards through the stills in the form of hollow columns, both the interior and exterior of the columns being heated. The vapours generated are led to an atmospheric condenser to be partially condensed by radiation; the partially condensed vapours are then allowed to expand and finally condensed by liquid cooling.—L. A. C.

Heavier hydrocarbons; Process for the extraction of lighter hydrocarbons from —— and especially of gasolene and another product from kerosene. F. A. Howard, Niagara Falls, N.Y. U.S. Pat. 1,284,687, 12.11.18. Appl., 25.1.18.

A MIXTURE of equal volumes of heavy hydrocarbon and cold water is heated in a still so that the temperature of the vapour is not above 98° C. The distillate of lighter hydrocarbons is condensed.
—W. F. F.

Oil still. O. C. Swan, Denver, Colo., Assignor to The Swan Process Oil Co. U.S. Pat. 1,284,945, 12.11.18. Appl., 28.4.17.

AN oil still, comprising an oil-heating chamber surmounted by a foam chamber, is provided with a dome-shaped double-walled vapour chamber above the foam chamber. The whole still is contained within a single vertical casing. A steam jacket is provided round the foam chamber, and steam is also circulated through the space between the double walls of the dome to superheat the vapour in the latter. The vapour is withdrawn through a central opening at the top, extending through the steam jacket.—W. F. F.

Gas-producers; Feeding mechanism for ——. C. W. Lummis, Assignor to Morgan Construction Co., Worcester, Mass. Reissue 14,548, 12.11.18, of U.S. Pat. 1,270,963, 2.7.18. Appl., 28.9.18.

SEE this J., 1918, 539 A.

Carbon and method of recovering same from the waste product of oil-cracking. R. D. Pike, San Francisco, Cal. U.S. Pat. 1,285,363, 19.11.18. Appl., 25.7.16.

SEE Eng. Pat. 102,645 of 1916; this J., 1917, 127.

Washing coal, etc. Eng. Pat. 121,512. *See* I.

Oil from shale, etc. U.S. Pat. 1,283,000. *See* IIB.

Recovering cyanides. Eng. Pat. 120,759. *See* VII.

Nitric oxide in internal combustion engines. U.S. Pat. 1,283,117. *See* VII.

Clarifying oil. U.S. Pat. 1,284,750. *See* XII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Lignites; Carbonisation of ——. E. Stansfield and R. E. Gilmore. Trans. Roy. Soc. Canada, 1917—18, [iii], **11**, 85—100.

LABORATORY tests were carried out on a sample of lignite having gross calorific value 4260 cals., moisture 31·8%, ash 5·2%, volatile matter 28·9%, fixed carbon 34·1%; the calorific value of the dried lignite was 6260 cals. In tests carried out between 200° and 700° C., it was found that loss of volatile matter was slight up to 300° C., increased rapidly up to 600° C., and by 700° C. was practically complete. The calorific value of the residue increased to a maximum (7530 cals.) at 550°—600° C. and then decreased. Adopting slow carbonisation the results obtained were similar to the above, except that for any given final temperature the loss of volatile matter was less than with more rapid carbonisation. A series of vacuum carbonisations (25 mm.) was also carried out; in these the amount of volatile matter driven off was greater than at ordinary pressures; the calorific value of the residue was the same as when working at normal pressures at 350° C. (6920 cals.); above that temperature it was less (*e.g.* 7365 at 600° C., the highest value recorded in this series). When steam was passed through the retort the results were similar to those in the previous tests up to about 450° C.; above that temperature variable results were obtained, and it is concluded that this is the maximum which should be used under these conditions;

the calorific value of the residue was in all cases slightly lower than in the vacuum series, the maximum obtained (at 550° C.) being 7285 cals. Tests under pressure gave results closely resembling those of the vacuum series; the calorific values of the residues were higher than in any other series, reaching a maximum of 7640 cals. at 550° C. When the lignite was dried before carbonisation, the residues obtained had very high calorific values. The hot carbonisation residue is highly inflammable and gains in weight on standing; thus a sample kept in a stoppered tube gained 2·2% in 26 days, whilst the calorific value fell by 3·8%. The losses in calorific value appeared to be greater than could be accounted for by occlusion of air or absorption of moisture. It is concluded that a temperature about 600° C. is the most suitable for carbonisation. The by-products are to be examined later.

PATENTS.

Coal-distilling apparatus. Oil Extractors, Ltd., London, and F. Lamplough, Feltham. Eng. Pat. 121,496, 16.10.17. (Appl. 14,997/17.)

THE coal is fed by two hermetically sealed worm conveyors into inclined retorts of oval cross-section, set so that the long diameter of the oval is vertical. Excess coal is returned to the hopper from the delivery end of the conveyor by another worm conveyor. The hot products of distillation pass into an expansion chamber and two off-take pipes lead them through two vertical tubular boilers, fixed one above the other. When the steam pressure in the top boiler reaches a given value, water is forced out at the bottom through a connecting pipe into the top of the lower boiler, and the water displaced from this boiler passes back to an overhead feed tank, the height of which determines the maximum steam pressure. After leaving the boilers the gases undergo the usual purification processes. The steam after passing through superheaters fixed in the retort setting passes into the bottom of each retort. Each retort is provided with a mechanical stirrer which extends the whole length.

—T. F. E. R.

Oil; Apparatus for recovering —— from oil-shale and other carbonaceous materials. Process for distilling carbonaceous materials. G. W. Wallace, Assignor to Wallace Coke, Oil and By-Products Co., East St. Louis, Ill. U.S. Pats. 1,283,000 and 1,283,001, 29.10.18. Appl., 8.2 and 26.3.18.

SOLID carbonaceous material is heated out of contact with air, liquids, gases, etc., other than those generated during the distillation, in a vertical retort, the walls of which taper from the lower to the upper end. The top and bottom of the retort are closed and within the retort is a vertical perforated tubular take-off duct which passes through the bottom of the retort and through which vapours and liquids generated during the distillation are withdrawn under reduced pressure. Steam can be introduced through a device fitted to the bottom of the retort.—L. A. C.

Incandescence electric lamps; Leading-in wires, or conductors, of ——, high vacuum apparatus, and the like. F. Hoge, Zug, Switzerland. Eng. Pat. 121,173, 4.12.17. (Appl. 17,941/17.)

THE leading-in wires or conductors of incandescence lamps are made from a wire of iron, steel, or alloy, coated with a paste of powdered glass mixed with tungsten, tungsten oxide, or a metal or oxide of the same group, the whole being heated to form an adherent coating on the wire.—B. N.

Incandescence [electric] lamps; Manufacture of ——. F. W. Gill, Arlington, N.J., Assignor to General Electric Co. U.S. Pat. 1,284,648, 12.11.18. Appl., 29.6.15.

SEE Eng. Pat. 11,544 of 1915; this J., 1916, 959.

III.—TAR AND TAR PRODUCTS.

Coal-tar industry; Methods of analysis used in the ——. III. Heavy and middle oils. J. M. Weiss. J. Ind. Eng. Chem., 1918, **10**, 911—916. (See this J., 1918, 648, 728 A.)

Heavy oil tests. Water, sp. gr., and matter insoluble in benzene, are determined as already described (*loc. cit.*). A retort distillation is also made, fractions being collected at 210°, 235°, 270°, 315°, and 355° C., and the sp. gr. of these is determined. The coke remaining after the retort has been heated to redness is weighed. Tar acids are determined in the distillate either by noting the decrease in volume of the distillate when this is shaken with sodium hydroxide solution, or by acidifying the alkaline extracts and measuring the liberated tar acids. The sample is submitted to a Hempel distillation and the refractive indices of the fractions determined. Tar bases are determined by extracting the distillate with sulphuric acid. The sulphonation test of the fractions is made in a graduated centrifuge bottle and the volume of the unsulphonated residue noted. To determine "dry salts," the oil, after extraction of the tar acids, is cooled at 4·5° C., and the separated solids are collected, dried between filter-paper, and weighed. The limpid point of the oil is determined by cooling it until crystals appear and then raising the temperature until a point is reached at which all crystals disappear. *Middle oil tests.* These are the same as for heavy oils, but the coke test is omitted.—W. P. S.

Coal-tar industry; Methods of analysis used in the ——. IV. Benzols and light oil. J. M. Weiss. J. Ind. Eng. Chem., 1918, **10**, 1006—1012. (See this J., 1918, 648 A, 728 A.)

Benzols. The sp. gr. is determined by methods mentioned previously (*loc. cit.*); the distillation test is made under prescribed conditions, as is also the sulphuric acid wash test. Carbon bisulphide is determined by conversion into xanthate, which is titrated with copper sulphate solution. Sulphonation is employed for the determination of paraffins, whilst hydrogen sulphide and sulphur dioxide are determined by extraction with sodium hydroxide solution and subsequent oxidation with bromine. The solidifying pt. is also determined. *Light oils.* The material is tested for water, sp. gr., tar acids, and tar bases as already described for heavy oils (see preceding abstract). Other special tests comprise distillation, tar acids by contraction and liberation method, determination of crude naphthalene, and a distillation method for the determination of benzene and toluene.—W. P. S.

Phenol, o-cresol, m-cresol, and p-cresol; Freezing points of mixtures of ——. H. M. Dawson and C. A. Mountford. Chem. Soc. Trans., 1918, **113**, 923—935.

THE freezing point curves of the six series of binary mixtures, which may be derived from this group of substances, have been determined by observation of the lowest temperatures at which the various mixtures undergo complete liquefaction. Weighed quantities of the carefully purified and thoroughly dried components of the mixture under

examination were sealed up in glass tubes, the contents melted and then partially solidified by cooling. The tubes were then made to rotate in a water bath of slowly rising temperature, and the temperature at which the last crystals disappeared was registered as that at which freezing would begin in the absence of supercooling effects. The results obtained, which differ very considerably from those recently recorded by Fox and Barker (this J., 1918, 268 T), show that definite chemical compounds are formed in the case of five out of the six pairs of substances. Such combination is not definitely excluded in the apparently exceptional case (phenol and *o*-cresol), although the freezing point observations suggest that the curve system consists of only two branches. Comparison of the changes in the freezing point which are produced when three of the substances of the group are severally added in equivalent quantities to the fourth in the capacity of solvent, shows considerable diversity in the behaviour of these chemically closely related substances. It is probable that these differences are to be explained in terms of the formation of solid solutions. (See also following abstract.)—H. M. D.

Phenol and the three isomeric cresols; Estimation of —— in mixtures of these substances. H. M. Dawson and C. A. Mountford. Chem. Soc. Trans., 1918, **113**, 935—944.

In virtue of their behaviour on fractional distillation, the eleven possible groups of mixtures which may be derived from the four substances in question may be reduced to four which are of practical importance, namely, (1) phenol and *o*-cresol, (2) *m*-cresol and *p*-cresol, (3) the three cresols, (4) all four components. It is shown that the determination of the composition of each of these groups of mixtures may be conveniently effected by freezing point observations. The value of a freezing point curve for this purpose is determined by its steepness and by its length. In the case of mixtures of phenol and *o*-cresol, the measurement is made with reference to the phenol curve. The unknown mixture, X, is mixed with a definite quantity of standard phenol and the freezing point of the resulting mixture, Y, is determined. From the curve the composition of Y is read off and the composition of X follows by a simple calculation. Mixtures of *m*-cresol and *p*-cresol may be similarly analysed by making use of the freezing point curve for *p*-cresol. According to an alternative method, the mixture is added to standard phenol to give a ternary mixture containing 60—70% of phenol, and the freezing point of this is determined. From this the ratio of *m*- to *p*-cresol in the mixture can be deduced (see Table III. below). In the case of ternary mixtures of the three cresols, two freezing point measurements are required. The method depends on the fact that the freezing point of *p*-cresol is lowered to the same extent by *o*-cresol and *m*-cresol and on the further observation that the freezing point of *o*-cresol is depressed to very nearly the same extent by *m*-cresol and *p*-cresol. The proportion of *p*-cresol and *o*-cresol in the unknown mixture can thus be determined and the *m*-cresol is obtained by difference. In applying these methods to the estimation of the composition of a quaternary mixture it is necessary to subject the mixture to a preliminary fractional distillation. A known proportion of *o*-cresol should be added to the mixture and the resulting liquid subjected to careful fractional distillation, when it is readily separated into two fractions: (*a*) phenol and *o*-cresol, (*b*) *o*-cresol, *m*-cresol, and *p*-cresol. The binary and the ternary fractions so obtained can then be examined by the methods already described. The curves used correspond with the numbers in the following tables showing: (I) the freezing points of binary mixtures rich in phenol or in *o*-cresol respectively; (II) freezing points of *p*-cresol in admixture with *o*- or *m*-cresol or phenol; (III) freezing points of ternary mixtures of phenol and *m*- and *p*-cresol; (IV) freezing points of *o*-cresol in admixture with *m*- and *p*-cresol.

TABLE I.

Phenol, % by weight ...	100	95	90	85	80	75	70
Freezing pt., ° C. ...	40·5	97·9	35·2 - 32·4		29·5	26·5	23·4
o-Cresol, % by weight ...	100	95	90	85	80	75	70
Freezing pt., ° C. ...	30·45	29·0	27·6	26·25	24·95	23·7	22·6

TABLE II.

p-Cresol, % ...	100	95	90	85	80	75	70	65
Freezing pt., ° C. ...	34·15	30·7	27·2	23·6	20·0	16·3	12·3	7·8

TABLE III.

Per cent. phenol in ternary mixture	Per cent. *m*-cresol in mixture of *m*- and *p*-cresol										
	0	10	20	30	40	50	60	70	80	90	100
	° C	° C	° C	° C	° C	° C	° C	° C	° C	° C	° C
60	9·5	10·5	11·6	12·7	13·8	15·0	16·4	17·8	19·8	21·0	23·6
65	14·4	15·1	15·1	16·8	17·8	18·8	19·9	21·0	22·2	23·5	25·0
70	19·0	19·5	20·1	20·7	21·4	22·1	22·9	23·8	24·8	26·0	27·3

TABLE IV.

o-Cresol, % ...	100	95	90	85	80	75	70	65
Freezing pt., ° C. ...	30·45	28·05	25·6	23·1	20·4	17·5	14·4	11·0

—H. M. D.

Phenols and sulphonic acids; Fusion of sodium hydroxide with several ——. M. C. Boswell and J. V. Dickson. J. Amer. Chem. Soc., 1918, **40**, 1786—1793.

When sodium benzenesulphonate is fused with sodium hydroxide at 300°—350° C. in presence of air, a certain amount of oxygen is absorbed and free hydrogen is evolved. A double oxidation appears to proceed, the first stage by atmospheric oxygen, the second by water with hydrogen formation. If the fusion is carried out in absence of air, no hydrogen is formed. Experiments made on 100-grm. quantities of benzenesulphonate showed that, when the fusion was carried out in presence of air, the maximum yield of phenol was 90%, whilst when an atmosphere of nitrogen was used, the yield was 98%. It is suggested that it might be advantageous to carry out fusions on a manufacturing scale with exclusion of oxygen. In the case of sodium naphthalene-β-sulphonate fusions, hydrogen formation is prevented by excluding air, and it is probable that in this case also the yield of β-naphthol might be improved by excluding air during fusion. The dihydroxy- and trihydroxybenzenes appear not to be formed during the benzenesulphonate fusion. Sodium hydroxide does not bring about the catalytic oxidation of these substances by water (compare page 72 A), except in the case of hydroxyquinol, which gives hydrogen even in absence of air. Sodium anthraquinone-β-sulphonate is also oxidised catalytically by caustic soda.—E. H. R.

Action of sodium hydroxide on carbon monoxide, etc. Boswell and Dickson. *See* VII.

PATENTS.

Nitro-compounds; Process of manufacturing ——. L. W. Andrews, Chicago, Ill. U.S. Pat. 1,283,617, 5.11.18. Appl., 8.2.17. Renewed, 14.9.18.

A nitrating mixture containing an acid amide is used for nitrating organic compounds.—L. A. C.

Aromatic hydrocarbons; Process for oxidising the side chains of ——. *Manufacture of phthalic anhydride, phthalic acid, benzoic acid, and naphthoquinones.* (A) H. D. Gibbs, and (B) H. D. Gibbs, San Francisco, Cal., and C. Conover, Philadelphia, Pa. U.S. Pats. (A) 1,284,887 and (B) 1,284,888, 12.11.18. Appl., 22.9.16 and 12.5.17. (Dedicated to the public.)

See Eng. Pats. 119,517 and 119,518 of 1917; this J., 1918, 684 A.

Phthalic anhydride, phthalic acid, benzoic acid, and naphthoquinones; Manufacture of ——. H. D. Gibbs, San Francisco, Cal., and C. Conover, Philadelphia, Pa. U.S. Pat. 1,285,117, 19.11.18. Appl., 17.2.17. (Dedicated to the public.)

See Eng. Pat. 119,518 of 1917; this J., 1918, 684 A.

Fractional distillation. Eng. Pat. 120,940. *See* I.

Coking pitch. U.S. Pat. 1,283,229. *See* IIA.

IV.—COLOURING MATTERS AND DYES.

PATENT.

Dyes; Method of making universal ——. C. C. Huffman, Assignor to Sunbeam Chemical Co., Chicago, Ill. U.S. Pat. 1,283,519, 5.11.18. Appl., 1.4.18.

A VEGETABLE oil is mixed with the requisite quantity of saponifying agent, and before the reaction attains completion, a solution of an aniline dyestuff is added. The mixture is well agitated, and moulded into a large cake at about 50° C. Saponification is completed in the moulded cake, the reaction bringing the temperature up to about 80° C. in two hours, after which the cake gradually cools to room temperature, and is cut into slabs.—S. S. A.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cotton of different degrees of purification; Behaviour of —— towards solutions of metallic salts. R. Haller. Chem.-Zeit., 1918, **42**, 597—599.

REPRESENTATIVE samples of Indian, American, and Egyptian cotton were prepared in different stages of chemical purification, following the usual industrial bleaching process. The samples were treated at the ordinary temperature for 48 hours with solutions of aluminium sulphate, aluminium acetate, and lead acetate. The change in the percentage of metallic base in the solutions was then determined in order to have an approximate measure of the adsorption, and the quantity of metallic base fixed by the cotton after washing was determined by incineration. In some cases with aluminium sulphate and in all cases with aluminium acetate, a negative adsorption was observed, that is, the concentration of metallic base in solution was increased instead of decreased by the action of the cotton. Using aluminium acetate, the negative adsorption was smallest in the case of the raw fibre and became greater as the degree of purification was increased. Cotton which had been boiled with lime gave higher values than that which had been boiled with caustic soda. Negative adsorption was most pronounced in the case of Egyptian cotton. Using aluminium sulphate, positive adsorption was observed in all cases with the raw cottons and with those which had been boiled with lime; on the other hand, the samples boiled with caustic soda, also those boiled first with lime and then with soda, and the fully bleached samples, all showed negative adsorption, increasing generally with the degree of purification. Lead acetate showed in all cases a large positive adsorption increasing with the purification of the cotton. The maximum adsorption in all cases, both positive and negative, appears to correspond with maximum purification of the cotton, which is attained by boiling first with lime and then with caustic soda, with a sour after each boil. Treatment with bleach liquor appears to decrease the purity of the cellulose, at any rate it lowers the adsorption values. An exceptionally large adsorption with lead acetate was shown by the raw cottons; no doubt, the ease of wetting by the various solutions plays a part. Adsorption does not necessarily run parallel with fixation of insoluble base in the fibre. In all the experiments with aluminium salts there was a fixation of alumina, even when negative adsorption values were recorded. In the experiments with lead acetate showing high positive adsorption, a large fixation was at the same time observed in the case of the raw cottons, and the appearance suggested that the lead oxide was combined with some of the non-cellulose constituents. After boiling, the amount of fixation of lead oxide became smaller with increasing purification of the cotton although the adsorption became more marked.—J. F. B.

PATENTS.

Paper; Manufacture of waterproof ——. J. T. Croll, Glasgow. Eng. Pat. 121,318, 4.12.17. (Appl. 17,920/17.)

THE web of paper is passed direct from the delivery end of the paper-making machine through a bath of waterproofing material, such as a solution of wax. The paper is led into, through, and out of the bath by guide rolls and passes into a drying chamber in which it travels round a series of rolls while subjected to the action of currents of air produced by fans or by forced draught.—J. F. B.

Paper; Removing impregnating material from ——. W. O. Gaynor, Assignor to M. Goodman, Chicago, Ill. U.S. Pat. 1,284,647, 12.11.18. Appl., 27.11.16.

THE impregnated paper is immersed in a liquid with which the impregnating material is freely miscible only when fused, and the liquid is heated directly to a temperature sufficient to fuse the impregnating material and to cause the convection currents to agitate the paper and diffuse the impregnating material throughout the liquid. The liquid containing the dissolved impregnating material is then withdrawn.—J. F. B.

Paper-machine. Paper-screen. A. J. Haug, Assignor to Improved Paper Machinery Co., Nashua, N.H. U.S. Pats. (A) 1,284,668 and (B) 1,284,669, 12.11.18. Appl., 13.7.16 and 4.1.17.

(A) A DEVICE for screening paper stock in stages comprises a screen drum, a central cylindrical fixed core having a semi-cylindrical chamber beneath it, end heads for the drum journaled about the core, and means for rotating the drum. An inlet passage for the stock enters the drum through one end of the core and has a lateral feed delivery-opening extending for a portion only of the length of the drum and adapted to deliver stock on the descending side of the drum. Stock-lifting plates are secured to the interior of the drum, the stock being screened and the unscreened residue lifted and dropped by the lifting blades on the ascending

movement of the latter. Means are provided for diluting the thickened residue and for re-screening the latter, including conveying means comprising a passage arranged helically around and beneath the core in the semi-cylindrical chamber and having an entrance to receive the diluted tailings from the preceding screening, together with deflecting walls to deflect tailings thereto, and an exit opening at a point axially advanced in the length of the drum, from which the tailings are delivered again to the descending side of the drum. Arrangements may be made for repeating the screening and discharging action as many times as desired before the final tailings are withdrawn. (B) A screen for paper stock has an exterior foraminous covering and a series of supports for the same with means for uniting the supports to form a skeleton frame. Interchangeable members are carried by the supports, each comprising segmental separated units and providing one assembled and main circumferential support for the foraminous covering. The units may be replaced without dismantling the skeleton frame.—J. F. B.

Wood pulp for nitrating or similar purposes; Process of refining ——. V. Drewsen, Brooklyn, Assignor to West Virginia Pulp and Paper Co., New York. U.S. Pats. (A) 1,283,113 and (B) 1,283,114, 29.10.18. Appl., 24.1.18 and 19.6.18.

(A) Soda or sulphate wood pulp is partially bleached by treatment for several hours with chlorine water equivalent to 2—8% of chlorine on the dry weight of the pulp. The partially bleached, yellow pulp is boiled under pressure for several hours with a solution of sodium carbonate to dissolve the colouring matter and other "converted products" and to reduce the matters soluble in caustic potash to considerably below 7%. (B) Sulphite wood pulp is thoroughly bleached by treating for 4—8 hours with bleaching powder solution. The bleached pulp is washed, boiled for several hours under pressure with caustic soda solution to dissolve the oxycellulose and hydrocellulose, and then washed and bleached again, while keeping the matters soluble in caustic potash below 7%.—J. F. B.

Sulphite-cellulose liquors; Process of treating waste —— [*for production of alcohol*]. R. H. McKee, New York. U.S. Pats. (A) 1,284,739 and (B) 1,284,740, 12.11.18. Appl., 22.6.17 and 23.1.18.

(A) In the production of alcohol by the fermentation of waste sulphite liquor, the liquor containing sulphites is treated with a soluble barium compound under oxidising conditions, whereby the injurious sulphur compounds are precipitated as barium sulphate. Alternatively, the liquor may be purified by treatment with barium carbonate under oxidising conditions, thereby producing a sludge containing barium sulphate; the sludge is separated, the liquor is fermented and distilled, and the sludge is heated in a furnace under reducing conditions to form barium sulphide, which is converted into barium carbonate by treating it under pressure with the carbon dioxide evolved from the fermentation vats. Hydrogen sulphide is formed at the same time. (B) The liquor is treated with barium sulphide under oxidising conditions, thereby producing barium sulphate and eliminating injurious sulphur compounds; the barium sulphide is then regenerated as described above.—J. F. B.

Bamboo and kindred material; Apparatus for preparing —— for pulp extraction. J. L. Jardine, Penicuik, and I. T. Nelson, Edinburgh. Eng. Pat. 121,679, 9.3.18. (Appl. 4151/18.)

Dehydrating textiles. Eng. Pat. 121,894. *See* I.

Dyeing. U.S. Pat. 1,283,296. *See* VI.

Fireproofing textiles. Ger. Pat. 306,600. *See* IX.

Dextrin. U.S. Pats. 1,283,839 and 1,284,120. *See* XVII.

Solvent [for cellulose esters]. U.S. Pat. 1,283,183. *See* XX.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Cotton and metallic salts. Haller. *See* V.

Patents.

Dyeing, bleaching or like treatment of cops; Process and apparatus for ——. A. Clavel, Basle, Assignee of W. Resch, Binningen, Switzerland. Eng. Pat. 117,630, 16.7.18. (Appl. 11,605/18.) Int. Conv., 20.7.17.

The cops, on paper tubes, are packed and pressed together in layers in a container. To ensure that the outside cops in the container maintain the proper position, there is inserted, in the end of the paper tube of the cop, a short stopper prior to the packing operation. This stopper forms a retainer for the yarn and a protection for the end of the cop tube. The container has perforated ends and is clamped tightly between two transverse filter chambers in a vat, so that the liquor is circulated longitudinally through the cops.—L. L. L.

Dyeing and like treatment of textiles; Machinery for ——. F. F. Larivei, Bath. Eng. Pat. 120,848, 9.4.18. (Appl. 6017/18.)

The machine comprises a perforated cage or frame carrying the fibre-bearing sticks, the whole being immersed in a dye-vat. The cage or frame is given a to and fro motion, whilst immersed in the vat liquor, and then an up and down motion, the speed of the up motion being different from that of the down. The periods of the respective motions are predetermined for different classes of goods.
—L. L. L.

Dyeing, washing, scouring, sizing, bleaching, and mercerising yarn in hank form; Machines for ——. J. S. and S. S. Lord, Manchester. Eng. Pat. 121,075, 27.4.18. (Appl. 7109/18.)

The machine comprises a horizontal rotating central shaft, with one or more sets of radial arms which can be rotated intermittently around the shaft. Each arm carries a pair of horizontal projecting rotary members for holding the hanks. The inner rotary members can be brought into and out of frictional contact with rollers attached to the central shaft, and are thereby frictionally rotated during treatment in the tank, and also act as squeezing rollers to aid penetration of the material and to remove superfluous liquor. During treatment in the bath one radial arm is in position for removal of the treated material and recharging with fresh material.—L. L. L.

Dyeing; Direct ——. J. Puring, Assignor to Robeson Process Co., New York. U.S. Pat. 1,283,296, 29.10.18. Appl., 1.5.17.

To obtain a composition for dyeing animal fibres, a thick solution of the characteristic solids of waste sulphite liquor is mixed with a small amount of naphthylamine, and a small amount of nitric acid

is added. Alternatively, a dry pulverulent material may be prepared, containing the solid matters of waste sulphite liquor, an aromatic cyclic substance, and the products of the reaction of nitric acid on the mixture of the two.—J. F. B.

Dyeing machines. Eng. Pat. 121,199. *See* I.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Ammonia; New method for the synthesis of ——. H. Hampel and R. Steinau. Chem.-Zeit., 1918, **42**, 594.

THE method consists in heating together iron, ammonium chloride, and nitrogen at 300° C. under 50 atm. pressure. The reaction proceeds according to the equation: $3Fe+6NH_4Cl+2N=3FeCl_2+8NH_3$. The gaseous mixture obtained contains 98 to 99% NH_3; of this, 75% comes from the ammonium chloride and 23 to 24% from the nitrogen. The ammonia may, subsequently, be passed into the ferrous chloride solution whereby ammonium chloride is again formed together with ferrous hydroxide which may be reduced to the metallic state and used again.—W. P. S.

Water-glass manufacture. O. Maetz. Chem.-Zeit., 1918, **42**, 569—570, 582—583.

IN the manufacture of sodium silicate Glauber salt is now generally used in place of sodium carbonate on account of its lower price, although a greater weight has to be used in addition to a quantity of coal as a reducing agent, whilst it has a more destructive action on the furnace walls than carbonate. The materials are used in the proportion of 100 parts of sand, 75 of Glauber salt, and 8 of coal. The finely ground mixture is fused at about 1500° C. in a tank furnace constructed of firebrick, the bottom being cooled externally by air-ducts connected with the chimney. The furnace proper communicates with a second compartment by means of a hole at a distance from the bottom one-quarter the depth of the charge. The fused glass falling to the bottom of the furnace, flows into the second compartment, which may be separately heated to keep the water-glass molten, and is thence discharged into an iron vessel filled with water to cool it. The furnaces are fired with producer gas and may be worked on the recuperative or the regenerative system, the former being suitable for small plant with a daily output of 1500—5000 kilos., whilst for larger installations, up to 20,000 kilos. per day, the regenerative system is better. The solidified water-glass is broken up into fairly small particles, usually by means of hammers. (It is not now generally ground in a ball mill as the finely divided particles ball together during the extraction process, and then only dissolve with difficulty.) The broken product is then transferred to the dissolving drums, in which it is treated with steam at about 5 atmospheres pressure, whilst the drums rotate at about 6 revs. per min., the solution process taking about 6 hrs. The capacity of the drums should be in the proportion of 1 litre to 1 kilo. of dissolved glass, so that, the sp. gr. of the water-glass being 1·5, the drum is ⅔ full at the end of the process. A convenient capacity is 6000 litres. For each kilo. of solid glass about 1½—2 kilos. of steam is used. When solution is complete the product is run off into settling tanks and, after the mud has settled, passed through a filter-press. The clear water-glass so obtained generally has to be concentrated, this being carried out in a closed steam-jacketed vessel connected to a vacuum pump, the solution being stirred during concentration to obtain a homogeneous product. (See also Caven, this J., 1918, 63 T.)—E. H. R.

Sodium hydroxide; Fusion of —— with some inorganic salts. M. C. Boswell and J. V. Dickson. J. Amer. Chem. Soc., 1918, **40**, 1773—1779.

WHEN sodium arsenite or ferrous sulphate is fused at 300°—400° C. with sodium hydroxide, hydrogen is evolved and the salt is oxidised. The volume of hydrogen evolved is equivalent to the oxygen taken up by the salt, the reaction consisting in the decomposition of water. Stannous chloride and vanadium sulphate also give much hydrogen when fused with sodium hydroxide. With cerous and uranous sulphates small amounts of hydrogen are formed, but with sodium sulphite and sodium nitrite there is practically no action. (See also J. Chem. Soc., Feb., 1919.)—E. H. R.

Sodium hydroxide; Action of —— on carbon monoxide, sodium formate, and sodium oxalate. M. C. Boswell and J. V. Dickson. J. Amer. Chem. Soc., 1918, **40**, 1779—1786.

AT 410°—430° C. carbon monoxide in contact with fused sodium hydroxide is oxidised to carbon dioxide, an equivalent amount of hydrogen being also produced. Sodium formate when fused with sodium hydroxide at 275° C., a temperature much below its normal decomposition point, gives a quantitative yield of carbon dioxide, an equivalent amount of hydrogen being again formed. Sodium oxalate at 290° C. is similarly oxidised. The effective oxidising agent is water present in the fusion, the reaction being catalysed by the sodium hydroxide. An explanation can now be offered of the process of Ger. Pat. 161,512 (this J., 1904, 911, and 1905, 150) according to which, by the addition of 5% of sodium hydroxide to sodium formate, the latter can be transformed into technically pure oxalate at a temperature below its melting point. The alkali here brings about the oxidation of the formate to oxalate by water at a temperature below that at which the velocity of oxidation to carbonate becomes appreciable. Similarly it is considered that alkali fusions involving the replacement of the carboxyl group by hydrogen, as in the formation of benzene from sodium benzoate, are brought about by simultaneous oxidation and reduction by the elements of water.—E. H. R.

Alkali hypochlorite solution; Determination of free alkali and alkali carbonate in ——. M. Philibert. J. Pharm. Chim., 1918, **18**, 260—272.

TEN c.c. of the sample is treated with 5 c.c. of 20% potassium iodide solution and 30 c.c. (an excess) of *N*/10 hydrochloric acid, and the liberated iodine is titrated with *N*/10 thiosulphate solution; potassium iodide-iodate solution is then added and the iodine again titrated with thiosulphate solution. The latter titration corresponds with the total free alkalinity of the sample. Another portion of 20 c.c. of the sample is treated with a quantity of *N*/10 barium hydroxide solution equal to the total alkalinity of the sample, barium chloride solution is added, the mixture diluted to 100 c.c., filtered, and the alkalinity of the filtrate determined as described above. The difference between this alkalinity (free alkali) and the total alkalinity is a measure of the carbonate alkalinity. If free alkali is not present, the barium precipitation will give the quantities of alkali carbonate and bicarbonate in the solution.—W. P. S.

Hypophosphites and phosphites; Iodometric determination of ——. Boyer and Bauzil. J. Pharm. Chim., 1918, **18**, 321—334.

In acid solution, hypophosphites are oxidised to phosphites by iodine; if the solution is then rendered alkaline, the reaction proceeds a stage further and the phosphite is converted into phosphate. *Hypophosphites.* Ten c.c. of a 1% solution of the hypophosphite (salts insoluble in water may be dissolved in dilute sulphuric acid) is treated in a stoppered flask with 10 c.c. of 25% sulphuric acid and 30 c.c. of *N*/10 iodine solution; after the mixture has stood for 10 hrs. in a dark place, the excess of iodine is titrated with *N*/10 thiosulphate solution. Each c.c. of *N*/10 iodine solution is equivalent to 0·00328 grm. of H_3PO_2. *Phosphites.* Ten c.c. of a 1% solution of the salt is treated with 10 c.c. of 5% sodium bicarbonate solution and 20 c.c. of *N*/10 iodine solution; after 2 hrs., 10 c.c. of 10% acetic acid is added and the excess of iodine titrated. Each c.c. of *N*/10 iodine solution corresponds with 0·00407 grm. of H_3PO_3. The method is applicable to mixtures of hypophosphites and phosphites.—W. P. S.

Silica; The "swelling" of ——. K. Hebbeler. Chem.-Zeit., 1918, **42**, 593—594.

When 2 grms. of kieselguhr is shaken with water in a 250 c.c. graduated cylinder and then allowed to settle for 24 hrs., the silicious sediment will occupy a volume of from 8 to 18 c.c.; if the clear water is then drawn off and replaced by calcium hydroxide solution, which is, in turn, drawn off and a fresh quantity added every day, the volume of the sediment will increase gradually until after 14 days it will measure from 68 to 196 c.c., according to the grade of kieselguhr employed. This increase in the volume of the sediment is not due to increase in the size of the silica skeletons constituting the substance, but is caused by the separation of calcium hydroxide which is occluded in the mass; the supernatant liquid contains less calcium hydroxide after it is shaken with the kieselguhr, and the greater part of the precipitated calcium hydroxide may be removed by extracting the mass with water. A small portion is precipitated as carbonate and this may be removed by means of water containing carbon dioxide; the volume of the kieselguhr then diminishes to that observed originally. There is no formation of calcium silicate and the phenomenon appears to be purely physical.—W. P. S.

Range of existence of substances, kinetic analysis, and the estimation of vapour pressures from reaction velocities. M. Trautz. Z. anorg. Chem., 1918, **104**, 169—210.

A theoretical paper in which the author discusses a number of chemical reactions, mostly gas or vapour reactions, in terms of his theory of reaction velocities. The formation of nitrosyl chloride and nickel-carbonyl, the combustion of hydrogen, and the decomposition of ammonia, phosphine, and arsine are fully discussed. It is shown that the vapour pressure and boiling point of nickel can be calculated from the velocity of formation of nickel-carbonyl and its temperature coefficient. There is a close relationship between the energy required to bring about the decomposition of a substance (the "heat of activation") and the wave-length of the light which will induce the same reaction photochemically. (See also J. Chem. Soc., Feb., 1919.)
—E. H. R.

Ammonia recovery. Smith. *See* IIA.

Nitre-cake in superphosphate manufacture. Shutt and Wright. *See* XVI.

Acetic acid from maize cobs. La Forge and Hudson. *See* XVII.

Zirconium phosphate. Steiger. *See* XXIII.

Patents.

Nitric acid; Manufacture of ——. B. Dawson, Bradford. Eng. Pat. 120,869, 4.9.18. (Appl. 14,359/18.)

In the absorption of nitrous gases by projecting sprays of water or weak acid from the bottom of an unobstructed tower by means of air jets, each jet is provided with a funnel-shaped attachment. The wide end of the funnel projects above the level of the liquid in the tower, while the apex surrounds, and is attached to, the jet at a point some distance below the water level. Access of the liquid to the interior of the funnel is obtained by means of holes near the apex and just below the tip of the jet. By means of this device efficient spraying can be effected notwithstanding variations in the level of liquid in the tower.—W. E. F. P.

Nitric acid; Process of concentrating ——. B. Thomas, Seattle, Wash. U.S. Pat. 1,283,598, 5.11.18. Appl., 24.7.17.

Nitrous gases are dissolved under pressure, and the lower oxides of nitrogen are converted into nitric acid by electrolysis.—S. S. A.

Nitric oxides; Production of —— in internal-combustion engines. R. Drawe, Assignor to Ehrhardt und Sehmer G.m.b.H., Saarbrücken, Germany. U.S. Pat. 1,283,112, 29.10.18. Appl., 26.11.15.

In the production of nitric oxide in internal-combustion engines, the combustible mixture, together with an excess of gaseous fluid which is injected into the combustible mixture in order to mix the particles thoroughly together, is preheated to a high temperature by means of the exhaust gases, in order to increase the amount of heat of the mixture in proportion to its volume. The high temperature of the mixture is maintained up to the end of the compression period to effect the formation of nitric oxide, combustion being completed when the highest temperature is reached. A rapid fall of temperature is effected immediately thereafter, to diminish the decomposition of the nitric oxide formed.—J. F. B.

Sulphuric acid; Process and apparatus for producing ——. H. V. Welch, Assignor to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,284,166, 5.11.18. Appl., 22.11.16.

In a mixture of sulphur dioxide, oxygen, oxides of nitrogen, and water, in the form of gases containing non-gaseous particles, the reactions are accelerated by producing agglomeration and precipitation of liquid particles by the successive action of electrical fields of sufficient intensity. Oxides of nitrogen, and fumes of sulphuric and nitrosyl-sulphuric acids are recovered from the effluent of the chamber process by passing the waste gases through a chamber fitted with electrodes, between which a high potential difference is maintained. The electric discharge produced precipitates the fumes on the collecting electrodes, from which they are recovered by washing the electrodes with concentrated sulphuric acid.—S. S. A.

Sulphuric acid; Contact process and apparatus for producing ——. H. V. Welch, Assignor to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,284,167, 5.11.18. Appl., 22.11.16.

SULPHUR-BEARING material is burned to produce gases containing sulphur dioxide. The gases are freed from suspended matter by subjecting them to a high-tension electric discharge, then mixed with hot air and passed over a substantially permanent catalyst of the ferric oxide type, maintained at the proper temperature. An aqueous liquid spray is introduced into the treated gases to dissolve the sulphur trioxide, forming a sulphuric acid mist, the particles of which are agglomerated and precipitated by the action of a high-tension electrical field.—S. S. A.

Sulphuric acid manufacture. L. Bradley, East Orange, N.J., Assignor to Research Corporation, New York. U.S. Pat. 1,284,175, 5.11.18. Appl., 24.2.17.

AN apparatus for the electrical precipitation of solid particles from gases containing sulphur dioxide and sulphuric acid, consists of two electrical precipitators arranged in series, in the line of the flow of the gas, and between them a heat interchanger, by means of which the precipitation may be carried out either above or below the condensing temperature of sulphuric acid.—S. S. A.

Sulphuric acid manufacture. L. Bradley, East Orange, N.J., Assignor to Research Corporation, New York. U.S. Pat. 1,284,176, 5.11.18. Appl., 25.8.17.

THE burner gases are freed from dust in an electrical precipitator maintained at a sufficiently high temperature to avoid deposition of sulphuric acid. They then pass through a Glover tower in which partial oxidation of the sulphur dioxide is effected, and are afterwards cooled to form a sulphuric acid mist, which is removed in a second electrical precipitator.—S. S. A.

Oxychloride of carbon and other substances; Catalytic apparatus for the production of ——. J. L. Darrasse, Paris. Eng. Pat. 115,422, 9.4.18. (Appl. 6062/18.) Int. Conv., 23.4.17.

IN the preparation of carbon oxychloride (phosgene) from carbon monoxide and chlorine by catalysis, a leaden U-tube, elliptical in cross-section and having restricted inlet and outlet extension pieces, is employed as container for the catalyst. The dimensions of the tube are: height, not less than 900 mm.; major and minor axis of elliptical cross-section, 180 and 100 mm., respectively.—W. E. F. P.

Thorium; Process for separating —— from other rare earths and for the manufacture of thorium nitrate. J. V. Clarke, Plumstead, and W. A. Clarke, London. Eng. Pat. 120,748, 21.9.17. (Appl. 13,617/17.)

THORIUM is precipitated from acid solutions as oxide or/and peroxide by the addition of an oxidising agent such as a permanganate or hydrogen peroxide. For example, the solution obtained by digesting 20 parts by weight of monazite sand with 50 parts of concentrated sulphuric acid at 180°—200° C., adding the pasty mass to 200 parts of cold water, and allowing the insoluble matter to settle, is treated with a weak solution of alkali permanganate until permanently coloured, and slowly heated to about 90° C., when thorium oxide or/and peroxide is precipitated. After being washed free from cerium and acid, the precipitate is dissolved in nitric acid (50%), and the solution evaporated, preferably *in vacuo*, to produce crystallised thorium nitrate.—W. E. F. P.

Cyanides contained in the by-products obtained in gas works; Recovery and utilisation of the ——. H. Baker, Barrow-in-Furness, Lancs. Eng. Pat. 120,759, 16.11.17. (Appl. 16,879/17.)

WASTE or effluent liquor from ammonia-recovery plants is concentrated in the presence of alkali carbonate, whereby certain of the cyanides present are decomposed with the production of ammonia which is recovered; the cyanides remaining in solution are precipitated by the addition of a metal compound other than a mercury salt. The precipitated cyanides are filtered off and decomposed by carbonisation, etc., to produce ammonia, in which case the alkaline filtrate is employed for liberating ammonia from fresh ammoniacal liquor; or the liquid containing the precipitated cyanides is evaporated to dryness and the residue decomposed by heat. Spent oxide is boiled with alkali carbonate and the solution, after concentration, is treated with a compound of a metal other than mercury to produce insoluble cyanides.—W. E. F. P.

Alumina; Manufacture of ——. E. E. and P. C. Dutt, Jubbulpore, India. Eng. Pat. 120,838, 4.3.18. (Appl. 3767/18.)

A MIXTURE of an aluminous substance (*e.g.* bauxite or clay) with calcium chloride is heated to redness in the presence of arsenious oxide to produce calcium aluminate and arsenious chloride. Part of the calcium aluminate is dissolved in hydrochloric acid, and the remainder is added to the acid solution, whereby aluminium hydroxide and calcium chloride are produced; the arsenious chloride is treated with steam to regenerate arsenious oxide and hydrochloric acid.—W. E. F. P.

Sulphate of ammonia; Manufacture of [neutral ——. S. E. Linder, Buckhurst Hill, Essex. Eng. Pat. 121,082, 3.6.18. (Appl. 9130/18.)

THE acidity of commercial ammonium sulphate is neutralised by agitating the dry or moist salt with the necessary quantity of ammonium carbonate in the form of powder or strong solution.—W. E. F. P.

Lead arsenate; Manufacture of ——. J. Lytle, jun., Formby, Lancs. Eng. Pat. 121,101, 19.8.18. (Appl. 13,436/18.)

LEAD arsenate is prepared by grinding lead carbonate (white lead) in a concentrated aqueous solution of arsenic acid.—W. E. F. P.

Gases; Method of and apparatus for conveying and absorbing ——. [*Manufacture of sodium bicarbonate.*] H. A. Frasch, New York. U.S. Pat. 1,282,799, 29.10.18. Appl., 1.3.17.

A CYLINDRICAL casing having inlets and outlets for gas and liquid is provided with a concentric rotary spiral-shaped drum (*i.e.*, a sheet coiled in the form of a spiral) mounted on a horizontal shaft in the axis of the casing. The drum is partly immersed in the liquid in the casing, and the gas to be absorbed and conveyed is thereby confined in the upper portions of the convolutions of the drum. The drum is rotated in such a direction that the gas and liquid are conveyed towards the centre of the spiral and discharged. Several such machines are connected in series, so that the liquid and gas are conveyed through the series in opposite directions. The apparatus is particularly applicable for use in the manufacture of sodium bicarbonate by means of ammoniated salt brine and carbon dioxide.—W. F. F.

Phosphorus, phosphoric acid, etc.; Manufacture of ——. W. H. Waggaman, C. R. Wagner, and H. Bryan, Washington, D.C. U.S. Pat. 1,282,994, 29.10.18. Appl., 12.11.17. (Dedicated to the public.)

A MIXTURE of mineral phosphate, silica, and carbonaceous matter is fed down a shaft to a combustion zone heated to incandescence. The products of combustion pass around, but not in contact with the incoming material to preheat it. Phosphorus compounds are collected from the volatile products. —L. A. C.

Phosphoric acid; Process for the direct preparation of crystallised —— [*from fumes containing oxides of phosphorus*]. J. N. Carothers and W. H. Ross, Washington, D.C. U.S. Pat. 1,283,398, 29.10.18. Appl., 18.2.18. (Dedicated to the public.)

FUMES of oxides of phosphorus evolved in smelting operations are collected by means of electric precipitation, using a connecting flue and precipitating system of such radiating surface that the fumes are precipitated above 100° C. The collected acid is allowed to cool below its melting point. (See also this J., 1917, 134.)—L. A. C.

Phosphorus fumes; Method for the recovery of —— *evolved in the volatilisation method of treating phosphate-rock.* A. R. Merz, W. H. Ross, and J. N. Carothers, Washington, D.C. U.S. Pat. 1,284,200, 5.11.18. Appl., 25.7.16. (Dedicated to the public.)

PHOSPHORUS is recovered from the fumes evolved during the treatment of phosphate rock by the volatilisation method (this J., 1916, 1154; 1917, 134) by introducing into the fumes any substance which will react with the oxides of phosphorus, and collecting the compound formed on a filter.—L. A. C.

Salt-bearing ores; Apparatus for obtaining salts from ——. P. G. Darling, Wilmington, Del., Assignor to E. I. du Pont de Nemours and Co. U.S. Pat. 1,283,099, 29.10.18. Appl., 17.7.14.

AN elongated horizontal receptacle is fitted with mechanism for introducing and withdrawing solid or liquid, in any desired proportion, without the escape of vapour, and is provided with heating arrangements. The ore is fed into the apparatus at one end, and the solvent at the other end. As the extraction proceeds, the solid is carried continuously on an inclined conveyor, to the outlet, and thence to a draining receptacle or to a pressure filter heated by the waste heat from the extraction vessel. —S. S. A.

Potassium compounds in cement flue-dust; Method of increasing the solubility of ——. F. S. Moon, Assignor to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,283,261, 29.10.18. Appl., 3.10.17.

CEMENT-KILN flue-dust is heated to near its sintering temperature by contact with gases substantially free from silicious ash, after which both the volatilised and the residual portions are leached to recover potassium compounds.—W. R. S.

Potassium salts; Process for recovery of pure —— *from kelp and like materials.* S. R. Oppenheim, Keeler, Cal. U.S. Pat. 1,283,547, 5.11.18. Appl., 7.6.17.

A SOLUTION of crude potassium salts from kelp or similar materials is filtered through bone char in order to remove organic impurities.

Silicious minerals; Process of treating —— *for the production of chemical compounds.* J. H. Stover, Trenton, N.J. U.S. Pat. 1,283,951, 5.11.18. Appl., 22.6.14.

SILICATE minerals are fused with an alkali base to form an insoluble compound silicate. Soluble products of the fusion are separated by leaching, the insoluble residue is decomposed with acid, soluble products are removed, and the residue digested with an alkali base.—L. A. C.

Ammonium perchlorate; Art of preparing ——. E. A. Le Sueur, Ottawa, Canada. U.S. Pat. 1,284,380, 12.11.18. Appl., 29.12.17.

AMMONIUM sulphate and sodium perchlorate are treated with water and heated to a temperature slightly above that at which substantial separation of hydrated sodium sulphate occurs, whereby a copious separation of ammonium perchlorate occurs. The liquor after filtering is diluted and chilled to obtain hydrated sodium sulphate. —J. H. P.

Electrolytic production of caustic alkali [*and chlorine*]; *Process of and apparatus for* ——. H. H. Dow, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pat. 1,284,618, 12.11.18. Appl., 12.8.15.

EACH electrolytic cell of a series is divided into anode and cathode compartments by a diaphragm of limited permeability to liquid. Each compartment of each cell is provided with an inlet and outlet, the outlet of each anode or cathode compartment being connected to the inlet of the succeeding anode or cathode compartment respectively. An alkali chloride solution is supplied to the first anode compartment, and the anode electrolyte in each cell is maintained at a higher level than the cathode electrolyte of that cell. Some electrolyte percolates through the diaphragms, and the excess passes successively from the anode compartments to the next in the series, then from the last anode compartment to the cathode compartment of that cell, and successively through the series of cathode compartments. Alkali hydroxide is withdrawn from the last cathode compartment, and the chlorine liberated in the process is collected.—B. N.

Liquefying air; Apparatus for —— *and separating it into its constituents.* C. F. Crommett, Chelsea, Mass., Assignor to G. L. Cabot, Cambridge, Mass. U.S. Pat. 1,283,472, 5.11.18. Appl., 30.6.15.

THE apparatus comprises means for compressing, cooling, and drying air, and then separating it into three portions, the first of which is allowed to expand and used to liquefy the second portion, the third portion being utilised to evaporate the liquid produced from the second portion. Both a one-stage and a two-stage rectifier are fitted underneath with containers to receive liquid passing down from the rectifiers, and these containers communicate with an auxiliary container. All the containers are provided with liquefying chambers and liquid is delivered from each chamber attached to a rectifier to its respective rectifier. The gaseous mixture issuing from the one-stage rectifier is compressed and delivered to the liquefying chamber attached to the auxiliary container, liquid from this chamber passing to the two-stage rectifier. Nitrogen gas from the two-stage rectifier and oxygen gas, evaporated in the auxiliary container, pass to receptacles through conduits in which they respectively cool the gaseous mixture from the second compressor, and dry and cool a fresh supply of compressed air for use in the apparatus.—L. A. C.

Hydrating magnesian lime. U.S. Pat. 1,284,505. *See* IX.

VIII.—GLASS; CERAMICS.

PATENTS.

Glass manufacture. T. J. McCoy, Wichita Falls, Tex. U.S. Pat. 1,283,538, 5.11.18. Appl., 22.5.16.

THE discharge chamber of a tank containing molten glass has a bottom wall inclined upwards, and adjacent side walls with ledges extending inwards. A cover-wall movable vertically is suspended freely between the ledges.—A. B. S.

Glass surfaces; Decorating ——. K. Warga, Brooklyn, N.Y., Assignor to American Lithographic Co., New York. U.S. Pat. 1,283,606, 5.11.18. Appl., 16.8.16. Renewed 11.5.18.

THE glass is decorated with mineral colours which are fusible at predetermined successive temperatures, the highest of which is below the fusion point of the glass. When several colours are superimposed, the most fusible is placed nearest to the glass. A combustible fixing agent which is insoluble in water, such as a mixture of spirits of turpentine 108 parts, fir balsam 50 parts, sugar of lead (lead acetate) 3 parts, and soft flux 1 part, may be mixed with the colour or applied to the glass. The colours are fixed by heating the articles to the required temperature.—A. B. S.

Glass drawing and blowing apparatus. W. E. Standley and T. B. Campbell, Pittsburgh, Pa., Assignors to Window Glass Rotary Pot Co. U.S. Pat. 1,285,450, 19.11.18. Appl., 20.8.15.

SEE Eng. Pat. 18,126 of 1915; this J., 1916, 1109.

IX.—BUILDING MATERIALS.

Cement; New researches on ——. K. Endell. Z. angew. Chem., 1918, **31**, 233—234, 238—240.

A SURVEY of the literature on cement published during the last 10 years. The raw materials for Portland cement do not require special investigation beyond that necessary to secure the correct ratio of $CaO : SiO_2+Al_2O_3+Fe_2O_3$ in the finished product. Only glassy blast-furnace slags, which have been cooled rapidly and granulated, can be used for slag cement. If cooled slowly they fall to a useless crystalline powder. The constitution of Portland cement-clinker is not definitely established. Cobb (this J., 1910, 69, 250, 335, 399, 608, 799) has shown that calcium carbonate, silica, and alumina can react at 800°—1200° C. without fusion, forming calcium silicates at temperatures much below the eutectic temperature. Sodium, magnesium, zinc, and barium silicates and aluminates may also be prepared in a similar manner. The incompletely burned and unsintered product in the manufacture of Portland cement, though largely soluble in *N*/1 hydrochloric acid, contains silicates and aluminates which are absorbed on heating to a higher temperature by the ternary or quaternary eutectic formed. Jesser and Dittler (Zement-Chemie, 1910, 71) observed first an absorption of heat (*i.e.* the fusion of a eutectic) when cement-mix was sintered at 1250° C. —1380° C., and the crystallisation of the chief constituent did not occur until the material had been heated to a higher temperature; this crystallisation was accompanied by evolution of heat. The triangular diagram summarising the researches at the Geophysical Institute, Washington (see this J., 1911, 543; 1915, 139), is reproduced, but it is suggested that, as equilibrium is seldom reached in burning cement-clinker, the phases indicated in the triangular diagram may not occur in commercial cement. The influence of iron oxide, magnesia, alkalis, and sulphur trioxide on the position of the various areas in the diagram has not been investigated, though it is known that small percentages of ferrous oxide and manganous oxide prevent "dusting." Killig (Protokoll der Verh. des Vereins deutsch. Portlandzementfabrik., 1913) produced sufficiently large amounts of pure calcium aluminates to permit the examination of their mechanical properties. He confirmed the known high crushing strength of aluminous cement, but found that tricalcium aluminate expands after being mixed with water, and suggested that this substance does not occur in good Portland cement. The setting and hardening of cements have been studied microscopically by Ambronn and others (this J., 1909, 366), Kaisermann (Diss., Jena, 1910), Blumenthal (this J., 1914, 964), and Scheidler (Diss., Jena, 1915). A 0·2% solution of alizarin orange or cryst. alizarin in dilute ammonia was used to identify lime, a similar solution of cyanin and chromotrop 2R was used to identify alumina, acetic acid for combined silica, and neutral methylene blue for free silica. After the cement and water had been in contact for 2—3 hours, hexagonal plates of calcium aluminate were visible around the cement grains; these plates were free from silica. Fine needles of calcium silicate were also formed. After 3—4 days, large hexagonal crystals of calcium hydroxide appeared; in contact with the atmosphere these formed spherolites of calcium carbonate. Simultaneously, a gelatinous calcium silicate was formed. It was found that these substances are not simply the hydrated products of compounds present in the clinker, but are new compounds formed by the decomposition of the clinker by the water. The hardening of cement appears to be due to the formation and crystallisation of calcium aluminate and silicate and to a gelatinous calcium silicate which unites the crystals present. The increase in volume during hardening has been shown by Jesser (Protokoll der Verh. des Vereins deutsch. Portlandzementfabriken, Berlin, 1913) to be due to the tension of aqueous vapour in the atmosphere. In regard to the destruction of cement by water, etc., sulphates are harmful, but chlorides are negligible. The absorption of the SO_3-radicle from sulphates causes large expansion of the cement and leads to its destruction. Synthetic calcium aluminium sulphate is decomposed by sodium chloride, magnesium chloride, and sea-water, and its formation in sea-water is therefore improbable. The expansion of cement in sulphate solutions increases with its content of alumina. Prolonged exposure to the air previous to immersion in the sulphate solution reduces the expansion, possibly on account of the decomposition of the calcium silicate and hydroxide by the carbon dioxide in the atmosphere. When cement is immersed in a magnesia solution, an equivalent amount of lime is replaced by magnesia.—A. B. S.

PATENTS.

Porous blocks; Apparatus for treating ——. F. S. Hoyt, Denver, Colo., Assignor to Fuller-Stow Co., San Francisco, Cal. U.S. Pat. 1,282,837, 29.10.18. Appl., 11.2.16.

AN apparatus for treating porous blocks comprises an inclined retort and a tank for the impregnating material, both placed within a heating chamber, the tank being at a higher level. Means are provided for introducing hot air or gas into the retort containing the porous blocks and for exhausting it. The impregnating liquid passes from the tank through a pipe entering the lower end of the retort and terminating near the bottom, and means are provided for creating pressure within the retort in order to force back surplus impregnating material to the tank.—A. B. S.

Wood-preservative and process of making same. Wood-preservative treatment. J. A. de Cew, Montreal, Canada. U.S. Pats. (A) 1,283,104 and (B) 1,283,105, 29.10.18. Appl., 4.5 and 11.8.16.

(A) A WOOD preservative is made by dissolving a toxic oil, such as creosote oil, together with rosin in a soap solution and then diluting by forcing it under pressure into hot water. (B) Wood is heated to charring temperature in a solution of coal tar pitch, so that the contained water is expelled, and the outer portion of the wood is impregnated with the pitch, and the surface of the wood is then coated with a harder pitch at a higher temperature.
—A. B. S.

Wood; Process of treating ——. R. L. Gilliam, Assignor to The Gilliam Process Co., Columbus, Ohio. U.S. Pat. 1,283,495, 5.11.18. Appl., 26.8.14.

WOOD, particularly that of the sweet gum tree, is subjected to the action of steam mixed with a solution of alkali, for the purpose of preventing it from warping or twisting.—A. B. S.

Fireproofing wood, textiles, etc. Bauholzkonservierung G.m.b.H., Berlin. Ger. Pat. 306,600, 15.1.14.

THE wood or other material is impregnated with a solution of ammonium sulphate and magnesium sulphate to which have been added alkali salts, such as sodium or potassium sulphate, which will lower the melting point of the magnesium sulphate and, preferably, produce an eutectic mixture. When the proofed material is exposed to the action of fire, the magnesium sulphate on its surface fuses readily and protects the underlying material.—A. B. S.

Cement material and method of producing. A. S. Dwight and R. L. Lloyd, Assignors to Dwight and Lloyd Metallurgical Co., New York. U.S. Pat. 1,283,483, 5.11.18. Appl., 30.12.12.

CEMENT raw materials are mixed with finely-ground fuel and the mixture formed into a thin stratum, and sintered by igniting one face of the stratum and passing air through the material towards the other face. The layer of cement materials and fuel may be deposited on a layer of previously burned cement and covered by a thin layer of fuel alone.
—A. B. S.

Cement; Process for making waterproof —— and product. H. M. Olson, Los Angeles, Cal. U.S. Pat. 1,283,546, 5.11.18. Appl., 19.1.17.

THE cement whilst being ground is mixed with 1 part of an anhydrous oleaginous material free from driers and alkalis to 99 parts of the dry cement.—A. B. S.

Heat-insulating composition. F. A. Headson, Milwaukee, Wis. U.S. Pat. 1,283,754, 5.11.18. Appl., 22.1.17.

FINELY divided, calcined diatomaceous earth is mixed with finely divided asbestos, a binder, and water, moulded into the desired form, and hardened.—A. B. S.

Dolomitic or magnesian lime; Method of hydrating ——. C. and I. Warner, Wilmington, Del. U.S. Pat. 1,284,505, 12.11.14. Appl., 10.7.14.

SUFFICIENT water is added to the lime to hydrate the calcium oxide present, at atmospheric pressure; the magnesia is then hydrated in a closed vessel under a higher pressure by means of an additional amount of water.—A. B. S.

Artificial stone; Production of ——. A. Krieger, Ickern. Ger. Pat. 306,539, 25.9.17.

ARTIFICIAL stone with an unusually large proportion of sawdust, asbestos, etc., may be made with the aid of a binder composed of magnesium sulphate and quicklime or calcined dolomite or other oxides which form insoluble sulphates.—A. B. S.

Cement-making materials; Treatment of ——. H. Cappenberg, Bochum. Ger. Pat. 308,884, 3.4.18.

ALUMINIUM chloride is mixed with the raw materials used for making cement. This reacts with the calcium carbonate, forming calcium chloride, aluminium hydroxide, and carbon dioxide. The aluminium hydroxide renders the mass more plastic and increases the strength of the bricks made from it, and the carbon dioxide retained in the mass increases its porosity and facilitates the burning of the cement.—A. B. S.

Cement flue-dust. U.S. Pat. 1,283,261. *See* VII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Cobalt silver ore; Smelting and refining of ——. S. B. Wright. Bull. 80, Canad. Min. Inst., Dec., 1918, 992—995.

AT the Deloro Reduction Co.'s smelter, silver-cobalt ore is smelted in a blast-furnace (run with 6—8 oz. blast pressure on account of the large proportion of fines), the charge being calculated to furnish speiss and a neutral slag. The speiss contains Co 22—25, Ni 16—18, As 25, Fe 18, S 7, Cu 1%, and 1000—2000 oz. Ag per ton; it is first liquated to recover part of the silver, then ground, roasted, chloridised, washed with water, and treated with cyanide. The silver is precipitated from the solution with aluminium dust, the cyanide being almost quantitatively regenerated. The liquated and the precipitated metal are melted in an oil-fired furnace which is tilted backwards into blowing position; the metal after 3 hours' blowing is 992—995 fine, and is refined by another melting. The desilverised speiss is sulphatised and leached; the liquor is first freed from copper and iron, cobalt precipitated with hypochlorite solution, and nickel, after removal of the cobalt, with milk of lime. The hydroxides are filter-pressed, washed, and dried ready for sale, or mixed with charcoal and reduced; the crude metals are separated magnetically from excess of carbon, re-melted in electric furnaces, and granulated by pouring into water. The dust and fume from the various furnaces, collected in a bag-house, are heated in a coke-fired reverberatory, and the pure arsenic trioxide condensed in chambers. The clinker from this operation goes back to the blast furnace for the recovery of silver.—W. R. S.

PATENTS.

Furnaces: Electric muffle —— *[for heat treatment of steel].* W. F. Jones, Birmingham. Eng. Pat. 120,944, 25.10.17. (Appl. 15,505/17.)

A VACUUM is established in the chamber of an electric resistance muffle furnace, containing resistance heating elements and the steel tubes and bars to be treated. The chamber is provided with a vacuum "lock" or "locks" and suitable gear, so that the tubes or bars may be introduced into and withdrawn from the muffle without destroying the vacuum or appreciably lowering the temperature. Cradles containing the articles to be treated are

mounted on " run-ways," and moved in the furnace and locks by means of endless ropes or chains. The vacuum in the lock may be destroyed by a jet of steam or water, so that the cover or door may be opened and the contents quickly ejected to a " quenching " tank. Any air remaining in the furnace, after evacuation by an air pump, is circulated by a fan through a small auxiliary furnace containing metal turnings for absorption of oxygen.—B. N.

Steel; Manufacture of ——. H. C. Dickson, Halesowen, and J. B. Micklin, Smethwick. Eng. Pat. 121,311, 10.11.17. (Appl. 16,512/17.)

A STEEL of medium tensile strength, and with high resistance to fatigue and shock, contains 0·1 to 0·3% C, 0·08 to 0·25% Si, 0·4 to 1% Mn, 0·05 to 0·2% V, 0·05 to 0·25% Cr, with sulphur and phosphorus as low as possible. The best combined results for machining, tenacity, and toughness are obtained by rolling the metal hot to nearly the required size, and reducing further by cold drawing or cold rolling, without annealing. If required in the form of sheets or slabs, the hot-rolled metal may be improved by a normalising process.—C. A. K.

Steel; Manufacture of —— direct from iron ores. L. T. Grouselle, Grenoble, France. U.S. Pat. 1,284,094, 5.11.18. Appl., 4.8.17.

AN ore-reducing chamber, into which reducing gases can be admitted, extends downwards into a melting chamber which is independently heated. The flue conveying the waste gases is separately connected with the reducing and melting chambers.—C. A. K.

Ferrosilicon; Process of making ——. G. C. Furness, New York, Assignor to Electro Metallurgical Co., Niagara Falls, N.Y. U.S. Pat. 1,284,645, 12.11.18. Appl., 26.3.18.

A CHARGE comprising silica, a reducing agent containing a high percentage of fixed carbon, a source of iron, and bituminous coal, the bituminous coal being more coarsely graded than the rest of the carbonaceous reducing agent, is smelted in an electric resistance furnace between deeply embedded electrodes.—J. F. B.

Lead; Extraction of ——. E. S. Berglund, Trollhättan, Sweden. Eng. Pat. 114,303, 19.2.18. (Appl. 2936/18.) Int. Conv., 10.3.17.

THE charge is introduced continuously into a hermetically closed electric furnace from which the molten lead is removed through a siphon tap while the non-condensable gases escape through a water-seal from a condenser connected to the furnace.
—W. R. S.

Roasting furnace; Mechanical ——. G. Gröndal, Djursholm, Sweden. Eng. Pat. 115,639, 7.5.18. (Appl. 7650/18.) Int. Conv., 24.3.17.

FOR the roasting of materials which require a relatively high temperature, the hearth of a furnace is heated from the under side by flues conveying the products of combustion from a fire-grate. The material fed on to the hearth is moved forward towards the hotter end by a movable arch provided with rabbles. The arch as a whole is capable of being moved forward a certain distance, then raised, and brought back to its original position, the rabbles being out of contact with the material on the hearth during the return movement.
—C. A. K.

Metallurgical furnace. J. Kralund, Brooklyn, N.Y., Assignor to Doehler Die Casting Co. U.S. Pat. 1,284,711, 12.11.18. Appl., 10.9.15.

A CRUCIBLE furnace is fitted with a rotary supporting block, near the outer edge of which a number of crucibles are placed. When the desired temperature is attained, crucibles may be successively drawn from, or inserted into, the furnace, through an opening in the side wall.—C. A. K.

[Metallurgical] furnaces; Lining for ——. W. C. Ely, Terre Haute, Ind. U.S. Pat. 1,284,880, 12.11.18. Appl., 5.2.16.

THE walls of a furnace are built of hollow blocks of refractory material, forming a cellular structure open to the atmosphere. An inner lining of metal is provided which melts on heating the furnace, and causes molten slag to enter the cells. The slag is chilled by the cooling action of the outside air and forms a solid refractory lining.—C. A. K.

Metallic surfaces; Preserving ——. N. C. F. Jensen, Southall, Middlesex. Eng. Pat. 121,150, 6.11.17. (Appl. 16,197/17.)

THE articles are coated with oil (*e.g.* a mixture of whale oil and mineral oil), then heated to a temperature high enough to gasify the volatile constituents in an oven which permits the escape of the lighter gases. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 2022 of 1873, 4486 of 1874, 9570 and 9848 of 1888; 1146 of 1896, 3682 of 1904, and 3945 of 1915; this J., 1889, 715, 712; 1904, 556; 1916, 54.)—W. R. S.

Ores [galena and blende]; Concentration of —— by flotation. E. Edser, S. Tucker, and Minerals Separation, Ltd., London. Eng. Pat. 121,303, 13.9.17. (Appl. 13,131/17.)

THE freshly-ground ore is agitated, with or without aeration, with water containing small proportions of sodium silicate and of a soluble soap, to produce a froth carrying the galena. After separation of the froth, the liquor is diluted with water and again agitated for the flotation of the zinc blende.
—W. R. S.

Metal spraying apparatus. T. S. Worthington, Montreal, Canada. Eng. Pat. 121,344, 12.12.17. (Appl. 18,437/17.)

THE apparatus consists of a cylindrical metal container, with a conical bottom, and open at the upper end, fitted concentrically in a similarly shaped closed container, so that an annular space is formed between the two vessels. An outlet from the apex of the conical section of the outer vessel is connected with the air branch of a blowpipe burner, the fuel gas being admitted through a second branch. The air supply to the burner is obtained by maintaining a positive pressure of air in the metal container, the air passing evenly down the annular space and through the connecting pipe to the burner. Powdered metal, contained in the inner vessel, is allowed to fall through an opening regulated by a spindle valve, into the air current as it leaves the outer container, and the metal dust passing through the flame is blown on to the article to be coated, in a molten or plastic condition.
—C. A. K.

Zinc retort furnace. A. Jones, Langeloth, Pa., Assignor to Metallurgical Co. of America, New York. U.S. Pat. 1,282,847, 29.10.18. Appl., 4.1.16.

A RETORT furnace contains a number of pillars spaced apart incorporated in its wall, each pillar being built up of blocks extending outwards beyond the face of the wall. Each pillar block has a vertical passage through the portion extending beyond the face of the wall, and a port leading from the passage and communicating with the retort chamber; the vertical passages in the pillar blocks are in alinement. Shelves for supporting the retorts at one end are provided between the blocks of each pillar.—W. R. S.

Zinc; Electrolytic production of ——. G. H. Clevenger, Palo Alto, Cal., Assignor to H. W. Gepp, Melbourne, Australia. U.S. Pat. 1,283,077, 29.10.18. Appl., 7.5.17.

COBALT is removed from zinc sulphate electrolytes containing manganese by neutralising the liquid, and then precipitating the cobalt by means of an oxidising agent.—B. N.

[*Electrolytic*] *zinc cell.* J. L. Malm, Denver, Colo. U.S. Pat. 1,284,403, 12.11.18. Appl., 29.7.14.

Two or more rows of cell chambers are arranged in a casing, with a trough between the rows. The trough is provided with a partition, and with ports for supplying separate portions of untreated material to the several cell chambers. The cover of the trough is spaced from the top of the partition, and means are provided for leading off gas from the top of the trough. A port in the casing leads from a point above the bath to a point below the surface. Anode supports, carrying the anodes, are arranged upon the bottom of the cells, with suitable connections from the anode to the outside of the cell, and a second electrical connection leads to a point in the port below the surface of the bath. —B. N.

Hot-work article [*alloy*]. J. W. Taylor, New Waterford, Ohio. U.S. Pat. 1,282,981, 29.10.18. Appl., 9.3.17.

A STEEL alloy for hot-work articles, *e.g.*, forging dies, contains 1·5 to 3·0% C and from 3·0 to 7·0% Cr. —C. A. K.

Detinning process; Chlorine ——. W. Zacharias, Pittsburgh, Pa. U.S. Pat. 1,283,016, 29.10.18. Appl., 24.6.15.

IN a process of detinning by chlorination, the reaction temperature is modified by introducing a finely divided metal, *e.g.*, tin, into the reaction chamber.—W. R. S.

Alloy; Precious-metal ——. W. E. Mowrey, St. Paul, Minn. U.S. Pat. 1,283,264, 29.10.18. Appl., 15.4.16.

AN alloy for dental, jewellery, and electrical purposes contains Pd 15, Ag 35, and Au 50%. —W. R. S.

Cyanide solutions; Continuous method of treating ——. *Method of treating metal-bearing solutions. Organised apparatus for treating cyanide slimes.* (A) and (B) L. C. Trent, (C) L. C. Trent and S. W. Mudd, Los Angeles, Cal. U.S. Pats. (A) 1,283,363, (B) 1,283,364, and (C) 1,283,365, 29.10.18. Appl., 24.8.14.

(A) THE ore pulp is agitated with the solvent by withdrawing material from the top and returning it to the bottom of the containing vessel. The mixture is drawn off to another vessel wherein it is subjected at its lower part to a gentle agitation to form zones of separation. The clear liquid containing values is withdrawn at the top for further treatment, and fresh solvent or solvent containing less dissolved material is supplied to the thickened material at the bottom. The solid residue is withdrawn and treated again in a similar manner. (B) In the process described in (A) the material under treatment is circulated by withdrawing it from the lower thickened zone and returning it to the same zone. Fresh solvent is also forced into it at this point to effect a further solution of the values and to displace the saturated solution at the top of the vessel. (C) The ore pulp is treated as above in four vessels successively, the saturated solvent being withdrawn at the top of each vessel by introducing fresh or more dilute solvent at the bottom into the solid material. The solid material is withdrawn by a pump and transferred to the next vessel, and at the same time is mixed with fresh solvent.—W. F. F.

Lead alloys and alloys containing lead, tin, copper, or antimony; Refining ——. F. A. Stief, East St. Louis, Ill. U.S. Pat. 1,283,427, 29.10.18. Appl., 6.5.15.

ALLOYS of lead, tin, copper, and antimony, containing arsenic, are treated continuously in a thin layer at a red heat with iron and carbon, the resulting speiss being separated from the cooled mixture in a settling-chamber by skimming.—W. R. S.

Smelting ore; Process of ——. J. H. Gray, New York. U.S. Pat. 1,283,500, 5.11.18. Appl., 20.7.17.

A BLAST of pure oxygen is introduced into a charge of ore and carbon so that the combustion of the carbon is effected in a comparatively small space (as distinguished from the high shaft of the ordinary blast furnace). The complete reduction of the ore is accomplished in the same space, and the charge of ore above is only such as to keep the localised reaction space filled.—C. A. K.

Ores; Process of roasting ——. W. A. Ingham, Los Angeles, Cal. U.S. Pat. 1,283,782, 5.11.18. Appl., 21.2.18.

ORES containing antimony sulphide are ground, and a thin layer is heated in a closed roasting chamber to a temperature sufficient to volatilise antimony sulphide, the vapours being withdrawn, and oxidised to form antimony oxide.—C. A. K.

Electroplating; Method of ——. W. Thum, Hammond, and J. J. Mulligan, East Chicago, Ind., Assignors to United States Metals Refining Co., New York. U.S. Pat. 1,283,973, 5.11.18. Appl., 31.7.18.

IRON, steel, and kindred base metals, are electroplated directly, by covering the surface to be plated with a protective film of gelatin, and subjecting the article to a current of abnormally high current density for a short interval, and then to a normal current density until the desired thickness of deposit has been obtained.—B. N.

Antimony smelting; Starring mixture for ——. C. Y. Wang, Hankow, China. U.S. Pat. 1,284,164, 5.11.18. Appl., 14.9.17.

THE mixture is composed of potassium carbonate and iron sulphide resulting from the precipitation process of antimony smelting.—W. R. S.

Metals from ores; Process for recovering ——. C. L. Larson, Kellogg, Idaho, Assignor to Bunker Hill and Sullivan Mining and Concentration Co., San Francisco, Cal. U.S. Pat. 1,284,910, 12.11.18. Appl., 30.4.17.

ORES containing lead sulphide and other metals (*e.g.*, copper, silver, gold) are treated so as to convert the metal values into a form soluble in brine. The contained metals, other than lead, are precipitated from the brine solution, and the lead is recovered by electrolysis. Any sulphates which may have accumulated are eliminated from the barren brine liquor, which can then be used for leaching a fresh portion of the treated ore.—C. A. K.

Iron and steel; Process of making —— in electric furnaces. E. Humbert, Welland, Ont., Canada. Eng. Pat. 121,674, 26.2.18. (Appl. 3420/18.)

SEE U.S. Pat. 1,252,443 of 1918; this J., 1918, 155 A.

Ferrosilicon; Producing —— in blast-furnaces. J. E. Johnson, jun. Reissue 14,547, 12.11.18, of U.S. Pat. 1,231,260, 26.6.17. Appl., 8.10.18.

SEE this J., 1917, 928.

Washing gold, etc. Eng. Pat. 121,512. *See* I.

Reducing oxides. U.S. Pat. 1,283,286. *See* XI.

Fertiliser. U.S. Pat. 1,283,677. *See* XVI.

Testing hardness. U.S. Pat. 1,283,362. *See* XXIII.

XI.—ELECTRO-CHEMISTRY.

PATENTS.

Furnaces; Electric ——. E. Grammont, Lyons, France. Eng. Pat. 120,786, 28.11.17. (Appl. 17,612/17.)

THE hearth of the furnace, acting as the lower electrode, is formed of a metal plate, *e.g.*, copper, an intermediate layer of conducting agglomerate (*e.g.*, carbon and pitch or tar), and an upper layer of insulating refractory material in which wells are provided at intervals. The material to be treated is partly contained in the wells, so as to produce convection currents in the molten material.—B. N.

Furnaces; Electric ——. T. H. Watson and Co. (of Sheffield), Ltd., H. A. Greaves, and H. Etchells, Sheffield. Eng. Pat. 121,563, 18.4.18. (Appl. 6563/18.) Addition to Eng. Pat. 106,626, 1.3.16 (this J., 1917, 891).

A METHOD of distributing three-phase currents so that the supply phases tend to have balanced loads, consists in the arrangement of three transformer secondary windings grouped in "delta," the terminal junctions being connected respectively to two upper electrodes, or groups of electrodes, and to a third electrode in the conducting hearth. The three transformer primary windings are grouped in "star," the ratio of transformation between the various transformer windings being arranged so that the three primary phases of supply are equally loaded for power and power factor, for any predetermined value of hearth resistance up to the resistance of one of the arcs, when the secondary system comprised by the furnace is symmetrically loaded, *i.e.*, when the two upper electrodes are each conveying equal power.—B. N.

Furnace; Laboratory [electric] ——. Process of [electrically] reducing metallic [tungsten] oxides. C. A. Pfanstiehl, Highland Park, Ill., Assignor to Pfanstiehl Co., Inc., North Chicago, Ill. U.S. Pats. (A) 1,283,285 and (B) 1,283,286, 29.10.18. Appl., 17.7; and 16.11.16.

(A) THE furnace comprises a substantially horizontal base having a groove in its upper surface, and a hollow cover which fits within the groove. The groove contains a sealing liquid, and the cover is provided with a water jacket having flexible inlet and outlet pipes, so that it may be raised or lowered without interrupting the flow of water. An observation window is clamped against the body of the furnace, a duct containing sealing liquid preventing gas from passing between the body of the furnace and the window. Electrical conductors and a rotary shaft extend through the base, and inlet and exhaust pipes conduct gases to and from the body of the furnace chamber. The joints of the device, except those which are soldered, are surrounded by a sealing liquid, so that the furnace may be allowed to stand for long periods without danger of escape of enclosed gas or entrance of the outside atmosphere. (B) Finely powdered tungsten trioxide is reduced by passing a blast of highly heated hydrogen over its surface, whilst heating the oxide just sufficiently to overcome radiation, and to vaporise the moisture formed in the action. —B. N.

Electrode [; Silicon-iron ——]. W. K. Page, Assignor to Chile Exploration Co., New York. U.S. Pat. 1,283,280, 29.10.18. Appl., 28.1.18.

MOLTEN silicon-iron is cooled to approximately the lowest temperature at which it will be sufficiently fluid to cast, and is then poured into a metal mould heated to about 300° C. Copper lugs are embedded in the electrode during the casting operation, the cast electrode being removed from the mould before it falls materially below a cherry-red heat, and embedded in kieselguhr to effect tempering. The slow cooling produces a fine, dense, resistant structure, extending for a considerable distance from the surface.—B. N.

Electric batteries; Wood separators for secondary ——. The Chloride Electrical Storage Co., Ltd., and B. Heap, Manchester. Eng. Pat. 121,188, 6.12.17. (Appl. 18,102/17.)

THE separators are made from wood which does not swell or expand unduly when immersed in an alkali solution. They are first cut to the desired shape and thickness, treated with a weak alkali solution, washed, and then dried rapidly in a heated vacuum oven.—B. N.

Storage batteries; Negative plate for ——. *Process of making storage-battery electrodes and filling mass therefor.* W. Morrison, Chicago, Ill. U.S. Pats. (A) 1,284,425 and (B) 1,284,426, 12.11.18. Appl., 19 and 23.2.18.

(A) NEGATIVE storage-battery plates are made by sand-blasting the grids, filling them with lead oxide, and electrolytically reducing the oxide to spongy lead in magnesium sulphate solution, whereby the reduced lead is maintained in intimate contact with the roughened grid. (B) The "filling mass" is saturated with water, and the plate "formed" in a sulphuric acid electrolyte.—B. N.

Electrical treatment of gases. Eng. Pats. 107,389 and 119,236-8. *See* I.

Separation of suspended particles. Eng. Pat. 120,904. *See* I.

Concentrating nitric acid. U.S. Pat. 1,283,598. *See* VII.

Sulphuric acid. U.S. Pats. 1,284,166, 1,284,167, 1,284,175, and 1,284,176. *See* VII.

Electrolytic process. U.S. Pat. 1,284,618. *See* VII.

Electric furnace. Eng. Pat. 120,944. *See* X.

[*Electrolytic*] *zinc cell.* U.S. Pat. 1,284,403. *See* X.

XII.—FATS; OILS; WAXES.

Fats; Oxydase reaction of —— as a means of detecting rancidity. J. Prescher. Z. Unters. Nahr. Genussm., 1918, **36**, 162—166.

INVESTIGATION of the reaction described previously by Vintilesco and Popescu (this J., 1915, 1214), which depends on the blue coloration obtained when a rancid fat is shaken with blood solution and guaiacum tincture, showed that it is reliable for the detection of rancidity in butter and tallow. Fresh fats do not give the reaction and free fatty acids do not interfere with the coloration yielded by rancid fats.—W. P. S.

Fats and waxes; Vegetable and animal ——. II. A. B. Weinhagen. Z. physiol. Chem., 1918, **103**, 84—86.

A SOLID fat containing no glycerides can be extracted from rice bran. Ether also extracts an oil containing 1·7% of glycerol. (See further J. Chem. Soc., Feb., 1919.)—H. W. B.

Soya beans. Fellers. *See* XVI.

PATENTS.

Oils or liquids; Apparatus for expressing —— from seeds, nuts, and other oil or liquid containing materials and substances and for compressing the residuum into solid form. A. W. Sizer, Kingston-upon-Hull. Eng. Pat. 120,747, 19.9.17. (Appl. 13,435/17.)

IN apparatus of the worm-screw compression type (see Eng. Pat. 29,331 of 1912; this J., 1914, 428), a tube is mounted within the cylindrical casing in which the worm rotates, so that it encloses part of the worm, and rotates round it. The walls of the tube contain a number of tapered longitudinal passages, whilst at the end of the tube is a hollow plate or cap provided with outlets formed by an arrangement of tubes through which the expressed oil can escape into a receiving tank. Means may also be provided for assisting the expression of the oil by the creation of a vacuum, whilst a knife or knives may be mounted on the shaft of the compressing worm for cutting the expressed material extruded from the press into pieces of suitable length.—C. A. M.

Oil cake and like hydraulic presses. B. C. Barton, North Ferriby, Yorks. Eng. Pat. 120,990, 5.12.17. (Appl. 17,996/17.)

THE press-plates have the form of an inverted rectangular box without ends. The top of the box is provided with a number of transverse ribs upon which rests a perforated metal plate, which is secured to some of the ribs, and is of the same length but slightly wider than the length of the ribs so that it will fit into the box immediately above. Each box is provided with bolts which pass through holes in directly opposite positions in the side walls and through spaces between the transverse ribs immediately beneath the perforated plate on the top of the box next below; the lower box is thus supported by its perforated plate on the bolts in the box above. Each box can rise in telescopic fashion into that above it. The bottom box of the series has an enlarged bottom with edges turned up to form a channel for receiving the expressed oil, whilst the top box, which has a closed top, is provided with flanges by means of which it can be bolted to the underside of the press-head. The charge of seed, etc., to be pressed may be placed in removable perforated metal trays which are left in the press during the expression.—C. A. M.

Clarifying oil; Process for ——. A. G. Munro, San Antonio, Tex., Assignor to Refiners Engineering and Supply Co. U.S. Pat. 1,284,750, 12.11.18. Appl., 7.4.17.

OIL is clarified and separated from fullers' earth by filtering the sludge in a filter-press provided with means for successively forcing air, water, and steam therethrough.—A. de W.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS

PATENTS.

Japan; Manufacture and application of ——. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 121,533, 7.1.18. (Appl. 988/18.)

A JAPAN, of a consistency suitable for application without the use of an inflammable solvent, is obtained by heating together japan, water, and a suitable alkali, *e.g.*, ammonia or sodium or potassium hydroxide, in an enclosed space until an emulsion is formed. The constituents of a japan which would prove incompatible when dissolved together in the usual inflammable solvents may be separately emulsified and the emulsions then mixed. A coating of japan may be applied to an electrically-conductive object by immersing the same in the japan emulsion, electrolysing by employing the object as anode, and finally baking the coating obtained. An object may alternatively be coated by heating materially above 100° C., *e.g.*, to 250° C., plunging into the cold emulsion, withdrawing it and finally baking. (See also U.S. Pat. 1,266,335 of 1918; this J., 1918, 476 A.)—A. de W.

Oils; Process and apparatus for the oxygenation and polymerisation of ——. J. K. Blogg, Surrey Hills, Victoria. U.S. Pat. 1,284,572, 12.11.18. Appl., 19.12.17.

OIL, *e.g.*, linseed oil, is simultaneously polymerised and oxidised for printing-ink varnish by heating it in a closed retort over an open fire, a current of air being drawn through the body of oil by exhausting the air in the retort above the surface of the oil by means of a water-jet ejector. Air is supplied to the oil by means of a valved supply pipe open to the air at its upper end and extending to the bottom of the retort. A condenser is interposed between the ejector and the retort. The degree of exhaustion above the liquid level is increased when the flash-point of the oil is reached by closing the valve of the supply pipe, thus discontinuing the supply of air.—A. de W.

Drying pigments. Eng. Pat. 121,372. *See* I

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Influence of certain chemicals on the inner qualities of ——. O. de Vries, H. J. Hellendoorn, N. L. Swart, J. C. Hartjens, and A. J. Ultée. Comm. Centr. Rubber Stat., Buitzenzorg, Java, 1918, **2**, No. 6, 1—38.

The addition of sodium sulphite or bisulphite to latex causes a slight improvement in the properties of the rubber; a small increase is observed in the tensile strength, viscosity index, and rate of vulcanisation and a small decrease in the "slope." The effect is more marked in smoked sheet than in pale crêpe. With sodium thiosulphate the result is a very small decrease in the viscosity and the rate of vulcanisation, the alteration in tensile strength and slope being negligible. Sodium carbonate in the customary proportions as an anti-coagulant has very little influence on the quality of the rubber. Formalin has an effect just contrary to that of the sodium sulphites; with formalin the direct influence of the substance as well as its effect in preventing putrefactive change act in the same direction, whereas with the sulphites the result of the antiseptic effect is opposed to the changes actually observed and tends to reduce these in extent. Sodium acetate causes an increase in the viscosity and in the rate of vulcanisation, whilst sulphurous acid, when used as a coagulant, effects a small increase in the tensile strength and viscosity and a marked decrease in the slope. The effect observed in the use of the sodium sulphites is probably to be attributed to the combined action of the sodium acetate and sulphurous acid produced by the interaction of the sulphite with the acetic acid used for coagulation.—D. F. T.

Rubber; Regeneration of vulcanised ——: *estimation of metastable rubber.* A. Dubosc. Caoutchouc et Gutta Percha, 1918, **15**, 9646.

According to Harries (this J., 1916, 747) vulcanised rubber contains a mixture of "polyprene sulphide" which yields a hydrochloride insoluble in chloroform, with "stable" rubber which under the influence of the sulphur has undergone molecular change so that its hydrochloride is insoluble in chloroform, and unaltered "metastable" rubber the hydrochloride of which is soluble in chloroform. The value of rubber scrap or reclaim should be dependent on its content of "metastable" rubber. A method is described for the prolonged treatment of finely divided vulcanised rubber with dry hydrogen chloride in a cooled vessel; by extracting the product with chloroform the hydrochloride of the "metastable" rubber can be removed and its amount determined.—D. F. T.

Rubber; Ageing of vulcanised ——. O. de Vries. Indiarubber J., 1919, **57**, 77—81.

As the result of further experiments on the ageing of a mixing of rubber (92·5%) and sulphur (7·5%) vulcanised for various periods at 148° C. (compare this J., 1917, 296) it is shown that the product obtained by vulcanising for 70 mins., if subsequently heated at 72° C. for 24 hours, gives a similar stress-strain curve to the product obtained with a vulcanisation period of 90 mins. without any subsequent "ageing." Heating at 72° C. for 24 hours produces no appreciable change in the degree of vulcanisation, but its effect on the mechanical properties as represented by the stress-strain curve is evidently equivalent to an extension of the period of vulcanisation by 20 mins., or, in other words, the effect of the accelerated ageing in the above experiment renders it possible with one mixing to obtain vulcanised products of quite different vulcanisation coefficients but exhibiting coincident stress-strain curves. Although the curves follow the same course, however, that for the "aged" sample is less prolonged because the increase in tensile strength observed on ageing for one day is less than that produced by the extended vulcanisation. With continued ageing at 65°—72° C. the rate of alteration in the position of the stress-strain curve steadily decreases, but no steady condition is attained, the samples finally becoming brittle like over-vulcanised rubber. It is noteworthy, however, that whereas for the first day the effect of ageing is greater the lower the vulcanisation coefficient, the alteration on the subsequent days (as recorded by the elongation at a certain load) is the same for rubbers with vulcanisation coefficients between 2 and 4. It is suggested that it will be necessary to examine ageing phenomena not only with one mixing, but with mixings containing varying amounts of sulphur and also containing the commoner compounding ingredients. In examining vulcanised rubbers prepared by different methods and of uncertain history, it will be advisable to record not only the vulcanisation coefficient but also the stress-strain curve and possibly other characteristics. In an investigation as to whether the method of testing rubber 24 hours after vulcanisation gives as trustworthy comparative results as testing after 3 or 4 days, it was found that the difference of 5—10% observed in the elongation at 1·3 kilos. load under the two methods corresponds only with a difference of 2—3 mins. in the period of vulcanisation; the conditions of the test, as generally performed, are such that a small shifting of the curve causes no appreciable difference in the tensile strength and the rest period of 24 hours after vulcanisation is quite sufficient for trustworthy results to be obtained; indeed the variation observed between different samples of the same rubber was actually slightly less after 24 hours than after 72 hours.—D. F. T.

XV.—LEATHER; BONE; HORN; GLUE.

Tanning materials; Comparative analysis of ——. R. W. Griffith. J. Amer. Leather Chem. Assoc., 1918, **13**, 382—388.

A committee of sixteen chemists has studied the analysis of four materials, *i.e.*, solid chestnut and quebracho extracts, ground divi-divi, and ground mangrove bark, by the hide-powder method. The results show that storing of hide powder for a year does not affect its quality, and that variations in the acidity of chrome alum used for chroming the hide powder have no effect on the results of analyses. It is recommended that the temperature of chroming and detannising be kept within defined limits. The analyses of chestnut extract gave the best concordance, the difference between the maximum and minimum being 2·64% of tannin. In the case of the solid extracts, the greatest differences in the tannin values are attributable to the variation in the amounts of insoluble matter found. In the case of divi-divi, which is not easily sampled, the difference was 12·28% of tannin. The non-tannins show a variation equally great.—F. C. T.

Chrome [tanning] liquors; Investigation of ——. J. R. Blockey. J. Soc. Leather Trades' Chem., 1918, **2**, 205—212.

Measurements of hydrion concentrations by means of the hydrogen electrode show that the acidity of green chrome solutions is roughly ten times that of violet solutions of equal strength, the cause being the greater hydrolysis in the green solutions. This explains the greater swelling action on hide of the

green solutions. The difference in colour probably depends on the degree of ionisation. Undissociated molecules are violet, whilst chromium ions are green. The colour differences may also be explained by Werner's theory of the constitution of the hydrates of chromic chloride. As violet and green solutions are diluted, the differences become less marked. A violet solution when made basic by gradual addition of sodium carbonate or hydroxide gives a permanent precipitate much sooner than a green solution. The hydrogen electrode may under certain conditions be used for determining the basicity (*i.e.*, ratio of Cr to SO_4) of chrome liquors. If liquors are made up in the same way and are of fairly constant strength, they show a definite hydrion concentration corresponding to the basicity. A graph should be constructed from observations on liquors of known basicities.—F. C. T.

Chrome [tanning] liquors; Analysis of one-bath ——. C. Smith and F. Enna. J. Soc. Leather Trades' Chem., 1918, **2**, 213—214.

The oxidation of chromium salts to chromate in liquors containing organic matter is not always easy; on acidification prior to determination of the chromate the organic matter sometimes causes reduction back to chromic salt. The authors describe a rapid method free from this difficulty. Chromic hydroxide is precipitated from the liquor, washed, and oxidised after dissolving in hydrochloric acid. The Procter-McCandlish titration for SO_4 (this J., 1907, 458) is modified to permit of rapid execution. 5—10 c.c. of a liquor containing less than 0·8 grm. of chromium per litre is diluted with 100 c.c. of boiling water, and immediately titrated with *N*/10 sodium hydroxide solution, using 4—6 drops of 1% phenolphthalein solution as indicator. The containing beaker should be placed on a white tile, and the end-point, *i.e.*, the appearance of a grey-violet colour, is quite sharp. The method gives consistent and accurate results.—F. C. T.

Chrome [tanning] liquors; Analysis of single-bath ——. A. Harvey. J. Soc. Leather Trades' Chem., 1918, **2**, 215.

A liquor containing ammonium compounds gives false results for SO_4 when titrated boiling with *N*/2 sodium hydroxide solution according to the Procter-McCandlish method (this J., 1907, 458). The ammonia must first be removed by distillation with alkali, and the equivalent amount of alkali deducted from that used in titration before calculating the SO_4 content.—F. C. T.

Chrome [tanning] liquors; Statement of basicity of ——. H. R. Procter. J. Soc. Leather Trades' Chem., 1918, **2**, 259.

Basicity is usually expressed in Europe as parts of SO_4 combined with 52 of Cr, and in America as the fraction Cr_2O_3/SO_3. A better and more general method, applicable for instance to aluminium compounds, is to express basicity as the proportion of basic to acid valencies, the normal salt being unity. For instance, the basicity of $Cr_2(SO_4)_3$ would be 6 : 6 or 1; that of $Cr(OH)Cl_2$ would be 3 : 2 or 1·5; that of bisulphates, bisulphites, and bichromates would be 0·5; that of normal sulphates, etc., unity.—F. C. T.

[Tannery] lime liquors; Sodium sulphide in ——. H. Hayes. J. Soc. Leather Trades' Chem., 1918, **2**, 258.

In the determination of sodium sulphide in lime liquors by *N*/10 ammoniacal zinc sulphate, direct titration is not satisfactory. It is better to add an excess of sulphate solution to a comparatively large volume of lime liquor, then render faintly acid with acetic acid, shake and filter, and finally estimate the zinc not precipitated. This can be done by titration with potassium ferrocyanide using uranium acetate as external indicator.
—F. C. T.

Leather chemistry; Recent developments in ——. H. R. Procter. J. Roy. Soc. Arts., 1918, **66**, 747—753 and 776—781.

Two lectures in which the advances in leather chemistry during the last ten or twenty years are discussed.—F. C. T.

Patents.

Tanning; Process of —— and manufacture of tanning liquors. C. Blanc, Paris. Eng. Pat. 120,049, 17.10.18. (Appl. 16,968/18.) Int. Conv., 27.9.17.

Chrome tanning liquors are prepared by the reduction, in an acid medium, of chromic acid by cellulose or lignocellulose materials in a finely divided state, *e.g.* sawdust, cotton and paper waste, spent tan, etc., which may or may not have been previously treated with hydrolysing acids. The reduction takes place fairly rapidly in concentrated solutions provided the temperature is maintained for an hour or two at 100° C., or higher if a more basic liquor is desired. The reduced liquors are filtered through sawdust to remove fine oxycellulose powder and are employed in tanning.—D. W.

Tanning; Method of ——. R. B. Cock, Gomshall, Surrey, and W. W. Williams, Rhyddlan, Flint. Eng. Pat. 121,325, 9.12.17. (Appl. 18,183/17.)

For the production of sole leather or dressing leather delimed hides are tanned in pits or drums with a tanning extract containing equal parts of myrobalans, gambier, quebracho, and mimosa. The strength is gradually increased from 30° to 60° Barkometer and a mixture of sodium thiosulphate, aluminium sulphate, vaseline, glycerin or lanoline, and turpentine is added to the tanning liquors. The tannage is completed by treating the hides for 4 hours in each of three rocker pits containing liquors of 90°, 100°, and 120° Barkometer at 110° F. (43° C.). The goods are finished in the ordinary way.—D. W.

XVI.—SOILS; FERTILISERS.

Soil aldehydes. A new class of soil constituents unfavourable to crops, their occurrence, properties, and elimination in practical agriculture. J. J. Skinner. J. Franklin Inst., 1918, **186**, 165—186, 289—316, 449—480, 547—584, 723—741.

The author has examined seventy-four soils of which fourteen were garden soils and sixty field soils; of these latter thirty were classed as productive and thirty as unproductive, being collected in pairs from the same soil type and the same field or locality. Of the fourteen garden soils, five contained aldehydes, and of the sixty field soils aldehydes were present in twelve, these being divided amongst the productive and unproductive soils in the proportion of 1 : 3. Certain aldehydes such as salicylaldehyde and vanillin have already been detected in soils by other workers, and the author has now investigated the influence of six aldehydes, salicylaldehyde, vanillin, heliotropin, benzaldehyde, formaldehyde, and paraformaldehyde on the growth of plants in water and in nutrient-culture solutions, and of the first two named aldehydes in pot and field trials. Sixty-six culture solutions were used containing varying proportions

of sodium nitrate, calcium superphosphate, and potassium sulphate, always prepared so as to contain 80 parts per million of $P_2O_5+NH_3+K_2O$. All of the aldehydes were found to be harmful in aqueous solutions in comparatively small amounts. Salicylaldehyde was less harmful when the solutions contained a high percentage of phosphate and its effect was lessened somewhat by the presence of calcium carbonate. Vanillin was less harmful than salicylaldehyde. It affected the roots more severely than the tops of the plants. Its harmful effect was much lessened by the presence of sodium nitrate in considerable amount. Benzaldehyde when present to the extent of 25 parts per million was injurious to plant growth. There was no very marked beneficial influence exerted by any one of the nutrient salts. Heliotropin was much more harmful than benzaldehyde and the plants were so severely injured that it was difficult to differentiate its effects in the different solutions. Formaldehyde was equally harmful in the different nutrient solutions. Paraformaldehyde was also harmful, but phosphates have a marked ameliorating action on its effect. From the pot and field trials it was found that the two aldehydes examined, salicylaldehyde and vanillin, had no harmful action on well-drained, good productive soils in a high state of cultivation, which, when examined in the laboratory, were found to possess good oxidising power. Further in these soils the aldehydes disappeared. The soils in which the added aldehydes were found to have a harmful effect had a lower crop-producing power and their general management had not been so good. The aldehydes remained in these soils. In these latter soils lime and manganese greatly aided in lessening the effects of both aldehydes, phosphates ameliorated the harmfulness of salicylaldehyde and nitrate of vanillin. Unfertile soils, poor owing to the presence of aldehydes, can be made productive by good drainage and by the use of lime and of certain fertilisers.—W. G.

"Alkali" content of soils as related to crop growth. F. T. Shutt and E. A. Smith. Trans. Roy. Soc. Canada, 1918, **12**, 83—97. (Reprint.)

As a commencement towards the establishment of standards as regards safe limits of "alkali" in soils, adapted to Canadian conditions, the authors have determined the alkali content in the layers 0″—6″, 6″—18″, 18″—36″, and 36″—60″ in depth in soils of the same type on which there was respectively good growth, poor growth, and no growth for crops of western rye grass, native prairie grass, oats, wheat, and onions respectively. The limits of toxicity of total saline content are found to vary considerably with the crop.—W. G.

Soil samples; Are unusual precautions necessary in taking —— for ordinary bacteriological tests? C. B. Lipman and D. E. Martin. Soil Sci., 1918, **6**, 131—136.

In taking samples of soil it has been usual to take special precautions to collect samples under "aseptic" conditions, such as the flaming of the surface of a vertical wall of soil. This method was compared with sampling by means of an auger, and it was found that there was no significant dissimilarity in bacteria numbers, ammonifying power, nitrification, and nitrogen fixation between samples taken by the two methods. Incidentally it was noticed that bacteria penetrated to a much greater depth in arid soil than in humid soil. From 2 ft. below the surface to 6 ft. there was little difference in the number of bacteria and bacterial activity.—J. H. J.

Liming [soils]; Effect of —— on crop yields in cylinder experiments. J. G. Lipman and A. W. Blair. Soil Sci., 1918, **6**, 157—161.

Three sets of experiments were made, alike in all respects except that in one sodium nitrate, in another ammonium sulphate, and in the third dried blood was added. The experiments covered two periods of ten years each, with a five-year rotation of crops. Each set received a good supply of lime at starting, and during the second period cylinder A in each set received no more lime, cylinder B received lime, and cylinder C received lime and a leguminous green manure. The weight of the dry matter in the crop in each year was ascertained. It was found at the end of the first period that there was little difference between the cylinders of each set. At the end of the second period, the yield in cylinder A had fallen off, while that in cylinder B had increased, and that in cylinder C had increased still more. These results show the importance, where commercial fertilisers are used, of the application of lime at the same time, and also the importance of increasing the supply of available nitrogen by the introduction of a leguminous crop in the rotation.—J. H. J.

Mould action in the soil; Importance of ——. S. A. Waksman. Soil Sci., 1918, **6**, 137—155.

Moulds have been isolated in large numbers from cultivated and uncultivated soil, and the identity of many has been established. By the growth of their mycelia in the soil, transformation of the organic and inorganic constituents is effected, but no nitrification nor nitrogen fixation. Decomposition of nitrogenous organic matter takes place with production of ammonia, the amount depending on the source of the nitrogen and the carbohydrates available. The carbohydrates are decomposed with production of carbon dioxide. Nitrogenous fertilisers are utilised to form protein which is taken up by the plant; this is returned to the soil, however, when the body of the plant undergoes autolysis. Much enzyme action in soil is due to moulds; also much acid production. Many species are parasitic to green plants. (See also J. Chem. Soc., Feb., 1919.)—J. H. J.

Soya beans; Effect of inoculation, fertiliser treatment, and certain minerals on the yield, composition, and nodule formation of ——. C. R. Fellers. Soil Sci., 1918, **6**, 81—129.

From pot and field experiments it was found that inoculation of soya-bean seeds before planting or of the soil in which they were planted with pure and commercial cultures of *B. radicicola* or with well infected soil caused a substantial increase in the crop. The protein content of the crop increased and the oil content decreased in direct proportion to the thoroughness of the infection. There appeared to be little natural spreading of the nodule organism in the soil, apart from its transference by outside agency, as water, air, etc. In acid soils the application of small quantities of lime was as important as inoculation, and stimulated nodule formation enormously. The protein and oil content were affected as before. Small applications of acid phosphate (superphosphate) were also beneficial, and in this case oil production was increased when the phosphate was applied after liming. Potash was beneficial to a less extent. Sodium nitrate inhibited nodule formation, and soya beans do not appear to require soluble nitrogen compounds. Manganese had little effect, and sulphur was somewhat injurious.

—J. H. J.

Nitre-cake; Utilisation of —— in the manufacture of superphosphate. F. T. Shutt and L. E. Wright. Roy. Soc. Canada, May, 1918. Canadian Chem. J., 1918, **2**, 314—316.

FINELY ground Florida pebble phosphate (total P_2O_5, 32·3%) and Canadian apatite (total P_2O_5, 39·4%) were separately mixed with powdered nitre-cake (60-mesh, containing 30% free sulphuric acid) in various proportions, in the dry and moist conditions, and the mixtures were allowed to stand at atmospheric temperature for periods up to one week. From the results obtained it is concluded that either phosphate could be converted into superphosphate containing 7—9% of available phosphoric acid (as determined by the methods of the American Association of Official Agricultural Chemists) by the method indicated, the only apparatus required being that necessary for grinding and mixing the materials.—W. E. F. P.

PATENTS.

Fertiliser; Production of an available phosphoric anhydride and potash ——. R. F. Gardiner, Clarendon, Va. U.S. Pat. 1,282,805, 29.10.18. Appl., 29.5.18. (Dedicated to the public.)

PHOSPHATIC and potash minerals are mixed with calcium chloride and sawdust, or other wood waste, and heated at a bright red heat.—J. H. J.

Fertiliser; Process of manufacturing —— [from blast-furnace flue-dust]. J. H. Connor, Sharpsburg, Pa. U.S. Pat. 1,283,677, 5.11.18. Appl., 23.9.14.

BLAST-FURNACE flue dust containing iron and potassium is mixed with "salt residue" and the mixture calcined to convert the potassium into a soluble form.—J. H. J.

Fertiliser, etc.; Process of making artificial ——. J. H. Connor, Pittsburgh, Pa. U.S. Pat. 1,283,678, 5.11.18. Appl., 27.4.16.

A TOBACCO product, bone calcium phosphate, and an alkaline reagent are digested in a vat under steam pressure; the liquid is drawn off and evaporated. The mixture may be made up also from a tobacco product, nitrogenous organic matter, flue dust, and an alkaline reagent.—J. H. J.

Fertiliser from sewage-sludge. U.S. Pats. 1,284,441 and 1,284,442. *See* XIXB.

XVII.—SUGARS; STARCHES; GUMS.

Starch glucose; Determination of —— in molasses by polarisation at 87° C. L. E. Johnson. Lab. Inland Rev. Dept., Ottawa, Bull. 407, 1918. Int. Sugar J., 1919, **21**, 40.

MIXTURES of pure cane molasses with increasing amounts of starch glucose were examined by polarising at 87° C. after inversion of the sucrose, an allowance being made for the dextro-rotation which molasses always exhibits at 87° C. after inversion, this being found to amount to +3·02° V. (average for 13 samples). The Leach method (U.S. Bureau of Chemistry, Bulletin 81, p. 73) was also tested, the calculation being made by the formula $\frac{(P-S)100}{175}$, in which P is the direct polarisation, and S the sucrose by double polarisation. It is concluded that approximate results may be obtained by the method of polarising at 87° C., but that the Leach method cannot be used when there are considerable amounts of invert sugar present, as is the case with cane molasses, some of the results obtained being as follows:

	Sample straight	5% Glucose added	10% Glucose added	20% Glucose added	30% Glucose added
Reading at 87° C. ...	+4·0	+7·84	+13·14	+30·56	+52·0
Calculated glucose ...	2·45	4·81	8·25	18·75	31·9
Calculated glucose, using Leach formula, polarising at 20° C....	—	—	4·38	15·26	26·38

—J. P. O.

Reducing sugars; Volumetric determination of ——. W. B. Clark. J. Amer. Chem. Soc., 1918, **40**, 1759—1772.

A MODIFICATION of Scales' method (this J., 1915, 1264) is described, the principal feature of which is that the reduced copper is estimated directly by titration in the same solution in which it was precipitated. Unlike Scales, who used Fehling's solution, the author uses a modified Benedict solution (this J., 1907, 1102; 1911, 439) and carries out all the operations in one vessel. A copper-citrate-carbonate solution is used containing 16 grms. of copper sulphate crystals, 150 grms. of sodium citrate crystals, 130 grms. of anhydrous sodium carbonate, and 10 grms. of sodium bicarbonate per litre. The reduction is carried out under conditions which must be standardised exactly, according to the amount of sugar to be estimated. The solution is heated to boiling in 4 mins., and the boiling continued another 2 mins. The reduced copper is dissolved by the addition of strong hydrochloric acid sufficient to give a distinct acid reaction, and oxidised by addition of a slight excess of 0·1 or 0·04*N* iodine solution. The excess of iodine is then titrated with standard 0·04*N* thiosulphate. The thiosulphate is standardised under the same standard conditions. The ratio of copper to reducing sugar is fairly constant, except for small quantities of sugar. The author considers it better for each worker to standardise his own conditions rather than to use tables drawn up for a set of conditions which he may not be able exactly to fulfil. Duplicate results carried out by this process differ by less than 0·25 mgrm. of reducing sugar, and four determinations can be made in an hour. Sucrose in amounts not exceeding 100 mgrms. per 10 c.c. and 50% ethyl alcohol has no reducing action on the citrate-carbonate solution, but 10% formaldehyde has a small reducing action.—E. H. R.

Aldopentoses; Crystallography and optical properties of three ——. E. T. Wherry. J. Amer. Chem. Soc., 1918, **40**, 1852—1858.

CRYSTALS of the three sugars α-*d*-lyxose, α-*d*-xylose, and β-*d*-arabinose have been carefully examined and it is found that the differences between their optical properties are sufficient to serve as a means of identification. A determinative table for this purpose is given. The sugar is immersed in an oily liquid with refractive index $n=1·53$ and examined in a refractometer in yellow light with the polarising nicol in and the diaphragm partly closed. With α-xylose, one refractive index is decidedly lower than that of the liquid; between crossed nicols colours of the 2nd or 3rd order are shown; and in convergent light interference figures are frequently observed. With α-lyxose, one index is about equal to that of the liquid; 1st or 2nd order colours are shown between crossed nicols; and interference figures are rarely observed in convergent light. With arabinose, all indices are decidedly higher than that of the liquid; 2nd order colours are mostly shown between crossed nicols; and interference figures are rarely observed in convergent light; the lowest index of α-arabinose is less and that of β-arabinose greater than 1·553. (See also J. Chem. Soc., 1919, **1**, 65.)—E. H. R.

Corn [maize] cobs; Preparation of several useful substances [gum, sugars, and acetic acid] from ——. F. B. La Forge and C. S. Hudson. J. Ind. Eng. Chem., 1918, **10**, 925—927.

THE disintegrated cobs are first heated with water at 140° C. under pressure; the aqueous extract, when evaporated, yields an adhesive gum (about 30% of the weight of the cobs). The extracted cobs are then heated with 1·75% sulphuric acid at 130° C.; the acid extract yields about 5% of acetic acid when distilled, and the residue, on concentration, gives 5% of crystallised xylose. The cellulose residue remaining after these treatments is treated with an equal weight of 75% sulphuric acid for 6 hrs., the mixture then diluted with water, boiled for 1 hr., neutralised with lime, filtered, and concentrated to obtain dextrose; the yield of the latter is about 37% of the weight of the dry cobs.—W. P. S.

Starch; Preparation of soluble ——. A. Leuller. J. Pharm. Chim., 1918, **18**, 291.

A MIXTURE of wheat, rice, or maize starch, 25, alcohol (95%), 100, and sulphuric acid, 5 grms., is boiled for 15 mins. under a reflux condenser; the starch is then collected on a filter and washed with water until free from acid. If it is desired to dry the starch rapidly, it may be washed with alcohol in place of water. The product is readily soluble in hot water and the solution gives a clear blue coloration with iodine.—W. P. S.

PATENTS.

Dextrin; Process of manufacturing ——. W. McLaurin, Brookfield, Mass. U.S. Pats. (A) 1,283,839 and (B) 1,284,120, 5.11.18. Appl., (A) 20.7.15 (renewed 27.4.18) and (B) 22.6.16.

(A) COMMERCIALLY pure starch is treated with an equal quantity of water and a quantity of acid materially less than 1% of the weight of the starch, in a closed vessel in which the mixture is subjected to the indirect action of steam at a temperature of about 280° F. (138° C.) and under a corresponding pressure, until the starch is uniformly converted into dextrin in the form of a colourless solution which is liquid at 60°—70° F. (15°—21° C.). (B) A clear, ready-dissolved dextrin solution of about 50% concentration, suitable without further treatment as a coating, adhesive, or impregnating material for paper, textiles, or the like, of uniform quality throughout, and containing less than 10% of sugar calculated on the weight of the dry product, is prepared from commercially pure starch, *e.g.*, as described under (A).
—J. F. B.

XVIII.—FERMENTATION INDUSTRIES.

Phosphoric acid; Volumetric determination of —— in brewing materials. W. Wöllmer. Z. ges. Brauw., 1918, **41**, 145—147.

DETAILED procedure is described for applying the method of titration with alkali, using two indicators (*cp.* Smith, this J., 1917, 415; Fiehe and Stegmuller, 1912, 943) to the determination of phosphoric acid in the ash of barley, malt, wort, or beer. The ash, after evaporation to dryness several times with hydrochloric acid on a water-bath, is dissolved in 1 c.c. of dilute hydrochloric acid and filtered. The filtrate and washings, which should occupy 20—30 c.c. and contain not more than 70 mgrms. PO_4, are treated with a drop of 0·1% methyl orange solution and exactly neutralised with sodium hydroxide, a concentrated solution of the latter being used except for the final adjustment. Thirty c.c. of 40% calcium chloride solution, exactly neutral to phenolphthalein, is then added, and the liquid is heated just to boiling, cooled to about 14° C., treated with 2 drops of 1% phenolphthalein solution and titrated, whilst being continuously agitated, with *N*/10 sodium hydroxide solution free from carbonate. After a red coloration has been attained the liquid is allowed to stand at 14° C.; the colour is slowly discharged and after 2 hours the titration is completed. The total volume of *N*/10 sodium hydroxide used is reduced by 1% to allow for traces of carbonate unavoidably present; 1 c.c. corresponds with 3·55 mgrms. P_2O_5. The method gives sufficiently accurate results with the materials named above, but is vitiated by the presence of considerable quantities of iron, alumina, manganese, or borates.
—J. H. L.

Malting and a new process for the reduction of malting loss. C. A. Nowak. Pure Products, 1918, **14**, 219—223. Bull. Agric. Intell., 1918, **9**, 1241—1242.

CLEANED barley is soaked in steeping vats and air is passed through the water, no lime being added. In hot weather, bleaching powder is added to give 0·034% of chlorine in the water. After steeping, the barley is spread on the floor and sprinkled with a 0·1—0·4% solution of phosphoric acid. After the acrospire has sprouted sufficiently, the malt is put on the kiln. The use of phosphoric acid has a stimulating effect on the grain, enabling the germination period to be shortened by 24 hrs. The process produces a malt which gives 1% more extract than ordinary malt and an increase in acidity of 0·018% of the total acid.—J. H. J.

Mashing process; The Plesch ——. G. Fries. Z. ges. Brauw., 1918, **41**, 73—75, 81—83.

THE author describes the working of this process, which is one of many mashing methods proposed during the war in Germany with a view to economising material, fuel, and time. It involves the following operations:—cold digestion of the finely ground malt overnight; withdrawal of a portion of the cold water extract for future use; peptonisation and saccharification of the mash; addition of hops (previously ground and digested with cold water) to the mash; boiling of the hopped mash; filtration of the hot mash; cooling of the filtered wort and saccharification of any starch therein by addition of the cold malt extract previously reserved; destruction of diastase by heating the saccharified wort to boiling. The wort is then cooled and fermented as usual. The author points out that, apart from the addition of hops to the mash, the process differs little from the Schmitz method of mashing (this J., 1898, 261). The results were fairly satisfactory; the wort deposited only a small quantity of sludge on the cooler but developed a slight turbidity which necessitated the use of a filter-press. The dark beer produced was of good quality, but the economies claimed on behalf of the process have been greatly exaggerated. It is claimed that if the malt is very finely ground the wort from the boiled mash will require no further saccharification, but the author considers that the continued production of such a fine grist is beyond the capacity of any known malt mills.
—J. H. L.

Mashes and worts; Colloidal transformations in the boiling of —— by direct flame and by steam. A. Reichard. Allg. Brauer- u. Hopfenzeit., 1918. Z. ges. Brauw., 1918, **41**, 141—143.

IN the boiling of brewery mashes and worts the temperature of the floor of the copper or other vessel is practically the same, about 120°—130° C.,

whether heating is effected by direct flame or steam jacket. The author describes experiments which confirm the view that these two methods of heating differ somewhat in their effects on the wort. Two series of laboratory mashings and wort boilings were carried out in metal beakers under similar conditions except that heating was effected in one case by direct flame and in the other by a water- or brine-bath. In mashing, the former method of heating, as compared with the latter, led to more rapid saccharification and brighter worts, and in some cases to higher sugar-content and acidity of the worts. In wort boiling also, heating by direct flame resulted in improved "break," higher wort acidities, and more complete emulsification of hop resins. To account for these differences the author suggests that, even where the two methods of heating produce the same temperature in the mash or wort, the direct flame provides a surplus of radiant energy which is expended as work in the modification of colloidal complexes, *viz.*, subdivision of particles of colloids such as hop resins and enzymes, thus promoting contact of the latter with their substrates.—J. H. L.

Nuclein-content of yeast; Determination of ——. C. A. Lubsen. Pharm. Weekblad, 1918, **55**, 1625—1628.

JEBBINK'S method of determining nucleins consists in hydrolysing the material by means of pepsin and hydrochloric acid, using a solution containing 0·20% HCl; the insoluble residue consists of the nuclein, which is estimated by means of a phosphorus determination. This method has been criticised by Grijns, who states that by long digestion with hydrochloric acid solution containing more than 0·1% HCl, the nucleins are partially dissolved, and therefore low results are obtained. The author has carried out experiments to test the validity of this criticism, using yeast, and finds that Jebbink's method gives accurate results even when solutions containing as much as 0·35% HCl are used. (See also J. Chem. Soc., Feb., 1919.)
—S. I. L.

Yeast; Dependence of maltase-activity on the state of development of ——. F. Schönfeld, H. Krumhaar, and M. Korn. Woch. Brau., 1918, **35**, 175—176. (See also this J., 1918, 161 A, 779 A.)

THE authors determined the maltase-activity of brewers' yeast taken from the vat at different stages of the primary fermentation. The maltase activity of the yeast was found to increase to more than twice its original value as the intensity of fermentation rose to its maximum, and to decline again at the close of fermentation It is suggested that yeast taken from the vats at the most vigorous stage of the primary fermentation might be added to beer at the commencement of storage to stimulate the secondary fermentation, since it possesses greater maltase- and zymase-activities than the yeast which normally remains in the beer on leaving the vats.—J. H. L.

Yeast; Influence of wort concentration on the biology of ——. H. Zikes. Allg. Z. Bierbr. u. Malzfabr., 1918, **46**, 21. Z. ges. Brauw., 1918, **41**, 135—136.

THE author enumerates the degenerative effects of cultivation of beer yeast in worts of very low gravity, e.g., 3°—5° Balling. The fermentative and reproductive functions are impaired. The cells become smaller and tend to assume abnormal forms (*cp.* Schönfeld and Goslich, this J., 1918, 779 A). The number of vacuoles and granules (fat globules) increases, and the formation of glycogen is less active than in strong worts. The Schlichting-Winther method of staining with methylene blue gives direct evidence of degeneration.—J. H. L.

Yeast from war beers; Dark colour of ——. H. Will. Z. ges. Brauw., 1918, **41**, 181—183.

THE yeast obtained in the production of thin war beers in Germany is often abnormally dark in colour. This is due to contamination with substances—coagulated protein and gluten particles—derived from the wort, which are found also, though in smaller amounts, on yeast from beers of normal gravity. The relatively large amounts found on war yeasts are mainly due to the fact that these substances separate from worts of low gravity in a very finely divided state and remain suspended for a long time, so that the worts on entering the fermentation vats still contain a considerable quantity which is ultimately deposited on the yeast cells.—J. H. L.

Beers; Carbon dioxide-content of thin ——. F. Schönfeld and C. Goslich. Woch. Brau., 1918, **35**, 167—168.

THE solubility of carbon dioxide in beer decreases by 0·01% for a rise of 1° C., and by 0·015% for a fall of 0·1 atm. pressure. It diminishes also with decrease in the content of sugars, dextrins, alcohol, and other constituents which contribute to the viscosity of beer, and is therefore lower for thin beers than for those of normal gravity. This difference may be compensated by storing thin beer under a relatively high pressure, but when the pressure is released there is apt to be a too copious evolution of gas from the beer. The retention of gas by beer is favoured by absence of suspended matters. In the carbonation of thin beers, the conditions most favourable to retention of the gas are low temperature, high pressure, intimate contact between liquid and gas, and subsequent storage of the beers for several days under a pressure of carbon dioxide.
—J. H. L.

Beer; Production of turbidity in thin —— by yeasts and bacteria after carbonation with oxygen-containing carbon dioxide. P. Lindner. Woch. Brau., 1918, **35**, 225.

IT is suggested that the frequent occurrence of turbidity in German war beers may be due to carbonation with carbon dioxide containing oxygen, which encourages the development of wild yeasts and bacteria.—J. H. L.

Beer; So-called carbolic odour of soured thin ——. W. Windisch. Woch. Brau., 1918, **35**, 240—241.

THE appearance of turbidity of biological origin in thin beers is often accompanied by a peculiar odour incorrectly described as "carbolic." It is probably due to reduction of nitrates present in the brewing water, by the bacteria responsible for the turbidity, and the liberation of free nitrous acid. Yeast washed and stored with water containing nitrates suffers in fermenting power, and such weakened yeast dies if stored in thin beer and acquires a somewhat nitrous odour. It is possible that the weakened yeast itself can reduce nitrates.
—J. H. L.

Food value of yeasts. Meyer. *See* XIXA.

PATENTS.

Sulphite-cellulose liquors. U.S. Pats. 1,284,739 and 1,284,740. *See* V.

Solvent. U.S. Pat. 1,283,183. *See* XX.

XIXA.—FOODS.

Wheat and mill products; Capacity of —— for moisture. W. L. Stockham. North Dakota Agric. Exp. Stat., Bull. No. 120, 97—131. Bull. Agric. Intell., 1918, **9**, 1242—1244.

WHEAT has a higher moisture capacity than any of its products; it absorbs 12·4%, whilst "patent" flour absorbs 11·31%, bran 11·17%, "first clear" flour 11·07%, and "second clear" flour 10·86%. The starch prepared from "patent" flour has also a greater moisture capacity than that prepared from "clear" flour. The capacity diminishes with increase of temperature; between 0° and 40° C. the saturation is only from one-third to one-half of the theoretical value, on account of secondary biochemical changes. Sprouting causes wheat to absorb water more rapidly, but the maximum reached is not so high. In the case of the various grades of flour, the absorption capacity varies inversely with the protein content. The effect of storage is to increase the moisture capacity of flour. Gluten absorbs 180% of moisture and retains practically a constant amount at temperatures below its decomposing point. Starch has its moisture capacity doubled by hydrolysis, whereas by dextrinisation it is decreased. The maximum staleness of bread occurs when the ratio of water present in the bread to the moisture capacity of the starch is least. The moisture capacity of the inner portion of a loaf indicates that all the starch is hydrolysed during baking; the moisture capacity of the crust is less, indicating some dextrinisation.—J. H. J.

Bread; Measurement of the acidity of ——. E. J. Cohn, P. H. Cathcart, and L. J. Henderson. J. Biol. Chem., 1918, **36**, 581—586.

THE acidity or hydrogen ion concentration of bread is determined by cutting a loaf cleanly and allowing 4 drops of a 0·02% solution of methyl red in 60% alcohol to fall upon a point near the centre of the loaf. After waiting 5 minutes the colour is compared with a colour chart which permits of the hydrogen ion concentration being read off with a considerable degree of accuracy. It is found that "ropiness" in bread, due to the growth of *B. mesentericus*, cannot develop unless the hydrogen ion concentration is below p_H=5.—H. W. B.

Milk; Determination of the fat-free residue of ——. N. Schoorl. Pharm. Weekblad, 1918, **55**, 1645—1664.

THE author gives an exhaustive account of the methods and formulæ used to determine the dried fat-free residue of milk, and discusses the theoretical basis of the simple formula of the type, $R_f = R - F = \frac{S}{a} + \frac{F}{b}$, in which R_f is the dry fat-free residue in grms. per 100 c.c., R the total residue, F the fat, S the excess of the specific gravity over 1·000, multiplied by 1000, and a and b constants depending on the specific gravity of the fat-free residue and of the fat. Constant additive terms may be included (as in the formulæ of Droop Richmond and van Herz) to make the formulæ agree better with determined values. The employment of the formulæ is considered in relation to the accuracy of the experimental methods. The accuracy of the ordinary determination of the sp. gr. of milk, for example, does not extend beyond the third decimal figure; a difference of 0·001 in the specific gravity corresponds to a difference of 0·25% in the calculated value for fat-free residue. In the direct determination of the residue, the various materials used for taking up the milk before evaporation give different results; sand is probably most suitable since it absorbs least moisture on exposure to air. The milk-residue itself absorbs moisture very readily, even whilst being weighed, and to allow for this, several weighings should be made at definite intervals, a curve plotted, and the true weight determined by extrapolation. In a series of experimental determinations of the dry residue of a sample, it was found that the possibility of error amounted to 0·5%. The results of direct determination of the residue are compared with the results obtained by the various formulæ, and it is showed that only when an exact definitive procedure is followed can uniform results be obtained. It is suggested that the simple formula of Mœslinger, $R_f = \frac{S+F}{4}$ should be employed, and a method of direct determination laid down to give results which shall agree with those obtained by calculation. The importance of the determination of the fat-free residue as a criterion is discussed, and the procedure of A. Mayer and Droop Richmond is recommended; the advantage of using the specific gravity of theoretically fat-free milk as a standard is pointed out.—S. I. L.

Milk; Reducing enzymes of ——. J. Perriraz. Arch. Sci. Phys. et Natur., 1918, **46**, 101—102. Bull. Agric. Intell., 1918, **9**, 1250—1251.

MILK was sampled at the byre and 10 c.c. was treated with ammonium nitrate and acetaldehyde and incubated at 60° C. for 1 hour. The serum was filtered off, and re-filtered after addition of basic lead acetate. The nitrite in the clear filtrate was titrated with standard sulphanilic acid and naphthylamine acetate. The results of these experiments showed that a very minute quantity of a reducing enzyme was present, depending upon the animal species, the age, and the food. At the beginning of milking the enzyme is almost absent, whilst towards the end it increases greatly. Boiling causes the enzyme to disappear completely, so that sterilised milk has lost a very important element in its digestibility.—J. H. J.

Curd and whey proteins; Method of differentiating ——. A. Beythien and P. Pannwitz. Z. Unters. Nahr. Genussm., 1918, **36**, 145—152.

THE method depends on the solubility of curd (casein), and on the practical insolubility of whey proteins, in calcium hydroxide solution; whey proteins, however, when made into cheese and ripened, yield a considerable quantity of soluble protein, and a preliminary treatment is necessary in order to remove these soluble proteins. From 5 to 6 grms. of the well-mixed sample, *e.g.*, cheese, is ground to a thin paste with water and heated at 40°—50° C. for 90 mins.; after cooling, the mixture is diluted to 200 c.c., filtered, and the nitrogen determined in the filtrate. This gives a measure of the degree of ripening. The insoluble portion on the filter is then washed with cold water, and pressed. The nitrogen is determined in a portion (1 to 2 grms.), whilst the remainder (3 to 4 grms.) is heated at 40°—50° C. with about 90 c.c. of saturated calcium hydroxide solution for 90 mins.; after cooling, the mixture is diluted to 100 c.c., filtered, and the nitrogen determined in the filtrate. If the whole of the nitrogen is soluble in calcium hydroxide solution, the sample consists of curd cheese; if only about 5%, or less, is soluble, the cheese was made from whey proteins.—W. P. S.

Potatoes; Solanin content of ——. A. Behre and H. Ehrecke. Chem.-Zeit., 1918, **42**, 593.

WHILST good-grade potatoes contain only traces of solanin and ordinary market potatoes a very small

quantity, potatoes which have turned green by exposure to air and sunlight may contain up to 0·019%; the solanin is concentrated in the green portions. Two kilos. of these green potatoes would contain a quantity (0·3 grm.) sufficient to produce poisonous effects.—W. P. S.

Banana flour and other flours from tropical starchy products. B. J. Eaton. Agric. Bull. Fed. Malay States, 1918, **6**, 430—436.

Banana flour has the following percentage composition: moisture, 9—12; fat, 0·32—0·44; protein, 3·0—4·8; fibre, 0·7—0·8; starch, 77—83; glucose, 0·9—1·8; ash, 1·8—2·3; phosphate (P_2O_5), 0·13—0·17. The protein content is thus very low. In the tropics the substitutes for wheat flour consist chiefly of flours prepared from cassava, yams, sweet potatoes, and sago. All of these consist essentially of starch with little or no protein. Banana flour is prepared by peeling the fruit, cutting it into slices, and exposing to the sun for 2—3 days. The dried slices are crushed in a mill and sifted through fine muslin. A banana crop removes 123 lb. of potash, 12·5 lb. of phosphate, and 43·7 lb. of nitrogen per acre from the soil, and in addition the stalks left on the ground contain 150 lb. of potash, 6 lb. of phosphate, and 41·4 lb. of nitrogen. In manuring, potash may be applied as sulphate, phosphate as basic slag or superphosphate, and nitrogen as dried blood or calcium nitrate.—J. H. J.

Brewers' yeasts; Food value of various — —, and the new so-called "mineral yeast." D. Meyer. Landw. Wochenschr. Sachsen, 1916 [45]. Bied. Zentr., 1918, **47**, 189—190.

The composition of three specimens of dried brewers' yeast was compared with that of the so-called mineral yeast prepared by Delbruck's process. The former contained 52·7% of crude protein and the latter 50·9% reckoned on an ash-free basis. The figures for pure "protein" were 38·6 and 37·2, and for non-nitrogenous substances, including fat and fibre, 27·9 and 25·1 respectively. The mineral yeast yields 18·3% of ash consisting chiefly of calcium phosphate, whilst brewers' yeast yields only 7·9% composed of alkali phosphates.
—H. W. B.

Proteins; Compounds derived from — by energetic treatment with nitric acid. VII. C. T. Mörner. Z. physiol. Chem., 1918, **103**, 80—83.

The suggestion of Knoop (Z. physiol. Chem., 1918, **101**, 210) that the acid substances discovered by Mörner (ibid., 1917, **101**, 15) amongst the oxidation products of protein were 5-nitroglyoxaline-4-carboxylic and glyoxaline-4-carboxylic acids has been found to be correct.—H. W. B.

Peanut, Arachis hypogæa; Proteins of the —. III. Hydrolysis of arachin. C. O. Johns and D. B. Jones. J. Biol. Chem., 1918, **36**, 491—500.

Arachin contains 16·7% of glutamic acid. It resembles kafirin (see this J., 1917, 155) in containing tryptophan, but no glycine. (See further J. Chem. Soc., Feb., 1919.)—H. W. B.

Baking powders; Analysis of phosphate —. L. Wolfrum and J. Pinnow. Z. Unters. Nahr. Genussm., 1918, **36**, 129—144.

The available carbon dioxide in baking powders having an acid phosphate as their acid ingredient is best determined by boiling the sample in a Geissler apparatus; the alkalinity of the mixture after reaction has taken place is not a measure of the excess of sodium bicarbonate present. This latter must be calculated from the total amount of sodium in the sample, after making allowance for that combined with chlorine, sulphuric acid, and available carbon dioxide.—W. P. S.

Rancidity of fats. Prescher. *See* XII.

Soya beans. Fellers. *See* XVI.

Substances from maize cobs. La Forge and Hudson. *See* XVII.

Nuclein in yeast. Lubsen. *See* XVIII.

Patents.

Potatoes; Preparing — for dehydration. M. F. Mangelsdorff, Union Hill, N.J., U.S.A. Eng. Pat. 121,405, 21.2.18. (Appl. 3145/18.)

Potatoes, with the skins and eyes removed, are sliced in a cutting machine and then passed through a horizontal cylindrical casing in which the slices are turned over and exposed to the action of steam for a few minutes so as partially to cook them. From the casing they are delivered into a tank of cold water where they are quickly cooled by being moved by a scoop round the tank and lifted gradually to a vertical exit pipe in the centre of the tank. From the exit pipe, they fall on to a perforated belt which conveys them to a dehydrating chamber.—J. H. J.

Semolina; Treatment of —. A. R. Goodwin, Kidderminster. Eng. Pat. 121,408, 4.3.18. (Appl. 3776/18.)

Wheaten semolina is submitted to the action of steam until it becomes slightly glutinous, care being taken that its granular nature is not destroyed. Flavouring essences in powder form are added to the steamed product, and the mixture is shaken, dried, and sifted.—D. W.

Bread-making composition. H. A. Kohman, Pittsburgh, Pa., C. Hoffman, New Rochelle, N.Y., and A. E. Blake, Pittsburgh, Pa., Assignors to Ward Baking Co., New York. U.S. Pats. (A) 1,282,867 and (B) 1,282,868, 29.10.18. Appl., 10.12.14.

(A) Ammonium chloride, either alone or with calcium sulphate, is mixed with flour or other starchy material, and the mixture is used along with yeast in the making of bread. (B) A small proportion of calcium sulphate is mixed with flour or other starchy material, and the mixture is used along with yeast in preparing a dough batch, whereby a still smaller proportion of the calcium salt is incorporated homogeneously in the dough.
—J. H. J.

Fruit-juices; Process for preserving —. H. C. Gore, Lakoma Park, Md. U.S. Pat. 1,284,187, 5.11.18. Appl., 17.7.15. (Dedicated to the public.)

Fruit-juice is filtered and treated with a suitable proportion of "absorbent black," which is then filtered off, and the filtrate is treated with infusorial earth and again filtered. The second filtrate is sterilised.—J. H. J.

Dehydrating vegetable substances. Eng. Pat. 121,394. *See* I.

XIXB.—WATER PURIFICATION; SANITATION.

Water; Adsorption of metals from drinking —— by glass. K. Scheringa. Pharm. Weekblad, 1919, *56*, 8—9.

It is shown that no diminution occurs in the proportion of metal in dilute solutions of salts after standing for two days in glass vessels which have previously been thoroughly cleansed. The diminution in the lead-content of drinking water on standing cannot therefore be due to adsorption, but must be attributed to chemical causes. (See also J. Chem. Soc., Feb., 1919.)—S. I. L.

Sunlight (total white light and partial or coloured lights); Bactericidal action of ——. M. de Laroquette. Ann. de l'Inst. Pasteur, 1918, **32**, 170—192. Bull. Agric. Intell., 1918, **9**, 1146—1148.

Experiments were made at Algiers in the summer of 1914 and the autumn of 1916. Coloured light was obtained by the use of coloured glass. Plants, bacteria, yeasts, and moulds were exposed under various conditions to the action of the sun's rays and it was found that sunlight was only bactericidal with prolonged or direct application, acting particularly on the surface of solid media and on air, in which positions organisms are more exposed to desiccation. In liquid media bacteria are destroyed only at shallow depths and under intense light. Diffused daylight is insufficient, and white light is much more active than any coloured light. Blue light is slightly more bactericidal than yellow, and yellow than red. The luminous part of the solar spectrum is more active than the ultra-violet and the infra-red. The heat of the rays has a certain influence, as cooling with ice during exposure delays the death of the organisms and the drying of the medium. The bactericidal power of the rays seems to be connected with their chemical action and especially their dehydrating action on solid media. The death of bacteria in sunlight appears to be due to too great an absorption of energy, of which the effect is dehydration and coagulation of the protoplasm; the rays with the shortest wave-lengths are the most active on the surface because they are the most largely absorbed by the bacteria and the medium. In practical hygiene in temperate regions, it would be useless to rely on the bactericidal action of sunlight, as it was found to have no effect at a depth exceeding a few millimetres and to be inhibited by thin layers of fat, muscle, and skin.—J. H. J.

Alkali hypochlorite solution. Phillibert. *See* VII.

Patents.

Sewage-sludge; Treatment of ——. Treatment of sewage-sludge and fertiliser produced thereby. J. W. Phillips, Assignor to A. R. Smart, Chicago, Ill. U.S. Pats. (A) 1,284,441 and (B) 1,284,442, 12.11.18. Appl., 10.4.16.

(A) Phosphoric acid is added to sewage sludge in excess of the quantity required to decompose the metallic soaps and carbonates, and the oily matter which separates is extracted. (B) In the preceding process, sulphuric acid is used as the acid and the mixture is neutralised with phosphate rock before extracting the oily matter.—J. H. J.

Water; Apparatus for purifying ——. C. F. Wallace and M. F. Tiernan, New York. U.S. Pat. 1,285,491, 19.11.18. Appl., 26.3.15.

See Eng. Pat. 113,106 of 1916; this J., 1918, 192 A.

Water; Apparatus for and process of treating liquids with gases or purifying ——. C. F. Wallace and M. F. Tiernan, New York. U.S. Pat. 1,285,492, 19.11.18. Appl., 26.3.15.

See Eng. Pat. 113,228 of 1916; this J., 1918, 192 A.

Valve; Back-pressure —— [for water-purifying apparatus]. C. F. Wallace, New York, and M. F. Tiernan, New Rochelle, N.Y. U.S. Pat. 1,285,493, 19.11.18. Appl., 11.11.16.

See Eng. Pat. 113,198 of 1916; this J., 1918, 192 A.

[*Water-purification;*] *Means for increasing the rate of solubility of gas in a liquid [for use in ——].* C. F. Wallace, New York, and M. F. Tiernan, New Rochelle, N.Y. U.S. Pat. 1,285,494, 19.11.18. Appl., 11.11.16.

See Eng. Pat. 113,374 of 1916; this J., 1918, 192 A.

Treating liquids with gases. Eng. Pat. 121,521. *See* I.

Applying gas to fluids. U.S. Pat. 1,285,496. *See* I.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Opium analysis. D. B. Dott. Pharm. J., 1918, **101**, 318.

In a recent communication by Annett and Singh (this J., 1918, 441 A) it was suggested that the presence of codeine prevents complete precipitation of morphine by the official method according to which the solution of calcium morphinate is decomposed by ammonium chloride. The author points out that whatever may be the solvent influence of codeine on morphine in aqueous solutions, the conditions of the assay process are entirely different, because sufficient ether is added to hold in solution all the codeine possibly present. The claim of Annett and Singh that a higher yield of morphine is obtained when the codeine and other substances are previously removed from the lime solution could not be confirmed. The author has repeated their experiments, using benzene instead of toluene. On shaking the lime solution with benzene a slight precipitate causes the production of a troublesome emulsion which however can be separated after filtering with the aid of the pump. The morphine precipitate obtained after this treatment weighs more and gives higher result by titration than that obtained by the official process, but it is obviously less pure and its alcoholic solution more highly coloured. When the two kinds of precipitate are washed side by side with 80% alcohol saturated with morphine, the preparation from the benzene process yields more soluble matter in the washings and gives a morphine result no higher and sometimes slightly lower than that prepared in the usual way. (See also this J., 1896, 91.)—J. F. B.

Berberine; Extraction of —— from "michai" (Barberis Darwinii) and "calafate" (B. buxifolia), in the Argentine. F. Richert. Rev. Centro Estud. Agron. y Vet. Univ. Buenos Aires, 1918, **11**, 11—13. Bull. Agric. Intell., 1918, **9**, 1194—1195.

In Patagonia the roots of "michai" and "calafate" are powdered and treated with hot water, whereby an aqueous solution of berberine is obtained which is used locally for dyeing mats. The dried powder of "michai" root yields 8·9% of

crystalline berberine after extraction with hot alcohol. In the case of "calafate," when the alcoholic extract is acidified with dilute nitric acid, 3·5—4·0% of crystalline berberine nitrate is obtained.—J. H. J.

Podophyllin [; Test for ——]. D. B. Dott. Pharm. J., 1918, **101**, 318—319.

The author has devised a test for distinguishing beween the resins of *Podophyllum peltatum* and *P. Emodi*, based on their respective solubilities in dilute ammonia. The resin of *P. Emodi* leaves at least twice as much insoluble matter as that of *P. peltatum*. The absolute amount of insoluble matter depends on the proportion of the dilute solution of ammonia used and the time of maceration. Convenient conditions for the test are as follow:—0·5 grm. of resin is treated with 5 c.c. of dilute ammonia and 5 c.c. of water, well mixed by stirring, filtered after 20 minutes, washed, and dried at about 100° C. If the resin has been prepared from the rhizome of *P. peltatum* the residue should not amount to more than 26%, while that from *P. Emodi* will show over 50%.—J. F. B.

Glycyrrhizin; Gravimetric determination of ——. A. Astruc and G. Pichard. J. Pharm. Chim., 1918, **18**, 289—290.

Three grms. of liquorice extract, dried previously at 100° C., is dissolved in 30 c.c. of water containing 5 drops of ammonia, the solution is filtered, and 20 c.c. of the filtrate is treated with 2·5 c.c of sulphuric acid; after 24 hrs., the precipitate is collected on a filter and washed with small quantities of water, using 30 c.c. in all. The precipitate is then dissolved in a few c.c. of ammonia and the filter washed with water containing 5 drops of ammonia per 10 c.c.; the solution is evaporated, the residue dried at 100° C. for 1 hr., and weighed. To the weight found is added 0·04 grm. to correct for the solubility of the glycyrrhizic acid in the wash water.—W. P. S.

Nitroso-β-naphthol; Estimation of ——. P. Nicolardot and L. Valli-Douau. Bull. Soc. Chim., 1918, **23**, 455—459.

Two grms. of the material, dried at 35° C., is shaken with 120 c.c. of acetone and after ½ hour the volume is made up to 200 c.c. with water. Of this solution, 100 c.c. is titrated with a 1·5% solution of iron alum; after the precipitate formed flocculates, the iron alum is added slowly and the end-point is ascertained by spot tests with ammonium thiocyanate. The iron alum solution is standardised against pure nitroso-β-naphthol. For a more exact estimation an excess of iron alum is added, the precipitate is allowed to settle over-night, filtered off, washed with cold water until free from iron salts, and then dried at 70° C. and weighed. The factor for converting the weight of precipitate into weight of nitroso-β-naphthol is 0·907.—W. G.

Patents.

Synthetic drugs [ephedrine]. E. C. R. Marks, London. From N. Nagai, Tokyo-fu, Japan. Eng. Pat. 120,936, 13.7.17. (Appl. 10,184/17.)

Synthetic racemic N-methylmydriatin (phenylmethylaminopropanol), resembling the alkaloid ephedrine from the Chinese plant *Ephedra vulgaris*, and having the formula $C_6H_5.CH(OH).CH(NHCH_3).CH_3$, is prepared by reducing phenylnitropropanol in the presence of a solution of formaldehyde. Benzaldehyde and nitroethane are agitated together at the ordinary temperature for several hours in the presence of a small quantity of a solution of a weakly basic substance; the resulting phenylnitropropanol is separated by means of ether in the presence of aqueous sodium bisulphite, and is then dissolved in dilute alcohol, treated with formaldehyde in molecular proportion, reduced at a low temperature by zinc dust and dilute acetic acid, and the zinc is removed by hydrogen sulphide. The acetate of the base thus obtained may then be converted into the hydrochloride, which is recrystallised from alcohol.—J. F. B.

Solvent [butyrone] and process of producing the same. H. Hibbert, Pittsburgh, Pa. U.S. Pat. 1,283,183, 29.10.18. Appl., 27.10.15. Renewed, 19.3.18.

A solvent for nitrocellulose and other cellulose esters, composed largely of butyrone, is prepared by fermenting carbohydrates to form a mixture of acids comprising a large amount of butyric acid. The acids are converted into a mixture of the corresponding ketones, the mixture having b.pt. 110°—160° C., mainly 120°—145° C., and sp. gr. about 0·8; it distils readily with steam and is immiscible with water. If desired, the mixture of ketones may be submitted to hydrogenation and the product acetylated.—J. F. B.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Gum bichromate process with a new colloid. H. S. Starnes Phot. J., 1918, **58**, 287—293.

In the gum bichromate process as usually worked there is uncertainty as to exposure, the actinometer readings being unreliable. It is suggested that this is due to the action of light being in two stages; in the first stage the gum-bichromate film is rendered somewhat more easily soluble, in the second stage the usual insolubilising occurs; the relationship between the two stages depends on the colloid. The best results were obtained by using gum senegal in preference to gum arabic and a sensitising solution containing sodium bichromate, alum, and hydrochloric acid, a very thin coating being given. An acid alum solution was used for development, followed by local treatment with a fine stream of water.—B. V. S.

[Photographic] developers; Causes of variation in the Watkins factor for different ——. J. C. Kingdon. Phot. J., 1918, **58**, 270—280.

It is shown that the variations in rates of diffusion of different developers are insufficient to account for the variations that occur in the Watkins factors—*i.e.*, the numbers by which the times of appearance of the image must be multiplied to get total times of development. Rates of diffusion were observed in tubes of gelatin jelly, using strips of bromide paper as indicators; as the developer progressed up the tube the portion of the paper showing complete development was preceded by a band, generally red, of partial development, which band was wider for high-factor developers than for low-factor developers. It is suggested that there is for any developer a critical concentration, dependent on its molecular stability, which is the chief factor in determining time of appearance of the image—the lower the critical concentration the shorter the time of appearance; as rates of diffusion are very similar for different developers, total times of development are very similar and the Watkins factors are therefore smaller for longer times of appearance.—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

PATENTS.

Waste acid liquors [from manufacture of explosives]; Concentration or evaporation of ——. J. N. Brooke, Halifax. Eng. Pat. 120,951, 8.11.17. (Appl. 16,355/17.)

WASTE acid liquors containing nitric acid, from the manufacture of picric acid or like explosives, are passed at atmospheric pressure through a succession of earthenware or vitreous enamelled vessels, and are heated by means of ordinary or superheated steam circulating through coils or the jacketed walls of the vessels or both. The concentrated acid overflows through a pipe into the next vessel or into a trough.—C. A. M.

Nitro compounds. U.S. Pat. 1,283,617. *See* III.

Wood pulp for nitrating. U.S Pats. 1,283,113 and 1,283,114. *See* V.

Solvent [for nitrocellulose]. U.S. Pat. 1,283,183. *See* XX.

XXIII.—ANALYSIS.

Arsenic; Estimation of minute quantities of ——. O. Billeter. Helv. Chim Acta, 1918, 1, 475—498. (Compare this J., 1915, 199.)

THE estimation of arsenic in organic substances is effected in the following manner. The organic matter is destroyed by treatment with nitric acid and concentrated sulphuric acid. In the case of urine, the sample is preferably made alkaline with sodium carbonate and concentrated to a syrup; for each 100 c.c. of urine, potassium perchlorate (2 grms.) and potassium sulphate (4 grms.) are added; the mixture is dried at 120° C., and introduced in small portions at a time into a platinum crucible heated to dull redness; when the action has subsided, the mass is heated to tranquil fusion. The arsenic is then separated from other metals by distillation with a mixture of sodium chloride (2 grms.) and potassium bromide (0·2 grm.) for each 20 c.c. of sulphuric acid used or, if the destruction of organic matter has been effected with potassium perchlorate, by treatment with potassium bromide (0·1—0·2 grm.) and sulphuric acid (90%, 6 c.c.). Mercury is completely retained by one distillation, but, if antimony is present, it is necessary to re-distil after addition of 5—6 grms. of sulphuric acid (90%). Hydrochloric acid is eliminated from the distillate by treatment with hypochlorous acid, and the solution is evaporated to dryness. The residue is dissolved in 1 c.c. of sulphuric acid (12%) and evaporated on the water bath to destroy any chloric acid present, and after addition of water (0·85 c.c.) it is transferred to a Marsh apparatus. By this method 0·01 mmgrm. of arsenic may be detected. Detailed instructions are given for the preparation of the reagents in the requisite degree of purity. (See also J. Chem. Soc., 1919, ii, 32.)—H. W.

Calorimetric lag. W. P. White. J. Amer. Chem. Soc., 1918, **40**, 1858—1872.

A GENERAL and mathematical discussion of thermal lag effects, particularly in the case of bodies external to the calorimeter. The principal effect of such lag is equivalent to a change in the heat capacity of the calorimeter. A thin metal shield midway between calorimeter and jacket has an effective heat capacity only one-quarter its actual capacity. Such a shield can often be used advantageously to reduce thermal leakage, and is specially useful as a cover to prevent evaporation. (See also J. Chem. Soc., Feb., 1919.)—E. H. R.

Calorimetric precision; Conditions of ——. W. P. White. J. Amer. Chem. Soc., 1918, **40**, 1872—1886.

MOST calorimetric errors come in the determination of the thermal leakage or cooling correction. The usual practice of diminishing the thermal head (difference of temperature between calorimeter and environment) is not so important as diminishing the thermal leakiness of the calorimeter. The errors due to lags can be largely eliminated. Stirring must be as regular as possible, as the heat produced by stirring varies as the cube of the speed. The type of stirrer used and design of the calorimeter with reference to stirring are important. (See also J. Chem. Soc., Feb., 1919.)
—E. H. R.

Calorimetric methods and devices. W. P. White. J. Amer. Chem. Soc., 1918, **40**, 1887—1898.

THE general rules for calorimetric precision are applied to the consideration of jacket covers and stirrers, and special devices such as vacuum-jacketed vessels, the adiabatic method, aneroid or dry calorimeters, double or differential calorimeters, and the measured-shield calorimeter, a new device in which a thin metal shield is placed between the jacket and calorimeter, and connected to the jacket wall by thermo-elements which are used to measure the thermal head. The advantages of the different types of calorimeter are compared.—E. H. R.

Gases; Quantitative analysis of small quantities of ——. H. M. Ryder. J. Amer. Chem. Soc., 1918, **40**, 1656—1662.

A SOMEWHAT complicated apparatus is described by means of which a quantitative analysis of 5 cub. mm.—1 c.c. of a gaseous mixture of water vapour, carbon dioxide, carbon monoxide, oxygen, hydrogen, nitrogen, and methane may be carried out with an accuracy of about 5% for each constituent.
—J. F. S.

Density of gases; An accurate method for measuring the ——. O. Maass and J. Russell. J. Amer. Chem. Soc., 1918, **40**, 1847—1852.

THE principle of the method, which is applicable to gases which can be condensed in liquid air or some other refrigerating agent, is as follows. A large evacuated glass bulb of known volume is filled with the gas and the pressure and temperature are recorded. The bulb is then connected to a small evacuated bulb immersed in liquid air, the gas condensing in the bulb, which is sealed off and weighed, and again weighed after being broken open and emptied. The weight of the gas is thus determined, the volume being obtained from the volume of the large bulb less that of the gas left behind after the bulb has been sealed off. By this method the following densities were determined: acetylene, 1·1695; methyl ether, 2·1103; hydrogen bromide, 3·6397. (See also J. Chem. Soc., Feb., 1919.)—E. H. R.

Zirconium phosphate; Precipitation of ——. G. Steiger. J. Wash. Acad. Sci., 1918, **8**, 637—639.

IN the case of average rocks containing only small amounts of zirconium results of sufficient accuracy may be obtained without special precautions by

assuming that the ignited precipitate of zirconium phosphate has the composition ZrP_2O_7, but in determining larger quantities of zirconium the influence of the acidity of the solution on the composition of the precipitate is important. The solution is oxidised with hydrogen peroxide to prevent the precipitation of titanium, and treated with 3 to 5% of sulphuric acid, and the zirconium precipitated with constant stirring by means of microcosmic salt. After standing overnight the precipitate is separated, washed, ignited, and weighed. The acidity of the solution prevents the simultaneous precipitation of iron and titanium; phosphates of other metals, except those of the rare earths, are readily soluble, and may be separated from the acid filtrate. (See also J. Chem. Soc., Feb., 1919.)—C. A. M.

Heavy and middle tar oils. Weiss. *See* III.

Benzols and light oil. Weiss. *See* III.

Phenol and cresols. Dawson and Mountford. *See* III.

Alkali hypochlorite solution. Philibert. *See* VII.

Hypophosphites and phosphites. Boyer and Bauzil. *See* VII.

Rancidity of fats. Prescher. *See* XII

Estimating metastable rubber Dubosc. *See* XIV.

Tanning materials. Griffith. *See* XV.

Chrome tanning liquors. Smith and Emna. *See* XV.

Chrome tanning liquors. Harvey. *See* XV.

Sulphide in lime liquors. Hayes. *See* XV.

Glucose in molasses. Johnson. *See* XVII.

Reducing sugars. Clark. *See* XVII.

Idopentoses. Wherry. *See* XVII.

Soluble starch. Leulier. *See* XVII.

Phosphoric acid in brewing materials. Wöllmer. *See* XVIII.

Nuclein in yeast. Lubsen. *See* XVIII.

Acidity of bread. Cohn and others. *See* XIXA.

Fat-free residue of milk. Levy. *See* XIXA.

Curd and whey proteins. Beythien and Pannwitz. *See* XIXA.

Baking powders. Wolfrum and Pinnow. *See* XIXA.

Opium analysis. Dott. *See* XX.

Podophyllin. Dott. *See* XX.

Glycyrrhizin. Astruc and Pichard. *See* XX.

Nitroso-β-naphthol. Nicolardot and Valli-Douau. *See* XX.

PATENTS.

Pyrometry; Apparatus for optical ——. I. B. Smith, Ambler, Pa., Assignor to Leeds and Northrup Co., Philadelphia, Pa. U.S. Pat. 1,282,967, 29.10.18. Appl., 6.3.18.

AN optical pyrometer comprises a frame carrying at one end a tube with closed end (serving as a black body), which is presented to the object of which the temperature is to be measured, and at the other end an optical system including an incandescence lamp, which may be adjusted so that its axis coincides with that of the tube. The frame is provided with a transverse handle through which electrical connecting wires may be passed.
—W. F. F.

Hardness; Apparatus for testing ——. F. J. Tone, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,283,362, 29.10.18. Appl., 7.5.15.

THE test piece of material is cut by a revolving tool which is pressed upon it by a constant load. The tool is revolved through a measured peripheral distance, and the torque required is also measured. The hardness is estimated from the measured depth of penetration of the tool.—W. F. F.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Corner. Apparatus for evaporating, concentrating, or distilling liquids or solutions. 1504. Jan. 21.

Cruse. Pulverising materials and collecting and grading pulverised materials. 1316. Jan. 18.

Farrell. 1076. *See* V.

Fidler. Conversion of round downdraft and updraught intermittent type kilns to annular continuous kilns. 1524, 1525, 1526. Jan. 21.

Hocking. Fluid condensing, cooling, and heating apparatus. 1353. Jan. 20

Kestner. Centrifugal pumps for acids etc. 1101. Jan. 15. (Fr., 10.12.17.)

Marks (Smith). Refrigerating and ice-making plants. 1439. Jan. 20.

Marshall. Condenser. 1122. Jan. 15.

Rennie and Rennie. Manufacture of crucibles. 1035. Jan. 15.

Rennison. 1308. *See* II.

Stockel. Refrigerating machines. 1821. Jan. 24.

COMPLETE SPECIFICATIONS ACCEPTED.

530 (1918). Hinds, Stinchecombe, and Chemical Engineering and Wilton's Patent Furnace Co. Furnaces. (122,232.) Jan. 29.

3784 (1918). Brackett and Co., and Brackett. Screening or filtering apparatus. (122,311.) Jan. 29.

4444 (1918). Hutchins. Drying and like apparatus. (122,077.) Jan. 22.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Abrahams and Bamber. Gas-producers. 901. Jan. 13.

Bellby and Bellby. Manufacture of reducing gases from carbonaceous materials. 1784. Jan. 24.

Brighten. Purifying producer gas for heating purposes. 1808. Jan. 25.

Carpenter, and South Metropolitan Gas Co. Purification of coal etc. gas. 1649. Jan. 22.

Cossor. 1716. *See* XXIII.

Davidson and Liversedge. Gas-cleaning apparatus. 1267. Jan. 17.

Greenwood and Zealley. 890. *See* XXIII.

Pearson. Treatment of shale etc. 1167. Jan. 16.

Perry. Apparatus for distilling carbonaceous material. 1425, 1426. Jan. 20.

Raiger and Co., Raines, and Younger. Preparation for saving coal. 1361. Jan. 20.

Rennison. Gas-fired oven furnaces. 1308. Jan. 18.

Russell Apparatus for drying, revivifying, and decarbonising bone black etc. 1146. Jan. 16.

Sutton. Destructive distillation of coal etc. 1153. Jan. 16.

COMPLETE SPECIFICATIONS ACCEPTED.

14,317 (1917). Drakes, Ltd., and Drake. Retorts and apparatus for use in making gas. (121,975.) Jan. 22.

16,978 (1917). Ekelund. Pulverised fuel. (122,214.) Jan. 29.

1274 (1918). Pieters. Coke ovens and the like. (113,782.) Jan. 29.

4589 (1918). Pickard and Dobson. Combustible gases. (122,079.) Jan. 22.

17,693 (1918). Smith. Briquets, and method of making the same. (120,585.) Jan. 22.

III.—TAR AND TAR PRODUCTS.

APPLICATION.

Barrett Co. Process of hydrocarbon sulphonation. 2494. Jan. 31. (U.S., 13.5.18.)

South Metropolitan Gas Co., and Stanier. 1338. *See* XX.

IV.—COLOURING MATTERS AND DYES.

COMPLETE SPECIFICATION ACCEPTED.

1633 (1918). Ges. f. Chem. Industrie in Basel. Manufacture of chlorinated derivatives of N-dihydro-1.2.2′.1′-anthraquinoneazine. (113,783.) Jan. 29.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Farrell. Textile etc. drying cylinders. 1876. Jan. 25.

Frood. Material prepared from fibres. 1593. Jan. 22.

Jackson (West Virginia Pulp and Paper Co.). Treatmentof waste soda liquors produced in chemical processes of making paper pulp. 1570. Jan. 21.

Johnson (Philadelphia Textile Machinery Co.). Drying or steaming etc. apparatus wherein materials are subjected to the action of gases or vapours. 1415. Jan. 20.

McEwen. Treatment of flax etc. 1871. Jan. 25.

Marks (Dunnicliff). Production of waterproof paper or like cellulosic material. 891. Jan. 13.

Poulson. Treatment of wool. 2055. Jan. 28.

Smith. 1923. *See* XIX.

Suursalmi, and Kangas Pappersbruks Aktiebolaget. Manufacture of paper. 2593. Feb. 1. (Sweden, 4.4.17.)

COMPLETE SPECIFICATIONS ACCEPTED.

1181 (1918). Marks (Du Pont de Nemours and Co.). Solvents used in connection with pyroxylin compositions and the pyroxylin compositions containing the same. (122,456.) Feb. 5.

3139 (1918). Ogawa, Okubo, and Murata. Production of zinc chloride solution of cellulose. (122,527.) Feb. 5.

9026 (1918). Thames Paper Co., and Privett. Apparatus for drying paper, paper-board, and like material in the course of manufacture. (122,352.) Jan. 29.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATION.

Stanworth. Dyeing yarns for weaving. 1466. Jan. 20.

COMPLETE SPECIFICATIONS ACCEPTED.

18,011 and 18,933 (1917). Jackson. Cloth dyeing, bleaching, and like machines. (121,987.) Jan. 22.

279 (1918). Kershaw and Cole. Machines for dyeing, mordanting, bleaching, scouring, or similarly treating slubbing, yarn, or other fibrous material. (122,227.) Jan. 29.

846 (1918). Thornber and Henshilwood. Machines for bleaching, dyeing, finishing, and otherwise treating fabrics. (122,241.) Jan. 29.

3233 and 3234 (1918). Dudley. Dyeing-machines. (114,621 and 114,421.) Feb. 5.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Ashcroft. Treatment of hydrated magnesium chloride for obtaining magnesium metal and by-products. 2503. Jan. 31.

Evans, Hollings, and South Metropolitan Gas Co. Manufacture of ammonium sulphate. 1427. Jan. 20.

Howorth (Norsk Hydro-Elektrisk Kvaelstofaktieselskab.). Concentration of sulphuric acid. 1637. Jan. 22.

Jackson (West Virginia Pulp and Paper Co.). 1570. *See* V.

Jones and Pearson. Oxidising phosphine. 1442. Jan. 20.

Joshua, Lowe, and Parsons. Manufacture of permanganates. 1646. Jan. 22.

Kestner. 1101. *See* I.

Lessing and Linder. Manufacture of sulphate of ammonia. 1313. Jan. 18.

Matheson. Recovery of waste acids. 1730. Jan. 23.

Parrish, Valon, and South Metropolitan Gas Co. Manufacture of neutral sulphate of ammonia. 1744. Jan. 23.

Rumbold. 2132. *See* X.

Weight, and South Metropolitan Gas Co. Manufacture of sulphate of ammonia. 1428. Jan. 20.

COMPLETE SPECIFICATIONS ACCEPTED.

16,147 (1917). Place. Liquefaction of air and separating the same into oxygen and nitrogen. (122.212.) Jan. 29.

815 (1918). Hill and Eden. *See* XVI.

1149 (1918). Twynam. Recovery of potash salts in the manufacture of pig iron. (122,048.) Jan. 22.

1390 (1918). Ekeley and Stoddard. Extraction of tungstic acid and acids of certain other heavy acid-forming elements and salts thereof. (122,051.) Jan. 22.

1391 (1918). Ekeley and Stoddard. Process for obtaining pure tungstates. (122,264.) Jan. 29.

2078 (1918). Norske Aktieselskab for Elektrokemisk Industri. Production of aluminium compounds poor in iron. (113,278.) Jan. 29.

2611 (1918). Pope. Manufacture of sulphuryl chloride. (122,516.) Feb. 5.

3057 (1918). Lindblad. Production of nitrides. (122,523.) Feb. 5.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Carborundum Co. Manufacture of refractory articles. 927. Jan. 13. (U.S., 27.9.18.)

Ionides. 2470. *See* IX.

James. Manufacture of earthenware. 949. Jan. 14.

COMPLETE SPECIFICATIONS ACCEPTED.

3707 (1918). Carborundum Co. (Urtel). Methods of making abrasive articles. (122,533.) Feb. 5.

5715 (1918). Mississippi Glass Co. Light-refracting glass. (118,269.) Jan. 29.

19,370 (1918). Sankey and Foster. Manufacture of silica bricks, tiles, and other articles. (122,388.) Jan. 29.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Boillot and Daudignac. Manufacturing cement. 1113. Jan. 15.

Cafferata and Johnson. Manufacture of slabs, plates, etc. of plaster etc. 1105. Jan. 15.

Hobson. Materials for making roads, footpaths, etc. 1700. Jan. 23.

Ionides. Heat treatment of bricks, pottery, etc. 2470. Jan. 31.

COMPLETE SPECIFICATION ACCEPTED.

4752 (1918). Afford. Artificial stone. (122,546.) Feb. 5.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Ashcroft. 2503. *See* VII.

Bolton. Electroplating. 1271. Jan. 17.

Coles. Recovery of iron from scrap tinned steel. 1861. Jan. 25.

Coles. Electrodeposition of iron alloys. 1862. Jan. 25.

District Chemical Co., and Hoblyn. Mixtures for carburising steel during case-hardening. 1456. Jan. 20.

Gingell and Muntz. Casting metals. 1356, 1483. Jan. 20 and 21.

Goldthorpe. Ore-roasting furnaces. 1401. Jan. 20.

Jones. Furnaces for heating metal etc. without oxidation. 1410. Jan. 20.

Rumbold. Recovery of lead and tin as metals from the solution of chloride of lead and chloride or sulphate of tin etc. 2132. Jan. 28.

Smith. Art of desulphurising ores, and roasting-furnaces therefor. 1060. Jan. 15.

Sulman. Metallurgical furnaces. 2493. Jan. 31.

Thomas. Manufacture of tin and terne plates etc. 1490. Jan. 21.

Weyman. Apparatus for cooling blast-furnace gases. 1150, 1261. Jan. 16 and 17.

COMPLETE SPECIFICATIONS ACCEPTED.

17,494 (1917). Sanders. Obtaining by-products from the waste flux of galvanising or equivalent processes. (121,984.) Jan. 22.

526 (1918). Pettevil. Welding different metals to form a composite ingot. (122,231.) Jan. 29.

577 (1918). Rogers, Lancaster, Walker, and Jackson. Treatment of tinned scrap. (122,025.) Jan. 22.

920 (1918). Fletcher. Puddling of iron. (122,244.) Jan. 29.

1149 (1918). Twynam. *See* VII.

4545 (1918). Gayley. Methods and apparatus for sintering ores. (115,023.) Jan. 22.

6193 (1918). Marks (United States Nickel Co.). Separation of nickel from nickel-copper mattes. (122,335.) Jan. 29.

7025 (1918). Crocker and Crocker. Increasing the production of zinc dust from spelter retorts. (122,566.) Feb. 5.

10,519 (1918). Eaton. Etching steel or other plates. (122,358.) Jan. 29.

12,583 (1918). Pittevil. Welding different metals to form a composite ingot. (122,365.) Jan. 29.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Bolton. 1271. *See* X.

Coles. 1862. *See* X

Debauge. Electrolytic processes. 2369. Jan. 30. (Fr., 30.1.18.)

Debauge. Electrolytic apparatus. 2370. Jan. 30. (Fr., 30.1.18.)

Matheson. Electrolytic cells. 1731. Jan. 23.

Matheson and Kaelin. Electrolytic cells. 1732. Jan. 23.

Naylor and Tyler. Electric batteries. 1071. Jan. 15.

Soc. Electro-Métallurgique Française. Electric furnaces. 1650. Jan. 22. (Fr., 11.2.18.)

Travis, and Watson and Co. Resisters for electric furnaces. 1123. Jan. 16.

COMPLETE SPECIFICATIONS ACCEPTED.

729 (1918). Kayser and Robinson. Electrode holders for electric furnaces. (122,034.) Jan. 22.

839 (1918). Connolly and Ellison. Electric batteries. (122,240.) Jan. 29.

933 (1918). Bayeux and Richard. Ozonising apparatus. (113,606.) Jan. 29.

1896 (1918). White (Industrial Electric Furnace Co.). Electric furnaces. (122,282.) Jan. 29.

15,587 (1918). Stewart. Electrodes or plates for electric accumulators of the alkaline type. (122,380.) Jan. 29.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

De Raedt. Apparatus for extracting oils, fats, sugar, etc. 1849. Jan. 24.

Spensley. Manufacture of dry soaps. 1890. Jan. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

18,335 (1917). Bevan. Treatment of fatty acids to render them suitable for use as oil-mediums for paint and other purposes. (121,992.) Jan. 22.

44 (1918). Blogg. Oxidation and polymerisation of vegetable oils. (122,224.) Jan. 29.

505 (1918). Wilkins and Co., and Allsebrook. *See* XIII.

12,254 (1918). Gaudart. Extraction of coconut butter. (117,819.) Jan. 29.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Goldthorpe. Paints, and method of making same. 1462. Jan. 20.

Govan. Ink manufacture. 1462. Jan. 20.

Griffith. 1676. *See* XIV.

COMPLETE SPECIFICATIONS ACCEPTED.

18,335 (1917). Bevan. *See* XII.

505 (1918). Wilkins and Co., and Allsebrook. Manufacture of linseed oil substitutes suitable as mediums for the manufacture of paints, vehicles, linoleum, etc. (122,015.) Jan. 22.

604 (1918). Wade (Redmanol Chemical Products Co.). Phenolic condensation product varnishes. (122,027.) Jan. 22.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATIONS.

Griffith. Vulcanising pigments etc. 1676. Jan. 23.

Van Hasselt. Process for vulcanising rubber with aid of an accelerator. 1008. Jan. 14. (Holland, 8.5.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

980 (1918). Dunlop Rubber Co., and Twiss. Method and apparatus for reclaiming rubber. (122,249.) Jan. 29.

3783 (1918). Broomfield. Manufacture of a rubber compound. (112,310.) Jan 29.

XV.—LEATHER; BONE; HORN; GLUE.

COMPLETE SPECIFICATION ACCEPTED.

1990 (1918). Haley and Co., and Bolton. Machines for treating hides, skins, and leather. (122,505.) Feb. 5.

4837 (1918). McCay. Manufacture of leather. (122,084.) Jan. 22.

XVI.—SOILS; FERTILISERS.

COMPLETE SPECIFICATION ACCEPTED.

815 (1918). Hill and Eden. Apparatus for use in making superphosphate. (122,039.) Jan. 22.

XVII.—SUGARS; STARCHES; GUMS.

APPLICATIONS.

De Raedt. 1849. *See* XII.

Durham. Handling and storing of sugar cane in sugar factories. 1894. Jan. 25.

Russell. 1146. *See* II.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATION.

Robinson. Preservation of yeast. 1845. Jan. 24.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Hartley and Hartley. Purification of sewage. 1604. Jan. 22.

Marks (Mortensen). Milk etc. separators. 1909. Jan. 25.

Pape. Preserving organic materials. 1837. Jan. 24.

Powrie. Food product, and process of making same. 1141. Jan. 16.

Smith. Apparatus for separating sewage, paper pulp, etc. from liquids. 1923. Jan. 25.

Wauguier et Cie. Desiccation of potatoes etc. 1083. Jan. 15. (Fr., 15.1.18.)

Weddle. Utilisation of animal and vegetable matters. 1885. Jan. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

380 (1918). Stevens and Dunlap. Preparing and preserving food preparations consisting of cereals and milk. (115,618.) Jan. 22.

7094 (1918). De Grousseau and Viconge. Treatment of cocoa and the waste products of chocolate manufacture. (116,694.) Jan. 29.

15,699 (1918). Manuel. Preserving fish, fowl, and flesh. (122,154.) Jan. 22.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Atack and Haworth. Manufacture of aromatic alkylamino compounds. 1600. Jan. 22.

Barrett Co. 2194. *See* III.

Jackson (Citro Chemical Co.). Manufacture of organic acids. 2376. Jan. 30.

Matheson. Manufacture of acetone. 1729. Jan. 23.

South Metropolitan Gas Co., and Stanier. Manufacture of colourless organic compounds. 1338. Jan. 18.

COMPLETE SPECIFICATION ACCEPTED.

1796 (1918). Haworth and Irvine. Preparation of dimethyl sulphate. (122,498.) Feb. 5.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

COMPLETE SPECIFICATION ACCEPTED.

2911 (1918). Hess-Ives Corporation. Colour photography. (113,618.) Feb. 5.

XXII.—EXPLOSIVES; MATCHES.

COMPLETE SPECIFICATION ACCEPTED.

1181 (1918). Marks (Du Pont de Nemours and Co.). *See* V.

XXIII.—ANALYSIS.

APPLICATIONS.

Cossor. Apparatus for ascertaining composition of furnace gases. 1716. Jan. 23.

Greenwood and Zealley. Apparatus for detecting and/or recording small quantities of a combustible gas in gaseous mixtures etc. 890. Jan. 18.

I.—GENERAL; PLANT; MACHINERY.

Heat insulation and lagging materials. J. S. F. Gard. Nat. Assoc. Ind. Chem., Jan. 11, 1919. Chem. Trade J., 1919, **64**, 47.

THE most efficient lagging for boilers, steam-pipes and engines is "magnesia covering" composed of hydrated magnesium carbonate 85%, and asbestos fibre 15%; it has a density of 12-15 lb. per cub. ft. and will retain 85-87% of the heat which would escape from an uncovered pipe. Silicate cotton or slag wool is an efficient lagging material, but when subjected to vibration it is reduced to half its original volume. None of the various asbestos materials is as efficient as magnesia. Various plastic compounds containing kieselguhr, felt, clay, lime, etc., are also used for lagging purposes. Furnace settings are chiefly lagged with very light, porous silica bricks having a honeycomb structure, and a density of 30-35 lb. per cub. ft. (compared with 112-125 lb. for common bricks and 137-150 lb. for firebricks). The following figures show the heat lost from a pipe lagged with various materials each 1½ in. thick, with steam at 400° F. (204·5° C.), and an outside temperature of 68° F. (20° C.):—

Magnesia, 118 B.Th.U.; blue asbestos, 121; mica (best only), 123; white asbestos, 126; plastics, etc. (best), 133; plastics, etc. (inferior), 143; bare pipe, 1070 B.Th.U. per sq. ft. per hour. The graph representing the ratio of heat-loss to thickness of covering of magnesia is almost hyperbolic, so that complete insulation is impossible. For a temperature of 400° F. (204·5° C.) covering more than 1½ in. thick is of little additional value. For temperatures above 400° F. a thickness of 2 in. is necessary. The thickness of covering which will give the maximum retention of heat at minimum cost is most readily ascertained by such a graph. Where an acid-resisting lagging is required, magnesia covered with an acid-resisting coating is best.—A. B. S.

Ovens and kilns. Bigot. *See* VIII.

PATENTS.

Gases; Method of and apparatus for electrical treatment of ——. L. Bradley, East Orange, N.J., U.S.A. Eng. Pat. 120,573, 21.6.17. (Appl. 17,277/18.) Int. Conv., 21.6.16.

THE apparatus is similar to that described in Eng. Pats. 107,389, 119,236, 119,237, 119,238 (this J., 1919, 61 A), the localised frictional resistance, for maintaining uniformity of flow in the gases in the treater ducts, being obtained by providing gas inlet or outlet openings not associated individually with the respective pipes or flues, as in the prior patent, but located adjacent to the treater ducts. The total superficial area of the openings is smaller than the total cross-section of the treater ducts, so that increased velocity through the latter will result in greater friction in the corresponding part of the constricting means. The constricting passages may be formed in plates located in the bottom or top headers, and may be provided with means for regulating the size of the openings, or the passages may be made in the form of "venturi" pipes.
—B. N.

Heat; Means or apparatus for transmitting and utilising [waste] ——. E. L. Pease, Darlington. Eng. Pat. 121,752, 22.6.17. (Appl. 9016/17.)

A STRONG solution of calcium chloride or creosote or other non-acid liquid of high boiling point is sprayed into the top of a tower and absorbs heat from the waste gases of a furnace or an internal combustion engine, which pass upwards through the spray. The cooled washed gases are drawn off at the top. The hot liquid is discharged at the bottom, and passes through an apparatus in which floating impurities are skimmed off, to a steam generator or other heat-utilising device of the type described in Eng. Pats. 4154 of 1915, 103,492, and 104,721. The liquid may then be returned to the top of the tower. The same apparatus may also be used as a means for washing soluble constituents from the gas. The initial temperature of the hot gases may be reduced by passing them through a preliminary tower through which water is sprayed. In a modification, the heat-absorbing apparatus may consist of a tank containing the absorbing liquid, and provided with a series of parallel rotating discs mounted on a horizontal shaft and dipping into the liquid. Heat is taken from the gas by the upper portions of the discs, and transferred to the liquid by the rotation of the discs. The heated liquid may be conveyed to, and its heat utilised at a distance from the tower or other heat-absorbing apparatus.
—W. F. F.

Furnaces or muffles; Gas heated ——. J. M. Wallwin, Warwick. Eng. Pat. 121,917, 27.6.18. (Appl. 10,589/18.) Addition to 112,747, 4.9.17.

A GAS-HEATED furnace or muffle of the type described in the principal patent (this J., 1918, 141 A) is provided with a removable hollow metal cover through which the gas or air is passed to preheat it before passing to the burner. In a modification, the furnace may be divided centrally by a horizontal hollow member with an orifice for the combustion products, and this member is used in conjunction with the hollow cover for preheating the gas and air separately. The dividing member and also the cover may be grooved or corrugated.—W. F. F.

Furnaces and firebricks therefor; Method of constructing ——. J. W. Kunzler, Assignor to W. W. Lapham, Pittsburgh, Pa. U.S. Pat. 1,285,211, 19.11.18. Appl., 15.9.14 Renewed 11.9.18.

THE bricks used for lining a furnace are saturated with water, then "laid" in the usual manner; the exposed surface of the brickwork is coated with a fireclay composition, containing an alkali, and the furnace is then fired to "set" the coating.
—A. B. S.

Desiccation process. F. W. Lietzow and O. F. Fleischer, Chicago, Ill., Assignors to Merrell-Soule Co., Syracuse, N.Y. U.S. Pat. 1,282,093, 22.10.18. Appl., 29.5.12.

LIQUID to be desiccated is atomised and projected into a desiccating chamber near the top, and falls through heated air which is introduced laterally at the middle of the chamber. The air and vapour rise through the chamber and are discharged at a point above the inlet for the liquid. The desiccated substance is collected as a dry powder in the bottom of the chamber.—W. F. F.

Steam-boiler economisers; Method of operating ——. D. S. Jacobus, Jersey City, N.J., and H. C. Heaton, Chicago, Ill., Assignors to The Babcock and Wilcox Co., Bayonne, N.J. U.S. Pat. 1,285,201, 19.11.18. Appl., 8.12.14.

THE cooling water from the condenser is brought into contact with the air supply for a boiler furnace, and the moist air passed through the furnace. The waste gases are passed over an economiser in the flue, through which feed water is passed to the boiler, and part of the moisture is condensed on the tubes of the economiser.—W. F. F.

Filter film or bed and process of making the same. L. S. Knight, New York. U.S. Pat. 1,285,233, 19.11.18. Appl., 27.6.17. Renewed 7.5.18.

FLOCCULENT asbestos fibre is distributed over a suitable surface and a cylinder having a removable woven fabric covering is rolled over it. The fibre adheres to the cylinder; it is coated with a purifying agent, and the cylinder is then rolled over another mass of fibre. The tubular fibrous form is then removed and dried.—W. F. F.

Vacuum-cooler with interior absorption. P. Schou, Copenhagen. U.S. Pat. 1,285,415, 19.11.18. Appl., 16.3.18.

A CENTRAL evaporation chamber is surrounded by an absorption chamber contained [illegible] by opposed annular trays forming a series of superposed. The absorption chamber communicates with the evaporation chamber through openings in the walls above the levels of the liquid in the trays, and the whole is surrounded by a cooling jacket.—W. F. F.

Weighing and delivering apparatus for charging cupolas or like uses; Proportional ——. J. W. Hartley, Stone, Staffs., and W. and T. Avery, Ltd., Birmingham. Eng. Pat. 121,993, 12.12.17. (Appl. 18,404/17.)

Air-filter. F. W. R. Williams, London. U.S. Pat. 1,282,345, 22.10.18. Appl., 14.3.17.

SEE Eng. Pat. 100,876 of 1916; this J., 1916, 915.

Drying materials in sacks or similar vessels; Apparatus for ——. H. P. Dinesen, Herlóv, Denmark. U.S. Pat. 1,282,771, 29.10.18. Appl., 30.10.17.

SEE Eng. Pat. 109,965 of 1917; this J., 1917, 1171.

Expressing liquids. Eng. Pat. 121,759 *See* IIA.

Fractional distillation. Eng. Pat. 121,748. *See* III.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Petroleum oil and coal. J. Marcusson. Chem.-Zeit., 1918, **42**, 437—439.

ASPHALTENES (*i.e.* the bituminous constituents of natural and artificial asphalts insoluble in petroleum spirit) closely resemble coal in their behaviour with reagents. They contain about the same proportions of carbon but somewhat more hydrogen and less nitrogen than coal, whilst both contain oxygen and sulphur. They swell up when heated, but, unlike coal, are soluble in benzene, carbon tetrachloride, and carbon bisulphide. In a few natural asphalts such as grahamite, compounds termed carbenes, which are akin to asphaltenes, are found. These resemble coal in appearance and are insoluble in cold carbon tetrachloride. Products representing a still further stage of decomposition occur in albertite and Bentheim asphalt. These are deep black and lustrous, and, like coal, are insoluble in organic solvents. The name "carboids" is suggested for these compounds. All three classes of compounds form distinctive addition compounds with sulphuric acid, whilst coal forms similar compounds, which are also insoluble in water. The products of the reaction (100 to 110%) are greyish-black and lustrous, and contain from 2·5 to 5·1% of sulphur, the coal derivative being intermediate in this respect. When boiled with water or dilute hydrochloric acid they are decomposed, with the liberation of sulphuric acid, but are stable towards alcoholic alkali. The asphaltene and carbene sulphuric acid compounds are soluble in pyridine, and the solution can be diluted with water. On adding mineral acids or salts of calcium, iron, or silver to the dilute solution precipitates of the acids or the corresponding salts are obtained. The reaction products of carboids are insoluble in pyridine. By treating asphaltenes with strong sulphuric acid and heating the mixture for 2 hours in a steam-bath, products containing a somewhat higher proportion of sulphur and insoluble in pyridine are obtained. By using fuming sulphuric acid higher yields (119 to 156%) of products containing 6·8 to 10·1% of sulphur are obtained. When the compounds from carboids or coal are heated with aqueous potassium hydroxide solution a considerable amount of sulphuric acid is split off, and the amount of sulphur in the residual products is similar to that in the original samples, whereas the compounds from asphaltenes and carbenes are not affected by aqueous potassium hydroxide. On adding concentrated sulphuric acid to suspensions of finely-powdered asphaltic substances or coal in methylal, formolites are produced. Chlorosulphonic acid acts upon them energetically. On treating asphaltic substances or coal with nitric acid of sp. gr. 1·52, from 121 to 130% of dark brown dinitro compounds are produced. The compounds from asphaltic substances are completely soluble in acetone whilst those from coal are almost completely soluble if treated with the solvent while still moist. The soluble products contain from 6·2 to 4·8% of nitrogen. By adding an ethereal solution of ferric chloride or mercuric chloride to the acetone solution double compounds are precipitated. The compounds with sulphuric acid formed by coal have not the characters of sulphonic acids but of sulphuric acid oxonium compounds, and a similar atomic grouping of the oxygen atoms must be assigned to the asphaltic compounds. The observed resemblances in the behaviour of coal and asphaltic substances must be attributed not only to the carbold content of the coal, but also to the fact that the products of the decomposition of cellulose, although not identical with carboids, yet have a similar polycyclic structure, are saturated compounds, and contain oxygen linked in an analogous manner. The close chemical relationship of asphaltenes from petroleum and of coal may thus be explained without the necessity of assuming a genetic relationship between coal and petroleum.—C. A. M.

Humic acids. J. Marcusson. Z. angew. Chem., 1918, **31**, 237—238.

HUMIC acids prepared from Silesian lignite (yield 65%) contained 2·1% of nitrogen, 0·37% of sulphur, and 7·6% of mineral matter, and formed dark coloured alkali salts resembling those of the "oxidised" acids of blown oils. On treatment with strong sulphuric acid and addition of water they yielded about 70% of dark brown products containing 1·5% of sulphur, and with fuming sulphuric acid 43% containing 2·6% of sulphur. By treatment with nitric acid (sp. gr. 1·42) and addition of water, 53% of a dark brown substance separated. This was readily soluble in alkali solutions and the liquid frothed when shaken, but was too dark to be suitable for a soap substitute. It was a cyclic nitro compound containing 2·9% of nitrogen. By the action of nitric acid of sp. gr. 1·52 a dinitrohumic acid was obtained. The compounds of humic acids with sulphuric and nitric acids resemble in many respects the analogous compounds given by coal and lignite (see preceding abstract), but owing to their carboxyl content the oxonium compounds obtained from humic acids are, unlike the coal compounds, completely soluble in alkali solutions. The nitration product of humic acids resembles

that from coal in being insoluble in ether, benzene, chloroform, and petroleum spirit, but is readily soluble in acetone, dichlorhydrin, pyridine, and alkalis. It combines with alkalis to form soluble salts of isonitro compounds which are decomposed by acids with the liberation of nitrous oxide. Nitrohumic acids, like nitro-coal, can form addition compounds with sulphuric acid and bromine, and form double compounds with ferric chloride and mercuric chloride. Since coal contains as its main constituents polycyclic oxygen compounds the oxygen of which is linked in bridge formation, it may be assumed that humic acids contain similar nuclei. This conclusion is supported by the fact that acids closely resembling natural humic acids in character may be prepared by the hydrolysis of carbohydrates, whilst the fact that furan derivatives are obtained by the dry distillation of humic acids indicates that they contain a furan nucleus. Natural humic acids are mixtures of nitrogenous and non-nitrogenous acids. The former contain a pyridine ring, which is perhaps also combined with a furan nucleus, and also an amino or imino group in open chain formation. It is probable that humic acids are the source of both the oxygenated and nitrogenous constituents of coal.—C. A. M.

Steaming horizontal [gas] retorts. R. J. Rew. Gas J., 1919, 145, 69—70.

The author, as the result of extended trials, recommends very slight steaming, if any, during the first eight hours of the carbonising period, the retort being fully steamed during a subsequent 40-hour period. Superheated steam must be employed, and its temperature should be as high as possible. Maximum time contact between steam and coke is desirable, and to this end, the steam is admitted at as low a pressure as possible. The make of water-gas per retort (21″×15″×10′) varies from 3000 to 13,000 cub. ft. The percentage of carbon dioxide in the purified water-gas averages about 5%.

—J. S. G. T.

Gasoline; Recovery of —— from natural gas by compression and refrigeration. W. P. Dykema. U.S. Bureau of Mines, Bull. 151, 1918, 123 pages.

The natural gas obtained from oil wells invariably carries greater or smaller amounts of hydrocarbons which are liquid at ordinary atmospheric temperature and pressure, and the recovery of these hydrocarbons is now extensively carried out by compressing and cooling the natural gas. As a general rule, if the crude oil has sp. gr. below 0·920 the casing-head gas can be profitably treated for gasoline by compression. The "dry" gas remaining after treatment is used to drive the gas engines of the compression plant and also for gas and steam engines in pumping and drilling wells. At present plants are in operation treating 6 to 9 million cub. ft. daily of gas yielding as low as 1 gall. of liquid products per 1000 cub. ft., using pressures of 250 to 300 lb. per sq. in. in two stages of compression, with elaborate systems of cooling the gas before compression and after each stage of compression. In some plants the gas is further cooled by expanding the dry treated gas through the cylinders of an expansion engine and using the cold expanded gas to cool the high-pressure gas from the water-cooled coils. Temperatures as low as 0° F. (−18° C.) are often obtained, causing the separation of nearly all condensable fractions commercially valuable for making gasoline. Ammonia is also used as an auxiliary cooling agent. Gas from wells which are held under high vacuum is composed largely of the heavier vapours, and in these cases single-stage plants working at a pressure of about 100 lb. per sq. in., and using cooling coils submerged in water, give satisfactory recoveries. In plants using two-stage compression, the average pressure developed by the first stage is between 40 and 50 lb. per sq. in., the temperature rising to 200°—250° F. (93—121° C.). The proportion of condensed liquid collected in the low-stage accumulator tanks averages 15—30% of the total yield. This material, which has sp. gr. about 0·737, is itself an ideal motor fuel, but is usually mixed with the lighter fractions. The condensed liquid obtained at the maximum pressure generally represents the principal bulk of the total recovery, seldom being less than 30% of the total product. The average sp. gr. of the high-stage condensed liquid is approximately 0·651 in eastern American fields, 0·673 in Oklahoma, and 0·693 in California. This product is "wild," *i.e.* contains constituents normally gaseous at atmospheric temperature and pressure, and is usually at once discharged into tanks containing the heavier fractions. The lightest fraction of all is that obtained from the expansion exhaust, and this may have as low a sp. gr. as 0·60. The condensed liquid is preferably removed from contact with the gas as soon as possible, and this is accomplished by the use of small automatic traps which drain the liquid from the accumulator tanks to storage tanks at lower pressure as soon as collected. Most casing-head gasoline is mixed or blended with about an equal volume of naphtha, consisting of those fractions distilling from crude oil after the cuts marketed as "straight still-run" gasoline have been distilled off, and having an end point of about 400° F. (204° C.). Such blending is often necessary to produce suitable motor spirit, and also to reduce the vapour tension to the degree required for safe transport. Loss of the lighter fractions is also prevented by blending the casing-head gasoline with naphtha at as early a stage as possible. The practice at every stage of the process of the recovery of gasoline from natural gas varies considerably at different works. The author has visited a large number of recovery plants in all parts of the United States, and describes the various methods of procedure adopted. Data relating to the engines and compressors used at 80 compressor plants are given, together with details of capacity, output, etc.—T. St.

Ammonium sulphate. Wolff. *See* VII.

Spent oxide. Colman and Yeoman. *See* VII.

Flue-gas analysis. Dubrisay and others. *See* VII.

PATENTS.

Expressing liquid from materials [e.g. peat]. J. W. Hinchley, London, C. S. D. Harper, and The Power-Gas Corporation, Ltd., Stockton-on-Tees. Eng. Pat. 121,759, 30.10.17. (Appl. 15,824/17.)

An extrusion press which is particularly suitable for expressing water from peat comprises two narrow vertical rectangular compressing chambers, separated and bounded by hollow walls in which narrow cells extending the full height of the walls are formed. The surfaces adjacent to the compressing chambers are perforated to allow expressed liquid to pass into the cells, and the liquid is discharged through pipes at the bottom of the cells leading to a common discharge pipe. The compressing pistons are moved horizontally by a hydraulic ram. Hot gas is introduced into the compression chambers by short valved pipes opening into the top and connected to a common main. The extrusion orifice is rectangular in cross-section, with parallel side walls and curved converging top and bottom walls. The outlet is closed by a sliding shutter, attached at one end to a plunger con-

nected to a constant pressure accumulator, and at the other end to a plunger connected to the cylinder of the ram which operates the compressing pistons. At the beginning of the compression stroke the pressure due to the constant pressure accumulator will preponderate and keep the shutter closed, but when the resistance increases the pressure on the opposing plunger will preponderate and open the shutter. The extrusion orifice is lined with porous ceramic material, backed by perforated plates to conduct the filtered liquid away. A modification is described in which the building up and dismounting are facilitated.
—W. F. F.

Motor fuel; Apparatus for making —. W. A. Hall, New York. U.S. Pat. 1,285,136, 19.11.18. Appl., 9.2.16.

OIL of high boiling-point is forced by a pump, at a pressure of several atmospheres, through a preheater to a retort comprising a series of vertical loops, in which it is cracked. The gases and vapours pass through a reducing valve to a condenser at a substantially lower pressure. The gases and vapours leaving the condenser are compressed, and passed through a second condenser.
—W. F. F.

Hydrocarbons; Art of cracking —. E. W. Isom, Assignor to Sinclair Refining Co., Chicago, Ill. U.S. Pat. 1,285,200, 19.11.18. Appl., 10.9.17.

OIL is circulated under pressure from a tank through vertical heating pipes extending completely through the heating flues of a furnace, and then back to the tank. Hand holes are provided in the flue at each end of the heating pipes.—W. F. F.

[*Fuel*] *briquettes and method of making the same.* C. H. Smith, Short Hills, N.J., U.S.A. Eng. Pat. 111,285, 29.8.17. (Appl. 12,433/17.) Int. Conv., 15.11.16.

SEE U.S. Pat. 1,276,429 of 1918; this J., 1918, 646 A.

Coke-ovens; Method of heating —. R. Geipert, Assignor to Dessauer Vertikal Ofen Ges., Berlin. U.S. Pat. 1,281,775, 15.10.18. Appl., 21.2.15.

SEE Fr. Pat. 471,644 of 1914; this J., 1915, 414.

[*Mineral*] *oils; Treating* —. A. Philip, Portsmouth. U.S. Pat. 1,286,091, 26.11.18. Appl., 5.6.14.

SEE Eng. Pat. 14,778 of 1913; this J., 1914, 824.

Utilising [*waste*] *heat.* Eng. Pat. 121,752. *See* I.

Gas-heated furnaces. Eng. Pat. 121,917. *See* I.

Fractional distillation. Eng. Pat. 121,748. *See* III.

Extracting ammonia from gases. Eng. Pat. 121,754. *See* VII.

Diolefines. U.S. Pat. 1,282,906. *See* XX.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Gas-mantle lamps; Influence of quality of gas and other factors on the efficiency of —. R. S. McBride, W. A. Dunkley, E. C. Crittenden, and A. H. Taylor. U.S. Bureau of Standards, Tech. Paper 110, 1918, 49 pages.

THE paper is a report of a part of a general investigation to determine the relative usefulness of gases of different heating values for mantle lighting, cooking, water heating, etc. (*cf.* this J., 1918, 681 A). Experiments were carried out with various types of upright and inverted incandescence mantle burners and the gases employed in the investigation comprised carburetted water-gas of about 665 B.Th.U. and 565 B.Th.U. per cub. ft., coal-gas of about 565 B.Th.U. per cub. ft., some specially enriched gases of higher calorific value, and natural gas of calorific value 1120 B.Th.U. per cub. ft. In general the candle power of the upright incandescence burners was determined in a horizontal direction only, and that of the inverted burners in a direction making an angle of 20° with the horizontal. The mean spherical candle power in each case was, when necessary, calculated by means of a reduction factor, experiments having shown that the values so obtained agreed with those determined by means of the integrating sphere or otherwise. In the first series of experiments the various burners were adjusted until the maximum candle power at 2″, 3″, and 5″ water column respectively was obtained, and then the candle power ascertained at various supply pressures, varying from 1″ to 8″ water column. The main results are as follow:—(1) The lower the pressure at which the lamp is adjusted to maximum candle power, the greater is the gas consumption at any given pressure. (2) The candle power increases with increasing pressure up to and beyond the pressure for the maximum efficiency until a maximum candle power is obtained, after which the candle power decreases with further increase of pressure. (3) The maximum efficiency is almost invariably found at pressures between 2″ and 4″ water column. In the investigation of the effect of quality of gas upon the performance of the various lamps, the pressure at the burner was maintained constant, the gas and air supply being adjusted so that the best result, separately, as regards candle power and efficiency respectively was obtained. The chief conclusions drawn are:—(1) The inverted burners show no difference in efficiency with lean water-gas with either adjustment. (2) Upright burners have a higher efficiency with lean water-gas than with town gas both at maximum efficiency adjustment and at maximum candle power adjustment. (3) The upright burners similarly show a distinct advantage in the use of the benzol-enriched gas as compared with ordinary town gas. (4) With all types of burners there is a small advantage gained by the use of water-gas rather than coal-gas of the same heating value, except in some cases at very low pressures. Experiments involving alterations of gas quality lead to the conclusion that if a lamp is adjusted for maximum candle power, an increase in the heat value of the gas supplied produces a decrease of efficiency and *vice versâ*. It is concluded that the usefulness of a uniform quality of coal-gas of 550 to 575 B.Th.U. per cub. ft. increases or decreases with a corresponding change in the calorific value of the gas.—J. S. G. T.

PATENTS.

Oil-bearing shale, bitumens, hydrocarbons, and other elements of a volatile nature; Apparatus for the treatment [*distillation*] *of* —. J. H. Galloupe, Denver, Colo. U.S. Pat. 1,283,723, 5.11.18. Appl., 19.11.17.

A RETORT in the form of a longitudinal bed of semi-circular cross-section is fitted with a hood from which partitions extend nearly to the bed. A horizontal shaft passes through the retort and operates rabbles which cause the material to pass from the feeding to the discharging end of the apparatus. Products of distillation are withdrawn through a number of pipes leading from the upper parts of the cells formed by the partitions.—C. A. K.

Coal and other carbonaceous matter; Carbonisation and distillation of —— by electricity. C. W. Simpson, Leeds, and L. Moorhouse, Barnsley. Eng. Pat. 121,854, 19.2.18. (Appl. 2878/18.)

Coal and like carbonaceous material is carbonised and distilled to produce coke, fuel oil, and gas, by an electric current transmitted through the charge by electrodes partly embedded in the lining of the retort. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 20,115 of 1910 and 13,951 of 1914; this J., 1911, 1391; 1916, 547.)—W. F. F.

Vacuum [X-ray] tubes. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 121,878, 20.3.18. (Appl. 4933/18.)

The anode for an electron discharge device, particularly for "X-ray targets," comprises a plate of metal, such as "invar," having a substantially zero coefficient of thermal expansion, with means for cooling the plate, which is also provided with a facing of tungsten united to it by means of a film of copper.—B. N.

III.—TAR AND TAR PRODUCTS.

Patents.

Fractional distillation of liquids [crude benzol, etc.] and apparatus therefor. G. E. and S. H. Walker, Radcliffe, Lancs. Eng. Pat. 121,748, 9.12.16. (Appl. 17,710/16.)

Crude liquor containing lighter hydrocarbon oils flows by gravity from a tank through a succession of stills, each at a lower level and a higher temperature than the preceding one. The liquor enters each still at the base and passes upwards through a set of vertical tubes round which steam is circulated, to another chamber which is surmounted by a fractionating column. The distilled vapour passes from the first still to a heating coil in the supply tank and thence to a condenser. The first still may be heated by hot vapour from the second still instead of by steam, and the second still by vapour from the third still. Crude benzol may be treated thus for the separation of benzol, toluol, and solvent naphtha.—W. F. F.

Tar and the like; Distillation of ——. J. W. Westwood, Birmingham. Eng. Pat. 121,801, 2.1.18. (Appl. 47/18.)

Tar is heated in a tank by high-pressure hot water tubes to about 140° C., to expel water vapour, and then passed through a horizontal still containing horizontal high-pressure hot water tubes, by which its temperature is raised to about 230° C. The still is mounted over a hot gas flue leading from a furnace which contains a set of heating tubes in series with the tubes in the still. The tar passes from the still to a vertical separating tank heated internally by three superposed coils of high-pressure hot water tubes connected in series. The outlet of the pipe conveying the tar is provided with a spraying or film-forming device which is surrounded by the middle hot water coil. The remaining water vapour and light oils are thus removed by contact with the hot coil, and pass out of the separating tank to a condenser. The tar residue is discharged at the bottom of the tank.—W. F. F.

IV.—COLOURING MATTERS AND DYES.

Yellow dye. Mees and Clarke. *See* XXI.

[Sulphur dyes from] trinitrotoluene residues. Copisarow. *See* XXII.

Patent.

Colouring matters; Manufacture of new compounds to be employed as ——, or in the production of colouring matters. M. L. Angel, Oxford, Executrix of A. Angel. Eng. Pat. 121,347, 13.12.17. (Appl. 18,484/17.)

The name "parazenes" is suggested for a new type of compounds in which two benzenoid nuclei are linked together by two nitrogen atoms through four para carbon atoms of the nuclei. They may be prepared by heating a *p*-halogenaminobenzene (or 1.4-aminohalogennaphthalene) or a derivative of either in which indifferent groups are substituted in the nuclei (or a mixture of such compounds) with a condensing agent such as zinc chloride, ferric chloride, aluminium chloride, phosphorus pentoxide, etc. The resulting product is a dihydroparazene, and on oxidation yields a parazene. For example, *p*-chloroaniline or *p*-bromoaniline is heated with constant stirring in an open vessel with three times its weight of zinc chloride for 1 to 1½ hours at about 200° C. After cooling, the mass may be dissolved in acetic acid and the solution used as a dye for silk or wool. The parazene from *p*-chloroaniline may be isolated as a dark blue powder by filtering the solution after the whole of the zinc chloride has dissolved. (See also J. Chem. Soc., 1919, i, 98.)—C. A. M.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Patents.

Flocks, rags or the like; Machines for washing ——. E. V. Chambers and T. C. Hammond, Lightcliffe, Yorks. Eng. Pat. 121,689, 8.4.18. (Appl. 5946/18.)

In a washing machine comprising an open trough with perforated false bottom and a circulating paddle wheel, baffles are arranged near the bottom of the trough, obstructing the circulation of the water at the lower depth sufficiently to cause the sand and heavy impurities to be intercepted and settle out, so that they fall through the perforations of the false bottom. The baffle-plates may be arranged parallel with each other, transversely of the vessel, or at opposing angles to each other, or else parallel with each other at an angle with the axis of the trough.—J. F. B.

Paper pulp; Process for utilising dead leaves as stock for making ——. K. Bramson, Paris. Eng. Pat. 121,847, 7.2.18. (Appl. 2258/18.)

Dead leaves of deciduous trees are treated for the separation of the blade from the ribs and stalks. The portion derived from the blade is unsuitable for paper manufacture, but the rib and stalk material, after disintegration, is treated with water or with a solution of caustic soda at 120°—143° C. An apparatus suitable for grinding and separating the ribs and stems consists of a hollow spherical casing in which is rotated a perforated spherical body, provided with stirring arms and containing iron or stone balls. The material of the blades of the leaves is ground so that the particles fall through into the casing and are discharged, leaving

the disintegrated rib material ready for charging the pulp digesters. (Reference is directed under Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 1853 and 2168 of 1871, 4529 of 1882, and 18,572 of 1892; this J., 1893, 261.)

—J. F. B.

Nitro-acetic esters of cellulose; Process of making ——. J. Koetschet, Lyon, and M. Theumann, St. Fons, Assignors to Soc. Chim. des Usines du Rhône, Paris, France. U.S. Pat. 1,286,025, 26.11.18. Appl., 2.6.15.

See Eng. Pat. 8046 of 1915; this J., 1916, 39.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Cleaning and dyeing with volatile solvents. H. Hey. J. Soc. Dyers and Col., 1919, **35**, 12—18.

The solvents most generally employed in dry cleaning are petroleum spirit (benzine) and solvent naphtha; the chloro-compounds of hydrocarbons, though non-inflammable, are not satisfactory in other respects. One of the essential points in dry cleaning is the absence of "free" water. The solvents contain small proportions of water (0·2—0·3%) which may be deposited on cold surfaces; their capacity for holding water may be increased by using the solvents warm, or by adding "benzine soap." The latter also assists in holding the particles of dirt in suspension and preventing them from settling out upon the goods. In dry cleaning, the goods are first dried thoroughly with hot air and dusted. They are then treated systematically in baths of solvent of increasing cleanness. This treatment may be carried out in one machine connected with storage tanks for the different solvent baths, or in several machines, containing solvent of different degrees of purity, in which case the goods are moved from one machine to the next in closed wagons. The former method is preferable and the entire operation can be carried out in a closed system in an atmosphere of inert gas. Two systems are in common use: the Barbe system and Smith's system. The latter is distinguished by a particularly efficient type of machine consisting of a perforated inner cylindrical cage of steel revolving in an outer casing of iron. The shape of the cylinder is adapted for the advantageous utilisation of the minimum quantity of solvent, being large in diameter and short in length. The cage is divided radially into four compartments, each of which may be brought in succession opposite a door in the end of the casing for charging and discharging the goods. The goods are carefully sorted according to colour and condition, the lighter and cleaner materials constituting the first charge, and the darker ones being treated later. The casing is tightly closed, the air is pumped out, and a small amount of solvent admitted through a heater. The cage is slowly revolved with reversible gearing while the goods are tumbled about through the liquid at the bottom of the casing. The dirty liquid is discharged to the appointed tank and the cage is revolved at high speed, in one direction only, to drain the goods. The treatment is repeated with a fresh quantity of solvent which is collected in a separate tank. Altogether, three washes may be given, with a whizzing between each. The expulsion of the solvent by centrifugal force is so complete that not more than 5—7% of liquid is left in the goods and the latter may be removed without further treatment. They may, however, be dried in the machine, if desired, by circulating an inert gas through the casing in a closed circuit, containing a heater and a cooler, by means of a fan. Dry dyeing is performed in a somewhat similar manner, but the principle is dependent on the presence of water in homogeneous solution. The incorporation of water is effected by the admixture of a common solvent of water and hydrocarbon, so that the dyestuff may be carried in solution. Suitable blending media are methylated spirit, ammonia and fatty acid, "benzine soap," formic acid, and latterly phenol or cresol (see Fort, this J., 1919, 9 A). These miscible liquids are employed as solvents of the dyestuff and the concentrated solution is then diluted with the inert hydrocarbon. (See also Boursier, this J., 1887, 819; Farrell and May, 1908, 220, and Eng. Pat. 22,876 of 1910; this J., 1911, 889.)—J. F. B.

Woven fabrics; Influence of dyeing and finishing processes on ——. E. Midgley: J. Soc. Dyers and Col., 1919, **35**, 20—23.

During the dyeing and finishing processes woven fabrics are subject to alterations in appearance, handle, strength, and elasticity, according to the type and quality of the raw material employed, the type and structure of warp and weft yarns, the structure and setting of the cloth in the loom, and the nature and degree of the processes of treatment. A number of systematic tests of tensile strength were applied to various types of wool fabrics, the strength and elasticity being determined after each of the operations involved in preparing, dyeing, and finishing. These established that, although there were slight fluctuations between one operation and another, the net result of the whole process was an appreciable loss of strength, particularly after crabbing, scouring, and permanent finishing. There is considerable scope for new effects by the suitable application of mechanical and chemical treatments of woollen fabrics, by which superior qualities may be imparted or union fabrics or even all-cotton fabrics substituted for wool. Among the most serious troubles in the dyeing and finishing industry are what are known as "crimps," which have their source in irregularities of shrinkage. This irregularity may either be inherent in the woven goods or may be introduced by uneven treatment in the wet processes of dyeing and finishing. A very troublesome cause of "crimps" in the original fabric has been traced to the recently introduced practice of artificially conditioning the weft yarn, whereby the outer layers of the spool tend to receive considerably more moisture than the inside.

—J. F. B.

Patents.

Wool-like effects on cotton fabrics; Process for producing ——. O. Klauser. Assignor to Akt.-Ges. Cilander, Herisau, Switzerland. U.S. Pat. 1,285,738, 26.11.18. Appl., 24.8.17.

See Eng. Pat. 103,432 of 1916; this J., 1917, 289.

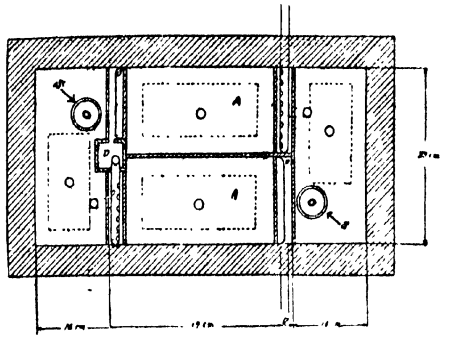
Chromium and iron compounds. Eng. Pat. 121,617. *See* VII.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Caustic alkali and chlorine; Electrolytic production of —— by the mercury process. G. Yamazaki, Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, **21**, 1097—1117.

The author has devised an improved form of the Castner cell shown in plan in the figure. The cell differs from the ordinary Castner cell in that the

brine is decomposed in the middle compartment, containing the anodes, A, of Acheson graphite, whilst the sodium amalgam is made to circulate into the outer cathode compartments by the action of two worm screws, s, s, which revolve in small wells, and is decomposed by the water in the



compartments. By means of this cell, with a current density between 20·8 and 25·0 amp. per sq. dcm. on the mercury, and a temperature of 45° to 50° C., pure 7 to 10 *N*-solutions of caustic alkali were obtained. The anode gas contained on the average 99·2% Cl, with 0·2% CO_2+O_2, 0·3% H_2, and 0·3% of other constituents. Even when the concentration of alkali in the amalgam reached 0·2%, the anode gas did not contain as much as 0·5% H_2. —C. A. M.

Ammonium sulphate; Works experience in the manufacture of ——. E. Wolff. J. Gasbeleucht., 1918, **61**, 577—580.

The impossibility of obtaining suitable material for the renewal of worn out parts of the plant, and the necessity of using sulphuric acid containing nitric acid, are among the war conditions which have made it difficult to maintain efficiency. At the Mannheim municipal gasworks, the indirect process is used. The saturator consists of a closed iron vessel, lined with lead and with acid-proof stone, and is joined by a connecting pipe of "chemical" lead to a smaller vessel, the supersaturator, also lead lined. A steam ejector of phosphor-bronze removes the liquor from the saturator, carrying it by means of a blow-over pipe through a receiving vessel and a sloping trough to a salt-box, provided with a sluice-valve, by means of which the mother-liquor is sent through a return pipe to the supersaturator, the salt being delivered through the sluice-valve to a hydro-extractor. The liquor from the extractor is also diverted to the supersaturator. Phosphor-bronze is no longer available, and when the corrosive action of the sulphuric acid produces a hole in the blow-over pipe the damaged part of the pipe is cut out, and the end of one of the sound parts is widened and forced over the end of the other part until fast, or the two parts are joined by a piece of lead piping, fastened by bronze bands. Steam and blow-over pipes of wrought iron, covered with lead and into which a lining of lead piping has been forced, have been recommended. A particularly vulnerable portion of the blow-over pipe is the elbow at the point at which the pipe turns towards the draining trough. A stoneware elbow with an iron cover has proved to be best. When the lead lining of the supersaturator was damaged, it was replaced by a lining of acid-proof stone, and the connection to the saturator was lined with a stoneware pipe, but these proved unsatisfactory. The supersaturator was therefore again lined with lead, but in the middle, over the lead lining, a thin iron sheet was placed, and screwed to the base, the screws and iron plate being finally covered with lead. This arrangement prevented the lead lining from being torn up by the fluctuations of temperature. Stoneware was tried for the pipe carrying the vapours through the roof from the saturator, but it soon became very brittle, especially the part above the roof. Wrought iron covered with lead is recommended for the construction of the draining trough. The masonry foundation of the hydro-extractor is protected from the destructive action of the liquor by a covering of lead.—S. S. A.

Ammonium sulphate; Practical experience in the manufacture of ——. E. Wolff. J. Gasbeleucht., 1918, **61**, 601—604.

The paper deals mainly with certain difficulties encountered in the manufacture of ammonium sulphate from ammoniacal liquor (see preceding abstract). The chief source of trouble is the increase in volume of the contents of the saturator due to the steam-ammonia supply containing too low a percentage of ammonia. Steam with an ammonia content of from 12 to 15% should be employed. Among other difficulties encountered are included the stoppage of the preheater with lime, and trouble due to the ammoniacal liquor containing tar. The use of 20% sulphuric acid is recommended.—J. S. G. T.

Spent oxide; Valuation and methods of analysis of ——. H. G. Colman and E. W. Yeoman. Gas J., 1919, **145**, 68—69, 112—113, 169—170.

The method for the determination of the sulphur content employing carbon bisulphide as solvent gives high results, as certain tarry constituents of the mass are extracted along with the sulphur. A modification of the method whereby the extracted matter is treated with concentrated nitric acid, the sulphur being thereby converted into sulphuric acid, the tarry matters remaining undissolved, is capable of giving accurate results but is a tedious and unpleasant operation (compare Diamond, this J., 1918, 336 T). The authors find that the method proposed by Davis and Foucar (this J., 1912, 100), in which the free sulphur is converted into thiocyanate by boiling with alcoholic potassium or sodium cyanide, affords accurate results, and a slight modification of the original procedure is detailed. The modified sulphuric acid method due to Marsden (this J., 1914, 909) also yields accurate results. In this method the combined sulphur and tarry matters extracted with carbon bisulphide are treated with 95% sulphuric acid at 100° C. for two or four hours. The authors find that separation of the sulphur from tarry matter can be achieved by shaking with 15 c.c. of 95% sulphuric acid for about a minute. About 2 grms. of the spent oxide should be employed, and details are given for carrying out the various methods with such an amount. Benzene may be used in place of carbon bisulphide, 200 c.c. being used for every grm. of sulphur extracted. The ammonia is determined by distillation with caustic soda solution as usual, a small flame being employed and steam passed in from a separate vessel. A number of analytical processes are detailed which taken together enable the separate cyanogen compounds to be determined quantitatively. These involve determination of combined ferrocyanide and carbonyl ferrocyanide, thiocyanate, and ferrocyanide proper, excluding carbonyl ferrocyanide (see this J., 1912, 468.)—J. S. G. T.

Alkaline carbonates; Physico-chemical method of estimating —— in the presence of free alkali bases. Application to the analysis of flue gases. R. Dubrisay, Tripier, and Toquet. Comptes rend., 1919, **168**, 56—59.

If 50 c.c. of solutions of a definite alkalinity, containing varying proportions of sodium hydroxide and sodium carbonate, are mixed with 50 grms.

of phenol and heated until solution is complete, and then allowed to cool, the temperature at which the solution first becomes turbid is higher as the proportion of sodium carbonate to sodium hydroxide increases (see this J., 1919, 37A). Curves have been plotted for solutions having a total alkalinity of 2*N*, *N*, *N*/2, and *N*/4. By means of these the amount of sodium carbonate in a given solution may be readily estimated by bringing the solution up to a definite alkalinity, proceeding as above, and then reading direct on the curve the amount of sodium carbonate corresponding to the temperature found. For the analysis of flue gases, one litre of the gases is slowly bubbled through 71·5 c.c. of *N*/4 sodium hydroxide, after which the above estimation is carried out.—W. G.

Ferric oxide; Direct determination of combined —— in silicates insoluble in acid. O. Hackl. Chem.-Zeit., 1919, **43**, 9.

In adapting Knecht's volumetric method of determining ferric salts by means of titanous chloride (this J., 1907, 1165) to the analysis of silicates, it was found that the hydrofluoric acid used for the decomposition of the mineral prevented the appearance of the colour reaction with the potassium thiocyanate used as indicator. The influence of hydrofluoric acid may be inhibited by adding boric acid to the solution before the titration; or methylene blue may be used as indicator instead of potassium thiocyanate.—C. A. M.

Chromic hydroxide; Evolution and oxidation of —— in alkaline solution. F. Bourion and A. Sénéchal. Comptes rend., 1919, **168**, 59–62.

An alkaline solution of chromic hydroxide undergoes a change on standing, which tends to make it lose all chemical activity, particularly in respect to its reducing properties, the change being more rapid, the greater the concentration of the chromium, and the smaller the concentration of the alkali. By adding from 4 to 5 times the calculated quantity of hydrogen peroxide to an alkaline chromium solution immediately after its preparation it is not possible to oxidise more than 90% of the chromium to chromate, but by adding the alkali to a mixture of the chromium solution and hydrogen peroxide, 97% of the chromium can be converted into chromate.—W. G.

PATENTS.

Nitric acid; Manufacture of ——. C. Toniolo, Milan, Italy. Eng. Pat. 121,635, 27.12.17. (Appl. 19,139/17.)

Oxides of nitrogen are absorbed in water, in absorption towers arranged in series and worked on the counter-current principle. By means of refrigeration, using cooling coils or heat interchangers, the liquid is cooled so that it enters each tower at a temperature below 0° C., or at temperatures comparable with the freezing points of the solution at different stages. The temperature of the liquor is reduced progressively as it travels to the end at which the gas enters, where the heat of reaction is greatest, thereby facilitating absorption, increasing the speed of production, and reducing the number of towers necessary. The process of refrigeration is particularly useful when using gas of comparatively high concentration of oxides of nitrogen, as when ammonia is employed as the source of the oxides.—S. S. A.

Phosphoric acid; Process for making ——. W. H. Allen, Detroit, Mich. U.S. Pat. 1,285,575, 26.11.18. Appl., 27.5.18.

Phosphoric acid is produced by injecting a mixture of fuel, phosphates, and silica into a combustion chamber containing steam by means of a blast containing oxygen.

Chromium and iron compounds [for use in dyeing, etc.]; Manufacture of ——. T. J. I. Craig, and P. Spence and Sons, Ltd., Manchester. Eng. Pat. 121,617, 26.10.17. (Appl. 15,581/17.)

Solutions containing mixtures of chromium and ferric salts are produced by the reducing action of metallic iron, or of suitable iron compounds, upon compounds of chromium in solution. A solution containing a higher molecular proportion of chromium salt over ferric salt may be prepared, for example, by treating 56 parts by weight of sodium bichromate with an equal weight of water and 140 parts by weight of hydrochloric acid (sp. gr. 1·15), and adding an excess (20 parts by weight) of ground iron pyrites. A solution is thus produced, containing sulphate and chloride of chromium and iron, the molecular proportion of Cr_2O_3 to Fe_2O_3 being about 5 : 1. The degree of basicity or acidity is controlled by regulating the amount of acid used. To obtain a solution containing approximately equimolecular proportions of chromium and iron salts, metallic iron or ferrous sulphite is used as the reducing agent. Thus, 56 parts by weight of sodium bichromate is mixed with 220 parts by weight of hydrochloric acid (sp. gr. 1·15) and the chromic acid is completely reduced to Cr_2O_3 at a temperature below 70° C. Any excess of metallic iron is separated, and the remaining solution consists of a mixture of chromic and ferric chlorides in substantially molecular proportions. A preparation containing a higher molecular proportion of ferric salt over chromium salt is produced by the use of a ferrous salt the acid radicle of which has no reducing action on sodium bichromate under the conditions prevailing. For example, if 56 parts by weight of sodium bichromate is treated with 162 parts by weight of hydrochloric acid (sp. gr. 1·15) and 516 parts by weight of a solution of ferrous chloride, containing 13·5% of metallic iron, a mixture of chromium and iron chlorides is obtained, containing approximately 1 mol. Cr to 3 mols. Fe. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 4890 of 1896, 14,052 of 1897, 5902 of 1903, and 16,887 of 1907; this J., 1896, 901; 1898, 589; 1903, 959; 1908, 82.)—S. S. A.

Ammonia; Extraction of —— from gases and vapours and the production of nitrogen compounds. E. L. Pease, Darlington. Eng. Pat. 121,754. (Appls. 13,560, 22.6, and 13,608, 21.9.17.)

The gases and vapours from gas producers, blast furnaces, etc., are passed upwards through a vessel into which is sprayed a solution of calcium or zinc chloride or other salt capable of forming a double compound with ammonia. Solid particles of soot, etc., removed from the gas, float on the solution and may be removed by means of a scraper. The solution from the absorption vessel is mixed with milk of lime, and the ammonia is distilled off. The residual liquid is filtered and used again as an absorbent. If the gases contain carbon dioxide, all horizontal projections must be avoided in the absorption vessel, as otherwise concretions of calcium carbonate will occur. Gases containing tarry matter may first be scrubbed with water and then treated with the salt solution or they may be treated directly with the latter. The hot ammoniacal solution may also be used for producing steam before being treated with milk of lime, and the ammonia-eliminating vessel may be combined with plant for producing nitric acid, nitric anhydride, or ammonium nitrate.—A. B. S.

Potassium-bearing silicates; Method of treating ——. W. Glaeser, Brooklyn, N.Y., Assignor to Potash Extraction Corporation, New York. U.S. Pats. (A) 1,285,121, and (B) 1,285,122, 19.11.18. Appl., 8.3.15.

(A) FINELY divided potassium-bearing silicate, or the material resulting from heating potassium-bearing silicates, in lump form, to about 800° C. and then suddenly cooling, is intimately mixed with quicklime and coke, in the proportion of 100 parts of silicate to 30 parts of lime. This mixture is heated in the presence of steam and air, at a temperature above 700° C. (B) Finely divided potassium-bearing silicate, or the material produced by heating the lump silicate, suddenly cooling it, and grinding to pass a 100-mesh screen, is mixed with sodium phosphate in the proportion of 100 to 25, and the mixture is heated above 1000° C. —S. S. A.

Magnesium carbonate; Process of manufacturing [light] ——. B. B. Grunwald, Redwood City, Cal., Assignor to National Magnesia Manufacturing Co. U.S. Pat. 1,285,683, 26.11.18. Appl., 20.5.16.

LIGHT calcined magnesite containing dead-burned magnesite is subjected to sedimentation in water to separate the latter.

Radioactive preparation. E. Heydenreich, Niederschöneweide, Germany, Assignor to Kunheim und Co. and Allgemeine Radiogen A.-G., Berlin. U.S. Pat. 1,285,704, 26.11.18. Appl., 11.12.13.

A BLOCK of inert porous material, *e.g.*, kieselguhr, having a cavity containing radiothorium, is arranged within a receptacle containing a liquid, *e.g.*, an acidulated weak solution of sodium chloride, which will not dissolve radiothorium but will dissolve the thorium-X formed by self-decomposition of the latter. (See also Ger. Pat. 279,956; this J., 1915, 355.)

Sulphur in globular form, and process of producing the same. R. P. Perry, Upper Montclair, N.J., Assignor to The Barrett Co. U.S. Pat. 1,285,358, 19.11.18. Appl., 11.10.17.

MOLTEN sulphur is injected, in the form of a spray, into a cooling medium by which it is solidified in the form of small globular bodies, devoid of sharp edges such as would be produced by a fracture. The process is applied to the production of sulphur, in this form, from subterranean deposits, the sulphur being fused *in situ* by means of superheated water.—S. S. A.

Tungstic acid and acids of certain other acid-forming elements and salts thereof; Process of extracting ——. J. B. Ekeley and W. B. Stoddard, Boulder, Colo., U.S.A. Eng. Pat. 122,051, 24.1.18. (Appl. 1390/18.)

SEE U.S. Pat. 1,255,144 of 1918; this J., 1918, 206 A.

Alkali perborates; Process of making ——. O. Liebknecht, Frankfort, Germany, Assignor to The Roessler and Hasslacher Chemical Co., New York. U.S. Pat. 1,281,983, 15.10.18. Appl., 29.2.16.

SEE Eng. Pat. 102,089 of 1916; this J., 1917, 31.

Acid pots. Eng. Pat. 121,855. *See* VIII.

Reducing metallic compounds. U.S. Pat. 1,288,716. *See* X.

VIII.—GLASS; CERAMICS.

Optical glass; Effect of certain impurities in causing milkiness in ——. C. N. Fenner and J. B. Ferguson. J. Amer. Ceram. Soc., 1918, 1, 468–476.

THE occasional production of milky optical glass was traced to the separation of clouds of minute crystals of cristobalite due to the catalytic action of small proportions of sulphate and chloride in the impure Russian potash which was used (*cf.* Turner and Cauwood; this J., 1917, 387). The defect was prevented by the use of a purer potash, containing not more than 0·3% SO_4 and 2·0% Cl, by prolonged stirring, more reliable control of the temperature, and by working at a slightly higher temperature. The devitrifying effect of the sulphates and chlorides present varies with the composition of the glass.—A. B. S.

Rational analysis of clays; Calculation of the ——. H. S. Washington. J. Amer. Ceram. Soc., 1918, 1, 405–422.

THE author assumes that clays are composed of four minerals corresponding to generalised formulæ, *viz*:—kaolinite ($Al_2O_3,2SiO_2,2H_2O$), orthoclase ($K_2O,Al_2O_3,6SiO_2$), albite ($Na_2O,Al_2O_3,6SiO_2$), anorthite ($CaO,Al_2O_3,2SiO_2$), limonite (Fe_2O_3,H_2O), with, in some cases, muscovite ($K_2O,2H_2O,3Al_2O_3,6SiO_2$), and recalculates the ultimate chemical analysis into the assumed minerals. The lime, soda, and potash are first calculated to the felspars, and the alumina and silica required for these are deducted from the total. The iron oxide is calculated as limonite. Any surplus alumina is calculated as kaolinite, and any surplus silica is then regarded as quartz. The author states that clays form a mineral mixture of so simple a character that this method of calculation expresses the actual composition very accurately. —A. B. S.

Firebricks at furnace temperatures: Porosity and volume changes of clay ——. G. A. Loomis. J. Amer. Ceram. Soc., 1918, 1, 384—404.

TEST-PIECES measuring $2\frac{1}{2} \times 1\frac{1}{4} \times 1\frac{1}{4}$ in. were cut from firebricks, dried at 110° C., soaked in boiling water under vacuum for four hours, and the wet weight and "suspended weight" of the soaked bricks determined. The percentage porosity was found from the expression:—

$$\frac{\text{wet weight} - \text{dry weight}}{\text{wet weight} - \text{suspended weight}} \times 100.$$

The volumes of the test-pieces were determined to within 0·2 c.c. in a Seger voluminometer. In burning the test-pieces the temperature was brought rapidly to 280°—300° C., held for 3—4 hours to volatilise any oil, then raised to 800° C., and afterwards rapidly to 1200° C. From 1200° C. to 1500° C. the temperature was increased at the rate of 30° per hour. The porosity and final volume of the test-pieces burned at different temperatures were afterwards determined. The softening point of the same firebricks without a load and the reduction in height after exposure for $1\frac{1}{2}$ hrs. at 1350° C. to a load of 40 lb. per sq. in. were also determined. Most of the firebricks which withstood the load test showed less than 3% change in volume and less than 5% decrease in porosity when burned at 1400° C. The majority of the bricks which failed under the load test showed greater changes in volume and porosity at some temperature below 1425° C. Bricks which are notably expanded and overburned below 1425° C. invariably fail under the load test. The changes in volume and porosity of bricks burned at some temperature between 1350° and 1425° C. give a fair

idea as to their ability to pass the load test, but no relation exists between the softening point with and without a load. The author suggests that the determination of the changes in volume and porosity before and after burning the samples at 1400° C. is quicker, simpler, and less costly (for a large number of samples) than the load test. For most purposes the volume may be measured sufficiently accurately by deducting the suspended weight from the wet weight of the sample, no voluminometer being required. The changes in porosity and volume after heating to various temperatures afford a means of determining the uniformity or otherwise in the quality of bricks, and of ascertaining the causes of failure, such as underburning or excessive shrinkage.—A. B. S

Silica refractories. D. W. Ross. J. Amer. Ceram. Soc., 1918, 1, 479—501.

THE most suitable quartzites for silica bricks are those which in thin sections under the microscope show the interstitial impurities as sharply defined lines between the interlocking grains of silica. Those which show cloudy areas between the grains are less suitable for silica bricks. Sandstones which, when crushed, break down to individual sand grains yield an excess of grains of certain sizes. Moderately metamorphosed material when crushed follows the theoretical curve for minimum pore space (Taylor and Thompson, "Concrete, Plain and Reinforced," p. 775), and the breaking of the grains is chiefly through the interstitial material. In highly metamorphosed quartzites the breaking is chiefly through the grains, but some grains break away from the interstitial material. In the screened material from several well known American silica brick works, most of the original rounded grains which broke free from the interstitial material passed through a No. 30 sieve (0·503 mm.), the greater part being retained on a No. 40 sieve (0·381 mm.) and No. 60 sieve (0·221 mm.). The quartzites which when crushed break by fracture through the interstitial material or by the grains breaking away therefrom, produce more porous bricks than those in which the silica grains themselves are broken. In some cases, ground material should be sifted into three sizes, which are afterwards mixed in the desired proportions in a concrete mixer. By this means, the percentage of material of each grade is kept constant. The porosity of the finished brick depends on that of the unburned material. The conversion of quartz into cristobalite progresses from the surface and along cracks towards the interior, and is the most rapid in quartzites having the greatest surface areas, but above 1400° C. the transformation is so rapid that this effect is scarcely noticeable. Bricks which contain a large percentage of untransformed quartz, *e.g.*, those produced by heating to 1500° C. in one day, are friable and porous ("punky"), but by maintaining the kiln at 1250° C.—1350° C. until a large proportion of the quartz has been converted into cristobalite or tridymite and then finishing the burning at a higher temperature (14 days' heating in all), a strong brick is formed. Such a treatment should produce non-porous bricks of low specific gravity. The specific gravity of silica bricks readily shows the degree of conversion of the quartz and a comparison of the sp. gr.-temperature curves shows clearly the manner in which the lime present increases the amount of transformation produced by a given heat-treatment. Increasing the lime to above 2% also increases the rate of transformation. Sodium chloride has a similar effect, but clay, alumina, and iron oxide have little effect. The strength of moderately burned or underburned silica bricks—when cooled—depends largely on the glassy bond formed by the action of the basic fluxes on the silica, and on the porosity of the raw material. Well-burned bricks have their strength increased by interlocking crystals of forms of silica of low specific gravity. The silica content should not be less than 94%; the alkalis should not exceed 0·5%. Iron oxide up to 1·6% does not appear to affect the refractoriness of the bricks. The limit for lime is usually said to be 2%, but larger amounts do not greatly lower the softening temperature. When ground and made into "cones" the softening point of the silica should not be less than that of cone 31 (1690° C.). The porosity of first-class American silica bricks is seldom below 23%, but a lower porosity may be desirable. When heated at 1500° C. under a load of 25 lb. per sq. in. a silica brick should not expand or contract linearly more than 1%.—A. B. S.

Magnesia; Sintering of ——. J. B. Ferguson. J. Amer. Ceram. Soc., 1918, 1, 439—440.

PURE, silky calcined magnesia which had been used as insulating material between the two heaters in a small electric resistance furnace of the cascade type was found to have formed a dense cake around the inner heater after the furnace had been maintained at 1600°—1720° C. for some hours. Under the microscope, the cake appeared to consist of periclase (crystalline magnesia) with less than 1½% of forsterite ($2MgO,SiO_2$) and no binder. The manufacture of magnesia ware without a binder therefore appears feasible if the product is fired at 1600°—1700° C.—A. B. S.

[*Ceramic*] *ovens and kilns with high thermal efficiency.* A. Bigot. Ceram. Soc., Jan. 9, 1919. [Advance proof.]

THE flue of a Perrot laboratory crucible furnace, 50 cm. × 31 cm. internal capacity, heated by several Bunsen burners, was built of refractory materials and surrounded by a pipe also of refractory material. Air drawn through the intervening space was used as a source of secondary air to the furnace. By this means, using 10 cb. m. of illuminating gas of inferior quality per hr., at a pressure of 40 mm., a temperature of 1750° C. was reached in 5½ hours. A small tunnel kiln 15 m. long has been erected in Paris, in which the "car" consists of one or more slabs of refractory material running on a series of balls, made of the same material, in a grooved track. The kiln is heated by illuminating gas of 8000 calories per kilo. by means of Bunsen burners, and by air passed through the cooling goods in the customary manner. This kiln at 1250° C. utilises 78% and at 1450° C. 70% of the available heat in the gas, and if lengthened sufficiently it would probably utilise 85%. It has been employed successfully for burning stoneware and clay products at 1250° C. with a fuel consumption of 50 kilos. per ton of fired products, for burning porcelain insulators at 1350° C. with a fuel consumption of 61 kilos. per ton, for porcelain insulators, cements, bauxite products, corindite, and chromite at 1450° C. with a fuel consumption of 75 kilos. per ton, for magnesia products at 1530° C. with a fuel consumption of 105 kilos. per ton, and for silica bricks at the same temperature with 130 kilos. of fuel per ton. The total period of burning from the setting to drawing does not exceed 5 hours. The output is 15—25 tons of material per 24 hours. Narrow tunnels are essential in order to make use of the radiant heat; for large outputs a series of tunnels should be used. The tunnel is completely surrounded by a porous insulating material. The tunnels may be fired direct, *i.e.* with the products of combustion distri-

buted among the goods, or muffled so as to protect the goods from contact with flame. Such kilns are suggested for reheating metals, enamelling, annealing glass, burning earthenware and other ceramic products, refractory bricks, crucibles, and chemical products.—A. B. S.

[*Pottery*] *colours produced by the use of soluble metallic salts.* P. G. Larkin. J. Amer. Ceram. Soc., 1918, 1, 429—435.

The use of soluble colours greatly facilitates the production of polychrome effects in terra-cotta manufacture and saves labour. The ware is sprayed with a glaze or slip to be used as a base and the soluble salt solution is then applied by hand painting. The colours were produced by dissolving a suitable metallic salt (ferric nitrate, cobalt chloride, uranium nitrate, manganese nitrate, chromium nitrate with zinc chloride, nickel nitrate, copper nitrate, tin chloride, or zinc chloride) in a mixture of 3 vols. of water and 1 vol. of glycerin and mixing 100 c.c. of the solution with 10 c.c. of wood alcohol. In each case a 50% solution of the salt was used, with the exception of the chromium nitrate, of which only a 25% solution was used and 2% of zinc chloride was added to produce a salmon colour. Compound colours were prepared by mixing two or more of the solutions together. For greens, a mixture of two or more of the following was used:—ferric nitrate, cobalt chloride, uranium nitrate, nickel nitrate, copper nitrate, and manganese nitrate. For blues, cobalt chloride was mixed with iron nitrate, nickel nitrate, or manganese nitrate. Browns were made by blending two or more of the following solutions:—manganese nitrate, ferric nitrate, nickel nitrate, chromium nitrate, and uranium nitrate. Greys were obtained by blending cobalt chloride and a brown solution. Yellows and orange were made by blending three or more of the following solutions:—uranium nitrate, manganese nitrate, chromium nitrate, ferric nitrate. A little aniline dye was added to the solutions in order that the painted area might be recognised more easily. The addition of a lead frit to a standard finish engobe—making due allowance in the latter to prevent it becoming glossy—greatly improves the colours produced by soluble salts.—A. B. S.

Cast iron enamels; Antimony oxide as an opacifier in ——. J. B. Shaw. J. Amer. Ceram. Soc., 1918, 1, 502—513.

Antimony oxide has the same opacifying power as tin oxide and is much cheaper. Only the purest oxide should be used. The best colour was found in the enamels with the highest silica; it may be controlled by the addition of ferric oxide, manganese dioxide, and lead oxide. The most brilliant of the enamels made were those highest in silica and lowest in cryolite. Enamels containing neither lime nor cryolite are liable to froth when melting and no enamel of the types examined can be made in the absence of lime, lead, or cryolite, though not more than 3% of cryolite should be used. Part of the lime should be present as fluorspar, but not more than 5% of this should be used. The fusibility of these enamels is similar to that of the ordinary tin enamels, and the opacity is quite as good when the tin oxide is replaced by an equal weight of antimony oxide. The batch should be melted under exclusively oxidising conditions. Special attention should be paid to proportioning the raw materials; efficient mixing, and proper melting. —A. B. S.

Enamel; Action of acetic acid solutions of different strengths on a sheet steel ——. L. J. Frost. J. Amer. Ceram. Soc., 1918, 1, 422—428.

Equal volumes of solutions containing from 1 to 100% of technically pure acetic acid were evaporated to dryness in small weighed dishes, coated internally with an alkaline borosilicate enamel of the composition (0·885 Na_2O, 0·085 K_2O, 0·015 CaO, 0·015 MnO), 0·263 Al_2O_3 (2·291 SiO_2, 0·452 B_2O_3, 0·701 F_2). The dishes were then washed and scoured with a soft abrasive so as to remove any loose material, dried on a hot plate, cooled, and re-weighed. The results showed a considerable variation in the action of the acid, the greatest effect (0·0223 grm. loss) being obtained with a 24% solution. With the 4% solution ordinarily used for testing cooking utensils, the loss was 0·014 grm. —A. B. S.

Patents.

Acid pots; Composition for the manufacture or lining of —— *or such like vessels.* C. F. Curtis, Pontardawe. Eng. Pat. 121,855, 19.2.18. (Appl. 2904/18.)

The pots are made of or lined with a composition the chief ingredient of which is a waste residue from furnaces in which pyrites has been burned, obtained in the form of a fine red powder. The following composition is suggested:—Sawdust 30%, Portland cement 30%, whiting 10%, waste residue 30%. The materials are mixed together and moistened. The mixture may be applied with a trowel to existing pots or moulded into any desired shape. The composition is also useful for the manufacture of electric fuse-boxes for use in coal mines.—A. B. S.

Furnaces and firebricks therefor. U.S. Pat. 1,285,244. *See* I.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Cast iron; Melting and freezing temperatures of the eutectic in iron-carbon alloys and the formation of grey ——. R. Ruer. Z. angew. Chem., 1918, 31, 242—244.

By means of autographic heating and cooling curves taken during the repeated melting and freezing of a white cast iron—preferably with about 2½% carbon—direct proof has been obtained of the existence of two distinct eutectic arrests. The higher one which occurs at about 1153° C. is the austenite-graphite eutectic, and the lower one, at 1144° C., the austenite-cementite eutectic. Both arrests have been observed in the same curve and a gradual transformation from the upper to the lower horizontal, *i.e.* from white to grey iron, produced by repeated re-heatings. Proof is thus adduced that graphite in grey pig iron can separate out directly from the liquid phase and need not necessarily be the result of the decomposition of pre-existing cementite.—F. C. Th.

Aluminium alloys; Analysis of ——. A. Travers. Chimie et Ind., 1918, 1, 708—711.

Two grms. of the alloy is heated with sodium hydroxide solution containing a small quantity of sodium carbonate; aluminium and zinc dissolve, whilst iron, copper, nickel, cobalt, calcium, magnesium, and the greater part of the manganese remain insoluble as hydroxides. The latter are separated by filtration and washed with dilute

alkali solution. The zinc in the filtrate is precipitated with sodium sulphide, the zinc sulphide is collected, dissolved in hydrochloric acid, and treated with an excess of ammonium chloride and ammonia to precipitate remaining traces of aluminium. The ammoniacal zinc solution is then neutralised and the zinc precipitated at 70° C. by the addition of an excess of ammonium sodium phosphate, NH_4NaHPO_4; the precipitate is collected, washed, and titrated with $N/5$ sulphuric acid, using methyl orange as indicator. Aluminium is determined in the filtrate from the zinc sulphide precipitate by Stock's method (Comptes rend., 1900, **130**, 175; this J., 1900, 276). The precipitate consisting of the hydroxides of the other metals contained in the alloy is dissolved in nitric acid, the solution boiled with the addition of ammonium persulphate, then rendered ammoniacal, the precipitate collected, dissolved in hydrochloric acid, the solution boiled, and the iron determined by titration with titanium trichloride solution. Manganese and copper are determined in separate portions of the alloy, the former by the persulphate method and the latter iodometrically. Cobalt and nickel, if present, are separated as sulphides before the manganese is determined; cobalt is determined by precipitation with nitroso-β-naphthol. Magnesium is precipitated as ammonium magnesium phosphate in the filtrate from the iron and manganese precipitate, and the phosphate is then titrated.—W. P. S.

Arsenic; Determination of —— in ferro-molybdenum and other alloys. O Binder. Chem.-Zeit., 1918, **42**, 619.

FOR the rapid estimation of arsenic in ferro-molybdenum, etc., the alloy is decomposed with nitric acid (sp. gr. 1·2) in a long-necked Kjeldahl flask, and the solution heated over a free flame with sulphuric acid until acid fumes cease to appear. The clear solution is then diluted with water, mixed with strong hydrochloric acid containing a ferrous salt, and the arsenious chloride distilled directly from the Kjeldahl flask.—C. A. M.

Ovens and kilns. Bigot. *See* VIII.

PATENTS.

Titaniferous iron material; Smelting ——. Industrie-en Mijnbouw-Mij: "Titan," The Hague, Holland. Eng. Pat. 114,309, 15.3.18. (Appl. 4633/18.) Int. Conv., 15.3.17.

A PORTION of the intimately mixed charge of ore, flux, and reducing agent is smelted in an electric furnace either in the briquetted or unbriquetted state, whilst another portion is reduced in a shaft furnace, this latter charge being exclusively in the form of briquettes. The shaft furnace is heated either partially or completely by the combustible gases generated in the electric furnace. Calcium fluoride may be incorporated in the charge in the proportion of ½—2% of the total weight.—C. A. K.

Iron and steel surfaces; Protection of ——. The Parkinson Stove Co., Ltd., and J. A. Thompson, Birmingham. Eng. Pat. 121,781, 24.12.17. (Appl. 19,057/17.)

FOR the production of a coating of magnetic oxide on iron or steel, the metal is heated in a gas furnace to 850°—925° C., a reducing atmosphere being maintained. Steam is then admitted to the furnace chamber through a number of pipes passing through the arch, and connected to a self-contained gas-heated steam generator by means of a horizontal main. The furnace is heated by means of atmospheric burners, the gas burning in a longitudinal combustion chamber in the presence of secondary air.—C. A. K.

Steel from scrap; Production of ——. W. G. Armstrong, Whitworth, and Co., Ltd., F. B. Trevelyan, and W. C. Rowden, Newcastle-on-Tyne. Eng. Pat. 121,785, 29.12.17. (Appl. 19,220/17.)

IN the process of melting steel scrap, briquettes of carbon, pressed into a dense mass with pitch or other similar material, are first charged into the furnace. As the metal melts carbon is absorbed and "burning" of the metal is prevented.
—C. A. K.

Reducing metallic compounds; Process of —— [with simultaneous production of cyanide]. H. Foersterling, Perth Amboy, N.J. U.S. Pat. 1,283,716, 5.11.18. Appl., 30.12.12. Renewed 28.3.18.

METALLIC oxides are reduced by a vaporised metal, *e.g.*, sodium, in the presence of carbonaceous and nitrogeneous matter. The reaction is carried out at a temperature suitable for the formation of the cyanide of the vaporised metal, and the reduction process is rendered substantially self-sustaining by the heat liberated in the formation of the cyanide.
—C. A. K.

Metallic composition [alloy]. G. P. Kline, Moline, Ill. U.S. Pat. 1,285,231, 19.11.18. Appl., 10.3.17.

AN alloy of 80 parts of copper and 20 parts of lead, and containing not more than 2% of phosphorus.
—C. A. K.

Electroplating apparatus. L. Potthoff, Flushing, N.Y. U.S. Pat. 1,285,369, 19.11.18. Appl., 31.1.16.

A ROTARY, perforated, tumbler barrel, of non-conducting and non-absorbent material, is mounted on a driving shaft at one end, and an "angularly adjustable" shaft passes through the other end, and is supported in a bearing on the inside of the driving end of the barrel. Adjustable cathode arms, of a material non-adherent to the metal to be deposited, are supported on the adjustable shaft, and means are provided for holding the arms stationary or permitting them to rotate with the barrel. The articles to be plated are suspended in contact with the cathode arms, and an anode member is supported outside the barrel.—B. N.

Lead; Method of refining ——. P. Werner, Philadelphia, Pa., Assignor to R. Spicer, Willmar, Minn. U.S. Pat. 1,285,511, 19.11.18. Appl., 3.1.17.

A BATH of molten lead is subjected to the action of the products of destructive distillation of a resinous substance, *e.g.*, by introducing amber into the molten metal. A layer of material is maintained on the surface of the bath to prevent oxidation of the surface metal.—C. A. K.

[Zinc] retort charging machines. W. J. Mellersh-Jackson, London. From Edgar Zinc Co., St. Louis, Mo., U.S.A. Eng. Pat. 112,119, 4.6.18. (Appl. 9233/18.)

Sintering ores; Methods and apparatus for ——. J. Gayley, New York. Eng. Pat. 115,023, 14.3.18. (Appl. 4545/18.) Int. Conv., 30.3.17.

SEE U.S. Pat. 1,247,061 of 1917; this J., 1918, 62 A.

Ores and solid salts; Treatment of —— by electrochemical reduction. A. A. M. Hanriot, Paris. U.S. Pat. 1,285,690, 26.11.18. Appl., 18.5.14.

See Fr. Pat. 469,516 of 1913; this J., 1915, 36.

Annealing metal wire by electricity. H. Alexander, W. T. Vint, and A. Imbery, Leeds. U.S. Pat. 1,285,887, 26.11.18. Appl., 6.6.18.

See Eng. Pat. 117,822 of 1917; this J., 1918, 589 A.

Case-hardening compound. L. C. Munn, Stourport. U.S. Pat. 1,286,061, 26.11.18. Appl., 12.2.17.

See Eng. Pat. 102,205 of 1916; this J., 1917, 38.

Extracting ammonia from gases. Eng. Pat. 121,754. *See* VII.

XI.—ELECTRO-CHEMISTRY.

Electrolytic production of alkali and chlorine. Yamazaki. *See* VII.

Electro-titrimetric analyses. Freak. *See* XXIII.

PATENTS.

Battery; Electric ——. H. F. French and R. C. Benner, Fremont, Ohio, Assignors to National Carbon Co., Inc. U.S. Pat. 1,285,054, 19.11.18. Appl., 6.6.16.

The battery comprises a zinc electrode, and an electrolyte consisting of ammonium hydroxide and an alkali hydroxide.—B. N.

Electrolytic apparatus employing filmed electrodes. R. D. Mershon and J. S. Riddle, New York. U.S. Pat. 1,285,305, 19.11.18. Appl., 14.12.10. Renewed 18.5.18.

Film-coated aluminium electrodes (see Fr. Pat. 423,598; this J., 1911, 632) are wholly submerged in the electrolyte, with similar film-coated aluminium connecting devices attached to alternate electrodes, and extending outside the electrolyte for connection to an external circuit. A supporting frame for the electrodes is provided with non-conducting spacing members between the electrodes, parallel to the flow of current through the electrolyte, and with supporting members below the electrodes, these members being provided with spacing and supporting devices having tapered ends engaging the electrodes at parts of small area.
—B. N.

Electrode-holders for electric furnaces [; Water-cooled ——]. C. W. Kayser and J. E. Robinson, Sheffield. Eng. Pat. 122,034, 12.1.18. (Appl. 729/18.)

Insulating mass especially for electric use. J. Andersen, Lillehammer, Norway. U.S. Pat. 1,285,889, 26.11.18. Appl., 1.6.16.

See Eng. Pat. 101,067 of 1916; this J., 1916, 971.

Electrical treatment of gases. Eng. Pat. 120,573. *See* I.

Carbonising coal, etc. Eng. Pat. 121,854. *See* IIB.

XII.—FATS; OILS; WAXES.

Shark and ray liver oils. M. Tsujimoto. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, 21, 1015—1042.

The oil from the liver of the shark, Imori-zame (*Pristiurus pilosus*, Garman), had the highest iodine value of the liver oils of the 13 species of Japanese sharks examined. It had the following characters:—Sp. gr. at 15°/4° C., 0·8664; acid value, 0·32; saponif. value, 28·2; iodine value (Wijs), 309·0; refr. index (20° C.), 1·4912; unsaponifiable matter, 85·5%; insoluble bromides of fatty acids, 7·0%; and squalene, about 79%. The other shark-liver oils had iodine values ranging from 91·3 to 236·6. The oils of low sp. gr. (below 0·9 at 15°/4° C.) invariably contained the hydrocarbon squalene. Both the liver and egg oils of the sharks known as the frill shark, *Chlamydoselachus anguineus*, Garman, and kinbei-zame, *Lepidorhinus kinbei*, Tanaka (a new species), also contained squalene. It was not present in the liver oils of the five species of Japanese rays examined, nor in the liver oil of an elephant fish, *Chimæra mitsukurii*, Dean.
—C. A. M.

Kaolin and alumina soaps; Determination of fatty acids in —— . E. Alpers. Z. öffentl. Chem., 1918, 24, 247—250.

Owing to the absorptive capacity of alumina for oils and soaps the determination of fatty acids in soaps containing kaolin and alumina is liable to give low results. Thus in the case of a commonly used method in which the soap is boiled with alkaline alcohol, and the residue washed with alcohol and then extracted for several hours in a Soxhlet apparatus with the same solvent, it was found that the alumina residue still contained soap after 25 hours' extraction. Accurate results are given by the following modification of Thieme's method (Seifens.-Zeit., 1916, 859):—Five grms. of the soap is heated on the water bath with sufficient water to dissolve the actual soap, and the solution treated with sufficient acid to redden litmus paper. It is then mixed with sodium sulphate and evaporated to dryness, and the residue ground with sand in a mortar, and extracted for 12 hours with ether. The ethereal extract is evaporated, and the residue of fatty acids dried for half-an-hour in the water-oven, and weighed. The method requires modification in the presence of the fatty acids of coconut or palm-kernel oils, which must be weighed in the form of their potassium soaps.—C. A. M.

Wax of shuei flowers. Tsuchihashi and Tasaki. *See* XX.

PATENTS.

Fatty materials; Process of hydrogenating ——. Hydrogenating unsaturated bodies. C. Ellis, Montclair, N.J. U.S. Pats. (A) 1,285,959 and (B) 1,285,960, 26.11.18. Appl., 21.10.15 and 24.3.16.

(A) Liquid fatty oils containing unsaturated bodies are hydrogenised by atomising a mixture of the oil together with a fatty acid soap of a metal having catalytic properties, *e.g.* nickel, with hydrogen at a temperature at which the catalyst is active, *i.e.* reduced to the colloidal metallic condition. The unabsorbed hydrogen is separated from the hydrogenated oil product and the liquid fatty oil material again atomised with the unabsorbed hydrogen. (B) An improvement in the process of hydrogenating unsaturated organic materials in the presence of a colloidal catalyst is effected by employing hydrogen freed from oxygen and chlorine.—A. de W.

Soap and process of making the same. J. W. Bodman, Western Springs, Ill. U.S. Pat. 1,285,004, 19.11.18. Appl., 17.1.16.

The compound consists of a non-liquid homogeneous mixture of an alcoholic soap mass and a hydrocarbon grease solvent, the proportion of the alcohol being less and that of the hydrocarbon more than 20% of the weight of the mixture.—W. P. S.

Oxidised products from fatty acids. Eng. Pat. 121,237. *See* XIII.

Treating fatty acids. Eng. Pat. 121,992. *See* XIII.

Linseed oil substitute. Eng. Pat. 122,015. *See* XIII.

Edible oils. Eng. Pat. 121,711. *See* XIXA.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Luminescence; Phenomena of ——, more especially those connected with radioactive luminous paints. Bahr. J. Gasbeleucht., 1918, **61**, 604—607, 614—616.

The phenomena of photoluminescence are briefly reviewed and the theory of the subject based on the work of Lenard and Klatt is given. According to the theory, the photoluminescence of alkaline-earth sulphides results from their crystalline structure and the presence of small quantities of impurities such as bismuth, lead, and copper; with increas of atomic weight and of dielectric constant, the radiation emitted moves towards the region of longer wave lengths in the spectrum. The phenomena of radioactivity are briefly reviewed and the nomenclature employed in evaluation of radioactive substances scientifically and in commerce is explained. Self-luminous paints are produced by admixture of radioactive matter with zinc blende. The binding material usually employed consists of pure nitrocellulose lacquer. The intensity of the emitted light in the case of feebly luminous paints is proportional to the amount of α-radiation furnished by the radioactive substance per unit weight of the paint. The luminosity however reaches a limiting value as the concentration of radioactive substance is increased. The laws determining the efficiency of any definite mixture of zinc blende and radioactive matter are obscure. The life of such luminous paint is determined by the alteration of the blende, and not by the decay of the radioactive matter incorporated. There is no appreciable chemical alteration produced in the blende. For any given powdered zinc blende, there is a definite thickness of layer with which the maximum luminous effect is secured, and this best thickness is determined by the size of the crystal particles constituting the powder. The luminosity of a paint containing 1 mgrm. of radiothorium per grm. of blende, corresponds to that of white paper illuminated by light of intensity 0·7 lux. The radioactive content of the commoner paints varies between 0·01 mgrm. and 0·1 mgrm. of radiothorium per grm. Applications of luminous paints are discussed. Bloch has used a luminous paint as a comparison standard in photometry, measuring thereby lights varying in intensity between 1000 and 0·1 lux.
—J. S. G. T.

Patents.

Varnish coating, dope, or lacquer; Manufacture of a plastic or solid material applicable also as a ——. S. J. Peachey, Stockport. Eng. Pat. 121,091, 11.12.17. (Appl. 11,267/18.)

In the manufacture of a plastic or solid material from rubber as described in Eng. Pat. 1894 of 1915 (this J., 1916, 479) the following solvents may be employed as alternatives to chloroform and carbon tetrachloride: alkyl, alkylene, alkenyl or aryl halides, such as trichloroethylene and tetrachloroethane.—E. W. L.

Varnish, lacquer, coating, or dope; Plastic or solid material, applicable also as a ——. S. J. Peachey, Stockport. Eng. Pat. 121,194, 11.12.17. (Appl. 18,342/17.) Addition to Eng. Pat. 1894, 6.2.15 (this J., 1916, 479).

In place of the chlorine used in the process described in the prior patent for the conversion of rubber into a plastic substance, sulphuryl chloride, or a mixture or succession of the two halogens, bromine and chlorine, may be used; and in place of the rubber balata or gutta-percha may be used.
—E. W. L.

Fatty acids or their metallic salts; Treatment of —— and manufacture of oxidised products therefrom. A. A. Lockwood and M. R. A. Samuel, London. Eng. Pat. 121,237, 14.3.18. (Appl. 4523/18.)

Fatty acids or their metallic salts, particularly those of linseed oil, are caused to react or combine with a borate; the fatty acids can then be oxidised with or without driers. For example, a mixture of the fatty acids with an equal weight of 10% borax solution is agitated and oxidised by a current of air and slowly heated to about 60° C. until suitable drying properties are acquired. Any of the usual substances employed in the manufacture of paint—such as litharge and metallic salts—may be added. Pale products may be obtained by treatment with calcium borate in the cold.
—E. W. L.

Fatty acids; Treatment of —— for use as oil mediums for paint and other purposes. A. P. Bevan, Liverpool. Eng. Pat. 121,992, 11.12.17. (Appl. 18,335/17.)

Fatty acids obtained by deglycerination of oils are treated, and in the case of linseed or analogous oils are rendered suitable as linseed oil substitutes for paint grinding and mixing or varnish manufacture, by reacting on them with calcium hydroxide or similar neutralising alkaline medium to such a degree as to inhibit solidification on mixing with pigments. A clear product is obtained by allowing the stearic acid and calcium stearate to separate by gravity or other means. For example, linseed oil fatty acids are heated to 160°—180° F. (71°—82° C.) and milk of lime in the proportion of 4%—7% by weight of dry $Ca(OH)_2$ on the fatty acids is added. The temperature is raised to 220°—230° F. (104·5°—110° C.) to drive off the water, the mixture being agitated meanwhile. The product is then allowed to stand at 70° F. (21° C.), with or without addition of 15%—20% of petroleum spirit, until clear, to separate stearic acid and calcium stearate. Addition of 3% by weight of cobalt resinate or other drier will produce a good drying oil.—A. de W.

Linoleum and the like; Manufacture of ——. A. B. Craven, Selby, and The Yorkshire Dyeware and Chemical Co., Ltd., Leeds. Eng. Pat. 121,777, 20.12.17. (Appl. 18,891/17.)

The resilient, tacky, and adhesive residue from the distillation, preferably *in vacuo* or inert gas, of fatty acids from drying or semi-drying oils (except tung oil) or their glycerides, or waste products from their refining, is employed as a linoleum "cement" for admixture with cork dust, etc., for the manufacture of linoleum. Waste products from

oils may be subjected to a preliminary bleaching process, whilst fatty acids or their glycerides may be thickened by heating previous to distillation. The waste products should be free from products derived from non-drying oils for use in the process described.—A. de W.

Linseed oil substitutes for paints, varnishes, linoleum and the like; Manufacture of ——. O. Wilkins and Co., Ltd., and W. A. Allsebrook, Derby. Eng. Pat. 122,015, 9.1.18. (Appl. 505/18.)

LINSEED oil substitutes suitable for the manufacture of paints, waterproofing compositions, linoleum, etc., are obtained by treating linseed oil fatty acids or products containing a proportion of the same with finely divided metals, *e.g.* iron, until partial saturation has taken place. Solution of the metal may conveniently be effected in the case of iron by allowing linseed oil fatty acids to percolate through a layer of iron filings in the presence of air, an iron content of 2—4% yielding a product liquid at ordinary temperatures and suitable as a paint medium, etc. A product containing 10% of iron is a solid elastic substance suitable for use in linoleum manufacture.—A. de W.

Varnish; Process for hardening ——. C. A. Cutler, Buffalo, N.Y. U.S. Pat. 1,283,685, 5.11.18. Appl., 28.5.12.

THE film of varnish on varnished articles is hardened by placing the latter in a closed chamber having at one side a permeable wall, the air within the chamber being heated at the side opposite to the permeable wall. The heated air which rises is cooled by contact with the wall of the chamber, and a portion is forced through the permeable wall near the top of the chamber, whilst at the same time external air is drawn through the lower portion of the permeable wall, thereby regulating the "quality" of the air within the chamber.
—A. de W.

Impregnating process. R. W. E. Moore, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,286,057, 26.11.18. Appl., 19.2.14.

POROUS material is moistened with a liquid of relatively low boiling-point, *e.g.* water, and is then treated under pressure with an impregnating liquid of higher boiling-point and immiscible with the moistening liquid, *e.g.* a melted waxy substance. The pressure at the time of treatment with the impregnating liquid is such that the moistening liquid cannot boil although at a temperature above its normal boiling-point. The temperature is then raised to the boiling-point of the moistening liquid at the working pressure and maintained until bubbling ceases.—A. de W.

Varnishes; Phenolic condensation product ——. H. Wade, London. From Redmanol Chemical Products Co., Chicago, Ill., U.S.A. Eng. Pat. 122,027, 10.1.18. (Appl. 604/18.)

SEE U.S. Pat. 1,261,615 of 1918; this J., 1918, 433 A. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 3497 of 1911 and 9281 of 1914; this J., 1912, 347; 1915, 562.)

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Preparation and vulcanisation of plantation Para ——. B. J. Eaton, J. Grantham, and F. W. F. Day. Agric. Bull., Fed. Malay States, 1918, No. 27, 398 pages.

A DESCRIPTION is given of the Malaya Experimental Testing Laboratory, together with a systematic compilation of the investigations which have emanated from this source; most of the experimental results have already been published in full or in abstract in this Journal (1913, 666; 1915, 989; 1916, 263, 264, 371, 715, 854, 1046, 1164; 1917, 16, 1116, 1217). The matters brought into consideration include the technique of vulcanisation methods, the variability of plantation rubber and its dependance on the conditions of coagulation, special processes for the preparation of raw rubber, and the acceleration of the vulcanisation of rubber by natural or artificial organic bases.—D. F. T.

PATENTS.

Ebonite, bakelite and such-like materials; Process for the manufacturing of a product substituting ——. Naami. Vennoot. Nederlandsche Maatschappij tot Exploit. van Optimietfabrieken, Assignees of S. van Raap, Amsterdam, Holland. Eng. Pat. 118,270, 13.6.18. (Appl. 9746/18.) Int. Conv., 14.8.17.

A SUBSTITUTE for ebonite, galalith, bakelite, and similar compositions is obtained by dissolving raw or vulcanised rubber waste in a drying oil, such as linseed oil, or in a vulcanisable oil, such as rapeseed oil, to which paraffin wax, stearin, resin, or similar materials have been added, and then introducing finely divided absorbent fillers, *e.g.*, chalk, barytes, infusorial earth, and clay; after the addition of sulphur or other vulcanising agent and thoroughly mixing, the mass is vulcanised.
—D. F. T.

Rubbers; Processes for producing pigmented —— *and products obtained thereby.* W. J. Mellersh-Jackson, London. From India Rubber Co., New York. Eng. Pat. 120,824, 2.1.18 (Appl. 147/18.)

A DRY, finely-divided pigment, *e.g.* aluminium powder, is applied to the surface of a sheet of unvulcanised rubber, and is embedded in the surface by vulcanising the rubber in contact with a confining surface, such as a layer of metal foil, which may be reeled into a compact roll with the rubber before vulcanisation. A smooth glossy pigmented surface is thus produced.—E. W. L.

Rubber; Artificial ——. E. R. Talley, Grinnell, Iowa. U.S. Pat. 1,285,463, 19.11.18. Appl., 12.9.18.

Two separate mixtures, one comprising a vulcanisable vegetable oil and resinous hydrocarbon bodies, and the other comprising a similar oil with fillers such as camphor and powdered shale, are blended together with the addition of sulphur, the mass being then vulcanised by heat and subjected to pressure after partial cooling.—D. F. T.

[Rubber] tyres; Method of treating old —— *to produce new material.* F. L. Harley, Folsom, Pa. U.S. Pat. 1,285,992, 26.11.18. Appl., 30.1.18.

THE rubber covering of old tyres is stripped from the fabric which is then subjected to heat and great pressure in order to compress the rubber particles with which it is impregnated and unite them firmly with the fabric. The resultant fabric stock is cut up into pieces, and the waste cuttings are ground up, spread over the pieces, and pressed together with them to form a built-up stock.—E. W. L.

Rubber; Compounding —— with powdery substances. W. C. Knowlton and H. A. Hoffman, Akron, Ohio, Assignors to B. F. Goodrich Co., New York. U.S. Pat. 1,286,024, 26.11.18. Appl., 28.8.17.

Powdery substances such as lampblack are converted into a granular form by mixing them with a concreting and binding liquid—*e.g.* water and a "binder"—drying the paste, and subdividing the mass into grains or lumps, which are then incorporated with the plastic substance (rubber) in a heated mixing mill.—E. W. L.

Plastic material. Eng. Pats 121,091 and 121,194. *See* XIII.

XV.—LEATHER; BONE; HORN; GLUE.

Patents.

Leather scrap; Making composition from ——. H. E. White, Birmingham. Eng. Pat. 120,802, 7.12.17. (Appl. 18,176/17.)

Leather waste or scrap is treated with a relatively weak solution of acid, *e.g.* 10% hydrochloric acid, with or without salts such as magnesium sulphate or common salt, and is then heated either alone or with methylated spirit, olive oil, or other oil, or with gelatin, until it becomes a more or less homogeneous mass which may be mechanically worked into a desired form by rolling, extruding or the like, and then treated with hardening agents such as formaldehyde, chromium compounds, tanning extracts, synthetic or other tanning compositions, or picric acid alone or in conjunction with oils. Organic or inorganic filling materials may be added during the treatment.—E. W. L.

Hides; Process for tanning or impregnating ——. K. Haring, Assignor to Anhydat-Leder-Werke A.-G., Hersfeld, Germany. U.S. Pat. 1,285,144, 19.11.18. Appl., 16.2.16.

Hides are impregnated with a filling material, *e.g.* molten asphaltic material, while subjected to reduced pressure, and they may then be subjected to a pressure greater than atmospheric. The hides may be previously dehydrated by treatment with a suitable liquid.—D. W.

Glue-extracting process. F. J. Turner, Walpole, Mass. U.S. Pat. 1,285,174, 19.11.18. Appl., 13.12.17.

Chrome-tanned leather or leather scrap is digested with an aqueous alkaline solution containing 0·75 oz. of caustic alkali per 1 lb. of dry leather, the mass is boiled until the glue substance is liberated, drained, and filtered clear. The glue solution, which is substantially free from chromium compounds, is evaporated to the desired viscosity. —D. W.

XVI.—SOILS; FERTILISERS.

Soil acidity as affected by moisture conditions of the soil. S. D. Conner. J. Agric. Res., 1918, **15**, 321—329.

Different types of acid soils were kept under different moisture conditions in pots for a year, at the end of which time it was found that the acidity varied with the different moisture conditions. Soils high in organic matter showed the greatest acidity when kept fully saturated, soils low in organic matter when kept half saturated. The potassium nitrate extracts of the fully saturated soils (U.S. Dept. Agric., Bureau of Chem., Bull. 107, 1908) contained much larger amounts of ferrous iron than those from soils kept at a lower water content. In the case of mineral soils the fully saturated soils had much greater amounts of soluble manganese but less soluble aluminium than the other soils. The measurable acidity of acid soils varies to a large degree under the different conditions of moisture and aeration, these variations being due to chemical rather than to physical changes in the soil.—W. G.

Hydrogen-ion concentration—soil type- common potato scab. L. J. Gillespie and L. A. Hurst. Soil Sci., 1918, **6**, 219—235.

The authors find that the results from the electrometric (this J., 1916, 266) and colorimetric (see Clark and Lubs, J. Bact., 1917, **2**, 1, 109, 191; also this J., 1915, 1226) methods of determining hydrogen-ion concentrations of soils agree within the limits of experimental error. It is necessary to add 1 or 2 c.c. of water per gram of air-dry soil, but this addition of water does not seem to be a serious limitation. Examination of a large number of soils showed a correlation between hydrogen-ion concentration and occurrence of common potato scab. Scabby potatoes were rarely produced on soils having a hydrogen-ion exponent as low as 5·2, but where the exponents were higher the soils generally did give scabby potatoes. The limiting zone of hydrogen-ion concentration for the scab organism is thus about the same for soil as for culture media. Further examination of a number of samples of Caribou and Washburn loams confirms the characteristic difference of hydrogen-ion concentration of these two types, the former having an exponent of about 4·8 and being free from scab, whereas the latter generally shows larger exponents and gives scabby potatoes.—W. G.

Aluminium; Presence of — as a reason for the difference in the effect of so-called acid soil on barley and rye. B. L. Hartwell and F. R. Pember. Soil Sci., 1918, **6**, 259—279.

Seedlings of barley and rye are equally affected by a given amount of acidity both in water and sand cultures, although rye will grow far more satisfactorily on an acid soil than will barley. Partial sterilisation of the soil by heat or antiseptics did not remove this difference in effect on the two crops. Various substances such as dihydroxystearic acid, manure extract, and ammonium sulphate, likely to be present in acid soils, were found to have an equal effect on barley and rye in water culture, and the aqueous extract of an acid soil affected barley and rye the same as did the acid soil itself. From a careful examination of the aqueous soil extract, it was shown that aluminium was the element responsible for the different influence on the plants. Equivalent amounts of aluminium sulphate and sulphuric acid when added to an optimum nutrient solution produced about the same depression of the growth of barley, and while a similar depression of the rye crop was obtained with the acid, the aluminium sulphate caused very little depression and scarcely affected the rye roots. Further, as the hydrogen-ion concentration of the nutrient solution containing the aluminium sulphate was only about one-fourth of that containing the sulphuric acid it was concluded that aluminium exerted a toxic effect on the barley. This active aluminium may be largely removed from the soil solution by the application of lime or phosphates, even acid phosphates (superphosphate).—W. G.

Aluminium; Influence of —— on the germination of seeds and the development of plants. J. Stoklasa, J. Sebor, W. Zdobnicky, F. Tymich, O. Horák, A. Nemec, and J. Cwach. Biochem. Zeits., 1918, **91**, 137—223.

A VERY detailed investigation on the action of aluminium, manganese, and iron ions on the germination of seeds, and on the growth of seedlings when present in the nutrient medium. Generally it was found that aluminium and manganese have a favourable effect in small amounts, but in larger quantities they are toxic. The toxicity of manganese can to an extent be counteracted by aluminium when the latter does not exceed a certain quantity. The investigations on growth refer to the action on xerophytes (to which aluminium is very toxic), hydrophytes, and hydrophils (which are relatively very resistant to aluminium). As regards mesophytes a toxic action could be determined in the case of iron ions which could be counteracted by aluminium. The paper contains a large amount of theoretical discussion on the mechanism of growth and the intensity of physiological action of the various ions. (See also J. Chem. Soc., 1919, i, 109.)
—S. B. S.

Soils; Determining the absolute salt content of —— by means of the freezing-point method. G. J. Bouyoucos and M. M. McCool. J. Agric. Res., 1918, **15**, 331—336.

IT is found that at a comparatively high moisture content the influence of the "unfree" water on the concentration of the soil solution is practically negligible. Based on this the following procedure has been adopted for making a comparative study of the absolute salt content of all kinds of soils. 15 grms. of the air-dry soil is poured into a freezing tube containing 10 c.c of distilled water, and the freezing-point is determined in the usual manner. From the depression the salt content of the soil in parts per million can readily be calculated. In the case of light soils it is better to use 20 grms. of soil to 10 c.c. of water and for alkali soils 1 grm. of soil to 5 c.c. of water.—W. G.

Soil factors affecting the toxicity of alkali. F. S. Harris and D. W. Pittman. J. Agric. Res., 1918, **15**, 287—319.

THE authors have made some 12,000 determinations of the effect of sodium salts on the germination and growth of wheat under different conditions. In sand cultures the toxicity of the alkali is not influenced by the size of the particles. Loam soils are more tolerant of alkali than either sand or clay, but in the case of coarse and fine loams, the moisture content is the important factor in controlling their tolerance as indicated by the behaviour of the seedling. Organic matter increases the resistance of the plant to alkali when the soil is given sufficient moisture, but if the content of organic matter is high and the moisture supply is low the resistance is diminished. As a general rule increasing the moisture content of a soil up to the maximum that will produce good crops increases resistance to alkali. The toxicity of sodium chloride and sodium sulphate seems to depend to some extent on the relation between concentration of salt and percentage of moisture present, whilst the toxicity of sodium carbonate is more largely affected by the presence of organic matter, which seems actually to remove sodium carbonate from the soil solution in large quantities.—W. G.

Actinomycetes in the soil; Occurrence of ——. S. A. Waksman and R. E. Curtis. Soil Sci., 1918, **6**, 309—319.

AN examination of 25 soils of North America and the Hawaiian Islands shows that on the average the actinomycetes form 17% of the total flora of bacteria and actinomycetes. Heavy soils and those rich in undecomposed organic matter are, as a rule, relatively richer in actinomycetes than corresponding lighter soils or soils poor in undecomposed organic matter. In the case of one soil, which was acid and covered with water for a large part of the year, the percentage of actinomycetes (on the total bacterial flora) fell to as low as 3·5. Many species of actinomycetes were isolated from the different soils examined.—W. G.

Soil; Organic phosphorus of ——. R. S. Potter and R. S. Snyder. Soil Sci., 1918, **6**, 321-332.

THE authors dispute the conclusions of Gortner and Shaw (this J., 1917, 606) that their method (see Soil Sci., 1916, **2**, 291) does not distinguish between absorbed and organic phosphorus in humus of soil. No organic phosphorus was found by their method in a subsoil containing colloidal clay in considerable amount but no organic matter. Thus their original results were not due to colloidal clay as Gortner and Shaw suggest. An examination of the curves for the hydrolysis of phytin and of nucleic acid by 5% sulphuric acid at 100° C. shows that both of these reactions are of the first order. No definite conclusions could be drawn from the curves for the hydrolysis of the organic phosphorus of three soils, but the direction of the curves was such that the organic phosphorus might have been due to phytin or to a pyrimidine nucleotide.—W. G.

Plant-food within the soil; Movement of ——. E. van Alstine. Soil Sci., 1918, **6**, 281—308.

FROM an examination of the three successive layers of the soil on the various permanent "Park" grass plots at Rothamsted, and of the 4-year rotation plots at the Pennsylvania State College, and the 5-year rotation plots at the Ohio Agricultural Experiment Station, taking into account the fertilisers applied over a long period of years, and of the yield and composition of the crops during that time, the author concludes that phosphorus, when applied as a fertiliser, remains almost at its place of application in the soil, until removed in crops or by erosion. The utilisation of phosphates from the surface layer, particularly by leguminous crops, is encouraged by the application of alkali salts. During the growing season with crops on land kept in good condition, the loss of nitrogen by drainage is very small, there being a tendency for nitrogen, added in the form of ammonium salts, to accumulate in the surface soil. Potassium is liable to movement within the soil as a result of the application of other fertilisers and may thus be leached beyond the reach of plant roots. Loss of magnesium is brought about by the use of ammonium salts as fertilisers. Calcium decreases with loss of carbonates, and application of alkali salts and ammonium salts also causes the loss of calcium from the soil.—W. G.

Potash; Solubility of the soil —— in various salt solutions. D. K. Tressler. Soil. Sci., 1918, **6**, 237—257.

CALCIUM sulphate increases the solubility of soil potash to an appreciable extent in some soils, whereas tricalcium and dicalcium phosphate have little or no action on the solubility of the soil potash and monocalcium phosphate appears to diminish the solubility. The action of calcium sulphate is more marked on the clay fraction of the soil than on the silt or sand. Solutions of carbon dioxide or calcium bicarbonate increased the solubility of the soil potash in a Dunkirk silt loam. Sodium salts are quite active in dissolving potash from soils, and the influence of sodium chloride increases with its concentration in the soil solution.
—W. G.

Azofication [in soils]. J. E. Greaves. Soil Sci., 1918, **6**, 163—217.

A SUMMARY of the literature on the subject of nitrogen fixation by *Azotobacter* and *Clostridium pasteurianum*.—W. G.

"Chlorine index" as a comparative measure of the richness of soils in humus. L. Lapicque and E. Barbé. Comptes rend., 1919, **168**, 118—121.

WHEN a quantity of soil is shaken with sodium hypochlorite solution, the hypochlorite is decomposed to an extent varying with the character of the soil. The "chlorine index" of the soil is taken as the volume of active chlorine which disappears when 10 c.c. of the soil is shaken with 50 c.c. of aqueous sodium hypochlorite (5 or 10 vols. of chlorine) for half an hour. This index affords a means of classifying soils in the order of their probable richness in humus, as it is found to vary directly with the humus content of certain known soils.—W. G

Soil; Absorbent power of dry or moist —— with respect to chlorine gas. D. Berthelot and R. Trannoy. Comptes rend., 1919, **168**, 121—123.

DRY sand, whether white or ferruginous, has a very low capacity for absorbing chlorine, but a peaty soil or leaf mould shows marked absorptive powers. The addition of 10% by weight of water either to the sand or to the soil markedly increases the absorption of the gas, but any further addition of water is without effect except so far as the added water dissolves some chlorine.—W. G.

Humic acids. Marcusson. *See* IIA.

PATENT.

Potassium from flue-dust; Process of extracting combined ——. E. W. Haslup, Bronxville, N.Y., Assignor to Haslup and Peacock, Inc., New York. U.S. Pat. 1,285,152, 19.11.18. Appl., 15.12.17.

FOR the preparation of crude potassium compounds suitable for use as fertilisers from flue dust containing potassium sulphides and silicates, the dust is treated with magnesium chloride solution to decompose the potassium sulphides present, and extract the soluble potassium compounds The insoluble residue, containing potassium silicate, is separated, and digested with hydrated calcium sulphate, thereby obtaining potassium sulphate.

—S. S. A.

XVII.—SUGARS; STARCHES; GUMS.

Determining copper. Kolthoff. *See* XXIII.

PATENT.

Adhesive material [from maize cobs]; Process of manufacturing an ——. F. B. La Forge, Washington, D.C. U.S. Pat. 1,285,247, 19.11.18. Appl., 13.4.18. (Dedicated to the public.)

CORN (maize) cobs are heated under pressure in water to dissolve colloidal matter; the colloidal solution is separated by pressure from the insoluble residue and concentrated to the consistence of a thick syrup.—J. F. B.

XVIII.—FERMENTATION INDUSTRIES.

Wine; Analysis of ——. Detection of cider, currant wine, etc., in wine. W. Schulte. Chem.-Zeit., 1918, **42**, 537—539, 557—558.

THE ordinary analytical data do not afford a means of detecting the presence of cider in wine, or even, in some cases, of distinguishing wine from cider. Wine, however, contains a considerable quantity of tartaric acid which is present in traces only in cider, gooseberry wine, currant wine, etc. Six genuine wines examined contained from 0·1535 to 0·2775 grm. of tartaric acid per 100 c.c., whilst the quantity in 8 samples of cider, gooseberry and currant wines varied from 0·0045 to 0·0486 grm. Wine does not contain citric acid, but this acid is present in cider, etc. The following procedure is recommended for the detection of tartaric acid:—20 c.c. of wine is treated with 1 c.c. of saturated calcium acetate solution and the mixture is placed aside for 24 hrs.; characteristic crystals of calcium tartrate are deposited. Such crystals are not given by cider or "berry" wines. If the clear liquor is then decanted from the crystals and mixed with an equal volume of 95% alcohol, the calcium salt of an unidentified acid is deposited. This calcium salt resembles calcium citrate in that it is soluble in water and insoluble in 45% alcohol, but the form of the crystals is quite different. The acid occurs in wine (0·076 to 0·331 grm. per 100 c.c.) but not in cider or "berry" wines. A further test for distinguishing between wine and cider, etc., consists in mixing 2 c.c. of the sample, 7·5 c.c. of water, and 0·5 c.c. of lead acetate solution in a graduated tube and allowing the mixture to settle for 24 hrs. In the case of wine the volume of the sediment will be from 25 to 42% of the volume of the mixture; with cider the sediment will be 4 to 20% of the total volume, whilst gooseberry wine gives 27 to 41% of sediment. If 10 c.c. of wine is treated with 10 c.c. of alcohol and 0·5 c.c. of saturated calcium acetate solution, the sediment produced will amount to 22 to 51% of the total volume; with cider, the sediment measures only 2 to 15% of the total volume. If 5 c.c. of wine is mixed with 10 c.c. of water and 5 drops of ammonia, a yellowish or violet coloration is produced and the mixture becomes slightly turbid; cider, under these conditions, yields a much stronger coloration but usually remains clear. (Compare also Pratolongo, this J., 1918, 745A.)

—W. P. S.

Glycerol in wines; Estimation of ——. M. Canónica. Anal. Soc. Quím. Argentina, 1918, **6**, 94—101.

THE method proposed has been tested on wines with low and also with high sugar content before and after the addition of a known quantity of glycerol; also with wines containing no sugar before and after the addition of 1% of sugar, and has been found to give concordant results. The technique of the method varies slightly according to the sugar content of the wine, the variation affecting chiefly the extent to which the preliminary evaporation is carried. 50 c.c. of the wine is acidified with a few drops of sulphuric acid, about 100 grms. of lead shot is added, and the solution is evaporated on the sand bath to about 3 c.c. 2—3 grms. of finely powdered slaked lime is added, and by rotation of the shot a fine homogeneous paste is produced. After a few minutes the glycerol is extracted with a mixture of alcohol and ether (1 : 1·75 by vol.), the residue washed by decantation, and the extract and washings are filtered and distilled to remove the solvent. The syrupy residue is dried at 70° C., cooled, and weighed. The impurities in the glycerin thus determined may be estimated by dissolving the residue in a

little water in a platinum crucible and evaporating to dryness on a sand bath at 180° C. The weight of the final residue is deducted from that already found. In the case of wines containing over 2% of sugar the procedure varies in that the lime paste first formed is extracted thoroughly with hot alcohol and filtered. The extract is then treated as a wine with low sugar content.—W. S. M.

Alcohol, etc.; Use of mucedines in the production of ——. P. Baud. Chimie et Ind., 1918, **1**, 699—707.

DURING recent years the use of moulds (Mucor Boulard No. 5; see this J., 1914, 497) for the saccharification of carbohydrates has extended considerably, having been adopted by more than 24 works; the quantity of alcohol produced by this means was 10,000 hectolitres in 1914 and 182,962 in 1917. Mucors may also be used in the preliminary saccharification in the manufacture of vinegar.—W. P. S.

Ether in ethyl alcohol. COX. *See* XX.

PATENTS.

Phlegms or wines and fermented musts; Apparatus for the rectification of ——. E. Barbet et Fils et Cie., Paris. Eng. Pat. 121,797, 10.6.14. (Appl. 19,326/17.) Addition to 14,041/14 (see Fr. Pat. 470,242; this J., 1915, 194).

A HEAT regenerator is added to the original apparatus in which circulate, on the one hand, the phlegms before admission to the purifying and concentrating column and, on the other hand, the residual waters from the rectifying column. Further, there are fitted steam-inlet valves for the purifying and concentrating column and for the rectifying column, also plugs between the purifying column for the forerunnings and the purifying and concentrating column and between the exhaust column of the musts and the rectifying column, the whole being arranged in such a way that, by merely operating the valves or plugs, the purifying column for wines and the exhaust column for musts, as well as the two differential regulators, may be put out of use, while the two ordinary regulators are employed for regulating the admission of steam to the phlegm purifying and concentrating column and to the rectifying column. Thus the continuous distilling and rectifying apparatus for wines and musts may be transformed at will into a continuous rectifying apparatus for phlegms.—J. F. B.

Brewing. E. Moufang, Kirn, Germany, Assignor to Nathan-Institut A.-G., Zurich, Switzerland. U.S. Pat. 1,286,055, 26.11.18. Appl., 11.5.17.

SEE Ger. Pat. 301,830 of 1915; this J., 1918, 346A.

XIXA.—FOODS.

Bread; Changes during the baking of ——. H. Mohorčič. Arch. Hyg., 1917, **86**, 241. Chem.-Zeit., 1919, **43**, Rep., 1.

A BREAD-BAKING test was made with 1595 grms. of flour (equal parts of wheat and rye flours), 100 grms. of pressed yeast, 50 grms. of salt, and 1000 grms. of water. The following changes were noted: Pentosans and rhamnosans were hydrolysed to pentoses and rhamnose. A loss of flour substance occurred in respect of starch and pentosan, amounting to 1·88% on a flour containing 13% of moisture. During the fermentation of the dough a new formation of fat took place as a result of the growth of the yeast.—J. H. J.

Milk; Sterilised, bake-house, "enzyma-," and "uviol-" ——. K. Müller. Zentr. Bakt., 1917, **47**, 385. Chem.-Zeit., 1919, **43**, Rep., 1.

IN sterilised infants' milk and bake-house milk there were as a rule by far fewer organisms than in pasteurised and raw milk, but still about 50,000 per c.c. In "enzyma" milk and "uviol" milk, in about 45% of the samples there were found more than 50,000 organisms per c.c. Streptococci characteristic of mastitis were found in sterilised infants' milk, bake-house milk, and "uviol" milk, but not in "enzyma" milk. Sediment was least in "enzyma" milk. Milk-souring bacteria were absent in sterilised milk, but present in the other cases. Enzyme reaction was negative in sterilised milk and bake-house milk, but positive in "uviol" and "enzyma" milk. Pathogenic bacteria were not found. The author considers that milk pasteurised in bottles for ½ hr. at 63° C. has the advantage that subsequent infection is prevented. The high price of "uviol" milk is not justified by the poor results obtained.—J. H. J.

Cacao shell; Determination of ——. A. W. Knapp and B. G. McLellan. Analyst, 1919, **44**, 2—21.

THE various processes for the determination of cacao shell in cacao powder are reviewed and described in detail and each has been subjected to critical investigation, the results of which are given. The authors are of opinion that the only method which, employed by itself, can give results of any value is the determination of crude fibre. Even this method has faults and necessitates consideration of the amount of crude fibre in cacao shell itself; this quantity may vary from 15·4 to 21·4% of the dry, fat-free substance, the average being 18·7%. The average amount in cacao powder may be taken as 5·8%. No process will determine as low a proportion of husk as 5%; if 8% is deducted from the shell percentage found, the cacao powder under examination will contain at least the remainder. The other methods examined included the determination of the nitrogen, elutriation and flotation methods, pentosan method, microscope methods, "cacao-red method," ash, soluble silica, iodine value of fat, cold water extract, etc. (See this J., 1908, 637; 1910, 369; 1911, 1466; 1918, 438A.)—W. P. S.

Silica and sand; Determination of —— [*in feeding stuffs*]. F. J. Lloyd. Analyst, 1919, **44**, 27—28.

To differentiate between sand and silica in the ash of a feeding stuff or similar substance, 2 grms. of the sample is incinerated at a low heat, the ash extracted with hydrochloric acid, and the insoluble portion collected and weighed; it represents the silica and sand together. Another portion of 2 grms. of the sample is also incinerated and the ash boiled with 10 c.c. of 10% sodium hydroxide solution; after dilution, the insoluble matter is collected, washed, ignited, digested with hydrochloric acid, again collected, ignited, and weighed; this gives the "sand" as distinguished from "natural silica."—W. P. S.

Silica and sand; Determination of —— [*in feeding stuffs*]. B. Dyer. Analyst, 1919, **44**, 28.

IN the determination of sand and "natural" silica in Indian rice bran (which may contain 20% or more of "natural" silica) the author prefers to use sodium carbonate in place of sodium hydroxide as recommended by Lloyd (preceding abstract). The total siliceous matter (ash insoluble in boiling hydrochloric acid) is weighed and then boiled with 100 c.c. of 10% sodium carbonate solution, the mixture filtered, and the residue washed, ignited, and weighed.—W. P. S.

PATENTS.

Food preparations consisting of cereals and milk; Preparing and preserving ——. W. H. Stevens, Portland, and S. C. Dunlap, Amity, Oreg., U.S.A. Eng. Pat. 115,618, 7.1.18. (Appl. 380/18.) Int. Conv., 2.5.17.

MILK is heated at 160°—170° F. (71°—77° C.) for 15 mins., and after cooling is mixed with 2 oz. of cleaned rice for every 13½ oz. of milk. The mixture is placed in a can, which is hermetically sealed, and sterilised at 236° F. (113° C.) for 20 mins., the can being agitated during the process. After removal from the steriliser, the can may be placed in a shaking machine for a few minutes.
—J. H. J.

Cereals, nuts, seeds, and the like; Sterilising ——. J. W. C. Hamilton and E. W. Quirk, Liverpool. Eng. Pat. 121,650, 10.1.18. (Appl. 585/18.)

THE grains, seeds, etc., are passed through a chamber where they are subjected to the action of formaldehyde vapour under slight pressure. The rate of movement of the conveyors is such that the seeds are in contact with the vapours for about 1 min.—W. P. S.

Edible oils and fats; Means for imparting a definite flavour and aroma to ——, and edible oils and fats so treated. J. de Bruyn, London. Eng. Pat. 121,711, 12.8.18. (Appl. 13,091/18.)

A SUBSTANTIALLY fat-free meal prepared from the seeds or fruits of leguminous plants, palms, etc., is heated at 130° to 195° F. (54° to 88° C.) for 10 to 30 mins. with water containing a small quantity (0·05 to 0·2%) of alkaline salts; the mash is then passed through a coarse wire sieve, cooled to 70° F. (21° C.), and treated with pepsin, pancreatin, or rennin, and a culture of lactic bacteria, preferably *Streptococcus lacticus*. Three oz. of pepsin is added to each 1000 gals. of liquid containing 3 to 4% of crude protein. The mixture is stirred until the desired degree of acidity has been produced, and is then emulsified at 70° to 100° F. (21° to 38° C.) with edible oils or fats; the quantity of the mixture used should be from 10 to 30% of the total emulsion. If desired, the mash obtained from the nuts may be dried under reduced pressure; the powder obtained can be stored for a long time, and is mixed with water, pepsin, etc., when required for use.—W. P. S.

Bread and other food products and processes for producing same. R. Graham, Cupar, Scotland. Eng. Pat. 116,272, 1.5.18. (Appl. 7300/18.) Int. Conv., 28.5.17.

SEE U.S. Pat. 1,264,876 of 1918; this J., 1918, 439 A.

XIXB.—WATER PURIFICATION; SANITATION.

Absorption of chlorine by soil. Berthelot and Trannoy. *See* XVI.

Electro-titrimetric analyses. Freak. *See* XXIII.

PATENTS.

Water-softening reagent; Process of manufacturing a ——. F. Blumenthal, Cologne-Braunsfeld, Germany. U.S. Pat. 1,285,603, 26.11.18. Appl., 3.1.18.

A SOLUTION of iron salts is precipitated by means of water-glass, and the precipitate is treated with a hot solution of an alkali with the object of increasing its capability of exchanging the base.
—J. H. J.

Sewage and analogous liquids; Apparatus for purification of ——. W. Jones, Stourbridge. U.S. Pat. 1,282,587, 22.10.18. Appl., 7.11.16.

SEE Eng. Pat. 19,916 of 1914; this J., 1915, 632.

Sewage and analogous liquids; Purification of ——. W. Jones, Stourbridge. U.S. Pat. 1,286,017, 26.11.18. Appl., 18.10.15.

SEE Eng. Pat. 22,736 of 1914; this J., 1915, 195.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Morphine in complex products; Determination of ——. *III. Opium and mixtures containing opium.* A. Tingle. Amer. J. Pharm., 1918, **90**, 851—861. (See this J., 1919, 27 A, 54 A.)

THE methods described previously (*loc. cit.*) cannot be applied to the determination of morphine in opium owing to the presence of resinous matters in the latter. These are precipitated and extracted together with the morphine, but may be separated by digesting the aqueous solution with salicylic acid, and cooling the mixture; the resins are, for the greater part, precipitated, and the morphine may be further purified by re-solution and extraction with a chloroform-alcohol mixture. The details of the method are as follows:—6 grms. of the opium is mixed with 2 grms. of calcium carbonate and a small quantity of water and heated for 10 mins. on a water-bath; after cooling, 60 c.c. of cold saturated barium hydroxide solution is added, the mixture shaken occasionally during 30 mins., then diluted to 100 c.c., and filtered. Fifty c.c. of the filtrate is rendered slightly acid with sulphuric acid (1 : 5), then slightly alkaline with sodium hydroxide solution, and solid salicylic acid is added, in small quantities at a time, until the mixture has an acid reaction; an excess of 0·5 grm. of salicylic acid is then added, the mixture heated in boiling water for 10 mins., cooled, diluted to 55 c.c., and filtered. Fifty c.c. of the filtrate is evaporated almost to dryness, the residual solution diluted to 5 c.c., and 5 c.c. of chloroform and about 3 drops of ammonia are added; the distinctly alkaline mixture is stirred, set aside for 4 hrs., and the precipitate then collected on a cotton-wool filter and washed with about 10 c.c. of water (this may be saturated previously with morphine). The impure, yellowish morphine thus obtained is dissolved in dilute sulphuric acid, the cotton-wool filter is washed with water, and the solution, measuring not more than 20 c.c., is rendered alkaline with ammonia and extracted repeatedly with a chloroform-alcohol mixture (2 : 1); the united extracts are evaporated, and the residue of morphine titrated.—W. P. S.

Nicotine; The physical constants of ——. *I. Specific rotatory power of nicotine in aqueous solution.* H. Jephcott. Chem. Soc. Trans., 1919, **115**, 104—108.

THE specific gravity and specific rotatory power of pure nicotine have been determined. Nicotine purified through the nitroso compound showed sp. gr. 1·00920 at 20°/4° C.; $[\alpha]_D^{20}=168{\cdot}52$, and another preparation, purified through the double zinc chloride compound, showed: sp. gr. 1·00925 at 20°/4° C.; $[\alpha]_D^{20}=168{\cdot}61$. The same constants have been determined for aqueous solutions of nicotine over the entire range. The sp. gr. at 20°/4° C. has a maximum value of 1·03990 at a concentration of 71·963 grms. per 100 c.c., or 69·202% by weight. The specific rotatory power falls rapidly at first on

dilution and then more gradually, reaching a minimum value of 79·25 at a concentration of 6·622 grms. per 100 c.c. The curve, however, is not a continuous sweep downwards, but shows a series of small rises at intervals corresponding to hydrates in molecular proportions. The sp. gr. of pure nicotine has been determined at various temperatures from 20° (1·00925) to 97·7° C. (0·94534). The specific rotatory power rises slightly with increase of temperature to 169·71 at 92° C. Owing to the so-called closed curve of solubility of nicotine in water, the constants cannot be determined for solutions containing between 7 and 87% of nicotine at all temperatures, because separation occurs at about 60° C. For concentrations just outside these limits, values have been determined at 20° and 90° C., which show a strong increase of specific rotatory power at the higher temperature. The peculiar behaviour of mixtures of nicotine and water is explained by the fact that nicotine is only sparingly soluble in water, and water is only sparingly soluble in nicotine, but the hydrates of nicotine are miscible with either, a state of balance existing between nicotine, its hydrates, and water. —J. F. B.

Phenacetin and other p-aminophenol derivatives; Determination of — — by hypochlorous acid. A. D. Powell. Analyst, 1919, **44**, 22—25.

In acid solution, *p*-aminophenol and *p*-phenetidine react with sodium hypochlorite, quinonechlorimine being formed: $HO.C_6H_4.NH_2,HCl+4Cl=4HCl+O:C_6H_4.NCl$. Owing to the difficulty of determining when an excess of chlorine has been added, direct absorption does not form a suitable base for calculating the result; however, when the quinonechlorimine is treated with hydriodic acid, the reverse reaction takes place, four atoms of iodine being liberated and *p*-aminophenol re-formed. The *p*-aminophenol or *p*-phenetidine is dissolved in 100 c.c. of water and 5 c.c. of concentrated hydrochloric acid and 10 c.c. of sodium hypochlorite solution (about 0·8*N*) are added; air is then blown through the mixture for 15 mins., to remove excess of chlorine, potassium iodide solution is added, and, after 5 mins., the iodine is titrated with *N*/10 thiosulphate solution. Each c.c. of the latter is equivalent to 0·00273 grm. of *p*-aminophenol or 0·00343 grm. of *p*-phenetidine; the result obtained is multiplied by 1·015 to correct for loss during aeration. In the case of phenacetin, the substance is boiled for 1 hr. with hydrochloric acid (phenacetin, 1 grm., concentrated hydrochloric acid, 25 c.c., and water, 15 c.c.) before the above process is applied. One c.c. of *N*/10 thiosulphate solution is equivalent to 0·00448 grm. of phenacetin. The presence of caffeine does not interfere with the determination of phenacetin, but if salol is present salicylic acid and phenol must be removed after the hydrolysis; the method cannot be used for mixtures of phenacetin and acetanilide, unless the latter is separated previously, but may be applied to the determination of lactophenin (lactyl-*p*-phenetidine), salophen (salicylic ester of acetyl-*p*-aminophenol), and certain photographic developers such as metol (methyl-*p*-aminophenol sulphate). In the case of metol, the presence of the methyl group prevents chlorination of the amino group, although a quinone derivative is formed; the latter liberates two atoms of iodine per molecule instead of four, as in the case of quinonechlorimine.—W. P. S.

Ether in ethyl alcohol; Determination of small quantities of ethyl ——. H. E. Cox. Analyst, 1919, **44**, 26—27.

Alcohol of 99%, and upwards, distils over unchanged under ordinary conditions; any ether present passes over in the first fractions, and no constant boiling mixture is formed. It is, therefore, possible to determine the amount of ether by taking the sp. gr. before and after distillation. The sp. gr of the alcohol is assumed to be that found after the removal of the ether. Each 1% of ether lowers the sp. gr. of alcohol by 0·0007, and the quantity of ether present is indicated by the expression: $\frac{\text{sp. gr. of alcohol} - \text{sp. gr. of mixture}}{0{\cdot}0007}$. Tables are given showing the effect of ether on the sp. gr. of alcohol.—W. P. S.

Essential oil and wax of shuci flowers (Jasminum odoratissimum, L.). R. Tsuchihashi and S. Tasaki. Kōgyō-Kwagaku-Zasshi (J. Chem. Ind., Tokyo), 1918, **21**, 1117—1143.

The fresh flowers of shuei (*Jasminum odoratissimum*, L.), which is cultivated in Formosa and used for perfuming tea, yielded on extraction with petroleum spirit 0·277% of "concrete essence," which was separated by maceration with alcohol into 0·116% of essential oil and 0·166% of "flower wax." The enfleurage process of extracting the essential oil was unsuccessful. The oil was a reddish-brown liquid with the following characters:—Sp. gr. at 15° C., 0·9309; $n_D^{15}=1{\cdot}4845$; α_D^{15} (100 mm.) $=+5{\cdot}64$; acid value, 5·85; saponif. value, 92·25; and saponif. value after acetylation, 186·20. By fractional distillation the oil was separated into a series of fractions boiling at 66° to 200° C., in which the following constituents were identified:—*d*-Linalool, 6%; *d* linalyl acetate, 6%; benzyl alcohol, 1·6%; benzyl acetate, 6%; indole and methyl anthranilate, 10%. In the higher fractions a substance which was probably a sesquiterpene alcohol or diterpene alcohol was separated. It constituted the main portion (57%) of the oil. Hesse's "jasmon" was not found in any fraction, and the characters of the oil were different from those of *Jasminum grandiflorum*, L., studied by Hesse and Müller (this J., 1901, 275, 1137). The flower wax had the following characters:—Sp. gr. at 100°/15° C., 0·8259; m.pt., 45°—47° C.; $n_D^{60}=1{\cdot}4622$; $[\alpha]_D^{18}=-0{\cdot}11$; acid value, 1·25; saponif. value, 67·53; unsaponif. matter, 67·07%; iodine value (Hübl), 100; and Reichert-Meissl value, 1·0. The unsaponifiable matter consisted mainly of triacontane, $C_{30}H_{62}$.—C. A. M.

Patents.

Diolefines; Process of making ——. G. Mersereau, New York, Assignor to Chemical Development Co. U.S. Pat. 1,282,906, 29.10.18. Appl., 30.9.12.

Vapours of a petroleum oil are maintained in contact with a surface heated to a gas-making temperature (about 700° C.) for a time insufficient to convert all of the vapours into gas but until the proportion of diolefines in the gas has become substantial and ceases to increase rapidly. The gas is then removed from contact with the heated solid surface, cooled to remove oil vapours, and the diolefines are subsequently removed from the gas, the residue being re-heated to produce more diolefines.—J. F. B.

Hydantoin; Process for the production of new derivatives of —— L. Hermanns, Heidelberg, Assignor to Farbw. vorm. Meister, Lucius, und Brüning, Höchst, Germany. U.S. Pat. 1,285,703, 26.11.18. Appl., 14.2.16.

See Eng. Pat. 105,719 of 1916; this J., 1917, 615.

Hydrogenating. U.S. Pat. 1,285,960. *See* XII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Yellow dye; New —— and [photographic] light filters made from it. C. E. K. Mees and H. T. Clarke. Communication No. 75 from Eastman Kodak Res. Lab. Brit. J. Phot., 1919, **66**, 48.

THE dye most commonly used, before the war, for the preparation of yellow light-filters for use with colour-sensitised plates was the German Filter Yellow K, introduced in 1907. A satisfactory substitute for this has been found in the group of phenylglucosazones, the best compound being the sodium salt of glucosephenylosazone-*p*-carboxylic acid. This is prepared from *p*-nitrotoluene by successive oxidation, reduction, diazotising, and formation of the glucosazone of the resulting acid. The acid is insoluble in water and almost insoluble in alcohol, but the sodium salt is very soluble in water and gives light-filters which are very stable to light, though not quite so stable as those prepared with Filter Yellow, have a sharper cut in the light blue than Filter Yellow, and nearly as strong an absorption in the ultra-violet. Absorption curves are given for filters of various strengths of the new dye, Eastman Yellow, compared with Filter Yellow and Tartrazine.—B. V. S.

Moisture; Action of —— on the sensitiveness of photographic plates. E. Cousin. Bull. Soc. Franç. Phot., 1918, **6**, 27—28.

EXPERIMENTS are described to demonstrate the reduction of sensitiveness of a photographic plate by moistening the film. For example if a plate be placed in contact for some time with a piece of damp paper, on which a design is printed in greasy ink, impervious to moisture, a positive of the design is obtained on slightly exposing and developing the plate.—B. V. S.

[*Photographic*] *reducing bath of acid potassium bichromate.* E. Cousin. Bull. Soc. Franç. Phot., 1918, **6**, 26—27.

IN consequence of the high price of potassium ferricyanide a reducing solution is recommended containing one part of potassium bichromate and 20 parts of sodium bisulphate per 1000 parts of water. If too low a proportion of bisulphate is used an intensifying effect is produced by the formation of silver chromate.—B. V. S.

Phenacetin, etc. [*metol*]. Powell. *See* XX.

PATENTS.

Coloured photographic views; Method of producing ——. H. Pedersen, Copenhagen. Eng. Pat. 121,776, 15.12.17. (Appl. 18,648/17.)

A TRANSPARENT base is provided with a multicolour screen, the colours of which are insoluble in water but soluble, for example, in alcohol, and to this is applied a light-sensitive film containing also a white pigment. After exposure through the colour screen and development, the silver image is bleached in a bath which at the same time hardens the gelatin film proportionally to the depth of the image, the bleached image is fixed out, and the soluble parts of the gelatin film are then removed by treatment with hot water. After drying the film is pressed into contact with a colourless gelatin film moistened with alcohol, the colours of the screen being then transferred to the two upper films in proportion to the quantity of the lower film which is left at any part. When the transfer of the colours is complete the upper film is removed, and the lower film dried and transferred by a double transfer process to a black paper support.

—B. V. S.

Photo-engraving. C. P. Browning, New York. U.S. Pat. 1,285,015, 19.11.18. Appl., 8.6.15.

A METALLIC plate is provided with two sensitive films, the lower one being much less sensitive than the upper one and separated from it by a transparent protective coating. A negative is formed on the upper film, the lower film exposed through it, the negative and protective coating removed, and the positive developed. The lower film forms the resist in etching the metal support.—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Trinitrotoluene residues and their utilisation [*for explosives and sulphur dyes*]. M. Copisarow. Chem. News, 1919, **118**, 13—14.

THE recovery of trinitrotoluene residues from the used nitration acids is usually effected by diluting the acids with water so as to precipitate the nitro compounds. This process if carried beyond a certain point has the drawback of requiring the concentration of large volumes of dilute acid to recover the acid. A better method is to dilute the acid sufficiently to precipitate the bulk of the nitro compounds and then to extract the acid with toluene, so as to obtain a still fairly concentrated acid, and a toluene extract, which can be nitrated (cf. Leitch, Eng. Pat. 15,455 of 1915; this J., 1916, 869). For the purification of crude T.N.T. by means of alcohol, the latter is used either as a solvent and crystallising agent or as a washing medium. In either case the residual alcohol when evaporated leaves a dark brown thick liquid, sparingly soluble in water, forming a yellowish solution, which on treatment with sodium hydroxide gives a red coloration characteristic of α-trinitrotoluene and other nitro compounds accompanying it. Analysis of a sample of the residue gave the following results:—Sp. gr. at 20° C., 1·47 and 1·50; volatile matter (alcohol, water, etc.), 0·77 and 0·81%; substances insoluble in benzene (oxidation and condensation products of polynitrotoluenes and inorganic substances), 1·35 and 1·40%; and nitrogen in purified residue, 15·95 and 16·01%. The proportion of nitrogen showed that the purified residue consisted of 80·32 to 82·26% of dinitrotoluenes and 17·74 to 19·68% of trinitrotoluenes. On standing for a long time at the ordinary temperature the residue gradually crystallises into a semi-solid mass, which can be separated by means of a filter-press or centrifuge into:—(*a*) a brown solid containing 1·45 to 1·55% of substances insoluble in benzene; and (*b*) a liquid resembling the original residue. The proportion of solid matter varies with the conditions of the alcoholic treatment, and duration and range of cooling, but is seldom less than 18%. By nitrating the crude residue at 100°—120° C. with a mixture of nitric and sulphuric acids containing 6% of water and 15 to 17% of nitric acid, a light yellow opaque liquid (sp. gr 1·49 to 1·51 at 20° C.) is obtained. It contains 16·94 to 17·4% N, corresponding to 48·4 to 64·5% of trinitrotoluenes, and forms a gelatinous mass with guncotton. It may thus be regarded as a "liquid T.N.T." suitable for the preparation of gelatinous dynamite and compares favourably with Nobel's explosive (Ger. Pats. 24,235, 264,503). Nitration of a residue previously freed from volatile substances and substances insoluble in benzene yields practically the same product, though it effects a certain economy in acid. By nitrating the products thus obtained from the residue or the original residue itself with a mixed acid containing 4% of water and 17% of nitric acid at 120° C. a slightly yellowish solid resembling crude trinitrotoluene of good quality is obtained. This solidifies at 57°—58° C.,

whilst the amount of nitrogen (18·44%) indicates that it contains at least 98% of trinitrotoluenes. It appears to be a mixture of isomeric trinitrotoluenes or additive compounds thereof, and may be conveniently termed "iso-trotyl." It could be used as a constituent of blasting powders, such as bellite and roburite, or for war explosives, especially when a lowering of the m.pt. is required, as in the case of trinitroxylenes. The method of dissolving the residue in toluene and nitrating the filtered solution in two or three stages is unsatisfactory, since a portion of the nitrated product is the liquid compound described above. This is probably due to the fact that the dinitrotoluenes derived from *m*-mononitrotoluene are not nitrated so readily as those derived from the *o*- and *p*-modifications, and also to the gradual reduction in the strength of the mixed acid. The facts support the conclusion that the solid compound represents a higher stage of nitration than the liquid, but that both ultimately yield, on complete nitration, a mixture of isomeric trinitrotoluenes. The most economical method of preparing "liquid T.N.T." and "isotrotyl" in one operation is to cool the crude residue, separate the solid, which is then nitrated to "isotrotyl," whilst the filtrate is nitrated to "liquid T.N.T." By an adaptation of Hofmann's method of preparing chloropicrin, $CCl_3(NO_2)$, (Annalen, 1866, **139**, 111), it is possible to prepare that compound by treating T.N.T. residues with bleaching powder, the yield, allowing for the proportion of nitrogen, being as satisfactory as that obtained from picric acid residues. By fusing T.N.T. residues or their nitration products with sodium sulphide, with or without the addition of sulphur, dyestuffs are obtained which dye unmordanted cotton colours varying from grey to khaki and brown. The particular shade depends upon the concentration of the dye-bath, the temperature and duration of the fusion, and whether sulphur is or is not used in making the dyestuff.—C. A. M.

Glyceryl methyl ether dinitrate (*α-methylin dinitrate*). D. T. Jones. Chem. Soc. Trans., 1919, **115**, 76—81.

THE dinitrate was prepared by the nitration of glyceryl α-monomethyl ether by a mixture of nitric and sulphuric acids between 13° and 20° C. The product was completely soluble in the nitrating acid and mostly precipitated by dilution; the portion soluble in the dilute acid was extracted by ether after neutralisation, the total yield being 77% of the theoretical quantity. The pure dinitrate crystallised with difficulty; the crystals melted at 24° C. It distilled at 124° C. under 18 mm. pressure. Evaporation tests showed a rate of volatilisation at 100° C. 7—8 times as fast as that of nitroglycerin. The liquid has sp. gr. 1·374 at 15°/15° C., and $n_D^{21}=1·4478$. It is soluble in many organic solvents but not in carbon bisulphide or light petroleum. It gelatinises nitrocellulose rapidly in the cold and after warming yields a gelatin softer and more plastic than that made with nitroglycerin. Comparative tests with dynamites made with the methyl ether dinitrate and ordinary nitroglycerin showed that the ballistic power of the dinitrate-dynamite was slightly more than two-thirds of that of nitroglycerin, and it was far less sensitive to shock. On heating, the methyl ether dinitrate exploded at 182°, as compared with 192° C. for trinitroglycerin. Determinations of the molecular freezing point depression constant for nitroglycerin in admixture with the dinitrate showed values from 72·4 to 81·0, not very greatly different from those obtained with ethyl nitrate and monochlorohydrin dinitrate. Attempts to obtain a labile form of the dinitrate analogous to that of nitroglycerin gave no result.—J. F. B.

XXIII.—ANALYSIS.

Electro-titrimetric analyses; Effect of dilution in ——. G. A. Freak. Chem. Soc. Trans., 1919, **115**, 55—61.

WITH a view to the possible application of electro-titrimetric methods to the analysis of potable waters, the author has determined the lower limits of concentration at which the method can be used. The conditions of experiment employed were kept as simple as possible, no special precautions being taken to maintain a constant temperature during the titration, which usually occupied 15—20 minutes; burettes capable of being read to 0·01 c.c. were used. In the estimation of sulphates by the addition of *N*/25 barium chloride the results were accurate only down to a concentration of 200 mgrms. SO_4 per litre. In more dilute solutions no definite end point, as indicated by a sharp break in the conductivity curve, was observed. When barium sulphate was added before titration, in order to saturate the liquid with the precipitated product, good results were obtained down to a concentration of 50 mgrms. SO_4 per litre. This appeared to be the limit for a definite end point, but results within about 5% of the truth could be obtained with a solution containing 25 mgrms. SO_4 per litre by extending the two straight limbs of the curve to a point of intersection. In the estimation of chlorides by *N*/25 silver nitrate definite end points were obtained down to 10 mgrms. Cl per litre; the addition of precipitated silver chloride did not render the end point sharp at lower concentrations. In the titration of calcium chloride by *N*/10 ammonium oxalate, the limit for sharp results was 200 mgrms. Ca per litre. The same limit was obtained in the titration of magnesium sulphate by *N*/10 sodium hydroxide. In neither of these cases did the addition of some of the precipitated substance improve the results at lower concentrations.—J. F. B.

Barium; Volumetric determination of ——. T. Steel. Analyst, 1919, **44**, 29.

IN the determination of barium as chromate according to the method described by Waddell (this J., 1918, 561A), the author recommends the use of water saturated with barium chromate for washing the precipitate before the latter is dissolved and titrated.—W. P. S.

Copper; Determination of —— by means of potassium thiocyanate, potassium iodide, and thiosulphate. I. M. Kolthoff. Chem.-Zeit., 1918, **42**, 609—610.

THE method, originally proposed by Bruhns (this J., 1918, 751A), is criticised and modified; when carried out as follows it is reliable:—The copper solution is treated with 10 c.c. of 0·2% potassium iodide solution, 5 c.c. of 4*N* sulphuric acid, and 10 c.c. of 10% potassium thiocyanate solution, and then titrated with *N*/10 thiosulphate solution. The acid must be added before the thiocyanate. The reaction may be used for the determination of excess of copper in sugar determinations; in this case, the cuprous oxide need not be separated but it is essential that the acid and thiocyanate be added immediately one after the other to prevent oxidation of the cuprous oxide. Copper may be determined in the presence of ferric salts provided that the mixture is first treated with sodium pyrophosphate solution.—W. P. S.

Alkali carbonates in presence of free alkali, and flue gases. Dubrisay and others. *See* VII.

Spent oxide. Colman and Yeoman. *See* VII.

Ferric oxide in silicates. Hackl. *See* VII.

Rational analysis of clays. Washington. *See* VIII.

Aluminium alloys. Travers. *See* X.

Arsenic in ferromolybdenum. Binder. *See* X.

Fatty acids in kaolin and alumina soaps. Alpers. *See* XII.

Salt content of soils. Bouyoucos and McCool. *See* XVI.

"Chlorine index" of soils. Lapicque and Barbé. *See* XVI.

Wine analysis. Schulte. *See* XVIII.

Glycerol in wines. Canónica. *See* XVIII.

Cacao shell. Knapp and McLellan. *See* XIXA.

Silica and sand [in feeding stuffs]. (1) Lloyd. (2) Dyer. *See* XIXA.

Morphine in opium, etc. Tingle. *See* XX.

Phenacetin, etc. Powell. *See* XX.

Ether in alcohol. Cox. *See* XX.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Ablett. Subjecting material to chemical treatment and grinding and/or mixing etc. 2004. Jan. 27.

Dick. Evaporating apparatus. 3046. Feb. 7.

Green and Lewis. Distilling or recovering volatile inflammable liquid solvents. 2482. Jan. 31.

Gregson and King. Gas-heated furnaces. 2543. Feb. 1.

Imray (Jefferies and Norton). Cooling and liquefying gaseous fluids. 2380. Jan. 30.

Kirby and Lakin. Grinding and pulverising materials. 2213. Jan. 29.

Krüger. Apparatus for drying granular etc. substances. 2858. Feb. 5.

Levy. Collection and recovery of volatile solvents evaporated into the atmosphere. 1940. Jan. 27.

Mann. Decomposition of substances in liquid and/or vapour phases. 2905. Feb. 6.

Read (Read Machinery Co.). Mixing and agitating machines etc. 2759. Feb. 4.

Rigby, and Rigby and Mellor. Drying cylinders. 2041. Jan. 28.

Sonsthagen. Machine for mixing liquid, semi-liquid, or viscid materials. 3117. Feb. 8.

Swinburne. 2208 and 2210. *See* II.

Wetter (Weinrich). Manufacture of carbonaceous material for filtering media etc. 2437. Jan. 31.

Weyman. 1955. *See* X.

Complete Specifications Accepted.

19,116 (1917). Kitson. Furnaces. (122,672.) Feb. 12.

19,189 and 19,190 (1917). Davis and Twigg. Regenerative gas-fired furnaces. (122,673 and 122,674.) Feb. 12.

1369 (1918). Anderson. Installation for use in the extraction of mineral, animal, and vegetable substances. (122,477.) Feb. 5.

1500 (1918). Lloyd and Wild. Recovery of solvents and volatile liquids. (122,685.) Feb. 12.

1822 (1918). Reavell, and Kestner Evaporator and Engineering Co. Apparatus for concentrating, distilling, and/or elevating liquids. (122,500.) Feb. 5.

1925 (1918). Smallwood. Furnaces. (122,504.) Feb. 5.

2171 (1918). Hutchins. Apparatus for facilitating the obtaining of crystals from solutions. (122,507.) Feb. 5.

2594 (1918). Mouneyrat. Chambers for effecting manipulations out of contact with the air, or in any desired atmosphere. (122,515.) Feb. 5.

2677 (1918). Leitch and Warburton. Apparatus for heating or cooling liquid or semi-liquid materials on a revolving cylinder. (122,721.) Feb. 12.

3842 (1918). Huntington, Heberlein and Co., and Bingham. *See* XI.

5027 (1918). Francart. Kilns, furnaces, ovens, etc. (122,742.) Feb. 12.

17,493 (1918). Fletcher. Conversion of water pastes into oil pastes by chemical and mechanical action. (122,612.) Feb. 5.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Acland, Garrow, and Nielsen. Carbonisation and destructive distillation of carbonaceous materials. 2240. Jan. 29.

Bartolomeis and La Porta. Distillation of asphalt rock, bituminous slate, etc. 2661. Feb. 3.

Bennett, Gillott, and Marple. Producer-gas generators. 2829. Feb. 5.

Boughton and Hack. Apparatus for washing gas. 2825. Feb. 5.

Bradley and Graham. Artificial fuel. 3107. Feb. 8.

Byrom. Desulphurising oils. 2388, 2579. Jan. 30 and Feb. 1.

Carpenter. Operation of horizontal carbonising retorts. 1983. Jan. 27.

Edwards. 2073. *See* III.

Everett and Salerni. Treatment of carbonaceous materials for manufacture of power gas with recovery of hydrocarbon oils. 2864. Feb. 5.

Gregson and King. 2543. *See* I.

Heeley. Coke-quenching devices. 2013. Jan. 27.

Hills. Manufacture of fuel briquettes. 2444. Jan. 31.

Hills and Wheeler. Manufacture of briquettes. 2566. Feb. 1.

Holt and Walker. Manufacture of gas from coal etc. 2706. Feb. 4.

Humphreys. Gas-generating apparatus. 2592. Feb. 1.

Hurez. Coke-ovens. 2974. Feb. 6. (Fr., 26.1.18.)

King. Fuel for internal-combustion engines. 2256, 2257. Jan. 29.

Kneen and Murray. Means for decomposing steam and using the products for heating. 2223. Jan. 29.

McHarry. Gas-producers etc. 2036. Jan. 28.

Pearse (Kennedy). Rotary retorts, and destructive distillation of carbonaceous material therein. 2249. Jan. 29.

Renkin. Apparatus for burning pulverised fuel. 2308. Jan. 30. (U.S., 31.1.18.)

Stein et Cie. Coal-distillation furnaces. 3128. Feb. 8. (Fr., 22.2.18.)

Swinburne. Low-temperature destructive distillation. 2208. Jan. 29.

Swinburne. Distillation of fragile fluids 2210 Jan. 29.

Waring and Waring. 2997. *See* X.

Wetter (Weinrich). 2437. *See* I

Weyman. 1955 *See* X.

COMPLETE SPECIFICATIONS ACCEPTED.

1170 (1918) Russell Coal-washing (122,454.) Feb. 5.

1276 (1918). Penrose and Penrose Manufacture of vegetable charcoal. (122,465.) Feb. 5.

1337 (1918). British Oxygen Co., and others. *See* VII.

1746 (1918). Hiller. Apparatus for low-temperature distillation of coal and other bituminous substances. (122,496.) Feb 5.

1779 and 7415 (1918). Leadbeater Obtaining carbon from peat for decolorising purposes (122,698.) Feb. 12

1815 (1918). West and Glover Destructive distillation of coal and like carbonaceous materials. (122,700.) Feb. 12

7528 (1918). Lamberty. Manufacture of briquettes. (119,443.) Feb 5.

10,767 (1918) South Metropolitan Gas Co., and Somerville Removal of carbon monoxide (122,781.) Feb 12

III.—TAR AND TAR PRODUCTS

APPLICATIONS.

Colcilis Manufacture of synthetic carbolic acid 2946 Feb. 6.

Edwards Fractional distillation plant for coal tar, hydrocarbons, etc 2073 Jan 28

IV.—COLOURING MATTERS AND DYES

APPLICATION

Brotherton and Co., Mersey Chemical Works, Ehrhardt, and Ehrhardt. Manufacture of colouring matters dyeing by the metachrome process 3122 Feb. 8

COMPLETE SPECIFICATION ACCEPTED.

4289 (1918). Morris. *See* XIII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Goisseder. Process for production of derivatives of cellulose. 2911. Feb. 6.

Papelera Espanola. Manufacture of paper. 2939. Feb. 6. (Spain, 8.2.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

830 (1918). Marks (Du Pont de Nemours and Co.). Production of coated fabrics (122,677.) Feb. 12.

1180 (1918). Marks (Du Pont de Nemours and Co.). Methods of producing pyroxylin-coated fabrics. (122,680.) Feb. 12.

1182 (1918). Marks (Du Pont de Nemours and Co.). Production of pyroxylin-coated fabrics. (122,681.) Feb. 12.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Brotherton and Co., Merriman, and Mersey Chemical Works. Production of blue-black to black shades on wool by the metachrome process. 3123. Feb. 8.

Moser. Treatment of woven and other fabrics for decorative etc. purposes. 2733. Feb. 4.

COMPLETE SPECIFICATIONS ACCEPTED.

2053 (1918). Dudley. Dyeing-machine. (113,440.) Feb. 12.

11,427 (1918). Ainsworth and Mather. Machines for winding and dyeing yarns, threads, or similar materials. (122,786.) Feb. 12.

VII.—ACIDS; ALKALIS; SALTS; NON METALLIC ELEMENTS

APPLICATIONS.

Evans, Holmes, and South Metropolitan Gas Co. Manufacture of ammonium sulphate. 2379. Jan. 30.

Higgins, and United Alkali Co. Manufacture of caustic potash. 2942. Feb. 6

Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Production of pure concentrated nitric acid and tetroxide of nitrogen. 2729. Feb 4. (Norway, 13.3.18.)

Serret. Production of acetic acid. 3086. Feb. 7.

Tyrer. Process for manufacturing alumina from blast-furnace slag. 2755. Feb. 4.

COMPLETE SPECIFICATIONS ACCEPTED.

15,608 (1917). Hayhurst. Vessels for containing acids and other liquids. (122,661.) Feb. 12.

17,413 (1917). Standard Oil Co. Art of producing aluminium carbide. (112,929.) Feb. 12.

1337 (1918). British Oxygen Co., Bray, and Balfour. Treatment of spathic iron ore for use in the manufacture of hydrogen. (122,474.) Feb. 5.

6525 (1918). Ridoni, and Soc. Talco e Grafiti Val Chisone. Process and apparatus for the manufacture of hydrofluoric acid. (115,125.) Feb. 12

VIII.—GLASS; CERAMICS

APPLICATIONS.

Doyle Treatment of clay etc 2787. Feb. 5.

Forster. Machinery for manufacture of sheet glass 2017 Jan. 28.

Newton. Tap for filter presses for filtering potters' slip. 2445. Jan. 31.

Quimby and Robinson. Apparatus for building up an object of quartz glass 2866. Feb. 5.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Arend Manufacture of alloys of copper, zinc, and lead. 2495. Jan. 31.

Arend. Process for making alloys rich in lead. 2496 Jan. 31.

Ballantine Manufacture of alloys. 2921 Feb. 6.

Boisselier. Solder for aluminium 2288. Jan. 30. (Fr., 26.3.18.)

Bolton. 2134. *See* XI.

Brearley and Johnson. 3171. *See* XXIII.

Brighten and Peakman. Furnaces for heat-treatment of metals. 2737. Feb. 4.

Coles. Process for building up or growing iron upon steel etc. surfaces. 2601. Feb. 3.

Coles. Electrolyte for deposition of iron. 2602. Feb. 3.

Dixon. Melting iron and steel. 2740. Feb. 4.

Hall. Metal-melting furnaces. 2851. Feb. 5.

Howe. Metallurgical furnaces. 2493. Jan. 31.

Ingle. Preparation for removing rust from, and preventing formation of rust upon, iron. 2033. Jan. 28.

Kievits, and Kynoch, Ltd. Pyrometer for measuring temperatures of molten non-ferrous metals. 2331. Jan. 30.

Sulman. Manufacture of alloys. 2921. Feb. 6.

Tyrer. 2755. *See* VII.

Waring and Waring. Gas-producing and steam-raising combined with steel-melting furnaces etc. 2997. Feb. 7

Weyman. Apparatus for separation of dust from blast-furnace etc. gases. 1955. Jan. 27.
White (Byers Co.). Puddling iron. 3066. Feb. 7.
Wood and Wood Cupolas. 2705. Feb. 4

COMPLETE SPECIFICATIONS ACCEPTED.

1603 (1918). Armstrong. Metallurgy of zinc. (122,688.) Feb. 12.
5179 (1918). Critchley, Sharp, and Tetlow, and Hepworth. Hardening and tempering of wire (122,743.) Feb. 12.
21,520 (1918). Rogers, Lancaster, Waller, and Jackson. Treatment of tinned scrap (122,618.) Feb 5.

XI.—ELECTRO-CHEMISTRY

APPLICATIONS.

Bolton Electric heating-element for raising temperature of solution in electro-plating vats 2134. Jan. 29.
Coles. 2602. *See* X
Cooke. Storage batteries for electricity 3021. Feb. 7.
Exley and Leitner. Charging-boards for electric accumulators 2191. Jan. 29
Exley and Leitner. Manufacture of electric accumulators. 2507. Jan. 31.
Fuller Accumulator Co., and Jones. Electric storage batteries or accumulators. 2916. Feb 6
Hossack. Dry batteries. 2203. Jan. 29

COMPLETE SPECIFICATIONS ACCEPTED.

1765 (1918). Robin. Electrodes of electric batteries. (122,697.) Feb. 12.
3842 (1918). Huntington, Heberlein, and Co., and Bingham. Apparatus for the electrical separation of suspended particles from gaseous bodies. (122,534.) Feb. 5.

XII.—FATS; OILS; WAXES

APPLICATIONS.

Dacey. Apparatus for eliminating free fatty acids etc. from crude oils. 2032. Jan. 28.
Dixon and Harvey. Hydrogenation 2727 Feb. 4.
Dunham. Emulsifiable oil material in dry form, and process of making same. 2362. Jan 30

COMPLETE SPECIFICATIONS ACCEPTED.

1750 and 10,424 (1918). Witter. *See* XIII.
2388 (1918). Co-operative Wholesale Society, Martin, and Brizell. Process for deodorising and decolorising cocoa butter. (122,512.) Feb. 5.
8209 (1918). Pink. Separating solid and liquid fatty or fat-like bodies. (122,764.) Feb. 12.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

1372 (1918). Bailey Manufacture of anti-fouling paints. (122,683.) Feb. 12.
1750 and 10,424 (1918). Witter. Process for treating linseed oil residual fatty acids and utilising the same as oil for paint or for oxidation for the manufacture of linoleum or like products. (122,696.) Feb. 12.
4289 (1918). Morris. Manufacture of lakes (122,540.) Feb. 5.
17,493 (1918). Fletcher *See* I.

XIV.—INDIA-RUBBER; GUTTA-PERCHA

APPLICATION.

Shaw. Washing crude rubber etc. containing grit. 2072. Jan. 28.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATION.

Kent. Process for regeneration of leather from leather scraps or waste. 3018. Feb. 7.

COMPLETE SPECIFICATIONS ACCEPTED.

1178 (1918). Marks (Du Pont de Nemours and Co.). Process for producing artificial leather (122,678.) Feb. 12.
1179 (1918). Marks (Du Pont de Nemours and Co.). Methods of producing artificial leather (122,679.) Feb. 12.
19,236 (1918). Peyrache and Bailly. Method of preparing bates for hides. (120,928.) Feb. 5.
19,897 (1918). Channon Liquid glue. (122,807.) Feb. 12.

XVI.—SOILS; FERTILISERS.

COMPLETE SPECIFICATION ACCEPTED.

2083 and 12,160 (1918) Conder. Apparatus for use in excavating superphosphates and the like (122,709.) Feb. 12.

XIX.—FOODS; WATER PURIFICATION, SANITATION

APPLICATIONS.

Beeton, and Trufood, Ltd. Drying organic substances. 2655. Feb. 3.
Falk and Frankel. Preserving food. 2382 Jan. 30. (U.S., 30.1.18.)
Scorer. Refuse destructors. 2996. Feb. 7.
Selden Co., and Selden. Process of purification 2657. Feb. 3.
Wilson. Apparatus for treatment of sewage 2675. Feb. 3.

COMPLETE SPECIFICATIONS ACCEPTED.

12,136 (1917). Jones, and Jones and Attwood Purification of sewage and other liquids. (122,428.) Feb. 5
2388 (1918). Co-operative Wholesale Society and others *See* XII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Dixon and Harvey. 2727. *See* XII.
Leach, and United Alkali Co. Manufacture of benzoic acid. 2943. Feb. 6.
Mitsui Kozan Kabushiki Kaisha Process for decomposing paranitracetanilide. 2951. Feb. 6 (Japan, 16.5.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

15,755 (1917). Soc. Chim. des Usines du Rhône, anc. Gilliard, Monnet, et Cartier. Manufacture of ethylidene diacetate. (112,765.) Feb. 12
6262 (1918). Abbott Laboratories. β-Bromo ethyl *p*-nitrobenzoate. (121,578.) Feb. 12.
10,180 (1918). Napp (Hoffmann, La Roche and Co.). Process for the manufacture of easily soluble compounds of the CC-dialkyl-, CC-diallyl-, and CC-alkyl-aryl-barbituric acids (122,778.) Feb. 12

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

Bradshaw Colour photography. 3081. Feb. 7
Thornton. Kinematograph films and manufacture thereof. 2027. Jan. 28.
Thornton Kinematograph colour films. 2028 Jan. 28.

XXII.—EXPLOSIVES; MATCHES

APPLICATION.

Clark Matches. 2918. Feb. 6.

COMPLETE SPECIFICATION ACCEPTED.

13,263, 16,276, and 18,115 (1916). Sumner. Apparatus for filling explosive material into shells or other receptacles. (122,425.) Feb. 5.

XXIII.—ANALYSIS.

APPLICATION.

Brearley and Johnson. Apparatus for testing the hardness of materials. 3171. Feb. 8.

I.—GENERAL; PLANT; MACHINERY.

Volatile inflammable solvents; Recovery of — in industrial operations. Q. Sestini. Annali Chim. Appl., 1918, **10**, 117–130.

A METHOD devised for the recovery of the solvent used in impregnating gauze dressings with iodoform is also applicable in other directions. The gauze is delivered from rollers into a closed chamber divided into three compartments. In the first of these it is immersed in an ethereal solution of rosin and iodoform; in the second the solvent is evaporated; and in the third the dried gauze is wound on another roller. Electric heating is used for evaporating the ether, since it is necessary strictly to regulate the temperature to prevent loss of iodoform. Simple resistance coils are unsuitable for the purpose, owing to the ether being oxidised to acetaldehyde and formaldehyde in contact with the hot wires. To obviate this the resistance coil, to which a charge of 15, 10, or 5 kilowatts can be supplied at will, is immersed in hot oil in a rectangular box of iron plate, autogenously welded. A little below the surface of the oil is an iron tube which passes out through the side of the box and then extends downwards and upwards to form a U-tube. Near the base of the U-tube is a lateral tube for the injection of compressed air, and to this injector is conducted the air saturated with ether vapour within the apparatus. The emulsion of oil and air in the ascending arm of the U-tube rises to a level much higher than that of the oil in the electric resistance box, and passes to a small box provided with an outlet tube for the escape of air. The hot oil flows from the box downwards through a coil composed of four parallel tubes, over which passes the travelling band of gauze, and is led back into the resistance box. The ether evaporated from the gauze is withdrawn from the apparatus by means of a Leiman aspirator, and condensed in two spiral condensers, the first of which is cooled with water and the second with ice. From 50 to 80% of the ether is recovered, the average being about 70%.—C. A. M.

PATENTS.

Drying and like apparatus. T. W. S. Hutchins, Middlewich, Cheshire. Eng. Pat. 122,077, 13.3.18. (Appl. 4444/18.)

THE apparatus is particularly adapted for drying a paste containing carbon, as used in the preparation of carbon blocks for metallurgical or like purposes. The material is introduced into a horizontal rotating cylinder through a pipe at one end, and the evolved vapour and gas are withdrawn through a concentric pipe. The cylinder contains a number of loose short rollers. The charging end of the cylinder is at first slightly tilted up when the paste is charged into it, and the paste becomes spread over the internal surface during rotation, the rollers being at the lower end. After a predetermined charge is introduced, the temperature is raised to expel all liquid and leave the caked material on the walls of the cylinder. The inclination of the cylinder is then reversed so that the rollers work towards the other end and break up the deposit on the cylinder. The tilting of the cylinder may be repeated as often as necessary and then the cover at the end remote from the charging pipe is removed and the material discharged.—W. F. F.

Drying apparatus. S. S. Amdursky, Rochester, N.Y. U.S. Pat. 1,286,195, 3.12.18. Appl., 4.5.18.

THE material to be dried is placed on the foraminous top of a casing containing a set of heating pipes and provided with an inlet for the drying air. The heater comprises a drum having branch pipes extending outwards and downwards from its opposite sides, with separate gas burners extending across the outer ends of the branch pipes, and having jets opening into the ends of the pipes. The outlet of the drum discharges outside the casing. Separate valves are provided for the burners, and a damper for the outlet is connected to the valves so as to be opened when either valve is opened.—W. F. F.

Desiccating apparatus. C. F. Coleman, Philadelphia, Pa. U.S. Pat. 1,286,538, 3.12.18. Appl., 6.3.17.

AN endless belt travels around two drums spaced apart vertically within a housing and dips into a liquid receptacle below the lower drum. Between the drums is a pair of vertical casings having inlet and outlet pipes and with their outer sides convex and bearing against the endless belt. Means are provided for tightening the belt so that it is held in frictional engagement with the casings.—J. H. P.

Dryer. E. B. A. Zwoyer, Perth Amboy, N.J. U.S. Pat. 1,290,009, 31.2.18. Appl., 16.2.17.

A HEATED chamber contains a rotary sectional platform with a second similar platform beneath the first but rotating in the opposite direction. Briquettes or other materials are placed in a thin layer on the upper platform and means are provided for their transference to the lower platform.—C. A. K.

Furnaces. A. F. Hinds, London, T. Stinchcombe, Chesterfield, and The Chemical Engineering and Wilton's Patent Furnace Co., Ltd., London. Eng. Pat. 122,232, 9.1.18. (Appl. 530/18.)

THE fuel is supported on perforated plates carried by perforated channel irons which may be reciprocated in any known manner. The chamber below the hearth is divided by transverse partitions into three compartments, and three air-supply pipes of the form described in Eng. Pat. 24,785 of 1904 (this J., 1905, 1293) extend from the front of the furnace into the three compartments respectively. Air is injected into the three pipes by steam nozzles projecting into the outer ends of the pipes, so that the air supply to each section of the grate may be regulated. The ash is discharged at the further end of the grate. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 9732 of 1894.) —W. F. F.

Furnace construction. W. S. Robinson, Benton Harbor, Mich. U.S. Pat. 1,286,114, 26.11.18. Appl., 26.2.17.

THE roof of a furnace is constructed as a hollow arch lined with firebrick, through which air for combustion is passed to the furnace. The outlet for the air extends longitudinally along the bottom of the arch, and means are provided to deflect the air at intervals through the outlet into the furnace.—W. F. F.

Furnace; Regenerative ——. T. F. Bally and F. T. Cope, Assignors to The Electric Furnace Co., Alliance, Ohio. U.S. Pat. 1,286,907, 10.12.18. Appl., 25.1.18.

THE furnace comprises a heating chamber and a regenerative hood. Two trains of material move in parallel directions through the furnace, one

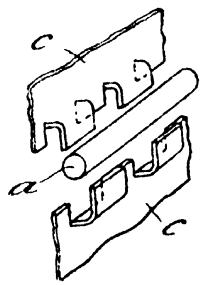
above the other, and means are provided for dropping material from the upper to the lower train. —J. H. P.

Annealing furnace. T. F. Bally, Assignor to The Electric Furnace Co., Alliance, Ohio. U.S. Pat. 1,286,908, 10.12.18. Appl., 31.1.18.

THE furnace consists of a heating furnace and a regenerative hood. The heating furnace is located at the centre of the hood and receives heat from electrical resistance elements placed longitudinally in the sides of the furnace. Two parallel trains of material move in opposite directions through the regenerative hood and the furnace.—J. H. P.

Screening and filtering apparatus. F. W. Brackett and Co., Ltd., and F. W. Brackett, Colchester. Eng. Pat. 122,311, 4.3.18. (Appl. 3784/18.)

THE edges of the plates, *c*, of an endless screen or filter are formed as shown in the figure, the



bent portions fitting over and the straight portions under cross-bars, *a*.—W. H. C.

Filter-film-forming apparatus. G. Moore, Joplin, Mo. U.S. Pat. 1,287,074, 10.12.18. Appl., 17.5.17.

A FILTER-FRAME is placed in a container mounted on pivots and the material which is to form the film is introduced into the container under pressure. When the film is formed the frame is removed.—W. H. C.

Filtering machine; Continuous automatic centrifugal ——. H. A. Herr, Philadelphia, Pa. U.S. Pat. 1,286,626, 3.12.18. Appl., 23.12.15.

THE material to be filtered is fed into a rotating basket provided with a central opening in the bottom which is normally closed by a cover. The solid material is deposited on the walls of the basket and the liquid is discharged. The speed of rotation of the basket is then reduced for a predetermined time, and the solid material removed from the walls by an oscillating scraper. The cover of the central opening is lifted off at a predetermined time, and the material which has collected on the bottom is swept through the opening by a conveyor.—W. F. F.

Gases; Apparatus for subjecting —— to the action of heat and pressure. E. E. Somermeier, Englewood, Fla. U.S. Pat. 1,286,135, 26.11.18. Appl., 26.4.17.

A REACTION chamber of refractory material is provided with an internal heating coil and is surrounded by a pressure chamber of metal. Gases to be treated are supplied to the reaction chamber and means are provided for putting the two chambers into communication and for maintaining the desired pressure in the pressure chamber. The products of the reaction are withdrawn from both chambers.—W. F. F.

Condenser. M. T. Brown and G. W. Southerland, Jacksonville, Fla. U.S. Pat. 1,286,523, 3.12.18. Appl., 29.6.15. Renewed 24.1.18

A CONDENSER consists of an upper and a lower tank, the upper tank having a horizontal partition with pockets opening alternately in opposite directions. Certain of the pockets are provided with baffles for causing a tortuous passage of fluid through the tank. An outlet in the bottom of the upper tank opens into a pipe passing through the lower tank. The overflow from the upper tank supplies the lower tank.—J. H. J.

Cooler. F. A. Phillippi, Assignor to A. R. May and D. L. Evans, Pottstown, Pa. U.S. Pat. 1,286,764, 3.12.18. Appl., 24.11.15.

A PORCELAIN cylinder having a spiral projection formed on its outer surface is surrounded by an outer casing the inner surface of which is in contact with the spiral projection, thus forming a spiral channel through which liquid may flow. —W. H. C.

Cooling-machine. A. McD. Gray, Elizabeth, N.J. U.S. Pat. 1,286,880, 3.12.18. Appl., 6.3.17.

UPRIGHT cooling vessels, each having a central rotating shaft provided with scrapers to detach the solids deposited on the interior surface of the vessels, are connected together at alternate ends by conduits within which means are provided to move the contents forward from vessel to vessel. —W. H. C.

Cooling tower. C. V. Nordberg, Butte, Mont. U.S. Pat. 1,287,402, 10.12.18. Appl., 23.6.17.

THE floor of a natural draught cooling tower is inclined towards a well. Air inlets are arranged between the piers supporting the tower and between the tower and the piers. Stepped inclined girders are carried by the piers and support the floor. Annular series of concentric baffles are disposed in stepped and lapped relation above the floor. Each baffle has, at its lower edge, a retaining flange provided with an outlet, the outlets being out of vertical alinement. A grating extends across the lower portion of the tower above the baffles, and a supply pipe extends upwards from the well above the grating and is provided with a spray head at the top. An outlet pipe from the well is also provided.—J. H. P.

Disintegrating-machine. W. A. Patterson, Assignor to A. P. and R. H. Boulware, Dallas, Tex. U.S. Pat. 1,286,757, 3.12.18. Appl., 4.2.18.

THE grate of a disintegrator mill is formed of spaced longitudinal bars which are alternately of different height and have exposed cutting edges on their upper corners.—W. H. C.

Crushing-mill. T. J. Sturtevant, Wellesley, Mass., Assignor to Sturtevant Mill Co., Boston, Mass. U.S. Pat. 1,286,831, 3.12.18. Appl., 23.2.18.

THE casing of a disintegrator mill is divided along a vertical plane, parallel with the shaft, into two unequal portions which are hinged together, so that the smaller may be swung aside to allow of access to the interior. The axial shaft and part of the curved crushing surface are supported within the larger portion of the casing and the rest of the crushing surface within the movable portion.—W. H. C.

Refrigerating machine with revolving evaporating chamber. H. Lanz, Mannheim. Ger. Pat. 308,695, 21.1.17.

THE revolving evaporation chamber is provided with a separate shaft which is coupled, inside the suction chamber of the compressor, to the shaft which operates the compression piston. This arrangement permits a permanent union between the evaporation chamber and the compressor shaft, whereby a gas-tight connection is obtained without interfering with the accessibility of the machine for maintenance and repairs.—J. F. B.

Dryer; Continuous automatic ——. C. A. Wendell, Joliet, Ill. Reissue 14,574, 17.12.18, of U.S. Pat. 1,088,754, 3.3.14. Appl., 17.6.15.

SEE this J., 1914, 631.

Shaft-kiln. A. and W. Steiger, Zürich, Switzerland. U.S. Pat. 1,287,505, 10.12.18. Appl., 4.8.17.

SEE Eng. Pat. 109,266 of 1917; this J., 1918, 374A.

Evaporator. N. Deerr, Brooklyn, N.Y. U.S. Pat. 1,287,650, 17.12.18. Appl., 16.8.17.

SEE Eng. Pat. 120,276 of 1917; this J., 1918, 755A.

Drying. Eng. Pat 111,112. *See* XIXA.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Oxidation of ——. J. R. Partington. Chem. News, 1919, 118, 50—51.

DISCUSSING the experimental results of R. V. Wheeler (this J., 1919, 65A) on the slow oxidation of coal at low temperatures (15°—100° C.), the author criticises the hypothesis that air is absorbed by the freshly won coal with the formation of a complex addition compound, and suggests, as an alternative explanation of the observed facts, that the process is primarily one of adsorption. The primary oxidation product is probably carbon monoxide, carbon dioxide being formed only through the agency of moisture, with simultaneous production of hydrogen which, however, was not looked for by Wheeler. The adsorption hypothesis explains the differences observed between the behaviour of moist and dry air, the ratio CO_2/CO being smaller when the air is dried before coming in contact with the coal.—E. H. R.

Coal ash; Fusibility of —— and determination of the softening temperature. A. C. Fieldner, A. E. Hall, and A. L. Feild. U.S. Bureau of Mines, Bull. 129. 1918. 146 pages. (See also this J., 1915, 704, 1001, 1079.)

THE investigation was made with a series of ashes, obtained from 110 samples of coal, lignite, and peat, and containing SiO_2, 12·3—76; Al_2O_3, 8·6—34·7; Fe_2O_3, 3·8—69·7; CaO, 0·6—18·6; and MgO, 0·2—10%. The ashes were moulded into the form of Seger cones and heated in furnaces of various types, and at different rates, under oxidising, reducing, and neutral conditions such as occur in different parts of a fuel bed in ordinary boiler practice. The chief factors affecting the softening temperatures were found to be:—*Fineness.* Ash ground to an impalpable powder softened at a slightly lower temperature than ash of 100-mesh size; a fineness of at least 200-mesh was preferred. *Carbonaceous matter.* In atmospheres of air, of hydrogen and water vapour, and of carbon monoxide and carbon dioxide, at rates of heating up to 5° C. per min., no appreciable difference in softening temperature was found between cones composed of carbon-free ash and distilled water and similar cones in which a 10% solution of dextrin was employed as binder. At more rapid rates of heating, in the reducing atmosphere of a gas furnace, swelling and intumescence occurred when the cones contained carbonaceous matter. Ignition of the re-ground ash in oxygen was found to promote more definite and reliable softening points, especially when the original ash had been incompletely ignited. *Size and shape of cone.* Since slender cones of coal ash were found not to bend as uniformly as the standard pyrometric cones, the bending tendency was eliminated entirely by increasing the width of the base, and the softening temperature was taken as the point where the cone had become roughly spherical. The best size for this purpose was found to be a cone ¾ in. high and ¼ in. wide at the base; and the end point was found to be reproducible within 30° C. *Inclination of cones.* Vertical mounting of the cones was found to be the most satisfactory; horizontal or inclined cones generally indicated a softening temperature at too early a stage in the fusion process. *Rate of heating.* Rates below 2° or above 20° C. per min. were unsatisfactory. *Atmosphere.* The highest results were obtained in air (platinum wire resistance furnace) or in a strongly reducing atmosphere of carbon monoxide (Northrup furnace), the iron content of the ash, in the latter case, being reduced to metal and thus eliminated as a flux; and the lowest results in atmospheres of mixed gases (hydrogen and water vapour or carbon monoxide and carbon dioxide) in which the iron was converted mainly into ferrous oxide. By heating the cones in contact with the products of combustion in a gas furnace operated with the maximum excess of gas over air, the required degree of reduction was obtained without production of metallic iron, and the condition of the iron in the softened ash cones was found to approximate to that of the iron in clinker obtained in boiler practice. From the above considerations, the following procedure is recommended as a standard method for determining the softening temperature of coal ash:—Ash of 200-mesh fineness, which has been previously ignited for 2 hrs. in oxygen at 800°–850° C., is moistened with distilled water or with a 10% solution of dextrin and moulded into cones ¾ in. high and ¼ in. wide at the base. These are dried, set vertically on a support by means of a plastic mixture of kaolin and alumina, and, if containing dextrin, heated in an open muffle for 30 mins. The cones are then heated, within a loosely-covered crucible, in a pot melting furnace having three tangential gas burners near the base and provided with a sighting aperture and thermocouple opening at the sides. The crucible has an opening at the side in alinement with the sighting aperture of the furnace, and the furnace is operated with the maximum excess of gas over air. At 800° C. the temperature increase is reduced to between 5° and 10° C. per min., and this rate is maintained until the end of the test, temperatures being taken by means of an optical pyrometer or protected thermocouple. Record is made of the temperatures at which initial deformation, softening, and actual flowing of the cones occur.

—W. E. F. P.

Water-gas production; Contribution to knowledge of the principles of ——. *Decomposition of steam by red-hot charcoal.* J. Gwosdz. Verhandl. ver. Bef. Gewerbfleisses, 1918, 33—45, 55—70. Z. angew. Chem., 1918, 31, Ref., 398.

As the result of a series of experiments, the author concludes that in the decomposition of steam by red-hot charcoal, carbon monoxide can be produced as a primary product even at a relatively low tempera-

ture, provided experimental conditions are suitably chosen. This result is obtained when charcoal containing a minimum ash content is used. The primary process in water-gas production appears to be the formation of carbon monoxide and carbon dioxide, in relative proportions corresponding to the equilibrium established between these two gases in presence of carbon. Further, at the surface of the charcoal, carbon dioxide is produced by the interaction of carbon monoxide and steam, the extent of this reaction being largely conditioned by the ash content of the charcoal. The quantity of steam decomposed in unit time varies with the surface area of the charcoal (see this J., 1918, 538 A.)
—J. S. G. T.

Ser... ter-gas; Soft coal for ——. R. B. Harper. Gas Record. Gas J., 1918, **145**, 121.

A COMPARISON of the behaviour of bituminous coal with that of good coke in water-gas generators showed that when bituminous coal is employed, considerable clinkering troubles are introduced; there is an increase of as much as 40 B.Th.U. per cub. ft. in the calorific value of the blue water-gas obtained, such increase being liable to cause overheating of parts of the installation; the amount of hydrogen sulphide is increased; the quantity of ash is increased; the daily make of gas with a given installation may be decreased by as much as 5%; 3% of the fuel may be lost in the clinker or ash; and the steam consumed per 1000 cub. ft. of gas is higher than when coke is used.—J. S. G. T.

Benzol in gas; Estimation of ——. St. Claire Deville. J. Usines à Gaz, Dec. 20, 1918. Gas J., 1919, **145**, 272—273.

THE author has revised his earlier freezing method (J. Usines à Gaz, 1889, 13; this J., 1889, 972) to meet the need for determining the benzol content of gases poor in that constituent, *e.g.*, gas which has been scrubbed in order to recover its benzol. The gas, dried by calcium chloride, is passed through a narrow vertical glass vessel which is maintained at a temperature of −81° to −72° C. by immersion in a paste of carbon dioxide snow and acetone. 120 litres (4·24 cub. ft.) per hour of fairly rich coal gas may safely be passed and the whole of the benzol is frozen out. A test can be completed in about 1½ hrs. The cooling agent is contained in a Dewar vessel and will remain below −72° C. for five hours; eight or nine tests can be carried out with a cylinder of liquid CO_2, containing 22 lb. When sufficient gas has been cooled (150 to 200 litres for ordinary coal gas and correspondingly more for poorer gases) the freezing tube is disconnected, closed, and brought to room temperature. The expanded gas is released and the weight of the benzol determined. If the freezing tube contains some liquid at the bottom, immediately it is taken from the Dewar vessel, the presence of toluene (freezing pt., −93° C.) is indicated and a rough estimate of the amount can be made by noting the volume of the liquid. The benzol condensed out during 41 tests, amounting to 400 c.c., had sp. gr. 0·8825, and its composition as determined by distillation, after allowance for a 2·7% loss, was:—Boiling below 80° C., 1·75%; from 80° to 84°, 79·48%; 84° to 90°, 8·29%; 90° to 100°, 2·62%; 100° to 115°, 3·93%; above 115° C., 3·93%. Data are given relating to the past and present benzol contents of Paris gas.—T. F. E. R.

Coke-oven gas; Washing of light-oil fractions from ——. F. D. Schreiber. Gas Age. Gas J., 1919, **145**, 269.

THE washing of benzol, toluol, and solvent naphtha is performed in an agitator of the Koppers type of 5200 galls. capacity. Full charges are always used and the procedure successfully adopted is tabulated in detail. After washing with acid and water, the oils are washed with lime water, followed in the case of the benzol by a washing with caustic soda. The consecutive use of lime and caustic soda in the benzol washing is efficacious in removing the benzenesulphonic acids which frequently cause corrosion of dephlegmator tubes in subsequent distillation when not removed. The lime must be of high quality, free from grit, and when slaked and made into milk of lime must not deposit suspended matter. In washing solvent naphtha, the charge is prone to heat up considerably and care must be taken to keep it as cool as possible.—T. F. E. R.

Inflammability of gaseous mixtures; Dilution limits of ——. *Part III. Lower limits of some mixed inflammable gases with air. Part IV. Upper limits of some gases, singly and mixed, in air.* H. F. Coward, C. W. Carpenter, and W. Payman. Chem. Soc. Trans., 1919, **115**, 27—36.

THE lower limits of inflammability of various mixtures of hydrogen, methane, and carbon monoxide with air have been determined, the combustible gases being taken two at a time, or all three together. A mixture of "town's gas" and air was also examined. The results obtained show that the lower limits for the various mixtures may be calculated with fair accuracy from Le Chatelier's formula, according to which if n_1, n_2, n_3 . . . are the proportions of the several combustible gases in the lower limit mixture, expressed in percentages of the total gas mixture, and N_1, N_2, N_3 . . . are the corresponding percentages for each of the combustible gases taken separately, then

$$n_1/N_1+n_2/N_2+n_3/N_3 \ldots = 1$$

The upper limiting mixtures have also been determined for hydrogen, methane, and carbon monoxide, and for various mixtures of these gases. The upper limits in air saturated with water vapour at 18°–19° C. were found to be in the neighbourhood of 74·2% for hydrogen, 15·4% for methane, and 74·2% for carbon monoxide. For mixtures of these gases, the upper limits can be calculated approximately from the additive formula referred to above.—H. M. D.

Flame; Propagation of —— *through tubes of small diameter. Part II.* W. Payman and R. V. Wheeler. Chem. Soc. Trans., 1919, **115**, 36—45.

FOLLOWING the method previously used in experiments with mixtures of methane and air (this J., 1918, 568 A), the authors have determined the speeds of the uniform movement of flame in mixtures of air with coal-gas, hydrogen, and a 1:1 methane-hydrogen mixture, using glass tubes of varying diameter. The results obtained show that not only can the composition of the upper and lower limiting mixtures for mixed combustible gases be calculated from the upper and lower limit data for the individual gases in the mixed combustible by means of Le Chatelier's formula (compare preceding abstract), but that the speeds of the uniform movement of flame can be calculated from a formula of the same type. This formula appears to be applicable to the mixtures, whatever may be the speed of propagation of flame. The experimental data lead to the conclusion that coal-gas is an unsuitable gas for the testing of miners' safety lamps, since small variations in composition have a considerable effect on the speed of propagation of flame in its mixtures with air. The reduction in the proportion of paraffins and increase in the proportion of hydrogen, which occur when carburetted water-gas is employed to dilute the coal-gas, give a mixture which, with air, has a much greater speed

of propagation than can be attained by mixtures of methane and air. Moreover, the speed attainable with gas produced solely by carbonisation at normal retort temperatures is more than double that attained in mixtures of methane and air. Although the speed of propagation is the main factor which determines the ability of flames to pass through tubes or holes of small diameter, this appears to depend also on the quality of the inflammable gas. The hydrogen present in coal-gas is in considerable measure responsible for the behaviour of the flame in mixtures of coal-gas and air.

—H. M. D.

Ethane and air; Inflammation of mixtures of —— in a closed vessel: the effects of turbulence. R. V. Wheeler. Chem. Soc. Trans., 1919, **115**, 81—94.

THE speed at which flame is propagated through an inflammable mixture in a closed vessel is dependent on the degree of mechanical agitation of the mixture. Experiments made with mixtures of ethane and air near the lower limit of inflammability (3·10% ethane) have demonstrated that mechanical agitation of a mixture poor in combustible gas renders it difficult for the flame, which originates during the passage of the discharge, to spread away from the source and travel throughout the mixture. The difficulty increases as the degree of agitation increases and as the proportion of combustible gas in the mixture is decreased. If, however, the flame spreads in such an agitated mixture, it travels very rapidly. The appearance of the flames in mechanically agitated mixtures of 5·0% methane and air suggests that the action of the form of turbulence used in the experiments is purely mechanical. The flame is forcibly dragged in the wake of the rapid current induced by the revolving fan used as agitator and burns the mixture in its path. In accordance with this view it has already been found by Hopkinson (Rep. Brit. Assoc., 1912, 201) that the rapidity of combustion increases with the degree of turbulence, and experiments with mixtures of ethane and air are now recorded which show that mixtures for which the speed of propagation of flame is normally slow are more susceptible to the influence of turbulence than mixtures for which the normal speed is high. With regard to the rate of development of pressure in non-turbulent mixtures of ethane and air, it is found that the time-pressure curves are of the same type as those previously obtained for mixtures of methane and air (this J., 1919, 3 A). In other respects, the ethane-air mixtures differ notably from those of methane and air. The ethane-air mixtures which produce the highest pressures contain from 6·5 to 7·0% of ethane, whilst the mixture corresponding with complete combustion contains only 5·63% of ethane. The speed of propagation under the conditions of the experiments (central ignition in a spherical vessel) is also greatest for mixtures which contain 6·5 to 7·0% of ethane.—H. M. D.

Paraffin wax and its manufacture. A. Campbell and W. J. Wilson. Inst. Petrol. Techn., Jan. 21, 1919. [Advance proof.]

IT is estimated that 350,000 tons of paraffin wax is produced annually by the distillation of crude petroleum and shale oil. American crude oils yield 2 to 3% of paraffin wax, whilst Scotch shale oil contains about 11%, Galician petroleum 5 to 6%, and Burma and Assam crude oils 12% or more. A considerable amount is also present in Borneo and Persian crude oils, but the latter have not yet been commercially worked. Experiments to determine the effect of varying the conditions on the results of sweating the crude wax showed that a much greater yield of white wax is obtained in less time by sweating of the total scale than by sweating the hard and soft scales separately. For example, a hard scale melting at 129° F. (54° C.) and a soft scale melting at 113° F. (45° C.), when mixed in the proportions in which they were obtained, melted at about 120·5° F. (49° C.). When these scales were separately sweated only 17·26% from the soft scale reached the proper colour, whilst 58·33% of the combined residues was yellow and required re-sweating to obtain the maximum yield of white wax. When, however, the scales were combined proportionately and sweated, 41·8% of white wax was obtained in one operation, and only 42·24% required re-sweating, and this gave a further yield of 32% of white wax. The sweating was carried out in 5 stages of 6 hours each with rises of 5° F. (2·8° C.), and thus 30 hours was required to sweat the scales separately to residues of m.pt. 135·5° F. (57·5° C.) and 125° F. (51·5° C.) respectively, only the latter being white, whilst the same size of apparatus produced more than double the yield of white wax from the same quantity of the combined scales in 42 hours. It was subsequently found that equally good results could be obtained by reducing the stages to 4 of 4 hours each, with rises of 10° F. (5·5° C.) between each. By mixing, crystallising, and re-sweating the sweatings from the first and second stages 6·5% of a yellowish oily wax of m.pt. 122·5° F. (50·2° C.) was recovered. In experiments to determine the bending-point of candles composed of mixtures of paraffin wax and stearine, candles 7¾ in. long and 1/16 in. diameter were exposed for 30 mins. at successive stages rising by 5° F. until they bent from the perpendicular. The following results were obtained with mixtures of paraffin waxes melting at 133° F. (56° C.) and 139° F. (59° C.) respectively with stearine melting at 130·5° F. (54·5° C.):—

Paraffin wax, m.pt. 133° F.	Stearine	Melting point	Bending point	Paraffin wax, m.pt. 139° F.	Stearine	Melting point	Bending point
%	%	°F.	°F.	%	%	°F.	°F.
100	—	133	93	100	—	139	110
80	20	129	108	80	20	135·5	119
70	30	127	109	70	30	133·5	120
60	40	124	115	60	40	133	125

Mixtures of paraffin wax with stearine frequently show a lower m.pt. than that of either constituent. For example, a mixture of 55% of stearine of m.pt. 130° F. (54·5° C.) with 45% of paraffin wax of m.pt. 120° F. (49° C.) melted at 114° F. (45·5° C.). In the Henderson apparatus for separating the scale from petroleum distillates, 2400 galls. can be cooled from 86° F. (30° C.) to 35° F. (1·5° C.) in 24 hours by means of brine at 13° F. (−10·5° C.); whilst 1500 galls. of an average paraffin distillate can be cooled from 120° F. (49° C.) to 40° F. (4·5° C.) and pumped through the filter-presses in the same time, with brine at 16° F. (−9° C.). Similar variations are shown by other types of coolers. The following are examples of sweating in the tray form of stove and in cylindrical stoves:—

	Tray form of stove	Cylindrical stove
M.pt. of scale ..	126°–127° F.	111° F.
Time of cooling .	24 hours	12 hours
,, ,, sweating	35 ,,	48 ,,
White wax as residue	31·5% m.pt. 138° F.	33·3% m.pt. 127° F.
Sweatings, yellow	59·5% ,, 120° F.	31·4% ,, 113° F.
Soft sweatings and oil	9·0% ,, 100° F.	9·0% ,, 100° F.

The complete operation in the tray form of stove takes about 58 hours, the time of cooling and

sweating varying with the composition of the scale, as for example:—

M.pt. of mixture	Time for filling	Time for cooling	Time for sweating	Time for melting
°F.	Hours	Hours	Hours	Hours
127	½	21	17	3½
117	¼	31	17	2½
108	¼	28	11½	2½

—C. A. M.

Ignition of explosive gases by electric sparks. J. D. Morgan. Chem. Soc. Trans., 1919, **115**, 94—104.

In continuation of experiments made by Wheeler and Thornton (Home Office Report on Electric Signalling with Bare Wires, June, 1916) on the ignition of explosive gases by sparks produced in signal bell circuits, the author has made a series of new observations with low-tension sparks covering a wide range of variation in the magnetic conditions. The results obtained with air-core coils, open iron-core coils, and closed iron-core coils lead to the conclusion that under widely varying conditions the igniting sparks are characterised by the liberation of the same amount of heat energy. This is not apparent from measurements on the spark circuit prior to the production of the sparks. Reviewing the results of recent work on the spark ignition of explosive gases, it is found that the igniting power of a spark does not depend on its total energy. In consideration of the author's results for ignition with low-tension sparks, it would therefore seem that the whole of the energy of the spark is not utilised in the process of ignition. The suggestion is made that the ignition is determined by the initial spark energy and that in every spark there is a certain amount of unused energy which makes no contribution to the process of ignition. This view may offer an explanation of the diverse results which have been obtained in attempts to specify the inflammability of an explosive mixture in terms of the total energy of the least igniting spark.—H. M. D.

PATENTS.

Fuel and process of forming the same. D. Markle, Hazleton, Pa. U.S. Pat. 1,287,382, 10.12.18. Appl., 11.9.17.

A MIXTURE of anthracite culm and hard pitch is heated to distil off the volatile constituents of the pitch without forming coke.—W. F. F.

Coke ovens or the like. J. Pieters, Paris. Eng. Pat. 113,782, 22.1.18. (Appl. 1274/18.) Int. Conv., 28.2.17.

VERTICAL coke ovens oblong in horizontal cross-section are arranged in a setting and are heated by a large number of vertical flues or combustion chambers arranged in the upper part of the dividing walls, each set of flues opening into a common horizontal discharge flue. The air for combustion passes upwards through zigzag passages in the lower part of the dividing walls and meets the combustible gas, which may be rich coke-oven gas, at the bottom of the combustion chambers. The heat of the descending coke is thus recovered, and transferred to the air. The cooling passages have a surface approximately equal to that of the heating flues. When the ovens are heated by means of cold poor gas obtained from blast furnaces, both the gas and the air for its combustion are preheated by circulating them through two separate sets of flues in the lower parts of the dividing walls of the ovens. The coke is discharged and removed by means of a cutting device and a conveyor. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 1660 of 1884 and 101,306; this J., 1885, 199; 1916, 1006.)

—W. F. F.

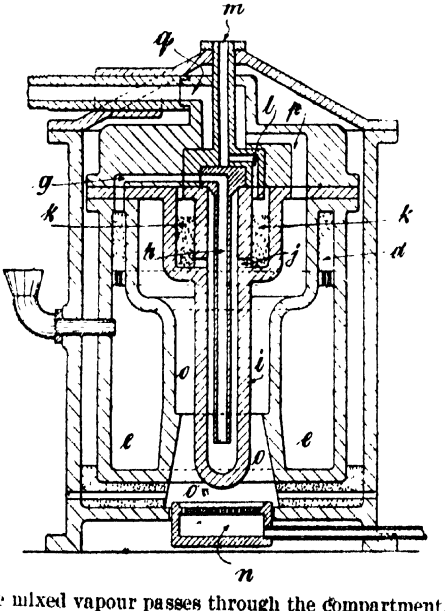
Gas; Retorts and apparatus in connection therewith for use in the manufacture of ——. Drakes Ltd., and J. W. Drake, Halifax. Eng. Pat. 121,975, 4.10.17. (Appl. 14,317/17.)

A PAIR of vertical retorts is mounted on, and in communication with, a pair of horizontal retorts, the whole being arranged in a common setting with a pair of producers at a lower level. The outlet of each producer is divided into two conduits which are controlled by a single damper, so that the producer gas may pass either into a common chamber leading into both horizontal retorts, or into the heating chamber surrounding the two sets of combined retorts. Coal may be fed into the retorts and coal gas produced by the heat of the producer gas circulating through the heating chamber. The producer gas may be partly burnt if necessary, by admitting air to the heating space after passing it through a preheater in the flues leading from the heating chamber. Alternatively the producer gas may be passed through the retorts to obtain a mixture of coal gas and producer gas. Producer gas may also be withdrawn for use separately. The retorts may be charged with coke, and air and steam blown through them alternately for the continuous production of water-gas; or steam may be blown through the retorts charged with coal, while producer gas is being passed through them, and thus a mixture of coal gas, producer gas, and water-gas, in any desired proportions, may be obtained. The apparatus may also be used for the manufacture of hydrogen by filling the retorts with iron, heating them by burning producer gas in the surrounding heating chamber, and passing steam through them.

—W. F. F.

Gases; Combustible ——. W. Pickard, Rochdale, and D. R. Dobson, Bolton. Eng. Pat. 122,079, 15.3.18. (Appl. 4389/18.)

THE compartment, *e* (see fig.), is partly filled with a mixture of crude hydrocarbon and acidulated water, which is vaporised by means of a burner, *n*.



The mixed vapour passes through the compartment, *d*, filled with iron filings, and thence through the passage, *g*, tube, *h*, strongly heated casing, *i*, and

passage, *j*, to the compartment, *k*, which is filled with a mixture of iron filings and charcoal. The compartments, *d* and *k*, are kept hot by the hot gases passing through the space, *o*, and passage, *p*, to the outlet, *q*. The permanent gases leaving the compartment, *k*, through the passage, *l*, are withdrawn at the outlet, *m*. Gas suitable for internal combustion engines may be obtained from a mixture of water 2 parts, heavy tar oil 1 part, together with about 1% by volume of sulphuric acid.—W. F. F.

Gaseous mixtures; Proportioning of combustible —. A. C. Ionides, jun., London. Eng. Pat. 122,215, 13.12.17. (Appl. 18,508/17.)

A COMBUSTIBLE mixture of gas and air in such proportions that combustion will not continue under normal conditions is passed through a control valve and a back-flash extinguishing device such as that described in Eng. Pat. 12,546 of 1912 (this J., 1913, 412) to a small horizontal nozzle of silica glass having a flared mouth. The mixture will burn continuously at such a mouthpiece, and the character of the flame is observed against a semi-cylindrical blackened trough projecting in front of and below the mouthpiece. In a modification, continuous combustion may be secured by heating the combustible mixture as it passes through a tube of small bore to the nozzle. A pressure gauge is provided on a branch pipe between the regulating valve and the back-flash extinguishing device, and the proportions of the mixture may be determined and regulated by comparison of the flame with that produced by known mixtures. The length of the flame may be measured by a scale on the semi-cylindrical trough, and the whole apparatus may be enclosed in a portable casing.—W. F. F.

[Fuel] gases; Process for manufacturing —. H. F. Freuler, Walla Walla, Wash. U.S. Pat. 1,286,577, 3.12.18. Appl., 6.6.16.

A MASS of carbonaceous material is heated by an electric current of high voltage, and when its resistance is lowered, the electrodes are separated farther apart and the applied voltage is reduced. Superheated steam is then injected and the resulting mixture of carbon monoxide and hydrogen is drawn off.—W. F. F.

Petroleum oils; Process of refining mineral —. R. E. Humphreys, Assignor to Standard Oil Co., Whiting, Ind. U.S. Pat. 1,286,179, 26.11.18. Appl., 17.5.15.

THE oil is treated with strong sulphuric acid, and the acid sludge drawn off. The oil, containing a small proportion of dissolved sulphonic acid, is neutralised with caustic soda, and the resulting solution of alkali salt in mineral oil is extracted with a dilute solution of alcohol.—W. F. F.

Petroleum and the like; Method of and apparatus for distilling —. L. O. Sherman, East Chicago, Ind. U.S. Pat. 1,288,711, 24.12.18. Appl., 15.11.17.

A PORTION of the oil is vaporised by heating in a still under pressure, and higher boiling fractions are condensed in a return-condenser connected with the still. The condensed liquid, together with a portion of the oil from the still, is passed into one end of a pipe in which it is heated to a temperature higher than that of the oil in the still and at a pressure above that of the initial vaporisation. The other end of the pipe opens into the vapours passing into the return-condenser. Lower-boiling fractions are condensed separately, and the condensed liquid is collected.—L. A. C.

Fuel; Pulverised —. N. K. H. Ekelund, Jönköping, Sweden. Eng. Pat. 122,214, 17.11.17. (Appl. 16,978/17.)

SEE Ger. Pat. 306,727 of 1917; this J., 1918, 616 A.

Coke; Manufacture of —. A. McD. Duckham, Ashtead. U.S. Pat. 1,289,045, 24.12.18. Appl., 19.5.15.

SEE Eng. Pat. 17,502 of 1914; this J., 1915, 787.

Heating wash-oils [in benzol recovery]. Ger. Pat. 306,570. *See* III.

Carbon dioxide analyser U.S. Pat. 1,285,927. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

PATENTS.

Decolorising and purifying agent [carbon] and method of making the same. R. W. Mumford, New York, Assignor to Refining Products Corporation, Wilmington, Del. U.S. Pat. 1,286,187, 26.11.18. Appl., 11.5.17.

FINE-GRAINED carbon for decolorising purposes is prepared by mixing granular, moist, vegetable matter, containing colloid substances, with granular dolomite and manganese dioxide, and heating the mixture slowly to a temperature above 600° C., whereby the vegetable material is charred and the pores of the carbon are cleansed by the gases evolved from the mineral matter. The product is then cooled out of contact with air and the mineral matter removed.—W. F. F. P.

Decolorising carbon; Process of making —. R. W. Mumford, New York, Assignor to Refining Products Corporation, Wilmington, Del. U.S. Pat. 1,287,592, 10.12.8. Appl., 15.1.18.

MOIST comminuted carbonaceous or vegetable matter is mixed with pulverised dolomite to form a plastic material, which is placed in shallow layers in metal trays and subjected to a gradually increasing temperature rising above 800° C., with precautions to avoid any sudden rise in temperature. The carbonaceous material is quenched in water with exclusion of air, and the mineral matter removed as a sediment. The carbon is dried in a rotating heated tube by means of the gases from the carbonising furnace. In a modification, the dolomite is replaced by the product of the reaction of milk of lime and mono-calcium phosphate, and the carbon is similarly dried by means of dry steam.
—W. F. F.

Electrode; Arc-lamp —. W. R. Mott, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,289,514, 31.12.18. Appl., 28.1.16.

AN arc-lamp electrode is composed of carbon, calcium fluoride, and rare earth compounds substantially free from cerium, and consisting, to the extent of one-third or more, of yttrium fluoride.
—B. N.

Seal for electric apparatus. U.S. Pat. 1,288,916. *See* XI.

III.—TAR AND TAR PRODUCTS.

Pyridine and ammonia; Estimation and separation of ——. *An application of the electrolytic dissociation theory.* E. B. R. Prideaux. Faraday Soc., Jan. 21, 1919. [Advance proof.] 10 pages.

THE best indicator for the titration of ammonia with an acid is methyl red, but lacmoid is also good for dilute solutions; for pyridine the best indicator is congo or methyl violet, the acid used being preferably nitric acid. Based on electrochemical considerations, calculations are made as to the correct conditions for the titration of pyridine, alone or in the presence of ammonia, and for the separation of the two by distillation. For the titration of ammonia in the presence of small quantities of pyridine, α-naphtholphthalein is a good indicator, the amount of pyridine being subsequently determined by the addition of congo and continuing the titration; rosolic acid can also be used as indicator but is not as satisfactory as α-naphtholphthalein. The partial separation of ammonia and pyridine can be effected by distillation from a solution of which the acidity is maintained at such a degree as to produce a reddish brown colour with congo or an orange colour with methyl orange; the distillate contains no ammonia but most of the pyridine, which may be estimated by titration; the residual liquid contains all the ammonia and a little pyridine, which are then liberated by the addition of alkali and titrated after removal by further distillation. The degree of acidity for the first distillation is obtained by adding a small excess of *N*/1 sulphuric acid and then introducing disodium hydrogen citrate until the necessary condition is reached.

—D. F. T.

Benzol in gas. St. Claire Deville. *See* IIA.

Washing light oils. Schreiber. *See* IIA.

PATENTS.

Wash-oils [in benzol recovery processes]; Process for retarding corrosion of vessels used for heating ——. A. Krieger, Ickern. Ger. Pat. 306,570, 5.8.17.

APPARATUS used for recovering benzol from wash-oils is frequently rendered useless after a relatively short time by corrosion of the heating coils due to the presence of ammonium salts in the wash-oil. To overcome this difficulty it is proposed to heat the wash-oil in presence of alkali or alkaline-earth hydroxides or of metals, such as iron.

Phenanthraquinone; Process for the manufacture of ——. H. F. Lewis, Urbana, Ill., and H. D. Gibbs, San Francisco, Cal. U.S. Pat. 1,288,431, 17.12.18. Appl., 10.1.18. (Dedicated to the public.)

PHENANTHRAQUINONE is prepared by heating phenanthrene vapour mixed with air to 600°—500° C. in the presence of oxides of metals of the fifth and sixth groups of the periodic system.—L. A. C.

IV.—COLOURING MATTERS AND DYES.

Pyrrole Black; New mode of formation of ——. A. Angeli and A. Pieroni. Atti R. Accad. Lincei, 1918, **27**, ii, 300—304. (See this J., 1918, 685 A.)

AN intensely coloured Pyrrole Black may be obtained by the action of air on a dilute ethereal solution of magnesium ethyl iodide and pyrrole. (See also J. Chem. Soc., 1919, i, 134.)—T. H. P.

PATENTS.

[*Vat dyes.*] *Manufacture of chlorinated derivatives of N-dihydro-1.2.2.'1'-anthraquinoneazine.* Ges. für Chem. Ind. in Basel, Switzerland. Eng. Pat. 113,783, 28.1.18. (Appl. 1633/18.) Int. Conv., 27.2.17.

THE chlorination of finely divided N-dihydro-1.2.2.'1'-anthraquinoneazine (indanthrene) may be efficiently carried out, with excess of chlorine, in a non-aqueous inorganic liquid containing halogen, other than chlorosulphonic acid, such as sulphuryl chloride, thionyl chloride, sulphur chloride, phosphorus oxychloride, antimony pentachloride, or bromine. The indanthrene may be halogenated to tri- or tetra-chloro derivatives and these may be readily reduced, giving vats which yield dyeings or printings perfectly fast to chlorine. Under these conditions the dihydro-azine is not oxidised to azine, as is the case when sulphuric or chlorosulphonic acid is used. When indanthrene is suspended in bromine for a long period a bromo-derivative is obtained which is fast to chlorine but is very difficult to vat. By passing chlorine through bromine in which indanthrene is suspended, halogen derivatives free from bromine are produced.—L. L. L.

Anthraquinone derivative and process of making same. Vat colour and process of making same. G. Kalischer, Mainkur, Germany. U.S. Pats. (A) 1,285,726 and (B) 1,285,727, 26.11.18. Appl., 25.2 and 28.2.18. Renewed 30.4.18.

(A) 1-AMINOANTHRAQUINONE-2-ALDEHYDE is prepared by treating with acids the condensation products obtained by heating 1-amino-2-methylanthraquinone with aromatic nitro compounds in the presence of alkalis, alone or with the addition of primary aromatic amines. The aldehyde produced melts at about 233° C., dissolves in concentrated sulphuric acid with a brown colour which, on addition of paraformaldehyde, changes to an intense blue; it yields with hydrosulphite and caustic soda a bright green vat. (B) 1-Aminoanthraquinone-2-aldehyde is condensed with hydrazine, yielding a dark red dyestuff, very sparingly soluble in organic solvents of high boiling point and giving with hydrosulphite and caustic soda a vat which dyes cotton claret-red shades of very good fastness. The same dyestuff is also produced by condensing the azomethine compounds corresponding to 1-aminoanthraquinone-2-aldehyde, which form the intermediate stage in the preparation of the latter substance, with hydrazine. It is soluble in concentrated sulphuric acid with an olive colour, changed on the addition of paraformaldehyde to an intense greenish-blue.—J. F. B.

[*Azo*] *dyestuff of the pyrazolone series and process of making same.* E. Reber, Assignor to Society of Chemical Industry in Basle, Switzerland. U.S. Pat. 1,286,411, 3.12.18. Appl., 15.2.18.

Azo dyestuffs of the pyrazolone series are prepared by combining a diazo compound of an amine, which is not substituted in its ortho position by a hydroxyl or a carboxyl group, with 1-phenyl-3-methyl-5-pyrazolone, having a hydroxyl and a carboxyl group in the phenyl radicle.—L. L. L.

Dye. S. M. Tootal, Blackpool. U.S. Pat. 1,289,968, 31.12.18. Appl., 20.11.17.

SEE Eng. Pat. 111,365 of 1916; this J., 1918, 5 A.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Beating tests [for paper pulp]. E. Sutermeister. Pulp and Paper Mag., 1919, **17**, 47—49.

MANY useful results in testing the quality of wood pulps and the influence of certain chemical factors in the operation of beating have been obtained by

treating the fibre in a small porcelain ball-mill. Thus the superiority of moist sulphite pulp, which has never been dried, over the same pulp, steam dried, has been demonstrated by comparing the strength of papers prepared from pulps beaten in this way. On the other hand, experiments made to ascertain the influence of chemical solutions on the behaviour of the pulp during beating have led to very divergent conclusions on the part of different observers when beating in the presence of alkalis, although there is no doubt as to the injurious effect of bleaching powder and acid solutions. This method of testing has further demonstrated the deterioration of dry unbleached sulphite pulp when stored for a number of years exposed to air, light, and all normal indoor changes of humidity, the decrease in strength being accompanied by a change in the fibre, which became less absorbent and more difficult to break up into pulp. Another method of employing the beating test is to beat the fibre for periods increasing from 10 to 50 minutes and to note the course of the development of strength in the papers made at intervals during the period. Some observers experience trouble due to the rolling up of the fibres into knots by this method of beating, whereas others never encounter knots at all. This difference can only be attributed to some difference in the conditions of beating, and in order to produce comparable results the dimensions of the mill, the number, size, and weight of the balls, the consistence of the pulp, and the relative volume occupied by the pulp should be recorded for standardisation. Further, in making comparative studies great care should be taken to compare the strengths of sheets having approximately the same weights, since it is shown that the strength to weight ratio is not a constant for the same pulp. A sheet-making machine can be operated to give sheets of constant weight, whereas hand-moulds tend to give sheets of decreasing weights as the beating is prolonged.—J. F. B.

Wood pulps in paper: Detection of soda and sulphite ——. R. Wasicky. Papierfabrikant, 1918, **16**, 212—213, 228—229. Z. angew. Chem., 1918, **31**, Ref., 371.

PIECES of the paper to be examined are boiled up once with a 0·2% aqueous solution of Gentian Violet, allowed to remain in the liquid for 2 minutes, rinsed with 95% alcohol, and steeped for 2 minutes in 95% alcohol containing 0·5% of hydrochloric acid. They are subsequently washed for 15 minutes in 95% alcohol, which is renewed once, and finally washed in water. Papers made of pure soda wood pulp lose the colour entirely, whereas sulphite papers are stained a deep violet. Papers of mixed composition may be analysed with an accuracy of about 5% by comparing them with known standards.—J. F. B.

Absorption of water by vulcanised fibre. Allen. *See* XI.

PATENTS.

Paper, paper-board and like material; Apparatus for drying —— in the course of manufacture. Thames Paper Co., Ltd., and J. B. J. Privett, Purfleet, Essex. Eng. Pat. 122,352, 31.5.18. (Appl. 9026/18.)

THE drying cylinders or vessels of a paper machine are connected with an air pump in such a way that a partial vacuum is maintained in the header or pipe leading from the drying cylinders or vessels, so that the condensed water and accumulated air are drawn off from the drying cylinders and passed through a condenser, whence the water may be returned to the boiler through a hot well or pump. In case exhaust steam at low pressure is employed for drying the paper, a reheater is interposed through which the steam is passed before it enters the cylinders. The reheater may be heated by electricity or gas, with an arrangement for the automatic regulation of the temperature of the steam passing through.—J. F. B.

Paper; Dryer for coated ——. J. Janson, Lawrence, Mass. U.S. Pat. 1,287,027, 10.12.18. Appl., 15.5.18.

A DRYER for coated paper comprises a pair of rotary supports arranged to sustain a web of paper with its coated surface uppermost and to permit the web to be loosely suspended between them in a loop; means are provided to feed the web without engagement with its coated surface and to flex it oppositely as it is fed, while heated air is simultaneously applied to the coated surface.
—J. F. B.

Drying apparatus [for paper or fabrics] and method of drying. J. O. Ross, Assignor to B. F. Sturtevant Co., Boston, Mass. U.S. Pat. 1,287,110, 10.12.18. Appl., 8.12.13.

AN apparatus for drying webs of paper or fabric comprises a conveyor for carrying the web, a blower, an air conduit extending longitudinally along the web, and a tubular nozzle for discharging a stream of air from the conduit, impinging against the middle portion only of the web, in order to counteract the tendency to dry more rapidly at the edges than at the middle.—J. F. B.

Drying material in the form of webs; Apparatus for ——. B. R. Andrews, Braintree, Mass. U.S. Pat. 1,287,172, 10.12.18. Appl., 25.4.18.

IN a drying machine having a number of poles over which the web material to be dried is festooned, means are provided to deliver the web material to the poles successively and to direct a current of air against the web as it is being laid over each pole.—J. F. B.

[Roofing] felt; Composite —— and process of making the same. Method of making construction materials. R. P. Perry, Upper Montclair, N.J., Assignor to The Barrett Co. U.S Pats. (A) 1,288,158 and (B) 1,288,159, 17.12.18. Appl., 14.4 and 1.11.17.

(A) A COMPOSITE sheet is made of paper consisting of a layer containing a definite quantity of finely divided fusible bituminous matter and at least one other united to the first, but containing a smaller proportion of bituminous matter (B) Finely divided fibrous material is added to segregated particles of fusible waterproofing material whilst the latter are in a soft adherent condition and the mixture is then formed into a sheet by pressure.—A. B. S.

Cellulose or cellulosic materials; Preparation of solutions of ——. Zellstoff-Fabrik Waldhof, and V. Hottenroth, Mannheim-Waldhof. Ger. Pat. 306,818, 3.1.17.

CELLULOSE is dissolved in a mixture of hydrochloric and sulphuric acids containing less than 39% HCl, for instance, in a mixed acid containing 34·7% HCl, 5·5% H_2SO_4, and 59·8% H_2O.—J. F. B.

Paper-making; Treatment of certain plants for ——. C. Beadle, London. U.S. Pat. 1,286,502, 3.12.18. Appl., 19.6.17.

SEE Eng. Pat. 116,005 of 1917; this J., 1918, 409 A.

Waste flux from galvanising. Eng. Pat. 121,984. *See* X.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

PATENTS.

Bleaching process. A. E. Jury, New York, Assignor to National India Rubber Co. U.S. Pat. 1,289,803, 31.12.18. Appl., 11.5.16.

TEXTILE material is bleached, then soured with an inorganic acid, treated with alkali to neutralise any remaining acid, and excess of alkali is finally neutralised by a volatile organic acid.—S. S. A.

Cloth dyeing, bleaching and like machines. R. Jackson, Chinley. Eng. Pat. 121,987. (Appls. 18,011, 5.12.17, and 18,933, 21.12.17.) Addition to Eng. Pat. 110,715 (this J., 1918, 6A).

IN machines of the type specified in the original patent, having alternately positively driven guiding rollers together with squeezing rollers, the rolls are coupled together in pairs by frictional means so proportioned that in use the non-positively driven guide roller tends to accelerate the motion of the oppositely disposed squeezing roller. The guide rollers may be so interconnected that both rolls are driven at the same peripheral speed. Braking devices may be fitted to the cloth reel. A baffle is provided in the beck so that the dyestuff solutions or other chemicals may be added without splashing the rollers or the end fents of the goods.—J. F. B.

Dyeing, mordanting, bleaching, scouring or similarly treating wool, slubbing, yarn and other fibrous material; Apparatus for ——. J. Kershaw and J. T. Cole, Menston, Yorks. Eng. Pat. 122,227, 5.1.18. (Appl. 279/18.)

THE apparatus is of the type in which the material is placed in a tank or vat between a movable, perforated false bottom and a fixed lattice top, both the lattice top and the false bottom being preferably made in sections, and is repeatedly compressed when saturated with liquor and allowed to open out or expand after each compression (see Eng. Pat. 16,329 of 1908; this J., 1909, 979). The false bottom is raised slowly during compression and then lowered rapidly. By means of pipe connections and stopcocks, the liquid may be passed through the material in either direction without reversing the pump. A spraying device is provided, located above the lattice top. The machine may be provided with an apparatus for raising the lattice top, and fitted with an attachment for treating material in bank form.—L. L. L.

Bleaching, dyeing, finishing and otherwise treating fabrics; Apparatus for use in connection with machines for ——. J. Thornber and A. B. Henshilwood, Bradford. Eng. Pat. 122,241, 15.1.18. (Appl. 846/18.)

THE apparatus consists of a wagon or "coach" fitted with adjustable bearings to receive the axial shaft of a roller so that coils of fabric, "batched" upon the roller, may be transferred from one bleaching, dyeing, or finishing machine to another, or unwound from it on to another machine, without the necessity of lifting the batch by hand labour. The axle is fitted with a weighted friction rope in order to deliver the fabric from the wagon to any other machine under proper tension. The machines are fitted with suitable detachable devices for the transference of the batch of fabric from the machine to the wagon, or *vice versâ*.—L. L. L.

Yarn and like textile fibres; Machines for treating ——. H. Smethurst, Hollingwood, Lancs. Eng. Pat. 122,309, 20.7.18. (Appl. 3695/18.)

PERFORATED tubes or bobbins, closed at one end, on which the yarn is wound, are fed from a hopper into holders carried by an endless belt. When the bobbins, in the holders, have been carried into suitable positions in the machine, they are clamped against liquid-supply connections and may be treated with a regulated quantity of liquid, and followed if necessary by aeration by means of compressed air. The bobbins, after treatment, are then automatically discharged from the belt.—L. L. L.

Yarn-treating machine. W. J. Going, Amsterdam, N.Y., Assignor to Klauder-Weldon Dyeing Machine Co., Yardley, Pa. U.S. Pat. 1,287,962, 17.12.18. Appl., 6.4.16.

THE machine comprises an impregnating tank and a pair of squeezing rollers. One of the rollers is covered with several lappings of an absorbent textile material, fixed to the roller at one end so as to be easily removed.—S. S. A.

Dyeing fabrics and the like; Method of and means for ——. E. J. Wilkinson, Manchester, Assignor to Bradford Dyers' Association, Ltd., Bradford. U.S. Pat. 1,287,543, 10.12.18. Appl., 7.7.15.

SEE Eng. Pat. 17,215 of 1914; this J., 1915, 902.

Wool-like effects on cotton fabrics; Process for producing ——. G. Heberlein, Wattwil, Switzerland. U.S. Pat. 1,288,884, 24.12.18. Appl., 18.5.16.

SEE Eng. Pat. 100,483 of 1916; this J., 1916, 1057.

Cotton fabrics; Process for imparting a transparent appearance to ——. G. Heberlein, Wattwil, Switzerland. U.S. Pat. 1,288,885, 24.12.18. Appl., 6.6.18.

SEE Addition of 30.11.15 to Fr. Pat. 468,642 of 1914; this J., 1917, 133.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Ammonia; Effect of phosphine and hydrogen sulphide on the oxidation of —— to nitric acid. G. B. Taylor and J. H. Capps. J. Ind. Eng. Chem., 1919, 11, 27—28.

PURE acetylene has no effect on the catalytic action of platinum in oxidising ammonia to nitric acid (see this J., 1918, 465A), and hydrogen sulphide in low concentrations has no immediate toxic effect. Phosphine to the extent of two or three parts per hundred million in the ammonia-air mixture diminishes the yield of nitric acid by several per cent., whilst with 20—30 parts per 100,000 the yield is very seriously affected. Phosphine is a sufficiently active catalyst poison to account for previous results obtained with crude acetylene and the difficulty of efficiently oxidising ammonia prepared from cyanamide is almost certainly due to the phosphine present. The phosphine appears to exert a cumulative action, since the platinum becomes less efficient with use.—T. H. P.

Nitrous vapours; Constitution of ——. P. Jolibois and A. Sanfourche. Comptes rend., 1919, 168, 235—237.

WHEN nitric oxide and oxygen are mixed in the proportion of 4:1 by volume, combination is instantaneous at the ordinary temperature, nitro-

gen trioxide, N_2O_3, being formed and remaining stable. If the gases are mixed in the proportion of 2 : 1 the combination very rapidly reaches the stage N_2O_3 and subsequently the peroxide is formed to the extent of 34% in 20 secs., the transformation being complete after 100 secs.; even if oxygen is supplied in excess the time required for the formation of the peroxide is of the same order. If the nitrous vapours are submitted to a temperature of 400° C., the equilibrium tends towards N_2O_3.—W. G.

Hydrochloric acid; Estimation of solutions of — and of ammonia by weighing ammonium chloride, and the volatilisation of this salt at different temperatures. Auger. Bull. Soc. Chim., 1918, **23**, 467—472.

A REPLY to Villiers (Bull. Soc. Chim., 1918, **23**, 306) in which the author reaffirms the loss in weight of ammonium chloride when heated at 100° C. even in narrow-necked flasks.—W. G.

Potassium cyanide; Action of — on ammoniacal copper sulphate, and its application to the determination of hydrocyanic acid and copper. L. Jennesseaux. Ann. Chim. Analyt., 1919, **1**, 15—20.

WHEN a cyanide solution is treated with a drop of copper sulphate solution and a small quantity of sodium hydroxide solution, and then acidified with sulphuric acid, a white precipitate is obtained. In this reaction, which was described originally by Lassaigne, only a portion of the cyanide enters into combination, the greater part being converted into cyanogen, but it may be rendered much more sensitive if the copper sulphate solution is treated previously with sufficient sodium bisulphite to change the colour of the solution from blue to green. The test will then detect as little as 0·002 mgrm. of hydrocyanic acid in 1 c.c. of solution. Another sensitive reagent for hydrocyanic acid may be prepared by adding 100 c.c. of 4·99% (*N*/5) copper sulphate solution to a mixture of 80 c.c. of *N*/1 ammonia and 20 c.c. of water. If potassium cyanide solution is added to this reagent a crystalline blue-green precipitate, having the composition $2Cu_2(CN)_2,Cu(CN)_2,4NH_3$, is first formed; on the addition of a further quantity of cyanide, the solution becomes colourless and the precipitate dissolves. This requires a definite quantity of cyanide and if the reagent is standardised against pure potassium cyanide it may be used for the volumetric determination of cyanides. Conversely, the reaction may be applied to the determination of copper.—W. P. S.

Barytes; Analysis of —. Frenkel Ann. Chim. Analyt., 1919, **1**, 10—12.

WHILST commercial barytes is in some cases practically pure barium sulphate, specimens are met with containing 6% of silica and appreciable quantities of alumina; other specimens contain but little silica and up to 10% of calcium sulphate. The content of barium sulphate is best determined by reducing the substance by heating to bright redness in an atmosphere of coal-gas, for 15 mins., dissolving the mass in boiling water, decomposing the sulphide with hydrochloric acid, boiling the solution to expel hydrogen sulphide, and then precipitating the barium with sulphuric acid. If calcium sulphate is present it may be separated by shaking about 1 grm. of the finely divided sample with 50 c.c. of water at 38° C., filtering the mixture, and washing the residue; the calcium is then determined in the filtrate. The author has examined certain specimens of barytes which contained organic matter; these samples gave an abnormal loss when ignited owing to reduction of the sulphate.—W. P. S.

Osmium tetroxide; Reduction of — by hydrogen chloride. O. Ruff and S. Mugdan. J. prakt. Chem., 1919, **98**, 143—144.

WHEN treated with hydrochloric acid, osmium tetroxide remains mostly unchanged, a small proportion undergoing reduction to the dioxide but not to the monoxide, as stated by Milbauer (J. prakt. Chem., 1917, **96**, 187; see also J. Chem. Soc., Mar., 1919.)—T. H. P.

Pyridine and ammonia. Prideaux. *See* III.[CA]

Silicate specific heats. White. *See* VIII.

Iodine tincture. Raubenheimer. *See* XX

PATENTS.

Sulphuric and hydrochloric acids; Process for manufacture of —. H. V. Welch, Assignor to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,285,856, 26.11.18. Appl., 10.5.17.

BY reaction between sulphur dioxide, chlorine, and steam a mixture is produced from which, by partial cooling, practically all the sulphuric acid is condensed in the form of finely divided, suspended particles, while the hydrochloric acid remains in the gaseous state. The sulphuric acid is then separated by electrical precipitation.—W. E. F. P.

Hydrofluoric acid; Production of —. E. S. Fickes, Pittsburgh, Pa. U.S. Pat. 1,288,400, 17.12.18. Appl., 31.3.14. Renewed 14.8.18.

AN elongated, horizontal retort, consisting of a number of cast iron sections joined end to end, has a rotary agitator extending through its length, and is provided at opposite ends with means for the continuous discharge of hydrofluoric acid gas and solid residue respectively. The retort is enclosed by a flue through which circulate the products of combustion from a furnace at one end of the apparatus.—W. E. F. P.

Aluminium compounds poor in iron; Production of —. Det Norske Aktieselskab for Elektrokemisk Ind. Norsk Industri-Hypotekbank. Christiania, Norway. Eng. Pat. 113,278, 5.2.18 (Appl. 2078/18.) Int. Conv., 6.2.17.

ALUMINOUS minerals, such as plagioclase rocks of the labradorite-anorthite series—in which the bulk of the contained iron is present as a constituent of mineral silicates (hypersthene, diallage, epidote, etc.) less easily decomposed than the plagioclases—are either mixed with carbon and heated to 600°—1000° C., in a current of chlorine or hydrochloric acid, to produce aluminium chloride, which is condensed; or heated to 300°—600° C., in a current of nitrogen oxides and steam, to produce aluminium oxide and sodium and calcium nitrates. In the latter case, the product is treated with water to eliminate the nitrates, and then with a mineral acid to produce an aluminium salt practically free from iron compounds and silicic acid.—W. E. F. P.

Tungstates; Process for obtaining pure ——. J. B. Ekeley and W. B. Stoddard, Boulder, Colo., U.S.A. Eng. Pat. 122,264, 24.1.18. (Appl. 1391/18.)

To remove phosphorus and arsenic, an aqueous solution of the tungstate is treated successively with an oxidising agent (sodium hypochlorite), a salt of an alkaline-earth metal (magnesium chloride), ammonia, and ammonium chloride, and then filtered.—W. E. F. P.

Felspar, leucite and the like; Treatment of ——. F. A. Rody, Johnson City, Tenn., Assignor to Metallurgical Co. of America, New York. U.S. Pat. 1,285,796, 26.11.18. Appl., 18.5.15. Renewed 20.7.18.

FOR the recovery of alkalis and alumina the mineral is treated with a basic alkali compound, and the product is heated to a sintering temperature with an oxygen compound of an alkaline-earth metal, whereby an ortho-silicate of the latter metal is produced, and the alkali and alumina are combined in water-soluble form.—W. E. F. P.

Potassium salt from felspar, etc.; Process of extracting soluble ——. H. Blumenberg, jun., Assignor to Chemical Construction Co., Los Angeles, Cal. U.S. Pat. 1,286,513, 3.12.18. Appl., 7.11.17.

A MIXTURE of felspar, powdered calcium carbonate, and "acid sludge" is heated in the presence of air to form potassium sulphate and an insoluble calcium aluminium silicate.—W. E. F. P.

Silicates; Method of treating ——. H. N. Morse, Baltimore, Md. U.S. Pat. 1,286,718, 3.12.18. Appl., 6.4.18.

SILICATES containing potash and alumina and which are attacked by sulphur dioxide are heated in a current of sulphur dioxide to a temperature at which the gas attacks the potash but not the alumina.—J. H. P.

Potash in cement-mill dust; Process for rendering water-soluble the ——. A. R. Merz, Washington, D.C. U.S. Pat. 1,288,137, 17.12.18. Appl., 19.11.17. (Dedicated to the public.)

PORTLAND cement-mill dust is ignited in an oxidising atmosphere.—W. E. F. P.

Nitrates; Preparation of metal ——. W. O. Snelling, Long Island City, N.Y. U.S. Pat. 1,285,824, 26.11.18. Appl., 10.5.16.

NITRIC acid is sprayed into a solution of barium sulphide, the mixture being disposed in thin sheets and maintained under reduced pressure.
—W. E. F. P.

Nitrates; Production of —— from ammonia, ammonium combinations, or organic nitrogen combinations. Process for the production of calcium nitrate. C. T. Thorssell and H. L. R. Lundén, Gottenborg, Sweden. U.S. Pats. (A) 1,286,838 and (B) 1,286,839, 3.12.18. Appl., 10.4.18.

(A) A SOLUTION of calcium nitrate, inoculated with nitrifying bacteria, is applied to a porous mass of calcium carbonate, and the mass is afterwards treated with a dilute solution of a nitrogen compound to be oxidised, and compressed air passed through. (B) Calcium cyanamide, dissolved in water, is mixed with a solution of calcium nitrate, and the mixture brought into intimate contact with nitrifying bacteria, with an ample supply of air, for the production of calcium nitrate.—B. N.

(A and B) *Nitrates; Production of —— by means of bacteria.* (C) *Process for oxidising ammonia, ammonium combinations, or organic nitrogen combinations.* C. T. Thorssell and H. L. R. Lundén, Gottenborg, Sweden. U.S. Pats. (A) 1,288,754, (B) 1,288,755, and (C) 1,288,756, 24.12.18. Appl., 10.4.18.

(A) A LIQUID containing calcium carbonate, calcium nitrate, and ammonium sulphate is inoculated with a nitrifying bacterium which oxidises the ammonia to nitrate, a solution of calcium nitrate resulting. (B) In oxidising ammonium compounds by means of a nitrifying bacterium a suitable inorganic substance is added which has no effect on this bacterium but is poisonous to other bacteria injurious to the reaction. (C) A thin layer of a substratum free from organic nutriment and containing an alkali is placed on a suitable support, inoculated with a nitrifying bacterium, and a liquid containing an ammonium salt is passed through it in presence of air.—B. V. S.

Potassium chloride from saline waters, Process of recovering ——. G. B. Burnham, Berkeley, Cal. U.S. Pat. 1,286,932, 10.12.18. Appl., 20.12.17.

LIQUOR containing potassium and sodium chloride, sulphate, and carbonate, and approximately saturated with sodium chloride, is cooled to effect separation of sodium sulphate and carbonate, which are removed; and then concentrated by evaporation until separation of sodium chloride occurs and the liquid is approximately saturated with potassium chloride. After separation from the deposited sodium chloride, the warm liquor is cooled to effect crystallisation of the potassium chloride.—W. E. F. P.

Borax and potassium chloride; Process for separating ——. *Process of obtaining potassium chloride from brines. Process for separating salts from a mixture of salts in solution.* J. W. Hornsey, Summit, N.J., Assignor to General Reduction Gas and By-Products Co. U.S. Pats. (A) 1,288,591, (B) 1,288,592, and (C) 1,288,593, 24.12.18. Appl., 17.4.15.

(A) A SOLUTION containing borax and potassium chloride is diluted to a sp. gr. of 1·12—1·22, *e.g.*, 1·16, at about 200° F. (93° C.), and cooled to about 40° F. (4·5° C.). Borax is precipitated and is separated from the solution. Subsequent concentration of the liquor at about 200° F., followed by cooling to 40° F. precipitates potassium chloride. (B) To separate potassium chloride from solutions containing potassium chloride, sodium chloride, borax, sodium sulphate, and sodium carbonate, the last-named is precipitated by carbon dioxide, sodium chloride is removed by evaporating the filtrate at an elevated temperature, and borax and potassium chloride are then obtained by cooling the residual liquor. The solution is then subjected to successive evaporations to remove sodium chloride and sulphate, and coolings to remove borax and potassium chloride. The borax and potassium chloride are separated as described under (A). (C) After removing some of the sodium carbonate and chloride, borax, and potassium chloride as described under (B), the solution is re-carbonated to remove the balance of carbonate, and the filtrate is again evaporated to remove sodium chloride and sulphate. The filtrate is mixed with a hot dilute solution of the borax and potassium chloride separated at an earlier stage to produce a solution of sp. gr. 1·12—1·22 at about 200° F., and this is treated as under (A), the final filtrate being returned to the cycle.
—S. S. A.

Manganese peroxide; Process of preparing ——. M. L. Kaplan, Brooklyn, N.Y. U.S. Pat. 1,287,041, 10.12.18. Appl., 4.8.17.

MANGANOUS nitrate is decomposed in the presence of another nitrate.—W. E. F. P.

Sulphuric acid pickle liquors; Utilisation of ——. P. Fireman, Trenton, N.J., Assignor to Magnetic Pigment Co., New York. U.S. Pat. 1,287,939, 17.12.18. Appl., 20.12.17.

FREE sulphuric acid present in the pickle liquor is neutralised and the resulting iron sulphate solution is treated with an alkaline-earth (calcium) chloride, thereby producing a solution of ferrous chloride and a precipitate of calcium sulphate. An alkaline-earth oxide (calcium hydroxide) is then added to the ferrous chloride solution, ferrous hydroxide being precipitated and a solution of calcium chloride formed.—L. A. C.

Titanium hydrates; Process of precipitating ——. M. Fladmark, Bretteshes, Assignor to Titan Co A./S., Christiania, Norway. U.S. Pat. 1,288,863. 24.12.18. Appl., 10.5.17.

THE process consists in heating a concentrated solution containing titanium and iron sulphates in which the proportion of sulphuric acid is less than that required to form normal salts with the bases present.—W. E. F. P.

Sodium sulphide; Process of producing ——. E. M. Symmes, Bacchus, Utah, Assignor to Hercules Powder Co., Wilmington, Del. U.S. Pat. 1,289,016, 24.12.18. Appl., 9.6.17.

SODIUM sulphate is heated to fusion with carbon in a container of "corrosiron."—W. E. F. P.

Chlorides; Method of dehydrating [rare earth] ——. C. W. Balke, Highland Park, Ill., Assignor to Pfanstiehl Co., Inc., North Chicago, Ill. U.S. Pat. 1,289,079, 31.12.18. Appl., 20.9.17.

AMMONIUM chloride is added to a solution of the chloride, the mixture is evaporated to dryness, and the temperature is slowly raised to red heat, in the presence of a current of hydrogen chloride, until all the ammonium chloride has been driven off.—S. S. A.

Sulphur burner. H. C. Ellis, Assignor to Ellis Drier and Elevator Co., Chicago, Ill. U.S. Pat. 1,289,417, 31.12.18. Appl., 19.8.15.

A BURNING chamber of firebrick, having an inlet and an outlet, is supported on a bed of reinforced concrete and enclosed by a brick structure having a roof of reinforced concrete. The two structures are spaced apart to effect insulation and permit expansion of the inner chamber; and the roof and bed of reinforced concrete are connected by tie-rods extending vertically through the outer walls.
—W. E. F. P.

Sulphur burning. G. F. Hurt, Assignor to Pratt Engineering and Machine Co., Atlanta, Ga. U.S. Pat. 1,289,783. 31.12.18. Appl., 14.7.17.

AN upward spray of molten sulphur is produced within a burning chamber at the bottom of which a pool of the liquid material is maintained; and the gaseous product, containing a large proportion of sulphur vapour, is conducted into spacious channels to which sufficient air to effect complete oxidation of the sulphur is supplied.—W. E. F. P.

Copper oxide; Manufacture of technical hydrated —— free from chlorides. Bayerische A.-G. für chem. u. landwirts.-chem. Fabr. H. Hackl, and H. Bunzel, Heufeld. Ger. Pat. 306,035, 23.3.17. Addition to Ger. Pat. 305,738 (this J., 1918, 467 A).

BASIC copper chloride, precipitated by the addition of strong bases to solutions containing copper, is separated as completely as possible from the liquid, heated under atmospheric pressure with milk of lime or magnesium hydroxide, and washed, the treatment being repeated, if necessary, once or several times.—J. F. B.

Liquefying atmospheric air and separating the same into its constituents, oxygen and nitrogen; Apparatus and process for ——. J. F. Plate, Essex, N.J., U.S.A. Eng. Pat. 122,212, 5.11.17. (Appl. 16,147/17.)

IN an apparatus having a number of pressure-regulating valves consecutively arranged, each valve has a high- and a low-pressure port and is connected with an expansion chamber within which a high-pressure feed-pipe or coil is disposed. Each of the feed-pipes is supplied with compressed air from the preceding expansion chamber, and delivers to the high-pressure port of the valve connected with its own chamber; and the low-pressure port of each valve discharges into its own expansion chamber through a space immediately surrounding the high-pressure feed-pipe. The compressed air admitted to the high-pressure port of each valve is thus cooled by the partially expanded air delivered from the low-pressure port of the same valve.—W. E. F. P.

Hydrogen purifying, cleaning, and circulating system. C. A. Pfanstiehl, Waukegan, Assignor to Pfanstiehl Co., Inc., North Chicago, Ill. U.S. Pat. 1,286,088, 26.11.18. Appl., 26.4.15.

IN a circulating system for drying and purifying hydrogen, the impure gas, containing a trace of free oxygen, is delivered to a supply reservoir in which a constant pressure is maintained, and the oxygen is removed by means of a heated reagent in a de-oxidising chamber connected in series with the supply reservoir and a circulating pump.
—W. E. F. P.

Nitrogen; Production of ——. M. Shoeld, Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pat. 1,287,472, 10.12.18. Appl., 6.3.18.

FROM a mixture of nitrogen and carbon dioxide, the latter is removed by means of an aqueous solution which is afterwards boiled to recover the carbon dioxide and regenerate the absorbent. The hot liquid is utilised for preheating a further quantity of solution already charged with carbon dioxide.—W. E. F. P.

Acetic acid; Manufacture of ——. *Manufacture of acetic acid from acetaldehyde.* H. Dreyfus, Basle, Switzerland. U.S. Pats. 1,286,255 and 1,286,256, 3.12.18. Appl., 1.6 and 4.6.17.

SEE Eng. Pats. 105,065 and 108,459 of 1917; this J., 1918, 180 A, 266 A.

Hydrogen; Producing ——. H. Keller, Assignor to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,286,650, 3.12.18. Appl., 19.4.13.

SEE Fr. Pat. 453,077 of 1913; this J., 1913, 791.

Nitrogen and carbon dioxide; Apparatus for making ——. C. D. McCourt, London, and C. Ellis, Montclair, N.J., Assignors to Surface Combustion, Inc., Wilmington, Del. U.S. Pat. 1,289,496, 31.12.18. Appl., 26.1.12. Renewed 18.5.18.

See Eng. Pat. 25,629 of 1912; this J., 1913, 751.

Waste flux from galvanising. Eng. Pat. 121,984. *See* X.

Recovering potash salts. Eng. Pat. 122,048. *See* X.

Electrolytic apparatus. U.S. Pat. 1,287,156. *See* XI.

VIII.—GLASS; CERAMICS.

Silica bricks and their manufacture. L. Dauphin. Bull. Soc. de l'Ind. Min., 1918, **13**, 137—190.

Typical silica bricks of best quality and medium quality respectively have the following properties: Refractoriness (T), 1750° C., 1730° C.; refractoriness after adding 6% Fe_2O_3 (t), 1735° C., 1710° C.; true sp. gr., 2·35, 2·47; porosity, 18%, 20%. The durability of the brick is a function of T and t; no brick should have T less than 1730° C. and t less than 1710° C. The porosity should not usually be less than 18%. The value 2·47 for the true sp. gr. may be regarded as a strict maximum. The refractoriness test should be made on the ground sample, moistened with dextrin solution and then made into small tetrahedrons. When silica bricks are ground with 6% of ferric oxide the refractoriness is reduced by 15°—50° C. The effect of iron oxide is much more marked if sufficient lime has previously been added to reduce the refractoriness to a definite figure. Alumina is very harmful in silica bricks. In one case it was found that the addition of 1·5% of alumina in the presence of lime greatly reduced the refractoriness. The proportion of lime used should not exceed 2%. Bricks containing 3% of lime, mixed by hand, are not as strong as those containing only 1% of lime which have been tempered in an edge-runner mill. The milk of lime should be prepared at least 5 hours and preferably 24 hours before it is required, and unslaked pieces should be removed by passing the milk through a 25-mesh sieve. Mechanically hydrated lime in the form of a fine powder is preferable to milk of lime. The best material for silica bricks is a very pure quartzite which does not crack on heating. When this is unobtainable a quartz which cracks moderately should be used. Rock which contains veins of quartz or other intrusions should be rejected. The rock should be crushed until it passes completely through an 8- or 10-mesh sieve. The crushed material should also be carefully graded. The larger grains of silica rock (7—10 mm.) should not crack or fall to pieces when heated. All forms of silica are equally good if they are sufficiently pure and the rock is of sufficiently fine grain. Bricks made of such materials have also high porosity. Sand is usually unsuitable for the manufacture of silica bricks because it produces bricks of too great a porosity and too low a strength, but if a portion of the sand is ground so fine that it passes wholly through a 50-mesh sieve and half of it passes through a 200-mesh sieve, it may be used quite satisfactorily, provided the sand is sufficiently pure. The greater the pressure used in shaping the bricks the stronger are the bricks and the smaller is the loss in manufacture. The soft pastes used in England do not give the densest bricks. By using a stiffer paste and a powerful press (400 kilos. per sq. cm.) better and denser bricks are produced. In burning the bricks the smallest particles of silica are transformed the most readily into cristobalite and tridymite; impure quartzites—particularly those containing a little alumina—are most difficult to transform. The most suitable kilns are the downward draught type in which the bricks are set in benches 9 in. wide, placed 2½ to 4 in. apart, but continuous kilns appear to give almost equally good results, and the saving of fuel effected by them is very considerable. The heating should occupy at least 72 hours per chamber. A comparison of British and foreign silica bricks gave the following results:—

	Refractoriness	True sp. gr.	Porosity %	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Refractoriness after adding 6% Fe_2O_3
British bricks:									
B.W.	1725° C.	2·44	24	94·3	1·40	1·66	2 30	—	—
B.A.Y.D.	1733° C.	2 36	28	95·0	0 87	2 03	2 00		—
B.S.Y.D.	1710° C.	2 33	26	95·0	1·17	1·33	2 20		—
B.F.P.	1735° C.	2 43	32	95·6	0 68	2·22	1 30		—
B.B.	1725° C.	2 53	28	93 9	0·86	1 84	3 0	—	
German bricks:									
Zurbig	1728° C.	2 30	23	95 1	1·53	0·97	2 0	—	—
Stella	1730° C.	2 47	20	95·9	0·41	1·87	1 7	—	—
French bricks:									
Loire	1725° C.	2 34	31	95·48	1·86		1 78	traces	1715° C.
"	1725° C.	2 56	28	96 46	1·18		2 06	0 27	1700° C.
S.A.M.	1715° C.	2·35	27	93·82	1·12	2 54	1 78	—	—
C.F.D.	1750° C.	2 35	17	96 15	0·37	1·24	1 75	0 18	1735° C.
American brick:									
"Star"	1730° C.	2 31	30	97 8	0 9	0·85	0 10	0·15	1710° C.

—A. B. S.

Silica refractories. N. Parravano. Annali Chim. Appl., 1918, **10**, 150—158.

Slight variations in the conditions of burning silica bricks may have a pronounced effect upon the porosity of the product and its mechanical resistance. Thus while the chemical composition may be the same the resistance to compression may vary from 1 to 10. Slow heating and cooling are necessary to obviate the effect of the changes in volume. The two methods of transforming the quartz into cristobalite and tridymite (*i.e.* with or without the use of a flux) produce different effects. The crystallisation of the flux does not cause expansion, since the new crystals are deposited in the free spaces, whilst, on the other hand, the change which takes place in the absence of a flux promotes expansion of the granules owing to the diminution in density which accompanies it. Silica bricks made by the ordinary method consist principally of cristobalite (70%) and a little tridymite (5%). On continuing the burning the proportion of tridymite continually increases until, after 20 days' continuous heating, the whole mass becomes tridymite. Bricks insufficiently burned give unsatisfactory results, since they are not yet converted into a continuous block, and the quartz granules at a high temperature are isolated and suspended in a liquid. The material is therefore plastic as in the case of re-

fractory materials of clay and magnesia. Successful welding of the quartz granules depends upon the quantity of flux, the temperature of burning, and the size of the granules. The flux has a great influence on the capacity of the refractory material to resist the effect of a high temperature. This is owing to the fact that the solubility of the silica in the flux increases with the temperature, and that the block thus has a tendency to disintegrate. Hence, the higher the temperature to which the refractory material is to be subjected the smaller should be the proportion of flux used. Experience has shown that for refractories for steel furnaces the proportion of foreign oxides should not exceed 3 to 5%, whilst in the case of those for coke ovens twice as much may be used. The temperature of burning should be such that the flux becomes a mobile fluid; the most suitable temperature appears to be about 1400° C. Since fine granules of quartz dissolve most readily they should be present in the largest proportion, but it is necessary also to have a certain amount of coarse granules, since fissures spread too readily in a mass composed of uniformly fine granules. To prevent the formation of fissures the burned refractory material should not contain unaltered quartz granules. Refractories in which the granules are thoroughly welded should show a resistance to compression equal to at least 10 kilos. per sq. cm., after being heated for an hour at 1600° C. (See also this J., 1917, 961; 1918, 546 A., 695 A.)—C. A. M.

Silica refractories for glassworks use. W. J. Rees. J. Soc. Glass Tech., 1918, **2**, 253—259.

SILICA bricks are preferred to fireclay bricks in the crowns of glass furnaces because they expand and are less likely to allow the crown to fall and because pieces which fall from them into the molten glass are readily soluble in the latter and do not form "stones." Ganister is more readily inverted than most silica rocks, and is therefore very suitable for silica bricks. The use of 25% of the silica in an impalpable form is recommended. The texture of the bricks should be uniform; bricks with a fine texture resist hot gases and fluxes better than coarse-grained bricks. For glass works, bricks of medium texture and containing no particles larger than ¼ in. diam. are preferable. Owing to expansion and contraction accompanying the inversion of the silica during the heating and cooling of the furnaces, the tie-rods should be released or tightened as may be required. The bricks should be laid dry and the cement applied as grouting. To test the cement a thin layer should be placed between two bricks and when dry, the bricks should be heated to a temperature well above that at which they will be used. A good cement should be only slightly less refractory than the bricks (not more than 2 cones lower). A good cement may be made by grinding those portions of used silica bricks which have not been in contact with fluxes, or by grinding a high quality silica rock with not more than 6% of fireclay.—A. B. S.

Refractory materials and the glass industry. J. W. Cobb. J. Soc. Glass Tech., 1918, **2**, 262—272.

THE maximum temperature reached in the glass industry is 1400° C., except in certain tank furnaces which are worked at a higher temperature to secure high output. In addition to the corrosive effect of the molten glass on the pots or tanks, the bricks in the furnace have to withstand the action of mechanically carried dust and of volatilised matter. Most of the refractory materials used in the glass industry are composed of fireclay or silica, or mixtures of these. When finely ground silica is added to finely ground alumina the melting point is steadily reduced from cone 42 to cone 29 (1650° C.) for a mixture of 8 mols. SiO_2 to 1 mol. Al_2O_3, which is the same ratio as that in a very good and widely used brick. The anomaly is due to the material in the bricks being coarse-grained, so that the interaction between the silica and alumina is not so complete as in finely ground material. In mixtures of equal weights of fine fireclay and silica fragments of different selected sizes, heated under laboratory conditions, the silica did not begin to act as a flux unless the fragments were less than 0·0025 in. diameter. Larger fragments act as a stiffening agent and increase refractoriness, but when exposed for a week in a works furnace at 1500° C. all the silica fragments less than 0·025 in. diameter exercised a definite fluxing effect. On substituting pitch for fireclay (so as to eliminate the solvent action of the fireclay on the coarse silica), it was found that the addition of silica always had a stiffening action, the most marked effect being with fine material which had passed through a 100-mesh sieve. Hence, the greater stiffening effect of the coarse fragments in silica-fireclay mixtures is due to their greater resistance to solvent-action by the fireclay. There is an upper limit to the size of silica fragments which is permissible in bricks which depends upon the mechanical strength of the fragments and the local expansion of the silica. The proportion of clay which can be used in a mixture is limited by its shrinkage when the bricks are in use. Excessive shrinkage causes wide cracks into which liquids and vapours may penetrate and cause corrosion. Excessive expansion causes distortion and "crushing." If an alkaline vapour attacks a clay surface in such a manner as to form a molten silicate immediately, the latter soon closes the pores and the subsequent fluxing action is low. If the attack occurs at a lower temperature than that at which much fusion can occur, the vapour penetrates the brick or block and a complicated action of a destructive character may occur (see this J., 1910, 69, 250, 335, 399, 608, 799, 1091). If the temperature is afterwards increased the vitrified mass produced is liable to disintegrate. If crystallisation occurs the disintegrating effect will be still greater. The cement used in laying refractory bricks and blocks should be very fine grained so as to allow joints of minimum thickness.

—A. B. S.

Optical glass; The presence of iron in the furnace atmosphere as a source of colour in the manufacture of ——. E. W. Washburn. J. Amer. Ceram. Soc., 1918, **1**, 637—639.

AN optical glass melted in an electric furnace was free from colour whilst the same batch when melted in a gas-fired furnace was distinctly green. The colour was traced to the presence of iron in the gases constituting the furnace atmosphere. A sample of glass withdrawn previous to stirring was much less coloured than the finished glass. After replacing the iron gas-burners by others made from clay and coating the interior walls of the furnace with kaolin, a distinct reduction in the colour of the glass was obtained. The kaolin on the walls gradually acquired a red colour due to absorption of iron either from the bricks or from the furnace atmosphere. It is desirable to use iron-free bricks for lining the furnaces, and any metallic iron used in the interior of the furnace should be water-cooled to prevent volatilisation of the metal.

—A. B. S.

Glass-house pots: Requirements of clay for ——. S. N. Jenkinson. J. Soc. Glass Tech., 1918, **2**, 272—280.

THE following provisional specifications for clays for glass-house pots are suggested. Clay mixtures for pots should consist of bind clay, base clay, and grog. The bind clay should be a fat aluminous weathered clay of low sintering point so that vitrification will

start early, but the clay must not show signs of over-firing until high temperatures are reached. The refractoriness under load is of secondary importance. The grains should be very small. The base clay should be a highly aluminous refractory clay in specially selected lumps as free as possible from pyrites. Freedom from iron in segregated form is necessary. Fine grinding is important. The more angular the grains the better. The grog should have been prepared from specially selected lumps of clay calcined at 1250° C. or above, and with no signs of "blue stoning" or black cores. Ground firebrick should not be used as grog. The grog is used to form a skeleton of shrunk clay and to delay over-firing. It must be fully shrunk, and well graded, preferably with a considerable proportion of flour with angular grains. None of the clays when fired in a slightly reducing atmosphere at 1400° C. should show signs of speckling, but should have a dense structure. A wide range of vitrification (1140°—1450° C.) is necessary, especially in the bind clay. Three grades of each clay are suggested as shown in the following table:—

	Grade I.			Grade II.			Grade III.		
	Bind clay	Base clay	Grog	Bind clay	Base clay	Grog	Bind clay	Base clay	Grog
*Silica %	60 (a)	55 (a)	50 (a)	65 (a)	60 (a)	60 (a)	70 (a)	70 (a)	70 (a)
*Alumina %	34 (b)	40 (b)	40 (a)	30 (b)	35 (b)	35 (b)	25 (b)	25 (b)	25 (b)
*Ferric oxide %	1·8 (a)	1 (a)	1 (a)	2 (a)	2 (a)	2 (a)	2·5 (a)	2 (a)	2 (a)
*Na_2O and K_2O %	1·8 (a)	1·5 (a)	1·5 (a)	2 (a)	1·8 (a)	1·8 (a)	2·5 (a)	1·8 (a)	1·8 (a)
*MgO and CaO %	1·0 (a)	0·5 (a)	0·5 (a)	1 (a)	0·6 (a)	0·6 (a)	1·0 (a)	1·0 (a)	1·0 (a)
Refractoriness (cone)	32	35	35	30	32	32	28 29	30 31	31
Ground to	80 mesh (d)	80 mesh	10 mesh	50 mesh (c)	50 mesh	10 mesh	12 mesh	12 mesh	10 mesh
Calcining temperature (cone)	—	—	14 (b)		—	12 (b)	—		9 (b)

* = Determined in the fired samples.
(a) = and under.
(b) = and over.
(c) = When blunged it must not leave more than 10 per cent. residue on a 50-mesh sieve.
(d) = When blunged it must not leave more than 10 per cent. residue on a 80-mesh sieve.

It is necessary to select the clays to suit the temperature of the furnace, as it is essential that the pots shall be well vitrified before use.—A. B. S.

[Glass] pot attack; Notes on ——. E. A. Coad-Pryor. J. Soc. Glass Tech., 1918, **2**, 285-287.

Small pots of 100 grms. capacity and rods of ¼ in. diameter of the same material were fired at different temperatures and the thickness of the bottoms of the pots and the diameters of the rods were measured. The rods were suspended vertically with their lower end ⅛ in. above the bottom of the inside of the pots. The pots were then filled with cullet and the latter melted in an electric furnace at a controlled temperature. The bottom of the pot was invariably attacked more than the sides and the rod was always tapered. The effect of porosity in well-fired pots was not large. The protection of the sides of the pot appears to be due to the formation of sillimanite. With a refractory material denser than clay the corroded rod has a smaller diameter near the surface of the glass than lower down. This is the characteristic of all materials in the process of solution whereas abrasion produces a taper with the thin end downwards. The phenomena are attributed to currents set up during the process of solution, these currents depending on the relative densities of the molten glass, the refractory material, and the solution.—A. B. S.

Glass pots; Apparent causes of failure of lead ——. A. F. Gorton. J. Amer. Ceram. Soc., 1919, **1**, 648—659.

The chief causes of failure in pots used for melting lead glasses are cracking and corrosion. Cracks may be produced by strains set up by heating the pot-arch too rapidly, by not preheating sufficiently, and by throwing the glass batch into the pots. Corrosion may be due to the slagging action of iron on the clay, to solution of the pot material following the action of alkalis and glass, and to insufficient burning of the bottom of the pot in the pot-arch. The last-named defect could be obviated by allowing the pot to remain empty in the furnace for three days. The vitreous layer formed by heating the inner surface of the pot with a burner or by molten glass is too thin to protect the pot sufficiently. A lining of aluminous or porcelain-like material is liable to crack and spall. The safest method is to burn the pot thoroughly at a temperature of 2500° F. (1380° C.) the heat being applied directly to the bottom. The addition of porcelain grog to the pot batch is of little use and tends to cause the sides to bulge.—A. B. S.

Glass; Solubility of clay in ——. J. H. Davidson and W. E. S. Turner. J. Soc. Glass Tech., 1918, **2**, 280—284.

Ground samples of clays, burned at various temperatures, were mixed with a standard glass batch and the time taken to dissolve the clay at a definite temperature was noted. It was found that finely ground clay even when fired at 1450° C. is readily soluble in soft glass batch at 1350°—1400° C., the rate of solution depending on the size of the particles. It is therefore desirable to subject the part of the pot or block exposed to the glass to hard firing before use so as to close the pores or cracks and thus reduce the surface area. The pots may also be made with a smooth surface, for example, by using Weber's casting process.—A. B. S.

Glass; Identification of "stones" in ——. N. L. Bowen. J. Amer. Ceram. Soc., 1918, **1**, 594—605.

A chemical analysis of "stones" in glass is unsatisfactory on account of the small amount of material available, but their nature may be rapidly ascertained by crushing them, and determining their refractive index, extinction angle, and other optical properties under the microscope. "Pot stones" are detached fragments of the vessel in which the glass has been melted. Under the microscope they show crystals of sillimanite (Al_2SiO_5) with a little interstitial glass. Sillimanite is never found in "stones" of other origin. "Pot stones" may be avoided by more carefully preheating the pots, by using pots of more uniform texture or of more suitable composition, by altering the glass batch so as to reduce its action on the pots, and by melting at a lower temperature. "Batch stones" are particles of unmelted material from the glass batch and consist wholly of silica, sometimes in the form of the original quartz (sand), with or without a coating of cristobalite or tridymite; sometimes in the form of cristobalite or tridymite without interstitial glass. "Batch stones" frequently have a "tail" of glass of lower refractive index due to the gradual solution of the silica of the "stone"; these

"rails" are absent in "stones" caused by devitrification. To prevent the formation of "batch stones," the glass should be melted at a higher temperature or more fluxes should be added, finer or more uniform sand should be used, and the batch materials should be better mixed. Occasionally, adventitious materials in the batch cause "batch stones"; these may be sometimes identified under the microscope. "Crown drops" are fragments detached from the brickwork in the crown of the furnace or are drops of material formed by the action of vapours on the brickwork. When silica bricks are used the "drops" usually consist mainly of tridymite in relatively large crystals, which are readily distinguished from "batch stones." In cases of doubt a comparison with pieces of the glaze chipped from the brickwork should be made. "Devitrification stones" are opaque masses containing 10—15% of crystals formed by the devitrification of the glass, and analogous to the spherulites which occur in volcanic lavas. The crystals are composed of:—(*a*) principally tridymite, but cristobalite is usually present; (*b*) wollastonite ($CaSiO_3$) fibres, sometimes with cristobalite; (*c*) other silicates such as $BaSi_2O_5$, $PbSiO_3$. "Devitrification stones" differ from "batch stones" in having no central core of dense crystalline nature free from glass, and no core of quartz. The nature of the compound separating from the glass suggests which of the raw materials is probably at fault or the change in the composition of the batch which should be made. The optical properties of the above-mentioned substances are briefly described.—A. B. S.

Boric oxide in glass; Determination of ——. J. D. Cauwood and T. E. Wilson. J. Soc. Glass Tech., 1918, **2**, 246—252.

The most easy, rapid and satisfactory method for determining boric oxide in glass is Sullivan and Taylor's modification of Wherry's method (this J., 1914, 1154). Wherry's method (this J., 1908, 1179) gives high results with glasses containing lead or zinc, but is satisfactory for glasses free from these metals. The glass apparatus used should not contain boric oxide. The volume of the solution should be kept as low as possible consistent with thorough washing, and if Wherry's method is used the boiling with calcium carbonate should not be unduly prolonged. The volume of the solution titrated may be as high as 300 c.c. if sufficient mannitol is present.—A. B. S.

Glass; Effect of temperature on the rate of corrosion of ——. J. D. Cauwood and W. E. S. Turner. J. Soc. Glass Tech., 1918, **2**, 260—262.

Flasks of different types of glass previously examined (this J., 1917, 873; 1918, 692A) containing various reagents were heated in a thermostat to carefully regulated temperatures between 60° and 100° C. for varying periods; in every case the corrosion of the glass increased rapidly with a rise in temperature. With water the amount of material dissolved was doubled for each rise of 5° C. between 90° C. and 100° C., except in one case in which the loss at 100° C. was four times that at 95° C. With 2*N* Na_2CO_3 the action was roughly doubled for each 10° rise between 60° C. and 100 C. With 20% hydrochloric acid the rate of increase in chemical action with temperature was distinctly less than with water and alkali.—A. B. S.

Porcelain; Some types of ——. F. H. Riddle and W. W. McDanel. J. Amer. Ceram. Soc., 1918, **1**, 606—627.

A study of the burning range of porcelain bodies composed of varying proportions of kaolin, felspar, and flint with a constant proportion (1·5%) of whiting, burned at or above cone 10, including electric insulators, hotel china, chemical porcelain, and some domestic china. The materials, in the desired proportions, were ground wet in a ball mill, passed through a 140-mesh silk lawn, filter-pressed, and the cakes hand-wedged and made up into trial pieces and standard cups three days later. The effect of increasing the felspar was to reduce the porosity without greatly altering the burning range. There was very little difference in the softening points of bodies with from 45 to 70% of kaolin and from 12½ to 30% of felspar; there was more difference between bodies containing from 12½ to 30% of felspar with 45% of clay than in similar mixtures with 70% of clay. The shrinkage-temperature graph was parabolic. The higher the proportion of clay the less was the effect of variations in the proportion of flux. Bodies containing 45—50% of clay vitrified at a slightly higher temperature than those with 55—60% of clay, but also containing 1·5% of whiting. When the damp body was kept for eight months its strength increased, the "aged" bodies in which the whole of the clay was kaolin being stronger than fresh bodies containing 16% of ball clay. Difficult shapes can be made much more easily from "aged" than from fresh bodies and a smaller proportion of ball clay can be used, thus enabling a whiter product to be made. Ball clay tended to reduce the porosity and to cause the ware to be over burned, but was sometimes useful in permitting a reduction in the felspar content. At higher temperature the "aged" bodies shrank less and had less porosity than the fresh ones and the ware was burned more uniformly. Ball clay reduced the burning range and should therefore be kept at a minimum in bodies which can be improved by storage. The addition of 0·2—1·0% of magnesia, lime or barium carbonate to a typical hard paste porcelain body showed that barium oxide only reduced the porosity slightly, but magnesia caused the body to mature earlier and caused overburning at a lower temperature. Lime did not hasten the maturing of a body, but caused overburning at a lower temperature and shortened the burning range. A mixture of magnesium and calcium carbonates in molecular proportions behaved like magnesia alone. The translucency of the ware was increased by the addition of lime or magnesia up to 1%, but not by baryta. Hence the addition of a little magnesite or dolomite to a porcelain body should be better than that of whiting. The shrinkage was greater in the presence of magnesia and dolomite than in that of lime. Sillimanite was prepared by calcining a mixture of kaolin and anhydrous alumina with 20% of boric acid at cone 20, grinding the product, and passing it through a 100-mesh sieve. A body in which this material replaced the flint was made of sillimanite calcine 22·5%, kaolin 51·0%, felspar 25%, and whiting 1·5%. It had a long range of vitrification, was free from the strains resulting from the volume changes due to the conversion of quartz into other forms of silica and had a low coefficient of expansion. The kaolin-alumina mixture may also be incorporated with the flux, making it possible to reduce the temperature of calcination to cone 11. Dolomite can be used in bodies for hotel china, for which the following limits of composition for a burning range of cones 10—12 are suggested: flint, 30 to 40%; felspar, 14 to 18%; alkaline-earth fluxes, 4·0 to 6·5%; ball clay, 3 to 8%; china clay, 45 to 25%; Florida clay, 10 to 6%. When very white porcelain is required it may be secured by the use of very pure materials, by burning under oxidising conditions to cone 09 and under reducing conditions from 09 to 8, and by the use of a blue stain such as basic cobalt carbonate. The use of small proportions of dolomite, magnesite, or whiting also improves the whiteness of the ware.—A. B. S.

Porcelain; Electrical resistance of —— at different temperatures. R. G. Allen. Sci. Proc. Roy. Dublin Soc., 1918, **15**, 289—309.

THE electrical resistance of various samples of porcelain was measured at various temperatures, between 80° C. and 300° C. The samples examined were: (*a*) (*b*) Two low-tension porcelain insulators for transmission wires, of thickness 0·7 cm., 0·65 cm. respectively; (*c*) an old porcelain insulator (date 1862), 0·65 cm. thick; (*d*) an evaporating dish of German make, 0·22 cm. thick; (*e*) a long Berlin porcelain tube, 0·8 cm. internal and 1·1 cm. external diameter; (*f*) a porcelain crucible lid of German make, 0·16 cm. thick; (*g*) a bowl of Portland china, 0·22 cm. thick; and (*h*) an evaporating dish of Royal Worcester porcelain, 0·16 cm. thick. In each case, except the inner surface of the tube, the samples were glazed. The results confirm the approximate truth of Rasch and Hinrichsen's formula (Z. Elektrochem., 1908, **14**, 41):—

$$\log \sigma = \frac{a}{T} + b,$$

in which σ is the specific insulation resistance, T is the absolute temperature, and a and b are constants for a given material. For temperatures below 250° C. the insulation resistance of porcelain is frequently independent of the voltage, but porcelains of different varieties show great differences in resistance. Approximate values for the insulation resistance in megohms per cm. cube of the samples examined, at ordinary temperatures, are given in the following table:—

Sample	10° C.	20° C.	30° C.	100° C.
g	500,000 × 10⁶	126,000 × 10⁶	25,500 × 10⁶	10,000 × 10⁶
h	200,000 ,,	71,000 ,,	17,800 ,,	6,300 ,,
d and *e*	11,200 ,,	3,200 ,,	850 ,,	250 ,,
g and *c*	3,980 ,,	1,260 ,,	397 ,,	158 ,,
a and *b*	1,590 ,,	416 ,,	129 ,,	40 ,,

The high electrical resistance of Portland china and Royal Worcester chemical porcelain is noteworthy.—A. B. S.

Enamels; Control of the lustre of ——. H. F. Staley. J. Amer. Ceram. Soc., 1918, **1**, 640—647.

FOR enamelling metal, enamels with a bright finish are required, and they must not crystallise under normal conditions of working and use. The simplest method of preventing this is to use an enamel highly viscous at the temperature at which crystallisation occurs, and to cool rapidly. Silica and silicates high in silica melt to viscous glasses, so that the addition of silica or felspar to an enamel will lessen the tendency to crystallisation, but the maturing temperature of the mixture will usually be raised beyond working limits. Boric oxide forms a very viscous glass at low temperatures, but the viscosity decreases rapidly as the temperature increases. Borate glasses become more viscous as the percentage of boric acid increases, but the viscosity decreases as the temperature increases. The presence of eutectic and other compounds has no noticeable effect on the viscosity curves. Kaolin and opacifiers increase the viscosity of enamels, and a reduction in the proportions of any of the fluxing metallic oxides has the same effect. Hence the proportion of all fluxes except boric and lead oxides should be kept low, and a large variety of such oxides used so as to limit the concentration of any one of them. Partial cooling and re-heating of the enamelled ware should be avoided. Sulphur in the materials composing the enamel batch is not likely to be harmful, but the saturation of a thin film of enamel by sulphur from the kiln atmosphere may cause "feathering." This defect occurs chiefly in badly ventilated muffles, in those with cracked floors, and in open-arch or semi-muffles in which there is not sufficient draught to cause the flame to "hug the roof." The use of quicklime inside the muffle is seldom effective; it is most so when it is piled over temporary patches in the floor of the muffle, but it must be renewed daily as soon as it becomes saturated. Mixtures containing lead, barium, and zinc oxides tend to produce enamels of great brilliance. Potash gives greater brilliancy than soda, and boric acid than silica. Enamels rich in flint are usually more brilliant than those in which felspar is the only refractory.—A. B. S.

Silicate specific heats. W. P. White. Amer. J. Sci., 1919, **47**, 1—43.

THE specific heats of various silicates were determined by the method used in an earlier investigation (this J., 1909, 1127), improved in various details so as to obtain increased accuracy (see page 158 A). The following results were obtained:—

Interval specific heats.

	0°–100° C.	0°–300° C.	0°–500° C.	0°–700° C.	0°–900° C.	0°–1100° C.	0°–1300° C.	0°–1400° C.
Crystals:								
Quartz	0·187	0·217	0·238	0·254	0·260	0·264	—	—
Pseudo-wollastonite	0·184	0·204	0·217	—	—	0·238	0·243	0·245
Cristobalite	0·188	0·233	0·213	0·251	0·257	0·262	0·266	0·268
Anorthite	0·190	0·214	0·230	0·240	0·248	0·255	0·263	0·267
Andesine	0·192	—	0·233	0·244	0·252	—	—	—
Microcline	0·187	0·211	(0·226)	0·237	0·245	(0·251)	0·116	0·125
Wollastonite	—	—	—	0·227	0·234	0·240	0·242	—
Diopside	0·192	0·216	0·231	0·242	0·250	0·256	—	0·260
Amphibole	0·203	0·230	0·246	0·258	0·266	0·273	—	—
Pyroxene	0·204	0·231	0·249	—	—	—	—	—
Glasses:								
Silica	0·185	0·212	0·230	0·242	0·251	—	—	—
Anorthite	0·188	0·215	0·230	0·240	—	—	—	—
Andesine	0·193	0·221	—	0·248	(0·262)	—	—	—
Albite	0·198	0·224	0·241	—	0·264	—	—	—
Microcline	0·192	0·216	0·232	0·243	0·251	0·260	—	—
Wollastonite	0·185	0·208	0·221	0·235	—	—	—	—
Diopside	0·193	0·219	0·233	0·244	—	—	—	—
Mag.-silicate	0·204	0·230	0·247	0·260	—	—	—	—

For quartz and silica glass, the values of the interval specific heats satisfy the expressions:—

Quartz ... $0{\cdot}1685 + 0{\cdot}0001940 - 0{\cdot}000000116^2$

Silica ... $0{\cdot}1670 + 0{\cdot}0001890 - 0{\cdot}0000001250^2$

The true atomic heats rise regularly from about 3·5 at 0° C. to about 5·96 (with anorthite to 6·6) at 1300° C. On comparing the specific heats of various silicates in the crystalline and glassy form respectively, it was found that the specific heat of the glass is seldom greater than that of the crystal, the exceptions being the glasses containing sodium

or potassium. Some glasses show a decided increase in specific heat at a fairly elevated temperature. The specific heat of anorthite glass is much less than that of the crystal. At 1300° C. magnesium metasilicate (amphibole) undergoes a monotropic inversion with evolution of heat. This unstable form has a specific heat more than 1% below the other. At 1170° C. wollastonite (calcium metasilicate) undergoes an enantiotropic inversion into pseudo-wollastonite with absorption of heat, the product having a lower specific heat. The reversion on cooling does not occur without a solvent. Neither form shows any perceptible irregularity in its specific heat near the temperature of inversion. At 575° C., quartz undergoes a sharp reversible inversion from α- to β-quartz with an increase in volume and changes in most of its optical properties. The specific heat largely follows these other changes, but, if the effect of the expansion on the specific heat is calculated, the increase in specific heat is more than four times too small to account for the work demanded by the expansion. The relatively high specific heat of cristobalite at 100° C. indicates that the α- to β-cristobalite inversion is of the same type as that of quartz at 575° C. The transformations of quartz into cristobalite and tridymite resemble the inversion of wollastonite into pseudo-wollastonite rather than the prompt change from α- to β-quartz. The former are accompanied by negligible changes in the specific heat, whereas in the latter the change is strongly marked. It is suggested that in the change from α- to β-quartz, and from α- to β-cristobalite, the crystal changes *en masse*, involving a stretching rather than a re-arrangement of the atomic pattern, whilst in the wollastonite—pseudo-wollastonite and quartz—cristobalite inversions there is no general shifting, but the new crystals grow at the expense of the old ones, as they might grow in glass, but more slowly. When a substance occurs in two or more forms, none of them shows any variation in the specific heat near the inversion temperature. (See also J. Chem. Soc., Feb., 1919.)—A. B. S.

Zirconia; its utilisation as a refractory, opacifier, and abrasive. A. Granger. Monit. Scient., 1919, 9, 5—14.

An account is given of the most important published researches on Brazilian zirconia, its purification, and utilisation for the manufacture of refractory ware. For his own experiments the author prepared zirconia from zircon. The mineral was first extracted with hydrochloric acid to remove iron, and converted into sulphate by treatment with hot concentrated sulphuric acid, the zirconia being precipitated as hydroxide or basic sulphate after removal of the silica. The zirconia obtained by ignition of the hydroxide was moulded into crucibles in a press, an organic binding material being used. The firing temperature employed is not given, but it is claimed that good results were obtained when the zirconia had previously been strongly ignited. Attempts to prepare zirconia tubes for use in a carbon resistance furnace were not successful, because at high temperatures the zirconia itself becomes a good conductor. The author does not consider that zirconia is likely to displace stannic oxide in enamels on account of the high cost of iron-free zirconia, although possibly it may find application for special acid-resisting enamels. Zircon may be used as an abrasive for certain purposes.—E. H. R.

PATENTS.

Glass; Method of delivering —— from furnaces. **G. E. Howard, Butler, Pa., U.S.A. Eng. Pat. 122,258, 21.1.18. (Appl. 1186/18.)**

The glass is passed from the melting tank through a comparatively long interval of time, and is then discharged through a larger opening and hence at a faster rate by lowering one or more displacing blocks of refractory material into the glass in the delivery chamber. When refilling the delivery chamber the displacement blocks are not raised clear of the surface of the glass.—A. B. S.

Glass-furnace. A. L. Schram, Hillsboro, Ill., Assignor to Drey Automatic Glass Machine Co., St. Louis, Mo. U.S. Pat. 1,288,227, 17.12.18. Appl., 15.4.15.

A device for delivering glass from a glass furnace comprises an adjustable plug in a sectional fireproof hood mounted on a metal framework adjacent to the discharge outlet of the furnace.—A. B. S.

Glass-annealing oven. J. M. Lents, Evansville, Ind., Assignor to The Owens Bottle Machine Co., Toledo, Ohio. U.S. Pat. 1,289,208, 31.12.18. Appl., 19.5.16.

The glass is carried through the lehr by a continuously moving conveyor. A loading conveyor passes through the wall above the lehr conveyor, and inside the lehr is enclosed in a casing, from which a smooth surface extends and rests on the lehr conveyor. Means are provided for pushing the ware from the loading conveyor on to the smooth surface at intervals, and for preventing the passage of ware into the lehr whilst the pushing movement is in operation.—A. B. S.

Illuminating-glass. J. O. Handy, Assignor to Macbeth-Evans Glass Co., Pittsburgh, Pa. U.S. Pat. 1,287,005, 10.12.18. Appl., 11.4.17.

A white semi-translucent illuminating glass, "free from fire," is formed by fusing a lead soda batch or other mixture capable of producing clear glass with opacifying agents free from fluorine, such as aluminium oxide, a phosphate, and an agent having "the colouring effect or reaction characteristic of sodium chloride."—A. B. S.

Silica bricks, tiles and other articles; Manufacture of ——. C. H. Sankey, Chislehurst, and J. E. Foster, Hanley. Eng. Pat. 122,388, 25.11.18. (Appl. 19,370/18.)

Bricks or other articles are made of a mixture of 65 to 80% of silica which has been calcined at 1600° C., crushed, and graded to pass through a sieve having from 16 × 16 mesh to 100 × 100 mesh per square inch, together with 5 to 20% of fibrous material, such as straw, chaff, peat, wool, or hair, and 10 to 30% of calcined silica which has been reduced to a very fine powder by water-grinding. The articles are made in a press or mould, dried, and burned at a temperature above 1500° C., so as to develop a crystalline structure. No flux or binder is needed.—A. B. S.

Brick-drying apparatus. E. J. Moore, Assignor to The Charles Woodward Co., Cleveland, Ohio. U.S. Pat. 1,288,116, 17.12.18. Appl., 6.3.17.

The bricks to be dried are carried on rollers through a series of compartments, arranged one above another, with doors at the end of each compartment which can be turned down into a carrying position.—A. B. S.

Kiln. J. B. Owens, Metuchen, N.J. U.S. Pat. 1,288,975, 24.12.18. Appl., 15.7.16.

A tunnel kiln is provided with a furnace intermediate of the ends, a burning zone extending from it towards the inlet of the tunnel, and a drying

the walls of the kiln) between the burning zone and the tunnel inlet, equipped with means for circulating air in an upward direction. For the supply of air a tunnel space extends beneath the car-track in the burning zone and another space beneath the car-track in the cooling zone, with intersecting inspection tunnel spaces constituting air inlets. Means are provided for controlling the currents of air flowing from the inspection tunnels to the tunnel spaces.—A. B. S

Kiln. J. B. Owens, Metuchen, N.J. U.S. Pat. 1,289,530, 31.12.18. Appl., 7.4.16.

A KILN combining in one structure a furnace, smoke exit, and one or more muffle tunnels and open tunnels, is provided with means for conveying the products of combustion transversely from the furnace to the exit in one direction only, producing various temperatures in the several tunnels according to their distance from the furnace. The muffle tunnels and open tunnels are arranged side by side alternately. The furnaces are at one side of the burning zone, and the smoke exits at the other. The preheating and burning zones have communicating flues adjacent to the side wall on which the smoke exits are situated; auxiliary smoke exits are provided adjacent to the opposite side of the preheating zone. The smoke outlets are provided with means for controlling the direction and discharge of the products of combustion.—A. B. S

Tunnel kilns; Controllable draught for —. J. B. Owens, Metuchen, N.J. U.S. Pat. 1,289,889, 31.12.18. Appl., 3.3.17.

A TUNNEL kiln open throughout its active length, but normally closed at its entry portion where the main draught outlet is situated, has one or more controllable draught outlets for the active entry portion of the kiln, between the main draught outlet and the point where the ware enters the kiln, another controllable draught outlet connected with the interior of the kiln beyond the main draught outlet, and means whereby the direct draught may be caused to pass through the active length of the kiln and out through the draught outlets, and whereby the heat may be forced or "surged" into the normally closed entry portion of the kiln beyond the main draught outlet, so that the ware may be preheated as soon as it has entered the kiln.—A. B. S.

Muffle- [tunnel] kiln. J. B. Owens, Metuchen, N.J. U.S. Pat. 1,289,890, 31.12.18. Appl., 1.4.18.

A TUNNEL kiln has sides constructed of thin panels with intervening thicker panels so as to form muffle walls, and has continuous combustion chambers alongside the latter. The tunnel has an upper section in which a high temperature may be maintained, a lower section containing "semi-inert air," in which a lower temperature is maintained, and means whereby air may pass from the lower to the upper section, the two sections being otherwise kept separate from each other. Means are also provided for withdrawing heated air from the upper section.—A. B. S.

Refractory article. F. J. Tone, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pats. (A) 1,289,578 and (B) 1,289,966, 31.12.18. Appl., 26.7.18.

A REFRACTORY article containing graphite, a binder, and (A) fine granular, fused crystalline alumina, or (B) zirconia.—A. B. S.

Enamel oven. S. Wiester, Beach Dam, Wis., Assignor to R. Weimer, Sheboygan, Wis. U.S. Pat. 1,285,682, 26.11.18. Appl., 5.10.17.

LEDGES of reinforced brickwork extend horizontally inwards, one above another, from the outer wall of the oven, and support removable lining sections —A. B. S.

Seal for electric apparatus. U.S. Pat. 1,288,946. *See* XI.

IX.—BUILDING MATERIALS.

Blast furnace slags. Hollmann. *See* X.

PATENTS.

Moulded articles [electrical insulators] of cement: Manufacture of —. W. E. Windsor-Richards, Southall, Middlesex. Eng. Pat. 121,986, 4.12.17. (Appl. 17,958/17.)

ELECTRIC insulators or other articles are made of a mixture of Portland cement 30 parts, waste asbestos, glass wool, or other suitable fibre 15 parts, and clay 10 parts, with about $\frac{1}{10}$ of its weight of water. For making tubes by extrusion a suitable mixture consists of equal amounts of clay and Portland cement. The wet paste immediately after it has been made is placed in moulds, and subjected to a pressure sufficiently great to remove any excess of water. The moulded articles are dried first on racks open to the air and then in an oven at a temperature of 300° - 400° F. (about 150° - 200° C.) for 24 hours. The articles may then be impregnated with a waterproofing composition in the customary manner. The clay increases the ability of the paste to flow freely and the crushing strength of the articles and enables them to take a finer polish. A. B. S.

Moulded articles; Process of making —. J. P. A. McCoy, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,286,371, 3.12.18. Appl., 3.7.14.

THE articles are made of a mixture of dry sodium silicate and Portland cement which is moistened sufficiently for moulding without dissolving an appreciable quantity of the silicate. The moulded articles are then subjected to the action of steam. —A. B. S.

Water-proof cement, and method of producing it. D. Davidson, Assignor to Bradley and Vroonan Co., Chicago, Ill. U.S. Pat. 1,285,636, 26.11.18. Appl., 12.8.18.

CLAIM is made for a waterproof cement containing an insoluble metallic naphthenate.—A. B. S.

Heat insulating material and process for making the same. H. Castor, McKeesport, Pa. U.S. Pat. 1,288,834, 24.12.18. Appl., 30.7.18.

INFUSORIAL earth cut from natural deposits is subjected to a temperature of 1800° F. (about 980° C.) or above, and is afterwards cut or formed into finished shapes.—A. B. S.

Insulating and building material and process of making the same. A. M. Mitchell, Tuckaboe, N.Y., Assignor to Mitchell and Grenelle, Inc. U.S. Pat. 1,289,862, 31.12.18. Appl., 23.3.16.

DOLOMITE is pulverised and heated to dehydrate it, and whilst still hot a mixture of hot sulphur with a little paraffin is added, and the mixture is poured into moulds and pressed.—A. B. S.

Cement; Acid-resisting ——. A. E. Holley and H. W. Webb, Assignors to Chance and Hunt, Ltd., Oldbury. U.S. Pats. 1,287,995 and 1,288,413, 17.12.18. Appl., 4.9.17 and 26.3.18.

See Eng. Pats. 110,258 of 1917 and 119,966 of 1918; this J., 1917, 1237; 1918, 768 A.

[*Roofing*] *felt.* U.S. Pats. 1,288,178-9. *See* V.

Potash in cement-mill dust. U.S. Pat. 1,288,437. *See* VII.

Waste flux from galvanising. Eng. Pat. 121,981. *See* X.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Phosphorus and silicon in cast iron; Determination of ——. A. Cavazzi. Annali Chim. Appl., 1918, **10**, 137—149.

Various modifications of the method of determining phosphorus in cast iron (this J., 1917, 1095) are described. The mixture of ferric sulphate with silica and carbon obtained as in the original method is boiled with about 50 c.c. of water and 10 c.c. of strong nitric acid in a beaker over which is placed a small retort containing cold water to act as a reflux condenser. The retort is changed every 10 to 15 mins. After 30 to 45 mins. the ferric sulphate will have dissolved and the whole of the phosphorus have been converted into orthophosphoric acid. The liquid is then filtered and the residue of silica and carbon washed six times with water acidulated with nitric acid. The filtrate is treated with 15 grms. of ammonium nitrate, and then, while boiling, with 40 c.c. of a boiling solution of ammonium molybdate, stirred for a few mins. and kept at 70° to 80° C. for 30 mins. The precipitate is washed, dissolved, re-precipitated and dissolved in ammonia solution as described (*loc. cit.*). At this point 3 grms. of sodium chloride is added and the solution boiled, with the result that the iron remaining in the phosphomolybdate is completely precipitated as ferric phosphate. After 10 mins. the precipitate is filtered off while hot, washed six times with a boiling solution of 1 grm. of sodium chloride in 50 c.c. of water, ignited, and fused with about 0·3 grm. of a mixture of sodium and potassium carbonates and potassium nitrate. The mass is treated with six successive portions of 3 c.c. of boiling water and filtered, and the filtrate acidified with a few drops of nitric acid, treated with ammonia in slight excess, and added to the main filtrate, and the phosphoric acid is then precipitated with magnesia mixture substantially as previously described. For the determination of silicon the residue of silica and carbon, from which all iron has been removed, is dried apart from the filter paper, and the latter incinerated and added to the dried residue. A quantity corresponding to 1 or 2 grms. of the cast iron is then ignited in a platinum crucible in a blowpipe flame until all the carbon is consumed, and the residue weighed.—C. A. M.

Cast iron and steel; Suggested unification of methods of analysis of ——. A. Marinot. Ann. Chim. Analyt., 1919, **1**, 5—10.

Methods are submitted with the hope that, by their use, different chemists will be able to obtain concordant results. To determine total carbon, three methods are recommended, namely, combustion with sulphuric acid and potassium bichromate, the ordinary combustion method, and a method described by Mahler and Goutal (this J., 1912, 688). For the determination of silicon, the metal is dissolved in a mixture of nitric acid, 400, water, 400, and sulphuric acid, 200 c.c.; the solution is evaporated until sulphuric acid fumes are evolved, cooled, the residue treated with hydrochloric acid, and the silica collected, and weighed. The silica should then be evaporated with hydrofluoric acid to ascertain whether it still contains tungstic or titanic acids. Travers' method (this J., 1917, 966) should be employed for the determination of manganese; phosphorus is determined by the molybdate method, and sulphur by conversion into hydrogen sulphide, which is collected in zinc acetate solution, the zinc sulphide formed being titrated iodometrically. Hollard and Bertiaux's method (this J., 1900, 563) is recommended for the determination of arsenic.

—W. P. S.

Steels; Tension, impact, and repeated impact tests of ——. T. Matsumura. Mem. Coll. Eng., Kyoto Imp. Univ., 1918, **2**, 63—69.

The impact tests were made in the Charpy machine with the "international" notch, the repeated impact tests on a modified Stanton machine designed by the author. The test-pieces for the latter were 160 mm. long, 15 mm. in diameter with a central notch of 2·5 mm. radius, the diameter of the notched part being 12 mm. At each end is an open slit by means of which it is supported and turned through 180° between successive blows of the hammer. The energy of the blow imparted in cm.-kilos. being three times the diameter in mm., no appreciable difference was observed as the diameter of the test piece was increased from 9 to 13 mm. The number of blows required to produce fracture was taken as the resistance of the steel to repeated impact. The cold work put upon the steel in turning the notched part was removed by wrapping round it a red-hot wire which was allowed to cool before removal. The means of the results recorded are tabulated. The maximum resistance to repeated impact occurred with the 0·25% carbon steel. Resistance in this form of test cannot be correlated with any of the other tests carried out.

Carbon, per cent.	Tensile tests			Impact tests		Repeated impact tests
	Yield point, tons per sq. in.	Max. stress, tons per sq. in.	Elongation, per cent. on 150 mm.	Energy absorbed in m.-kilos.	Specific impact energy, m.-kilos.	No. of blows
0·10	15·1	21·0	32	73	42	460
0·19	17·4	27·1	29	43	25	490
0·25	17·5	30·4	25	36	22	570
0·30	19·5	33·6	25	21	12	470
0·55	26·9	49·3	13	12	6·5	480
0·65	28·3	51·7	15	11	6	470

—F. C. Th.

Molybdenum-steel versus gun-erosion. M. Okôchi, M. Majima, and N. Sato. J. Coll. Eng., Tokyo Imp. Univ., 1918, **9**, 153—195.

It has been stated that German gun steel contains 3—4% Mo. Recorded analyses, however, do not show the presence of this element. The physical properties of a series of molybdenum-, tungsten-, and other alloy steels are recorded in Table II., the corresponding analyses being collected in Table I.

TABLE I.

Mark	C %	Si %	Mn %	S %	P %	Mo %	W %	Ni %
M_1	0·35	0·10	0·29	0·009	0·037	1·05	0	0
M_2	0·63	0·58	0·22	0·024	0·009	0·69	0	0
M_3	0·70	0·59	0·28	0·007	to	0·70	0	0
M_4	0 64	0·69	0·21	0·032	0·013	0·32	0	0
M_5	0 55	0·25	0·71	0 003	0·036	1·58	0	0
M_6	0·61	0·32	0·78	0 003	0·034	1·60	0	0
M_7	0 64	0·36	0·39	0·014	0·027	1·24	0	0
NM_1	0·54	0·20	0·63	to	0·062	3 65	0	1·02
N_1	0·59	0·12	0·66	0 003	0·027	0	0	3·50
T_1	0·62	0·42	0 39	0 004	0·023	0	2·38	0
C_1	0·32	—	—	—	—	0	0	0

TABLE II.

Mark	Modulus of elasticity, kilos. per sq. mm.	Modulus of rigidity, kilos. per sq. mm.	Poisson's ratio	Coefficient of expansion at 50° C. × 10^6	Thermal conductivity at 50° C.	Electrical resist. at 15° C. × 10^6
M_1	22,100	8,670	0 275	1·16	0·129	1 602
M_2	22,050	—	—	1·23	0 093	1·937
M_3	22,360	—	—	1·17	0·127	1·505
M_4	21,960	—	—	1·28	0·104	1·924
M_5	22,746	—	—	1 28	0·102	2·031
M_6	22,330	—	—	1·29	0·102	2·089
M_7	21,700	—	—	1·29	0·081	2·159
NM_1	21,350	8,330	0·281	1·24	0·087	3·144
N_1	—	—	—	1·16	0·093	2·721
T_1	21,321	—	—	1·18	0·087	2·802
C_1	21,800	—	—	1·28	0·127	1·850

The hardness numbers obtained for steel quenched at the same temperature, on heating and on cooling respectively, do not coincide but make a hysteresis loop. In the nickel-molybdenum steel there is a gap of 370° C., *i.e.*, from 330° C. to 700° C., between temperatures to produce equal hardnesses. The rate of expansion of these steels in the γ state ($2·0-2·2\times10^{-5}$) is greater than in the α condition ($1·0-1·7\times10^{-5}$). A small percentage of molybdenum in steel has no conspicuous influence on the mechanical properties, but produces an increase in the thermal conductivity.

—F. C. Th.

Iron; Rusting of —— in contact with other metals and alloys. O. Bauer and O. Vogel. Mitt. K. Materialpruf., 1918, **36**, 114—208.

EXPERIMENTS were made to determine to what extent contact with another metal influenced the rate of corrosion of iron in a 1% sodium chloride solution at 18° C. In all cases where two metals were in contact the more noble metal was considerably less corroded than it would have been had it been alone in the solution. This protection is obtained at the expense of the more electronegative metal In solutions of lower electrical conductivity this effect is not so marked. Magnesium and zinc alone are of practical value as protective metals for iron, the advantage resting with the zinc on account of the easier disintegration of the magnesium. In contact with copper iron is much more strongly attacked than it would be were it alone. As the concentration of the salt solution is increased the rate of attack of the iron in contact with copper is diminished. Zinc and magnesium when alone are more strongly attacked as the salt content of the electrolyte is raised, while iron alone is rather less attacked. With regard to the protective effect of zinc and magnesium in different salt solutions it was shown that the conductivity of the electrolyte is of considerable influence, the higher this is the more efficient is the protection of a given amount of the protecting metal. When no visible rusting of the iron could be detected complete immunity from corrosion occurred. It was noticed that the direction in which an electric current was passed through the electrolyte was of importance, since a higher resistance was shown when the current passed from a large electrode to a smaller one than when the direction was reversed. A "limit of protection" was determined which is given as the current in ampères per sq. cm. which will just inhibit corrosion. For the 1% salt solution this limit was 0·0000106. It is thus possible to determine the current required completely to protect a given surface of iron in sea water. (See also J. Chem. Soc., Mar., 1919.)—F. C. Th.

Iron; Periodic passivity of ——. A. Smits and C. A. Lobry de Bruyn. Proc. Acad. Wetensch. Amsterdam, 1919, **21**, 382—385.

ANODICALLY polarised iron can be activated by the introduction of halogen ions. Hence by the electrolysis of a solution of ferrous sulphate and chloride the phenomenon of passivity can be made periodic (compare this J., 1916, 471). This periodicity has been photographically recorded together with the time duration of each stage of the process. The potential difference varied from −0·3 volt to +1·4 volt with respect to the normal calomel electrode and the current density changed from 33 milliamps. to 28 milliamps. per sq. cm. With a sealed-in electrode 1·5 cm. long the iron was active for a short period and passive for a comparatively long period. With a smaller current density the active and passive periods became nearly equal. When a larger iron electrode was used, the potential difference showed irregular oscillations whilst the current strength was regularly periodic. The irregularity was such that even the most active state did not recur regularly and the whole curve showed periodicity under the influence of great disturbances. Hence it follows that the electrode was never active throughout the whole area at the same time. This confirms the previous view that the difficulty of rendering an iron electrode passive increases with increasing size of the electrode.—J. F. S.

Iron-oxygen; The system ——. A. Smits and J. M. Bijvoet. Proc. Akad. Wetensch. Amsterdam, 1919, **21**, 386—400.

THE three-phase systems FeO-Fe-gas, and Fe_3O_4-FeO-gas are considered theoretically for the cases where the gas phase is either CO and CO_2 or H_2 and H_2O. On the basis of the deductions drawn from the above considerations, the processes operative in the blast-furnace are theoretically investigated. The P.T.-diagram of the system oxygen-iron is derived from the equilibria of the iron oxides in reducing and oxidising gases respectively. Calculations are made of the oxygen dissociation tension: these values, as was to be expected, are very small.—J. F. S.

Blast-furnace slags; Microstructure and disintegration of —— rich in lime. E. Hollmann. Stahl u. Eisen, 1919, **39**, 57—62, 91—95.

THE microstructure of a slag obtained in smelting for pig iron for use in the basic process is described, and illustrated by means of 18 photomicrographs. Its composition is given as SiO_2 31·82, Al_2O_3 17·11, CaO 42·01, MgO 2·85, FeO 0·84, MnO 2·63, CaS 2·11, and P_2O_5 0·17%. The principal crystallographic constituent was melilite, which is regarded as an isomorphous mixture the two end-members of which are gehlenite ($3RO,Al_2O_3,2SiO_2$) and akermanite ($4RO,3SiO_2$). Besides melilite the microsections show practically nothing but glass, the quantitative ratio between melilite and glass varying from about 1 : 10 to 1 : 2. When the melilite crystals are fully developed but little glass is present, and usually another silicate, regarded as lime-olivine, appears. The latter separates after melilite. Another slag of very similar composition showed a considerable quantity of lime-olivine in the melilite crystals. These inclusions were observed only in the case of slags showing a tendency to crumble, and unequal expansion of the two constituents is advanced as a possible explanation of disintegration. Slags containing more than 43% CaO must be regarded as likely to undergo disintegration.—W. R. S.

Lead in brass and alloys; Rapid estimation of —. G. H. Hodgson. Chem. News, 1919, **118**, 37—38.

RAPID gravimetric and volumetric methods for the estimation of lead in brass and similar alloys are described. *Gravimetric method.* Five grams of the alloy is dissolved in 25 c.c. of nitric acid (sp. gr. 1·4), the solution is diluted with 200 c.c. of water, and sufficient ammonia solution (20 c.c. of sp. gr. 0·880) added to precipitate all the copper. Sufficient 80% acetic acid is then added to produce a clear, slightly acid solution, which is treated with 10 c.c. of 3% potassium bichromate, shaken, and allowed to stand for an hour. The precipitated lead chromate is collected on a paper pulp pad, washed to remove the copper, and treated on the filter with hot 30% sulphuric acid until entirely converted into sulphate. The sulphate is washed with water and dissolved by pouring about 40 c.c. of hot ammonium acetate solution containing acetic acid through the filter. The solution is raised to the boiling point, and treated with ammonium molybdate. The precipitate is collected on an ashless paper pad, washed with water containing a little ammonium acetate, ignited, and weighed as lead molybdate. The whole process may be completed in four hours. *Volumetric process.* The lead is precipitated as chromate as described above, the chromate precipitate is washed with water and warm dilute acetic acid (5%) until free from copper and excess potassium chromate, then dissolved by pouring cold hydrochloric acid (1 : 4) on the filter, and the pad is finally washed with water to collect all the chromic acid. The free chromic acid may then be estimated by titration with standard ferrous ammonium sulphate or by adding potassium iodide solution and titration of the liberated iodine by standard sodium thiosulphate solution.—J. F. S.

Solids [metals, etc.]; Determination of the compressibility of —— at high pressures. L. H. Adams, E. D. Williamson, and J. Johnston. J. Amer. Chem. Soc., 1919, **41**, 12—42.

THE compressibility of a number of metals and minerals has been determined for pressures up to 12,000 megabars (1 megabar=0·987 atm.). The principle of the method employed is to compare the change of volume under pressure of a cylinder of the material with that of a similar cylinder of soft steel, the compressibility of which was considered to be $0·60\times10^{-6}$ sq. cm. per megadyne. The solid, surrounded by kerosene, is enclosed in a thick-walled steel bomb fitted with a movable non-leaking piston, and pairs of simultaneous readings are made of the displacement of the piston, that is the volume change and the pressure. The pressure-compressibility graphs for gold, copper, brass, silver, aluminium, and calcite, like that of steel, are linear, but the graphs for zinc, tin, cadmium, lead, a tin-bismuth alloy, quartz, bismuth, and sodium chloride show an appreciable curvature, indicating for those substances a measurable decrease of compressibility with increasing pressure. A comparison was made of the compressibility of two alloys with that of their components. In the case of a simple mixture such as the tin-bismuth alloy, the measurements indicate that the compressibility of mixtures, whose other properties, such as specific volume, electrical conductivity, and specific heat are approximately linear functions of the composition, is related in the same way to the compressibility of the components. On the other hand, the compressibility of alloys of the type of brass is much lower than the sum of the individual compressibilities.—J. F. S.

Electric welding. T. T. Heaton. Inst. Mech. Eng., Nov., 1918. [Advance proof.] 23 pages.

OF the hand-operated processes, the Bernardos method, using a carbon electrode, is the only one which fuses together the two metal surfaces, and gives a true weld. Other processes, *e.g.*, the Kjellberg and Quasi-Arc processes, employ a metallic electrode, which is usually of different composition to that of the work metal, and therefore are more in the nature of soldering. The speed of welding by the Bernardos method is considerable, a rate of 1·73 mins. per foot for mild steel 3·5 mm. thick being quoted for an unhammered weld. This method is considered superior to others for metal sheets of less than $\frac{3}{16}$ in. thickness. In the Kjellberg and Quasi-Arc processes the metallic electrode is positive to the work and in fusing is deposited upon it together with a protective vitreous slag from a silicious coating on the electrode. Mechanically operated machines are to be preferred for work of a straightforward nature where the relative positions of the electrode and work can be maintained. Resistance welding may be performed either slowly with a small electrical input or at a quick rate, a heavy current being used for a short time and the metal "burned" at the joint. The weld is then pressed up and the "burned" metal squeezed out. In all cases the metal to be welded must be of suitable quality, and mild open-hearth steel with carbon content below 0·1% and sulphur not above 0·05%, together with low phosphorus, was found most satisfactory. The testing of welds depends on the service required, and when not subject to pressure a simple penetrative test with petroleum is suggested. High-pressure tests must be used with caution and in many cases, *e.g.*, the hulls of ships, cannot be applied. Tensile and elongation tests are often misleading and further research is needed to establish useful working test methods.—C. A. K.

Oxy-acetylene welding. J. H. Davies. Inst. of Mech. Eng., Jan., 1919. [Advance proof.] 10 pages.

THE oxy-acetylene process possesses many advantages over other methods as the operating flame can be readily controlled and the heating localised. Pure acetylene and an accurate adjustment of the mixed gases to give a neutral atmosphere are essential. Both the chemical and physical proper-

ties of the metal are altered by the rapid heating and melting. Carbon, silicon, and manganese are diminished, but the use of a welding rod of suitable composition may correct this defect. The alteration in mechanical properties (tenacity and elasticity) cannot be remedied by simple hammering of the hot weld, but should be aided by proper thermal treatment. Slow cooling gives the most efficient weld. The oxy-acetylene flame is preferred for lighter sheets, but when the metal has a thickness of $\frac{3}{8}$ in. or more electric welding has the advantage both in speed and cost.—C. A. K.

PATENTS.

Potash salts; Recovery of —— *in the manufacture of pig iron.* T. Twynam, Redcar, Yorks. Eng. Pat. 122,948, 21.1.18. (Appl. 1149/18.)

MOLTEN blast-furnace slag is treated with sodium chloride, or a mixture of the latter with lime or sodium carbonate, and the resulting fume of potassium chloride is condensed. Potash-bearing minerals, such as felspar, may be previously added to the slag or introduced with the sodium chloride. —W. E. F. P.

Iron; Puddling of ——. J. E. Fletcher, Dudley. Eng. Pat. 122,244, 16.1.18. (Appl. 920/18.)

FOR the production of metal suitable for puddling and the manufacture of good wrought iron, non-hæmatite pig iron and scrap steel or iron, in about equal proportions, are melted in a cupola with or without the addition of lime and silica, and the melted metal is run off at a temperature of about 1500° C. A small proportion of powdered, rich iron ore may be added to the molten metal or to the cupola charge.—C. A. K.

Steel rails; Treatment of —. *Steel rail.* R. A. Lewis, W. R. Shimer, and W. J. Thomas, Bethlehem, Assignors to Bethlehem Steel Co., South Bethlehem, Pa. U.S. Pats. (A) 1,285,748 and (B) 1,285,749, 26.11.18. Appl., 15.5.15.

(A) THE hot rail from the finishing rolls is quickly cooled to a temperature between 1300° F. and 1090° F. (700° C. 550° C.), and reheated uniformly to between 1400° F. and 1500° F. (770° C. -830° C.). It is again rapidly cooled to between 1600° F. and 600° F. (550° C.—330° C.), reheated in an annealing furnace to 1000° F. 1200° F. (550° C.—660° C.), and finally cooled. (B) Claim is made for a steel rail of finely granular pearlitic structure, almost free from ferrite, containing 0·60—0·90% C, 0·50—1·0% Mn, with other impurities as in open-hearth steel. The mechanical properties are: tensile strength over 115,000 lb. per sq. in.; elastic limit over 70,000 lb. per sq. in.; elongation over 15%; reduction in area over 30%, and a hardness number (Brinell) over 225.—C. A. K.

Steel alloy. J. W. Weitzenkorn, Assignor to Electric Reduction Co., Washington, Pa. U.S. Pat. 1,287,153, 10.12.18. Appl., 25.1.18.

AN alloy steel containing not more than 0·60% (0·35%) C, 0·5—1·5 (1·0%) Cr, 0·1—0·5 (0·15%) V, and 0·5—1·25 (0·75 to 1·0%) Mo.—C. A. K.

Chrome-steel. Spring steel. C. H. Wills, Detroit, Mich. U.S. Pats. (A) 1,288,344 and (B) 1,288,345, 17.12.18. Appl., 7.8.17.

(A) THE claim is for a case-hardening steel containing up to 1% Mo. The refining of the core and case may be accomplished simultaneously. (B) A heavy-duty spring steel containing 0·38—0·55% C, 0·40—1·25% Mn, up to 2% Cr, 0·10—0·40% Si, and up to 1% Mo, is drawn at a temperature materially above 320° C.—C. A. K.

Open-hearth steel; Manufacture of ——. H. C. Ryding and A. W. Allen, Birmingham, Ala. U.S. Pat. 1,289,057, 24.12.18. Appl., 6.7.17.

BASIC open-hearth steel is made in two alternating operations: (1) The furnace is charged with lime and iron oxide, then with molten low-carbon metal, and heated until the bath and slag are in proper condition. High-carbon metal is then added and the operation carried to a finish. (2) The furnace is first charged with molten low-carbon metal, then with iron oxide and lime, and the same procedure follows. The first set of conditions builds up the bottom of the furnace, the second tends to erode it, and the alternating conditions maintain an approximately uniform bottom.—C. A. K.

[*Steel;*] *Process of annealing metal* [——]. J. H. Bennett, Worcester, Mass. U.S. Pat. 1,289,092, 31.12.18. Appl., 14.8.18.

LOW-CARBON steel is heated, and afterwards cooled and "softened" by means of water to which a saponaceous material has been added.—T. H. B.

Iron or iron alloys; Manufacture of articles from pure powdered ——. Allgem. Elektricitäts Ges., Berlin. Ger. Pat. 306,772, 24.5.16.

POWDERS of pure iron or of iron alloys prepared by electrolytic processes, alone or in admixture with powders of other metals, are formed under heavy pressure into articles which are hardened in a reducing atmosphere and may be fashioned into the desired shape by subsequent mechanical working. The electrolytic metal powder may be subjected to a heating process before compressing. —J. F. B.

Iron and steel; Solution for rust-proofing —. W. H. Allen, Assignor to Parker Rust-Proof Co. of America, Detroit, Mich. U.S. Pat. 1,287,605, 17.12.18. Appl., 16.6.16.

A RUST-PROOFING bath consists of a solution of phosphoric acid and an alkali chromate.—T. H. B.

Rust-proofing and nut-locking; Solution for —. C. D. Matthews, Assignor to H. R. Pedane and B. F. Feltel, New Orleans, La. U.S. Pat. 1,289,855, 31.12.18. Appl., 19.2.18.

A SOLUTION for treating iron and like metals consists of a saturated acetic acid solution of common salt mixed with an equal amount of nitric acid. —T. H. B.

Electric [smelting] furnaces. A. E. White, London. From Industrial Electric Furnace Co., Chicago, Ill., U.S.A. Eng. Pat. 122,282, 1.2.18. (Appl. 1896/18.)

THE ore charge is fed over an inclined surface, in an upward direction, to the melting chamber by means of a feeding mechanism, and is brought into contact with the lower edge of the furnace roof forming a seal therewith. Contact of the charge with the central electrode projecting downwards through the roof of the furnace is prevented. The escaping gases pass through the charge, and the condensed metal flows down the inclined surface, away from the source of heat, into troughs from which it is drawn off.—B. N.

Furnace; Metallurgical ——. B. Zobel, Philadelphia, Pa. U.S. Pat. 1,285,883, 26.11.18. Appl., 17.12.17.

IN a crucible furnace heated by means of a fire chamber below, the crucible rests on a supporting column which can be moved in a vertical or rotary direction.—C. A. K.

Melting furnace. T. W. Muckle, Denver, Colo., Assignor to The Case Manufacturing Corp. U.S. Pat. 1,286,719, 3.12.18. Appl., 18.3.18.

A MELTING furnace disposed in a substantially horizontal position has a melting chamber with a flat bottom and is provided with a fuel inlet towards the top rear end and an outlet towards the opposite forward end. Means are provided for introducing fuel in the form of a strong blast flame projected across the top of the melting chamber and down its opposite side wall, so that combustion of the fuel is completed before the flame strikes the melting mass on the flat bottom of the furnace.—J. H. P.

Furnace; Metal-heating ——. W. S. Rockwell, Assignor to W. S. Rockwell Co., New York. U.S. Pats. (A) 1,288,202, 17.12.18, and (B) 1,289,547, 31.12.18. Appl., 28.8. and 20.8.18.

(A) GASEOUS fuel is burned in a combustion chamber under the heating chamber and the products of combustion are admitted through a number of holes through the bed. The gases leave through ports extending along the side walls and are discharged through collecting flues on each side of the furnace, controlled by dampers, into a casing in which the air for combustion is preheated. (B) A metal-heating furnace is provided with burner openings arranged alternately in each of its opposite side walls, and flaming gases are introduced through the burners into the heating chamber above the floor. Flaming gas-ducts below the floor of the heating chamber are each connected at one end with a burner and at the other end with the heating chamber through the floor. Outlet flues are arranged in the side walls alternately with the burner openings.—C. A. K.

Annealing furnace. W. A. Wood, Dunellen, N.J., and W. S. Rockwell, Assignors to W. S. Rockwell Co., New York. U.S. Pat. 1,288,353, 17.12.18. Appl., 16.4.17.

THE furnace has a chamber heated by non-oxidising products of combustion, and is provided at opposite ends with hoods which extend downwards below the floor of the chamber nearly to the surface of a body of water. The water level can be varied to vary the discharge of gases from the hoods. The articles to be annealed are carried through the heating chamber and hoods by a conveyor.
—T. H. B.

Waste flux of galvanising or equivalent processes; Obtainment of by-products from —— S. Sanders, Birmingham. Eng. Pat. 121,984, 27.11.17. (Appl. 17,194/17.)

WASTE flux from a galvanising process is broken up, lixiviated with boiling water, and the zinc oxide froth is removed and dried. Suspended matter is allowed to settle, the process being aided by the addition of a little lime. The clear liquor, consisting of a mixture of zinc and ammonium chlorides, is run over a bed of "bleaching lime" to remove impurities, and may then be utilised in the fireproofing of wood or textile materials. Any metal is recovered from the sediment by washing, and after drying, the residue is mixed with a binding agent, *e.g.*, waste lime obtained in the process, and pressed into fireproof sheets.—C. A. K.

Tinned scrap; [Electrolytic] treatment of ——. H. Rogers, M. L. Lancaster, C. M. Walter, and J. Jackson, Birmingham. Eng. Pat. 122,025, 10.1.18. (Appl. 577/18.)

A ROTARY gauze drum containing the tinned scrap may be lowered into, or completely removed for emptying from, a vat which contains the electrolyte. Trunnions on the drum rest on supports carried by the vat and serve to convey current to the scrap metal. Cathode plates suspended in the vat are preferably of corrugated form, and a tray is arranged beneath the drum for the collection of tin oxide or sediment. The drum may be oscillated or rotated, and the electrolyte may be circulated through the drum by pumping.—C. A. K.

Electroplating device. J. E. Woodbury, Worcester, Mass. U.S. Pat. 1,285,875, 26.11.18. Appl., 29.3.18.

THE apparatus comprises a cathode supported above the surface of the electrolyte in a suitable container, an anode extending towards the cathode, and a nozzle, having an outlet opening at the upper edge of the anode; by means of a pump a concentrated stream of electrolyte is delivered through the nozzle over the anode against a restricted area on the bottom of the cathode, and a current is passed from the anode to the cathode through the stream.
—B. N.

[Zinc] furnace; Electric ——. B. Raeder, Kykkelsrud, Norway. U.S. Pat. 1,286,100, 26.11.18. Appl., 22.1.18.

THE walls of the charging shaft project into the reaction chamber of the furnace, and terminate at a point above the level of the bath, the reaction chamber being provided with electrodes and the charging shaft with a supplementary electrode.
—B. N.

Separation of minerals by flotation; Apparatus for the ——. F. D. S. Robertson, Toronto, Canada. U.S. Pat. 1,286,111, 26.11.18. Appl., 5.12.17.

A DISHED table is journaled on the crank of a cranked hollow vertical shaft and is caused to rotate on the crank at the same time as the shaft is rotating. The mineral pulp is delivered on to the table through holes in the upper part of the shaft over a distributing plate and the heavier constituents are discharged near the centre of the table into a catch pan below, which communicates with the lower part of the hollow shaft. The table is enclosed in a tray which receives material discharged from the rim of the table.—C. A. K.

Separating minerals by flotation. A. G. Betts, Stockhouse, N.C. U.S. Pat. 1,286,922, 10.12.18. Appl., 14.8.14. Renewed 1.6.18.

FINELY divided sulphide ores are agitated with water and a flotation reagent. An oxidising reagent, *e.g.*, chlorine, is added to the bath, whereby the surface of the sulphide particles become coated with a thin film of sulphur which aids the buoyancy of the particles and facilitates their separation by flotation.—C. A. K.

Ores; Concentration of ——. O. Wiser, Assignor to Chino Copper Co., Hurley, N. Mex. U.S. Pat. 1,288,350, 17.12.18. Appl., 27.2.17.

THE ore in a finely divided condition is agitated in a mixture of oil, water, and a suitable resinate, and the metallic particles separated by froth flotation.
—T. H. B.

Alloy; Bearing ——. W. D. Berry, New Brighton, Pa. U.S. Pat. 1,286,921, 10.12.18. Appl., 13.8.18.

A COPPER base bearing alloy containing 60—80% Cu, 1—35% Pb, and 3—20% Sb.—C. A. K.

Alloys rich in phosphorus; Process of manufacturing metallic phosphides or ——. P. E. Demmler, Pittsburgh, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,287,655, 17.12.18. Appl., 4.2.18.

PHOSPHORUS in the form of vapour is passed over heated copper (or zinc, etc.) at such a temperature that the phosphorus combines with the metal, but neither the metal nor the resulting alloy melts. —T. H. B.

Tungsten-reducing furnace. C. A. Pfanstiehl, Waukegan, Ill., Assignor to Pfanstiehl Co., Inc., North Chicago, Ill. U.S. Pat. 1,289,896, 31.12.18. Appl., 26.4.15.

A FURNACE for reducing tungsten trioxide comprises a comparatively long and slender metal tube, with means for passing a reducing fluid through it from end to end. A portion of the tube at one end constitutes a charging chamber heated by the escaping hot reducing fluid. Next to this is a second chamber surrounded by an electric heating device, then a third chamber heated by an independent electric heater, and finally a cooling chamber at the fluid admission end of the tube. Means are provided for passing the tungsten trioxide through the successive chambers.—A. R. S.

Castings of rare-earth metals and their alloys; Process of making ——. A. and M. Hirsch, New York, Assignors to Alpha Products Co., Inc. U.S. Pats. (A) 1,290,010 and (B) 1,290,011, 31.12.18. Appl., 9.5.18 and 17.9.17. (B) Renewed 29.11.18.

(A) IN casting cerium and lanthanum, or alloys of these metals with 10% or less of iron, the temperature of the metal when poured is kept sufficiently low to prevent inflammation of the metal. The ratio of the area (in sq. in.) of the metal moulding surface from which withdrawal of heat may take place to the volume (in cub. in.) of the casting to be made is greater than 16 : 1, and the residual heat-absorbing capacity of the mould is reduced so as not to affect the homogeneity of the cast metal. (B) Cerium and similar metals are melted under a layer of molten barium chloride to prevent oxidation and ignition. C. A. K.

Copper; Treatment of cement — —. C. A. Hall, Assignor to Pennsylvania Salt Manufacturing Co., Philadelphia, Pa. U.S. Pat. 1,290,024, 31.12.18. Appl., 8.1.17. Renewed 10.9.18.

CEMENT copper is compressed into brick form in the presence of "waste liquor," which acts as a binder, the bricks being afterwards dried, and melted to recover the copper.—T. H. B.

Copper; Extraction of —— *from its ores.* H. W. Morse, Los Angeles, Cal., Assignor to Chino Copper Co., Hurley, N. Mex. U.S. Pat. 1,288,121, 17.12.18. Appl., 27.2.17.

ORES containing cuprite with other oxides and copper sulphide are treated with dilute sulphuric acid in amount corresponding to one-half of the copper in the cuprite, whereby part of the copper in the cuprite is dissolved as sulphate and part is precipitated as metallic copper. The resulting pulp is subjected to flotation to separate metallic copper and sulphide. Dissolved copper is precipitated as metal by a reducing agent, and the precipitated copper is separated together with the remaining copper sulphide by flotation.—T. H. B.

Nickel; Extraction of —— *from silicate ores.* H. W. C. Annable, Egham, Assignor to Nickel Concentration, Ltd., London. U.S. Pat. 1,289,072, 31.12.18. Appl., 15.5.17.

A SILICATE nickel ore is heated in presence of moist hydrogen sulphide to convert the nickel silicate into sulphide.—T. H. B.

Cinder, ores, and metallurgical products containing copper and zinc; Process for roasting and chlorinating ——. W. Buddeus, Berlin. Ger. Pat. 306,790, 29.6.17.

CINDER, ores, or metallurgical products containing copper or zinc are mixed with not more than 10% of salt and, after undergoing a preliminary heating, the mass is introduced in the form of a "closed, travelling column of ore" into a shaft furnace in which it is roasted by means of compressed air.—J. F. B.

Etching steel or other plates; Method of ——. W. S. Eaton, Sag Harbor, N.Y., U.S.A. Eng. Pat. 122,358, 26.6.18. (Appl. 10,519/18.)

SEE U.S. Pat. 1,275,408 of 1918; this J., 1918, 659 A.

Zinc; Refining of ——. G. C. Fricker, Luton. U.S. Pat. 1,287,949, 17.12.18. Appl., 27.1.17.

SEE Eng. Pat. 110,970 of 1916; this J., 1917, 1278.

Drying apparatus. Eng. Pat. 122,077. *See* I.

Annealing furnace. U.S. Pat. 1,286,908. *See* I.

Treating pickle liquors. U.S. Pat. 1,287,939. *See* VII.

Electrolytic apparatus. U.S. Pat. 1,287,156. *See* XI.

Electrical etching. U.S. Pats. 1,288,775 and 1,289,022. *See* XI.

Electric furnace. U.S. Pats. 1,289,055-6. *See* XI.

Determining transformation points. U.S. Pat. 1,285,929. *See* XXIII.

XI.—ELECTRO-CHEMISTRY.

Erinoid; Insulating properties of ——. R. G. Allen. Sci. Proc. Roy. Dublin Soc., 1918, **15**, 331–358.

THE electrical insulation resistance of different varieties of "erinoid" (a by-product of milk) and of red vulcanised fibre was measured at various temperatures up to 110° C. The results agreed with Rasch and Hinrichsen's formula (see Allen, page 140 A) Dry erinoid is a good insulator of fairly constant insulation resistance. It is slightly hygroscopic, but not so much so as vulcanised fibre. Erinoid does not absorb water when in direct contact with it so readily and to such an extent as vulcanised fibre, nor is it so retentive of the water absorbed as the latter. Of the varieties tested, red erinoid is the most absorbent of water, and generally of the lowest insulation resistance. Dry erinoid has a fairly constant electrical resistance, but in a moist atmosphere the resistance decreases with time owing to the absorption of water. The resistance of the unprepared surface of erinoid depends greatly on the value of the applied voltage unless water electrodes are used, but if the surface has been machined the resistance is

dependent on the voltage like that of vulcanised fibre. Erinoid is almost free from dielectric absorption; that of red vulcanised fibre is appreciable. The specific resistance of erinoid diminishes with the thickness of the sample. Erinoid of blonde colour has a considerably higher resistance than the other varieties tested: this is due to greater skin or contact resistance, as the difference disappears when machined specimens of the different varieties are compared. The break-down voltage of erinoid is the same as that of red vulcanised fibre; for a well-dried sample 2 mm. thick the r.m.s. value is within the range 10,000—16,000; it is diminished by soaking the material in water, mineral oil, or castor oil.—A. B. S.

Vulcanised fibre and erinoid: Absorption of water by — — on exposure to moist air and the subsequent change in electrical resistance. R. G. Allen. Sci. Proc. Roy. Dublin Soc., 1918, **15**, 405—414.

SAMPLES of red vulcanised fibre and erinoid were well dried in an air oven at 70° C., weighed, and re-weighed at intervals after exposure to air nearly saturated with moisture. It was found that red vulcanised fibre is much more hygroscopic than erinoid, and red erinoid somewhat more so than blue erinoid. After being thoroughly dried and then exposed to moist air, the electrical resistance of both fibre and erinoid, particularly that of the former, diminishes rapidly. The variation of resistance of the moist samples with the temperature is in accord with Rasch and Hinrichsen's formula, and supports the theory that electricity is conducted through insulating materials by means of water films therein.—A. B. S.

Electrical resistance of porcelain. Allen. *See* VIII.

PATENTS.

Ozonising apparatus. R. R. Bayeux and J. Richard, Paris. Eng. Pat. 113,606, 16.1.18. (Appl. 933/18.) Int. Conv., 5.2.17.

Two independent concentric solenoids are carried by glass tubes, and are connected each to one pole of the secondary of an induction coil for the production of ozone. The apparatus is provided with a stop-cock, connected to an oxygen supply, whereby the gas may be distributed in fixed and variable proportions to the ozoniser and to a by-pass tube parallel to the ozoniser. The gases from the ozoniser and the by-pass tube are passed into a mixing chamber which is designed to receive a hypodermic needle or the like, or a suitable pipe or tube, whereby fixed proportions of ozone and oxygen, which may be varied by the regulating stopcock, may be used for hypodermic injections or the like.—B. N.

Electric conductors [: Covering for — —]. Fullers Wire and Cable Co., Ltd., and G. Fuller, Chadwell Heath, Essex. Eng. Pat. 122,295, 14.2.18. (Appl. 2376/18.)

A MIXTURE of rubber and vegetable fibrous material is worked into a plastic condition, and "forced" in the known manner as a covering for cable or wire, which is then vulcanised. The proportion of fibrous material may be as high as 60%. The covering prepared in this way is exceedingly tough and resistant to wear by abrasion.—D. F. T.

Insulating material; Composite — — and process of making the same, L. McCulloch, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,286,043, 26.11.18. Appl., 3.2.16.

A COMPOSITE insulating material is composed of heat-resistant flake material, such as mica, the flakes being superposed and cemented together by coating with a binder of "bentonite" and water, the assembled material being pressed and dried. —B. N.

Electrolytic cell. La F. D. Vorce, Sandwich, Ont., Canada. U.S. Pat. 1,286,844, 3.12.18. Appl., 2.4.18.

THE cathode, carrying a diaphragm, is spaced from the outer casing of the cell, the diaphragm forming a partition between the cathode chamber and an electrolyte chamber. The space between the cathode and the casing is closed by a sealing ring, carried by the top of the cathode, and anodes, within the electrolyte chamber, are carried by a cover supported by the casing.—B. N.

Electrolytic apparatus [for production of tin silicofluoride]. R. L. Whitehead, Perth Amboy, N.J. U.S. Pat. 1,287,156, 10.12.18. Appl., 22.6.15.

A CELL or vat containing a hydrofluosilicic acid electrolyte is provided with a number of tin anodes. Removable cathodes, enclosed in porous compartments to prevent the deposition of metallic tin thereon, alternate with the anodes.—C. A. K.

Electric battery. N. K. Chaney, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,287,634, 17.12.18. Appl., 7.6.16.

THE carbon used in a dry cell is wetted with an acid, an oxidising agent is added to oxidise the ferrous sulphide therein, and zinc oxide is added to neutralise any excess of acid.—B. N.

Electric battery. R. C. Benner, and H. F. French, Fremont, Ohio, Assignors to National Carbon Co., Inc. U.S. Pats. (A) 1,289,365 and (B) 1,289,366, 31.12.18. Appl., (A) 13.7, (B) 31.7.16.

(A) THE negative element is composed of copper oxide bound together by sulphur, in an alkaline electrolyte. (B) Selenium is used in place of sulphur in the negative element.—B. N.

Electric battery. W. C. Bauer, Evanston, Ill. U.S. Pat. 1,289,609, 31.12.18. Appl., 3.4.14.

A ZINC anode and a lead oxide cathode are immersed in an alkali hydroxide electrolyte, together with a substance to precipitate the soluble lead compounds which may be formed.—B. N.

Depolarising agent; Black-streak manganese dioxide — . C. Ellis, Montclair, N.J., Assignor to National Carbon Co., Inc. U.S. Pat. 1,289,707, 31.12.18. Appl., 2.10.17.

DEPOLARISING material, containing manganese dioxide which gives a dead black streak, is formed by exposing manganous sulphate in aqueous solution at a temperature near the boiling point of water to the action of free chlorine, the solution containing less than 10% of free acid. The higher oxide of manganese formed is washed till substantially free from bodies tending to cause local action in Leclanché cells.—B. N.

Temperature control apparatus [for electric furnaces]. E. F. Collins, Scheneetady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,287,236, 10.12.18. Appl., 6.5.18.

IN electric furnaces having co-operating arcing electrodes, moved by a motor, the motor is controlled by a device provided in the electrical supply circuit for the electrodes, which is responsive to the electrical condition in the circuit. The furnace is provided with a pyrometer connected to an electro-responsive device, with a means responsive to this

device for adjusting the setting of the motor control means. The length of the arc is thus regulated in accordance with an electrical condition of the operating current, and the relation between the arc length and this condition is adjusted in accordance with the temperature of the furnace.—B. N.

Furnace; Electric ——. W. K. Booth, Assignor to Booth-Hall Co., Chicago, Ill. U.S. Pat. 1,287,849, 17.12.18. Appl., 4.4.18.

A FURNACE-WALL contact is formed by placing in a bed in the furnace wall a mixture of materials adapted to react and produce a metallic carbide, a skeleton grid being embedded in the mixture and equipped with a shank extending through the furnace wall. The mixture, whilst in position, is subjected to the action of an electric arc, thus raising it to the temperature necessary to form a monolithic mass of carbide.—B. N.

Furnace; Electric ——. L. L. Simpson, Assignor to A. H. Sroufe, Seattle, Wash. U.S. Pat. 1,288,240, 17.12.18. Appl., 24.7.15.

THE cover of the electric furnace comprises a pair of parallel side leaves spaced at their inner edges when laid so as to close the furnace, and a second pair of leaves of a width approximately the distance between the closed side leaves. All the leaves, when the furnace is closed, co-operate to form an opening for a carbon.—B. N.

Electric furnace. L. G. Rowand, Brooklyn, N.Y., Assignor to New Jersey Zinc Co., New York. U.S. Pats. (A) 1,289,055 and (B) 1,289,056, 24.12.18. Appl., 5.6.17.

(A) A VERTICAL chamber is heated by a number of annular electric resistors lining the furnace. The charge is admitted at the top and withdrawn at the lower end, and vapours from various sections of the furnace are withdrawn at different heights and condensed in separate condensers. Resistors extending across the furnace, out of vertical alinement, may also be provided to agitate the descending charge. (B) A series of narrow vertical heating chambers for ore reduction are arranged in line for convenience in charging and discharging. The several vapour outlets of a chamber communicate by means of a flue with a single condenser, and the resistors are so arranged as to heat the upper part of the flue.—C. A. K.

Gases; Process and apparatus for the electric arc treatment of ——. *Stretching out double or multiple electric arcs.* F. H. A. Wielgolaski, Christiania, Norway. U.S. Pats. (A) 1,287,807 and (B) 1,287,808, 17.12.18. Appl., 28.9.16.

(A) AN elongated arc is maintained lengthwise and substantially centrally in a long arc chamber between two electrodes, one of which is hollow and constitutes a restricted outlet for the gases. The latter are introduced through a tangential slit-like opening throughout substantially the length of the chamber, and are withdrawn through the restricted opening, which is located opposite to a conical projection on the shell of a steam boiler. A current of cooling water is projected against the inner concave surface of the cone, thus effecting rapid cooling of the gases. A pressure is maintained in the arc chamber materially higher than in the cooling chamber. (B) Elongated bent arcs are maintained by blowing into the chamber surrounding the arc a current of cold air around "the legs of the bight of the arc" so that the resistance in a U-shaped arc is lower near the centre of the furnace space. "Insulating walls" of cold gases moving transversely prevent the arc short-circuiting upon itself.
—B. N.

Electrical etching. J. H. Weeks, Rutledge, Pa., Assignor to J. S. Weeks, Delaware County, Pa., and R. M. Weeks, Philadelphia, Pa. U.S. Pat. 1,288,775, 24.12.18. Appl., 3.3.17.

A RESISTANT image to be etched is carried by the anode in an electrolyte consisting of a solution of ammonium chloride with the addition of an acid.
—B. N.

Electrical etching; Process and composition for ——. J. H. Weeks, Rutledge, Pa., Assignor to J. S. Weeks, Delaware County, Pa., and R. M. Weeks, Philadelphia, Pa. U.S. Pat. 1,289,022, 24.12.18. Appl., 8.7.16.

A SOLUTION for electrolytic etching contains ammonium chloride, sodium chloride, and iron perchloride or an equivalent, together with a quantity of acid.—L. A. C.

Seal for electric apparatus. F. G. Keyes, East Orange, N.J., Assignor to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,288,916, 24.12.18. Appl., 7.7.14.

A SEAL for a vacuum container of non-conducting vitreous material is composed of a central copper rod surrounded by, but spaced from, a yielding inner tube of nickel steel welded to an outer platinum tube, the thermal coefficient of the composite tube lying within a region the highest limit of which is equal to the coefficient of expansion of the container material. The copper rod and the tube are united by a metal cap sealed to both.—B. N.

Electro-osmosis, Process and apparatus for employing the dehydrating cells in removing water by ——. Bergmann-Elektricitäts Werke A.-G., Berlin. Ger. Pat. 308,011, 16.5.17.

THE dehydrated material is discharged without disturbing the cells themselves, the process being particularly adapted to plant with stationary cells. For example, the dehydrated mass may be forced out of the cells by air or fluid pressure or by means of a jet of liquid, or by a mechanical arrangement. A container is situated on one side of the cells, in which the air is compressed by the pressure of a liquid and when the pressure is released, the air from the container blows the material out of the cells. The material to be dehydrated enters the bottom of a chamber from which it passes directly into the cells and into another chamber at the other end of the cells. The water percolates through the cells and the space between the electrodes becomes filled with the thickened mass. When the cells are full, the inflow of liquid is stopped and the chambers at both ends of the cells are emptied. Compressed air is then admitted from the container at the top of the feed chamber and blows the thickened material into the further chamber, from which it is discharged, the cells being slightly inclined downwards towards the latter chamber.
—J. F. B.

Electric furnace. O. Sahlin, London. U.S. Pat. 1,286,794, 3.12.18. Appl., 1.5.18.

SEE Eng. Pat. 115,719 of 1917; this J., 1918, 381 A.

Annealing furnace. U.S. Pat. 1,286,908. *See* I.

[*Fuel*] *gases.* U.S. Pat. 1,286,577. *See* IIA.

Sulphuric and hydrochloric acids. U.S. Pat. 1,285,856. *See* VII.

Cement [*insulators*]. Eng. Pat. 121,986. *See* IX.

XII.—FATS; OILS; WAXES.

Oil in oil-seeds; Determination of ——. R. Biazzo. Annali Chim. Appl., 1918, **10**, 130–133.

The following rapid process prevents the oxidation of the oil and loss of volatile substances which occur in the usual preliminary drying of oil-seeds before extraction:—About 100 grms. of the seeds is crushed and ground to a fine flour, and a quantity sufficient to yield not more than about 2 grms. of oil is triturated with about three times its vol. of anhydrous copper sulphate, and sufficient calcined sand to give a finely divided friable mass. This is transferred to an extraction thimble, the mortar etc. being rinsed with a little anhydrous sodium sulphate and then with a little of the solvent. The mass is extracted for 3 hours with ether, then remixed, and again extracted. The extract is filtered, the solvent evaporated, and the residue dried for 30 mins. at 105° C., with occasional blowing with dry air or, in the case of drying oils, in a current of an inert gas. In the presence of any considerable amount of volatile fatty acids the oil is saponified and the quantity calculated from the mean saponification value.—C. A. M.

PATENTS.

Vegetable oils; Process and apparatus for the oxygenation and polymerisation of ——. J. K. Blogg, Surrey Hills, Victoria. Eng. Pat. 122,224, 2.1.18. (Appl. 14/18.)

See U.S. Pat. 1,284,572 of 1918; this J., 1919, 81 A. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 2518 of 1879, 14,629 of 1890, 15,440 of 1911, and 5773 of 1912; this J., 1891, 263; 1912, 443, 1015, 1151.)

Hydrocarbonated oil; Product containing ——. *Hydrocarbonated-oil composition.* C. Ellis, Montclair, N.J. Reissues 14,568, 14,569, and 14,570, 17.12.18, of U.S. Pats. 1,276,509, 1,276,508, and 1,276,507, 20.8.18. Appl., 26.10.18.

See this J., 1918, 771 A.

Cocoa waste products. Eng. Pat. 116,394. *See* XIXA.

Coconut butter. Eng. Pat. 117,819. *See* XIXA.

Treating cottonseed. U.S. Pat. 1,286,389. *See* XIXA.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Resins. Prins. *See* XX.

PATENTS.

Lake pigment, and the manufacture thereof. L. E. Barton, Niagara Falls, N.Y., and H. A. Gardner, Washington, D.C., Assignors to The Titanium Alloy Manufacturing Co., New York. U.S. Pat. 1,286,916, 10.12.18. Appl., 28.11.17.

An organic colouring matter is precipitated upon a white composite pigment comprising a carrier material having coalesced therewith adherent particles of titanic oxide.—C. A. K.

Condensation product and related composition and process of making the same. J. P. A. McCoy, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,286,372, 3.12.18. Appl., 12.4.15.

Condensation products are made from a mixture of equal parts of pyrogallol and gum arabic with 5% of trioxymethylene or other polymer of formaldehyde or substance containing an active methylene group and 50% of a filler, the mixture being heated under pressure or compressed in a hot mould.—A. B. S.

Phenol-formaldehyde condensation products; Method of making ——. J. O. Handy, Assignor to Pittsburgh Testing Laboratory, Pittsburgh, Pa. U.S. Pat. 1,287,299, 10.12.18. Appl., 19.3.18.

A mixture of commercial cresylic acid of 97–99% concentration with more than a molecular proportion of formaldehyde of 40% concentration is boiled without any condensation agent until the solids in the viscous condensation product determined at 110° C. equal or exceed 40% by weight, the final boiling during which water and excess of formaldehyde are removed being at a temperature between 110° C. and 120° C.—D. F. T.

XIV. INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Vulcanisation of —— at constant temperature and at a series of increasing temperatures. G. D. Kratz and A. H. Flower. J. Ind. Eng. Chem., 1919, **11**, 30–33.

It is found possible to calculate and apply a series of rising temperatures such that the vulcanisation-time curve for any rubber-sulphur mixture may be made a straight line, the slope of which is dependent on the temperatures employed and the amount of catalyst present (compare this J., 1916, 643). To obtain the best physical properties by vulcanisation at constant temperature, sulphur must be present in the mixture in such amount that its active mass is not decreased sufficiently to diminish the rate of reaction appreciably before the desired vulcanisation coefficient is attained. With rubber-sulphur mixtures containing 5% or less of total sulphur, the physical properties of the mixture after vulcanisation at a series of rising temperatures are inferior to those given by vulcanisation at constant temperature; this is true particularly for vulcanisation coefficients of 2·8 or more. For Hevea rubber the optimum vulcanisation coefficient probably lies between 1·7 and 2·8. The coefficients recommended by various authorities are found to be excessive and unless the history of the vulcanisation phenomenon is fully known it is unsafe to judge samples solely on the basis of their sulphur content. T. H. P.

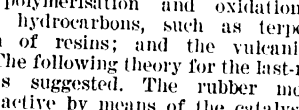
Rubber goods; Determination of free carbon in ——. A. H. Smith and S. W. Epstein. J. Ind. Eng. Chem., 1919, **11**, 33–36.

One gram of the sample, after extraction for 6 hours with acetone and then for 3 hours with chloroform or carbon bisulphide, is transferred to a 250 c.c. beaker and heated on a steam-bath until it no longer smells of chloroform. The residue is treated with a few c.c. of hot concentrated nitric acid and allowed to stand in the cold for about 10 minutes, after which a further 50 c.c. of the acid is added, care being taken to wash down the sides of the beaker. The mass is then heated on the steam-bath for an hour or more until all bubbles or foam disappear from the surface. The hot liquid is poured

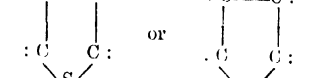
into a Gooch crucible containing a fairly thick pad of ignited asbestos, gentle suction being applied and thorough washing effected with hot concentrated nitric acid. The filter flask is then emptied and the filter washed alternately with acetone and benzene until the filtrate is colourless and afterwards well washed with hot 15% sodium hydroxide solution. The presence of lead is tested for by running warm ammonium acetate solution containing excess of ammonia through the pad into sodium chromate solution; if a yellow precipitate forms, the pad must be washed with the ammonium acetate solution until the washings no longer give a precipitate with sodium chromate. The residue is then washed well with warm 5% hydrochloric acid solution and the crucible dried for 1½ hours in an air-bath at 150° C. The crucible is then weighed before and after the carbon is burned off at a dull red heat. The loss in weight represents approximately 105% (101—108%) of the carbon originally present in the form of lampblack or gas-black. Where the percentage of free carbon is over 10%, only 0·5 grm. of the sample should be used for analysis.—T. H. P.

Terpenes, resins, and rubber; Condensation of unsaturated compounds in relation to ——. H. J. Prins. Chem. Weekblad, 1919, **16**, 64—74.

CONDENSATION between molecules of the same substance containing the group : C : C : is brought about by catalysts such as acids, acid anhydrides, halogens and halogen compounds with active halogen, sulphur and sulphur compounds with active sulphur (persulphides), oxygen and oxygen compounds (peroxides), metallic oxides, and metals. The catalyst and substrate are "reciprocally activated." Three reactions are possible:—polymerisation of the unsaturated substance, combination of catalyst with the substance at the double bond, and combination of catalyst with the polymerised substance formed. The theory of reciprocal activation is discussed in relation to the simultaneous polymerisation and oxidation of unsaturated hydrocarbons, such as terpenes; the formation of resins; and the vulcanisation of rubber. The following theory for the last-mentioned process is suggested. The rubber molecule is rendered active by means of the catalyst sulphur and the sulphur undergoes a change analogous to the formation of ozone from oxygen in presence of unsaturated substances. There then results: (1) a simple polymerisation of the rubber molecule with formation of cyclobutane derivatives, (2) polymerisation of the rubber molecule with simultaneous fixation of sulphur, giving compounds of the type



(3) direct addition of sulphur at the double bond with formation of



—W. S. M.

PATENTS.

Rubber; Method of reclaiming —— and apparatus therefor. Dunlop Rubber Co., Ltd., and D. F. Twiss, Birmingham. Eng. Pat. 122,249, 17.1.18. (Appl. 980/18.)

THE vulcanised rubber is cut into pieces and submitted to a uniform temperature inside a chamber from which the air has been expelled by steam; the necessary temperature can be obtained conveniently by surrounding the chamber with a jacket in which a heated heavy oil circulates. For the treatment of solid tyre rubber a temperature of approximately 450° F. (about 230° C.) in the reclaiming chamber is preferred.—D. F. T.

Rubber compound; Manufacture of an improved ——. F. H. Broomfield, London. Eng. Pat. 122,310, 4.3.18. (Appl. 3783/18.)

A RUBBER compound with much less tendency to harden at higher temperatures than the rubber compounds commonly used for dielectric purposes, is obtained by vulcanising a mixture of rubber, golden sulphide of antimony and asbestos or mica; black antimony sulphide does not produce the desired result. Suitable proportions are Pará rubber 60, golden sulphide of antimony (containing 17% free sulphur) 14, asbestos or mica powder 16; cables or wires coated with this mixture may be vulcanised by heating for 2 hours at 280° F. (138° C.).

—D. F. T.

[Covering for] electric conductors. Eng. Pat. 122,295. *See* XI.

XV.—LEATHER; BONE; HORN; GLUE.

Tannins; Effect of hard water on ——. T. A. Faust. J. Amer. Leather Chem. Assoc., 1918, **13**, 409—417.

CALCIUM sulphate appears to have a precipitating effect on tannins, but other common constituents of hard waters have not been proved to cause any loss in tannin. On account of the salts present, the analysis of tannin solutions made with hard water leads to results showing too high non-tannin content.—F. C. T.

Non-tannin enigma; The ——. J. A. Wilson and E. J. Kern. J. Amer. Leather Chem. Assoc., 1918, **13**, 429—438.

HIDE powder when shaken with basic chromic chloride or chrome alum solution, before use in tannin analysis, combines not only with chromium, but with the acid. An ionisable collagen salt is formed which is still present even after thorough washing of the chromed hide powder. On the basis of the work of Procter on gelatin-acid equilibria (this J., 1916, 615) it can be shown that the presence of sulphate ions in the hide powder will cause a lessened concentration of electrolytes in the absorbed part of any electrolyte solution with which the hide powder is shaken. The external liquid will show a corresponding increase in concentration. This assumes that the electrolyte does not combine with hide powder. Thus the analysis of a tanning material containing such electrolyte non-tannins will show too high a result for non-tannins. As an example, a 1% potassium sulphate solution increased in concentration to 1·046% after shaking with chromed hide powder. A similar result in the case of non-electrolytes which do not combine with hide powder (*e.g.*, glucose) is due to the salting-out effect of the ions of the collagen sulphate. In the case of a substance which combines with hide powder, its uncombined portion will tend to raise the non-tannin content, whilst the combined portion will act in the opposite sense.—F. C. T.

Tan liquors; Effect of impure kaolin on the determination of acid in ——. D. McCandlish and F. B. Lederer. J. Amer. Leather Chem. Assoc., 1918, **13**, 570—572.

QUANTITIES of from 5 to 50 c.c. of *N*/10 acetic acid were diluted to 250 c.c. giving solutions containing from 0·012 to 0·12 grm. of acid per 100 c.c., and therefore comparable in acidity with tan liquors.

In each case 15 grms. of kaolin was added, the mixture shaken and allowed to settle. Portions for titration were withdrawn after standing for 20 minutes and for 1 hour, and titrated with *N*/10 sodium hydroxide using Grübler's hematine as indicator. There was a loss of acid in each case, varying from 92% in the case of the weakest acid to 33% in the case of stronger acid. This was after 20 minutes' standing. This loss of acid is attributed to impurity in the kaolin, due to imperfect washing with acid in manufacture. The kaolin was found to contain iron, which seriously interfered with the end-point in the case of the stronger acids. The authors suggest the following test of the quality of the kaolin: 15 grms. of kaolin is shaken with 250 c.c. of *N*/50 acetic acid and allowed to stand for one hour, after which 50 c.c. of the acid is withdrawn and titrated with *N*/10 sodium hydroxide, using hematine as indicator. 10 c.c. of alkali should be necessary, and the end-point characteristic.

—F. C. T.

Tannic acid; Absorption of —— in sole leather manufacture. A. Rogers. J. Amer. Leather Chem. Assoc., 1918, **13**, 520—527.

SAMPLES of both leather and tan liquor were taken at different stages of sole leather tanning, and analyses made to determine the absorption of tannin by the hide and the diminution in strength of the liquors. Half the total absorption of tannin was effected in the first 15 days, and four-fifths after 13 days more. 62 days were required for the absorption of the remaining one-fifth of the tannin.

—F. C. T.

Tannery waste waters; Profitable recovery of proteids [for manufacture of fertilisers] from ——. C. L. Peck. J. Amer. Leather Chem. Assoc., 1918, **13**, 417—428.

THE alkaline effluent from the lime-yard, etc., is screened, passed through settling tanks to remove undissolved lime and other inorganic matter, and then mixed with acid spent tan liquors in a reaction tank. By this means proteids are precipitated and may be run off as a sludge containing 95% of water. The sludge is air-dried until the moisture content is not more than 30%. The screenings are also nitrogenous and, like the sludge, are saleable after drying for the manufacture of fertilisers.

—F. C. T.

PATENTS.

Leather; Process of manufacturing a substitute for ——. A. Meier, Schmargendorf, and H. Rall, Karlshorst, Germany, Assignors to Ges. für Verwertung Chem. Produkte m. b. H., Berlin. U.S. Pat. 1,287,387, 10.12.18. Appl., 12.2.15.

ALBUMINOUS material is treated with a mineral tanning agent and then with an organic tanning agent, and finally with formalin.—W. F. F.

Glue and the like; Making ——. R. W. Mumford, New York, Assignor to Refining Products Corporation, Wilmington, Del. U.S. Pat. 1,289,053, 24.12.18. Appl., 30.6.17.

FOR the production of clear, decolorised glue, a solution of gelatinous animal matter is agitated with porous vegetable carbon of open texture, possessing nearly the same cellular structure as that of the material from which it was made. Kieselguhr may also be added. The purified solution is then further concentrated.—C. A. K.

Tanning medium. A. Turnbull and T. B. Carmichael, Liverpool. U.S. Pat. 1,288,458, 17.12.18. Appl., 16.7.17.

SEE Eng. Pat. 110,470 of 1917; this J., 1917, 1244.

XVI.—SOILS; FERTILISERS.

Organic phosphorus of soil; Experimental work on methods for extraction and determination of ——. C. J. Schollenberger. Soil Sci., 1918, **6**, 365—395.

THE author gives very full details for the estimation of inorganic and total phosphorus in the soil, using Neumann's wet combustion method for the latter. The procedure best adapted for obtaining an ammoniacal extract of the soil which contains the minimum of clay and the maximum amount of phosphorus, consists in filtering the extract through a layer of the soil itself in a Buchner funnel. The most satisfactory strength of ammonium hydroxide for the extraction is 4—6%, 400 grms. of soil being shaken for 2—8 hours with 1 litre of this solution; the filtration takes 1—3 days. For the preliminary removal of the bases from the soil, prior to the extraction with ammonia solution, it is recommended to wash with 1% hydrochloric acid until no calcium can be detected in 50 c.c. of the filtrate and then to wash out the acid with a saturated solution of carbon dioxide. Sodium and potassium hydroxides are no more efficient than ammonia solution in extracting organic phosphorus from the soil, and one extraction by ammonia, using the proper procedure, removes from the soil practically all of the organic phosphorus that is capable of being taken into solution. No constant relation was observed between total organic matter and organic phosphorus in ammoniacal extracts, although there was a general tendency for these to vary together. The inorganic phosphorus of soils adsorbed by organic or inorganic colloids is not included in the apparent organic phosphorus content determined by the methods described. It is found that the humus and organic phosphorus, the colour of the ammoniacal extracts, and the total nitrogen in the four depths of soil, 0"—6", 6"—12", 12"—18", and 18"—24" are in the same relative proportions in each layer. W. G.

Phosphate; Effect of sulphofication and nitrification on rock ——. J. W. Ames and T. E. Richmond. Soil Sci., 1918, **6**, 351—364.

IN an acid soil the oxidation of free sulphur proceeds vigorously, and is somewhat depressed by the addition of calcium carbonate, whereas the latter is essential for "sulphofication" in sand cultures. In an acid soil, in the absence of calcium carbonate or nitrogen carriers, the oxidation of sulphur incorporated with rock phosphate causes a considerable portion of the phosphorus to be converted into a readily available form. In the presence of calcium carbonate, however, the acidity resulting from the sulphofication being neutralised, there is practically no breaking down of the rock phosphate. The presence of ammonium sulphate and the nitrification of either ammonium sulphate or dried blood have no appreciable action on the breaking down of rock phosphate in the soil, and nitrification is only stimulated to a very limited extent by the presence of rock phosphate. —W. G.

Nitrogenous fertilisers; Experiments with various ——. E. A. Mitscherlich, S. v. Saucken, and F. Iffland. J. Landw., 1918, **66**, 187—198.

EXPERIMENTS on sand-cultures of oats show that urea and its nitrate are at least equivalent to the other ordinary nitrogenous fertilisers, the nitrate

forming an excellent top-dressing, for which purpose it may replace sodium nitrate. (See also J. Chem. Soc., Mar., 1919.)—T. H. P.

Seed germination; Effect of certain organic substances on —. E. B. Fred. Soil Sci., 1918, **6**, 333—349.

THE results of experiments on the effect of alfalfa, casein, peptone, and sugar on the germination of a considerable number of different types of seeds indicate that, unless used in very large quantities, the three nitrogenous substances do not seriously affect seed germination. They are thus far less injurious on the basis of nitrogen content than is green manure. The decrease in germination caused by excessive amounts of casein or alfalfa powder is not lessened by the application of calcium carbonate. Sugar retards the rate of seed germination and at the same time increases bacterial growth. In large amounts it also decreases the percentage of germination. Sterilisation of the soil often inhibits the rate of seed germination.—W. G.

Proteids [for fertilisers] from tannery waste waters Peck. *See* XV.

PATENT.

Superphosphate; Apparatus for use in manufacture of —. T. Hill and C. H. Eden, Swansea. Eng. Pat. 122,069, 14.1.18. (Appl. 815/18.)

AN open, cylindrical "den," for the reception of liquid superphosphate, has a movable base consisting of a closed, floor-like portion and a wire or blade cutter portion, either portion being capable of covering the whole opening; and is also provided with a vertical plunger. On solidification of the liquid charge in the receptacle, the base is moved horizontally until the cutter portion is in position, when the plunger is operated and the material pressed through the cutter openings.—W. E. F. P.

XVII.—SUGARS; STARCHES; GUMS.

Sugar manufacture; Development of nitrogenous colouring substances during —. C. A. Oudemans. De Suikerind., 1918, 384; Archief Suikerind Nederl.-Indië, 1918, **26**, 1686—1694.

DURING sugar manufacture, whether from the cane or beet, there may be a development of colour from three different causes, namely (1) the action of lime upon the reducing sugars, (2) caramelisation on heating and evaporating, and (3) the reaction between reducing sugars and amino-acids or their derivatives (*cf.* Maillard, this J., 1912, 144). Experiments by the author showed that when mixtures of 0·5 grm. of glutamic or aspartic acid, glutamine or asparagine, 1 grm. of invert sugar or sucrose, and 15 c.c. of water were heated to 115° C. after neutralising, intensely dark-coloured products were formed, which were precipitated by basic lead acetate, and insoluble for the greater part in alcohol. Parallel tests in which the amino-acid or its derivative was absent gave a much smaller production of colour, and the coloured substances were readily soluble in alcohol. Cane juice as it comes from the mills already possesses a degree of colour (*cf.* Zerban, this J., 1918, 778 A), but most of the colour developed subsequently during the course of manufacture is considered by the author to be due to the presence of amino-acids and their derivatives, particularly asparagine.—J. P. O.

Gentiobiose and the two β-glucosides of glycol: Simultaneous biochemical synthesis of — *by emulsin.* E. Bourquelot and M. Bridel. Comptes rend., 1919, **168**, 253—256.

FROM the products of the action of emulsin from almonds on a mixture of dextrose and glycol in the molecular proportion of 2 : 1 in aqueous solution, the authors have isolated and characterised gentiobiose, glycol β-glucoside, and glycol β-diglucoside.
—W. G.

PATENTS.

Sugar industry; Apparatus for separating slimy and solid matters in the —. R. Kujawski, Milejow, Poland. Ger. Pat. 308,062, 9.5.12.

THE material is stirred in a closed vessel with a sieve bottom, while subjected to the action of compressed air, steam, or vacuum. The prongs of the agitator arms are arranged at an angle and their inclination is in an opposite sense on consecutive arms. The sieve floor of the containing vessel is carried on girders which form separate outflow chambers, and movable troughs can be introduced under the outflow chambers in order to catch the juice flowing through for the purpose of testing it.
—J. F. B.

Sucrose; Process for inverting —. C. Petzold, Zwickau. Ger. Pat. 308,850, 17.6.17.

AIR is introduced into the liquid undergoing inversion and is brought into intimate contact therewith by means of revolving combs with fine teeth or by devices resembling brushes, situated inside the inversion vessel. The oxygen is stated to have an intensifying effect on the inversion, so that this may be produced by a smaller proportion of acid and at a lower temperature (about 75° C.), thereby avoiding undesirable secondary modifications of the sugar. The oxygen also has a favourable influence on the colour of the product.—J. F. B.

Glucose; Process of manufacturing — [*from maize cobs*]. F. B. La Forge, Washington, D.C. U.S. Pat. 1,288,429, 17.12.18. Appl., 13.4.18. (Dedicated to the public.)

CORN (maize) cobs are treated with dilute sulphuric acid and the insoluble portion is separated, washed free from acid and soluble matter, and then dried and finely ground. The powder is mixed with about an equal weight of 75% sulphuric acid and after standing for several hours is diluted with a large quantity of water, and heated until hydrolysis is complete. The liquor, after separation of insoluble matter by filtration, is neutralised with slaked lime, the calcium sulphate filtered off, and the resulting solution concentrated to a syrup from which glucose separates in crystalline form.
—L. A. C.

Decolorising carbon. U.S. Pats. 1,286,187 and 1,287,592. *See* IIB.

XVIII.—FERMENTATION INDUSTRIES.

Yeasts from thin beers, and their "working power." F. Schönfeld and C. Goslich. Woch. Brau., 1918, **35**, 201—203.

YEASTS obtained in the fermentation of brewery worts of low gravity, *e.g.*, 6%, were found to possess a greater "working power" than those from worts of full gravity. This is attributed to the practice of arresting the vat fermentation of thin worts at an earlier stage than is usual with normal worts. The yeast is accordingly in a very

vigorous condition; its protein-content, in spite of the low gravity of the worts, is high, and this is generally indicative of high "working power."
—J. H. L.

Maltase, its capacity for penetrating the wall of the yeast cell, and its dependence on the cultivation of the yeast in light and heavy worts. F. Schönfeld, H. Krumhaar, and M. Korn. Woch. Brau., 1918, **35**, 181–182.

THE diffusion of maltase from yeast cells into the surrounding medium can only take place when the cells have been killed or ruptured. It was found that killing by means of toluene does not enable the maltase to escape from all types of yeast; among the exceptions observed were the bottom-fermentation races K, U and M. The maltase-activity (cp. this J., 1918, 161 A) of yeasts grown in thin worts was found to be lower than that of yeasts from worts of normal gravity.—J. H. L.

Beers; Preparation of thin —— by dilution, and the question of decarbonation. F. Schönfeld. Tageszeit. für Brauerei, 1918, **16**, 243. Z. ges. Brauw., 1918, **41**, 198.

IN the preparation of thin beers by fermenting worts of normal gravity and diluting afterwards, the presence of carbonates in water used for the dilution is of no practical importance where the dilution is carried out after the secondary fermentation, *i.e.*, on the fully conditioned beer. The only case where decarbonation might be advisable is where dilution is effected just after the primary fermentation and where a vigorous secondary fermentation is desirable: in such a case a high proportion of carbonates in the added water might weaken the yeast during the secondary fermentation. (See also Krumhaar, this J., 1918, 779 A.)—J. H. L.

B. coli; Medium with autolysed yeast water for the culture of ——. F. Diénert and A. Guillerd. Comptes rend., 1919, **168**, 256—257.

500 GRMS. of pressed brewers' yeast is heated at 50° C. for 24 hours, at the end of which time it is completely liquefied. This liquid is diluted to 2 litres, boiled for ½ hour, filtered, and further diluted to 7·5 litres. This autolysed yeast gives a medium very constant in composition and can be used quite satisfactorily to replace peptone bouillon for the culture of *B. coli*.—W. G.

Biochemical synthesis of gentiobiose, etc. Bourquelot and Bridel. *See* XVII.

PATENTS.

Alcohol-reduced beverages; Process of making ——. H. Heuser, Chicago, Ill. U.S. Pat. 1,286,315, 3.12.18. Appl., 24.2.17.

A CHARGE of an alcoholic beverage, *e.g.* beer, is made to flow in a continuous film through a boiling-zone on the inner surface of a vacuum pan while steam under pressure is diffused over the opposite surface of the pan, so as to boil the liquid film momentarily and instantaneously to evaporate alcohol therefrom. The area of the boiling-zone over which the liquid flows may be varied by regulating the area to which steam is applied.—J. F. B.

Producing nitrates by means of bacteria. U.S. Pats. 1,286,888—9 and 1,288,754—1,288,756. *See* VII.

XIXA.—FOODS.

PATENTS.

Drying goods such as wheat, fruit, vegetables, or fish; Method of and apparatus for ——. J. Westerbeek, and N. V. "Techniéma," Rotterdam. Eng. Pat. 111,112, 8.11.17. (Appl. 16,369/17.) Int. Conv., 24.3.11.

THE material to be dried is delivered by a conveyor on to a horizontal platform at the top of a tower formed of a number of perforated horizontal sections each mounted on horizontal pivots just below. A number of such platforms are provided in the tower, one below the other, and all the sections forming a platform are connected to a reciprocating mechanism, by which they are simultaneously turned through 90° into a vertical position. Those forming the platform next below may then be turned through 90° in the opposite direction, and so on. The material thus passes from one platform to the next in a series of small heaps which are alternately spread out on their opposite sides on successive platforms and separated by uncovered spaces. The drying gas passes upwards through the platforms and also through adjustable openings in the side of the tower throughout its height. The gas may be withdrawn through openings on the opposite side of the tower between each pair of platforms, so that moist air may be withdrawn without passing through the whole of the platforms. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 1701 and 3976 of 1868, 8942 of 1901, and 17,740 of 1910; this J., 1902, 695.) W. F. F.

Cocoa and the waste products of chocolate manufacture; Processes for treating — —. [Recovery of theobromine, caffeine, and fat.] E. de Grousseau and A. Vicogne, Clichy, France. Eng. Pat. 116,694, 27.4.18. (Appl. 7094/18.) Int. Conv., 11.6.17.

THE material, principally waste products, is heated at 100° C. for 1 hr. with water containing 3 to 4% of sulphuric, hydrochloric, or acetic acid, then neutralised with an alkaline-earth carbonate (*e.g.*, magnesium carbonate), and dried at 100° C. The dry powder is extracted with hot tetrachloroethane: the extract is distilled to remove the solvent and the residue, consisting of fat, theobromine, and caffeine is treated with carbon tetrachloride which dissolves the fat and caffeine. The solution is filtered to separate the insoluble theobromine, the filtrate is distilled and the caffeine extracted from the residue with hot water. The caffeine crystallises out when the aqueous solution is cooled; the theobromine may be re-crystallised from boiling water.—W. P. S.

Coconut butter; Process for the extraction of ——. E. E. R. Gaudart, Paris. Eng. Pat. 117,819, 27.7.18. (Appl. 12,254/18.) Int. Conv., 28.4.17.

KERNELS of fresh coconuts are reduced to small fragments and then ground in a runner mill with a quantity of "skimmed coconut milk" (obtained in a later operation) at 30° C. The milky and fluid mixture is filtered through coarse cloth and then centrifuged to separate resinous substances in suspension. The liquid is delivered into a centrifugal cream-separator, the "cream" obtained is pasteurised, submitted to lactic fermentation for 12 hrs. at 25° to 30° C., and then churned at 15° C. The "butter" is washed and kneaded in the usual way. A portion of the liquid ("skimmed coconut milk") separated from the "cream" is reserved

for working up a further charge of kernels, and the remainder is stirred and heated with the addition of calcium sulphate, 500 grms. of this being added to every 1000 litres of "skimmed milk"; the proteins are thus precipitated, and are collected, washed, and dried.—W. P. S.

Cottonseed meats, hulls, and lint; Method of and apparatus for treating a mixture of ——. J. S. Mullen, Richland, Ga. U.S. Pat. 1,286,389, 3.12.18. Appl., 13.7.16.

THE mixture is passed over an inclined screen to separate the fine meal, and the coarser portion, as it falls from the lower edge of the screen, passes in front of a suction nozzle which removes the hulls and lint. A deflecting plate prevents passage of finer material into the nozzle. The suction is regulated so as to vary the amount of hulls removed, and thus to alter the protein and ammonia content of the meal as desired.—W. P. S.

Food product; Flaked cereal —— and method of making the same. W. H. Post, Assignor to Postum Cereal Co., Battle Creek, Mich. U.S. Pat. 1,286,766, 3.12.18. Appl., 6.4.17.

CORN (maize) grits are cooked with wheat bran, and the product is submitted to a flaking operation so as to embed the bran in the surface of the flakes, which are then sprayed with a sugar solution. Additional bran is added to the flakes, and the whole is toasted.—J. H. J.

Baking powder and process of making same. F. C. Atkinson, Indianapolis, Ind. U.S. Pat. 1,286,904, 10.12.18. Appl., 20.8.17.

THE particles of the active constituent of a baking powder are coated with hydrogenated corn (maize) oil by mixing with the molten fat, spraying the mixture, and cooling the spray as it falls.—J. H. P.

Leavening agent. F. B. La Forge, Washington, D.C. U.S. Pat. 1,288,428, 17.12.18. Appl., 13.4.18. (Dedicated to the public.)

A LEAVENING agent is prepared by mixing sodium bicarbonate with gulonic lactone.—L. A. C.

Eggs; Preserving ——. G. Fütterer, Chicago, Ill. U.S. Pat. 1,286,989, 10.12.18. Appl., 24.11.17.

EGGS are dipped in a mixture of beeswax, 5, and lard, 95 parts, heated at 203° F. (95° C.); the excess of the mixture is then removed and the remainder allowed to solidify on the shells to form a bacteria-excluding coating.—W. P. S.

Food product of milk; Process of making a new ——. P. W. Turney, Richmond, Va. U.S. Pat. 1,289,021, 24.12.18. Appl., 19.4.18.

FRESH milk is curdled by means of an enzyme until the precipitate is of a flocculent, slightly adherent consistency. Further curdling is prevented by rapidly lowering the temperature, and the mass is agitated to facilitate separation of the whey. The precipitate is then allowed to settle and the whey poured off and concentrated to about one-fourth of its bulk. The concentrated whey is mixed with the precipitate, and the mixture maintained at a low temperature to prevent further action.—L. A. C.

Gluten; Process for drying ——. G. A. Olson, Pullman, Wash., Assignor to the Government and People of the United States. U.S. Pat. 1,289,883, 31.12.18. Appl., 23.12.15.

A QUANTITY of gluten is rolled into a solid mass under hot water, and placed in an oven heated to a temperature slightly below 100° C., the pressure being reduced at first so as to allow the gluten to expand, and afterwards increased to that of the atmosphere.—A. B. S.

Milk; Dried —— and method for producing the same. C. H. Campbell, Assignor to Borden's Condensed Milk Co., New York. Reissue 14,567, 17.12.18, of U.S. Pat. 1,233,446, 17.7.17. Appl., 6.9.18.

SEE this J., 1917, 1025.

XIXB.—WATER PURIFICATION; SANITATION.

Boiler feed water; Linseed process for softening ——. R. Heuss. Z. ges. Brauw., 1918, **41**, 200—201.

THE Brun process for preventing incrustation by introducing linseed extract into boilers (this J., 1910, 76) was tested by E. Hohn on behalf of the Swiss Association of Boiler Proprietors. Examination of the contents of the boilers after working showed satisfactory results in most cases, the salts precipitated from the water being present in the form of a sludge. The fatty matters of the linseed appeared to have been volatilised with the steam, for very little free or combined fatty acid was found in the boilers; and the organic matter remaining in them exerted no pronounced corrosive action. Whilst the process appears to have no harmful effect on the boiler it is possible that the fatty matters entrained by the steam may give rise to corrosion elsewhere, *e.g.*, in the condensed water pipes, and until the results of its working over a long period are known the process cannot be recommended.—J. H. L.

Waters; Methods of analysis of ——. A. A. Bado, V. J. Bermaola, A. F. Mazza, and L. Dasso. Obras Sanitarias de la Nación, Buenos Aires, 1918. [Reprint.]

THIS monograph gives a detailed description of the methods adopted in the *Laboratorio de Análisis de Aguas y Ensayos de Materiales de las Obras Sanitarias de la Nación* of Buenos Aires for the complete chemical and microbiological analysis of potable waters.—W. S. M.

Atmospheric nitrogen and oxygen; Determination of the rate of solution of —— by water. W. E. Adeney and H. G. Becker. Sci. Proc. Roy. Dublin Soc., 1918, **15**, 385—404.

THE rate of solution of atmospheric oxygen and nitrogen has been determined by allowing a large bubble of air to rise slowly through a narrow column of water. This method of bringing the air and water into contact ensures the presentation of the air to a continually changing water surface and also effectual local stirring of the water. The results confirm the authors' theory of the mechanism of the solution of air by water, which is that absorption occurs at the surface and then, under gravitational forces, the air-charged layer descends through the solution and a second surface is presented to the air.—J. F. S.

Culture of B. coli. Dlérert and Guillerd. *See* XVIII.

PATENTS.

Sewage; Apparatus for aerating ——. A. M. Brosius, Pasadena, Cal. U.S. Pat. 1,286,520, 3.12.18. Appl., 28.8.16.

SEWAGE is introduced into a tank which is provided with a pipe for blowing in air, and a paddle arrangement for mixing the air and sewage to form a foam. The air may be introduced also along with the sewage through a pipe opening at the bottom of the tank, the mixture being mechanically broken up into a foam which is expelled into the tank. —J. H. J.

[*Sewage*] *sludge; Device for activating* ——. L. E. Rein and J. W. Cox, Assignors to Pacific Flush Tank Co., Chicago, Ill. U.S. Pat. 1,286,775, 3.12.18. Appl., 6.10.16.

A SEWAGE tank with an overflow outlet is provided with a pump, the inlet of which extends into the tank, while the exhaust has a return pipe attached to it carrying an injector which is adapted to inject air into the return pipe. The return pipe has a deflector guide at its outlet, adapted to deflect the discharge into the body of the sewage.—J. H. J.

Disinfectant. A. A. Wells, Montclair, N.J. Reissue 14,562, 10.12.18, of U.S. Pat. 1,280,602, 1.10.18. Appl., 7.11.18.

SEE this J., 1919, 27 A.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Stramonium leaves; Influence of the presence of stems and roots upon the total alkaloid content of ——. G. P. Koch. Amer. J. Pharm., 1919, **91**, 11—16.

OF the whole stramonium plant, the leaves constitute about 41%, the stems 44%, and the roots 15%. The leaves yield from 0·398 to 0·596% of total alkaloids, the stems 0·080 to 0·660%, and the roots 0·160 to 0·319%. The whole plant (leaves, stems, and roots) can, therefore, be harvested and used for the commercial preparation without risk of the total alkaloid content falling below 0·25%, the requirement of the U.S. Pharmacopœia.—W. P. S.

Guttameter; The —— and its use for the examination of drugs and poisons. F. Eschbaum. Ber. deuts. pharm. Ges., 1918, **28**, 397—416.

THE guttameter is a capillary pipette with a rubber bulb above and a wide delivery orifice of 8·627 mm. diameter, the instrument being constructed to deliver, at 20° C., 10 drops of water weighing approximately 1·200 grm. The interior having been cleaned with chromic acid mixture and rinsed out with the liquid to be examined, it is charged with liquid and the total absence of air bubbles is confirmed. Ten drops are then delivered into a weighing bottle and the weight ascertained. This weight is then corrected by the factor of the instrument to bring it to that corresponding to a standard of 1·2 grm. of water. The results are directly proportional to the surface tension of the liquid and are inversely proportional to the results found by the stalagmometer. The author has used the instrument for the investigation of an observation by Traube and Onodera (this J., 1915, 509) that the physiological activities of alkaloid solutions are generally related to their surface properties. Incidentally it was found that the guttameter could be applied for detecting the decomposition of solutions of quinine hydrochloride on storage in glass bottles. Quartz or Jena glass was established as the best material for keeping these solutions. A series of solutions of alkaloids of the quinine group have been studied. Increasing proportions of sodium carbonate were added to 0·1% solutions of the alkaloid salts, and the decrease in surface tension thus produced was measured. The lower the surface tension, the higher the toxicity of the alkaloid. Quinine and quinidine were about equally toxic; the other alkaloids were grouped, according to this manner of classification, in the following order of increasing toxicity: hydroquinine, ethylhydrocupreine, ethylapohydroquinidine, isoamylhydrocupreine and iso-octylhydrocupreine. In Traube's investigation it was found that morphine and apomorphine salts, when treated with sodium carbonate, did not lower the surface tension of water; this exceptional behaviour is confirmed by the author, but he found that by treatment with ammonia in certain proportions, the morphine could be obtained in a disperse form which had the expected surface activity.—J. F. B.

Tinctures and fluid extracts; New method for determination of extract in ——. F. Eschbaum. Ber. deuts. pharm. Ges., 1918, **28**, 417—419.

THE difficulty of obtaining concordant and accurate results in determining the solid matters in tinctures and fluid extracts by ordinary methods of drying may be overcome by drying the liquid on filter paper. A strip of filter paper, 20 cm. long and 6—7 cm. wide, is folded over to the extent of about 5 mm. along both its longitudinal edges, then rolled up and inserted in a metal ring. The roll is dried in the oven at 108° C. and weighed in a weighing bottle. The paper is unrolled and clipped at both ends in a pair of clamps, 5—6 cm. broad, supported over a hot plate. A measured quantity, 2—5 c.c., of the tincture is then distributed over the paper from a pipette, and when the liquid has evaporated the paper is again rolled up, dried in the oven, and weighed. On account of hygroscopicity the weighings must be made as quickly as possible and the loss of time in cooling may be avoided by employing a weighing bottle with a vacuum jacket and weighing immediately after removing the paper from the oven.—J. F. B.

Acetylsalicylic acid. H. L. Dahm. J. Ind Eng. Chem., 1919, **11**, 29—30.

AN apparatus is described which overcomes the difficulty of determining the melting point of acetylsalicylic acid caused by the progressive decomposition of the acid when gradually heated. A 250 c.c. CO, flask is filled with paraffin oil which is stirred by a motor-driven propeller. A standardised thermometer graduated to 0·2° C. and provided with an air-jacket for protection against draughts, is immersed permanently in the oil-bath to a depth of 3 inches, for which immersion it is calibrated. The capillary melting point tube is attached by means of two rubber bands to a glass rod sliding through a clamped cork. The temperature of the bath is raised, with constant stirring, at a uniform rate of 1° per minute to 130° C., the melting point tube being then immersed in the oil. By this method samples of aspirin from various sources were found to melt within the range, 133°—135° C. (corrected). For determining the approximate proportions of free salicylic acid in aspirin a series of standard colours was prepared from a solution of 10 grms. of $CoCl_2+2H_2O$ in 50 c.c. of water

and 5 c.c. of 10% hydrochloric acid, the liquid being then diluted to 100 c.c. This solution was diluted with water in the following proportions:

C.c. of solution	C.c. of water	% of $CoCl_2 + 2H_2O$	Colour No.	Grms. of salicylic acid in equal volumes
5	395	0·125	0	0·00005
10	390	0·25	1	0·0001
10	190	0·50	2	0·0002
10	90	1·00	3	0·00025
10	75	1·50	4	0·0003
10	65	2·00	5	0·00035
10	40	2·50	6	0·0004

The standards thus obtained are preserved in glass-stoppered bottles of uniform size and holding about 25 c.c. of liquid. They were standardised by using a 0·1% solution of salicylic acid, a definite volume of this being mixed with 5 c.c. of alcohol and diluted to a final volume of 25 c.c.; one drop of 10% ferric chloride solution was then added. After standing for 5 minutes in a flask similar to those holding the cobalt chloride solutions, the colour was matched against these. In this way the results given in the last column of the table were obtained. Such results are accurate only for definite experimental conditions.—T. H. P.

Iodine; Churchill's tincture of ——. H. C. Raubenheimer. Amer. J. Pharm., 1919, **91**, 37—44.

THE present method of preparing this tincture (U.S.A. National Formulary, IV., 1916) is unsatisfactory owing to a deficiency in the quantity of potassium iodide used; particles of undissolved iodine are present. It is recommended that the potassium iodide be increased from 3·3 to 3·85 grms. The quantities would then be:—Iodine, 16·5 grms.; potassium iodide, 3·85 grms; water, 25 c.c.; alcohol, sufficient to make 100 c.c.—W. P. S.

Recovering volatile inflammable solvents. Sestini. *See* I.

Gentiobiose and glucol-glucosides. Bourquelot and Bridel. *See* XVII.

Terpenes. Prins. *See* XIV.

PATENTS.

[*Halogen*] *compounds* [*of hydrocarbons*]; *Preparation of* —— *by the action of light.* W. O. Snelling, Pittsburgh, Pa. U.S. Pat. 1,285,823, 26.11.18. Appl., 1.7.13.

A GASEOUS mixture of the halogen and hydrocarbon is exposed to actinic light of gradually increasing intensity by passing it towards the source of illumination through a transparent vessel divided into a series of communicating compartments by means of transparent, vertical partitions.—W. E. F. P.

Pinacone; Process for the manufacture of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 306,523, 4.2.17. Addition to Ger. Pat. 252,759.

PINACONE is prepared by the electrolytic reduction of acetone in acid solution, using electrodes composed of lead containing 2% or more of Cu. The yield of pinacone is thereby increased and that of the valueless isopropyl alcohol diminished. For instance, according to the original process the ratio of pinacone to isopropyl alcohol is about 2:1, whereas with lead cathodes containing 4% Cu the ratio is raised to about 30:1.—J. F. B.

Hydrogenised compounds; Manufacture of ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 306,724, 7.10.15. Addition to Ger. Pat. 305,347 (this J., 1918, 487 A).

AROMATIC isocyclic or heterocyclic compounds other than bases are treated with alkali or alkaline-earth metals and alcohols in the presence of indifferent solvents. In this process ethyl alcohol may be employed instead of amyl alcohol and the violence of the reaction is controlled by the inert solvent.—J. F. B.

Bacteria preparations; Permanently-stable dry —— *and process of making same.* E. Helbig, Frankfort, Assignor to Farbw. vorm. Meister, Lucius, u. Brüning, Höchst, Germany. U.S. Pat. 1,288,582, 24.12.18. Appl., 28.6.15.

SEE Ger. Pat. 291,405 of 1914; this J., 1916, 654. Special claim is made for a tuberculin preparation made by the process described.

Halogen products of hydrocarbons; Process of manufacturing ——. B. S. Lacy, Sewaren, N.J., Assignor to The Roessler and Hasslacher Chemical Co., New York. U.S. Pat. 1,286,353, 3.12.18. Appl., 6.10.15.

SEE Eng. Pat. 101,708 of 1916; this J., 1917, 1063.

Cocoa waste products. Eng. Pat. 116,694. *See* XIXA.

XXI. PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENTS.

[*Photographic*] *toning process and product thereof.* E. R. Bullock, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pat. 1,286,890, 3.12.18. Appl., 20.6.17.

A SILVER image is converted into silver sulphide and then treated with a solution of a salt of seleno-sulphuric acid, the residual image being reddish in tone and containing compounds of silver, sulphur, and selenium.—B. V. S.

Photographic printing process. J. E. Thornton, London, Assignor to J. O. O'Brien, Manchester. U.S. Pat. 1,288,753, 24.12.18. Appl., 30.6.15.

A HALF-TONE negative is obtained in the usual way from the original full-tone negative, and from this is obtained a positive by the carbon process. In a three-colour film, three such positives, suitably coloured, are superimposed in register.—B. V. S.

XXIII.—ANALYSIS.

Specific heat determinations at higher temperatures. W. P. White. Amer. J. Sci., 1919, **47**, 44—59.

WHEN determining the specific heat of a solid substance by the method of mixtures, the chief discrepancies are due to:—(1) The temperature determination in the furnace; (2) the loss of heat in dropping the material into the calorimeter; (3) exposure of the calorimeter to the outer air during the drop; (4) the effect of external conditions (jacket or electrical measuring system); (5) the calorimeter after the drop; (5) internal effects (temperature change) in the calorimeter after the drop. The most serious of these errors is the

due to the loss of heat in transferring the hot body to the calorimeter. A simple form of automatic drop is desirable, and the author has successfully used a container hung on a latch, which is released by pulling a fine wire; the container then falls into a gauze tube fitted with a tin-foil rim, this tube sinking with the hot body into the water with a minimum of splash and without any escape of steam. A much longer time than is usually allowed —about 20 minutes—is needed before the hot body and the water in the calorimeter are in equilibrium. Many of the discrepancies observed when water is used may be avoided by replacing it by a block of copper, but this greatly increases the time required for a determination and is very exacting in regard to the control of the temperature of the jacket. (See also J. Chem. Soc., Feb., 1919.)—A. B. S.

Calcium and magnesium; Estimation of —— in different saline solutions. E. Canals. Bull. Soc. Chim., 1918, **23**, 422–430.

THE simplest and most satisfactory method of estimating calcium in its solutions is to precipitate it as calcium oxalate by the addition of oxalic acid to the slightly acid boiling solution, followed by the addition of ammonia in slight excess. The excess of ammonia is subsequently removed by boiling. The precipitate is washed with hot water, dried, ignited, and weighed as calcium oxide. The method of estimation by precipitation and weighing as calcium sulphate is very exact if certain precautions, as to the amount of acid used for the precipitation, dilution of the alcohol used for washing, time of ignition, etc., are observed.—W. G.

Gold; Quantitative determination of —— especially in animal tissues. S. M. Cadwell and G. Leavell. J. Amer. Chem. Soc., 1919, **41**, 1–12.

SMALL amounts of gold (0·08—3·0 mgrms.) present in animal tissues can be estimated with a maximum error of 0·05 mgrm. by the following process: 10 grms. of fresh tissue is placed in a 300 c.c. Kjeldahl flask, treated with 10 c.c. each of concentrated sulphuric and nitric acids and digested over a free flame until the cooled solution is colourless. Air is then blown into the flask and the mixture again heated until the volume is reduced to 2 c.c.; this procedure removes the sulphuric acid. One c.c. each of hydrochloric and nitric acids is added and the mixture boiled for a few minutes and a further 1 c.c. of hydrochloric acid added. The solution is cooled, diluted with 5 c.c. of water, and concentrated ammonia added until the colour is discharged and then an excess of 2 c.c. The mixture is boiled and the white precipitate which forms at this point dissolved by adding 5 c.c. of concentrated hydrochloric acid and boiling for 3 minutes. The solution is filtered through asbestos on an alundum plate and the filtrate treated with excess of ammonia. The volume of the solution should now be about 40 c.c.; 1·1 c.c. of 85% phosphoric acid and 0·75 grm. of disodium hydrogen phosphate are added and the solution electrolysed using a rotating anode and a platinum sheet cathode. The difference of electrode potential should be 0·9—1·2 volts and the temperature 60° C. The method has been slightly modified to allow of its use for larger quantities of gold. By the addition of 6 grms. of ammonium chloride to prevent precipitation, 30—40 mgrms. of gold can be deposited at 60° C., with a voltage of less than 0·6 volt for the first 30—45 minutes and below 1·3 volts for the remainder of the time, complete deposition usually requiring 1¼ hours. Under the conditions stated, gold can be completely separated from equivalent amounts of copper and iron, but the time required for electrolysis is greater than when these metals are not present. It makes very little difference whether the electrolysed solution is neutral or much more acid than stated above. The average time required for carrying out a complete determination of gold by this method is less than 2 hours.—J. F. S.

Fusibility of coal ash. Fieldner and others. *See* IIA.

Benzol in gas. St. Claire Deville. *See* IIA.

Pyridine and ammonia. Prideaux. *See* III.

Beating tests [for paper pulp]. Suiermeister. *See* V.

Soda and sulphite pulp or paper. Wasicky. *See* V.

Hydrochloric acid and ammonia. Auger. *See* VII.

Hydrocyanic acid and copper. Jennesseaux. *See* VII.

Analysis of barytes. Frenkel. *See* VII.

Boric oxide in glass. Cauwood and Wilson. *See* VIII.

Cast iron and steel. Marinot. *See* X.

Phosphorus and silicon in cast iron. Cavazzi. *See* X.

Lead in brass and alloys. Hodgson. *See* X.

Oil in oil-seeds. Biazzo. *See* XII.

Free carbon in rubber. Smith and Epstein. *See* XIV.

Acid in tan liquors. McCandlish and Lederer. *See* XV.

Organic phosphorus of soil. Schollenberger. *See* XVI.

Water analysis. Bado and others. *See* XIXB.

Extract in tinctures, etc. Eschbaum. *See* XX.

Acetylsalicylic acid. Dahm. *See* XX.

PATENTS.

Transformation points; Method of and apparatus for determining ——. R. P. Brown, Assignor to The Brown Instrument Co., Philadelphia, Pa. U.S. Pat. 1,285,920, 26.11.18. Appl., 14.11.17.

THE substance to be tested and a neutral substance are subjected to the same heat conditions, by which their temperature is varied through a range which includes the transformation point. The varying temperatures of the two substances are used to maintain two differences of potential, one of which is a function of the temperature of the test substance, and the other a function of the temperature difference between the two substances. The movable element of an electric measuring instru-

ment is deflected by two forces alternately, one due to both differences of potential simultaneously, and the other due to the first difference of potential only.—W. F. F.

Carbon dioxide analyser. A. Butcher, Philadelphia, Pa. U.S. Pat. 1,285,927, 26.11.18. Appl., 22.3.17.

A CIRCULAR plug is provided with an internal pocket communicating with two ports on its periphery, and is arranged to turn in a casing provided with ports. In one position the pocket communicates by one port in the casing with the supply of gas to be examined, and by another port with the atmosphere, so that the pocket is filled with gas. On turning the plug, the pocket communicates by its two ports with a carbon dioxide absorbent contained in a cup carried by the casing, and with a closed indicator tube respectively, and by a further turn of the plug, the indicator tube is placed in communication with the air.—W. F. F.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Davies. Separation of gases. 4428. Feb. 22.

Du Pont de Nemours and Co. Recovering solvent. 4276. Feb. 20. (U.S., 19.1.18.)

Fadden. Apparatus for producing mineral distillates of definite composition. 3944. Feb. 18.

Fowler. Apparatus for subjecting air, gases, and vapour to the action of liquids. 3638. Feb. 14.

Gröndal. Lixiviating granular or pulverulent material. 3464. Feb. 12.

Harberd and Sonsthagen. Atomising viscid material. 3364. Feb. 11.

Morison. Condensing plant. 3935. Feb. 17.

Schuck. Production of a catalyst. 3985. Feb. 18.

Shaw. Apparatus for evaporating or concentrating liquids. 3238. Feb. 10.

Smith. Crucibles and melting-pots. 3483. Feb. 13.

Soc. d'Etudes Chimiques. Fractional distillation of liquids. 3728. Feb. 15. (Switzerland, 20.2.18.)

Soder. Grinding-mills. 3582. Feb. 13.

COMPLETE SPECIFICATIONS ACCEPTED.

1523 (1918). Stansfield. Treating smoke, furnace gases, exhaust gases, etc. (122,871.) Feb. 19.

2242 (1918). Huhn. Drying granular materials. (122,910.) Feb. 19.

2246 (1918). Fraser, and Fraser and Co. Machines for mixing triturated or granulated materials. (123,135.) Feb. 26.

2524 (1918). Pulsometer Engineering Co., and Bjornstad. Filters. (123,152.) Feb. 26.

2662 (1918). Perry. Apparatus for distilling. (122,925.) Feb. 19.

2765 (1918). Adams. Apparatus for lifting insoluble or semi-solid matter. (123,169.) Feb. 26.

5081 (1918). Francart. Tunnel kilns, ovens, etc. (122,957.) Feb. 19.

5107 (1918). Kestner. Evaporators. (122,958.) Feb. 19.

8482 (1918). Wilson. Filter-presses. (122,979.) Feb. 19.

10,474 (1918). Walker. Pulverising-mills. (123,250.) Feb. 26.

14,248 (1918). Stein et Cie. Tilting-furnaces. (120,200.) Feb. 19.

16,518 (1918). Aubert. *See* X.

17,520 (1918). Sands and Gourlay. Apparatus for separating immiscible liquids. (123,033.) Feb. 19.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Balfour and others. 3621. *See* VII.

Crank and Svensson. Gas generators. 3358. Feb. 11.

Davies. Carbonisation and gasification plant etc. 4339. Feb. 21.

Davies. 4428. *See* I.

Fadden. 3944. *See* I.

Fornas. Gas-producers. 3431. Feb. 12 (Fr., 13.2.18.)

Fornas. Gas-producers. 3504. Feb. 13.

Freeman. Gasifying solid and liquid fuels. 1154. Feb. 19.

Pearson and Son (Coxon). 4266. *See* III.

Pollock. Fuel. 4080. Feb. 19.

Serret. Treatment of fuels. 3417. Feb. 12. (Fr., 23.10.16.)

Smith. Gasifying coal and obtaining by-products therefrom. 3916. Feb. 17. (U.S., 16.2.18.)

Smith. Furnace retorts. 3918. Feb. 17. (U.S., 18.2.18.)

Townsend. Apparatus for heating water-gas in coal carbonisation. 3191. Feb. 10.

West and Wild. Gas-producers. 4010. Feb. 18.

COMPLETE SPECIFICATIONS ACCEPTED.

15,524 (1917). Marks (Ledoux). Kilns for carbonising and distilling wood. (123,111.) Feb. 26.

2521 (1918). Deakin (Roth and Venturino). Transforming heavy petroleum and products into lighter products. (123,151.) Feb. 26.

2851 (1918). Marks (Soc. Anon. Ital. Ansaldo and Co.). Refractory material used in surface-combustion processes. (123,175.) Feb. 26.

2924 (1918). Marks (Soc. Anon. Ital. Ansaldo and Co.). Simultaneously producing gas from lignite and other combustible materials, and slag for agricultural purposes. (123,177.) Feb. 26.

14,708 (1918). Stafford. Destructive distillation of wood. (119,040.) Feb. 19.

III.—TAR AND TAR PRODUCTS.

APPLICATIONS.

Pearson and Son (Coxon). Distillation of hydrocarbons. 4266. Feb. 20.

Selden Co., and Selden. Treatment of cymene. 4275. Feb. 20.

Sutton. Sulphonation. 4278. Feb. 20.

COMPLETE SPECIFICATION ACCEPTED.

2646 (1918). Blakeley. Stills or preheaters for dehydrating tar etc. (123,163.) Feb. 26.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Baxter. Solution for rendering combustible materials fire-resisting. 3485. Feb. 13.

Frood. Treatment of organic and inorganic fibres and fibrous fabrics and materials. 3975. Feb. 18.

Murray. Manufacture of paper. 3963. Feb. 18.

Wilson. Apparatus for drying wool. 3489. Feb. 12.

COMPLETE SPECIFICATION ACCEPTED.

5732 (1918). Marx. Refining-engines for producing paper pulp. (122,964.) Feb. 19.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Morley. Machines for bleaching etc. textile fabrics and yarns in rope form. 4229. Feb. 20.

Soc. des Combustibles Industriels. Impregnating or coating material with insulating, dyeing, or other fluid product. 4369. Feb. 21. (Belg., 7.2.16.)

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Balfour, Bray, and British Oxygen Co. Manufacture of hydrogen. 3621. Feb. 14.

Dupont, and Darrasse Frères. Utilising marine algæ for making formic, acetic, and butyric acids and for extracting salts of iodine and potash. 3508. Feb. 13. (Fr., 13.2.18.)

Fairbrother (Chemical Construction Co.). Production of potassium nitrate. 4255. Feb. 20.

Freeth and Munro. Removal of calcium and magnesium from rock-salt brine or solutions of rock-salt in water. 3754. Feb. 15.

Gros et Bouchardy. Production of nitrogen compounds containing hydrogen with aid of electric discharges. 4490. Feb. 22. (Switzerland, 25.2.18.)

Joseph. Ozone generators. 3558. Feb. 13.

Complete Specifications Accepted.

2039 (1918). Turnbull and Morris. Chlorination of water, alkaline, or other solutions. (122,888.) Feb. 19.

2130 (1918). Gaillard. *See* XVI.

2253 (1918). Norton Co. *See* VIII.

4291 (1918). Morris. Manufacture of acetate of lead and other acetates. (122,953.) Feb. 19.

7841 (1918). Dutt and Dutt. Manufacture of aluminium chloride and aluminium-sodium chloride. (123,243.) Feb. 26.

VIII.—GLASS; CERAMICS.

Applications.

Antoine. Compounds of glass. 3581. Feb. 13.

August. 3410. *See* X.

Hunter. Production of glass articles. 3564. Feb. 13.

Complete Specifications Accepted.

16,229 (1917). Mottram. Manufacture of refractory goods. (123,116.) Feb. 26.

2253 (1918). Norton Co. Composition containing alumina and zirconia. (113,958.) Feb. 26.

2440 (1918). Peeters. Glass furnaces. (123,146.) Feb. 26.

2773 (1918). Marlow. Ovens or kilns for use in the manufacture of tiles, pottery, etc. (122,927.) Feb. 19.

2851 (1918). Marks (Soc. Anon. Ital. Ansaldo and Co.). *See* II.

5081 (1918). Francart. *See* I.

9727 (1918). Keith and Keith. Glass-annealing lehrs. (123,254). Feb. 26.

IX.—BUILDING MATERIALS.

Applications.

Hoare. Production of building etc. material. 3470. Feb. 12.

Kernot. Adhesive or cementing compositions. 3897. Feb. 17.

Complete Specifications Accepted.

19,058 (1917). Evans and Andrews. Substitute for wood. (122,861.) Feb. 19.

18,379 (1918). Coates, Lupton, and Anderton. Cement. (123,037.) Feb. 19.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Aspinall, Denholm, and Schwartz. Separation of very finely divided ore from gangue. 4182. Feb. 20.

August. Furnaces for hardening or tempering steel tools or for heating or annealing metals, glass, pottery, etc. 3410. Feb. 12.

Barkes, Besford, and Day. Solder for aluminium etc. 3366. Feb. 11.

Bingham, and Huntington, Heberlein and Co. Rotary furnaces for roasting ores. 4474. Feb. 22.

Coles. Production of spring or tempered copper. 3857. Feb. 17.

Coles. Converting blue billy into high-grade iron. 3858. Feb. 17.

Dunlop Rubber Co., and Twiss. Pickling or cleansing iron and steel articles. 3787. Feb. 15.

Hutchins. Apparatus for manufacture of sodium. 3595 and 4126. Feb. 13 and 19.

Hutchins. Manufacture of sodium. 4125. Feb. 19.

Jensen. Preservation of metals and metallic articles. 4161. Feb. 19.

Mackay. Drying blast-furnace air. 3915. Feb. 17.

Mathy. Rocking crucible furnaces. 4182. Feb. 22.

Smith. 3483. *See* I.

Stock. Manufacture of grey iron. 4082. Feb. 19

Walker. Separation of metals. 3962. Feb. 18.

Complete Specifications Accepted.

E315 (1917). Turner. Manufacture of steel. (123,102.) Feb. 26.

4531 (1917). Turner and Blackwell. Manufacture of metal alloys. (123,103.) Feb. 26.

8782 (1917). Turner. Manufacture of rustless or stainless and like steel. (123,104.) Feb. 26.

8813 (1917) Turner Manufacture of ferro-chromium. (123,105.) Feb. 26.

15,858 (1917). Turner Manufacture of steel or ferro-alloys. (123,113.) Feb. 26.

369 (1918) Rand and Vautin. Aluminium alloy. (122,870.) Feb. 19.

12,781 (1918). Hulst. Treatment of lead bullion. (123,272.) Feb. 26.

14,621 (1918). Giton. Furnace for re-fusing and refining metal. (123,283.) Feb. 26.

16,518 (1918). Aubert. Regenerative tipping-furnaces. (120,559.) Feb. 26.

18,621 (1918). Davis and Twigg. Crucible furnaces (123,039.) Feb. 19.

XI.—ELECTRO-CHEMISTRY.

Applications.

Clarke, and London Battery Co. Electric batteries. 4386 and 4387. Feb. 21.

Coles. Manufacture of zinc cylinders for primary batteries. 3860. Feb. 17.

Etchells, Greaves, Travis, and Watson and Co. Electric furnaces. 4320. Feb. 21.

Gerber. Devices for carrying out chemical processes by electrolysis. 4268. Feb. 20.

Gros et Bouchardy. 4490. *See* VII.

Harris. Electrolytic cell. 4382. Feb. 21.

Hutchins. 3595, 4125, and 4126. *See* X.

Joseph. 3558. *See* VII.

Moore. Electric arc furnaces. 3555. Feb. 13.

Moore. Electric furnaces. 3693. Feb. 14.

Soc. des Combustibles Industriels. 4369. *See* VI.

Complete Specifications Accepted.

14,991 (1917). Joel. Electric accumulators. (123,110.) Feb. 26.

14,372 (1918). Kayser and Macdonald. Improving the conductivity at the joints of electrodes for electric furnaces. (123,017.) Feb. 19.

XII.—FATS; OILS; WAXES.

Applications.

Calvert. Treatment of oils, fats, etc. 4366. Feb. 21.

Fellowes and Hyatt. 4271. *See* XIII.

Complete Specifications Accepted.

19,323 (1917). Davidson. Machines for forming oil-cakes (122,864.) Feb. 19.

6760 (1918). Martin and others. *See* XIX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Fellowes and Hyatt. Treatment of vegetable gums, resins, oils, and turpentines. 4271. Feb. 20.

Knecht. Production of nitrogenous compounds from resin. 3659. Feb. 14.

Complete Specifications Accepted.

2377 (1918). Suzukawa. Paint for coating the bottoms of vessels. (113,612.) Feb. 19.

3394 (1918). Murray. Manufacture of water paint. (122,940.) Feb. 19.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Peachey. Process for accelerating vulcanisation of caoutchouc etc. 4330. Feb. 21.

Smith (Claessen). Utilising bark shavings from rubber trees and extracting rubber from such shavings. 4242. Feb. 20.

Complete Specification Accepted.

16,093 (1917). Gregory. Composition having the general properties of rubber. (123,114.) Feb. 26.

XV.—LEATHER; BONE; HORN; GLUE.

Application.

Neil and Smith. Leather solution. 3488. Feb. 13.

Complete Specification Accepted.

1975 (1917). Goldreich, and Stern and Co. Substitutes for leather etc. (123,101.) Feb. 26.

XVI.—SOILS; FERTILISERS.

Complete Specifications Accepted.

2130 (1918). Gaillard. Process for enriching phosphates. (122,897.) Feb. 19.

2167 (1918). England. Chemical product for use as a fertiliser. (122,902.) Feb. 19.

2924 (1918). Marks. (Soc. Anon. Ital. Ansaldo and Co.). *See* II.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Candy. Purification of water. 3955. Feb. 18.

Darrasse Frères, and Dupont. Utilising hydrocarbon matter in plants, vegetable offal, etc. 3509. Feb. 13. (Fr., 13.2.18.)

Linden. Reducing percentage of water in sewage sludge etc. 3245. Feb. 10.

Savy. Drying vegetables, fruit, etc. 4043. Feb. 18. (Fr., 8.3.18.)

Savy. Manufacture of chocolate. 4208. Feb. 20. (Fr., 16.9.18.)

Yeomans. Process of drying and preserving vegetables. 3383. Feb. 12.

Complete Specifications Accepted.

1943 (1918). Peyton and Ferguson. Food preparations. (122,882.) Feb. 19.

2039 (1918). Turnbull and Morris. *See* VII.

2316 (1918). Straus. Non-alcoholic beverage, and process of making same. (113,611.) Feb. 19.

4197 (1918). Talbot. Apparatus for purifying and softening water. (123,198.) Feb. 26.

6760 (1918). Martin, and Co-operative Wholesale Society. Preparation of cocoa-butter for cooking and like purposes. (123,231.) Feb. 26.

12,779 (1918). Peyton and Ferguson. Food preparations. (123,271.) Feb. 26.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Aciéries et Forges de Firminy. Catalytic treatment of acetylene for synthetic manufacture of acetaldehyde, paraldehyde, and acetic acid. 4017. Feb. 18. (Fr., 13.3.18.)

Aciéries et Forges de Firminy. Manufacture of acetic acid and ethyl acetate from acetaldehyde or the primary material. 4018. Feb. 18. (Fr., 13.3.18.)

Aciéries et Forges de Firminy. Manufacture of acetone and carbonic acid. 4019. Feb. 18. (Fr., 16.11.18.)

Applebaum. Manufacture of aldehydes. 4163. Feb. 19.

Crosfield and Sons, and Hilditch. Manufacture of acetaldehyde. 3541 and 3542. Feb. 13.

Darrasse Frères, and Dupont. 3508. *See* VII.

King and Wellcome. Isolation of a physiologically-active compound. 3305. Feb. 11.

Mouneyrat. Process of bonding arsenic to organic molecules. 4245. Feb. 20.

Radcliffe. Preparation of allyl alcohol. 3497. Feb. 13.

Selden Co., and Selden, 4275. *See* III.

Thomson. Preparation of detoxicated vaccine. 3695. Feb 14.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Applications.

Saunders and Wellesley. Production of photographic films in natural colours. 4053. Feb. 19.

Smith. Photographic plates and films. 4390. Feb. 21.

XXII.—EXPLOSIVES; MATCHES.

Complete Specification Accepted.

14,461 (1918). James. Matches. (123,018.) Feb. 19.

XXIII.—ANALYSIS.

Complete Specification Accepted.

2827 (1918). Roberts. Apparatus for automatically taking samples of liquids. (123,173.) Feb. 26.

I.—GENERAL; PLANT; MACHINERY.

Electrical precipitators. E. E. Thum. Chem. and Met. Eng., 1919, **20**, 59—64.

THE author reviews the practical details which require attention in equipping a Cottrell electrical precipitator, and the conditions which require investigation and adjustment, to obtain efficient operation. In large plants it is advantageous to divide the treater into sections, each equipped with a complete set of motors, transformers, rectifiers, voltage regulators, etc., so that it can be worked and controlled independently. If the treater sections are all supplied with energy from a commercial current supply, outside loads may detrimentally alter the wave form. The electrical properties of the precipitated material should be determined, as a thin film of non-conducting material may lower the resistance of the gap between clean discharging and collecting electrodes as much as 50%. In such cases the deposit should be made conductive by humidifying the gas, or by adding a conducting dust (*e.g.* carbon). The wave form of the rectified current is regulated by slight rotation of the rectifier brushes. The treater clearance is adjusted by throwing the brush holder to one limit of its travel, and moving it slowly to and fro until the best position is obtained. The electrical conditions in the treater are indicated by the appearance of the arcing, or by the reading of a milliammeter on the high tension line. It is of first importance that the alternating current and rectifier should synchronise. The negative current is distributed to wires, chains, or thin pipes, passing through the collecting tubes, stretched by springs or weights and accurately centered at both ends by lattice frames, supported on insulated beams. In treating fumes containing sulphuric acid, the insulators are rapidly attacked and punctured by the thin film of acid deposited on them, and their replacement is an important item in the maintenance charges. Mechanical rapping is employed to remove the precipitate from the treater. In order that the current may be interrupted whilst cleaning a unit without overloading the others, a spare treater unit should be provided. If this is not possible, the plates or tubes should be cleared at short intervals without interrupting the current or gas, cutting off the current only when rapping the charged electrodes at longer intervals. Means should be provided whereby if localised arcing occurs (this is indicated by a jumping ammeter needle and heavy flames at the rectifier) circuit breakers are opened, or a protective resistance is automatically introduced. The current of the gas or vapour through the treater is best maintained by suction fans placed beyond the treater. The rate of flow of the gas, length of pipe, and temperature of gas require careful regulation. Large temperature variations should be avoided on account of the consequent variation of the volume of the gas treated, and its velocity through the tube; a rise in temperature lowers the arcing voltage. Steel skeleton tubes, lined with "transite board" (an acid-proof asbestos board) are used for treating gases which deposit inflammable or explosive fume. Combustible material should be removed from the apparatus as rapidly as it is precipitated.—S. S. A.

System of drying. Petit. *See* XIXA.

Drying and concentrating. Marmier. *See* XIXA.

PATENTS.

Extraction of mineral, animal, and vegetable substances. W. Anderson, Helensburgh. Eng. Pat. 122,477, 24.1.18. (Appl. 1369/18.)

THE claim is for the combination of the centrifugal extractor described in Eng. Pat. 23,148 of 1910 (this J., 1911, 941) with a condenser, a gravity separator, and an evaporator.—W. H. C.

Concentrating, distilling and/or elevating liquids; Apparatus for ——. J. A. Reavell, Beckenham, and The Kestner Evaporator and Engineering Co., Ltd., London. Eng. Pat. 122,500, 31.1.18. (Appl. 1822/18.)

To prevent waterlogging in the apparatus described in Eng. Pat. 24,024 of 1899 (this J., 1900, 1092), pockets are formed in the outer tube or jacket of each element. Any liquid which may be condensed collects in these pockets and is discharged into a common outlet duct.—W. H. C.

Evaporator. G. H. Benjamin, New York. U.S. Pat. 1,288,480, 24.12.18 Appl., 29.12.17.

THE casing of an evaporator is provided with a number of removable doors on which internal heating coils with their connecting supply and exhaust pipes are mounted. A main steam inlet pipe is permanently connected to the upper part of the casing and an exhaust pipe to the lower part, and means are also carried by the doors to make the necessary connections between the connecting pipes of the coils and the main supply and exhaust pipes.—W. F. F.

Solutions; Method of concentrating ——. H. V. Welch, Assignor to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,289,984, 31.12.18. Appl., 10.5.17.

A SOLUTION containing a number of volatile constituents is heated to vaporise these constituents, and the mixed vapours are cooled in stages, so that each constituent is condensed in the form of a cloud which is then precipitated.—W. F. F.

Crystals from solutions; Obtaining of ——. T. W. S. Hutchins, Middlewich. Eng. Pat. 122,507, 6.2.18. (Appl. 2171/18.)

THE solution to be crystallised is filled into bucket-shaped vessels from a storage and automatic measuring apparatus. The buckets are then conveyed by an endless chain conveyor through a series of baths, being raised as they pass from bath to bath and lowered during their passage through the baths. In the first two baths the buckets dip into cooled brine and crystals are deposited. They then pass through a third bath where they are slightly heated to loosen the crystals and are next emptied by a tippler on to an inclined grid. The crystals are retained and removed and the mother liquor passes through into a trough below.
—W. H. C.

Manipulations out of contact with the air; Chambers for effecting —— or in any desired atmosphere. A. Mouneyrat, Paris. Eng. Pat. 122,515, 13.2.18. (Appl. 2594/18.)

A CHAMBER of rectangular section is provided with five openings. Long flexible rubber gloves are inserted into the chamber through four of these openings, the wrists of the gloves being turned back and secured to flanges round the openings.

The fifth opening is furnished with a long flexible rubber tube whereby any desired substance may be introduced into the chamber, being received therefrom into the hands of the operator enclosed in the gloves. Any desired gas is introduced into the chamber by means of a nest of perforated tubes. The presence of air in the chamber may be detected by means of a benzene or like lamp in conjunction with a sparking device; the sparks light the lamp if air is present.
—J. S. G. T.

Electrical separation of suspended particles from gaseous bodies; Apparatus for the ——. Huntington, Heberlein and Co., Ltd., and H. C. Bingham, London. Eng. Pat. 122,534, 5.3.18. (Appl. 3842/18.)

Gases containing suspended particles are passed through vertical pipes, which serve as the receiving electrodes, and are suspended in groups of four placed close together and equidistant from a common centre, the groups being spaced a suitable distance apart. Each pipe is built up from four flanged longitudinal segments, with distance or steadying pieces engaged between the segment flanges, and secured thereto by means of bolts through the flanges.—B. N.

Condensers and coolers for steam and other fluids. A. W. Brown, London. Eng. Pat. 122,563, 22.4.18. (Appl. 6747/18.)

The cooling fluid passes through a series of vertical Field tubes, transmission of heat from the outer to the inner tube of the Field tube being reduced by means of a heat insulator. The tubes are surrounded by the fluid to be cooled, this flowing through the annular space between each Field tube and a concentric pipe of slightly larger diameter. The whole is arranged within a shell provided with suitable inlets and outlets.—J. S. G. T.

Cooling and condensing tower; Combined atmospheric ——. E. Burhorn, Hoboken, N.J. U.S. Pat. 1,287,630, 17.12.18. Appl., 15.3.17.

The sides of the tower structure are open to the air, and cooling water supplied at the top descends over a series of spaced superposed platforms. The condensing pipes are arranged in tiers between the platforms, and are exposed to the air and to the cooling water.—W. F. F.

Acids and other liquids; Vessels for containing ——. W. Hayhurst, Accrington. Eng. Pat. 122,661, 26.10.17. (Appl. 15,608/17.)

The joints between the tiles with which the vessel is lined are sealed with a condensation product of an aldehyde with phenol or its homologues. When the jointing is complete the vessel is subjected to an increased temperature to harden the jointing material. The latter may be mixed with asbestos if desired.—W. H. C.

Hearth furnaces; Method of operating superposed ——. O. F. S. Carlson, Ljungaverk, Sweden. Eng. Pat. 122,712, 7.2.18. (Appl. 2247/18.)

In a superposed hearth furnace, in which the material is transferred from hearth to hearth by means of mechanically or manually operated implements, the implement operating on the lowest hearth of any group is first actuated and then subsequent implements upwards through the group. By this mode of operation the material remains on each shelf for a longer time than when, as is usual, the implements are actuated in the reverse order, and hence fewer hearths are required to attain the desired heating effect.—J. S. G. T.

Kilns, furnaces, ovens and the like. H. Francart, London. Eng. Pat. 122,742, 21.3.18. (Appl. 5027/18.)

A kiln for the heat treatment of metals, annealing, firing pottery, etc., consists of two parts, the combustion chamber and the treatment chamber. Fuel is burnt in the lower part of the combustion chamber which is provided with a regenerator of chequer brickwork. The top and bottom of the combustion chamber are respectively in open communication with the top and bottom of the treatment chamber. In operation, circulation of gases is thus maintained throughout the chambers, hot gases passing upwards in the combustion chamber and downwards in the treatment chamber. Such circulation, combined with the effect of the chimney draught, causes the gases to pursue a helicoidal path in the treatment chamber.
—J. S. G. T.

Drying-kiln. E. E. Perkins, Chicago, Ill. U.S. Pat. 1,290,778, 7.1.19. Appl., 19.3.17.

The outlet pipe for the exhaust air extends downwards through the roof into the drying chamber and is hinged so that its lower part may be swung into an inoperative position to reduce the effective length of the pipe.—W. H. C.

Kiln and similar structure. H. R. Straight, Adel, Iowa. U.S. Pat. 1,290,848, 7.1.19. Appl., 11.11.16.

A kiln or similar structure is provided with a composite wall consisting of an inner and an outer shell with a heat-insulating packing of loose resilient material between them, a reinforcement for the top of the inner shell, and a crown supported on the top of it.—A. B. S.

Heating or cooling liquid or semi-liquid materials on a revolving cylinder; Apparatus for —— J. W. Leitch, Huddersfield, and G. H. Warburton, Heckmondwike. Eng. Pat. 122,721, 14.2.18. (Appl. 2677/18.) Addition to 117,500, 17.11.17 (this J., 1918, 496 a).

In the apparatus described in the chief patent, a bucket wheel discharge is substituted for the worm conveyor, the casing in which the bucket wheel revolves being in communication with a chamber of considerable volume, evacuated by means of an air pump. In this manner a bucket, after discharge of material, is rendered "more or less vacuous" before again receiving material.
—J. S. G. T.

Filtering process and apparatus; Continuous pressure ——. J. A. McCaskell, Salt Lake City, Utah. U.S. Pat. 1,288,433, 17.12.18. Appl., 1.5.17.

The solid and liquid constituents of a mixture are separated by a rotating filter, the mixture being subjected to continuous pressure. The separated solids are continuously removed from the periphery of the filter by a scraper, and discharged in a semi-dry condition while maintaining the pressure in the filter chamber—W. F. F.

Filter. E. E. Chapin, Wyoming, N.J. U.S. Pat. 1,288,508, 24.12.18. Appl., 20.6.16.

Two filtering elements are combined, one having an external filtering surface, and surrounding the other which has an internal filtering surface. The space between the two elements communicates with an outlet for the filtrate.—W. F. F.

Filter; Self-cleaning ——. E. Gminder, Reutlingen. Ger. Pat. 305,843, 15.4.17.

A FILTER-DRUM rotating within a chamber containing the material to be filtered communicates with an outlet chamber by a pipe leading from its interior. Adjacent to the bottom of the outer surface of the drum is a trough communicating with a separate outlet. In consequence of the greater head of liquid in the main chamber as compared with that in the outlet chamber, solid matter is dislodged from the outer surface of the drum and falls into the trough.

Filter with a surrounding annular filtering bed. L. Honigmann, Aachen. Ger. Pat. 308,727, 12.6.17.

FILTRATION is effected under reduced pressure in a cylindrical vessel with double concentric walls, between which is a bell dipping into liquid in the annular space. The outer portion of the top of the bell is perforated and serves as support for the filtering medium. The bell is rotated and the material to be filtered is delivered on to it from a hopper, the filter cake being removed by a scraper. The air is exhausted through a tube opening into a central chamber formed by a cylindrical partition rising from the bottom to above the level of the liquid in the vessel.—C. A. M.

Steam-boiler economiser plant. D. S. Jacobus, Jersey City, Assignor to The Babcock and Wilcox Co., Bayonne, N.J. U.S. Pat. 1,289,182, 31.12.18. Appl., 8.12.14.

THE burnt gases from a boiler furnace pass downwards through a vertical flue and then through a horizontal flue. The vertical flue contains a part of the economiser comprising a series of tubes inclined upwards in the direction of the flow of water and connected to horizontal headers, and the horizontal flue contains several sets of vertical tubes. The first mentioned part of the economiser is maintained at high pressure and the second at low pressure, and the flow of water is in counter-current to the flow of hot gases. Means are provided for the escape of air or gas from the heated water between the low- and high-pressure sections. In a combination of a number of boilers, each boiler has its own high-pressure section of the economiser and the low-pressure section is common to all the boilers. Means may be provided to direct the hot gases either through or around the low-pressure section.—W. F. F.

Heat-exchanging apparatus. H. Zimmermann, Assignor to Schutte and Koerting Co., Philadelphia, Pa. U.S. Pat. 1,289,350, 31.12.18. Appl., 21.9.16.

A NUMBER of heat-interchanging tubes are mounted with their opposite ends in tube-plates, and the structure is inserted bodily into a casing so as to leave spaces between the tube-plates and the end walls of the casing. These spaces are divided transversely by partitions so as to compel the fluid to take a zigzag course through the tubes, and baffles are provided for the fluid in the space surrounding the tubes. These baffles are supported by a pair of supports which engage the inner walls of the casing when the tube structure is inserted.
—W. F. F.

Air-purifier. R. P. Fairbanks, Pocatello, Idaho. • U.S. Pat. 1,289,421, 31.12.18. Appl., 31.10.17.

A CASING is divided by a vertical partition into two unequal compartments, and a horizontal rotating shaft passing through both compartments carries a drum in the larger compartment having a foraminous cylindrical surface and solid end walls, one of which is journaled against the partition. This end wall and the partition are each provided with an aperture communicating with the smaller compartment, and both compartments contain water to above the level of the lower part of the drum. Air to be purified enters the larger compartment above the drum, passes through the wetted foraminous wall into the drum, and thence through the partition to the other compartment, from which it is discharged.—W. F. F.

Tube-mill. A. P. Hachtmann, Allentown, Pa., Assignor to Lehigh Pulverizer Mill Co., Catasauqua, Pa. U.S. Pat. 1,290,178, 7.1.19. Appl., 15.3.16.

A TUBE-MILL is constructed with a number of independent longitudinal grinding compartments spaced away from the axis. Each compartment is provided with a number of abrupt corners to promote grinding action and communicates with the outer portions of the inlet and outlet compartments common to all the grinding compartments.
—W. H. C.

Drying apparatus for liquids. M. Oschatz, Dresden. Ger. Pat. 305,411, 13.10.14.

THE apparatus is of the type in which a heated cylinder rotates while partly immersed in the liquid to be dried, which is contained in a trough. The liquid overflows at one long side of the trough in order to maintain a constant level and is fed to the trough at the opposite side, the flow of liquid from one side to the other of the trough being in the same direction as that in which the cylinder rotates. By this arrangement there is less tendency for partly dried material to be dislodged from the cylinder as it emerges from the liquid and the output of the apparatus is increased.

Heat accumulator. Dr. Praetorius und Co., Breslau. Ger. Pat. 308,171, 4.12.17.

IRON oxide is mixed with clay or fireclay, with the addition of organic substances, soaked with combustible matter, and briquetted. When placed in a hot furnace, the briquette takes fire, and the oxide is reduced partly to iron, and partly to the lower oxides by the action of the products of combustion, and owing to the removal of the combustible matter, the briquette finally possesses considerable porosity. Oxidation of the reduced iron by the oxygen of the air, with evolution of heat, immediately follows the reduction process, and a considerable saving of fuel is claimed for the process.—J. S. G. T.

Separating substances in suspension by washing; Method of ——. B. Schwerin, Frankfort, Germany. Reissue 14,583, 7.1.19, of U.S. Pat. 1,029,579, 11.6.12. Appl., 11.2.13.

SEE Fr. Pat. 429,310 of 1911; this J., 1911, 1299.

Recovering solvents. Eng. Pat. 122,685. *See* V.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal. A. Pictet. Ann. Chim., 1918 [ix], **10**, 249—330.

A MORE detailed account of work already published (see this J., 1913, 1098; 1914, 70; 1915, 163, 604; 1916, 1145; 1917, 958).—W. G.

Acetylene; Product of the action of the silent electric discharge on ——. H. P. Kaufmann. Annalen, 1918, 417, 34—59.

If the reaction vessel is kept cool the product of the action of the silent discharge on acetylene is a brown viscous liquid $(C_2H_2)_n$, but when it is allowed to get warm a solid and a liquid are obtained. The liquid is very unstable and readily changes into the solid. Both readily absorb oxygen and on oxidation with alkaline permanganate yield benzoic, isophthalic, and terephthalic acids. Since it forms an explosive silver derivative the liquid product appears to contain a CH group. (See also J. Chem. Soc., Apr. 1919).—C. S.

Calorimeter efficiency. White. *See* XXIII.

PATENTS.

Coal washing and apparatus therefor. W. Russell, London. Eng. Pat. 122,454, 21.1.18. (Appl. 1170/18.)

FINE coal containing waste material, or the water from coal washeries, is agitated with water containing 1—5 lb. of a frothing agent per ton of dry material. The frothing agent may be crude coal tar oil, crude creosote, eucalyptus oil, or oleic acid. The coal is separated from the waste material and pyrites by flotation, for instance as described in Eng. Pats. 7803 of 1905, 2359 of 1909, and 21,857 of 1910 (this J., 1906, 184; 1910, 496; 1911, 1263) and the froth containing the coal is removed by a Dorr classifier as described in Eng. Pat. 28,500 of 1910 (this J., 1911, 544). The finer portions of the waste material are treated in a Dorr thickener as described in Eng. Pats. 29,383 of 1910, 13,606 of 1914, and 110,188 (this J., 1915, 947, and 1917, 1228), and the water which is thus separated, containing a small proportion of oil, is used over again.

—W. F. F.

Coal and the like; Apparatus and method for cleaning ——. H. R. Conklin, Joplin, Mo. U.S. Pats. 1,290,515 and 1,290,516, 7.1.19. Appl., 27.12.17 and 5.8.18.

A SEPARATING tank for coal is provided with an inclined plate at each end above the liquid level, the plates converging downwards with a space between them. An endless conveyor passes over the upper surfaces of the two plates and along the liquid surface between them and over the inclined bottom of the tank. The coal is delivered on to one of the plates and the conveyor, and on reaching the space between the plates the impurities sink through the conveyor and liquid on to the submerged portion of the conveyor, and the coal floats and is transferred on to the other inclined plate and thence to the discharge. The separating liquid consists of a mixture of water and the "fines" which are separated by a flotation classifier from ground argillaceous material. The material is ground to a fineness which allows its suspension in water without agitation, and the pulp is free from colloidal ingredients. The refuse is discharged by the submerged portion of the conveyor from the other end of the tank. The coal and refuse are washed free from the separating medium by water decanted from the vessel containing the separated fines, and the washing water is returned to the flotation classifier. The liquid level in the tank is maintained by a device which permits overflow from below the liquid surface.—W. F. F.

Peat; Method and means for removing water from ——. A. ten Bosch and N. J. Zoon, The Hague. U.S. Pat. 1,290,494, 7.1.19. Appl., 23.4.18.

PEAT pulp is fed to the top of a vertical tower of such a height that the pressure due to the column is sufficient to force the pulp out at the bottom through a constricted discharge opening. Steam under pressure is forced into the column through a pipe passing through the side of the tower, and water expressed from the peat passes through a perforated portion of the wall, at a lower level, into an annular discharge chamber.—W. F. F.

Coke-oven. R. S. Moss, Chicago, and A. Roberts, Evanston, Ill. U.S. Pat. 1,289,870, 31.12.18. Appl., 7.1.14. Renewed 23.3.18.

A COKE-OVEN is heated by hot gases passing through vertical flues in the walls, while the air supply is preheated by passing it through other flues alternating with the gas flues. The oven is mounted on a structure having a central longitudinal spent-gas tunnel into which the lower ends of the gas flues discharge. The air supply is admitted to one arm of a horizontal U-shaped passage, the arms of which extend along either side of the spent-gas tunnel, and the hot air passes from the other arm of the passage into the lower ends of the vertical air flues in the retort walls.—W. F. F.

Furnace gases; Device for causing combustion of ——. G. P. Brown, Lake Bluff, Ill., Assignor to Combustion Improvement Co., Chicago, Ill. U.S. Pat. 1,287,864, 17.12.18. Appl., 7.2.17.

A HOLLOW circular member is arranged in the combustion chamber at some distance from the fuel zone, and is provided with openings in its periphery through which air is injected into the combustion chamber for the combustion of the unburnt gases. Hollow radial ribs are formed on the hollow member, having small openings for the discharge of air, so as to maintain combustion of the gases close to the hollow member. The latter is thereby heated so as to preheat the air which passes through it.—W. F. F.

Furnaces; Gas burner for ——. H. C. Smart, Brooklyn, N.Y., Assignor to Standard Oil Co. of New York, New York. U.S. Pat. 1,288,450, 17.12.18. Appl., 11.4.18.

AN air-supply pipe embedded longitudinally in the wall of a still setting is provided with short transverse burner tubes extending to the inner surface of the wall. An inner concentric gas-supply pipe is provided with transverse jets extending into but shorter than the burner tubes. Adjustable supports are provided within the air-supply pipe and between its ends, to maintain the gas-supply pipe in its concentric position.—W. F. F.

Gas manufacture; Method of ——, W. D. Wilcox, Chicago, Ill. U.S. Pat. 1,289,336, 31.12.18. Appl., 23.7.15.

COAL containing excess of moisture is continuously distilled in a series of vertical retorts heated externally. The gaseous products of low temperature distillation in the upper part of the retort are withdrawn through an outlet in that part, and the products of high temperature distillation are similarly withdrawn at the bottom. The solid residue from each retort passes into a generator below, through which air and the gaseous products of low temperature distillation are passed alternately. The gas produced whilst air is passing through the generator is burnt in a common heating chamber which supplies the heating flues of the retorts. The gas produced by the passage of the gaseous products of low temperature distillation through the generators and the lower part of each retort is withdrawn and stored.—W. F. F.

[Petroleum] spirit; Device for separating or trapping water contained in —— immiscible with it, or in clean or refined oil. W. G. Tench, Southampton. Eng. Pat. 122,794, 13.8.18. (Appl. 13,116/18.)

A CYLINDRICAL vessel contains two very fine wire gauze strainers. The upper strainer is of hollow double conical form with a mid-peripheral ring which is attached to the wall of the separating vessel. The lower strainer forms an inverted cone, the top of which is closed by a sheet of gauze while the apex end is open and communicates through a valve with a spherical glass "trap" vessel beneath. The mixed spirit and water is fed into the lower strainer, when the water sinks and runs into the glass trap, while the spirit passes through the gauze into the upper part of the vessel, then through the upper strainer to an exit pipe. A cock at the bottom of the trap allows of water being run off as fast as it enters so that a constant level of water is maintained in the trap. An external pipe connects the upper part of the trap with the part of the vessel intermediate between the two strainers, and serves for the recovery of any spirit which has passed into the trap.—T. St.

[Petroleum] oil; Process of and apparatus for treating ——. F. M. Seibert and J. D. Brady, Houston, Tex., Assignors to Gulf Production Co., Beaumont, Tex. U.S. Pat. 1,290,369, 7.1.19. Appl., 11.1.18.

PETROLEUM emulsions are passed between a pair of concentric tubular electrodes which are connected to a source of direct current giving a potential difference of 250 to 600 volts. The inner electrode is shorter than the outer and the two are spaced sufficiently far apart to prevent the passage of any substantial current. Oil is removed at the top of the inner electrode and water at the base of the outer.—T. St.

Hydrocarbons; Continuous treatment of —— with liquid sulphur dioxide. Allgem. Ges. für Chem. Ind. m.b.H., Berlin. Ger. Pat. 297,131, 28.4.15.

THE hydrocarbon to be purified (petroleum, paraffin, etc.) is passed upwards and the liquid sulphur dioxide downwards through the treatment chamber. The liquid sulphur dioxide is preferably introduced drop by drop and its flow through the treatment chamber and also that of the hydrocarbon are regulated by pumps so that adequate opportunity is afforded for the sulphur dioxide to dissolve hydrocarbons soluble therein.

Distillation of petroleum, tar, etc.; Vertical preheaters for use in the ——. L. Steinschneider, Brünn-Königsfeld. Ger. Pat. 308,768, 14.10.17.

A VERTICAL vessel for preheating petroleum, tar, etc., before distillation is fitted with a heating system below the level of the liquid therein, but above the level of the layer containing water. Below the heating system, through which the hot vapours from the still are passed, is a partition provided with a flap which can be closed, or opened to any desired extent, so that the liquid surrounding the heating system may be separated either wholly or partly from the remainder of the liquid in the preheater. Below the partition is a second heating system through which the hot still residues are passed.—L. A. C.

Briquettes and method of making the same. C. H. Smith, Short Hills, N.J., U.S.A. Eng. Pat. 120,585, 29.8.17. (Appl. 17,093/18.) Int. Conv., 15.11.16.

SEE U.S. Pat. 1,276,429 of 1918; this J., 1918, 646 A.

Producer-gas tar. Ger. Pat. 305,861. *See* III.

Hydrogen. Eng. Pat. 122,474. *See* VII.

Removing carbon monoxide. Eng. Pat. 122,781. *See* VII.

Calorimeters. U.S. Pat. 1,289,918. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Welsbach mantle; A physical study of the ——. H. E. Ives, E. F. Kingsbury, and E. Karrer. J. Franklin Inst., 1918, **186**, 401—438, 585—625.

THE authors have investigated the spectral distribution of the luminous radiation from incandescent mantles containing mixtures of thoria with the oxides of the following metals:—cerium, uranium, manganese, nickel, lanthanum, praseodymium, neodymium, erbium. A detailed study is made of the conditions determining the behaviour of the absorption bands to which the enhanced visible radiation of the more efficient mantles is due. The characteristic features of the luminous radiation found in the case of the thoria-ceria mixtures are also exhibited by the various other mixtures, but in very different degrees. In all cases there is a mixture yielding a maximum luminous radiation. The value of this maximum is greatest with the mixture containing 0·75% of ceria, the radiant efficiency in this case being three times that of a black body at the same temperature. Mixtures of thoria with the oxides of uranium and neodymium likewise exhibit a radiant efficiency in the Bunsen flame notably exceeding that of a black body. The high efficiency of both the cerium and uranium oxides is due to a strong absorption band in the blue end of their spectra, this absorption band in the case of ceria being present only when the oxide is hot. The radiant luminous efficiency of a black body at 2100° abs. (1827° C.) is 0·5%. The radiant efficiency of a thoria-ceria mantle was increased threefold by raising the mantle temperature from 1900° to 2100°, the flame being fed with oxygen. The melting point of thoria is 2440° C. and of ceria 1950° C. Practical and theoretical considerations show that if ceria in the thoria-ceria mixture were replaced by a suitable colorant then a threefold increase of radiant luminous efficiency should be attainable with the flame temperature at present available. Such a colorant would differ from ceria in two respects; it would add nothing to the radiation in the long wave region near 2μ, and the absorption band responsible for the visible emission would be sharply defined on the red side. Convection losses largely neutralise any increase of radiant efficiency that may be theoretically possible with higher flame temperature, in the case when the flame is supplied with air, the energy loss due to convection being about 75% at 1900° abs. (1627° C.). The maximum possible efficiency attainable by heating a mantle in the customary manner is 2·6%. The efficiency at present realised with incandescence mantles is 0·19%, and in the case of the nitrogen-filled tungsten lamp the percentage efficiency is 3·2. The efficiencies referred to the coal used as the original source of energy, in the case of lighting by incandescent mantles and by the nitrogen-filled lamp are not greatly different. When subjected to cathode discharge, a thoria-ceria mixture shows no superiority of radiant efficiency over pure ceria. This phenomenon is ascribed to the reducing action of the discharge, the result being that no

colour is imparted to the mantle by ceria under these conditions. The far greater radiant efficiency of thoria in the discharge compared with ceria is ascribed to the large reduction of the convection losses in the vacuum tube.—J. S. G. T.

Oil of turpentine and rosin. Besemfelder. *See* XIII.

PATENTS.

Charcoal; Manufacture of vegetable ——. G. Penrose, London, and J. D. Penrose, Watford. Eng. Pat. 122,465, 22.1.18. (Appl. 1276/18.)

PINE and like needles are mixed with 1—5% of lime or soda-lime or a larger equivalent of calcium carbonate. The mixture is carbonised with a limited amount of air at a temperature of 1000°—1200° C. The charcoal is freed from lime by washing with water containing 1—5% of hydrochloric acid, and is finally washed with water, with or without 1% of alkali.—W. F. F.

Carbon from peat; Means and method of obtaining —— for decolorising purposes. J. W. Leadbeater, Doncaster. Eng. Pat. 122,698. (Appls. 1779, 31.1.18, and 7415, 3.5.18.)

PEAT is dried, ground, and mixed with ground quicklime. The dry mixture is placed in trays arranged in one or more rows, or in tiers of one or more rows, in a horizontal retort, with spaces between them, so that the hot gases may circulate round them. The retort is provided with a removable door at each end. The trays may be wholly or partly open at the top, and may be provided with hinged covers or slides for regulating the openings. They are also provided with suitable projections, or mounted on rollers, to permit the hot gases to pass round them. The resulting charcoal in granular form is washed with water, treated with hydrochloric or other acid to remove impurities, and then returned to the trays to be heated and dried.—W. F. F.

Carbon; Process of manufacturing decolorising —— [from kelp]. F. W. Zerban, New Orleans, La., Assignor to the Government and people of the United States. U.S. Pat. 1,290,002, 31.12.18. Appl., 30.8.18. (Dedicated to the public.)

KELP is dried and carbonised, and the carbon then heated to a high temperature and cooled. The potash is removed from the material by washing with water, and the residue is treated with an acid and finally washed with water.—W. F. F.

Coal and other bituminous substances; Apparatus for the low temperature distillation of ——. H. K. Hiller, London. Eng. Pat. 122,496, 30.1.18. (Appl. 1746/18.)

COAL, cannel, lignite, shale, colliery waste, bastard cannel, or other bituminous substance is distilled at a low temperature in a shallow, horizontal, rectangular retort heated externally by hot gases passing through longitudinal passages below the floor. The distillation gases pass through inclined louvres in the roof of the retort into a discharge flue above, extending the whole length of the retort and parallel to it. The louvres occupy about one-third of the area of the retort roof, and are inclined at 30° to the horizontal. Dust and air are excluded from the louvres during charging by placing a steel plate of the same width as the retort and longer than the stroke of the charging ram over the coal of the previous charge. The burner flues are wholly or partly filled with carborundum to prevent explosion and ensure surface combustion of the combustible gases, which are admitted below the discharge end of the retort. The coal is charged into the other cooler end of the retort, and the distillation gases are swept out of the discharge flues above the retort by high-pressure gas admitted above the discharge end of the retort. —W. F. F.

Coal and like carbonaceous materials; Destructive distillation of ——. J. West, Southport, and S. Glover, St. Helens. Eng. Pat. 122,700, 31.1.18. (Appl. 1815/18.)

CANNEL coal and like bituminous materials are continuously distilled in vertical retorts arranged as described in Eng. Pats. 2663 of 1907 and 7757 of 1914 (this J., 1915, 482) and heated by surrounding superposed combustion chambers. The upper portion is heated to about 700° C., and the lower portion to about 1400° C., and superheated steam is passed into the lower portion of the retort. The steam may be superheated by hot waste gas as described in Eng. Pat. 120,458 (this J., 1919, 4 A). A high yield of blue water-gas is produced in the high-temperature zone and passes through the low-temperature zone, serving as a carrier for, and mixing with, the distillation products.—W. F. F.

Photometer. U.S. Pat. 1,288,067. *See* XXIII.

III.—TAR AND TAR PRODUCTS.

Action of silent electric discharge on acetylene. Kaufmann. *See* IIA.

PATENTS.

Producer-gas tar or its crude distillates; Purification of ——. Allgem. Ges. für Chem. Ind. m.b.H., Berlin. Ger. Pat. 305,861, 21.12.16.

PRODUCER-GAS tar or low-temperature tar contains considerable quantities of oxygen compounds. These may be removed, together with unsaturated hydrocarbons, by treatment with liquid sulphur dioxide (see Ger. Pats. 216,459 and 297,131; this J., 1910, 111, and page 167 A), in which they are almost completely soluble.

Pyridine; Dehydration of ——. C. R. Downs, Cliffside, N.J., Assignor to The Barrett Co. U.S. Pat. 1,290,124, 7.1.19. Appl., 24.4.18.

PYRIDINE bases are dehydrated by adding benzol and distilling the mixture.—L. A. C.

Treating hydrocarbons with liquid sulphur dioxide. Ger. Pat. 297,131. *See* IIA.

Distillation of tar etc. Ger. Pat. 308,768. *See* IIA.

IV.—COLOURING MATTERS AND DYES.

Aminoflavones, flavone-azo-β-naphthol dyes, and other flavone derivatives; Synthesis of ——. M. T. Bogert and J. K. Marcus. J. Amer. Chem. Soc., 1919, 41, 83—107.

FLAVONE (benz-2-phenyl-γ-pyrone) is of interest as the parent substance of several yellow vegetable colouring matters, notably those of quercitron bark and old fustic. The authors prepared it by a modification of Ruhemann's method (Chem. Soc. Trans., 1903, 83, 1154), by treating β-phenoxycinnamoyl chloride with anhydrous aluminium chloride. Flavone was nitrated in glacial acetic acid solution in

the presence of sulphuric acid by slowly adding nitric acid, sp. gr. 1·5, dissolved in glacial acetic acid, the whole being kept cold. The mononitroflavone obtained was separated into mixtures of the 3′- and 4′- and the 2′- and 3′-isomerides. From these, by reduction with stannous chloride, the corresponding aminoflavones were prepared and subsequently isolated by taking advantage of their differing basicities and solubilities. The aminoflavones were diazotised, and in this way 2′-, 3′-, and 4′-hydroxyflavones were prepared. The diazonium salts of the aminoflavones, when coupled with β-naphthol, gave rise to orange to red azo dyestuffs, which could be developed on silk and wool impregnated with β-naphthol with satisfactory results; on cotton the dyeings always developed unevenly. On silk and wool the 2′- and 3′- compounds gave bright or dull shades of orange, the 4′-isomeride giving red shades; in all cases the shades were brighter on silk than on wool. The dyeings were very fast to light and alkalis but were dulled by dilute acetic acid.—J. F. B.

Dyes; The genus Coprosma as a source of ——. B. C. Aston. N.Z. J. Sci. Tech., 1918, **1**, 264–267, 346–351.

The author has examined the dyeing-capacity of the bark of a number of species of *Coprosma*, notably *C. grandifolia*, *C. lucida*, *C. Baueri*, *C. robusta*, *C. areolata*, and *C. fœtidissima*. The mode of extraction of the dye varies considerably with the different varieties. *C. grandifolia* and *C. areolata* fall into a class apart, giving fast purplish or maroon shades on chrome mordants with wool and orange-scarlet (tangarene) to dark red shades with stannous mordants and tartar in the single-bath method. *C. Baueri* and *C. robusta* gave negative results in the dyeing tests. *C. lucida* gives good reddish-brown colours, fast to light and soap, on chrome and alumina mordants. *C. fœtidissima* gives excellent brown and yellow colours, fast to soap on chrome and stannous mordants respectively, but the tints are not fast to light. The colour of the cortex and the colour reaction when treated with 10% sodium hydroxide solution of twenty species of *Coprosma* are recorded and attention is drawn to the very pronounced individuality which is displayed. The colours given by various species of *Coprosma* with various mordants (potassium bichromate; aluminium sulphate and potassium hydrogen tartrate; aluminium sulphate, potassium hydrogen tartrate and oxalic acid; stannous chloride and potassium hydrogen tartrate; iron pyrophosphate; ammonium molybdate and acid; sodium tungstate; uranium acetate) are tabulated together with their behaviour towards light and soap.—H. W.

Quinocyanins. Fischer. *See* XXI.

PATENT.

[*Colour*] *lakes.* Eng. Pat. 122,510. *See* XIII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Bast fibres; Retting of ——. P. Krais. Z. angew. Chem., 1919, **32**, 25–27.

Experiments, performed chiefly with nettle stems, showed that retting can be effected by steeping the stems in a 0·5–1·0% solution of sodium bicarbonate at 33°–38° C. for 3–5 days. Other bicarbonates, *e.g.*, those of potassium, magnesium, and ammonium are similarly effective, sodium carbonate and magnesium hydroxide are less so, and sodium, potassium, and calcium hydroxides are non-effective. The action is inhibited by poisons and is regarded as undoubtedly a biological retting. It may also be induced in a moderately hard water (9° hardness) by the addition of a little urine. The action does not take place at the ordinary temperature, but it is not essential that the favourable temperature of about 35° C. be constantly maintained; the liquid may be allowed to cool down and the retting will start again on re-warming. Similarly satisfactory results can be obtained with the stems of lupins, flax, and hemp, but these generally require a day longer than nettles. Previous breaking of the stems appears to favour a quicker retting, but it is considered much more advantageous to steep the stems whole, as the woody portions can then be withdrawn intact, whereas with broken stems particles of wood become entangled among the fibres. The process is eminently adapted for small cultivators. The air-dry stems are steeped in 20 times their weight of water containing 0·5% of sodium bicarbonate or other effective substitute, and maintained for about 3 days, continuously or intermittently, at about 35° C., until a sample, when treated with hot water, shows that the fibres are completely liberated from the wood. The mass is then scalded with water at 80° C., the woody stems are separated by agitation, and the fibrous mass is washed on a sieve. This mass may be freed from adherent gummy residues by boiling with dilute alkali, or more simply, by kneading to a paste with wet clay etc., drying, wetting again, and again kneading, washing and drying A light beating with a wooden mallet will soften the strands ready for spinning.—J. F. B.

Balloon fabrics; Determination of permeability of ——. J. D. Edwards. U.S. Bureau of Standards, Technol. Paper No. 113. India Rubber J., 1918, **56**, 753–757, 789–793, 821–825, 863–867.

Of the two possible methods for the determination of the permeability of balloon fabrics by hydrogen, *viz.*, by measurement of the volume loss and by direct estimation of the amount of hydrogen which penetrates the fabric under definite conditions, the former gives results which approximate to 70% of those obtained with the latter; this is due to the simultaneous permeability of the fabric to hydrogen and air. The latter method is preferred and the proportion of hydrogen which diffused across the film into the air on the other side was determined by means of an interferometer (see Adams, this J., 1915, 638; Edwards, J. Amer. Chem. Soc., 1917, **39**, 2382). It was found that various fabrics gave similar curves for the effect of temperature on the permeability and that for approximate comparisons the permeability at 15° C. may be taken as 65% of that at 25° C.; alteration in pressure has but little influence on the permeability, the effect, however, being rather more marked at pressures below 60 mm. of water than between 60 and 110 mm.; humidity of the gas also does not greatly affect the permeability. As a result of some hundreds of tests it is shown that the fabric attains its maximum permeability in less than one hour, and generally in less than 30 minutes, but the period necessary for the complete sweeping out of the air from the apparatus may be longer and should be determined by trial. If the same piece of fabric is kept under continuous test for several days a gradual decrease in the permeability is generally observed and a similar effect may be produced by gently heating the fabric, *e.g.*, to 70° C. Details of the method of carrying out the test are given.—D. F. T.

Paper tearing-resistance tester. H. N. Case. J. Ind. Eng. Chem., 1919, **11**, 49–51.

Twelve strips, 1 in. by 2½ in., are cut from the paper to be tested; these are then cut down the

centre from one end to within ¼ in. of the other end, and this end is cut off so that the slit stops ¼ in. from the end. One-half of the strips should have the long dimension parallel with the grain and the other half should be cut across the grain. One side of the cut-open end of a strip is then fastened in a clamp and the other side is bent over and a vessel is attached to it; water is allowed to flow steadily into the vessel until the uncut portion of the strip tears through; the weight of water required to effect this, expressed in grms., is termed the tearing-resistance value of the paper. Papers which appear to be of approximately equal strength when examined by the Mullen "pop-tester" and the Schopper tensile machine, often show a great difference in tearing quality.—W. P. S.

Specific inductive capacity of impregnated paper. Weber and McKay. *See* XI.

Cottonseed fibres. De Segundo. *See* XII.

Oil of turpentine and rosin. Besemfelder. *See* XIII.

[*Cotton*] *bolly refuse.* Dowell and Friedemann. *See* XIXA.

Selective coloration of lignified plant membranes. Bugnon. *See* XXIII.

PATENTS.

Leather, yarn, textile and other materials; Machines for drying and conditioning ——. A. N. Marr, Horsforth. Eng. Pat. 122,544, 18.3.18. (Appl. 472/18.)

THE machine comprises a single drying chamber closed at the end opposite the feeding end. Above and below the drying chamber, air conduits extend along the whole length of the machine and are in communication with the drying chamber by means of openings provided in the top and the floor of the chamber. At the closed end of the machine a closed compartment is situated containing a fan which draws air from the end of one of the conduits and delivers it into the end of the other. Radiators are arranged in the fan compartment for warming the air drawn in before it is discharged into the other conduit. The air may be circulated through the drying chamber in either an upward or a downward direction. Pipes or coils supplied with steam or freezing liquid for heating or cooling the air may be arranged in one or both of the conduits. The material to be dried or conditioned is carried through the chamber on poles engaged by two or more endless chains travelling on a number of longitudinal races.—J. F. B.

Recovery of solvents and volatile liquids —— and apparatus therefor. J. Lloyd, Stockport, and J. H. Wild, Salford. Eng. Pat. 122,685, 26.1.18. (Appl. 1500/18.)

IN an apparatus for the recovery of the volatile solvents from solutions used in rubber spreading, proofing, cleaning, etc., of fabrics, the proofed fabric travels over a steam-heated table, over which a closely fitting hood is erected. Dried air is circulated over the fabric and together with the vaporised solvent is drawn by means of a fan into a duct arranged across the hood near the centre of the table. The air and vapour pass thence into a condenser where the solvent is recovered; the air passes on, and is heated by steam and purified before again circulating over the fabric. A by-pass is arranged so that when necessary a portion only of the air is reheated and returned to the fabric, the remainder of the air being employed for cooling and condensing. By means of side covers the width of air space may be varied to suit different widths of fabrics.—J. S. G. T.

Fibrous material; Impregnated and coated sheet of —— and process of producing the same. J. J. Byers, Brookline, Mass., Assignor to Products Syndicate, Inc., Boston, Mass. U.S. Pat. 1,290,073, 7.1.19. Appl., 18.4.17.

FIBROUS material, substantially free from moisture, is immersed in a bath containing a cellulose derivative, a non-oxidising oil, and a suitable solvent, the bath being heated and the material immersed for a sufficient time to cause the "cement" containing the oil to impregnate it throughout its mass. The impregnated material is subjected to pressure and heat before the "cement" has completely set. One or more surface films or coatings are applied in succession, these also being composed of a cellulose derivative in a suitable solvent. After the application of a finishing coat, the material is subjected to heat and pressure to impart the desired lustre.—J. F. B.

Yarn or thread; Sized ——. E. W. Snyder, Los Angeles, Cal., Assignor to Ocotillo Products Co. U.S. Pat. 1,290,795, 7.1.19. Appl., 9.8.17.

YARN or thread is treated with a sizing composition containing ocotillo gum.—J. F. B.

Cellulose; Method for producing zinc chloride solution of ——. W. Ogawa, S. Okubo, and I. Murata, Tokyo. Eng. Pat. 122,527, 21.2.18. (Appl. 3139/18.)

SOLID zinc chloride is added to a solution of zinc chloride which is saturated below 40° C. and the mixture is heated so that the solid salt dissolves completely above 40° C. The solution is heated further to nearly 100° C. and cellulose is then added, for example, 5% of the weight of the solution. The cellulose is rapidly dissolved, solution being complete within about half-an-hour; hot water may then be added if desired.—J. F. B.

Paper making [*drying*]. J. O. Ross, Assignor to B. F. Sturtevant Co., Boston, Mass. U.S. Pat. 1,290,360, 7.1.19. Appl., 11.12.13.

A SOFT, wet web of paper formed on the paper machine is supported during its passage over heated drying rolls and, as soon as the paper is sufficiently dry to support its own weight, it is removed from the rolls and the drying is completed by means of air blown against the surface of the paper, *e.g.* while carried in festoons.—J. F. B.

Adhesives or binders [*from sulphite-cellulose waste liquor*]; *Manufacture of* ——. W. H. Dickerson, Muskegon, Mich. U.S. Pat. 1,290,118, 7.1.19. Appl., 10.1.13.

WASTE sulphite liquor is treated with a neutralising agent insoluble in water, for instance, calcium carbonate, insufficient in quantity to neutralise the whole of the acid, the neutralising agent being added during or before the concentration of the liquor under vacuum.—J. F. B.

Pyroxylin compositions; Solvents used in connection with —— and pyroxylin compositions containing the same. E. C. R. Marks, London. From E. I. Du Pont de Nemours and Co., Wilmington, Del., U.S.A. Eng. Pat. 122,456, 21.1.18. (Appl. 1181/18.)

SEE U.S. Pat. 1,266,073 of 1918; this J., 1918, 401A.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Laundry goods [textiles]; Oxygen tendering of ——. B. Haas. Chem.-Zeit., 1919, **43**, 49—51.

Previous investigations on the injurious action of laundry preparations containing peroxidised compounds (this J., 1918, 238 A, 576 A) have all been carried out on strips of fabric rendered uniformly dirty by artificial means. If the tests could have been organised under more natural conditions with unevenly dirty and worn garments, the results would have shown far more strikingly the unfavourable action of the oxidising reagents. The tendering action takes place unevenly because, in order to obtain the complete bleaching of certain dirty spots, it is necessary to over-treat the cleaner parts of the fabric. Exposure to artificial actinic light or to natural sunlight, particularly on the grass, induces an initial decomposition of the dirt, whereby the later application of peroxide detergents is enabled to complete the bleaching more easily, in more dilute solution, and with considerably less damage to the fabric. On the other hand the storage of the dirty goods for a considerable time in tightly enclosed bundles fixes the dirt more permanently and increases the difficulty and danger in removing it by peroxidised reagents. Moreover the nature of the dirt is such that acidity is either present or developed during steeping, so that rapid generation of active oxygen may be induced or metallic stains possibly with catalytic properties may appear. For this reason a preparatory alkaline treatment should not be omitted; in default of soda, mixtures of lime and ammonium salts may be used with advantage. The proper employment of an alkaline detergent may, in fact, render the subsequent application of oxygenated laundry agents, in highly dilute form, comparatively harmless.

—J. F. B.

Dyes from Coprosma species. Aston. *See* IV.

Patents.

Kier-bleaching. G. B. Flood, North Adams, Mass. U.S. Pat. 1,290,156, 7.1.19. Appl., 17.5.18.

A bleaching kier is provided with two separate ducts below the grating, each having a check valve opening outwards and leading to a separate closed receptacle for the liquor, from the bottom of which a return pipe rises and discharges directly into the top of the kier. The two receptacles are also connected with a steam supply, the valves controlling the admission of steam to the receptacles being connected with mechanism whereby they are opened and closed alternately, so that the contents of one receptacle is being forced by steam pressure into the top of the kier, while the steam valve of the other is closed and liquor is draining into the receptacle from the bottom of the kier. These alternate operations take place in continuous succession, so that the circulation of the liquor is effected at a quantitative rate approximately commensurate with that of its drainage.—J. F. B.

Dyeing machine. H. M. Dudley, Philadelphia, Pa., U.S.A. Eng. Pat. 113,440, 5.2.18. (Appl. 2053/18.) Int. Conv., 15.2.17.

See U.S. Pat. 1,261,498 of 1918; this J., 1918, 412A.

Dyeing machine. H. M. Dudley, Philadelphia, Pa., U.S.A. Eng. Pats. 114,421 and 114,621, 23.2.18. (Appls. 3234 and 3233/18.) Int. Conv., 29.3 and 31.3.17.

See U.S. Pats. 1,259,839 and 1,259,840 of 1918; this J., 1918, 297 A.

Dyeing yarns, threads, or similar materials; Machines for winding and ——. W. A. Ainsworth and C. N. Mather, Grand Rapids, Mich., U.S.A. Eng. Pat. 122,786, 12.7.18. (Appl. 11,427/18.)

See U.S. Pat. 1,274,972 of 1918; this J., 1918, 621 A.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sulphuric acid; Application of electric heating to the concentration of ——. S. Pagliani. Annali Chim. Appl., 1918, **10**, 134—137.

For the concentration of 100 kilos. of sulphuric acid from 50°–52° B. (sp. gr. 1·53—1·563) to 65·6° B. (sp. gr. 1·832) in platinum stills a minimum consumption of 18 kilos. of anthracite is required, the average amount being 20 kilos. For apparatus of the Kessler type the consumption is only 10 kilos., whilst modern platinum apparatus of the Desmoutis type requires 12 to 15 kilos. of fuel. Experiments in which the acid was concentrated in vessels containing platinum electrodes showed that on the average 43 kilowatt-hours was required to obtain 100 kilos. of acid at 65·6° B. (sp. gr. 1·832) from acid of 52° B. (sp. gr. 1·563). Taking 7500 cals. as the mean calorific power of anthracite the thermal efficiency, *i.e.*, the ratio of the heat theoretically necessary for concentration of the acid to that actually consumed is 0·25 for lead pans, 0·34 for platinum stills, and 0·49 for apparatus of the Kessler type, as compared with 0·93 for concentration by electric heat. The yield by the electric method may be increased by using closed apparatus of quartz, cast iron, or lava, provided with a scrubber, as in Kessler's apparatus. In one series of experiments a yield of 40 kilos. of acid of 65·6° B. (sp. gr. 1·832) per hour was obtained. With regard to the relative costs of the processes, with coke at 60 lire (45s.) per ton, electric energy would be 1·4 centesimi per kilowatt, and the relative costs with electric energy and with anthracite would be in the ratio of 9 to 5.—C. A. M.

Sulphur in pyrites; Determination of ——. H. C. Moore. J. Ind. Eng. Chem., 1919, **11**, 45—49.

The Allen and Bishop method (oxidation with bromine in carbon tetrachloride solution, followed by treatment with nitric acid, and precipitation of the sulphuric acid as barium sulphate after removal of silica and reduction of ferric salts; see this J., 1912, 919) is described in detail. The method is accurate, and yields very concordant results, as is shown by figures reported by thirty-three different analysts working independently on portions of the same sample of pyrites.—W. P. S.

Sulphide sulphur in pyrites; Rapid determination of ——. A. Bartsch. Chem.-Zeit., 1919, **43**, 33—34.

A rapid method of determining sulphide sulphur in pyrites is based upon the fact that the whole of the sulphur in that form is liberated as hydrogen sulphide on treating the mineral with hydrobromic acid in presence of metallic mercury. The ordinary apparatus used for the determination of sulphur in iron and steel may be used. Sufficient mercury (about 20 c.c.) to cover the bottom of the evolution flask is introduced, and after the addition of 0·25 grm. of the finely powdered sample, the air is removed from the apparatus by means of a strong current of carbon dioxide. The pyrites is dissolved in 50 c.c. of hydrobromic acid (free from chlorine) which is forced into the flask by means of a current of carbon dioxide, the flask being meanwhile gently heated. The hydrogen

sulphide is absorbed in 600 c.c. of a solution of 25 grms. of cadmium acetate and 200 c.c. of acetic acid per litre, or of 20 grms. of zinc acetate, 5 grms. of cadmium acetate, and 200 c.c. of acetic acid per litre. After solution of the pyrites is complete, the liquid is boiled for a short time, and, after removal of the flame, a rapid current of carbon dioxide is passed through the apparatus for at least 15 mins. Fifty c.c. of standard iodine solution (197·88 grms. in 10 litres) is then added to the contents of the absorption flask, and, after the addition of 50 c.c. of hydrochloric acid (1 : 1), the excess of iodine is titrated with standard thiosulphate solution. Each c.c. of iodine solution corresponds to 1% of sulphide sulphur.—C. A. M.

Nitric oxide; Oxidation of —— by dry air. A. Sanfourche. Comptes rend., 1919, **168**, 307—310. (See this J., 1919, 132A.)

THE first stage in the oxidation of nitric oxide, $4NO+O_2=2N_2O_4$, is practically instantaneous and independent of the temperature between −50° C. and 525° C. The second stage $2N_2O_4+O_2 \rightleftarrows 4NO_2$, is reversible. Up to 200° C. it tends from left to right, but from 200° to 525° C. it tends more and more from right to left as the temperature rises.
—W. G.

Furnace settings for caustic pots. F. H. Nickle. Chem. and Met. Eng., 1919, **20**, 65—69.

IN the most usual type of caustic pot setting, *i.e.* the radial Dutch oven type, the products of combustion from a Dutch oven built on the centre line of the pot, are delivered radially towards the pot, and dividing on the centre line, travel around the pot in opposite directions, to a common flue in the rear. A battery of two pots is frequently worked in conjunction with a third or back pot used as a preheater. Sometimes, for economy of space, the flue connection between the front and back pots is built on the line joining the centres of the pots, but this construction causes the gases to short circuit along the shorter flue on one side of the front pot, leaving the other side deficient in supply of heating gases. A V-shaped fire-guard, fixed just in front of the pot, to protect it from direct contact with the flames, necessitates widening of the flue entrance, with consequent weakening of the arch at its rear end. The Nickle tangential Dutch oven type of setting, consists of a battery of two pots, each heated by a Dutch oven, the gases from which strike the pot tangentially, and after travelling almost completely around the pot, discharge into a soot chamber. As a fireguard is unnecessary, the throat behind the bridge wall is unrestricted; a relatively low velocity of the heating gases is thus attained and this, combined with the tangential effect, eliminates local overheating. The velocity of the gases travelling round the pot is maintained by reducing the area of the heating passage as it advances round the circumference. The rate of heat absorption by the dry wall of a caustic pot is dependent on the length of the path along which the gas is in contact with the heating surface, and the "hydraulic mean depth," or the average mean distance of the gas from the heating surface. The average "hydraulic mean depth" of the radial type of setting is 2·00 and of the Nickle tangential type 0·75, the latter type thus giving 2·66 as many contacts of the gas with the heating surface in a given time. The tangential setting promotes horizontal circulation of the caustic liquor about the axis of the pot (see U.S. Pat. 1,191,338; this J., 1916, 915). The non-conducting steam bubbles generated at the surface of contact of the liquor with the pot, are removed by the friction of the liquor against the pot, and assist in further promoting the circulation. This manner of circulation causes suspended impurities to collect in the centre, where they rapidly settle, saving time in settling, and reducing the amount of caustic bottoms in the finished product. To recover the waste heat from the gases without using a third pot, an auxiliary flue is provided, by means of which the furnaces may be operated in reversible series or in parallel. In another type of furnace, designed specially for firing with crude oil or gas, good combustion is obtained by passing the products of combustion through a series of radial ducts leading to the heating passage. Waste flue gases are used for heating the exterior of the fire-wall that surrounds the combustion chamber and the pot. This type of pot setting is used in the manufacture of carbon bisulphide as well as of caustic soda.—S. S. A.

Ammonia; Production of —— from nitrolim [crude calcium cyanamide], and the time yield under various conditions. W. Grahmann. Z. Elektrochem., 1918, **24**, 385—391.

THE rate of production of ammonia from boiling solutions of nitrolim; nitrolim and sodium hydroxide or carbonate; and nitrolim and potassium hydroxide or carbonate, of various concentrations, has been determined. In the case of nitrolim and water the rate of decomposition of calcium cyanamide is extremely slow in all concentrations at the boiling point and atmospheric pressure. Thus in a 1% solution 98% is decomposed by 72 hours' boiling. In the presence of sodium carbonate the reaction measured is really the decomposition of sodium cyanamide at first under constant sodium hydroxide concentration and then (after the whole of the calcium of the cyanamide has been replaced by sodium) under a concentration of sodium hydroxide which increases during the reaction. In the case of an addition of sodium hydroxide the decomposition of the sodium cyanamide takes place under a regularly increasing concentration of the hydroxide. The same remarks apply to the decomposition in the presence of the potassium compounds. The presence of caustic alkali or alkali carbonate has an accelerating influence on the reaction; the velocity increases with increasing concentration of the added salt to a maximum after which it remains constant. The maximum in the case of alkali hydroxides occurs with much lower initial concentrations of alkali than in the case of alkali carbonates, for in these experiments the alkali concentration increases continuously from beginning to end of the decomposition. The experiments with potassium hydroxide and carbonate do not show the same maximum as the sodium compounds under similar conditions, so that since sodium hydroxide and potassium hydroxide are ionised to practically the same extent, it must be taken that the acceleration of the decomposition velocity is not dependent entirely on the hydroxyl ion concentration but that the cation and the non-ionised molecules also exert a specific action. A number of experiments were also carried out under 30 atmospheres pressure at 150° C. Under these conditions even without addition of alkali the decomposition occurs very rapidly until 75% of the calcium cyanamide is decomposed, after which the velocity becomes much less; thus in aqueous solution 75% is decomposed in 45 minutes but only 90% decomposed in 120 minutes; in the presence of 10% sodium hydroxide 75% decomposition is reached in 30 minutes and 90% in 75 minutes. The nitrolim used in the experiments contained 16·85% of cyanamide nitrogen, 0·65% of dicyandiamide nitrogen, 22·30% of free lime, and 0·31% of sulphur.—J. F. S.

Potash salts; Separation of ——. H. P. Bassett. Chem. and Met. Eng., 1919, **20**, 76—77.

IT was found to be almost impossible to separate the potassium salt efficiently from a three ion

system, such as sodium sulphate and potassium sulphate. Sodium chloride was therefore added, which produced a four ion system, and tended to cause separation of the salt with the common ion, *viz.*, sodium sulphate. In the presence of an alkali or a salt acting as an alkali, the "heavy acid" salts (*e.g.*, sulphates and chlorides) tend to be precipitated in the proportion in which they exist in solution, and in this case it is necessary to effect a preliminary separation of the "heavy acid" salts from the alkali, and treat them on the four ion principle. In a particular case, the solution to be treated contained 10·49% by weight of total solids, which on analysis gave 9·19% K_2SO_4, 78·35% Na_2SO_4, 0·56% $CaSO_4$, 11·90% NaCl. 20 grms. of common salt was added to 2000 c.c. of the solution, and on evaporation the salt precipitated (total 54 grms.) contained 99·29% Na_2SO_4. By adding 14 grms. of common salt to the mother liquor, plus 1320 c.c. of stock solution, and evaporating, a second salt crop was obtained (total 98·50 grms.), containing 99·34% Na_2SO_4. A third salt crop gave in this way 99·40% Na_2SO_4, and a fourth crop showed on analysis 89·60% Na_2SO_4, 2·08% NaCl, 8·32% K_2SO_4. To the liquor from the fourth crop, 65 grms. of sodium nitrate was added, the liquor was evaporated, and a fifth crop obtained (total 39·20 grms.), containing 50·06% NaCl, 48·28% Na_2SO_4, 1·23% $NaNO_3$. On cooling the mother liquor from this crop to the ordinary temperature, potassium nitrate crystallised out, which contained 92·96% KNO_3, 0·50% NaCl, 0·39% Na_2SO_4, 6·15% $NaNO_3$. Thus the first three crops gave a marketable quality of salt-cake, the fourth crop and the final mother liquor were returned to the evaporator, whilst the fifth crop contained the requisite sodium chloride.—S. S. A.

Lime; Determination of available calcium oxide in the different classes of —— supplied to Rand reduction works. C. A. Melklejohn. J. Chem., Met., and Min. Soc. S. Africa, 1918, **19**, 86—88.

In the determination of available calcium oxide in lime by extraction with sugar solution and subsequent titration, the whole sample of unslaked, lump lime should be passed through a disc pulveriser and the sample for analysis then ground in an agate mortar. With slaked and air-separated limes the top layer (about 1 inch) should be removed from the sample and rejected, the remainder being spread evenly on a sheet of paper and sampled with a spatula to obtain the portion for fine grinding. The lime and sugar solution should be agitated intermittently for 2—3 hours and allowed to settle overnight before titration, filtration being thus avoided.—W. E. F. P.

Phosphorites and superphosphates from the point of view of the sulphur industry. L. Tirelli. Chem. News, 1919, **118**, 73—76.

In the extraction of sulphur from ores by partial combustion in sulphur-extraction furnaces, large quantities of sulphur dioxide, representing about one-quarter of the sulphur obtained, are lost. The author discusses in detail the possibility of success of processes devised for utilising this sulphur dioxide in place of sulphuric acid, in the production of superphosphate from phosphorites. By digesting 5 grms. of finely crushed and sifted phosphorite for 12 hours in 10 c.c. of a saturated solution of SO_2 (containing 300 c.c. SO_2 at 20° C.), evaporating the water in a closed vessel, and again mixing with 10 c.c. of SO_2 solution and digesting for 12 hours, Tennessee phosphorite gave 0·13 grm. of citrate-soluble phosphoric anhydride and Gafsa phosphorite 0·14 grm. 50 grms. of Tennessee phosphorite crushed, etc., as above, mixed with 50 c.c. of water, and subjected for 5 hours to the action of a cold moist current of 100% SO_2 at a pressure of 1·5 atmospheres, gave 2·41% of citrate-soluble and 0·32% of water-soluble phosphoric anhydride. Two samples of porous Tennessee phosphorite, one of which was preliminarily treated with distilled water for 2 hours, and the other with a saturated solution of sodium nitrate for 2 hours, were exposed for 8 hours to a cold moist current of 100% SO_2, and gave respectively, 1·25% and 1·62% of phosphoric anhydride soluble in water and citrate. Phosphorite powder exposed in thin layers to the long-continued action of SO_2 of various strengths, gave no better results. Very porous fragments of phosphorite, 1—5 cm. thick, treated for 10 days at 400°—500° C. in a current of gas containing 20% SO_2, 9% oxygen (by volume), and traces of moisture, and then left in a damp atmosphere for some days, became covered with a light grey powder, the interior remaining apparently unchanged. The powder was found to contain 6·2% moisture (at 60°—70° C.), 8·9% P_2O_5 soluble in water, and 7·5% insoluble P_2O_5, whilst the internal portion contained 0·1% P_2O_5 soluble in water, and 32·6% insoluble P_2O_5. It is concluded that sulphur dioxide reacts only at the surface of particles of phosphorite, and that the process has no chance of success.—S. S. A.

Bucher cyanide process for the fixation of nitrogen. E. Posnjak and H. E. Merwin. J. Wash. Acad. Sci., 1919, **9**, 28—30.

Examination of some samples of the crude technical products made by the Bucher process (this J., 1917, 451) showed the presence of weakly double refracting grains of about 0·03 mm. diameter. These had refractive indices $\alpha=1·527$, $\beta=1·532$, and $\gamma=1·537$, whereas sodium cyanide is essentially an isotropic substance. According to Bucher, sodium cyanide may be distilled from the mixture obtained by the Bucher process at 800° C., but these grains do not distil at 975° C. It is therefore concluded that the nitrogen-bearing constituent of the samples of the crude product examined consists principally of some substance other than sodium cyanide.

—J. F. S.

Chlorate and perchlorate in potassium nitrate [and ammonium nitrate]; Determination of ——. A. Wogrinz and J. Kuber. Chem.-Zeit., 1919, **43**, 21—22.

Investigation showed that the methods described by Winteler (this J., 1897, 358), Foerster (*ibid.*, 1898, 694), Hendrixson (*ibid.*, 1904, 951), and Tschernobajeff (*ibid.*, 1905, 561) are accurate when applied to potassium nitrate. For ammonium nitrate, Tschernobajeff's method gives results much too low and Winteler's method is unsuitable. Foerster's method, however, gives good results.

—W. P. S.

Calcium ferrite and aluminate; Mixed crystals of ——. E. D. Campbell. J. Ind. Eng. Chem., 1919, **11**, 116—120. (Compare this J., 1914, 964; 1915, 139; 1916, 1108.)

Dicalcium ferrite, $2CaO,Fe_2O_3$, and monocalcium ferrite, CaO,Fe_2O_3, are shown to be the only definite compounds formed by lime and ferric oxide. Pure tricalcium aluminate, $3CaO,Al_2O_3$, has been obtained by crystallisation from a melt composed of a solution of lime in the compound, $5CaO,3Al_2O_3$. When a solution with the empirical formula, $8CaO,3R_2O_3$, in which the ratio $Fe_2O_3 : Al_2O_3 = 1 : 3$, is slowly cooled, mixed crystals in which this ratio is 1 : 7 first crystallise out until the ratio in the residue reaches the value 3 : 5; mixed crystals in the latter ratio then crystallise out until at about 1370° C. the ratio in the residue reaches the value 1 : 1. (See also J. Chem. Soc., Apr., 1919.)—T. H. P.

Aluminium hydroxide; Disperse ——. *I.* V. Kohlschütter. Z. anorg. Chem., 1919, **105**, 1—25.

When crystals of ammonium alum or aluminium sulphate are brought into contact with ammonia solution (1 to 10 *N*), they are rapidly and completely changed into more or less perfect pseudomorphs of aluminium-hydroxide. The pseudocrystals can be dried (at 40°—110° C.) and even dehydrated, without losing the external form of the original crystals, although there is considerable shrinkage. The physical characteristics of the pseudomorphs, such as density and degree of dehydration at different temperatures, vary with the conditions of formation; thus strong ammonia solutions give denser and more perfect pseudomorphs than dilute ammonia, and alum gives denser products than aluminium sulphate. The pseudomorphs are true gels and after drying at 40°—110° C. are dissolved (peptised) by dilute acids forming colloidal solutions. The character of the sol obtained varies considerably with the method of preparation of the pseudomorph. The differences between the various products are ascribed to different degrees of dispersity in the gel. (See also J. Chem. Soc., Apr., 1919.)—E. H. R.

Alkali aluminosilicates; Behaviour of —— *at high temperatures.* H. Leitmeier. Z. anorg. Chem., 1919, **105**, 69—80.

When the very pure variety of orthoclase, adular, m.pt. 1145°±5° C. is kept for upwards of 500 hours at a temperature 10° below its melting point, it loses weight to the extent of 0·2%. The loss is attributed to volatilisation of alkali, but this cannot be confirmed by direct analysis owing to experimental limitations. The sodium aluminosilicate, labrador, shows a similar behaviour at 1235° C. (See also J. Chem. Soc., Apr., 1919.)—E. H. R.

Basic exchange in silicates. II. E. Ramann and A. Spengel. Z. anorg. Chem., 1919, **105**, 81—96.

A study of the action of salt solutions containing two basic ions on ammonium-permutite. When mixed potassium and calcium chloride solutions are used containing equivalent proportions of the two metallic ions, the ammonia is completely eliminated and the composition of the resulting permutite is independent of the total salt concentration in the solution used. In general, when mixed solutions are used, the ratio of the bases in the final permutite is not the same as their ratio in the solution, the permutite generally containing more of the base in which the solution is poorer. When calcium is present in solution in excess, together with sodium, potassium, or ammonium, the proportion of calcium in the final permutite is much smaller than in the solution. The same is true to a smaller extent of sodium in presence of potassium or ammonium. The alkali bases cannot be completely eliminated from permutites by prolonged treatment with calcium chloride. It is concluded that basic exchange in the case of such silicates as permutite is an ionic reaction following the general mass action law, but in the case of calcium and to a less extent sodium salts, a disturbing factor, probably of a physical character, comes into play.—E. H. R.

Silica; Precipitated amorphous ——. P. Braesco. Comptes rend., 1919, **168**, 343—345.

Precipitated silica was mixed with 5% of sodium silicate as a paste, cast into sticks, dried and calcined. Its coefficient of dilatation was measured and compared with that of fused silica, on which a direct determination was made, and which was then powdered and treated as above. The results indicate that precipitated silica, dried and heated only to 600° C., is in the amorphous form, but that if it is calcined at a temperature exceeding 1000° C., it is converted into crystalline cristobalite.—W. G.

Ceric oxide; Carburation of ——. A. Damiens. Ann. Chim., 1918 [IX.], **10**, 330—352. (See this J., 1918, 723 A.)

The formation of cerium carbide, CeC_2, from the oxide in an electric furnace takes place in three stages:

$$2CeO_2+C=Ce_2O_3+CO,$$
$$Ce_2O_3+9C=2CeC_2+3CO,$$
$$CeC_3=CeC_2+C.$$

The carbide CeC_3 is soluble in cerous oxide, and the intermediate products obtained in the carburation, one of which has been wrongly described by Sterba as an oxycarbide, $CeC_2,2CeO_2$, are really solid solutions of this nature. The carbide, CeC_3, is stable only between very narrow limits of temperature and outside these limits dissociates giving the carbide CeC_2 and graphitic carbon.—W. G.

Arsenic trichloride; Manufacture of ——. R. C. Smith. J. Ind. Eng. Chem., 1919, **11**, 109—110.

The best method of making arsenic trichloride, on account of the simplicity of the process, the small amount of apparatus required, the short time necessary for the completion of the operation, and the high yields of almost pure product, consists in treating arsenious anhydride with sulphur monochloride: $2As_2O_3+6S_2Cl_2=4AsCl_3+3SO_2+9S$. The arsenious anhydride used should be as dry as possible. With proper control of the temperature (about 100°—125° C.) the reaction proceeds without difficulty. Based on the amount of sulphur chloride treated, the yield obtained on a small manufacturing scale was 93% of arsenic trichloride, having an average purity of 99%. Details are given of the manufacture and subsequent distillation of the product.—T. H. P.

Graphitic carbon. V. Kohlschütter. Z. anorg. Chem., 1919, **105**, 35—68.

A lengthy discussion of the properties of graphite, its mode of formation and probable structure. On account of the very variable properties of graphite and of the insensible gradations which can be obtained between graphite and amorphous carbon, the author concludes that all kinds of "black carbon" are merely physical varieties of one allotropic modification of diamond. Whether graphite or amorphous carbon is formed in any reaction producing free carbon depends upon the reaction conditions. The favourable condition for graphite formation is that the reaction should be localised, as for example in surface reactions such as the catalytic decomposition of acetylene or carbon monoxide, or in reactions where the carbon is formed *in situ* by the decomposition of a carbide, *e.g.*, silicon carbide. Graphite is to be regarded as a special disperse form of carbon characterised by a dense lamellar structure. The author's view is confirmed by the results of the X-ray examination of graphite and amorphous carbon, which show that they are structurally identical. (See also J. Chem. Soc., Apr., 1919.)—E. H. R.

Potash in cement mill dust. Merz and Ross. *See* IX.

Ultramicroscopic examination of very thin deposits of salts. Hamburger. *See* X.

Fertilisers from ammonia. Bosch. *See* XVI.

Calcium phosphate and ammonium compounds from sewage. Gonné. *See* XIXB.

PATENTS.

Hydrofluoric acid; Process and apparatus for the manufacture of ——. E. Ridoni, and Soc. Talco e Grafiti Val Chisone, Turin, Italy. Eng. Pat. 115,425, 17.4.18. (Appl. 6525/18.) Int. Conv., 19.4.17.

A FURNACE is divided into a number of chambers, each of which contains a shallow muffle provided with a door in front and two openings on top. At the end nearest the door the bottom of the muffle is raised to form an edge which limits the quantity of the charge to a thin layer. Calcium fluoride is fed into the furnace through the door, and sulphuric acid through one of the openings on top. The hydrofluoric acid passes through the other opening to a horizontal pipe connected to each of the muffles and an outlet pipe conveys the acid to a condenser. A fan is also attached to the horizontal pipe whereby a strong suction can be created in the muffles when the reaction is complete, and by this means the residues are rapidly dried and assume a sandy character, facilitating their removal from the muffles. At the same time, the escape of acid vapours into the air is avoided when the muffles are opened.—L. A. C.

Titanium compounds; Production of ——. Titan Co. A./S., Christiania. Eng. Pat. 115,020, 1.3.18. (Appl. 3624/18.) Int. Conv., 23.3.17.

FINELY powdered titaniferous iron-ore, *e.g.*, ilmenite, is mixed with sufficient carbon (or other reducing agent) to reduce the iron and titanium oxides to metals, and the mixture is heated in an electric furnace in an atmosphere of nitrogen to about 1200°–1400° C. until reduction of the iron oxide is complete and the titanium is converted into a titanium nitrogen compound. The material is then crushed and lixiviated with dilute mineral acid to remove the iron. The dried residue is heated with concentrated sulphuric acid in the proportion of 2 pts. of 90% acid to 1 pt. of residue, yielding a product consisting of titanium sulphate, ammonium sulphate, and traces of ferrous sulphate. This is dissolved in 4 pts. of water, filtered, and the titanium precipitated as hydroxide by boiling the solution. Ammonium sulphate may be recovered from the solution by crystallisation, and the residual acid may be utilised for lixiviating the product from the furnace.—L. A. C.

Sulphuryl chloride; Manufacture of ——. W. J. Pope, Cambridge. Eng. Pat. 122,516, 13.2.18. (Appl. 2611/18.)

A MIXTURE of dried chlorine and sulphur dioxide gases in approximately equimolecular proportions is brought in contact with charcoal, whereby the two gases combine with formation of sulphuryl chloride. The reaction proceeds more rapidly at or below the ordinary temperature than at higher temperatures, and as a large quantity of heat is evolved during the reaction, the vessel containing the charcoal is preferably cooled by cold water or ice.—L. A. C.

Nitrides; Production of ——. A. R. Lindblad, Stockholm. Eng. Pat. 122,523, 20.2.18. (Appl. 3057/18.)

NITRIDES, *e.g.*, silicon nitride, are prepared by heating the materials, *e.g.*, a mixture of crushed quartz and carbon, in an electric furnace the electrodes of which enter the charge in places where it forms a "free spreading or sliding surface," nitrogen or nitrogenous gases being simultaneously introduced into the furnace chamber and led through the charge. The product is removed from the furnace in an unmelted condition, either continuously or at intervals. Two suitable types of furnace are described. The first is of the ordinary shaft-furnace type, open at the top, one electrode hanging down into the shaft, and the other consisting of the furnace lining. The raw material is fed into the top of the furnace and is removed from the bottom through a water-cooled opening. Nitrogen is blown in through a pipe at the lower end of the furnace and reaction gases pass out at the top. The second furnace is of the closed type, the chamber being of such a shape that one or more free spaces exist between the charge and the walls. The electrodes pass through holes in the wall of the furnace and through the free spaces before entering the charge. The nitrogen may be led in at the bottom of the furnace or through the spaces surrounding the electrodes into the free spaces. The material is fed into the top of the furnace and removed at the bottom.—L. A. C.

Carbon monoxide; Process for removing —— and manufacture of a material therefor. South Metropolitan Gas Co., and J. M. Somerville, London. Eng. Pat. 122,781, 29.6.18. (Appl. 10,767/18.)

CARBON monoxide is removed from gases by passing the gases over caustic alkali containing ferric oxide, to the extent of not more than 50% of the mixture, at about 400° C., *i.e.* above the temperature at which alkali formate is produced. The material is prepared by adding an equal weight of precipitated anhydrous ferric oxide to a hot saturated solution of commercial caustic soda. The pasty mass is stirred until it is of the consistency of hard putty after which it is heated to 130°—150° C. until loss of water ceases, and then to 320°—350° C. for about three hours. The product is then broken up to a suitable size.—L. A. C.

Alumina; Production of ——. R. H. McKee, Ridgefield Park, N.J. U.S. Pat. 1,290,269, 7.1.19. Appl., 9.6.17.

ALUMINA is prepared from acid-soluble aluminous materials containing iron by dissolving the material in an acid, fractionally removing iron by electrolysis, and then electrically precipitating aluminium hydroxide. The acid solvent is regenerated thereby and is used for dissolving fresh material.—L. A. C.

Hydrogen; Treatment of spathic iron-ore for use in the manufacture of ——. The British Oxygen Co., Ltd., London, S. W. Bray, Manchester, and I. H. Balfour, Buckhurst Hill, Essex. Eng. Pat. 122,474, 23.1.18. (Appl. 1337/18.)

SPATHIC iron-ore for use in the production of hydrogen by alternate reduction and then oxidation by the action of steam is first treated by allowing the ore, broken into pieces of suitable size for use, to stand for about ½ hr. in a vessel containing sufficient commercial hydrochloric acid or other mineral acid to cover the material completely. The ore is then removed, washed, and allowed to drain. Ore so treated is rendered more porous, and remains active for a longer time, and the yield and purity of the hydrogen are much improved.
—L. A. C.

Aluminium carbide; Art of producing ——. Standard Oil Co., Assignees of M. Barnett and L. Burgess, New York. Eng. Pat. 112,929, 26.11.17. (Appl. 17,413/17.) Int. Conv., 26.1.17.

SEE U.S. Pat. 1,222,593 of 1917; this J., 1917, 646.

Carbon dioxide; Absorption of —— from gaseous mixtures. J. C. H. Kramers, Nijmegen, Netherlands. U.S. Pat. 1,290,244, 7.1.19. Appl., 12.1.16.

SEE Fr. Pat. 480,774 of 1916; this J., 1917, 188.

Reactions in gases in closed systems; Process for the production of ——. J. L. La Cour, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania. U.S. Pat. 1,290,584, 7.1.19. Appl., 17.11.15.

See Fr. Pat. 480,205 of 1915; this J., 1917, 215.

Vessels for acids. Eng. Pat. 122,661. *See* I.

Decolorising carbon [from kelp]. U.S. Pat. 1,290,002. *See* IIB.

Alkali-bearing rocks. Ger. Pat. 308,690. *See* IX.

VIII.—GLASS; CERAMICS.

Plastic clay; Determination of air in ——. H. Spurrier. J. Amer. Ceram. Soc., 1918, **1**, 710—713.

As kerosene does not disintegrate clay nor dissolve air, the air in a clay paste may be determined by placing a weighed or measured specimen in a flask filled with kerosene and connected with a gas-measuring tube which is also filled with kerosene. The kerosene in the flask is then displaced by boiling water which disintegrates the clay, any air thus liberated being collected in the measuring tube. The flask is heated by immersion in a water bath and the collecting bottle for the liquid displaced from the measuring tube is connected with a vacuum pump so as to expand and facilitate the collection of the air. After about 15 mins., the pump is disconnected, and the volume of air is measured. A sample of fre-air filter-pressed clay was found to contain 9·61% by vol. of air; the same clay after passing through a pug-mill contained 9·88%. Another sample after passing five times through a pug-mill contained 13·8% of air. This method lends itself to determining the proper setting of the blades in the pug-mill as well as the soundness of the pugged material. A pug-mill is not an efficient apparatus for making a plastic paste and over-pugging may spoil a clay by the introduction of excess of air. When a piece of clay paste is placed in boiling water, the manner in which it "slakes" indicates the manner of its formation. An extruded sample broke down in longitudinal lines, a thrown sample along spiral lines, and a section cut from a filter-press cake did not disintegrate at all. The disintegration is attributed to the disruptive effect of air vesicles expanding under the increased temperature.—A. B. S.

Sagger clay and mixtures. G. H. Brown. J. Amer. Ceram. Soc., 1918, **1**, 716—729.

FAILURES of saggers may be caused by too rapid heating, especially if they are not dry; by too rapid cooling, this being the commonest cause of leakage; or by the use of vitrifiable wad-clay which necessitates the saggers being struck to separate them when emptying the kiln. A sagger material when burned should rapidly reach an equilibrium of porosity and shrinkage. The mechanical strength of the saggers in use depends on the amount of vitrification which occurs, the grading and proportion of the grog, and the presence or absence of hair cracks, due to too coarse grog, faulty grains, or a bond clay with excessive shrinkage. Resistance to deformation is obtained by avoiding an excess of fluxes. Resistance to temperature changes, especially in cooling, is increased by avoiding the use of clays containing free quartz (sand). The material should be free from iron and all materials likely to cause "popping" or "spitting." Saggers should be made of clay which remains porous at all temperatures attained in use and the employment of a second quality kaolin or the addition of 10% or more of kaolin to a sagger clay is recommended. A wet pan is stated to be better than a soaking pit even when the clay from the latter is subsequently pugged—and permits a larger proportion of grog to be introduced and the plasticity of the clay to be developed to the fullest extent.—A. B. S.

Porcelain; Certain characteristics of ——. A. V. Bleininger. J. Amer. Ceram. Soc., 1918, **1**, 697—702.

PORCELAINS differ widely in some of their physical properties on account of the various stages of development represented by different samples. In porcelains fired at cone 10 the amount of undissolved quartz is large and that of sillimanite is small, and such products, when heated, are subject to the change in volume coincident with the conversion of quartz to cristobalite. In electrical insulators the proportion of free quartz permissible should probably be quite low and the use of a high clay content is therefore desirable. By replacing quartz by clay or synthetic sillimanite, porcelain of excellent stability to sudden changes of temperature has been obtained. This was particularly the case with a sillimanite prepared by grinding kaolin 258 parts, anhydrous alumina 102, and boric acid 7·2 parts, and heating the mixture to cone 20. Porcelains containing 40% of sillimanite calcine or other minerals such as fused alumina, zirconia, etc., which are not subject to molecular transformation, 40% of clay, and 20% of flux when burned at cone 16 showed high resistance to sudden heating and cooling and high mechanical strength. The addition of sillimanite or analogous minerals increases the firing range of felspathic porcelains. Bodies containing zirconia seem to be specially desirable where high mechanical strength is necessary. The electric conductivity of porcelains and other vitrified bodies increases rapidly with the temperature. If R is the electrical resistance of the material in ohms, t the temperature in 0° C., and a and b are constants, $\log_{10}R = a - bt$. The chief factor in increasing the conductivity is felspar and by the elimination of this material from the ware the latter could be obtained with a resistance of 1 megohm per cm. cube at 800° C. (fused quartz has the same resistance at 880° C.). With a high felspar content the polarisation phenomena become more prominent, showing that felspar acts as an electrolyte. Felspar and quartz should not be present in porcelains required for use with high electrical tensions.—A. B. S.

Enamels for cast iron. H. F. Staley. J. Amer. Ceram. Soc., 1918, **1**, 702—709.

BORIC oxide and lead oxide are the only fluxing oxides permissible in large proportions in tin enamels. Boric oxide is always used, but the amount of lead oxide may vary from 0 to 25% on the melted batch. Leadless enamels must be rich in boric oxide, soda, and cryolite. With less than 10% of lead oxide the boric oxide is usually over 8%; in America low-lead enamels are usually rich in zinc oxide. In enamels containing 16—25% of lead oxide, the boric oxide may be as low as 6%, though preferably 7—8%, so as to give greater strength and elasticity. The remaining fluxing oxides do not exceed 10%. The tin oxide (opacifier) varies from 8 to 18% of the melted batch. Antimony enamels may contain sodium metantimonate as the opacifying agent. German leadless enamels of this type are generally rich in boric oxide, whereas

American products are generally high in zinc oxide. In enamels with only 3—5% of lead oxide, the boric oxide and zinc oxide are somewhat lower than in the leadless enamels and the amount of each of the other fluxes is kept low. In enamels with 5—12% of lead oxide the boric oxide is lower than in the preceding type but is higher than in the corresponding tin enamels and the percentage of other fluxes is kept low. In some cases calcium carbonate is replaced by fluorspar in order to maintain the proper lime content and to produce a good colour. Antimony oxide may be used as the opacifier in association with much sodium nitrate but a corresponding low proportion of other sodium compounds and a considerable amount of cryolite. The characteristics of such enamels correspond closely with those containing sodium metantimonate; possibly this compound is formed *in situ*.
—A. B. S.

PATENTS.

[*Glass*] *furnaces.* T. B. Kitson, Leeds. Eng. Pat. 122,672, 27.12.17 (Appl. 19,116/17.)

IN a reverberatory furnace for use in glass manufacture, the air is preheated by passing it first through a flue beneath the bottom of the furnace, then through vertical flues at the end of the furnace, and finally through an unobstructed chamber or flue between the furnace crown and an upper flue, through which the waste gases from the furnace pass. The air and waste gases both flow in the same direction. The exhaust ports or outlets of the furnace also serve as troughs or spouts for feeding glassware machines, the glass in them being kept hot by the waste gases impinging on it with a blow-pipe action.—A. B. S.

Fireclays; Art of purifying ——. H. L. Kohler, St. Louis, Mo. U.S. Pat. 1,290,241, 7.1.19. Appl., 31.7.18.

A FALLING charge of the dried crushed fireclay is subjected to transverse currents of air; the heavy particles of sand and felspar are deposited, whilst the relatively light particles of clay are carried along by the air and circulated around one or more magnetised deflecting plates to separate magnetic impurities, after which the "pure silicate of aluminium" is recovered.—A. B. S.

Enamelling furnace. A. J. Boland, St. Louis, Mo. U.S. Pat. 1,290,060, 7.1.19. Appl., 14.5.17.

IN a muffle enamelling furnace the vertical side flues are arranged in pairs with a longitudinal connecting flue along the top and an escape conduit extending through the furnace wall. The flues in each pair are provided with a left- and right-hand burner respectively below the level of the muffle floor; these burners direct the heating gases partly horizontally beneath and around the muffle and partly vertically along its sides.—A. B. S.

Enamelled ware; Method of marking [*decorating*] ——. W. J. Kohler, Sheboygan, Wis., Assignor to Kohler Co., Kohler, Wis. U.S. Pat. 1,290,580, 7.1.19. Appl., 6.1.16.

THE article to be marked is provided with a ground coat of binding material; it is then heated to a white heat, a coat of powdered enamel is applied, the article is again heated so as to fuse the first coat of enamel, and whilst it is hot a second coating of enamel is applied. Lines of marking enamel of a different colour are then applied and the article is re-heated so as to fuse the second coating of enamel and form a smooth surface.
—A. B. S.

Refractory product. L. P. Kraus, jun., New York. U.S. Pat. 1,289,049, 24.12.18. Appl., 13.2.15. Renewed 29.3.17.

A SHAPED kiln-burned refractory product is formed from compressed or moulded refractory material having clinkered grains of a spongy character and rough irregular outline, combined with a bond.
—D. F. T.

Abrasive articles; Methods of making ——. The Carborundum Co., Ltd., Manchester. From H. Urtel, La Salle, N.Y., U.S.A. Eng. Pat. 122,533, 2.3.18. (Appl. 3707/18.)

SEE U.S. Pat. 1,243,783 of 1917; this J., 1917, 1275.

Kilns. Eng. Pat. 122,742. *See* I.

Kiln. U.S. Pat. 1,290,848. *See* I.

IX.—BUILDING MATERIALS.

Portland cement; Solubility of —— and its relation to theories of hydration. J. C. Witt and F. D. Reyes. Philippine J. Sci., 1918, **13**, 147—161.

WHEN Portland cement is shaken with water free from carbon dioxide in a closed vessel, large amounts of lime and relatively small amounts of most of the other oxides are dissolved. When the weight of water is 8000 times that of the cement 90% of the lime goes into solution in 24 hours. Hence, under favourable conditions all the important compounds in cement may be rapidly hydrated with formation of calcium hydroxide. The constituents and concentration of the solution depend on the method and duration of agitation, the size of the cement particles, and the proportions of cement and water, especially the last. There appears to be no relation between the percentage of lime dissolved and the amount of the other constituents present. It has not been found possible to obtain a saturated solution of calcium hydroxide by shaking cement with water. The addition of a larger proportion of water in gauging facilitates hydration and should therefore increase the strength of the cement, but this is more than counterbalanced by the leakage of water from the mixture with consequent loss of lime and cohesion. Hence, the net effect of an excess of water is to reduce the strength of the mixture. This is confirmed by the fact that if a mixture containing an excess of water is evaporated until only the normal amount of water is present, the strength is increased.—A. B. S.

Calcium aluminates; Hydraulic properties of the ——. P. H. Bates. J. Amer. Ceram. Soc., 1918, **1**, 679—696.

ALL the aluminates of the lime-alumina-silica system possess hydraulic properties except $3CaO,Al_2O_3$. The last-named decomposes at about 1535° C. into CaO and a liquid. If the product is reground and reburned at 1350° C. for several hours the aluminate may be obtained free from any lime. Pure tricalcium aluminate when ground and mixed with water agglomerates into masses only the exteriors of which are hydrated. Pats of the paste show an initial set in about three hours and a final set in 48—72 hours, but the interior of the pats is quite soft and if the pats are left in a moist atmosphere they become soft throughout in a week. When placed in water they disintegrate completely, forming a colloidal gelatinous material which soon crystallises. If tricalcium aluminate is mixed with less than 10% of lime and then with water, a smooth plastic paste, which hardens like Portland cement, is produced.

$5CaO,3Al_2O_3$ when ground reacts so readily with water that it is difficult to handle except in the presence of a large excess of water (which gives products of low strength) or of 3% of gypsum, which retards the action. The products of the action are hydrated tricalcium aluminate and gelatinous hydrated alumina. CaO,Al_2O_3 and $3CaO,5Al_2O_3$ both set slowly and harden rapidly and attain high strengths. Eight mixtures, consisting chiefly of lime and alumina, with varying quantities of silica and ferric oxide, were burned at temperatures ranging from 1360° C. to 1500° C. Those which approached most closely to $3CaO,5Al_2O_3$ required the longest time to set. Those corresponding to CaO,Al_2O_3 had a quick initial set but a normal final set. The results with the other mixtures show that the setting time depends on the lime-alumina content. The constituents other than the aluminates ($2CaO,Al_2O_3,SiO_2$; $2CaO,SiO_2$) did not appear to affect materially any of the properties, but acted merely as non-hydraulic diluents. The addition of 3% of plaster of Paris accelerated the setting. All the mixtures (except two) gave high tensile strength tests when mixed with sand and stored in a damp place for a year, and several of them had, after 24 hours, a greater strength than Portland cement after 28 days. One mixture (Al_2O_3 74·1, CaO 23·8, SiO_2 0·7, Fe_2O_3 0·4, MgO 0·8, loss on ignition 0·4%) gave a 1 : 3 mortar which developed a tensile strength of 770 lb. per sq. in. in 90 days and 960 lb. in 26 weeks, and a crushing strength of 8610 lb. at 7 days and 10,690 lb. at 28 days. Somewhat lower strength tests were obtained when plaster of Paris was added. Storage under water greatly increased the strength of the material, but storage in a damp place tended to reduce it. The commercial possibilities of calcium aluminate cements are not promising as the alumina would be too costly.

—A. B. S.

Potash in cement-mill dust; Nature of the recombined ——. A. R. Merz and W. H. Ross. J. Ind. Eng. Chem., 1919, **11**, 39—45.

The water-soluble potash in cement dust consists chiefly of potassium salts volatilised in the burning of the cement; smaller quantities are derived from silicates carried over mechanically in the dust, and from the coal ash. The water-insoluble but acid-soluble potash present in the dust is due to re-combination of a portion of the volatilised potassium salts with the coal ash, to recombination, under certain conditions, with the silicious material occurring in the raw mix, and to partial decomposition of the silicates of the raw mix and of the coal ash carried over mechanically. The acid-insoluble portion of the potash consists of undecomposed silicates and coal ash, and of substances formed by re-combination of the volatilised potassium salts with the coal ash when the amount volatilised is small. This re-combined potash is of the nature of potash slag or impure glass; it is probable that the extent of the re-combination would be reduced if the burning of the cement were carried out under oxidising rather than reducing conditions, and also by any process which would introduce lime or sodium chloride into the dust at the hottest part of the kiln.—W. P. S.

Calcium aluminium sulphate as a destroyer of concrete. H. Nitzsche. Z. angew Chem., 1919, **32**, 21—24.

Calcium aluminium sulphate was first synthesised by Candlot, and was shown by Michaëlis in 1892 to have the formula $Ca_2Al_2O_4,3CaSO_4$, with $30H_2O$ if produced in a cold solution and $12H_2O$ if produced in a hot one. Its existence in mortar and concrete was not definitely proved until 1917. It may be produced by adding aluminium sulphate solution to lime water or by mixing lime water and precipitated alumina with a solution of any sulphate. It is also formed when water containing sulphates comes in contact with cement, and the crystallisation pressure of the highly hydrated crystals causes the concrete to crack as soon as the pores cannot contain any further quantity of crystals. The crystals are only stable in the presence of lime water; in water they dissociate into calcium sulphate, calcium hydroxide, and alumina; the two former are dissolved more or less completely and the alumina forms a white flocculent mass. The crystals are still more rapidly dissociated in solutions of salts or acids and in sea water. The relative harmfulness of a water or solution towards cement or concrete may be judged by comparing the crystals produced when lime and alumina are allowed to interact in its presence. Comparative results are obtained in a few days. No crystals of the double salt were produced in a long series of such tests using either natural or artificial sea water, nor could they be found in test mortars which had been immersed for a prolonged period in sea water. Consequently the destructive action of sea water on concrete must be referred to other causes and not to the sulphates present. The destruction of concrete by surface water, moorland (peaty) water, sewage, or sulphate solutions may be attributed to the formation of the double salt. The author has found crystals of calcium aluminium sulphate in many samples of concrete and mortar taken from structures exposed to the action of sulphate solutions. The crystals may be readily recognised by microscopical examination, using a magnification of 50—100 diameters; the examination should not be made on completely disintegrated material, because after disintegration of the concrete the calcium aluminium sulphate is rapidly decomposed. The presence of a white aluminous mass is an indication that disintegration has been caused by the double salt. A very dilute sulphate solution or a water with a low SO_3-content will, in time, destroy a structure exposed to it, if sufficient lime is present in the cement or mortar to prevent dissociation of the double salt. Preventive measures are of two kinds, *viz.*, the use of concrete of such a nature that the harmful fluids cannot penetrate it, and the use of resistant materials in the cement. The concrete may be made waterproof by coating it with bitumen, asphalt, or tar, but such treatment is usually too costly. The concrete may be rendered resistant by using cement containing iron oxide in place of alumina, or by use of blast-furnace slag-cements low in lime; the latter is at present one of the most certain preventives. Alternatively silicious material may be added, such as puzzuolana, trass, brick dust, granulated slag, santorin earth, etc., which will combine readily with the lime set free by the action of water on the cement. Such materials reduce the porosity of the cement, but their chief action is in converting the lime into a compound which cannot take part in the formation of the double sulphate. The reaction between the lime in the cement and the silica in the added material is, however, very slow, and such materials do not invariably prevent the formation of the double salt.—A. B. S.

Mixed crystals of calcium ferrite and aluminate, Campbell. *See* VII.

PATENTS.

Artificial stone. A. Afford, Romford. Eng. Pat. 122,546, 18.3.18. (Appl. 4752/18.)

An artificial stone composed of broken "free stone," Bath stone or Weldon stone, and Portland cement mixed together in a wet condition and

moulded into blocks, slabs, or other forms. The product is stronger than natural Bath or Weldon stone.—A. B. S.

Mineral [slag] wool; Manufacture of ——. G. A. Herdman, Redcar. Eng. Pat. 122,779, 21.6.18. (Appl. 10,283/18.)

DAMP-PROOF mineral wool or slag wool is made by projecting molten slag from a cupola into a receiving chamber by means of a steam blast into which a dust-settling and damp-proofing liquid (oil) is introduced, whereby the resulting fine filaments of slag become impregnated with the fluid. If air or other gas is substituted for steam in the blast the oil should be used in a hot state. The receiving chamber has a number of air vents at the top, one of which is placed directly above the entry tube and another at a point diagonally opposite the first. —A. B. S.

Alkali-bearing rocks; Treatment of —— *[for production of cement with volatilisation of the alkali]*. F. Krupp A.-G. Grusonwerk, Magdeburg-Buckau. Ger. Pat. 308,690, 24.6.14. Addition to 304,080 (this J., 1918, 374 A).

THE alkaline-earth (calcium) salts specified in the chief patent may be replaced by salts of other bases suitable for use in the production of Portland cement, for example iron or aluminium salts or the like. If iron salts, *e.g.*, ferrous sulphate, are used, the addition of ferric oxide may not be needed.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron in iron ores; Determination of —— *by permanganate*. R. Schwarz and B. Rolfes. Chem.-Zeit., 1919, **43**, 51.

THE titration of ferrous chloride by permanganate in presence of hydrochloric acid and manganous sulphate always gives rather too high results owing to the oxidation of a little of the hydrochloric acid, in spite of the presence of the manganous salt. The addition of colloidal silicic acid entirely prevents the oxidation of the hydrochloric acid in the presence of manganous sulphate. The silicic acid is added in the form of a solution of sodium silicate, containing about 0·1 grm. of SiO_2 per 1 c.c. After the addition, it is important that the silicic acid remain in colloidal solution, unflocculated; the titration should therefore be made without delay. The iron ore, 4—5 grms., is dissolved in boiling concentrated hydrochloric acid, 10—12 c.c. per 1 grm. of ore, the solution is made up to 500 c.c. and 50 c.c. taken for the titration. It is reduced with stannous chloride, the excess of which is removed by mercuric chloride; 10 c.c. of manganese sulphate and phosphoric acid mixture is added and about 5 c.c. of "water-glass" solution of sp. gr. 1·17. The solution is then titrated with permanganate standardised in the ordinary way.—J. F. B.

Steels; Influence of different factors on the critical velocity of quenching [hardening] of carbon ——. Portevin. Comptes rend., 1919, **168**, 346—348. (See also this J., 1917, 720.)

CONSIDERING the time of quenching as a function of the diameter of homothetic cylinders (having a length equal to three times the diameter), and the hardness as a function of the time of quenching or the diameter it is shown that for a carbon steel, containing C 1·07%, Mn 0·08%, the ratio of the time of cooling (from 700° to 200° C.) to the diameter is given graphically by two straight lines, one corresponding to cylinders above 14 mm. and the other to cylinders below 13 mm. in diameter. The hardness of the quenched steel also undergoes a sudden change of about 200 Brinell units between these two diameters. Analogous results are obtained with other steels at different diameters according to the character of the steel. These two phenomena are the consequence of the sudden lowering of the transformation temperature and of the change in the microstructure from troostitic to martensitic. The critical velocity of quenching, or more exactly the region of velocities of cooling in which this sudden change of phenomena occurs, appears to be the most characteristic property in the hardening of steels. The critical velocity is notably influenced by the manganese content of the steel, decreasing with it. The minimum temperature of quenching for effective hardening is a function of the velocity of cooling, and is lower as the velocity is higher. A comparison of Chevenard's results (see this J., 1917, 881) using a steel wire, 0·32 mm. diameter, with those for a cylinder 20 mm. in diameter made of steel of almost identical carbon and manganese content, lends support to the view that pressure plays an important part in the formation of troostite.—W. G.

Iron alloys; Dependence of the magnetic properties, specific resistance, and density of —— *on their thermal treatment*. E. Gumlich. Z. Elektrochem., 1918, **24**, 372—377. (See this J., 1918, 374 A.)

FOR pure electrolytic iron the following values were obtained: Sp. gr., 7·876; specific resistance per sq. mm. 0·0994; temperature coefficient of the resistance between 20° C. and 100° C., 0·57%; saturation value, $4\pi J_\infty = 21620$, where J is the intensity of magnetisation. These values were very little changed by annealing and stand in contrast to the magnetic properties. The improvement in the magnetic properties brought about by annealing is not due, as generally believed, to a molecular change, but to the removal of adsorbed gases. In the iron-carbon alloys the transition points found correspond with those given by the equilibrium diagram. The carbon content has a marked effect on the coercive force, especially in low-carbon alloys; the effect is much greater in the case of quenched alloys than in those of pearlitic structure. The presence of silicon diminishes the magnetic properties; this substance behaves like a non-magnetic impurity which diminishes the magnetic properties of the iron. The presence of aluminium affects the iron in much the same way as silicon; the specific resistance increases nearly proportionally to the aluminium content. The second transition point is lowered 100° C. by 10% Al. The manganese alloys show similarities to the carbon alloys. The coercive force of the slowly cooled alloys is extraordinarily high, and with 10% Mn has a value of 60 gauss, whereas the retentiveness disappears with 14—16% Mn.—J. F. S.

Phosphorus; Determination of —— *in vanadium steels, ferrovanadium, non-vanadium steels, and pig-iron*. C. M. Johnson. J. Ind. Eng. Chem., 1919, **11**, 113—116.

THE methods described below require the following solutions. Nitric acid for titrating: 35·4 c.c. of nitric acid (sp. gr. 1·42) diluted to 4000 c.c. with distilled water. Sodium hydroxide solution: A stock solution is prepared by stirring 150 grms. of pure sodium hydroxide and 1 grm. of barium hydroxide with 1000 c.c. water, decanting or filtering the solution after 24 hours, and diluting with an equal volume of water; the solution for titrating is

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prepared by diluting 500 c.c. of the stock solution to 8000 c.c. with water. Ferrous sulphate solution: 55 grms. of steel (low in phosphorus and sulphur) is dissolved in 720 c.c. of sulphuric acid (1 : 3), a little water being added occasionally to prevent salting out and the liquid heated gently but not boiled, filtered, cooled, and diluted to 1000 c.c. Potassium permanganate solution: 50 grms. in 1000 c.c. of water. Nitrate wash: 8 grms. of potassium nitrate in 8000 c.c. of water. Acid wash: 102·4 c.c. of nitric acid (sp. gr. 1·42) diluted to 8000 c.c. with water. Faintly ammoniacal ammonium molybdate solution: Into each of four beakers are weighed 50 grms. of ammonium molybdate and 50 grms. of ammonium nitrate, to which 40 c.c. of ammonia solution (sp. gr. 0·95) is added; each solution is diluted to 700 c.c. with water, then heated for about 30 minutes with occasional stirring until all the salts are in solution. The contents of the four beakers are united in a large bottle, diluted to 4000 c.c. with water, left overnight, and the in soluble matter removed by filtration through double 15 cm. filter-papers but not washed. The clear solution thus obtained should remain clear indefinitely.

I. *Steel containing vanadium up to* 2·6%. 1·63 grm. of the sample is dissolved in 45 c.c. of nitric acid (sp. gr. 1·13) over a low flame; when the solution is clear and brown fumes have been expelled, 3 c.c. of permanganate solution is added and the liquid boiled for 3 minutes, 3 c.c. of the ferrous sulphate solution being then added to dissolve the precipitate caused by excess of permanganate and the solution boiled until brown fumes disappear; large excess of ferrous sulphate is to be avoided. After addition of 40—50 c.c. of concentrated nitric acid (sp. gr. 1·42) the liquid is brought to the boil, the cover and sides of the beaker being then rinsed with the least possible quantity of water and 50 c.c. of the ammonium molybdate solution added. The whole is stirred vigorously for a minute or two and left overnight, after which it is decanted through a 7 cm. filter-paper with a little paper pulp in the apex, the main precipitate being left in the beaker. Iron is removed by washing 15 times with the nitric acid wash and the main precipitate then introduced into the filter as far as possible with the aid of the nitric acid wash; about 2 c.c. of the latter is added to the beaker and adhering particles removed with a rubber-tipped rod, the washings being caught in a separate beaker. The precipitate is washed 15 times with the nitric acid wash and then 25 times with the potassium nitrate wash or until the outside of the filter, especially along the double thickness, has no sour taste. To the washed precipitate, in a 150 c.c. beaker, enough of the standard sodium hydroxide solution is added to cause the yellow colour of the precipitate to disappear on macerating the paper to a pulp with a rubber-tipped rod. The volume is made up to about 30 c.c. with water and a drop of phenolphthalein added; this should produce a deep red coloration, otherwise more sodium hydroxide solution is needed. The liquid is then titrated back with standard nitric acid solution until the pink colour just disappears. The difference in c.c. between alkali and acid solutions multiplied by 0·01 gives the percentage of phosphorus in the steel.

II. *U.S. standard steels and pig-irons to which* 28% *of vanadium has been added; also ferrovanadium containing* 56·7% *vanadium.* 0·5 grm. of steel and 0·5 grm. vanadium pentoxide (56·14% V) are digested in a 250 c.c. porcelain dish with a mixture of 30 c.c. of hydrochloric acid (sp. gr. 1·20) and 30 c.c. of nitric acid (sp. gr. 1·42) for about an hour, the cover being rinsed and the liquid evaporated to dryness with 100 c.c. of nitric acid (sp. gr. 1·42). The residue is baked for 5 minutes at 750° in an electric muffle furnace, the oxides dissolved in 35 c.c. of concentrated hydrochloric acid, the liquid evaporated to 10 c.c., and, after addition of 50 c.c. of nitric acid (sp. gr. 1·42), again to 10 c.c., and then heated with 10 c.c. of concentrated nitric acid with the cover-glass on the dish. The solution is filtered by suction through a platinum Gooch crucible with a thin pad of acid-washed asbestos, which is afterwards washed 15 times with a mixture of 200 c.c. of nitric acid (sp. gr. 1·42), 100 c.c. of water and 20 grms. of ferric nitrate [the ferric nitrate is made by dissolving 5 grms. of melting bar steel low in phosphorus in 50 c.c. of hydrochloric acid (1 : 1) and evaporating to a syrup twice with 50 c.c. of nitric acid (sp. gr. 1·42) each time]. The filtrate from the separated vanadium pentoxide is concentrated to 10 c.c. in a 150 c.c. beaker and the second crop of vanadium "rust" filtered off as before; a third concentration to 10 c.c. should show no "rust" (V_2O_5). After the third concentration the liquid is brought to the boil with 40 c.c. of nitric acid (sp. gr. 1·42), the cover and sides of the beaker being rinsed with water and the liquid precipitated with 50 c.c. of the faintly ammoniacal ammonium molybdate solution, the whole being stirred vigorously for about 2 minutes. After an hour the solution is filtered and washed as described under I, titration with alkali and acid being then carried out in the usual manner.

III. *Non-vanadium steels or pig-iron.* 1·63 grm. of the sample is dissolved in 45 c.c. of nitric acid (sp. gr. 1·13). (In the case of pig iron and certain chrome steels, when all the metal is dissolved the carbon residue is collected on a 7 cm. filter-paper and washed 15 times with dilute nitric acid wash, the filtrate being caught in a 150 c.c. beaker and concentrated to the original volume.) The solution is boiled for 3 minutes with 3 c.c. of the potassium permanganate solution, just sufficient of the ferrous sulphate solution (about 3 c.c.) being afterwards added to dissolve the oxides of manganese. The brown fumes are expelled by boiling, 15 c.c. of nitric acid (sp. gr. 1·42) is added, the cover and sides of the beaker are rinsed with the least possible amount of water, 50 c.c. of the ammonium molybdate solution is added, and the liquid is stirred briskly until the phosphorus precipitate is completely formed (about 2 minutes). After standing for half an hour or less the solution is filtered through a 7 cm. paper, which is washed 15 times with the nitric acid wash and then with the nitrate wash until the outside fold of the filter-paper has no sour taste; with samples rich in phosphorus 35—40 washings may be necessary. The subsequent procedure is as described above.—T. H. P.

Tinning of cast iron. E. A. Schott. Stahl u. Eisen, 1919, **39**, 119—124.

In the usual process, the articles are pickled in dilute acid and then scoured with pebbles, basalt fragments, etc., in rotary drums to free the surface from graphite. The cleaned moist pieces are then digested with dilute cupric chloride solution to which a little cyanide is added from time to time. When a thin film of copper has deposited, the articles are dipped, while still wet, into tin heated 80°—150° C. above its melting-point, the bath being kept covered with palm oil or wool fat to prevent oxidation; this covering is removed during introduction and withdrawal of the articles; a perforated lid is used to keep the articles immersed while the bath is being heated up to its former temperature. The bath, in dissolving small amounts of iron, becomes gradually contaminated with a tin-iron alloy; for this reason, tinning is generally done in two stages, first in a bath of impure tin, then in pure tin. The articles

after being freed from excess tin by shaking are cooled by a cold air fan or by quenching in water. Improperly tinned ware may be greatly improved by several immersions in a tin bath covered with fused resin.—W. R. S.

Silver and gold refining; Electrolytic —— at Perth Amboy, N.J. G. G. Griswold. Amer. Electrochem. Soc., Apr., 1919. [Advance proof.] 7 pages.

An illustrated description is given of the treatment of doré bullion, by the Moebius process, at the works of the American Smelting and Refining Co. The bullion forms the anode of an electrolytic cell having a cathode of pure silver, the electrolyte being a neutral solution containing 15—20 grms. of silver and 30—40 grms. of copper per litre (as nitrates); a current density of 40 amp. per sq. ft. is employed. The insoluble residue (gold slime) from the anodes—collected in bags by which the latter are enclosed—is treated with sulphuric acid to remove silver and copper and is then melted and cast into anodes for electrolytic refining by the Wohlwill process. For this purpose, cathodes of thin sheet gold are employed in an electrolyte containing 30% of free hydrochloric acid and 80—85 grms. of gold per litre, the current density being 150 amp. per sq. ft.—W. E. F. P.

Gold amalgams rich in gold. N. Parravano and P. Jovanovich. Atti R. Accad. Lincei, 1918, **27**, ii, 364—368. (Compare this J., 1919, 42 A.)

The course of the specific electrical conductivity curve for gold amalgams containing from 0 to 10% Hg indicates that such amalgams rich in gold consist of solid solutions of mercury in gold. (Compare J. Chem. Soc., Apr., 1919.)—T. H. P.

Silver amalgams rich in silver. N. Parravano and P. Jovanovich. Atti R. Accad. Lincei, 1918, **27**, ii, 411—412.

The specific electrical conductivity curve for silver amalgams containing 0—14% Hg consists of two branches: The first, from 0 to about 2% Hg, has the form characteristic for solid solutions, and the second, from about 2 to 14% Hg, is a straight line, which is characteristic of alloys composed of two crystalline individuals, these being saturated mixed crystals with 2% Hg and the compound, Ag_4Hg. (Compare J. Chem. Soc., Apr., 1919.)—T. H. P.

Copper; Action of reducing gases on hot solid ——. N. B. Pilling. J. Franklin Inst., 1918, **186**, 373—374.

Copper containing disseminated copper oxide is rendered weak and friable by heating in a reducing gas such as hydrogen, carbon monoxide, etc. The suggested explanation is that the reducing gas is more soluble in the copper than the steam or other gas which results from the reducing action on the copper oxide, and that a considerable internal pressure is set up which produces a separation of the individual grains. Comparative diffusion rates through copper at 700° C. supported this view: taking the rate of diffusion of hydrogen as 1000, that of steam was found to be 65, carbon monoxide 17, and carbon dioxide 0·6. Similar results were obtained by noting the depth to which the oxide was reduced. In the case of hydrogen the action begins between 400° C. and 500° C. The effect is more strongly marked with cast copper in which the oxide is segregated as a eutectic at the grain boundaries than with wrought copper where the oxide particles are uniformly disposed throughout the grains.—B. V. S.

Zinc blende; Gases escaping from the muffles during reduction of roasted ——. O. Mühlhaeuser. Metall u. Erz, 1918, **15**, 431—436.

A number of analyses of gas given off during the distillation of roasted blende with Pennsylvanian anthracite are tabulated. From the results it is deduced that a good deal of gas penetrates into a new muffle from the furnace; this quantity decreases from day to day until a minimum is reached after about 8 days. The presence of fire gases in the muffles must be due chiefly to reciprocal diffusion of reaction and fire gases. The position occupied by a muffle in the furnace appears to be without influence on the composition of the escaping gas.—W. R. S.

Cadmium [in brass]; Determination of —— by the hydrogen sulphide method. E. Schramm. J. Ind. Eng. Chem., 1919, **11**, 110—113.

The literature of the subject is reviewed and the general considerations governing the estimation of cadmium in brass discussed, the following procedure being finally adopted: Ten grams of the brass is dissolved in 75 c.c. of nitric acid (1 : 1), the solution is boiled for half an hour, the metastannic acid filtered off, and the filtrate diluted to 350 c.c., this bringing the concentration of nitric acid to about 3%. After addition of 10 c.c. of sulphuric acid (1 : 1), the liquid is electrolysed for about 2½ hours with a current of 4 ampères, a rotating cathode being used, until nearly all the copper is removed. The electrolyte is siphoned off and, after addition of a further 10 c.c. of sulphuric acid, evaporated nearly to dryness. The residue is dissolved in 100 c.c. of water, the solution neutralised with ammonia and treated with 5 c.c. of sulphuric acid (1 : 1), and hydrogen sulphide passed through the cold solution for 30 minutes until the sulphides settle. Ammonia is added until zinc begins to precipitate and hydrogen sulphide then again passed through for 30 minutes; the liquid is filtered, water containing ammonium chloride and hydrogen sulphide being used to wash the precipitate from the beaker. The precipitate is boiled for 15 minutes with 20 c.c. of sulphuric acid (1 : 5), the volume being maintained by occasional addition of water; the liquid is filtered and the precipitate washed, the volume being kept down to 50 c.c. Through the filtrate, treated with 5 c.c. of concentrated ammonia, hydrogen sulphide is passed for half an hour, ammonia being then added until the cadmium begins to precipitate. The solution is filtered and the precipitate treated with a little cold hydrochloric acid (1 : 1), the solution being neutralised with ammonia and treated with 5 c.c. of sulphuric acid (1 : 5); the total volume should be kept down to about 30 c.c. Hydrogen sulphide is passed through as before and ammonia added to start the precipitation of the cadmium, the liquid being then filtered, the cadmium sulphide dissolved from the filter in a little hydrochloric acid (1 : 1), and the solution collected in a weighed platinum or porcelain dish, in which it is evaporated with 1 c.c. of sulphuric acid until fumes appear and then treated with a little concentrated nitric acid. The solution is evaporated carefully to dryness and the residual cadmium sulphate weighed. If the presence of tin in this residue is possible, the cadmium sulphate is dissolved in 25 c.c. of water and 5 c.c. of sulphuric acid (1 : 5) and the cadmium re-precipitated with hydrogen sulphide, a little ammonium chloride being added to the solution. After the sulphide has settled, the supernatant liquid is decanted on to a filter, the precipitate in the beaker being warmed for several minutes with a little ammonium polysulphide and ammonium chloride and the liquid poured on to the filter. The cadmium sulphide is dissolved in hydrochloric acid, the liquid evaporated, and the sulphate weighed as before.—T. H. P.

[*Tin ores;*] *Slime treatment* [*of* ——] *on Cornish frames: Supplements.* S. J. Truscott. Bull. 173, Inst. Min. Met., Febr., 1919. [Advance proof.] 31 pages.

THE experiments previously described (this J., 1918, 376 A) were continued, and the following conclusions are now submitted. While a finely fluted surface is more effective with sand tailings ground to slime, *i.e.*, with material of a granular character, a plane surface is preferable for recovering the finest impalpable tin from the slimy portion of the ore. By reducing the length of the frame bed from 6 to 3 ft., the capacity of the frame was doubled, the longer bed requiring prolonged washing for removing the slime. The inclination of the frame should be such that during the feed about 80% of the gangue is removed; in this case subsequent washing raises the value of the concentrate with small loss in tin. A rate of feed of 4½ tons per day for an 18-ft. round frame and 15 cwt. per day for a straight 6-ft. frame, and a pulp ratio of 1 : 10 are recommended. A straight frame should be flushed after 4 minutes' feeding; a round frame should make one revolution in about 4½ minutes. Stepped beds are not suitable for slime treatment, as the very fine tin must be given time to settle. It is considered that the present recovery could be obtained with one-half the present frame area, thus giving additional space for re-treatment of tailings, whereby the total recovery could be improved by about 3½%.—W. R. S.

Cassiterite; Comparison of concentration results with special reference to the Cornish method of concentrating ——. E. Edser. Bull. 173, Inst. Min. Met., Febr., 1919. [Advance proof.] 17 pages.

IN comparing results obtained by the use of different appliances, a difficulty arises from the fact that a greater enrichment is frequently accompanied by a diminished recovery. The method worked out for making the results comparable is based on the assumption that the "waste modulus," $k = \frac{\text{assay of tailings increment}}{\text{assay of concentrate}}$, does not vary as the material in passing over the tables becomes richer and richer in cassiterite. The value of k lies between 1 and 0, for with $k=0$ the tailings contain no tin while with $k=1$ no concentration takes place. The formula $\frac{2-\log(\text{percentage recovery})}{\log(\text{enrichment ratio})}$ gives the "waste index" n, from which k can be calculated by the equation

$$k = \frac{n}{1+n}.$$

— W. R. S.

Nickel; Process for electrolytically refining ——. G. A. Guess. Amer. Electrochem. Soc., Apr., 1919. [Advance copy.] 4 pages.

IN the process as tested on a laboratory scale, anodes of crude nickel, containing copper and iron, are suspended in a bath of nickel sulphate to which finely divided calcite is added periodically; the cathodes (lead or aluminium) are enclosed in a bag of light canvas mounted on a wooden frame. The copper is precipitated as a basic double sulphate $2CuO,2NiO,SO_3$ which settles in the form of mud. The latter is fused with silica in graphite pots to a matte containing Ni 36·1, Cu 37·8, and S 19·5%. The matte may be roasted, then reduced to metal and cast into anodes, from which the copper can be recovered electrolytically. The nickel anodes are produced by roasting copper-nickel matte, leaching the calcine with dilute sulphuric acid to extract the bulk of the copper, fusing the dried residue with charcoal, and casting the crude metal. The nickel deposited on the cathode usually contains less than 0·001% of copper.—W. R. S.

Metals and salts; Ultramicroscopic examination of very thin deposits of —— produced by evaporation in high vacua. L. Hamburger. Kolloid-Zeits., 1918, **23**, 177—199.

THE deposits produced when the metals silver, gold, tungsten, molybdenum, platinum, iron, copper, nickel, magnesium, zinc, and cadmium, as well as carbon, sodium chloride, and calcium fluoride, were heated *in vacuo*, have been examined ultramicroscopically. Metals with high melting point (molybdenum, platinum, nickel, and iron) and also carbon produce sublimates which are either completely or mainly unresolvable into particles. The lower melting elements with a higher vapour tension (gold, silver, copper, magnesium, zinc, and cadmium) show a great tendency to form a less disperse deposit exhibiting a complete network of ultramicrons. Generally the higher the temperature necessary for slow sublimation the finer is the structure of the sublimate. The electrical conductivity of films of gold, silver, platinum, and tungsten, of measured thickness, shows that warming the films from the temperature of liquid air to the ordinary temperature produces a non-reversible resistance change which is very great in the case of silver and gold. (Compare J. Chem. Soc., Apr., 1919.)—J. F. S.

Calcium oxide in lime. Meiklejohn. See VII.

Spectra of iron, cobalt, and nickel. Meggers and Kiess. *See* XXI.

Action of alkalis on alloys of platinum and of gold. Nicolardot and Chatelot. *See* XXIII.

PATENTS.

Iron; Manufacturing of ——. G. C. Carson, San Francisco. U.S. Pat. 1,287,221, 10.12.18. Appl., 15.5.17.

THE process consists in reducing the ore with carbon produced from natural gas or petroleum, the sulphur from which has been removed in the form of carbon bisulphide.—W. R. S.

Rust-proof coating for iron and steel. W. H. Allen, Detroit, Mich. U.S. Pat. 1,290,476, 7.1.19. Appl., 8.1.17.

A RUST-PROOFING liquid for application to iron and steel consists of a 10% solution of phosphoric acid in water, in which is dissolved about 1% by weight of ferric phosphate.—C. A. K.

[*Crucible*] *smelting furnaces and the like.* J. Tylor and Sons, Ltd., H. T. White, J. Gaunt, and D. Brookfield, London. Eng. Pat. 121,213, 14.1.18. (Appl. 802/18.)

IN furnaces of the type described in Eng. Pat. 114,684 (this J., 1918, 308 A), especially such as are provided with a metal cover forming a preheater for the charge to be melted (see Eng. Pat. 118,750; this J., 1918, 659 A), the products of combustion from the furnace or preferably from a pair of furnaces, are led through a second preheating chamber for the charge to be melted and also through a crucible preheater before passing to the chimney.—C. A. K.

Furnace [*for forging, etc.*] A. Smallwood, London. Eng. Pat. 122,504, 2.2.18. (Appl. 1925/18.)

A FURNACE is heated by gas from a central gas producer, the gas entering the furnace through two horizontal flues, extending transversely in opposite directions. Waste gases are conveyed from the

sides of the furnace in a downward direction and thence through transverse flues under the working bed, in the direction of, and then away from the gas producer. Finally the gases are led upwards through a narrow flue above the arch of the furnace and into a stack located centrally above the furnace. Intermediate with the hot waste gas flues are similar transverse air passages, the hot air meeting the gas in the horizontal flues before entry into the furnace. Provision is made for the admission of gas from other producers through a branch flue.—C. A. K.

Furnaces for annealing metal plates. W. John, Swansea. Eng. Pat. 122,699, 31.1.18. (Appl. 1808/18.)

A FURNACE adapted to receive trolleys is tapered towards the entrance end. At the wider end of the furnace, a coal fire-box is built at each side of the discharge door, and an additional firebox, adapted for coke, is fitted on each side near the middle of the furnace. Products of combustion are conveyed from the coal fire along the sides of the furnace and over the central coke fire, and are withdrawn at the narrow end of the furnace into a flue connected to a chimney, or they may be conveyed by means of a fan back to the coal fires.
—C. A. K.

Melting and pouring furnace. I. Kormutt, Charleroi, Pa. U.S. Pat. 1,290,242, 7.1.19. Appl., 4.5.18.

AN oven is fixed over a fire-box, the flue from which communicates with an adjacent melting chamber. A tilting ladle is mounted in the melting chamber, and metal may be transferred from the oven to the ladle by means of a sliding spout.
—C. A. K.

Alloying furnace. F. L. McGahan, Los Angeles, Cal. U.S. Pat. 1,290,268, 7.1.19. Appl., 21.4.17.

Two adjacent smelting chambers are separated by a partition in the form of a hood with oppositely inclined faces. One is fitted with a number of fuel injectors and the second with carbon electrodes. Above the smelting chambers, and separated from them by water-cooled gates, are roasting compartments, separated from each other by water-cooled "grate-tubes." The roasting chambers communicate with a condenser and a vacuum draught stack.
—C. A. K.

Copper-coated printing rollers. Taylor, Garnett, Evans and Co., Ltd., and W. W. Bassham, Manchester. Eng. Pat. 122,433, 20.12.17. (Appl. 18,879/17.)

To efface the design from copper-coated printing rollers the cavities in the latter are filled with a non-electrolytic substance and the roller is then made the anode in an electrolytic bath. The rollers are first coated with the non-electrolytic substance and the raised parts are then exposed by removing the coating from these parts by a "doctor." The cathode of the bath is a similar roller which requires a further deposit of copper, and means are provided, for instance an abrading and burnishing device, for ensuring a uniform deposit over the whole surface.—T. St.

Zinc dust; Increasing the production of —— from spelter retorts. C. W. and C. Crocker, Irvine. Eng. Pat. 122,566, 26.4.18. (Appl. 7025/18.)

A SET of baffles, not in alinement, mounted on a frame is inserted in the prolong used in connection with a zinc distillation retort, to facilitate the deposition of zinc dust. A removable nozzle is fitted to the exit of the prolong to act as a burner and to form a receptacle for any zinc oxide formed. A guard at the inner end of the burner prevents this oxide from passing into the prolong, and means are also provided for preventing zinc oxide formed at the mouth of the condenser from passing into the prolong. An air-cooling device, which extends over part of the prolong, consists of a jacket, perforated on its underside, and bulged out and tapered on its upper side, with an air-exit at the apex of the tapered part. A "spoon" for use with sealed condenser pipes consists of a cylindrical portion which fits into the prolong, and an inner reduced tubular portion which passes through the sealing material into the condenser. There is a small hole in the inner end of the spoon to enable fumes etc. to pass from the sealed condenser to the prolong.—T. St.

Zinc; Metallurgy of ——. J. Armstrong, London. Eng. Pat. 122,688, 28.1.18. (Appl. 1603/18.)

OXIDISED zinc ore is comminuted with bituminous coal, the mixture subjected to a low temperature coking process out of contact with air, and the resulting mass crushed and charged continuously into vertical tubular retorts formed in three sections, the middle one of which is heated and constitutes the reduction retort. This section is made of pure silica or corundum. The upper and lower sections are enclosed in the brickwork of the furnace, as are also the extremities of the middle section. Means are provided for introducing the charge and withdrawing the residue without admittance of air. A branch pipe opening into the upper section serves for the passage of the evolved metallic vapours to the condenser, which may consist of a tank of molten zinc protected from the atmosphere by a floating hood.—T. St.

Composite ingot; Welding of different metals to form a ——. A. G. C. Pittevil, London. Eng. Pats. 122,231 and 122,365, 9.1.18. (Appls. 526/18 and 12,583/18.)

(A) In welding other metals (copper, brass, silver) to a steel or iron ingot, relative displacement of the metals is prevented by providing flanges or depressions on the surface of the ingot and by enclosing the composite ingot in a thin metal covering during manipulation, heating, and the first passage through the rolling mill. The covering is then removed and the rolling completed. The composite ingot is preferably heated in a closed receptacle, the cover of which rests on the ingot. To prevent welding of the metal covering to the ingot the latter may be coated with a mixture of calcium phosphate, phosphoric acid, and oil of turpentine. (B) A thin sheet of copper or other metal which will combine with a constituent of the metals to be welded, or of a fusible metal, such as tin, is interposed between the faces of the metals. The compound ingot is then heated and pressed. If the metal to be welded to the iron or steel is of considerable thickness, it is advantageous to divide it into sections and to interpose a thin sheet of the same metal between successive sections.—C. A. K.

Welded joints. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 122,604, 19.9.18. (Appl. 15,250/18.)

THE edge of one of two plates which are to be welded together is shaped to make a flange, preferably at an angle of about 40° to 50° with the surface of the plate. The second plate is then placed adjacent to the flange and the intervening wedge-shaped space is filled in with molten welding metal, which is welded to each of the plates.
—T. St.

Tinned scrap; Treatment of ——. H. Rogers, M. L. Lancaster, C. M. Walter, and J. Jackson, Birmingham. Eng. Pat. 122,618, 10.1.18. (Appl. 21,520/18.)

IN the electrolytic recovery of tin from tinned scrap, the latter is treated in a rotary container bodily removable from the vat, and the electrolyte, which is heated to about 180° F. (82° C.), is composed of a 1% solution of stannous chloride in a 7—10% solution of sodium or potassium hydroxide. After the detinning operation, the container is transferred to a recovery tank containing steam-heated water to recover the salts remaining on the scrap.—T. St.

Hardening and tempering wire. Critchley, Sharp, and Tetlow, Ltd., and H. Hepworth, Cleckheaton. Eng. Pat. 122,743, 23.3.18. (Appl. 5179/18.)

IN the process of tempering wire by means of gas flames, the wire is first drawn through a gas flame and quenched in an oil bath, and is then drawn over, but at a greater distance from, the same flame, and tempered in the same oil bath. Less gas is consumed than in the normal process of using molten lead for the second heating and separate oil baths.—C. A. K.

Lead bullion; Process of treating ——. G. P. Hulst, Hammond, Ind. U.S. Pat. 1,285,714, 26.11.18. Appl., 20.3.18.

LEAD bullion is liquated and the copper dross removed. The metal is then subjected to oxidising agents to separate other impurities, in the form of a lead-antimony slag, desilverised by means of zinc, again subjected to oxidising agents to form a "refiner skim," the refined lead moulded whilst hot, and then treated to remove any remaining copper in the form of dross. The "refiner skim" and "moulding skim" are added to the charge during the first oxidising treatment, and the "zinc skim" from the desilverised bullion is retorted, the retort bullion cupelled, the yellow litharge from the cupels reduced, and the resulting high-grade bullion added to the main charge of retort bullion in the cupels.
—C. A. K.

Magnetic ore; Apparatus for treatment of ——. E. W. Davis, Minneapolis, Minn. U.S. Pat. 1,286,247, 3.12.18. Appl., 18.5.16. Renewed 5.5.17.

THE apparatus comprises a spout, through which the coarse and fine ore is delivered into a classifier; the spout is surrounded by a tapered demagnetising alternating current coil. The overflow from the classifier passes through a launder surrounded by a tapered re-magnetising direct-current coil.
—W. R. S.

[Molybdenum] ores; Process of treating ——. A. L. Pellegrin, Tucson, Ariz. U.S. Pat. 1,286,400, 3.12.18. Appl., 2.1.17.

REFRACTORY oxide ores containing molybdenum, vanadium, uranium, etc., are crushed to —150 mesh and mixed with strong sulphuric acid so as to cause a rise in temperature without reduction of the acid oxide. The acid solution is separated from the insoluble portion, neutralised, and the molybdenum precipitated as sulphide.—W. R. S.

[Copper] ores; Process of treating ores —— by flotation; Process of treating copper ores by flotation and sulphitisation. N. C. Christensen, Assignor to Metallurgical Improvement Corporation, Salt Lake City, Utah. U.S. Pats. (A) 1,286,531 and (B) 1,286,532, 3.12.18. Appl., 6.3 and 3.4.18.

(A) THE ground ore is agitated with a solution of sulphur dioxide, the liquor is treated with a soluble lime compound and heated, whereby cupro-cupric sulphite is formed. The latter is separated by flotation. (B) A thick aqueous pulp of the ore is treated with sulphur dioxide in presence of an excess of metallic copper at the temperature of boiling water. The cupro-cupric sulphite formed and the excess of copper are removed by flotation.
—W. R. S.

Copper; Process for recovering —— from ores and ore-products. G. N. Kirsebom, Copenhagen. U.S. Pat. 1,286,652, 3.12.18. Appl., 5.12.17.

SULPHIDE ores rich in copper, roasted siliceous sulphide copper ores, and a quantity of coke sufficient to reduce ferric to ferrous oxide, are smelted together in an electric resistance furnace.
—W. R. S.

Clayey ores; Apparatus for clearing ——. E. F. Goltra, T. S. Maffitt, and J. D. Dana, St. Louis, Mo., and R. W. Erwin, Waukon, Iowa, Assignors to Mississippi Valley Iron Co., Wilmington, Del. U.S. Pat. 1,288,404, 17.12.18. Appl., 5.1.14.

THE material is heated and tumbled in a "converter" operated with or without a blast, and is then crushed and screened; the over-size is subjected to similar treatment in a second converter operated with a strong blast to remove the gangue.
—W. E. F. P.

Metallurgical process. Process of producing ferromanganese. J. T. Jones, Assignor to T. J. Howells, Pittsburgh, Pa. U.S. Pats. (A) 1,288,422, 17.12.18, and (B) 1,289,799, 31.12.18. Appl., 13.12 and 12.10.17.

(A) FINELY divided ore containing iron and manganese is mixed with finely divided coal, and the mixture is heated to 2000° F. (about 1090° C.), out of contact with air. After separating the metallic iron from the coked product, the residue is heated to 3000° F. (about 1650° C.), in the presence of air, to produce metallic manganese. (B) The metals produced as above are melted together to form ferromanganese.—W. E. F. P.

Metal [aluminium]; Process of printing on ——. P. MacGahan, Pittsburgh, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,289,215, 31.12.18. Appl., 29.12.14.

A SMOOTH and even coating of aluminium oxide is produced on sheet aluminium by immersing the metal in a solution of a soluble silicate through which an electric current is passed. The metal is then dried and printed upon, as for example in the manufacture of dials for clocks.—W. E. F. P.

Ore-reducing furnace and process. Metallising process and apparatus. Ore-reducing apparatus and process. (A) J. T. Jones, (B) (C) J. M. Longyear and J. T. Jones, Marquette, Mich., Assignors to New Metals-Process Co., Chicago, Ill. U.S. Pats. (A) 1,289,800, (B) 1,289,834, and (C) 1,289,835, 31.12.18 Appl., 23.2.15. Renewed 2.11.18.

(A) THE shaft of a vertical furnace is shaped so as to provide a tortuous (zigzag) path for a stack of solid fuel and ore, and to afford supports at intervals, dividing the stack into separate portions, to each of which air is supplied (through tuyères at one side) in such limited quantity as to maintain a deoxidising atmosphere throughout the shaft. (B) The shaft of the furnace is constricted at regular intervals to form a series of superposed sections, each having tuyères at the lower part. Air is supplied to these sections in such manner as to maintain deoxidising conditions throughout the lower part of the stack, to provide a high-temperature zone near the bottom, and to preheat the solid fuel in

the upper part. (c) In a furnace of the type described under (b), adjustable, horizontal supports for the different burden sections are provided at the constricted portions of the shaft.—W. E. F. P.

Flotation process. R. Gahl, Miami, Ariz., Assignor to The Utah Copper Co. U.S. Pat. 1,290,166, 7.1.19. Appl., 31.1.16.

Ore is mixed with a solid material, *e.g.*, sub-divided metallic iron, capable of increasing the efficiency of flotation. The added material is subsequently recovered from the flotation tailings and used with a further supply of ore.—C. A. K.

Metallic dust; Manufacture of ——. E. J. Hall, Assignor to Metals Disintegrating Co., New York. U.S. Pat. 1,290,181, 7.1.19. Appl., 4.5.17.

A small quantity of a metal with a greater affinity for oxygen than the metal under treatment is added to the bulk of molten metal before disintegration. Substantially pure metal dust free from oxide may then be obtained by atomising the molten mixture without complete exclusion of oxygen.—C. A. K.

Nickel copper mattes; Method of separating nickel from ——. E. C. R. Marks, London. From United States Nickel Co., New York. Eng. Pat. 122,335, 11.4.18. (Appl. 6193/18.)

See U.S. Pat. 1,273,465 of 1918; this J., 1918, 591 A.

Kilns. Eng. Pat. 122,742 *See* I.

XI.—ELECTRO-CHEMISTRY.

Paper; Change of specific inductive capacity with temperature and impregnation in ——. H. C. P. Weber and T. C. MacKay. J. Franklin Inst., 1918, **186**, 374—377.

The measurements were made by the simple bridge method in which two arms are resistances and the other two capacities. The resistances were each 9000 ohms, one capacity was a calibrated air condenser, and the other a pair of massive iron electrodes kept at a definite separation by glass stops and between which was placed the sample under examination. The temperatures taken were those of the iron electrodes. Curves of the changes in specific inductive capacity with temperature are given for paper impregnated with ceresin, paraffin, Carnauba wax, montan wax, and ammonium stearate respectively, and for the same substances alone. In each case the specific inductive capacity of the pure substance was lower and less affected by temperature change than that of paper impregnated with the substance.—B. V. S.

Electrical precipitators. Thum. *See* I.

Electric heating in concentration of sulphuric acid. Pagliani. *See* VII.

Porcelain. Bleininger. *See* VIII.

Patents.

Electrodes of electric batteries. M. Robin, Buenos Ayres, Argentine. Eng. Pat. 122,697, 30.1.18. (Appl. 1765/18.)

A battery electrode comprises a zinc base, coated with a mixture of grease, insoluble in the electrolyte, and a ferrocyanide. Alternatively an amalgamated zinc plate coated in the above manner is used as the negative electrode in a battery, which is then charged and discharged to the normal coefficient, and afterwards charged to a very high coefficient; the coating is then removed from the zinc electrode and compressed. The electrode thus formed retains its charge on "open circuit," and may be withdrawn from the electrolyte without discharge and disintegration.—B. N.

Battery electrode. W. O. Snelling, Pittsburgh, Pa. U.S. Pat. 1,288,722, 24.12.18. Appl., 24.4.15.

An electrode for primary galvanic cells is formed from a mixture of granular carbon, granular manganese dioxide, and up to 1% of finely divided nickel.—D. F. T.

Electric safety-fuse. W. O. Snelling, Pittsburgh, Pa. U.S. Pat. 1,288,724, 24.12.18. Appl., 22.3.15. Renewed 8.6 18.

An electric safety-fuse comprises a body of readily fusible conducting material associated with a solid ethane polyhalide capable of volatilisation into a fire-preventing vapour.—D. F. T.

Electrical separation of suspended particles. Eng. Pat. 122,534. *See* I.

Treating [petroleum] oil. U.S. Pat. 1,290,369. *See* IIA.

Production of nitrides. Eng. Pat. 122,523. *See* VII.

XII.—FATS; OILS; WAXES.

Cotton seed; Removal of the residual fibres from — and their value for non-textile purposes. E. C. de Segundo. J. Roy. Soc. Arts, 1919, **67**, 181-198. (See this J., 1918, 118 T, 172 T.)

In the treatment of a woolly cotton seed retaining 10—12% of fibre, the first process after ginning is the "linting" process with saw-linting machines. The quantity of fibre removed as "linters" may be varied, partly voluntarily, by the adjustment of the saws, and partly involuntarily, by the wearing down of the cutting edges. If the latter are sharpened at very frequent intervals, the removal of the linters may be maintained at the maximum percentage, but their total commercial value for textile purposes is not increased by increasing the quantity, since their quality decreases in the same ratio. Nevertheless, since the war, the demand for linters for explosives manufacture has been so keen that the quantity removed in this process shows a progressive increase. The author points out that the legitimate function of the saw-linting machine is to skim off the inferior textile fibre left by the gin and that if it is used for removing the non-textile fibre also, its productive and mechanical efficiency falls rapidly and the textile linters are contaminated with the non-textile, as well as with an abnormal amount of hull debris. The author has devised a seed-defibrating machine for removing as much of the non-textile lint as is desired in a separate process, following the removal of the textile linters by the saw-linting machine. He proposes the following distribution of the different fractions of fibre obtainable from American Upland cotton retaining 11% of total fibre: High grade (textile) linters by the saw-linting machine, 2%; seed-lint (non-textile) by the seed-defibrator, 3%; and hull-fibre, after decortication and screening, 6%. Egyptian and Bombay seeds would have to be crushed by the British system, because they do not retain sufficient fibre after ginning to carry them through the decorticating process, but the seed-

defibrator would still be applicable to these varieties for the removal of the 1·5—2% of lint which now finds its way into the cake. Certain considerable advantages as regards storage, transport, and the selection of germinable seeds are to be obtained by defibrating the seeds in the country of origin, and if this operation could be established in India, the seeds exported would command a premium of 12*s*.—25*s*. per ton on the British market.—J. F. B.

Oils; Study of the viscosity of various colonial ——. F. Helm. Bull. de l'Office Colonial, 1918, **11**, 251—264. Bull. Agric. Intell., 1918, **9**, 1367—1368.

The viscosity of an oil or fat increases with the m.pt. of the fatty acids, except in the case of very viscous oils. It also increases with the sp. gr. of oils arranged in the three groups—drying, semi-drying, and non-drying oils. It varies inversely with the iodine value.—C. A. M.

Soaps containing clay; Determination of fatty soap in ——. F. Bodinus. Z. Unters. Nahr. Genussm., 1918, **36**, 190—191.

To determine the total amount of fatty soap in soaps containing clay, 5 grms. of the finely divided sample is mixed with 50 grms. of sand and extracted with hot methyl alcohol; the alcoholic extract is evaporated, and the residue of soap contained therein is dried and weighed. This residue may be dissolved in water and the fatty acids liberated and determined in the usual way.—W. P. S.

Oil of turpentine and rosin. Besemfelder. *See* XIII.

Sorghum fat. Francis and Friedemann. *See* XIXA.

Utilising animal carcases. Frabot. *See* XIXA.

Fat extraction apparatus. Griffiths-Jones. *See* XXIII.

Patents.

Solid and liquid fatty or fat-like bodies; Separating ——. F. Pink, Portsmouth. Eng. Pat. 122,764, 16.5.18. (Appl. 8209/18.)

The fatty matter is charged into a long tube or bag, and is pressed by drawing the bag through a draw-through aperture or against scraping edges, or between internally heated or cooled rollers with an adjustable nip. Fractionation of the fatty material may be obtained by employing several dies or draw apertures maintained at any desired temperature or housed in air at any desired temperature. The fatty material may be fed into the tube or bag by a driving spiral or packing mill.—A. de W.

Fatty materials; Process of treating solid ——. W. P. Schuck, Assignor to Superior Oil and Process Co., Portland, Oreg. U.S. Pat. 1,288,228, 17.12.18. Appl., 9.1.17.

Fats, such as coconut oil, consisting of a mixture of normally solid and normally fluid constituents, are treated with a small amount (5%) of hollow fibres, such as flax, and made into cakes. These are wrapped in filter-cloths and expressed at a temperature only slightly below the m.pt. of the solid fat. A large proportion of the liquid constituent can thus be expelled, and the residual cakes are then melted, and the fibres separated.
—C. A. M.

Soap; Process of making ——. L. Stastney, Chicago, Ill. U.S. Pat. 1,288,255, 17.12.18. Appl., 27.5.18.

The heated soap mass is introduced into a closed mould, where it is compressed and left to cool while compressed.—C. A. M.

Oil composition and process of making same. R. Boehringer, Newark, N.J. U.S. Pat. 1,289,097, 31.12.18. Appl., 1.6.16.

A composition soluble in water is obtained by dissolving a resin in animal or vegetable fats or fatty acids, treating the solution with sulphuric acid, and neutralising the sulphonated product with an alkali.
—C. A. M.

Linseed oil fatty acids. Eng. Pat. 112,696. *See* XIII.

Utilising animal carcases. Ger. Pat. 308,753. *See* XV.

Cocoa butter. Eng. Pat. 122,512. *See* XIXA.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Oil of turpentine and rosin; German ——. E. R. Besemfelder. Chem.-Zeit., 1919, **43**, 4—5.

All soft woods and many coniferous woods can be advantageously dried by the method previously described (this J., 1917, 148). Apparatus has also been constructed in which sawdust is introduced pneumatically at one end, freed from rosin, and withdrawn dry and sterile at the other ready for mixing with molasses for fodder. The dissolved lignin substance is evaporated, dried and distilled and the residue ignited to recover the alkali salts. It is suggested that no wood should be burned without previous extraction of fat and rosin. From one-third to one-quarter of the extract of wood, calculated on the dry substance, consists of fatty acids. Since the amount of oil of turpentine and the solubility of the rosin rapidly decrease, it is advisable that the wood should be extracted on the spot and as soon after felling as possible. The drying can be effected by means of a solvent of such low b.pt. that the sap can be expelled from fresh wood without coagulating the albuminous constituents. The process renders fir wood immediately available for the manufacture of cellulose, whereas under ordinary conditions storage for about 6 years is required to render the fat and rosin innocuous.
—C. A. M.

Rosin; [Determination of] melting point of ——. T. L. Crossley. J. Ind. Eng. Chem., 1919, **11**, 52—53.

Rosin has no definite melting point, and any specification aiming to grade it by reference to its behaviour when heated should state the method used. If the m.pt. is determined by dipping glass tubes into the molten substance so that a definite depth of substance remains in the tube on cooling, then dipping these tubes 1 in. below the surface of water, raising the temperature of the latter, and noting the point at which the water penetrates the layer of rosin, the results obtained are not very definite. The result is merely the point at which the viscosity of the rosin is so reduced that it is overcome by the pressure of 1 in. of water. The greater the thickness of the column of rosin, the higher is the m.pt. observed. Results from 10° to 20° C.

lower are obtained if a mere film of rosin is formed on the end of the tube and these results agree closely with those found by the capillary tube method in which the powdered rosin is heated in a capillary and the temperature noted at which the particles coalesce; the heating should not be continued until the whole of the rosin becomes clear. —W. P. S.

Resins; Constituents of ——. *III. Siaresinol from Siamese gum benzoin.* A. Zinke and H. Lieb. Monatsh. Chem., 1918, **39**, 627—639.

FURTHER examination of *d*-sumaresinol and siaresinol (this J., 1918, 520 A, 663 A) has shown that these isomeric substances are acidic in character and that the acidic hydrogen is contained in a carboxyl- and not in a hydroxyl-group as assumed by Lüdy (this J., 1893, 946; 1894, 821); the former is therefore to be regarded as *d*-sumaresinolic acid and the latter as *d*-siaresinolic acid. Oxidation of *d*-siaresinolic acid leads to the formation of a monobasic acid, $C_{27}H_{40}O_4$, and the loss of three atoms of carbon and eight atoms of hydrogen appears to denote the elimination of a propyl or isopropyl group: the formula for the mother-substance may be written, $C_{24}H_{40}O_2.C_3H_7.CO_2H$. Chromic acid oxidises the double compound of acetic and *d*-siaresinolic acid (this J., 1918, 520 A) to an acid, $C_{27}H_{40}O_4$, short prisms, m.pt. 317° C., $[\alpha]_D^{16} = -193{\cdot}8°$ in chloroform solution.—H. W.

PATENTS.

[*Colour*] *lakes; Manufacture of* ——. E. F. Morris, Liverpool. Eng. Pat. 122,540, 12.3.18. (Appl. 4289/18.)

NEUTRAL lakes are obtained by absorbing acid dyes under acid conditions with aluminium hydroxide, alone or with substrata such as barium sulphate. The absorbed acid dye is then treated with a neutral solution of a salt of the same or another dyestuff. A further treatment of such lakes with soluble barium or calcium salts varies the shades obtained. —A. de W.

Oil-pastes; Conversion of water-pastes into —— *by chemical and mechanical action.* H. P. Fletcher, Sydney, N.S.W. Eng. Pat. 122,612, 26.10.18. (Appl. 17,493/18.) Int. Conv., 15.8.18.

THE formation of oil paste, *e.g.*, white lead paste, from a water paste, without previous drying, is accomplished by milling the water paste with a predetermined quantity of manganese borate, the necessary oil being then added and milling continued until the water separates. The amount of manganese borate necessary varies with the water content of the paste but should never exceed 0·5% of the wet paste.—A. de W.

Anti-fouling paints; Manufacture of ——. W. Bailey, London. Eng. Pat. 122,683, 8.7.18. (Appl. 1372/18.)

AN anti-fouling paint which remains in permanent suspension and has no softening effect on the anti-corrosive undercoat is obtained by mixing together a liquid vehicle and a powder base separately prepared. The vehicle is prepared by melting 5 parts by weight of rosin at 165° C. and adding it in the molten condition to 6 parts by weight of white spirit (petroleum). The powder base consists of a mixture of zinc oxide 20 parts, powdered whiting 30 parts, red iron oxide 65 parts, barytes 100 parts, cuprous oxide 22 parts, yellow mercury oxide 15 parts, and copper thiocyanate 15 parts; 7 parts of silica may also be added. The paint is prepared by mixing the powder as above with (say) 150 parts of the liquid vehicle together with (say) 45 parts of rosin oil, grinding in a paint mill, and thinning with more of the liquid vehicle.—A. de W.

Titanic oxide product [pigment]; Composite —— *and method of producing same.* L. E. Barton, Niagara Falls, N.Y., Assignor to The Titanium Alloy Manufacturing Co., New York. U.S. Pat. 1,288,473, 24.12.18. Appl., 11.8.17.

A SOLUTION of titanium sulphate or other titanium compound is mixed with an "extender-pigment," and treated with a reagent to produce the required amount of an insoluble sulphate. A titanic compound is then precipitated in the mixture, and the resulting coalescing mass of "extender-pigment," sulphate base and titanium compound is separated and calcined.—C. A. M.

Pigments; Manufacture of ——. F. Steinitzer, Fürstenfeldbruck. Ger. Pat. 305,774, 4.1.17.

TALC as free as possible from clay is treated with acid, neutral, or basic solutions of metallic salts and then with solutions of other suitable salts to form coloured products or with solutions of lake-forming organic colouring matters. The products when made into paints dry better and are superior in other respects to those obtained by using clay or talc admixed with clay.

Linseed oil residual fatty acids; Process for treating —— *and utilising the same as oil or for paint or for oxidation for the manufacture of linoleum and like products.* E. C. Witter, Appley Bridge, Lancs. Eng. Pat. 122,696. (Appls. 1750, 30.1.18, and 10,424, 25.6.18.)

RESIDUAL linseed oil fatty acids are converted into a paint oil by heating to 500°—600° F. (260°—315·5° C.) for about four hours or upwards, with or without the addition of driers. For use in linoleum manufacture the product described above is further treated by a known process of oxidation (Eng. Pats. 12,000 of 1890 or 7126 of 1894; this J., 1891, 713; 1895, 372) or preferably by steam-heating to 150°—180° F. (64·5°—82° C.) with a mixture of about 5% of drier (lead and/or manganese resinate or cobalt base) and 5—10% of whiting or finely-divided earth colour whilst subjecting to a current of air and agitation for about 24 hours. When stiffening takes place, suitable gums and/or resins are added and heating and agitation continued until the desired consistency is obtained.—A. de W.

Resinous product; Manufacture of a ——. E. Zimmermann, Elberfeld. Ger. Pat. 305,775, 13.2.17.

LACTIC acid is heated *in vacuo* for a long time, the temperature being raised gradually from 100° to 200° C., and the product is condensed with formaldehyde or paraldehyde. An odourless, non-inflammable resinous product, soluble in chloroform and glacial acetic acid, slightly soluble in benzene, insoluble in ether, alcohol, and petroleum spirit, is thus obtained. Its colour varies from pale yellow to almost black, according to the purity of the lactic acid used.

Pipe-caulking composition. R. B. Howell, Omaha, Nebr. U.S. Pat. 1,290,204, 7.1.19. Appl., 19.5.17.

A PIPE-JOINTING composition is obtained by melting together sulphur (46 parts), sand (46), and carbon (8 parts).—A. de W.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

[*Rubber*] *latex; Bacterial changes in* ——. G. S. Whitby. Agric. Bull., Fed. Malay States, 1918, **6**, 513—516.

THE conclusions drawn by Kendall (J. Biol. Chem., 1913, **13**, 63; J. Amer. Chem. Soc., 1913, **35**, 1201) to the effect that bacteria which can utilise both carbohydrate and protein, preferentially act on the

former, explain the influence of the addition of sugars in preventing the putrefactive decomposition of the nitrogenous constituents of latex and in increasing the degree of acidity produced; it is not necessary to assume the existence of two distinct sets of bacteria, one capable of attacking carbohydrates and at the same time unfavourable to the growth of the other which is capable of causing the decomposition of the nitrogenous compounds. The anti-coagulative effect of the putrefactive or proteolytic activity in latex is probably due only in part to the production of alkaline substances.—D. F. T.

Rubber; Moisture-content of plantation ——. O. de Vries. Comm. Central Rubber Stat., Buitzenzorg, Java, 1918, No. 12, 852—860.

THE average moisture content (loss in weight at 95° C.) of crêpe rubber is rather higher during the wet monsoon than during the dry monsoon, but with smoked sheet the reverse is the case; this conclusion is based on results obtained with a total of 261 samples. Even with samples of the same type the moisture content may vary considerably owing to variation in the hygroscopic state of the atmosphere and to differences in the proportion and nature of the non-caoutchouc constituents of the rubber. Processes causing loss of serum substances, *e.g.*, dilution of the latex, keeping freshly rolled crêpe or sheet under water, or allowing a day to elapse before rolling the coagulum, tend to give drier rubbers. The use of formalin has no effect on the final proportion of moisture retained by the rubber, but sodium bisulphite or sodium carbonate may cause a higher moisture content; smoking the rubber sheet introduces a further complication and in cases where the smoking caused an increase in weight of 1 to 2%, a slight increase was also observed in the moisture content.—D. F. T.

Rubber-sulphur mixtures; Tensile strength of ——. O. de Vries and H. J. Hellendoorn. Comm. Central Rubber Stat., Buitzenzorg, Java, 1918, No. 11, 769—791.

ON vulcanising a mixture of rubber 92½% and sulphur 7½% for a series of increasing periods, a gradual increment is at first observed in the tensile strength of the product until a maximum is attained, after which the tensile strength decreases rapidly; the resistance to stretching, however, continues steadily to increase so that the end-points of the stress-strain curves for the various periods of vulcanisation form a rough parabola. With mixtures containing higher percentages of sulphur a similar phenomenon is observed, but with a lower proportion, *e.g.*, 5%, although the tensile strength reaches a maximum when the proportion of combined sulphur is approximately 4½%, further "vulcanisation" causes an increase in the extensibility so that the stress-strain curve no longer descends steadily but begins to recede; it is, therefore, possible with such low proportions of sulphur to vulcanise the mixing for two periods, one on each side of the period for maximum tensile strength, and to obtain products of different free sulphur content but giving coincident stress-strain curves. This possibility demonstrates the advisability, in rubber testing, of using a standard mixing with a relatively high content of sulphur, *e.g.*, 7½ or 10%. —D. F. T.

Rubber stress-strain curve. P. Schidrowitz and H. A. Goldsbrough. India-Rubber J., 1919, 57, 269—270.

THE results of experiments are quoted in agreement with the observation of other workers that when a rubber mixing free from inorganic and organic accelerators and containing a comparatively small proportion of sulphur is vulcanised for such a period that the free sulphur has almost entirely disappeared, further heating may cause the rubber to become more extensible, so that the stress-strain curve undergoes "reversion" or begins to assume a steeper initial course, although the alteration is small compared with the opposite effect of the earlier stages of vulcanisation. This phenomenon is in accord with the view that during vulcanisation two changes occur concurrently: (1) a process of integration or "firming up" accompanied by chemical combination with sulphur, and (2) a degradation process due to the action of heat only. In the presence of accelerators the "reversion" appears to be more rapid and may be accompanied by alteration in the "type," viz., an increase in the slope of the curve, which indeed may finally become convex towards the load axis. The phenomenon of reversion is indicated as the main cause of the difference between the physical character of reclaimed rubber and of the waste vulcanised rubber from which it is made. (See De Vries, preceding abstract.) —D. F. T.

Caoutchouc; Synthetic —— C. Duisberg. Z. Elektrochem., 1918, 24, 369—372.

SYNTHETIC rubber from dimethylbutadiene (methylisoprene) as first made on a commercial scale was very susceptible to oxidation and combined very slowly with sulphur. These difficulties were overcome by the addition of organic bases (especially piperidine and similar substances) and in this way hard rubber (vulcanite) equal in strength to that made from natural rubber and with an electrical resistance about 20% higher has been made. The production of soft vulcanised rubber from the synthetic product has not been equally successful. Leather-like products are usually obtained and although the elasticity can be improved by addition of dimethylaniline and other substances, the material does not work well on the rolls, does not vulcanise satisfactorily, and is inferior in "nerve" to vulcanised rubber made from the natural product.—J. F. S.

Permeability of balloon fabrics. Edwards. *See* V.

PATENTS.

Rubber derivatives; Manufacture of ——. W. O. Snelling, Pittsburgh, Pa. U.S. Pat. 1,288,723, 24.12.18. Appl., 15.11.15.

A PLASTIC oxidation product of rubber is obtained by treating natural rubber with an oxidising agent such as ozone in the presence of water and a small quantity of copper oleate.—D. F. T.

Rubber goods; Process and apparatus for vulcanising ——. A. L. Comstock, Boston, Mass., Assignor to American Rubber Co. U.S. Pat. 1,289,043, 24.12.18. Appl., 16.5.13.

VULCANISATION is effected by removing the atmosphere surrounding the goods and subjecting them to an atmosphere of inert gas which is maintained at the required temperature. The gas is heated outside the vulcanising chamber and is made to circulate by means of a pump. The articles to be vulcanised are placed on forms, introduced into the heated vulcanising chamber which is then closed, and the internal pressure is reduced; on again raising the pressure, the articles become compacted and firmly adherent to the forms, and whilst the pressure is maintained the interior of the chamber is heated, vulcanisation being thereby effected. —D. F. T.

Vulcanising; Method of ——. J. R. Gammeter, Akron, Ohio, Assignor to B. F. Goodrich Co., New York. U.S. Pat. 1,290,731, 7.1.19. Appl., 18.4.17.

Rubber articles are vulcanised by intermittently pressing and continuously heating a series of moulds containing them, in a succession of overlapped curing periods, and replacing with fresh moulds those of the series the curing period of which is complete, during the intervals of release of pressure.—E. W. L.

Rubber or like substance; Process of synthetically producing ——. L. Gottschalk, Metuchen, N.J. U.S. Pat. 1,289,444, 31.12.18. Appl., 14.5.15.

Commercial turpentine, from which the resin has been removed, is heated together with an acid to a temperature not exceeding 240° C., and the resulting mixed vapours are passed through a tube the first portion of which is at 250° C. and the further portion at 300° C. or higher. At the former temperature the pinene undergoes conversion into limonene which at the latter temperature changes, at least in part, into a rubber-like substance. The vapours are then condensed, and after removal of the acid, by-products are separated by distillation from the resulting material, and the residual rubber-like material is dried in the air at a temperature not exceeding 85° C. The by-product and the recovered acid are used again in the process.—D. F. T.

Caoutchouc-like substances; Process for improving ——. Badische Anilin u. Soda Fabrik. Ger. Pat. 307,341, 13.10.16.

The caoutchouc-like substances obtained by treating butadiene or its homologues with metals such as sodium, in presence of carbon dioxide (see Fr. Pat. 459,005; this J., 1913, 1164) do not yield satisfactory products on vulcanisation. Good results are obtained, however, if the substances before vulcanisation are subjected to mild oxidation, corresponding to an absorption of 3—4% or even 6% of oxygen. For example, the product obtained from isoprene by the action of sodium in presence of carbon dioxide, after being washed with water, is spread out whilst still moist and exposed to the air. After three days, when about 3% of oxygen has been absorbed, the sticky mass is worked on the rolls, mixed with sulphur etc., and vulcanised.

Recovering solvents. Eng. Pat. 122,685. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

Utilising animal carcases. Frabot. *See* XIXA.

Patents.

Bates for hides; Method of preparing ——. L. R. Peyrache, Paris, and O. V. Bailly, Saint-Mandé, France. Eng. Pat. 120,928, 22.11.18. (Appl. 19,236/18.) Int. Conv., 22.11.17.

A bate for the treatment of hides consists of an opotherapeutic pancreatic or pancreo-intestinal powder prepared from fresh pancreatic glands and the fresh mucus of the small intestines, and contains in addition to their water-soluble principles the whole of the soluble and insoluble enzymes of these glands and mucus. It may be prepared (1) by mixing the finely triturated pulp of 87 kilos. of fresh ovine, equine, porcine, or bovine pancreas with 250—300 litres of acetone, filtering after a few minutes, pressing the residue, treating it with two further quantities of 1½—2½ times its own volume of anhydrous acetone, and finally allowing the last traces of acetone to evaporate from the mass and reducing it to the finest possible powder; or (2) by treating 32 kilos. of fresh intestinal mucus with 100—120 litres of acetone in a similar manner. The products are perfectly stable for several months, and may be used, preferably at 30°—40° C., alone or in conjunction with neutral or faintly alkaline or acid deliming agents, and in presence of inert substances such as cellulose.—E. W. L.

Tanning. E. Schwarz, Berlin, and L. Blangey, Mannheim, Assignors to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,289,280, 31.12.18. Appl., 27.4.17.

Hides are tanned in a bath containing a carbazolesulphonic acid.—C. A. M.

Tanning with the aid of sulphonated oils. O. Röhm, Darmstadt. Ger. Pat. 308,386, 16.2.16.

Sulphonated oils from which the whole or a greater part of the soaps have been removed are dissolved in a volatile solvent, treated successively with flour and a solution of alum and salt, and then applied directly to hides. (See also Fr. Pat. 470,594 of 1914; this J., 1915, 190.)

Glue; Liquid ——. F. W. Channon, West Byfleet, Surrey. Eng. Pat. 122,807, 2.12.18. (Appl. 19,897/18.)

Ordinary glue, 18 lb., is soaked for 12 hrs. in soft water, 12 qts., then heated to 80° F. (27° C.) and stirred till fluid. The following mixture is then slowly added, at 60° F. (15·5° C.), whilst the liquid mass is stirred:—Ammonium carbonate, 1½ oz., in soft water (at 120° F.), 10; phosphoric acid, 20; absolute alcohol, 10; oil of lavender, 4; amyl acetate, 1; carbolic acid (pure), 40 oz. The whole is heated to 120° F. (49° C.) for 15 mins. and then allowed to cool. The glue remains liquid at 70° F. (21° C.), and is said to possess the power of penetrating wood.—E. W. L.

Animal carcases; Apparatus for utilisation of —— [*for recovery of glue, fat, etc.*]. H. Goslar, Aachen. Ger. Pat. 308,753, 15.11.16. Addition to Ger. Pat. 308,152 (this J., 1919, 23 A).

A system of heating tubes is arranged in the charging chamber, separated from the interior of the chamber by perforated angle-sheets. The arms of the stirrer, situated at the bottom of the charging chamber, work in contact with a perforated annular portion at the outer circumference of the floor of the chamber. Below the charging chamber there is arranged a rotating sieve table, provided with a scraper at its outer edge. The fleshy residues, sterilised and freed from fat, are thereby reduced to the form of a meal.—J. F. B.

Drying leather, etc. Eng. Pat. 122,544. *See* V.

XVI.—SOILS; FERTILISERS.

Soil; Flocculating power in ——. *I. Coagulating action of some soluble salts on clay in soil.* G. Masoni. *II. Determination of the flocculating power of soil solution.* G. Leoncini and G. Masoni. R. Univers. di Pisa. Istit. di Chim. Agr., Stud. e. Ricerche, 1909—1914, Pt. 22, 247—293, 406—420, Bull. Agric. Intell., 1918, **9**, 1285—1287.

I. The flocculating power of the chlorides, nitrates, and sulphates of sodium, potassium, ammonium, and calcium was studied, using an ordinary soil not too rich in clay and poor in organic matter. The soil was first air-dried and then sifted to remove the fine particles. The results show that, weight for weight, chlorides have a greater flocculating

power than nitrates and these in turn than sulphates. Calcium salts have a greater flocculating power than potassium and ammonium salts, and the latter are more active than sodium salts. There is no ratio between the weight of salts used and their flocculating action. The flocculating power of each salt decreases with increase in the ionic concentration, but there is no simple relationship between the dissociation and the flocculating power of a salt. The flocculating action of the salts tested is due exclusively to the cations, the clay acting as a negative colloid. Concentration and dissociation being equal, salts with identical cations but different anions have the same flocculating power. The valency of the cation, but not the atomic weight of the element, has a relative influence on the flocculating power. Taking the flocculating power of the sodium ion as 1, the relative flocculating powers of the other cations studied are approximately: potassium 2·4, ammonium (NH_4) 2·4; calcium 5·7. The modifications in the permeability of the soil caused by saline solutions have no direct relation to the flocculating power of these solutions on clay, even in the case of very thick layers of soil and relatively concentrated solutions.

II. To measure the flocculating power of a soil solution, 0·5 grm. of very fine kaolin and 200 c.c. of the solution to be tested are placed in an Appiani levigator, and the whole is shaken for ½ hour and left to stand 6 hours. The thick liquid is poured into a flask and the amount of kaolin in suspension is determined by the difference between the residue left by 100 c.c. of this liquid when evaporated to dryness at 105° C., and the residue left, under the same conditions, by 100 c.c. of the soil solution. The flocculating power Pf, as compared with distilled water, is given by $Pf = A/S$, where A is the weight of kaolin left in suspension in distilled water, and S the weight of kaolin left in suspension in the solution examined.—W. G.

Soils, muds, and farm manures; Biological absorption of methane and the distribution of Kaserer and Söhngen methane organisms in ——. I. Giglioli and G. Masoni. R. Univers. di Pisa, Istit. di Chim. agr., Stud. e. Ricerche, 1909—1914, Pt. 22, 76—108, Bull. Agric. Intell., 1918, **9**, 1288—1289.

THE authors confirm the results of Kaserer and Söhngen that methane in the presence of oxygen is absorbed by soil bacteria. Its absorption and oxidation are purely biological phenomena, not influenced apparently by light, but favoured especially by temperatures about 30° C. Different varieties and species of methane bacteria seem to exist and to act at different temperatures. In ploughed field and meadow soil these organisms are rare and not very active on the surface, but are abundant and active in the lower layers. They are also present in large numbers in river mud, manure (especially rotted and moistened), liquid manure, and sewer contents. Thus manure well dug in should help to enrich the soil in micro-organisms which prevent the loss of methane by forming from it new organic matter.—W. G.

Sewage; Influence on the fertilising power of —— of the bacteria it brings to the soil. G. Masoni. R. Univers. di Pisa, Istit. di Chim. agr. Stud. e. Ricerche, 1909—1914, Pt. 22, 295—327. Bull. Agric. Intell., 1918, **9**, 1289—1290.

A COMPARISON of the influence of natural sewage and partly or completely sterilised sewage on ordinary soil and on soil sterilised by heating at 130°—140° C. for eight hours. The sewage was sterilised by boiling, by the addition of 1% by weight of sulphuric acid, or by the addition of an equivalent amount of sodium sulphate. In one series of experiments the sewage was spread over the soil and in another mixed with it in pots, the effects being measured by the yields and conditions of the crops. With untreated soil, sterilised sewage gave much better results than natural sewage, the addition of sodium sulphate being the least satisfactory of the three methods of treatment. With sterilised soil the pots with natural sewage gave higher yields than the control pots or than the pots with sterilised sewage.—W. G.

Farm manure; Effect of —— in stimulating the yields of irrigated field crops. C. S. Scofield. J. Agric. Res., 1918, **15**, 493—503.

THE effect of farmyard manure, applied at the rate of 12 tons per acre once during the rotation, on the yields of Irish potatoes and sugar beets under irrigation has been tested for six years in seven different rotations, varying from two-course to six-course, at three stations in the northern Great Plains. In the case of potatoes the general effect was to increase the yield of potatoes by 26—40 bushels per acre, with an increase of up to 8% in the proportion of marketable potatoes. Similarly the yield of sugar beets was increased by 1·9—4·3 tons per acre without materially affecting the percentage of sugar in the beets. In five of the seven rotations the manure was applied to the crop which was weighed, and in the other two rotations it was applied for the preceding crop.—W. G.

Phosphatic fertilisers; Analysis of ——. I. Adulteration of bone superphosphates. G. Masoni. *II. Use of ammonium citrate in the determination of phosphoric acid.* A. Quartaroli and A. Rogai. R. Univers. di Pisa, Istit. di Chim. agr., Stud. e. Ricerche, 1909—1914, Pt. 22, 139—170, 427—443. Bull. Agric. Intell., 1918, **9**, 1291—1293.

I. WHERE adulteration of a bone superphosphate is suspected the following tests may be applied. A little of the substance is charred in a porcelain dish and then calcined in a platinum dish which is removed now and then from the flame. Pure bone superphosphate gives off no white fumes. After prolonged calcination, the still incandescent substance should not have a deep yellow colour, which subsequently disappears, but should remain white or at the most yellowish. The cold, calcined residue should remain white or have only a pale reddish tinge and should be completely soluble in warm 10% hydrochloric acid. Quantitative determinations should be made of the moisture content, total P_2O_5, water- and citrate-soluble P_2O_5, total SO_3, and residue insoluble in *aqua regia*. On calculating the results on a dry matter basis at 100° C., and taking ST = 100× total SO_3/total P_2O_5 and SS = 100× total P_2O_5/citrate-soluble P_2O_5; then in good bone superphosphate the values of ST and SS should not exceed 130 and the difference ST—SS should not be great. If the values of SS and ST fall much below 110, precipitated phosphates have probably been added. A value of 1·3 for the percentage of residue insoluble in *aqua regia* is high.

II. Comparing the ammonium citrate method with the molybdate method for the estimation of phosphoric acid in superphosphates and basic slag, the authors find that, in the case of basic slag, the citrate method may sometimes lead to serious errors. If the results disagree and the precipitates are not perfectly white and amorphous after calcination, it is possible, by estimating the iron, to determine whether errors are due to its presence. In such a case, preliminary elimination of the iron by means of "cupferron" might give reliable results. This method, however, is not generally applicable, in practice, to commercial analyses. In the cases where iron or aluminium phosphates are concerned the citrate method is not applicable.—W. G.

Greensand; Value of —— as a source of potassium for plant culture. R. H. True and F. W. Geise. J. Agric. Res., 1918, **15**, 483—492.

THE greensands (mainly glauconite, with or without fossil shells) or greensand marls used in the experiment contained CaO 0·33—12·50%; P_2O_5 0·16—1·25%; SO_3 0·0—0·50%; total K_2O, 1·52—7·63%; K_2O soluble in dilute hydrochloric acid, 1·35—6·80%. Their effects on the growth of Turkey Red wheat and red clover during the first two months in pots were examined and compared with the results obtained with various potassium salts. Greensands and greensand marls appear to be able to supply sufficient potassium to satisfy the demand of the two crops mentioned during the first two months of their growth. The plants yielded a greater dry weight of tops than was obtained in similar cultures where potassium salts were used. Exceptional results were obtained with one greensand, which was found to belong to the unusual class of so-called "poisonous marls." Even in this case, however, the greensand applied at the rate of 1—5 tons per acre would probably be a useful fertiliser if ground limestone at the rate of 1 ton or more per acre were also applied.—W. G.

Manganese dioxide; Action of —— on nitrogenous organic substances, especially amides, with a view to the use of this dioxide as a fertiliser. G. Leoncini and C. Pieri. R. Univers. di Pisa, Istit. di Chim. agr., Stud. e. Ricerche, 1909—1914, Pt. 22, 328—348. Bull. Agric. Intell., 1918, **9**, 1290—1291.

EXPERIMENTS, *in vitro*, have been made to determine whether manganese dioxide in the soil is capable of causing the oxidation of nitrogenous organic substances. Ammoniacal compounds are not oxidised by manganese dioxide. Amides of the fatty acids and urea in aqueous solution are easily oxidised at the boiling point with the formation of nitric acid, whether the solution be alkaline, acid, or neutral, but at 30° C. hardly any oxidation occurs, except in the case of dicyanodiamide which gives traces of nitric acid at this temperature. Amino-acids and their amides are not oxidised in aqueous solution either at 30° C. or at the boiling-point. Hippuric acid, uric acid and its xanthine and hypoxanthine derivatives are slightly acted on by manganese dioxide, there being a tendency for the formation of small quantities of ammonia.—W. G.

Fertilisers; Manufacture of —— from ammonia. C. Bosch. Z. Elektrochem., 1918, **24**, 361—369.

A DESCRIPTION is given in slight detail of methods employed in the production of fertilisers from synthetic ammonia. In the production of ammonium sulphate at the rate of 100—120 tons per day, using five saturators, each with an output of 25 tons of sulphate, trouble was experienced due to the rapid corrosion of the lead bell. Experiments showed that boiling ammoniacal ammonium sulphate solution rapidly corroded lead and the trouble was traced to the large diameter of the bell, whereby wave-motion of the liquid was set up and local supersaturation with ammonia occurred. Corrosion of the phosphor-bronze parts of the pumps and centrifuge was also produced, but was prevented by cooling the ammonium sulphate solution. It was necessary to cool slowly to obtain a salt which drained readily, and cooling by accelerated evaporation, for instance, by means of a current of air or by application of a vacuum is recommended. Ammonium sulphate is also produced by leading carbon dioxide and ammonia into an aqueous suspension of finely powdered gypsum. It is stated that in the future more ammonium sulphate will be produced by this method in Germany than was formerly obtained as a by-product of the coking industry. A third method for the production of ammonium sulphate consists in heating ammonium bisulphite solution, prepared from ammonia and sulphurous acid, $6NH_4HSO_3 = 3(NH_4)_2SO_4+H_2SO_4+2S+2H_2O$. With concentrated solutions this reaction proceeds with explosive violence and experiments showed that the sulphur produced catalytically accelerates the reaction. By adding sulphur or another catalyst, *e.g.*, selenium, at the beginning the reaction can be carried out at a low temperature without risk of explosion. The sulphur obtained as a by-product is of high purity. Practically neutral ammonium sulphate can be obtained, instead of a mixture of sulphate and sulphuric acid, by starting with a solution containing 2 mols. NH_4HSO_3 to 1 mol. $(NH_4)_2SO_3$, and since a solution of this composition exhibits very low partial pressures of sulphur dioxide and ammonia, the process can be adapted to the recovery of sulphur dioxide from waste gases. Other products mentioned are a fertiliser made by absorbing ammonia in superphosphate; ammonium nitrate made from nitric acid obtained by the oxidation of ammonia in the presence of iron and bismuth oxides; and a product in which the four molecules of water of crystallisation of calcium nitrate are replaced by urea. Urea is produced by heating ammonium carbonate and carbamate to 130° C.—140° C. In the manufacture of ammonium nitrate it was observed that hot concentrated solutions of this salt rapidly render wrought iron very brittle.—J. F. S.

Sulphur industry and superphosphate. Tirelli. *See* VII.

[*Cotton*] *boll refuse.* Dowell and Friedemann. *See* XIXA.

Calcium phosphate and ammonium compounds from sewage. Gonné. *See* XIXB.

PATENTS.

Superphosphates and the like; Apparatus for use in excavating ——. C. M. Conder, Harrow. Eng. Pat. 122,709. (Appls. 2083, 5.2.18, and 12,160, 25.7.18.)

SUPERPHOSPHATE deposited in a series of parallel receptacles is discharged by a single excavator which is moved on rails in front of the series. The excavator consists of a helical blade supported on a transverse horizontal shaft, with or without lateral cutters, and it may be driven in either direction so as to transfer the cut material to one side or the other and discharge it on to tray conveyors arranged between each pair of receptacles. Alternatively a bucket cutter may be used, driven only in one direction, and the material delivered on to a reversible conveyor which conveys it to the tray conveyors. The side walls of the receptacle are carried on overhead girders by rollers, and both may be moved outwards or returned to their places simultaneously. The excavator is carried on a trolley, and rails on the trolley may be locked in continuation with the supporting rails of the receptacle.

—W. F. F.

Fertilising method and material. W. O. Snelling, Allentown, Pa. U.S. Pat. 1,289,565, 31.12.18. Appl., 16.7.18.

A CHARGE of explosive material associated with micro-organisms beneficial to plant growth is exploded in the soil.—C. A. M.

Fertiliser composition. L. L. Jackson, Assignor to O. C. Horney, New York. U.S. Pat. 1,289,789, 31.12.18. Appl., 17.3.17.

The fertiliser contains a precipitated calcium salt, such as calcium carbonate, and a precipitated silicon compound, such as calcium silicate, with or without the addition of precipitated aluminium hydroxide and potassium nitrate.—C. A. M.

XVII.—SUGARS; STARCHES; GUMS.

Cane juices; Colouring matter of —— [caused by the presence of iron-polyphenol compounds]. M. A. Schneller. Louisiana Bulletin 157. (*Cf.* Zerban, this J., 1918, 778 A.)

In the clarification of raw cane juice by addition of an excess of lime followed by sodium phosphate, a very striking improvement was observed in the colour, which changed from a dark blackish tint to a bright yellow. Similarly good results were obtained by the production of another flocculent precipitate, namely aluminium hydroxide, in the juice. The author attributes this notable clarifying effect to the elimination of compounds of iron with polyphenols and phenolcarboxylic acids, the so-called "tannins," which are present in the vascular bundles of the eyes, shoots, and tops of the cane. An aqueous extract of young shoots gave a very strong greenish-black coloration with ferric salts, and by soaking bagasse in a solution of ferric chloride it was stained black, the colour of the eyes being particularly intense. Compounds such as iron glucosate or saccharate are incapable of accounting for so deep black a colour. An analogous effect is observed in the case of freshly expressed beet juices, which darken rapidly on account of the presence of catechol and traces of ferrous salts, the latter being oxidised by the action of an oxidase. In the cane sugar factory, the colour due to the presence of such compounds may be decomposed by heating with phosphoric acid, but the clear yellow liquor thus obtained darkens again on cooling, when the compound is re-formed. Sulphurous acid acts similarly, its influence being principally due to reduction, but here again the effect is not permanent, since a sulphited syrup may darken gradually at its surface; while a sugar boiled from such a syrup, though of good colour at first, may darken more or less after a time, due to re-oxidation. Complete elimination of the colour-forming impurities is accomplished by the aluminium hydroxide process of clarification mentioned, or more practically and economically by a method of carbonatation, as, *e.g.*, by warming the clarified juice to 50° C., liming to 3—4 c.c. (of *N*/10 acid per 100 c.c.), carbonating back to 0·5 c.c., heating to boiling, filtering, sulphiting to slight acidity, and again filtering. Juice thus clarified should be concentrated and grained in evaporators and vacuum pans of copper, aluminium, or suitable rust-proof enamel; or alternatively, if a plant of iron be used, the formation of glucosates (which result from the action of alkalis on reducing sugars at high temperatures, and also give an intensely dark colouring matter) should be avoided by heating in neutral or slightly acid solution. Animal charcoal and decolorising carbon are capable of removing this colouring matter completely by adsorption.

—J. P. O.

[*Sugar*] *juice clarification and decolorisation with a new carbon.* S. S. Peck and A. Adams. Hawaiian Chem. Assoc., Oct. 28, 1918. Int. Sugar J., 1919, 21, 72—74.

In laboratory experiments made with a new decolorising carbon (see U.S. Pat. 1,251,546; this J., 1918, 133 A), the best results were obtained by using it as a filter layer, instead of mixing the liquor to be treated with the carbon and subsequently filtering. Increases in purity as high as 4·4° from clarified juices were obtained, though generally the increase was smaller, depending upon the number of times the carbon was used and the amount of juice that was passed through it. About 95% of the colour could be eliminated from the juice at first, but as the carbon became charged with impurities this amount gradually sank to 70%. Factory-scale tests were also made. The carbon was placed in frames in a filter-press and gave a clear, almost colourless filtrate when clarified juice was passed through it. The passage of juice through the carbon was continued until the rate of flow was considerably retarded. The remaining sucrose was readily washed out from the filter-press, and hot water and steam were then passed through, the runnings thus obtained being very dark and of an extremely disagreeable odour and taste. Following this treatment, juice was again passed through the carbon layer, and the increase in purity and the removal of the colour were still satisfactory, though less so than before. These operations were repeated six times, the highest increase in purity noticed being 2·6°, and the lowest 1·2°, while the amount of colour eliminated varied from 87% during the first hour's run to 60% at the end of an hour's test after the seventh time of re-use. In addition to the partial removal of colour, there was an almost complete disappearance of the flavour peculiar to raw cane juice. The treated juice evaporated and grained very readily, owing to the decreased amount of gums and other viscous matters present. Moreover most of the scale-forming impurities were removed from the juice, the evaporators after several days' use showing no deposit, whilst the ash content of the carbon increased from 30 to 60%.—J. P. O.

Decolorising carbons; Investigations on — —, using "Carboraffin." V. Stanek. Z. Zuckerind. Böhm., Oct., 1917 and 1918; Tijdschr. Algem. Tech. Vereen. Beetwortelsuikerfabr. en Raffin., 1919, No. 8, 116—122.

According to the author, "Eponit," "Norit," and "Carboraffin" (which much resemble one another) are prepared from wood, peat, etc., by Zelniczek's method (Austrian Pat. 68,169; Fr. Pat. 471,295; this J., 1915, 216), though some modification may sometimes be used. In experiments with "Carboraffin" for decolorising syrups in the refinery, the best results were obtained by passing the liquor through a layer of the carbon, in a special pressure filter, a layer of kieselguhr or of fine asbestos fibre being deposited upon the cloth before introducing the carbon. Tests on the large scale in a refinery in Bohemia showed that working with slightly acid liquors at 96°—98° C. a greater decolorisation was obtained with 0·07% of "Carboraffin" than with 6·5% of animal charcoal. Several disadvantages, however, were noticed, the principal of which were the slowness of filtration and the difficulty in obtaining a perfectly bright filtrate. In spite of much care, particles of the carbon passed over into the filtrate, these appearing later as black specks on the surface of the finished sugar "loaves."—J. P. O.

Colloid chemistry of Fehling's sugar test. M. H. Fischer and M. O. Hooker. J. Lab. and Clin. Med., 1918, 3, No. 6. Int. Sugar J., 1919, 21, 76—78.

In the determination of sugars by reduction of Fehling's solution, the precipitate is not always bright red, but sometimes orange or yellow, whilst occasionally only a greenish discoloration is obtained, from which a light greenish or dirty

yellow precipitate may settle out in the course of many days. The yellow precipitate has frequently been described as a hydrated form of the oxide. According to the authors, however, the composition of the oxide, whatever its colour may be, is identical, and the varying colour is due to differences in the degree of subdivision, depending upon the particular conditions prevailing during precipitation. If Fehling's solution be mixed with a small quantity of a solution of reducing sugar at the ordinary temperature, a series of such colour changes may be observed. The originally clear solution first becomes less transparent, then the colour changes to a leaf green, and next to a yellowish green. At this time more or less precipitate may separate out; while later, not only this yellow precipitate, but the supernatant liquid as well, becomes yellow orange, then brilliant orange, and finally bright red. Microscopical examination shows that as the different colours are being developed there is coincidently a gradual increase in the size of the particles. Hence a positive reaction indicates the presence of a reducing substance, whether it is merely a dirty green solution, a yellow or orange precipitate, or a bright red precipitate To ensure the formation of the red precipitate a small amount of reducing sugar should be used, for with much present the number of points at which the copper salt is attacked and reduced will evidently be much greater than when only a small amount is present. Cuprous oxide in any of its intermediate states of subdivision may be stabilised by the addition to the reaction mixture of a suitable hydrophilic colloid, *e.g.*, gum or egg albumin; some of the degradation products resulting from the action of the alkali of the Fehling's solution on the reducing sugar are themselves hydrophilic in type. Temperature also may play a part in determining the state of dispersion, and reduction at a high temperature (as in the usual procedure) is more likely to yield the colloidal types of reduction products than at the ordinary temperature. Thus, a urine containing a small amount of reducing substances which upon boiling with Fehling's solution yields only a dirty green solution will show a bright red precipitate if the same proportions are simply mixed and set aside at the ordinary temperature for 24 hours.—J. P. O.

Soluble starch; Determination of —— in the presence of starch and its hydrolytic cleavage products. J. C. Small. J. Amer. Chem. Soc., 1919, **41**, 107—112.

THREE grms. of the sample is suspended in about 200 c.c. of water which is then raised to the boiling point with continuous agitation. The solution is cooled, made up to 250 c.c. and filtered to remove the ordinary starch, if necessary, after centrifuging. Two hundred c.c. of the filtrate is placed in a 500 c.c. centrifuge bottle and 10 c.c. of 4% iodine solution in 6% potassium iodide solution is added. An equal volume of saturated ammonium sulphate solution is added and the iodine compound of soluble starch is thereby precipitated. The liquid is centrifuged at a moderate speed, the reddish-brown supernatant liquor siphoned off, the precipitate shaken with water, again precipitated with an equal volume of saturated ammonium sulphate solution and again centrifuged. Five washings in this manner are generally sufficient to remove the red coloration due to dextrin. All the liquors should be passed through a filter before being discarded, and the precipitate on the filter is finally washed back into the bottle. The washed precipitate is transferred to a flask with a total volume of water not exceeding 300—400 c.c.; 5 c.c. of hydrochloric acid (sp. gr. 1·125) is added and the liquid is boiled for 2½ hours so as to reduce its volume to about 200 c.c. A further quantity of 20 c.c. of hydrochloric acid is added and the whole heated in a boiling water bath for 4 hours under a reflux condenser. The quantity of dextrose is estimated polarimetrically and calculated to starch. Control analyses have shown the accuracy of the method, even when soluble starch is mixed with large quantities of commercial dextrin. It is to be noted, however, that amylodextrin yields an iodine compound which is precipitated by half-saturated ammonium sulphate solution in the presence of excess of iodine. Amylodextrin may therefore be determined by the difference in the results obtained, on the one hand by adding iodine solution with each of the washing liquors, to preserve the excess of iodine, and on the other by washing out the whole of the iodine with ammonium sulphate solution.—J. F. B.

Soluble starch; Method for the preparation of ——. J. C. Small. J. Amer. Chem. Soc., 1919, **41**, 113—120.

THE method of preparing a soluble starch by boiling with alcoholic hydrochloric acid has been studied, in order to fix the most favourable conditions for complete conversion without the formation of more profoundly modified products. Alcohol of 95% strength and hydrochloric acid of sp. gr. 1·19 were employed. Time of treatment, concentration of acid, and proportion of liquid to starch were varied. The highest yield of soluble starch was obtained when 0·75 c.c. of strong hydrochloric acid was added to 100 c.c. of 95% alcohol and used for the conversion of 20 grms. of starch, the liquid being boiled for 10 minutes with good agitation. The exact quantity of sodium bicarbonate required to neutralise the acid was added at once and the product filtered off, washed with alcohol, and dried. Under favourable conditions it is possible to produce a completely converted starch, which shows no reaction for erythrodextrin and no cupric-reducing power.—J. F. B.

PATENTS.

Vegetable glue or adhesive. C. Bergquist, Assignor to F. W. Tunnell & Co., Philadelphia, Pa. U.S. Pat. 1,287,841, 17.12.18. Appl., 15.12.17.

A GELATINISING starch adapted to yield a clear film in drying is prepared from starch and hexamethylenetetramine.—C. A. M.

Vegetable charcoal. Eng. Pat. 122,465. *See* IIB.

Decolorising carbon. Eng. Pat. 122,698. *See* IIB.

Decolorising carbon. U.S. Pat. 1,290,002. *See* IIB.

XVIII.—FERMENTATION INDUSTRIES.

Wood; Alcohol from ——. Laskowsky. Chem.-Zeit., 1919, **43**, 51.

AN account is given of the operation of a plant for the production of alcohol from sawdust by Classen's process which was worked in England 12 years ago. The plant comprised an autoclave of 12 cub. m. capacity, a lixiviating plant with neutralising vessels, filter-presses, fermentation tuns, storage vats for the fermented wash, stills, spirit storage vats, and spent-wash pits. The autoclave had a steam jacket and a homogeneously lead-lined interior, and could be slowly rotated. The charge was 1 ton of sawdust with a solution of sulphurous acid. The steam pressure in the jacket was 4 atmos. giving an internal temperature of

145° C. and a pressure of 7 atmos. This pressure was maintained for a certain time and the sulphur dioxide then released. The conversion was complete in 45—60 minutes. The average saccharification corresponded to 22% of reducing sugar calculated on the dry substance of the wood. In the most favourable cases about 60% of this reducing sugar was fermentable. The converted sawdust was lixiviated with water, the solution was neutralised with chalk, and filtered. The sweet worts at 10—15% of extract were fermented partly direct and partly with the addition of nutrient salts. The fermentations were extremely slow and the yield of alcohol amounted in favourable cases to 5—6 litres per 100 kilos. of dry wood substance. The sawdust contained about 20% of moisture and cost £1 per ton. Classen's process has undergone many improvements in recent years, and it should be possible now to double the above yield of alcohol. The residue from the lixiviating plant could be used for mixing with molasses and with evaporated spent-wash for fodder purposes.—J. F. B.

System of drying. Petit. *See* XIXA.

Effect of acids on B. coli. Wyeth. *See* XIXB.

PATENTS.

Beverages; Manufacture of extracts of beer and other fermented ——. *Manufacture of liquid-condensed yeast-treated extracts from beverages.* H. Heuser, Chicago, Ill. U.S. Pats. (A) 1,290,191 and (B) 1,290,192, 7.1.19. Appl., 11.12.16 and 5.4.17.

(A) FERMENTED beverages such as beer are concentrated and afterwards subjected to fermentation with yeast. (B) Syrups capable of conversion into beverages by dilution with water, are produced from partially fermented beverages such as beer wort, by concentration and subsequent fermentation with yeast.—J. H. L.

Glycerol; Process of manufacturing ——. J. R. Eoff, jun., Washington, D.C. U.S. Pat. 1,288,398, 17.12.18. Appl., 21.7.17. (Dedicated to the public.)

GLYCEROL is produced by fermenting a sugar in an alkaline medium.—C. A. M.

XIXA.—FOODS.

Milk; Methods of calculating added water in ——. L. J. Harris. Analyst, 1919, **44**, 43—45 (See this J., 1918, 712 A.)

A TABLE is given showing percentages of solids-not-fat in fat-free milk and in milk of minimum standard composition corresponding with percentages of added water; this table is constructed from the formula given previously (*loc. cit.*). The figures may also be used in the form of an alinement chart or as a calculating (slide) rule.—W. P. S.

Cabbage; Antiscorbutic value of ——. *I. Antiscorbutic and growth-promoting properties of raw and heated cabbage.* E. M. Delf. Biochem. J., 1918, **12**, 416—447.

IT has been shown experimentally that a very small amount of raw cabbage daily in conjunction with a diet of grain and autoclaved milk is sufficient to afford protection from symptoms of scurvy. The antiscorbutic factor of cabbage is exceedingly sensitive to heat. After heating for 1 hour at 60° C., 70% is lost, and at 90° C. over 90% is destroyed. The results indicate broadly that the least loss of antiscorbutic properties will be obtained by cooking green vegetables for a short time at a higher temperature, rather than for a longe time at a lower temperature. Steaming should b employed, for preference, but if boiling is adopted the addition of either acid (citric acid) or alka (sodium carbonate) should be avoided.—W. G.

Cabbage; Antiscorbutic value of ——. *II. Effec of drying on the antiscorbutic and growth-pro moting properties of cabbage.* E. M. Delf and R. F. Skelton. Biochem. J., 1918, **12**, 448—464.

THERE is a loss in antiscorbutic properties of more than 93% when cabbage is dried at a low temperature and stored for 2—3 weeks, and if the storing is prolonged to 3 months nearly all the protective value of the fresh material is lost. The loss is not so great if the cabbage is plunged into boiling water before drying. During drying and storage there is also destruction of the fat-soluble, growth-promoting factor, the loss being about 86% at the end of two weeks. The preservation of vegetables by drying is an unprofitable process having regard to the labour and fuel involved, to the low nutritive and antiscorbutic value of the product, and to the subsequent deterioration on storage.—W. G.

Drying [milk, eggs, etc.]; New system of ——. P. Petit. Brasserie et Malterie, 1918, **8**, 282—287.

THE desiccation of milk and eggs, for purposes of preservation and transport, has been carried out on a very large scale at Bucarest with a new type of apparatus in which the liquid is atomised by striking a rapidly rotating plate. The liquid is injected, together with air, into an atomising chamber in which it strikes a rotating plate situated in front of the outlet. The mixture of air and liquid particles passes into a cylindrical drying chamber into which hot air, *e.g.*, at 100°—120° C., is introduced. The air is rapidly cooled by evaporation of the moisture and the dried particles never attain a high temperature. In a second form of apparatus described, the rotating plate is absent. The liquid is injected as a spray into the lower end of a vertical cylinder and is carried upwards and dried by a helical current of hot air. The dried material is carried by the air into a separator. It is suggested that the principle of the rotating plate system might be applied to the drying of malt, brewers' spent grains, and yeast, the material being scattered by falling on the plate and dried by subsequently falling through a rising column of hot air.—J. H. L.

Drying and concentrating liquids at low temperatures; The Marmier and Canonne apparatus for ——. L. Marmier. Ann. Inst. Pasteur, 1918, **32**, 145—149. Bull. Agric. Intell., 1918, **9**, 1360—1362.

THE apparatus, intended for the concentration or desiccation of liquids such as milk or grape must, consists of a vertical cylindrical water-jacketed still in communication with a suitable condenser and a vacuum pump. The liquid to be treated enters the still from above through a hollow vertical rotary shaft which passes through the hood of the still and bears, inside the latter, hollow radial arms provided with nozzles, so that the liquid is sprayed against the hot walls of the still and rapidly evaporated. The shaft also carries scrapers which remove the concentrated or desiccated material from the walls of the still and sweep it over the floor towards a sunken chamber, at the centre, from which it is afterwards discharged. The evaporation of the sprayed liquid is so rapid that with proper regulation of the rate of inflow, rotation of the shaft, and temperature of the jacket, it is often possible to keep the shaft in continuous rotation, but if necessary a pause may be made after each complete rotation. In conse-

quence of the rapid evaporation the temperature of the material is considerably below that of the jacket, *e.g.*, in concentrating fresh grape must, with the jacket at 36°—40° C., the temperature of the must itself did not exceed 20°—26° C.—J. H. L.

Flours; Composition of various —— used as substitutes for wheat flour. Balland. Ann Falsif., 1918, **11**, 388—390.

THE following is the composition of various flours etc. which have been used in bread-making —

	Moisture	Proteins	Fat	Starch	Cellulose	Ash
Morocco beans :						
Flour (yield 80%)	10 28	26 66	1 44	58 32		3 30
Bran (yield 10%)	10 90	19 19	4 49	81 45		2·98
Maize, parti-coloured, U.S.A. :						
Flour (yield 86 3%) .. .	13 18	8 73	4 14	70 23	2 36	1 36
Bran (yield 5 4%)	12 78	4 09	1 83	65 75	14 40	1 10
Maize, La Plata :						
Flour (yield 86 9%) .. .	12 20	9 23	4 29	72 23	0 93	1 12
Bran (yield 6 2%) . .	11 12	9 13	7 38	60 58	9 11	2 38
Buckwheat :						
Flour (yield 72 2%) .	16 52	8 74	1 66	71 15		1 95
Millet, Algerian :						
Flour (yield 54 6%) .. .	12 53	15 70	6 28	61 42 (+ extractives)	0 88	3 20
Bran (yield 15 9%) .. .	10 16	5 40	1 10	43 34 (+ extractives)	22 30	17·10

—W. P. S.

Animal carcases etc.; Utilisation of ——. Frabot. Ann. Chim. Analyt., 1919, **1**, 55—65.

FOR the utilisation of carcases of diseased animals, offal, etc., a process is recommended by which fats and gelatin are recovered and the remainder of the material converted into a meat-meal. The carcase or other raw material is placed in a perforated rotating cylinder mounted horizontally in a steam-jacketed autoclave and the cooking operation is maintained for 4 to 5 hours. During this time, fats and soluble substances collect in the autoclave and are drawn off and passed into a fat-separating apparatus, the aqueous portion is then conducted to an evaporator in which it is concentrated to form glue. The hot vapours from the evaporator may be used for heating the autoclave. After the fats etc have been withdrawn from the autoclave, the perforated cylinder is rotated while the mass of material is dried: the disintegrated material, as it dries, falls through the perforations and is reduced to a fine powder in the autoclave. This drying operation takes from 2 to 5 hrs. The whole apparatus is self-contained; any vapours evolved and which cannot be utilised are either condensed or conducted to a flue and burned with the furnace gases. The meat-meal obtained contains: water, 8; proteins, 50 to 60; phosphoric acid, 8; and fat, 10 to 12%; it may be used as a pig or poultry food.—W. P. S.

Food canning; Utility of blanching in ——. Effect of cold shock upon bacterial death rates. E. M. Bruett. J. Ind. Eng. Chem., 1919, **11**, 37—39.

PRELIMINARY heating followed by chilling does not, apparently, render bacterial spores more sensitive to the effects of heat, and blanching (immersion first in boiling and then in cold water) as a preliminary to the cold pack process of canning is not justified on the basis of increased susceptibility of the bacteria to sterilisation because of "cold shock." Blanching, however, has a marked cleansing effect, and hence fewer spores are introduced into the canned material; as the time required for sterilisation varies with the initial contamination, it is desirable to reduce this as much as possible.
—W. P. S.

Sorghums; Fats and fatty acids of the grain ——. C. K. Francis and W. G. Friedemann. Okla. Agric. Exp. Stat., Bull. 117, 1917. 14 pages.

THE nature of the fat present in kafir, feterita, and milo, the chief varieties of the grain sorghums, was determined. Six fatty acids were found, namely, oleic and linolic (80—86% of the fat), stearic and palmitic (7—10%), butyric and formic (0·59—0·85%). Traces of saturated acids higher than stearic were found in kafir and milo fat.
—J. H. J.

Bolly refuse [from cotton]; Experiments with ——. C. T. Dowell and W. G. Friedemann. Okla. Agric. Exp. Stat., Bull. 121, 1918. 8 pages.

BOLLY refuse consists of the burr and some unginned cotton from unopened bolls of cotton gathered at the close of the picking season. Feeding experiments on cattle showed that the refuse was readily eaten, serving as a good roughage, and that when the percentage of cotton was high the animals gained in weight. The results of a chemical analysis of the refuse were: moisture 12%, ash 6%, protein 10%, fibre 41%, nitrogen-free extract 40%, fat 2·5%. A mechanical analysis showed: cotton 10%, seed 15%, burrs 75%. A sample containing only 4% of seed was unsuitable as a feeding stuff. The seed from the bollies and the oil cake made from it were of inferior quality. The ash is rich in phosphate and potash, and is a good fertiliser.—J. H. J.

Vegetable fibres; Determination of the digestibility of the cellulosic part of ——, especially woody fibres. P. Waentig and W. Gierisch. Z. physiol. Chem., 1918, **103**, 87—103.

To obtain material of a moderately high degree of digestibility from woody matter requires thorough removal of the lignified substance from the fibres. The following method has been devised for obtaining rapidly an approximate measure of the material which is non-saccharifiable and therefore undigestible, and which interferes with the digestion of the nutrient constituents in woody substances: the method is based on the fact that, when chlorine acts on woody fibre, the lignin is at first almost exclusively attacked, the proportion of lignin present thus corresponding with that of the chlorine absorbed. 10 grms. of the material is moistened thoroughly but not to such an extent that water separates from it and introduced into a wide-necked gas washing bottle with a ground top; the bottle is then tared and connected, by way of a tower charged with wet pumice and a bubble-counter, with a source of chlorine. A slow stream of chlorine is passed through the material for half an hour, the apparatus being then freed from excess of chlorine and weighed to within 0·01 grm.; this

procedure is repeated as long as any appreciable increase in weight occurs, 1—2 hours being usually sufficient. The "chlorine number" represents the percentage increase in weight, calculated on dry matter. The losses due to evolution of water vapour and of the volatile acids formed by the action of the chlorine are very small; the chlorine taken up by the water present amounts to 0·7 grm. per 100 c.c. at the ordinary temperature. In isolated cases of hard, resinous woods not very finely divided, the limit of absorption is indistinct owing to diffusion being difficult; such cases are, however, those of fibres very rich in lignin, which give chlorine numbers of about 45%, and may at once be characterised as indigestible. As a general rule, the chlorine number and indigestibility increase or diminish together. Processes for the removal of the woody substance from woody fibres must reduce the chlorine number to about 30 to give a moderately digestible cellulosic fodder, or to 20 or less if a highly digestible material is required. The chlorine numbers of natural straws do not differ greatly, the mean being 31·8; straws which have been treated with alkali or otherwise give values of 20, 15, or even less.—T. H. P.

Amino-acids [from caseinogen]. H. D. Dakin. Biochem. J., 1918, **12**, 290—317.

THE author describes a new method of separation of the products of hydrolysis of proteins and gives an account of its application to the hydrolysis of caseinogen. After hydrolysis of the protein with sulphuric acid, and subsequent removal of the latter as barium sulphate, the neutral concentrated solution of amino-acids was submitted to continuous extraction with butyl alcohol, and five fractions were obtained:—(1) Mono-amino-acids, both aliphatic and aromatic, which although insoluble in butyl alcohol, were extracted in the above process, but deposited as a cream-coloured, granular powder in the extraction flask. (2) Proline, soluble in alcohol, and extracted by the butyl alcohol. (3) Peptide anhydrides (diketopiperazines) extracted by butyl alcohol but separated from (2) by their sparing solubility in alcohol or water. (4) Dicarboxylic acids, not extracted by butyl alcohol. (5) Diamino acids not extracted by butyl alcohol, but separable from (4) by phosphotungstic acid and other means. No indication of racemisation of the products during the process was observed, this being of importance in the application of the method to the preparation of material for bacterial and animal metabolism experiments. By this method fraction (1) is readily obtained as a dry, almost neutral, amino-acid mixture suitable for furnishing a basis for nutrient media with or without the addition of tryptophan. Further, since most of the amino-acids which furnish dextrose in the diabetic organism are absent from this mixture, there are possibilities of its use for dietetic purposes. The method of extraction with butyl alcohol was found to be applicable to the products of digestion of caseinogen by active pancreas extract and readily furnished tryptophan in a pure state. The method could probably be operated on a considerable scale and may be of service in obtaining tryptophan for bacteriological and other purposes. A new hydroxyamino-acid, β-hydroxyglutamic acid, and a new peptide, *d*-isoleucyl-*d*-valine anhydride (isopropyl-*sec*-butyldiketopiperazine), were isolated. (See further J. Chem. Soc., Apr., 1919.)—W. G.

Carnosine, its constitution and synthesis. G. Barger and F. Tutin. Biochem. J., 1918, **12**, 402—407.

FROM its behaviour towards 2.4.5-trinitrotoluene carnosine is shown to be β-alanylhistidine. It has been synthesised by condensing β-nitropropionyl chloride with histidine methyl ester and reducing the resulting product with stannous chloride and hydrochloric acid. (See further J. Chem. Soc., Apr., 1919.)—W. G.

Cotton seed. De Segundo. *See* XII.

Alcohol from wood. Laskowsky. *See* XVIII.

Saccharin in tablets. Bonis. *See* XX.

Selective coloration of lignified plant membranes. Bugnon. *See* XXIII.

PATENTS.

Cocoa butter; Process for deodorising and decolorising ——. Co-operative Wholesale Soc., Ltd., Manchester, G. Martin, Manchester, and W. J. Brizell, Liverpool. Eng. Pat. 122,512, 9.2.18. (Appl. 2388/18.)

Cocoa butter is deodorised and decolorised by passing steam through it at a high temperature, *e.g.*, 140° C. The material is heated to the required temperature in a pre-heating vessel fitted with stirring mechanism, and discharged under gravity into a steam-jacketed still provided with an internal perforated coil for the injection of steam into the charge. The steam issuing from the still-head is condensed in cooling coils and discharged into an effluent chamber in which a vacuum may be maintained. The duration of treatment varies from 20—10 mins. to several hours. In a modified form of the process, suitable for the treatment of small quantities of cocoa butter, the steam is generated in the heated charge by introduction of moist material such as potatoes; the solid residue of the latter assists in the subsequent clarification of the charge.—J. H. L.

Cream, Method and apparatus for deodorising ——. J. Priskey, Detroit, Mich. U.S. Pat. 1,286,404, 3.12.18. Appl., 7.9.17.

THE apparatus comprises a container into which the cream is fed continuously, a hollow porous body, immersed in the cream, through which compressed air can be forced, and a downwardly directed jet of air above the cream for breaking the froth.—W. R. S.

Utilising animal carcases. Ger. Pat. 308,753. *See* XV.

XIXB.—WATER PURIFICATION; SANITATION.

Calcium phosphate and ammonium compounds; Production of —— from sewage. J. Gonné. Chem.-Zeit., 1919, **43**, 39—40.

SEWAGE is separated into its solid and liquid constituents in receivers the special construction of which prevents the escape of volatile ammonia compounds. The separation is accelerated by the addition of certain waste products, which clarify the liquid and cause a preliminary precipitation of phosphoric acid, and the precipitation is completed by the addition of a concentrated solution of calcium salts (also waste products). Sodium phosphate may also be added. After separating and pressing the solid matter, the liquid is transferred to a distillation apparatus, the free ammonia is distilled, and the dissolved phosphoric acid pre-

cipitated. The precipitate from this second precipitation process consists of pure calcium phosphate containing at least 40% of water-soluble and citrate-soluble phosphoric acid. The sludge obtained in the first precipitation normally contains 3 to 5% of nitrogen, 12 to 15% of phosphoric acid, and 1 to 2% of potassium. When dried and powdered it closely resembles guano in composition, and can be used by itself as a fertiliser or in admixture with ammonium sulphate, which is also obtained in the process.—C. A. M.

Bacillus coli; Effect of acids on the growth of ——. F. J. S. Wyeth. Biochem. J., 1918, **12**, 382—401.

All strains of *B. coli*, whether of human or bovine origin, behave similarly when exposed to similar conditions. The degree of acidity finally produced by a culture of *B. coli* cannot be used for diagnostic purposes, the value not being a "physiological constant" but dependent on three factors, namely: (1) the initial H-ion concentration of the medium; (2) the composition of the medium, especially the degree to which it is "buffered"; (3) the nature of the acid used to produce the initial reaction of the medium. There is a definite latency of growth of *B. coli*, when the amount of acid added is insufficient completely to inhibit the fermentation. For any given medium, a greater initial addition of acid causes a longer latent period. Each acid has its own specific effect in inhibiting the growth of *B. coli* in a given medium, highly dissociated acids being more strongly inhibitory than those undergoing a less degree of dissociation. For a mixture of any given medium and acid there appears to be a definite "critical point" beyond which the slightest rise in the degree of acidity results in a complete inhibition of the growth of *B. coli*.—W. G.

Basic exchange in silicates. Ramann and Spengel. *See* VII.

Fertilising power of sewage. Masoni. *See* XVI.

Patents.

Sewage and other liquids; Purification of ——. W. Jones, Stourbridge, and Jones and Attwood, Ltd., Amblecote, Staffs. Eng. Pat. 122,428, 24.8.17. (Appl. 12,136/17.)

Sewage is treated with bacterial (activated) sludge and the mixture agitated by the injection of air. The sludge is separated continuously or intermittently from the liquid, and passed to another tank where its activity is intensified by the injection of air, and the active sludge is returned to the treating tank. The separation of the sludge is effected in a series of tanks so arranged that the mixture flows through them at varying rates, and sludges of varying specific gravity are separated and deposited in separate sludge pits connected with the settling tanks. All the operations form a continuous cycle. (See also Eng. Pats. 22,736 of 1914 and 111,720; this J., 1916, 195, and 1918, 72 A.)
—W. F. F.

Sewage; Method of and apparatus for treating ——. P. F. Brown, Huntingdon, N.J. U.S. Pat. 1,289,378, 31.12.18. Appl., 2.5.18.

The flow of sewage is directed downwards through the central portion of each of a series of compartments, to promote rapid subsidence of solid materials, means being provided to divide the flow so as to break up the solids and allow the contained gases to escape. The sewage is then conveyed upwards and discharged at the opposite sides of the compartment, into the next compartment, and so on, until finally it is discharged from the apparatus at the opposite sides of the last compartment.—C. A. M.

Purifying and disinfecting air; Apparatus for ——. W. J. Calder, Edinburgh. Eng. Pat. 122,438, 10.8.18. (Appl. 579/18.)

The air is passed through a number of superposed wire resistance grids, which are spaced apart in a vertical tubular vessel having a flared upper end. The grids are heated electrically to incandescence.
—W. H. C.

Air-purifier. U.S. Pat. 1,289,121. *See* I.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS

Morphine determination; Effect of morphine concentration on the B.P. method of ——. H. E. Annett and H. Singh. Analyst, 1919, **44**, 41—43.

The B.P. method gives low results in the case of opiums of low morphine content; for example, when the morphine falls below 5%, the results obtained are about 0·5% too low. The method, however, is accurate when applied to opiums of normal morphine content (about 10%); useful results can be obtained when only 2 grms. of the sample is available for the determination provided that correspondingly reduced quantities of reagents are employed and the corresponding corrections applied. (See also this J., 1918, 315 T.) W. P. S.

Morphine; Use of ethyl acetate in the determination of —— *in opium.* O. von Friedrichs. Pharm. Zentralh., 1918, **59**, 329—330.

Ethyl acetate is used in place of ether in the determination of morphine in opium by the methods of the German, Swedish, Belgian and other pharmacopœias. As a rule it gives slightly lower values, which may be attributed to hydrolysis of the ethyl acetate by the excess of ammonia, especially when the solution is left for a long time in contact with the ethyl acetate, as in the method of the Swedish pharmacopœia. Under these conditions the liberated acetic acid is shared between the ammonia and the alkaloid, and a certain proportion of the crystallised morphine is dissolved again. Impure ethyl acetate containing methyl formate and amyl acetate gave very low results in the method. Under ordinary conditions the difference between the results obtained with ether and with pure ethyl acetate in the determination of morphine in a sample of opium was less than 0·1%.—C. A. M.

Alkaloid of Isopyrum thalictroides, L.; Microchemical reactions and localisation of the ——. M. Mirande. Comptes rend., 1919, **168**, 316—317.

The alkaloid, isopyrine, gives the following microchemical reactions in the plant cells:—(1) with iodine in potassium iodide a granular, brown precipitate completely filling the cells, and which by the controlled action of water, alcohol, and the reagent, can be transformed into a mass of brown acicular crystals, soluble in sodium thiosulphate; (2) with picric acid, an immediate, very dense, yellow, granular precipitate; (3) with mercuric chloride, an immediate, dense, white precipitate; (4) with gold chloride or platinic chloride, a dense yellow precipitate; (5) with moderately dilute sulphuric

acid, an accumulation of oily drops, which soon coalesce into one or several large masses, changing gradually into collections of greyish crystals, which soon dissolve and are replaced by crystals of calcium sulphate; (6) with ammonia, a dense, granular, bright yellow precipitate, insoluble in water, soluble in alcohol; (7) with solutions of potassium hydroxide, potassium bichromate, or sodium molybdate, finely granular, yellowish precipitates. The alkaloid occurs principally in the subterranean organs of *Isopyrum thalictroides* and to a lesser extent in the green aërial organs.—W. G.

Digitalis leaves; Effect on activity of temperature during drying of ——. H. C. Hamilton. J. Amer. Chem. Soc., 1919, **41**, 125—129.

EXPERIMENTS were made to test a statement that digitalis leaves yield a more active extract if previously dried in an oven at 75°—90° C. than if extracted in the fresh or air-dry condition, this statement being at variance with previously accepted experience. The extracts were made with 95% alcohol and their toxic activity was tested by administering to frogs in increasing doses. The results showed that the extracts from fresh leaves were the most powerful. The preparations made from sun- and air-dried leaves showed considerably lower values, and those from oven-dried leaves were rather less active than the air-dried.—J. F. B.

Stovaine and cocaine; Microchemical identification of ——. Denigès. Bull Soc. Pharm. Bordeaux, 1917, No. 4. Ann. Chim. Analyt., 1919, **1**, 65—66.

WITH platinum chloride, a 1% stovaine hydrochloride solution yields a fine granular precipitate, but a precipitate does not form if the concentration of the stovaine solution is as low as 0·5%. Cocaine hydrochloride solution of either strength gives a characteristic crystalline precipitate of the platinichloride. Both alkaloids give yellow crystalline precipitates when treated with gold chloride, but the microscopic appearance of the crystals is different. Stovaine picrate forms yellow crystals, whilst cocaine picrate appears as amorphous granules which change to liquid droplets when stirred. (See also J. Chem. Soc., Apr., 1919.)—W. P. S.

Urea; Formation, by oxidation, of organic substances of an intermediate character spontaneously producing ——. R. Fosse. Comptes rend., **1919, 168**, 320—322.

WHEREAS proteins such as casein, or amino-acids such as asparagine or glycine, only give a very small yield of urea when oxidised with potassium permanganate, the yield is very considerably increased if the products of oxidation are heated with aqueous ammonium chloride. (See further J. Chem. Soc., Apr., 1919.)—W. G.

Saccharin; Determination of —— in tablets. A. Bonis. Ann. Falsif., 1918, **11**, 369—372.

THE tablets usually consist of saccharin or sodium saccharinate mixed with sodium bicarbonate and, possibly, lactose. Titration with *N*/10 sulphuric acid, using methyl orange as indicator, gives the quantity of free sodium bicarbonate present. Saccharin is determined by fusing the sample with a mixture of sodium carbonate and sodium nitrate, and precipitating the resulting sulphate as barium sulphate. The quantity of sulphur found is calculated into saccharin and, if the product did not effervesce when mixed with water, this is expressed as sodium saccharinate. If effervescence occurred it indicates that free saccharin was present and this is determined by extracting the material with ether; the quantity of saccharin which may be present as sodium saccharinate is found by fusing the residue insoluble in ether with sodium carbonate and sodium nitrate as described. Lactose, if present, is also determined. To detect the presence of *p*-sulphaminobenzoic acid, 1 grm. of the substance is hydrolysed by boiling for 2 hrs. with dilute hydrochloric acid, the solution is evaporated to about 10 c.c., and cooled. The *p*-sulphaminobenzoic acid crystallises out within 24 hours, and is collected, washed with a little cold water, dried at 100° C., and weighed. (See also Richmond and others, this J., 1919, 55 A.)—W. P. S.

Mustard gas [*2.2-dichloroethyl sulphide*]; *Physical constants of* ——. L. H. Adams and E. D. Williamson. J. Wash. Acad. Sci., 1919, **9**, 30—35.

THE compressibility of 2.2-dichloroethyl sulphide has been determined over the pressure range 392—1713 megabars (1 megabar = 0·987 atm.) at 31·5° C. The compressibility at $P=0$ is $49{\cdot}5\times10^{-6}$ per megabar and at 1000 megabars $34{\cdot}4\times10^{-6}$ per megabar. The melting point at atmospheric pressure is 13·9° C., and the pressures required to induce freezing at higher temperatures are 570 megabars at 21·9° C., 1210 at 31·4° C., and 1800 megabars at 38·9° C. The decrease in volume on solidification at the temperatures and pressures mentioned is 0·054, 0·050, 0·047, and 0·042 c.c. per grm. respectively. The latent heat of fusion is 25 cals. per grm.—J. F. S.

Methyldichloroarsine; Manufacture of ——. R. H. Uhlinger and R. V. Cook. J. Ind. Eng. Chem., 1919, **11**, 105—109.

THE steps in this manufacture are as follows: (1) Sodium arsenite solution is treated with methyl sulphate at 85° C.: $Na_3AsO_3+(CH_3)_2SO_4=Na_2(CH_3)AsO_3+Na(CH_3)SO_4$. In this reaction a considerable proportion of the methyl sulphate is lost owing to its hydrolysis to sodium methyl sulphate and methyl alcohol by the action of the sodium hydroxide of the arsenite solution, or to methyl hydrogen sulphate and methyl alcohol by the action of water; some methyl sulphate is lost also as methyl ether. (2) The disodium methyl arsenite is converted to methyl arsenoxide by treatment with sulphur dioxide: $Na_2(CH_3)AsO_3+SO_2=CH_3AsO+Na_2SO_4$. The sodium bisulphite formed simultaneously from the excess of sulphur dioxide and the excess of sodium hydroxide present, is decomposed after the reduction by addition of sulphuric acid; otherwise the sulphur dioxide would be liberated during the final stage of the process and would then carry off a large part of the final product. (3) The methyl arsenoxide is converted into methyldichloroarsine by passing hydrogen chloride through the solution at 70°—85° C.: $CH_3AsO+2HCl=CH_3AsCl_2+H_2O$. The hydrogen chloride is added until the concentration of the excess hydrochloric acid is about 20%, this giving a mixture of constant boiling point distilling unchanged and tending to prevent reversal of reaction (3); in adding hydrogen chloride the temperature must be kept above 85° C. at the end in order to prevent formation of arsenic trichloride. On distillation, a lower layer of methyldichloroarsine and an upper one of constant boiling hydrochloric acid are obtained: these are separated and any of the product dissolved in the acid layer salted out with saturated calcium chloride solution. The methyldichloroarsine is finally freed from water, methyl alcohol, and hydrogen chloride by distillation. The details of small scale manufacture are described. A yield of nearly 50% of the theoretical

quantity of methyldichloroarsine was obtained. The arsenic in methyldichloroarsine may be determined by mixing 5 c.c. of the product with 200 c.c. of water, neutralising towards litmus by means of hydrochloric acid, adding excess of sodium bicarbonate and starch, and titrating in the cold with a *N*/10 solution of iodine in potassium iodide.
—T. H. P.

Allyl alcohol [; Determination of ——]. M. J. Stritar. Monatsh. Chem., 1918, **39**, 617—626.

Bromine is quantitatively absorbed by allyl alcohol; the reaction is suitable for the estimation of allyl alcohol, which may be effected either by direct titration with bromine water until a permanent yellow coloration is observed, or by treating the acidified aqueous solution of the alcohol with an excess of bromide-bromate solution, followed by addition of potassium iodide and titration of the liberated iodine with thiosulphate. (See also J. Chem. Soc., 1919, i., 118.)—H. W.

Hydrocarbons; Influence of catalysts on the chlorination of ——. V. R. Kokatnur. J. Amer. Chem. Soc., 1919, **41**, 120—125.

The influence of various catalysts was studied in the action of chlorine on acetylene tetrachloride, with the object of preparing pentachloroethane. Vegetable charcoal, animal charcoal, and metallic iron respectively were suspended in the liquid and chlorine was passed through at various temperatures. In all cases the reaction products contained no pentachloroethane but only hexachloroethane and unchanged acetylene tetrachloride. Attempts to chlorinate by means of bleaching powder and by heating with anhydrous aluminium chloride also yielded only hexachloroethane, although some of the acetylene tetrachloride was converted into the isomeric unsymmetrical tetrachloroethane.
—J. F. B.

[*Organic*] *acids; Identification of* ——. *IV. Phenylacetyl esters.* J. B. Rather and E. E. Reid. J. Amer. Chem. Soc., 1919, **41**, 75—83.

It was previously shown (this J., 1917, 236) that many organic acids can be identified by means of their nitrobenzyl esters, and it is now found that the phenacyl esters may be employed for a similar purpose. Phenylacetyl bromide is easily prepared by treating 20 grms. of acetophenone, dissolved in 30 grms. of glacial acetic acid, with 23 grms. of bromine, which is slowly added with constant shaking and occasional gentle warming when necessary. The sodium salt of the acid is dissolved in a little water (0·05 grm.-mol. in 5 c.c. of water), 1 grm. of phenylacetyl bromide is added and then 10 c.c. of 95% alcohol. The mixture is boiled under a reflux condenser for one hour for monobasic, 2 hours for dibasic, and 3 hours for tribasic acids. If the ester separates during the heating, more alcohol is added. The product is recrystallised until the melting point is constant. The esters of a large number of organic acids have been prepared and characterised and phenylacetyl bromide is recommended as a convenient and useful reagent for the identification of acids, superior in some cases to p-nitrobenzyl bromide. Phenylacetyl lactate, m.pt. 96° C., is especially interesting, since lactic acid is not easily identified by other means. Sulphonic acids, however, do not give derivatives with either reagent. (See also J. Chem. Soc., Apr., 1919.)—J. F. B.

Patents.

Organic acids; Manufacture of ——. H. Tobler, Hackensack, N.J., Assignor to Citro Chemical Co., Maywood, N.J. U.S. Pat. 1,288,293, 17.12.18. Appl., 9.11.17.

The impure calcium salt of an organic acid, such as citric acid, can be purified by treatment with an alkali bisulphate; the resulting solution of the acid is then neutralised with lime in the presence of sufficient calcium sulphate to complete the precipitation of the calcium salt, whilst the impurities remain dissolved.—D. F. T.

Glycerol. U.S. Pat. 1,288,398. *See* XVIII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photographic papers; Bubble formation in ——. R. E. Liesegang. Kolloid-Zeits., 1918, **23**, 200—202.

Photographic papers often exhibit bubbles in the gelatin during development and fixation. These bubbles are sometimes filled with solution and sometimes with air, but in both cases their origin is osmotic. The air comes from the paper where it was originally present and is driven between the paper and gelatin layer by osmotic processes.
—J. F. S.

Quinocyanins (pinacyanols, dicyanins). O. Fischer. J. prakt. Chem., 1918, **98**, 204—232.

Considerable light is thrown on the conditions of formation of the blue cyanins used as sensitisers in photography which have been put on the market under the names pinacyanol chloride, dicyanin bromide, and ψ-dicyanin iodide. For the production of pinacyanols and of their homologues, the ψ-dicyanin obtained from 2.4-di- and 2.4.6-trimethylquinoline alkyl iodides, two quinoline molecules are necessary, each containing a methyl group in position 2, by means of which the two molecules are united together. For the production of dicyanins two quinoline molecules are necessary, one containing a methyl group in position 2 and the other a methyl group in position 4. The presence of formaldehyde claimed in Ger. Pat. 172,118 (Eng. Pat. 16,227 of 1905; this J., 1906, 368) is unnecessary provided air or other oxidising agent is present. (See also J. Chem. Soc., Apr., 1919.)
—C. S.

[*Photographic*] *developer sludge; The nature of* ——. J. I. Crabtree. Communication No. 62 from the Eastman Kodak Research Lab. J. Franklin Inst., 1918, **186**, 371—372.

A sludge occurring in a deep developer tank in which a "pyro" developer had been used was found to consist chiefly of needle-shaped crystals of hydrated calcium sulphite, $CaSO_3,2H_2O$. This forms on standing in solutions of sulphite or bisulphite containing as little as 0·025% of calcium sulphate or chloride. In the particular case examined the calcium salt was introduced with the water used in making the developer, and not as an impurity in the salts used. The sludge has no deleterious effect on the developer apart from a slight reduction of the sulphite content, and the possibility, if it is stirred up, of fine crystals settling on the surface of the plate or film and forming pinholes.—B. V. S.

Photoelectric sensitivity of bismuthinite and various other substances. W. W. Coblentz. Scientific Paper No. 322, U.S. Bureau of Standards. J. Franklin Inst., 1918, **186**, 512.

Pure gallium and silver sulphide show slight photoelectric activity when charged to a negative potential and exposed to light. Exposure to light causes no change in the electric conductivity of tellurium, boleite, pyrites, silicon, and mixtures of

the sulphides of lead and antimony, but increases that of crystals of bismuthinite, cylindrite, molybdenite, selenium, stibnite, boulangerite, jamesonite, and silver sulphide. When connected through a battery to the grid circuit of an audion amplifier and a telephone and exposed to intermittent illumination there is an audible sound in the telephone with crystals or cells of selenium and some samples of bismuthinite and of molybdenite.—B. V. S.

Iron, cobalt and nickel arcs; [Photographic records of] wave lengths in the red and infra-red spectra of ——. W. F. Meggers and C. C. Kiess. Scientific Paper No. 324, U.S. Bureau of Standards. J. Franklin Inst., 1918, **186**, 513–514.

Using colour-sensitised plates made by bathing in pinacyanol and in dicyanin, and in the first order spectrum from a concave grating of 645 cm. radius of curvature, photographic records of the arc spectra of the ferrous metals were obtained in 10 mins. up to 7060 A, in 20–30 minutes from 7000 A to 9000 A, and over 10,000 A with 5 to 10 hrs. exposure. For the iron arc 298 lines were measured between the limits 6750 A and 10,689 A, for the cobalt arc 606 lines from 5503 A to 11,023 A, and for the nickel arc 290 lines from 5504 A to 10,843 A. Although the number of lines recorded photographically is several times that recorded radiometrically in regions between these limits where both methods of observation have been used, for longer wave lengths than 10,000 A the radiometric method is still much the more sensitive.—B. V. S.

PATENTS.

Etched intaglio printing surfaces; Method of producing ——. C. W. Saalburg, Richmond Hill, Assignor to Multicolor Intaglio Press Co., New York. U.S. Pat. 1,290,786, 7.1.19. Appl., 27.2.17.

In the production of an intaglio printing surface the resist is formed of two superimposed carbon tissue prints, the lower one being from a half-tone negative, the upper one being a grain-screen print. —B. V. S.

Coloured photographic element and method of making the same. S. E. Sheppard, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pat. 1,290,794, 7.1.19. Appl., 24.5.17.

To a solution of nitrocellulose in amyl acetate is added an alcoholic solution of a dye which "has a molecular affinity for nitro-cellulose" and will not wander from it into gelatin or ordinary photographic solutions. The dyed nitrocellulose is emulsified in a solution of gelatin, the gelatin precipitated by the addition of a suitable electrolyte, the greater part of the amyl acetate removed and the gelatin containing finely divided coloured particles of nitrocellulose again brought into solution. This may be used as a coloured substratum film on a transparent support for a light-sensitive film etc.—B. V. S.

Colour photography. Hess-Ives Corporation, Assignees of F. E. Ives, Philadelphia, Pa., U.S.A. Eng. Pat. 113,618, 19.2.18. (Appl. 2911/18.) Int. Conv., 20.2.17.

See U.S. Pat. 1,278,667 of 1918; this J., 1918, 784A.

XXII.—EXPLOSIVES; MATCHES.

Chlorate and perchlorate in nitrates. Wogrinz and Kuber. *See* VII.

Cottonseed fibres. De Segundo. *See* XII.

PATENTS.

Smokeless powder; Method of drying —— and recovering solvents therefrom. L. Gathmann, Washington, D.C. U.S. Pat. 1,289,150, 31.12.18. Appl., 17.2.17.

Smokeless powder is dried in a chamber by means of a current of gas which passes in a closed circuit from the chamber to a condenser, and thence through a heating device back into the chamber. The temperature in the condenser is gradually raised as the drying proceeds, so that smaller amounts of solvent are condensed at the later stages of the operation.—C. A. M.

Match. L. V. Aronson, Newark, N.J. U.S. Pat. 1,287,819, 17.12.18. Appl., 9.3.18.

A "persistently combustible" match-head, ignitable by friction, contains a small proportion of potassium salts containing oxygen (*e.g.* 1 part of potassium chlorate and 2 parts of potassium nitrate) with a relatively large proportion of phosphorus mixed with about an equal proportion of lampblack, or other non-glowing material (60 parts each), together with a suitable binding agent (*e.g.* 20 parts of dextrin). The whole is coated with a waterproofing composition.—C. A. M.

Match composition and process of producing the same. W. A. Fairburn, Short Hills, N.J., and F. V. D. Cruser, Oswego, N.Y., Assignors to The Diamond Match Co., Chicago, Ill. U.S. Pat. 1,290,146, 7.1.19. Appl., 28.9.15.

The composition consists of barium chromate, potassium chlorate, sulphur, inert matter, and a binder, the amount of barium chromate being about double that of the potassium chlorate. Barium chlorate, barium hydroxide, and potassium bichromate in molecular proportions are mixed with the other ingredients made into a paste with water. —T. St.

Fertilising. U.S. Pat. 1,289,565. *See* XVI.

XXIII.—ANALYSIS.

Apparatus; Laboratory ——. H. Vigreux. Ann. Falsif., 1918, **11**, 385—387.

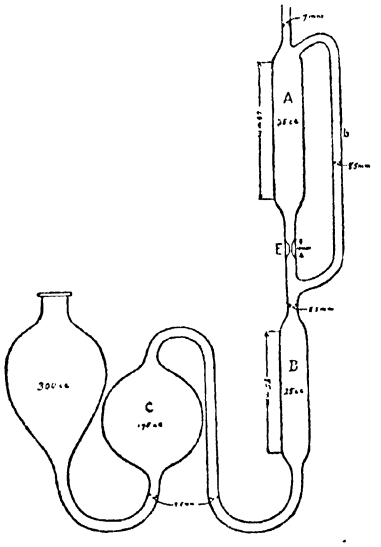
A fractionating column for use in ammonia distillations consists of a glass tube provided inside with projections arranged in rings; alternate rings consist of projections inclined downwards towards the centre of the tube and of horizontal projections. The upper end of the column is fused into the side of a condenser inclined slightly to the horizontal; at the junction the condensing tube is enlarged to a bulb provided with numerous projections to increase its surface. The greater part of the steam passing up the column is condensed and flows back into the flask, whilst the ammonia vapours pass into an absorption apparatus. A safety-valve for use with water pumps to prevent back-flow of water consists of a float fitted in a chamber; if water enters the lower part of the chamber (this part is connected with the water pump) the float rises and closes the tube in the upper part leading to the vessel to be exhausted. A side-tube and tap are provided for admitting air to the apparatus when required. A condenser is also described in which a large number of cross tubes are provided in the inner condenser tube; the water in the jacket has a free passage through these cross tubes.—W. P. S.

Reflux condenser. J. J. Bajda. J. Ind. Eng. Chem., 1919, 11, 52.

In the type of condenser described the vapours are led directly to the top of the condenser jacket by means of an external side tube extending from the stem of the condenser just above the neck of the distilling flask. The upper end of the side tube enters the top of the jacket and forms a spiral inside the jacket; the lower end of this spiral is provided with a siphon-trap which discharges the condensed liquid through a tube extending down the stem of the condenser. A branch vertical tube extends from just above the siphon-trap axially through the spiral and through the top of the jacket.—W. P. S.

Pipettes; Absorption ——. E. Van Alstine. J. Ind. Eng. Chem., 1919, 11, 51—52.

A carbon dioxide absorption pipette in which absorption is rapid and shaking is unnecessary is shown in the figure. When the bulbs A and B have been filled with the solution, the gas under examination is admitted from the measuring



burette into the top of A. The outflow of solution from this bulb to the lower one is restricted owing to the constriction, E, of the connecting tube, and the gas passes through the side tube, *b*, into the bulbs B and C. The solution flows for some time from A and comes into contact with the gas in B, a portion of the gas at the same time bubbling through the solution into C.—W. P. S.

Fat extraction apparatus. E. Griffiths-Jones. Analyst, 1919, 44, 45—47.

The lower end of the tube of a vertical condenser is fitted with two corks; the upper and larger cork serves for attaching the extraction flask to the condenser, and an extraction thimble, containing the substance to be extracted, is fitted to the lower cork. A side tube also passes through the larger cork and extends upwards to the top of the condenser and then down the condenser tube to approximately the level of the water intake. The vapours from the solvent contained in the flask pass up this side tube, and are condensed in the portion of the tube reaching inside the condenser tube, and the condensed liquid falls into the thimble and so returns to the flask. (See also J. Chem. Soc., Apr., 1919.)—W. P. S.

Crucibles made of alloys of platinum and of gold; Action of alkalis on ——. P. Nicolardot and C. Chatelot. Bull. Soc. Chim., 1919, 25, 4—9.

New platinum crucibles are more resistant than old ones to the corrosive action of fused sodium or potassium hydroxides, and the presence of iridium diminishes somewhat the resistance of the platinum to the corrosive action of the alkalis. Of the gold alloys studied, those of gold with palladium were the most resistant, but even these were very seriously attacked by sodium peroxide at the concentration necessary for the decomposition of such minerals as chromite. Barium oxide at 825° C. is less corrosive than the fused alkali hydroxides.

—W. G.

Calorimeter efficiency; Some points regarding ——. W. P. White. J. Franklin Inst., 1918, 186, 279—287.

The errors in calorimetry of moderately high precision, as practised commercially, are classified as errors due to (1) the main temperature measurement, (2) the value taken for the heat capacity of the calorimetric body, (3) the associated determinations, and (4) thermal leakage. The thermo-electric thermometer is regarded as most suitable in order to reduce errors of temperature measurement. Errors due to (2) are reduced by calibration of the calorimeter either electrically or by means of a standard substance. Under (3) are included errors due to sampling etc. Factors determining thermal leakage are the external and calorimetric temperatures, heat due to stirring, evaporation, and thermal lag. The temperature change of the calorimeter due to leakage in 5 minutes should be less than 0·015 of the difference between the calorimetric and external temperatures. Stirring should be vigorous enough to heat the calorimeter 0·001° per minute. Evaporation should be prevented, and this result can be achieved by covering the calorimeter with a thin metal cover. Precision is secured by uniformity of conditions. Adiabatic calorimeters have the advantage of ease of calculation, but not of precision. (See also this J., 1918, 257 A; 1919, 92 A.)—J. S. G. T.

Gravimetric analysis. Estimation of calcium in the presence of phosphoric, arsenic, and boric acids. L. W. Winkler. Z. angew. Chem., 1919, 32, 24.

Calcium is precipitated quantitatively as oxalate in solutions containing phosphoric, arsenic, and boric acids provided the solution is hot and acetic acid and ammonium chloride are present. About 50 c.c. of solution, containing not more than 0·1 gram of calcium, is made slightly alkaline by the addition of ammonia. The solution is diluted to 100 c.c., 3 grms. of ammonium chloride is dissolved therein, 10 c.c. of *N*/1 acetic acid is added, and the calcium precipitated as oxalate. The last traces of precipitate may be removed from the beaker by means of a little pure methyl or ethyl alcohol. If a considerable proportion of arsenic or phosphoric acid is present a double precipitation is desirable, the first precipitate being allowed to stand overnight, filtered, washed with ammonium oxalate solution, ignited, the residue dissolved in hydrochloric acid, and the calcium oxalate re-precipitated as before.—A. B. S.

Ring reactions; Phenomenon of ——. F. Reiss and G. Diesselhorst. Chem.-Zeit., 1919, 43, 30.

The formation of a ring, as distinct from a zone, which characterises certain reactions, notably the diphenylamine test for nitrates, is shown to be due to adhesion between the liquid and the glass wall

of the test-tube. The greater the surface of contact between the liquid and the glass, the more sensitive is the ring and subsequent zone reaction —C. A. M.

Zirconium; Estimation of ——. P. Nicolardot and A. Reglade. Comptes rend., 1919, 168, 348—351.

ZIRCONIUM is quantitatively precipitated by ammonium phosphate from solutions which are either neutral or contain up to 20% of sulphuric acid. The precipitate is calcined, ignited, and weighed as the pyrophosphate, the factor for conversion to ZrO_2 being 0·487. The method may be used for the estimation of zirconium in the presence of iron, chromium, and aluminium, but an acidity equal to 20% sulphuric acid is necessary if the first two are present, or 10% if only aluminium is present, in order to prevent simultaneous partial precipitation of these metals.—W. G.

Lignified plant membranes; New method of selective coloration of ——. P. Bugnon. Comptes rend., 1919, 168, 62—64.

THE author recommends the use of Light Green F.S. (sodium diethyldibenzyldiamidotriphenylcarbinolsulphonate) under the following conditions. The sections are first treated with sodium hypochlorite to destroy the cell contents, then washed and immersed for 12 mins. in a saturated aqueous or alcoholic solution of the stain, containing 5% of hydrochloric or acetic acid, and finally washed in water. The coloration obtained is permanent and preparations may be made in the usual way. This stain may be used in conjunction with Soudan III. in 70% alcohol, by which means the lignified membranes are coloured green and the suberised and cutinised membranes are stained orange-red. As a second dye, in the place of Soudan III., for the selective coloration of the suberised and cutinised membranes, ammoniacal Gentian Violet may be used, and for the coloration of the pectocellulose membranes, Alum Carmine, "Hemalum," lead bichromate, ammoniacal Congo Red, or ammoniacal Benzoazurin may be used in conjunction with Light Green. Finally from these dyes, by using colours which contrast sufficiently, a whole series of triple colorations may be obtained.—W. G.

Permeability of balloon fabrics. Edwards. *See* V.

Paper tearing-resistance tester. Case. *See* V.

Sulphur in pyrites. Moore. *See* VII.

Sulphide sulphur in pyrites. Bartsch. *See* VII.

Chlorate and perchlorate in nitrates. Wogrinz and Kuber. *See* VII.

Calcium oxide in lime. Meiklejohn. *See* VII.

Air in plastic clay. Spurrier. *See* VIII.

Iron in iron ores. Schwarz and Rolfes. *See* X.

Phosphorus in vanadium steels etc. Johnson. *See* X.

Cadmium [in brass]. Schramm. *See* X.

Soaps containing clay. Bodinus. *See* XII.

Melting point of rosin. Crossley. *See* XIII.

Flocculating power of soil solution. Leoncini and Masoni. *See* XVI.

Phosphatic fertilisers. Masoni and others. *See* XVI.

Fehling's sugar test. Fischer and Hooker. *See* XVII.

Soluble starch. Small. *See* XVII.

Water in milk. Harris. *See* XIXA.

Digestibility of vegetable fibres. Waentig and Gierisch. *See* XIXA.

Morphine. Annett and Singh. *See* XX.

Determination of morphine. Von Friedrichs. *See* XX.

Alkaloid of Isopyrum thalictroides. Mirande. *See* XX.

Stovaine and cocaine. Denigès. *See* XX.

Methyldichloroarsine. Uhlinger and Cook. *See* XX.

Allyl alcohol. Stritar. *See* XX.

Saccharin in tablets. Bonis. *See* XX.

Identification of organic acids. Ruther and Reid. *See* XX.

PATENTS.

Photometer. A. P. Little, Washington, D.C. U.S Pat. 1,288,067, 17.12.18. Appl., 8.9.17.

A STANDARD comparison screen is enclosed by a casing the walls of which carry a self-luminous material. Another screen is illuminated by the light, of which the intensity is to be measured, and means are provided to vary and to indicate that intensity.—W. F. F.

Thermo-couple and method of constructing the same. L. W. Chubb, Pittsburgh, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,289,116, 31.12.18. Appl., 19.2.14.

Two thin flat strips of dissimilar metals are connected together at one end, and arranged one over the other with strips of insulating material, *e.g.*, impregnated paper, between and on each side of them, so as to make a relatively thin flexible element.—W. F. F.

Calorimeters; Combustion-pan for bomb ——. V. H. M. Roehrich, St. Paul, Minn. U.S. Pat. 1,289,918, 31.12.18. Appl., 27.7.14. Renewed 3.4.16.

THE combustion-pan of a bomb calorimeter is provided with a short channel extending from it and containing a small quantity of the material which is to be burnt in the pan. The electrical igniting device is applied to the material in the channel and the ignition extends to the main body of

material in the pan so that the combustion of this material does not injure the igniting device.
—W. F. F.

Liquids; Apparatus for determining the specific gravity of ——. A. T. Hassinger, Chicago, Ill. U.S. Pat. 1,290,553, 7.1.19. Appl., 13.10.17.

A VESSEL calibrated to indicate volume is provided with a flexible bottom and with a thermometer. The volume of the vessel is varied by a setscrew, acting on the flexible bottom to distort it, and provided with a graduated head calibrated to compensate for temperature variations. The vessel may thus be filled with liquid to a volume corresponding to a standard temperature, and the specific gravity determined from the weight of liquid.—W. F. F.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Aktiebolaget Svenska Kullagerfabriken. Furnaces. 5390. Mar. 4. (Sweden, 4.3.18.)

Barnes. Hydro-extractors. 6361. Mar. 14.

Benjamin. Tunnel kilns. 5605—5608. Mar. 6.

Bernitz. Furnace walls. 6184. Mar. 12.

Brand. 6053. *See* II.

Brian. Vertical drying kiln. 5121. Mar. 1.

Chaudière. Shaft furnaces. 5220. Mar. 3.

Chemical Equipment Co. Corrosive-fluid valves. 6330. Mar. 13. (U.S., 13.3.18.)

Cowburn, and Cowburn and Cowpar. Carboy hampers or crates. 5643, 5644. Mar. 7.

Crompton and Gallagher. Apparatus for calculating thermal efficiency etc. of steam-generating plant. 5528. Mar. 6.

Forsyth. Grinding or pulverising ores, clinker, etc. 6329. Mar. 13.

Gay. Arrangement of plates for absorption, reaction, distillation, and rectification columns, etc. 5730. Mar. 7.

Giovannoni. Filters 5051. Feb. 28. (Italy, 22.5.18.)

Greco. Refractory brick-work for water-tube boilers. 6494. Mar. 15.

Helmer. Separating-devices. 5044. Feb. 28. (U.S., 25.4.18.)

Hodges and Kent. Combined washing-machine and hydro-extractor. 6031. Mar. 11.

Holehouse. Towers etc. for cooling water etc 5637. Mar. 7.

Irwin. Degreasing-plant. 5327. Mar. 4.

Kirke. Waste-heat boilers etc. 6068. Mar. 11.

Laverack. Apparatus for drying excreta, mucilaginous matters, etc. 5975. Mar. 11.

Lessing. Rings for absorption towers, distillation columns, etc. 4967. Feb. 27.

Lewis. Appliances for effecting heat transference between gases, vapours, or liquids. 6182. Mar. 12.

Musgrove. 5419. *See* VIII.

Newbery and Sturgeon. Separation of liquids. 4517. Feb. 24.

Pfenninger. Heat-storing and water-evaporating plants. 6320. Mar. 13.

Ransome-ver-Mehr Machinery Co., and Webb. Mixing machines. 6096. Mar. 11.

Roberts. 5748. *See* VIII.

Roberts. Grinding-mills, 6337. Mar. 13.

Sadler and Sadler. Filter strainer. 6505. Mar. 15.

Savy. Drying-apparatus. 4856. Feb. 26. (France, 30.11.16.)

Smallwood. Furnaces. 4913. 5953. Feb. 27 and Mar. 11.

Smith. Roller grinding and crushing mills for pigments etc. 5414. Mar. 5.

Smith and Zulver. Furnaces. 4589. Feb. 24.

Soc du Four Vertical Continu. Producing regular progression of materials in vertical ovens. 5251. Mar. 3. (France, 1.3.18.)

Tullis. Drying articles. 6175. Mar. 12.

Van Norman. Grinding machines. 4959. Feb. 27.

COMPLETE SPECIFICATIONS ACCEPTED.

24,296 (1914) Marks (Du Pont de Nemours Powder Co.) Removal of liquids from solid materials soluble therein. Mar. 12.

16,878 (1916) Hinchley and Gorton. Processes and apparatus for expressing liquid from material containing the same. (123,774.) Mar. 19

10,862 (1917). Bernard and Vibert. Apparatus for sorting material. (108,325.) Mar. 12.

2438 (1918). Sturgeon. Centrifugal machines or separators. (123,797.) Mar. 19.

2737 (1918). Thompson and Brown. Heat-exchangers for used as feed-water heaters, evaporators, condensers, coolers, and the like, but more particularly as heaters for use in oil fuel installations. (123,369.) Mar. 5.

3340 (1918). Watterson. Method of and apparatus for arresting sparks and economising fuel in furnaces (123,575.) Mar. 12.

3516 (1918). British Dyes, Ltd., Turner, and Parker Filter press. (123,589.) Mar. 12

4041 (1918). Turrettini. Apparatus for heating liquids by the heat generated by chemical reactions. (117,601.) Mar. 12.

4196 (1918). Talbot. *See* XIX.

4237 (1918). Blyth and Miles. *See* III.

4738 (1918). Searle. Distillation of solid and liquid substances. (123,616.) Mar. 12.

4805 (1918) Masters, and Gibbons Bros. *See* II.

5629 (1918). Brownell. Apparatus for drying and similarly treating materials. (114,626.) Mar. 5.

5651 (1918). Marles, and Ransome & Marles Bearing Co. Grinding-machines. (123,866.) Mar. 19.

6597 (1918). Simon, Hinchley, and Fisher Chemical Engineering Co. Construction of apparatus for extracting oils, fats, grease, wax, indiarubber, sulphur and other substances, soluble in organic solvents, from materials containing the same. (123,645.) Mar. 12.

6612 (1918). Alexander. Apparatus or kilns for drying granular, pulverulent, and pasty materials. (123,646.) Mar. 12.

7734 (1918). Grondal. Mechanical feeding furnace. (115,640.) Mar. 19.

11,905 (1918). Soc. de Moteurs à Gaz et d'Industrie Mécanique. Vapour condensers (117,814.) Mar. 19.

13,200 (1918). Hofmann. Apparatus for drying goods in bulk. (123,923.) Mar. 19.

13,741 (1918). Brown (Bangkok Dock Co.). Devices for the removal of ash, dust, and like matter from gases and the like. (123,924.) Mar. 19.

17,293 (1918). Pinkney. Mixing-machines. (120,393.) Mar. 5.

20,605 (1918). Kettle. Apparatus for the electrical protection against corrosion, pitting, and the like, of the tubes, ferrules, doors, and other parts of surface condensers and the like. (123,961.) Mar. 19.

21,553 (1918). Hardinge. Grinding-mills. (123,705.) Mar. 12.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Alsh. Incandescent electric lamps. 6237. Mar. 13.

Appleby and Bentley. Apparatus for agitating fuel in gas generators etc. 6336. Mar. 13.

Bates and Bates. 6251, 6252. *See* VII.

Berk and Co., and Hood. Purification of coal gas. 5079. Feb. 28.

Box. Incandescent gas lighting. 5963. Mar. 11.

Brand. Apparatus for firing furnaces with powdered fuel. 6053. Mar. 11.

Caracristi and Muhlfeld. Burning pulverised fuel. 1544. Feb. 24.

Cash. Briquette fuel. 5296. Mar. 4.

Corrigall. Incandescent electric lamps etc. 5079. Mar. 7.

Cummins. Vertical gas-retorts. 5002. Feb. 28.

Cummins and Tooley. Horizontal gas-retorts. 5112. Mar. 1.

Cuthbertson and Greensmith. Apparatus for quenching and transporting coke from coke-ovens. 5209. Mar. 3.

Dibdin. Revivifying spent oxide. 6523. Mar. 15.

Dunham. Burning combustible gases. 5664. Mar. 7. (U.S., 10.4.18.)

Hood. Purification of petroleum oils. 4576. Feb. 24.

Hood. Recovery of cyanogen from coal gas. 6445. Mar. 14.

Hookham. Incandescent electric lamps. 5819. Mar. 8.

Kelllar. 5039. *See* VIII.

Knowles. Composition for treating coal. 5844. Mar. 10.

Macdonald and Macdonald. Method of making hydrocarbon gas. 5814. Mar. 8.

McLeod. Apparatus for carbonisation and distillation of moist carbonaceous materials. 6426. Mar. 14.

Mancini and Mancini. Explosive mixtures for internal-combustion etc. engines. 5241. Mar. 3. (Italy, 26.8.18.)

Mathy. Apparatus for heating by combustion without flame. 4855. Feb. 26.

Nerrière. Apparatus for extracting coke from coke-ovens. 4304. Feb. 24. (France, 28.3.18.)

Pearse (Kennedy). Rotary retorts, and destructive distillation of carbonaceous material therein. 6057. Mar. 11.

Rideal and Tarrant. 5904. *See* XXIII.

Rogerson. Coal-washing plant. 5286. Mar. 4.

Shedlock. Treatment of hydrocarbons for extraction of volatiles and conversion into liquids of different specific gravities etc. 5237. Mar. 4.

Sloan. Process for utilisation of peat, brown coal, straw, moss, coal, cellulose, carbonaceous material, natural bitumen, and hydrocarbons either in combination or separately. 6135. Mar. 12.

Soc. du Four Vertical Continu. 5251. *See* I.

Testrup. Combustion. 6514. Mar. 15.

Walker. Heating bitumen asphalt, tar, etc. 6238. Mar. 13.

Complete Specifications Accepted.

10,981 (1915). Robertson, Nelson, and Petrol Patents, Ltd. Treatment of hydrocarbon oils and residues for the production of lower-boiling hydrocarbons. Mar. 19.

7956 (1917). Croft, Carr, and Nairne. Method of and means for treatment of gas-liquor. (123,337.) Mar. 5.

2737 (1918). Thompson and Brown. *See* I.

3240 (1918). Firth, Blakeley, Sons, and Co., and Shaw. Arrangement and operation of vertical gas retorts. (123,408.) Mar. 5.

3340 (1918). Watterson. *See* I.

3521 (1918). Day. Extraction of hydrocarbon products from shales and coals. (123,415.) Mar. 5.

4738 (1918). Searle. *See* I.

4805 (1918). Masters, and Gibbons Bros. Method of and means for feeding the furnaces of gas retorts, settings, coke ovens, muffles, and the like. (123,617.) Mar. 12.

5359 (1918). Warburton. Method of drying peat turves. (123,637.) Mar. 12.

5692 (1918). Ten Bosch. Method of and means for removing water from peat. (123,517.) Mar. 12.

5788 (1918). West and Wild. Charging of retorts or chambers for the destructive distillation of carbonaceous materials. (123,441.) Mar. 5.

6598 (1918). Dent, and United Alkali Co. Apparatus for use in the distribution of liquids in gas scrubbers and for analogous purposes. (123,879.) Mar. 19.

6772 (1918). Marks (Fayd'herbe). Fuels for internal-combustion engines. (123,450.) Mar. 5.

19,066 (1918). Aktiebolaget Ingeniörsfirma Egnell. *See* XXIII.

III.—TAR AND TAR PRODUCTS.

Applications.

Imrie (Geigy Soc. Anon.). Process of manufacture of 2-aminoanthraquinone. 5930. Mar. 10.

Mailhe. Process for production of aminophenol bases. 6094. Mar. 11. (France, 21.4.17.)

Shedlock. 5237. *See* II.

Walker. 6238. *See* II.

Complete Specifications Accepted.

10,981 (1915). Robertson and others. *See* II.

15,320 (1917). Selden Co., and Gibbs. Process of chlorinating the side chains of aromatic hydrocarbons. (123,341.) Mar. 5.

1004 (1918). Hintikka. Manufacture of paranitrotoluene-ortho-sulphonic acid. (123,548.) Mar. 12.

4237 (1918). Blyth and Miles. Means of and apparatus for purifying benzol and other oils, and washing or mixing two liquids of different specific gravity. (123,839.) Mar. 19.

5080 (1918). Crabb. Methods and apparatus for separating and purifying creosote oil. (123,857.) Mar. 19.

6667 (1918). Archer. Tar stills. (123,880.) Mar. 19.

IV.—COLOURING MATTERS AND DYES.

Applications.

Brotherton and Co., Ehrhardt, and Kay. Manufacture of black sulphur colours. 6242. Mar. 13.

Brotherton and Co., Ehrhardt, and Ehrhardt. Manufacture of violet colouring-matters dyeing by the metachrome process. 6243. Mar. 13.

Complete Specification Accepted.

9962 (1915). Badler and Holliday. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Aktieselskabet Frogner Garage Motor Co. Fro-Ga-Mo. Method of impregnating balloons etc. 6499. Mar. 15. (Norway, 29.5.18.)

Barefoot. Compound for removal of iron mould etc. from textile goods etc. 5957. Mar. 11.

Barnes. 6361. *See* I.

Barnes and Sinnatt. 5974. *See* XIII.

Hodges and Kent. 6031. *See* I.

Irwin. 5327. *See* I.

Johnson. Paper-making etc. machines. 6229. Mar. 13.

Kirschbraun. Waterproof products and processes. 5596. Mar. 6.

Kloss. Waterproof material. 5885. Mar. 10.

Nash. Continuous beating and refining engine for manufacture of paper etc. 5479. Mar. 5.

Poulson. Treatment of wool. 5297. Mar. 4.

Schiller. Paper-making machines. 5946. Mar. 10.

Thornber. Composition for rendering wearing-apparel non-inflammable. 4660 Feb. 25

COMPLETE SPECIFICATIONS ACCEPTED.

5915 (1915). Wheatley, and North British Rubber Co. Fabric for balloon envelopes and the like, and the method of manufacturing and after-treating the same. Mar. 12.

6698 (1915). Portadown Weaving Co., and Greeves. Fabrics applicable for aeroplane and other purposes and aeroplane wings and planes. Mar. 12.

17,817 (1917) and 10,567 (1918). Manchester Oxide Co., Clayton, Huebner, and Williams. Process of treating celluloses. (123,784.) Mar. 19.

1519 (1918). Huebner. Machines or apparatus for coating textile and other fabrics. (123,551.) Mar. 12.

3474 (1918). Anderson, Anderson, and Wilson Hollander beating engines. (123,584.) Mar. 12.

3598 (1918). Dagnall. Process for the manufacture of parchmentised or like paper. (123,594.) Mar. 12.

4422 (1918). Fry and Whitton Fabrics. (123,613.) Mar. 12.

4516 (1918) Kelsey. Process for recovering grease and the like from water which has been used in scouring or washing wool, hides, flax, jute, and the like, or from magma obtained from such water. (123,848.) Mar. 19.

VI.—BLEACHING; DYEING; PRINTING; FINISHING

APPLICATIONS.

Driver and Sunderland. 5788. *See* XXIII.

Henshilwood and Wrigley. Finishing fabrics. 5538. Mar. 6.

Whitaker and Whitaker. Machines for dyeing, scouring, and washing wool etc 6362. Mar. 13

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS

Bates and Bates. Means for producing spathic ore for manufacture of hydrogen. 6251. Mar. 13.

Bates and Bates. Means for charging retorts or apparatus with spathic ore for manufacture of hydrogen. 6252. Mar. 13.

Breuille. 5134. *See* X.

British Thomson-Houston Co (General Electric Co.). Fractionating air. 6438. Mar. 14.

Comment. Process for preparation of anhydrous sulphide of zinc. 6089. Mar 11 (France, 30 4.18.)

Dibdin. 6523. *See* II.

Fairbrother (Chemical Construction Co.). Apparatus for recovering potassium compounds. 4562. Feb. 24.

Fairbrother (Chemical Construction Co.). Process of recovering potassium compounds. 4563. Feb. 24.

Gibbs. Manufacture of inorganic chlorine compounds. 5737. Mar. 7.

Gros et Bouchardy. Production of nitrogen compounds containing hydrogen with aid of electric discharges. 4600. Feb. 24. (Switz., 2.10.18.)

Hood. 6445. *See* II.

Lindsay Light Co. Process of purifying thorium compounds. 6456. Mar. 14. (U.S., 29.5.18.)

Orton and Robinson. Manufacture of alumina. 4827. Feb. 26.

Rideal and Tarrant. 5904. *See* XXIII.

Soc. l'Air Liquide. Transformation of synthetic ammonia into a transportable product for use in agriculture in conjunction with production of carbonate of soda. 6448. Mar. 14. (France, 24.8.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

6048 (1915). Gidden. Manufacture of ammonium nitrate. Mar. 12.

10,595 (1915) and 1059 (1916). Smith, and Ammonia Soda Co Process for the production of calcium nitrate. Mar. 19.

10,781 (1915). Maxted and Ridsdale. Production of oxides of nitrogen. Mar. 19.

12,401 (1915). Freeth and Cocksedge. Manufacture of ammonium nitrate from ammonium bicarbonate or the components thereof and sodium nitrate. Mar. 19.

7956 (1917) Croft and others. *See* II.

16,692 (1917). Dawson Manufacture of nitric acid. (123,344.) Mar. 5.

1467 (1918). Soc Industrielle de Produits Chimiques. Process for transforming sodium monochromate into bichromate. (119,219.) Mar. 12.

2286 (1918) Carlson. Manufacture of nitrogen compounds from carbides. (123,796.) Mar. 19.

6111 (1918). Titan Co. Aktieselskab Titanium products. (116,266.) Mar. 12.

6597 (1918) Simon and others. *See* I.

8072 (1918) Barrett and Pennington. Method of and apparatus for the manufacture of carbonic acid gas. (123,898.) Mar 19.

11,020 (1918) Bracq Pyrites furnaces (118,094.) Mar 5.

11,369 (1918). Patentaktiebolaget Jungners Kali-Cement. *See* IX.

12,001 (1918). Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Production of alumina nitrates from clay, argillite, and similar minerals. (120,035.) Mar. 12.

VIII GLASS; CERAMICS

APPLICATIONS.

Bairstow. Brick composition, and articles manufactured therefrom. 4565. Feb. 24.

Barratt. Manufacture of glass tube. 4905. Feb. 27.

Benjamin. 5605 -5608. *See* I.

British Thomson-Houston Co. (General Electric Co.). Porcelain. 6303. Mar. 13.

Denis. Manufacture of refractories. 5441. Mar. 5.

Gowen (Leecsne). Manufacture of refractory materials. 5597. Mar. 6. (France, 25.3.16.)

Greco. 6494. *See* I.

Hughes. Method of printing upon glass. 6518. Mar. 15.

Keillar. Fire bricks for furnaces, coke-ovens, etc. 5039. Feb. 28.

McMinn. Glazing cement for use in fire-clay retorts and furnaces. 5075. Feb. 28.

Musgrove. Recuperator brick. 5419. Mar. 5.

Musgrove. Bricks. 6377. Mar. 14.

Roberts. Blocks, and heating-walls made from such blocks. 5748. Mar. 7.

Sharratt. Brick kilns. 5347. Mar. 4.

COMPLETE SPECIFICATIONS ACCEPTED.

2254 (1917) Norton Co. Aluminous abrasive, and method of preparing the same. (113,959.) Mar. 19.

2257 (1917) Norton Co Aluminous abrasives and process for making the same. (118,592.) Mar. 19.

2848 (1918) Barron and Barron. Artificial millstones and the manufacture thereof. (123,377.) Mar. 5.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Bolvie, Shaw, and Stanley. Manufacture of artificial stone. 6355 Mar. 14.

Bravin. Concrete etc 5153. Mar. 1.

Clarke. Manufacturing concrete etc 4701. Feb. 25.

De Vecchis Metallisation of wood. 5208. Mar. 3.

Forrester (Internationall Isolations Kompani Aktieselskabet Ikas). 6522. *See* XI.

Frydenhind. Production of porous building and insulating bodies 5358 Mar 1 (Denmark, 5.3.18.)

Hill-Jones, Ltd., and Hughes Manufacture of bricks, slabs, tiles, etc for paving, building, etc. 6510. Mar. 15.

Lovell. Building blocks or bricks 5821 5825 Mar. 8

Price. Manufacture of faced artificial stone products. 5811. Mar. 8

Price. Apparatus for manufacture of artificial stone products 5812. Mar. 8.

COMPLETE SPECIFICATIONS ACCEPTED.

1040 (1918). Ferguson. Blocks used for building purposes. (123,361) Mar 5

11,369 (1918). Patentaktiebolaget Jungners Kali-Cement Method of manufacturing simultaneously hydraulic cement and alkali from alkaliferous mineral substances and lime. (117,460) Mar. 5.

15,712 (1918). Olsen and Westell Process for making waterproof cement and the product thereof (123,695) Mar. 12

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY

APPLICATIONS

Adam, Mabbitt, and Stevenson. Detinning tinned iron scrap. 4838. Feb. 26.

Alloy Welding Processes, Ltd., and Jones. Electrodes and welding etc. rods used in soldering and depositing metals. 4818. Feb. 26.

Ashton, and Oates and Green. Acid etc. baths for treating wire. 4665. Feb. 25

Ayala. Solder for aluminium, and process for making same. 5381. Mar. 4. (Spain, 10.9.17.)

Bell. Separating mineral from crushed ores, ore from alluvial and placer deposits, etc. 5362. Mar. 4.

Brearley and Johnson. 5374. *See* XXIII.

Breuille. Agglomerating and desulphurating blocks composed of ashes of roasted pyrites. 5134. Mar. 1.

Cowper-Coles. Matrix for manufacture of plates by electro-deposition. 5438. Mar. 5.

Cowper-Coles. Manufacture of copper plates for process printing. 5439. Mar. 5.

Cowper-Coles. Process for manufacture of wire. 5440. Mar. 5.

Dear. Oil-hardening steel plates. 5744. Mar. 7.

Dear. Nickel-steel alloys. 5745. Mar. 7.

Delves-Broughton. Flux for soldering metals 5521. Mar. 6.

Dendrinos. Method for protecting iron, steel, etc. from oxidation when heated to a high temperature. 4837. Feb. 26.

De Vecchis. 5208. *See* IX.

Forsyth. 6329. *See* I.

Gasche. Concentration of ores. 6392. Mar. 14.

Hole. Electric smelting-furnaces. 5573. Mar. 6. (Norway, 11.4.18.)

Kuehnrich. Alloy. 6276. Mar. 13.

Meacher. Method of electrically welding platinum etc. disks to ends or heads of metal screws or rods 4632. Feb. 25.

Pecks. Pudding-furnaces. 4638. Feb. 25.

Ross. Obtainment of sulphate of copper, metallic copper, etc., from ores. 5580. Mar. 6.

Stabilimenti Biak-Ing. A. Pouchain. Electric furnace for heating, annealing, or melting metallic materials 5931. Mar. 10 (Italy, 9.3.18.)

Vautin Recovery of metals from slags 6541. Mar. 15.

Wade (Central Mining and Investment Corporation). Electrodes for electrolytic recovery of metals from solutions 4622. Feb 24.

Wade (Central Mining and Investment Corporation) Electrolytic recovery of metals from solutions. 4623 Feb 24

Webster Method of malleablising cast metal 6210 Mar 12.

COMPLETE SPECIFICATIONS ACCEPTED.

12,200 (1917) Hall and Bailey. Furnaces for melting steel and other metals. (123,778.) Mar. 19.

2213 (1918). Robertson Device to lessen oxidation while tapping steel from smelting furnace (123,793) Mar 19.

3505 (1918). Youricff Production of spongy lead. (123,587.) Mar 12.

3591 (1918) Cito. Process for treating copper sweepings and scraps (123,418.) Mar. 5.

7171 (1918) Aitken. Crucible furnaces for melting metals. (123,457.) Mar. 5.

11,020 (1918) Bracq. *See* VII.

XI ELECTRO CHEMISTRY

APPLICATIONS.

Adam, Fieldhouse, Mabbitt, and Stevenson. Electrolysis. 4948. Feb. 27.

Alloy Welding Processes, Ltd., and Jones. 4848. *See* X.

British Thomson-Houston Co. (General Electric Co.). Electric-furnace control apparatus. 5465. Mar. 5.

British Thomson-Houston Co. (General Electric Co.). Electric heating units, and methods of manufacturing same. 6195. Mar. 12.

Cowper-Coles. 5438. *See* X.

Cowper-Coles. Process for production of zinc battery elements. 5783. Mar. 8.

Dreyfus. Chemical processes conducted in electrical furnaces. 4933. Feb. 27.

Féry. Electric storage cells. 5706. Mar. 7. (France, 30.4.17.)

F.I.A.T. Soc. Anon. Electrical furnaces. 5894. Mar. 10. (Italy, 2.11.18.)

Forrester (International Isolations Kompani Aktieselskabet Ikas). Manufacture of insulating bodies etc. 6522. Mar. 15.

Gros et Bouchardy. 4600 *See* VII.

Hepburn. Electrolysers. 5698. Mar. 7.

Hole. 5573. *See* X.

Marriott. Electric furnaces. 5212. Mar. 3.

Meacher. 4630. *See* X.

Thompson. Manufacture of carbon electrodes. 5764. Mar. 8.

Wade (Central Mining and Investment Corporation). 4622. 4633. *See* X.

Worsnop. Electrical accumulators. 4509. Feb 21

COMPLETE SPECIFICATIONS ACCEPTED.

19,041 (1917). Prescott and Baker. Electrical apparatus for subjecting articles to varying temperatures. (123,545.) Mar. 12.

3430 (1918). Yourieff. Electric accumulators and the like. (123,582.) Mar. 12.

4428 (1918). Howard. Control of electric furnaces. (123,845.) Mar. 19.

16,762 (1918). Newbery and Gerrard. Electrodes. (123,936.) Mar. 19.

20,605 (1918). Kettle. *See* I.

2507 (1919). Leitner and Exley. Manufacture of electric accumulators (123,969.) Mar. 19.

XII.—FATS; OILS; WAXES

APPLICATIONS.

Irwin. 5327. *See* I.

King. Deodorising and decolorising oils and fats. 6059. Mar. 11.

Musgrave. Manufacture of soap. 4762. Feb. 26.

N.V. Jurgens' Vereenigde Fabr. 6142. *See* XIX.

COMPLETE SPECIFICATIONS ACCEPTED.

1856 and 2618 (1918). Boehm and Reihl. *See* XIII.

3613 (1918). Moore and Moore. Cleansing compound or paste for toilet purposes. (123,597.) Mar. 12.

4160 (1918). Douglass. Detergent soaps and means for and method of making same. (123,835.) Mar. 19.

4516 (1918). Kelsey. *See* V.

6597 (1918). Simon and others. *See* I.

11,785 (1918). Napp (Preiswerk). *See* XX.

21,895 (1918). Lane. Apparatus for hydrogenising oils and fats. (123,966.) Mar. 19.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Barnes and Sinnatt. Manufacture of paints, inks, polishes, filling-materials for rubber, paper, artificial leather, etc. 5974. Mar. 11.

Ingram. Antifouling paint. 5567. Mar. 6.

Oltmans. Pliant floor covering. 4960. Feb. 27.

Smith. 5414. *See* I.

COMPLETE SPECIFICATIONS ACCEPTED.

1600 (1918). Craven, and Yorkshire Dyeware and Chemical Co. Linoleum and linoleum cement. (123,791.) Mar. 19.

1856 and 2618 (1918). Boehm and Reihl. Process for converting linseed oil fatty acids or any other fatty acids of drying or semi-drying oils into well-drying oils. (123,792.) Mar. 19.

3664 (1918). Sperr and Darrin. Manufacture of resins. (123,806.) Mar. 19.

4290 (1918). Morris. Manufacture of chrome yellows. (123,841.) Mar. 19.

5300 (1918). Cellon, Ltd., Tyrer & Co., and Tucker. Production of dopes. (123,628.) Mar. 12.

16,317 (1918). McLean. Washable distemper or water paint. (123,931.) Mar. 19.

16,318 (1918). McLean. Thinning-composition for use with washable distemper or water paint. (123,932.) Mar. 19.

XIV.—INDIA RUBBER; GUTTA-PERCHA.

APPLICATIONS.

Barnes and Sinnatt. 5974. *See* XIII

Bowdler. Treatment or recovery and purification of rubber. 5427. Mar. 5.

Wade (Goodyear Tire and Rubber Co.). Manufacture of rubber compounds. 4551. Feb. 24.

COMPLETE SPECIFICATION ACCEPTED.

6597 (1918) Simon and others. *See* I.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATIONS.

Barnes and Sinnatt. 5974. *See* XIII.

Dufour and Dufour Tanning and liming hides or skins. 5124. Mar. 1. (Italy, 6.4.18.)

Garner Apparatus for liming hides. 5671. Mar. 7

Tully. Preparation for waterproofing leather. 4793. Feb. 26.

COMPLETE SPECIFICATIONS ACCEPTED.

1974 (1917). Goldreich, Jackson, and Stern & Co. Waterproofing, polishing, preserving, and restoring preparations for boots and the like, and for other articles of leather or the like. (123,775.) Mar. 19.

17,879 (1917) Meyzonnier. Process for preparing solutions suitable for chrome tanning. (123,785.) Mar. 19.

4516 (1918) Kelsey. *See* V.

5874 (1918) Gilardini. Apparatus for the rapid tanning of hides and skins. (114,631.) Mar. 12.

6686 (1918). Wright and Wright. Tanning machinery. (123,448.) Mar. 5.

XVI.—SOILS, FERTILISERS.

APPLICATIONS.

Radmann. Fertiliser and method of producing same. 5477. Mar. 5

Soc. l'Air Liquide. 6448. *See* VII.

Tasker. Fertiliser. 6231 Mar. 13

COMPLETE SPECIFICATIONS ACCEPTED.

9855 and 20,597 (1918). Goulding, Goulding, and Allibon. Apparatus for the manufacture of superphosphates or like artificial fertilisers. (123,912 and 123,960.) Mar 19.

XVII.—SUGARS; STARCHES; GUMS.

APPLICATIONS.

Laverack. 5975. *See* I.

Lenders. Method of manufacturing starch and conversion products thereof. 5512. Mar. 5.

COMPLETE SPECIFICATION ACCEPTED.

13,530 (1918). Pictet. Manufacture of levoglucosan. (121,725.) Mar. 12.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATIONS.

Armitage. Separating yeast etc. in suspension from beer and stout. 5687. Mar. 7.

Ramplchini & Co. Processes based on the action of enzymes, and baths, mixtures, etc., containing one or more enzymes. 4571. Feb. 24. (Italy, 23.3.18.)

Timmermans. Filter for use in breweries etc. 6162. Mar. 12.

COMPLETE SPECIFICATION ACCEPTED.

4845 (1915). Welzmann. Bacterial fermentation of carbohydrates and bacterial cultures for the same. Mar. 12.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Burkhalter. Preparation for making bread, biscuits, etc. 6082 Mar. 11.

Coleman and Jones. Treatment of cereals. 1608. Feb. 24.

Ferguson. Bread-making. 6114. Mar. 12.

Fletcher and Lewis. 5401. *See* XXIII.

Fothergill and Whyte. Apparatus for treatment of sewage etc. 5028. Feb. 28.

Kelsey. Process for making bread. 5245. Mar. 3.

Laverack. 5975. *See* I.

Linden. Drying sewage sludge etc. 4740. Feb. 25.

Linden. Reducing percentage of water in sewage sludge etc. 5864. Mar. 10.

Linden. Siphons for reducing percentage of water in sewage sludge etc. 6078. Mar. 11.

Mills. Testing milk etc. for cheese-making. 4764. Feb. 26.

N. V. Jurgens' Vereenigde Fabrieken. Processes for recovering oils and fats from waste water. 6142. Mar. 12. (Holland, 9.3.18.)

Watson. Furnaces for destruction of refuse etc. 6172. Mar. 12.

COMPLETE SPECIFICATIONS ACCEPTED.

12,861 (1917). Sutherland Process and apparatus for increasing the yield of bread and improving the baking qualities of flour or meal and milling products. (115,410.) Mar. 5.

3132 (1918). Van Dantzig, and N.V. Chemisch & Pharmaceutisch Laboratorium. Process of preserving vegetables and fruits. (123,403.) Mar. 5.

3523 (1918). Dowding. Treatment of potatoes for obtaining food products. (123,991.) Mar. 12.

3625 (1918). Lyle. Combined food and beverage, and process of making the same. (123,804.) Mar. 19.

4196 (1918). Talbot. Means or apparatus for purifying air. (123,609.) Mar. 12.

4983 (1918). Greville. Treatment of flour. (123,435.) Mar. 5.

6971 (1918). Graham. Bread and other food products and process of producing same. (123,883.) Mar. 19.

8250 (1918). Smithers. Apparatus for use in sterilising and/or pasteurising canned or tinned food. (123,899.) Mar. 19.

13,811 (1918). West. Method of treating grain for the preservation thereof, and apparatus employed in connection therewith. (123,925.) Mar. 19.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATION.

Dunningham, Hargreaves, and Hutchins. Manufacture of tetrachlorethane. 5149. Mar. 1.

COMPLETE SPECIFICATIONS ACCEPTED.

17,776 (1914). Lefranc. Process for the commercial manufacture of acids of the fatty series and of butyric acid in particular. Mar. 12.

15,320 (1917). Selden Co., and Gibbs. *See* III.

11,785 (1918). Napp (Preiswerk). Process for the manufacture of isobutyl ester of oleic acid. (123,685.) Mar. 12.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATION.

Balchin. Photographic film and production thereof. 5926. Mar. 10.

COMPLETE SPECIFICATIONS ACCEPTED.

17,881 (1917). Hamburger. Polychrome cinematography. (123,786.) Mar. 19.

17,882 (1918). Hamburger. Colour photography. (123,787.) Mar. 19.

XXII.—EXPLOSIVES; MATCHES.

APPLICATIONS.

Gale and Hodgkinson. Utilisation of waste explosives. 6351. Mar. 13.

Johnston and Orr. Process for moisture-proofing matches. 4645. Feb. 25.

Short and Ward. Explosives. 5102. Mar. 1.

Van Cleef. Matches. 4738. Feb. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

2169 and 2172 (1915). Mellersh-Jackson (Palmer Perchlorate Powder Co.). Manufacture of explosives. Mar. 12.

9962 (1915). Badler and Holliday. Process of manufacture of picric acid. Mar. 19.

10,865 (1915). Pronk and Bowen. High explosives. Mar. 19.

XXIII.—ANALYSIS.

APPLICATIONS.

Brearley and Johnson. Measuring-apparatus for testing hardness of materials etc. 5374. Mar. 4.

Driver and Sunderland. Apparatus for testing colour fastness in dyed fabrics. 5788. Mar. 8.

Fletcher and Lewis. Device for testing milk. 5404. Mar. 5.

Khan. Pyrometer or high-temperature thermometer. 5133. Mar. 1.

Muddiman. Adjustable means for holding nitrometers etc. having mercury bulbs. 4522. Feb. 24.

Rideal and Tarrant. Detection and estimation of ammonia in gases. 5904. Mar. 10.

COMPLETE SPECIFICATION ACCEPTED.

19,066 (1918). Aktiebolaget Ingeniörsfirma Egnell. Gas-analysing apparatus. (120,921.) Mar. 5.

I.—GENERAL; PLANT; MACHINERY.

Liquids; Washing —— with liquids. C. H. Borrmann. Z. angew. Chem., 1919, **32**, 46—48.

THE method of extracting one liquid with another by counter-current contact in a column filled with Raschig's rings or other suitable packing material is likely to supersede the older method of shaking or stirring intermittently and separating the two layers of liquid. An apparatus for counter-current contact between two liquids or a liquid and a gas was described by the author for large-scale work (this J., 1915, 1232). The device recommended by Raschig (this J., 1918, 677 A) does not meet all requirements, because it takes no account of the alterations in density of the liquids as the result of their mutual action. In washing one liquid with another in this way, the lighter liquid should enter at the bottom of the column and flow slowly out at the top, while the heavier liquid should enter at the top and fall downwards in a finely divided form. If the lighter liquid is the solvent it may become heavier through its enrichment in the extracted substance and the action of the column may be upset through the fresh, lighter portions of the solvent which enter at the bottom rising suddenly to the top, while the enriched portions sink. In the author's design this failure of the counter-current principle is avoided as far as possible and the apparatus has worked satisfactorily for years. If the rising liquid becomes lighter, Raschig's design is correct, but Raschig's rings are not necessarily the best type of packing material. In fact, any unsymmetrical type of packing runs the risk of accumulating more on one side of the column than on the other and diverting the even flow of the falling liquid. For this reason, symmetrical packings are always to be preferred and the author uses plates of spiral wire-work simply packed one over the other. These have a maximum surface per unit weight, are easily cleaned, and only occupy 4% of the sectional area of the column. The design of the packing is, however, a minor point and the chief consideration is the correct adaptation of the working principle of the apparatus to the physical conditions to be dealt with. It is important also to make provision for continuous rectification of the products, since each liquid is to some extent soluble in the other and the solvent has to be recovered not only from the extract but also from the residue. Kubierschky's three-column apparatus (*loc. cit.*) provides for this, and several are working with capacities up to 8000 litres per hour.—J. F. B.

PATENTS.

Furnaces; Regenerative gas-fired ——. H. N. Davis and W. R. Twigg, Luton. Eng. Pats. (A) 122,673 and (B) 122,674, 28.12.17. (Appls. 19,189 and 19,190/17.)

(A) THE furnace comprises a heating chamber and a number of chambers which can be employed either as regenerators or preheaters. These regenerators or preheaters are provided in sets of two arranged longitudinally left and right in the furnace structure, and two sets of burners supplied with pressure air are similarly provided in the furnace proper, the pressure air necessary for the combustion of the gas induced being preheated by passage through the appropriate preheater. The products of combustion are discharged through the regenerator chambers. The sets of burners are employed alternately, the sets of chambers meanwhile being employed as preheater and regenerator respectively. The change over from one set of burners to the other is effected by means of a valve so devised that the rôles of the preheater and regenerator are simultaneously interchanged when the valve is operated. In this manner the second set of burners is supplied with preheated air, and the heat of the products recovered regeneratively.

(B) In a furnace of the type described under (A) the air and gas valves are so mounted and connected that the supplies of air and gas are controlled simultaneously.—J. S. G. T.

Heating furnace with removable hearth. E. C. R. Marks, London. From Soc. Anon. Ital. Gio. Ansaldo & Co., Genoa, Italy. Eng. Pat. 122,928, 16.2.18. (Appl. 2799/18.)

IN a furnace having a removable hearth provided with openings in its upper part through which gases pass to a collecting flue within the hearth, the collecting flue is arranged transversely. Lutes are provided between the sides of the hearth and the furnace walls both above and below the flue.

—C. A. K.

Smoke, furnace gases, exhaust gases and the like; Treating ——. J. W. Stansfield, Hartlepool. Eng. Pat. 122,871, 26.1.18. (Appl. 1523/18.)

THE smoke or other gas is sprayed with water in a constricted part of a chamber, the spray being projected in the direction of motion of the gas. The washing water is subsequently treated for the recovery of any valuable products washed out of the smoke etc. The device is claimed to afford increased draught for boiler or other furnaces. (Reference is directed in pursuance of Sect. 7, Subsect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 15,418 of 1900, 18,744 and 27,947 of 1907, and 20,963 of 1908.)—J. S. G. T.

Drying granular materials; Process and apparatus for ——. A. Huhn, Minneapolis, Minn., U.S.A. Eng. Pat. 122,910, 7.2.19. (Appl. 2242/18.)

A BATTERY of steam pipes is arranged inside a drum rotating about an axis slightly inclined to the horizontal. The inlet and outlet for the granular material to be dried are sealed by the material itself. The material after entering the drum is lifted by flights, and poured down over the steam pipes. Moisture expelled during the drying is removed through a pipe situated at the upper end of the drum. A partial vacuum is maintained within the drum by means of a positive blower, the degree of evacuation being regulated by the admission of air to the lower part of the drum. Any dust particles are removed from the moist exit gases by means of centrifugal dust collectors before the gases reach the blower.—J. S. G. T.

Dryer [for grain, beets, grass, malt, etc.]. F. Kohlank, Brackwede. Ger. Pat. 309,010, 12.12.14 Addition to Ger. Pat. 293,416.

IN a dryer similar to that described in the chief patent (this J., 1916, 1145), the rotation of the ventilator fans attached to the axes of the drums is independent of that of the drums.—L. A. C.

Drum dryer; Steam-heated, rotary ——. S. Mertens, Brunswick. Ger. Pat. 309,084, 8.5.17.

IN a rotary drum dryer, having shelves or ledges for lifting the material inside, the shelves are not fixed radially, but are inclined in the direction of rotation of the drum.—L. A. C.

Vacuum dryer. B. Schilde Maschinenfabrik und Apparatebau, G.m.b.H., and A. Boleg, Hersfeld. Ger. Pat. 309,086, 20.4.16.

WITHIN a vessel fitted with a removable air-tight lid, is a group of heating plates, the material to

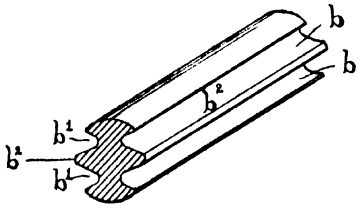
be dried being placed in the spaces between the plates. The group of plates is surrounded on at least four sides by a heat insulator, and the walls of the vessel itself are either uninsulated or provided with a cooling jacket. A tube leads from the bottom of the vessel through a cooler to a receptacle underneath.—L. A. C.

Evaporators. P. Kestner, Paris. Eng. Pat. 122,958, 22.3.18. (Appl. 5107/18.)

THE liquor undergoing concentration and the vapour given off are passed together through a long duct surrounded by a steam jacket. The duct consists of at least three vertical sections, from the upper end of the last of which the liquor and vapour are delivered into a separator. In this way the hot concentrated liquor is obtained at such a level that it can be transferred by gravity to any vessels desired.—W. H. C.

Filter-presses. J. A. Wilson, Manchester. Eng. Pat. 122,979, 22.5.18. (Appl. 8482/18.)

BARS of the form shown in the figure are built up vertically in a frame to form a corrugated filter-plate. The ribs, b^2, abut on similar ribs of adjacent bars, while the channels, b, b^1, serve to conduct



the filtrate to a collecting duct in the lower part of the frame. Owing to the form of the surface, the filter cloth cannot sag into the drainage channels and block them.—W. H. C.

Filters. The Pulsometer Engineering Co., Ltd., and J. Björnstad, Reading. Eng. Pat. 123,152, 12.2.18. (Appl. 2524/18.)

THE bottom plate of the filter is provided with a number of recessed pockets the bottoms of which are perforated and provided with water nozzles, whilst the spaces between the pockets are perforated and provided with air nozzles. The water and air required for cleansing the filter medium are supplied separately under pressure. The air being delivered just beneath the plate and above the level of the water nozzles, depresses the level of the water slightly and passes upwards through the air nozzles while the water passes upwards through the water nozzles.—W. H. C.

Filter; Suction ——. R. Wüster, Dassel. Ger. Pat. 309,015, 17.3.18.

A SUCTION filter consists of two cylinders, one sliding inside the other, with an air-tight ring attached to the lower end of the inner cylinder. By drawing upwards the inner cylinder, the bottom of which forms the filtering surface, a partial vacuum is created in the space between the bottoms of the two cylinders. The liquid to be filtered is led into the inner cylinder.—L. A. C.

Filter; Suction ——. C. A. Beringer, Charlottenburg. Ger. Pat. 309,016, 10.1.17.

IN a suction filter means are provided whereby, on stopping the introduction of the liquid and suction, the surface of the filter cake is covered over, thereby preventing access of air and the formation of cracks in the cake. Liquid for washing the cake may be added through the covering if this is constructed of a permeable material. A suitable appliance consists of a filter cloth loosely attached to a frame suspended in the liquid which is being filtered. The filter may be built up of several units as in a filter-press, each containing the necessary means for covering the cake.—L. A. C.

Separating immiscible liquids; Apparatus for ——. J. L. Sands, London, and J. Gourlay, Glasgow. Eng. Pat. 123,033, 28.10.18. (Appl. 17,520/18.)

THE closed float of the separating apparatus described in Eng. Pat. 106,165 (this J., 1917, 698) is replaced by an open-topped float of large dimensions into which tubes depend from the separating drum. The float is sustained by a spring the tension of which can be adjusted.—W. H. C.

Mixing granulated or triturated materials; Machines for ——. L. McG. Fraser, and W. J. Fraser and Co., Ltd., Romford. Eng. Pat. 123,135, 7.2.18. (Appl. 2246/18.)

THE materials to be mixed are fed from a hopper into a pivoted shoot, which passes through the front of the mixing drum and discharges the material near the rear end of the drum. The latter is provided with internal lifting blades, and is rotated on rollers. As the drum rotates, the materials are lifted by the blades and dropped into the shoot, by which they are returned to the rear end of the drum. When the mixing is complete the shoot is tilted and the mixed materials are discharged.—W. H. C.

Samples of liquids; Apparatus for automatically taking ——. T. Roberts, Bolton. Eng. Pat. 123,173, 18.2.18. (Appl. 2827/18.)

IN apparatus of the type in which the liquid to be sampled is fed into a central vessel which is rotated above a series of stationary receptacles, electrical or other devices are provided by means of which the rotation of the central vessel may be controlled from a distance, for instance from a central office.

Pulverising-mills. H. Walker, London. Eng. Pat. 123,259, 25.6.18. (Appl. 10,474/18.)

IN a ring and roll mill the rolls, which take the form of hoops mounted on discs, are pressed by a spring or other suitable device against the revolving ring. The rolls and ring are larger in diameter at the centre than at the ends.—W. H. C.

Heat changes; Method and apparatus for inducing ——. R. Vuilleumier, New Rochelle, N.Y. U.S. Pat. 1,275,507, 13.8.18. Appl., 29.1.17.

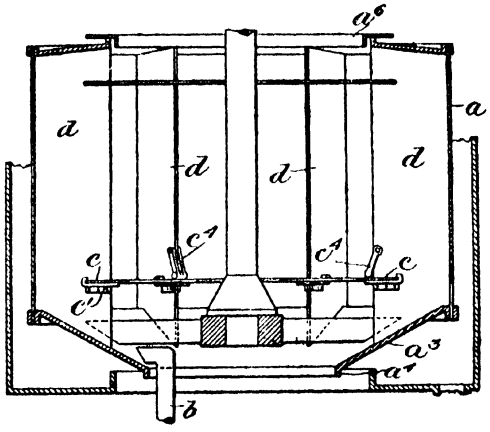
THE invention comprises methods and apparatus whereby the heat expended in doing positive or negative work upon expansion or contraction of a fluid is utilised to secure secondary heating or cooling effects. A cylinder having walls of high conductivity is furnished with two easily movable pistons, each piston being provided with a suitable heat regenerator. One end of the cylinder is surrounded by a heating jacket and the other end by a refrigerating jacket, the central section being surrounded by a cooling jacket. The cylinder is charged with any suitable fluid, *e.g.* air. A cycle of operations of the pistons is described during which the regenerators produce primary heat changes of equal but opposite values, these inducing

secondary heating and cooling effects. The cycle being repeated, the cumulative effect of such heating and cooling enables any desired degree of heating or refrigeration to be attained.

—J. S. G. T.

Centrifugal-separator. D. B. Weston, Sharon, Mass. U.S. Pat. 1,279,057, 17.9.18. Appl., 15.11.13.

THE material is fed through the pipe, *b*, on to the sloping bottom ring, a^5, of the rotating basket, *a*, and is thrown against the peripheral wall of the basket by the directing plate, *c*, and the action

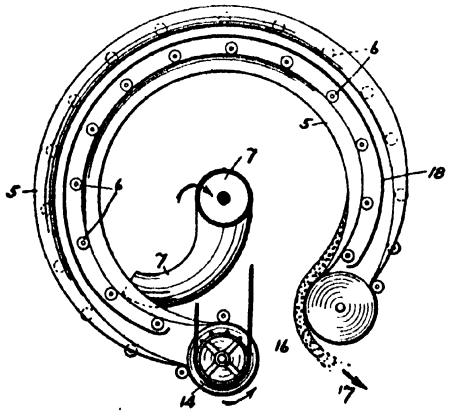


of centrifugal force. The solids collect on the wall between the radial division plates, *d*, and the liquid escapes between the edge of the deflecting ring, a^6, and the upper edge of the basket. The directing plate, *c*, is made in sections, the outer parts resting on the ledges, c^1, and being held in position by the catches, c^4, so that when discharging the solids the sections can be lifted inwards and the solids dropped through the opening, a^5.

—W. H. C.

Centrifugal apparatus. J. L. Hiller, Mattapoisett, Mass. U.S. Pat. 1,280,469, 1.10.18. Appl., 19.9.13.

THE material to be separated is fed through the shoot, 7, on to the inner concave face of the endless band of filter-medium, 5, which travels twice



round the periphery of a rotating drum, being actuated by the sprocket wheel, 14, and guided by the rollers, 6. The centrifugal force causes the liquid to pass through the band and it is then guided by the plate, 18, to the discharge. The solids are carried round by the band and discharged through the gap, 16, as indicated by the arrow, 17, the band itself returning round the outer path to the sprocket wheel, after which it again receives supplies of material from the shoot, 7.—W. H. C.

Vacuum-separator. H. A. Thuneman, St. Louis, Mo. U.S. Pat. 1,281,881, 15.10.18. Appl., 16.3.17.

THE separator comprises an outer vertical cylindrical casing, closed at its upper end, the lower end being connected to an exhauster and thence to a discharge pipe. Pulverised products are carried vertically upwards into the separator by means of a current of air, and impinge against a deflector composed of a pair of conical frusta attached base to base with axes vertical. The heavier particles, owing to decrease of velocity, fall into a hopper leading to a discharge pipe fitted with an air valve. The lighter particles are carried further by the air current into a chamber composed of a number of telescoping sections, the total height of which may be regulated from outside. Here further deposition of heavy particles occurs, these being recovered *via* the hopper as above. The lighter particles pass over the top of the uppermost telescopic section, down through the outer casing, and through the exhaust into a receptacle.—J. S. G. T.

Sludge; Apparatus for removal of — — from liquids. Brünn-Königsfelder Maschinenfabrik der Maschinen- und Waggonbaufabriks-Akt.-Ges. Simmering, vorm. H. D. Schmid, Königsfeld. Ger. Pat. 309,039, 16.4.16. Int. Conv., 6.12.13 and 14.12.15.

THE liquid is sucked through a number of disc-shaped filters arranged around a hollow cylinder and separated into sectors. Within the cylinder is a compressed air tube containing slots equal in number to the filter discs, there being also corresponding slots in the cylinder itself, so that when the slots are opposite one another, the filter sector connected therewith is blown free of the mud layer.

—L. A. C.

Solution of solids, Process for the continuous — —, especially for slaking lime with sugar juice or water. H. Eberhardt, Wolfenbüttel. Ger. Pat. 309,332, 4.12.17. Addition to Ger. Pat. 268,442.

IN an apparatus similar to that described in the chief patent (this J., 1914, 127), the sieve and scraper are omitted, the solution cylinder being lengthened to a corresponding extent. To the upper side of the lower end of the tube containing the worm elevator is fixed a wide tube, which serves in place of an opening in the dissolving vessel for the removal of the solution. In passing up this tube, the solution deposits any fine sediment present, which is then removed together with the remainder of the solid matter.—L. A. C.

Absorption towers; Apparatus for adjusting the head of liquid in — — arranged in series. R. Schad, Tuttlingen. Ger. Pat. 309,387, 2.5.17.

IN a series of absorption towers through which a current of liquid flows and into which gases are led in at the bottom, the head of liquid in each tower is adjusted by means of intermediate containers having two divisions so arranged that the level of the liquid in the lower division is equal to that of the previous tower, and in the upper division the head of liquid is that desired in the following tower.—L. A. C.

Distilling; Process for boiling and ——. H. Frischer, Cologne. Ger. Pat. 308,649, 22.9.17.

In a still provided with two or more outlet pipes for the vapour, or in a series of stills connected to a common delivery pipe, each outlet pipe passes through a separate vessel in which a portion of the vapour is condensed. The uncondensed vapour is led through the condensed liquid, and as the amount of the liquid, and consequently its resistance to the passage of the vapour, varies with the amount of vapour passing through the corresponding tube, the vessels exert an equalising effect upon the delivery from each tube.—L. A. C.

Emulsions; Apparatus for the preparation of ——. W. G. Schröder, Dinkelsbühl. Ger. Pat. 309,717, 8.5.17.

The apparatus is similar to that described in U.S. Pat. 1,237,222 (this J., 1917, 1088), but on the outer surface of the cylindrical portion of the inner chamber are channels wider at the top than at the bottom, whereby the liquids are drawn down and forced into the space between the inner and outer cones. The spindle attached to the rotating chamber can be raised and lowered by means of a lever worked by an adjustable screw.—L. A. C.

Carboy hampers or crates. A. W. Cowburn, and W. H. Cowburn and Cowpar, Ltd., Manchester. Eng. Pat. 123,012, 27.8.18. (Appl. 13,890/18.)

Lifting insoluble or semi-solid matter; Apparatus for ——. C. H. Adams, Fulford, Yorks. Eng. Pat. 123,169, 16.2.18. (Appl. 2765/18.)

Gas stoves for drying etc. Eng. Pat. 122,492. *See* IIA.

Stills or preheaters. Eng. Pat. 123,163. *See* III.

Tilting furnaces. Eng. Pat. 120,200. *See* X.

Tipping furnaces. Eng. Pat. 120,559. *See* X.

Drying chamber. U.S. Pat. 1,282,363. *See* XIXA.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Gas retorts; Regenerative fired ——. O. Peischer. J. Gasbeleucht., 1919, **62**, 17–19.

The flue gases from recuperative-fired gas retort settings form a considerable source of potential heat although it is not at present commercially feasible to use it. The fuel consumption reckoned on the coal carbonised in such settings is placed at 18% at least, under normal working conditions, although in new plants under test conditions much lower figures may be attained. With a plant devised by the Koppers Co. it is claimed that the fuel consumption can be reduced to 12% of coke containing 15% of ash and moisture. The heat is supplied from outside gas producers with revolving grates consuming low-grade fuel, and the gas produced can be cleaned prior to entering the setting with advantage to the working life of the refractory material used. The gas and air are preheated to 1000° C. by regenerators of which two pairs are built under each bed of retorts. The direction is reversed every half-hour. The increased thermal efficiency is evident in the temperature of the flue gases, which leave the setting at 240° C. as against 500°—600° C. in the case of the recuperative furnaces. The continuous mechanical clinkering of the producer is an advantage, conducing to greater regularity of temperature in the setting and obviating much arduous, costly, and often inefficient labour spent in clinkering the fires of built-in producers.—H. J. H.

Carbonisation; Low-temperature —— in relation to the production of motor spirit, fuel oils, smokeless fuel, and power gas: its aims and objectives. F. D. Marshall. Gas J., 1919, **146**, 383—385, 451—454. (See also this J., 1917, 620; 1918, 2 A, 175 A, 212 T.)

The author considers that the maximum utilisation of the material and energy of raw coal would be achieved by low-temperature carbonisation of the coal with recovery of the liquid products and a portion of the ammonia, gasification of the resulting coke with further recovery of ammonia, and conversion of the producer gas into electrical power. The ash residue could be employed for brick making etc. The high-temperature carbonisation of a ton of coal at 2000°—2200° F. (1090°—1200° C.) yields 12,000—13,000 cub. ft. of gas of calorific value 500 B.Th.U., 66% of coke residue, 9—10 gallons of tar, and 20 to 28 lb. of ammonium sulphate. Low-temperature carbonisation at 900°—1000° F. (480°—540° C.) results in the production, per ton of coal, of 4000—6000 cub. ft. of gas of calorific value 650 B.Th.U., 70—75% of coke residue, 18—22 gallons of tar oils, and 15—22 lb. of ammonium sulphate. Low-temperature coke obtained by carbonisation in Tozer retorts (this J., 1914, 912) is not friable and moreover a high yield of ammonia is obtained by its gasification. The volatile content of the coke varies from 9 to 12%, the calorific value being 13,300 B.Th.U. per lb. By stripping the gas produced by the low-temperature carbonisation, 1½—4 gallons of an oil of the nature of motor spirit (sp. gr. 0·760—0·800) is obtained per ton of coal. The oils possess the properties of paraffins. Results are tabulated of the yields of the various products obtained by the carbonisation at temperatures below 1200° F. (650° C.) of 21 samples of different coals. The various fractions of the tar oils possess properties rendering them useful as motor spirit, fuel oil, and lubricants respectively. Naphthalene and anthracene are absent. The pitch is characterised by its plasticity and low percentage of free carbon. The Tozer low-temperature retort (*loc. cit.*), in which coal is carbonised in a number of concentric annular iron segments enclosing a central gas way, is described.
—J. S. G. T.

Gas; Present and future of ——. *Possibilities of carbonisation of all coal at low temperatures.* S. W. Parr. Western Soc. of Engineers (U.S.A.). Gas J., 1919, **145**, 388—389.

The prime function of the gas industry is that of a purveyor of fuel. Attention is directed to various products other than gas, resulting from coal carbonisation, and possible lines of progress of the gas industry are briefly adumbrated. Such lines of progress include the low-temperature carbonisation of coal etc., and the possible hydrogenation of the resulting oils. The author suggests the possibility of fractionating coal gas in such manner that the sulphur compounds, which are all evolved below 600° C., are entirely contained in the one fraction, the rest of the gas being sulphur-free; the line of demarcation occurs just after the first cubic foot of gas per pound of coal has been evolved. Very little value is attached to "lean" gas as compared with "rich" gas. Coke is improved by the retention of the hydrogen evolved during the "lean" gas period, which period commences at about 650° C.—750° C.—J. S. G. T.

[*Gas*] *purification; Secondary reactions of oxide of iron* ——. G. Weyman. Gas J., 1919, **145**, 322—323.

A SECONDARY reaction involving the decomposition of steam by sulphur vapour, with evolution of hydrogen sulphide and sulphur dioxide, is cited to account for the large quantities of steam, sulphur dioxide, ammonia, and hydrogen sulphide found in the gas issuing from a box charged with partially spent oxide and into which gas of normal composition was passing. The reaction, which is reversible, operates increasingly in the direction indicated with rise in temperature, and by passing a mixture of sulphur vapour and steam through a tube at 200° C., sulphur dioxide was produced in sufficient quantity to be detected by smell, and hydrogen sulphide, sulphite, and thiosulphate were also present. The sulphur formed by the reverse reaction is insoluble in carbon bisulphide, and probably spent oxide contains such sulphur. That these reactions occur on the large scale is confirmed by the detection of steam and hydrogen sulphide on opening a heap of freshly discharged oxide, and by the fact that the heap which is at first alkaline, gradually becomes acid. The difficulty in removing the last traces of hydrogen sulphide from gas is no doubt due to the above secondary reaction, and may be overcome by working the last box at a lower temperature, without the admission of steam. The wetter an oxide, the greater will be the amount of sulphur lost through this reaction. The usual fouling tests of oxides do not give reliable results, as sufficient hydrogen sulphide may be formed by this secondary reaction to contaminate the gas before the oxide is spent.—S. S. A.

Ammonia and sulphur; Simultaneous recovery of —— in the carbonisation of coal. W. Bertelsmann. J. Gasbeleucht., 1919, **62**, 3–4, 21—22.

THE author reviews the proposals which have been made to reach a solution of the problem mentioned. The processes of one class, including those of Fabry, Bergfeld, and Cobb (see this J., 1910, 1203; 1913, 414, 971), involve the washing of the gas with solutions of sulphates of heavy metals, ammonium sulphate being formed and sulphide being precipitated. Here the sulphur is recovered separately from the ammonia and has to be oxidised to sulphuric acid. Burkheiser's process (this J., 1909, 359; 1911, 13, 1303), using iron compounds, appears to have failed, also Fritzsche's process (this J., 1913, 425), in which aluminium sulphate is used. In another group of processes ammonia is fixed as ammonium sulphite which is then oxidised to the sulphate. Atmospheric oxidation processes seem to be limited by the attainment of equilibrium conditions, while oxidation in solution is attended by loss of both ammonia and sulphur dioxide. Owing to the difficulties attending the considerable dissociation tension of sulphites, Feld devised a process based on the oxidation of thionates, in its more recent form without the use of metal salts. In spite of the way in which the process has been scientifically perfected, in practice it has proved too cumbersome. Other processes employing thionates have been proposed, but it is concluded that the method of oxide purification and sulphuric acid manufacture still remains commercially the most satisfactory.—H. J. H.

Hydrogen; Combustion of ——. Volcanic explosions. I. Explosive eruptions and their phases. V. Sabatini. Atti R. Accad. Lincei, 1918, **27**, ii., 360—364.

IT is shown that water vapour alone is capable of explaining the mechanical effects of volcanoes and the projections from the latter. (See J. Chem. Soc., April, 1919.)—T. H. P.

Hydrogen; Calculations on the combustion of ——. Comparison with ordinary explosives. II. V. Sabatini. Atti R. Accad. Lincei, 1918, **27**, ii., 405—407. (Compare preceding abstract.)

THE energy developed in the explosion of hydrogen under volcanic conditions is compared with that of ordinary explosives. (See J. Chem. Soc., April, 1919.)—T. H. P.

Mineral oil emulsions; Destruction and avoidance of ——. R. Koetschau. Z. angew. Chem., 1919, **32**, 45–46.

IN the treatment of Galician crude oil considerable quantities of a troublesome by-product are formed consisting of emulsions of crude oil and salt water of various degrees of consistence and stability. Similar emulsions are also produced in the refining of Rumanian machine oil distillates. Among the methods available for the breaking down of emulsions are: centrifugal treatment; selective filtration sometimes in combination with electrolysis; the action of chemicals, for instance, acids; high voltage electrical treatment on the principle of the Cottrell process; the application of heat. In the case of these mineral oil emulsions, the application of heat in open vessels is of little use, but heating under pressure at 120°—130° C. affords a very simple and inexpensive means for the rapid and quantitative separation of the oil and water. In the refining of mineral lubricating oil, emulsions are formed during the process of neutralising and washing the oil distillates, owing to the presence of naphthenic soaps. These naphthenic soap emulsions are broken down by heating for 2 hours under 4–5 atmos. pressure in a closed vessel with direct steam. Treatment with alcohol affords an effective means of breaking down the soap emulsions, but it is too costly for ordinary lubricating oils and is only employed for white oils (vaseline oils) which are refined by the oleum process. The sulphonic acids which are produced in the refining of mineral oils with sulphuric acid possess colloidal characters, and acid distillates containing sulphonic acids give emulsions not only with alkaline liquors, as in the case of naphthenic and fatty acids, but also with water alone. It has been the custom to avoid strong agitation in the neutralising and washing of highly viscous distillates, but when using the steam-pressure system, the mixing may be as vigorous as desired since the emulsions are easily broken down. Moreover, in order to avoid the complications due to the hydrolysis of naphthenic soaps it is desirable to carry out the neutralisation with concentrated solutions; this is now possible, since the emulsion difficulty is solved. In fact, by neutralising the acid distillates directly under steam pressure, emulsions may never be formed.

—J. F. B.

Asphaltic substances; Determination of hard —— in oils prepared from Boryslaw crude petroleum. S. Prozynski. Petroleum, 1918, **14**, 9—10. Chem. Zentr., 1919, **90**, II, 73.

HOLDE'S method of determining asphalt (this J., 1909, 831) is not trustworthy when the oil contains paraffin wax. In the case of oils, such as those derived from Boryslaw crude petroleum, which contain paraffin wax, it is necessary to separate the latter from the asphalt. Treatment with hot ether is too tedious, and it is better to use petroleum spirit of b.pt. 50°—65° C., which has previously been purified by treatment with fuming sulphuric acid. The paraffin wax thus separated is very hard and of high m.pt.—C. A. M.

Oils; Viscosity of ——. E. Oelschläger. Z. Ver. Deutsch. Ing., 1918, **62**, 422—427. Chem. Zentr., 1919, **90**, II., 73—74.

IF the viscosity factor, Z, of different oils is calculated by means of the formula—$Z = 4{\cdot}072E + 3{\cdot}518/E$,

where E represents Engler degrees, and the results are plotted in relation to the temperatures in a logarithmically divided co-ordinate system, a series of nearly straight lines is obtained, which cut one another approximately at one point, *viz.*, $Z=1$ and $t=185^{\circ}$ C. This characteristic holds good for most technical oils, and enables a formula to be constructed to express the relationship between the temperature and viscosity factor or the temperature and Engler degrees. The viscosity of mixtures of oils is not proportional to the ratio of the constituents, but may be calculated approximately by means of the empirical formula—$E_{1+2}=(n_1E_1+kn_2E_2)\div(n_1+kn_2)$, where E_1 and E_2 represent the respective viscosities of the oils to be mixed, E_2 being that of the more fluid oil, n_1 and n_2 the respective proportions, and k [illegible] E_1E_2.—C. A. M.

PATENTS.

Water used for washing coal and the like; Process for removing loam and clay from — by filtration. H. Herzbruch, Datteln. Ger. Pat. 309,407, 1.2.14.

THE separation of loam, clay, etc., by filtration from water used for washing coal and the like is more efficient if the temperature of the water is raised, *e.g.*, by the addition of the hot water obtained on quenching coke or by means of waste steam.—L. A. C.

[Fuel] briquettes; Manufacture of ——. P. Lamberty, Zeist, Holland. Eng. Pat. 119,143, 4.5.18. (Appl. 7528/18.) Int. Conv., 24.9.17.

WASTE carbonaceous material such as coal dust or powder, coke waste, brown coal dust, soot, or flue-dust is mixed with about 10% of slaked lime and moulded into briquettes at high pressure. The briquettes are hardened by exposure to steam at 8–10 atmospheres pressure for 6–8 hours.—W. F. F.

Acid coke; Utilisation of ——. G. L. Prichard, Port Arthur, Tex., Assignor to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,290,345, 7.1.19. Appl., 2.5.17.

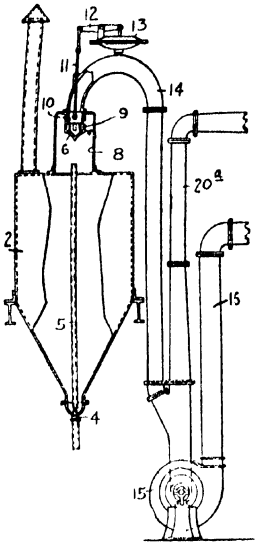
ACID coke from sludge acid is mixed with heated oil and burnt.—W. F. F.

Burning inferior or anthracite fuel in any existing furnace or automatic stoker; Method of and apparatus for ——. R. Boizard, Lancey, France. Eng. Pat. 121,149, 20.2.18. (Appl. 3006/18.) Int. Conv., 14.12.17.

FUEL rich in ash or low in volatile constituents is supplied from a hopper on to one end of a travelling furnace grate, where it is retained in a thick bed by a bridge projecting downwards from the furnace roof to within a short distance of the grate. Additional air is supplied to this bed of fuel through openings in the furnace front so as to maintain its incandescence and kindle the fresh fuel supplied. The kindled fuel is carried forward by the travelling grate to the furnace proper. The burnt gases from the thick bed of fuel pass over the bridge and downwards through the furnace roof into the main combustion space. In a modification the openings in the furnace front for supplying additional air to the thick bed of fuel are omitted, the air being supplied only through the grate as part of the main air supply for the furnace.—W. F. F.

Pulverulent fuel; Methods of and apparatus for feeding ——. E. C. Covert, Avalon, Pa., U.S.A. Eng. Pat. 123,277, 16.8.18. (Appl. 13,322/18.)

POWDERED coal contained in the hopper, 2, is projected upwards through the pipe, 5, into the chamber, 8, by air injected through the pipe, 4, which has a slightly smaller nozzle. The mixture of coal and air impinges on the conical spreader, 6, and then passes through the openings, 9, into the pipe,



14, and thence to the blower, 15. The mixture is circulated by the blower through the pipe, 16, and back through the pipe, 20a, and the furnaces are supplied by branch pipes from the pipe, 16. The return pipe, 20a, is made of smaller section to maintain the pressure in the pipe, 16. The openings, 9, are automatically regulated by the valve, 10, connected to the rod, 11, lever, 12, and diaphragm, 13. An increase or decrease in the demand by the furnaces causes a corresponding decrease or increase in the pressure in the pipe, 14, and a consequent opening or closing of the openings, 9.—W. F. F.

Water-gas; Process for the simultaneous production of — in the manufacture of lighting gas in continuous vertical retorts. A. Birkholz, Zürich. Ger. Pat. 309,669, 7.3.16.

IN order to accelerate the decomposition of the steam introduced into the retort and to produce gas low in carbon dioxide, the retort receives additional heating, preferably by means of gas withdrawn from the heating-gas producer. Throughout the process the retort is kept at the high temperature required for complete liberation of gas from the contents of the retort, and for the production of water-gas poor in carbon dioxide.—C. A. M.

Gas stoves for cooking, lacquering, drying and other purposes. The Etna Lighting and Heating Co., Ltd., H. R. Prosser, and E. Derry, Birmingham. Eng. Pat. 122,492. (Appls. 1591, 28.1.18, and 12,245, 27.7.18.)

THE oven is constructed of sheet metal and is surrounded on top, bottom, and three sides by an outer casing. A heating burner is arranged below a central opening in the bottom of the casing and is surrounded by a smaller casing having openings in its sides and bottom to admit air. A central horizontal plate in the opening in the bottom of the casing deflects the hot gases upwards round the oven and the colder air at the top of the jacket descends and passes out through the opening in the side of the burner casing. This continues till the jacket is filled with burnt gases at a maximum

temperature and the outflow of these gases then damps down the burner, with a consequent fall in the temperature of the jacket and a following increase in the supply of fresh air to the burner. The outer casing of the oven may be lined internally with asbestos, and with expanded metal which acts as a radiator towards the oven and also deflects the hot gas towards it.—W. F. F.

Petroleum products; Process for transforming heavy —— into lighter products. F. B. Deakin, London. From P. Roth and M. E. Venturino, Buenos Aires, Argentine. Eng. Pat. 123,151, 12.2.18. (Appl. 2521/18.) Addition to 106,042, 20.8.16.

An improvement of the process described in the chief patent (see U.S. Pat. 1,208,378 of 1916, this J., 1917, 126). The temperature of the contents of the retort, *i.e.*, crude petroleum from which the lighter constituents have been distilled, residues of petroleum, asphalt or the like, is gradually raised while the material under treatment is sprayed into the retort, *e.g.*, from 360° C., when the spray is first introduced, at the rate of 2° C. per hour to 420° C.—L. A. C.

Lignite and other combustible materials; Process for simultaneously producing gas from — —, and slag capable of being used for agricultural purposes. E. C. R. Marks, London. From Soc. Anon. Ital. Gio. Ansaldo & Co., Genoa, Italy. Eng. Pat. 123,177, 19.2.18. (Appl. 2924/18.)

See U.S. Pat. 1,269,795 of 1918; this J., 1918, 539 A.

Gas-fired furnaces. Eng. Pats. 122,673-4. *See* I.

Refractory material for surface combustion. Eng. Pat. 123,175. *See* VIII.

Determining methane etc. Ger. Pat. 309,627. *See* XXIII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Wood; Researches on the lignin of ——. I. Destructive distillation of lignin. E. Heuser and C. Sklöldebrand. Z. angew. Chem., 1919, **32**, 41—45.

Lignin was prepared from spruce wood sawdust, previously extracted by ether, by hydrolysing the cellulose with 42% hydrochloric acid according to the method of Willstätter and Zechmeister (this J., 1913, 822). Two treatments with the strong hydrochloric acid left the lignin apparently free from cellulose, giving a yield of 33·12% of dry lignin on the dry wood substance. The lignin contained, in the air-dry state, 9·25% of moisture and 0·485% of ash; it yielded no furfural on distillation with hydrochloric acid but showed a copper value by Schwalbe's method of 12·90%. The methyl value according to Zeisel's method was 6·77%. This lignin was subjected to destructive distillation and the results compared in the following table with those obtained from the raw wood and wood cellulose by Klason:

	Spruce wood	Cotton cellulose	Wood cellulose	Lignin	
Charcoal	37·81	38·82	34·86	50·64	% by weight on dry ash-free subst.
Tar	8·08	4·16	6·28	13·00	
Acetone	0·20	0·07	0·13	0·19	
Methyl alcohol	0·96	—	0·07	0·90	
Acetic acid	3·19	1·39	2·79	1·09	
CO_2	56·50	57·87	62·90	9·60	% by vol. on the gases
C_nH_{2n}	1·72	1·53	1·56	2·00	
CO	32·55	36·37	32·42	50·90	
CH_4	9·23	4·23	3·12	37·50	

In the distillation of the lignin, charring began at 270° C. and the reaction was most intense at 400°—450° C.; gas was still produced up to 627° C. As in the case of wood and cellulose, the reaction was exothermic. The formation of carbon dioxide per unit of time was largest at the beginning of the gasification and then fell off rapidly. The lignin is distinguished from the other materials by the large production of methane and carbon monoxide and the small production of carbon dioxide; thus the heating value of the gas from lignin is very high. In a similar way the yield of charcoal and tar is very high in the case of the lignin as compared with the other materials. As regards the yield of methyl alcohol the result was disappointing, as it should have been three times as much as that obtained from raw wood; this deficiency is attributed to the breaking up of the methoxyl groups into gases, owing to the higher temperature employed. If the lignin be digested with dilute hydrochloric acid under steam pressure, larger yields of methyl alcohol can be obtained than by destructive distillation. The acetone also is probably derived from the same groups and the relative yield is low for the same reason; the acetone produced by the distillation of wood cellulose may be derived from the methylpentosans. Acetic acid is formed from the lignin but only to the extent of one-third of the amount produced from the raw wood. Acetic acid is derived both from the cellulose and the lignin and in larger quantities from the former than from the latter; the absence of furfural-yielding groups from the lignin precludes the pentosans as the source of the acetic acid.—J. F. B.

Molybdenum filament; Clean-up of nitrogen by a heated — —. Chemical reactions at low pressures. I. Langmuir. J. Amer. Chem. Soc., 1919, **41**, 167—194.

When molybdenum filaments are heated to 2000°—2400° abs. in nitrogen at pressures of 40 bars (0·03 mm.) or less in absence of moisture, the filaments lose weight at the same rate as if heated in a vacuum. The nitrogen does not attack the filaments but disappears at a rate independent of the pressure if the latter exceeds 1 bar, the amount of the nitrogen thus disappearing being much less than the chemical equivalent of the molybdenum evaporated. The formation of two compounds of molybdenum and nitrogen is indicated; the properties of these and of the deposit formed on the bulb are discussed. (See also J. Chem. Soc., Apr., 1919.)—T. H. P.

Patents.

Wood; Process of destructive distillation of ——. O. F. Stafford, Eugene, Oreg., U.S.A. Eng. Pat. 119,040, 10.9.18. (Appl. 14,708/18.) Int. Conv., 10.9.17.

Finely-divided wood, *e.g.*, sawdust, is dried and supplied to a heat-insulated retort at a temperature of 100°—250° C., the retort being previously heated to about 400° C. The carbonisation process being exothermic, the temperature of the retort remains materially above the lower limit of 280° C., but below a red heat, and fresh dried and heated wood may be continuously added, and distillation continued without further application of heat.—W. F. F.

Distilling [wood etc.]; Apparatus for ——. W. P. Perry, London. Eng. Pat. 122,925, 14.2.18. (Appl. 2662/18.)

Carbonaceous material such as wood or peat is supplied by means of a conveyor and valve to the top of a distillation chamber provided with pipes for

withdrawing vapour at various heights, and the charcoal or the like is withdrawn by a conveyor at the bottom. The charcoal is similarly supplied to the top of an adjacent producer chamber to which air and steam are supplied through perforations at the side. The resulting mixture of carbon dioxide and monoxide with ammonia is passed through a connecting passage near the bottom of the two chambers, and in passing upwards through the distillation chamber distils the fresh charge. The mixture of air and steam may alternatively be supplied to the producer through a pipe which passes through the side and is embedded in the charge. In another modification the fresh charge may be supplied to the top of both chambers and in that case the supply of steam to the producer is unnecessary.

—W. F. F.

Wood; Kilns for carbonising and distilling ——. E. C. R. Marks, London. From E. Ledoux, Paris. Eng. Pat. 123,111, 25.10.17. (Appl. 15,524/17.)

Wood is distilled in retorts consisting of long horizontal tunnels arranged side by side and separated by walls containing vertical heating flues. The flues are heated by the burning gases from a gas producer, which are passed into horizontal flues above the vertical flues and communicating with them by openings which may be regulated by dampers operated from outside. The wood is loaded into trucks and a train of trucks is passed into the retort which is then sealed. The distillation products are passed to a condenser to recover by-products, and the non-condensable gases are passed on to the combustion chamber of the gas producer, or mixed with air and distributed to different points in the horizontal flue to maintain a uniform temperature in the retort. The retort is constructed entirely of brickwork except the doors and the rails for the trucks.—W. F. F.

Electron-emitting cathodes. Eng. Pat. 123,126. *See* XI.

III.—TAR AND TAR PRODUCTS.

Tars; Dehydration of various ——. W. A. Twine. Midland Jun. Gas Assoc., Feb. 27, 1919. Gas J., 1919, **145**, 462—464.

Horizontal and inclined retort tars are unsuitable for use in the Diesel engine on account of their high content of solid matter. More suitable tars are obtained if speedy separation of tar and liquor occurs in the hydraulic main; no oil should be allowed to mix with the tar, as emulsification may result. Tar containing small quantities of "pitch oils" may contain over 20% of water. The tar contains from 1% to 30% of free carbon, present chiefly as an emulsion. Various methods of dehydration are noted. In these the tar may be sprayed, centrifuged, or atomised, and heated by hot air or steam, under reduced pressures. The distillation of tar containing 7·5% of water is described. A vacuum equal to 25 in. of mercury was maintained in the still, the end point of the distillation being ascertained from the melting point of the pitch. The resulting oil contained 2·7% of water and the pitch 13·7% of free carbon, its melting point being 89° C. The dehydration of 1¼ million gallons of water-gas tar emulsion containing 58% of water was carried out in two stills of the Hird, Hammond, and Chambers type (Eng. Pat. 16,385 of 1912; this J., 1913, 744). For successful working, the following points are to be observed: constant water content of the emulsion, regular rate and constant temperature of feed to still, water content of outflowing tar to be less than 0·5%. The water content of the outflowing tar was determined by pressing a drop of the tar between two thin glass plates and counting the transparent globules thus produced. The stills are cleaned at intervals of a month, 40—45 cwt. of solid matter being removed. Cleaning is facilitated by having the bottom of the still sloping away from the fire. Condensed products from the still are passed through a separator, the water passing thence to a coke-dust filter. In the ensuing discussion, E. W. Smith stated that for successful distillation the tar before entering the still must be nearly at 100° C. and the condenser area must be ample.

—J. S. G. T.

Benzene; Determination of the degree of purity of samples of ——. W. J. Jones. J. Soc. Dyers and Col., 1919, **35**, 45—47.

The impurities naturally present in commercial benzene comprise chiefly toluene, xylene, paraffin hydrocarbons, and sulphur compounds; much of the commercial benzene now on the market, however, contains only 1—2% of total impurities. The freezing point of pure benzene is 5·48° C. and the cryoscopic constant for dilute solutions of toluene in benzene has been found to be 4·92. For the determination of the percentage of benzene in commercial samples by the cryoscopic method, the error involved by assuming the total impurities to have the same influence on the freezing point as toluene is practically negligible. The percentage by weight of pure benzene, x, in a commercial sample is calculated from the freezing point, t, of the sample by the formula $x=90{\cdot}51+1{\cdot}73t$, in the case of dry samples, and $x=90{\cdot}68+1{\cdot}73t$, in the case of wet samples. This method is superior to that based on the determination of sp. gr. and distillation range, in that the presence of paraffin hydrocarbons having the same boiling point as benzene is directly indicated by a depression of the freezing point.

—J. F. B.

Benzene; Analysis of the mixtures obtained in the chlorination of —— in presence of catalysts. W. J. Jones. J. Soc. Dyers and Col., 1919, **35**, 42—43.

The mixtures obtained in the chlorination of benzene in the presence of finely divided iron as a catalyst may be analysed with satisfactory results by fractional distillation according to the method of Young and Fortey (this J., 1902, 726). The principal constituents are unchanged benzene, monochlorobenzene, and *p*-dichlorobenzene, together with small amounts of *o*-dichlorobenzene and higher chlorinated products. The sample is first thoroughly shaken with water; the oil is separated and dried with sodium sulphate. A weighed quantity of oil is introduced into a tared round-bottomed flask provided with an 8- or 12-pear fractionating column. The liquid is distilled very slowly and the first fraction is cut at 106° C., the mid-point between the boiling points of benzene and monochlorobenzene. The second fraction is cut at 153° C., midway between monochlorobenzene and *p*-dichlorobenzene. The residue is also collected and weighed. The sum of the three weights will be less than the original weight and the deficit is equally apportioned between the benzene, monochlorobenzene, and the higher chlorobenzenes. These last may be further analysed by transferring the residue from the first fractionation to a tared four-bulb fractionating flask. The temperature of distillation rapidly rises to 171° C. and then more slowly. Distillation is stopped at 195° C. and the distillate is weighed as dichlorobenzenes, chiefly the *para*-compound. The residual oil consists of the more highly

chlorinated benzenes and is small in amount. A typical sample of chlorinated benzene showed the following results:—Weight of washed, dry oil, 283 grms. Fractions: benzene, 31 grms.; monochlorobenzene, 209 grms.; dichlorobenzenes, 40 grms.; residue, 3 grms.—J. F. B.

Pyrocresols (dimethylxanthenes), phenylxanthenes, and Xanthene Brown; Relationship of —— to coal tar constituents. F. Ruszig. Z. angew. Chem., 1919, **32**, 37—40.

THE isomeric compounds $C_{15}H_{14}O$ isolated by Schwarz (Ber., 1882, **15**, 2201; this J., 1882, 442) from the final residue of the distillation of crude phenol, and termed pyrocresols, have the same composition and properties as those obtained from the aluminium compounds prepared by Gladstone and Tribe (J. Chem. Soc., 1889, **55**, 51) from *o*-, *m*-, and *p*-cresols. These compounds have now been identified as dimethylxanthenes, whilst the compound $C_{13}H_{10}O$ prepared by Gladstone and Tribe from aluminium phenoxide gives the reactions of xanthene. The decomposition of aluminium phenoxide on heating is in accordance with the equation—$2Al(OC_6H_5)_3=(C_6H_5)_2O+C_{13}H_{10}O+C_6H_5OH+CH_4+C_4+Al_2O_3$. Since crude phenol from coal tar contains the three cresols and phenol it may be assumed that crude pyrocresol is a mixture of xanthene with different isomeric dimethylxanthenes. The oily liquid of high b.pt. separating at the end of the distillation of aluminium phenoxide has the composition $C_{13}H_{14}O$, and is formed from xanthene by the substitution of the phenyl nucleus for an atom of hydrogen. On dissolving this oil in strong nitric acid and adding water a yellow amorphous compound is precipitated, and this when reduced with zinc and acetic acid and treated with ammonia yields a brown base, which combines with hydrochloric acid to form a soluble salt. This salt gives a dark red solution, which is decolorised by zinc dust. It is precipitated by sodium chloride and by sodium hydroxide, whilst the precipitated base dissolves in strong sulphuric acid giving a yellowish-brown solution, with pronounced green fluorescence. All the reactions correspond with those of triphenylmethane, except that a brown instead of a red fuchsine is obtained. The name Xanthene Brown is suggested for this dyestuff. The other oily product, boiling above 400° C., formed in the decomposition of aluminium phenoxide, agreed in composition with diphenylxanthene. The corresponding products obtained in the distillation of aluminium cresylates agreed in composition with tolyldimethylxanthenes, and also yielded Xanthene Browns. The so-called green oils or anthracene oils obtained in the distillation of coal tar yielded brown dyestuffs analogous to those obtained by the method described. Their hydrochloric acid salts were soluble in water, and acted as direct dyes for wool and silk. In neutral or weak acetic acid baths they dyed the fabrics shades ranging from greenish-brown (olive) to violet-brown (lilac) or grey. It is probable that a portion of the anthracene oils consists of triphenylmethane derivatives, and in particular of liquid phenyl- and diphenyl-xanthenes. (See also J. Chem. Soc., 1919, i., 168.)—C. A. M.

Dimethylaniline; Determination of the degree of purity of samples of ——. W. J. Jones. J. Soc. Dyers and Col., 1919, **35**, 43—45.

THE impurities of dimethylaniline usually consist mainly of water, aniline, and monomethylaniline, together with inappreciable quantities of nitrobenzene, the toluidines and their methyl derivatives, and aminothiophens. The most satisfactory method for the rapid valuation of the dimethylaniline is by the determination of its freezing point and, apart from water, no appreciable error is introduced by assuming the mean molecular weight of all the organic impurities to be equal to that of monomethylaniline. The freezing point of pure dry dimethylaniline is 2·07° C., and that of the pure substance saturated with water is 1·75° C. With samples of these cryoscopic determinations have been made for increasing proportions of monomethylaniline added as an impurity. The results are expressed as straight-line graphs represented by the equations $x=96·1+1·87t$ for the dry samples and $x=96·7+1·87t$ for the wet samples, where x is the degree of purity in % of dimethylaniline by weight and t is the freezing point of the sample. The results of the determinations agree well with those obtained by the acetic anhydride method. When the sample has a freezing point below −2° C. it is advisable to dilute it with a known proportion of fairly pure dimethylaniline of which the freezing point is known.—J. F. B.

PATENTS.

Stills or preheaters for dehydration of tar and other chemical purposes. W. Blakeley, Church Fenton, Yorks. Eng. Pat. 123,163, 14.2.18. (Appl. 2646/18.)

WITHIN an outer casing is a series of horizontal hollow trays diminishing in size as they approach the top of the still. The cavity in each tray is connected to that in the tray above and the tray below. Steam or other heating medium, *e.g.*, furnace gas, is led into the cavity of the bottom tray and passes up the series. Tar is passed in at the top of the still on to the uppermost tray and after passing down the series is led off at the bottom. An escape pipe is provided at the top of the still for the escape of vapour, and condensed products can be removed from the interior through a drain at the lower end. The casing may also be heated externally.—L. A. C.

Asphalt composition. Eng Pat. 122,922. *See* IX.

IV.—COLOURING MATTERS AND DYES.

Anthocyanins; Colour variation in ——. K. and Y. Shibata and I. Kasiwagi. J. Amer. Chem. Soc., 1919, **41**, 208—220.

THE authors have studied the reduction of compounds of the flavone and flavonol series by magnesium and an organic (acetic) acid and on the results obtained, together with those of experiments on the pigments of a number of flowers, a theory of the various flower colours is based. The theory is confirmed by the behaviour of the natural anthocyanin solutions towards the salts of alkaline-earth and heavy metals. The "blue" anthocyanins are considered to be complex compounds of reduced flavonol-glucosides, which possess several hydroxyl groups belonging to the flavonol nucleus besides those of sugar molecules, and the metal with which they are coördinated is probably calcium or magnesium. The "violet," "violescent red," or "red" colouring matters are either the analogous metallic complex compounds of flavonol-glucosides, which contain fewer of the auxochrome hydroxyl groups, or are a mixture of the blue colouring matters and their products of decomposition by excess of acids, *i.e.*, the red oxonium salts of Willstätter (this J., 1914, 18). (See also J. Chem. Soc., 1919, i., 166.)—T. H. P.

Xanthene Brown. Ruszig. *See* III.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

"Cell yarns." A. Leinveber. Kunststoffe, 1918, **8**, 234—235. Chem. Zentr., 1919, **90**, II., 24.

"CELL YARN" is prepared from paper pulp which has never gone through the stage of finished paper. Soda wood pulp is broken down in the edge-runners, brushed out in the hollander, diluted with water, and passed over sand-tables and strainers to the stuff-chest. The stuff is run over the paper machine wire on which it is formed directly into ribbons. The actual taking up of the pulp is done either by pressure or suction, as is customary on certain paper machines or ribbon cylinder machines; long wire machines are preferable to the cylinder machines on account of their greater speed of working and efficiency. The stuff delivered on to the wire in the form of ribbons is drained by suction-boxes and passes from the couch-press on to a drying cylinder, which only removes a portion of the water, leaving sufficient in the strips for the subsequent spinning operation without re-damping. The moist strips are wound up in the form of flat rolls or narrow spools and placed in the spinning machines. The fibres in the yarns prepared in this manner are distributed almost entirely in the longitudinal direction of the strip and the fibres at the edges are not wasted, whereas in yarns twisted from strips cut from paper the fibres are distributed more or less in all directions.—J. F. B.

Sulphite-cellulose waste liquors; A new use for —— [as fertiliser]. T. Bokorny. Chem.-Zeit., 1919, **43**, 64—65.

THE spent wash from sulphite spirit distilleries is especially liable to fungus growths, but the addition of 0·5—1·0% of a mineral acid is sufficient to make the liquid stable. The undiluted spent wash is injurious to plant life, but if no acid has been added, a dilution of one to ten makes it harmless. In practical use as a fertiliser the dilution takes place on the land. Spent wash from sulphite spirit distilleries has been used as a fertiliser as a source of carbon nutrition and, with barley, the crop-yield was considerably increased. The transport and application of the sulphite liquor may be greatly facilitated by converting it into a dry powder by the Krause process (see Fr. Pat. 460,895 and U.S. Pats. 1,213,659 and 1,213,887; this J., 1914, 64; 1917, 329, 377). The use of sulphite liquor as a carbonaceous fertiliser is based in the first place on the favourable conditions it offers for the development of fungi whereby the air of the soil and that near the ground becomes charged with carbon dioxide, and in the second place on the direct nutrition afforded to the growing plant by the sugars, organic acids, etc., contained in the liquor. Nitrogenous nutrition must be supplied from another source, and for this purpose human urine is a valuable adjunct.—J. F. B.

Lignin of wood. Heuser and Skiöldebrand. *See* IIb.

Viscosity of nitrocellulose solutions. Leysieffer. *See* XXII.

PATENTS.

Paper pulp; Refining engines for producing ——. R. J. Marx, London. Eng. Pat. 122,964, 4.4.18. (Appl. 5732/18.)

IN a refiner of the Jordan or other conical type the bars of the shell are made up of groups of stone grinding bars arranged circumferentially; each group is composed of sets of bars arranged longitudinally with their ends abutting, the number of sets in one group being different from those of a succeeding group and the sets in the adjacent groups being out of alinement with each other. Wedge keys are provided between the groups longitudinally and shorter wedges for anchoring each of the bars. The core or plug has a grooved periphery, with the stone grinding bars in the grooves. The bars in the grooves may consist of sets of two bars each, increasing in width from one end of the core to the other, the bars being grooved on the sides and held in position by cement. The bars of the shell and the core may be grooved on the working face with feeding notches extending longitudinally, some of the bars having one notch and others several notches in discontinuous succession.—J. F. B.

Lignin-producing substances; Process for obtaining the so-called —— from wood. Akt.-Ges. für Zellstoff- und Papierfabr., Aschaffenburg. Ger. Pat. 309,551, 20.6.16.

THE finely divided wood is boiled with formic or acetic acid containing a small quantity of a mineral acid having a powerful hydrolysing action. For example, in presence of 0·5 to 0·7% of sulphuric acid pine wood yields about four times as much extract (40%) as when that acid is absent. The extraction is promoted by boiling under pressure, by preliminary saturation of the wood with the aid of a vacuum, and by mechanical disintegration of the fibres. The separation of the dissolved substances, which are essentially of the nature of phenols of high molecular weight, is effected by concentrating the solution in a partial vacuum, if necessary after the addition of water. The product is a pale gray powder, insoluble in water, partially soluble in alcohol, benzene, and petroleum spirit, and soluble in formic and acetic acids. The carbohydrates simultaneously extracted remain in solution. The phenolic substances may be used as industrial intermediate products or for pharmaceutical purposes.—C. A. M.

Cleansing material. Eng. Pat. 120,195. *See* XII.

Waterproofed materials. Eng. Pat. 123,101. *See* XV

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Bleaching of striped cotton piece goods. A. C. Walsh. J. Soc. Dyers and Col., 1919, **35**, 35—39.

GOODS with coloured stripes which are bleached in the piece comprise chiefly coloured shirtings and dhooties with coloured borders. In the former class a good white ground is desired and dyes of great fastness to bleaching have to be used; in the latter, destined only for the Eastern market, clearness of the white is not so essential and colours of only fair fastness are employed. A mixture of grades can only be treated according to the power of resistance of its most sensitive component, and it is always desirable to put a range of patterns through the process before treating the actual pieces. There is no standard method of treatment, but in general the purification and bleaching are performed as efficiently as possible with treatments less severe than those employed for white goods. Thus the alkaline scouring baths are free from caustic; low-pressure kiers are employed with sodium carbonate equal to about 1 lb. per cwt. of

cloth, and boiling is restricted in duration to about 4 hours. A very reliable method is to run the pieces at open width through a boiling alkali solution at 2°—3° Tw. (sp. gr. 1·010—1·015), giving five or six dips, with squeezing and washing. The goods are then packed in a kier provided with an external heater and circulating pump, in which they are treated with alkali solution at 70° C. instead of at the boiling temperature. In the scouring process reduction of vat dyestuffs is liable to occur under the influence of the alkaline solution of organic matters, and these reduced dyestuffs then tend to "mark off" on the white ground. The scouring at the lower temperature practically averts this danger. A preliminary treatment with malt-extract is generally advantageous. In the chemicking process the colours are best preserved by avoiding the acidification of the bleach liquors by the carbon dioxide of the air. The bleach liquor should not be circulated but the goods should be steeped in cisterns and well covered by the liquor, which should be pumped on to them as they are entering the vats. A little lime-water may be added as a precaution. The souring process also should be carried out in cisterns; Turkey Red is nearly always present among these pieces, and the prolonged action of the acid is liable to attack the mordants, making the colour "run." Arrangements must be made for very thorough washing between the various processes and especially to avoid carrying forward bleach liquor into the acid. Washing machines with deep boxes and at least six "nips" must be provided. In some cases a second turn may be given with correspondingly weaker treatments. The final wash must be very thorough, as striped goods generally have to be hot-ironed; a wash with soap clears the whites and protects the goods against acid. In no case should any goods be treated until the degree of resistance of the colours to kier boiling and to bleach liquor with exposure to air has been determined under conditions which reproduce as closely as possible those of actual practice.—J. F. B.

PATENT.

Chlorination of water, alkaline and other solutions [for bleaching etc.]. N. K. Turnbull and H. N. Morris, Manchester. Eng. Pat. 122,888, 5.2.18. (Appl. 2039/18.)

THE water or alkaline or other liquid to be saturated is supplied to the inner chamber of an atomiser arranged near the top of a receiving tank, and the supply of chlorine gas, preferably from a cylinder of liquid chlorine, is connected with the outer chamber of the atomiser. The relative proportions of the liquid and gas are separately controlled by needle valves attached to the inlets of the atomiser, and the main supply of both is governed by interconnected valves, so that one cannot be opened without the other. A perforated globular chamber of earthenware is fitted over the delivery orifice of the atomiser to spread the mixture of liquid and gas. The tank is provided with a siphon discharge pipe and a vent-flue, connected with the upper part of the tank by means of a siphon, to prevent excess pressure.—J. F. B.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitric oxide; Cycle of oxidation of —— in the presence of water. A. Sanfourche. Comptes rend., 1919, **168**, 401—404. (See this J., 1919, 132 A, 172 A.)

IN the presence of water nitric oxide is oxidised to nitrogen trioxide and not the peroxide, the trioxide then being decomposed by the water, with formation of nitric acid and partial regeneration of nitric oxide. In the presence of concentrated nitric acid (sp. gr. 1·5) the nitrogen trioxide is oxidised with the formation of nitrogen peroxide and water: $2HNO_3+N_2O_3=2N_2O_4+H_2O$. If dilute nitric acid is used the action is the same as in the presence of water, until the acid reaches a concentration of about 50% (sp. gr. 1·3), whereupon the second action becomes apparent and increases as the concentration of the acid increases.—W. G.

Ammonia; Synthesis of —— at high temperatures. III. E. B. Maxted. Chem. Soc. Trans., 1919, **115**, 113—119. (See also this J., 1919, 232 T.)

THE equilibrium ammonia concentration in a mixture of 1 vol. of nitrogen and 3 vols. of hydrogen at increasing temperatures passes through a minimum and then rises to as much as 1·7% in a gas which has been passed in contact with a high-tension electric arc (see this J., 1918, 232). These results have been confirmed, using a larger arc formed between two platinum electrodes on either side of a silica tube with a flattened orifice extending centrally into an inverted flask which served as the reaction chamber. The gas was passed into the flask through a side orifice and emerged down the silica tube across the orifice of which the arc was kept steadily burning. The percentage of ammonia in the emerging gases varied according to the rate of flow, in so far as this influenced the temperature to which the moving gas was heated. A rapid flow of gas caused a considerable decrease in the percentage of ammonia formed. The possibility of the formation of ammonia by the reduction of nitric oxide owing to the presence of traces of oxygen in the gases was studied and every precaution taken to eliminate such a possibility by employing gases free from oxygen. Moreover, the direct synthesis of the ammonia was proved in another apparatus by subjecting the same gas mixture several times to a passage through the arc and determining the ammonia each time by the diminution of volume after absorption. This decrease was found to be constant for every successive passage, corresponding to the formation of 1·6—2·0% of ammonia per operation.—J. F. B.

Ammonia; Formation of — by the electric discharge. E. Briner and A. Baertuss. Helv. Chim. Acta, 1919, **2**, 95—100.

THE effects produced on the yield of ammonia obtained by circulating a mixture of nitrogen and hydrogen in a tube containing an electric arc by varying the pressure, the composition of the gaseous mixture, the intensity of the electric current, the distance apart and the material of the poles have been examined. Nickel or iron poles are less efficient than platinum. At low pressures (100 mm.) the amount of ammonia produced per ampère-hour is independent of the distance between the poles. The yield is practically the same at all pressures when a mixture of 1 vol. of nitrogen to 3 vol. of hydrogen is used, but with an excess of nitrogen higher yields are obtained at lower pressures; for example the yield is more than doubled if a mixture of 15 vols. of nitrogen to 3 vols. of hydrogen is used at a pressure of 100 mm. Yields of 7·5—10 grms. of ammonia per kilowatt-hour have been obtained, the volume concentration of the ammonia being 0·6—1%. (See also J. Chem. Soc., Apr., 1919.)—C. S.

Nitrogen compounds; War-time production of —— in Germany. Bueb. J. Gasbeleucht., 1919, **62**, 2—3.

GERMANY'S pre-war production of nitrogen compounds was in excess of requirements, but a great

deficit became apparent soon after the outbreak of war owing to the cessation of the importation of Chili saltpetre. The supply of ammonia from the distillation of coal was limited by the capacity of the carbonisation industries and did not reach one-third of requirements. At first the production of calcium cyanamide was developed by the erection of several new factories which began to be effective in 1915, but owing to the exigencies of war it became necessary to concentrate efforts on the existing plants. The synthesis of ammonia by the Haber process was found to be the most economical in labour and fuel and the process had already been perfected at Ludwigshafen. A second large factory erected on the lignite coalfield of central Germany came into operation early in 1917, and promises to be the principal factor in the supplies of nitrogen compounds. The catalytic oxidation of ammonia to nitric acid was widely practised, sodium nitrate being produced and thence strong nitric acid by the ordinary process. Experience gained shows that it is only a question of time before concentrated nitric acid will be prepared directly without the intervention of sodium nitrate. In spite of all efforts the supply of nitrogenous fertilisers had to be cut down to 50% of normal requirements. With the passage of war-time conditions it is anticipated that synthetic products in combination with potash will suffice to make Germany independent of imported nitrogen compounds.—H. J. H.

Gas evolved when fused sodium hydroxide is dissolved in water; Nature of the ——. W. H. Schramm. Chem.-Zeit., 1919, **43**, 69—70.

When fused sodium hydroxide is dissolved in water which has been freed previously from dissolved gases, evolution of a small quantity of gas occurs; from 400 grms. of sodium hydroxide the author collected 14·45 c.c. of gas which contained 4·17 c.c. of oxygen. The gas therefore consisted of 13·33 c.c. of air and 1·12 c.c. of oxygen. The oxygen is derived from the decomposition of a highly oxidised iron compound, probably sodium perferrite, Fe_2O_4,Na_2O, contained in small quantity in the sodium hydroxide. (See also J. Chem. Soc., Apr., 1919.)—W. P. S.

Sodium sulphates; Normal and acid ——. P. Pascal and Ero. Bull. Soc. Chim., 1919, **25**, 35—49.

A study of the equilibrium of the ternary system $Na_2SO_4-H_2SO_4-H_2O$ over a temperature range from −30° to 120° C. The results confirm the existence of nine anhydrous or hydrated neutral or acid salts (see further J. Chem. Soc., Apr., 1919). In order to obtain sodium bisulphate from its solutions, a considerable quantity of sulphuric acid must be added, an acidity equal to 65% sulphuric acid being necessary to obtain the anhydrous bisulphate, whilst the acid sulphates of the type $NaHSO_4$,H_2SO_4 are only obtained with an acidity exceeding 80%. To recover the acid from sodium bisulphate two processes may be adopted. (1) At the ordinary temperature a 40—45% solution of the acid sulphate is prepared and then cooled to −20° C., the liquid being sown with some of the decahydrate Na_2SO_4,$10H_2O$. The liquid phase, when separated from the solid phase thus obtained, contains at the most 30% of sulphuric acid with about 10% Na_2SO_4. (2) A 75% solution of acid sulphate is prepared at 100° C. and cooled to the ordinary temperature. The liquid phase in this case contains 50% of sulphuric acid. Trials on a large scale with one ton of the acid sulphate showed a complete recovery of the acid by method (1) and an 80% recovery by method (2). Using the heat in the bisulphate, at the moment of tapping, for preparing the solution, method (2) is probably the more economical means of recovering the acid. A diagram showing the fusibility of mixtures of normal sodium sulphate and sulphuric acid is given, from which it is shown that industrial bisulphates (nitre-cake) having an acidity inferior to 36% are partially liquid at ordinary tapping temperatures. They contain in suspension some anhydrous normal sulphate which, on cooling, is transformed at 179° C. into the intermediate sulphate Na_2SO_4,$NaHSO_4$. In utilising the acidity remaining in bisulphates to prepare dilute nitric acid from sodium nitrate in the presence of water, in order to obtain complete utilisation of the nitrate and to have an easy method of working, it is not advisable to try to use more than half the acidity of the bisulphate, leaving as residue the salt Na_2SO_4,$NaHSO_4$.—W. G.

Perphosphoric acid; Electrochemical preparation of salts of —— and of monoperphosphoric acid. F. Fichter and A. Rius. Helv. Chim. Acta, 1919, **2**, 3—26.

Most of the work has been already published (Fichter and Müller, this J., 1918, 731 A; Rius, An. Soc. Fis. Quim., 1918, **16**, 573). Perphosphate and monoperphosphate are formed in moderate yield even in the absence of fluoride, provided the electrolyte is rich in alkali. Both salts are also obtained by the electrolysis of a mixture of tetrapotassium and dipotassium pyrophosphates. In strongly acid solution perphosphoric acid decomposes spontaneously in about 2 days into monoperphosphoric acid and phosphoric acid. Monoperphosphoric acid also decomposes in acid solution, but much more slowly than monoperphosphate in alkaline solution.—C. S.

Stannous and arsenious chlorides; Interaction of ——. R. G. Durrant. Chem. Soc. Trans., 1919, **115**, 134—143.

Stannous chloride reduces arsenious chloride in hydrochloric acid solution with the formation of elementary arsenic. The arsenic is probably first formed in the colloidal state before it is precipitated, and in some cases it subsequently appears in the form of a yellow modification. The appearance of solid arsenic is always preceded by a pale buff tint in the colloidal solution and from this a buff-brown precipitate slowly falls. If this deposit of arsenic, after washing, is immediately shaken with carbon bisulphide a large proportion of it is soluble. A greater yield is obtained if carbon bisulphide is shaken violently with the two chloride solutions while they are reacting. The reaction takes place according to the equation $2AsCl_3+3SnCl_2=3SnCl_4+2As$, and in the presence of hydrochloric acid of sufficient concentration it is complete in a few hours. The anhydrous chlorides do not give the reaction. The velocity of the reaction increases with increase in the concentration of hydrochloric acid, the curve showing a sharp change in direction at a concentration of about 6·5 *N*-HCl. Below this point, dilution causes an extremely marked retardation and at 2*N*-HCl no visible precipitation of arsenic occurs even after 29 days. Next to the influence of hydrochloric acid concentration comes that of the concentration of arsenious chloride, whilst the concentration of stannous chloride has the least influence.

—J. F. B.

Lead sub-acetate and sub-sulphate. H. G. Denham. Chem. Soc. Trans., 1919, **115**, 109—113. (See also this J., 1917, 336; 1918, 300 A.)

Lead sub-acetate has been obtained by the action of acetic anhydride on lead sub-oxide at 195° C.

It is bluish-grey in colour and behaves similarly to other sub-salts of lead. Its solubility in alcohol differs slightly from that of lead acetate, but the behaviour of the two acetates on heating in a vacuum supports the view that the sub-acetate is a chemically individual substance and not a mixture of metal and normal acetate. The sub-sulphate was prepared by the action of methyl sulphate vapour on the sub-oxide at 280° C. The substance is dark grey, and conductivity experiments indicated that it decomposes on solution in water; it appears to be more soluble in alcohol than lead sulphate. On heating at 120° C. above the melting point of lead, no change in its appearance could be detected nor any sign of globules of lead.

—J. F. B.

Tartrates; Test for —— depending on the formation of the copper-tartrate complex. L. J. Curtman and B. R. Harris. J. Amer. Chem. Soc., 1919, **41**, 207.

The statement made by Curtman, Lewis, and Harris (this J., 1918, 56 A) that comparatively small amounts of phosphates or borates, when treated according to Böttger's procedure ("The Principles of Qualitative Analysis," 1906, 159), respond in the same way as tartrates, is now found to be incorrect; neither of these anions, even in amounts as high as 0·5 grm., gives a blue filtrate.

—T. H. P.

Cuprous oxide; Yellow ——. L. Moser. Z. anorg. Chem., 1919, **108**, 112—120.

The yellow form of cuprous oxide is best prepared by the reduction of a cupric salt by hydroxylamine in alkaline solution. When first formed the product has a light yellow colour and is probably a hydroxide. It quickly changes, however, to an orange or brick-red colour, probably through loss of water. It can then be dried unchanged. The dried product contains 2 to 3% water, held probably by adsorption. The yellow amorphous cuprous oxide is regarded as a primary metastable form. It is stable at ordinary temperatures, but when heated in absence of air it loses water and changes into the ordinary red crystalline modification. (See also J. Chem. Soc., Apr., 1919.)—E. H. R.

Gallium chloride; Purification by sublimation, and analysis of ——. T. W. Richards, W. M. Craig, and J. Sameshima. J. Amer. Chem. Soc., 1919, **41**, 131—132.

Gallium chloride sublimes and distils at a relatively low temperature and may thus be separated from contaminating chlorides, which are much less volatile. Gallium chloride, prepared from gallium and chlorine, and purified by fractional distillation and sublimation first in a stream of chlorine and afterwards in a vacuum (*cf.* Dennis and Bridgman, this J., 1918, 738 A), showed no trace of impurity when examined in the spectrometer. Atomic weight determinations of gallium made with small quantities of the chloride gave the value 70·10. (See J. Chem. Soc., Apr., 1919.)

—T. H. P.

Graphitic carbon and graphitic acid. V. Kohlschütter and P. Haenni. Z. anorg. Chem., 1919, **108**, 121—144.

The oxidation of graphite to graphitic acid has been studied by treating pure electrically prepared graphite with a mixture of potassium chlorate, sulphuric and nitric acids in the cold. Contrary to what is generally supposed, the colour of the graphitic acid does not depend on the particular sample of graphite used. By repeated treatment of the graphitic acid with the oxidising mixture, the colour of the product changes from green to yellow whilst the carbon content gradually diminishes from 59·0% after the first treatment to 54·4% after the fifth. The graphitic acid, after repeated washing with water, dissolves to form a reversible colloidal solution. The variable colour of the product is attributed to different degrees of dispersity, the lighter coloured graphitic acid having a more highly disperse structure. The graphitic acid is not crystalline, the apparently crystalline particles being pseudomorphs of the original graphite particles. The decomposition of graphitic acid by heat and by reducing agents has been studied, and it is found that the character of the resulting carbon, graphitic or amorphous, depends upon the reaction conditions, confirming the previous conclusion (this J., 1919, 174 A) that there is no essential difference between amorphous and graphitic carbon. (See also J. Chem. Soc., Apr., 1919.)—E. H. R.

Spectrographic study of the ashes of marine plants. E. Cornec. Comptes rend., 1919, **168**, 513—514.

A spectrographic study of the ashes of laminaria reveals the presence of silver, arsenic, cobalt, copper, manganese, nickel, lead, zinc, bismuth, tin, gallium, molybdenum, gold, antimony, germanium, glucinum, titanium, tungsten, and vanadium. Of these the first eight have already been reported as occurring in marine plants, whilst the next five have been found in sea water. The occurrence of the last six has not been previously reported either in marine plants or in sea water. Gold, bismuth, gallium, and germanium were only present in spectrographic traces in the ashes examined.

—W. G.

Oxide of iron purification. Weyman. *See* IIA.

Ammonia and sulphur recovery. Bertelsmann. *See* IIA.

Clean-up of nitrogen by a heated molybdenum filament. Langmuir. *See* IIB.

Lead in zinc oxide. Collins and Clarke. *See* XX.

Patents.

Acetate of lead and other acetates; Manufacture of ——. E. F. Morris, Liverpool. Eng. Pat. 122,953, 12.3.18. (Appl. 4291/18.)

Sodium acetate solution, *e.g.*, the liquor obtained in the manufacture of chrome yellows from lead acetate, is treated with sufficient sulphuric acid to liberate the acetic acid and then extracted with benzol, toluol, or other organic solvent immiscible with water. The solvent containing the acetic acid is then mixed with an excess of an aqueous solution of basic lead acetate or milk of lime, and the solvent separated from the aqueous solution.—L. A. C.

Aluminium chloride and aluminium - sodium chloride; Process for the manufacture of ——. E. E. and P. C. Dutt, Jubbulpore, India. Eng. Pat. 123,243, 10.5.18. (Appl. 7841/18.)

A mixture of calcined clay and sodium (or potassium) chloride is heated to bright redness in a stream of arsenious oxide vapour in a rotary furnace, resulting in the formation of sodium (or potassium) aluminate, silica, and arsenic trichloride: $6NaCl+3Al_2Si_2O_7+As_2O_3=3Na_2Al_2O_4+6SiO_2+2AsCl_3$. The arsenic trichloride vapour is led

into a brickwork chamber heated to at least 450° C., into which steam is also introduced; and the mixture of arsenious oxide and hydrochloric acid produced passes into a long flue provided at intervals with condensing chambers in which the arsenious oxide collects. The hydrochloric acid is converted into chlorine by the Deacon process, and the chlorine is washed, dried, and led into a retort heated to bright redness and containing briquettes prepared by heating a mixture of hydrated alumina (prepared from the sodium aluminate obtained earlier in the process) and coke made into a paste with tar or oil, either with or without the addition of sodium chloride. Aluminium chloride (or aluminium-sodium chloride, if sodium chloride was present in the briquettes) passes out of the retort as vapour, and is condensed.—L. A. C.

Solution of solids. Ger. Pat. 309,332. *See* I.

Chlorination of water, etc. Eng. Pat. 122,888. *See* VI.

VIII.—GLASS; CERAMICS.

Silica bricks; Apparatus [and methods] for controlling the manufacture of ——. H. Le Chatelier and B. Bogitch, Rev. Mét., 1918, **15**, 511–531.

A GOOD silica brick should contain 95–97% of silica; one of best quality should contain 97% of silica and not more than 1% each of lime, alumina, and ferric oxide. The customary method of analysis—fusion with sodium or calcium carbonate—is inapplicable, as the silica results are inaccurate and the lime and alkalis cannot be determined. Decomposition of the material with hydrofluoric and sulphuric acids gives accurate results for the bases. For control purposes it is sufficient to weigh the resulting sulphates, as the relative proportions of the various bases do not differ greatly from day to day. For the best bricks the sulphates should not exceed 10%. 1 grm. of the very finely powdered sample is heated in a platinum crucible with 20 c.c. of hydrofluoric acid for 12 hours, the temperature being kept so low that evaporation of the acid is then only just complete. The residue is heated with 10 c.c. of *N*/1 sulphuric acid to decompose the fluorides and then to redness to decompose any organic matter present. After cooling, 1 c.c. of *N*/1 sulphuric acid is added and the crucible heated until the acid fumes just disappear and the sulphates have a lemon-yellow colour (400° C.), but not to a temperature sufficient to decompose the ferric sulphate. The residual sulphates are weighed. To test the absence of undissolved silica, 20 c.c. of water and 1 c.c. of *N*/1 sulphuric acid are added, the crucible is heated for a quarter of an hour to a temperature just short of boiling, and its contents are then transferred to a glass flask with about 100 c.c. of water and boiled gently for an hour. Any residue is filtered off and its weight deducted from that of the sulphates; it usually consists chiefly of quartz with a little titanic acid. Well-burned bricks should have sp. gr. 2·30–2·40. The specific gravity is determined by introducing 8 grms. of the finely powdered brick into carbon tetrachloride or benzine contained in a graduated cylinder and measuring the volume of liquid displaced. The crushing strength should be at least 100 kilos. per sq. cm. but 200 kilos. per sq. cm. is desirable and 300 kilos. per sq. cm. is sometimes reached. The determination of the crushing strength of silica bricks gives such uncertain results that it is preferable to use the Brinell ball test described previously (this J., 1918, 373A). The expansion and the loss of crushing strength on heating to 1600° C. give important indications as to the behaviour of the bricks when in use in steel furnaces. The maximum expansion and loss of strength both occur at 1500°–1600° C.; above this latter temperature they are affected by the partial fusion which occurs. The expansion after heating to 1600° C. is measured on square prisms of 20 mm. side, and with a height of 50–60 mm. These are heated slowly up to 300° C. (the inversion temperatures of cristobalite) and afterwards rapidly to 1600° C.; so that the latter temperature is reached in half an hour. After 1 hour's heating at 1600° C. the furnace is allowed to cool for an hour or more and the samples are withdrawn when their temperature has fallen below 200° C. The crushing strength at 1600° C. is determined on cubes of 1 cm. side cut from the bricks. The sample is placed in the furnace and the pressure applied to it by means of a sensitive system of external weighted levers mounted on ball bearings. The resistance of the sample may be ascertained from the movement of the levers. The sample is supported by a block of carborundum or electrode carbon, 50 mm. in diameter and 100 mm. high. The pressure is transmitted through a cylinder, 20 mm. in diameter and 30 mm. high, with a cavity, 10 mm. in diameter and 20 mm. deep at the top, into which fits a vertical iron rod connected to the system of levers, its lower end projecting only 10 mm. into the furnace. The cylinder is composed of 90 parts of calcined alumina and 5 of kaolin made into a paste, moulded, and burned at 1700° C. Fragments of old cylinders may be mixed with a little of the fresh mixture and used again. The furnace is heated so as to attain a temperature of 1600° C. in half an hour and is maintained at this temperature until the sample fails under the pressure exerted upon it. The furnace is a vertical cylinder heated by high pressure gas and primary air under pressure of 1 atmosphere, the secondary air being heated recuperatively. The grading of the mixture used for making silica bricks may be estimated by determining the percentage of material passing through a 200-mesh sieve; it should not be less than 25%. The variation in the percentage of the silica flour is the commonest cause of variation in the quality of the bricks. The compactness of the bricks should be constant; it may be judged by comparing the weights of the "green" bricks. The moisture in the "green" bricks should be constant and as high as is compatible with easy moulding. It should be determined regularly several times a day, as workmen tend to use too dry a paste which is easier to work, but produces weak and laminated bricks. The temperature and duration of the firing have a dominating influence on the quality of the bricks. In addition to the use of cones it is desirable to measure the expansion of the bricks at various points in the kiln.—A. B. S.

PATENTS.

Glass furnaces. A. F. Peeters, Leerdam, Holland. Eng. Pat. 123,146, 11.2.18. (Appl. 2440/18.)

A GLASS furnace has two or more working spaces connected with a single melting space, the total vertical cross-sectional area of the working spaces exceeding that of the melting space. The hot gases for melting the batch enter at one end of the melting space, pass through it and then through the two working spaces to chimneys or flues at the opposite end of the furnace.—A. B. S.

Glass-annealing lehrs. J. and G. Keith, London. Eng. Pat. 123,254, 13.6.18. (Appl. 9727/18.)

A GLASS-ANNEALING lehr comprises a tunnel-like passage inclined upwards from the inlet to a level portion or muffle heated by gas, and down-

wards from the muffle towards the exit, which is somewhat higher than the inlet. The downward portion is provided with flues with adjustable outlets.—A. B. S.

Ovens and kilns for use in the manufacture of tiles, pottery and other ware and for other purposes [; Combustion chamber for ——]. J. H. Marlow, Stoke-on-Trent. Eng. Pat. 122,927, 16.2.18. (Appl. 2773/18.)

A COMBUSTION chamber for tunnel kilns is built up of sectional tubular pieces or hollow slabs formed of several tubes side by side and integral with one another. The slabs are curved and interlock with each other, and are connected so that they form a corrugated arched chamber or flue with double walls having a clear passage between the walls.
—A. B. S.

Tunnel kilns, ovens, and the like. H. Francart, London. Eng. Pat. 122,957, 22.3.18. (Appl. 5081/18.)

ONE or more steam boilers are placed above or at the side of the cooling zone of a tunnel kiln, and are heated by hot air and by gases from this zone, the volume of the air or gases thus utilised being controlled by means of valves. The steam produced passes through pipes extending through the kiln to two water-gas generators, arranged vertically on either side of the tunnel. The resulting water-gas is employed as a fuel for heating the kiln. A portion of the burnt gases from the hot zone of the kiln may also be passed into the generators, the carbon dioxide in the gases being thereby reduced to carbon monoxide.—A. B. S.

Refractory goods; Manufacture of ——. G. W. Mottram, Hanley. Eng. Pat. 123,116, 7.11.17. (Appl. 16,229/17.)

IN making refractory bricks and other articles, a suitable binder or flux such as lime or other basic oxide, iron oxide, salts, and/or fireclay is mixed with water and 1—4 times its weight of dry-ground base material, which may be either old, used, or discarded refractory material (silica brick etc.) or new material (silica stone etc.). The mixture is ground until it will pass through a sieve of 30—200 meshes per linear inch, according to the character of the goods to be made, then mixed with a suitable proportion of the base material (previously ground to pass through a sieve of 8—40 meshes per linear inch and saturated with water) in a mixer which has no grinding action, and after standing a sufficient time to stiffen, the excess of water, if any, is removed and the material dried and burned. When fireclay is used as a binder, peaty water, the slime from the effluent of sewage works, or refuse liquid from tanneries may be added to increase the plasticity and binding power of the clay.—A. B. S.

Refractory materials used in surface combustion processes. E. C. R. Marks, London. From Soc. Anon. Ital. Gio. Ansaldo & Co., Genoa, Italy. Eng. Pat. 123,175, 18.2.18. (Appl. 2851/18.)

IMPROVED porous bodies for surface combustion are made of graphite which is agglomerated with tar or the like and the mixture calcined so as to remove the volatile constituents and leave a porous structure. When direct contact between the refractory material and the object to be heated is necessary, very small fragments of graphite are used. Graphite thus prepared is preferable to fireclay as a refractory material for surface combustion because it permits the passage of the combustible gaseous mixtures at a lower pressure and does not swell when heated.—A. B. S.

Graphite crucible. E. Kötteritzsch, Neukölln. Ger. Pat. 298,682, 26.11.15.

THE crucible is made from a mixture containing between 5 and 40% of compounds of the rare earths, *e.g.*, zirconium compounds.—L. A. C.

[Abrasive] composition containing alumina and zirconia. Norton Co., Worcester, Mass., Assignees of L. E. Saunders and R. H. White, Niagara Falls, N.Y., U.S.A. Eng. Pat. 113,958, 7.2.18. (Appl. 2253/18.) Int. Conv., 12.2.17.

SEE U.S. Pat. 1,240,490 of 1917; this J., 1917, 1130.

IX.—BUILDING MATERIALS.

Wood; Bleaching of —— by hydrogen peroxide. C. Marggraf. Kunststoffe, 1917, 7, 165. Chem.-Zeit., 1918, **42**, Rep., 200.

FRESHLY cut wood, 1—5 mm. thick, is treated for some days with a 3% solution of H_2O_2, containing 20 grms. of aqueous ammonia in 11 gallons, the bath being kept alkaline. About 1 kilo. of 3% H_2O_2 is used per square metre of wood (2 lb. per sq. yard). The bleaching is accelerated by warming to 34° C. A pure white is obtained, the strength and toughness of the wood are unimpaired, and the graining is accentuated.—S. S. A.

PATENTS

Wood-substitute. L. P. Evans, Swanwick, and W. Andrews, Pye Bridge, Derby. Eng. Pat. 122,861, 28.1.18. (Appl. 19,058/17.)

A MIXTURE of sawdust or cork dust 50—70 parts, waste from the manufacture of twine, ropes, bags, cocoa matting, animal hair, or other fibrous material 10—15 parts, and small proportions of silica, alumina, ferric oxide, magnesia, and calcium sulphate is made into a plastic mass with water, and the product is pressed in moulds, then exposed to the air for several days, and impregnated with oils, glue, gum, resin, or wax or a combination thereof. The finished articles are fire- and waterproof.—A. B. S.

Asphalt composition for paving and other purposes; Preparation of ——. H. H. Jones, Swansea. Eng. Pat. 122,922, 12.2.18. (Appl. 2510/18.)

A COMPOSITION for paving and similar purposes is made by adding three parts by weight of sand (or a mixture of three parts of sand and one part of any of the following: calcined aluminium silicate, felspar, silica, limestone, or calcined crushed granite) heated to 104°–120° C., to 1 part of tar-asphalt prepared by heating coal tar to 180°—270° C. until it has thickened and attained a specific gravity of 1·18 to 1·21. The composition, which sets in about 20 minutes, may be spread on the road as required or may be moulded into blocks.
—A. B. S.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Speiss; Treatment of copper —— in the electric furnace. P Papencordt. Metall u. Erz, 1919, **16**, 6—13.

A SPEISS containing Cu 23·5, Pb 16·3, As 12·1, Sb 13·2, Fe 26·2, Ni+Co 2·9, Zn 3·1, S 2·1, and Au+Ag 0·12%, was fused in portions of 1 kilo. with 0·5 to 1·5 kilo. of pyrites between carbon electrodes in a sealed crucible connected with a condensing

chamber. There were obtained: a matte practically free from arsenic and antimony and containing 75—87% of the copper; a secondary antimonial speiss containing As 0·02—0·27, Sb 16·5—18, and Cu 3·66—7·96% (*i.e.*, about 20% of the copper); a slag; and an arsenical sublimate practically free from antimony. The antimonial speiss was worked up by fusion with coal and sodium sulphate, giving a residue suitable for further treatment along with the matte, and a solution of thioantimonite from which the metal was recovered by electrolysis. The sublimate was re-sublimed, yielding pure arsenic disulphide.—W. R. S.

Tin; Investigation by means of X-rays of the crystal structure of white and grey ——. *II. Structure of white tin. III. Structure of grey tin* A. J. Byl and N. H. Kolkmeyer. Proc. K. Akad. Wetensch. Amsterdam, 1919, **21**, 494—500, 501—504.

FROM the photographs of white and grey tin previously obtained (see this J., 1918, 658 A) the crystal structures of the two forms have been deduced.

—T. H. P.

Gallium; Purification of —— *by electrolysis and the compressibility and density of gallium.* T. W. Richards and S. Boyer. J. Amer. Chem. Soc., 1919, **41**, 133—134.

THE separation of gallium from indium by a method based on the different solubilities of the hydroxides of the two metals in alkali hydroxide solution is incomplete, but electrolysis in slightly acid solution of the gallium thus obtained yields a metal with m.pt. 30·8° C., which is the highest yet found. The compressibilities of solid and liquid gallium are $2{\cdot}09\times10^{-6}$ and $3{\cdot}97\times10^{-6}$ respectively and the specific gravities 5·885 and 6·081 respectively. (See also J. Chem. Soc., Apr., 1919.)—T. H. P.

Replacing platinum in electrolytic analysis. Nicolardot and Boudet. *See* XXIII.

PATENTS.

Steel; Manufacture of ——. W. L. Turner, Atherstone, Warwick. Eng. Pat. 123,102, 26.3.17. (Appl. 4315/17.)

ALLOY steel is produced by the "alumino-thermic" process from mixtures containing aluminium, magnesium, silicon, or like elements and oxides, sulphides, chlorides, and other salts of chromium, vanadium, tungsten, cobalt, molybdenum, or like metals, in conjunction with iron or steel. Some of the metals may be employed as constituents of alumino-thermic mixtures, and one or more in the form of iron or ferro-alloys containing carbon.

—T. H. B.

Alloys; Manufacture of ——. W. L. Turner, Atherstone, Warwick, and H. A. Blackwell, Blackpool. Eng. Pat. 123,103, 29.3.17. (Appl. 4531/17.)

WASTE or scrap aluminium ("swarf") containing zinc, copper, iron, etc., alone, or in conjunction with commercially pure aluminium, magnesium, silicon, or the like, is used in the reduction of ores, sulphides, oxides, chlorides, or other salts, by the "alumino-thermic" process to form alloys or ferro-alloys.—T. H. B.

"Rustless" or "stainless" or like steel; Manufacture of ——. W. L. Turner, Atherstone, Warwick. Eng. Pat. 123,104, 19.6.17. (Appl. 8782/17.)

A LOW-CARBON chrome steel is produced by the action of aluminium upon a mixture of iron oxide practically free from carbon, and chromium oxide. The mixture may consist, for example, of 72 parts by weight of iron oxide, 34·5 parts of chrome ore (50% Cr_2O_3), and 30·25 parts of aluminium. A steel containing 12 to 15% Cr and substantially under 0·1% C is thus produced.—T. H. B.

Ferro-chromium; Manufacture of ——. W. L. Turner, Atherstone, Warwick. Eng. Pat. 123,105, 19.6.17. (Appl. 8813/17.)

FERRO-CHROMIUM free from carbon is obtained from an alumino-thermic mixture of chrome iron ore and aluminium (or other equivalent reducing medium) and bichromate or chromate of potassium or sodium.—T. H. B.

Steel or ferro-alloys; Manufacture of ——. W. L. Turner, Atherstone, Warwick. Eng. Pat. 123,113, 31.10.17. (Appl. 15,858/17.)

FINELY divided hammer scale from high-speed steel, containing approximately 80% of iron oxide and about 14% of tungsten oxide, with smaller amounts of oxides of chromium, vanadium, molybdenum, cobalt, manganese, and silicon, is used in the "alumino-thermic" process in conjunction with suitable amounts of ferro-chromium, wrought iron, or mild steel, preferably in a fine state of division, and aluminium, for the direct production of alloy steel.—T. H. B.

Furnace; Tilting ——. C. M. Stein et Cie., Paris. Eng. Pat. 120,200, 2.9.18. (Appl. 14,248/18.) Int. Conv., 24.10.17.

CREVICES between the moving and stationary parts of tilting furnaces are sealed by a band of flexible, heat-resisting material (asbestos fabric), one end of which is attached to a fixed support, and the other end to a stretching appliance regulated by a movable balance weight.—C. A. K.

Furnaces; Regenerative tipping ——. A. M. Aubert, Billancourt, France. Eng. Pat. 120,559, 10.10.18. (Appl. 16,518/18.) Int. Conv., 22.10.17.

IN order to enable suitable openings in a tilting furnace to be used alternately as inlets and outlets when a reversal of the regenerated gaseous current is effected, a framework fitted with two discs provided with apertures (inlet and outlet) is pivoted on each end of the furnace. A corresponding framework is mounted on the regenerator port to provide a connection. Before reversing the direction of the current, the discs are moved so as to connect the inlet or outlet orifice to correspond with the new conditions.—C. A. K.

Crucible furnaces. H. N. Davis and W. R. Twigg, Luton. Eng. Pat. 123,059, 28.2.18. (Appl. 18,621/18.)

A REGENERATIVE system is provided by two superposed annular passages which surround the crucible chamber, and open into it tangentially. Air under pressure is supplied through each passage alternately with products of combustion and means are provided to reverse simultaneously the direction of flow of the air and heating gas to the furnace.

—C. A. K.

Furnace for re-fusing and refining metal [aluminium]. A. C. Giton, London. Eng. Pat. 123,283, 9.9.18. (Appl. 14,621/18.)

A COVERED crucible with a tapping hole and spout at the base is fixed in the upper part of a furnace chamber. Products of combustion pass around the crucible and are withdrawn from the top of the

chamber and passed around a preheating oven before discharge. The crucible cover is provided with an opening for the admission of metal to be melted.—C. A. K.

Roasting-furnace shaft. E. J. Fowler, Redwood City, Cal., Assignor to General Chemical Co., New York. U.S. Pat. 1,278,129, 10.9.18. Appl., 3.7.15.

A COOLED shaft for a multiple-hearth roasting furnace consists of an outer cylindrical shell with inlet and outlet ports for rabble arms, the ports of one set being angularly disposed to those of the next higher or lower set. The shaft is divided longitudinally into two passages of unequal section by a partition of -O-section, which is of spiral form so as to separate the inlet from the outlet ports. A cooling medium is supplied through the smaller longitudinal section and passes through the rabble arms and thence outwards through the larger section of the shaft.—C. A. K.

Aluminium alloy. F. R. Rand and C. T. J. Vautin, London. Eng. Pat. 122,870, 7.1.18. (Appl. 369/18.)

AN alloy consisting of 85% to 97·5% of aluminium, and the remainder of an alloy of 20% to 25% of nickel and 80% to 75% of copper.—T. H. B.

Furnace with vertical retorts for zinc distillation. H. Siegel, La Mallene, and J. Thede, Engis. Ger. Pat. 309,468, 26.4.17.

THE combustion chamber for the heating gas is placed at the side of the reduction chamber in its lower half. To minimise loss by radiation the combustion chamber should be circular.—L. A. C.

[*Condensers for zinc furnaces;*] *Presses for the manufacture of hollow articles of refractory materials* [*e.g.*, ——]. L. Van Gulck, Bristol. Eng. Pat. 123,009, 16.8.18. (Appl. 13,334/18.)

Crucible smelting furnaces; Tilting mechanism for ——, particularly applicable to the lip-axis type. J. Tylor and Sons, Ltd., H. T. White, J. Gaunt, and D. Brookfield, London. Eng. Pat. 123,040, 25.11.18. (Appl. 19,382/18.)

Lead bullion; Process of treating ——. G. P. Hulst, Hammond, Ind., U.S.A. Eng. Pat. 123,272, 6.8.18. (Appl. 12,781/18.)

SEE U.S. Pat. 1,285,714 of 1918; this J., 1919, 184 A.

Nickel-copper matte; Process of refining ——. C. and O. Langer, Clydach, Wales. U.S. Pat. 1,291,030, 14.1.19. Appl., 10.11.17.

SEE Eng. Pat. 109,402 of 1917; this J., 1917, 1135.

Metal scrap; Treatment of ——. E. R. Sutcliffe, Leigh. U.S. Pat. 1,291,672, 14.1.19. Appl., 1.3.17.

SEE Eng. Pat. 103,553 of 1916; this J., 1917, 344.

Heating furnace. Eng. Pat. 122,928. *See* I.

XI.—ELECTRO-CHEMISTRY.

Formation of ammonia. Briner and Baerfuss. *See* VII.

Electrochemical preparation of salts of perphosphoric and monoperphosphoric acids. **Fichter and Rius.** ***See*** **VII.**

Replacing platinum in electrolytic analysis. **Nicolardot and Boudet.** *See* XXIII.

PATENTS.

Heating by electric induction; Method of and apparatus for ——. The Ajax Metal Co., Philadelphia, Pa., Assignees of E. F. Northrup, Princetown, N.J., U.S.A. Eng. Pat. 111,844, 14.11.17. (Appl. 16,738/17.) Int. Conv., 25.11.16.

THE invention relates to methods and apparatus for heating electric furnaces by the inductive effect of currents of very high frequency (*e.g.*, 25,000, 12,400) compared with the frequencies previously used in power circuits, whereby, owing to the very high rate of change of such currents, the electromagnetic energy associated with the inductor coil can be converted into heat at a high efficiency without the necessity for the interlinkage of iron. The high frequency may be obtained by intermittent oscillatory discharge from a condenser or condensers. A multiphase current supply may be used, with such mutually inductive relations between the phases that the supply of current to the furnace from one phase reacts inductively upon another phase to produce a transfer of energy in the said phase, and *vice versâ*. The furnace coil used for the heating means is helically wound from flat strip material, with the wider dimension of the strip placed radially with respect to the helix, and arranged in circuit with a condenser and spark gap. Inductive heating by successive resisters may be employed, the frequency of the inducing current being increased until the rate of change of the current secured makes whole or partial interlinkage of a magnetic material with the induced current circuits of the resisters, unnecessary. Initially, there is a marked preponderance of capacity over reactance, and the initial positive reactance in the supply circuit is substantially balanced by means in the work circuit, for the purpose of securing unity power factor in the supply circuit.—B. N.

Electric furnaces; Improving the conductivity at the joints of electrodes for ——. C. W. Kayser and D. W. Macdonald, Sheffield. Eng. Pat. 123,017, 4.9.18. (Appl. 14,372/18.)

A METALLIC spring washer is arranged between the meeting faces of the sections of the electrode and surrounding the central screw plug connecting the two parts. Upstanding resilient wings are connected to both sides of the washer, and molasses is used to fill in the interstices when the faces are screwed together.—B. N.

Cathodes; Electron-emitting —— for vacuum discharge tubes, and process of making the same. Western Electric Co., Ltd., London. From Western Electric Co., Inc., New York. Eng. Pat. 123,126, 8.1.18. (Appl. 411/18.)

SUBSTANCES, usually deemed "thermionically" active, such as compounds of alkaline-earth metals, *e.g.*, calcium, strontium or barium oxides, are mixed in desired proportions with compounds of the noble metals, such as platinum or gold. The mixture is applied to a platinum or similar filament, which is heated so as to reduce the compound of the noble metal to the metallic state.
—B. N.

Electric heating by high-frequency currents; Method and apparatus for ——. Oscillation-current method and apparatus. E. F. Northrup, Princeton, N.J., Assignor to The Ajax Metal Co., Philadelphia, Pa. U.S. Pats. 1,286,894 and 1,286,895, 3.12.18. Appl., 19.9.17 and 25.11.16.

SEE Eng. Pat. 111,844; preceding.

XII.—FATS; OILS; WAXES.

Egyptian lettuce oil. E. Griffiths-Jones. Report and Notes, Pub. Health Lab., Cairo. Reprint. 1918. 7 pages.

Lettuce oil is expressed from the seeds of *Lactuca scariola oleifera*, a variety of the prickly lettuce extensively cultivated in Upper Egypt. The moistened seed, which contains 33 to 37% of oil, is crushed in a large stone mortar, and the pulp is expressed by means of a vertical hand-press. The oil is of a golden colour, and has a characteristic pleasant taste. It yields no deposit even when kept for a long time at 0° C. A sample expressed from hand-picked seed had the following characters:- Sp. gr. at 15·5/15·5° C., 0·9247; ref. index (Abbé) at 40° C., 1·4672; acid value, 1·8; saponif value, 190·0; Reichert-Meissl value, 0·1; iodine value (Hübl), 127·0; Polenske value, 0·2; and acetyl value, 12·0. Samples of commercial oil and of oil expressed from commercial seeds had: Sp. gr. 0·9252 to 0·9334; and iodine value, 122 to 136·3. The oil contained linolic acid but no linolenic acid. It behaved like a semi-drying oil, yielding a hard and dry film after 5 days' exposure to the air at 28° to 30° C. A sample of the picked seeds had the following composition:—Oil, 36·3; proteins, 22·7; digestible carbohydrates, 16·3; crude fibre, 6·3; and moisture, 14·3%.- C. A. M.

German resins; Suitability of —— for the manufacture of soap. F. Goldschmidt and G. Welss. Z. angew. Chem., 1919, **32**, 32—36.

German resins are dark and often opaque, especially when obtained by an extraction process. They contain a large proportion of oxidised resin acids, the soaps of which, like those of oxidised fatty acids, are fairly soluble in salt solutions. Hence such resins cannot be used in the manufacture of soap without considerable loss. The following analytical method may be used to determine the amount of this loss:—Ten grms. of the resin and 5 grms. of stearine are gradually introduced, with stirring, into a boiling solution of 25 c.c. of 10% sodium hydroxide diluted with 225 c.c. of water, and the mixture boiled and occasionally stirred for 20 mins., the water being renewed from time to time. An additional 5 grms. of stearine is then added, and the boiling continued for 5 mins., after which 25 grms. of salt is added, and the liquid again boiled for 5 mins. If, on cooling, the lower lye is not clear the presence of alkali is indicated, and a further 3 grms. of stearine must be added, and the boiling repeated for 5 mins. After cooling, the lower lye is filtered, and the soap washed with cold 10% sodium chloride solution. The particles of soap on the filter are added to the main cake of soap, the whole is decomposed with dilute hydrochloric acid, and the separated mixture of fatty and resin acids is melted until clear and then cooled. The aqueous acid layer is separated, and the cake of resin and fatty acids is washed with water until free from acid, the washings being added to the aqueous acid layer. The cake is dried with filter paper and then heated over a very low flame until constant in weight. The acid layer is extracted with ether (200 c.c. in all), the extracts combined and evaporated and the residue dried and weighed, and its amount added to that of the cake of resin and fatty acids. The sum less the quantity of added stearine gives the amount of utilisable resin. The degree of solubility of a resin in petroleum spirit does not afford a criterion of its suitability for soap-making. For example, a resin, which by the above stearine method showed 84·0% of available constituents, contained 41·2% soluble in petroleum spirit, whilst in the case of another resin the respective quantities were 88·5% and 61·5%. Certain very dark extraction residues yielded a dark sediment when the soap was salted out, amounting in one case to 43% of the total resin. These deposits were found to consist of acid iron salts of highly oxidised resin acids. The resins are extracted in iron vessels by means of trichloroethylene. This solvent attacks and dissolves the iron and also acts as a catalyst in oxidising the resin acids. A sample of light colophony was converted by the simultaneous action of trichloroethylene, iron, and air, into a dark product analogous in composition to the commercial extracted resins.—C. A. M.

Viscosity of oils. Oelschläger. *See* IIA.

Fatty acids from varnish oils. Pearce. *See* XIII.

Patents.

Oil cakes; Machines for forming ——. J. Davidson, Greenville, S.C., U.S.A. Eng. Pat. 122,864, 31.12.17. (Appl. 19,323/17.)

The patent relates to improvements in machines for forming oil cakes by means of a hydraulic "former" device, whereby the operation of the machine is rendered more automatic and effective and cakes of uniform character may be produced notwithstanding the presence of lumps in the meal.

Cleansing material; Manufacture of a new ——. G. A. Paulin, Asnières, France. Eng. Pat. 120,195, 26.6.18. (Appl. 10,537/18.) Int. Conv., 23.10.17.

A preparation particularly suitable for cleaning fabrics of wool, silk, cotton, etc., is made by hydrating casein with water and treating it with a solution of sodium carbonate, but not in such a way as to dissolve it. The resulting product is mixed with rosin which has been saponified with caustic soda lye. The plasticity and fluidity of the final preparation depend upon the quantity of water used for hydrating the casein.—C. A. M.

Rubber substitute. Eng. Pat. 123,114. *See* XIV.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Varnish oils and varnishes; Study of the fatty acids obtained from ——. W. T. Pearce. J. Ind. Eng. Chem., 1919, **11**, 121.

With the object of finding methods for determining China wood oil (tung oil) and other oils that are being used in place of linseed oil in varnishes, the author records the refractive indices of the fatty acids obtained from various mixtures of linseed oil and China wood oil, and the results of the "jelly" test of the fatty acids obtained from mixtures of China wood oil and linseed, menhaden, soya bean, and cottonseed oils. The fatty acids had the following refractive indices at 20° C.:—Pure linseed oil, 1·4666; linseed, 95, China wood, 5, 1·4707; linseed, 90, China wood, 10, 1·4775; linseed, 80, China wood, 20, 1·4824; linseed, 50, China wood, 50, 1·4895. In the "jelly" test, the fatty acids from mixtures of soya bean oil or cottonseed oil and China wood oil gave as good results as did mixtures of linseed oil and China wood oil, but mixtures of linseed, soya bean, and cottonseed oils

gave no jelly. Menhaden oil yielded a small brown residue. Mixtures containing from 10 to 20% of China wood oil gave small amounts of jelly. Fatty acids from a varnish containing copal and rosin and an oil mixture consisting of China wood oil, 25, menhaden oil, 25, and linseed oil, 50%, gave a fair amount of jelly.—W. P. S.

Resins; Separation of —— by borax solution. H. Wolff. Chem. Umschau, 1916, 1. Chem.-Zeit., 1919, **43**, Rep., 10.

A COMPLETE separation of a mixture of resins cannot be obtained by means of solutions of borax, only a concentration of one of the constituents being effected. Colophony alone is not dissolved, but in admixture with shellac it is partially soluble. Copal is partially soluble alone, and its solubility is affected by the addition of shellac. Shellac, by itself, and generally but not invariably in admixture with other resins, is completely dissolved.—S. S. A.

Resins; Constituents of —. IV. β-Dammar-resen. A. Zinke and E. Unterkreuter. Monatsh. Chem., 1918, **39**, 865—869.

ANALYSES and determinations of molecular weight show the hydrocarbon portion of β-dammar-resen (compare Dalb, Jahrb. f. prakt. Chem., 1848, **45**, 16; Tschirch and Glimmann, J. Chem. Soc., 1896, i, 164) to have the composition, $C_{20}H_{16}$; it melts indefinitely at 195° C. after softening at 165° C. and possibly represents a mixture of hydrocarbons.
—H. W.

Resins for soap making. Goldschmidt and Weiss. *See* XII.

PATENTS.

Paint for coating the bottoms of vessels. I. Suzukawa, Hiroshima, Japan. Eng. Pat. 113,612, 9.2.18. (Appl. 2377/18.) Int. Conv., 22.2.17.

A BENZOL solution of a compound obtained by slowly heating together phenol and an alkaloid (*e.g.*, quinine or strychnine) is incorporated with a mixture of a soap of a heavy metal and a fine metallic powder obtained by heating together a mixture of a poisonous oxide of a heavy metal (*e.g.*, lead oxide or copper oxide) and a fatty acid. To the resulting mixture is added rosin, a volatile solvent, and a pigment such as iron oxide. The compounds of phenol with quinine, $(C_6H_5OH)_2,C_{20}H_{24}O_2N$, or with strychnine, $C_6H_5OH,C_{21}H_{22}O_2N_2$, are insoluble in water. They are slowly decomposed by salt water with the liberation of a poison which destroys molluscs and seaweeds.—C. A. M.

Water paint; Manufacture of ——. C. H. Murray, London. Eng. Pat. 122,940, 26.2.18. (Appl. 3394/18.)

A WATER-RESISTING paint or paint medium is obtained by treating a solution of casein or of casein and soap with alum, washing the precipitate and grinding it with water, with or without the addition of a pigment.—C. A. M.

Gas stoves for lacquering etc. Eng. Pat. 122,492. *See* IIA.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

PATENT.

Rubber; Composition having the general properties of —— and method of making same. M. Gregory, Tacoma, Wash., U.S.A. Eng. Pat. 123,114, 5.11.17. (Appl. 16,093/17.)

FISH oil or fish scrap rich in oil, or raw fish containing about 5% of oil, is mixed with sulphur, in the proportion of about 25% of the oil present, at about 175° C. in an open vessel, and the temperature gradually raised to about 220° C. The resulting plastic material is heated at about 155° C. under pressure until the reaction is complete. Alternatively, the mixture, after the gradual addition of sulphur and heating to 220° C., may be treated with further quantities of sulphur and lead oxide, and then heated for 30 to 60 mins. in a closed vessel at about 155° C.—C. A. M.

XV.—LEATHER; BONE; HORN; GLUE.

Sulphuric acid; Method of determining free —— in leather. C. Immerheiser. Ledertechn. Rundsch., 1918, **10**, 81—83, 86—87. Chem. Zentr., 1919, II., 75—76.

THE ordinary method of determining free sulphuric acid in leather is not applicable to leather which has been tanned with materials containing sulphited tannin extracts, sulphite-cellulose extract, etc. In such cases 10 grms. of the leather is extracted three times for 12 hours each time with 200 c.c. of water at the ordinary temperature, and the united extracts are evaporated with 5 grms. of quartz sand on the water-bath. The dry residue is powdered and treated in a stoppered flask for about 2 hours with 100 c.c. of anhydrous ether, the flask being meanwhile occasionally shaken. The ethereal extract is filtered and the leather again twice extracted with 40 c.c. of anhydrous ether. The united extracts are treated with hydrochloric acid and barium chloride, the ether distilled, and the residue evaporated to dryness on the water-bath in order to decompose the ethylsulphuric acid. The dry residue is treated with 50 c.c. of hot water acidified with hydrochloric acid, allowed to settle, the liquid filtered, and the barium sulphate determined in the usual way. The sulphuric acid thus determined is present in the leather in the free state. The combined sulphuric acid present in the form of soluble sulphates may be determined in the residue from the extraction with ether.—C. A. M.

Artificial leather and leather substitutes; Analysis of ——. R. Lauffmann. Z. öffentl. Chem., 1918, **24**, 212—220, 239—240.

THE base of artificial leather usually consists of animal fibres (hide, muscle, or wool) either raw or tanned, vegetable fibres, and cellulose, formed into sheets by the aid of such binding materials as caoutchouc, guttapercha, glue, casein, dextrin, starch, resins, tar, etc., varnishes, cellulose esters, and viscose. Oils, particularly castor oil, are added to render the material pliable, and the following are used as fillers:—Aluminium compounds, antimony sulphide, lead oxide, ochre, zinc oxide, zinc sulphate, calcium carbonate, calcium chloride, sodium silicate, cement, and various pigments. A microscopical examination of the material before and after treatment with water and solvents will give some indication of the character of the substances present. The procedure given below is suggested for the chemical analysis of the material; in many cases, it is almost impossible to isolate the various constituents, but these may be separated into groups which may be examined by the usual methods to ascertain, as far as possible, the nature of the components. A. The finely-divided material is extracted thoroughly with ether and petroleum spirit; fatty oils, paraffins, rosin oil, resin, waxes, portions of incompletely sulphonated oils, and certain portions of caoutchouc and guttapercha are dissolved. B. The insoluble residue from A is

extracted with cold water and then with hot water; the aqueous extract will contain glue, gelatin, albumin, casein, starch, dextrin, gum, tannin, glycerol, alkali soaps of normal and oxidised fatty acids, resin acids, and soluble mineral substances. C. The insoluble residue from B is warmed with dilute hydrochloric acid and then extracted with ether; the ethereal solution will contain the fatty and resin acids of soaps which were insoluble in water, and the aqueous acid extract the bases of these soaps together with other mineral substances. D. The residue from C is extracted with acetone; nitrocellulose and acetylcellulose pass into solution probably contaminated with soluble portions of caoutchouc etc. E. The residue from D is dried and the nitrogen is determined in a portion of it; if nitrogen is absent, the material does not contain animal fibres or leather. The residue is then boiled with alcoholic potassium hydroxide solution; oxidised fatty acids, resins from varnishes, sulphonated oils, and animal and vegetable substances are dissolved. F. The insoluble residue from E is extracted with pyridine to dissolve tar, pitch, and asphalt; portions of caoutchouc and guttapercha also go into solution. G. The residue from F is extracted with toluene; caoutchouc and guttapercha are dissolved. The final insoluble residue consists of vegetable fibres, cellulose, and mineral substances. The total mineral substances should be determined and identified in the ash of the original material.

—W. P. S.

Gelatin; Mutarotation of — — and its significance. C. R. Smith. J. Amer. Chem. Soc., 1919, **41**, 135–150.

Study of the mutarotation of gelatin solutions indicates the existence of two forms of gelatin, the one, termed the sol Form A, stable above 33°—35° C., and the other, called the gel Form B, stable below 15° C.; at intermediate temperatures the two forms co-exist and the mutarotation appears to be due to the transformation of one into the other by a reaction which is reversible with temperature and apparently bimolecular. Increase in lævo-rotation, indicating increasing formation of the gel Form B, follows closely increase in viscosity. For the production of a jelly of standard viscosity a definite proportion of Form B is necessary, and this proportion, increased slightly as the concentration increases, produces the standard viscosity in gelatin solutions of much higher concentrations. At temperatures above 35° C. no gelatinisation of gelatin solutions occurs. The behaviour of gelatin solutions towards alcohol confirms the existence of two forms of gelatin. (See also J. Chem. Soc., 1919, i., 179.)

—T. H. P.

Patent.

Leather substitutes, waterproofed materials and the like. S. Goldreich, and M. Stern and Co., Ltd., London. Eng. Pat. 123,101, 8.2.17. (Appl. 1975/17.)

A textile material (such as cotton or flax) or paper or cellulose, is impregnated with a waterproofing preparation consisting of a mixture of gilsonite (900 lb.) with petroleum jelly (210 lb.) and an oxidisable oil, such as boiled linseed oil (210 lb.), with or without the addition of eucalyptus oil (8 oz.) as an antiseptic agent.—C. A. M.

XVI.—SOILS; FERTILISERS.

Nitrogen-fixing and nitrifying organisms; Effect of carbon bisulphide and toluene upon ——. P. L. Gainey. J. Agric. Res., 1918, **15**, 601—614.

Azotobacter in soils is destroyed and nitrification is checked if sufficient carbon bisulphide or toluene is applied to the soil. The amounts of antiseptics necessary to produce these effects vary with the conditions, diminishing for example as the moisture content of the soil rises. If the organisms of the azotobacter group are affected at all they are usually completely destroyed by a given amount of antiseptic, but there is a great difference in the quantity necessary to destroy nitrifying organisms and that necessary to check their activity. There is no appreciable accumulation of ammonia in the soil unless nitrification has been checked. There are present in soils nitrogen-fixing organisms other than azotobacter which are not destroyed by the application of 10 c.c. of carbon bisulphide or toluene to 100 grms. of soil, even when the moisture content of the soil is high.—W. G.

Ammonium nitrate; Use of —— as a fertiliser. E. J. Russell. J. Bd. Agric., 1919, **25**, 1332—1339.

The author has examined the effect of ammonium nitrate as a fertiliser for potatoes, mangolds, and wheat, and finds that, using equal weights of nitrogen, it is as valuable as ammonium sulphate or sodium nitrate. The sample used was of 96% purity and contained 33·5% of nitrogen. Its proper use is as a top-dressing and not as a constituent in mixed manures. With potatoes it is rather risky as it induces a large growth of haulm, which may be disadvantageous if there is much blight. It is essential to use the "non-deliquescent" variety, as the other forms absorb moisture rapidly and either form a tough cake, which cannot easily be broken, or become pasty. The material may contain trinitrotoluene as an impurity, but provided the amount of this impurity does not exceed 1%, no harm need be feared.—W. G.

Sulphite-cellulose waste liquor. Bokorny. *See* V.

Copper in ashes and soils. Maquenne and Demoussy. *See* XXIII.

Patents.

Phosphates; Enriching of ——. E. A. Gaillard, Paris. Eng. Pat. 122,897, 6.2.18. (Appl. 2130/18.)

Commercial calcium phosphate is treated with sulphuric acid so as to produce superphosphate, which is dried, crumbled, and treated by physical means, such as sifting, centrifugal action, etc., to separate the large particles of superphosphate from the small particles of inert substances. By these means an enriched superphosphate is obtained, together with a waste product or a low-grade superphosphate.—J. H. J.

Fertiliser; Chemical product for use as a ——. R. England, London. Eng. Pat. 122,902, 6.2.18. (Appl. 2167/18.)

In the manufacture of an improved form of ammonium sulphate for use as a fertiliser, about 5% of phosphoric acid is added to the sulphuric acid in the absorption tanks, in order to obtain a product consisting of a compound or mixture of ammonium sulphate and phosphate. To secure a dry and powdery condition of the product, ground bone or precipitated phosphate is added.—J. H. J.

XVII.—SUGARS; STARCHES; GUMS.

Nitration of sucrose. Hoffman and Hawse. *See* XXII.

Patents.

Sugar; Process of extracting ——. L. Naudet, Chelles, France. U.S. Pat. 1,281,057, 8.10.18. Appl., 24.5.17.

In a diffusion battery system, the dense juice from one diffuser is passed through a large external re-

heater and thence into the top of a second diffuser which has been freshly charged with beet and mashing liquor. The highly heated dense juice possesses little or no extracting power because its density is approximately the same as that of the original beet juice, but it parts with its heat to the new charge and raises the temperature of the beet in the second diffuser to that required for proper working. The hot juice becomes cooled and displaces the mashing liquor, passing out of the system into the measuring tank. As the juice from the first diffuser becomes weaker, owing to partial exhaustion of the charge, it is passed directly through a small heater into the top of the new diffuser and comes in contact with the upper, heated portion of the charge from which it extracts sugar with an increase in its density. Dense juice thus continues to flow from the second diffuser, displacing the weak juice which had collected in the external portion of the system and by-passing it out into the measuring tank. When the external system is again filled with dense juice, this latter is passed into the bottom of a third freshly charged diffuser to serve as mashing liquor. Lastly this third diffuser is fed through the re-heater from the top with dense juice and the second diffuser takes the place of the first.—J. F. B.

Solution of solids. Ger. Pat. 309,332. *See* I.

XVIII.—FERMENTATION INDUSTRIES.

Yeast; Valuation of pressed ——. A. Janke. Z. landw. Vers.-Wesen Oesterr., 1917, **20**, 12—33. Chem. Zentr., 1919, **90**, II., 15—16.

In the valuation of pressed yeast by the baking test, it is advisable to take 120 minutes as the maximum permissible time of fermentation and to credit a bonus to those products which have a fermentation time of less than 100 minutes. Most pressed yeasts show a shorter time of fermentation after storage, so that the test should be made not later than 96 hours after they are discharged from the factory. For estimating the physiological condition of the yeast cell or for judging the keeping properties of the pressed yeast, staining with Methylene Blue solution is most suitable.—J. F. B.

Amylases; Influence of hydrogen-ion concentration on the enzymic activities of three typical ——. H. C. Sherman, A. W. Thomas, and M. E. Baldwin. J. Amer. Chem. Soc., 1919, **41**, 231—235.

The results of Sherman and Thomas (this J., 1915, 371) on the optimum hydrogen-ion concentration for malt amylase are confirmed and the optimum hydrogen-ion concentration for pancreatic amylase has been more sharply defined; the maltase of *Aspergillus oryzæ* resembles malt amylase more closely than the pancreatic enzyme in this respect. The lower and upper limiting values and the optimal value of P_H are: pancreatic amylase, 4, 10, 7; malt amylase, 2·5, 9, 4·4—4·5; *Aspergillus oryzæ* maltase, 2·6, 8, 4·8. The influence of the concentration of electrolyte, as distinguished from concentration of hydrogen-ion alone, appears to be greatest with pancreatic amylase and least with the *Aspergillus* enzyme. (See also J. Chem. Soc., 1919, I., 181.)
—T. H. P.

Diastase; Course of the formation of —— by Aspergillus niger. F. A. F. C. Went. Proc. K. Akad. Wetensch. Amsterdam, 1919, **21**, 479—493.

Measurements of the amounts of diastase formed in different times by *Aspergillus niger* in a solution containing dextrose and various salts show that, during the first days after germination of the spores introduced, a great quantity of the enzyme is formed in the mycelium. Simultaneously there takes place destruction of the diastase, which is at first negligible compared with the formation but soon becomes so marked that the total quantity of enzyme quickly decreases from the maximum reached about five days after germination begins. Never more than a very small fraction of the enzyme passes from the mycelium, possibly in part from dead cells, into the nutrient solution. (See also J. Chem. Soc., 1919, I., 189).—T. H. P.

Sulphite-cellulose waste liquor. Bokorny. *See* V.

PATENTS.

Beverage; Non-alcoholic — — and process of making same. A. L. Straus, Baltimore, Md., U.S.A. Eng. Pat. 113,611, 8.2.18. (Appl. 2316/18.) Int. Conv., 23.2.17.

See U.S. Pat. 1,223,121 of 1917; this J., 1917, 608.

Dryer [for malt etc.]. Ger. Pat. 309,010. *See* I.

XIXA.—FOODS.

Cow's milk; The so-called reductase of ——. O. Allemann. Milchw. Zentr., 1918, **47**, 282—285.

The rate at which milk decolorises methylene blue-formaldehyde solution (Schardinger's reagent) is influenced to a great extent by the acidity of the milk, the temperature, and the aldehyde content of the solution. The time required for the disappearance of the blue coloration increases with the acidity, and decreases as the temperature rises up to 55° C., and then increases (the limiting temperature is 70° to 75° C.); the most favourable aldehyde content of the mixture appears to vary with different milks.—W. P. S.

Cow's milk; Physicochemical state of the proteins in — —. L. S. Palmer and R. G. Scott. J. Biol. Chem., 1919, **37**, 271—284.

From determinations of the total protein and non-protein nitrogen in the filtrates from samples of fresh skim-milk, skim-milk preserved either with 5·0% chloroform or 0·05% formaldehyde, and of the lactic acid whey from fresh skim-milk, when filtered under pressure through Pasteur-Chamberland filters, it was found that the amount of non-casein protein recovered did not in any case exceed 10% of that in the original milk and in most cases was considerably less than this figure. In the experiments with milk preserved with chloroform or formaldehyde there was only a partial recovery of the non-protein nitrogen of the original milk (see Van Slyke and Bosworth, this J., 1915, 297). The experimental data indicate considerable variation in the size of the pores of different Pasteur-Chamberland filters.—W. G.

Cow's milk; State of proteins in ——. L. L. Van Slyke and A. W. Bosworth. J. Biol. Chem., 1919, **37**, 285—286.

A reply to Palmer and Scott (see preceding abstract).—W. G.

Cow and buffalo milk; Differentiation of ——. C. Todd. Reports and Notes of Pub. Health Lab., Cairo. Reprint, 1918. 3 pages.

The Egyptian Dept. of Public Health has adopted the following standards for the two kinds of milk:—Cow's milk: fat 3%, solids-not-fat 8·5%.

Buffalo milk: fat 5%, solids-not-fat 8·5%. By Uhlenhuth's method of "crossed immunisation" (Arbb. Kaiserl. Gesundh., 1908, 28, 499) it was found that on immunising a cow with buffalo milk the serum from the animal formed precipitins with the milk of the buffalo and cow, and to a less extent with that of the goat. By treating the immunised serum with cow's milk the precipitins for cow's and goat's milk were removed, leaving the specific precipitin for buffalo milk. By means of this precipitin 10% of buffalo milk could be detected in cow's milk. Immunisation of the buffalo with cow's milk only produced traces of a precipitin.

—C. A. M.

Wheat; Determination of acidity and titrable nitrogen in — — with the hydrogen electrode. C. O. Swanson and E. L. Tague. J. Agric. Res., 1919, **16**, 1—15.

When wheat is extracted by shaking with water at 5° C., 20° C., 40° C., or 50° C., over periods varying from 5 mins. to 24 hours, the hydrogen-ion concentration of the extract, as measured by the hydrogen electrode, is practically independent of the temperature or the duration of shaking. On the other hand, the volume of $N/20$ barium hydroxide required to bring the extract to a definite P_H value increases with the time of shaking and within certain limits is proportional to it. There is, however, a limit to the volume which is required, which is reached sooner as the temperature of extraction rises. The amino-nitrogen as determined by Sörensen's formaldehyde method is all extracted in two hours at 40° C. In an extract prepared with water at 20° C. the amount of phosphorus directly precipitable by magnesia mixture is about one-half the total phosphorus present, whereas in an extract made at 40° C. the two values are equal.

—W. G.

Barley as a foodstuff. M. Rubner. Arch. Anat. Phys., Physiol. Abt., 1916, 339—50. Chem. Zentr., 1919, **90**, II., 18.

Experiments were made on human subjects to determine the food value of barley bread, which was given together with fat. The losses determined were in calories 8·11% in one case and 10·95 in another; the losses of nitrogen were 26·54 and 36·45% respectively. In the most favourable case the loss of protein was 15·3%. The average utilisation of the total pentosans was 15·73% and of the cell walls, 38·97%; of the constituents of the cell walls, 53·10% of the cellulose, 37·28% of the pentosans, and 29·55% of the residual substance were utilised; of the free pentoses, 8·53%. The matter unassimilated averaged 5·75%. According to these results, cereals of a similar degree of milling show in general only unimportant differences. Rye, however, even when well milled, is inferior to wheat and barley owing to the inferior digestibility of its protein.—J. F. B.

Vegetables [asparagus, rhubarb, and cucumbers]; Composition of —. M. Rubner. Arch. Anat. Phys., Physiol. Abt., 1916, 151—158. Chem. Zentr., 1919, **90**, II., 19.

Fresh asparagus showed 7·61% dry substance, the heads 10·82% and the stems 7·05%. One hundred parts of the dry substance of the heads, stems, and entire vegetable respectively contained: ash, 8·08, 4·90, and 5·23; pentoses, 8·65, 8·74, and 8·75; crude protein, 36·53, 21·94, and 23·44; purified protein, 27·66, 9·85, and 11·27; cellulose, 7·52, 10·03, and 9·77; cell wall, 24·21, 21·00, and 21·32, in which were pentoses, 4·31, 2·12, and 2·31; the calorific values were 431·80, 435·10, and 431·50 Cals. The pressed juice was strongly acid. The pressed juice contained 63·0% of the ash and 43·9% of the nitrogen of the asparagus. Rhubarb stems contained 5·33% of dry substance. One hundred parts of dry substance contained:—ash, 8·43; pentoses, 8·56; cellulose, 15·12; cell walls 27·27, in which were 4·48 of pentoses; nitrogen, 1·95; fat, 8·24; calorific value 338·4 Cals. The cell walls contained 46·41% of the pentosans; their composition was: cellulose, 55·44%; pentosans, 14·50%; residual matter, 30·05%. The expressed juice contained 62·30% of the total dry substance, 90·40% of the ash, 69·80% of the organic matter, and 30·40% of the pentoses. Cucumbers showed 3·69% of dry substance. One hundred parts of dry substance contained: ash, 11·93; pentosan, 7·21; cellulose, 12·74; cell walls, 22·79, with 3·89 pentosan; protein, 18·12; fat, 5·80; calorific value, 386·9 Cals. The cell walls contained 55·90% of cellulose, 17·26% of pentosan, and 26·83% of residual substance. The cell walls contained 53·95% of the total pentosans. The expressed juice amounted to 71·8% of the fresh cucumber.—J. F. B.

Alfalfa [lucerne] silage; Bacteriological studies on — —. O. W. Hunter. J. Agric. Res., 1918, **15**, 571—592.

Silage made from lucerne alone is inferior in quality, but if the lucerne is mixed with available carbohydrate, preferably in the form of molasses, silage of good quality is obtained. The difference in quality is apparently not due to any difference in the microbial flora. The chief chemical differences are a lower acidity and a higher protein decomposition when lucerne is used alone than when admixed with carbohydrate before making into silage.—W. G.

Crude fibre, Digestion apparatus for the determination of —. H. D. Spears. J. Ind. Eng. Chem., 1919, **11**, 141—142.

To prevent loss of water by evaporation, a round flask is placed over the top of the digestion beaker and a current of cold water is passed through the flask. W. P. S.

Pepsin. I. Chemical changes in the purification of pepsin. L. Davis and H. M. Merker. J. Amer. Chem. Soc., 1919, **41**, 221—228.

The purification of commercial pepsin by fractional precipitation, salting-out, filtration, and dialysis is accompanied by gradual elimination of secondary protein derivatives, including α-amino-acids, the purified enzyme tending more and more to approach the proteins (possibly a glycoprotein) in character as the proteolytic activity increases. At the same time, the chlorides are entirely expelled and the phosphorus content undergoes marked diminution, but the sulphur and calcium appear to be unaffected and the proportion of total nitrogen shows very little change. The diminution in the content of α-amino-acid is almost proportional to the increase in proteolytic activity and the small amount left in the most active sample of the enzyme is apparently lysine. The optical activity of the enzyme does not vary with the proteolytic activity. The rennetic activities of the different samples of pepsin obtained correspond closely with the proteolytic activities. (See also J. Chem. Soc., 1919, i., 180.) T. H. P.

Pressed yeast. Janke. *See* XVIII.

Patents.

Cocoa butter; Preparation of —— for cooking and like purposes. G. Martin, and the Co-operative Wholesale Soc., Ltd., Manchester. Eng. Pat. 123,231, 22.4.18. (Appl. 6760/18.)

Cacao butter is melted and mixed while at or above its m.pt. with 10 to 20% of starchy material, such

as rice flour, potato starch, farina, etc., and the mixture is cooled and reduced to a powder by disintegrating machinery.—C. A. M.

Drying chamber [for alimentary pastes]. P. Barducci, Naples, Italy. U.S. Pat. 1,282,363, 22.10.18. Appl., 24.2.16.

A CHAMBER for drying alimentary pastes is provided with a fan rotating on a vertical axis which travels along the length of the chamber, and with inlet and outlet air ports in the walls at different levels, so that the air current passes over the material to be dried. The inlet port is arranged so that the air stream is initially parallel to the plane of the fan, and each outlet port is furnished with an exhauster.—J. S. G. T.

Foodstuffs, vegetables and the like; Process for preserving moist ——. Ges. für Volksnahrungsmittel, Berlin. Ger. Pat. 305,840, 16.6.16.

THE foodstuffs are dried at as low a temperature as possible until they contain such a small proportion of moisture (about 20-25%) that they are capable of being preserved by no more than the correct quantity of sugar or salt which is necessary for their preparation as food, for instance, 1·5% of salt or 3—9% of sugar, calculated on the original weight.—J. F. B.

Phosphorus compound contained in vegetable foodstuffs; Process for the manufacture of the assimilable organic ——. M. Girard, Assignor to Soc. of Chem. Ind. in Basle, Switzerland. U.S Pat. 1,290,971, 14.1.19. Appl., 7.7.17.

SEE Eng. Pat. 109,519 of 1916; this J., 1917, 1191.

Dryer [for grain etc.]. Ger Pat. 309,010. *See* I.

XIXB.—WATER PURIFICATION; SANITATION.

Formaldehyde; Fumigation with ——. A substitute for the permanganate-formalin method. D. W. Horn. J. Ind. Eng. Chem., 1919, **11**, 126—129.

COMPARISON of the bleaching powder-formalin, permanganate-formalin, and bichromate-formalin methods of fumigation showed that by using 620 grms. of bleaching powder and 800 c.c. of formalin for each 1000 cub. ft. to be fumigated, as much formaldehyde gas was evolved as by the use of 250 grms. of permanganate and 500 c.c. of formalin, and at only one-sixth of the cost. Further, the bleaching powder-formalin method was found to be only one-third as costly as the bichromate-formalin method.—W. P. S.

Carbon bisulphide-air mixtures; Course of reaction in explosions of ——. G. R. Stewart and J. S. Burd. J. Ind. Eng. Chem., 1919, **11**, 130—133.

COMBUSTION of dilute mixtures of carbon bisulphide (2·5 to 4%) and air always results in the formation of carbon dioxide, carbon monoxide, sulphur dioxide, and some residual carbon bisulphide; sulphur trioxide is not formed. Variations in the reaction appear to take place, however, even under laboratory conditions; greater variations would occur in the field, when fumigation with carbon bisulphide is used for the destruction of small animal pests. On an average, from 25 to 35% of the initial carbon bisulphide is converted into carbon monoxide and sulphur dioxide: $2CS_2+5O_2=2CO+4SO_2$; from 40 to 60% is converted into carbon dioxide and sulphur dioxide; $CS_2+3O_2=CO_2+2SO_2$; the balance of 15 to 30% remains unchanged. With 2·5% of carbon bisulphide the oxygen content of the air is reduced from about 20 to 15%, the carbon dioxide content increases to about 1%, carbon monoxide and carbon bisulphide seldom exceed 1%, whilst the sulphur dioxide content is about 4%. The residual carbon bisulphide and the sulphur dioxide appear to be the important factors in the toxicity of the explosion gases.—W. P. S.

PATENTS.

Water, Apparatus for purifying and softening ——. F. J. Talbot, Sheffield. Eng. Pat. 123,198, 9.3.18. (Appl. 1197/18.)

THE water to be softened is treated in the heated condition and after the addition of the necessary reagents is delivered to a mixing chamber inside a large tank. This chamber is not rigidly connected to the side of the tank, but is free to expand under the influence of the hot water. An upwardly inclined pipe leads from the mixing chamber to the top of a completely immersed sedimentation chamber, the top of which is connected to the top of a second similar chamber. These chambers are closed above by sloping roofs with air pipes reaching above the water level in the main tank, and are open below; they are supported or suspended in the tank so as to be movable. The water as it cools passes out from the lower portion of these chambers into the main tank, and then through a wood filter and a sand filter in the tank in the usual manner.—J. H. J.

Water purification; Permeable material for use in plants for ——. M. Klinkenberg, Aix-la-Chapelle. Ger. Pat. 309,035, 12.5.17.

A PERMEABLE material for use instead of a layer of ashes in water purification is composed of small dust-free lumps of clinker or ash bound together by means of cement.—L. A. C.

Chlorination of water etc. Eng. Pat. 122,888. *See* VI.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Holarrhena congolensis, Stapf; Alkaloids of ——. F. L. Pyman. Chem. Soc. Trans., 1919, **115**, 163—166.

BY extracting the bark of the trunk of *Holarrhena congolensis*, Stapf with very dilute hydrochloric acid, making alkaline with ammonia, and extracting with chloroform, the author obtained a dark viscous residue from which were isolated a new alkaloid, holarrhenine, $C_{24}H_{38}ON_2$, and conessine, $C_{24}H_{40}N_2$, which had previously been obtained from other species of the same genus. These alkaloids possess a local anæsthetic action but are of no practical value, since they produce local necrosis when injected. The alkaloids are separated by extracting the crude extract, first with light petroleum and then with ether, and purifying the products; the petroleum extract yields most of the conessine, amounting to 0·25% of the bark, and the ether extract the holarrhenine in small quantity. The conessine is characterised by its acid oxalate, m.pt. 280° C. (corr.), and the holarrhenine by its hydrobromide, m.pt. 265°—268° C. (corr.) after drying. Conessine melts at

125° C. (corr.) and has $[\alpha]_D = -1{\cdot}90°$ in chloroform solution. Holarrhenine melts at 197°—198° (corr.) and has $[\alpha]_D = -7{\cdot}1°$. The latter contains a hydroxyl group, and both alkaloids contain three N-alkyl groups, probably methyl.—J. F. B.

Nicotinic acid derivatives. II. Guvacine and isoguvacine. E. Winterstein and A. Weinhagen. Z. physiol. Chem., 1919, **104**, 48—53.

In view of recent publications on the same subject (Hess and Liebbrandt, this J., 1918, 559 A; Hess, *ibid.*, 560 A, Freudenberg, *ibid.*, 560 A) the authors submit a short account of their experiments, fuller details being promised in a subsequent paper. They consider that guvacine is in all probability Δ^1-tetrahydronicotinic acid, since it yields hexahydronicotinic acid when reduced by hydrogen in the presence of platinum and, when methylated, yields a product which is identical with Willstätter's arecaidine methyl betaine (J. Chem. Soc, 1897, 1., 385). Isoguvacine appears to be a simple derivative of pyrrole. (See also J. Chem. Soc., 1919, 1., 171.)—H. W.

Adsorbents; Use of —— and the estimation of their adsorptive value. I. M. Kolthoff. Pharm. Weekblad, 1919, **56**, 207—225, 237—258.

A discussion of the adsorptive capacity of various substances with reference to their medicinal value. The adsorbents investigated are charcoals, silica, kieselguhr, clays, talc, aluminium hydroxide; the adsorbed substances being Methylene Blue, Congo Red, Alkali Blue, iodine, alkaloids (quinine hydrochloride, strychnine nitrate), mercuric chloride, mercuric cyanide, arsenious oxide, hydrocyanic acid, hydrogen sulphide, and bacteria (*Staphylococcus pyogenus aureus* and *Bacterium coli communis*). The adsorptive activity of blood charcoal (Merck) is extraordinarily marked in comparison with all other adsorbents used.—W. S. M.

Nucleic acids; Pyrrole reaction of true ——. R. Feulgen. Z. physiol. Chem., 1919, **104**, 1.

A pine shaving moistened with concentrated hydrochloric acid is coloured carmine-red by the vapours obtained by heating a dry mixture of sodium nucleate and ammonium chloride; the reaction is not shown by sodium nucleate alone. Since furane derivatives are readily converted into derivatives of pyrrole by dry distillation with ammonium salts, the author regards the reaction as a confirmation of his theory (Z. physiol. Chem., **100**, 241) that the carbohydrate group of the true nucleic acids belongs to the furane type.—H. W.

Geraniol content of citronella oil; Estimation of the ——. A. W. K. De Jong. Proc. K. Akad. Wetensch. Amsterdam, 1919, **21**, 576—581.

The method for the estimation of geraniol in citronella oil proposed by Schimmel und Co. (this J., 1899, 1160) is based on quantitative esterification of the geraniol by phthalic anhydride and this the author finds to be impossible of attainment, although with mixtures of geraniol and citronellal the method gives results approximating to the true values. (See J. Chem. Soc., Apr., 1919.)—T. H. P.

Geraniol, linalool, and nerol; Constitution of ——. Verley. Bull. Soc. Chim., 1919, **25**, 68—80.

The author assigns to geraniol the constitution, $CH_2 : C(CH_3).(CH_2)_2.C(CH_3) : CH.CH_2OH$, to linalool, $CH_2 : C(CH_3).(CH_2)_2.C(CH_3)(OH).CH : CH_2$, and to nerol, $C(CH_3)_2 : CH.(CH_2)_2.C(CH_3) : CH.CH_2OH$, the new formula for geraniol offering a ready explanation of its close relationship to dipentene. (See further J. Chem. Soc., 1919, 1., 146.)—W. G.

Grignard reagent; Action of halogens on the —— and replacement of halogen atoms by one another. R. L. Datta and H. K. Mitter. J. Amer. Chem. Soc., 1919, **41**, 287—292.

In general, one halogen is able to displace other halogens from the Grignard reagent with production of the corresponding haloid derivatives, the yield of the latter being greatly influenced by the nature of the halogen introduced and by the experimental conditions employed. The reaction is sometimes accompanied by secondary reactions due to the union of the Grignard residues. (For experimental results, see J. Chem. Soc., 1919, 1., 183.)—T. H. P.

Organic chemical reagents. III. β-Phenylhydroxylamine and "cupferron" (ammonium salt of nitrosophenylhydroxylamine). C. S. Marvel and O. Kamm. J. Amer. Chem. Soc., 1919, **41**, 276—282.

β-Phenylhydroxylamine is conveniently prepared as follows: 8 litres of water, 500 grms. of nitrobenzene, and 250 grms. of ammonium chloride are vigorously stirred in a 4-gallon earthenware jar by means of a mechanical stirrer, 670 grms. of zinc dust (75—80%) being sifted into the mixture during the course of 15—20 minutes; the temperature rises gradually to 50° or 60° C. as the reduction proceeds. In order to obtain a light-coloured product, the temperature should be kept below 60° C., best by addition of small portions of cracked ice; usually less than 1 kilo. of ice is sufficient. The stirring is continued for 15—20 minutes after all the zinc dust has been added, the end of the reaction being indicated by no further rise of the temperature. After being stirred for an additional 5 minutes, the phenylhydroxylamine solution is filtered by suction from the zinc oxide and the residue washed with about a litre of warm water. The filtrate, which should measure not more than 10 litres, is saturated in an enamelled pan with common salt and cooled to 0° C., the phenylhydroxylamine beginning to crystallise out even at 30° C. The average yield of dry product is 290 grms., which is 64% of the theoretical quantity; the loss owing to absorption by the zinc oxide may be partially obviated by the use of pressure filtration. For preparing "cupferron," the moist crude β-phenylhydroxylamine from 725 grms. of nitrobenzene is weighed and dissolved in 3 litres of ordinary ether; the material (sodium chloride) left undissolved by the ether is also weighed, the difference between the two weighings representing fairly accurately the amount of β-phenylhydroxylamine in solution. The ethereal solution is filtered through a dry filter-paper into a 5-litre round-bottomed flask fitted with an efficient mechanical stirrer and immersed in an ice-salt bath. When the temperature of the solution has fallen to 0° C., a rapid stream of dry ammonia from a cylinder of the compressed gas is passed into the liquid and after about 5 minutes the theoretical quantity of freshly distilled amyl nitrite (107 grms. per 100 grms. of β-phenylhydroxylamine) is added slowly from a dropping funnel. The temperature of the mixture should be kept below 10° C.; the addition of the amyl nitrite usually requires about half an hour, during which time the stream of ammonia is continued in order that ammonia may always be in excess; otherwise a coloured product will result.

The mass is stirred for about 10 minutes after complete addition of the amyl nitrite, the "cupferron" being then filtered off and washed several times with small portions of fresh ether. The product is spread on paper until all traces of ether have disappeared and is then stored in bottles in which it is exposed to the vapours of ammonium carbonate; the cork of the bottle may be protected with a double sheet of filter-paper, between which and the cork a lump of ammonium carbonate is placed. The yield of "cupferron" is 80—90% of the theoretical amount. Even with the present high prices of materials and labour, "cupferron" may be made in the laboratory at a cost considerably less than the pre-war price of the product.

—T. H. P.

Monomethylamine; Preparation of —— from chloropicrin. P. F. Frankland, F. Challenger, and N. A. Nicholls. Chem. Soc. Trans., 1919, **115**, 159—162.

Chloropicrin is readily obtainable in large quantities and is a suitable raw material for the commercial preparation of methylamine according to the equation $CCl_3.NO_2+12H=CH_3.NH_2+3HCl+2H_2O$. When iron filings and hydrochloric acid are employed for the reduction, the composition of the product varies according to the conditions of the experiment and when the reagents are used in the theoretical proportions necessary to prevent the formation of iron hydroxide, namely $6Fe:9HCl:1CCl_3.NO_2$, a large percentage of ammonium chloride is produced. By decreasing the proportion of acid to about one-fortieth of the theoretical proportion as recommended by Krause (this J., 1916, 1081) for the reduction of nitroparaffins, the yield of methylamine hydrochloride is very satisfactory and the ammonium chloride does not exceed 4%. 500 grms. of fine iron filings is gradually shaken into a large jar containing 2500 c.c. of water and 60 c.c. of concentrated hydrochloric acid, clogging of the filings being avoided. The mixture is stirred mechanically and 250 grms. of chloropicrin is introduced in the course of 1¼ hours, the jar being cooled with water. Efficient stirring is essential, in order to prevent the chloropicrin being enclosed in masses of iron filings or hydroxide. The temperature is allowed to rise to 60° C. and maintained at that for about 3 hours, when the odour of chloropicrin should have disappeared. The mixture is then added gradually to a boiling solution of sodium hydroxide and the methylamine is distilled over with steam into hydrochloric acid. The solution of the hydrochloride is evaporated, the yield being 95·5%, and the product containing only 3·5% of ammonium chloride.—J. F. B.

Ether; Impurity in —— giving blue coloration with benzidine. F. Weehuizen. Pharm. Weekblad, 1919, **56**, 301—303.

Ether used for analytical purposes gives in some cases a blue coloration with hydrogen peroxide and benzidine. A few pieces of caustic potash kept in the ether for a time, with occasional shaking, will remove the impurity.—W. S. M.

Mercury; Estimation of —— in mercury salicylate. A. Costantino. Giorn. Farm. Chim., 1918, **67**, 7—12. Chem. Zentr., 1919, **90**, II., 4—5.

0·25 grm. of mercury salicylate is dissolved in 2 c.c. of concentrated sulphuric acid, heated for about 6 mins. in a porcelain basin on a water-bath, and diluted to 160 c.c. with water. The solution is then electrolysed for 14 mins. in a platinum dish, using a rotating platinum anode and a current of 5 volts and 6 amps. The deposit of mercury is washed, without stopping the current, with distilled water, alcohol, and ether, and dried in a desiccator. In place of the platinum dish, a mercury cathode may be employed, in which case the volume of the solution should not exceed 30 c.c., and the current should be 7—10 volts and 3 amps.—L. A. C.

Zinc oxide; Lead in pharmaceutical ——. W. D. Collins and W. F. Clarke. J. Ind. Eng. Chem., 1919, **11**, 138—139.

For a short time after the beginning of the war, the zinc oxide produced in the United States contained excessive quantities of lead; several samples examined by the authors contained more than 0·2% of lead. At the present time, however, the amount of lead present is usually less than 0·01%. The U.S.P. method for the detection of heavy metals will not detect less than 0·05% of lead in zinc oxide.

—W. P. S.

Patents.

Ethylidene diacetate; Manufacture of —— [from acetylene]. Soc. Chim. des Usines du Rhône, anc. Gilliard, P. Monnet et Cartier, Paris. Eng. Pat. 112,765, 29.10.17. (Appl. 15,755/17.) Int. Conv., 9.12.16.

Acetylene is absorbed in glacial acetic acid in the presence of sulphonic acids and mercuric acetate. Sulphonic acids of the aromatic series or aliphatic sulphonic acids, such as sulphoacetic acid or methionic acid, may be employed as catalysts and, there being no formation of sulphuric acid during the reaction, no appreciable formation of tar nor decomposition of the ethylidene diacetate occurs. Example: 40 parts of mercuric oxide is dissolved in 800 of glacial acetic acid at about 70° C. and a hot solution of 50 parts of β-naphthalenesulphonic acid in 200 of glacial acetic acid is run in, while stirring. This solution will absorb 200 parts of acetylene during a period of 2 hours at 70° C.

—J. F. B.

Dimethyl sulphate; Preparation of ——. W. N. Haworth and J. C. Irvine, St. Andrews. Eng. Pat. 122,498, 31.1.18. (Appl. 1796/18.)

Dimethyl ether and sulphur trioxide are passed simultaneously in equimolecular proportions into a considerable quantity of a solvent, which may consist of pre-formed dimethyl sulphate. The liquid is stirred during the passage of the gases and is cooled by a water jacket or coil. The sulphur trioxide may conveniently be employed in the form of the dilute vapours issuing from the contact chamber in the manufacture of sulphur trioxide by the contact process. The formation of dimethyl sulphate is continuous and there are no by-products, but it is essential that the reacting gases be perfectly dry and free from alcohol vapour. The crude dimethyl sulphate withdrawn from the apparatus is treated with iron filings to reduce any excess of sulphur trioxide, and then rectified under diminished pressure.—J. F. B.

CC-Dialkyl, CC-diallyl and CC-alkylaryl barbituric acids; Manufacture of easily soluble compounds of the ——. H. R. Napp, London. From F. Hoffmann-La Roche & Co., Basle, Switzerland. Eng. Pat. 122,778, 20.6.18. (Appl. 10,180/18.)

Easily soluble compounds of CC-dialkyl-, diallyl-, and alkylaryl-barbituric acids are obtained by combining the free acids with alkylamines, for instance diethylamine or dimethylamine, by adding rather more than the theoretical quantity of alkylamine to the free acid, so that the latter is dissolved, and then evaporating off the excess of alkylamine. The

products are more powerful hypnotics than the free substituted barbituric acids and are much more stable in aqueous solution than the sodium salts of these acids.—J. F. B.

Lignin-producing substances Ger Pat 309,551. *See* V.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Metol (N-methyl-p-aminophenol sulphate); Preparation of . R. N. Harger. J. Amer. Chem. Soc., 1919, **41**, 270–276.

In the preparation of metol from quinol and methylamine by Merck's process (Ger. Pat. 260,234; this J., 1913, 807), better results are obtained by using a lower temperature and a much shorter period of heating than those specified. By heating 20 grms. of quinol with 2 equivalents of aqueous methylamine (10 %) for 4 hours at 200° C. in a sealed tube, then pouring the product into a quantity of sulphuric acid (1 : 20) equivalent to the methylamine used, concentrating, and cooling with ice, a total yield (including that recovered from the mother liquor) of 73% of the theoretical quantity of metol was obtained. Metol begins to char at 245° C. and melts with decomposition at 250°–260° C. It is soluble in 6 parts of boiling water and in 20 parts of water at 25° C. A solution of metol gives an intense purple coloration with mercuric acetate, and this reaction may be used to determine metol colorimetrically. Quinol and salts of *p* aminophenol do not give a coloration with mercuric acetate; amidol (2 4-diaminophenol) also gives a purple colour, but this is changed to pink on addition of acetic acid, whereas the purple colour due to metol is not affected by acetic acid.

PATENTS.

Colour photography; Subtractive and additive . W. V. D. Kelley, Brooklyn, Assignor to Prizma, Inc. U.S. Pat. 1,278,162, 10.9.18. Appl., 8.2.17.

In a four-colour process for cinematograph film the colours of the taking screens are in two complementary pairs; in printing a positive from the four-colour negative record a film coated on both sides may be used, two of the colour records being printed on one side of the film, and two on the other side of the film in register with the first two and each of the colour records having its complementary opposite to it. The positives on one side of the film are stained one suitable colour and those on the other side the complementary colour. For example, if the taking screens are red and yellow and their respective complementaries green and blue, the positives on one side of the film are from the red and yellow colour records and are stained a blue-green, and those on the other side are from the green and blue records and are stained an orange-red, the yellow colour record being opposed by the blue and the red by the green. Instead of using film coated on both sides, a single-coated film may be used for the first set of positives, which is then recoated for the second set of positives.

—B. V. S.

[*Photographic*] *colour-printing.* D. F. Comstock, Brookline, Assignor to Kalmus, Comstock and Wescott, Inc., Boston, Mass. U.S. Pat. 1,283,087, 29.10.18. Appl., 31.7.16.

In multicolour photographic processes where two or more negatives are taken through two or more coloured screens, a certain amount of inaccuracy of colour rendering results, if all the negatives have to be developed for the same length of time, by reason of the differences in steepness of gradation of the negatives produced by exposure to lights of different wave-lengths; the light of longer wave-length gives the steeper gradation. For example if red and green screens are used the negative through the red screen will have a steeper gradation than that through the green screen; this difference will normally be repeated in the positives and it will not therefore be possible to get a correct colour balance through the whole scale of tones of the picture, there being either too much green in the shadows or too much red in the high lights or both. This difficulty is obviated by printing the positives by lights differing in wave-length in the opposite direction to that of the taking screens, for instance, printing the red negative by a violet light and the green negative by a blue light, the difference in gradation of the positives thus counterbalancing that of the negatives.—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Nitrocellulose solutions; Relations between the viscosity of —— and the nitration process, with special reference to wood cellulose. G. Leysieffer. Koll. Chem. Beih., 1918, **10**, 145–178.

The influence of the various factors operating during the nitrating process has been determined on the viscosity of acetone solutions of nitrocelluloses prepared from pure cellulose obtained from deal (α-cellulose, 80·4; β-cellulose, 6·8; γ-cellulose, 12·8%; ash, 0·20%; fat, 0·44%). It is found that the same value of the viscosity is always obtained provided all these factors are kept constant. The greater the nitric acid content of the nitrating acid the higher is the viscosity. When, however, the amount of nitric acid equals or exceeds that of the sulphuric acid, smaller values are found for the viscosity. Increasing the water content of the mixed acid from 0 to about 11%, causes an increase in the viscosity, provided the nitric acid content is less than the sulphuric acid content. Otherwise, and if the water content exceeds the above limit smaller values of the viscosity are obtained. Nitration at temperatures below 0° C. produces nitrocelluloses having high viscosity values. Insufficiently nitrated celluloses (5—30 minutes) show variable values of the viscosity. This increases as long as the nitrogen content increases, but prolonged nitration results in decreased viscosity. Acetone solutions of nitrocelluloses become more mobile with keeping. The kind, method of preparation, and previous treatment of the cellulose are of great influence on the viscosity. A high content of γ-cellulose causes increased viscosity in the nitro-derivative. Nitrocelluloses from cotton cellulose show higher viscosities than those from wood cellulose.—C. S.

Sucrose; Nitration of —— : sucrose octanitrate. E. J. Hoffman and V. P. Hawse. J. Amer. Chem. Soc., 1919, **41**, 235–247.

Nitration of sucrose in the cold by sulphuric and nitric acids yields a mixed product, and evaporation of the alcoholic solution of the latter at the ordinary temperature gives sucrose octanitrate, $C_{12}H_{14}O_3(NO_3)_8$, m.pt. 85·5° C., $[\alpha]^{20} = +56·05°$; this compound shows normal cryoscopic behaviour in nitrobenzene and shows no sign of decomposition when heated gradually from 33° to 87° C. in about two hours. Sucrose octanitrate in explosive mixtures may be estimated by means of its rotatory power and nitrogen content (15·95%). (See also J. Chem. Soc., 1919, 1., 148.)—T. H. P.

Combustion of hydrogen. Comparison with explosives. Sabatini. *See* IIA.

XXIII.—ANALYSIS.

Filter-paper pulp; Use of —— in analysis. O. Hackl. Chem.-Zeit., 1919, **43**, 70–71.

By adding paper pulp to a solution containing a precipitate, the filtration of the mixture is often facilitated. The pulp is particularly useful in the case of barium sulphate, calcium oxalate, sulphur, and ferric and aluminium hydroxides. On the other hand, it should not be used when it is desired to separate a silica precipitate from a solution containing aluminium salts; the latter appear to have an astringent action on the fibres and the rate of filtration is retarded. The presence of the pulp in a mixed precipitate of aluminium and ferric hydroxides has the further advantage that, after ignition, the oxides are in a fine state of division and are readily soluble in hydrochloric acid. The pulp should not, however, be used when the hydroxides are to be re-dissolved in hydrochloric acid, since the latter attacks the fibres and much organic matter passes into solution.—W. P. S.

Platinum; Replacement of —— by an alloy in apparatus for electrolytic analysis. P. Nicolardot and J. Boudet. Bull. Soc. Chim., 1919, **25**, 84–86. (See this J., 1918, 750 A.)

For the manufacture of cathodes, the authors recommend the use of an alloy of gold and copper in the proportion of 9 : 1, in place of platinum. Such a cathode, weighing 23·5 grms., only lost 0·001 grm. in weight during twenty estimations of different types. Anodes may be prepared from the same alloy but should be electroplated with a thin layer of platinum. The cost of such electrodes is only about one-third that of platinum electrodes, reckoned at pre-war prices.—W. G.

Copper; A very sensitive reaction for ——. Application to the analysis of ashes and of arable soils. L. Maquenne and E. Demoussy. Comptes rend., 1919, **168**, 489–492.

When potassium ferrocyanide is added to a solution of a copper salt acidified with hydrochloric acid and containing zinc to the extent of four times that of the copper, a blue precipitate separates. This test is a very delicate one for copper in the absence of iron, manganese, or nitric acid. It may be used for the estimation of copper in plant ashes as follows:—0·05–0·2 grm. of the ash is heated in a quartz crucible, with a few drops of nitric acid and a slight excess of sulphuric acid, then boiled for 20 mins. with 1·5 c.c. of 5% sulphuric acid, water being added from time to time. The liquid is transferred to a small, stoppered tube and centrifuged, the supernatant liquid (2·5 c.c.) then being submitted to electrolysis. The cathode is washed with 3 drops of nitric acid and a little water, the liquid is evaporated to dryness, and the residue calcined, and then dissolved in 2 c.c. of dilute hydrochloric acid. Two drops of a 1·104% solution of zinc sulphate and 1 drop of 10% potassium ferrocyanide solution are added and the whole is again centrifuged. The blue tint of the precipitate is compared against standards and by this means a close approximation to the weight of copper in the original ash is obtained. A similar process is used for the examination of soils, 5 grms. of the soil being taken.—W. G.

Iodotannic reagent; The red ——. D. E. Tsakalotos and D. Dalmas. Bull. Soc. Chim., 1919, **25**, 80–84.

The sensitiveness of the iodotannic reaction (this J., 1918, 750 A) is much greater than that of starch-iodide especially for dilute solutions of iodine, except in the presence of potassium iodide, which weakens the former reaction, whilst enhancing the sensitiveness of the latter. An excess of either iodine or tannin inhibits the formation of the red colour in the iodotannic reaction.—W. G.

Phosphoric anhydride; Estimation of —— as ammonium phosphomolybdate. J. Clarens. Bull. Soc. Chim., 1919, **25**, 87–90. (See also this J., 1918, 352 A.)

A reply to Villiers (this J., 1918, 532 A).—W. G.

Analysis; Microelementary —— of [organic] compounds containing sulphur, halogens, and oxidised nitrogen. Double combustion. C. Granacher. Helv. Chim. Acta, 1919, **2**, 76–84.

A "universal tube" suitable for the estimation of the carbon and hydrogen in any organic substance is filled from the boat onwards with (1) silver roll, (2) a mixture of equal parts of copper oxide and lead chromate, (3) silver roll, and (4) lead peroxide. The lead peroxide, in a layer 5 cm. in length, is maintained at a temperature between 175° and 180° C. by enclosing this portion of the combustion tube in a copper chamber containing boiling aniline. Arrangements of apparatus are described whereby the estimation of the nitrogen or of the carbon and the hydrogen in two substances in two tubes side by side can be performed simultaneously.—C. S.

Organic substances; Micro-elementary analysis of ——. J. V. Dubsky. Helv. Chim. Acta, 1919, **2**, 63–75.

A description of the methods of estimating carbon, hydrogen, and nitrogen by micro analysis. The advantages of a new micro-balance are enumerated.—C. S.

Selenium; Is —— present in the vegetable and animal organism? [Detection of selenium.] R. Fritsch. Z. physiol. Chem., 1919, **104**, 59–64.

The author was unable to detect the presence of selenium in thirty-five samples of spinach, corn, clover, potatoes, and bones. The method adopted consisted of incinerating the plant in the presence of sodium carbonate and sodium nitrate and finally obtaining any selenium present as a solution of selenious acid in concentrated sulphuric acid; in this solution, the presence of selenium was detected by the green to bluish-green coloration with codeine or the intense yellow coloration with colchicine. Test experiments showed that 2–0·5 mgrm. of selenious acid could be detected in 30–50 grms. of plant material in this manner. Selenium does not appear to be present in urine or bones.—H. W.

Methoxyl groups; Determination of —— in substances containing sulphur. M. Hönig. Monatsh. Chem., 1918, **39**, 871–872.

The method employed by Hönig and Spitzer (see this J., 1918, 502 A) was erroneously described as a modification of that of Kirpal and Bühn (this J., 1914, 570). In reality an entirely different principle is involved since a solution of silver nitrate in pyridine (which absorbs both methyl iodide and

hydrogen sulphide) is used in the one case whereas pure pyridine (which absorbs only methyl iodide) is used in the other.—H. W.

Asphaltic substances in petroleum. Prozynski. *See* IIA.

Benzene. Jones. *See* III.

Chlorinated benzene. Jones. *See* III.

Dimethylaniline. Jones. *See* III.

Tartrates. Curtman and Harris. *See* VII.

Silica bricks. Le Chatelier and Boglitch. *See* VIII.

Resins for soap making. Goldschmidt and Weiss. *See* XII.

Fatty acids from varnish oils and varnishes. Pearce. *See* XIII.

Separating resins. Wolff. *See* XIII.

Sulphuric acid in leather. Immerheiser. *See* XV.

Leather substitutes. Leuffmann. *See* XV.

Pressed yeast. Janke. *See* XVIII.

Cow and buffalo milk. Todd. *See* XIXA.

Crude fibre determination. Spears. *See* XIXA.

Nucleic acids. Feulgen. *See* XX.

Geraniol in citronella oil. De Jong. *See* XX.

Organic reagents. Marvel and Kamm. *See* XX.

Mercury in mercury salicylate. Costantino. *See* XX.

Impurity in ether. Weehuizen. *See* XX.

Sucrose octanitrate. Hoffman and Hawse. *See* XXII.

PATENT.

Methane; Estimation of —— in mine air, and of other gases in gaseous mixtures. F. Krüger, Danzig-Langfuhr, O. Reinkober, Berlin, and H. Riegger, Ostrach. Ger. Pat. 309,627, 20.6.14.

A METHOD for estimating methane in mine air or of other gases in gaseous mixtures, depends upon the property of methane and other gases of absorbing ultra-red rays. The difference in intensity of the rays from a suitable source of radiation before and after passing through the gas is measured by means of a thermopile, bolometer, or selenium cell. —L. A. C.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Aeschbach A.-G. Mixing and kneading machines. 7022. Mar. 20. (Switzerland, 20.3.18.)

Antrobus. Furnaces. 7898. Mar. 29.

Berry. 6716. *See* X.

Burdon, and Burdons, Ltd. Apparatus for liquid-fuel firing of steam-boilers. 7943. Mar. 29.

Calinaud. Centrifugal liquid-separators. 6726. Mar. 18. (France, 4.4.18.)

Carter and Travis. Means for preventing loss of heat by radiation from water pipes, engine cylinders, etc. 7266. Mar. 24.

Castleman. Filter for cleaning and cooling air or gas. 7503. Mar. 26.

Constantinesco. Method of pulverising or atomising liquids. 7836. Mar. 28.

Cruse. Pulverisation of materials, and collection and grading of pulverised materials. 7106. Mar. 21.

Davenport Engineering Co., and Gill. Cooling-towers etc. for cooling water etc. 7264. Mar. 24.

Davis. Apparatus for drying or cooling coal, limestone, etc. 7250. Mar. 24.

Fenton and Wright. Furnace roofs, walls, coke-oven doors, boiler bridges, etc. 7363. Mar. 24.

General Chemical Co. Apparatus for absorbing gases from gaseous mixtures. 7871. Mar. 28. (U.S., 3.11.17.)

Grocott. 6929. *See* X.

Hush. Mills or machines for grinding or pulverising ore etc. 7584. Mar. 26.

Lumsden. Grinding-machines. 7364. Mar. 24.

McOustra. Condensing apparatus. 7581. Mar. 26.

Mallet. Method of producing intimate mixture of liquids or causing reaction of liquid on pulverulent substance. 7867. Mar. 28. (France, 3.6.18.)

Matter. Process for concentrating or evaporating liquids. 6640. Mar. 17. (Switzerland, 28.3.18.)

Melland and Nield. Furnaces. 6831. Mar. 19.

Morison. Steam-condensing apparatus. 7630. Mar. 26.

Smidth & Co. Ball-mills. 7467. Mar. 25. (Sweden, 27.3.18.)

Smith. Edge-runner, pan, etc. mills. 7896. Mar. 22.

Smith. Steam-generators and furnaces. 7896. Mar. 29.

Sturgeon. Centrifugal separating-machines. 6611. Mar. 17.

Summers and Whittard. Rotary furnaces, retorts, etc. 7052. Mar. 21.

Western Electric Co. (Western Electric Co.). Producing vacua. 6951. Mar. 20.

Wirth-Frey. Utilising heat of liquids. 7118. Mar. 21. (Switzerland, 12.4.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

2520 (1918). Kirke. Gas-fired boilers. (124,016.) Mar. 26.

3054 (1918). Hope. Apparatus for drying sand and similar granular material. (124,244.) Apr. 2.

4443 and 14,933 (1918). Hutchins. Means for treating gases with liquids. (124,045.) Mar. 26.

4561 (1918). Dunsford and Linley. Refrigerating-apparatus. (124,054.) Mar. 26.

4776 (1918). Rouse. Manufacture of agglomerates of various materials and their utilisation. (124,262.) Apr. 2.

4853 (1918). Harbord. *See* X.

5021 (1918). Wolff. Manufacture of useful substances from organic waste products. (121,576.) Apr. 2.

5085 (1918). Dunker. Apparatus for humidifying or filtering air or other gases. (124,287.) Apr. 2.

7959 (1918). Reynard. Method of and means for effecting rapid crystallisation of substances in solution. (124,324.) Apr. 2.

9760 (1918). Richards. Filters. (116,725). Mar. 26.

16,440 (1918). Sharp and Gardiner. Mixing or agitating appliances. (124,386.) Apr. 2.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications

Allen and Clements. Gas-producers. 7469. Mar. 25.

Antrobus. Treatment of fuels for obtainment of by-products therefrom. 7899. Mar. 29.

Beilby. Carbonisation of coal, shale, peat, etc. 7446. Mar. 25.

British Thomson-Houston Co. (General Electric Co.). X-ray apparatus. 7749. Mar. 27.

British Thomson-Houston Co. (General Electric Co.). Electron discharge apparatus. 7851. Mar. 28

British Thomson-Houston Co. (General Electric Co.). Manufacturing electric incandescent lamps etc. 7960. Mar. 29.

Burdon, and Burdons, Ltd. 7943. *See* I.

Castleman. 7503. *See* I.

Cole. Oil-fuel burners. 7696. Mar. 27.

Corthesy. Generation and/or treatment of gas 7559. Mar. 26.

Crick. Arc lamps. 7102. Mar. 21.

Davis. 7250. *See* I.

Fenton and Wright. 7363. *See* I.

Garbarini. Electric lamps. 6743. Mar. 18. (France, 3.7.18.)

George. Quartz mercury-vapour lamps. 7830. Mar. 28. (France, 24.4.18.)

George. Mercury lamps. 7841. Mar. 28. (France, 8.7.18.)

Grocott. 6929. *See* X.

Hall. Electric lamps. 7763. Mar. 28.

Harger. Gas-producers. 7182. Mar. 22.

Helps. Manufacture, utilisation, and combustion of fuel. 6956. Mar. 20.

McCoulough. Filament electric lamp. 7167. Mar. 22.

Mayer, and Welsbach Light Co. 6791 *See* VIII.

Nelson. Distillation and carbonisation of wood. 7353. Mar. 24.

Pearse (Kennedy). Rotary retorts, and destructive distillation of carbonaceous material therein. 7607. Mar. 26.

Seymour. Combustion of fuel. 7737. Mar. 27.

Smoot. Regulation of pressure or volume of gases. 7502. Mar. 25. (U.S., 25.3.18.)

Thiry. Distilling, carbonising, and gasifying coal etc. 7590. Mar. 26.

Vello. Electric lamps. 7336. Mar. 24. (Spain, 23.3.18.)

Complete Specifications Accepted.

18,911 (1917). Thaberg. Process of producing gas from moist fuel in furnaces, gas-producers, and similar apparatus, and of simultaneously recovering by-products, and apparatus relating thereto. (112,443.) Apr. 2.

18,983 (1917). Nelson. Low-temperature distillation of coal, shale, and the like. (124,231.) Apr. 2.

2462 (1918). Freeman. Carbonising or distillation apparatus. (124,015.) Mar. 26.

2520 (1918) Kirke. *See* I

3282 and 11,318 (1918). Rew. Manufacture of gas. (124,217.) Apr. 2.

4287 (1918). Beilby. Carbonisation of coal, shale, peat, wood, and other bituminous or organic materials, and apparatus therefor. (124,039.) Mar. 26.

4543 (1918). Maxon. Process and apparatus for the combustion of gas. (124,052.) Mar. 26.

4925 (1918). Spicer (Wells). Carbonisation of wood and the like. (124,274.) Apr. 2.

5021 (1918). Wolff. *See* I.

5085 (1918). Dunker. *See* I.

5511 (1918). Lamplough, and Oil Extractors, Ltd. Processes and apparatus for the distillation of coal. (124,294.) Apr. 2.

5865 (1918). Marks (General Engineering Co.). Devices for burning liquid fuel. (124,303.) Apr. 2.

6175 (1918). Allata. Control and regulation of combustion in producer-gas and other gas furnaces. (115,423.) Mar. 26.

6574 (1918). Grimani. Combustible block or tablet. (124,310.) Apr. 2.

6779 (1918). Wood. Drying fuel supplied to boiler furnaces or the like (124,314.) Apr. 2.

10,823 (1918). Leadbeater. Means or method of treating peat so as to render it more adaptable or useful as a fuel. (124,348.) Apr. 2.

14,953 (1918). Wilputte. Burner nozzles for coke ovens and the like. (119,464.) Mar. 26.

III.—TAR AND TAR PRODUCTS.

Applications.

Ashcroft. 7120. *See* XX.

Gros et Bouchardy. Manufacture of mono- and di-nitrophenols. 7300. Mar. 24. (Switzerland, 23.3.18.)

Complete Specification Accepted.

14,402 (1915). Lapworth and Morris. Method of isolating sulphonic acids in the form of salts from the products obtained on sulphonating carbon compounds. Mar. 26.

IV.—COLOURING MATTERS AND DYES.

Application.

Gros et Bouchardy. 7298. *See* XXII.

COMPLETE SPECIFICATIONS ACCEPTED.

14,367 (1915). Graesser and Titherley. *See* XXII.

16,607 (1915). Green. *See* XXII.

17,525 (1915). MacDonald. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Evans, and Saundevan, Ltd. Fireproofing fabrics. 7094. Mar. 21.

Farrell. Textile etc. drying-cylinders. 7073. Mar. 21.

McKechnie, Ryan, and Vickers, Ltd. Fabrics for air-ships. 7465. Mar. 25.

Mellersh-Jackson (Arkell Safety Bag Co.). Wrapping or packing paper. 6619. Mar. 17.

Robinson-Bindley, Dulcken, and Weller. Production of substitutes for celluloid, vulcanite, etc. 7109. Mar. 21.

Thompson. Paper making machines. 7873. Mar. 28.

COMPLETE SPECIFICATIONS ACCEPTED.

13,689 (1915). Williams, and North British Rubber Co. Balloon fabrics and the like. Mar. 26.

13,690 (1915). Williams, and North British Rubber Co. Manufacture of balloon fabrics and the like. Mar. 26.

14,157 (1918). Ashourkoff and Gaszynski. Machines for separating incrustations and other refuse from crushed or broken fibrous materials. (124,376.) Apr. 2.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Gibson. Finishing-composition for yarns and fabrics. 7239. Mar. 24.

Henshilwood and Thornber. Mechanism for stretching and guilding fabrics in bleaching, dyeing, finishing, etc. machines. 7399. Mar. 25.

Hunt. Apparatus for bleaching open fabrics. 6817. Mar. 19.

Samuel. Machines for printing fabrics etc. 6926. Mar. 20. (France, 16.5.18.)

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Brownlee, Chance and Hunt, Gidden, and Ragg. Manufacture of oxide and carbonate of zinc. 7214. Mar. 22.

Crosfield and Sons, and Wheaton. 7119. *See* XIX.

Davis. 7250. *See* I.

Ekeley and Stoddard. Method of obtaining pure tungstates. 6999. Mar. 20.

Fricker. Manufacture of zinc oxide. 7966. Mar. 29.

General Chemical Co. Apparatus for production of nitric acid. 7869. Mar. 28. (U.S., 3.11.17.)

General Chemical Co. Treating gases containing carbonic oxide. 7870. Mar. 28. (U.S., 3.11.17.)

General Chemical Co. Apparatus for synthetic production of ammonia. 7872. Mar. 28. (U.S., 3.11.17.)

Goold (Balfour-Guthrie Investment Co.). Method of producing cyanogen and ammonia. 7403. Mar. 25.

Greenwood and Tate. Electric heaters for apparatus for synthetic production of ammonia etc. 7323. Mar. 24.

Mellersh-Jackson (Sperry). Producing lead salts. 7131. Mar. 21.

COMPLETE SPECIFICATIONS ACCEPTED.

17,541 (1915). Tyrer. Process for removing nitrous and nitric acids from sulphuric acid. Apr. 2.

4272 (1918). Mirza. Zinc oxide furnaces or kilns. (124,038.) Mar. 26.

4854 (1918). Harbord. *See* X.

13,873 (1918). Larson and Bergman. Production of pure aluminium hydroxide and ammonium sulphate. (120,550.) Mar. 26.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Bey and Bundy. Method of applying decorative treatment to enamelled metal articles. 7307. Mar. 24.

Mayer, and Welsbach Light Co. Manufacture of clay rings for inverted incandescent gas mantles. 6791. Mar. 18.

Muggeridge, Straughan, and Straughan. Process for manufacture of strengthened glass. 7095. Mar. 21.

Tuhten. Process of decorating earthen etc. ware. 7373. Mar. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

2252 (1918). Norton Co. Aluminous abrasive. (113,957.) Mar. 26.

4922 (1918). Kitson. Furnaces for glass manufacture and like purposes. (124,273.) Apr. 2.

5821 (1918). Pickard, Sherlock, Callcott, and Smith. Cement for mending ceramic, glass, and other articles. (124,302.) Apr. 2.

6057 (1918). Ghijsen, and Naaml. Vennoots. Vitrite Works. Glass-melting furnaces. (124,307.) Apr. 2.

11,420 (1918). Clegg. Machines for manufacturing glass-ware. (124,356.) Apr. 2.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Clarke. Manufacturing dense or compact concrete etc., and forming structures thereof. 7209. Mar. 22.

Cooper, Millard, and Robertson. Building brick or block, and method of manufacturing same. 7832. Mar. 28.

COMPLETE SPECIFICATION ACCEPTED.

5821 (1918). Pickard and others. *See* VIII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Bastian. Determining decalescent point of steel. 7482. Mar. 25.

Bates and Newman. 7460. *See* XI.

Bates and Newman. Ebonising metals. 7461. Mar. 25.

Berry. Apparatus for drying slag and removing moisture from ores, stone, etc. 6716. Mar. 18.

Bingham. Method of protecting metallic vessels from damage. 7555. Mar. 26.

Blaiberg. 7142. *See* XI.

Bloxam (Soc. Anon. des Usines Giulini). Process for increasing hardness, tenacity, and ease of working of metals. 7111. Mar. 21.

Clarke and Gregg. Alloy of aluminium. 7128. Mar. 21.

Cowper Coles. Process for sherardising. 7636 Mar. 26

Danson. Apparatus for cleaning tuyères and/or tapping-holes of blast, cupola, Siemens, etc. furnaces. 7759. Mar. 28.

Gathmann. Apparatus for teeming ingot moulds. 6667. Mar. 17.

Gathmann. Method of teeming ingot moulds. 6668. Mar. 17.

Grocott. Melting-furnaces burning producer gas. 6929. Mar. 20.

Guise, and Redditch Electro Plating Co. Rust-preventing process for needles, hat-pins, etc. 6825. Mar. 19.

Hush. 7584. *See* I.

Joly. Method of separating alloys or mixtures of metals. 7767. Mar. 28.

Leopard. Solder for aluminium and its alloys. 6985. Mar. 20.

Marcotly, and Soc. Anon. de Vedrin Roasting-furnaces for sulphurous ores. 6759. Mar. 18.

Minerals Separation, Ltd., and Wood. Concentration of ores. 7956. Mar. 29.

Mordey. Electro-magnetic separation or concentration of minerals. 7848. Mar. 28.

Rogers. Steel for resisting corrosion and high temperatures. 6824 Mar. 19.

Rondelli. Process of oxidising iron or steel surfaces. 7617. Mar. 26.

Smith. Electric arc welding. 7370. Mar. 25

Stabilimenti Biak—Pouchain. Metal alloy containing manganese. 6986. Mar 20.

COMPLETE SPECIFICATIONS ACCEPTED.

4228 (1915). Hadfield and Jack Manufacture of metal ingots. Apr. 2.

19,170 (1917). Leech, Slater, and Slater. Electrolytic preparation of metals or alloys in the form of paste or sludge. (124,005.) Mar. 26.

2653 (1918). White. Process for the recovery of brass from foundry ash and the like. (124,019.) Mar. 26.

4853 (1918). Harbord. Muffled chamber suitable for use as a roasting furnace or kiln. (124,265.) Apr. 2.

4854 (1918). Harbord. Roasting complex zinc sulphide ores or concentrates particularly in conjunction with the manufacture of sulphuric acid. (124,266.) Apr. 2.

5023 (1918). Daponte and Newman. Zinc vapour rustproofing. (124,283.) Apr. 2.

9226 (1918). Hazard and Morris. *See* XI

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Adkins and Austin. Electric cells or batteries. 7179. Mar. 22.

Bates and Newman. Electrolyte for copper deposition. 7460. Mar. 25.

Blaiberg. Electrodes for electric arc welding. 7142. Mar. 22.

Dorrian. Electrical primary cells. 6942. Mar. 20.

Greenwood and Tate. 7323. *See* VII.

Gros et Bouchardy. Manufacture of ozone. 7299. Mar 24. (Switzerland, 23.3.18.)

Grove. Non-acid mixture for charging accumulator cells. 7578 Mar. 26.

Lewis and Quain. 7714. *See* XIX.

Morgan Crucible Co., and Speirs. Electrically-heated furnaces. 6651 Mar. 17.

Oldham and Oldham Galvanic batteries. 6781. Mar. 18.

Osborne. Electric muffles and furnaces. 6722. Mar. 18.

Pattison (General Research Laboratories). 6738. *See* XIX.

Smith. 7370. *See* X.

COMPLETE SPECIFICATIONS ACCEPTED.

19,170 (1917). Leech and others. *See* X

4530 (1918) Leitner and Exley. Manufacture of electric accumulators. (124,050.) Mar. 26.

4868 (1918) Ajax Metal Co. Method and apparatus for electric heating by high-frequency currents. (119,220.) Mar. 26.

5479 (1918). Matsushima. Apparatus for electrolysing salt solution. (114,623.) Mar. 26.

9226 (1918). Hazard and Morris Electrodes particularly for use in electric smelting and like purposes. (124,116.) Mar. 26.

11,464 (1918). Horil Process of resuscitating spent electric dry cells (124,137.) Mar. 26.

14,530 (1918). Pearson, and General Electric Co. Electric accumulators. (124,378.) Apr. 2.

XII.—FATS; OILS; WAXES.

COMPLETE SPECIFICATION ACCEPTED.

5167 and 5635 (1918) Carper and Tulloch. *See* XIV.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Buckley. Plastic composition. 7319. Mar. 24.

Morley. Red waterproof marking-ink. 7371. Mar. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

2272 (1918). Dior. Process for the manufacture of synthetic resins. (124,010.) Mar. 26.

4458 (1918). Benneche. Paint. (124,046.) Mar. 26.

10,668 (1918). Grozier. Process for the reclaiming of used printers' roller composition and analogous substances or compositions and apparatus therefor. (121,941.) Apr. 2.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATIONS.

Buckley. 7319. *See* XIII.

Chatterley. Reinforced rubber compound. 6543. Mar. 17.

McKechnie and others. 7465. *See* V.

Robinson-Bindley and others. 7109. *See* V.

COMPLETE SPECIFICATIONS ACCEPTED.

13,689 and 13,690 (1915). Williams, and North British Rubber Co. *See* V.

4944 (1918). Dunlop Rubber Co., and Twiss. Vulcanisation of rubber and similar materials. (124,276.) Apr. 2.

5167 and 5635 (1918). Carper and Tulloch. Preparation of solvents for India-rubber and animal fats. (124,072.) Mar. 26.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATIONS.

Seymour-Jones. Apparatus for treatment of hides and skins. 7291. Mar. 24.

Waley. Composition for treating leather. 7346. Mar. 24.

COMPLETE SPECIFICATIONS ACCEPTED.

4347 (1918). Abrahamsen. *See* XX.

11,375 (1918). Rast-Ruttimann. Waterproof leather substitute and process for making the same. (117,628.) Mar. 26.

XVI.—SOILS; FERTILISERS.

APPLICATION.

Grossmann. Manufacture of manure from sewage sludge. 7680. Mar. 27.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATION.

MacCallum. Substitute for whisky, brandy, rum, etc. 6939. Mar. 20.

COMPLETE SPECIFICATIONS ACCEPTED.

1195 (1918). Jensen (Magne). Pure-culture apparatus for yeast, mucorini, moulds, bacilli, and micro-organisms. (124,237.) Apr. 2.

8925 (1918). Block. Manufacture of non-alcoholic malt beer. (124,330.) Apr. 2.

12,205 (1918). Dupire. Process for the extraction of the yeast contained in fermented molasses. (123,711.) Mar. 26.

12,255 (1918). Dupire. Process for the extraction of yeast from the fermented molasses. (124,364.) Apr. 2.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Bates. Preparation for destroying blight. 7462. Mar. 25

Calder's Margarine Co., and Clayton. Manufacture of margarine etc. 6938. Mar. 20.

Crosfield and Sons, and Wheaton. Base-exchanging compound, and its employment in purification and/or softening of water. 7119. Mar. 21.

Ferguson and Peyton. Process for preservation and treatment of meat, fish, jam, etc. 7236. Mar. 24.

Grossmann. 7680. *See* XVI.

Kawanishi. Disinfecting. 6962. Mar. 20.

Kelly. Apparatus for sterilising milk etc. 7422. Mar. 25.

Lewis and Quain. Treatment of fluids with ozone. 7744. Mar. 27.

Pattison (General Research Laboratories). Ozonising substances. 6738. Mar. 18.

Schindler. Converting vegetable substances of little or no nutritive value into food of high nutritive value. 7432. Mar. 25.

Sorensen. Manufacture of margarine. 6733. Mar. 18.

COMPLETE SPECIFICATIONS ACCEPTED.

5671 (1918). Greville. Treatment of flour. (124,298.) Apr. 2.

5973 (1918). Bullot. Preservation of meat and other alimentary substances and apparatus therefor. (117,805.) Apr. 2.

6404 (1918). Croft. Coffee preparation. (124,309.) Apr. 2.

10,639 (1918). Austin. Separator and filter for purifying water for use in steam-generators and for manufacturing purposes. (124,130.) Mar. 26.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Ashcroft. Processes involving organic chemical reactions. 7120. Mar. 21.

Blom. Process for manufacture of asymmetric ureas. 6639. Mar. 17. (Switzerland, 17.4.18.)

Cremonese. Antimalaric serum. 6869. Mar. 19.

Golding, Raschen, and United Alkali Co. Purification of calcium citrate and manufacture of citric acid. 6928. Mar. 20.

Guinot and Job. Process for preparation of arsene derivatives. 6780. Mar. 18.

COMPLETE SPECIFICATIONS ACCEPTED.

14,085 (1915). Sidgwick and Lambert. Manufacture of di-ethyl and di-methyl ketones. Mar. 26.

14,607 (1915). Fernbach and Strange. Manufacture of certain organic salts and acids. Mar. 26.

4347 (1918). Abrahamsen. Tanno-casein compound and a process for the manufacture of the same. (111,158.) Mar. 26.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATION.

Boake, Roberts, and Co., and Lewis. Absorption of ultra-violet light. 6891. Mar. 19.

XXII.—EXPLOSIVES; MATCHES.

APPLICATION.

Gros et Bouchardy. Manufacture of picric acid. 7298. Mar. 24. (Switzerland, 23.3.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

14,367 (1915). Graesser and Titherley. Manufacture of picric acid. Mar. 26.

14,655 and 14,656 (1915). Rintoul, Cross, and Nobel's Explosives Co. Explosives. Mar. 26.

14,706 (1915). Rintoul, Beckett, and Nobel's Explosives Co. Explosives. Mar. 26.

14,932 (1915). Perchlorate Explosives, and Harris. Manufacture of explosives. Mar. 26.

16,607 (1915). Green. Manufacture of picric acid. Apr. 2.

17,525 (1915) and 5551 (1916). McDonald. Manufacture of picric acid and apparatus employed therewith. Apr. 2.

I.—GENERAL; PLANT; MACHINERY.

PATENTS.

Drying and similarly treating materials; Apparatus for ——. W. M. Brownell, London. Eng. Pat. 114,626, 2.4.18. (Appl. 5629/18.) Int. Conv., 6.4.17.

THE apparatus consists of a horizontal cylinder rotating on a central shaft and built up of a number of compartments separated by transverse foraminous partitions and having reversed spiral flanges supported by radial arms and provided with lifting buckets at intervals. The material enters the first compartment at the periphery and is carried to the centre; it then passes through an opening into the second compartment and is carried to the periphery, and so on to the last compartment from which it is discharged through a door which is normally closed, but is opened when in its lowest position by a cam and tappet. Drying is effected by heated air or gas which is passed horizontally through the cylinder in the opposite direction to that taken by the material.—W. H. C.

Drying granular, pulverulent, and pasty materials; Apparatus for ——. H. Alexander, Leeds. Eng. Pat. 123,646, 18.4.18. (Appl. 6612/18.)

THE material is fed into a distributor mounted on a vertical shaft rotating in a cylindrical casing and is discharged on to a tray also mounted on the shaft. It is pushed round by stationary rakes and falls through slots in the tray to another tray below, which is fixed to the casing. Scrapers mounted on the rotating shaft carry the material round, and it drops on to a similar tray below and so on to the bottom. The openings in the trays are provided with inclined baffles which cause the air to pass in a spiral path through the apparatus and to come into intimate contact with all the material.—W. H. C.

Heat exchangers for use as feed water heaters, evaporators, condensers, coolers, and the like, but more particularly as heaters for use in oil fuel installations. H. A. Thompson and T. T. Brown, North Shields. Eng. Pat. 123,369, 15.2.18. (Appl. 2737/18.)

A NUMBER of heat-exchanging tubes are enclosed within a casing, to one end of which are secured inner and outer tube-plates. Each heat-exchanging tube is composed of an inner and outer tube arranged coaxially. The free ends of the inner tubes are preferably tapered. A rod is arranged axially within each inner tube, and a wire is wound helically upon the rod. A wire is similarly wrapped helically upon the inner tube. The inner tubes are secured to the outer tube-plates by expanding, and the outer tubes are similarly secured to the inner tube-plate. The outer tube plate is enclosed with a cover provided with inlet and outlet branches. The space between the outer tube-plate and cover is divided into chambers so that the fluid may be passed any desired number of times through the tubes. The outer casing is curved inwards from the tube-plate end so as to reduce the volume of heating fluid in the apparatus, and is surrounded by a lagging plate.—J. S. G. T.

Furnaces; Method of and apparatus for arresting sparks and economising fuel in ——. W. A. Watterson, Euchareena, N.S.W. Eng. Pat. 123,575, 25.2.18. (Appl. 3340/18.)

A STEAM nozzle projects transversely into the discharge flue of the furnace and a jet of steam passes across the flue into the flared mouth of a pipe opposite to the nozzle. Smoke, sparks, etc. are drawn into this pipe and after passing through a control valve and a mixing device, such as a fan or blower, are finally discharged into the ashpit for further passage through the fire. An auxiliary steam jet may be provided in the flue below the jet mentioned above, for checking flame and steadying the upward flow of hot gas. A damper is provided in the flue above the jets.—W. F. F.

Furnace. W. Crow and J. C. Schaffer, Tiffin, Ohio. U.S. Pat. 1,291,125, 14.1.19. Appl., 13.11.17.

A ROTARY kiln has its discharge end open, and of approximately the same diameter as the kiln. A furnace provided with a combustion chamber furnishes a supply of heating gas which flows into the kiln over the entire cross section of the discharge end of the kiln. The furnace may be moved with respect to the kiln.—J. S. G. T.

Filter-press. British Dyes Ltd, J. Turner, and R. G. Parker, Huddersfield. Eng. Pat. 123,589, 27.2.18. (Appl. 3516/18.)

COMPRESSIBLE frames are used between the filter-plates in order that the filter-cakes formed in the ordinary way may have the bulk of the residual liquid squeezed out of them by hydraulic pressure which forces the plates together, compressing the frames. The latter are formed by hollow circular rings of copper or other suitable material which are open on their inner circumference and have beaded edges. The hollow part of the ring is filled with a hollow core of rubber or other elastic material to facilitate expansion when the hydraulic pressure is released.—W. H. C.

Purifying air; Apparatus for ——. F. J. Talbot, Sheffield. Eng. Pat. 123,609, 9.3.18. (Appl. 4196/18.)

Two fans are mounted on parallel shafts in a single casing. The fans are enclosed in permeable material, such as gauze, and dip into water in the lower part of the casing, which is provided with a division plate between the fans. The fans are rotated in opposite directions, and the air enters through two pipes, one for each fan, and is discharged through one pipe common to both. Channels are provided to collect the water from the casing and to return it to the interior of the fans.—W. H. C.

Extracting oils, fats, grease, wax, india-rubber, sulphur, and other substances soluble in organic solvents, from materials containing the same; Apparatus for ——. L. J. Simon, J. W. Hinchley, and Fisher Chemical Engineering Co., Ltd., London. Eng. Pat. 123,645, 18.4.18. (Appl. 6597/18.)

THE extractor and the distilling vessel are formed in one piece, and the vapour from the latter passes up through two spaces, one on each side of the former, to the condenser. The extractor has a central top charging aperture closed by a cover and a lateral discharging door near the bottom. It is provided with upper and lower straining grids so that the extraction with heated solvent can be made either in an upward or downward direction. A sight and sampling gauge is provided so that the process of extraction can be watched, and a discharge receptacle for the extract is connected with the still by sealed pipes in such a manner that air cannot enter the latter. The extractor has a cover which can be lowered so as to seal it off and allow it to be emptied and recharged whilst the distilling chamber is working.—W. H. C.

Grinding-mills. H. W. Hardinge, New York. Eng. Pat. 123,705, 23.12.18. (Appl. 21,553/18.)

THE axial outlet of a rotary grinding drum is provided with a baffle which allows only the finer particles to be discharged, and deflects the coarser particles into external conduits which are arranged spirally with regard to the drum, and return the coarser material to the axial inlet at the opposite end of the drum.—W. H. C.

Tube-mills; Lining for —. A. V. Jensen, Devils Slide, Utah, Assignor to American Manganese Steel Co., Augusta, Me. U.S. Pat. 1,291,008, 14.1.19. Appl., 21.4.15

THE lining plate on its inner side is undulatory in form, the section by a plane perpendicular to the axis of the tube mill being trochoidal. The undulations are different in successive longitudinal sections of the lining.—J. S. G. T.

Tube-mill. H. W. Weimer, Milwaukee, Wis., Assignor to Worthington Pump and Machinery Corp., New York. U.S. Pat. 1,291,311, 14.1.19. Appl., 25.3.18.

A TUBE-MILL is provided with a diaphragm divided into sections, which are hinged at their outer edges to the mill wall by means of lugs which enter recesses in the wall, and secured at the centre to a fixed hub by means of a bolt passing through the hub, and a clamping washer.—J. S. G. T.

Grading solid materials; Process of and apparatus for —. C. J. Reed, Philadelphia, Pa. U.S. Pat. 1,291,137, 14.1.19. Appl., 18.9.16.

THE material under treatment is fed into a grading vessel, the bottom of which is composed of a porous septum, uniformly resistant to the passage of fluid. A stream of fluid is caused to flow uniformly upwards through the porous septum at such a rate that horizontal stratification of the solid particles in layers of approximately uniform size results. The graded layers of particles are withdrawn by pipes immersed to suitable depths in the grading vessel, the motion of the particles in such pipes being initially upwards.—J. S. G. T.

Joint for fume pipes and absorption towers. W. Fletcher, Radcliffe, Lancs. Eng. Pat. 123,679, 26.6.18. (Appl. 10,504/18.)

Sorting material; Apparatus for —. J. Bernard and C. Vibert, Paris. Eng. Pat. 108,325, 28.7.17. (Appl. 10,862/17.) Int. Conv., 2.12.15.

SEE Fr. Pat. 480,376 of 1915; this J., 1917, 124.

Furnace. A. Smallwood, London. U.S. Pat. 1,290,383, 7.1.19. Appl., 18.4.16.

SEE Eng. Pat. 6323 of 1915; this J., 1916, 680.

Channel-furnace. E. E. Brand, Halsingborg, Sweden. U.S. Pat. 1,291,748, 21.1.19. Appl., 19.1.18.

SEE Eng. Pat. 119,366 of 1918; this J., 1918, 700 A.

Refrigeration; Process of and apparatus for —. F. W. Wolf, Assignor to The Isko Co., Chicago, Ill. U.S. Pat. 1,291,334, 14.1.19. Appl., 8.4.16.

SEE Eng. Pat. 110,533 of 1916; this J., 1917, 1228.

Heat-interchanging apparatus. E. L. Pease, Darlington. U.S. Pat. 1,291,632, 14.1.19. Appl., 1.3.17.

SEE Eng. Pat. 114,863 of 1917; this J., 1918, 289 A.

Calcining or treating granular material; Process for —. C. D. McCourt, London, Assignor to Surface Combustion, Inc., Wilmington, Del. U.S. Pat. 1,291,965, 21.1.19. Appl., 23.1.12. Renewed 6.5.18.

SEE Fr. Pat. 450,733 of 1912; this J., 1913, 587.

Spraying and atomising liquids; Apparatus for —. E. Slater, Greenfield. U.S. Pat. 1,292,898, 28.1.19. Appl., 22.6.18.

SEE Eng. Pat. 117,481 of 1917; this J., 1918, 497 A.

Washing or mixing liquids. Eng. Pat. 123,839. *See* III.

Extracting soluble substances U.S. Pat. 1,282,407. *See* XII.

Matter in a finely-divided state. U.S. Pat. 1,259,708. *See* XIII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Preparation of samples and elementary analysis of —. A. Zschimmer. J. Gasbeleucht., 1919, **62**, 54–56.

THE air-dried coal is powdered and 50 to 100 grms. is sifted, and the amount of water determined before and after sifting. In the case of ordinary coal the loss of moisture in the process is trifling (*e.g.* 0·01 to 0·20%), but in the case of lignite and brown coal it may be sufficient (*e.g.* 0·62 and 0·88%) to cause appreciable errors in the subsequent analysis. The use of Deiglmayr's thermo-regulator (Ber., 1902, 1978) enables a combustion of coal to be made without attention. This apparatus consists essentially of a U-tube, filled with mercury, and is placed between the calcium chloride tube and the potash bulbs. One arm of the U-tube has a cross-piece at the top provided with a tap and connecting the absorption vessels; the other arm has an extension with a side tubulure connected with the gas supply for the burners below that portion of the combustion tube containing the sample of coal, whilst the gas outlet tube is attached to a tube which passes through a cork in the top of the extension to near the level of the mercury. The supply of gas to the burners is then automatically regulated by the pressure of the gas evolved from the sample of coal.—C. A. M.

Sulphur; Fusion bomb for determining — *in coal.* S. W. Parr. J. Ind. Eng. Chem., 1919, **11**, 230–231.

A BOMB for determining sulphur in coal by fusion with sodium peroxide has a removable fusion cup provided with a cover, which is held in position by a screw cap. The charge of 0·5 grm. of coal with 9 to 10 grms. of sodium peroxide is thoroughly mixed by shaking the sealed cup, and is then ignited by heating the bottom of the cup with a Meker burner, or by means of a flame from a blast lamp. Combustion is complete within half a minute, and, after cooling the bomb under the tap, the cup is removed and placed in water. The apparatus is also applicable to the determination of sulphur in pyrites, rubber, etc., of carbonaceous matter in soils, and of halogens in organic compounds.—C. A. M.

Gas; Production of —— from lignite. K. Bunte. J. Gasbeleucht., 1919, **62**, 34—36.

THE results of gas-making tests with Hungarian "Totis" lignite carried out in 1909 are described. The air-dried lignite contained 10·58% moisture, 9·88% ash, and 79·54% of combustible matter with the following composition:—Carbon, 72·93; hydrogen, 5·98; oxygen, 16·27; nitrogen, 1·12; and sulphur, 3·70%. Each retort received a charge of 120 kilos., and the distillation was continued for 4 hours at 1200° to 1250° C. The yield of gas per 100 kilos. of lignite was 38·8 cb.m. at 1200° to 1220° C. and 40·0 cb.m. at 1220° to 1240° C., or, excluding carbon dioxide, 34·1 and 35·2 cb.m. respectively. After the usual cooling, washing, and purifying, the gas obtained at 1215° C. had the following composition:—CO_2, 12·6; C_nH_m, 4·0; CO, 14·1; H_2, 45·2; CH_4, 23·5; and N_2, 0·6%. After purification with soda-lime the yield per 100 kilos. of coal was 34·3 cb.m., with sp. gr. 0·460, gross calorific power 5950 cals., and illuminating power (150 litres per hr., slit burner) 11·8. After purification the gas still contained, per 100 cb.m., 220 grms. of sulphur in the form of carbon bisulphide and organic compounds. Even after further purification with lime the sulphur could not be reduced below 188 grms. per 100 cb.m., although wood charcoal reduced it to 40 grms. On this account the gas was unsuitable for use, but it is suggested that other kinds of lignite containing less sulphur might prove more satisfactory in this respect. The residue in the retort averaged 45·5 kilos. from 100 kilos. of lignite. It was a grey pulverulent mass which required forced draught for burning. The tar (average yield 4·61%) was fluid and had sp. gr. 1·19. On distillation 25·9% distilled between 170° and 270° C. and 15·6% above 270° C., whilst the yield of pitch was 58·5%. There was also obtained 14·7 kilos. of gas-liquor containing 1·18% ammonia, the total yield of ammonia being 228 grms. per 100 kilos. of lignite. Cyanogen (45 grms. HCN per 100 kilos.) was also separated. Preliminary drying would be necessary to render many kinds of lignite suitable for distillation.

—C. A. M.

Natural gas; Testing —— for gasoline content. G. G. Oberfell, S. D. Shinkle, and S. B. Meserve. J. Ind. Eng. Chem., 1919, **11**, 197—200.

SOLID material, such as charcoal, is used as an absorbent for gasoline vapours in natural gas, instead of oil as in the method previously described (this J., 1918, 231 A). The charcoal is packed into the absorber, preferably of aluminium, consisting of four tubes, each 22 cm. long and internal diameter 2 cm. A removable perforated disc in each tube is kept in position about 3 cm. from the bottom by means of a hollow cylinder attached to it and resting upon a plate at the bottom of the tube. The tubes are connected in series by means of tubes attached to the bottom plate and the top plate of the absorber, and these plates are covered with rubber fittings to make the apparatus gas-tight and fixed down with thumb-screws. The gas is passed through a flow meter, then through a calcium chloride tube, a dry meter, and a manometer, before entering the absorption tubes, and finally, after leaving the tubes, through a second manometer. The sp. gr. of the gas may be approximately determined by measuring the time required for the delivery of a definite volume of air, with a constant differential height on the manometer of the flow meter, and applying the following formula:—

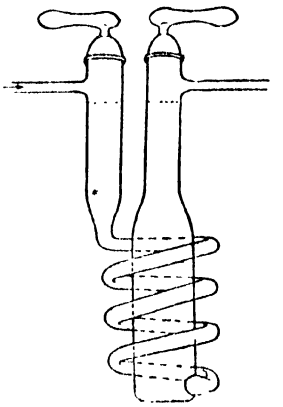
$$\text{Sp. gr. of gas} = \frac{(\text{Time for gas flow})^2}{(\text{Time for air flow})^2}$$

After the absorption the charcoal from the tube is mixed in a distilling flask with 600 c.c. of "straw oil" (petroleum distillate of about 30° B., sp. gr. 0·875), and the gasoline distilled, preferably in the presence of glycerin. The results thus obtained are about 6% higher than those obtained with the portable oil absorber (*loc. cit.*).

—C. A. M.

Tar vapour in producer-gas, Determination of ——. A. Zschimmer. J. Gasbeleucht., 1919, **62**, 53—54.

THE author uses an apparatus based on the same principle as that of Gwiggner (Chem.-Zeit., 1912, 461), in which the gas after leaving the filter is chilled to separate tar oils. The filter-tube is packed with cotton-wool and asbestos, or for higher temperatures with glass wool and asbestos, and after being weighed is introduced into the gas tube. The outlet of the filter is connected with a cooling-tube (see diagram), which is suspended in ice-water, and which has plugs of cotton-wool in its inlet and outlet tubes. As a rule the gas is passed through the cooling-tube for about 12 hours, the filter-tube being changed every two hours. At the end of the given time the contents of the cooling-tube are transferred to a stoppered flask,



and the cooling tube rinsed with freshly-distilled ether in the case of lignite gas or with benzene in the case of coal gas. The filter-tube is also washed out with the appropriate solvent, the solutions dehydrated by means of freshly-ignited sodium sulphate, filtered through cotton-wool and sodium sulphate, evaporated at as low a temperature as possible, and the residue dried and weighed. The filter-tube containing gas-black and ash is dried by means of a current of hot air, and weighed. It still contains particles of tar, which must be washed out with hot benzene or toluene when a separate determination of gas-black and ash is required. For a simultaneous determination of water vapour in the gas two calcium chloride tubes are inserted between the filter-tube and cooling-tube, and the whole apparatus weighed before and after the passage of the gas. The following results were obtained with typical samples of producer gas:—

Combustible	Water	Gas at 0° C. and 760 mm.	Tar and ash in filter	Tar oils in cooling tube	Increase in yield of tar by tar oils
	%	litres	grms.	grms.	%
Peat . .	16·5	196	7 754	0 639	8·24
,, ...	33·3	303	6 948	1·423	20·4
Lignite ..	34·7	87	2·121	0·145	6·84
Brown coal briquette .	14·2	483	11 700	0·328	2·8
Brown coal ..	51·7	649	7·000	2 603	37·1

—C. A. M.

Polythionate process of [gas purification]; Economic importance and scientific principles of Feld's —. A. Sander. J. Gasbeleuecht., 1919, **62**, 65—68.

THE author describes the reactions underlying Feld's process of removing hydrogen sulphide and ammonia from gases (this J., 1911, 1381; 1912, 430) and gives a brief account of the manner of using the method on the large scale. It is pointed out that in the German Empire in 1913, there were produced 32 million tons of coke and 14 million tons of gas containing about 140,000 tons of hydrogen sulphide, or 130,000 tons of sulphur, equivalent to 30% of the total import of pyrites. By means of the Feld process, sulphur could be recovered equivalent to 500,000 tons of sulphuric acid of 60° B. (sp. gr. 1·71) per annum.—S. S. A.

Motor fuels; Evaporation velocities and evaporation curves of —. K. Dieterich. Petroleum, 1917, **12**, 676—677. Chem. Zentr., 1919, **90**, II., 31.

THE author has determined the rate of evaporation of several motor fuels, including "normal," light, medium, and heavy benzine (petroleum spirit), motor benzol (90%), and motor alcohol (95%), and has plotted the results graphically. Good "normal benzine" gives a nearly straight, steeply falling, short curve. The higher the proportion of less volatile fractions present, the longer and more irregular the curve becomes, until it finally takes a nearly horizontal direction, as is shown in the curves for motor alcohol. The method of plotting the evaporation against the time is shown to be of great utility in the valuation of a motor fuel, a short, steep, straight curve indicating the best quality of fuel. J. F. B.

Petrol; Determination of the calorific value and sulphur content of — by means of a bomb. A. Philip. Analyst, 1919, **44**, 95—96.

THE petrol is weighed out in a small sealed glass bulb or, preferably, in a small stoppered bottle such as is sometimes used for vapour density determinations. This bottle is placed on the platinum tray of the bomb together with a weighed amount of pure naphthalene and the latter is ignited in the usual way. The heat liberated blows out the stopper of the bottle or breaks the bulb and ignites the petrol. The bomb used should be stronger than the ones usually employed and, as repeated use may produce "fatigue" in the metal, the determination should be carried out in an enclosure which will protect the observer from the results of an explosion.—W. P. S.

Petrol vapour; Physical properties of —. J. Rey. Comptes rend., 1919, **168**, 509—513.

A MATHEMATICAL discussion of the laws governing the variation of pressure, volume, and temperature of petrol vapour and the velocity of flow of the vapour through an orifice.—W. G.

Naphthenic acids; Utilisation of the — present in certain mineral oil products. E. A. Kolbe. Seifensieder-Zeit., 1917, **44**, 377—378. Chem. Zentr., 1919, **90**, II., 31.

THE sodium salts of the naphthenic acids give a strong lather, but the penetrating and clinging odour is a disadvantage. To minimise this drawback the author recommends an addition of rosin soap (1 : 3), but even in that case, after washing the hands, the odour is perceptible after some time. The best result in suppressing the odour was obtained by the addition of 1—1·5 parts of fullers' earth to the mixed naphthenic and rosin soaps. The soap is suitable for the dilution of soap stock or for the preparation of lubricants for drilling machines. Petroleum distillate from Borysław oil yielded 0·02% of naphthenic acids; gas oil yielded 0·1%.—J. F. B.

Tar from gas producers using lignite. Schulz and Kabelač. *See* III.

Ammonium salts from gas-liquor. Heineken. *See* VII.

Carbon monoxide in hydrogen. Rideal and Taylor. *See* VII.

Copper oxide in gas analysis. Ott. *See* XXIII.

PATENTS.

Briquette and method of manufacturing the same. C. E. Hite, Philadelphia, Pa., Assignor to American Briquet Co. U.S. Pat. 1,290,992, 14.1.19. Appl., 17.4.17.

AN emulsion for binding briquettes of coal or similar material is made by mixing starch 1 part and water 12 parts, and heating and stirring the mixture till the starch granules burst and form a paste. Two parts of the residue from petroleum distillation is then added and the mixture agitated to form an emulsion. The coal is mixed with 7·5% of the emulsion.—W. F. F.

Briquetting machines for lignite; Coal mixture for adjusting —. G. Neubert. Ger. Pat. 309,454, 7.9.16.

WHEN the moulds of a lignite briquetting machine have to be changed and a newly-ground mould has been put in position, the feed hopper is first charged with a suitable mixture of powdered coal and tar and the machine adjusted before charges of lignite alone are worked.—J. F. B.

Coke-ovens; Gas and air controlling means for —. F. Peiter, Assignor to A. G. McKee and Co., Cleveland, Ohio. U.S. Pat. 1,291,109, 14.1.19. Appl., 5.9.16.

THE gas supply and air supply to a by-product coke oven are separately controlled by means which produce a progressive throttling of both supplies.
—W. F. F.

Vertical gas retorts; Arrangement and operation of — —. Firth, Blakeley, Sons & Co., Ltd., Dewsbury, and E. J. A. Shaw, Leeds. Eng. Pat. 123,408, 23.2.18. (Appl. 3240/18.)

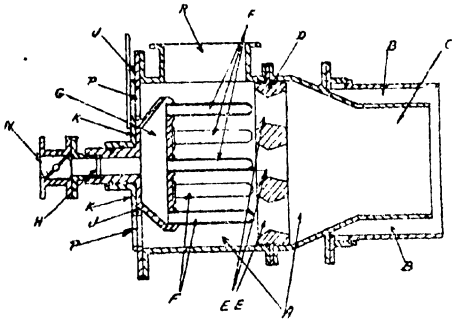
THE retorts are arranged in a circle or regular polygon and each is provided with a feed hopper which is charged from a radial shoot travelling on a circular track. The top and bottom lids of the retorts are actuated by shafts which work in unison so as to allow of the simultaneous charging and discharging of all the retorts.

Gas-generator. R. W. Polk, Assignor to Laclede-Christy Clay Products Co., St. Louis, Mo. U.S. Pat. 1,264,207, 30.4.18. Appl., 7.1.14.

Two tiers of retorts are arranged side by side, with a common vertical standpipe between them connected to each retort. The portion of the standpipe between the tiers of retorts is composed of movable sections, so as to permit relative movement of the retorts due to expansion on heating. Liquid-seals are provided between the sections.
—W. F. F.

Burners; Atmospheric ——. J. E. Weyman, Newcastle-on-Tyne. Eng. Pat. 123,434, 13.3.18. (Appl. 4416/18.)

AIR is admitted through the valve, N, and pipe, H, to the chamber, G, and thence to the nozzles, F, which are concentric with the openings, E. Gas is supplied through the conduit, R, to the space, A, and air may also be admitted directly to this space through openings, P, in a plate, J, controlled by a disc, K. The valve, N, and disc, K, are con-



nected to a governor which is controlled by the pressure in the gas main. Secondary air is supplied to the space, B. The gas is drawn in and mixed with the air issuing from the nozzles, F, in proportion to the velocity and volume of the air, and the mixture passes out of the nozzle, C, at a high velocity. The burner allows of high efficiency being attained with gas of low calorific value, *e.g.*, blast-furnace gas, at low pressures.—W. F. F.

Gas; Process for the combustion of —— H. R. Maxon, Muncie, Ind. U.S. Pat. 1,291,589, 14.1.19. Appl., 16.3.18.

GAS and air are supplied to a mixer in the proportions necessary for complete combustion, and are passed to a burner at a velocity of flow which is just sufficient to prevent back firing.—W. F. F.

Gas liquor; Method of and means for the treatment of ——. C. M. Croft, H. O. Carr, and U. O. S. Nairne, London. Eng. Pat. 123,337, 2.6.17. (Appl. 7956/17.)

THE invention relates to a self-contained apparatus for producing ammonium sulphate from ammoniacal liquor, carried by a self-propelled vehicle, which may thus be used for dealing with the ammoniacal liquor produced at small works in different localities.—W. F. F.

Fuel for internal combustion engines. E. C. R. Marks, London. From P. d'O. Fayd'herbe, Mauritius. Eng. Pat. 123,450, 22.4.18. (Appl. 6772/18.)

THE fuel consists of ethyl ether, 10—60%, a petroleum fraction of relatively high flash point, *e.g.*, kerosene, 5—30%, and alcohol of not less than 36° Cartier (sp. gr. 0·84), 30—80%.—W. F. F.

Refining apparatus [for natural-gas gasoline]. W. O. Snelling, Pittsburgh, Pa., Assignor to Consolidated Liquid Gas Co., Chicago, Ill. U.S. Pat. 1,259,679, 19.3.18. Appl., 21.2.13. Renewed 26.1.18.

THE apparatus comprises a vaporiser and a series of superposed condenser sections with separating pieces between them. Gasoline is introduced through a central tube and is delivered through a spraying pipe so that it falls over a steam coil arranged within the vaporiser. The valves of the apparatus are so adjusted that a pressure up to 900 lb. per sq. in. is developed by the vapours evolved from the gasoline. The unvaporised portion escapes through a pipe at the bottom. The vapours pass upwards through the condenser sections in succession and are subjected to fractional condensation, hot water being circulated through the coil in the lowermost condenser section, warm water through that in the middle section, and cold water through that in the top section.—L. A. C.

Hydrocarbons; Apparatus for cracking ——. J. W. Coast, jun., Tulsa, Okla., Assignor to The Process Co. U.S. Pat. 1,291,414, 14.1.19. Appl., 27.3.17.

Two horizontal cylindrical pressure stills, which are heated from below, are in free communication through a vessel serving as a trap, to retain carbonaceous matter separated during cracking and to equalise the internal pressures in the stills. An overflow pipe leads from the lower portion of one still to the trap, and a second overflow pipe leads from the upper portion of the trap to the second still.—T. St.

Lubricating oils; Manufacture of highly viscous —— *from oils of low viscosity such as "gas oil" etc.* Zeller und Gmelin, Eislingen. Ger. Pat. 297,771, 28.4.15.

THE mineral oil fraction serving as the raw material is chlorinated until its sp. gr. at 15° C. rises to 1·1—1·2. The chlorinated product is then dissolved in twice its weight of an organic solvent, treated with sulphuric acid of 66° B. (sp. gr. 1·84) and subsequently neutralised and washed. After the treatment with strong sulphuric acid, the oil may be further treated with fuming sulphuric acid containing about 20% SO_3.—J. F. B.

Feeding the furnaces of gas retort settings, coke ovens, muffles, and the like; Method of and means for ——. E. Masters, London, and Gibbons Bros., Ltd., Dudley. Eng. Pat. 123,617, 19.3.18. (Appl. 4805/18.)

Peat; Method of and means for removing water from ——. A. ten Bosch, The Hague. Eng. Pat. 123,517, 3.4.18. (Appl. 5692/18.) Int. Conv., 21.2.18.

SEE U.S. Pat. 1,290,494 of 1919; this J., 1919, 166A.

Coke-furnace [oven]; Regenerating ——. E. Oré, Caen, France. U.S. Pat. 1,291,621, 14.1.19. Appl., 12.10.17.

SEE Eng. Pat. 118,470 of 1917; this J., 1918, 616A.

Illuminating-gas; Furnace for production of ——. P. G. Strassmann, Crefeld-Linn, Germany. U.S. Pat. 1,285,823, 26.11.18. Appl., 12.12.16.

SEE Eng. Pat. 107,308 of 1916; this J., 1917, 957.

Hydrocarbon products; Extraction of —— *from shales and coals.* D. T. Day, Washington, D.C., U.S.A. Eng. Pat. 123,415, 27.2.18. (Appl. 3521/18.)

SEE U.S. Pat. 1,244,840 of 1917; this J., 1918, 4A.

Economising fuel in furnaces. Eng. Pat. 123,575. *See* I.

Gas-analysing apparatus. Eng. Pat. 120,921. *See* XXIII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Acetone. H. P. Bassett. Chem. and Met. Eng., 1919, **20**, 190.

FREMY (Ann Chim., 59, 7) referred to the production of acetone by the distillation of wood, sugar, gums, etc. with 8 parts of lime. Under proper conditions this large quantity of lime may be materially reduced, and if the mixture of lime and wood dust attains the maximum temperature in not less than 10 hours, and the distillation products are removed from the retort quickly by means of a current of inert gas, or preferably steam, a yield of 26% of acetone and mixed ketones may be obtained with 24% of lime calculated on the weight of dry wood. The higher ketones are valuable where a retardation of evaporation of the solvent is required, as in aeroplane dopes. Sulphite-cellulose waste liquors can be utilised in this manner by evaporation to a thick consistency, and the addition of slaked lime, with subsequent drying and distillation.—C. A. K.

PATENTS.

Retorts or chambers for the destructive distillation of carbonaceous materials; Charging of ——. J. West, Southport, and W. Wild, Blackpool. Eng. Pat. 123,411, 4.4.18. (Appl. 5788/18.)

COAL or the like is fed from a charging hopper into one end of a horizontal retort and pressed forward by a horizontal ram. The ram is made in two parts, one above the other, and the upper part is directly actuated by hydraulic means. The lower part is actuated by the upper part through a lost motion device so that both parts move forward together only when the acting faces of both parts are in line. The upper part of the ram reciprocates immediately below the hopper so as to control the mouth of the latter, and the material is moved forward by the upper part of the ram to fill the space between the lower part and the carbonised material already in the retort. The whole ram then moves forward to press the charge through the retort. An automatic catch is provided to prevent the lower part of the ram from moving forward before the two parts have their acting faces in line.—W. F. F.

Distillation of solid and liquid substances. A. B. Searle, Sheffield. Eng. Pat. 123,616, 18.3.18. (Appl. 4738/18.)

THE continuous distillation of peat, coal, oil, etc. is effected by placing the material on a series of cars which are passed through a long tunnel oven heated externally or internally without the products of combustion coming into contact with the material being distilled. The tunnel is divided into a series of compartments so that the products of any desired stage of the distillation may be collected separately. The material on the cars may be compressed, if necessary, during the distillation. The contents of the tunnel may be treated with steam, flue gases, or with a portion of the distillation products in order to effect desired chemical changes or for the production of a neutral or other atmosphere in the oven. The heat contained in the residual products is used for warming the air required for the combustion of the fuel.—A. B. S.

Heating liquids by the heat generated by chemical reactions; Apparatus for ——. H. Turrettini, Geneva, Switzerland. Eng. Pat. 117,601, 7.4.18. (Appl. 4041/18.) Int. Conv., 17.7.17.

AT the bottom of a cylindrical chamber is a cage containing quicklime, baryta, or the like, above which is a box containing acid, the bottom of the box being closed by a lead diaphragm. A fixed piston is placed between the lead diaphragm and the cage. The chamber is closed above by a cover provided with a screw plunger, whereby pressure may be exerted upon a lead cap in contact with the top of the acid-box, so as to displace the lead diaphragm, and discharge the acid on to the material within the cage. Escape of gases from the apparatus is ordinarily prevented by the lead cap, but should rupture of the lead cap occur, the gases can escape by way of notches in the plunger screw. The heater is inserted bodily in the liquid it is desired to heat.—J. S. G. T.

Lamp; Electric gas or vapour ——. F. Skaupy, Assignor to Deutsche Gasglühlicht A.-G. (Auerges.), Berlin. U.S. Pat. 1,291,209, 14.1.19. Appl., 9.6.16.

THE lamp consists of a receptacle containing a conducting substance which is made luminous by the current, and argon at such a high pressure that "the light column is contracted in cross-section and spaced away from the walls of the receptacle."—T. St.

Incandescence electric lamps, particularly for high illuminating powers. Ver. Glühlampen und Elektrizitäts-A.-G., Ujpest, Hungary. Ger. Pat. 309,094, 15.3.17.

THE electrodes of the lamp are not fused into the glass but are connected with the external leads by means of pole vessels containing a substance which excludes the air and is a conductor of electricity. Heavy incandescence bodies may be used in such lamps, which can be constructed to give an illumination of 100,000 candle power.—J. F. B.

Incandescence lamps and apparatus with glass bulbs exhausted of oxygen; Sealed-in wires for ——. Schweiz. Glühlampenfabrik A.-G., Zug, Switzerland. Ger. Pat. 309,313, 10.2.18.

THE wires are composed of a core of base metal surrounded by a composition made up of a mixture of glass or similar material with a difficultly fusible metal free from platinum. For instance, powdered metallic tungsten is made into a paste with water and intimately mixed with powdered glass; the wire is coated with the paste which is then heated to the fusion point, so that it forms a strongly adherent layer over the wire. Wires coated with this composition can be fused into glass in the same manner as platinum wires.—J. F. B.

Vacuum [e.g., in X-ray tubes]; Method of producing and maintaining ——. W. D. Coolidge, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,289,672, 31.12.18. Appl., 5.2.16.

SEE Eng. Pat. 104,230 of 1916; this J., 1917, 448.

III.—TAR AND TAR PRODUCTS.

Tar from gas producers using lignite as fuel. F. Schulz and V. Kabelač. Mitt. Industrieförderungsinst. Handels- u. Gewerbekammer Prags, 1917. Chem. Zentr., 1919, **90**, II., 26—30.

THE tar from gas producers in which lignite is used as fuel somewhat resembles wood tar. In the determination of asphaltum by Holde's method (precipitation with alcohol from ethereal solution; this J., 1897, 471) only traces are obtained; "normal benzine" (Holde, this J., 1909, 831), however, precipitates nearly half the tar.

3—4 grms. of tar is digested with 40 times its weight of "normal benzine" at a gentle heat and filtered after 24 hours. The insoluble residue is then extracted successively with hot benzine and hot chloroform and the soluble extracts are determined. On prolonged extraction with light petroleum spirit or hot alcohol the tar is almost entirely dissolved. The tar from ordinary producers contains about 10% of water and that from Mond producers about 30%. In the laboratory the greater part of the water may be separated by allowing the tar to settle at about 90° C. The separated tar is then dehydrated at about 140° C.; calcium chloride is unsuitable for drying the tar and tar oils, owing to the presence of phenols. In the distillation of the tar the first oil comes over at 215°—225° C.; the distillate is colourless at first but later turns brown. Distillation proceeds normally up to 290° C.; cracking then begins and oils containing paraffins distil from 300° to 310° C., leaving 20% of coke residue; during cracking the temperature of the boiling pitch rises to 400° C. The distillation of the tar yields about 30% of first running oil, boiling up to about 290° C. and free from paraffins, and about 50% of cracked oil containing paraffins. The first running oil contains organic acids, phenols, nitrogenous bases, unsaturated aromatic and saturated hydrocarbons. The phenols are partly soluble in water; on shaking the oil with dilute caustic soda in the absence of air, a yellow solution is obtained which immediately turns red in the air and finally black. After extracting the phenols with 5% caustic soda a further extraction is obtained by shaking with 20—25% lye; the extract absorbs oxygen but does not turn red. After removing phenols and bases the oil is still liable to turn black or brown and reacts strongly with concentrated sulphuric acid It may however be refined with an acid containing less than 80% sulphuric acid. After refining and distilling, the oil does not change its colour and the unsaturated hydrocarbons may be precipitated by diluting the waste acid. The phenols are highly oxidisable and deposit a black resinous mass from which the simple phenols may be distilled with steam. Treatment of the oil with petroleum spirit in the presence of a little water precipitates a heavy oil which contains the greater part of the phenols; this is due to the formation of a phenol hydrate. Treatment with a small quantity of 75% sulphuric acid also precipitates a heavy oil very rich in phenols, but these separations are not complete.

—J. F. B.

Anthracene, carbazole, and phenanthrene; Solubilities, separation, and purification of ——. [*Determination of carbazole.*] J. M. Clark. J. Ind. Eng. Chem., 1919, **11**, 201–209

For the recovery of anthracene, carbazole, and phenanthrene from "anthracene oil," the solids are separated by cooling, the creosote oil drained off, and the residual crystals centrifuged or pressed A typical sample contained 30·1% of anthracene, 22·0% of carbazole, and 47·9% of phenanthrene. For the separation of these compounds 10,000 grms. of the mixture was slowly heated to 80° C. with 15,000 grms. of crude coal-tar naphtha, cooled to 30° C., and filtered. The insoluble portion (A) consisted of 4125 grms. of a mixture of 60·2% of anthracene, 35·1% of carbazole, and 4·7% of phenanthrene, whilst the soluble portion (B), after distillation of the naphtha, consisted of 5760 grms. of a mixture of 8·4% of anthracene, 11·1% of carbazole, and 80·5% of phenanthrene. The insoluble portion (A) was slowly heated to 80° C. with 10,000 grms. of light pyridine, cooled, and filtered at 15° C., leaving an insoluble portion (C) consisting of anthracene 85·2%, carbazole 13·6%, and phenanthrene 1·2%; and a soluble portion (D) consisting of 16·4% of anthracene, 72·2% of carbazole, and 11·4% of phenanthrene. The insoluble portion, C, was purified by further treatment with pyridine, sublimation, distillation after fusion with potassium and sodium hydroxides, and crystallisation from benzene, yielding a product (645 grms.) containing 99·91% of anthracene, 0·06% of carbazole, and 0·03% of phenanthrene The soluble portion, D, was treated with naphtha as before, and yielded 1241 grms. of insoluble solids containing 81·5% of carbazole This was purified by treatment with 98% sulphuric acid, and addition of water, which dissolved the sulphonated anthracene, and on subliming the insoluble portion 960 grms of 99·5% carbazole was obtained. The soluble portion, B, containing the bulk of the phenanthrene was again treated with naphtha and fractionated into an insoluble portion (825 grms.) containing 2·8% of phenanthrene, and a soluble portion (4872 grms.) containing 93·8% of phenanthrene. By fusion with alkali hydroxides, distillation, further treatment with naphtha, decolorisation with bone-black, and treatment with alcohol, 2490 grms. of pure crystallised phenanthrene was obtained. It was found that in the fusion with alkalis for the removal of carbazole the best results were obtained with a mixture of sodium and potassium hydroxides. For the purification of carbazole from anthracene by means of sulphuric acid a large excess of acid is required. In practice it does not pay to work up the "green salts" for anthracene unless they contain at least 15% thereof. For the determination of the carbazole the following modification of the Kjeldahl method is rapid and gives results in agreement with the Du Pont nitrometer method: A mixture of 0·5 grm. of the material with 30 c.c. of strong sulphuric acid and 0·7 grm. of mercuric oxide is digested for one hour over a low flame, then cooled, and, after the addition of 10 grms. of potassium bisulphate, boiled until clear. The liquid is cooled to 35° C., and diluted with 200 c.c. of water, 10 grms. of sodium thiosulphate added, and the whole made strongly alkaline and distilled.—C. A. M.

Nitro-groups; Estimation of —— in organic compounds by means of stannous chloride. J. G. F. Druce. Chem. News, 1919, **118**, 133.

The following modification of Young and Swain's method (J. Amer. Chem. Soc., 1897, **19**, 812) is found to give good results with nitrobenzene, *o*-nitrotoluene, *m*- and *p*-nitroanilines, *m*-dinitrobenzene, and *p*-nitrophenol (compare also Altmann, this J., 1901, 622): A weighed quantity (about 0·2—0·6 grm.) of the nitro-compound is placed in a 200 c.c. Erlenmeyer flask and about 30 c.c. of alcohol is added. A slow stream of carbon dioxide is passed through the flask while the latter is warmed on a water-bath. When the air of the flask is displaced by carbon dioxide, 50 c.c. of standard stannous chloride solution is introduced and the mixture warmed for 2 hours on the water-bath, the gas current being continued meanwhile. The flask is then allowed to cool and its contents titrated with *N*/10 iodine in presence of starch. The stannous chloride solution is prepared by dissolving 25 grms. of tin in 250 c.c. of concentrated hydrochloric acid and making up to 1000 c.c.; it is standardised against the iodine solution immediately before use, as it undergoes gradual oxidation.—T. H. P.

PATENTS.

Tar stills. J. Archer, Stockton-on-Tees. Eng. Pat. 123,880, 19.4.18. (Appl. 6667/18.)

In an apparatus for dealing with tar containing up to 40% of water, the tar is blown by steam pres-

sure from a steam-heated tar egg to an overhead tank heated by steam coils, from which it flows through a heat-interchanger to the still, which is shallower than the usual type and is provided with partitions so that the tar takes a zig-zag course through narrow channels. The depth of the tar in the still is 4 to 6 inches. Fins equal in depth to the tar layer are arranged between the partitions on the inside of the bottom of the still to assist in the transmission of heat. Heat is supplied to the still by passing the products of combustion from gas burners through a zig-zag flue arranged below the still. The distillate is collected in a closed pot in which the oil and water are separated, and the waste gases are burned under the still. The residual pitch, on leaving the still, flows through the heat interchanger in the opposite direction to the tar.—S. S. A.

Benzol and other oils; Means of and apparatus for purifying — and washing or mixing two liquids of different specific gravity. M. W. Blyth and T. V. Miles, Sheffield. Eng. Pat. 123,839, 11.3.18. (Appl. 4237/18.)

Benzol or other oil is fed into a tank provided with two valves, through one of which a regulated flow of benzol is admitted to a convoluted pipe, whilst the other valve admits a controlled quantity of benzol to the upper part of a tank containing sulphuric acid, thereby displacing the acid from the bottom of the tank through a siphon to the convoluted pipe where it mixes with the benzol. The benzol is purified by the acid as it passes down the pipe to a tall separating vessel from the bottom of which the spent acid is drawn off, the benzol flowing from an opening near the top through a pipe which enters a second tall cylinder midway between the top and the bottom. In this vessel the benzol is treated with caustic soda lye which is introduced at about the same level as the benzol, through a pipe entering the cylinder at the top. The caustic soda lye is drawn off by a siphon from the bottom of the cylinder, whilst the benzol flows from the top of the cylinder to other similar vessels in which it is washed with water in the same manner. The working of the apparatus is continuous.—S. S. A.

Creosote oil; Separating and purifying —. W. Crabb, West Hartlepool. Eng. Pat. 123,857, 22.3.18. (Appl. 5080/18.)

Crude creosote oil and sulphuric acid (1 : 3 by weight) are delivered in the proportion of 1 of acid to 160 of the oil, to the same part of the upper end of a lead-lined, sloping, horseshoe-shaped trough, provided with lead baffle-plates. The oil and acid mix intimately in the trough and flow from its lower end into a settling tank which is subdivided longitudinally by partitions having top and bottom holes at alternate ends, so that in filling the tank the mixture enters at one end and follows a tortuous course. Arrangements are made for drawing off the creosote oil and the acid layer from taps fixed at suitable levels.—S. S. A.

Para-nitrotoluene-ortho-sulphonic acid; Manufacture of —. S. V. Hintikka, Helsinki, Finland. Eng. Pat. 123,548, 17.1.18. (Appl. 1004/18.)

Twenty kilos. of *p*-cymene is sulphonated by slowly stirring with 60—80 kilos. of sulphuric acid (66° B., sp. gr. 1·84) at about 60° C. The product, consisting chiefly of cymene-α-sulphonic acid, is added to a slowly-stirred mixture of 18 kilos. of nitric acid (sp. gr. 1·48) and 20 kilos. of concentrated sulphuric acid, keeping the temperature at 40°—60° C. Instead of nitric acid, corresponding quantities of sodium or potassium nitrate may be mixed with the sulphuric acid, in which case the temperature is maintained at 60°—70° C.—L. A. C.

Naphthol and allied products; Manufacture of —. R. N. Wallach, Wappingers Falls, N.Y. U.S. Pat. 1,291,300, 14.1.19. Appl., 12.1.18.

A concentrated aqueous solution of a salt of a naphthalenesulphonic acid at about 100° C. is gradually fed into a covered vessel containing fused aqueous caustic alkali at about 300° C.—L. A. C.

IV.—COLOURING MATTERS AND DYES.

Indigo industry; Present position and future prospects of the natural —. IV.—Effect of superphosphate manuring on the yield and quality of the indigo plant. W. A. Davis. Agric. J. India, 1919, **14**, 21—41.

From the results of manurial trials made by various planters it is shown that manuring with superphosphate not only very greatly increases the yield of green plant per acre, but also gives a plant of very superior quality, on the Bihar indigo soils which have recently shown such serious signs of impoverishment. When the soil conditions are favourable, and these can be assured by proper manuring, enormous yields of indigo can be obtained even in a year of unfavourable climatic conditions and with the existing Java plant. A combination of green manuring with "sannai" and superphosphate is apparently an ideal one to ensure not only a high yield of plant but also high quality.—W. G.

Sulphur dyestuffs; Structure of highly sulphurised —. W. Zänker. Z. angew. Chem., 1919, **32**, 49—53.

When highly sulphurised sulphur dyestuffs are treated by the method previously described (this J., 1918, 685 A) for the conversion of the labile sulphur into sulphuric acid, the residual purified dyestuff yields a further quantity of sulphuric acid if again heated strongly in the air. This oxidation may be brought to completion by the following procedure, which results not only in the transformation of the labile sulphur into sulphuric acid but also in the coagulation of the whole of the adsorbed sulphur. From 30 to 50 grms. of the commercial dyestuff, either alone or with addition of the quantity of pure sodium sulphide just necessary, is dissolved in water and the solution filtered hot, the cooled filtrate being made up to about 3 litres and rendered faintly acid with acetic acid. After deposition of the dyestuff the liquid is decanted off, neither acetic acid nor neutral salts being detectable as a rule after six such decantations. Any difficulty in the deposition and decantation usually disappears if the water added each time is made just acid with acetic acid; the trace of adherent acetic acid is eliminated during the subsequent drying, but the sulphuric acid formed during drying should not then be determined by titration. The dyestuff is filtered off, dried at 100° C., and rubbed in a mortar with such a quantity of *N*/10 sodium hydroxide that the mass does not turn blue litmus paper (writing paper best) red. The drying and mixing with alkali solution are repeated until no further formation of acid is detectable. With dyestuffs yielding much sulphuric acid, a larger proportion of the sodium hydroxide solution may be added at first and the drying may be effected at a higher temperature, but 120°—130° C. should not be exceeded. With careful working the

sulphuric acid formed may be calculated from the volume of standard alkali added, but determination by titration in presence of phenolphthalein (*loc. cit.*) is preferable. When heated with sodium hydroxide solution, certain dyestuffs tend to form sodium salts, which do not yield their sulphur readily to solvents. After the above treatment the dyestuff is, therefore, moistened with very dilute acetic acid, freed from any excess of the latter, and dried. After removal of organic impurities by extraction with alcohol, the residue is extracted for 5—10 days in a Soxhlet apparatus with acetone or carbon bisulphide; this dissolves all the free sulphur, which has been brought by the treatment described into a much less highly disperse condition. The sulphur thus extracted amounts to 0·8—3%. The material may be subsequently freed from acetone or carbon bisulphide by a short extraction with alcohol or light petroleum, inorganic salts being then eliminated from the dried dyestuff by repeated lixiviation with water; in some cases the latter purification is impossible as the dyestuff itself dissolves in water. The dyestuffs ultimately obtained readily form voluminous precipitates, which assume a highly gelatinised condition, the water-content and capacity for swelling often exceeding those of gelatin. When dried, these jellies form hard, brittle masses, which behave as reversible colloids, rapidly gelatinising with water, especially in presence of a few drops of sodium hydroxide solution; repetition of this treatment destroys the power to gelatinise. The different extracted dyestuffs differ greatly in properties but they are all insoluble in ordinary organic solvents, and in sodium sulphide or alkali hydrosulphite solution they mostly dissolve more readily than the original products; the solutions have markedly inferior dyeing properties.—T. H. P.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

[*Wool*] *scouring process; Some problems relating to the* ——. S. A. Shorter. J. Soc. Dyers and Col., 1919, **35**, 55—58.

Soap acts as a detergent in two ways: by lowering the interfacial tension between water and grease and by stabilising fine emulsions and suspensions. The first effect may be studied by determinations of the "drop number" of soap solutions in mineral oil. Experiments showed that the influence of the concentration on the drop number increased at an extremely rapid rate up to 0·4% soap concentration, after which a further increase in concentration had but little effect. Thus it is not economical to employ stronger soap solutions. Experiments on the effect of soap on the stability of fine suspensions showed that there is a maximum effect at a concentration of 0·2—0·3%. The action of alkali in the soap is to increase the surface tension effect, even against mineral oils; the alkali also tends, if its concentration exceeds a certain small amount, to diminish the stabilising effect. In practice it is usually advisable to sacrifice to some extent the stabilising effect for the sake of obtaining a rapid initial emulsification. When piece goods are scoured with alkali alone the emulsification is due to the formation of soap on the surface layers by the action of the alkali on free fatty acid in the oil. For this purpose weak alkaline solutions are of no use, since they have no stabilising power. The alkali must be strong enough to form a sufficiently strong soap solution and there must be sufficient free fatty acid present in the oil. On the other hand, if the alkali be too strong, a soap solution cannot be formed owing to the coagulation of the emulsion droplets. The addition of soap tends to diminish this coagulating effect. When scouring with alkali alone, the oil should contain 30% of free fatty acid and it is better to avoid high concentrations of alkali in the initial stages until sufficient soap has been formed and dissolved to produce the requisite stabilising effect; better results should therefore be obtained by adding the alkali gradually. The emulsion produced with alkali alone is coarser than when soap is used. In some cases the detergent action is deliberately sacrificed in order to avoid the "bleeding out" of the colours, the strong alkali tending to salt out not only the soap but also the dyestuff. The exhaustion of the soap bath may be partly due to the removal of soap as a surface layer on the fine droplets of the emulsion, but the principal cause is fouling of the bath by dirt and grease.—J. F. B.

Raffia and cutocelluloses—composition and constitution. C. F. Cross and E. J. Bevan. J. Soc. Dyers and Col., 1919, **35**, 70—75.

Raffia is a complex tissue composed of a true epidermis or cuticle and underlying sclerenchyma, the cells of which are sufficiently elongated to rank as fibres; under most chemical treatments the two tissues exhibit a joint resistance. The material showed: moisture 8·9%; ash 2·7%; on boiling with 1% caustic soda solution the loss was 16·8% in 5 minutes and 24·3% in 60 minutes. The attack by aqueous caustic soda was not, however, sufficiently specific to afford a pure preparation of cellulose by the chlorination method. On the other hand, a preliminary treatment with alcoholic caustic soda broke down the resistance of the cutocellulose ester and subsequent chlorination yielded 42% of cellulose. The loss of weight with alcoholic soda was considerable: 39·94% with 2% NaOH and 46·7% with 5% NaOH. The residue after saponification was readily chlorinated, the lignone groups of the sclerenchyma fibres being attacked and the ultimate fibres, 2 mm. in length, being separated. The ratio of HCl formed to chlorine combined with the lignone was approximately 2:1. The isolated cellulose yielded 5·2% of furfural, as compared with 8% for the crude raffia. From the soaps of the alkaline hydrolysis, 11·12% of a fatty acid and 6·7% of a resin acid, the sodium salts of which are insoluble in alcohol, were separated. The fatty acid had a composition corresponding to the formula $C_{17}H_{32}O_3$, with one COOH and one OH group; iodine value (Wijs), 13·6%. The resin acid contained 58·4% of carbon and 10·0% of hydrogen. On fusion with aqueous sodium hydroxide at 250°—300° C. the separation of the fat constituent occurred with less modification, its lower acid value being held to indicate a higher molecular weight; the cellulose on the other hand was profoundly decomposed with formation of volatile acids. Conversion into viscose, benzoylation and acetylation of the raffia gave mixed reactions of no sharply differentiated character. Nitration gave results indicating profound oxidation of the fat and resin components. The lignin reactions of raffia are considerably suppressed; it does not combine with phloroglucinol and reduces permanganate only to a limited extent. Certain effects of nitric acid are specific: a mixture of 36 parts of glacial acetic acid and 2 parts of nitric acid to 5 of raffia at 95° C. gave the fat-resin complex in solution in a form showing minimum modification. Dilute aqueous nitric acid produced a structural cleavage between the cuticle proper (40%) and the sclerenchymatous tissue (60%). The cuticle proper closely resembles that of apple peel. The general characteristic of raffia is that of an ester of fatty and resin acids

with an oxidised modification of cellulose in intimate association with a lignocellulose ether. A purple reaction with ferric chloride, which is intensified by alkaline saponification, appears to be a characteristic of the complex tissue.—J. F. B.

Sal bark (Shorea robusta) and some physiological problems. C. F. Cross and E. J. Bevan. J. Soc. Dyers and Col., 1919, **35**, 68—70.

SAL bark is the product of an Indian tree and its extracts are largely employed for tanning. The original bark contains 10·5—12·6% of tannin, 10·2—10·8% of non-tannin extractive matter, and 8·5—9·8% of ash. The exhausted tan bark has been investigated from the point of view of a raw material for paper making. It yields 45% of cellulose by the chlorination method and the ultimate fibre has a length of 1·0—1·5 mm., but the material is not adapted for the industrial manufacture of bleached cellulose, although it may be converted into a brown pulp, suitable for wrapping papers and boards, with a yield of 40—42%. A peculiarity of this bark is the high proportion of ash, which is largely due to the presence of calcium oxalate. The exhausted bark contains 12—16% of oxalate, calculated as CaC_2O_4, existing largely, however, in the form of the binoxalate. This oxalate is not readily extracted in the cold, and for its recovery by an industrial process, it is necessary to steep the material in a solution containing 15% HCl. The extraction of the oxalic acid could be operated in conjunction with the manufacture of paper pulp. The authors discuss the possible hypotheses which would account physiologically for the production and accumulation of oxalic acid in the cortical tissues.—J. F. B.

Waxed paper; Recovery of paraffin wax from waste —— by extraction with volatile solvents. O. Kress and L. F. Hawley. J. Ind. Eng. Chem., 1919, **11**, 227—229.

BY shredding waste waxed paper and treating it with free steam in a beater for 2 days the amount of paraffin wax in the pulp was reduced to 0·9%, but the pulp was not suitable for regular use in an ordinary paper machine. Better results were obtained by extracting the wax with gasoline (b.pt. 90° to 140° C.) in a vertical cylindrical extractor provided with a closed steam coil and a steam jet. After the extraction with the boiling solvent, steam was admitted, the solution drained off from the bottom, and the extraction continued with fresh solvent. By using 8 galls. of solvent to 20 lb. of paper in a series of 4 extractions, according to the counter-current principle, from 97·0 to 97·5% of the wax was extracted. Paper made from the recovered pulp was as strong as the original paper, and, after bleaching, could be used again for the manufacture of waxed paper.—C. A. M.

Acetone. Bassett. *See* IIb.

PATENTS.

Viscose; Process for the precipitation of —— for the production of artificial threads and other structures. G. Walther, Crefeld, Germany. U.S. Pat. 1,292,544, 28.1.19. Appl., 9.6.14.

SEE Fr. Pat. 473,256 of 1914; this J., 1915, 546.

Material resembling celluloid from fish scales. U.S. Pat. 1,264,979. *See* XV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Titanium compounds; Properties and uses of some —— [in dyeing etc.]. J. Barnes. J. Soc. Dyers and Col., 1919, **35**, 59—62.

TITANIUM salts are employed as mordants for alizarin dyestuffs, logwood, etc., as a constituent of a red colouring matter in combination with tannin and as stripping agents for dyestuffs and reducing agents in analysis. The most important commercial salt is titanium sodium sulphate $TiO(SO_4Na)_2,2H_2O$. It is very difficult to dissolve in pure water and is at once decomposed by boiling water, giving insoluble metatitanic acid. By adding a certain amount of sulphuric or oxalic acid it may readily be dissolved by heating. A strong solution may be prepared by frequent stirring with 2—3 parts of cold water for several days. This solution may be diluted to a certain point without decomposition or it may be neutralised and rendered basic by the addition of alkali, provided it be kept cold and concentrated; by moderate dilution of the basic solution the titanium is precipitated as hydroxide; on heating the precipitate is converted into metatitanic acid which is useless from a tinctorial point of view. After addition of a certain amount of sulphuric acid to a highly diluted solution of the sulphate, the latter may be heated to 40° C. without serious change. By stirring 1 part of the salt with 9 parts of a cold solution of Glauber's salt at 5° Tw. (sp. gr. 1·025) for several days a solution containing 2% of TiO_2 may be obtained which is stable in the cold and may be diluted almost indefinitely with weak sodium sulphate; such a solution is useful for fixing tannin in mordanted goods. Titanium potassium oxalate, $TiO(C_2O_4K)_2,2H_2O$, is now replaced by the cheaper sodium salt. In using these salts for leather dyeing it is important to add sufficient oxalic acid to combine with the whole of the calcium in the water. The ammonium salt is more soluble than the potassium salt and is not so readily obtained free from iron; with the addition of sodium acetate it may be dried on cotton without tendering. Titanium tanno-oxalate is simply a solution of titanium tannate in oxalic acid. Titanous salts may also be used as mordants by steeping the cloth in a solution of the chloride or sulphate, squeezing and exposing to the air; a considerable deposit of TiO_2 in the fibre is thus produced and may be increased by preparing the cloth with Turkey-red oil or tin. With titanous solutions, any iron present has no deleterious effect. Titanium browns are more resistant to light than the sulphur colours. Any shade of brown may be obtained on tanned yarn by combining iron with the titanium sulphate liquor and varying the shade by adjusting the acidity of the bath, the iron tannate being more sensitive to acids than the titanium. J. F. B.

PATENT.

Textile fabrics; Stop motion for machines for treating —— with liquids. F. Wood and T. France, Huddersfield. Eng. Pat. 123,626, 26.3.18. (Appl. 5259/18.)

THE invention relates to mechanism whereby the operation of the machine is stopped automatically in the event of the drafts of fabric or any of them failing to pass through the respective openings in the guide rail, or the draft of fabric winding around one of the nipping rollers, or the breakage or failure of the belt which transmits motion to the draw roller.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sulphuric acid; Manufacture of —— from galena. Goldmann. Metall u. Erz, 1919, **16**, 41—48.

A CONTACT plant for the manufacture of sulphuric acid from galena has been in operation at the Binsfeldhammer lead smelter, Stolberg, since January 1912. The ore mixed with about 20% of limestone is subjected to preliminary sintering in a cylindrical coke-fired furnace the sole of which has a diameter of 6—8 m., and revolves at a speed of 20 revolutions per hour. The mixture, which contains 11% of sulphur, thus loses 10% of its sulphur content; the furnace gas contains 0·15—0·20% of sulphur dioxide. The moistened material is then blast-roasted in an automatic Dwight-Lloyd-von Schlippenbach sintering pot containing 24 compartments, 16 of which communicate with a fan; the other eight are used for cooling and re-charging. The fuel consumption is ½—¾%. The richest gas from the first 8 compartments contains 4—5% of sulphur dioxide; the poorer gases from the last 8 compartments are led into the first compartments. The total cost of roasting is M. 3·12—3·50 per metric ton. The most difficult problem, elimination of the fume from the gas current, was eventually solved by the use of filters containing sawdust resting on wood shavings, which becomes impregnated with lead fume and is renewed from time to time. The platinum contact mass has been in use for 3 years without regeneration.—W. R. S.

Nitric acid; Concentration of — M. Kaltenbach Chim. et Ind., 1919, **2**, 142- 152

PRELIMINARY concentration of nitric acid to 65-68% is effected by heating with gases obtained by the combustion of solid or liquid fuel. The plant consists of a series of closed earthenware pans, arranged in cascade and connected by tubes. The acid and hot gases flow in counter-current. The series of pans is divided into two distinct parts. In the first part the acid is heated to the boiling point, whilst the second part forms the concentrator proper. The vapours pass to a tower divided into two sections. In the lower portion the vapours from the pans meet weak nitric acid which is thereby concentrated on its way to the pans. In the top portion of the tower the last traces of nitric acid are absorbed by a spray of cold water. The vapours issuing from the top of the tower pass to an ejector-condenser of the barometric column type which maintains the apparatus under diminished pressure. The weak acid recovered in the top portion of the tower may be used in washing towers for the recovery of nitrous vapours. For further concentration of the acid, distillation in admixture with a dehydrating agent, such as sulphuric acid, is necessary. A plant is described in which the sulphuric acid is introduced at the top of a tower of volvic stone, granite, or acid-proof metal, where it meets with the weak nitric acid. The nitric acid is vaporised at the bottom of the tower by steam. After contact with the sulphuric acid, the dehydrated nitric acid emerging from the top of the tower is conveyed to condensers. The resistance of the system is overcome by a vacuum pump. The efficiency of the process is best controlled by compiling a heat balance sheet. The author indicates in detail the factors affecting the balance and a table is given which combines the results of several trials. It is shown that the proportion of steam required, relative to the amount of water evaporated, rises as the nitric acid becomes more concentrated. The production of a tower is relatively lower as the concentration is increased. By superheating the steam to 450° C. and preheating the sulphuric acid to 90° C. there is an increase of 11·5% in the production of a tower treating 45% acid, whilst the amount of sulphuric acid required is reduced by 18% and the quantity of steam injected by 38·5%. The concentration of the two acids and the rate of their delivery to the tower require careful control.

—S. S. A.

Hydrocyanic acid; Manufacture of ——. H. A. Pelton and M. W. Schwarz. Chem. and Met. Eng., 1919, **20**, 165 -166.

HYDROCYANIC acid is produced by the interaction of sodium cyanide and dilute sulphuric acid, an excess of acid being used to prevent the formation of dark tars. Sodium cyanide solution (30%) is slowly run into dilute sulphuric acid contained in a 50-gallon steam-jacketed lead-lined vessel, provided with a mechanical stirrer, and the hydrocyanic acid evolved, together with steam, passes through a column packed with coke into a reflux condenser consisting of a coil of 1 in. diam. iron piping surrounded by ice. Condensed liquor runs back into the still and the cooled gas is passed through a much larger ice-cooled condensing worm, from which the liquefied hydrocyanic acid runs into a sheet iron cylinder surrounded by ice. The receiving cylinder is provided with a bottom outlet pipe and a vent pipe at the top. Towards the end of the reaction, the charge in the still is heated to boiling by means of steam to expel the last traces of hydrocyanic acid. The contents are run out from a bottom discharge while hot to avoid trouble from crystallisation. An average yield of 78% of the theoretical quantity has been obtained, the acid having a purity of 90–95%, and a production of 250 lb. per 24 hours was maintained in a plant of this capacity. Provision is made for brine cooling and more accurate temperature control in an enlarged plant, and a bisulphate tower is introduced between the main condenser and the receiver to obtain more efficient dehydration, as the stability of the acid is dependent upon its purity.—C. A. K.

Ammonium salts; Simple apparatus for obtaining —— from the gas liquor in small gas-works. M. Heineken. J. Gasbeleucht., 1919, **62**, 30—31.

THE gas liquor flows from a high level lead-lined wood reservoir about 1 cb.m. in capacity, through a coke or charcoal filter into a tank, where it is nearly neutralised with waste hydrochloric acid or sodium bisulphate, and is then run into evaporating pans at a lower level. These are heated by means of a water- or sand-bath, the coke from the filter being utilised for heating the bath. About 175 kilos. of sodium bisulphate is required to neutralise 1 cb.m. of gas liquor containing 2·5% of ammonia. The resulting salt contains 9 to 15% of nitrogen.

—C. A. M

Lead; Determination of —— in lead salts. R. L. Morris. Chem. and Drug., 1919, **91**, 242—243.

INVESTIGATION of the B.P. method for the determination of lead in pure lead salts (precipitation as oxalate and titration of the precipitate with permanganate solution) showed that low results are obtained unless the precipitation is made in relatively concentrated acetic acid solution. The following procedure is recommended:—0·5 grm. of lead acetate is dissolved in 50 c.c. of 50% acetic acid, the solution heated to boiling, and 1 grm. of oxalic acid is added; when cold, the precipitate is collected on an asbestos filter, washed with water to remove all free oxalic acid, then transferred to a vessel containing 150 c.c. of hot 6% sulphuric acid and titrated with *N*/10 permanganate solution.

—W. P. S.

Manganese dioxide; Process for the regeneration of ——. P. Hulot. Ann. Chim. Analyt., 1919, 1, 85—87.

Owing to the scarcity and high cost of natural manganese dioxide, various methods have been proposed for the regeneration of dioxide from waste products or the conversion of manganese compounds into the dioxide. These methods include oxidation of manganous oxide with nitric acid, calcination of manganous nitrate or manganous carbonate, fusion of manganous carbonate with potassium chlorate, action of chlorine on manganous carbonate suspended in water; action of manganous chloride on permanganate; and action of sodium hypochlorite on manganous chloride. The products obtained by these methods do not contain more than 70 to 80% of MnO_2. A product containing 95% MnO_2 may be obtained by treating Weldon mud with 20% nitric acid which dissolves the excess of calcium carbonate and leaves the manganese dioxide unattacked.—W. P. S.

Zirconium oxide; Partial purification of ——. A. J. Phillips. J. Amer. Ceram. Soc., 1918, 1, 791—800.

Crude zirconia when sintered with sodium carbonate and then leached with weak acid was not freed from iron oxide. Repeated roasting of zirconia with ammonium chloride, sodium chloride, sodium sulphate and carbon, sodium sulphide, sodium fluoride, or sodium fluoride and borax also proved unsatisfactory. Extraction with hydrochloric acid did not reduce the iron oxide below 0·62%. The best results were obtained by passing a current of moist chlorine vertically through the zirconia mixed with 4% of finely powdered petroleum coke, moulded into balls and packed in a cylindrical furnace heated externally to 900° C. (See also J. Chem. Soc., May, 1919.)—A. B. S.

Carbon monoxide in hydrogen; Instrument for the determination of small quantities of ——. E. K. Rideal and H. S. Taylor. Analyst, 1919, **44**, 89—94.

In the apparatus described the carbon monoxide is oxidised to carbon dioxide by preferential catalytic combustion. The catalyst consists of a mixture of iron and chromium oxides to which small quantities of ceria and thoria are added; between 200° and 300° C., this catalyst oxidises the carbon monoxide completely but does not attack the hydrogen. The hydrogen in which the carbon monoxide is to be determined enters the apparatus through an inlet tube and its volume is measured by a Venturi-type gauge; it then meets a supply of oxygen (obtained by electrolysis of sodium hydroxide solution between nickel electrodes) and is conducted to the catalyst chamber which is heated to about 230° C. The exit gases from the chamber pass to an absorption column filled with glass wool through which is flowing, at regulated speed, a standard (about *N*/200) calcium hydroxide solution. The latter absorbs the carbon dioxide and, as it leaves the column, is passed through a small electrolytic cell where the conductivity of the solution is measured. A knowledge of the speed of gas and liquid flow and of the strength of the calcium hydroxide solution, and observation of the electrical measuring instrument, enable the percentage of carbon monoxide in the original gas to be obtained, or the percentage may be read directly by using a suitably graduated chart in a recording type of instrument.—W. P. S.

Polyatomic gases; Calculation of the chemical constants of ——. A. Langen. Z. Elektrochem., 1919, **25**, 25—45.

The following "chemical constants" (Nernst, Verhandl. Deuts. Phys. Ges., 1916, **18**, 102) have been calculated: NO, 0·92; O_2, 1·021—0·539; CO, −0·04; N_2, −0·05; CO_2, −0·406; H_2O, −1·930; and NH_3, −2·454. From these values the Einstein function of the specific heat has been calculated and the following values obtained: H_2, 430; NH_3, 67·5; H_2O, 30; CO_2, 7·23; O_2, 0·736; and NO, 0·543.—J. F. S.

Feld's polythionate process. Sander. *See* IIa.

Titanium compounds. Barnes. *See* VI.

Zinc from sulphuric acid chamber sludge. Broughton. *See* X.

Nitrous fumes in air. Toombs. *See* XIXb.

Patents.

Nitric acid; [Towers for use in the] manufacture of ——. B. Dawson, Bradford. Eng. Pat. 123,344, 14.11.17. (Appl. 16,692/17.)

A tower for scrubbing the gases from the condensers in the manufacture of nitric acid is provided at the bottom with a tank containing water, a water supply pipe, and a draw-off cock. Below the level of the water is a nozzle or nozzles connected with a compressed air supply, whereby the water is forced upwards and descends again into the tank as a fine spray. An inlet pipe just above the level of the water and an outlet pipe at the top of the tower are provided for the gases.—L. A. C.

Nitrogen oxides; Production of ——. E. B. Maxted and G. R. Ridsdale, Walsall. Eng. Pat., 10,781, 26.7.15.

A mixture of ammonia and oxygen is passed at 400° C. to 600° C. over a catalyst containing iron oxide and the oxide or hydroxide of another metal appreciably electronegative to iron and reduced but not melted at the temperature employed in the catalytic oxidation of ammonia, together with the oxide or hydroxide of an alkaline-earth metal. For example, 100 parts by weight of pure crystallised ferric nitrate and 10 parts by weight of pure copper nitrate are dissolved in water and precipitated by the theoretical quantity of sodium hydroxide or sodium carbonate. The precipitate is well washed with hot water, and stirred with a paste containing 15 parts by weight of slaked lime. The mixture is partially dried, formed into lumps, and heated to about 500° C. to give stability. Alternatively, the calcium hydroxide may be incorporated by dissolving 30 parts by weight of calcium nitrate together with the ferric nitrate and copper nitrate, and precipitating as above.—S. S. A.

Pyrites furnaces. E. C. Bracq, Paris. Eng. Pat. 118,094, 1.7.18. (Appl. 11,020/18.) Int. Conv., 22.2.17.

In a pyrites furnace of the type with helical hearths and scraper arms, the mechanism driving the arms is situated beneath the furnace and the shaft is in two separate portions, the upper part carrying the scraper arms being connected to the lower part, which reaches just above the floor of the furnace, by tenons and screw-threaded rods. The upper end of the shaft works in a bearing supported by girders, the other ends of which are secured to pivot pins in the furnace walls. By disconnecting the shaft from the bearing and pivoting the girders about the supporting pins, the top of the furnace can be uncovered and the upper portion of the shaft together with the scraper arms removed from the furnace after loosening the screw-threaded rods connecting the two parts of the shaft.—L. A. C.

Ammonium nitrate; Manufacture of ——. W. T. Gidden, Oldbury. Eng. Pat. 6048, 22.4.15.

A SUITABLE apparatus for the manufacture of ammonium nitrate consists of a closed vessel provided with a stirrer and thermometer, outlets at the top and bottom respectively for steam and the finished product (the latter opening being closed during the process by a plug), an inlet pipe for ammonia gas reaching nearly to the bottom of the vessel and through which hot air may also be blown if desired, and an inlet for nitric acid. Sufficient water, nitric acid, and ammonia or ammonium nitrate solution is run into the apparatus to seal the ammonia tube, and then, with the stirrer in motion, nitric acid and ammonia gas are passed in simultaneously, the rates of feed being so adjusted that the mixture is kept slightly acid. When the temperature reaches 145° to 155° C., its further increase is checked, if necessary, by the addition of water, but care must be taken that the total amount of water added, including that present in the nitric acid, does not exceed the amount which can be evaporated by the heat of the reaction. The amount of water present in the final product may be reduced to about 0·06% by blowing hot air through the charge for an hour as soon as the addition of the nitric acid and ammonia is complete, and then, after the charge has been run out into trays and allowed to solidify, pulverising it in a disintegrator whilst still hot.—L. A. C.

Ammonium nitrate; Manufacture of —— *from ammonium bicarbonate or the components thereof and sodium nitrate.* F. A. Freeth, Great Crosby, and H. E. Cocksedge, London. Eng. Pat. 12,410, 28.8.15.

AMMONIUM bicarbonate is treated with sodium nitrate in solution of such concentration, that on the completion of the reaction, sodium bicarbonate separates out. This is removed and washed. The liquor which is saturated with sodium bicarbonate, ammonium nitrate, and ammonium bicarbonate at the reaction temperature, is concentrated and cooled, when ammonium nitrate crystallises. This is washed with water and dried, and the washing liquor is used together with the mother liquor from the ammonium nitrate crystallisation and the washing liquor from the precipitated sodium bicarbonate for dissolving fresh quantities of sodium nitrate. For example, a reaction mixture of sodium nitrate and ammonium bicarbonate is prepared so that after the separation of sodium bicarbonate the liquor contains 161 parts by weight of ammonium nitrate, 40 parts by weight of sodium nitrate, and 100 parts by weight of water. The solution is concentrated until it contains 100 parts by weight of sodium nitrate to 122 parts by weight of water. It is then cooled to 25° C., and 40% of the ammonium nitrate originally present in the concentrated solution crystallises.—S. S. A.

Calcium nitrate; Process for the production of ——. S. Smith, and The Ammonia Soda Co., Ltd., Northwich. Eng. Pats. 10,595, 21.7.15, and 1059, 22.1.16.

CALCIUM chloride solution is treated with excess of sodium nitrate, the liquor is concentrated until the boiling point reaches 140° C., and after removing the sodium chloride which separates, it is cooled to 60° C., thereby producing a further separation of sodium chloride which is removed together with any other salt held in suspension. The remaining clear liquor is diluted until it has a boiling point of 128° C. and further cooled, when calcium nitrate, $Ca(NO_3)_2,4H_2O$, crystallises. Artificial cooling may be employed. The process is applicable to the production of pure calcium nitrate from the waste liquor of the ammonia-soda process and from other waste liquors.—S. S. A.

Alumina nitrates; Production of —— *from clay, argillite, and similar minerals.* Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania. Eng. Pat. 120,035, 23.7.18. (Appl. 12,001/18.) Int. Conv., 25.9.17.

ALUMINIUM nitrate is prepared from clay, argillite, etc., by heating the mineral with nitric acid, in an autoclave under pressure, whereby dissociation of the nitric acid at high temperatures is prevented. The silica which separates is in a granular state and is easily removed by filtration.—L. A. C.

Nitrogen compounds from carbides; Manufacture of ——. O. F. S. Carlson, Ljunga Verk, Sweden. Eng. Pat. 123,796, 9.2.18. (Appl. 2386/18.)

CALCIUM carbide intimately mixed with a catalyst (fluorspar, calcium chloride) and with an indifferent substance, is treated with nitrogen in a multistage furnace provided with a stirring mechanism for each shelf. The intensity of the stirring is regulated in inverse ratio to the proportion of substances added to the carbide. The added substances, assisted by the stirring, promote rapid extension of the reaction throughout the mass, and prevent sintering, or dissociation of the calcium cyanamide formed. The product is porous and easily crushed. About 80% of the nitrogen employed is absorbed.—S. S. A.

Magnesium carbonitride; Process of making —— *in blast-furnaces.* E. W. Haslup, Bronxville, N.Y., Assignor to Gilchrist, Haslup and Peacock, Inc., New York. U.S. Pat. 1,291,498, 14.1.19. Appl., 9.8.18.

A MIXTURE of magnesium oxide with sufficient carbon to maintain a reducing atmosphere during the reaction is heated in a blast-furnace to a temperature sufficient to produce magnesium carbonitride, which is withdrawn from the reaction zone as fast as it is formed.—L. A. C.

Sodium monochromate; Process for transforming —— *into bichromate.* Soc. Industrielle de Produits Chimiques, Paris. Eng. Pat. 119,219, 25.1.18. (Appl. 1467/18.) Int. Conv., 31.8.17.

SODIUM chromate is converted into bichromate by treatment with carbon dioxide in the presence of a quantity of water insufficient to dissolve all the sodium chromate at 15° C.; an organic solvent, *e.g.*, ethyl or methyl alcohol, acetone, etc., may also be added. Pressure and agitation assist the reaction. Sodium bicarbonate is removed by filtration, and sodium bichromate obtained from the liquor by evaporation and crystallisation. A very small quantity of water may be employed for the reaction, in which case sodium bichromate is extracted from the product, with water and/or an organic solvent. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 1642 of 1892; this J., 1893, 156.)—L. A. C.

Carbonic acid gas; Manufacture of ——. F. Barrett, Staines, and A. J. Pennington, Manchester. Eng. Pat. 123,898, 14.5.18. (Appl. 8072/18.)

LIMESTONE is charged into a horizontal retort which is built into a combustion chamber, and heated by the products of combustion from a furnace. A spiral metal coil is fixed in the combustion chamber for superheating steam which is introduced into the retort through a perforated spraying pipe. The products of combustion and the steam are passed through a non-return valve into a cooling coil which condenses the water, and thence to a vessel in which the water is separated and drawn off, whilst the gaseous products pass through one or more scrubbers to a gas-holder or a compression apparatus.—S. S. A.

Extracting apparatus for sulphur. Eng. Pat. 123,645. *See* I.

Cement and alkali. Eng. Pat. 117,460. *See* IX.

Concentrating acetic acid. U.S. Pat. 1,291,025. *See* XVIII.

VIII.—GLASS; CERAMICS.

Glass analysis; Methods of —— with special reference to boric acid and the two oxides of arsenic. E. T. Allen and E. G. Zies. J. Amer. Ceram. Soc., 1918, 1, 739–786.

TOTAL arsenic may be rapidly and accurately determined by isolating the arsenic as sulphide, oxidising this to arsenic acid, then reducing with hydrochloric acid and titrating with iodine as recommended by Gooch and Browning (Amer. J. Sci., 1890, 3, 40, 66). 1 grm. of the glass is fused with 3 grms. of sodium carbonate and about 0·1 grm. of potassium nitrate. The fused cake is treated with water, evaporated with 10 c.c. of sulphuric acid (1 : 1), the solution diluted with hot water, boiled, and the silica and any insoluble sulphates are filtered off under reduced pressure, washed with boiling water, and sucked dry, the total bulk of the filtrate being kept down to 100 c.c. The residue is heated with sulphuric and hydrofluoric acids to remove the silica, then boiled with water and filtered, the filtrate being added to the principal one. To the mixed filtrates a fragment of potassium iodide is added, the solution is heated, and the arsenic precipitated with hydrogen sulphide. After standing over-night, the liquid is filtered, the residue dissolved in a little strong ammonia, or digested with ammonia and ammonium carbonate, 3–5 c.c. of 3% hydrogen peroxide added, and the solution boiled to oxidise the arsenic and decompose the excess of peroxide. The solution is diluted to 100 c.c. with hot water, treated with 0·3 grm. of potassium iodide, and boiled vigorously in a current of carbon dioxide to expel the free iodine. After boiling down to 40 c.c., a little more water and a fragment of potassium iodide are added and the boiling continued, these operations being repeated until reduction of the arsenic acid is complete. The solution is then diluted quickly with 75–100 c.c. of cold water, cooled rapidly in ice water, treated with 12–14 c.c. of a saturated solution of potassium carbonate, neutralised with solid sodium bicarbonate, and titrated with a standard solution containing 1·1 grm. of iodine per litre; 1 c.c. of the iodine solution is equivalent to 0·5 mgrm. As_2O_5. To determine the quinquevalent arsenic the arsenious acid is removed as arsenic trifluoride by heating the glass with hydrofluoric and sulphuric acids, and the residual arsenic acid is determined as above. This method is not affected by ferrous or ferric iron, chlorine, or platinum. Boric acid may be most satisfactorily determined by Chapin's method (this J., 1908, 1180). Where the amount of boric acid to be determined is very small the use of glass apparatus—which may contain boric acid—should be avoided. The results are not affected by small amounts of fluorides and arsenic. Iron may be determined by decomposing the glass with sulphuric acid and hydrofluoric acid as in determining quinquevalent arsenic, and boiling the residue with water. Lead and arsenic are removed from the filtrate by means of hydrogen sulphide. If zinc is present, the solution is neutralised with sodium carbonate and 0·3–0·5 c.c. of 50% formic acid added before passing the hydrogen sulphide. The filtrate is boiled to expel hydrogen sulphide and the iron precipitated by ammonia in the presence of hydrogen peroxide. The insoluble sulphates (if any) are leached with ammoniacal ammonium acetate to remove lead sulphate, and the residue is ignited in a platinum crucible, fused with potassium bisulphate, the iron in the product extracted by dilute sulphuric acid and precipitated by ammonia. The combined ferric oxide precipitates are fused with potassium bisulphate, dissolved in water, the solution reduced by hydrogen sulphide, filtered, boiled in a current of carbon dioxide which has been washed with copper sulphate solution, and titrated with permanganate. Jena glasses contain an almost constant amount (0·1–0·2%) of Fe_2O_3. Zinc is determined by decomposing 1 or 2 grms. of the glass with hydrofluoric and sulphuric acids, precipitating the arsenic as sulphide in acid solution, then nearly neutralising the filtrate and precipitating the zinc as sulphide. Alternatively, the arsenic and zinc may be precipitated together in a slightly acid solution, the precipitate dissolved in hot hydrochloric acid (1 : 1), and the zinc determined by evaporating to dryness with sulphuric acid, heating to redness, and weighing the zinc sulphate; by precipitating with sodium carbonate, filtering, igniting, and weighing as carbonate; or by evaporating with sulphuric acid, cooling, diluting to 100 c.c., adding an excess of caustic soda, acidulating with 0·5 c.c. of glacial acetic acid, diluting to 150 c.c., and electrolysing at the ordinary temperature, using a rotating platinum cathode coated with copper and a potential difference of less than 4 volts. Lead and barium in glass are best determined by precipitating them simultaneously as sulphates, and determining the barium directly in a separate portion. Aluminium may be separated from barium and calcium either by precipitating it cold with ammonium sulphide in faintly ammoniacal solution, allowing to stand all night, filtering, dissolving the precipitate and precipitating the alumina with ammonia, or by a double precipitation with ammonia in the usual manner. As the proportion of alumina in glasses is small, the ammonia used should be free from alumina and silica and should be kept in gold or ceresin bottles. In the analysis of borosilicate glasses after separation of the silica as described above, the residue should be evaporated twice with methyl alcohol to remove boric acid. Alkalis are preferably determined by the Lawrence Smith method, the mixed chlorides being treated with methyl alcohol to expel any boric acid. Gases occluded by glass are determined by heating *in vacuo* in a silica tube at 1200° C. and analysing the gases in the customary manner.—A. B. S.

Arsenic in glass; Condition of —— and rôle in glass-making. E. T. Allen and E. G. Zies. J. Amer. Ceram. Soc., 1918, 1, 787–790.

THE major part of the arsenic in all the glasses examined by the authors was in the quinquevalent state but a portion was present in the trivalent state. With regard to the part played by arsenic in removing small bubbles from glass ("fining"), careful analyses indicate that up to 30% of the arsenious acid added is lost by volatilisation; some is oxidised even at low temperatures, but the product slowly dissociates at a higher temperature into oxygen and arsenic trioxide, both of which assist in the fining.—A. B. S.

Clays; Microscopical examination of ——. R. E. Somers. J. Wash. Acad. Sci., 1919, 9, 113–116.

QUARTZ in medium or coarse grains is readily distinguished by means of its index of refraction, low interference colour, and lack of cleavage. Smaller grains of quartz resemble kaolinite, from which it is distinguished by its more angular shape and more rapid extinction. Kaolinite—when sufficiently large—is distinguished by its low index of refrac-

tion, low birefringence, flaky nature, and a tendency to form fan- or worm-shaped bunches. The smallest particles show as minute transparent plates with a low interference colour and an index of refraction close to that of the balsam used as mounting medium. Hydromica represents a transition stage between sericite and kaolinite, due to weathering. It has single and double refractions higher than those of kaolinite, but lower than those of muscovite or sericite. Hydromica forms "fans" similar to those of kaolinite, but it may occur in larger grains. Halloysite occurs in plate-like grains and is isotropic. Rutile was present in every clay examined, sometimes in grains or prisms 0·015 - 0·020 mm. diam., but more generally as minute needles, 0·001—0·010 mm. diam. and 5 or 6 times as long as they are wide. The interference colour is of the first order, but the particles are so small that the birefringence is very high. Tourmaline is well marked by its pleochromatism. Epidote is occasionally seen as a greenish mineral of moderate single and double refractions. Zircon and titanite are frequently present as grains of high refractive index and high birefringence; titanite may be distinguished from zircon by its higher interference colour. Diaspore occurs in regular grains with a moderately high refractive index and double refraction; it may be separated from clay and quartz by means of bromoform (sp. gr. 2·8) in which diaspore (sp. gr. 3·4) sinks whilst the other minerals float. The relatively coarse particles of clays average 0·100 mm. or more in diam., the medium grains 0·020–0·025 mm., and the fine grains 0·010 mm. or less. In clays which have been fired at 950°, 1150°, and 1300° C. respectively and then ground to thin sections, quartz grains are more clearly visible under the microscope than in the raw clay. Hydromica disappears or loses the greater part of its interference colour when heated to 1150° C., unless the grains are very large. Kaolinite appears to retain its shape and much of its interference colour. Tourmaline and epidote disappear at 1150° C., but rutile, zircon, and probably titanite seem to be unaffected at 1300° C. Sillimanite was observed in a Florida clay fired at 1300° C.; it was probably formed from kaolinite or hydromica, as one composite flake of kaolinite and sillimanite was observed. In some clays a double refraction is produced in the ground mass by firing at a sufficiently high temperature. The relative proportions of the above-mentioned minerals in a large number of American clays are shown in tabular form.

—A. B. S.

Slag; Influence of temperature upon the action of — upon refractory materials. R. M. Howe. Chem. and Met. Eng., 1919, **20**, 167–168.

A LABORATORY test of the penetration of slag (35 grms.) contained in a cavity ($2\frac{1}{2}'' \times \frac{1}{2}''$) bored in a firebrick gives a reliable relative indication of the service of bricks in works practice. At any given temperature of testing, variation of the time factor and the quantity of slag have no pronounced effect, and a reaction time of 2 hours is in general use. Increase in temperature has a marked influence and in several cases an increase of 100° C. resulted in nearly doubling the area of penetration. The lives of furnace linings should not be compared on a daily, or tonnage, basis when one furnace is worked at a moderate, and another at a forced rate, as if a furnace is operated at a higher temperature so that the output of metal is increased by 50%, it cannot be expected to last even two-thirds as long (during which time equal tonnage would have been produced) as if worked under the normal conditions.

—C. A. K.

Purifying zirconia. Phillips. *See* VIII.

PATENTS.

Electrical apparatus for subjecting articles to varying temperatures [e.g., for annealing glass]. W. E. Prescott, Harlesden, and G. R. Baker, Willesden. Eng. Pat. 123,545, 22.12.17. (Appl. 19,041/17.)

A SERIES of receptacles attached to a conveyor is caused to pass at a desired speed through a chamber, the receptacles being provided with a number of electrical resistances, the terminals of which make movable contact with suitable contacts in the chamber so that the temperature therein may be raised or lowered, as required, by varying the voltage of the electric current employed as a heating agent. The apparatus is specially useful for annealing glass.—A. B. S.

Millstones; Artificial — and the manufacture thereof. W. S. and G. S. Barron, Gloucester. Eng. Pat. 123,377, 18.2.18. (Appl. 2848/18.)

A HARD abrasive material such as emery, corundum, French burr, or quartz is granulated, mixed with 25–33% of its weight of Portland cement and a suitable proportion of calcium chloride solution of sp. gr. 1·04, and made into the desired shape. After the initial set, the stone is immersed in water for 3 weeks, then dried for 3 weeks in a chamber through which are passed sulphur-free furnace gases. The dry stone is then immersed for 4 or 5 days in a solution of alkali silicate of sp. gr. 1·08, washed in hot water, and dried.—A. B. S.

Glass and batch therefor. W. C. Taylor, Assignor to Corning Glass Works, Corning, N.Y. U.S. Pats. 1,292,147 and 1,292,148, 21.1.19. Appl., 27.3.16. Renewed 25.6.18.

SEE Eng. Pats. 118,397 and 118,398 of 1918; this J., 1918, 584 A.

Aluminous abrasives and process of making the same. Norton Co., Worcester, Mass., Assignees of L. E. Saunders and R. H. White, Niagara Falls, N.Y., U.S.A. Eng. Pats. 113,959 and 118,592, 7.2.18. (Appls. 2254 and 2257/18.) Int. Conv., 12.2.17 and 2.8.17.

SEE U.S. Pats. 1,240,491 and 1,263,710; this J., 1917, 1130; 1918, 418 A.

Sealed-in wires for glass bulbs. Ger. Pat. 309,343. *See* IIB.

IX.—BUILDING MATERIALS.

PATENTS.

Cement; Method of manufacturing simultaneously hydraulic — and alkali from alkaliferous mineral substances and lime. Patentaktiebolaget Jungner's Kall-Cement, Norrkoping, Sweden. Eng. Pat. 117,460, 11.7.18. (Appl. 11,369/18.) Int. Conv., 11.7.17.

A MIXTURE of an alkaliferous mineral, such as felspar, and lime is burned in a fuel-heated shaft or rotary kiln at about 900° C. to expel water and carbon dioxide, and the hot mass is then transferred to a resistance or radiating electric furnace and heated at about 1450° C. until sintering occurs, the alkali being volatilised. The alkali is recovered in a purer form than when the whole of the heating is effected by fuel. A suitable electric furnace consists of a tilting or semi-rotary cylinder lined with refractory material and containing a number

of parallel plates of carbon or graphite which are placed longitudinally in the cylinder and are supported at each end by alternate blocks of conducting and non-conducting material. Electrical contact is made through pieces of conducting refractory material which are pressed on to the plates by means of screws extending outside the cylinder and serving as terminals. The calcined material is introduced into the spaces between the carbon plates. The volatilised alkali is collected on the metal cover of the electric furnace, and when the heating is finished the cover, with the adherent alkali, is removed and the cement-clinker in the body of the furnace is discharged by tilting the cylinder. The alkali may be carbonated, if desired, by placing the cover with its contents in a chamber through which the gases from the calcining chamber are passed.—A. B. S.

Bricks and the like and process of making the same. A. C. Spencer, Washington, D.C. U.S. Pat. 1,269,331, 11.6.18. Appl., 24.8.17.

A MIXTURE of lime and greensand or glauconite (a double silicate of potassium and iron) is heated until the particles are softened externally and is then compressed into bricks or other structural shapes. For example the clinker obtained by the process described in U.S. Pat. 1,209,219 (this J., 1917, 218) may be moulded whilst still hot and plastic.—A. B. S.

Waterproof cement; Process for making — and the product thereof. H. M. Olson and F. J. D. Westell, Los Angeles, Cal., U.S.A. Eng. Pat. 123,695, 26.9.18. (Appl. 15,712/18.)

SEE U.S. Pat. 1,283,546 of 1918; this J., 1919, 77 A.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron and steel; Unification of methods for the analysis of — —. A. Marinot. Ann. Chim. Analyt., 1919, 1, 87—93. (See this J., 1919, 143 A.)

THE following methods are suggested. *Nickel.* In the absence of chromium this metal is determined electrolytically after ferric chloride has been removed by extraction with ether. If chromium is present, the cyanide method is recommended. One grm. of the metal is dissolved in nitric acid, the solution diluted with water, treated with 50 grms. of ammonium chloride and a large excess of ammonia, cooled, diluted to 500 c.c., and filtered; 250 c.c. of the filtrate is neutralised with hydrochloric acid, 2 c.c. of ammonia, 10 c.c. of 4% potassium iodide solution, and exactly 5 c.c. of 0·2% silver nitrate solution are added, and the mixture is titrated with potassium cyanide solution which has been standardised against the silver nitrate solution and a solution containing a known amount of nickel. The silver iodide first formed is dissolved completely by the cyanide solution only when the double salt (potassium nickel cyanide) is formed, and the disappearance of the last trace of silver iodide is taken as the end-point. *Chromium.* The solution resulting from the determination of the manganese (*loc. cit.*) is treated with nitric acid, any pink coloration which develops is destroyed by the addition of arsenious acid solution, 10 c.c. of the latter is then added in excess, and the mixture is titrated with permanganate solution. Three mols. of arsenious acid are equivalent to 4 mols. of chromic acid (CrO_3). *Copper* is precipitated as sulphide by means of sodium thiosulphate in acid solution, the sulphide is ignited to oxide, the latter dissolved, and the copper determined iodometrically. *Titanium.* The portion of the metal insoluble in potassium cupric chloride solution (Carnot and Goutal, this J., 1890, 521) is ignited, treated with hydrochloric acid, and fused with a mixture of potassium nitrate and potassium carbonate; the mass is treated with water, the insoluble portion fused with potassium bisulphate, the mass dissolved in sulphurous acid solution, filtered, the filtrate treated with acetic acid and sodium acetate, boiled, and the precipitated titanic acid collected, ignited, and weighed. *Aluminium.* After the greater part of the iron has been separated by the ether extraction method, the remaining iron and the aluminium are precipitated as hydroxides; the precipitate is dissolved in hydrochloric acid, the solution treated with concentrated sodium hydroxide solution, the mixture heated, cooled, and an aliquot portion of the clear liquid treated with ammonia. The precipitate is collected, re-dissolved in hydrochloric acid, and the aluminium precipitated as phosphate in the presence of a slight excess of ammonia. *Tungsten.* Silica and tungsten are separated together by dissolving the metal in nitric acid and evaporating the solution with the addition of sulphuric acid in the usual way; after ignition, the silica is removed by treatment with hydrofluoric acid and the residue of tungstic acid is weighed.—W. P. S.

Iron; Determination of oxygen in —. P. Oberhoffer. Stahl u. Eisen, 1918, 38. 105—110.

A DESCRIPTION of the construction and use of apparatus for the determination of oxygen in iron. The metal is heated to 900°—1000° C. in a current of hydrogen (generated by electrolysis of one-third saturated caustic potash) in a quartz tube in an electric resistance furnace. The total time required for an estimation is one hour.—W. R. S.

Phosphorus in steel, cast iron, and basic slag; Estimation of — —. A. Travers. Chim. et Ind., 1919, 2, 133—141.

THE high results usually obtained by the phosphomolybdate method of determining phosphorus are due to precipitation of MoO_3 along with the phosphomolybdate; in a properly conducted estimation, the error due to silica and iron oxide is negligible. To obtain complete precipitation of the phosphomolybdate an excess of molybdate must be employed, together with a corresponding excess of ammonium nitrate, and to avoid precipitation of free MoO_3, the separation is effected in a strongly acid (HNO_3) medium. Thus 1 grm. of steel is treated with 15 c.c. of nitric acid of 24° B. (sp. gr. 1·2), a few c.c. of permanganate solution (20 grms. per litre) is added, and the precipitated manganese dioxide redissolved by addition of sodium nitrite. 10 c.c. of nitric acid of 36° B. (sp. gr. 1·33) is added and the solution boiled for 3 or 4 minutes. Then 25—30 c.c. of molybdate reagent is added, and the precipitation is hastened by scratching the beaker with a glass rod. After a few minutes the precipitate is centrifuged. The total error in the results obtained by this rapid method, including experimental error and traces of SiO_2 and Fe_2O_3, is not greater than 0·005%. The nitric acid should not contain arsenic. Hydrofluoric acid and fluorides retard the precipitation of the phosphomolybdate, and may prevent it entirely.—S. S. A.

Galvanised sheet iron; Resistance of — to rusting. M. Schlötter. Stahl u. Eisen, 1919, 39, 243—248.

THE comparative rates of corrosion of 20 samples were determined by dipping them in dilute sul-

phuric acid and weighing them at regular intervals until all the zinc was removed, which was easily ascertained by the cessation of the evolution of gas. All the samples of material galvanised in a bath of molten zinc were stripped after less than 1 hour's immersion, while those coated electrolytically required more prolonged contact. This may be explained by the greater purity of the electrolytic deposit, which behaves like a sheet of pure zinc until sufficiently porous to expose some of the iron, when galvanic action is induced. In judging the resistance to corrosion, the time at which the corrosion curve attains its maximum should be considered, not that required to remove the whole of the zinc.—W. R. S.

Iron-carbon-chromium alloys; Structure of ——. T. Murakami. Twenty-fourth Report of the Alloys Research Inst. Sci. Rep. Tôhoku Imp. Univ., 1918, 7, 217—276.

The existence of Cr_4C is confirmed and a eutectic of Cr_4C and a solid solution of carbon in chromium shown to exist. The A2 point in steels is lowered by the addition of chromium. The following double carbides of iron and chromium are stated to exist: $(Fe_3C)_{18}Cr_4C$, $(Fe_3C)_9Cr_4C$, and $Fe_4C_4Cr_4C$. The first of these is magnetic, with a critical point at 150° C.; the other two are non-magnetic. By etching with an alkaline solution of potassium ferricyanide these three compounds may be distinguished from each other. The first is coloured brown both by boiling alkaline ferricyanide and by boiling sodium picrate, the second is coloured by the boiling ferricyanide but not by the picrate, while the third is coloured brown to blue in the cold. Cr_4C dissolves in the austenite above Ac 1, and on further heating dissociates according to the equation $2Cr_4C = Cr_3C_2 + 5Cr$. On cooling the reverse process takes place only slowly and the dissolved chromium is responsible for the lowering of the Ar 1 point. If the rate of cooling through 700° C. be sufficiently slow the normal Ac 1 point is found. A specimen which has a normal transformation point is troostitic or pearlitic, one having a lowered transformation is martensitic, while if the change is completely suppressed the steel is austenitic. The hardness of chrome steel is caused by the solid solution of Cr_4C and chromium in iron. By the addition of chromium the Ac 1 and Ar 1 points are raised and for high chrome steels the Ac 1 point is above Ac 2. The temperatures of the critical points for certain steels cooled from 900° C. were as follow:

% Cr	C %	Cooling			Heating		
		Ar 1	Ar 2	Ar 3	Ac 1	Ac 2	Ac 3
		° C.	° C.	° C.	° C.	° C.	° C.
4·44	0 27	650	720	650	830	760	830
9 32	0 39	640	700	640	840	760	840
13·7	0 74	640	690	640	840	760	840
0·86	0 98	680	680	680	780	780	780
4 42	0 95	685	685	685	790	790	790
9·33	1 09	690	690	690	820	780	820
24 3	0 65	Abs.	Abs.	Abs.	Abs.	Abs.	Abs.

The specific resistances of some of the samples are tabulated.

Chromium-carbon alloys with more than 5% of carbon are not acted on by any acid, even *aqua regia*. The "saturation" point of chrome steels, *i.e.* carbon per cent. at which ferrite ceases to occur, is lower than that of iron-carbon alloys, *e.g.*, 0·62 for 5% Cr, 0·45 for 10%, 0·35 for 15%, and 0·25 for 20% Cr. In the same way the carbon per cent. at which the "pig iron" eutectic (ledeburite) is first found is lowered by chromium from 2% in steel free from chromium to 0·6% for a content of 20% Cr. (See also J. Chem. Soc., May, 1919.)—F. G. Th.

Electric ferromanganese furnaces; Eliminating phosphorus and sulphur in ——. J. Lonergan. Chem. and Met. Eng., 1919, **20**, 245.

An attempt to smelt a high-phosphorus ore (0·32% P) with excess of lime failed, as the resulting ferromanganese contained 0·6% P. Tables are given to show the proportion of sulphur and phosphorus which can be eliminated in ordinary practice. The distribution of the elements is expressed as a percentage of the total sulphur and phosphorus charged into the furnace.

	Sulphur	Phosphorus
Metal	1·148	52·6
Slag	31·60	14·75
Duty metal and slag... ...	4·75	6·06
Dust and volatilisation (by difference) ...	59·40	31·40

It is assumed that the greater part is lost mechanically and that the phosphorus in the dust retains its original form. Calculating for a maximum of 0·25% P in the metal, and making allowance for the phosphorus content of the coal and lime, the maximum allowable percentage of phosphorus in a manganese ore is 0·17%. This figure has been substantiated by a furnace run of several months' duration.—C. A. K.

Copper; Influence of cold rolling upon the mechanical properties of oxygen-free ——. F. Johnson. Inst. of Metals, Mar., 1919. [Advance copy.] 12 pages.

The break in the curve of the tenacity of cold-rolled copper against the corresponding reduction of area during rolling discovered by Alkins (this J., 1918, 587A) for tough-pitch copper is fully confirmed for oxygen-free electrolytic copper. A second break, which was not however beyond doubt, appeared to exist for a 80% reduction. Results of the same order are obtained whether the tests are carried out on the materials as cast or in the annealed condition.—F. C. Th.

Corrosion of brass in sea-water. P. T. Bruhl. Chem. and Met. Eng., 1919, **20**, 239.

The effect of strain in the metal is not serious, as the method of manufacture does not permit of a difference in solution pressure greater than 0·0002 volt. Annealing increases the E.M.F. but the effect is small; rolling also imparts added energy to the metal. Bilge water and oil are harmful owing to the formation of corrosive sulphur compounds from the former and the hydrolysis of the oil by steam with the production of free acid. The rate of corrosion must be increased by the voltaic couples formed within the metal between the products of corrosion and the metal itself, and the deposits which are generally conceded to be injurious are the green oxychloride (which promotes de-zincification), carbon, and ferric hydroxide. Muntz metal, which consists of the alpha and beta phases, corrodes more rapidly than ordinary brass, which consists of the alpha phase only. In general, increase in temperature or an increase in the amount of carbon dioxide present, accelerates the corrosion of brass.—C. A. K.

Copper alloys; Properties of some ——. W. Rosenhain and D. Hanson. Inst. of Metals, Mar., 1919. [Advance copy.] 12 pages.

For copper-manganese and copper-manganese-aluminium alloys a process of pressure casting was adopted. The crucible containing the molten alloy was placed on a firebrick stand in an enclosure

in which the pressure could be raised to 30 lb. per sq. in. The molten metal was thus forced up an iron tube, ¾ in. internal diameter, into the hot mould to be filled. The bottom of the mould was heated to 500°—600° C. The pressure—which was at first regulated so that the mould was filled without splashing—was increased to 30 lb. per sq. in. and maintained until the metal had solidified. The manganese-copper alloys were deoxidised with 0·25% of aluminium and broken down in the rolls at 800° C. For annealing a temperature of 650° to 750° C. is satisfactory; the adherent oxide film formed on the surface is removed by pickling the hot alloy in hydrochloric acid of sp. gr. 1·1. The following results were obtained for the metals as rolled and after being annealed at 650° C. for half an hour:—

Al	Mn	Condition	Yield point, tons per sq. in.	Ultimate stress, tons per sq. in.	Elongation, % on 2 in.	Brinell no.
%	%					
3	0	Rolled	26 6	26 8	9	138
		Annealed	5 8	17 7	55	60
5	0	Rolled	34 3	35 1	17	175
		Annealed	8 3	25 5	70	85
7	0	Rolled	38 7	39 8	18	195
		Annealed	7 0	27 5	71	76
3	1	Rolled	26 2	26 8	11 5	142
		Annealed	10 0	20 2	50	73
5	1	Rolled	28 7	31 1	27	163
		Annealed	12 0	26 3	57	90
7	1	Rolled	34 1	35 5	28	184
		Annealed	11 5	29 3	65	100
2	5	Rolled	29 6	29 9	9	145
		Annealed	10 4	22 4	45	83
4	5	Rolled	35 0	35 7	10	182
		Annealed	11 3	26 7	55	95
6	5	Rolled	29·3	29 3	9	150
		Annealed	9 2	21 0	45	81

In the case of copper-zinc and copper-zinc-nickel alloys, borax as a flux was eminently satisfactory. These were not pressure cast.

Cu	Mn	Zn	Ni	Pb	Condition	Yield point, tons sq. in.	Ultimate stress, tons sq. in.	Elongation % on 2 in.
%	%	%	%	%				
95 5	4	—	—	0·5	Rolled	30	38	4 5
					Annealed	11	21	35
88	2	10	—	—	Rolled	35	37	5
					Annealed	8	21	41 5
87	3	10	—	—	Rolled	12	47	3
					Annealed	11	23	35
85	—	5	10	—	Rolled	31	34	—
					Annealed	8	20	—
88	—	7	5	—	Rolled	27·5	32 5	—
					Annealed	7	19	10 5
80	—	10	10	—	Rolled	35	39	3
					Annealed	10	21	35

—F. C. Th

Metals; Corrosion of* ——. *Fourth Report to the Corrosion Committee of the Institute of Metals. G. D. Bengough and O. F. Hudson. Inst. of Metals, Mar., 1919. [Advance proof.] (See also this J., 1911, 219; 1913, 913; 1916, 471.)

THE authors have studied the action of distilled water and sea-water on copper and zinc in some detail, and conclude that the initial action is a process of chemical oxidation rather than electrochemical displacement. Metallic zinc is normally covered with a partially protective scale, which consists largely of oxide or basic carbonate. Water containing carbon dioxide can attack or dissolve the oxidised layer, and zinc can then be found in solution as a slightly soluble bicarbonate. The attack on the scale begins at certain points, and a true metallic surface is exposed to the action of the water. At such places a peculiar form of oxide is formed on the surface of the metal. Probably this oxide contains zinc peroxide, and catalyses the corrosion of the underlying metal. It is slightly soluble and passes into solution, and is afterwards largely precipitated as the ordinary hydroxide and carbonate. The precipitated hydroxide has a distinctly protective action on the metal beneath it, and reinforces the original scale and enables it to resist the action of carbon dioxide. The action is thus localised. In the presence of very large amounts of carbon dioxide, as for instance, when the water is kept saturated by bubbling carbon dioxide through it, the products of corrosion are largely kept in solution and local action is almost entirely avoided, though the total amount of corrosion that takes place is increased. When metallic copper free from oxide is immersed in water a lower oxide Cu_4O or Cu_2O is immediately formed over the surface. This may become further oxidised at irregularly distributed spots, and the product thus formed does not protect the underlying metal from oxidation to the same extent as does the original tarnish layer. The dark oxidation product itself, which is probably a cupric hydroxide or basic carbonate, tends to flake off the metal, probably owing to the formation of bulky oxidation products beneath it. The latter are porous, and apparently amorphous, and probably act catalytically by increasing the rate of oxidation of the underlying metal. The amorphous oxide is slightly soluble, but it is finally precipitated from solution as crystalline cuprite, which has a lower solubility than the amorphous oxide. The result of the action ultimately is to cause shallow pits in the metal. Such pits are much less important than in the case of zinc. Experiments made to ascertain the effect of coupling together electrodes of different metals and immersing them in different electrolytes have led to the view that the effect of couples in some of the practical problems of corrosion has been overemphasised. The local severe pitting at or near the water-line in the case of aluminium and certain light alloys when immersed in distilled water and sea-water is considered to be due to the presence of a strongly acid salt. The nature of the action of distilled water on 70:30 brass has been studied in detail by means of the microscope and by analytical methods. The action is considered to be the chemical oxidation of the copper and zinc, and the partial solution of the oxidised products. Most of the zinc passes into solution, in the presence of carbon dioxide, and part of the copper, the remainder of both metals remaining on the surface of the alloy as an oxide scale. The scale becomes further oxidised and altered at certain spots which become covered with thick deposits of the products of attack. Such deposits are porous and allow, and probably accelerate, local attack on the underlying metal. The attack is accompanied by redeposition of copper by displacement by the zinc either electro-chemically or otherwise, and precipitation of cuprite. There are signs of slight local dezincification at such places, but the attack over the general surface of the alloy is complete corrosion. The positions at which local attack and pitting take place are not determined by the variation in the electrical properties of the original metal, but by the conditions of the experiment. In the presence of dilute acids, such as hydrochloric and sulphuric, local action of the type described does not occur, since there is little or no local accumulation of oxidation products. On the other hand, the absence of carbon dioxide retards the action. The action of sea-water is considered to be similar in type. Local pitting and dezincification are due to the accumulation

of the products of corrosion. The rate of corrosion is much greater than that in distilled water, and does not fall off so rapidly with time. At the ordinary temperature there is less tendency to local dezincification. Different batches of condenser tubes of 70 : 30 brass have been found to possess surface layers differing in behaviour from the underlying metal towards corrosive agents. It may become possible to adapt the surface layer to the conditions under which the tubes will be used. Local action initiated in condenser tubes by such bodies as clinker and coke is associated with the accumulation of products of corrosion and may be largely assisted by them. It is usually characterised by intercrystalline oxidation. Acidified water (5 to 10 parts of acid in 100,000 of water) produces accelerated corrosion and alters the type of action. Admiralty condenser tubes (Cu 70, Zn 29, Sn 1) are decidedly more resistant than 70 : 30 brass to the action of dilute acids. As regards the practical problem of protecting condenser tubes from corrosion the authors consider that no one single remedy is likely to be found effective for all the different kinds of attack which occur in practice. The nature of the tubes used and the protective measures chosen should be dependent on the particular set of conditions. A list is given of the characteristics which the cooling water should possess, and the chief causes of corrosion are tabulated with notes as to their action, together with suggested remedies. The effect of the presence of scale on the rate of corrosion is considered to be of great importance, and of the substances commonly occurring in scale, calcium carbonate is one of the most important. This compound may exert almost any kind of effect, according to its physical condition, from a considerable degree of protection to a serious attack. Observations of the working of the Cumberland process (this J., 1916, 51) at a power station near Brighton have shown that, under the conditions prevailing, a prolonged life of the tubes is ensured, provided that the process is applied to new tubes. The authors consider that the thin uniform scale which is maintained on the tubes by the process is an important factor in preventing serious corrosion. One of the important functions of the scale is to prevent contact between the tube and harmful deposits and products of corrosion; in addition, it retards, but does not entirely prevent, the general oxidation of the tube. Other possible methods of protection are briefly considered, and a preliminary account is given of a pre-oxidising process for reducing the rate of corrosion.—T. St.

Zinc; Electrolytic deposition of —— [*from sulphuric acid chamber sludge*]. H. E. Broughton. Chem. and Met. Eng., 1919, **20**, 155–162.

In the semi-pyritic method of smelting copper-zinc ores, all the zinc is lost, the greater part passing away as a fume containing over 40% of zinc, chiefly in the form of zinc sulphide, with smaller quantities of oxide and sulphate. The fume is carried over into the acid chamber and converted into zinc sulphate, and a sludge insoluble in the chamber acid is formed. Zinc sulphate is obtained together with other soluble sulphates by the agitation of the sludge with water, and lead sulphate and insoluble materials are allowed to settle. Purification of the clear liquor is necessary before electrolysis as elements electro-negative to zinc are present. The solution is neutralised and iron salts are precipitated by addition of marble, the precipitate being separated by an Oliver continuous filter. The liquor is then treated with metallic zinc to precipitate metals of lower potential, *e.g.*, copper, cadmium, bismuth. The time factor at this stage is important, and a slightly acid solution accelerates the reaction. Cadmium is never completely removed and as the deposited cadmium tends to re-dissolve, the liquor is quickly filtered without settling. Electrolysis is carried out in lead-lined wooden tanks with lead anodes and aluminium cathodes suspended from, and rigidly fastened to, aluminium bars above the tank. A current density of 17–20 amps. per sq. foot has been found most satisfactory, and in practice a 70% current efficiency is obtained. The presence of alkali sulphates has not a marked effect, but the use of a small quantity of an organic additive agent (glue) leads to more regular operation and less heating. The metal obtained is of superior quality, the impurities being 0·05% Cd, 0·03% Pb, and 0·02 Cu (Fe). In melting the metal slabs produced by electrolysis an addition of ammonium chloride prevents sponginess of the metal, and reduces loss of zinc by oxidation.—C. A. K

Lead and zinc: Metallurgy of the dry processes for the extraction of — —. K. Friedrich. Metall u. Erz, 1919, **16**, 21–31.

Losses in the recovery of lead are due to volatilisation of lead or lead compounds during the roasting etc., to removal of lead in the slag in the blast furnace, and to volatilisation etc. in the later processes of desilverisation etc. With modern plant and practice the loss during roasting can be kept down to 1% and a part of the volatilised lead will be condensed and can be recovered. This loss is partly mechanical, *i.e.*, dust, and partly true volatilisation, and the former can be considerably reduced. A well-sintered ore gives a considerably lower loss through dust formation in the blast furnace. The acid constituents of the gases from the roasting apparatus may be neutralised by limestone or zinc oxide. The most important of all the losses in the extraction of lead occurs in the finishing slag of the blast furnace, which contains 1·5%. Of the losses in the gases from the blast furnace 95% may be recovered by efficient condensation. Continental practice is tending ever towards poorer charges, down to 10% of lead, at which figure every 0·1% lead recovered from a slag containing 1·5% represents an increased yield of 0·9%. The volatilisation losses during the working up of the lead may be neglected. A lead-zinc alloy melted under lead chloride at 515° C. will be found on analysis to be free from zinc if the slag contains more than 4% of lead chloride; this may form the basis of a dezincification process. Silver sulphate from argentiferous sulphide ores commences to decompose at 1040° C. The addition of zinc oxide lowers this temperature to 1020° C., limestone to 590° C., magnesia to 510° C., lead oxide to 460° C., strontium oxide to 410° C., and barium oxide to 310° C. The losses in the extraction of zinc include the loss as dust and by leaching during storage; as dust and by volatilisation in roasting; and during distillation due to flaws in the furnace, to incomplete mixing of the ore with the reducing material, to the formation of dust, and to the presence of sulphur and iron in the roasted blende. The last source of loss is dependent on the skill with which roasting is carried out. The loss of zinc during roasting is about 1%. The elimination of the sulphur is never complete, 4–5% of the total sulphur remaining, the greater part as sulphate. Abnormally high losses in distillation - say 12% - are due to the flaws in the refractory material from which the furnace is made.—F. C. Th.

Aluminium and its alloys: Micrography of ——. D. Hanson and S. L. Archbutt. Inst. of Metals, Mar., 1919. [Advance copy.] 14 pages.

Iron occurs in aluminium and most of its alloys as $FeAl_3$, which is practically insoluble in solid aluminium; 0·1% of iron is readily detected. The compound is hard and whiter than aluminium

itself. Silicon forms a eutectiferous series with aluminium, the eutectic at 10·5% Si having a melting point of 570° C. Silicon in a micro-section appears somewhat darker than $FeAl_3$. The most suitable reagents for etching aluminium are 20% caustic soda and dilute hydrofluoric acid (not stronger than 5%). A 10% solution of hydrofluoric acid is useful to reveal the crystalline boundaries of aluminium itself; for the alloy caustic soda is better. $CuAl_2$ is best distinguished from $FeAl_3$ by etching with 20% nitric acid at 70° C. for two or three seconds. $CuAl_2$ is then coloured dark brown while $FeAl_3$ and most other constituents are unattacked. Zinc in commercial aluminium alloys is in solid solution and zinc-aluminium alloys are best etched for one minute in the caustic soda solution and the tarnish removed with an aqueous solution of chromic acid. Nickel forms with aluminium a compound $NiAl_3$ which has a very limited solubility in solid aluminium, and occurs as a hard white constituent very similar to $FeAl_3$. $NiAl_3$ is coloured brown by 5% hydrofluoric acid or 10% caustic soda. F. C. Th.

Chrome ironstone [chromite]; Errors in the analysis of ——, and a new process. J. Moir. J. S. Afr. Assoc. Anal. Chem., 1919, **2**, 9—16.

TESTS with synthetic mixtures containing known quantities of chromium showed that by the usual methods—fusion with sodium peroxide, alkali carbonates and nitrate, or potassium bisulphate—errors, generally minus, amounting to 10% of the quantity of chromium present are quite possible. By the following modification of the sodium peroxide fusion method the quantity of chromium found averaged 99·6% of that present, with a total variation of about 1%:—The finely-ground chromite is gently heated with 6—8 times its weight of sodium peroxide, in a thick, deep, iron crucible, until the initial effervescence ceases, and the melt is then maintained at low redness for 10 mins. (being agitated by rotation meanwhile), cooled, and extracted with water. After the addition of sufficient sulphuric acid (20%) to effect complete solution, 2 grms. of potassium persulphate or 3—5 grms. of ammonium persulphate is added to the liquid, which is then heated, at first rapidly to 80° C. and then slowly to boiling. The excess of persulphate is removed by diluting the liquid with about 25% of its bulk of sulphuric acid (20%) and boiling for 30 mins., and the solution is then cooled, diluted, and titrated with excess of standard ferrous ammonium sulphate followed by potassium permanganate. A marked red-brown colour in the final solution indicates the presence of permanganic acid (from manganiferous ore); it is discharged before titration by the addition of 2 drops of concentrated hydrochloric acid or about 1 mgrm. of benzoic acid to the nearly boiling liquid.—W. E. F. P.

Tungstic oxide; Reduction of ——. C. W. Davis. J. Ind. Eng. Chem., 1919, **11**, 201—204.

FOR the satisfactory reduction of tungstic oxide all water must be removed by drying in a current of air at about 500° C. When dried in a current of air at 100° C. the precipitated oxide retains 3·7% of water. The dried oxide is mixed with carbon by grinding together in a tube-mill with steel or wooden balls. At 650° to 850° C. the reduction produces a blue or purple oxide; at 900° to 1050° C. a chocolate brown mixture of oxides is obtained, whilst above 1050° C. a grey powder of metallic tungsten is left. To prevent oxidation the reduced material must be cooled in a reducing atmosphere. The ratio of tungstic oxide to carbon required varies from 10 : 1 to 10 : 1·6 according to the process used, the temperature of reduction, and the time. Part of the excess of carbon may be removed by washing the product. Reduction with wood charcoal in an iron tube in which the charge was kept in position by means of fireclay plugs yielded a product containing 98% tungsten, 0·3% carbon, and 0·8% silica. Since iron tubes are considerably oxidised at the reduction temperature (1100° to 1120° C.) it is advisable to use tubes of alundum or fireclay. Reduction with lampblack in fireclay crucibles gave a product containing 0·4% of carbon, which was reduced by washing to 0·1%. To prevent incomplete reduction of part of the material a continuous process was devised, in which the mixture of tungstic oxide and carbon was introduced into the upper end of a tube 3 ft. long and 1 in. diam., which was set at a slant in a furnace so that a portion of 9 in. was kept at about 1080° C. From time to time the material was poked through the tube, so that it was kept in the hot portion for about 30 mins., whilst the reduced portion was forced forward into the lower part of the tube, which was cooled with water. The final product contained 95·2% tungsten and 4·4% carbon, and, after washing with water, contained 98·5% tungsten. In experiments in which tungstic oxide was reduced by means of hydrogen, brown oxides were formed at 800° to 1000° C., whilst after 1½ hours at 1080° C. a product containing 99·4% of tungsten was obtained. Reduction with gasoline vapour for 2 hours at 1080° C. yielded a product containing 98% tungsten.—C. A. M.

Metals and alloys; Effect of work on ——. O. W. Ellis. Inst. of Metals, Mar., 1919. [Advance copy.] 15 pages.

THE existence of inversion points on the graphs connecting the percentage reduction of a metal by cold work and the corresponding tensile strength is shown for steel, copper, 70 : 30 brass, 60 : 40 brass, and 80 : 20 cupro-nickel. An explanation of this general phenomenon on the following lines is put forward. There exists a tendency at all temperatures for a cold-worked metal to recrystallise. For a certain amount of work this tendency to recrystallise becomes appreciably greater, and at this stage the effect of further cold work is lessened and a discontinuity in the curve is shown. The curve relating the amount of cold work with the work required to drive the rolling mill to produce further reduction also shows a change corresponding to that in the tenacity-reduction curve.—F. C. Th.

Flotation of oxidised lead ores. G. L. Allen. Chem. and Met. Eng., 1919, **20**, 169—175.

THE recovery of slime values, consisting principally of lead carbonate with some sulphide, is difficult in ordinary milling practice and a serious loss of lead and of silver often occurs. As the concentration of sulphide minerals has been successfully carried out by flotation processes, the author discusses the adaptation of this process by "sulphidising" the oxidised minerals with subsequent separation by flotation. The carbonates are treated with a soluble sulphide to convert them, at least superficially, into sulphides. This may be carried out as a wet reaction in the grinding mill, by the addition of a solution of hydrogen sulphide or sodium sulphide. The latter possesses a disadvantage in that the hydrolysis of Na_2S is almost complete and the formation of a strongly alkaline solution is detrimental to flotation. Sodium sulphide, however, is less active than hydrogen sulphide, and does not readily convert iron compounds, especially limonite, into the sulphide, and so a purer concentrate is usually obtained with this reagent. Cerussite, wulfenite, and cerargyrite (horn-silver) are easily converted into sulphide, but minium, anglesite, pyromorphite, vanadinite, and descloizite are less readily attacked and a poor recovery of the latter minerals is

effected. Pyrolusite and other manganese compounds, basic sulphate of iron, and lead peroxide interfere by reason of their oxidising effect on the sodium sulphide, and ferrous salts are undesirable owing to the consumption of the necessary sulphide to precipitate ferrous sulphide. It is calculated that only 6·9% of the theoretical quantity of sodium sulphide suffices to induce the flotation of a favourable ore.—C. A. K.

Sulphuric acid from galena. Goldmann. *See* VII.

Action of slag on refractories. Howe. *See* VIII.

Electrical synthesis of colloids. Svedberg. *See* XI.

PATENTS.

Iron alloys; Process of making ——. J. R. Speer, Trappe, Md. U.S. Pat. 1,291,220, 14.1.19. Appl., 3.5.15.

AN alloy "highly responsive to heat treatment" is made by melting together equal parts of charcoal iron and low-carbon steel with the addition of 0·50—2·0% of chromium and 0·25—1·0% of nickel. The molten metal is then cast.—C. A. K.

Manganese-steel; Method of making ——. *Process of recovering manganese-steel.* W. G. Nichols, Chicago Heights, Assignor to American Manganese Steel Co., Chicago, Ill. U.S. Pats. (A) 1,291,655 and (B) 1,291,656, 14.1.19. Appl., 2.3.17 and 31.5.17.

(A) MOLTEN metal is blown, the slag separated, and the metal weighed at about 1650° C. Manganese steel alloy at a temperature of about 1330° C. is added to raise the manganese content to 11—14%, and the mixed metal is poured. (B) Manganese steel is heated at an initial temperature below the oxidising temperature of manganese, and at successively increasing stages until the melting point of manganese steel is reached. When required for pouring, the necessary amount of manganese is added and the metal raised to a proper pouring temperature.—C. A. K.

Iron and steel; Solution for rust proofing articles of ——. W. H. Allen, Assignor to Parker Rust Proof Co. of America, Detroit, Mich. U.S. Pat. 1,291,352, 14.1.19. Appl., 11.1.17.

AN aqueous solution of phosphoric acid, manganese dioxide, and zinc.—T. St.

Metal; Process for cleaning ——. H. E. Finlay, Detroit, and F. L. Fangboner, Royal Oak, Assignors to Burroughs Adding Machine Co., Detroit, Mich. U.S. Pat. 1,290,952, 14.1.19. Appl., 8.6.17.

METAL articles are cleaned and protected from rust by pickling them in a hot solution of hydrochloric and nitric acids, then subjecting them to a cold solution of cyanide, washing, and finally immersing in oil heated to above 100° C.—T. St.

Copper sweepings and scraps; Process for treating ——. C. C. Cito, Brussels. Eng. Pat. 123,418, 28.2.18. (Appl. 3591/18.)

COPPER sweepings from foundries and smelting works may contain Cu 5 to 10, SiO_2 60 to 75, organic matter 5 to 10%, and small percentages of zinc, iron, tin, and antimony. To obtain the copper, the sweepings are roasted with crude common salt whereby either cupric chloride or cuprous chloride is formed, according to the temperature. The latter compound is volatile, and, if formed, is recovered in condensing apparatus. When cupric chloride is formed, the roasted mass is extracted with dilute sulphuric acid, the residue treated in a filter-press, and the copper precipitated from the liquor by scrap iron.—T. St.

Crucible furnace for melting metals. T. W. Aitken, Luton. Eng. Pat. 123,457, 3.5.18. (Appl. 7474/18.)

A BARREL-SHAPED crucible is supported horizontally in a furnace body on a longitudinal wall, which divides the chamber between the crucible and the furnace bottom into two flues. At the front end of the crucible the two flues turn upwards and communicate with a return flue on the upper side of the crucible. Each of the lower flues is provided with a high-pressure jet and the flames travel parallel with the crucible wall, thus reducing erosion. The upper portion of the furnace is constructed in two parts to facilitate replacement of the crucible, and the whole furnace is mounted, for tilting, on trunnions. C. A. K.

Spongy lead; Production of ——. V. G. Yourieff, Chingford, Essex. Eng. Pat. 123,587, 27.2.18. (Appl. 3505/18.)

A CURRENT is passed between a lead anode (*e.g.*, old accumulator plates) and a cathode of another material (*e.g.*, zinc), with a 20% solution of potassium or sodium hydroxide as electrolyte. The lead does not deposit on the cathode but is carried to the surface of the liquid by hydrogen bubbles, and may be collected at intervals as a spongy mass, which is neutralised and washed. A current density of about 12 amps. per sq. foot of anode surface is suitable.—C. A. K.

Castings; Composition for mending fissures in ——. W. F. Singer, Assignor to A. V. Fagerstrom, F. Clasby, and J. E. Fairbanks, Pueblo, Colo. U.S. Pat. 1,291,207, 14.1.19. Appl., 8.6.18.

A MIXTURE of 10 parts of graphite with 60 parts of molten sulphur.—T. St.

Alloy. L. W. Chubb, Edgewood Park, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,291,408, 14.1.19. Appl., 2.1.15.

AN alloy consisting of Fe 93 to 99, and Ni 7 to 1%, is suitable as a magnetisable member for use with inductions of 16,000 gausses and over.—T. St.

Zinc furnace; Vertical ——. F. Fiechtl, Cherryvale, Kans. U.S. Pat. 1,291,643, 14.1.19. Appl., 2.11.17.

A ZINC smelting furnace consists of a battery of vertical retorts with a movable charging car above. The charging car is fitted with at least one plunger for controlling the volume of material fed from the hopper.—C. A. K.

Aerating liquid [ore pulp]; Process for ——. F. B. Kollberg, Bisbee, Ariz., and M. Kraut, Los Angeles, Cal., Assignors to Southwestern Engineering Co. U.S. Pat. 1,261,556, 2.4.18. Appl., 8.11.16.

A DRUM with longitudinal riffles on its outer surface rotates in a chamber to which a mixture of ore pulp and oil is supplied. A curved plate extends around and close to part of the periphery of the drum. A thin layer of ore pulp is carried round by the drum and is aerated by air introduced into the drum and discharged through slots between the riffles. The air is held in the pockets between the riffles, and the pulp is drawn as a film over the air pockets whereby bubbles are formed. The aerated pulp is discharged from the drum into an adjoining chamber.—C. A. K.

Furnace for heat treatment. A. Smallwood, London. U.S. Pat. 1,290,384, 7.1.19. Appl. 19.9.16.

SEE Eng. Pats. 102,242 and 102,243; this J., 1917, 36.

Pyrites furnaces. Eng. Pat. 118,091. *See* VII.

Electrical etching. U.S. Pat. 1,291,310. *See* XI.

XI. ELECTRO-CHEMISTRY.

Colloids; Electrical synthesis of —. T. Svedberg. Kolloid-Zeits., 1919, **24**, 1–7.

METAL sols may be produced: (1) by passing a current of 10 amps. and 110 volts across a strip of gold or silver foil attached to a sheet of glass and immersed in alcohol, (2) by passing a similar current through thin strips or wires of platinum, copper, lead, zinc, or aluminium, stretched between two stout iron wires and immersed in alcohol. (See also J. Chem. Soc., May, 1919.)—J. F. S.

Reactions; Modality of — *and chemical dynamics; application to the phenomena of electrolysis and spectroscopy.* J. Meunier. Bull. Soc. Chim., 1919, **25**, 49–68.

A THEORETICAL paper. (See J. Chem. Soc., 1919, ii., 132.)—W. G.

PATENTS.

Electrical etching; Electrolytes for —. J. H. Weeks, Rutledge, Assignor to J. S. Weeks, Delaware, and R. M. Weeks, Philadelphia, Pa. U.S. Pat. 1,291,310, 14.1.19. Appl., 1.4.17.

THE surface to be etched is carried by the anode, the electrolytic bath being composed of an acidified solution in water of one or more of the chlorides of aluminium, ammonium, barium, cadmium, calcium, chromium, cobalt, copper, iron, lithium, magnesium, manganese, nickel, potassium, strontium, sodium, tin, zinc.—J. S. G. T.

Reaction in gases at high temperatures; Process for producing — *and apparatus for practising the same.* L. L. Summers, Chicago, Ill. U.S. Pat. 1,291,660, 14.1.19. Appl., 31.7.13.

A RELATIVELY inert gas is passed through the arc of an electric furnace until it is highly heated, and a material (in liquid form) to be combined with the gas is then injected together with a cooling liquid, which extinguishes the arc. Products of the reaction are immediately withdrawn and cooled.—C. A. K.

Spongy lead. Eng. Pat. 123,587. *See* X.

Electrical apparatus for subjecting articles to varying temperatures. Eng. Pat. 123,545. *See* VIII.

XII.—FATS; OILS; WAXES.

Naphthenic acids. Kolbe. *See* IIA.

Action of lipase on factice. Dubosc. *See* XIV.

PATENTS.

Hydrogenising oils and fats; Apparatus for —. H. Lane, Ashford, Middlesex. Eng. Pat. 123,966, 31.12.18. (Appl. 21,895/18.)

IN the apparatus described in Eng. Pat. 968 of 1915 (this J., 1916, 642) instead of using an exterior pipe for the circulation of the mixture of catalyst and oil, an inner vessel open at both ends is placed within the outer vessel. The agitator is within the inner vessel, and the mixture is withdrawn by a centrifugal pump at the lower end of the inner vessel and forced upwards into the annular space between the vessels, whence it overflows into the inner vessel.—A. de W.

Soluble substances [grease]; Apparatus for extracting — *[by volatile solvents].* W. E. Garrigues, New Orleans, La., Assignor to W. Garrigue and Co., Inc., New York. U.S. Pat. 1,282,407, 22.10.18. Appl., 3.10.17.

A HORIZONTAL rotating drum is provided with longitudinal perforated pipes arranged around its inner periphery and bent radially at one end where they terminate in a central hub attached to the drum. Solvent is introduced into the drum through a central valve at this end, and is discharged at the opposite end through a filter. When extraction is complete a hot gas (steam) is introduced through the hub to expel the residual solvent. The hub rotates on a fixed distributing member connected with a steam-supply pipe and constructed in such a way that steam is admitted to those pipes which are momentarily at the bottom of the drum, and cut off from those which are at the upper part of the drum. Steam is also passed through closed pipes within the drum in order to prevent condensation of water.—W. F. F.

Detergent soaps and means for and method of making the same. G. W. Douglass, Spondon. Eng. Pat. 123,835, 9.3.18. (Appl. 4160/18.)

A DETERGENT soap is prepared by dissolving a base soap (19–24%), with or without the addition of sodium silicate (up to 10%), in boiling water (20–25%), adding sodium carbonate (30%) and sodium bicarbonate (15%) and mixing thoroughly. A detergent spirit such as naphtha, benzol, carbon tetrachloride, or the like or a mixture of the same is then added in the proportion of 6%. The spirit may be added at the same time as the sodium salts.—A. de W.

Wool-fat and other similar substances; Process of producing high-melting fatty acids and hydrophilous neutral products from —. I. Lifschütz, Hamburg, Germany. U.S. Pat. 1,284,723, 12.11.18. Appl., 12.1.17.

SEE Ger. Pat. 286,244 of 1913; this J., 1915, 1153.

Extracting apparatus for oils, etc. Eng. Pat. 123,645. *See* I.

Drying oils from fatty acids. Eng. Pat. 123,792. *See* XIII.

Oleic acid isobutyl ester. Eng. Pat. 123,685. *See* XX.

Cetyl alcohol. U.S. Pat. 1,290,870. *See* XX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Pigments; Standardisation of colour as related to —. J. Lawrance. Oil and Colour Chem. Assoc., 1919, **2**, No. 6.

COLOUR measurements may be recorded on a "colour solid," where colours are plotted to a minimum of determinable values, *viz.*, "tone value," "purity value," and "hue value." The

colour solid takes the form of a graph with three axes at right angles to one another. Tone value, the position of a specified colour relative to black and white, or the amount reflected by its surface, is plotted in percentages on the vertical axis from pure black to pure white. Purity values are measured in distances at right angles to the vertical axis and determine in a colour the amount of admixture with a neutral grey of an intensity proportionate with its position in height on the vertical tone value axis. Colour circles bearing the primary colours on their circumferences at equal distances from one another are disposed about the vertical tone value axis and serve for measurement of purity values in angular measure clockwise from a primary colour. Thus, theoretically pure colours having equal tone and purity values would lie on the circumference of a circle of such diameter as to indicate no admixture with grey and at a height on the axis represented by 100% white. Any given colour can be matched by Maxwell's method of using interlocking discs of the standards chosen as primary colours, and black and white, and the position on the colour solid may be found from the results obtained. It being impossible to find standards of pure primary colours of equal visual intensity (tone value), the brighter colours, *e.g.*, lemon chrome etc., need to be toned down by neutral greys until they lie in the same horizontal plane as a grey consisting of 30% white and 70% black in order to be equivalent to the more sombre colours, such standards being then designated as of 30% tone value. The geometrical properties of the colour solid may be plotted as a polygon of colour forces and the resultant plotted. It has been found that apparent change in colour by visual inspection is not quantitatively identical with actual changes as measured by discs. Changes in hue value accompany reductions in the tone values of certain pigments by admixture although fairly good agreements were obtained from black and white in one case and yellow ochre in another. In the case of ultramarine blue and middle chrome, violets are obtained by admixture by discs, whilst greens are obtained by mixture of pigments.—A. de W.

Varnish analysis; Methods of — —. W. T. Pearce. J. Ind. Eng. Chem., 1919, **11**, 200—201.

VARNISHES of widely differing composition were prepared from weighed quantities of resins, colophony, oils, driers, and turpentine, and used to determine the degree of accuracy of different methods of analysis. In heating the resins in preparing the varnishes the loss in weight was between 20 and 30%, except when only resin was used, when it was 7%, whilst the loss in weight of the oils was from 1 to 2%. The results obtained by McIlhiney's method of determining rosin (this J., 1908, 866) agreed closely with the theoretical amounts, whilst for the separation of resins and oils Boughton's method (Techn. Paper 65, U.S. Bureau of Standards) gave results accurate within about 1%.
—C. A. M.

PATENTS.

Chrome yellows; Manufacture of —. E. F. Morris, Liverpool. Eng. Pat. 123,841, 12.3.18. (Appl. 4290/18.)

A LEMON chrome of greater staining power for a given lead chromate content is obtained by the use of a basic lead acetate solution which has been subjected to a preliminary treatment with chalk "or other purifying agent which will absorb lead oxide," the clear supernatant liquor being used.
—A. de W.

Matter in a finely-divided state [pigments etc.]; Art of producing —. J. Alexander, Assignor to National Gum and Mica Co., New York. U.S. Pat. 1,259,708, 19.3.18. Appl., 1.5.14.

SEPARATE solutions containing the various components of the compound to be prepared are treated with suitable protecting colloids and then mixed or otherwise caused to react. A much greater degree of subdivision is obtained by adding a protecting colloid to each of the components from which a precipitate is to be produced than when a protecting colloid is added only to one of the components. The process is applicable to the preparation of pigments, catalysts, etc. Examples are given of the preparation of the barium lake of Orange II, gum arabic being added both to the dye solution and to the barium chloride used as precipitant; and of lithopone by the interaction of barium sulphide and zinc sulphate, gelatin being added to both components.—W. E. F. P.

Linoleum and linoleum cement. A. B. Craven, Selby, and The Yorkshire Dyeware and Chemical Co. Ltd., Leeds. Eng. Pat. 123,791, 28.1.18. (Appl. 1600/18.)

THE fatty acids of drying oils and/or semi-drying oils or the glycerides of semi-drying oils (excluding tung, linseed, and soya bean oils), mixtures of the same, or the products from their refinement are converted into resilient, tacky, and adhesive products suitable for use as linoleum cements, by subjecting them, in the presence of a drier, to oxidation with gaseous oxygen or ozonised oxygen at a temperature not exceeding 110° C. The solidity of the resulting product is adjusted by varying the relative proportions of unsaturated and saturated acids and/or their glycerides by preliminary filtration and distillation to remove non-drying matter. The products may be incorporated with gum resins, rosin, aluminium hydroxide, etc.—A. de W.

Drying oils from fatty acids of linseed oil, other drying oils or semi-drying oils; Manufacture of —. F. Boehm Ltd., and C. A. Reihl, London. Eng. Pat. 123,792 (Appls. 1856, 1.2.18, and 2618, 13.2.18.)

A WELL-DRYING oil suitable for use as a linoleum oil, for waterproofing oil-cloth and floorcloth, or in the manufacture of paints, is obtained by heating fatty acids from drying or semi-drying oils to a temperature 20°—30° C. below their boiling-point in the presence of 0·25–0·5% of metallic copper, nickel, or cobalt whilst blowing in oxygen until the resulting product has attained a sp. gr. of 0·992—0·998. An addition of 12–15% of China wood (tung) oil together with a small percentage of an alkaline-earth soap greatly increases the speed of polymerisation.
—A. de W.

Resins; Manufacture of — *[from solvent naphtha].* F. W. Sperr, jun., Oakmont, Pa., and M. Darrin, Wilkinsburg, Pa., U.S.A. Eng. Pat. 123,806, 1.3.18. (Appl. 3664/18.)

SEE U.S. Pat. 1,263,813 of 1918; this J., 1918, 433 A. Strips of copper, silver, gold, or platinum, to act as catalysts, may be immersed in the liquid when it is being heated under pressure or when it is being distilled.

Proteids [for varnish, lacquers, celluloid-substitutes, etc.]; Process of recovering — *from vegetable proteid-containing material.* S. Satow, Sendai, Japan. Eng. Pat. 121,141, 28.6.17. (Appl. 9291/17.)

SEE U.S. Pat. 1,275,308 of 1918; this J., 1918, 669 A. The protein extract is purified by treatment in a

high-speed centrifugal separator, and filtration, and then, if a clear transparent solution is not obtained, is fractionally precipitated with an acid, *e.g.*, sulphuric or sulphurous acid, and the remaining liquid decanted and filtered until it is clear. Alternatively, the proteins may be precipitated from the extract together with the colloidal and suspended impurities, by addition of a limited quantity of sulphuric or acetic acid, and the precipitate treated with a weak solution of sulphurous or hydrochloric or other acid to dissolve the proteins. The purified proteins after the final separation are dried in a vacuum.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Devulcanisation of — — by hexamethylenetetramine under pressure. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9721–9722.

A SAMPLE of vulcanised rubber, after successive extraction with acetone, cold chloroform, hot chloroform, alcoholic potassium hydroxide, and water, was swollen with carbon tetrachloride and finely divided; the dry powder was then heated with a saturated aqueous solution of hexamethylenetetramine in a sealed tube by steam at 7 atmospheres pressure for 24 hours; the sulphur content was thus reduced from 2·179% to 0·367%. In similar experiments with steam pressures of 6 and 4 atmospheres respectively the final sulphur content was 0·432 and 0·742%; with a pressure of eight atmospheres the rubber undergoes considerable decomposition.—D. F. T.

Devulcanisation of rubber by catalysts. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9722.

THE effect of catalysts in vulcanisation is reversible and such compounds not only expedite the combination of sulphur with rubber but should also be able to aid the liberation of combined sulphur from vulcanised rubber. A boiling alcoholic solution of hexamethylenetetramine was found to reduce the combined sulphur in a sample of rubber from 2·667% to 1·495% (compare Spence, this J., 1917, 1056). Probably on account of the lower solvent power of water for sulphur and its feebler penetrative action on rubber, aqueous solutions of hexamethylenetetramine are less effective under similar conditions.—D. F. T.

Factice; Action of lipase on white — —. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9722–9727.

A WHITE factice of good appearance showed a tendency to become brown and sticky, the change being accompanied by the liberation of so much heat that the material on one occasion inflamed. Examination of the decomposed material revealed the presence of an increased percentage of acetone-soluble constituents and a marked diminution in the proportion of combined oils insoluble in acetone; glycerol was found in the aqueous extract of the damaged substitute. The alteration in the factice was therefore probably due to the presence of a lipase; a similar effect was produced in stable factice by moistening with a lipolytic extract prepared from castor oil seeds.—D. F. T.

PATENT.

Extracting apparatus for rubber. **Eng. Pat. 123,645.** *See* I.

XV.—LEATHER; HORN; BONE; GLUE.

Tannin compounds; Colloidal —— and their applications. C. F. Cross, C. V. Greenwood, and M. C. Lamb. J. Soc. Dyers and Col., 1919, **35**, 62.

THE authors deal with the application of the principle of restrained tannage, whereby skins may be completely tanned in a single treatment by a strong tanning liquor, which is prevented from forming a hard impervious layer, by the influence of a colloid which itself has an affinity for the tannin but parts with it to the hide substance. The colloid employed as a restraining agent is gum-tragasol, which in the form of a 3% solution is a fairly stiff jelly. The variations of viscosity of dilute solutions of the gum with temperature, concentration, and time of keeping have been studied. The viscosity increases very rapidly as the concentration is increased above 0·5%; it falls on keeping the solutions, apparently as the result of the activity of organisms. The gum, being a true hemicellulose, a manno-galactan, gives a precipitate with Fehling's solution in the cold and the condition of any sample of gum may be determined by estimating the amount of cupric oxide removed from Fehling's solution by this precipitate and the cuprous oxide formed by the hydrolysed products on boiling the filtrate. Although a hemicellulose, the gum gives solid films of great tenacity, comparable with those of colloid cellulose; tensile tests showed breaking lengths of 5300 to 8870m., and elongations of 5 to 7%. In practice, the proportions used are such as are represented by equal parts of a quebracho extract containing 25–29% of tannins and the commercial 3% tragasol jelly, both suitably diluted. The prepared hides may be steeped in this mixture and tannin added to replace that absorbed. The tannin strikes through in a remarkably short time as compared with that occupied in complete tanning with the plain extract. Alternatively, the treatment may be effected in the drum or Wilson tanning machine, using about 30% of tragasol calculated on the weight of the goods. Another way is to "drum" the hides in the strong tragasol jelly for 2–3 hours until they have become thoroughly impregnated with the colloid and then treat them with the strong tanning extract. By this method the reaction between the tragasol and the tannin takes place inside the goods. The interstices of the leather are filled with the tragasol-tannin compound and the product has a smoother, better filled texture than that tanned in the ordinary way; it is also less pervious to water and, the tannin being more protected from the action of the air, the colour is lighter than that of ordinary leather. The employment of the colloid has also proved advantageous in tanning with basic chromium sulphate, particularly in maintaining the plump and swollen condition of the fibres during the penetration of the chromium salt and in filling up the interstices, giving a superior finish and resistance to moisture. The composition of the tragasol-tannin compound corresponds to $2C_6H_{10}O_5$ to $1C_{14}H_{10}O_9$, but when the reagents are mixed in these proportions, precipitation is not complete; on increasing the tannic acid to 2 mols. the characteristic coherent coagulum is obtained. Further increase in the proportion of tannic acid is disadvantageous and lowers the viscosity.—J. F. B.

***Sal bark* (*Shorea robusta*).** Cross and Bevan. *See* V.

Titanium compounds. Barnes. *See* VI.

PATENT.

Fish scales; Method for treating ——. [*Material resembling celluloid*]. S. Sakane, Kyoto, Japan. U.S. Pat. 1,264,979, 7.5.18. Appl., 27.6.17.

A TRANSPARENT substance resembling celluloid is prepared by treating fish scales with an alkali (sodium carbonate) which removes all fatty matters and destroys the odour, and then treating the residue with an acid (dilute hydrochloric acid) to dissolve all the lime salts but leave the lines of growth unattacked and conspicuous. The product is steeped in a condensing agent (formaldehyde, aluminium sulphate, tannin, or the like) and then in a softening agent (glycerin solution).—J. F. B.

XVI.—SOILS; FERTILISERS.

Nitrates; Determination of —— in soil by the phenoldisulphonic acid method. H. A. Noyes. J. Ind. Eng. Chem., 1919, **11**, 213–218.

NITRATES are completely extracted from soil by extraction with cold water, and the presence of chlorides does not interfere with their accurate determination by the phenoldisulphonic acid method provided that the temperature is kept below that at which chlorides and nitrates react with the sulphuric acid. 50 grms. of soil is shaken for 1 min. in a stoppered bottle, with 200 c.c. of water, and the shaking twice repeated at intervals of 30 mins. The extract is then filtered, and as soon as 50 c.c. of clear filtrate has been obtained 5 c.c. is transferred to a 2½ in. porcelain evaporating dish, and evaporated to dryness on the water bath. At the same time 5 c.c. of potassium nitrate solution containing 0·0001 grm. of nitrate per c.c. is evaporated in a similar dish as a standard for comparison. When the dishes are cold 1 c.c. of phenoldisulphonic acid prepared as described by Chamot, Pratt and Redfield (this J., 1911, 442) is added drop by drop to each dish so as to form a ring round the residue. Each dish is rotated so that the whole of the residue is moistened, and after 15 mins. 15 c.c. of cold water is slowly added. Ammonium hydroxide solution (4 to 8%) is then sprayed from a wash-bottle into the liquid until a permanent yellow coloration is obtained, after which the solutions are transferred to a Schreiner colorimeter and the colours matched. If the soil gives a coloured extract or contains iron, 5 grms. of calcium hydroxide is added to it prior to the addition of the water. In the case of soils containing less than 100 parts of nitrates per million 20 c.c. of the extract is taken for the colorimetric comparison.—C. A. M.

Rock phosphate; Solvent action of dilute citric and nitric acids on ——. J. A. Stenius. J. Ind. Eng. Chem., 1919, **11**, 224–227.

PORTIONS of 3 grms. each of rock phosphate were extracted with 100 c.c. of dilute citric acid (0·5 to 0·1%) by shaking them in a machine for 30 mins. The liquid was then diluted to 500 c.c. and filtered, and the phosphorus determined in the filtrate. It was found that extraction with 0·2% citric acid gave a result for available phosphoric acid approximately equal to that obtained by using neutral ammonium citrate. Extraction with 0·5% citric acid removed more than twice as much phosphorus. Variations in the quantity of rock phosphate treated had also a pronounced influence on the amount of phosphoric acid extracted. For example, when 0·1 grm. was used instead of 3 grms. the amount of phosphorus extracted by 0·2% citric acid was 4·289%, as against 0·1918%. The presence of basic substances such as calcium carbonate reduces the solvent action of citric acid and this influence is not entirely eliminated by adding an extra amount of citric acid equivalent to the basic substance, as stated by Cousins and Hammond (Analyst, 1903, 238). In similar extractions with dilute nitric acid (0·06 to 0·015%) still larger amounts of phosphorus (11·91 to 8·13%) were removed, so that it is no more suitable than citric acid for determining the available phosphorus in rock phosphates. In the case of nitric acid, however, the effect of basic substances can be neutralised by adding the additional amount of acid equivalent to the bases. Neutral ammonium citrate solution does not extract the true amount of available phosphorus, but is probably as trustworthy as any solvent can be, whilst it affords an indication of the effect of treatment in rendering the phosphorus in rock phosphates available. It is essential, however, that two determinations should be made under uniform conditions before and after the treatment.—C. A. M.

Basic slag; Solubility of —— in organic acids. M. Sirot and G. Joret. Ann. Chim. Analyt., 1919, **1**, 80–85.

THE authors have determined the solubility of the different constituents of basic slag in various organic acid solutions. In each case a 2% acid solution was employed and the determination was made after the sample had been shaken with the solution for 30 mins. To a certain extent, the solubility depended on the fineness of the slag and the figures given below were obtained with a sample of which 86·6% passed a 100-mesh sieve; the figures express percentages of the total amount of constituent present.

	Total	Soluble in					
		Citric acid	Malic acid	Tartaric acid	Lactic acid	Acetic acid	Oxalic acid
Phosphoric acid	18·5	82·5	84·8	54·1	99·7	59·4	26·7
Lime	51·1	76·6	83·6	16·1	88·7	68·6	0·0
Silica	6·5	99·2	95·3	57·3	100·0	88·3	30·7
Iron	10·3	34·7	31·3	11·9	25·5	15·3	23·3
Manganese	4·0	27·5	25·0	15·5	22·5	14·5	13·5
Magnesia	3·0	21·0	31·3	5·0	25·0	19·0	Trace
Sulphur	0·18	43·7	47·9	—	—	33·3	—

The solubility of the sulphur was determined in a separate sample of the slag.—W. P. S.

Hops; Effect of fertilisers on the composition of ——. G. A. Russell. J. Ind. Eng. Chem., 1919, **11**, 218–221.

FIELD tests were carried out during three successive years on an upland and a sandy loam soil, the effect of irrigation being also studied. The total amount of available soft resins showed a large increase on the irrigated fertilised soil, but this was due to the increased growth of the hops, the percentage of resins in the hops being decreased. The results do not indicate any marked superiority of a particular fertiliser or combination of fertilisers in regard to the yield of available soft resins per acre. The amount of soluble ash was not greatly affected by the use of fertilisers or irrigation.—C. A. M.

Effect of superphosphate on indigo plant. Davis. *See* IV.

Phosphorus in basic slag. Travers. *See* X.

PATENT.

Phosphate fertiliser containing nitrogen; Method of manufacturing ——. A. Foss, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,292,293, 21.1.19. Appl., 8.5.17.

SEE Eng. Pat. 114,873 of 1917; this J., 1918, 315A.

XVII.—SUGARS; STARCHES; GUMS.

PATENTS.

Sugar; Method and apparatus for treating [centrifuging] ——. J. E. Drury and R. C. Folsom, Boston, Mass., Assignors to American Sugar Refining Co. U.S. Pat. 1,270,796, 2.7.18. Appl., 28.12.17.

AFTER the separation of syrup from moistened raw sugar by centrifuging, an outlet in the bottom of the centrifugal basket is opened, and a jet of water under high pressure is directed against the walls of the basket to detach the layer of sugar, which, with the water, discharges by gravity through the outlet into a melting pot below.—J. H. L.

Sugar juices; Method of treating raw - —. A. Krafft, Honolulu, Hawaii. U.S. Pat. 1,271,914, 9.7.18. Appl., 7.3.17. Renewed 1.12.17.

RAW sugar juice after liming is brought into direct contact with hot products of combustion from a boiler furnace or other source of heat; *e.g.*, boiler flue gases are passed upwards through a chamber in which the juice from the liming tank descends in the form of a shower. By using hot flue-gases the employment of juice heaters is rendered unnecessary. Moreover, the suspended solid matter in the flue-gases exerts a decolorising action on the juice.—J. H. L.

Sugar manufacture. L. Naudet, Chelles, France. U.S. Pat. 1,286,066, 26.11.18. Appl., 5.3.14.

SEE Fr. Pat. 466,590 of 1913; this J., 1914, 878.

XVIII.—FERMENTATION INDUSTRIES.

Alcohol; Production of —— from marine algæ. E. Kayser. Ann. Chim. Analyt., 1919, **1**, 79—80. (See this J., 1918, 524A.)

Laminaria flexicaulis and *L. saccharina* when dried, cut into small pieces, and heated with water under pressure give a liquid which can be fermented; the yield of alcohol is from 3·58 to 3·76 litres per 100 kilos. of the dry algæ. If 7% sulphuric acid is used instead of water and the liquid brought to an acidity of 0·1% before fermentation, the yield of alcohol is increased to 12 litres.—W. P. S.

Bacterial emulsions; Some optical properties of ——. F. Vlès. Comptes rend., 1919, **168**, 575—578.

THE loss which a ray of light undergoes when traversing a bacterial emulsion depends on phenomena connected with the optical properties of the inter-bacterial liquid as well as on phenomena dependent on the bacteria themselves. Using rays of wave length λ = about 620, in which region the inter-bacterial liquid has a minimum absorption, it was found that the transmission was almost directly related to the amount of substance in the liquid. Thus $I/I_0 = cp^{-1} + f$, where p is the dry weight of bacteria per c.c. of emulsion, c and f being constants dependent on certain experimental conditions and possibly on the kind of bacteria used. A second relation may be expressed by $I/I_0 = (An^{-1} + B)(Cv^{-1} + D)$, where n is the number of bacteria per c.c. and v is the mean volume of the bacteria.—W. G.

Effect of fertilisers on hops. Russell. *See* XVI.

PATENTS.

Vinegar and acetic acid; Apparatus for the concentration of ——. E. Klein, Peekskill, N.Y., Assignor to The Fleischmann Co., Cincinnati, Ohio. U.S. Pat. 1,291,025, 14.1.19. Appl., 24.5.16.

THE apparatus comprises a chamber provided with a feed pipe and an outlet pipe; the former enters below a perforated partition in the chamber and the outlet pipe is connected with a condenser. A pipe connects the feed and outlet pipes and is also connected with the condenser; a valve is provided for causing the flow from the outlet pipe to pass to the condenser or to the feed pipe. A number of these chambers may be arranged in series.
—W. P. S.

Rectifying process and apparatus. E. A. Barbet, Assignor to E. Barbet et Fils et Cie., Paris. U.S. Pat. 1,292,676, 28.1.19. Appl., 6.3.14.

SEE Fr. Pat. 470,242 of 1913; this J., 1915, 194.

Treating potatoes. Eng. Pat. 123,591. *See* XIXA.

XIXA.—FOODS.

Milk; Coagulation of —— and the physical condition of milk curd. O. Allemann. Kolloid-Zeits., 1919, **24**, 27—42.

THE solidity of rennet curd is directly proportional to the time which has elapsed since coagulation, and to the acidity of the mixture, and inversely proportional to the time taken in coagulation. The solidity of the curd is increased by the addition of potassium chloride in proportion to the amount added. The solidity increases with increasing temperature up to a maximum, but above 41°—42° C. it decreases rapidly. The solidification of the curd is a continuation of the coagulation and takes place according to the ordinary coagulation laws. The solidity is dependent on the individuality of the animal which has supplied the milk and is constant over long periods of time. Sudden changes in the solidity may occur, due to weather conditions and to physiological conditions, and after a short time disappear.—J. F. S.

PATENTS.

Flour or meal and milling products; Process and apparatus for increasing the yield of bread and improving the baking qualities of ——. E. C. Sutherland, Deventer, Holland. Eng. Pat. 115,410, 7.9.17. (Appl. 12,861/17.) Int. Conv., 28.4.17.

THE flour is heated at 40° to 60° C., and then cooled at −5° to −10° C. The heating and cooling may be repeated, but the maximum and minimum temperatures must be maintained for a short time only.
—W. P. S.

Flour; Treatment of ——. H. Greville, Birkenhead. Eng. Pat. 123,435, 21.3.18. (Appl. 4983/18.)

THE keeping properties of flour may be improved by the addition of 1 to 4 lb. of sodium chloride per 280 lb. of flour; acid phosphates and other "improvers" may also be added.—W. P. S.

Vegetables and fruits; Process of preserving ——. A. van Dantzig, Amsterdam, and Naaml. Vennoots. Chem. & Pharm. Laboratorium, Zaandam, Holland. Eng. Pat. 123,403, 21.2.18. (Appl. 3132/18.)

CABBAGE, spinach, salads, gherkins, olives, and the like, are pickled for about 2 days in 3% sodium

chloride solution, then washed, and centrifuged or pressed to remove superfluous moisture. Vegetables thus treated do not require packing in sealed receptacles. Sodium chloride must be added to the pickling solution from time to time to maintain its strength.—W. P. S.

Potatoes; Treatment of —— for obtaining food products. H. E. Dowding, Eltham. Eng. Pat. 123,591, 27.2.18. (Appl. 3523/18.)

Washed potatoes are steamed for 2 hrs. in a converter; water is then added to reduce the temperature to 156° F. (69° C.) and crushed malt is introduced. When the starch has been saccharified, the mixture is filtered, and the filtrate evaporated under reduced pressure to a suitable consistence. If desired, peptase or other enzyme may be added to the filtrate. The resulting syrup may be used in bread-making, whilst the filter-press cake serves as a fodder. When the syrup is intended for use in brewing, the filtrate, before evaporation, may be heated under a pressure dependent on the colour, flavour, and fermentability desired.—W. P. S.

Milk; Manufacture of synthetic ——. J. Piperno, New York. U.S. Pat. 1,267,449, 28.5.18. Appl., 7.5.17.

A mixture of fats and organic salts obtained by boiling grated coconut with water, and a mixture of protein, carbohydrates and organic salts extracted from suitable materials, *e.g.*, rice and oatmeal, by boiling with water, are mixed together, and the resulting liquid, while warm, is filtered and treated with a lactic acid culture.—W. P. S.

XIXB.—WATER PURIFICATION; SANITATION.

Water; Chlorine absorption and chlorination of ——. A. Wolman and L. H. Enslow. J. Ind. Eng. Chem., 1919, **11**, 209–213.

Experiments to determine the velocity of the absorption of available chlorine by the same water during varying intervals of time showed that in general the velocity constant, K, decreases with the time, but its value approaches a constant for different time intervals in the case of waters with low organic content. Even in the case of the same water supply changes in colour do not necessarily correspond with variations in the chlorine absorption over a constant interval of time. There is no definite correlation between the degree of turbidity of different waters and their rate of chlorine absorption, but in the case of the same water supply which has been studied under widely varying conditions the turbidity may afford some measure of the chlorine absorption. The amount of chlorine absorbed in a definite interval of time shows some relationship to the amount of oxygen absorbed in the same time, but the chlorine absorption does not increase in direct proportion with the increase in pollution (as measured by the oxygen absorption), but shows a decreasing acceleration. Hence it may be found possible to distinguish between water of good and comparatively poor quality by means of a chlorine absorption test made after 5 mins. There is no general agreement as to the necessary time interval for the test or the relative scale of the safety factor. From experimental data cited it would seem that a 30-minute absorption plus a high factor of safety is hardly required. It is suggested that the addition of a constant factor such as 0·2 to the result obtained in the 5 min. absorption would probably give as trustworthy results in the routine control of chlorination as the use of a longer time interval for the absorption. (See also J. Chem. Soc., May, 1919.)—C. A. M.

Nitrous fumes in mine air; Determination of ——. C. Toombs. J. S. Afr. Assoc. Anal. Chem., 1919, **2**, 3.

The sample of air is well shaken with a small quantity of dilute potassium hydroxide solution in which the nitrate and nitrite are then determined colorimetrically by the methods employed in water analysis, *e.g.*, by the phenolsulphonic acid or the Griess-Ilosvay method.—W. E. F. P.

Bacterial emulsions Vlès. *See* XVIII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Red cinchona bark; Assay of ——. W. Partridge. Analyst, 1919, **44**, 96.

For the determination of total alkaloids in red cinchona bark, the B.P. method consists in mixing 6 grms. of calcium hydroxide with 10 grms. of the powdered bark and 22 c.c. of water, and extracting the paste with "benzolated amyl alcohol." The author obtains better, and higher, results by reducing the quantity of water used to 12 c.c.; in this case the mixture forms a powder which is more readily extracted than is the paste obtained in the official method.—W. P. S.

Hyoscyamus niger. G. P. Koch Amer. J. Pharm., 1919, **91**, 68–82.

The author has determined that the alkaloid content of green *Hyoscyamus niger* leaves together with the seed pods, collected when most of the seed pods had formed, varied from 0·073 to 0·102%. The roots together with the stems contained 0·081% of mydriatic alkaloids. Dry leaves, collected after harvesting the mature seed, contained 0·057–0·065%. The mydriatic alkaloid in the stems of the dry plants, after harvesting the mature seed, amounted to 0·052–0·057%. It is concluded that it is more advantageous to harvest the plants intended for the preparation of the drug in the green state before maturity of the seeds, in which case the stems can also be utilised in conjunction with the leaves for the preparation of a material containing the quantity of alkaloid specified by the U.S.P. (not less than 0·065%). It was noted, moreover, that even after the plant was dry and the seeds mature, the roots contained an exceptionally high percentage of alkaloid (0·130), which indicates that these portions might be utilised.—J. F. B.

Robinia pseudacacia L.; Toxic constituents in the bark of ——. B. Tasaki and U. Tanaka. J. Coll. Agric. Tokyo, 1918, **3**, 337–356.

The fresh bark of the Japanese locust tree, *Robinia pseudacacia*, causes toxic symptoms when eaten by horses, cattle, and other animals. It was found that this was due to a glucoside, "robitin," which was isolated by concentrating an aqueous extract of the bark, clarifying, and precipitating with alcohol. The precipitate obtained, when dried in a vacuum, was a white, hygroscopic, amorphous powder, easily soluble in water and acids, but insoluble in organic solvents. On hydrolysis, it yielded dextrose and rhamnose. The amount obtained from the air-dried bark was 3%. The glucoside contains 2–3% of inorganic matter. On injection into horses and cows, it produced the same symptoms as the fresh bark, namely, rise of temperature, increase of secretions and excretions, and paralysis of hind-quarters. (See also J. Chem. Soc., May, 1919.)—J. H. J.

Acetone. Bassett. *See* IIB.

Electrical synthesis of colloids. Svedberg. *See* XI.

Quinosol and "superol." Schoorl. *See* XXIII.

PATENTS.

β-Bromoethyl-p-nitrobenzoate. The Abbott Laboratories, Chicago, Ill., Assignees of R. Adams and O. Kamm, Urbana, Ill., U.S.A. Eng. Pat. 121,578, 12.4.18. (Appl. 6262/18.) Int. Conv., 21.12.17.

β-BROMOETHYL *p*-nitrobenzoate is prepared by heating a salt of *p*-nitrobenzoic acid with an excess of ethylene bromide, preferably in the presence of an amine or of finely divided copper as catalyst. Example:—a mixture of 15 grms. of dry sodium *p*-nitrobenzoate, 75 grms. of ethylene bromide, and 0·5–1·0 c.c. of diethylamine is heated in a sealed tube at about 140° C. for 5 hours. The product is neutralised and distilled with steam in order to remove the excess of ethylene bromide. The residue of β-bromoethyl ester is contaminated with a small quantity of the di-*p*-nitrobenzoic ester of ethyleneglycol from which it may be separated by means of a suitable solvent, such as ether. The yield of crude product is about 15 grms. and after recrystallisation from alcohol the β-bromoethyl ester melts at 51°–52° C. It is utilised for the preparation of diethylaminoethyl *p*-aminobenzoate ("novocaine") by reaction with diethylamine and subsequent reduction.—J. F. B.

Chlorinating the side chains of aromatic hydrocarbons; Process of —. The Selden Co., Pittsburgh, Pa., and H. D. Gibbs, Cherrydale, Va., U.S.A. Eng. Pat. 125,341, 22.10.17. (Appl. 15,320/17.)

SEE U.S. Pat. 1,246,739 of 1917; this J., 1918, 52 A. The process is carried out at a temperature not materially below 150° C. By using a "low pressure" mercury vapour lamp mono- and di-chloro derivatives are almost exclusively produced, *e.g.*, benzyl and benzal chlorides from toluene, whilst by using a "high pressure" lamp, and the theoretical proportion of chlorine, the chief product is the trichloro derivative, *e.g.* benzotrichloride from toluene.

Isobutyl ester of oleic acid; Process for the manufacture of —. H. R. Napp, London. From E. Preiswerk, Basle, Switzerland. Eng. Pat. 123,685, 18.7.18. (Appl. 11,785/18.)

THE isobutyl ester of oleic acid, a liquid of sp. gr. 0·86 at 20° C., and b.pt. 190° C. at 4 mm. pressure, is insoluble in water but soluble in the usual organic solvents, and possesses valuable therapeutic properties in cases of tuberculous disease. It is prepared by the action of oleic acid chloride on isobutyl alcohol, or of oleic acid on isobutyl alcohol in the presence of hydrochloric acid or zinc chloride, and is purified by distillation under reduced pressure.
—L. A. C.

Benzaldehyde; Method of making —. M. E. Putnam, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pat. 1,272,522, 16.7.18. Appl., 18.9.16.

BENZYL bromide is mixed with a solution of sodium or calcium or other nitrate and the mixture heated approximately at the boiling point with constant stirring. The benzaldehyde produced is practically pure and is separated from the aqueous layer.
—J. F. B.

Arsenical compounds. W. A. Jacobs, Mount Vernon, W. H. Brown, M. Heidelberger, and L. Pearce, Assignors to The Rockefeller Institute for Medical Research, New York. U.S. Pats. (A) 1,280,119, (B) 1,280,120, (C) 1,280,121, (D) 1,280,122, (E) 1,280,123, (F) 1,280,124, (G) 1,280,125, (H) 1,280,126, and (I) 1,280,127, 24.9.18. Appl., (A) to (E), 3.10.17, (F) and (G) 16.1.18, (H) and (I) 28.1.18.

A SERIES of derivatives of N-phenylglycine-*p*-arsonic acid, prepared by the usual methods, is claimed as powerful agents in the treatment of trypanosomal and spirochætal infections:—(A) The arsonic acid of N-phenylglycinamide or an analogous amide having in its molecule an α-aminoacylamine side chain of the general formula, NH.CHR.CONR'R", where R is alkyl, aryl, or hydrogen and R' and R" are alkyl or hydrogen radicals, the aromatic nucleus of the arsonic acid being joined to the α-amino group of the side chain. (B) The arsonic acid of N-phenylglycine-β-methylureide or analogous urea having a side chain of the general formula, NH.CHR.CONHCONR'H, where R and R' are alkyl, aryl, or hydrogen. (C) The arsonic acid of N-phenylglycyl-*m*-aminophenol or analogous anilide, having a side chain of the general formula, NH.CHR.CONHAr, where R. is alkyl, aryl, or hydrogen and Ar is an aromatic radical which may have substituent groups in its nucleus. (D) The arsinoxides of the amides and anilides specified under (A) and (C). (E) Arsenoaryl derivatives formed by the deoxidation and condensation, *e.g.* by hypophosphorous and hydriodic acids, of two molecules of the anilides specified under (C), whereby the two molecules are united through their arsenic radicals. (F) Soluble salts of the derivatives specified under (A). (G) Sodium salts, readily soluble in water, of the ureides specified under (B). (H) Soluble salts, *e.g.* sodium salts, of the anilides specified under (C). (I) Soluble salts, *e.g.* hydrochlorides, of the condensed arsenoaryl derivatives described under (E), where the salt-forming acid group is attached to the amino groups of the arseno aryl nuclei.—J. F. B.

Oxycholesterin; Process of obtaining —. I. Lifschütz, Hamburg, Germany. U.S. Pat. 1,284,724, 12.11.18. Appl., 24.2.17.

OXYCHOLESTEROL is prepared by dissolving cholesterol in a neutral solvent (*e.g.*, a carbon-chlorine compound), or a mixture of solvents, having a boiling point below 100° C., and then heating with a mild oxidising agent, *e.g.*, a peroxide, with or without addition of acid.

Cetyl alcohol; Process of obtaining —. S. Axelrad and I. Hochstadter, New York. U.S. Pat. 1,290,870, 14.1.19. Appl., 14.1.18.

A CETYL ester (spermaceti) is saponified by means of lime and the product is heated, first to about 100° C. to drive off water, and then to about 340° C. to distil off the cetyl alcohol.—L. A. C.

Urea; Manufacture of —. K. Neresheimer, C. Bosch, and A. Mittasch, Assignors to Badische Anilin u. Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,292,019, 21.1.19. Appl., 20.12.16.

SEE Eng. Pat. 24,042 of 1914; this J., 1916, 71.

Ergot; Process for the manufacture of a product derived from —— soluble in water and suitable for injections. A. Gams, Assignor to Soc. of Chem. Ind. in Basle, Switzerland. U.S. Pat. 1,292,394, 21.1.19. Appl., 23.10.17.

SEE Eng. Pat. 119,287 of 1917; this J., 918, 717 A.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photographic reduction with ferric ammonium sulphate. H. Krause. Z. Wiss. Phot., 1918, **18**, 192—197.

FERRIC alum in neutral solution slowly reduces the intensity of photographic images, but more rapidly in slightly acid solution. Changes of temperature and concentration and the presence of chloride ions have little effect on the definition of the reduced image. A neutral solution converts the silver of the plate partly into soluble silver sulphate and partly into an insoluble compound, probably silver oxide. The formation of the insoluble compound is prevented by the presence of acid and this probably explains the more rapid action of the acidified solution.—J. F. S.

XXII.—EXPLOSIVES; MATCHES.

Nitro-groups. Druce. *See* III.

PATENTS.

Explosive; High — —. J. D. Thompson, Toronto, Canada. U.S. Pat. 1,291,258, 14.1.19. Appl., 3.4.16. Renewed 30.11.17.

THE explosive consists of potassium chlorate, randanite (decayed felspar), wood pulp, dinitrotoluol (liquid), trinitrotoluol (solid), soluble nitrocellulose, and insoluble nitrocellulose pulped.

—T. St.

Removal of liquids [solvents] from solid materials [smokeless powders] soluble therein. E. C. R. Marks, London. From E. I. Du Pont de Nemours Powder Co., Wilmington, Del., U.S.A. Eng. Pat. 24,296, 18.12.14.

SEE Fr. Pat. 477,343 of 1915; this J., 1916, 618.

Explosives; Manufacture of — —. W. J. Mellersh-Jackson, London. From Palmer-Perchlorate Powder Co. of Canada, Montreal, Canada. Eng. Pats. 2169 and 2172, 10.2.15.

SEE Fr. Pat. 477,678 of 1915; this J., 1916, 618.

XXIII.—ANALYSIS.

Laboratory apparatus for rapid evaporation. E. C. Merrill and C. O. Ewing. J. Ind. Eng. Chem., 1919, **11**, 230.

EVAPORATION of liquids in basins on a steam-bath is accelerated by a blast of air, which is first passed through a screw-capped brass cylinder, 3 cm. by 15 cm., packed with cotton to act as a filter, and then through a heating coil of copper tube 2 m. by 0·6 cm., which rests upon the steam pipes in the bath, and has its outlet raised above the bath, and connected by means of rubber tubing with a series of nozzles. Each of these is provided with a glass stop-cock, and is supported by a bent wire which slides within a hollow standard, thus enabling the height of the nozzle above the bath to be adjusted. The air issuing from the nozzle is at about 60° C. By its use water can be evaporated in less than half the usual time, and 95% alcohol in about one-sixth of the time. The apparatus is also useful for the rapid evaporation at low temperatures of substances which readily volatilise or polymerise at higher temperatures.

—C. A. M.

Copper oxide; Use of — — for combustions in gas analysis. E. Ott. J. Gasbeleucht., 1919, **62**, 89—90.

THE author has studied different factors affecting the accuracy of determinations of carbon monoxide, hydrogen, and methane in gas analysis by combustion over copper oxide. If chemically pure nitrogen is passed 10—15 times over brightly glowing copper oxide, dissociation of the copper oxide is found to take place to a certain extent, depending upon the temperature, the velocity of the gas, etc. If, however, the nitrogen, together with the dissociated oxygen, be again led 5 to 10 times over the copper oxide at a lower temperature, *i.e.*, at a dull red heat, quantitative re-absorption of the oxygen takes place. Care should be taken however that the temperature does not fall below that for dull red heat, as the activity of the reduced copper then rapidly diminishes. Nitrogen prepared from air free from carbon dioxide by allowing it to stand over phosphorus contains phosphorus vapour as an impurity. If nitrogen prepared by this means is passed over copper oxide as described above, a contraction of about 0·2% is observed, and although the gas is sufficiently pure for purposes of technical analysis, particularly as the phosphorus vapour can be removed by passing the gas over copper oxide at a dull red heat before delivering it to the apparatus, absorption of the oxygen from the air by means of pyrogallol must be employed for preparing nitrogen for extremely accurate work. No chemical action has been found to take place between the nitrogen and the copper oxide. During the combustion of chemically pure methane and carbon monoxide, a contraction of at least 0·5% has always been observed, in spite of the utmost precautions being taken to render the apparatus gas tight.—L. A. C.

Gold; Use of o-tolidine as a colorimetric test for — —. W. B. Pollard. Analyst, 1919, **44**, 94—95.

ONE part of gold (as gold chloride) in 1 million parts of water gives a bright yellow coloration when treated with a 0·1% *o*-tolidine solution in 10% hydrochloric acid; with a solution containing 1 part of gold in 20 million the yellow coloration can just be detected in a depth of 10 cm. of liquid. Ferric salts, ruthenium, osmic acid, and vanadic acid also give a yellow coloration with the reagent, but the following metals, when present as chlorides, do not react:—aluminium, antimony, barium, bismuth, cadmium, calcium, chromium, cobalt, copper, iridium, lead, magnesium, mercury, manganese, nickel, platinum, rhodium, sodium, strontium, tin, uranium, and zinc. The solution to be tested should be free from nitrous acid and reducing substances. If copper is present a green coloration is obtained instead of pure yellow.—W. P. S.

Quinosol (potassium salt of 8-hydroxyquinoline-5-sulphonic acid); Reaction products of — [and of "superol" (o-hydroxyquinoline sulphate)] with different metals. N. Schoorl. Pharm. Weekblad, 1919, **56**, 325—328.

EXTREMELY delicate reactions are given by quinosol or "superol" (*o*-hydroxyquinoline sulphate) with arsenic (arsenate), barium, mercury (mercurous), lead, strontium, tin (stannous and stannic), iron (ferrous), and silver. The precipitates formed are microcrystalline and of most characteristic appearance. The reagent is well adapted to micro-analysis.—W. S. M.

Analysis of coal. Zschimmer. *See* IIA.

Fusion bomb. Parr. *See* IIA.

Gasoline in natural gas. Oberfell and others. *See* IIA.

Tar vapour in producer-gas. Zschimmer. *See* IIA.

Petrol. Philip. *See* IIA.

Determination of carbazole. Clark. *See* III.

Nitro-groups. Druce *See* III.

Lead in lead salts Morris. *See* VII.

Carbon monoxide in hydrogen. Rideal and Taylor. *See* VII.

Glass analysis. Allen and Zies. *See* VIII.

Oxygen in iron. Oberhoffer *See* X

Iron and steel. Marinot. *See* X.

Phosphorus in steel etc. Travers *See* X

Chrome ironstone. Moir. *See* X

Varnish analysis. Pearce. *See* XIII.

Nitrates in soil. Noyes. *See* XVI

Rock phosphate and dilute acids. Stenius. *See* XVI.

Nitrous fumes in air. Toombs. *See* XIXB

Red cinchona bark. Partridge. *See* XX

PATENTS.

Gas-analysing apparatus. Aktiebolaget Ingenlörsfirma F. Egnell, Stockholm. Eng. Pat. 120,921, 20.11.18. (Appl. 19,066/18.) Int. Conv., 29.11.17.

In a gas-analysing apparatus in which the gas passes successively through a measuring receptacle, an absorbing receptacle, and another measuring receptacle, a valved by-pass is provided by means of which the gas can be passed direct from the first to the second measuring vessel when the zero point of the apparatus is to be determined.—W. F. F.

Melting points; Method of determining —. L. W. Chubb, Edgewood Park, and R. de S. Brown, Wilkinsburg, Pa., Assignors to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,291,409, 14.1.19. Appl., 6.5.15.

The material to be tested is placed in contact with a thermocouple which is heated at a uniform rate by an electric current. The couple is also connected with an electrical measuring instrument and the value of the potential generated by the couple is observed at the point at which the progressive increase in the generated potential is interrupted by reason of the absorption of heat at the melting point of the material under test. The couple consists of a thin plate composed of the two portions butt-welded together, and is notched to localise the applied heat at the junction point of the two materials.—T. St.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL: PLANT; MACHINERY.

APPLICATIONS.

Adams. Direct-displacement ejectors for raising and forcing liquids and semi-solids etc. 7992. Mar. 31.

Aston. 8777. *See* X.

Barron. 8402. *See* XIX.

Bentall and Bingham. Grinding-mills. 8524. Apr. 4.

Blakeley, Firth, Blakeley, Sons and Co., and Shaw. Assorting materials of different specific gravities and washing same. 8851. Apr. 8.

Brockway. 7986. 7987. 8058. 8059. *See* II.

Cruyt and Heenan. System of superheating steam from boilers. 8319. Apr. 2.

Cubley, and Harvey and Co. 8117. *See* X.

Duvieusart. Exchanging heat of liquids. 8424. Apr. 3.

Godwin and Pitman. Device for heating liquids. 8343. Apr. 2.

La Bour. Intimate mixing of fluids. 8444. Apr. 3. (U.S., 8.4.18.)

Lafenille. 8979. *See* XVII.

Parr. Methods of recovering vapours of volatile liquids when mixed with air. 8508. Apr. 4.

Roots (Kaegi). Straining or filtering device for liquids. 9109. Apr. 10.

Smith. Furnaces. 8445. Apr. 3 (U.S., 3.4.18.)

Soc. Chim. des Usines du Rhône anc. Gilliard, Monnet, et Cartier. Carrying out chemical reactions by catalysis. 8557. Apr. 4. (France, 3.5.18.)

Stewart. Vessels for containing liquefied gases etc. 8809. Apr. 8.

Sturtevant. Separators for grading crushed rock etc. 9032. Apr. 9.

Tiernan and Wallace. Packing-materials, and processes for making same. 8797. Apr. 7. (U.S., 28.8.18.)

White (Crane Packing Co.). Packing. 9028. Apr. 9.

Wirth-Frey. Evaporation of solutions. 9191. Apr. 10. (Germany, 3.6.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

9863 (1917). Hinchley. Apparatus for expressing liquid from materials containing the same. (124,530.) Apr. 9.

5691 (1918). Soc. Anon. Fonderie Officine Frejus-automobili Diatto. Apparatus for regulating the pressure of and cooling compressed air or other fluid. (115,822.) Apr. 9.

5728 (1918). Spence and Young. Machines or apparatus for filling measured quantities of jelly and like viscous or fluid substances into pots or other vessels. (124,884.) Apr. 16.

5919 (1918). Lonsdale. Non-conducting coating for insulating pipes and other vessels or articles in chemical work. (124,597.) Apr. 9.

6202 (1918). Huelin. Means for preventing or consuming smoke in furnaces. (124,603.) Apr. 9.

6233 (1918). Donald. Kilns. (124,909.) Apr. 16.

6444 (1918). Scheffers and Van Roggen. Kilns. (115,232.) Apr. 16.

6960 (1918). Newell and Co., and Woodhouse. Grinding-mills. (124,930.) Apr. 16.

9921 and 20,917 (1918). Furness. Filter press

plate for filtering acid and other liquid material. (124,974.) Apr. 16.

11,402 and 11,407 (1918). Wade (Pittsburgh Testing Laboratory). *See* II.

11,781 (1918). British Dyes, Ltd., Turner, and West. Tank for transporting hydrochloric acid or other corrosive liquids by rail, road, or water. (124,997.) Apr. 16.

14,230 (1918). McIntyre, and Milne and Son. Method of superimposing films of material to be dried on a pair of heated cylinders, the same being also applicable for evaporating moisture from solids. (124,668.) Apr. 9.

15,856 (1918). Newhouse. Comminuting mill. (125,012.) Apr. 16.

16,471 (1918). Bolton. Liquid sealed furnaces. (125,015.) Apr. 16.

19,253 (1918). Hopper. Crushing and drying machine. (120,931.) Apr 9.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Anderson. Process for combustion of fuel. 8570. Apr. 4.

Anderson. Apparatus for combustion of fuel. 8571. Apr. 4.

Bloomfield. Process of manufacturing peat fuel and briquettes. 8153. Apr. 1.

Boulton. 9136. *See* XXIII.

Brockway. Apparatus for washing and scrubbing coal gas etc. 7986. 7987. 8059. Mar. 31.

Brockway. Pan scrubbers etc. 8058. Mar. 31.

Carman. Coke-ovens. 8568. Apr. 4.

Castelli and Corthesy. Means to generate gas from coal etc. 9361 Apr. 12.

Commercial Cars, Ltd., and Thomas. Apparatus for production of gaseous fuel for internal-combustion engines. 8750. Apr. 7.

Evans. Utilisation of trinitrotoluene for production of fuel gas and ammonia. 9220. Apr. 11.

Forward. Refining oil. 8627. Apr. 5.

Gardner and Hunter. Suction-gas producers. 8543. Apr. 4.

Hogan. Incandescence lamps. 8669. Apr. 5.

Mellersh-Jackson (Standard Oil Co.). Sulphonic acids of petroleum oils, and process of producing same. 8628. Apr. 5.

Mellersh-Jackson (Twitchell Process Co.). Sulphonated products of mineral oils, and process of producing same. 8635. Apr. 5.

Mellersh-Jackson (Twitchell Process Co.). Sulphonic acids of mineral oils, and process of producing same. 8638. Apr. 5.

Mellersh-Jackson (Twitchell Process Co.). Alkali-metal sulphonate, and process of producing same. 8643. Apr. 5.

Naito. 8708. *See* XXIII.

Nielsen. Process for manufacturing a peat fuel. 8559. Apr. 4. (Denmark, 30.3.18.)

Proctor. Electric arc lamps. 9053. Apr. 9.

Rowlson and Wilson. Coal-dust blocks. 9384. Apr. 12.

Smith. Treatment of coal. 8443. Apr. 3. (U.S., 3.4.18.)

Smith. Gas-producers. 8662. Apr. 5.

Spicer (Wells). Gas-producers. 8193. Apr. 1.

Wadsworth. Composition for economy of fuel. 9058. Apr. 10.

Complete Specifications Accepted.

112 (1916). Shakespear. *See* XXIII.

177 (1916). Westercamp. Arc lamps. (124,455.) Apr. 9.

849 (1916). Dreyfus. Process for effecting the separation of nitro compounds from natural oils. (124,475.) Apr. 9.

5036 (1916). Mackie. *See* VII.

11,212 (1917). Gasoline Corporation. Art of cracking hydrocarbon oils. (115,014.) Apr. 9.

5051 (1918). Longsdon. *See* XII.

5816 (1918). Wirtz. Means for purifying and vaporising oils. (124,895.) Apr. 16.

6202 (1918). Huelin. *See* I.

6749 (1918). Bell. Carburettors for coal or water gas. (124,610.) Apr. 9.

7972 (1918). Sheard. *See* VII.

8330 (1918). Reed Extraction of hydrocarbon products from shales and coals. (119,648.) Apr. 9.

9037 (1918). Wade (China Sugar Refining Co., Shaw, and McTavish) Decolourising-carbon and the preparation thereof (124,638.) Apr. 9.

10,914 (1918). Flood and Flood Method of and apparatus for quenching coke. (124,652.) Apr. 9.

11,402 and 11,407 (1918). Wade (Pittsburgh Testing Laboratory). Process of regenerating lubricants. (124,990 and 124,991.) Apr. 16.

11,453 (1918). Milbourne. Gas purifiers (124,994.) Apr. 16.

16,826 (1918). Leendertze. Process for briquetting refuse (120,209.) Apr. 9.

III.—TAR AND TAR PRODUCTS.

Applications.

Anderson Treatment of coal tar etc. 8414 Apr. 3.

Loo. Process for manufacture of aromatic phenols and amines 9082. Apr. 10.

Mellersh-Jackson (Standard Oil Co.). 8628 *See* II.

Mellersh Jackson (Twitchell Process Co.). 8635 8638. 8643. *See* II

Morris. Tar distilling 8525. Apr. 4.

Complete Specifications Accepted.

849 (1916). Dreyfus. *See* II.

11,212 (1917). Gasoline Corporation. *See* II.

6306 (1918). Thorp and Thorp Recovery of benzol and other useful products from acid tars obtained in refining operations. (124,605.) Apr. 9

IV.—COLOURING MATTERS AND DYES.

Applications.

Vidal and Vidal. Production of sulphur black dyes. 8766. Apr. 7.

Vidal and Vidal. Preparation of sulphur dyes 8767. Apr. 7.

Complete Specifications Accepted.

1442 (1916). Holliday and Badler. *See* XXII.

5519 (1918). Wyler, and Levinstein, Ltd. Sulphur dyestuff. (124,589.) Apr. 9.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Denis. Machine for spinning, washing, and drying viscose threads. 8878. Apr. 8. (Belgium, 8.8.13.)

Dorr Co. Process of recovering alkali used in pulp digestion. 8086. Mar. 31. (U.S., 16.8.18.)

Fort, Lumsden, Mackenzie, and Robinson. Beetling and treatment of fabrics etc. 8616. Apr. 5.

Fort, Lumsden, Mackenzie, and Robinson. Treatment of yarns, fabrics, etc. 8684. Apr. 7.

Frood. Manufacture of fibrous fabrics or compositions. 8480. Apr. 4.

Haigh. Papers for use as dielectric for electrical condensers etc. 8969. Apr. 9.

Martin and Martin Paper-making machines. 8692. Apr. 7.

Stone. Couching of paper webs in paper-making machines. 8134. Apr 1

COMPLETE SPECIFICATIONS ACCEPTED

71 (1916). Tesse. *See* XIII.

1755 (1916). Mandleberg, and Mandleberg and Co. Impregnation of fabrics or materials. (124,494.) Apr. 9.

1756 (1916). Mandleberg, and Mandleberg and Co. Impregnation and coating of fabrics and the like. (124,495.) Apr. 9.

3012 (1916). Harrison and Bacon. Manufacture of paper. (124,516.) Apr. 9.

3217 (1916). Glazebrook, Rouse, and Johnston. Fabrics used in the manufacture of balloons and dirigible airships. (124,520.) Apr. 9.

5387 (1916). Zimmer and others. *See* XIII.

15,059 (1916). Leurquin. Process for preparing a canvas or other ground or surface for receiving an impression in one or more colours. (124,843.) Apr. 16.

4284 (1917). Tesse Treatment of fabrics, and particularly the treatment of aeroplane fabrics. (124,844.) Apr. 16

10,568 (1918). Manchester Oxide Co., Clayton, Huebner, and Williams Manufacture of parchmentized paper, vulcanised fibre, and the like. (124,979.) Apr. 16.

11,303 (1918). Schweizerische Versuchsanstalt für Textilindustrie. *See* XXIII.

15,772 (1918). Schauffelberger. Digesters for use in the manufacture of cellulose and like operations (124,676.) Apr. 9.

17,592 (1918). Mackenzie. *See* XIII.

19,203 (1918). Konagai. Waterproof paper. (124,689.) Apr. 9.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS

Cliffe and Wilde. Treating or finishing fabrics. 9223. Apr. 11.

Davis. Dyeing-machines 9108. Apr. 10.

Sharp Means of fastening dyes in material and waterproofing same. 8360 Apr. 3

COMPLETE SPECIFICATION ACCEPTED

17,620 (1918). Bright and Bros., and Evans. Machines for boiling, bleaching, dyeing, sizing, or similarly treating yarns or fabrics. (125,025.) Apr. 16.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Allen. Plant for manufacture of salt from brine etc. 8952. Apr. 9.

Ashcroft. Process for production of anhydrous magnesium chloride or anhydrous carnallite. 8091. Mar. 31.

Calvert and Commin. Production of cyanide. 8416. Apr. 3.

Damman. Process for purifying rock salt or sea salt. 8881. Apr. 8.

Davis. Extraction of arsenic etc. from sulphuric acid. 8776. Apr. 7.

Dorr Co. 8086. *See* V.

Evans. 9220. *See* II.

Industrial Inventions, Ltd., and Perry. Synthesis of ammonia. 8544. Apr. 4.

Lindsay Light Co. Manufacture of thorium compounds. 8585. Apr. 4. (U.S., 8.7.18.)

Shroff. Process for preparation of barium chloride etc. 8152. Apr. 1.

Taylor and Vivian. Production of arsenic. 8542. Apr. 4.

COMPLETE SPECIFICATIONS ACCEPTED.

2847 (1916). Freeth and Cocksedge. Separation and recovery of potassium salts from commercial nitrate of soda containing such salts. (124,513.) Apr. 9.

4483 (1916). Gillbert. Manufacture of calcium nitrate from calcium chlorides and sodium nitrate. (124,780.) Apr. 16.

5036 (1916). Mackie. Apparatus for the manufacture of hydrogen. (124,798.) Apr. 16.

6026 (1916.) Maxted and Ridsdale. Manufacture of a hydrogen/nitrogen mixture. (124,824.) Apr. 16.

872 (1918). Mills, Packard, and Packard and Co. Chambers used in the manufacture of sulphuric acid. (124,852.) Apr. 16.

1520 (1918). Boake, Roberts, and Co., and Durrans Manufacture or preparation of sulphuryl chloride. (124,542.) Apr. 9.

1774 (1918). Rigaud. Production of sulphates of copper or nickel from ores and metallic minerals. (116,263.) Apr. 9.

5072 (1918). Dutt and Dutt. Process for the manufacture and production of alumina, sodium and potassium aluminates, sodium and potassium carbonates, and potassium chloride. (124,553.) Apr. 9.

5073 (1918). Dutt and Dutt. Process for the manufacture and production of alumina, sodium and potassium carbonates, sodium and potassium aluminates, magnesia, and calcium chloride. (124,554.) Apr. 9.

7972 (1918). Sheard Manufacture of sulphate of ammonia. (124,946.) Apr. 16.

9283 (1918). Bailey, Denny, and Jefferis. Separation of potassium nitrate from sodium nitrate. (124,960.) Apr. 16.

9921 and 20,917 (1918). Furness. *See* I.

10,478 (1918). Dutt and Dutt. Process for the manufacture and production of manganese dioxide. (124,977.) Apr. 16.

11,253 (1918). Roge. Recovery of acid from acid alkali sulphates. (124,988.) Apr. 16.

11,781 (1918). British Dyes, Ltd., and others. *See* I.

12,000 (1918). Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Production of ammonia from cyanamide (120,034.) Apr. 9.

388 (1919). Elektrizitätswerk Lonza. Manufacture of mercuric oxide. (122,195.) Apr. 16.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Kennett and others. 9079. *See* IX.

Thame. Manufacture of refractory material. 8144. Apr. 1.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Ivinson and Roberts. Manufacture of Portland etc. cement. 8217. Apr. 1.

Juthy. Roofing-tiles, and method of manufacturing same. 8400. Apr. 3.

Kennett, Kennett, and Kennett. Kilns for burning bricks, cement, etc. 9079. Apr. 10.

Lowndes. 8194. *See* X.

Naaml. Vennoots. Hollandsche Asbest-Cement Fabriek. Manufacture of plates of Portland cement reinforced with fibres. 9393. Apr. 12. (Holland, 30.7.18.)

Staddon. Preparation for protecting logs from decay. 9291. Apr. 11.

COMPLETE SPECIFICATIONS ACCEPTED.

18,171 (1917). Baker. Method of waterproofing pavement and road-making and the like materials (124,851.) Apr. 16.

10,538 (1918). Herdman. Manufacture of mineral wool. (124,650.) Apr 9.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Aston. Crucible furnaces. 8777. Apr. 7.

Barkes, Besford, and Day. Solder for aluminium etc. 8667. Apr. 5.

Brandt and Brandt. Alloys for war purposes 9087. Apr. 10. (France, 19.6 17.)

Cowper-Coles Process for protection of iron and steel from corrosion. 8902 Apr. 8.

Cubley, and Harvey and Co Gas-heated crucible furnaces. 8117. Apr. 1.

Gray, and Wellman, Seaver and Head, Ltd Steel-making etc. furnaces or mixers. 8890. Apr. 8.

Hancock. Method of preventing metals from tarnishing and rusting 8054. Mar. 31

Harris. Process for coating metal upon metal etc surfaces for electrotyping, sound-producing records, etc 8023. Mar 31

Harris. Refining lead. 9147. Apr. 10.

Heyes. Electric welding. 8257. Apr. 2.

Ivinson and Roberts. 8290 *See* XIII.

Lowndes. Treatment of blast-furnace slag etc 8194. Apr. 1.

Minerals Separation, Ltd. (Emerson) Concentration of ores. 8165 Apr. 1

Saracchi. Soldering-composition. 8210 Apr. 1. (Switz., 10.1.19.)

Soc. Anon. Stabilimenti Biak Zinc alloy. 9012. Apr. 9. (Italy, 12 4.18.)

Tidswell. Method of casting aluminium on to wrought iron or steel. 8280. Apr. 2.

Wolf. Method of granulating or pulverising metals etc. 9041. Apr. 9.

COMPLETE SPECIFICATIONS ACCEPTED.

531 and 533 (1916) Dear, and Miris Steel Co. Manufacture of steel. (124,463 and 124,465.) Apr. 9.

532 and 11,426 (1916). Dear, and Miris Steel Co. Manufacture of steel. (124,464.) Apr. 9.

5756 (1916). Whyte. Manufacture of iron and steel. (124,816.) Apr. 16.

5765 and 8803 (1916). Hadfield. Manufacture of manganese steel. (124,817.) Apr. 16.

1174 (1918). Martin and Richards. Furnaces for roasting ores. (124,540.) Apr. 9.

4774 (1918). Rigaud. *See* VII.

4859 (1918). Abrahamsen and Pedersen. Manufacture of sheet metal plate with a protective metal coating. (124,548.) Apr. 9.

5696 (1918). Forrester. Process for melting tin, and apparatus for use therein. (124,594.) Apr. 9.

7505 (1918). Crocker and Crocker. Manufacture of zinc. (124,621.) Apr. 9.

10,553 (1918). Wilkes and Harris. Reverberatory furnaces for use in the recovery of zinc from dross. (124,978.) Apr. 16.

17,579 (1918). Hall, and Rolls-Royce, Ltd. Aluminium alloy. (124,683.) Apr. 9.

18,396 (1918). Murray. Methods of and apparatus for electrical welding. (120,906.) Apr. 16.

113 (1919) British Thomson-Houston Co. (General Electric Co.). Treatment of metals. (125,046.) Apr. 16.

XI. ELECTRO-CHEMISTRY.

APPLICATIONS.

Goodman Electric batteries. 9276. Apr. 11.

Haigh 8969. *See* V

Heyes 8257. *See* X

Ivey and Salisbury Storage batteries. 8550 Apr. 4.

Lotsch. Storage batteries. 9175. Apr 10

Quain Apparatus for production of ozone. 8338. Apr. 2.

Steiger. Electric furnaces 8795. Apr 7 (Switz., 8.4.18.)

Wade (Thomson) Electrical resistance elements. 8352. Apr. 2.

Wade (Thomson) Carbon conductors for electricity 8642. Apr. 5

COMPLETE SPECIFICATION ACCEPTED

18,396 (1918). Murray *See* X

XII. FATS; OILS; WAXES.

COMPLETE SPECIFICATIONS ACCEPTED.

1783 (1918). Downs, Bellwood, and Turnill. Method or process of extracting oil from vegetable seeds and nuts (124,856.) Apr. 16

5051 (1918) Longsdon. Apparatus for recovering waste oils or separating oil from water or other impurities. (124,551.) Apr. 9

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS

APPLICATIONS.

Ivinson and Roberts. Paint or composition for covering surface of metals. 8290. Apr. 2

Lane. Paints. 9107. Apr. 10.

COMPLETE SPECIFICATIONS ACCEPTED.

2879 (1916). British Emaillite Co., and Goldsmith. Manufacture of dopes. (124,515.) Apr. 9.

5387 (1916). Zimmer, Bryce, and Davies. Cellulose-acetate compositions for use as varnishes, lacquers, and for other purposes. (124,807.) Apr. 16.

5092 (1918). Hutchins Manufacture of lampblack. (124,557.) Apr. 9.

17,592 (1918). Mackenzie. Dissolving and breaking down of shellac for use in hat manufacture and other purposes. (124,684.) Apr. 9.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

COMPLETE SPECIFICATIONS ACCEPTED.

3217 (1916). Glazebrook and others. *See* V.

5758 (1918). Porzel. Process for treating rubber. (124,887.) Apr. 16.

5759 (1918). Porzel. Method and machine for vulcanising rubber and similar substances. (124,888.) Apr. 16.

XV.—LEATHER; BONE; HORN; GLUE.

COMPLETE SPECIFICATIONS ACCEPTED.

11,417 (1918). Walker. Plant or means used in the treatment of hides during soaking, liming, tanning, chroming, or like processes. (124,992.) Apr. 16.

17,486 (1918). Rendixen. Process for tanning fish skins or the like. (120,398.) Apr. 16.

XVI.—SOILS; FERTILISERS.

COMPLETE SPECIFICATION ACCEPTED.

8434 (1918). Bottomley. Treatment of peat for making useful products. (124,629.) Apr. 9

XVII.—SUGARS; STARCHES; GUMS.

APPLICATIONS.

Hardy, and Reckitt and Sons. Manufacture of rice starch. 8741. Apr. 7.

Lafenille. Rotary mixing-machines for sugar refineries etc. 8979. Apr. 9.

COMPLETE SPECIFICATION ACCEPTED.

9037 (1918). Wade (China Sugar Refining Co., and others). *See* II.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Barron. Sand-filters. 8402. Apr. 3.

Benenati. Process for preserving matter. 8637. Apr. 5. (U.S., 31.5.18.)

Casablanca. Product obtained from waste water of houses, factories, etc. 8778. Apr. 7.

Clayton and Nodder. Manufacture of butter substitutes, edible fats, etc. 8757. Apr. 7.

Higginbottom. Apparatus for separating and purifying wheat etc. 8961. Apr. 9.

Hilliard and Judge. Firing or drying tea leaf. 8189. Apr. 1.

Hiorth. Method for preservation of food. 8064. Mar. 31. (Norway, 6.4.18.)

Mousley. Process for obtaining a substitute for human milk from cows' etc. milk. 9216. Apr. 11.

O'Connor. 9154. *See* XX.

Walsh. Water-filter. 8002. Mar. 31.

COMPLETE SPECIFICATIONS ACCEPTED.

9736 (1918). Crossley. Process for treating powdered or other dried eggs to render them emulsifiable. (124,968.) Apr. 16.

14,353 (1918). Marquis. Food compound. (125,009.) Apr. 16.

14,863 (1918). Sutherland. Process for treating meal or flour and milling products. (121,943.) Apr. 9.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Christiansen. Manufacture of methyl alcohol. 8320. Apr. 2. (Denmark, 20.4.18.)

Confectionery Ingredients, Ltd., Kane, King, and Matthews. Manufacture of protocatechuic aldehyde. 8178. Apr. 1.

Hanly and Lush. Production of formaldehyde, formic acid, and derivatives thereof. 8067. Mar. 31.

Leach, and United Alkali Co. Manufacture of acetic anhydride. 8552. Apr. 4.

O'Connor. Preparation of perfumes, fruit essences, and flavourings. 9154. Apr. 10.

Sandoz Chemical Works. Process for manufacture of a highly active preparation of ergot and isolation of its principal alkaloid in pure crystallised state. 9006. Apr. 9. (Switz., 9.4.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

12,714 (1918). Orton. Manufacture of tetranitromethane. (125,000.) Apr. 16.

3541 (1919). Crosfield and Sons, and Hilditch. Manufacture or production of acetaldehyde. (124,702.) Apr. 9.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS

Donisthorpe. Photographic printing. 8373 Apr. 3.

Portass, Portass, and Portass. Development and chemical treatment of photographic film. 8689 Apr. 7.

COMPLETE SPECIFICATION ACCEPTED.

6435 (1918). Smith. Production of screens for half-tone and other photographic printing surfaces. (124,608.) Apr. 9.

XXII.—EXPLOSIVES; MATCHES

APPLICATIONS.

Evans. 9220. *See* II.

Holgate. Nitrate of cellulose. 8983. Apr. 9.

COMPLETE SPECIFICATIONS ACCEPTED.

317 (1916). Chance and Hunt, Holley, and Mott Nitration process and apparatus therefor. (124,461.) Apr. 9.

849 (1916). Dreyfus. *See* II.

1442 (1916). Holliday and Badler. Process of manufacture of picric acid from dinitrophenol in crystal form and the elimination therefrom of the sulphate of lead. (124,490.) Apr. 9.

5178 (1916). Clayton Aniline Co., Schedler, and Marchant. Process for the purification of trinitrotoluene. (124,803.) Apr. 16.

12,714 (1918). Orton. *See* XX.

XXIII.—ANALYSIS.

APPLICATIONS.

Boulton. Absorption apparatus for analysing gases. 9136. Apr. 10.

Naito. Analysing or estimating volatile constituents of coal. 8708. Apr. 7.

COMPLETE SPECIFICATIONS ACCEPTED.

112 (1916). Shakespear. Apparatus for the detection and measurement of gases. (124,453.) Apr. 9.

11,303 (1918). Schweizerische Versuchsanstalt für Textilindustrie. Process and apparatus for testing fabrics and other materials. (124,183.) Apr. 9.

I.—GENERAL; PLANT; MACHINERY.

Suspensions and smokes: Relation between the intensity of Tyndall beam and concentration of ——. R. C. Tolman, L. H. Reyerson, E. B. Vliet, R. H. Gerke, and A. P. Brooks. J. Amer. Chem. Soc., 1919, **41**, 300—303.

THERE is a strict proportionality between the concentration of liquid suspensions and smokes and the strength of the Tyndall beam, provided that the particles are of the same size and the concentration does not become high enough to give a degree of opacity which affects the results.—J. F. S.

Smoke; Disappearance of —— in an enclosed space. R. C. Tolman, E. B. Vliet, W. McG. Peirce, and R. H. Dougherty. J. Amer. Chem. Soc., 1919, **41**, 304—312.

SMOKE disappears in an enclosed space owing to coagulation, to settling, and to the diffusion of the particles to the walls, where they adhere. The rate of disappearance is increased by stirring, because of increased contact with the walls. The rate of disappearance of finely divided smoke of a given concentration is greater than that of a coarse smoke of the same concentration owing to the increased opportunity for coalescence. In smokes with the same size of particle the rate of disappearance increases with the concentration owing to increased chances of coagulation and removal by the walls.—J. F. S.

Thermal conductivity of laggings. Von Rinsum. *See* VIII.

PATENTS.

Drying goods in bulk; Apparatus for ——. A. Hofmann, Zürich, Switzerland. Eng. Pat. 123,923, 14.8.18. (Appl. 13,200/18.)

THE material to be dried is conveyed by an endless conveyor in a zigzag path, through a chamber from top to bottom, whilst heated air is passed upwards through the chamber. The conveyor consists of transverse plates pivoted on one side to the joint pins of the endless chain. Guides below the section of the conveyor which is just emptying its contents on to the section below, are curved in such a way that the transverse plates are tilted and the openings between them widened so as to discharge the material gradually on to the conveyor below. The guides for this latter section are curved so as to bring back the plates passing over the wheels into line to receive the falling material. The guide wheels outside the chamber for guiding the conveyor back to the top of the chamber are mounted on bell crank levers under the action of springs, so that the chain is kept in tension notwithstanding its expansion by the heat of the chamber. The combustion gases used to heat the material are passed from the furnace through zigzag horizontal pipes in the lower part of the chamber and then upwards through an external flue to the top of a series of zigzag horizontal pipes in the drying chamber between the conveyor sections, and then through horizontal pipes below the first-mentioned pipes. The drying air is passed upwards first over the latter coolest pipes and then over the hottest pipes, and finally over the upper set of pipes and the layers of material. The heating pipes are provided with hoods and inclined plates above them to mix the air and deflect any material which falls through the conveyor.—W. F. F.

Tunnel-dryer. G. D. Harris, Bayonne, N.J. U.S. Pat. 1,282,822, 29.10.18. Appl., 10.11.15.

THE material to be dried is placed in superposed trays mounted in wheeled cars which can be moved into and out of the drying chamber or tunnel. A drying medium is circulated back and forth through the tunnel and through the spaces between the trays, and heaters are arranged in the circuit for the purpose of keeping the drying medium in an efficient condition.

Drum dryer consisting of several horizontal concentric drying cylinders. O. Günster, Dillingen. Ger. Pat. 309,034, 10.12.16.

ON the inside and outside of the walls of the cylinders are fitted wedge shaped projections which, as the drum rotates, force the material forward, alternately in opposite directions, through the successive annular spaces between the cylinders.

—L. A. C.

Drying gases. T. W. S. Hutchins, Middlewich. Eng. Pat. 124,045. (Appls. 1443, 13.3.18, and 14,933, 13.9.18.)

THE drying liquid and the gas to be dried pass in counter-current through a number of drying compartments arranged either vertically or horizontally. In each compartment, a portion of the gas either before or after drying, is injected through spray tubes provided with nozzles placed below the surface of the drying liquid. The remainder of the gas passes through the liquid spray so produced. The apparatus may be used for drying chlorine by means of concentrated sulphuric acid.

—J. S. G. T.

Corrosion and pitting of the tubes, ferrules, doors, and other parts of surface condensers and the like; Apparatus for the prevention of ——. L. J. Kettle, Dublin. Eng. Pat. 123,961, 11.12.18. (Appl. 20,605/18.)

FOR the electrical protection of surface condensers etc. against corrosion, the electrodes take the form of metallic gratings of such size as practically to cover the tube-plates and water heads. The gratings are sufficiently open so as not to interfere with the flow of water, and are mounted on plugs of hardwood or fibre, driven into the ends of two or more of the tubes. Electrical connection with the gratings is made by means of conductors passing through insulators in the condenser casing.

—C. A. K.

Expressing liquid from material containing the same; Processes and apparatus for ——. J. W. Hinchley, London, and G. Gorton, Bexhill-on-Sea. Eng. Pat. 123,774, 24.11.16. (Appl. 16,878/16.)

IN apparatus for expressing liquid from peat and other fibrous or carbonaceous materials, paper, wool, felt, fibre, and similar residues, wool combings, sludge, sewage, fish refuse, fruit and fruit refuse, vegetables and vegetable refuse, palm kernels, copra, and the like, beet-roots, sugar cane, wood pulp and wood refuse, as described in Eng. Pats. 3998 of 1915, 14,576, 10,976, 14,601, 14,602, 14,603, 14,605, 14,606, and 15,262 of 1916 (this J., 1916, 1254; 1917, 998, 1227, 1230, 1263), the material is heated by hot fluid which does not come into direct contact with it. The press cylinder is provided with a grooved central column surrounded by a strainer and the cylindrical wall is also grooved internally and provided with a strainer. The material is heated by an internal annular cylinder traversed by the heating fluid. This annulus

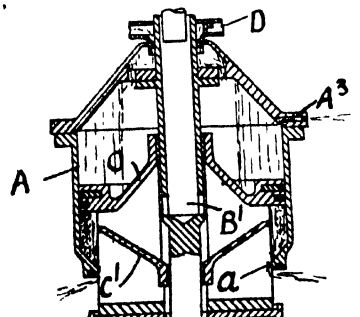
ontains a ring of vertical passages connected to ircular passages at top and bottom through which he fluid is supplied and exhausted. The material s pressed by two annular pistons separated by the eating annulus. In a modification, the vertical assages in the annulus contain electrical heating oils in their upper portions only, the heat being equired only when the material is compressed into he upper part of the cylinder.—W. F. F.

Vapour condensers. Soc. de Moteurs à Gaz et d'Industrie Mécanique, Paris. Eng. Pat. 117,814, 20.7.18. (Appl. 11,905/18.) Int. Conv., 26.7.17.

A SMALL auxiliary condenser is arranged between a main condenser of the "mixing" type, and the air extractor, to cool the air extracted from the main condenser. A steam injector is arranged to exhaust from the top of the evaporator of the auxiliary condenser and discharge into the main condenser. The condensed and cooled water in the bottom of this evaporator is withdrawn by a small auxiliary pump operated from the shaft of the main air pump, passed through a ribbed cooling tube in the auxiliary condenser, and sprayed into the top of the auxiliary evaporator to be evaporated by the suction of the steam injector. The air extracting pipe of the main condenser discharges into the top of the auxiliary condenser so that the air and saturated vapour sweep over the ribbed tube containing the cooled water and thence to the main air pump. The vapour is thus partly condensed in the auxiliary condenser so that there is a decrease both in weight and volume of the mixed air and vapour to be dealt with by the main air pump. A modification is also described in which the auxiliary condenser is used with a main condenser of the surface type, and another modification in which the auxiliary condenser has a cold-transmitting device of the spray form instead of the ribbed tube.—W. F. F.

Centrifugal machines or separators. R. A. Sturgeon, Portsmouth. Eng. Pat. 123,797, 11.2.18. (Appl. 2438/18.)

Liquid to be treated passes downwards through the pipe, B, and through the opening, B^1, into the space above the baffle, C^1. The rotation of the apparatus causes the liquid to take up a position



around the periphery of the casing, A, and to force the piston, C, upwards, carrying its connected parts, C^1 and C^2. The disc, C^3, closes the open end, *a*, of the casing, and the lighter portion of the separated liquid escapes through the openings, C^3. When a sufficient quantity of the heavier constituent has been separated, the inflow of liquid is stopped and another liquid is supplied by the passage, D, to the upper side of the piston, C, and the pressure produced by centrifugal force moves the piston downwards and allows the discharge of the separated material over the rim, *a*. The second liquid escapes through an outlet, A^3, which is sufficiently small to maintain the pressure within the chamber.—W. F. F.

Ash, dust and like matter; Devices for the removal of —— from gases and the like. S. Brown, Glasgow. From The Bangkok Dock Co., Bangkok, Siam. Eng. Pat. 123,924, 23.8.18. (Appl. 13,741/18.)

FURNACE gases are delivered by a fan tangentially into the top of an inverted conical casing having an outlet for gas at the top, and a central outlet at the bottom which is water-sealed. The suspended matter is deposited on the inner surface of the casing and conveyed away from the water-seal which is contained in a horizontal open water discharge conduit. In a modification, a perforated vertical discharge flue for the gas is arranged centrally in the separating chamber.—W. F. F.

Furnace; Regenerative ——. A. L. Stevens, Chicago, Ill. U.S. Pat. 1,292,126, 21.1.19. Appl., 19.5.16.

A FURNACE having a heating chamber with a working orifice which is constantly open is provided with superposed regenerators having discharge openings in the top which are provided with sliding valves. Air under pressure for the combustion chamber is passed through each regenerator alternately with the combustion products, under control of the valves, by which the cross-section of the discharge opening of the regenerator from which the combustion products are being discharged may be varied.—W. F. F.

Rotary kiln. F. Tschirner, Newark, N.J., Assignor to R. G. Wagner, New York. U.S. Pat. 1,292,927, 28.1.19. Appl., 13.4.17.

THE apparatus comprises an inclined rotary kiln heated by a burner, the flame from which is directed into the lower end of the kiln. A receptacle arranged beneath the lower end of the kiln receives the material discharged from the latter and is enclosed in an insulated housing to protect the material from currents of gases. The receptacle may be heated indirectly.—J. H. P.

Fabric [filter cloth]; Coated ——. E. J. Sweetland, Montclair, N.J., and F. W. Manning and W. S. Hilpert, Chicago, Ill. U.S. Pat. 1,292,535, 28.1.19. Appl., 8.2.17.

A MATERIAL suitable for use as filter cloth, and resistant to the corrosive action of fatty acids, is prepared by applying to a woven metallic fabric, so that the interstices are only partially closed, a thin coating of a substance which is inert to fatty acids, *e.g.*, a composition containing a phenol condensation product.—S. S. A.

Filter leaf or disc. O. J. Salisbury, Assignor to United States Filters Corp., Salt Lake City, Utah. U.S. Pat. 1,293,555, 4.2.19. Appl., 31.8.17.

A CIRCULAR filter leaf or disc is composed of segmental filtering units arranged around a central shaft. Any unit can be separately disconnected from the others and from the shaft.—J. S. G. T.

Mixing apparatus. W. M. Grosvenor, Ridgewood, N.J., Assignor to Perkins Glue Co. U.S. Pat. 1,293,087, 4.2.19. Appl., 29.2.16.

A VERTICAL shaft which can be rotated at high speed is arranged axially within a mixing chamber provided with an outlet. A pipe union open below and screwed to the bottom of the shaft has open ended pipes of smaller cross-section than the bottom opening screwed into it transversely to the shaft. The material to be mixed is drawn in through the bottom opening of the pipe union and ejected through the radial pipes, above which a transverse disc is arranged within the material to be mixed. A scraper carried loosely by the shaft rotates relatively to the same.—J. S. G. T.

Refrigerating apparatus. F. G. Keyes, Boston, Mass. U.S. Pat. 1,293,469, 4.2.19. Appl., 17.1.18.

THE dead space at the top of a still furnished with cooling coils contains a compartment provided with outlets which are normally below the level of liquid in the still, and which, when the level of the solution in the still is lowered, discharge liquid from the compartment upon the cooling coils. The compartment is connected with another, external to the still, by pipes which may be artificially cooled. A portion of the distillate is stored within this external compartment and being returned to the still via the cooled pipe serves to reduce the vapour pressure in the dead space of the still.—J. S. G. T.

Treating materials: Apparatus for —. J. W. Hornsey, Summit, N.J. Assignor to General Reduction Gas and By-Products Co. U.S. Pat. 1,293,780, 11.2.19. Appl., 15.7.10. Renewed 26.8.16.

A CYLINDRICAL rotary treating chamber has its axis slightly inclined to the horizontal. A number of lipped lifting blades are arranged longitudinally within the chamber which is partitioned transversely into compartments by retarding diaphragms. The material in any compartment is lifted by the blades and distributed in a shower across the path of travel of the treating medium, passing thus into the succeeding compartment.—J. S. G. T.

Still. B. Gallsworthy, Port Arthur, Tex. U.S. Pat. 1,294,357, 11.2.19. Appl., 8.6.16.

A TANK with corrugated roof constitutes an integral part of the still. Fixed troughs uniting in a shoot are arranged under the corrugations, and an annular gutter with an outlet is fixed to the still wall under the troughs.—J. S. G. T.

Gas-fired boilers: [Burners for —] P. St. G. Kirke, London. Eng. Pat. 121,016, 12.2.18. (Appl. 2520/18.)

Roller mill scrapers. A. W. Schmidt, Lewiston, Idaho, U.S.A. Eng. Pat. 124,033, 9.3.18. (Appl. 4194/18.)

Dryer. R. W. King, The Dalles, Assignor to Pacific Evaporator Co., Portland, Oreg. U.S. Pat. 1,293,799, 11.2.19. Appl., 30.6.16.

SEE Eng. Pat. 111,994 of 1917; this J., 1918, 46 A.

Filter. E. Zahm and C. A. Nagel, Assignors to Zahm Manufacturing Co., Buffalo, N.Y. U.S. Pat. 1,294,018, 11.2.19. Appl., 25.5.17.

SEE Eng. Pat. 108,897 of 1916; this J., 1917, 1086.

Distributing liquids in scrubbers. Eng. Pat. 123,879. *See* II A.

Coated wooden vessel. U.S. Pat. 1,291,696. *See* V.

Rotary kiln. U.S. Pat 1,292,928. *See* VII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal gas: Purification of —— *from hydrogen sulphide.* P. Schumann. J. Gasbeleucht., 1919, 62, 77—81.

GERMAN gas coals have a much lower average content of sulphur than English coals and the percentage of hydrogen sulphide in the crude gas is correspondingly smaller. As much as 60% of the hydrogen sulphide may be removed in the ammonia scrubbers. Assuming that 0·5% H_2S is present in the gas entering the oxide purifiers, it is estimated that 19,810 tons of sulphur per annum is recoverable in German gasworks.—H. J. H.

Ammonia washing and oxide purification [of gas]; Present practice in —. K. Liese. J. Gasbeleucht., 1919, 62, 113—119.

THE ammonia washing process may be either chemical or physical. Physical washers include the normal tower scrubber and the various types of mechanical and centrifugal washers. Chemical washing includes the so-called "direct" processes in which ammonia is absorbed from the crude gas by sulphuric acid as in coke-oven practice and "simultaneous" processes in which ammonia and hydrogen sulphide are removed together. The author considers that physical processes both now and, so far as can be seen, in the future will hold the field in gas-works practice in which absolutely reliable, efficient, and continuous operation is essential, the requirements on coking plants being less stringent. The tower scrubber is regarded as still the most satisfactory plant. In the author's experience trouble due to the formation of accretions among the upper tiers of filling of scrubbers can be avoided by placing on the topmost hurdle a layer of wood wool about 18 inches thick. The filling is kept clean and the wood wool requires renewal about once a year. Wash water is fed through a pipe fitted with a spraying jet and sliding concentrically in a stuffing-box through a larger pipe which is fitted with a full-bore tap. In case of stoppage the jet can be withdrawn through the tap which can then be closed, enabling the jet to be rectified without interrupting the working of the scrubber. The Raschig ring filling is advocated. The oxide purification process is discussed in relation to German practice.—H. J. H.

Gas producers. G. Marconnet. Chim. et Ind., 1919, 2, 6—14.

EXPERIMENTS on gas producers are described in which forced draught was used with the object of increasing the yield of gas from a given size of producer. A very high temperature was maintained in the producer, sufficient to fuse the clinker, and it was found that coal having a relatively high proportion of incombustible matter, up to 40%, gave the best results owing to the diminished tendency of the fused residue to solidify and obstruct the air passages. The material in the producer may have a depth of 1—5 metres and the air pressure may be 30—60 cm. of water. The proportion of carbon dioxide in the gas was about 2—3% and the capacity of the producer about 2000—3000 kilos. per sq. metre of section. When the depth of the charge was small it was found that a rectangular producer permitted a more complete penetration of the air blast into the centre of the charge. The efficiency increases with larger producers and decreases when small coal is used. In a modification, a mixture of dry coal dust and air, in the proportions necessary for the production of carbon monoxide,

was injected tangentially into a combustion chamber. The capacity of such a producer was found to be 500—1500 kilos. per sq. metre. The principal difficulty experienced was corrosion of the walls, but refractory linings of bricks consisting largely of alumina with less than 1% of iron, or graphite, were satisfactory. The best results were obtained with a water-jacketed metal wall. Results of tests on a water-tube boiler with hand and mechanical stoking, and heating by producer gas are given. The flue gases showed a steady proportion of 15—18% of carbon dioxide when a producer was combined with the boiler, and a very variable proportion of 1—10% with ordinary stoking. The evaporative power may be increased by 50% owing to the more uniform heating of the boiler tubes.—W. F. F.

Petroleum derivatives; Application of the Grignard reaction to the preparation of acids from some ——. H. Wegrzyn. Petroleum, 1918, **13**, 241—243. Chem. Zentr., 1919, **90**, II., 121—122.

BENZINE fractions from Borysław crude oil were treated with sulphuric acid to remove aromatic and unsaturated compounds, then halogenated, and treated with magnesium. The bromo-derivatives did not yield carboxylic acids. Of the chloro-derivatives from benzine (sp. gr. 0·7002, b.pt. 65°—75° C.), the fraction of b.pt. 64°—80° C. did not yield carboxylic acids, but the fraction boiling between 80° and 156° C. gave a yield of 40% of a mixture of carboxylic acids, having sp. gr. at 20° C. 0·947, b.pt. 202° to 216° C., mol. wt. 137·0. The author deduces from these values that the acids are alicyclic and that the chief constituent is hexanaphthenecarboxylic acid, $C_6H_{11}CO_2H$. Attempts to obtain acids from solid paraffin by the Grignard reaction, even when the experiment was conducted in an autoclave heated to 155° C., were wholly unsuccessful, from which the author concludes that only cyclic compounds are affected.
—T. St.

Paraffin wax; Theory of the process of crystallisation in the manufacture of ——. E. Bergel. Petroleum, 1918, **14**, 173—177. Chem. Zentr., 1919, **90**, II., 122—123.

COOLING is used exclusively in practice for the separation of paraffin wax from oil, and the more slowly this takes place, the larger are the crystals formed. Crystallisation is encouraged by dilution, but especially by increasing the solubility by the addition either of such substances as increase the solvent power of the oil, or of a suitable solvent (benzine). Viscosity is of considerable influence on crystal formation, the higher the viscosity the more numerous being the crystal-nuclei, with consequent prejudice to the formation of large crystals. Other substances such as asphalt also influence the crystallisation process, but their effect may be largely overcome by cooling in stages.—T. St.

Lignite tar. Erdmann. *See* III.

"Dracorubin" tests. Dieterich. *See* XXIII.

PATENTS.

Binding material for fuel-briquettes; Manufacture of a —— from petroleum residues, lime, and rosin. K. Elsentraut, Petrograd. Ger. Pat. 309,808, 25.4.12.

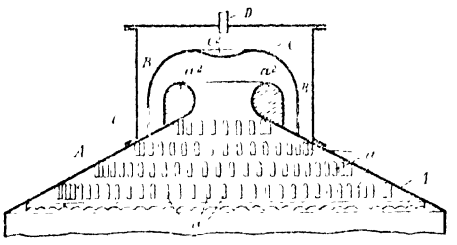
A MIXTURE of 75—125 parts by weight of fluid petroleum residues, 50—100 of solid petroleum residues, and 50—75 of wood pitch or rosin is heated in a closed vessel to 130° C., then 15—50 parts of powdered lime is added, and after a certain time, with continuous stirring, further heat is applied. In consequence of the preliminary heating, a smaller proportion of lime is required and the use of alkali entirely avoided. Briquettes of coal, lignite, peat, or sawdust made with this binding material are completely resistant to atmospheric influences, and burn with a long bright flame even when lean coals and anthracite are used.—J. F. B.

Coke-oven; Vertical ——. A. Putsch, South Bethlehem, Pa., Assignor to F. O. Dettmann, New York. U.S. Pat. 1,292,874, 28.1.19. Appl., 4.6.15.

A VERTICAL coke oven is provided with groups of horizontal heating flues in the dividing walls, each group comprising two outer flues and an intermediate flue. The inlet ends of all the intermediate flues are connected to one regenerator so as to preheat the air which is passing into the heating flues, and the outlets of the other flues are connected to another regenerator which is thereby heated by the combustion products.—W. F. F.

Gas scrubbers; Apparatus for use in the distribution of liquids in —— and for analogous purposes. J. H. Dent, and The United Alkali Co., Ltd., Liverpool. Eng. Pat. 123,879, 18.4.18. (Appl. 6598/18.)

LIQUID is supplied by the pipe, D, to the depression c^1 in the top of a dome, C, arranged in a casing, B, the liquid in which seals the openings, *c*. The



liquid passes over the edge, a^2 of the cone, A, which has a number of downward projections, *a*. The liquid spreads over the inner surface of the cone and drips from the projections, *a*.—W. F. F.

Gas-washing apparatus. A. L. Stevens, Assignor to O. R. Barnett, Chicago, Ill. U.S. Pat. 1,292,125, 21.1.19. Appl., 10.9.12.

GAS enters the lower end of a vertical casing and passes inwards between superposed horizontal annular washing plates in an enlargement of the casing, slightly spaced apart and mounted on a vertical rotating shaft, passing concentrically through the casing. The washing liquid passes outwards centrifugally over the surface of the plates and is discharged from the enlarged part of the casing. The washed gas passes upwards through a centrifugal fan at the top of the casing to the discharge. The washing liquid is sprayed into the top of the casing and passes through the ascending gas.—W. F. F.

Explosions [in gas-burning apparatus]; Apparatus for preventing ——. The British Thomson-Houston Co., Ltd., London. From The General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 123,888, 1.5.18. (Appl. 7293/18.)

A DEVICE for preventing back-firing and explosions in tanks containing hydrogen or acetylene is placed

in the gas conduit leading from the tank, and comprises an outer vertical casing containing an inverted cup of porous refractory material resting on the bottom over the gas inlet and sealed by any suitable material. The gas inlet projects slightly through the bottom into the cup, and carries a wire gauze cage which is embedded in a quantity of pellets of lead or fusible alloy contained within the cup. The gas outlet at the top of the casing is covered by a diaphragm of wire gauze and the gas inlet pipe below the casing contains a layer of steel shot resting on a diaphragm of wire gauze. A flame travelling backwards through the gas conduit is delayed or extinguished by the wire gauze, but if it reaches the space surrounding the refractory cup is further retarded and heats the latter till the fusible pellets melt, which may stop the gas flow. If the gas inlet still remains open, the melted metal falls through the gauze cage and is trapped by the steel balls and thus seals the inlet pipe.—W. F. F.

Hydrocarbon oils and residues; Treatment of —— for the production of lower boiling hydrocarbons. J. G. Robertson, Partick, J. Nelson, and Petrol Patents, Ltd., Glasgow. Eng. Pat. 10,981, 29.7.15.

HYDROCARBON oils or residues in a liquid or semi-liquid state are brought into contact with pumice-stone or sandstone heated to 500° to 800° C. in a closed retort. The vapours formed are removed, *e.g.*, by a pump, and are fractionally condensed, preferably under pressure. Viscous materials such as tars are preheated before treatment to increase their fluidity. The temperature of conversion is varied according to the hydrocarbon being treated (aromatic compounds requiring in general a higher temperature than aliphatic), the nature of the product desired, and the percentage to be converted in a single operation.—T. St.

Solvents for india rubber and animal fats; Preparation of —— [from mineral oils]. J. B. Carper and T. G. Tulloch, London. Eng. Pat. 124,072. (Appls. 5167, 23.3.18, and 5635, 2.4.18.)

A MIXTURE of about 25% of shale oil light fractions (sp. gr. 0·7 or below) and about 75% of once distilled (to about 200° C.) coal tar oil is washed successively with sulphuric acid, caustic soda, and water, and is then distilled. The first portion of the distillate, *i.e.*, the fraction giving on distillation 90% at about 160° C., is suitable for a light rubber solvent; a further portion of the distillate, *i.e.*, the fraction yielding 90% at 190° C., may be used as a heavy rubber solvent. The first distillate is also useful as a solvent for animal fats.—L. A. C.

Petroleum and other hydrocarbon oils; Apparatus for vaporisation and distillation of ——. G. A. Humason, Assignor to J. W. Parker, Houston, Tex. U.S. Pat. 1,291,899, 21.1.19. Appl., 1.7.18.

A SEPARATOR attached to a still is provided with condensing chambers and a vapour-outlet pipe leading to a condenser. Means are provided whereby the distillates from any of the separator chambers are automatically mixed with the liquid from the condenser to form a liquid of a desired specific gravity.—L. A. C.

Petroleum derivatives; Apparatus for treating ——. H. B. Setzler, Coffeyville, Kans., Assignor to The National Refining Co., Cleveland, Ohio. U.S. Pat. 1,292,966, 28.1.19. Appl., 29.10.15.

A HORIZONTAL cylindrical pressure-still is fitted with an internal rotating scraper in the form of a helical strip of approximately the same length and diameter as that of the still. The scraper is attached loosely to driving arms fitted to a shaft placed eccentrically with respect to the axis of the still and thus bears continually upon the bottom of the still.—L. A. C.

Crude-oil residuum; Method of and apparatus for coking ——. T. E. Murray and E. B. Ricketts, New York. U.S. Pat. 1,293,866, 11.2.19. Appl., 20.11.17.

A CURRENT of hot gas is passed over a thin layer of crude oil residuum flowing over the inner surface of a chamber; volatile portions of the residuum are evaporated and coke is deposited on the surface.—L. A. C.

Lubricating-grease; Process for making ——. F. B. Mason, Bayonne, N.J. U.S. Pat. 1,294,136, 11.2.19. Appl., 13.7.17.

A MIXTURE of fatty acid, mineral oil, and hydrated "lime flour" is heated below 100° C. without the addition of water.—L. A. C.

Oils containing paraffin; Double-tube cooler for ——. R. Neumann, Brünn, Austria. Ger. Pat. 309,850, 21.2.18. Int. Conv., 9.8.17.

THE apparatus consists of a battery of double tubes, oil passing through the inner tubes and cooling liquid through the outer; the cooling liquid is vaporised by the heat absorbed from the oil. The outer tubes are so connected by overflows for the cooling liquid that the latter, which enters through a single valve, largely or completely surrounds the inner tubes whilst leaving a space for the vapour formed.—T. St.

Coke ovens and the like; Burner nozzles for ——. L. Wilputte, New Rochelle, N.Y., U.S.A. Eng. Pat. 119,464, 13.9.18. (Appl. 14,953/18.) Int. Conv., 26.9.17.

Combustion of gas; Process and apparatus for the ——. H. R. Maxon, Muncie, Ind., U.S.A. Eng. Pat. 121,052, 14.3.18. (Appl. 4543/18.)

SEE U.S. Pat. 1,291,589 of 1919; this J., 1919, 245 A.

Ammonium sulphate. U.S. Pats. 1,291,729—30. *See* VII.

Hydrogen manufacture. Ger. Pat. 309,549. *See* VII.

Reclaiming asphaltic waste. U.S. Pat. 1,290,954. *See* IX.

Roofing felts. U.S. Pats. 1,293,185-6. *See* IX.

Fibre and asphalt from roofing-scrap. U.S. Pat. 1,293,293. *See* IX.

Soaps containing hydrocarbons. Ger. Pat. 309,574. *See* XII.

[Gas] testing apparatus. U.S. Pat. 1,282,409. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Distillation of albumin. Pictet and Cramer. *See* XIX A.

Distillation of wood of conifers. Huerre. *See* XX.

PATENTS.

Incandescence arc-lamp. P. K. Devers, jun., Lynn, Mass., Assignor to General Electric Co. U.S. Pat. 1,290,930, 14.1.19. Appl., 6.3.16.

TUNGSTEN electrodes, separated by a gap of "about the same order of magnitude as the electrodes," are used, and the lamp bulb is filled with a gas at approximately atmospheric pressure at the operating temperature, so as to suppress disintegration of the electrodes, the gas being inert to tungsten at high temperatures. A heater wire of refractory metal is coiled about the arc gap to render the gas between the electrodes conductive to the current, one terminal of the wire being connected to one of the electrodes. The necessary voltage for producing an arc is supplied to the electrodes, whilst they are at a temperature at which the electron emission is appreciable.—B. N.

Carburising material. U.S. Pat. 1,292,044. *See* X.

Lævoglucosan. Eng. Pat. 121,725. *See* XVII.

III.—TAR AND TAR PRODUCTS.

Lignite tar; New proposal for the treatment of ——. E. Erdmann. Braunkohle, 1918, **17**, 425. J. Gasbeleucht., 1919, **62**, 119—120.

EXISTING processes for working up lignite tars in Central Germany yield principally fuel oil and small quantities only of the more valuable lubricating oils and solid paraffin. The author considers as technically imperfect and wasteful of time, labour, and material, the repeated fractional distillation at high temperatures and the removal of unsaturated compounds by the normal acid and alkali washing. Solid paraffins are very sparingly soluble in cold acetone—1 grm. of hard paraffin is dissolved by 11,000 grms. and 1 grm. of soft paraffin by 2146 grms. of acetone at 2° C. This permits of the almost quantitative removal of paraffin from tars and tar oils accompanied by the small quantity of residual bitumen (montan wax) by the addition of acetone. The process can also be used for analytical purposes. Two volumes of acetone is mixed with one volume of warm tar, the solution is cooled to 0° C., and pressed to separate the hard paraffin in a saleable condition. Further cooling to −20° C. yields a softer paraffin. On distilling the acetone extract under normal pressure after removal of the acetone, oil commences to distil at 250° C. with evolution of gas which increases as the temperature rises and is somewhat violent at 400° C. when the distillation ends. The gas has the composition:—C_nH_m 11%, CO 11%, CH_4 77%. The evolution of gas was not due to the decomposition of phenols nor of bitumen as had been supposed, but rather to the breakdown of some of the heavy mineral oil constituents. On distilling the acetone extract under 4 mm. of mercury pressure about one-half passed over at 144° C., leaving a viscous residue which by distillation under normal pressure is broken down yielding fuel oil and permanent gas. Commercially it is better to distil the acetone extract in superheated steam and the residual viscous mass forms a valuable lubricating oil, the yield of which is increased from a few per cent. in the normal process up to 30% on the tar and even 50% on producer tars. The lubricating oil contains 2·35% of sulphur with which the high viscosity is believed to be connected.—H. J. H.

Coumarone resins. Marcusson. *See* XIII.

PATENTS.

Sulphonic acids; Method of isolating —— in the form of salts from the products obtained on sulphonating carbon compounds. A. Lapworth and H. N. Morris, Manchester. Eng. Pat. 11402/15. Appl., 6.4.16.

READILY soluble sulphates of certain di- and trivalent metals, such as magnesium, aluminium, iron, cobalt, nickel, cadmium, and zinc, are used to isolate sulphonic acids from the crude product of sulphonation in the form of salts, which are soluble in water to the extent of 5 to 25% but are more sparingly soluble in dilute sulphuric acid of 30—50% strength. The crude product is treated with not more than 5% in excess of the theoretical quantity of the sulphate of the metal in question, either wholly or partly in aqueous solution, and after cooling, the precipitated sulphonic acid salt is filtered off and washed with a prescribed quantity of a cold saturated solution of the pure salt from a previous operation. The filtrate and washings contain only sulphuric acid and a few per cent. of metallic salts, and the latter together with a requisite proportion of the filtrate are neutralised with metallic oxide or carbonate so as to provide a solution saturated with sulpho-salt, and containing the amount of metallic sulphate required for a repetition of the operation.
—G. F. M.

Toluene sulphonic acids; Process for the manufacture of ——. J. A. Ambler, Norwich, Conn., and H. D. Gibbs, San Francisco, Cal. U.S. Pat. 1,292,950, 28.1.19. Appl., 26.1.18.

A CONTINUOUS process for the production of toluene sulphonic acids consists in bringing toluene vapour in contact with a descending current of sulphuric acid.—L. A. C.

Anthraquinone; Method of purifying commercial ——. H. F. Lewis, Urbana, Ill., and H. D. Gibbs, San Francisco, Cal. U.S. Pat. 1,293,610, 4.2.19. Appl., 26.1.18.

COMMERCIAL anthraquinone in the solid state is reduced by the action of finely divided iron and a hot alkaline solution, the resulting solution is filtered, and anthraquinone of a high degree of purity is recovered by subsequent re-oxidation.
—G. F. M.

Treating hydrocarbon oils. Eng. Pat. 10,981. *See* IIA.

Solvents. Eng. Pat. 124,072. *See* IIA.

Trinitro compound from phenol. U.S. Pat. 1,292,266. *See* XXII.

IV.—COLOURING MATTERS AND DYES.

Citronines. T. Maki. Kōgyō-Kwagaku Zasshi (J. Chem. Ind. Tokyo), 1918, **21**, 1199—1234, 1919, **22**, 1—27.

ORANGE-IV, prepared by diazotising sulphanilic acid and coupling with diphenylamine, yields various Citronines when nitrated. These dyes are mixtures of nitrated Orange-IV and nitrodiphenyl-

amines. The best product, "Citronine-IV," is obtained by shaking Orange-IV with dilute nitric acid (sp. gr. 1·226) at 15°—17° C., for 20 hours. It is a dark brown powder, dyeing silk and wool a beautiful bright yellow, fast to reagents with the exception of stannous chloride. Another dye, Citronine-VII, is obtained when nitric acid of sp. gr. 1·377 is used. Fuming nitric acid entirely ruptures Orange-IV and gives hexanitrodiphenylamine and *p*-phenolsulphonic acid. When Orange-IV is heated with aniline hydrochloride and aniline (proportions, 1 : 1 : 2), at 100° C. for 2 hours and then to 180° C., Induline is formed. Citronines or polynitrodiphenylamines oxidise aniline or the toluidines when heated at 120°—130° C. and finally at 180° C., Magentas being formed. Similarly, with dimethylaniline they give a dye similar to Methyl Violet, and with α-naphthylamine a substance resembling Magdala Red.—J. C. W.

Adsorption compounds [of dyestuffs]. II. R. Haller. Kolloid-Zeits., 1919, **24**, 56—66. (See this J., 1918, 411 A.)

THE adsorption compounds produced by the addition of a 1% solution of Brilliant Green to 0·5 grm. of the following substances dissolved in 50 c.c. of water have been isolated and characterised: Metanitroparatoluidine Red, Metanitroanisidine Red, Paranitro-orthoanisidine Red, Sudan G, Sudan I, Paranitraniline Red, Alizarin Yellow GGW, Fast Orange O, Brilliant Orange, Chromotrope 2R, Ponceau 2G, and *p*-nitrobenzeneazonaphtholsulphonic acid. The effects produced by dyeing wool and cotton in the presence of tannic acid are noted.—J. F. S.

PATENTS.

Indoryl, its homologues, and their derivatives: Manufacture of ——. E. A. Bourcart, Assignor to Comp. Nationale de Matières Colorantes et de Produits Chimiques, Paris. U.S. Pat. 1,293,680, 11.2.19. Appl., 1.8.16. Renewed 10.10.18.

SEE Eng. Pat. 101,316 of 1916; this J., 1916, 1056.

Picric acid. Eng. Pat. 9962. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cellulon and artificial silk textiles. A. Kramer. Monatschr. Textilind., 1918, **33**, 81—82. Chem. Zentr., 1919, **90**, II., 118—119.

CELLULON yarns are manufactured by the Türk wet-spinning process by rolling and twisting narrow ribbons of fibrous pulp which are formed on cylinder moulds from suspensions of cellulose. They are superior in tensile strength to yarns made from paper and show a smaller loss in spinning; they are very resistant to washing and boiling and behave better than paper yarns in the bleaching and dyeing baths. Cellulon yarn, on account of its high strength, serves as a substitute for hemp for the manufacture of machine belting, girths, hose-pipes, and twine. "Staple fibre" is a product made from cellulose solutions like artificial silk. The cellulose solution is pressed through fine sieve-like spinnerets and, as soon as the threads are solidified, they are chopped up into pieces 4—5 cm. long and dried. These fibres are of the length of certain natural textile fibres, and the spun material is somewhat similar to wool; the fabrics have the feel of woollen fabrics and at the same time a high lustre. Fabrics woven from a mixture of "staple fibre" with wool or cotton are extremely strong and can be washed. The dyeing of "staple fibre" presents no difficulties.—J. F. B.

Paper textiles and yarns; Processes for making —— soft and waterproof. E. O. Rasser. Papierfab., 1918, **16**, 621—625, 645—647. Chem. Zentr., 1919, **90**, II., 114—115.

THE softness of the yarn stands in relationship to its roundness, smoothness, and moisture content. The yarn leaves the spinning discs with a moisture content of 39%, and the spinning machine at 20—25%. In the weaving sheds it is worked with not more than 15% of moisture. Moistening on the slitting machine, or by dipping the rolls, or in special chambers has not answered so well as damping on the spinning machine. In selecting a chemical softening agent, preference is given to those which do not decrease the tensile strength and which prevent the development of moulds. Mixtures of glycerin with a little carbolic acid are used; glycerin residues are also suitable. Alum is employed, but owing to its acid reaction it is not quite free from objection. For testing softened yarns a number of instruments have been devised, but their indications would not appear to be so accurate as the determination of the tensile stretch. A comparison of the elongation values affords a measure of the softness of the paper yarn. Strips cut from the machine direction of the paper have a smaller elongation than those cut from across the web; the mean of the two values is therefore taken. For softening paper yarn textiles, soaps are employed or, alternatively, the textiles are boiled for a long time in a weak solution of sodium carbonate, sometimes with the addition of sodium sulphide. For the preparation of soft, water-resistant fabrics, mixtures of casein-lime with soap and aluminium acetate are employed, also mixtures of sodium carbonate, lithopone, and calcined lime with alum, and mixtures of hydrogen peroxide, ammonia, soap, lime, talc, and aluminium acetate. A waterproofing composition is made from a solution of parchment waste in cuprammonium. The fabric impregnated with this solution is freed from copper by steeping in a solution of ammonium sulphate and aluminium acetate.—J. F. B.

Book papers: Manufacture of —— from wood fibres. A. O. Bowness. Pulp and Paper Mag., 1919, **17**, 195—198.

WOOD pulp intended for book papers should be very well boiled so that it can be bleached with a minimum quantity of bleaching powder, in order that the cellulose fibre may retain its strength and flexibility. A mixture of equal parts of sulphite and soda pulps makes a suitable blend, and if mechanical pulp be used, one ground on medium sharp stones at about 60 lb. pressure should be selected. The beating should be accomplished in about two hours with the roll rubbing rather than cutting; the beaters are preferably furnished rather thickly, so that whilst the fibres are well hammered out, their length is preserved. Any reduction in the length of the fibres, required to give a close pliable sheet with even surface, should be effected in the refiner, preferably of the Marshall type. The best arrangement of the chests is to have two large chests with the refiner placed between them. The beaters are emptied into one of these and the stuff is pumped through the refiner into the other. From this it is pumped into a smaller chest which supplies the mixing box of the machine by gravity. Rotary strainers are by far the best for wood fibre stock. On the machine, the best results for book papers are

obtained with a wire 38—40 ft. long. The shake of the wire must be smooth and not too long in the stroke. To prevent cockling the press-felts, especially that of the second press, must be kept clean so that the moisture in the paper is not unevenly distributed as it passes to the dryers. Strict attention must be paid to the draws to avoid uneven stretching at the edges. Smoothing rolls between two stacks of dryers are advantageous.—J. F. B.

Clays for use in paper-making. R. B. Roe. J. Amer. Ceram Soc., 1919, **2**, 69—73.

THE value of a clay used in paper-making for filling the interstices between the fibres depends chiefly on its whiteness which may be increased by the addition of a little blue pigment—the absence of grittiness, as judged by an examination of the residue left after washing the clay on a 200-mesh sieve, and on the amount of clay which is retained by a normal paper during manufacture. American clays are inferior to English ones for paper making.—A. B. S.

Coumarone resins. Marcusson. *See* XIII.

Transformations of nitrocellulose. Angell. *See* XXII.

PATENTS.

Textile belting. E. C. R. Marks, London. From Aktieselskabet Roulunds Fabriker, Odense, Denmark. Eng. Pat. 123,502, 25.10.18. (Appl. 17,469/18.)

IN order to eliminate hygroscopic matters from raw textile fabrics and to ensure that the impregnating substance will completely displace these matters, the textile belts are placed in a closed vessel in which a vacuum is produced, and the impregnating substance dissolved in a volatile hydrocarbon is admitted, preferably under pressure. After impregnation and removing the impregnating liquid, steam is admitted to the vessel and the solvent is evaporated. Under the action of the steam, the hygroscopic constituents of the textile exude and their place is filled by the impregnating fluid. A volatile solvent of high boiling point, *e.g.* "mineral turpentine," is advantageously employed to keep the impregnating material fluid during steaming. Finally the vapours and moisture are removed by heating the belts under reduced pressure.—J. F. B.

Textile and other fabrics; Apparatus for coating ——. J. Huebner, Cheadle Hulme. Eng. Pat. 123,551, 26.1.18. (Appl. 1519/18.)

THE fabric is passed between two rollers, the upper roller acting as the coating roller and having a surface stippled, engraved, or etched with a suitable design or with minute longitudinal, spiral or circumferential grooves. An adjustable "doctor" is fitted to the coating roller, adapted to form a containing trough for the rubber or cellulose plastic material to be applied to the fabric. As the roller passes the "doctor" a uniform film of plastic material adheres to the roll, forming a coating the thickness of which is determined by the adjustment of the blade. This coating is then transferred to the fabric as it passes between the two rollers.—J. F. B.

Wool, hides, flax, jute, etc.: Recovering grease and the like from water which has been used in scouring or washing —— or from magma obtained from such water. W. Kelsey, Bradford. Eng. Pat. 123,848, 14.3.18. (Appl. 4516/18.)

THE greasy water is agitated and strained by passing it through a filter of broken glass, iron filings, pieces of tin, etc. supported in the upper part of a tank in which the strained liquid is agitated and caused to deposit sand or other matters in suspension. The liquor passes through perforations in the side of this tank into a tank divided transversely by a number of partitions extending alternately from the top and from the bottom of the tank in such a way as to form a zigzag passage for the liquid through the compartments. Outlets are provided in the tops of the compartments for the removal of the grease as it rises above the water in the succeeding compartments. The grease passes off into a trough, whence it is forced into an apparatus similar to that used for separating cream from milk. The watery liquid is drawn off by a pipe leading from near the bottom of the last compartment and may then be treated with acid to liberate the fatty acids and remaining grease, these being separated in an apparatus similar to the first.—J. F. B.

Drying process and apparatus for tentering and other machines. F. P. Boland, Providence, R.I. U.S. Pat. 1,291,035, 14.1.19. Appl., 19.4.17.

THE goods to be dried are passed into a heated chest. Air is forced through a pipe, from a chamber situated beneath the chest, to one side of the goods, through the goods in a direction at right angles to the direction of travel, drawn off at the opposite side, and returned for re-application.—S. S. A.

Hemp; Process for preparing —— by warm water retting. C. Kuhnow, Wilhelminenhof. Ger. Pat. 291,326, 12.3.15.

BEFORE the raw material is subjected to retting by warm water, it is broken and freed as far as possible from particles of wood, then dried and further treated by breaking and shaking. The preliminary breaking and scutching has the effect of leaving only one-fourth of the original dry material to pass through the retting process; this is performed at about 30° C.—J. F. B.

Celluloses; Process of treating [dissolving] ——. The Manchester Oxide Co., Ltd., R. H. Clayton, J. Huebner, and H. E. Williams, Manchester. Eng. Pat. 123,784. (Appls. 17,817, 1.12.17, and 10,567, 27.6.18.)

SOLUTIONS and viscous gelatinous masses are prepared from cellulose by the action of certain thiocyanates, such as calcium, manganese, strontium, or lithium thiocyanates. In other cases satisfactory results are obtained by combining sparingly soluble thiocyanates with aqueous solutions of soluble thiocyanates. Examples: 4 grms. of dry cellulose is treated with 100 c.c. of calcium thiocyanate solution of sp. gr. 1·38. After heating at 100° C. with agitation for one hour, the temperature is raised to 120° C. and maintained at that until the cellulose is dissolved. Alternatively, a solution containing 70 grms. of sodium thiocyanate and 70 grms. of mercuric thiocyanate in 100 c.c. may be used. Part of the thiocyanate may be replaced by other salts, such as calcium chloride, for instance, a mixture of 30 c.c. of a solution containing 86 grms of calcium chloride per 100 c.c. and 70 c.c. of a solution containing 76 grms. of calcium thiocyanate per 100 c.c. may be used. The addition of 4% of acetic acid is advantageous.—J. F. B.

Pyroxylin compounds; Process of making ——. W. G. Lindsay, Newark, N.J., Assignor to The Celluloid Co. U.S. Pat. 1,292,819, 28.1.19. Appl., 15.6.17.

HYDROUS pyroxylin is mixed with benzyl benzoate and the water is removed by pressing.—S. S. A.

Dental filling [from celluloid] and process of making same. H. A. Black, Topeka, Kans. U.S. Pat. 1,294,355, 11.2.19. Appl., 27.4.18.

A MIXTURE of one part by weight of nitrocellulose (celluloid), ⅔ part of a saturated solution of gum arabic in chloroform, and ¼ part of powdered silica is dried in the form of a thin sheet, and then powdered.—L. A. C.

Sulphite-boiler plant. J. K. Ruths, Djursholm, Assignor to Aktiebolaget Vaporackumulator, Stockholm, Sweden. U.S. Pat. 1,292,080, 21.1.19. Appl., 24.2.17.

A STEAM accumulator is interposed between, and connected respectively to a steam generator and a sulphite boiler. The flow of steam is controlled in its passage from the generator to the accumulator. —S. S. A.

Cellulose digesters; Apparatus for charging ——. A. Staempfli, Bingen. Ger. Pat. 309,679, 15.3.18.

THE particles of the raw charge before filling into the digester are so heavily squeezed together that no elastic swelling up again to the original bulk takes place and the charging of the digester simply consists in running in the compressed particles. The reduction in space occupied may be as much as one-third of the original volume and depends on the pressure employed and the moisture-content of the wood.—J. F. B.

Wood cellulose and mechanical pulp; Process for separating the resin from ——. H. Wandrowsky, Berlin. Ger. Pat. 309,630, 5.5.18.

THE pulp is treated during the beating with salts which react by double decomposition to give sparingly soluble products. For instance, the pulp is treated in the hollander with calcium or magnesium chloride and an equivalent quantity of sodium oxalate is then added. Calcium or magnesium oxalate is formed and the resin acid remains in suspension in a finely divided state. It may be precipitated on the fibre by the addition of alum and so play a useful part in the sizing of the paper.—J. F. B.

Beating engines; Hollander ——. H. Anderson, St. Annes-on-Sea, G. E. Anderson and T. Wilson, Bury. Eng. Pat. 123,584, 27.2.18. (Appl. 3474/18.)

THE hollander is designed with the roll, plate, and plate-box in a relatively elevated position, so that the proportion of the roll immersed in the stuff is reduced. The bottom of the trough is inclined upwards to the roll and the inclination downwards from the back fall is continued gradually right round the trough to the lowest point. An emptying device is provided whereby fresh water or back water is injected through holes in the floor of the back fall, so that the stuff is diluted from below and flows easily down the incline to the discharge orifice. These apertures are covered with an apron when not in use, so that stuff cannot lodge therein during the beating. The sides of the trough adjacent to the ends of the roll are cut away and fitted with removable side plates, so that hoops may be fitted on the roll while it is in position in the engine. End-shields or spinners are provided on the ends of the roll shaft and are constructed with two flanges embracing the edges of the side plates of the trough to prevent leakage. —J. F. B.

Paper; Manufacture of parchmentised or like ——. W. Dagnall, Hampton Wick. Eng. Pat. 123,594, 28.2.18. (Appl. 3598/18.)

PAPER is treated successively in two baths of sulphuric acid of different concentrations, the first bath having sp. gr. 1·700—1·800 at 15·5° C. After passing through this bath the paper is squeezed between rollers and immediately enters the second bath, which has sp. gr. 1·200—1·400. For certain kinds of paper the sulphuric acid may be mixed with sulphurous acid, so that the sp. gr. of the first bath is reduced from 1·800 to 1·700—1·750. During the operation the sulphuric acid baths are kept cool, so that the temperature does not rise above 15·5° C. After leaving the second sulphuric acid bath the paper is squeezed, led between water sprays and thoroughly washed; it is then passed through a bath of alkali and again washed and squeezed; lastly, it is led through a bath containing a softening liquid, squeezed, dried, and calendered.—J. F. B.

Paper; Surfacing ——. G. H. Parks, Glen Falls, N.Y., Assignor to International Paper Co., New York. U.S. Pat. 1,291,626, 14.1.19. Appl., 9.3.14.

A SOFT surface glaze is imparted to both sides of a web of paper by condensing moisture on the periphery of a cooled roller, rolling the moisture with a light tension-roller pressure into and upon one side of the paper and repeating the same operation with another roller, in advance of the first, against the other side of the paper. The moistened paper is then ironed at a temperature higher than that of its moistened surfaces and is finally finished by calendering.—J. F. B.

Stencil-paper compounds and methods for making them. E. Thomas, New York. U.S. Pat. 1,293,983, 11.2.19. Appl., 2.7.12.

YOSHINO or other paper is coated with a mixture containing a soap, *e.g.*, aluminium oleate, and a wax, *e.g.*, ceresin, the soap being softer at the ordinary temperature, but having a higher melting point than the wax. This coating is faced with a layer of stearic acid. The aluminium oleate is prepared for application by making a strong hot mixture of it with a solvent, and then thinning it by the addition of more solvent.—S. S. A.

Pulp and paper from garbage; Manufacture of ——. J. F. and H. F. J. Puttaert, San Francisco, Cal. U.S. Pat. 1,294,163, 11.2.19. Appl., 12.12.16.

A FIBROUS pulp is obtained from garbage by removing hard unsuitable material, crushing the remaining substance, expressing a portion of the water, and boiling the residue with alkaline reagents. S. S. A.

Paper textiles; Process for coating —— with nitrocellulose solutions. A. Lehner, Berlin. Ger. Pat. 308,615, 6.11.17.

THE fabric, before coating, is filled with a paste composed of an indifferent powdered material and a liquid which in small quantities is miscible with the nitrocellulose solution but in larger quantities acts as a precipitating agent, for instance, xylene, heavy petroleum spirit, toluene or, in some cases, water. The nitrocellulose solution is spread upon the prepared fabric and dried, and the powder, which has also become dry, is removed from the fabric. The paper fabric coated in this manner is soft and pliable, and the coating adheres firmly without stiffening the fabric.—J. F. B.

Paper yarn fabrics; Manufacture of a strong, pliable and water-resistant sheet material from ——. E. Pohlmey, Erfurt. Ger. Pat. 309,516, 24.4.18.

ONE or several layers of paper yarn fabric impregnated with an adhesive are covered with paper on

both sides and then treated with tanning agents. In the hardening process, the dissolved adhesive is retained by the layers of paper and is subsequently dried between them.—J. F. B.

Paper, textiles, etc.; Process for sizing, waterproofing and finishing —. W. Schmidt, Elberfeld, and E. Heuser, Darmstadt. Ger. Pat. 309,680, 14.1.18. Addition to Ger. Pat. 296,124.

Wood-, lignite- or coal-tar soap in the form of a solution is applied to the web of paper or textile and then allowed to dry. It is not necessary to decompose the tar soap nor to treat it with formaldehyde; after drying, the treated paper has the properties and the colour of artificial leather. —J. F. B.

Carbon-paper. S. Hattori, Tokyo. U.S. Pat. 1,292,404, 21.1.19. Appl., 26.4.18.

Paper is coated with a mixture containing a barium soap (*e.g.* barium stearate), together with an oily material and a colouring matter.—S. S. A.

Paper and boards; Process for waterproofing —. H. Wandrowsky, Berlin. Ger. Pat. 309,565, 21.4.18.

Animal, vegetable, or mineral non-drying oils are mixed with finely powdered, solid, water-repellent substances and the paper or board is impregnated with the mixture. Suitable water-repellent substances are: graphite, soot, talc, and "bärlapp" seeds. The powder penetrates together with the oil into the pores of the paper and after the oil has been absorbed by the fibres the pores are stopped up with the solid matters.—J. F. B.

Paper; Manufacture of hard-sized —. O. Ruff, Breslau. Ger. Pat. 309,999, 8.12.17.

The paper pulp, or a portion of it, is subjected to a putrefactive or fermentation process before it is converted into paper and the paper prepared from this material is strongly heated. The heating process is stronger and of longer duration than is customary on the paper machine and produces a true sizing. For example, wood pulp is mixed with some of the putrefied mass and allowed to stand for about 14 days at 30°—40° C. The paper prepared from this material is led over a drying cylinder heated by steam at 2·5 atmos. pressure and is reeled upon a roll in close contact with the cylinder so that the temperature of the paper reaches 110°—120° C. After about 2 hours the paper is re-reeled with simultaneous damping. —J. F. B.

Wooden receptacle; Coated —. G. T. Bloom, Magnolia, N.J. U.S. Pat. 1,291,696, 14.1.19. Appl., 13.12.16.

The inner surface of a wooden receptacle is coated with a partly dried elastic coating consisting entirely of concentrated waste sulphite liquor or sulphite pitch of approximately 1·18 sp. gr. and having an unneutralised acid reaction.—J. F. B.

Adhesive [from sulphite-cellulose waste lye], and process of making same. J. S. Robeson, Pennington, N.J. U.S. Pat. 1,292,068, 21.1.19. Appl., 21.2.16.

A non-alkaline, alkali resinate is treated with concentrated sulphite waste liquor.—S. S. A.

Reclaiming asphaltic waste. U.S. Pat. 1,290,954. *See* IX.

Roofing felts, etc. U.S. Pats. 1,293,185—6. *See* IX.

Fibre and asphalt from roofing-scrap. U.S. Pat. 1,293,293. *See* IX.

Fat etc. from cellulosic materials. Ger. Pat. 309,555. *See* XII.

Balloon fabric. Eng. Pat. 5915. *See* XIV.

Adhesive. Ger. Pat. 309,650. *See* XVII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Adsorption compounds [of dyes]. Haller. *See* IV.

Patents.

Dyeing-machine. M. Nagle, Brooklyn, N.Y. U.S. Pat. 1,293,514, 4.2.19. Appl., 17.8.16.

A swinging and displacing motion is imparted to yarn suspended in a vat, by means of a shaft provided with yarn-retaining plates, between which is fixed an elongated web. The axis of the shaft is within the cross-section of the web and is relatively nearer to one longitudinal edge than the other.—S. S. A.

Ice colours on the fibre; Process for producing —. A. Porai-Koschitz, Petrograd. Ger. Pat. 308,909, 17.12.13.

Instead of the usual β-naphthol, β-naphthol sulphide is employed, either alone or in conjunction with other phenols or their derivatives, for printing and dyeing textile fibres by the single or multiple bath process. β-Naphthol sulphide (2 2′-dihydroxy-1.1′-dinaphthyl sulphide) possesses the advantage of being non-volatile during drying and steaming; it forms sparingly soluble salts with the heavy metals and is far more resistant to the action of air than the β-naphthol ordinarily used for padding.—J. F. B.

Adhesive. Ger. Pat. 309,650. *See* XVII.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Ammonia; Formation of — *at high temperatures.* E. Briner. Helv. Chim. Acta, 1919, **2**, 162—166.

A discussion of Maxted's recent work (this J., 1918, 232 T, 368 A). It is suggested that in order to explain the increased proportion of ammonia in the nitrogen-hydrogen equilibrium at temperatures above 2000° Abs. such factors as the dissociation of the elementary molecules into atoms must be considered. (See further J. Chem. Soc., May, 1919.)—J. C. W.

Ammonia; Determination of some physical constants of —. A. Berthoud. J. Chim. Phys., 1918, **16**, 429—437.

The density orthobars of liquid and gaseous ammonia have been determined at different temperatures from 0° C. up to the critical temperature and it is shown that ammonia follows the

law of the rectilinear diameter. The critical density of ammonia is found to be 0·2364. The surface tension of ammonia has been measured between 11° C. and 59° C. The results recorded confirm the view that ammonia is associated in the liquid state and up to the critical point.

W. G.

Glucinum; Method of treating beryl for the extraction of —. H. Copaux. Comptes rend., 1919, **168**, 610—612.

The finely powdered mineral is heated at 850° C. for half an hour with twice its weight of sodium silicofluoride. The product, which consists of silica and the double fluorides of sodium and aluminium and sodium and glucinum, is extracted three times with boiling water. The extract is filtered and to the filtrate boiling aqueous sodium hydroxide is added in slight excess. The oxide of glucinum precipitated, along with a little alumina and silica, is dissolved in sulphuric acid, and glucinum sulphate crystallises out on concentrating the solution. In this way 90% of the glucinum in the beryl is recovered. For the estimation of glucinum in beryl, 5 grms. of the powdered mineral is treated as above with 20 grms. of sodium silicofluoride. The precipitation with sodium hydroxide is omitted and an aliquot portion (300 c.c. out of 1 litre) of the filtered aqueous extract is evaporated with sulphuric acid until white fumes appear. The residue is treated with water and an excess of ammonia is added. If the precipitate contains a noticeable quantity of iron it is redissolved in acetic acid and the iron removed by means of nitroso-β-naphthol. The filtrate is boiled and made alkaline with ammonia and the precipitate is filtered off, dried, ignited, and weighed. Any silica present is removed by treatment with hydrogen fluoride and the aluminium and glucinum are separated by Wunder and Wenger's method (this Journal, 1912, 664) by fusion with sodium carbonate.—W. G.

Tellurium sulphide. A. M. Hageman. J. Amer Chem. Soc., 1919, **41**, 329—341.

Tellurium disulphide, TeS_2, is produced by passing hydrogen sulphide into an aqueous solution of tellurous acid, or into a solution of tellurium tetrachloride in an organic solvent. It is a reddish-brown powder which commences to dissociate above −20° C. Tellurium monosulphide, TeS, does not exist. Tellurium tetrachloride is soluble in benzene, toluene, methyl alcohol, ethyl alcohol, *n*-butyl alcohol, amyl alcohol, benzyl alcohol, xylene, chloroform, and ethyl acetate, sparingly soluble in light petroleum, benzaldehyde, acetone, isopropyl bromide, and carbon tetrachloride, and insoluble in carbon bisulphide. (See also J. Chem. Soc., May, 1919.)—J. F. S.

Iodine; Occurrence of — in plants. E. Winterstein. Z. physiol Chem., 1919, **104**, 51—58.

In thirty-five phanerogams which were examined, iodine was only found to be present in beetroot, potato, celery, cabbage-lettuce, and carrot. It could not be detected in mushrooms or yellow boletus. The method of examination consisted in reducing the plant to ash after adding sodium hydroxide solution, nearly neutralising the ash with dilute sulphuric acid, filtering off the carbonaceous matter, rendering this alkaline and incinerating it in presence of potassium nitrate, neutralising with sulphuric acid, mixing the solution with the first filtrate, making the liquid feebly acid with sulphur dioxide, evaporating, drying the residue at 100° C., extracting with 95% alcohol (in which iodides are soluble), evaporating the extract, and treating the aqueous solution of the residue with a solution of nitrosylsulphuric acid in concentrated sulphuric acid in the presence of chloroform, in which any liberated iodine dissolves to a red solution. Test experiments showed that 0·04 mgrm. of added iodine could be detected in 10 grms. of spinach by this method. Iodine could not be detected in milk, cheese, or cow's urine. (See also J. Chem. Soc., 1919, I., 190.)—H. W.

Ozone; Reagent for and method of estimating —. L. Benoist. Comptes rend., 1919, **168**, 612—615.

The fluorescence of a solution of fluorescein diluted to 1 in 1,000,000 is immediately destroyed by traces of ozone, the reaction taking place between two molecules of ozone and one of fluorescein, *i.e.*, in the proportion of 0·3 : 1 by weight. It requires an enormous excess of nitrous vapours similarly to destroy the fluorescence, and the fluorescence of fluorescein at the above dilution is not destroyed by a quantity of chlorine equal to three times or of carbon dioxide equal to twenty times the weight of fluorescein. An optical arrangement is described which permits of the detection, by observation in a dark room using an intense white light in a black-walled box, of fluorescence in a solution of fluorescein at a dilution of 1 in 1,000,000,000, and thus using 3 c.c. of such a solution it is possible to detect and estimate 10^{-9} gram of ozone, an amount far smaller than can be detected by starch-iodide.—W. G.

Magnetic concentration of pyrrhotite. Bonardi. *See* X.

Reagents for bases and acids. Chauvierre. *See* XXIII.

PATENTS.

Nitrous gases; Method of manufacturing concentrated —. O. Jensen, Rjukan, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,291,909, 21.1.19. Appl., 6.10.16.

Dilute nitrous gases are absorbed by sulphuric acid of sufficient concentration to decompose the resulting nitrosylsulphuric acid when heated under dephlegmation without the addition of denitrating substances.—L. A. C.

[*Nitrogen oxides suitable for making*] *nitric acid; Method of producing* —. W. S. Landis, Assignor to F. S. Washburn, New York. U.S. Pat. 1,292,814, 28.1.19. Appl., 24.2.17.

A mixture of ammonia, an excess of air, and sufficient oxygen to sustain the reaction is subjected to the action of a hot catalyst with the production of the higher oxides of nitrogen suitable for making nitric acid.—L. A. C.

Nitric acid; Process of concentrating — *and apparatus for use in connection therewith.* F. C. Zeisberg, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,292,948, 28.1.19. Appl., 30.6.17.

A mixture containing not less than 64% of sulphuric acid and from 3 to 25% of nitric acid is injected into a concentrating tower through a distributor having a number of openings with a uniform discharge and is subjected therein to the action of a hot gaseous current. Nitric acid vapours are removed from the tower and condensed.—L. A. C.

Sulphur trioxide; Process of making ——. W. H. Seamon, El Paso, Tex. U.S. Pat. 1,292,098, 21.1.19. Appl., 13.7.18.

SULPHUR trioxide is produced by fusing a mixture of sodium sulphate, calcium sulphate, and silica, in the absence of a reducing environment to avoid excessive decomposition of the sulphur trioxide formed.—J. H. P.

Furnace [for calcining sodium bicarbonate]. F. R. Hill, Keeler, Assignor to W. W. Watterson, Bishop, Cal. U.S. Pat. 1,283,515, 5.11.18. Appl., 5.3.18.

THE furnace has a central outlet opening in its floor and the material under treatment, *e.g.*, sodium bicarbonate, is charged in at the top so that it forms an annular pile sloping down towards the central opening. A burner for liquid fuel passes down into the furnace through a central opening in the crown and projects a flame outwards towards the sloping surface of the pile somewhat above the base, and the products of combustion are drawn downwards and through the central outlet to a draught flue.

Permanganates; Electrolytic production of ——. B. F. Lovelace, C. E. Lamming, and W. L. Judelind, Baltimore, Md. U.S. Pats. (A) 1,291,680, (B) 1,291,681, and (C) 1,291,682, 14.1.19. Appl., 21.1.18.

(A) A SOLUTION of a compound, which by hydrolysis gives an alkaline solution, is electrolysed, using an anode containing manganese and (A) silicon, (B) molybdenum, or (C) tungsten.—B. N.

Alkaline permanganates, chlorates, and hydrogen; Process for making ——. T. J. Brewster, New York. U.S. Pat. 1,291,751, 21.1.19. Appl., 17.10.17.

A MIXTURE of manganese oxides and a solution of a caustic alkali is evaporated to dryness and the residue is ground and calcined in the presence of air or oxygen. The product is leached with water and the solution treated with chlorine and hydrochloric acid.—L. A. C.

Ammonium sulphate; Apparatus and process for the recovery of ——. *Ammonium-sulphate-recovery process*. J. Becker, Assignor to The Koppers Co., Pittsburgh, Pa. U.S. Pats. 1,291,729 and 1,291,730, 21.1.19. Appl., 23.6.16 and 12.8.18.

AMMONIA liquor condensed from cooled and tar-free gas is distilled and at the same time a portion of the gas is reheated; the vapour and heated gas are then led together through a coil arranged in the bottom of a saturator into which the remainder of the gas is passed. The hot gases in passing through the coil cause evaporation of the liquor in the saturator and thus induce crystallisation of ammonium sulphate. On leaving the coil, the gases are separated from any condensed liquor and are also led into the liquor in the saturator.—L. A. C.

Aluminous material [alunite]; Purifying —— *[from silica]*. C. H. MacDowell and P. R. Hershman, Chicago, Ill., Assignors to Mineral Products Corporation, New York. U.S. Pat. 1,291,979, 21.1.19. Appl., 14.9.14.

ALUNITE is heated with carbon to a temperature high enough to volatilise the silica.—L. A. C.

Radium; Recovering ——. H. N. McCoy, Assignor to Carnotite Reduction Co., Chicago, Ill. U.S. Pat. 1,292,341, 21.1.19. Appl., 22.10.17.

A RADIUM-BEARING mass of silicious matter containing sulphates is treated with hydrofluoric acid, whereby most of the silicious matter is rendered soluble, whilst the admixed radium compound remains insoluble.—J. H. P.

Calcium carbide; Manufacture of ——. F. M. Becket, Niagara Falls, N.Y., Assignor to Union Carbide Co., New York. U.S. Pats. (A) 1,292,386 and (B) 1,292,387, 21.1.19. Appl., 10.4.16.

AGGREGATES suitable for furnacing for the production of calcium carbide are prepared by mixing with (A) lime or (B) unburned limestone, a carbonaceous material serving as a source of carbon for the carbide-forming reaction and also as a coking binder for the mass, and the whole coked.—J. H. P.

Tungsten compounds; Process of separating —— *from substances*. C. Andersen and E. H. Westling, San Francisco, Cal. U.S. Pat. 1,292,559, 28.1.19. Appl., 30.4.17.

TUNGSTEN compounds are separated from solution by adding a salt of a trivalent metal, *e.g.*, a ferric salt, and an alkali hydroxide to the solution. The tungsten is precipitated as a tungstate of the trivalent metal.—J. H. P.

Rotary kiln [for treating glauconite]. F. Tschirner, Newark, N.J. U.S. Pat. 1,292,928, 28.1.19. Appl., 18.5.18.

AN apparatus for converting the potassium compounds of glauconite and similar substances into a water-soluble state consists of a rotary kiln provided with heating means and a number of heat-insulated receptacles arranged in a housing at the discharge end of the kiln. The receptacles can be closed against strong currents of gases to prevent volatilisation of the material therein. Each receptacle is provided with a normally closed discharge opening and a conveyor is located in proximity to the discharge opening.—J. H. P.

Glauconite and similar substances; Process of treating —. F. Tschirner, Newark, N.J., Assignor to R. G. Wagner, New York. U.S. Pat. 1,292,929, 28.1.19. Appl., 13.4.17. Renewed 12.12.18.

MATERIALS, such as glauconite, containing hydrous iron potassium silicate are heated with the chloride of an alkali-forming metal in an oxidising atmosphere, in the presence of an alkali, at a temperature about 700° C. and below that necessary to produce any substantial clinkering of the mass. The mass is maintained at this temperature for a considerable time to complete the reaction under conditions to prevent volatilisation of potassium chloride.—J. H. P.

Bleaching powder; Arrangement for taking up the heat of reaction in the manufacture of —— *by artificial cooling*. J. L. C. Eckelt, Berlin. Ger. Pat. 309,667, 14.11.17.

THE chlorinating chamber is provided with plates supporting the lime in layers, successive plates being out of vertical alinement, and cooling pipes are mounted against or in the vertical walls of the chamber through which a cooling liquid is passed from the top to the bottom in the opposite direction to the flow of gas. The greatest amount of heat is developed near the top of the chamber where the lime is introduced and the development of heat decreases as the lime becomes saturated towards the bottom.—J. F. B.

Bromine; Recovering —— *[from gases]*. C. E. Murrell, Rockaway Beach, N.Y., Assignor to Research Corporation, New York. U.S. Pat. 1,292,016, 21.1.19. Appl., 6.6.18.

GASES containing bromine vapour are treated with ammonia to produce fumes of ammonium bromide,

which is precipitated by means of a high-tension electric discharge.—L. A. C.

Hydrogen; Process for preventing the scorifying and clogging together of the heated iron masses in the manufacture of ——. W. Näher and M. Nöding, Pforzheim. Ger. Pat. 309,549, 22.1.18.

In the manufacture of hydrogen by passing steam over heated iron, a flux is added consisting of the "ashes" produced by the working, melting or heating of metallic aluminium in the presence of air. This addition ensures that the layers of iron mass always lie loosely one over the other and can be readily discharged, without influencing the purity of the gas. The metallic aluminium contained in the ashes is oxidised by the water vapour with the production of hydrogen.—J. F. B.

Drying gases. Eng. Pat. 124,045. *See* I.

Titanium products. Eng. Pat. 116,266. *See* XIII.

Ammonium nitrate. Ger. Pat. 309,668. *See* XVI.

Waste acids from nitrocellulose. Ger. Pat. 309,936. *See* XXII.

VIII.—GLASS; CERAMICS.

Glass vessels; Permanent marking of —. J. C. Bock. J. Amer. Chem. Soc., 1919, **41**, 359–361.

A thin mixture of 4 parts of copaiba balsam, 1 of clove oil and 1 of lavender oil with sufficient of one of the colours Green 7281D, Blue 1079D, Brown 695D, and White enamel 1310D (Roessler and Hasslacher Chemical Co.) to make a paste which will run from a steel pen, is applied by a steel pen to the surface of clean glass or porcelain. The mark is then dried by holding above the flame, and when dry the marked place is held against the side of the flame of a Meker burner, when after blackening the mark will begin to glow a dull red. At this point the glass is cooled a little and then reheated until it again glows. In this way a smooth shiny surface is produced which cannot be removed by any ordinary cleaning. J. F. S.

Graphite ash; Fusibility of —— and its influence on the refractoriness of bond clay. M. C. Booze. J. Amer. Ceram. Soc., 1919, **2**, 65—68.

The fusibility of graphite ash does not indicate the effect on the refractoriness of a mixture of clay and graphite used in the manufacture of crucibles etc. At the temperatures at which brass is melted, the ash of the graphite used appears to have no appreciable effect.—A. B. S.

Enamels; Relative action of acids on ——. *III.* E. P. Poste. J. Amer. Ceram. Soc., 1919, **2**, 32—43.

In continuation of previous work (this J., 1917, 878), the author has found that acetic acid as ordinarily obtained varies too greatly in concentration to be used as a standard acid. Citric and tartaric acids are sufficiently uniform, more active, more definite in action, and the graphs representing the ratio of the loss of weight of the enamel to the concentration of the acid are such that slight variations in the concentration of the acid are of minor importance. Tartaric acid is less affected than citric acid by prolonged storage and is, for this reason, preferable. The corrosive effect of citric and tartaric acids is quite different from that of acetic acid and no simple ratio connecting them has yet been found.

—A. B. S.

Refractory materials; Thermal conductivity of —— at high temperatures, and of steam-pipe laggings, by means of a new method of measuring surface temperatures. W. von. Rinsum. Z. Ver. deut. Ing., 1918, **62**, 601–605, 639—641. Chem. Zentr., 1919, **90**, II., 94.

A thermo-electric apparatus for accurately measuring the surface temperature of bodies is described, and the results of measurements of the heat conductivities of different materials are given. Various refractory materials tested differed little from each other in this respect, the mean conductivity increasing with rising temperature, and having a value at 1000° C. of 0·8 to 1·2 units (Cals. per hour per metre per 1° C.). Different lagging materials also showed increasing conductivity with higher temperatures, the values at 200° C. lying between 0·06 and 0·1 unit. A hollow brick wall had a value 0·35 as against 0·78 for a solid brick wall.

—T. St.

PATENTS.

Glass sheets; Process for forming —. W. G. Shaw, Creighton, Pa. U.S. Pat. 1,283,333, 29.10.18. Appl., 12.8.15. Renewed 7.3.18.

A body of molten glass is collected on a horizontal draw-bar which is then withdrawn from the furnace, and allowed to cool. The bar is subsequently reheated until the glass flows from it under the influence of gravity to form a sheet, which passes into an area of lower temperature. Tension may be applied to the sheet to supplement the force of gravity, and the thickness of the sheet may be regulated by varying the tension and the intensity of heating.

[*Glass*] *tube manufacture.* F. G. Keyes, Boston, Mass., Assignor to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,291,921, 21.1.19. Appl., 18.2.13.

Above the crucible containing the glass or other material is a die with a circular opening through which a tube capable of gathering up a mass of the viscous material can be raised and lowered, and as the tube is raised, drawing the material with it, air is forced into its upper end, thus hollowing out the material as it is drawn up. Above the die is a container holding boiling metal surrounding the path of the tube, and an air condenser is attached to the container for condensing the vaporised metal.—L. A. C.

Ceramic tile; Antislipping —. G. N. Jeppson and C. F. Dietz, Worcester, Mass., Assignors to Norton Co. U.S. Pat. 1,292,953, 28.1.19. Appl., 29.4.18.

A compressed mixture of coarse and fine grains of a material with a hardness of 9 or more, *i.e.*, previously fused crystalline alumina, is bonded together by a glassy fused clay material to form an antislipping tile of high tensile strength.

—L. A. C.

Refractory bodies; Preparation of —— from powdered refractory materials for metallurgical, chemical, and ceramic purposes. A. Desgraz, Krölpa. Ger. Pat. 309,707, 7.3.16.

Calcined magnesite or zirconia, burnt gypsum, and iron oxides, or iron alloys or fine iron filings are mixed together, and the mixture, after being moistened with water, is formed into crucibles, muffles, etc. After they have hardened, the articles are heated to a high temperature when sulphuric acid is driven off and sintering takes place.—T. St.

Glass-furnace. A. F. Peeters, Assignor to Naaml. Vennoots. Glasfabriek Leerdam, Leerdam, Netherlands. U.S. Pat. 1,293,533, 4.2.19. Appl., 4.4.18.

SEE Eng. Pat. 116,477 of 1918; this J., 1918, 418A.

Aluminous abrasive. Norton Co., Worcester, Mass., Assignees of L. E. Saunders and R. H. White, Niagara Falls, N.Y., U.S.A. Eng. Pat. 113,957, 7.2.18. (Appl. 2252/18.) Int. Conv., 12.2.17.

SEE U.S. Pat. 1,247,337 of 1917; this J., 1918, 31A.

IX.—BUILDING MATERIALS.

Mortars; Compressive strength of cement-lime — —. F. A. Kirkpatrick and W. B. Orange. J. Amer. Ceram. Soc., 1919, **2**, 44—64.

MORTARS composed of Portland cement, hydrated lime, and river sand were made of such a consistency that a sphere 2 in. diameter when dropped from a height of 2 ft. was reduced to a mass 1 in. thick. Such mortars are much stiffer than those used by masons. Cubes of the mortars were made by moulding and were stored for 28 days prior to being crushed. Substitution of hydrated lime for part of the sand in a Portland cement mortar increased the density and therefore the strength in the same manner as an increase in the proportion of cement. The substitution of flint dust had a similar but smaller effect on the strength of the mortar. The porosity and water-content did not indicate the relative strengths of these mortars, but the compressive strength was directly proportional to the product of the volume of the cement and the volume of the total solids per unit volume of mortar.

—A. B. S.

PATENTS.

Asphaltic waste products [roofing felt]; Method of reclaiming —. S. M. Ford, St. Paul, Minn. U.S. Pat. 1,290,954, 14.1.19. Appl., 13.4.18.

WASTE produced in the manufacture of asphaltic felt roofing material is chilled and broken up in the chilled condition by treating it by means of knives or grinders. The broken-up material is mixed, if necessary, with fibrous and bituminous material and moulded under heat and pressure to make waterproof containers or other articles.—J. F. B.

[Roofing] felts and the like; Process of and apparatus for treating — . *Process of treating felts and the like.* (A) R. P. Perry, Upper Montclair, N.J., and J. M. Jack, Peoria, Ill., and (B) R. P. Perry, Assignors to The Barrett Co. U.S. Pats. (A) 1,293,185 and (B) 1,293,186, 4.2.19. Appl., 29.9. and 4.10.17.

IN drying felts for roofing, paper, etc., having on at least one side a layer of fusible adherent waterproofing material, by passing the same over heated surfaces, means are provided for interposing between the felt, etc., and the drying surface (A) a film of an oily liquid or (B) a finely divided non-adherent solid (soapstone), to prevent adhesion.

—L. A. C.

Fibre and asphalt; Recovery of — *from roofing-scrap.* B. A. Allison, Edwardsville, Ill., Assignor to The Barber Asphalt Paving Co., Philadelphia, Pa. U.S. Pat. 1,293,293, 4.2.19. Appl., 7.10.18.

ROOFING scrap is stirred in a boiling alkaline solution, and the disintegrated product rolled into sheets.—L. A. C.

Wooden articles impregnated with formaldehyde; Process for rendering — *capable of being glued with casein.* Luftschiffbau Schütte-Lanz, Mannheim-Rheinau. Ger. Pat. 309,423, 24.12.16.

THE parts to be glued are treated with an alkaline oxidising agent. For instance, the wood is painted with a solution of ammonia and hydrogen peroxide; the formaldehyde is thereby destroyed in the neighbourhood of the joint and its action on the casein glue is prevented.—J. F. B.

Sintering cement etc. Ger. Pat. 309,552. *See* X.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Acid Bessemer process; Present American —. R. S. McCaffery. Blast Furnace and Steel Plant, 1919, **7**, 140—142.

THE author describes present American practice with acid Bessemer converters of 25 tons capacity, the blast pressure being 20 to 25 lb. per sq. in. and the blow lasting 10 to 15 minutes. Experiments were made to determine if the reaction whereby the manganese in the pig is eliminated as oxide is reversible and whether spitting during the latter part of the blow with certain irons could be prevented. From consideration of the heats of combustion of the carbides and silicides in the converter under the conditions of a normal blow (the temperature being between 1600° and 1650° C.) and a blow which is excessively hot (finished at 1820° C.), it is concluded that in the latter the manganese carbide remains in the molten metal after the iron and manganese silicides have been oxidised and increases the basicity of the slag by its reducing action on silica and magnetic iron oxide, thus rendering the slag more infusible which results in the spitting phenomena. The elimination of the manganese as oxide is not reversible—even when finished at 1820° C. the manganese was frequently completely oxidised. In the blows in which there was residual manganese, it was due to the presence of carbide owing to the early and middle parts of the blow being too hot. Spitting was prevented by temperature control, i.e., steaming during the silicon blow. It was also found that the temperature during the carbon blow rose rapidly, due to the carbon monoxide being burnt in the vessel to carbon dioxide. To overcome this a new converter bottom was designed, the number of tuyères being increased and their distribution changed. Comparative blows with the old and the new style bottoms showed an increase in converter capacity of 45% with an actual saving in blowing power.—T. H. Bu.

Manganese alloys in open-hearth practice. S. L. Hoyt. Amer. Inst. Min. Eng., Feb., 1919. Blast Furnace and Steel Plant, 1919, **7**, 142—146.

THE following is a summary of the results of an investigation made by the Manganese Section of the War Minerals Investigation, U.S. Bureau of Mines, on the utilisation of domestic alloys. The use of molten spiegel mixture for recarburisation and deoxidising appears to be limited to the manufacture of steels with more than 0·3% of carbon. Its advantages compared with ferromanganese are discussed. At some plants the practice of melting and refining so as to secure a high residual content of manganese, *e.g.*, 0·25 to 0·30% for a final carbon content of 0·10% has been developed. The finishing temperature is kept high and the slag high in manganese and lime. The high manganese content of the charge is secured by using a pig iron with 2 to

3% Mn and low phosphorus content, and the temperature is raised so that finally the carbon is eliminated more quickly than the manganese. There is no advantage in decreased consumption of manganese but only in the form it is added. The use of manganese-silicon alloys depends on the amount of silicon that can be tolerated in the finished ingot. They find application in forging steel, high-carbon steel, and castings where the silicon content can be between 0·2 and 0·35%. In acid practice the use of manganese-silicon alloys is a subject of controversy, but the alloys are thought to give better separation of insoluble products and more powerful reduction. With regard to the percentage recovery of manganese when added as silico-manganese or as ferromanganese plus ferrosilicon, an examination of comparative heats was made. Given manganese and silicon contents of the finished steel were obtained with smaller amounts of manganese and silicon when using Mn-Si alloys and a more uniform product was obtained. The alloys could be substituted at once in acid practice using silicon spiegel with the correct Mn-Si ratio. In basic open-hearth practice the information is meagre, but the alloys should be satisfactory. Two good shell heats are quoted. In one the proportion of manganese recovered was 77·5% and of silicon 65·1%.

—T. H. Bu.

Steel; "Flaky" and "woody" —. F. Giolitti. Chem. and Met. Eng., 1919, **20**, 271—273.

"FLAKY" and "woody" structures in steel are not formed as cracks in the ingot, but originate as intercrystalline cracks, probably intensified by inclusions and segregations. Phosphorus and sulphur should be kept to a minimum and the materials charged into the furnace should be practically free from iron oxide (scale and rust). At the Ansaldo works (Italy) open-hearth steel is made from a high grade of pure puddled iron together with a proportion of electric furnace pig, and extreme care is taken to prevent superficial oxidation during melting. The slag covering consists only of silica combined with the fluxed impurities in the original iron and is very thin. Hot pouring is recommended. Chromium steel, made from pure materials under reducing conditions, will never develop flakes either during casting or subsequent forging of the ingot. On the other hand metal properly made will develop "woody" structure if only a few kilograms of scale are thrown into the furnace some time before tapping. It is suggested that the presence of ferrite near a slag inclusion is due to an establishment of equilibrium as represented by the equation, $3Fe+2CO \rightleftarrows Fe_3C+CO_2$. A similar equilibrium condition of an oxidising slag may change with changing temperature in such a way that an excess of carbon dioxide is transferred to the metal, thus disturbing the equilibrium with the production of a zone of decarburised iron somewhat supersaturated with carbon monoxide as well. On working, the ferrite flattens out into a thin sheet, and if the piece is strained beyond the elastic limit, the weaker ferrite is fractured. Heating to 1000° C. for 12—18 hours in a reducing atmosphere (largely to prevent surface oxidation) will allow an equilibrium to be re-established in defective metal, and a "woody" or "flaky" structure may be cured by suitable heat-treatment.—C. A. K.

Iron; Corrosion of —. P. Agostini. Annali Chim. Appl., 1919, **11**, 40—85.

A RÉSUMÉ of the various theories which have been advanced to explain rust-formation and of papers by different authors dealing with the influence of various agents on the phenomenon (compare Friend, "The Corrosion of Iron and Steel," London, 1911; Williams, this J., 1901, 44, 127; Stead and Wigham, this J., 1901, 995; Whitney, this J., 1903, 799; Jouve, this J., 1903, 1086; Diegel, this J., 1903, 1246; Dunstan, Jowett and Goulding, this J., 1905, 1235; Matignon, this J., 1918, 375 A).—T. H. P.

Aluminium; Metallography of —. R. J. Anderson. J. Franklin Inst., 1919, **187**, 1—47.

RECENT research by the crystal analysis method of Bragg, modified by Hall (Phys. Rev., 1917, **9**, 564—5) has shown that the crystal structure of aluminium is tetragonal and not isometric. Cast aluminium readily forms dendritic crystals on cooling, but the commercial metal is rarely of a high state of purity as compared with the purity of commercial copper, zinc, and tin. Metal containing 0·15% Cu, 0·30% Fe, 0·30% Si, and 99·15% Al (by difference) represents a fairly good commercial product, and the influence of iron and silicon, although not thoroughly understood, is important, both in commercial aluminium and in aluminium alloys. If cooled slowly, aluminium will retain up to about 4·5% Cu in solid solution (see also this J., 1918, 246 A). Iron forms a compound, $FeAl_3$, only slightly soluble in the solid state, and silicon can exist in solid solution or as crystals of free silicon (see also this J., 1919, 43 A). During the annealing of cold-rolled sheets an increase in hardness has been noted after very short exposures (this J., 1918, 424 A, 587 A). Cold working of aluminium tends to produce an amorphous condition of the metal, and aluminium, subjected to excessive cold working, shows an entire absence of structure and has the appearance of having passed into the vitreous state. The reverse process (of recrystallisation) takes place very slowly during annealing, and re-orientation and grain growth are not cogent factors in the softening of cold-worked metal. The effect of silicon and iron may be to retard grain growth. Aluminium which has been differentially strained, as by cold shearing, exhibits exaggerated grain growth on annealing, the grains of largest size being found a short distance away from the sheared edge of the metal. The pure metal, or its ductile alloys, show the formation of slip bands when strained, but no twinning has been observed as a result of direct mechanical strain. The polishing and etching of aluminium for micrography is difficult (this J., 1918, 211 A), but hydrofluoric acid, followed by immersion in concentrated nitric acid has hitherto proved most useful, although a tendency to develop etching pits is shown.—C. A. K.

Zinc dust; An abnormal form of —. O. Mühlhaeuser. Metall und Erz, 1919, **16**, 70.

THE author describes an abnormal form of zinc dust containing cadmium which is formed by the grey fumes emitted from the mouth of the condenser of a zinc furnace soon after the water vapour has escaped from the charge of roasted blende and anthracite. It occurs sometimes in the receiving vessel and if blown out into the air settles only with difficulty. It is dark grey or grey blue in colour, friable, and feels like tinder. It is an agglomerate of zinc oxide, cadmium oxide, metallic zinc and cadmium, and carbon dust, as confirmed by the following analysis: Zn 43·72%, Cd 11·71%, Fe 1·52%, C 28·84%. It is produced as follows: The metal vapour first formed by the reduction of the cadmium oxide and zinc oxide is partly oxidised by the carbon dioxide in the muffle gases and partly cools to a fine metallic mist. The droplets, consisting for the most part of a zinc-cadmium alloy having a low eutectic point, coalesce and attach themselves to dust particles and so form a deposit which quickly grows to a light porous aggregate. These structures resemble in many respects those observed during the formation of silicon carbide (cf. Mühlhaeuser, Z. anorg. Chem., 1893, **3**, 119).—T. H. Bu.

Electroplating on iron from copper sulphate solution. O. P. Watts. Amer. Electrochem. Soc., Apr., 1919. (Advance copy.) 10 pages.

AN adherent deposit of copper can be obtained on iron or steel using copper sulphate as electrolyte, if the object is first immersed in a solution of an arsenic, lead, or bismuth salt. The preliminary coat of nickel or the use of a cyanide electrolyte before the sulphate is thus avoided. This result is presumably due to the production on the iron of a film of metal whose potential is sufficiently near to that of copper to permit the deposition of a good copper plate, and not so far below that of iron that the film produced is of a powdery non-adherent character. In the same way bismuth can be deposited on iron by using a preliminary arsenic or antimony dip, and nickel can be deposited on aluminium after dipping it in ferric chloride solution.—W. H. P.

Pitting of electroplating; Remarkable —— . O. P. Watts. Amer. Electrochem. Soc., Apr., 1919. (Advance copy.) 3 pages.

HEAVY pitting which appeared during the plating of steel articles with lead was found to be due to air dissolved in the electrolyte. The bath of lead silicofluoride was worked by day at about 45° C. and cooled down in the night to about 25° C. The air dissolved during the cooling was deposited on the electrodes when the bath was again heated by passage of the current. The deposition took the form of minute bubbles which adhered to the electrodes and thus started the pitting.—W. H. P.

Uranium: its extraction from pitchblende. G. Gin. Amer. Electrochem. Soc., Apr., 1919. (Advance copy.) 6 pages.

A METHOD is proposed involving the following stages: (1) Roasting to remove sulphur and arsenic. (2) Heating in an electric furnace with a limited amount of carbon to give metallic lead, copper, iron, nickel, cobalt, and some tungsten, together with a slag containing silica and lower oxides of uranium, vanadium, tungsten, and molybdenum. (3) Treatment of the slag from (2) with enough carbon to convert the oxides into carbides. On treatment with water at 60° C. uranium carbide is decomposed, giving the hydroxide, which can be separated by flotation and used for the preparation of uranium or its salts.—W. H. P.

Magnetic concentration of pyrrhotite ores. J. P. Bonardi. Chem. and Met. Eng., 1919, **20**, 266—270.

THE utilisation of pyrrhotite ores for the production of sulphur in the manufacture of sulphuric acid is increasing, though the available sulphur is diminished by the presence of up to 30% of gangue material, consisting chiefly of granular silica, magnesia, lime, and silicates of the amphibole group. Magnetic separation of the ore before roasting is suggested and trials on a particular sample proved successful. Concentration was carried out on an experimental type of Wetherill magnetic separator and a current of 3 ampères was found to give the best commercial separation. Classification of the ore was unnecessary, provided that it was crushed to pass a sieve with 10 meshes per linear inch, in order to detach the sulphide from the gangue. Fine material passing a sieve with 100 meshes per linear inch cannot be separated, as the non-magnetic material is removed mechanically by the magnetic portion. A concentrate containing less than 7% of gangue was obtained from the mine discard ore, giving a recovery of between 85 and 90% of the sulphur and iron values.—C. A. K.

Pyromorphite group. M. Amadori. Gazz. Chim. Ital., 1919, **49**, I., 38—102.

A SUMMARY of previous work on the synthesis of minerals of the pyromorphite group, crystallographic investigations on some of these synthetic products and the compositions of natural pyromorphites.—T. H. P.

Effect of graphite ash in crucibles. Booze. *See* VIII.

PATENTS.

Iron; Preparation of pure ——. R. H. Muench, Goldfield, Colo. U.S. Pat. 1,292,630, 28.1.19. Appl., 13.8.18.

IRON is precipitated from an impure ferrous solution, as potassium ferrous-ferrocyanide, which is decomposed by concentrated hydrochloric acid, excess of acid being removed by evaporation. The resulting ferrous chloride is dissolved in water, separated from any insoluble residue, and used for the production of pure iron.—T. H. B.

Steel; Device to lessen oxidation while tapping —— from smelting furnaces. D. Robertson, Motherwell, Scotland. Eng. Pat. 123,793, 7.2.18. (Appl. 2213/18.)

EXPOSURE of molten steel to air during the usual practice of pouring into a ladle is avoided by the use of a shoot, with removable cover, from which the moulds are filled direct. The shoot is made in two parts, the section nearer the furnace being removable to permit access to the tapping hole. When the tapping hole has been opened, metal flows into the shoot to the far end, which is at a slightly lower level, and into a mould through one or more nozzles, controlled by stoppers.—C. A. K.

Furnaces for melting steel and other metals. I. Hall, Birmingham, and W. Bailey, Manchester. Eng. Pat. 123,778, 25.8.17. (Appl. 12,200/17.)

IN order to prolong the life of the lining of furnaces of the Siemens type, the preheated air is led into the end of the furnace through a flue which is expanded into funnel shape as it enters the furnace. At either side, or preferably immediately below the air port, converging ports admit preheated gas so that combustion is concentrated along the centre of the furnace and away from the side walls.

—C. A. K.

Blast-furnace practice. H. B. Weaver, Catasauqua, Pa., and J. Gayley, New York. U.S. Pat. 1,292,937, 28.1.19. Appl., 8.8.18.

AN atmosphere of reducing gases is produced in the furnace by a heated air blast introduced under pressure, and such portions of the reducing gases as are not required for maintaining the desired reducing conditions in the stack are withdrawn and treated for the separation of the compounds of alkali metals therein. The gases are withdrawn at a point in their upward travel below that at which the alkali metal compounds would be precipitated by the colder materials in the furnace. The withdrawals of gases take place periodically so as to allow of the accumulation of the compounds in the periods of time between withdrawals. The furnace conditions are regulated so as to produce slag of a light colour.—J. H. P.

[Roasting] furnace; Mechanical feeding ——. G. Gröndal, Djursholm, Sweden. Eng. Pat. 115,640, 8.5.18. (Appl. 7734/18.) Int. Conv., 26.4.17.

IN a mechanical roasting furnace of the type having an arch with a reciprocating movement as described

in Eng. Pat. 115,639 (this J., 1919, 78 A), the rabbles, fixed to the arch of the furnace, are triangular in cross-section, and have their apices turned away from the discharge end of the furnace. The transverse faces of the rabbles move the material a certain distance forward as the furnace arch moves, whilst on the return movement the oblique sides of the rabbles push the material laterally into the path of the adjacent rabbles, which during the next forward movement again push the material towards the outlet end of the furnace.—C. A. K.

Reduction furnace. T. F. Baily and F. T. Cope, Alliance, Ohio, Assignors to The Electric Furnace Co. U.S. Pat. 1,291,716, 21.1.19. Appl., 25.4.18.

CARS containing the material to be heated are caused to travel on a track through a heating chamber. A hood, designed to fit around the cars, extends from the furnace, so that heat leaving the furnace chamber may preheat the charge entering.
—C. A. K.

Container for articles to be heat-treated and the like. T. F. Baily and F. T. Cope, Alliance, Ohio, Assignors to The Electric Furnace Co. U.S. Pat. 1,291,717, 21.1.19. Appl., 14.6.18.

METAL articles to be subjected to heat-treatment are placed in containers and the containers are passed as a continuous train through a furnace, each container pushing the preceding one and forming a closure for it.—C. A. K.

Furnace; Annealing ——. V. E. Lane, Detroit, Mich. U.S. Pat. 1,292,617, 28.1.19. Appl., 18.4.18.

A MUFFLE furnace is supported in a water-seal above a pit, within which is a work-supporting table which can be raised so as to form the bottom of the muffle. Tunnels extend laterally in an upward direction from the pit, at the level of the table when in its lowered position, so that articles may be introduced through the water-seal on to the table.
—C. A. K.

Removing accretions from mechanical tuyères; Process and apparatus for ——. C. Van Amburgh, Tacoma, Wash., Assignor to American Smelting and Refining Co. U.S. Pat. 1,292,162, 21.1.19. Appl., 21.5.18.

THE volume and pressure of the air current through the tuyère are increased intermittently by connecting a high-pressure air line to the ordinary low-pressure air main. At intervals the low-pressure air main is closed, and the high-pressure air valve is opened.—C. A. K.

(A) *Galvanoplastic method and apparatus.* (B) (C) (D) *Electrolytic process.* (E) (H) (J) *Electrolytic process and product.* (F) (G) (I) *Galvanoplastic process and product.* M. M. Merritt, Danvers, Assignor to Copper Products Co., Boston, Mass. U.S. Pats. 1,282,261—70, 22.10.18. Appl., (A) 20.3.17, (B) (C) (D) 27.6.17, (E) (F) (G) 2.11.17, (H) (I) (J) 8.12.17.

(A) FOR the electrolytic production of copper tubes a metallic (preferably brass) mandrel is used, the surface of which has been coated with mercury. (B) For the production of metallic sheets electrolytically the metal is deposited on a cylindrical cathode which is partially immersed in the electrolyte and rotated at a peripheral speed of about 130 ft. per min. The cathode is preferably coated with a thin film of grease. (C) To prevent irregular deposits on or adjacent the edges of metallic plates deposited electrolytically on a mandrel which serves as cathode, a conductor is provided adjacent the edges of the cathode to form a supplementary cathode. (D) In the production of metallic sheets by electrodeposition, a thin sheet of the metal is deposited on a mandrel, a flexible non-conducting material is wound as a helix on the deposit, and electrodeposition is then continued, whilst the mandrel is being rotated, until a sheet of the desired thickness is obtained. The sheet is removed from the mandrel by tearing along the line of the helix. (E) (H) (J) Articles such as aeroplane propellers are produced by coating a core with a layer of electrolytically conductive material, depositing on this a film of metal by electrodeposition, applying a film of grease or metal amalgam to the deposit, and then building up the deposit to the desired thickness by deposition of successive layers of metal separated by films of grease or of amalgam. (F) (G) (I) Articles such as manifolds for aeroplane engines are produced by electrodeposition by methods similar to those described under (E) (H) (J).

Plating with metal; Apparatus for and method of ——. J. E. Woodbury, Worcester, Mass. U.S. Pat. 1,291,337, 14.1.19. Appl., 29.5.15.

AN electroplating apparatus comprises an anode member having a bottom through which the electrolyte can pass, and a cathode located under the anode bottom, with means for circulating the electrolyte through parts of the anode on to the cathode and back through other parts of the anode.—B. N.

Electroplating apparatus. J. Giullana, Newark, N.J. U.S. Pat. 1,291,830, 21.1.19. Appl., 1.11.17.

A ROTATING barrel is supported on a post in an electrolytic tank, the rotation of the barrel tending to swing the opposite ends of the post against supporting means on opposite sides, thus holding the post in an upright position. The current is supplied through the axle to a brush rotating with the barrel, and the cathodes are in electrical connection with the brush. The barrel is provided with an intermediate removable annular shell, on the circumference of which cathode members are mounted, and the articles, tumbling within the barrel, make contact with the cathodes. Connections, suitably covered, are arranged between the cathodes along the circumference of the shell for connecting them together, whilst the cathode members are exposed to the electrolyte which passes through the permeable ends of the barrel.—B. N.

Metals; Process of recovering —— from ores. R. Gahl, Miami, Ariz. U.S. Pat. 1,291,824, 21.1.19. Appl., 8.11.17.

ORE pulp from which the slime has been removed is subjected to flotation to produce a "middling" product, which is roasted and leached to obtain a solution of the metal. The tailings from the flotation process are also leached.—C. A. K.

Sherardising articles; Apparatus for ——. H. C. Harrison, Lockport, N.Y. U.S. Pat. 1,291,866, 21.1.19. Appl., 31.8.16.

ARTICLES of great length and small cross-section are caused to travel through an elongated chamber containing zinc dust at a suitable temperature. At each end of this chamber, and in alinement with it, is another chamber packed with cold zinc dust, which forms an air seal for the central section.
—C. A. K.

Manganese and other ores; Process of extracting values from ——. E. W. Haslup, Bronxville, N.Y., and B. A. Peacock, Philadelphia, Pa. U.S. Pat. 1,291,867, 21.1.19. Appl., 7.11.17.

THE finely divided ore is mixed with sulphuric acid and the mixture kept in a closed container until

the heat of reaction has raised the temperature of the mass to more than 100° C. The metal sulphates in solution are then recovered. (See also this J., 1918, 772 A).—C. A. K.

Carburising material and method of producing the same. G. W. Pressell, Assignor to E. F. Houghton & Co., Philadelphia, Pa. U.S. Pat. 1,292,044, 21.1.19. Appl., 23.5.17.

Coconut shells are carbonised in a retort, and, at or near the heat of distillation, subjected to the action of an aqueous solution of sodium carbonate. —T. H. B.

Ores; Process of sintering ——. A. H. Richards, Salt Lake City, Utah, Assignor to American Smelting and Refining Co. U.S. Pat. 1,292,059, 21.1.19. Appl., 27.10.15. Renewed 10.5.18.

The top surface of a layer of ore is ignited and subjected at the same time to a downward current of air passing through it, the resistance to the passage of air decreasing as the charge becomes sintered. A second layer of ore is then deposited on the first, and is in turn ignited under similar conditions.—T. H. B.

Blast furnace dust, fine ores, cements, etc.; Process and apparatus for sintering —— in rotary tube furnaces. Stahlwerk Thyssen A.-G., Hagendingen. Ger. Pat. 309,552, 21.5.16.

Before the material arrives in the sintering zone it is subjected to a preliminary treatment in a portion of the furnace the inclination of which is adjustable in relation to the inclination of the rest of the furnace, so that the forward velocity of the material may be controlled. The tubular rotary furnace is constructed in two or more parts which are independently adjustable as regards their inclination, the part in which the preliminary treatment takes place having a larger diameter than the other parts of the furnace.—J. F. B.

Copper; Hydro-metallurgy of ——. W. N. Rossberg and G. E. Sheridan, Butte, Mont. U.S. Pat. 1,292,075, 21.1.19. Appl., 20.12.17.

Oxidised copper ores are leached with sulphuric acid and copper is precipitated from the solution as cuprous sulphide by treatment with hydrogen sulphide in the presence of excess of sulphur dioxide. Further amounts of ore are leached with part of the regenerated acid, and sulphides are decomposed by other portions of it to produce hydrogen sulphide for further precipitation of cuprous sulphide.—T. H. B.

Zinc ore; Method of treating ——. D. B. Jones, Chicago, Ill. U.S. Pat. 1,292,330, 21.1.19. Appl., 10.6.18.

Zinc ore is made into balls with suitable reducing material, and passed through a heating chamber so inclined that the balls travel along it by gravity. A sufficient amount of air is admitted to the chamber to convert any zinc vapour into oxide. The balls are then passed through a suitable spelter furnace, subjected to a sufficient heat to expel the greater portion of the zinc content, which is condensed in the metallic form, and finally the balls are passed through an oxide furnace in which they are subjected to a higher degree of heat to expel the remaining zinc content, air being supplied to convert the metallic vapour to oxide.—T. H. B.

Copper and brass tubes; Method of and apparatus for bright-annealing ——. J. A. Moorhead, Sewaren, N.J. U.S. Pat. 1,292,352, 21.1.19. Appl., 28.3.18.

Long copper or brass tubes are passed progressively and continuously through a long alternating-current coil and are thereby heated to the proper annealing temperature by induced electrical currents. The coil is enclosed in a tube of non-conducting non-magnetic refractory material within which a non-oxidising atmosphere is maintained. An extension of the tube dips into a cooling medium so that the annealed tubes pass from the heated zone into the cooling medium without being exposed to oxidation. —T. H. B.

Metals; Reclaiming turnings of readily oxidisable ——. J. Coulson, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,292,582, 28.1.19. Appl., 22.9.15.

The sub-divided metal is boiled in a solution of a fluxing agent, and added in small quantities at a time to a molten mass of the same metal while still moistened with the solution. The slag which separates is heated with an alkaline-earth chloride, and the molten metal which separates is removed. A small amount of de-oxidising agent containing calcium aluminium silicide is added to the molten metal.—T. H. B.

Zinc-lead alloy. H. Falkenberg, Weetzen Ger. Pat. 309,695, 28.5.16. Addition to Ger. Pat. 300,111.

According to the principal patent an alloy containing 1·6% of iron, 94·9% of zinc, and 3·5% of lead was prepared at a melting temperature of 450° C. for use as a bearing metal; it had a crushing strength of 1470 kilos. per sq. cm. By raising the melting temperature and increasing the iron to 3%, a still higher resistance may be attained, for instance, an alloy melted at 1000° C. possesses a crushing strength of 1620 kilos. per sq. cm. —J. F. B.

Lead sodium alloy. W. Stockmeyer, Minden, and H. Hanemann, Charlottenburg. Ger. Pat. 309,758, 11.4.16.

A lead-sodium alloy is prepared containing less than 1·5% of sodium and less than 1% of magnesium. The small addition of magnesium considerably increases the hardness of the alloy.—J. F. B.

XI.—ELECTRO-CHEMISTRY.

Inductive heating with high frequency currents. E. F. Northrup. Amer. Electrochem. Soc., Apr., 1919. (Advance copy.) 89 pages.

The author shows that it is a feasible and efficient method of inductive heating to employ very high frequency current, and thus dispense with the interlinkage of an iron magnetic circuit with the primary and secondary electric circuits. He gives an exhaustive mathematical treatment of the principles involved, leading to a description of the laboratory installations used. In these it is possible to secure rapid heating of a crucible and its contents with thermal efficiency up to 60%, and to attain temperatures of 1800°—2000° C. Several kilos. of "Pyrex" glass, metallic iron and nickel have been rapidly melted both in air and *in vacuo*. The requisite frequency is secured by an oscillatory current circuit containing condensers and a discharge gap. Each rupture of the gap causes the condensers to discharge in an oscillatory manner, the oscillations damping out logarithmically. A specially devised gap, shown diagramatically at *g* in fig. 1, consists of graphite electrodes projecting into an iron box containing mercury and an atmosphere of alcohol vapour. When the discharge is taking place a very localised high temperature and consequent low resistance are maintained in the gap, and the oscillatory discharge proceeds in the

gap itself with little loss of energy. When the oscillations have nearly died out, and when the voltage between the mercury and one solid electrode reaches a certain minimum, the "negative electrode resistance" of mercury acts suddenly to open the circuit completely. This shuts off all flow of current from the supply transformer and thus completely avoids arc formation without the necessity for any air blast or rotating electrodes. The gap is practically noiseless and no chemical action takes place. For the high potential power condensers sheet glass has been found the most convenient dielectric under laboratory conditions. Owing to heating effects, however, such condensers cannot be used for more than three to four hours with oscillatory currents. It is therefore necessary, in long operations, to provide a duplicate set of condensers, so that one may be cooling while the other is in use. The glass and sheet metal plates are stacked and kept under oil to prevent brush discharge. A commercial condenser of similar type has paper for dielectric and aluminium foil

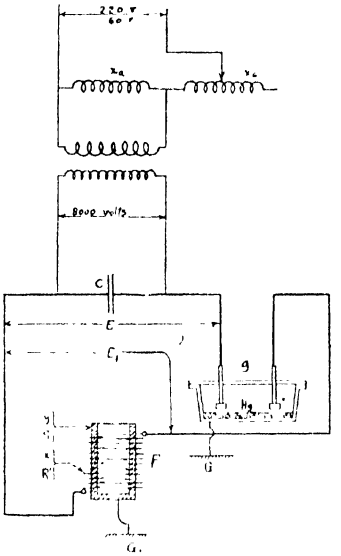


FIG. 1.

0·025 mm. thick for metal sheet. The layers are built up and strongly compressed under oil, and the built-up structure is sealed under oil in a metal case *in vacuo*. Such condensers cost twice as much as glass ones of similar capacity, but they are more portable and do not undergo dangerous heating. They cannot, however, be easily repaired when ruptured. The circuit used with single phase discharge is shown diagrammatically in Fig. 1. The furnace represented by F has usually a primary inductor coil with 50 or more turns. Within this is fitted a cylinder of micanite or quartz to give electrical insulation from the crucible or object to be heated. A convenient method of heating a small mass of material to a high temperature is to have within the insulation a "focus inductor," which is a single-turn coil made up of as many straps of conducting metal as will give a length approximately equal to that of the primary coil. These straps are arranged as shown in Fig. 2 connected to an interior portion which encloses the mass to be heated and which must be capable of resisting the temperature to be attained. This arrangement has the effect of focussing the electromagnetic field upon the mass to be heated. The high-frequency method of inductive heating can be very conveniently applied in the rapid melting of ferrous alloys in surroundings absolutely free from carbon. A cylinder of the metal or fragments occupying the same space is embedded in fine sand, lime, magnesia, or similar material, enclosed in a quartz tube and surrounded by a copper tube with ten or more turns wound round the cylinder. Water is circulated through the tube, the ends of which are

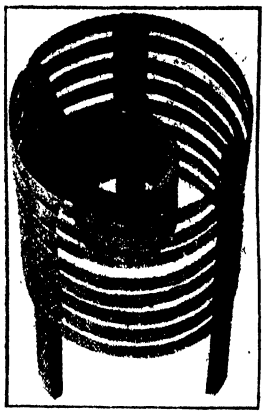


FIG. 2.

connected to the secondary of a suitable air transformer. A high frequency E.M.F. (10^5 cycles or more) is applied to the primary. The embedded mass rapidly fuses, retaining its shape in the mould from which it may, if desired, be run off through a plug-hole. In such experiments it is found that vigorous circulation takes place in a mass of molten conducting material lying in a non-conducting container. Under the influence of induced current the molten material flows upward along the axis of a cylindrical chamber and downward along its circumferential region. W. H. P.

Electric furnace; Temperature uniformity in an —. J. B. Ferguson. Chem. and Met. Eng., 1919, **20**, 283–288.

THE maintenance of a region of uniform temperature in an electric furnace requires that compensation be made for the heat losses at all points, and as the heat losses are never uniformly distributed, the heat supply must likewise be non-uniformly distributed. In a tube furnace it is necessary to control the heating of the ends independently and in the design of a furnace 45 cm. long, capable of heating uniformly a region 10–12 cm. long and 6 cm. diam., the centre was uniformly wound and the end sections, each independently controlled, were wound more closely. The heating element was composed of two helically grooved alundum tubes, one of which would easily slide into the other. Each end of the smaller tube was wound for a distance of 10 cm. with 0·8 mm. diam. platinum wire, and the whole was coated with alundum cement and baked. The tube was then inserted into the larger tube and the ends of the coils brought through holes made for the purpose, and wound back on the outer tube to its ends. The centre portion of the outer tube was then separately wound, and the whole covered with alundum paste. The heating tube was insulated with successive layers of magnesia, fireclay, and "calorox," and plugs were fitted in the ends of the tube. In general, the use of alternate layers of good and poor conductors effects the best insulation. The furnace as constructed gave a temperature

uniformity of ± 0·5° at temperatures ranging from 620° to 1190° C. and a constancy of ± 0·25° C. at 1000° C. and 1190° C.—C. A. K.

PATENTS.

Furnaces; Control of electric ——. W. J. Howard, Sheffield. Eng. Pat. 123,845, 13.3.18. (Appl. 4428/18.)

AN apparatus for raising and lowering an electrode in an electric furnace is combined with a solenoid or electromagnet, which is arranged in a shunt circuit between the electrode and the bath. The solenoid is inoperative during the normal working range of the voltage, but, when the latter drops below a predetermined value, acts upon the raising and lowering mechanism. The armature or movable member of the electromagnet or solenoid is acted upon by a spring or equivalent, which exerts little force upon the armature during the first stages of its movement, but acts strongly during the later stages.—B. N.

Furnaces; Regulator for electric ——. F. W. Smith, Westfield, N.J. U.S. Pat. 1,282,478, 22.10.18. Appl., 5.1.18.

THE regulator comprises a fluid motor, *e.g.*, a compressed air engine connected to one or more of the furnace electrodes and adapted to change their position. An electro-magnetic device, normally cut out of the circuit, is provided for regulating a valve for controlling the motor, the electro-magnetic arrangement being responsive to variations in the electric conditions of the electrode circuit, and adapted automatically to move the valve to shut off the motor on failure of voltage in the electrode circuit.—B. N.

Furnace; Electric ——. C. A. Cadwell, Assignor to The Electric Railway Improvement Co., Cleveland, Ohio. U.S. Pat. 1,290,902, 14.1.19. Appl., 1.5.15.

THE bottom of the furnace chamber is formed of granular high-resistance conducting material, and adjustable electrodes are mounted in the chamber above the material. Arcs are formed between the electrodes and the resister material, and the furnace is surrounded by an electro-magnetic coil, so as to produce a magnetic field for directing and steadying the arcs. Two furnaces may be connected in series, one being adapted to act as a rheostat and preheating furnace during the heating operation of the second, and the latter is then adjusted to act as the rheostat and preheater during the final heating operation of the first.—B. N.

Electrodes. E. Newbery, Manchester, and H. Gerrard, Harwich. Eng. Pat. 123,936, 14.10.18. (Appl. 16,762/18.)

AN electrode, for use in the detection of objects submerged in chloride solutions such as sea water, is formed of or coated with silver which is in electrical connection with a conductor, and no metallic surface, except silver, is exposed to the chloride solution. Silver chloride is applied to or deposited electrolytically on the silver surface, and the electrode is preferably enclosed in a protective wrapping of porous material, such as canvas or flannelette.—B. N.

Electrolytic cell. E. E. Niswonger, Dayton, Ohio, and P. McDorman, Niagara Falls, N.Y., Assignors to The Electro Chemical Co., Dayton, Ohio. U.S. Pat. 1,292,024, 21.1.19. Appl., 28.9.18.

A SERIES of vertical electrodes, of height less than that of the cell, are mounted in the bottom of the cell, and glass insulating members, extending to the top of the cell, are arranged to rest upon the electrodes.—B. N.

Battery; Electric ——. N. K. Chaney, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,292,254, 21.1.19. Appl., 17.6.18.

A DRY cell mixture contains carbon free from ferrous sulphide.—B. N.

Electric storage batteries; Process for preventing formation of an explosive gas mixture in ——. A. Aicher, Mülheim. Ger. Pat. 308,996, 1.12.17.

THE danger due to the formation of an explosive mixture of gases during the charging of accumulators is minimised by leading a current of air into the electrolyte and thus diluting the gases.

—J. F. B.

Galvanic cell with two electrolytes separated by a diaphragm. Schuster-Patent-Ges. m.b.H., Berlin. Ger. Pat. 309,531, 28.12.16.

THE two electrolytes have different densities, the lighter liquid which surrounds the diaphragm standing at a higher level than the heavier liquid which is inside the diaphragm. Thus a portion of the diaphragm is only moistened with liquid on the outer side and the lighter liquid is enabled to penetrate more easily to the inside. Moreover, the lighter liquid also has access on the outside to the bottom of the diaphragm, and its penetration upwards through the diaphragm into the heavier liquid is assisted by the difference in the specific gravity of the two liquids. The intimate interpenetration of the two liquids may be assisted by constructing the upper part of the diaphragm with thinner walls than the lower, so that the access of the lighter electrolyte to the heavier is facilitated.

—J. F. B.

Permanganates. U.S. Pats 1,291,680—2. *See* VII.

Recovering bromine. U.S. Pat 1,292,016. *See* VII.

XII.—FATS; OILS; WAXES.

Orange seed oils. I. S. Kobayashi. Kōgyō-Kwagaku Zasshi (J. Chem. Ind. Tokyo), 1918, **21**, 1235—1245.

AN account of analyses of the oils from the seeds of the citron (*Citrus aurantium*, L., sub. sp. *junos*, Mak.), Chinese citron (*C. aurantium*, L., sub-sp. *sinensis*, Engl.), and kumquat (*Fortunella japonica*, Swingle). The characters of the oils are shown in the following table:—

—	Oil from seed of:		
	Citron	Chinese citron	Kumquat
Sp. gr. at 15°/4° C. ..	0·9221	0·9200	0·9223
Acid value ..	4·97	0·90	1·05
Saponification value ..	195·1	192·7	193·4
Iodine value (Wijs) ..	100·42	105·27	113·03
Refr. index at 20° C. ..	1·4720	1·4722	1·4730
Unsapon. matter, % ..	1·28	1·22	1·22
Fatty acids:			
Sp. gr. at 50°/4° C. ..	0·8714	0·8738	0·872?.
M.pt., °C.	33·5–34	40–41	32–33
Solidif. pt., °C. ..	29–30	33·5–34·5	26–27·5
Neutralisation value	200·9	202·9	199·2
Mean mol. wt. .	279·6	276·8	281·7
Refr. index at 40° C.	1·4551	1·4558	1·4576
Iodine value (Wijs)	102·13	105·9	114·05

The oils are of the semi-drying class, and the proportion of solid fatty acids is about 19—27%.

—J. C. W.

Glycerol; Determination of —— and the water content of glycerin from the specific gravity and boiling point. A. Grün and T. Wirth. Z. angew. Chem., 1919, **32**, 59—62.

Recorded values for the sp. gr. of pure glycerol at 15°/15° C. range from 1·2594 (Nicol) to 1·2690 (Lenz). In the case of highly concentrated glycerin the sp. gr. alters, according to various authorities, by 0·0025 to 0·0030 for 1% of water. Glycerol purified by distilling twice in a vacuum and dried over phosphorus pentoxide in a vacuum for 5 months had the sp. gr. at 15°/15° C. 1·2653±0·0001, which agrees with the value given by Gerlach, and it is concluded that the table given by Gerlach (this J., 1885, 226) is the most trustworthy for determining the amount of glycerol from the sp. gr. For determining small quantities of water in glycerin the boiling-point method affords the most accurate means, the presence of 1% of water lowering the b.pt. of pure glycerol from 290° C. to 239° C. Schleiermacher's method (Ber., 1891, **24**, 944, 2251), in which the glycerin is heated over mercury in a sealed capillary extension of a U-tube, may be conveniently used for this determination. The following results were thus obtained:—

Glycerol %	100	99·5	99	98·5	98	97·5	97	96·5	96	95·5	95
B.pt. at 760 mm. ° C.	283–284	243–244	221–225	207–208	195–196	185–186	178–179	171 172	167–168	163 164	160–161

The lower b.pt. of the 100% glycerol as compared with that found by Gerlach (*loc. cit.*) is attributable to the absorption of 0·05% water in charging the capillary tube. Heated in a distillation flask the same glycerol showed a constant b.pt. of 289°—290° C. The presence of organic or inorganic salts (*e.g.* 1% of sodium chloride) in technical glycerins did not affect the b.pt., but the method is not applicable to glycerins containing more than traces of polyglycerols. For technical purposes the b.pt. may be determined by Emich's method (Monatsh. Chem., 1917, **38**, 219) in an ordinary capillary tube. (See also J. Chem. Soc., May, 1919.)—C. A. M.

Distillation of albumin. Pictet and Cramer. *See* XIXA.

PATENTS.

Chemical reactions [hydrogenation]; Method of effecting ——. R. F. Steward, Washington, D.C. U.S. Pat. 1,284,488, 12.11.18. Appl., 19.8.12. Renewed 10.6.16.

A fluid mixture of an unsaturated fatty acid or other substance with a catalyst is thrown by centrifugal force into a layer or film (*e.g.* by being fed on to a rapidly rotating surface near the axis thereof), and is simultaneously exposed to the action of hydrogen or other reacting gas.—C. A. M.

Fatty substances; Hydrogenation of ——. J. Boyce, Chicago, Ill., Assignor to American Cotton Oil Co., Guttenberg, N.J. U.S. Pat. 1,291,384, 14.1.19. Appl., 7.3.12.

Hydrogen is passed into a charge of oil which contains a divided catalyst and may be *in vacuo*, and after the absorption the excess of hydrogen is passed on to a second charge of oil also *in vacuo*. In one modification of the process the oil, after hydrogenation, is removed from the vessel leaving the catalyst behind, and a second charge of oil is introduced, care being taken to exclude air from the vessel.
—C. A. M.

Oil; Process of hardening ——. C. Ellis, Montclair, N.J. U.S. Pat. 1,294,068, 11.2.19. Appl., 2.2.16.

A current of hydrogen is made to circulate through a comparatively shallow layer of oil, containing a finely-divided catalyst, the unabsorbed gas collected, and a portion thereof purified, dried, and returned to the main body of the gas, which is then heated, and again passed through the oil. In a modification of the method a relatively large proportion of the hydrogen is purified and dried at that stage of the process at which a large amount of water is formed, and only a small proportion at the stage when only a little water is produced.—C. A. M.

Grease and oils; Apparatus for extracting —— from garbage. C. Edgerton, Philadelphia, Pa. U.S. Pat. 1,293,738, 11.2.19. Appl., 2.12.16.

Grease etc. is extracted from garbage in a tank-like receptacle with a vertical cylindrical wall, which is heated by means of internal steam coils connected with a series of pipes outside the vertical wall.—C. A. M.

Cotton-seed; Preparation of —— for milling. W. E. McCaw, Assignor to The Procter and Gamble Co., Cincinnati, Ohio. U.S. Pat. 1,293,830, 11.2.19. Appl., 21.7.13.

Prior to milling, cotton-seed is heated for a short time at 160° to 180° F. (71°—82° C.) and then cooled to atmospheric temperature.—C. A. M.

Fat, wax, resin, etc. from vegetable cellulosic materials; Process for recovering ——. C. G. Schwalbe, Eberswalde. Ger. Pat. 309,555, 3.8.17.

The raw plant materials are treated with acids, acid salts, or salts which produce acids; they are then heated or dried by heat and extracted with suitable solvents after neutralising the acid, if necessary. The yield of fatty substances is doubled by the preliminary treatment with acid. For instance, 1·5% of waxy matter can be extracted from straw by chloroform but after the treatment with acid 3% is obtained. Wood, leaves, peat, chaff, etc. may also be treated in the same manner.—J. F. B.

Soaps containing benzene hydrocarbons in soluble form; Preparation of ——. J. Simon und Dürkheim, Offenbach. Ger. Pat. 309,574, 10.10.16. Addition to Ger. Pat. 267,439.

Alkali salts of naphthenic and polynaphthenic acids are used in place of vegetable and animal fatty acids in soaps, as they possess a greater absorptive capacity for hydrocarbons.—J. H. J.

Solvents for fats. Eng. Pat. 121,072. *See* IIA.

Lubricating-grease. U.S. Pat. 1,294,136. *See* IIA.

Grease from wool-washing water etc. Eng. Pat. 123,048. *See* V.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Coumarone resins; Technical ——. J. Marcusson. Chem.-Zeit., 1919, **43**, 93—94.

The amount of coumarone resins produced annually in Germany rose from about 6000 tons prior to the war to 10,000 to 11,000 tons in 1917. The resins have been classified in 30 different grades, according to their hardness and colour, whilst four grades of distillation residues containing coumarone resin have been distinguished. The maximum price per 100 kilos. ranged from M.50 for black fluid resins to M.250 for pale hard and brittle resins. Coumarone

resins are soluble in the ordinary solvents for fats, with the exception of petroleum spirit, but this drawback may be remedied by adding benzene or solvent naphtha to the petroleum spirit. They are mainly utilised in the paint and varnish industry, a mixture of coumarone resin and boiled linseed oil drying to a durable, hard, non-sticky film. In the drying of a coumarone resin varnish the following processes occur:—(1) Evaporation of the solvent; (2) partial evaporation of the oily constituents of high b.pt.; (3) oxidation of the paraindene; (4) conversion of the paracoumarone into a polymeric modification. The varnish without the addition of linseed oil, tung oil, etc., has the drawback of yielding films which are lacking in elasticity and resistance to weather, whilst, even when completely dry, the layer is softened by the addition of a second coat. Considerable quantities of coumarone resins are also used in the manufacture of printing inks. The best preparations contain a mixture of ordinary lithographic varnish with the soft or fluid resins, whilst for newspaper inks mixtures of coumarone resins with mineral oil or tar oil, or distillation residues containing coumarone resins are used. A further application of these products is for sizing paper. Although they cannot be saponified, even when heated with alcoholic alkali in an autoclave, or by heating with soda-lime at 230° to 260° C., they can be made into an emulsion with glue or with rosin soap, which is suitable for this purpose.

—C. A. M.

PATENTS.

Titanium products [for pigments etc.]. Titan Co. A/S., Christiania, Norway. Eng. Pat. 116,266, 10.4.18. (Appl. 6111/18.) Int. Conv., 24.5.17.

THE SO_3 present in titanium hydroxide precipitated from a solution of the sulphate is neutralised by treatment with an insoluble alkaline-earth compound. For example, moist precipitated hydroxide (100 kilos.) containing TiO_2, 41·0; SO_3, 3·4; H_2O (combined), 9·7; water, 42·9%, is mixed with finely powdered chalk (5·72 kilos.) and the mass is calcined in a rotary furnace, whereby the excess of chalk is converted into calcium titanate whilst the hydroxide is converted into titanium dioxide. The resulting product contains TiO_2, 84·0; $CaTiO_3$, 3·8; and $CaSO_4$, 12·2%. Calcination is facilitated by the porous condition of the mass, brought about by the carbon dioxide which escapes on neutralisation. Calcium titanate has a high refractive index (n_D = 2·4), and a low solubility. The alkaline-earth compound may also be used in quantity only just sufficient to neutralise the SO_3 present.—E. W. L.

Dopes; Production of ——. Cellon, Ltd., T. Tyrer and Co., Ltd., and T. Tucker, London. Eng. Pat. 123,628, 26.3.18. (Appl. 5300/18.)

NITROCELLULOSE is dissolved in isobutyl isobutyrate, solutions up to 33% strength being thus obtainable. The rate of drying of the dope may be increased by the addition of acetone, or similar diluent, or of other esters, such as butyl acetate. The dope can be used on either cotton or linen fabric.

—E. W. L.

Pine resins; Process of and apparatus for distilling crude ——. R. Dunwody, New Orleans, La. U.S. Pat. 1,291,800, 21.1.19. Appl., 12.1.18.

CRUDE gum resin is passed through a number of strainers with meshes of different size, the unstrained portions separated from the strained portions, and the former distilled to separate the rosin. Vapours of the distillate are passed through the strainers to dissolve any gum present, which is then added to the strained portions previously separated.

—C. A. M.

Resin etc. from cellulosic materials. Ger. Pat. 309,555. *See* XII.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

PATENTS.

Balloon envelopes and the like; Fabric for —— and method of manufacturing and aftertreating the same. R. Wheatley, and The North British Rubber Co., Ltd., Edinburgh. Eng. Pat. 5915, 20.4.15.

THE layers of rubber or other gas-retaining media employed for coating balloon fabrics are protected from the action of actinic light by incorporating with the coating medium a red, orange, or yellow colouring matter which is soluble in the rubber or other composition employed for coating. For instance, to a dough containing 100 parts of rubber is added a solution of 2 parts of "Oil Red S" dissolved in coal-tar naphtha; or the coated fabric is treated with a solution of "Oil Amber 13777" in coal-tar naphtha by dipping or external application, the dyestuff being absorbed by the rubber.

—J. F. B.

Rubber waste; Process of treating ——. *Cotton-containing rubber composition.* J. F. Johnston, Barberton, Assignor to Electric Rubber Reclaiming Co., Akron, Ohio. U.S. Pats. (A) 1,291,535 and (B) 1,291,536, 14.1.19. Appl., 25.4.18.

(A) RUBBER waste, 100 lb., containing cotton, is heated at about 300° F. (150° C.), with a reclaiming mixture containing a 2% solution of sodium hydroxide, together with resin, 5 lb., and desulphurised petroleum (kerosene), 15 lb., the mixture being agitated. (B) A mass of reclaimed rubber having distributed through it cotton fibre which has been subjected to the action of caustic alkali.

—E. W. L.

Rubber; Process for vulcanising —— and products obtained thereby. W. A. Gibbons, Flushing, N.Y., Assignor to New York Belting and Packing Co. U.S. Pat. 1,291,828, 21.1.19. Appl., 30.8.17.

RUBBER or similar material is vulcanised by means of β-dinitroanthraquinone.—C. A. M.

Solvents for rubber. Eng. Pat. 124,072. *See* IIA.

Coating fabrics. Eng. Pat. 123,551. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

Tannins. I. Hamamelí-tannin. K. Freudenberg. Ber., 1919, **52**, 177—185.

BY hydrolysis with tannase in dilute aqueous solution hamamelí-tannin yields gallic acid and a sugar (calculated as a hexose) in quantities corresponding with the formula of a digalloylhexose, $C_{20}H_{20}O_{14}$. The sugar appears to contain a normal chain of six carbon atoms. (See also J. Chem. Soc., May, 1919.)—C. S.

Gelatin; Absorption of water by ——. E. B. Shreve. J. Franklin Inst., 1919, **187**, 319—337.

GELATIN jelly was made by dissolving 20 grms. of selected dried gelatin in 50 c.c. of water or of a desired solution, and allowing the solution to set in a refrigerator either in large flat dishes about 12″ diam. or in small dishes about 6 cm. in diam. In the former case the resulting slab of jelly was cut up into discs 2 cm. in diam., 30 of which were used in each experiment; in the latter case a measured quantity of the gelatin solution was taken and the jelly left in the dish throughout

the experiment. Estimation of the amount of imbibed water or solution was made by weighing, more constant results under the same conditions being obtained than by estimating the change of volume, either by a displacement method or by direct measurement. It was found that imbibition invariably increases with rise of temperature. It is suggested that this is not a contradiction of Le Chatelier's theorem, according to which, absorption of water by gelatin being always accompanied by evolution of heat and contraction, it should be favoured by cold and pressure, but that the rate of absorption is so low that equilibrium is never attained, the higher results with increase of temperature being due to higher rates. It is also shown that although the amount of imbibition is less in solutions of sodium sulphate, sodium tartrate, sodium citrate, sodium acetate, alcohol, dextrose, and sucrose than in water, and greater in solutions of potassium, sodium, and ammonium chlorides, and sodium chlorate, nitrate, and bromide, the imbibition of jellies made up with these solutions instead of with water is always greater than that of a jelly made with water only: the same effect is obtained if the water-jelly is allowed to absorb completely a small amount of a solution of any of these substances and is then reduced to its original weight by evaporation.

—B. V. S.

Fission products of horn. Brahm and Zuntz. *See* XIXA.

PATENTS.

Tanning of hides and skins; Apparatus for the rapid ——. F. Gilardini, Turin, Italy. Eng. Pat. 114,631, 5.4.18. (Appl. 5871/18.) Int. Conv., 6.4.17.

THE hide, stretched on a frame, is passed between (say three) successive pairs of superposed planes, each plane being so formed as to constitute a number of cells to which tanning liquor can be supplied under pressure, or in which a reduced pressure of air can be maintained. The cells of the three pairs of planes are so spaced and shaped as to ensure that on its exit from the third pair practically the whole surface of the hide has been in contact with tanning liquor under pressure. The tanning liquor may be supplied to both upper and under plane simultaneously, or it may be supplied to the cells of one plane only, a reduced air pressure being meanwhile maintained in the cells of the other plane of the pair. Automatic valves are provided in the inlet tubes leading to the cells for the purpose of closing the inlets in the event of an air-tight joint between hide and cells not having been made. It is stated that the tanning of each zone of the hide is complete in a few minutes. The successive pairs of planes may be replaced by successive pairs of cylinders with similar cells arranged radially.—E. W. L.

Adhesives; Process of manufacturing waterproof ——. S. Butterman, Madison, Wis., Assignor to United States of America. U.S. Pat. 1,291,396, 14.1.19. Appl., 3.8.18.

A WATERPROOF adhesive consists of casein, 1; water, 2; oil, 0·015; hydrated lime, 0·15, in water 0·90; and sodium silicate 0·70 part by weight.—E. W. L.

Feathers; Manufacture of plastic masses from ——. M. Matthaey, Berlin. Ger. Pat. 308,755, 12.12.16.

THE feather material is heated with water under pressure at 140°—160° C., then treated with sulphuric acid and washed with water, after which it is worked up into sheets, rods, etc. either directly or after grinding. The material is rendered resistant to water and acids by this treatment and can be turned and polished like vulcanite, galalith, celluloid, etc. Loading materials as well as sulphur may also be added.—J. F. B.

Grease from water used for washing hides. Eng. Pat. 123,848. *See* V.

Waterproofing paper etc. Ger. Pat. 309,680. *See* V.

XVI. SOILS; FERTILISERS.

Nitric-nitrogen accumulation in the soil; Influence of salts on the ——. J. E. Greaves, E. G. Carter, and H. C. Goldthorpe. J. Agric. Res., 1919, **16**, 107—135.

A SANDY loam soil was used for the experiments, containing all the elements of plant food in abundance except nitrogen, of which only 0·15% was present. The air-dried soil was divided into 100-grm. portions to each of which was added 2 grms. of dried blood. The salt whose action was to be investigated was added in graduated amounts as a standard solution, and then water to make the moisture content 20%. The sample thus treated was incubated at 28°—30° C. for 21 days, and then the nitric nitrogen determined by reduction with iron and sulphuric acid and distillation of the ammonia. The salts tested were the chlorides, nitrates, sulphates, and carbonates of sodium, potassium, calcium, magnesium, manganese, and iron. It was found that the toxicity of these salts was determined by the specific nature of the salt and not by the ions. In order of decreasing toxicity the salts were: sodium sulphate, sodium carbonate, calcium carbonate, potassium sulphate, potassium carbonate, ferric nitrate, sodium nitrate, magnesium sulphate, ferric sulphate, calcium nitrate, potassium nitrate, potassium chloride, magnesium nitrate, manganous carbonate, manganous chloride, manganous sulphate, ferric carbonate, magnesium chloride, manganous nitrate, ferric chloride, magnesium carbonate, sodium chloride, calcium chloride, calcium sulphate. The increase of toxicity with concentration was much more rapid in some cases than in others. The common alkali salts of soil were very toxic to the nitrifying organisms and greatly reduced the nitric nitrogen accumulation. Most of the salts acted as stimulants to nitrification in some at least of the concentrations used. The only ones which failed to give any stimulation were sodium sulphate and carbonate, calcium carbonate, potassium sulphate and carbonate, and ferric nitrate. Calcium chloride and sulphate increased the nitric nitrogen accumulation 67% and 97% respectively. The nitrates caused loss of nitrogen in some concentrations and fixation of nitrogen in others. Manganous nitrate was the strongest nitrate stimulant.—J. H. J.

Alkali salts in soils; Copper and zinc as antagonistic agents to the ——. C. B. Lipman and W. F. Gericke. Amer. J. Bot., 1918, **5**, 151—170.

EXPERIMENTS on barley have shown that small quantities of copper or zinc salts are capable of neutralising the toxic effect of comparatively large amounts of alkali salts in soils.

Plants; Influence of organic compounds on the development of ——. *III.* G. Clamician and C. Ravenna. Atti R. Accad. Lincei, 1919 [v], **28**, I., 13—20. (Compare this J., 1918, 598 A.)

FURTHER experiments have been made with various compounds related fundamentally to the vegetable alkaloids. (See J. Chem. Soc., 1919, i., 241.)

—T. H. P.

PATENTS.

Superphosphates or like artificial fertilisers; Apparatus for the manufacture of ——. W. and H. M. Goulding, Ltd., Dublin, and G. H. Allibon, Belfast. Eng. Pats. (A) 123,912 and (B) 123,960, 15.6.18. (Appls. 9855 and 20,597/18.)

(A) A VERTICAL superphosphate den with discharge opening across the bottom (see Eng. Pat. 11,215 of 1906; this J., 1907, 424) is provided with scrapers mounted on a hollow shaft extending upwards above the den and moving downwards by a screw feed during the process of rotation. The discharge opening extends right across the bottom and is provided with vertical sliding doors on each side which divide the den into two compartments with a central free space above the discharge opening. (B) In a vertical den, the sliding doors are operated automatically by the action of scraper feeding mechanism. In a horizontal den, the door which covers the discharge opening is operated automatically by the scraper feeding mechanism.—J. H. J.

Calcium cyanamide fertiliser; Manufacture of a non-dusty —— *capable of being spread.* O. Neuss and H. Stiegler, Essen. Ger. Pat. 298,200, 11.5.16.

PEAT-LITTER is saturated with a salt solution, *e.g.* the waste liquors from the potash industry, and the resulting slightly moist mass is mixed with crude calcium cyanamide.—J. F. B.

Ammonium nitrate; Process for the manufacture of non-hygroscopic —— *[for use as fertiliser].* Badische Anilin u. Soda-Fab., Ludwigshafen. Ger. Pat. 309,668, 25.3.16.

A SOLUTION containing ammonium nitrate mixed with potassium chloride is evaporated, preferably at a low temperature. A mixture containing equal parts of the two salts is no more hygroscopic than Chili saltpetre, for instance, whereas pure ammonium nitrate is difficult to apply as a fertiliser because it is deliquescent in the air.—J. F. B.

Fertiliser [; Sewage sludge ——]. G. J. Fowler and G. Mumford, Manchester. U.S. Pat. 1,294,080, 11.2.19. Appl., 1.6.16.

SEE Eng. Pat. 8397 of 1915; this J., 1916, 1074.

Waste acids from nitrocellulose. Ger. Pat. 309,936. *See* XXII.

XVII.—SUGARS; STARCHES; GUMS.

[Sugar] cane juice; Filtration of raw ——. R. S. Norris and W. R. McAllep. Int. Sugar J., 1919, **21**, 121.

RAW cane juice can be filtered satisfactorily if 50 grms. of kieselguhr per litre be added to the liquid. An ordinary Buchner funnel with a 12·5 cm. paper is used, but under the paper a flat piece of brass gauze is placed, the available surface being thus considerably increased. A litre of juice can thus be filtered in about 5 min., whereas without this treatment the filter is soon obstructed.
—J. P. O.

Sucrose; Action of neutral salts on the inversion of —— *by acids.* H. Colin and M. Lebert. Bull. Assoc. Chim. Sucr., 1918, **35**, 14—17.

THE authors studied the inhibitive action of alkali salts of acetic, citric, and oxalic acids on the hydrolytic activity of the free acids. The experiments were in all cases carried out at 96° C. with 7·7% sucrose solutions. Whilst *N*/2 acetic acid effected complete hydrolysis in 1 hour, it was without any action whatever during the same period in presence of *N*/2 sodium acetate. Similarly *N*/2 citric acid produced complete inversion in 15 mins. but was rendered quite inactive by the presence of *N*/2 sodium citrate. With *N*/20 oxalic acid inversion was complete in 15 mins. but no action took place in presence of *N*/5 potassium oxalate during the same period. It is known that the activity of strong acids, such as hydrochloric acid, is not diminished but slightly increased by the presence of their salts. In hydrolysis by hydrochloric acid, however, strongly marked inhibitive effects were found to result from the addition of acetate, citrate, or oxalate in quantities more than equivalent to the free acid present; in such cases the strong mineral acid is entirely replaced by the weak organic acid and the activity of the latter is diminished or entirely suppressed by the presence of its own salt.—J. H. L.

Striegler's reagent [for removing excess of lead from clarified molasses]; Composition of the precipitate produced in the preparation of ——. G. P. Brouwer. Archief Suikerind. Nederl.-Ind., 1918, **26**, 1909—1912.

PREVIOUS to determining the reducing sugars in cane molasses, it is generally necessary to clarify with lead acetate, the excess of the reagent being removed by the addition of a suitable salt. Striegler's reagent (Tervooren's "Handboek," p. 341), which is used in Java for removing the excess of lead after clarifying molasses with lead acetate, is prepared by dissolving 25 grms. of oxalic acid in 250 c.c. of water, neutralising with sodium carbonate, making up to 500 c.c., and filtering off the precipitate formed. Tervooren states that this precipitate is sodium bicarbonate, but experiments carried out by the author show that when sodium carbonate is added to oxalic acid under the conditions specified, two precipitates are successively formed, first, sodium binoxalate, which re-dissolves on continuing the addition of sodium carbonate, and, second, sodium oxalate, part of which later dissolves on making up the liquid to 500 c.c. with water. It is concluded that the reagent consists of a saturated solution of normal sodium oxalate, containing a small quantity of sodium bicarbonate, and a slight excess of sodium carbonate.—J. P. O.

Cupric-sodium hydroxide reagent; Preparation of —— *for use in the detection and determination of sugars.* E. Justin-Mueller. J. Pharm. Chim., 1919, **19**, 18—20. (See this J., 1919, 11 A.)

A REAGENT, which may be used in place of Fehling's solution, is prepared by adding 20 c.c. of 10% copper sulphate solution slowly to 100 c.c. of 33·69% sodium hydroxide solution. This solution remains clear when kept and does not give a precipitate of cupric oxide when boiled.—W. P. S.

Carbohydrates of lichens. Salkowski. *See* XVIII.

PATENTS.

Lævoglucosan; Manufacture of ——. A. Pictet, Geneva. Eng. Pat. 121,725, 20.8.18. (Appl. 13,530/18.) Int. Conv., 27.12.17.

LÆVOGLUCOSAN, which can be converted into alcohol by hydrolysis and fermentation, is produced by the dry distillation of carbohydrate materials, *e.g.*

cellulose, sawdust, or starch, under reduced pressure. (*Cp.* this J., 1918, 49 A.)—J. H. L.

Adhesive [from lupin seeds]; Process of manufacturing an ——. H. Thoms and H. Michaelis, Berlin. Ger. Pat. 309,650, 7.9.17.

Powdered shells of lupin seeds are heated gradually to about 100° C. with water or very dilute solutions of calcium hydroxide or calcium salts, and the resulting extract is evaporated to the consistence of fish-glue. The galactans of the lupin seeds are extracted and modified by partial hydrolysis during the treatment, giving an excellent adhesive which serves as a substitute for starch paste or gum arabic or for finishing yarns and textiles and sizing paper. The seed hulls are more suitable than the entire seeds for this treatment and the kernels may be utilised as foodstuffs. —J. F. B.

XVIII.—FERMENTATION INDUSTRIES.

Diastatic power [of malt]; Determination of ——. L. C. Wilson and A. L. Minchin. J. Inst. Brew., 1919, **25**, 65—67.

The authors have found that in determining the diastatic power of malt by the method published by the Committee of the Institute of Brewing (this J., 1906, 237) it is unnecessary to extract the 25 grms. of malt for 3 hours, as prescribed; equally high results are obtained by 1 hour's extraction. —J. H. L.

Yeast; Flocculent and powdery forms of ——: *their causes.* F. Schönfeld and H. Krumhaar. Woch. Brau., 1918, **35**, 302—304, 342—343.

Addition of mineral acids or their salts is known to transform yeast from the flocculent to the dispersed or powdery form. The authors found that by adding *N*/10 hydrochloric acid to a flocculent suspension of yeast in distilled water, until the flocks were dispersed, and then filtering, the filtrate on treatment with alkali yielded a precipitate consisting chiefly of protein, together with lime and phosphoric acid in proportions corresponding approximately to dicalcium phosphate, $CaHPO_4$. On treating a suspension of a powdery distillery yeast in distilled water, with a small quantity of *N*/10 monocalcium phosphate, and then adding *N*/10 sodium hydroxide drop by drop, flocculation occurred long before the liquid was alkaline to phenolphthalein. It is concluded that the formation of insoluble dicalcium phosphate can bring about flocculation. The fact that calcium hydroxide and calcium salts of very weak acids have a similar effect is attributed to the formation of dicalcium phosphate in the neighbourhood of the yeast cells owing to the exosmosis of phosphate ions from the cells. All cases of flocculation, however, cannot be explained by the action of calcium phosphate, and in some the change is probably brought about by proteins. If a suspension of yeast is treated with *N*/10 sodium hydroxide and filtered, the filtrate on acidification yields a precipitate consisting almost entirely of protein, which has a very strong flocculating action on yeast. If, for example, a suspension of a powdery distillers' yeast, in distilled water, is treated with an alkaline solution of the precipitate, and then acidified, the yeast flocculates strongly. Yeast from hopped worts yields a much larger quantity of the precipitate than yeast from sweet worts, and its colour is much darker, owing doubtless to the presence of resins and tannin. It is probable that in brewery fermentations, wort proteins which separate from solution, especially as the acidity of the wort increases, and are deposited on the yeast cells, exert this flocculating tendency, but where the yeast peptase is able to decompose the deposited proteins the yeast may retain its powdery form. Lange has observed that powdery yeasts are characterised by high peptic activity.—J. H. L.

Beers; Air in gas used for carbonating ——. A. R. Ling. J. Inst. Brew., 1919, **25**, 173—174.

It is well known that the aeration of worts at an early stage of fermentation is beneficial to yeast reproduction; but beyond the point at which attenuation has reached half gravity, it is actually harmful (*cp.* Ling, this J., 1915, 1159). When air gains access to the wort in the fermenting vessel at a late stage of the fermenting process, some of the cells are carried back to that phase of development which they should assume at pitching, and reactions other than alcoholic fermentation, which are necessary for the development of character, are brought to a standstill. A yeast from an aerated wort shows a number of budding cells which should never be present except in small quantity, in a good pitching yeast. In connection with chilled, filtered and carbonated bottled ales, even when the most efficient filters and pulp are used, it is impossible to remove all the yeast cells and other organisms present in the beer. Nor would this be desirable, for if anything approaching ultrafiltration were practised, colloidal particles might also be removed, which are known to help in maintaining character and condition. The point to which the author calls special attention, however, is that if the beer is to remain bright for a reasonable period, the smallest trace of air must not be allowed to gain access to it. If air is introduced with the gas used for carbonating the beer, a small number of yeast cells, which under strictly anaërobic conditions would remain dormant, will multiply to such an extent that the beer throws a deposit, and may even become turbid. The precaution against this is to test every batch of carbon dioxide used for carbonating beer for the presence of air. A sample of carbon dioxide should not contain more than one part of air in a thousand.

Beers; Light — and yeast reproduction. H. B. Wooldridge. J. Inst. Brew., 1919, **25**, 171—173.

The author describes the results of varying the proportion of pitching yeast, in the production of English light beers. When the present low-gravity beers first became compulsory, experiments were made by pitching bitter ales of sp. gr. 1·035 with 1¼ lb. of yeast per finished barrel, and mild ales and porters of sp. gr. 1·030 and 1·025 with 1 lb. per barrel. The yeast crops obtained were actually less in amount than the yeast added at pitching, and were so weak as to be unfit for further use. By reducing the amount of pitching yeast to one half those mentioned above much better results were attained. With bitter ales a crop amounting to 3 times the quantity of pitching yeast was obtained, and with mild ales of sp. gr. 1·030 the increase was between 4- and 5-fold. Moreover the yeast obtained was solid and vigorous and remained fit for pitching even 5—6 days after being skimmed. J. H. L.

Yeast reproduction; Light beer and ——. T. Bokorny. Allg. Brauer- u. Hopfenzeit., 1917, **57**, 1327. Z. ges. Brauw., 1918, **41**, 210. (See also this J., 1918, 162 A.)

In experiments with yeast and pure sugar solutions multiplication of the yeast was found to be influenced by the relative proportions of yeast and sugar present, by the temperature, and by the absolute concentration of sugar. With 0·01 grm. of pressed yeast and 1 grm. of sugar, reproduction

proceeded rapidly even in absence of air, but with 1 grm. of yeast and 1 grm. of sugar practically no reproduction occurred. Lowering of the temperature had a much more adverse effect on reproduction than on fermentation. As regards the absolute concentration of sugar, 6% solutions were found to be more favourable to reproduction than 3%, 5·4%, 7%, or 8% solutions.—J. H. L.

Yeast; Nutrition of —— *in light beers.* F. Schönfeld and H. Krumhaar. Woch. Brau., 1918, **35**, 213—214.

In spite of the low gravity of present-day German beer worts the yeast is capable of retaining its vigour and well-nourished condition throughout a number of successive fermentations. The protein-content remains normal or even increases, probably in consequence of relatively restricted reproduction and movement in light worts. The total content of mineral matter also remains normal, although the proportion of phosphoric acid to lime and magnesia is high. The acidity of the yeast is also higher than that of yeasts from normal worts.—J. H. L.

Beers; Effects of artificial carbonation of light ——. F. Schönfeld. Tageszeit. für Brau., 1918, **16**, 673, 675. Z. ges. Brauw., 1919, **42**, 13—14.

In the production of very light (German) beers artificial carbonation has often been found to result in lessened stability and in the appearance of haze due to hop-resins, tannins, or proteins. In very light worts the separation of these imperfectly dissolved colloidal constituents before or during fermentation is apt to be incomplete, and a certain proportion remains in a state of unstable solution and may separate in a very finely divided form as the result of carbonation. Light beers produced by dilution of heavier fermented worts are abnormally sensitive to carbonation, for the dilution disturbs the equilibrium between the colloidal wort constituents and renders some of them readily precipitable. Possibly dilution with water saturated with carbon dioxide might avoid this to some extent. It is advisable to allow light beers to remain under a pressure of carbon dioxide for some days after carbonation, to ensure the complete separation of all substances precipitable by carbon dioxide, before filtration. Cases of iron-sickness in light beers (*cf.* Windisch, this J., 1918, 779 A) have been traced to the use of carbon dioxide from iron containers which had rusted inside owing to the presence of moisture. (See also Lindner, this J., 1919, 87 A.)
—J. H. L.

Glycerol; Preparation of —— *by fermentation.* K. Schweizer. Helv. Chim. Acta, 1919, **2**, 167—172.

A yield of glycerol, amounting to about 21% of the sugar used, may be obtained by fermenting with a hardy species of pressed yeast in the presence of a considerable quantity of sodium sulphite, free aeration of the mixture being of course prevented. It is stated that some of the belligerents employed this method on the large scale during the war. (See also J. Chem. Soc., 1919, i., 239.)—J. C. W.

Fumaric acid fermentation of sugar. F. Ehrlich. Ber., 1919, **52**, 63—64.

The formation of free fumaric acid during the fermentation of sugar (Wehmer, Ber., 1918, **51**, 1663) has been previously observed by the author (Ber., 1911, **44**, 3737).—C. S.

Wines; Analyses of old ——. W. I. Baragiola and O. Schuppli. Helv. Chim. Acta, 1919, **2**, 173—181.

The results of exhaustive chemical and physical tests of an 1834 Yvorne and an 1840 Glacier wine are given.—J. C. W.

Wine, cider and other beverages obtained from fruit; Food value of the by-products and refuse in the preparation of ——. F. Honcamp and E. Blanck. Landw. Versuchs-Stat., 1919, **92**, 275—290.

Feeding experiments on sheep indicate that the dried refuse from apples and pears obtained in the preparation of beverages from these fruits constitutes an excellent cattle-food. The actual value varies according to the proportion of pips and stalks present in the refuse. The dried skins of grapes, however, have an inferior feeding value, a relatively small proportion being digested and absorbed by the animal.—H. W. B.

Alcoholic fermentation; Carbohydrate content of lichens and the influence of chlorides on ——. E. Salkowski. Z. physiol. Chem., 1919, **104**, 105—128.

Analyses of Iceland moss and reindeer moss (*Cladonia rangiferina*) are given. The sugar obtained by acid hydrolysis of these lichens is fermentable. Chlorides may exert an inhibiting influence on alcoholic fermentation. Lichenin is not converted into sugar by plant diastase or by the diastatic enzymes of the pancreas and saliva.
—J. C. D.

Fractional distillation [of alcohol-water mixtures]; Thermodynamics and . C. Mariller. Bull. Assoc. Chim. Sucr., 1918, **35**, 45—51.

The statement of Chenard that in vaporised mixtures of alcohol and water the lower layers become richer in alcohol than the upper ones owing to the higher density of alcohol vapour as compared with water vapour (this J., 1916, 293), is contrary to the general properties of gaseous mixtures. The author repeated Chenard's experiments, but found no evidence of any such layers of different composition, provided disturbing effects due to cooling and partial condensation of the vapours were avoided.—J. H. L.

Inversion of sucrose. Colin and Lebert. *See* XVII.

Nitrogen distribution in [yeast]. Eckstein and Grindley. *See* XIXA.

Asphodel tubers. Savini. *See* XIXA.

Nucleotides. Thannhauser and Dorfmüller. *See* XX.

PATENTS.

Acids of the fatty series; Manufacture of —— *and of butyric acid in particular [by fermentation].* L. Lefranc, Paris. Eng. Pat. 17,776, 27.7.14.

Fatty acids are produced from materials containing carbohydrates, *e.g.*, beetroots, molasses, potato-pulp, etc., by fermenting the sterilised material by means of bacteria previously cultivated in material of the same kind, and by employing simultaneously two types of bacteria, one, like the *Amylobacter* or *Clostridium* type, capable of acting upon sugars, cellulose, and proteins, and the other, like the *B. amylozyme* of Perdrix, capable of acting on starch. The fermentation is conducted in presence of calcium or magnesium carbonate, at 38°—39° C., in closed vats or under a protective layer of carbon dioxide. After fermentation and filtration, the filtrate may be concentrated in multiple effect apparatus until calcium butyrate begins to crystallise from the hot liquid.—J. H. L.

Bacterial fermentation of carbohydrates and bacterial cultures for the same. [***Manufacture of acetone and butyl alcohol.***] C. Weizmann, Manchester. Eng. Pat. 4845, 29.3.15.

SOLUTIONS or suspensions of materials rich in starch or other carbohydrates are fermented under aerobic or anaerobic conditions, by means of heat-resisting bacteria obtained from soil or cereals, characterised by ability to liquefy gelatin and to convert starch mainly into acetone and butyl alcohol under aerobic or anaerobic conditions. A mash of maize, for example, previously cooked under pressure and containing 1 part of maize to 15 parts of water, may be fermented, preferably under anaerobic conditions, at 35°—36° C. In preparing the organisms, a large number of tubes of sterile maize mash are inoculated with suitable material, such as maize meal; after 4—5 days at 35°—37° C. those showing the most vigorous fermentation and having a pronounced odour of butyl alcohol, are heated for 1—2 mins. at 90°—100° C. and used for the preparation of a series of consecutive sub-cultures each of which is similarly heated before re-inoculation into fresh maize mash. The organisms finally surviving probably consist chiefly of *B. granulobacter pectinovorum*.—J. H. L.

Lævoglucosan. Eng. Pat. 121,725. *See* XVII.

XIXA.—FOODS.

Milk; Significance of the colon count in raw ——. S. H. Ayers and P. W. Clemmer. U.S. Dept. Agric., Bull. No. 739, 1918, 1—35.

THE colon count as made at present includes the *B. aerogenes* as well as the *B. coli*. Since the *B. aerogenes* is principally of non-faecal origin, the colon count cannot be a direct measure of faecal contamination. Investigation showed that fresh milk, produced under clean conditions, usually contained a few colon-aerogenes bacilli, and if produced under dirty conditions contained up to 2000 per c.c. The colon count therefore in fresh milk (under 2 hrs. old) will indicate the conditions under which the milk has been produced. In milk kept below 10° C. the colon-aerogenes group did not multiply, but above this temperature growth was very rapid. The colon count in milk of unknown origin has no definite significance: counts below 2000 per c.c. indicate either the number of organisms originally present or growth from a smaller number of organisms; counts above 2000 per c.c. indicate growth and that the milk has been at some time above 10° C.—J. H. J.

Milk; Analysis of——, especially the determination of lactose. H. Salomon and R. Diehl. Ber. Deuts. Pharm. Ges., 1918, **28**, 493—498.

THE poor fodder available in Germany during the war does not appear to have affected the quality of the milk yielded by cows; results of analyses show that the milk contains normal quantities of fat, proteins, albumin, and lactose. With regard to the determination of lactose, treatment with copper sulphate and sodium hydroxide solutions does not always remove all proteins, particularly when the milk has been preserved with formaldehyde; the proteins may, however, be precipitated completely by boiling the milk after the addition of zinc sulphate, by treatment with copper sulphate alone, or by means of a solution containing asaprol (calcium β-naphthol-α-monosulphonate), 15, and citric acid, 15 grms. per 500 c.c. of water.—W. P. S.

Milk; Determination of the non-protein nitrogenous constituents of ——. W. Denis and A. S. Minot. J. Biol. Chem., 1919, **37**, 353—366.

THE total non-protein nitrogen is estimated by a micro-Kjeldahl method after the proteins, fat, and lactose have been removed by precipitations with copper reagents. Urea may be estimated directly in milk by the urease method. The colorimetric method for the estimation of creatine and creatinine may be applied to milk after the removal of protein, fat, and lactose. Amino-nitrogen is determined by the Van Slyke method (this J., 1911, 771, 1135; 1915, 1110) after removal of protein. Uric acid is estimated by precipitation as the zinc salt and subsequent application of the colour reaction with the reagent of Folin and Denis. (See further J. Chem. Soc., May, 1919.)—J. C. D.

Galapiezometer [*apparatus for measuring the pressure of gases in tinned foods*]. G. A. Le Roy. Ann. Falsif., 1919, **12**, 31—35.

To determine the relative pressure of gases in "blown" tins of food (*e.g.*, condensed milk), the tin is placed in a small vessel provided with an airtight cover; an opening in the cover is closed by a rubber stopper through which pass a thermometer, a tube with a three-way tap, and a sharp pointed metal rod. The three-way tap is connected with a mercury manometer which measures the pressure produced when the tin is pierced by the metal rod and the gases liberated.—W. P. S.

Straw and wood; Acid and alkaline digestion of —— and the valuation [*as foodstuffs*] *of straw and wood meals.* A. Jonscher. Z. öffentl. Chem., 1918, **24**, 279—283.

STRAW and wood, chiefly larch wood, have been recommended as foodstuffs for animals and even for human consumption. They are prepared either as raw meals (mechanical pulps) or after preliminary treatment, *e.g.*, with hydrochloric acid or caustic soda. The author has examined samples of straw meal, both raw and hydrolysed with hydrochloric acid. The normal treatment with acid gives a brownish-yellow fine powder; more severe treatments give light brown and dark brown products. Comparative examination of these and of raw straw showed that the product prepared by the normal treatment was by far the best. Calculated on the straw dry substance, raw straw gave 12·78% of matters soluble in water, whereas the product of the normal acid treatment gave 28·70%, 10·77% being sugar. Stronger acid treatments gave products with caramelised flavour, with no substantially increased solubility and with much of the sugar destroyed. Acid treatment made no appreciable difference in the percentage of crude cellulose (41·08—43·54%) nor in that of the mineral matter (6·21—6·37%). The normally hydrolysed straw is capable of serving as a fodder for ruminants, but it contains too much resistant cellulose for human consumption. Beech wood meal, after hydrolysis with hydrochloric acid, showed an aqueous extract of 21·24% and was quite as unsuitable for human consumption as the hydrolysed straw. By treatment with caustic soda the straw is modified in a different manner. The fat or wax and most of the silica are removed and the digested straw is brought into a soft condition more favourable to assimilation by ruminant animals, but loss of extractive matters is involved by the necessity of removing and washing out the alkali. This form of straw is prepared as a moist pulp and in that condition can be used as an adjunct to other fodders. It contains 60·5% of crude cellulose as against 42·5% in the raw straw and is therefore still less suitable than the latter for human food.—J. F. B.

Feeding stuffs; Reduction of the quantity of humin nitrogen formed in the hydrolysis of the nitrogenous constituents of ——. H. C. Eckstein and H. S. Grindley. J. Biol. Chem., 1919, **37**, 373—376.

THE application of the Van Slyke method for determining the distribution of nitrogen in proteins (this

J., 1911, 771, 1135; 1915, 1110) to the analysis of feeding stuffs has been difficult owing to the production of large amounts of humin matter during the hydrolysis. This difficulty has now been surmounted with apparent success. A process is described by which certain interfering substances may be removed prior to the hydrolysis, whilst a large proportion of the protein of the foodstuff is removed and hydrolysed separately. (See further J. Chem. Soc., May, 1919.)—J. C. D.

Nitrogen in certain seeds [and yeasts]; Determination of the distribution of ——. J. F. Brewster and C. L. Absberg. J. Biol. Chem., 1919, **37**, 367—371. (Compare J. Chem. Soc., 1915, i., 760.)

YEAST nucleic acid when analysed by the Van Slyke method for the determination of the distribution of nitrogen in proteins (this J., 1911, 771, 1135; 1915, 1110) yields 15% of its nitrogen in the arginine fraction, although it contains no arginine. The application of the Van Slyke method to the analysis of products containing nucleic acid may therefore lead to erroneous results. (See further J. Chem. Soc., 1919, i., 239.)—J. C. D.

Asphodel tubers; Utilisation of ——. G. Savini. Annali Chim. Appl., 1919, **11**, 1—5.

THE tubers of *Asphodelus ramosus* contain inulin (9·6—17·5%) and may either be saccharified by means of dilute acid and fermented to obtain alcohol or be subjected to pressure, the resultant juice being then evaporated to a syrup, which has the external characters of malt extract and possesses comparatively high nutrient qualities.
—T. H. P.

Horn; Value of the fission products of —— as nutrient and food stuff. C. Brahm and N. Zuntz. Deut. med. Woch., 1917, **43**, 1062—1063. Chem. Zentr., 1919, **90**, II., 66—67.

THE component groups of keratin are in the main the same as those of the animal and plant proteins, but the indigestible horn differs from the easily digestible proteins in that it contains considerably more cystine. On account of its richness in this and in aromatic groups (phenylamine and tyrosine), horn would appear to be particularly suitable for increasing the food value of nitrogenous substances, such as glue, which are almost devoid of these groups. The authors have confirmed the fact that equal quantities of nitrogen in the form of glue have a far lower value than in the form of true animal and vegetable protein. Moreover, glue preparations exert a positively injurious action on the organism. Experiments were started with partially hydrolysed horn substance, of which 24·37% could be extracted with water. The dissolved substance contained 8·8% of nitrogen, equivalent to 15·5% of the total nitrogen of the horn. Thus, the first products of hydrolysis consist of the less highly nitrogenous components of the horn, that is, amino-acids of high molecular weight. The administration of this extract to dogs previously fed on glue produced complete recovery, and from a diet containing 10% of horn extract on the weight of the glue, the animals were able to derive full nitrogenous nutrition. Further experiments with more completely hydrolysed horn led to the preparation of an extract with an agreeable flavour of meat extract which, in the proportion of 10% of the total nitrogen of the mixture, sufficed to impart to a glue diet the full equivalent nutrient value of protein. Larger quantities of horn extract, *e.g.*, 33·3% of the total nitrogen of the mixed horn and glue diet, were not so successful, the mixture proving unpalatable, but the albuminuria induced by a glue diet was always promptly cured.—J. F. B.

Egg albumin; Distillation of —— under reduced pressure. A. Pictet and M. Cramer. Helv. Chim. Acta, 1919, **2**, 188—195.

THIS work was undertaken in order to throw light, if possible, on the origin of the aniline, pyridine, and quinoline found in animal oils, since these bear no known relationship to the proteins. Egg albumin, distilled under 22 mm. pressure, gives a very porous coke (32%), much water and gases, and only 15% of volatile organic compounds. These include the lower fatty acids and succinic acid, a primary base which may be a dihydroaniline, pyrrolic bases, indole, but chiefly isocapramide. The isolation of this amide shows the origin of the isocapronitrile which is one of the main ingredients in ordinary animal oil. (See further J. Chem. Soc., 1919, i., 227.)—J. C. W.

Food value of wine-making residues etc. Honcamp and Blanck. *See* XVIII.

PATENTS.

Bread and other food products, and process of producing same. R. Graham, Cupar, Fife. Eng. Pat. 123,883, 25.4.18. (Appl. 6971/18.)

A FOODSTUFF for addition to cereal flour is prepared as follows:— Dried edible tubers, such as potatoes, are ground to a flour and mixed with a proportion of malted cereal and warm water; the temperature of the mass is slowly raised to 145° F. (63° C.) and then quickly to 212° F. (100° C.), and kept at that point for ½—1 hr. until complete gelatinisation and conversion of starch has been effected, when it is lowered to 160° F. (71° C.). The tubers may be used also in their original state. To 61% of the malted material an equal amount of fine white flour and a little yeast are added, and the mass is kept at 75° F. (24° C.) for 4½ hrs. To the remaining 39% of the malted material is added more malted cereal, and the mixture is kept at 160° F. (71° C.) for ½ hr., when second-grade flour and yeast are added, and the mass kept at 80° F. (27° C.) for 1½ hr. The two sponges thus produced are kneaded together with salt to form a dough which is then baked. A whole-meal bread may be prepared in a similar manner.—J. H. J.

Grain; Method of treating —— for the preservation thereof, and apparatus employed in connection therewith. C. West, London. Eng. Pat. 123,925, 24.8.18. (Appl. 13,811/18.)

A SMALL proportion of the grain to be treated is slightly crushed, in order to release a small amount of gluten, and is then mixed with the main portion, the whole being sterilised at 140°—210° F. (60°—99° C.) by steam. After sterilisation the grain is fed into moulds on the rotating table of a hydraulic press where it is compressed into blocks and discharged on to an endless band conveyor in readiness for storage or transit.—J. H. J.

Potatoes; Manufacture of readily digestible, preserved ——. E. E. Wever, Barmen-Rittershausen. Ger. Pat. 309,446, 2.10.17.

POTATOES are cooked in their own moisture, then cut up finely and passed alternately over cold and hot surfaces whereby they are reduced to a pulp and partially dried, after which the mass is fully dried in the usual way.—J. F. B.

Baking powder; Preparation of a durable ——. K. F. Töllner, Bremen. Ger. Pat. 309,712, 14.4.17.

A CARBONATE is mixed with the finely powdered dried peel of *Aurantiaceæ*, such as lemons or oranges, which is used instead of the acid or acid salts

commonly employed. Part of the sodium bicarbonate is preferably replaced by magnesium carbonate. The action of the peel is attributed to the aldehydes, such as citral, and the terpenes contained therein, which form resins and acids during the drying of the peel.—J. F. B.

Baking powders, lemonade powders, etc.; Preparation of ——. O. Börner, Berlin-Südende. Ger. Pat. 309,933, 2.9.17.

The acids and acid salts usually employed are replaced either wholly or in part by urea phosphate. —J. H. J.

Bread; Manufacture of a concentrated ——. C. A. Heudebert, Nanterre, France. U.S. Pat. 1,293,772, 11.2.19. Appl., 25.10.16.

See Eng. Pat. 107,192 of 1916; this J., 1917, 1191.

XIXB.—WATER PURIFICATION; SANITATION.

Concentration of smokes. Disappearance of smoke. Tolman and others. *See* I.

Patents.

Water-softening material; Method of producing ——. G. H. Widner, Des Moines, Iowa. U.S. Pat. 1,294,007, 11.2.19. Appl., 10.3.17.

See Eng. Pat. 116,023 of 1917; this J., 1918, 440A.

Extracting grease. U.S. Pat. 1,293,738 *See* XII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Alkaloids and adrenaline; Application of Grimbert and Leclère's apomorphine reaction to ——. G. Denigès. Bull. Soc. Pharm., Bordeaux, 1918, **46**, 185. J. Pharm. Chim., 1919, **19**, 49.

The reaction described by Grimbert and Leclère for apomorphine (this J., 1915, 150) may be applied to morphine and adrenaline. A characteristic green coloration is obtained when a few mgrms. of morphine are heated with 3 drops of sulphuric acid until browning occurs, the mixture then treated with 5 c.c. of saturated sodium acetate solution and 2 drops of 4% mercuric chloride solution, and boiled. Pyrocatechol gives a red-violet coloration when boiled with sodium acetate and mercuric chloride solutions; the colouring matter is soluble in ether, chloroform, and particularly easily in amyl alcohol. Adrenaline (methyl-amino-propanol-pyrocatechol) gives a red coloration when treated with the reagents in the cold; if the mixture is heated above 50° C., the coloration may disappear if only a small quantity of adrenaline is present. The reaction is given by as little as 0·01 mgrm. of adrenaline.—W. P. S.

Saponins. I. E. Winterstein and M. Maxim. Helv. Chim. Acta, 1919, **2**, 195—203.

A preliminary account of an investigation into the nature of saponins and their hydrolytic products, the sapogenins. The saponin of the soap-berry (*Sapindus saponaria*) appears to be a mixture of glucosides which is partially hydrolysed to a mixture of pentosides ("initial sapogenins") by cold acids and then to a compound, $C_{28}H_{28}O_3$, m.pt. 319° C., by warm acids. This "end sapogenin" resembles the resins in many respects and gives naphthalene derivatives on oxidation. (See further, J. Chem. Soc., 1919, i., 214.)—J. C. W.

Nucleotides: Cleavage of —— by means of hot picric acid solution. Isolation of crystalline cytidine-phosphoric acid. Experimental studies on nuclein metabolism. VI. S. J. Thannhauser and G. Dorfmüller. Z. physiol. Chem., 1919, **104**, 65—72.

Hydrolysis of triphosphonucleic acid from yeast with hot picric acid yields cytidine-phosphoric acid which may be isolated in the form of the brucine salt, $C_9H_{14}O_8N_3P(C_{23}H_{26}O_4N_2)_2$, m.pt. 180°—182° C. The free cytidine-phosphoric acid, $C_9H_{14}O_8N_3P$, crystallises in monoclin-spheroidal crystals, m.pt. 227° C., $[\alpha]_D^{20} = +23{\cdot}63°$.—J. C. D.

Polymethylcyclohexenones of the irone type; Preparation of —— L. Ruzicka. Helv. Chim. Acta, 1919, **2**, 144—161.

In order to synthesise perfumes of the type of irone, it would seem desirable to set out from cyclohexenones in which the double bond is already in the right position, rather than to leave ring closure to a more advanced stage. Cyclohexenones of the desired type have been synthesised as follows: δ-ketonic esters are condensed with α-bromoisobutyric ester by Reformatzsky's method. The lactonic esters so formed are converted into unsaturated dicarboxylic acids or their esters by boiling with alcoholic hydrobromic acid, and the latter are condensed to cyclohexenones. The last stage is, however, so difficult of achievement on any satisfactory scale that further developments of the synthesis seem to be hopeless. (See further J. Chem. Soc., 1919, i., 209.) J. C. W.

Linalool; Synthesis of ——. L. Ruzicka and V. Fornasir. Helv. Chim. Acta, 1919, **2**, 182—188.

Methylheptenone, from citral (Verley, this J., 1897, 351), is dissolved in ether, mixed with sodamide, and submitted to a slow stream of acetylene when a good yield of dehydrolinalool, $(CH_3)_2C:CH.(CH_2)_2CCH_3(OH).C:CH$, is obtained. This is reduced to linalool by shaking with sodium and moist ether. (See further, J. Chem. Soc., 1919, i., 193.) J. C. W.

Wood of Juniperus oxycedrus and other conifers; Dry distillation of ——. R. Huerre. J. Pharm. Chim., 1919, **19**, 33—42, 65—79. (See also this J., 1915, 1164.)

True oil of cade was prepared by the distillation of the wood of *Juniperus oxycedrus*; a similar oil was also prepared by distilling the wood after the essential oil had been removed. The first oil contained 5% of substances soluble in dilute sodium hydroxide solution, whilst the other oil contained 10%. The portions of the oils insoluble in sodium hydroxide solution had the following characters:—Oil of cade: 60% distilled between 250° and 300° C.; saponif. value, 78; iodine value, 103·12. Oil from wood freed from essential oil: 50% distilled between 250° and 300° C.; saponif. value, 89; iodine value, 115·30. The oil of cade was the more volatile when steam-distilled, and the volatile portions also showed slight differences in their analytical values. *Oil of Virginian cedar (Juniperus virginiana).* The portion of this oil insoluble in dilute sodium hydroxide solution had an iodine value of 116·33, and 50% distilled between 250° and 300° C. *Oil of Lebanon cedar (Cedrus Libani).* 20% distilled between 200° and 250° C. and 60% between 250° and 300° C.; these two fractions had iodine values of 91·69 and 93·72, respectively.—W. P. S.

Acetaldehyde; Synthesis of —— from acetylene. T. Shoji. Kōgyō-Kwagaku Zasshi (J. Chem. Ind., Tokyo), 1919, **22**, 28—42.

A 2% solution of mercuric oxide in 25% sulphuric acid is found to be the best absorbent of acetylene,

the yield of acetaldehyde being 80—84%. The solution should be warmed at first but subsequently no external heating is necessary.—J. C. W.

Formaldehyde; Polymerisation of —— by alkalis. C. Mannich. Ber., 1919, 52, 160—162.

α-Polyoxymethylene has been obtained in 43% yield by keeping for 1 months a 30% solution of formaldehyde (almost free from methyl alcohol) containing 4% of anhydrous sodium carbonate. The presence of methyl or ethyl alcohol diminishes the yield. (See also J. Chem Soc., 1919, i., 196.)—C. S.

Acids from petroleum derivatives. Wegrzyn. *See* IIa.

Patents.

Diethyl and dimethyl ketones; Manufacture of ——. N. V. Sidgwick and B. Lambert, Oxford. Eng. Pat. 14,085, 5.10.15.

A practically quantitative yield of acetone or diethyl ketone may be obtained by passing the vapour of acetic or propionic acid over manganous oxide at 350° C. The acid may be used in its concentrated form or diluted to 20% strength with water. The catalyst is prepared by boiling pumice stone in a strong aqueous solution or suspension of manganous acetate or carbonate, and continuing the boiling until all the water is evaporated, but the temperature must not be allowed to rise above 200° C. at this stage unless air is excluded.—W. G.

Tanno-casein compound, and a process for the manufacture of the same. B. Abrahamsen, Trondhjem, Norway. Eng. Pat. 114,158, 12.3.18. (Appl. 4547/18.) Int. Conv., 12.3.17.

New tanno-casein compounds for medicinal use which are soluble with difficulty in weak acids, water, or gastric juice, but readily soluble in weak alkaline solutions, are prepared by adding a solution of tannin to an alkaline solution of casein, heating the mixture to about 50° C., preferably after the addition of acetic acid to neutralise the alkali, separating the resulting precipitate, and drying first at 50° C., and finally, when most of the water has been removed, at 100°—120° C. The product contains from 40 to 60% of tannin, according to the amount used in precipitating the casein.
—G. F. M.

Chlorination; Process of continuous two-phase ——. H. T. Boyd, Homer, Ohio, Assignor to Ohio Fuel Supply Co., Pittsburgh, Pa. U.S. Pat. 1,293,012, 4.2.19. Appl., 21.1.18.

Lower members of the paraffin series of hydrocarbons having more than one carbon atom are treated with chlorine in the liquid phase and the vapours from this chlorination are then treated with chlorine in the vapour phase in a separate reaction chamber.—G. F. M.

Chlorination; Apparatus and process involved in ——. K. Brown, Montclair, N.J., Assignor to Condensite Co. of America, Bloomfield, N.J. U.S. Pat. 1,294,230, 11.2.19. Appl., 17.5.17.

Two or three closed reaction vessels are connected together by pipes leading from the upper portion of one vessel to the lower portion of the next, the upper ends being provided with valves capable of being regulated from the exterior of the vessels. A gas-admission pipe leads to the lower part of the first vessel and an exit pipe from the upper part of the end vessel, and means are provided for forcing the liquid contents of each vessel into the one next preceding it, for introducing different liquids into the second and third vessels respectively, and for heating the vessels.—G. F. M.

Mercury catalysts; Method of regenerating ——. H. A. Morton, Pittsburgh, Pa., Assignor to Union Carbide Co., New York. U.S. Pat. 1,293,863, 11.2.19. Appl., 9.4.18.

The exhausted catalyst is treated with chlorine, mercuric chloride is recovered from the resulting mixture, and re-converted into the desired catalyst.
—G. F. M.

Nicotine from tobacco; Method of removing ——. R. Sayre and E. Yanovsky, Washington, D.C. U.S. Pat. 1,294,310, 11.2.19. Appl., 16.5.18.

Tobacco is immersed in an infusion containing all the normally soluble constituents, except nicotine, whereby the latter passes into solution. The tobacco is then removed and the infusion pressed out, leaving such an amount adhering to the tobacco as substantially to preserve the normal amounts of the soluble constituents, other than nicotine, in the tobacco. The amount of soluble matter contained in the infusion is determined by the ratio of the amount of solvent used to the amount left adhering to the tobacco, and after each operation the infusion is regenerated for further use by precipitating the nicotine with a reagent containing the tannic acid radical, and adding to it a quantity of water equal to the amount of liquid left adhering to the tobacco.—G. F. M.

Bromoamylbromoisovaleric ester; Preparation of ——. E. Rath, Frankfort. Ger. Pat. 309,455, 8.9.16.

Equimolecular quantities of bromoamylene hydrate and bromoisovaleryl bromide or chloride are heated on the water bath in the presence of an indifferent solvent until vapours of hydrogen bromide are no longer evolved. Bromoamylbromoisovalerate is a slightly yellow oil with a faint characteristic odour, somewhat resembling that of valerian root; it can be rectified under vacuum and may be utilised in pharmacy.—J. F. B.

Calcium caseinate; Preparation of a compound of iron glycerophosphate with ——. P. Hoerling, Berlin. Ger. Pat. 309,843, 11.2.17.

Iron glycerophosphate is dissolved in fresh milk and methyl alcohol is added which produces a light brown, bulky precipitate. The mixture is centrifuged and the sediment washed with methyl alcohol and dried, when it is obtained as a voluminous powder, almost completely soluble in water.
—J. H. J.

[*Acetone and butyl alcohol.*] Eng. Pat. 4845. *See* XVIII.

Butyric acid. Eng. Pat. 17,776. *See* XVIII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Absorption of water by gelatin. Shreve. *See* XV.

Patents.

Polychrome cinematography. Colour photography. A. Hamburger, London. Eng. Pats. (A) 123,786 and (B) 123,787, 3.12.17. (Appls. 17,881 and 17,882/17.)

(A) In the production of two-colour cinematograph films where a film coated on both sides is used for the formation of the two positives, both sides are

coloured simultaneously. Three methods are given for carrying out this process—(*a*) The double film is passed between two bands of absorbent material passing over rollers and kept moistened with the respective dye solutions. (*b*) The film is passed through a series of clamping frames so arranged as to make liquid-tight connections along the edges of the film and hold the required dye solutions in separate chambers in contact with the film on each side. (*c*) The film is passed between bands of dyed carbon or gelatin-coated paper. The dyeing operation may be preceded by or combined with a bleaching of the images, a suitable bath being a solution of copper sulphate, potassium bromide, and potassium ferricyanide. A convenient way of combining the bleaching and dyeing operations is by process (*c*), the dyed carbon or gelatin-coated paper being soaked in the bleaching solution before application to the film. (B) Methods *b* and *c* of the preceding patent are applied to single pictures, a special design of frame for process *b* being described. The method may be extended to three-colour pictures, the two-colour film obtained in this way being combined in register with a third, preferably yellow, positive.—B. V. S.

[*Photographic*] *light-filter*. H. T. Clarke, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pat. 1,293,039, 4.2.19. Appl., 1.7.18.

A STABLE yellow light-filter, having a sharp-cut absorption in the blue-violet and a sustained absorption in the ultra-violet, is obtained by dyeing gelatin film with sodium glucosephenylosazone-*p.p'*-dicarboxylate. (See also this J., 1919, 118 A.)—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Primers for explosives; Modern ——. *I. Silver acetylide*. A. Stettbacher. Z. ges. Schiess- u. Sprengstoffw., 1916, **11**, 1—4. Chem. Zentr., 1919, **90**, II., 126—127.

ACETYLENE precipitates from an ammoniacal silver solution a grey-white substance which probably has the composition Ag_2C_2, whilst the product obtained by passing acetylene through a neutral or slightly acid (nitric) solution of silver nitrate almost certainly contains oxygen and may be a double compound of silver acetylide and silver nitrate. The former product is far inferior to the latter in explosive properties. When heated or ignited it explodes with a dull report with liberation of carbon. Its brisance is low. It does not explode, but dissolves with evolution of acetylene when mixed with concentrated sulphuric acid or fuming nitric acid. It is very sensitive to flame and more sensitive than mercury fulminate to shock and friction. As a detonator it is inferior to mercury fulminate, and has a tendency, moreover, to become extremely sensitive to shock and pressure when in contact with organic nitro-compounds. The products obtained from neutral and slightly acid solutions are apparently identical in their explosive properties. When ignited, they explode with a clear, sharp, report. They have high brisance, and tests made on iron plates show them to be equal to silver fulminate and silver azide. As detonators they do not equal the azides but have four times the power of mercury fulminate.—T. St.

Mercury fulminate and some of its impurities. P. Nicolardot and J. Boudet. Bull. Soc. Chim., 1919, **25**, 119—122.

SODIUM or ammonium thiosulphate in 5% aqueous solution dissolves mercury fulminate rapidly and completely, whilst leaving the impurities which it commonly contains undissolved. In these solutions the fulminate may be estimated by Heaven's method (this J., 1918, 143 T). These solvents are more satisfactory than 5% aqueous potassium cyanide. For the recovery of mercury from the residues from the manufacture of mercury fulminate the following process is recommended. The residues are extracted at 50° C. with a 15% solution of sodium thiosulphate (using 20 litres per kilo. of residue). The solution is acidified with sulphuric acid and boiled, whereby the whole of the mercury is precipitated in the form of sulphide, which is separated and distilled with lime, metallic mercury passing over.—W. G.

Nitrocellulose; Transformations of ——. A. Angeli. Atti R. Accad. Lincei, 1919 [v], **28**, I., 20—24.

THE action of pyridine on nitrocellulose yields a white, amorphous substance which contains 9—10% of nitrogen and forms very stable colloidal aqueous solutions. (See J. Chem. Soc., 1919, i., 196.)—T. H. P.

PATENTS.

Picric acid; Manufacture of ——. L. G. Badler and L. B. Holliday, Huddersfield. Eng. Pat. 9962, 8.7.15.

1.2.4-DINITROPHENOL, obtained from commercial 1.2.4-chlorodinitrobenzene, is mixed with 98% sulphuric acid, and a mixture of nitric and sulphuric acids added. The mixture is allowed to stand for about 12 hours and is then added to cold water. The picric acid is filtered off, washed with cold water, centrifuged, and dried.—T. St.

Trinitro compound; Process of producing —— *from phenol*. R. L. Datta and P. S. Varma, Calcutta, India. U.S. Pat. 1,292,266, 21.1.19. Appl., 17.8.16.

A PHENOL is sulphonated, and after removing all traces of unchanged phenol, the product is treated with nitrous gases with the formation of a trinitrophenol, which is then separated.—L. A. C.

Explosive; High . E. I. Pronk and F. E. W. Bowen, London. Eng. Pat. 10,865, 27.7.15.

THE explosive contains as essential constituents ammonium perchlorate and calcium or barium silicide. Other materials are added according to requirements, a suitable mixture consisting of ammonium perchlorate 75, calcium silicide 15, and paraffin wax 10%. Nitro-hydrocarbons may be added to render detonation more rapid, and alkali nitrates may be substituted for a part of the perchlorate to reduce the amount of gaseous chlorine compounds formed.—T. St.

[*Explosive mixtures*]; *Apparatus for solidification or evaporation* [*of* ——]. F. I. Du Pont, Wilmington, Del., Assignor to E. I. du Pont de Nemours and Co. U.S. Pat. 1,284,074, 5.11.18. Appl., 16.9.13.

THE apparatus comprises two concentric conical rotary drums with a thin partition between them. The material under treatment passes along a spiral groove on the outer face of the inner drum and a heating or cooling agent along a corresponding groove on the inner face of the outer drum. Both the heating or cooling agent and the material are discharged at the larger ends of the respective drums.

Smokeless powder; Process for recovering solvent from ——. F. I. du Pont, Assignor to Delaware Chemical Engineering Co., Wilmington, Del. U.S. Pat. 1,294,066, 11.2.19. Appl., 4.1.17.

THE solvent, *e.g.* alcohol and ether, is gradually evaporated, and only a portion of the vapours condensed, the remainder of the uncooled vapours being returned to the material.—C. A. M.

Waste acids; Recovery or utilisation of the —— left adhering mechanically to pulped nitrocellulose. J. Umbach, Kandern. Ger. Pat. 309,936, 1.3.18.

THE nitrocellulose, after centrifuging or pressing, is agitated with a solution of an alkali, such as ammonia, and the mixed ammonium sulphate and ammonium nitrate so obtained are either used direct as a fertiliser or are separated by fractional crystallisation. Up to 95% of the acid remaining with the nitrocellulose can be thus recovered in the form of salts.—T. St.

XXIII.—ANALYSIS.

Indicators; Colloid chemistry of ——. II. Wo. Ostwald. Kolloid-Zeits., 1919, **24**, 67—69.

CONGO-RUBIN (sodium salt of benzidine-bis-azo-β-naphthol sulphonaphthionic acid) in aqueous solution is a highly disperse system, intermediate between that of a true colloid and a molecular disperse system. It is negatively charged and has a red colour which is changed to blue by the addition of acids, a large number of neutral salts, by alkaline salts such as sodium carbonate, and by bases like barium hydroxide. The blue solutions, on dilution with large volumes of water, elevation of the temperature or addition of alcohol, acetone or pyridine, become red. A further addition of an electrolyte to the blue solution causes a precipitation of the coloured substance, which on washing with water passes into solution as a blue to violet hydrosol. The blue solutions are less highly disperse than the red solutions, and on standing deposit a slight precipitate leaving a red solution. The red solutions contain a still more highly disperse orange coloured fraction.—J. F. S.

Bases and acids; New reagent for — —. M. Chauvierre. Bull. Soc. Chim., 1919, **25**, 118—119.

A FILTERED aqueous extract of red beetroot is a violet-red, opalescent liquid, which turns deep yellow in the presence of alkalis, and retains its colour in the presence of either mineral or organic acids. It is sensitive to sulphuric acid containing 1 part of acid in 10,000 of water. Test-papers cannot be prepared from it as it does not dye paper.
—W. G.

Tyndallmeter for the examination of disperse systems. R. C. Tolman and E. B. Vliet. J. Amer. Chem. Soc., 1919, **41**, 297—300.

AN instrument for measuring the strength of a Tyndall beam in suspensions, colloidal solutions, smoke, and mists is described. It consists of a 6—8-volt lamp, a condensing lens, and a diaphragm through which the beam of light enters the chamber containing the gas or solution. The strength of the beam is then determined by a Macbeth illuminometer which has been standardised with either a suspension of finely divided silica or an opaque glass.—J. F. S.

Ultramicroscopic particles; Method of measuring the size of ——. P. V. Wells and R. H. Gerke. J. Amer. Chem. Soc., 1919, **41**, 312—329.

THE size of ultramicroscopic particles suspended in air can be measured by bringing the particles (*e.g.* smoke) into the field of an ultramicroscope which lies in a rapidly alternating electrostatic field and photographing the path of the particles. The diameter is calculated from the amplitude of the oscillation. Smoke particles have diameters varying between 5×10^{-6} cm. and 10^{-4} cm. (See also J. Chem. Soc., May, 1919.)—J. F. S.

Arsenious oxide as a standard substance in iodimetry. R. M. Chapin. J. Amer. Chem. Soc., 1919, **41**, 351—358.

FROM a series of accurate volumetric experiments it is shown that arsenious oxide is a more reliable substance than iodine as a standard in iodimetry.
—J. F. S.

"Dracorubin" and "dracorubin capillary" tests for identifying and differentiating colourless liquids. K. Dieterich. Ber. Deuts. Pharm. Ges., 1918, **28**, 449—492.

"DRACORUBIN" is the name given to the portion of Sumatra palm resin (palm dragon's blood) which is insoluble in boiling light and heavy petroleum spirit. Test-papers are prepared by dipping strips of filter-paper, 7 by 1 cm., in an alcoholic or benzene solution of "dracorubin"; the strips are then dried. The test is carried out as follows:—A stoppered cylinder, 10 cm. high and 3 cm. in diam., is nearly filled with the liquid to be tested and 4 strips of the paper are introduced; the appearance of the liquid is observed during the first 15 mins., the tube is then shaken, set aside for 24 hrs., and the papers removed. Various organic liquids have a different solvent action on the "dracorubin" and the coloration of the liquid and of the papers at the end of the test affords a means of identifying the liquid. For example, light petroleum spirit does not dissolve the substance and remains colourless; if the petroleum spirit contains a trace of benzene or alcohol, a red liquid is obtained. The coloration of the liquid and the appearance of the paper vary with the nature of the liquid under examination; these are described for such liquids as petroleum, benzene, formaldehyde solution, chloroform, turpentine, ether, ethyl acetate, toluene, xylene, carbon bisulphide, acetone, amyl alcohol, etc. In the "capillary" test, the paper is immersed to a depth of only 1 cm. in the liquid.
—W. P. S.

Glucinum in beryl. Copaux. *See* VII.

Reagent for ozone. Benoist. *See* VII.

Marking glass. Bock. *See* VIII.

Glycerol. Grün and Wirth. *See* XII.

Cuprie-sodium hydroxide reagent. Justin-Mueller. *See* XVII.

Striegler's reagent. Brouwer. *See* XVII.

Diastatic power. Wilson and Minchin. *See* XVIII.

Non-protein nitrogen in milk. Denis and Minot. *See* XIXA.

Lactose in milk. Salomon and Diehl. *See* XIXA.

Galapiezometer. Le Roy. *See* XIXA.

Nitrogen distribution in seeds. Brewster and Alsberg. *See* XIXA.

Feeding stuffs. Eckstein and Grindley. *See* XIXA.

Alkaloids and adrenaline. Denigès. *See* XX.

PATENTS.

Testing apparatus [for flue-gases]. F. B. Gilbert, Chicago, Ill. U.S. Pat. 1,282,409, 22.10.18. Appl., 14.8.16.

THE apparatus consists of a vessel provided with a gas inlet and outlet and containing a quantity of alkali solution covered with a layer of mineral oil. The oil prevents the gas under examination from coming in contact with the alkali whilst air is being displaced from the vessel. When the vessel is filled with the gas, it is shaken so as to bring the gas in contact with the alkali, and the diminution of pressure due to absorption of carbon dioxide is read on a pressure-gauge.

Gliding dialysis; Apparatus for carrying out ——. H. Thoms, Berlin-Steglitz. Ger. Pat. 309,809, 25.8.17.

THE dialysing membrane is arranged vertically between the two chambers filled with liquid, and carried on a rotating horizontal shaft. The liquids thus rest on the walls of the chambers instead of on the membrane. Considerably larger dialysing surfaces and quantities of liquid can be used without danger of bursting the membrane. (See also this J., 1918, 190 A.)—B. V. S.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Adams. Apparatus for heating and cooling fluids. 9851. Apr. 17.

Aktiebolaget Ljungströms Angturbin. Air-cooled condensers. 9500. Apr 14. (Sweden, 15.4.18.)

August. Treating liquid and solid bodies for heating, calcining, vaporising, or decomposing them. 9912. Apr. 22.

Ayrton and Sheppard. Cooling or heating means. 9781. Apr. 16.

Belton. Air or gas heating-apparatus. 9598. Apr. 15.

Boyd and Wilson. Continuous-shaft kiln. 10,380. Apr. 26.

Briggs. Apparatus for heating and boiling liquids. 10,144. Apr. 23.

British Thomson-Houston Co. (General Electric Co.). Controlling chemical reactions. 10,150. Apr. 23.

Camell, Cochet, Gritte, and Soc. Lyonnaise des Rechauds Catalytiques Camell, Cochet, Gritte, et Cie. Apparatus for heating by catalysis. 10,075. Apr. 22.

Collins. Furnaces for steam-generators, kilns, etc. 9738. Apr. 16.

Cruyt. Method of utilising heat of waste furnace gases etc. 10,356. Apr. 25.

Handel. Disintegrators. 10,210. Apr. 24.

Harrison. 9639. *See* II.

Heeley. Distillation furnaces. 10,174. Apr. 23.

Jenkins. Absorption of gases, and its application to vacuum flasks for storing low-temperature liquids. 9642. Apr. 15.

Kilburn (Sulzer Frères). Refrigerating-apparatus. 10,187. Apr. 23.

Laird. Centrifugal machines. 9785. Apr. 17.

Lodge Fume Deposit Co., Lodge, and Lodge. Electrical deposition of particles from gases. 9489. Apr. 14.

McLean. Furnace control. 9878. Apr. 17.

Pease. Subdivision and treatment of fluids. 9467. Apr. 14.

Pedersen. Separating liquid mixtures or emulsions. 10,061. Apr. 22. (Denmark, 20.4.18.)

Priest. Muffle and semi-muffle etc. furnaces. 10,439. Apr. 26.

Rennison. Reversible gas-heated furnaces. 10,307. Apr. 25.

Rouse. Device for transmitting heat from one fluid or vapour to another. 9901. Apr. 17.

Rouse. Air heating devices. 9902. Apr. 17.

Smith. Furnace retorts. 9768. Apr. 16. 9819. Apr. 17. (U.S., 9.9 and 9.5.18.)

Stokes. Refrigerating-apparatus. 10,035. Apr. 22.

Young and Young. Grinding-machines for vegetable products. 9733. Apr. 16.

COMPLETE SPECIFICATIONS ACCEPTED.

6652 (1916). Nobel's Explosives Co., Lyall, Wilson, O'Connor, and McKillop. Feed control of nitrating, mixing, and similar apparatus. (125,094.) Apr. 24.

6949 (1916.) West. Cooling-apparatus. (125,101.) Apr. 24.

9928 (1916). Chance and Hunt, Holley, and Mott. Apparatus for the treatment of one liquid with another. (125,426.) Apr. 30.

246 (1918). Garbutt, and British Carbonizing Co. Rotary furnaces. (125,484.) Apr. 30.

1493 (1918). Tilstone and Tilstone. *See* VIII.

6229 (1918). Smallwood. Furnaces. (125,224.) Apr. 24.

6408 (1918). Sturgeon. Centrifugal separators. (125,502.) Apr. 30.

6434 (1918). Pollak (Toronto Type Foundry Co.). Grinding-machines. (125,503.) Apr. 30.

6613 (1918). Alexander. Apparatus or kilns for drying granular, pulverulent, and pasty materials. (125,235.) Apr. 24.

6804 (1918). Smallwood. Furnaces. (125,515.) Apr. 30.

7832 (1918). King, Gregson, and Taudevin Gregson, Ltd. Gas-heated furnaces. (125,258.) Apr. 24.

10,050 (1918). Dunker. Apparatus for treating air or other gases. (125,280.) Apr. 24.

13,557 (1918). Mason. Filter presses. (125,304.) Apr. 24.

21,529 (1918). Draper. Separators for the treatment of coal, clays, ores, and the like. (125,344.) Apr. 24.

1284 (1919). Van Rede. Roller mills. (123,063.) Apr. 24.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Asseretо. Combustion of solid pulverised fuel. 10,175. Apr. 23.

Atkinson, and Powdered Fuel Plant Co. Combustion of powdered fuel. 9893. Apr. 17.

Berglund. 9903. *See* X.

Bilefeld. Incandescent electric lamps. 10,241. Apr. 24.

British Thomson-Houston Co. (General Electric Co.). Incandescent lamps etc., and manufacture of same. 9865. Apr. 17.

Camell and others. 10,075. *See* I.

Combustion Improvements, Ltd. (Surface Combustion, Inc.). Combustion of explosive gaseous mixtures. 10,323. Apr. 25.

De Ayestaran. Process for effecting agglomeration of coals. 10,237. Apr. 24.

Forwood and Taplay. Treatment of hydrocarbons. 9722. Apr. 16.

Freedman. Electric arc lamps. 9704. Apr. 16.

Grainger and Shadbolt. 9784. *See* VII.

Harrison. Apparatus for washing coal, coke, sand, etc. 9639. Apr. 15.

Hauser. Retort ovens for distillation of fuels and bituminous ores. 9970. Apr. 22. (Spain, 20.4.18.)

Heeley. 10,174. *See* I.

Olsson. Treatment of peat. 9756. Apr. 16.

Rennison. 10,307. *See* I.

Rock. Extracting hydrocarbons from coal etc. 9686. Apr. 16.

Sedcole. Apparatus for distilling carbonaceous material. 10,447. 10,448. Apr. 26.

Stafford. Process of destructive distillation. 9491. Apr. 14.

Swinburne. Low-temperature distillation. 9987. Apr. 22.

Wiltshire. Gas-producer plants for vehicles, locomotives, aircraft, etc. 10,092. Apr. 22.

COMPLETE SPECIFICATIONS ACCEPTED.

7286 (1916). Maxted and Ridsdale. *See* VII.

9181 (1916). Maxted. *See* VII.

10,479 (1916) and 798 (1917). Roxburgh, Sanderson, and Sanderson. Manufacture of charcoal from wood. (125,439.) Apr. 30.

4203 (1918). Toogood, and Dempster and Sons. Heating of horizontal retorts for gas production. (125,189.) Apr. 24.

5917 (1918). British Thomson-Houston Co. (General Electric Co.). Vacuum electric discharge apparatus for lighting. (125,201.) Apr 24.

6313 and 8438 (1918). Rew. Carbonisation of coal and similar carbonaceous substances. (125,496.) Apr. 30.

6427 (1918). Tai-Koo Sugar Refining Co. (Obrembski and Resker). Process for the production of decolorising carbon. (125,230.) Apr. 24.

7698 (1918). Soddy. Method of stripping the illuminants from and of purifying coal-gas by means of charcoal. (125,253.) Apr. 24.

7803 (1918). Arkell. Artificial fuels, and processes for manufacturing the same. (125,256.) Apr. 24.

7832 (1918). King and others. *See* I.

8624 (1918). Wise. Distilling oil from coal and the like. (125,528.) Apr. 30.

10,050 (1918). Dunker. *See* I.

21,529 (1918). Draper. *See* I.

III.—TAR AND TAR PRODUCTS.

APPLICATION.

Forwood and Taplay. 9722. *See* II.

COMPLETE SPECIFICATIONS ACCEPTED.

10,885 (1916). Hird. Process for extracting tar acids or phenols from coal or wood tar or coal or wood tar oils in the distillation or vaporisation of same. (125,445.) Apr. 30.

12,014 (1918). Soc. d'Eclairage, Chauffage, et Force Motrice. Production of high-percentage anthracene. (119,855.) Apr. 24.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

Davies. Manufacture of dyes. 10,247. Apr. 24.

MacLaurin. Manufacture of dyes. 10,246. Apr. 24.

COMPLETE SPECIFICATIONS ACCEPTED.

8773 (1916). Baxter. *See* XXII.

11,411 (1916). Ramy. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

De Cew and Marx. Treatment of paper pulp. 9576. Apr. 15.

Farrell. Textile etc. drying cylinders. 9681. Apr. 16.

COMPLETE SPECIFICATION ACCEPTED.

6587 (1916). Cochrane. Production of fabrics having the property of invisibility. (125,093.) Apr. 24.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Gatty. Dyeing on vegetable fibres, yarns, and fabrics. 9708. Apr. 16.

Lomax. Finishing or lustring textile fabrics. 9532. Apr. 15.

Poulson. Sizing textile fabrics etc. 9656. Apr. 16.

COMPLETE SPECIFICATIONS ACCEPTED.

7547 and 7826 (1918). Robertson. Printing woven fabrics. (125,251 and 125,257.) Apr. 24.

13,381 (1918). Hindle. Printing woven fabrics. (125,302.) Apr. 24.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Ashcroft. Manufacture of anhydrous magnesium chloride and anhydrous calcium chloride. 10,146. Apr. 23.

Ashcroft. Manufacture of oxides or salts of tungsten or metallic tungsten from substances containing tungsten. 10,147. Apr. 23.

Ashcroft. Manufacture of oxides or salts of metals, or of metals, or of non-metals, or of compounds of non-metals from ores, minerals, intermediate products, residues, wastes, etc. 10,148. Apr. 23.

Ashcroft. Manufacture of aluminium or its oxides or salts from materials containing aluminium. 10,149. Apr. 23.

Bloomfield, Boake, Roberts and Co., and Durrans. Method for manufacture of sulphuryl chloride. 9479. Apr. 14.

Boake, Roberts and Co., and Durrans. Method for manufacture of sulphuryl chloride. 9480. 9481. Apr. 14.

Grainger and Shadbolt. Manufacture of ammonium sulphate. 9784. Apr. 16.

Marks (Armour Fertilizer Works). Production of aluminium nitride etc. by electrically-generated heat. 9492. Apr. 14.

Mellersh-Jackson (Air Reduction Co.). Manufacturing cyanides. 10,188. Apr. 23.

Morel. Production of basic sulphate of chrome and its application to tanning etc. 10,074. Apr. 22.

Tyrer. Treatment of aluminiferous materials to obtain alumina etc. 9621. Apr. 15.

COMPLETE SPECIFICATIONS ACCEPTED.

7286 (1916). Maxted and Ridsdale. Manufacture of hydrogen. (125,112.) Apr. 24.

9481 (1916). Maxted. Manufacture of hydrogen. (125,410.) Apr. 30.

10,852 (1916). Cocking, and Kynoch, Ltd. Manufacture of nitric acid and ammonium sulphate. (125,444.) Apr. 30.

11,036 (1916). Bensa. Process for the production of alkaline nitrates by oxidation of ammonia. (125,453.) Apr. 30.

14,614 (1918). Gill (Fansteel Products Co.). *See* X.

14,756 (1918). Dawson. Process for the production of sodammonium sulphate from nitre-cake or other acid sodium sulphates. (125,311.) Apr. 24.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Hughes. Apparatus for annealing glass. 9960 Apr. 22.

Marks (Fours et Procédés Mathy Soc. Anon.). Glass ovens or furnaces. 9496. Apr. 14.

Sharp (Willmer). Pots or crucibles for melting glass or metals. 10,145 Apr. 23.

COMPLETE SPECIFICATIONS ACCEPTED.

4493 (1918). Tilstone and Tilstone. Fuel-economiser or heat-regulator for ovens and kilns for firing pottery and the like. (125,486.) Apr. 30.

21,529 (1918). Draper. *See* I.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Andouard. 9911. *See* XIII.

Bell's United Asbestos Co., Cann, and Hurden. Manufacture of slabs or blocks for buildings etc. 9578. Apr. 15.

Dale. Concrete. 9678. Apr. 16.

COMPLETE SPECIFICATION ACCEPTED.

6248 (1918). Kelsey. Waterproof compound or preparation for roofing and other purposes. (125,492.) Apr. 24.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Ashcroft. 10,147. 10,148. 10,149. *See* VII.

Berglund. Apparatus for sintering concentrates distilling slate, etc. 9903. Apr. 17.

Berry. Copper alloy. 10,358. Apr. 25. (U.S., 13.8.18.)

Bowen and Marino. Electrolytic process for coating iron or steel with lead or antimony or alloy of lead and antimony. 10,314. Apr. 25.

Comp. d'Applications Mécaniques. Steel for manufacture of ball and roller bearings etc. 10,141. Apr. 23. (France, 2.5.18.)

Cunningham, and Stein and Atkinson. Furnaces for heat treatment of metals. 10,132. Apr. 23.

Evans, Marquis, and Schader. Process of extracting copper from ores and refining crude copper. 10,037. Apr. 22.

Hauser. 9970. *See* II.

Jackson. Production of iron. 10,333. Apr. 25.

Le Chatelier. 9483. *See* XI.

Mumford, and Mumford, Ltd. Alloy, and method of making and using same. 9460. Apr. 14.

Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Metallurgical processes. 10,131. Apr. 23. (Norway, 15.5.18.)

Park. Machine for separating minerals from ore-bearing materials. 9510 Apr. 14.

Sharp (Willmer). 10,145. *See* VIII.

Speer. Chrome nickel steel. 10,338. Apr. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

7562 (1916). Annable, and Nickel Concentration, Ltd. Extraction of nickel from silicate ores. (125,119.) Apr. 24.

8655 (1916). Hadfield. Manufacture of manganese steel. (125,157.) Apr. 24.

3825 (1918). Alexander, Vint, and Imbery. Means for and method of hardening and tempering steel or other metal wire. (125,180.) Apr. 24.

5117 (1918). Frankignoul. Blast furnaces. (125,194.) Apr. 24.

11,148 (1918). Mooney. Treating steel for aircraft. (125,544.) Apr. 30.

11,553 (1918). Cliff. Puddling, reheating and similar metallurgical furnaces. (125,546.) Apr. 30.

14,611 (1918). Gill (Fansteel Products Co.). Treatment and circulation of hydrogen in connection with the reduction of tungsten trioxide. (125,310.) Apr. 24.

21,529 (1918). Draper. *See* I.

XI.—ELECTRO CHEMISTRY.

APPLICATIONS.

Bowen and Marino 10,314 *See* X.

Campbell, Gifford, Taylor, Waite, and Campbell, Gifford and Waite. Control of power absorbed in electric furnace. 10,357. Apr. 25.

Dekker. Process of electrolysis. 10,155. Apr. 23.

Ivey and Salisbury. Battery cells. 10,006. Apr. 22.

Le Chatelier. Electrodes for electric welding. 9483. Apr. 14.

Lodge Fume Deposit Co., and others. 9489. *See* I.

Marks (Armour Fertilizer Works). 9492. *See* VII.

Marks (Armour Fertilizer Works). Polyphase electric heating-furnaces. 10,053. Apr. 22.

Marsh. Electrolytic cells. 10,116. Apr. 23.

Oldham and Oldham. Galvanic batteries. 10,208. Apr. 24.

Roberts. Electric batteries. 9583. Apr. 15.

Teixeira. Electric furnaces. 9924. Apr. 22.

Withers (National Electro-Products, Ltd.). Apparatus for electrolysing liquids. 10,179. Apr. 23.

COMPLETE SPECIFICATIONS ACCEPTED.

3726 (1918). Bibby. Electric furnaces. (125,170.) Apr. 24.

6256 (1918). Brush Electrical Engineering Co., and Sutton. Electric resistances. (125,225.) Apr. 24.

6875 (1918). Wielgolaski. Electric arc furnaces. (125,516.) Apr. 30.
7727 (1918). Armelin. Electric dry batteries. (125,254.) Apr. 24.
7957 (1918). Gow and Campbell. Control of power absorbed in electric furnaces. (125,522.) Apr. 30.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Cooper. Apparatus for treating bones etc. for recovery of fats, oils, etc. 9437. Apr. 14.
Dave. Manufacture of castor oil. 9843. Apr. 17.
Force. Detergent compound. 10,094. Apr. 22. (U.S., 19.4.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

6170 (1918). Feldenheimer and Plowman. Saponaceous compositions, and the process of manufacturing the same. (125,491.) Apr. 30.
18,032 (1918). Schuck, and Superior Oil and Process Co. Process of separating liquid fats or oils from solid fatty materials. (125,327.) Apr. 24.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Audouard. Production of coatings for paint or cement etc. 9911. Apr. 17. (France, 27.11.13.)
Boake, and Boake, Roberts, and Co. Preparation and manufacture of dopes, varnishes, etc. 9751. Apr. 16.
Jones. Violin varnish. 9435. Apr. 14.
Lillie. Paints and antifouling etc. substances. 9433. Apr. 14.
Marter and Raw. 10,121. *See* XIV.

COMPLETE SPECIFICATION ACCEPTED.

369 (1919). Kohler. Process of producing colophony of high quality from old natural resin of conifers. (122,407.) Apr. 24.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATION.

Marter and Raw. Non-inflammable and plastic composition. 10,121. Apr. 23.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATIONS.

Couch. Manufacture of patent leather etc. 9782. Apr. 16.
Hefford and Hefford. Leather. 10,417. Apr. 26.
Morel. 10,074. *See* VII.

XVI.—SOILS; FERTILISERS.

COMPLETE SPECIFICATION ACCEPTED.

14,756 (1918). Dawson. *See* VII.

XVII.—SUGARS; STARCHES; GUMS.

APPLICATIONS.

Baker and Sons, Bradley, Carr, Peek, Frean, and Co., and Rowntree and Co. Treatment of sugar. 9826. Apr. 17.
O'Gorman and Schryver. Manufacture of adhesives. 9874. 9875. Apr. 17.

COMPLETE SPECIFICATIONS ACCEPTED.

6427 (1918). Tai-Koo Sugar Refining Co. (Obrembski and Resker). *See* II.
18,068 (1918). Barker. *See* XIX.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Franks. Process of preserving organic substances. 10,315. Apr. 25.
Kershaw. Refuse-destructors etc., and production and treatment of a fluid slag therefrom. 9854. Apr. 17.
Lillie. 9433. *See* XIII.
Naami. Vennoots. A. Jurgens' Vereenigde Fabrieken. Manufacture of artificial milk products. 10,176. Apr. 23. (Holland, 18.6.18.)
Thomson. Process for reduction of animal flesh in preparation of foods and medicinal animal extracts. 9610. Apr. 15.

COMPLETE SPECIFICATIONS ACCEPTED.

11,263 (1917). Stevens and Baumann. Milk food products and methods of making the same. (125,172.) Apr. 24.
18,068 (1918). Barker. Production of pectous substances. (125,330.) Apr. 30.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Loo. Manufacture of organic compounds and their condensation products. 9537. Apr. 15.
Marks (New Jersey Testing Laboratories). Alcohols etc. and process of making same. 10,050. Apr. 22.
Thomson. 9610. *See* XIX.

COMPLETE SPECIFICATIONS ACCEPTED.

8635 (1916). Cross and Dreyfus. Processes of hydrolysis or saponification of esters. (125,153.) Apr. 24.
483 (1918). Zollinger. Process for the production of polyoxy fatty acid esters. (112,624.) Apr. 24.
7119 (1918). Blanc. Manufacture of aromatic aldehydes. (115,244.) Apr. 24.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

COMPLETE SPECIFICATION ACCEPTED.

5810 (1918). Burnett. Negative plate substitutes for radio-photography. (125,490.) Apr. 30.

XXII.—EXPLOSIVES; MATCHES.

COMPLETE SPECIFICATIONS ACCEPTED.

6523 (1916). Baxter. Manufacture of nitroglycerine. (125,091.) Apr. 24.
6652 (1916). Nobel's Explosives Co., and others. *See* I.
7203 (1916). Dreyfus. Process for the purification of trinitrotoluene and such like bodies. (125,110.) Apr. 24.
7857 (1916). Johnson. Manufacture of explosives. (125,128.) Apr. 24.
8234 (1916) Chance and Hunt, Holley, and Mott. Process for the washing of trinitrotoluene and other nitro compounds (125,140.) Apr. 24.
8773 (1916). Baxter. Manufacture of picric acid and other products of nitration. (125,160.) Apr. 24.
11,411 (1916). Ramy. Process for manufacturing picric acid. (125,461.) Apr. 30.
8623 (1917). Du Pont de Nemours and Co. Propellant explosives. (125,482.) Apr. 30.

I.—GENERAL; PLANT; MACHINERY.

Selenium and its applications. Ancel. *See* VII.

PATENTS.

Drying sand and similar granular material; Apparatus for ——. G. F. W. Hope, Leigh-on-Sea. Eng. Pat. 124,244, 20.2.18. (Appl. 3054/18.)

THE material is delivered from a hopper on to perforated shelves hinged to the wall of a horizontal rotating drum. As the drum is rotated the hinged shelves drop to the side and any lumps formed are broken by beaters attached to the shaft of the drum. The outer ends of the beaters rest on angle-pieces attached to the shell of the drum, so that they are raised as the drum rotates until their outer ends slip off the angles and they fall back and crush any lumps they meet. The partly dried material is delivered from the lower part of the drum on to a series of heated vibrating drying plates.—W. H. C.

Dryer. A. F. Sinclair, New York U.S. Pat. 1,294,547, 18.2.19. Appl., 16.9.16.

A ROTARY drying cylinder is connected at one end with a furnace, and at the opposite end with a chimney. The furnace flame is prevented from entering the cylinder by means of a series of spaced screens of graded mesh, the screen nearest the furnace being the coarsest and that farthest from the furnace the finest.—S. S. A.

Crushing and drying machine. J. G. Hopper, Paris. Eng. Pat. 120,931, 22.11.18. (Appl. 19,253/18.) Int. Conv., 25.7.17.

Two metal discs, slightly concave, are arranged with their concave sides facing one another in a horizontal plane and are mounted on vertical shafts so as to rotate in opposite directions, or at different speeds in the same direction. The material is fed from a hopper through the hollow shaft of the upper disc into the space between the discs, the opposing faces of which are grooved or fluted to crush the material. The crushed material leaves the annular opening at the edges of the discs and is thrown by centrifugal force against a concentric cylindrical strainer which is vibrated rapidly. Any water separated from the material passes through the strainer, whilst the solid material falls into an annular receiver at the bottom of the strainer.
—W. F. F.

Grinding mills. E. Newell and Co., Ltd., and G. L. Woodhouse, Misterton. Eng. Pat. 124,930, 25.4.18. (Appl. 6960/18.)

A HORIZONTAL ball mill is divided into two compartments by a transverse partition. The material to be ground is fed through the hollow trunnion into the first compartment and after being ground passes through perforations in the circumferential stepped grinding plates to a cylindrical sieve plate which surrounds the grinding plates. The finer particles pass through the sieve into an annular space between the sieve plate and the outer shell, and the coarser particles are returned between the stepped grinding plates to be re-ground. The fine particles in the annular space are carried forward by helical conveyor ploughs and discharged through an aperture in the transverse partition into the second compartment, where the grinding is completed.
—W. H. C.

Comminuting mill. R. C. Newhouse, Wanwatosa, Wis., U.S.A. Eng. Pat. 125,012, 30.9.18. (Appl. 15,856/18.)

A HORIZONTAL ball mill rotated on hollow trunnions is divided into two compartments by an adjustable transverse partition. The material to be ground is fed through the hollow trunnion at one end into the first compartment and is ground by the action of the balls. The finer portions pass through an adjustable annular screen, formed of horizontal bars, supported near the partition, are lifted by a spiral elevator blade in the space between the screen and the shell, and are discharged into the second chamber where final grinding takes place. When ground sufficiently, the particles pass through a second transverse screen at the far end of the cylinder and are discharged through the other hollow trunnion. W. H. C.

Pulverising and separating machine. W. H. Berry, Chester, Pa. U.S. Pat. 1,292,686, 28.1.19. Appl., 11.10.17.

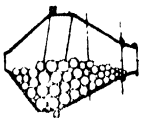
THE material is charged into a receptacle one side of which is formed of adjustable bars. The material is disintegrated by knives or teeth which project through the spaces between the bars and are reciprocated at varying angles and speeds by external mechanism. The pulverised material is ejected through the spaces between the bars, whilst the unpulverised portion is carried to the ends of the receptacle.—W. H. C.

Grinding mill. J. K. Griffith, Assignor to A. J. Griffith, Pittston, Pa. U.S. Pat. 1,295,482, 25.2.19. Appl., 18.4.16.

IN a tube mill having internal circumferential corrugations, the grinding elements consist of bodies shaped like dumb bells. The elements are so shaped that the ends co-act with the neck portions of adjacent grinding bodies. W. H. C.

Grinding mill. J. W. Garrow, Assignor to J. D. Cumming and G. R. Craig, Copper Cliff, Ont. U.S. Pat. 1,295,726, 25.2.19. Appl., 17.5.17.

A GRINDING-DRUM (see fig.), which rotates about a horizontal axis, has a short cylindrical section at the middle, the planes of the ends of this section



being inclined to the axis of the drum; from the cylindrical section the walls taper to the inlet and discharge openings.—W. E. F. P.

Humidifying or filtering air or other gases; Apparatus for ——. L. Dunker, Rugby. Eng. Pat. 124,287, 22.3.18. (Appl. 5085/18.)

THE filter described in Eng. Pat. 112,653 (this J., 1918, 111 A) is built up of plates of standard size so that its capacity may be increased by adding more plates.—W. H. C.

Air cleaner and process for cleaning air. O. Kutsche, Pittsburgh, Pa. U.S. Pat. 1,274,058, 30.7.18. Appl., 1.3.17.

THE conduit carrying the stream of warm, dust-laden air has a number of apertures through which cold clean air is introduced, to separate the dust-

laden air from the walls of the conduit, whereby the formation of charged particles is avoided and coalescence is induced. The air then enters tangentially the bottom of a vertical cylindrical vessel containing rotating vanes which impart a whirling motion to it, whereby particles of agglomerated, coalesced dust are separated. Leaving the top of this vessel in a tangential direction the air passes into a smaller vessel in which it is again given a whirling motion by vanes more steeply pitched than those in the first vessel; the dust which separates is collected on the conical bottom of the vessel and is removed through a pipe at the bottom.—J. H. P.

Boiler furnaces or the like; Drying fuel supplied to ——. W. R. Wood, London. Eng. Pat. 124,314, 22.4.18. (Appl. 6779/18.)

COAL is fed to a boiler furnace through an inclined shoot which passes through the waste gas flue so as to dry the fuel. The portion of the shoot within the flue is constructed of bars forming louvres so that the hot gases may pass transversely through the shoot, which is maintained full of coal. The flue is provided with a baffle which compels the hot gases to pass twice through the column of fuel, and dampers are provided in the wall separating the combustion chamber from the waste gas flue above and below the baffle, so that any desired proportion of the hot gas may pass directly to the flue without passing through the column of fuel. The fuel is finally discharged on to a mechanical stoker.

—W. F. F.

Furnaces; Means for preventing or consuming smoke in ——. J. W. Huelin, London. Eng. Pat. 124,603, 11.4.18. (Appl. 6202/18.)

A FURNACE for a boiler or the like is provided with a plate extending rearwards from the furnace front below the firebars, and with a flap valve in the "dead plate" in front of the firebars. Air may thus pass from the ashpit between the plate and the firebars, and then upwards, partly through the fire, and partly through the flap valve to the combustion space. The valve is connected to a liquid dashpot device, which is set so that the valve is fully open just after the furnace is supplied with fresh fuel, and preheated air is therefore supplied to burn the gases and smoke which are given off by the fuel. The dashpot is provided with a needle valve so as to permit the liquid to pass from one side of its piston to the other in a predetermined time, the flap valve reaching its closed position when the fire becomes incandescent. An open-work brick baffle is also provided at the back of the combustion chamber to intercept solid particles which may pass over the furnace bridge. The flat plate below the firebars may be formed in one or more sections which may be pivoted so as to be tilted to discharge ashes.—W. F. F.

Crystallisation of substances [*e.g., phenacetin*] *in solution; Method of and means for effecting rapid* ——. O. Reynard, Bradford. Eng. Pat. 124,324, 11.5.18. (Appl. 7959/18.)

THE solution is passed through a succession of dished metal trays, preferably made of aluminium, each having a false bottom and hollow sides through which a cooling medium is circulated. The solution, together with the deposited crystals, is then passed through a filter. The application of the process to the production of white crystals of phenacetin is claimed.—W. H. C.

Non-conducting coating for insulating pipes and other vessels or articles in chemical works. H. Lonsdale, Blackburn. Eng. Pat. 124,597, 6.4.18. (Appl. 5919/18.)

To provide an insulating covering that will withstand the injurious effects of ammonium nitrate, the pipe or other vessel is covered with five coats of material. The first coat consists of 20% sodium silicate, 20% kieselguhr, and 60% white asbestos fibre; the second of 20% sodium silicate, 25% kieselguhr, and 55% white asbestos fibre; the third of equal parts of kieselguhr, blue asbestos fibre, and sodium silicate, and the fourth of 50% blue asbestos fibre, 10% white asbestos fibre, 20% sand, and 20% sodium silicate. After application of the fourth coat the surface is painted with hydrochloric acid of 20° Tw. (sp. gr. 1·1) and the fifth or final coat consisting of 50% sodium silicate, 25% quartz, and 25% white asbestos fibre is applied.—W. H. C.

Super-imposing films of material to be dried on a pair of heated cylinders; Method of —— the same being also applicable for evaporating moisture from solids. J. McIntyre, Portobello, and J. Milne and Son, Ltd., Edinburgh. Eng. Pat. 124,668, 2.9.18. (Appl. 14,230/18.)

THE materials are applied to the exterior surface of the internally heated cylinders at three or more different parts of the periphery by distributing rolls, so that as the cylinders rotate additional layers of fresh material are deposited on those already partly dried.—W. H. C.

Mixing concrete and similar material; Machines for ——. C. C. Trew and E. le Bas, London. Eng. Pat. 124,961, 7.6.18. (Appl. 9406/18.)

THE material is fed from a hopper into one end of a horizontal drum through an opening provided with a shutter, and discharged through an opening at the other end which is provided with a pivoted shoot. Mixing blades, U-shape in cross-section, are provided at one or both ends of the drum to throw the material towards the other end or the centre of the drum, and lifting blades are provided to receive the material and complete the mixing.—W. F. F.

Spraying or atomising liquids or fluids and heating, cooling, or mixing the same. J. W. Stevenson, Ebbw Vale. Eng. Pat. 120,078, 22.10.17. (Appl. 15,340/17.)

THE apparatus comprises a drum of relatively small height, arranged vertically, with one or more tangential inlets for the liquid to be atomised at the periphery and an axial outlet. The inlet extends practically over the entire height of the drum, and the outlet has a sectional area equal to or greater than that of the inlet. In order to enhance the circular movement of the fluid, a cone may be provided on the end of the drum opposite the outlet, but not extending into or through the outlet; the interior surface of the drum may have a spiral formation. In a modification, two axial outlets are provided, in opposite ends of the drum. For cooling, heating, or mixing purposes a second fluid may be introduced through holes or ports in the periphery of the drum.—J. H. P.

Cooling apparatus with automatically controlled supply of cooling fluid. C. Mortensen, Christianla, Norway. Eng. Pat. 124,971, 13.6.18. (Appl. 9763/18.)

A CLOSED chamber containing an easily expansible medium is placed within the cooling or condensing conduit which is itself surrounded by the cooling fluid. The variation of pressure due to the expansion and contraction of the medium acts on a diaphragm which operates the valve controlling the supply of cooling fluid.—W. H. C.

Cooling and drying air; Art of ——. W. J. Baldwin, Brooklyn, N.Y. U.S. Pat. 1,292,562, 28.1.19. Appl., 26.9.17.

A CURRENT of air is drawn through a suitable cooling material by a fan. By the centrifugal action of the fan the condensed moisture is separated from the cooled air which is then discharged.—W. H. C.

Filter press plate for filtering acid and other liquid material. W. Furness, Huddersfield. Eng. Pat. 124,974. (Appls. 9921, 17.6.18, and 20,917, 16.12.18.)

A FRAME provided with tightening bolts extending through the top and bottom bars of the frame encloses filter panels of earthenware or other acid-resisting material. The panels have vertically grooved surfaces, the lower ends of the grooves communicating with discharge channels in the frame. Those parts of the frame that are exposed to the action of the acid are protected by a leaden or other suitable covering.—W. H. C.

Filtering-press. J. P. McGlaughlin, Chicago, Ill. U.S. Pat. 1,292,342, 21.1.19. Appl., 5.5.17.

SUPERPOSED horizontal filter leaves or shelves are arranged in two vertical series spaced apart within a cylindrical casing. The shelves are mounted on horizontal pipes so that they can be tilted, and are connected with a common discharge main for the filtrate, and a space is left between the two vertical series of shelves. The mixture to be filtered is introduced into the casing, the liquid passes into the filter leaves and is discharged, the solids being deposited on their outer surfaces. After a time the supply of material is stopped, the bottom of the casing is opened, and the deposited solids are discharged by tilting the leaves or shelves.
—W. H. C.

Filtering-machine; Centrifugal ——. A. Kendrick, Newton, Mass., Assignor to International Instrument Co., Cambridge, Mass. U.S. Pat. 1,293,111, 4.2.19. Appl., 3.2.15.

A ROTATING receptacle containing the liquid to be filtered carries a series of hollow filter elements projecting inwards from the periphery and each having an outlet for the filtered liquid extending through the periphery.—W. F. F.

Filter; Upright multistage — —. H. A. Hills, Grand Rapids, Mich. U.S. Pat. 1,294,463, 18.2.19. Appl., 7.5.17.

A NUMBER of superposed filter tanks are mounted in an upright frame so that they are movable vertically, and are provided with independent detachable inlet and outlet pipes so that the material to be filtered may be caused to flow upwards through them in succession. Means are provided for heating the contents of the tanks during filtration. The inlet and outlet pipes are valved and so arranged that any tank may be cut out of the series without interrupting the operation of the others.—J. H. P.

Transporting hydrochloric acid or other corrosive liquids by rail, road, or water; Tank for ——. British Dyes Ltd., J. Turner, and J. H. West, Huddersfield. Eng. Pat. 124,997, 18.7.18. (Appl. 11,781/18.)

THE tank is built up of sections of steel plate lined with ebonite or vulcanite, vulcanised on to the metal. The sections are connected together by rings of angle iron similarly protected, the joints being made with soft rubber. Baffle-plates of steel protected with ebonite and an ebonite discharge pipe are provided together with a protected manhole and cover, and air inlet and escape openings. The air-escape opening is provided with baffles to prevent acid escaping with the air.—W. H. C.

Waste gases; Apparatus for washing —— and utilising the heat thereof. F. Sargent and H. C. Heaton, Chicago, Ill., Assignors to Babcock and Wilcox Co., Bayonne, N.J. U.S. Pat. 1,291,175, 14.1.19. Appl., 10.7.17.

WASTE gases from a boiler furnace are delivered from the economiser to a chamber in which they encounter a spray of water or other liquid. The wash-liquid is afterwards used for moistening the air for combustion on its passage to the furnace.
—E. W. L.

Separating foreign materials from gases; Apparatus for — —. W. J. Baldwin, Brooklyn, N.Y. U.S. Pat. 1,292,561, 28.1.19. Appl., 18.5.17.

THE gas is passed longitudinally through a horizontal perforated cylinder which is rotated within another fixed cylinder having smaller perforations and surrounded by an outer casing.—W. H. C.

Tunnel-kiln. G. H. Benjamin, New York. U.S. Pat. 1,292,568, 28.1.19. Appl., 8.1.18.

THE combustion chambers are arranged external to the treating chamber and are supplied with heated air from a series of pairs of reversible regenerative preheaters.—W. H. C.

Muffle furnace. C. T. Torsell, Warren, Ohio. U.S. Pat. 1,295,637, 25.2.19. Appl., 4.6.14.

IN a muffle furnace having a pier extending longitudinally through it the muffle chamber is built of two parallel layers of tongued and grooved bricks or tiles with recesses therein so as to form a closed insulating air space entirely surrounding the chamber.—L. L. L.

Retorts; Method of and apparatus for reinforcing ——. F. W. Wood, Baltimore, Md. U.S. Pat. 1,291,743, 18.2.19. Appl., 12.7.15. Renewed 27.7.18.

A RETORT subjected to internal pressure is surrounded by a combustion chamber, and heating gas is introduced into the combustion chamber at a pressure sufficient to reinforce the retort against rupture from internal pressure. The combustion chamber has a flue for the discharge of products of combustion and a valve in the flue is connected with a piston working in a cylinder which communicates with the retort. Increase of pressure in the retort is transmitted to the cylinder and operates to close the valve and prevent egress of gases from the combustion chamber; the pressure in the latter is thus controlled by the pressure in the retort.—J. H. P.

Fire-extinguishing solution having a low freezing point. G. E. Ferguson, New York, Assignor to Pyrene Manufacturing Co. U.S. Pats. (A) 1,292,743 and (B) 1,292,744, 28.1.19. Appl., (A) 20.10.14, (B) 31.5.18.

A SOLUTION having a low freezing point and fire-extinguishing properties consists of (A) aniline or (B) ethyl benzoate, dissolved in carbon tetrachloride.—J. H. J.

Boiler compounds; Method of making — —. E. R. Williams, Sharksburg, Pa. U.S. Pat. 1,294,738, 18.2.19. Appl., 29.12.17.

FUSED caustic soda is mixed with tannin or with tannin and graphite.—J. H. P.

Centrifugal process and device. K. B. Howell, East Orange, N.J., Assignor to The Barrett Co. U.S. Pat. 1,294,909, 18.2.19. Appl., 1.11.17.

A NUMBER of superposed discs, spaced apart, are rotated by a vertical shaft attached to the lowest disc. Each of the discs except the lowest one has a central circular aperture, the diameter of the apertures decreasing downwards from disc to

disc. A cylindrical stream of molten material having a greater diameter than the opening in the uppermost disc is fed centrally on to the latter. Part is caught by the rotating disc and is projected outwards into a cooling medium and part passes through the aperture to the next disc, where another portion is caught and thrown outwards and so on to the bottom, where all that remains is projected outwards. An "anti-sticking" material is fed on to the outer edge of each of the discs.—W. H. C.

Oil and other liquid separator and cleaner. J. H. Packer, Liberty, Mo., U.S.A. Eng. Pat. 124,264, 19.3.18. (Appl. 4851/18.)

Recovering waste oils or separating oil from water or other impurities; Apparatus for ——. H. C. Longsdon, Keighley. Eng. Pat. 124,551, 22.3.18. (Appl. 5051/18.)

Wood vats or tanks. H. and J. E. Buckley, Manchester. Eng. Pat. 124,956, 4.6.18. (Appl. 9156/18.)

Low-temperature expansion [of gases]; Engine for ——. E. A. W. Jefferies, Assignor to Jefferies-Norton Corporation, Worcester, Mass. Reissue 14,597, 25.2.19, of U.S. Pat. 1,264,871, 30.4.18. Appl., 16.11.18.

SEE this J., 1918, 400 A.

Liquid sprayer or atomiser. T. Andrew, Heaton Moor. U.S. Pat. 1,294,373, 18.2.19. Appl., 21.7.17.

SEE Eng. Pat. 105,687 of 1916; this J., 1917, 585.

Separating dust or like matter from air or gases and collecting same; Apparatus for ——. G. Dod, Southport. U.S. Pat. 1,295,711, 25.2.19. Appl., 17.6.16.

SEE Eng. Pat. 8920 of 1915; this J., 1916, 821.

Kilns. Eng. Pat. 124,909. *See* VIII.

Kilns. Eng. Pat. 115,232. *See* IX.

Dryers. U.S. Pats. 1,294,804—5. *See* XIXA.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

***Sulphur** of coal. The inorganic and organic sulphur of coal and its transformations during the manufacture of coke. Experiments on the quantitative determination of pyrites in coal.* J. P. Wibaut and A. Stoffel. Rec. Trav. Chim. Pays-Bas, 1919, **38**, 132—158.

FOR their estimations the authors separated the coal into two fractions by shaking the finely powdered sample with a mixture of benzene and carbon tetrachloride (sp. gr. 1·3) and then leaving it to settle. The light fraction, which floated, had a very low ash content, whilst the heavy fraction had a high ash content. On the original coal and on each fraction the following estimations were made: (1) ash, by ignition of 2 grms.; (2) volatile matter, Muck's method (this J., 1886, 521); (3) total sulphur, Eschka's method, heating 1 grm. of coal with a mixture of magnesia and sodium carbonate; (4) sulphur as sulphates; (5) iron in the form of pyrites; (6) inorganic sulphur. For (4) and (5) 10 grms. of coal was boiled for ½ hour with 200 c.c. of 10% hydrochloric acid and then digested for 24 hours on a water bath. The residue was filtered off, washed, dried, and weighed, and the sulphur present in the filtrate as sulphate was estimated. The residue was calcined in a platinum crucible and the ash extracted with hot concentrated hydrochloric acid. The iron, which was estimated in the extract, was considered as that present in the form of pyrites in the original coal. For the estimation of inorganic sulphur 1 grm. of the finely powdered coal was mixed with 100 c.c. of water, 1 c.c. of bromine was added, and the mixture heated on the water bath for ½ hour, filtered, the residue well washed, and in the filtrate and washings the sulphate was estimated. This method, while only approximate, was found to give satisfactory results providing that the pyrites content of the coal did not exceed 5%. The organic sulphur content of the coal is given with a fair degree of accuracy by the difference between the result obtained in estimation (3) and the sum of the results obtained in estimations (4) and (6). Anomalous results were obtained in the case of a Scotch cannel coal, which was found to contain sulphur compounds soluble at the ordinary temperature in the mixture of benzene and carbon tetrachloride and also to contain some free sulphur. From an examination of samples of coal and of the coke formed from them it is considered probable that a portion of the sulphur originally combined with iron combines with carbon during the coking process. The sulphur present in coke is mostly in an organic form, coke containing relatively more organic sulphur than the coal from which it is derived. Results obtained with one kind of coal, in which the inorganic sulphur was almost all present as pyrites, indicate that during coking the pyrites decomposes according to the equation, $FeS_2 = FeS + S$.—W. G.

Sulphur; Behaviour of —— towards carbonaceous matter at high temperatures. J. P. Wibaut. Rec. Trav. Chim. Pays-Bas, 1919, **38**, 159—162 (See preceding abstract.)

WHEN sugar, or the carbon obtained by charring sugar, or wood charcoal is mixed with sulphur and the mixture heated in a closed crucible to bright redness, in each case a product is obtained which, after extraction first with carbon bisulphide and then with ether, contains sulphur to the extent of from 3—6%. Whether this sulphur is chemically combined or only absorbed is not decided.—W. G.

Vertical [gas] retort steaming tests at Springfield, U.S.A. L. J. Willien. New England Assoc. Gas Engineers. Gas J., 1919, **146**, 97—98.

THE usual practice with Dessau vertical retorts is to steam the charge during the last two hours of carbonisation only. The yield of gas is thereby increased about 20%, the candle power of the gas reduced 25%, and the calorific power reduced 8%. The steaming of the charge in a Glover-West system of retorts is continuous. The author records results obtained by steaming a system of 24 such retorts. 350 lb. of steam at a superheat of 200° F. (111° C.) was used per retort per day, the supply pressure being maintained at 20 lb. per sq. inch. The yield of gas was increased about 20% by steaming. There was no diminution in the amount of coke. The gas suffered a decrease of 3—4% in calorific value, and a decrease of about 25% in candle power. With steaming, the gas contains about 3% more carbon monoxide and 0·5% more hydrocarbons with less benzene. The hydrogen content is, if anything, slightly reduced. The amount of carbon on the sides of the retort is reduced between 40% and 50%, and moreover is more readily removed. The yield of ammonia is increased about 12%. The liability to the occurrence of stoppages in stand-pipes is reduced by steaming. (Compare this J., 1919, 99 A.)

—J. S. G. T.

Gas from wood and peat; Manufacture of ——. E. Ott. Swiss Gas Association. Gas J., 1919, **146**, 83—84.

Owing to their comparatively high oxygen content and low carbon content, wood and peat, when subjected to destructive distillation, yield gas containing a high proportion of carbon dioxide, and consequently of low calorific value. The carbon dioxide content of the gas may be reduced by passage of the gas through dry lime. The plan of enriching the crude gas by addition of $\frac{1}{20}$th of its volume of acetylene is also practicable, and a combination of both methods, entailing enrichment of the gas with acetylene and removal of some of the carbon dioxide by the lime produced from the carbide, is suggested. When using wood the best results are obtained by high temperature distillation in retorts charged to not more than half their capacity; the acetic acid evolved is then decomposed by the incandescent carbon. The difficulties introduced by the acid nature of the condensation products from wood may be reduced by neutralising them with ammonia in the hydraulic main, or by distilling peat or coal along with the wood. The tars yielded by wood and peat are very hygroscopic. The solid residue from wood distillation contains from 2 to 6%, and that from peat from 6 to 50%, of ash. Both solid residues absorb about 30% of water and hence should not be quenched with water.

—J. S. G. T.

Tar fog [from gas]; Electrical precipitation of ——. J. G. Davidson. Trans Canadian Min. Inst., 1918, **21**, 252—258.

From experiments made on the crude gases obtained in the distillation of coal, wood, and petroleum by the usual industrial methods, it is concluded that the Cottrell process for removing tar fog is efficient at the highest gas temperatures obtaining in the industries concerned, whereas ordinary methods of removal require a preliminary lowering of the gas temperature. In the case of coal and wood gases, a more complete removal of tar fog was obtained by the electrical method than by the use of ordinary tar extractors, and the aqueous distillates subsequently condensed were much cleaner. The feasibility of electrically precipitating the products of distillation fractionally, at successively lower temperatures, and of recovering ammonia direct from hot coal-gas after electrical precipitation of the tar was also demonstrated. The treater chamber employed in the experiments consisted of a pipe, 15 ft. long and 12 in. in diameter, provided with special insulators of fused quartz; the capacity was about a million cub. ft. of gas per day, for which the total consumption of electricity was equivalent to 2 or 3 H.P.—W. E. F. P.

Ethylene. W. Malisoff and G. Egloff. J. Phys. Chem., 1919, **23**, 65—138.

A résumé of the present state of knowledge of the physical and chemical properties and processes of formation and decomposition of ethylene. A very full bibliography is appended.—W. G.

Natural gas; Analysis of —— and the calculation and application of results. R. P. Anderson. J. Ind. Eng. Chem., 1919, **11**, 299—306.

In the analysis of natural gas by the combustion method, the point at which the combustion is complete may be ascertained by the use of the following modification of the ordinary apparatus. A narrow glass tube is placed in a vertical position adjacent to the combustion pipette and its lower end is connected with a T-piece inserted in the rubber tubing between the combustion pipette and the levelling bulb. When the gas has been passed into the pipette, the stop-cock on the bulb is closed. Contraction due to combustion is indicated by the fall of mercury level in the narrow tube and when this fall ceases the combustion is complete. The combustion pipette should be constructed of Pyrex glass. The calculation of results of combustions of natural gas according to theoretical equations is discussed; a statement of the average number of carbon atoms per mol. of paraffin hydrocarbon in the natural gas is recommended as being more logical than a statement of the percentages of two hydrocarbons forming a mixture equivalent, as regards combustion data, to the one actually burned. Tables of correction factors are given for use in correcting results obtained by the theoretical equations for differences in the molecular volumes of the gases considered, and the calculation of sp. gr. and heating value is discussed from the point of view of the theoretical and actual values. W. P. S

Sulphite coal. Strehlenert. *See* V.

Coal washing. Graham. *See* X.

Heating metallurgical furnaces. Lecocq. *See* X.

Action of coal gas on plants. Wehmer. *See* XVI.

Arsenical poisoning in the industries of coal and its derivatives. Bayet and Slosse. *See* XIXB.

Patents.

Refuse; Process for briquetting ——. P. K. Leendertz, Amsterdam. Eng. Pat. 120,209, 15.10.18. (Appl. 16,826/18.) Int. Conv., 25.10.17.

House refuse from which the metal has been removed is pounded, pulverised, rolled, and kneaded into a plastic mass which is briquetted without a binder and dried.—W. F. F.

Peat; Means or method of treating —— so as to render it more adaptable or useful as a fuel. J. W. Leadbeater, Doncaster. Eng. Pat. 124,348, 2.7.18. (Appl. 10,823/18.)

Peat 40—50%, pitch 15—25%, and coal or coke 45—25% are separately granulated and then mixed and placed in a mould which is heated in a retort to about 800°—1000° F. (430°—540° C.), the volatile products given off being collected and separated. The residue is a smokeless fuel.—W. F. F.

Fuels; Combustion of waste ——. A. C. L. Ekström, Balston Spa, N.Y. U.S. Pats. 1,295,455 and 1,295,456, 25.2.19. Appl., 6.8.18 and 26.11.18.

A fuel for steam boiler furnaces consists of anthracite mine waste mixed with a sufficient proportion of clinkering ash to act as a binder.—W. F. F.

Coke-ovens; Regenerator for ——. J. Plette, Brussels. U.S. Pat. 1,294,828, 18.2.19. Appl., 7.4.17.

Two systems of regenerators are built along the whole length of a group of ovens, one being reheated while the other is traversed by the gases for combustion. Each system consists of two channels separated by a central gallery, the latter being filled with chequer-work and provided with transverse partitions whereby pairs of juxtaposed regenerator compartments are formed. These compartments are connected with the respective channels by a series of narrow passages.—W. E. F. P.

Furnaces, gas-producers, and similar apparatus; Process of producing gas from moist fuel in —— and simultaneously recovering by-products, and apparatus relating thereto. N. T. Thäberg, Malmö, Sweden. Eng. Pat. 112,443, 20.12.17. (Appl. 18,911/17.)

MOIST fuel is fed into the top of a vertical retort or gas producer which is provided with a transverse funnel-shaped partition with a central opening through which the fuel passes so that there is an accumulation in both compartments. The fuel in the lower part is carbonised by external heat or partly burnt by admission of air, so that the fuel in the upper part is dried and preheated. The moist air, tar, ammonia, etc., are withdrawn from this compartment by an exhauster or fan and passed through an ejector, the suction chamber of which is connected to the lower compartment so that the dust, tar, etc., in the gas from this compartment are separated by the moist gas. The mixed gases pass to a condenser.—W. F. F.

Producer gas and other gas furnaces; Control and regulation of combustion in ——. G. Alliata, Locarno, Switzerland. Eng. Pat. 115,423, 11.4.18. (Appl. 6175/18.) Int. Conv., 3.5.17.

PRODUCER gas and other furnaces are fed with primary and secondary air which are drawn through auxiliary chambers by the draught of the furnace. Each of these chambers is provided with a control valve, the suction pressure within the chamber corresponding to the amount of air supplied. Each chamber is connected by a small pipe to a separate bell float the movement of which actuates an indicator pointer, so that by comparison of the two pointers the valves controlling the air admission may be operated to admit the proper quantities. In a modification, the two bell floats may be interconnected and may operate two indicators or a single indicator, which may be maintained in a predetermined position by adjustment of the air valves. The apparatus may be used to control the admission of gas and air to a gas-fired furnace.
—W. F. F.

[Water] gas; Manufacture of ——. R. J. Rew, Exeter. Eng. Pat. 124,247. (Appls. 3282, 25.2.18, and 11,318, 10.7.18.)

A HORIZONTAL retort setting used for the distillation of coal is provided with a spiral or other coil of piping above or at the side of the retorts. The discharge end of the pipe projects into the retort and the inlet end terminates outside the setting in a U-tube forming a liquid seal, and having a funnel into which water may be fed. When the distillation of the coal is complete, water is admitted to the pipe and is delivered to the retort in the form of superheated steam for the production of water-gas. In an alternative form, the piping is contained within the retort. (See this J., 1919, 99 A.)—W. F. F.

Gas-producer. F. E. Modlin, Fort Worth, Tex. U.S. Pat. 1,295,188. 25.2.19. Appl., 1.6.18.

FUEL is fed to a vertical drum comprising a fire-pot and a retort, and the gas from the upper part of the drum is passed through a horizontal superheater embedded in the fire, and thence to a storage vessel.—W. F. F.

Gas-purifiers. R. J. Millbourne, Newport, Salop. Eng. Pat. 124,994, 12.7.18. (Appl. 11,453/18.)

THE purifying material in a gas-purifier is arranged in two layers separated by a horizontal space, and the casing is provided with a junction-box at each end, connected to the gas inlet and outlet respectively. Each junction-box is provided with openings at the top, bottom, and centre, which may be closed by detachable covers. The gas may be made to pass upwards through both layers of material or downwards, or outwards from the central space through the layers, or inwards to the central space, by covering or uncovering the appropriate openings in the junction-boxes. This arrangement obviates the use of a valve as in Eng. Pat. 2768 of 1915 (this J., 1916, 168.)—W. F. F.

Gas-purifiers with removable baffle-walls. J. Schulte, Berlin. Ger. Pat. 309,796, 7.12.16.

PURIFIERS for gases containing tar, oil, or paraffin are provided with chambers corresponding in shape with and mounted above the individual baffle-walls and also with arrangements for raising the baffle-walls. When a baffle-wall becomes choked up with tar or the like, it is raised into the corresponding chamber, and steam is introduced into the chamber, whereby the tar or the like is liquefied. Behind each baffle device a manometer is fixed which affords an exact control of the progress of the gradual choking up.—J. F. B.

Quenching coke; Method of and apparatus for ——. G. A. Flood, Swaffham, and W. H. Flood, Sheffield. Eng. Pat. 124,652, 3.7.18. (Appl. 10,914/18.)

Purifiers and other gas apparatus; Gas-diverting valve of the rotating type, for use with ——. R. and J. Dempster, Ltd., and W. F. Rodger, Manchester. Eng. Pat. 125,040, 9.12.18. (Appl. 20,423/18.)

Pulverous fuel; Furnace with mixing-chamber for ——. K. H. V. von Porat, Stocksund, Assignor to Motala Verkstads Nya Aktiebolag, Motala Verkstad, Sweden. U.S. Pat. 1,294,730, 18.2.19. Appl., 21.12.15.

SEE Eng. Pat. 16,298 of 1915; this J., 1916, 1251.

Hydrocarbon products; Extraction of —— from shales and coals. V. Z. Reed, Denver, Colo., Assignee of D. T. Day, Washington, D.C., U.S.A. Eng. Pat. 119,648, 17.5.18. (Appl. 8330/18.) Int. Conv., 28.9.17.

SEE U.S. Pat. 1,280,178 of 1918; this J., 1918, 761 A.

Cracking heavy [mineral] oils; Process of ——. C. Ellis, Montclair, N.J., Assignor to Surface Combustion, Inc., Wilmington, Del. U.S. Pat. 1,295,825, 25.2.19. Appl., 1.4.12. Renewed 15.7.18.

SEE Eng. Pat. 25,631 of 1912; this J., 1913, 1098.

Lubricants; Process of regenerating ——. H. Wade, London. From Pittsburgh Testing Laboratory, Pittsburgh, Pa., U.S.A. Eng. Pats. 124,990 and 124,991, 11.7.18. (Appls. 11,402 and 11,407/18.)

SEE U.S. Pats. 1,281,354—5 of 1918; this J., 1919, 36 A.

Drying fuel. Eng. Pat. 124,314. *See* I.

Hydrogen. Eng. Pat. 124,798. *See* VII.

Chlorhydrins [from oil-gas]. U.S. Pat. 1,295,339. *See* XX.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Electrical precipitation of tar fog. Davidson. *See* IIA.

German seaweeds. Albert and Krause. *See* VII.

PATENTS.

[*Coal*] *carbonising or distillation apparatus.* N. H. Freeman, London. Eng. Pat. 124,015, 12.2.18. (Appl. 2462/18.)

A SERIES of flat distilling chambers are arranged in a vertical tier and a concentric vertical shaft passes through all the chambers and carries a horizontal rotating plate in each chamber. The chambers are connected by central passages through which the shaft passes. Coal or the like is fed into the uppermost chamber on to the rotating plate and is moved outwards over the plate by guides fixed to the top of the chamber. The coal passes over the edge of the plate and is moved inwards over the bottom of the chamber by guides carried by the rotating plate, to the central opening through which it passes to the next chamber. The chambers are separated by annular heating compartments containing gas burners so that the temperature of each chamber may be regulated as required, and the gaseous distillation products are withdrawn separately from each chamber.—W. F. F.

Coal, shale and the like; Low-temperature distillation of ——. J. Nelson, Glasgow. Eng. Pat. 124,231, 21.12.17. (Appl. 18,983/17.)

THE mixed vapours and gases from the process of cracking hydrocarbon oils by passing them through molten lead as described in Eng. Pat. 116,304 (this J., 1918, 457 A), or the gases remaining after removing the condensable hydrocarbons therefrom, are heated to 350°—450° C., and passed with or without superheated steam through coal, shale, or the like. The material is thus subjected to low-temperature distillation and the volatile products are collected. Motor fuel may be obtained from the condensate by fractional distillation.—W. F. F.

Coal; Processes and apparatus for the distillation of ——. F. Lamplough, Feltham, Middlesex, and Oil Extractors, Ltd., London. Eng. Pat. 124,294, 28.3.18. (Appl. 5511/18.)

COAL is preheated by gaseous combustion products from an auxiliary furnace, and then distilled by passing steam through it. The auxiliary furnace is connected to the vertical retort by chequerwork passages through which the hot gases pass to the retort. When the coal in the retort commences to give off gas, air is cut off from the auxiliary furnace and steam is admitted. The steam and hot gases are superheated in passing through the chequerwork to the retort, and the coal is distilled at a temperature of 300°—600° C. The volatile products together with steam and hot gases from the furnace pass from the top of the retort into the hydraulic main after which they may be separated. When distillation is complete the steam is shut off and the temperature of the furnace raised until the coke in the retort commences to burn to carbon monoxide. Steam is then re-admitted, and the volatile products are collected separately and treated for the recovery of ammonia, the carbon monoxide being used for heating purposes. The retort is provided with a rotary grate comprising two horizontal rotating shafts carrying interlocking toothed discs the teeth of which are curved towards one another in such a way that the charge is gradually transferred through the grate. The coal is admitted to the top of the retort and the residue withdrawn below the grate by rotary valves which prevent the admission of air.—W. F. F.

Wood and the like; Carbonisation of ——. H. H. Spicer, London. From J. Wells, Cairo. Eng. Pat. 124,274, 20.3.18. (Appl. 4925/18.)

THE material is fed into the top of a vertical cylindrical vessel provided with a grate, and is burned by air and steam admitted through an opening below the grate. The carbonised material is withdrawn through openings in the side of the vessel above the grate, leading to conduits which dip into a water-seal. Sliding rods project through the walls of these conduits to facilitate the passage of the carbonised material. The volatile products pass from the top of the vessel into a hood covering the upper part of the vessel and provided with means for collecting tar etc. and for discharging gas.—W. F. F.

Decolorising carbon and the preparation thereof. H. Wade, London. From China Sugar Refining Co., Ltd., G. M. Shaw, and H. M. McTavish, Hong Kong. Eng. Pat. 124,638, 31.5.18. (Appl. 9037/18.)

SAWDUST, wood chips, or other fibrous vegetable material is impregnated with milk of lime containing calcium hydroxide in the proportion of not more than 40% of the vegetable material, and heated in a closed retort to 1000° C. The carbonised material is washed with a 5% solution of hydrochloric acid to remove lime, and then with water to remove the acid, and finally dried. The product is suitable for decolorising sugar solutions or syrups.—W. F. F

Arc lamps. G. Westercamp, Paris. Eng. Pat. 124,455, 5.1.16. (Appl. 177/16.)

AN arc lamp, *e.g.*, a searchlight, is provided with a device for varying the current supplied and the distance between the carbons when required to burn at a lower candle power, and the negative carbon is provided with a "wick" of known composition (*e.g.*, powdered carbon agglomerated with alkali silicate) or with an axial passage through which liquid or gas may be supplied to stabilise the arc.
—W. F. F.

Electric lamps; Method of drawing wire filaments for incandescence ——. F. G. Keyes, East Orange, N.J., Assignor to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,293,116, 4.2.19. Appl., 11.2.14.

METALLIC tungsten is deposited electrolytically on a fine tungsten wire which is then hot-drawn through dies of an alloy of tungsten, iron, and carbon, with a lubricant of talcum powder.
—W. F. F.

Electric lamp; Incandescence ——. M. A. Hoyt, Bloomfield, N.J., Assignor to Westinghouse Lamp Co. U.S. Pat. 1,293,781, 11.2.19. Appl., 11.7.16.

THE tungsten filament of an incandescence electric lamp is joined to a nickel leading-in wire by pressing the two together and simultaneously passing an electric current through the joint.—W. F. F.

III.—TAR AND TAR PRODUCTS.

Fatty acids produced by the oxidation of lignite tar oil; Nature of the ——. C. Harries. Ber., 1919, **52**, 65—72.

FORMIC, acetic, propionic, oxalic, palmitic, stearic, and myristic acids and probably heptoic and octoic acids *are produced by the decomposition of the ozonides obtained from purified lignite tar oil (Harries, Koetschau, and Fonrobert, this J., 1917, 539). The complete absence of the* C_4–C_6 fatty acids is remarkable.—C. S.

Coumarone resins. Marcusson. *See* XIII.

Arsenical poisoning in industries of coal and its derivatives. Bayet and Slosse. *See* XIXB.

Catalytic dehydrogenation. Sabatier and Gaudion. *See* XX.

PATENTS.

Coal tars and the like; Production of oils from —— and also carbon, and pitch which may be free, or relatively free, from uncombined carbon. J. L. Major, Kingston upon-Hull. Eng. Pat. 17,140, 6.12.15.

THE material to be treated (coal-tar, blast-furnace tar, etc.) is agitated with a solvent (petroleum, shale oil, naphtha, etc.), the solvent employed and its quantity depending upon the nature of the tar, and whether the residue from the extraction is required to be pitch, or asphaltum and free carbon. By using a relatively large proportion of solvent, the residue consists almost entirely of free carbon. After agitation the mass is allowed to stand, and the supernatant layer is removed and distilled to recover the oil or oil and asphaltum. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 736 of 1894, 6739 of 1901, 20,281 of 1906, 16,908 of 1909, and 3003 and 10,958 of 1912, and in pursuance of Sect. 8, Sub-sect. 2, to Eng. Pat. 24,313 of 1914; this J., 1895, 24; 1902, 699; 1907, 1190; 1910, 1368; 1912, 1190; 1913, 666; 1916, 170.)—S. S. A.

Benzol and other products from acid tars obtained in refining operations; Recovery of ——. F. and H. T. Thorp, Whitefield. Eng. Pat. 124,605, 13.4.18. (Appl. 6306/18.)

WASTE acid tar obtained during the refining of benzol, toluol, solvent naphtha, etc., is washed by agitating it with 0·5—1 volume of water. On allowing to stand a pasty mass comprising tar oil and resinous substances separates above the acid liquor. The acid is run off and the pasty mass, after being well washed with water, is steam distilled for the recovery of benzene, toluene, etc. The residue, consisting of resinous substances, is transferred to a filter, washed free from acid, and dried.—S. S. A.

IV.—COLOURING MATTERS AND DYES.

Resinous substances [for production of dyestuffs]; Process for the manufacture of —— by the action of the sodium soap of γ-pinic acid on naphthols, aminonaphthols, and their sulphonic acids. L. Paul. Farben-Zeit., 1917, **22**, 464—465. Chem. Zentr., 1919, **90**, II., 64.

SOLUBLE compounds are obtained by warming a solution of sodium γ-resinate with naphthols or aminonaphthols, whereas the sulphonic acids in dilute solutions give emulsions and in concentrated solutions resinous precipitates which can be crystallised from alcohol. On heating 10 grms. of β-naphthol with 150 c.c. of a 10% solution of sodium γ-resinate a solution is obtained which sets to a mass of crystals on cooling. This is filtered off and washed with water until the washings are clear. About 30% of the β-naphthol is thus obtained combined with the resin soap as a soluble compound, which may be salted out of the mother liquor with sodium chloride and out of the washings with potassium chloride. *This compound can be fixed on cotton and forms azo dyestuffs with diazo and tetrazo compounds, either in solution or on the fibre.* These resinate dyestuffs possess many superior properties over the resin lakes prepared from basic dyestuffs as regards fastness to light and washing. On heating the resin soap solutions with β-naphthol-sulphonic acid (Schaeffer's acid) syrupy or lumpy masses separate; this product also forms insoluble resinate azo dyestuffs which can be produced on unmordanted cotton. A similar resin compound is produced with "R-acid" and a range of insoluble azo colours with bluish shades can be prepared. Crystalline sodium γ-resinate compounds with aminonaphthol-γ-sulphonic acid, β-naphthol-γ-disulphonic acid and aminonaphtholdisulphonic acid-H can also be obtained.—J. F. B.

Colour lakes; Theory of ——. O. Baudisch. Ber., 1919, **52**, 146—147.

A CLAIM of priority over Scholl and Zinke in regard to their work on the action of potassium ferricyanide on alizarin and the constitution of hydroxyanthraquinones (this J., 1918, 763A).—C. S.

PATENT.

Sulphur dyestuff. M. Wyler, and Levinstein, Ltd., Manchester. Eng. Pat. 121,589, 28.3.18. (Appl. 5519/18.)

A DYESTUFF soluble in sodium sulphide and dyeing cotton in reddish-brown shades fast to washing and chlorine is prepared by melting acenaphthene with sulphur at 250°—300° C. Thus, a mixture of 1 part of acenaphthene and 3½ parts of sulphur is heated at 250°—300° C. till the melt becomes thick and soluble in sodium sulphide. It is then cooled, powdered, dissolved in a boiling 10% solution of sodium sulphide, and the dyestuff precipitated with hydrochloric acid, collected, washed and dried.—S. S. A.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Sulphite-coal. R. W. Strehlenert. Pulp and Paper Mag., 1918, **16**, 671—672, 687—689, 709—710, 735—736.

THE author's scheme for the manufacture of a fuel from sulphite-cellulose waste liquor, which was described by B. Johnsen (this J., 1918, 130 T—131 T) is set forth in more complete detail. The process was first outlined in 1913 (this J., 1913, 652) but has been the subject of recent improvements. As originally designed, the presence of the merest traces of certain metals, *e.g.* 0·002% of iron, sufficed to inhibit the precipitation of the lignin. This and other defects have been remedied by first heating the liquor almost to its critical temperature, *i.e.* the temperature at which it begins to liberate large quantities of its combined SO_2, before admitting the air. Oxidation during the heating stage is prevented by pumping exhaust digester gases into the autoclave, so that a gas pressure of 1—2 kilos. per sq. cm. exists at the beginning of the heating. Then at the critical point air is admitted and oxidation and decomposition take place practically simultaneously. The concentration of dry substance for the optimum yield is 16—17%; this may be obtained when digesting the wood by the method of circulation of the liquor, but in the ordinary way of heating by indirect steam, the concentration does not

exceed 11%. Considerable improvement in the yield may, however, be obtained by extracting the liquor from the pulp by the process of systematic diffusion. About 75% of the organic matter in the lye can be precipitated at the maximum, and 72—74% is easily obtained; the remaining 25% is not in a form which is susceptible to the treatment. The fuel obtained normally contains 17—18% of ash, but this percentage may be considerably reduced by special treatment. The physical condition of the precipitated lignin is closely connected with the yield and a correct treatment giving the maximum yield gives also a quickly draining granular precipitate which can be drained to a content of 65% of dry substance. The autoclaves for the treatment of waste lyes which have previously been used for alcohol manufacture are constructed of lead-lined material. The oxidation of SO_2 must be restricted to a very small amount; consequently the consumption of air is only small and the autoclave space may be utilised for liquor to about 75% of its total capacity. To ensure minimum oxidation, it is necessary to work under high pressure and at a high temperature. The critical temperature of the liquor ranges between 170° and 190° C. and the exothermic reaction, which takes place very suddenly, may carry the temperature up to above 200° C. The liquor must not be allowed to boil, as this would involve a large loss of heat; consequently excess pressure up to a maximum of about 20 kilos. per sq. cm. is prescribed. The loss of organic matter in the filtrates amounts theoretically to 25% of the total. It is found, however, that a considerable proportion of this may be recovered by using the liquor for the hydrolysis of peat by the "wet carbonising" process. The hydrolysis of the peat is thereby facilitated and the organic matter absorbed from the sulphite fuel filtrates increases the yield of peat fuel. According to the quantity of free acid present, the hydrolysis is effected at 140° C. or lower and the mother liquor is used again until substantially exhausted.—J. F. B.

PATENTS.

Cotton-seed hull fibre; Method of purifying —. F. W. Stockton. Pittsburgh, Pa., Assignor to East St. Louis Cotton Oil Co., National Stock Yards, Ill. U.S. Pat. 1,295,078, 18.2.19. Appl., 13.9.17.

COTTONSEED hull fibre is softened by boiling it in a 4% solution of caustic soda for about 5 hours. The boiled fibre is passed between rollers in order to disintegrate the associated hull particles, and then subjected to a cleaning operation to separate the fine, disintegrated hull particles from the fibre. —L. L. L.

Coating composition and process of applying same, intended more particularly for coating aeroplane cloths. Treatment of fabrics, particularly of aeroplane fabrics. T. F. Tesse, Paris. Eng. Pats. (A) 124,763 and (B) 124,844, 3.1.16. (Appls. 71/16 and 4284/17.)

(A) AEROPLANE fabrics are treated with a dilute solution of cellulose acetate in acetone and methyl acetate, containing a small proportion (2—5%) of a solvent of high boiling point, such as carvacrol, eugenol, isoeugenol, safrol, isosafrol, methyleugenol; tri-acetin, glycerol benzoate, or benzyl alcohol, or a mixture of them may also be added. The high-boiling solvents impart a high degree of suppleness to the coating. The addition of an inert substance, such as zinc oxide (from 2 to 5% on the solvent), produces a smooth, impervious, opaque enamel, absolutely unaffected by spirits, oils, and water, and imparts to the composition the property of tensioning the fabric.

(B) The fabric is treated with one or several coats of cellulose ester free from high-boiling solvents, in order to give to the fabric the desired tension and impermeability. Following this, one or several layers of a supple coating composition of cellulose ester along with a high-boiling solvent are applied, and finally one or more coatings of cellulose ester, particularly cellulose acetates, free from or containing only very small quantities of solvents of high boiling point.—L. L. L.

Fabrics; Method of producing pyroxylin coated —. W. E. Masland, Assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. U.S. Pat. 1,267,785, May 28, 1918. Date of appl., Sep. 3, 1914. Renewed Oct. 4, 1917.

A FABRIC is coated first with a pyroxylin "jelly" composition and then with a plastic pyroxylin composition of such consistency as to constitute substantially a surface coating; the coated fabric is wound tightly upon a roll before the coating has set, the resulting pressure being maintained until setting has taken place, so as to cause the coating to adhere firmly to the fabric.—J. F. B.

Packing and process of manufacturing same. C. E. Vance and J. A. Vetter, Pittsburgh, Pa. U.S. Pat. 1,295,241, 25.2.19. Appl., 26.10.17. Renewed 9.1.19.

A PROCESS of manufacturing hydraulic packing consists in treating fibres, from which the moisture has been expelled, with a cellulose solution to render them waterproof and then coating the fibres with a lubricant.—L. L. L.

Paper; Means for making —. J. T. Tong, Chester, Pa., Assignor to Scott Paper Co. U.S. Pat. 1,295,636, 25.2.19. Appl., 26.10.17

A PAPER-MAKING machine is provided at the wet end with a "doctor," which gives an irregular ribbed condition to the paper web, and at the drying end with a conditioning device consisting of a pair of rubber rollers, between which the dried paper web passes, so that the ribbed portions of the web are crushed. The paper is thus rendered more pliable, and acquires a more cloth-like handle. —L. L. L.

Resin size. U.S. Pat. 1,292,721. *See* XIII.

Leather substitute. U.S. Pat. 1,291,180. *See* XV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

"Dry" mordanting, and dyeing of mordant dyes [in non-aqueous solution]. M. Fort. J. Soc. Dyers and Col., 1919, 35, 100—101.

THE difficulty of "dry" chroming of animal fibres was overcome by the use of an ethereal solution of perchromic anhydride. Salts of this compound with bases, *e.g.* pyridine, are obtained by reaction in ethereal solution, and it appears probable that a like union takes place with the basic constituents of wool. Mordanting is effected by immersing the wool in a blue ethereal solution of the peroxide, prepared by treating bichromate with dilute sulphuric acid in the presence of hydrogen peroxide and then extracting with ether. The chromed wool has a bluish colour, somewhat similar to that of the ethereal solution of the chromium peroxide. In a dry atmosphere the chromed wool remains blue or slate-coloured many hours, but in presence of sufficient moisture it turns yellow. The whole of the chromium may be exhausted from the ethereal solution by use of fresh batches of wool. The blue mordant has stronger oxidising proper-

ties than the well-known yellow chrome mordant, but it may be reduced to the yellow condition by treatment with sulphur dioxide. Mordant colours are applied to the chromed wool, similarly to the acid colours from a cresol petroleum bath (see this J., 1919, 9 A). As with acid colours, a little water is essential along with a mere trace of formic acid. *The shades produced are fast to rubbing, hot and cold water, and moderately resistant to soaping.*—L. L. L.

Resinate dyes. Paul *See* IV.

PATENTS.

Boiling, bleaching, dyeing, sizing, or similarly treating yarns or fabrics; Machines for ——. J. Bright and Bros., Ltd., and J. Evans, Rochdale. Eng. Pat. 125,025, 29.10.18. (Appl. 17,620/18.)

A MACHINE of the box or beck type for boiling, bleaching, dyeing, sizing, or similarly treating yarns or fabrics is fitted with counterbalanced guide rollers, placed within the beck, and arranged to rise and fall within certain predetermined limits under variations of tension on the yarns or fabrics. A locking device may be supplied for locking the rollers in any desired position. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 1518 of 1870.)—L. L. L.

Dyeing apparatus. W. J. Going, Amsterdam, N.Y., Assignor to General Textile Machinery Co., Yardley, Pa. U.S. Pat. 1,295,155, 25.2.19. Appl., 12.4.17.

THE apparatus comprises a dyeing chamber within a vat, provided with propellers for the circulation of the liquor in the vat, and with an automatic arrangement, such as a cam, whereby the circulation is reversed at predetermined intervals. A means of changing the interval between the reversals is also provided, and by a suitable device the dye liquor may be directed downwards on the top of the material in the vat, and circulated between the top and bottom of, or horizontally above and below, the dyeing chamber in the vat. Horizontally spaced baffles, consisting of triangular members with the apex of the triangle downwards, are used to present an inclined surface for deflecting the circulating fluid.—L. L. L.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Double salts of calcium and potassium and their occurrence in leaching cement mill flue dust. E. Anderson J. Ind. Eng. Chem., 1919, 11, 327—332.

DOUBLE sulphates of calcium and potassium can be obtained from solutions containing calcium sulphate and potassium sulphate; these double salts are potassium mono-calcium sulphate, or syngenite, $K_2SO_4,CaSO_4,H_2O$, and potassium penta-calcium sulphate, $K_2SO_4,5CaSO_4,H_2O$. In a solution containing 2·07% of potassium sulphate, syngenite and calcium sulphate are stable as solid phases below 31·8° C.; if potassium sulphate is added to such a solution, more syngenite will form. At 31·8° C., potassium penta-calcium sulphate can form and at this temperature the solid phases gypsum, potassium penta-calcium sulphate, and syngenite can exist in equilibrium with the solution, the latter containing 3·5% of potassium sulphate and being saturated with calcium sulphate. During leaching of cement mill flue dust for the recovery of potash, the conditions may be so adjusted as regards time of contact and solution concentration that the formation of double salts may be avoided.—W. P. S.

Iron and oxygen as necessary agents for the reduction of alkali nitrites by auto-oxidisable compounds. Nitrate and nitrite assimilation. XIV. O. Baudisch. Ber., 1919, 52, 35—40.

WHEN an aqueous alkaline solution of sodium nitroprusside is boiled in the absence of air or oxygen, no nitric oxide is liberated, but this gas is liberated in large quantity directly oxygen is admitted to the system. Similar results are observed when a solution of sodium carbonate and potassium nitrite is boiled with pentacyanoammineferric sodium, $[(CN)_5FeNH_3]Na_2$, or with potassium ferrocyanide; in the case of the last-named compound the addition of a little pyridine or phloroglucinol greatly accelerates the evolution of the nitric oxide. The fact that iron as well as oxygen is necessary for the reduction of alkali nitrite (this J., 1918, 556 A) is therefore now explicable. The whole process of the reduction of alkali nitrite is a replacement of inorganic or organic groups co-ordinatively attached to the iron atom by the NO-group of the alkali nitrite and the subsequent elimination of this group by oxygen on warming. (See also J. Chem. Soc., 1919, i., 237.)—C. S.

Iron and oxygen as necessary agents for the reduction of alkali nitrates. Nitrate and nitrite assimilation. XV. O. Baudisch. Ber., 1919, 52, 40—43.

AN alkali nitrate is unaffected by boiling in alkaline solution with ferrous carbonate or hydroxide in the absence of oxygen, but is reduced through the alkali nitrite to ammonia directly oxygen is admitted. Alkali nitrite is reduced to ammonia even in the absence of oxygen. The author explains the phenomenon by means of his peroxide formula of alkali nitrates. (See this J., 1916, 736; also J. Chem. Soc., 1919, i., 238.)—C. S.

Magnesite; Analysis of ——. V. Macrì. Boll. Chim. Farm., 1918, 57, 301—302.

FIVE grms. of calcined magnesite or 10 grms. of the natural product is digested with hydrochloric acid, and ammonia added to the hot solution until a persistent turbidity is produced. The liquid is then boiled, allowed to settle, and filtered, the filter ignited, and silica determined in the residue after treatment with hydrochloric acid. In the filtrate aluminium and iron are determined and in the filtrate from these, together with that from the first operation, the lime and magnesia are determined in the usual way. The magnesium is more conveniently weighed as the double phosphate dried at 100° C. than as the pyrophosphate after ignition. The calcium is preferably precipitated as sulphate in presence of alcohol, or the following rapid method of separating it for estimation may be used: A hydrochloric acid solution of the mineral, containing not more than traces of free acid, is introduced, together with the insoluble residue, into a measuring flask, the volume made up to the mark with water, and ammonia solution added. The flask is then closed and the liquid mixed and allowed to settle, the calcium being determined in an aliquot part of the clear liquid. This procedure gives concordant results which are rather lower than those obtained when the calcium is precipitated in presence of magnesium.—T. H. P.

Bromate and iodate; Iodometric estimation of ——. I. M. Kolthoff. Pharm. Weekblad, 1919, 56, 426—438.

IN the titration of bromate-iodide solution with thiosulphate solution it is essential that sufficient

acid be present if titration is performed immediately after the addition of the iodide. A minimum concentration of *N*/2 for hydrochloric acid is required and of *N*/1 for sulphuric acid. When too little acid is present thiosulphate is oxidised by bromate directly to sulphate The error arising from this cause may be avoided by postponing titration for a few minutes until the reaction between bromate and iodide is complete, or by catalysing the reaction by the addition of ammonium molybdate. This catalyst is effective both in strongly acid and in weakly acid solutions. The reaction between iodate and iodide takes place much more rapidly than that between bromate and iodide, hence the above precautions are unnecessary in estimating iodates iodometrically.—W. S. M.

Manganates and permanganates. I. Course of the reaction between manganese dioxide, potassium hydroxide, and oxygen, and the manufacture of potassium manganate. H. I. Schlesinger, R. D. Mullinix, and S. Popoff. J. Ind. Eng. Chem., 1919, **11**, 317—323.

When manganese dioxide is heated with potassium hydroxide in a current of air to produce potassium manganate, the reaction frequently stops before the maximum oxidation stage has been reached; this may be avoided by moistening and re-heating the mixture. The use of moist air is also recommended. The yield of potassium manganate varies with the proportion of potassium hydroxide present; at about 300° C., practically all the manganese dioxide is converted into manganate when 2·5 mols. of potassium hydroxide is used for each mol. of manganese dioxide. The statements by Sackur (see this J., 1910, 347; 1911, 487) that in this reaction mangani-manganates and not manganates are always formed, and that the maximum yield is only 60%, are incorrect. Larger proportions of alkali, however, decompose the manganate into a mangani-manganate similar to that postulated by Sackur. The yield of manganate is lowered considerably if sodium hydroxide is substituted for potassium hydroxide. It is important to pulverise the manganese ore very finely and to keep the mixture in a fine condition in the kilns in order to obtain the highest possible yields. Recovered manganese dioxide sometimes gives low yields, but its effectiveness for the manufacture of manganate may be restored by washing it with water or boiling it with dilute nitric acid.—W. P. S.

Seaweeds; Investigation of German ——. R. Albert and M. Krause. Chem.-Zeit., 1919, **43**, 97—99.

By boiling the stalks of various species of *Fucus* with water or very dilute acetic acid under pressure, up to five atmos., the external pectinous layer was removed, and the fibres liberated. Attempts to use these for textile purposes have as yet been inconclusive. Preliminary experiments on the utilisation of seaweeds in the manufacture of alcohol were unsuccessful. On the other hand not only species of *Fucus*, but also various species of *Laminaria*, especially *L. saccharina* and *L. digitata*, are suitable for fodder, and, after drying, can be ground to a coarse powder which keeps well. Of the various algæ examined the only one which appeared suitable for the manufacture of agar-agar was *Chondrus crispus*. The amount of ash obtained from various kinds of seaweeds from Heligoland ranged from 17·7% in *F. serratus* to 52·37% in the roots of *L. hyperborea*, whilst the ash contained the following amounts of iodine:—*L. hyperborea*, roots, 1·095; stalks, 2·962; leaves, 4·247; *L. saccharina*, leaves, 0·32 and 0·97; *Halidrys siliquosa*, 1·03; *Ascophyllum nodosum*, 0·79; *Himanthalea lorea*, 0·004; *F. serratus*, 0·536; *F. vesiculosus*, 0·187 and 0·217; *L. digitata*, 1·46 and 2·55; *Chondrus crispus*, 0·3%; and *Ceramium rubrum*, traces. It is estimated that about 10,000 tons of the dried palm seaweed (*L. hyperborea*) would supply the whole of the German demand for iodine, and of this quantity at least 1000 tons could be obtained from Heligoland. With reference to the proposed extraction of potash from seaweeds in the United States it is pointed out that in 1913, 1,000,000 tons of potassium salts was imported into that country from Germany, and that to obtain that quantity about 90,000,000 tons of fresh seaweed would be required. After extraction of the iodine, the most rational course is to use the whole of the residual ash as a fertiliser. By carbonising seaweed in closed vessels considerable quantities of ammonia and acetic acid may be obtained (*e.g.* 25—40 kilos. of ammonium sulphate and 3—9 kilos. of calcium acetate from one ton of air-dried seaweed).—C. A. M.

Selenium and its applications. L. Aucel. Chim. et Ind., 1919, **2**, 245—259.

An account is given of the methods in use for extracting selenium from its ores. All the scientific and technical applications of selenium, with one or two minor exceptions, depend upon the increase of the electrical conductivity of the element under the influence of light. The different allotropic forms differ widely in their sensitiveness to light, and attention is particularly directed to the very sensitive variety of vitreous selenium previously described by the author (this J., 1915, 379). Descriptions of different types of selenium cells are given, and of the methods used for determining their sensitiveness. Selenium cells have been used successfully for controlling the draught in factory chimneys. A selenium cell is placed in a suitable position in the chimney, and is illuminated by a lamp situated on the opposite side of the flue. The amount of light falling on the cell, influenced by the quantity of smoke passing between the lamp and the cell, determines the strength of the current passing through the cell, and the current variations are indicated by a recording galvanometer. The same principle has been applied to the control of the manufacture of sulphuric acid by the contact process, the degree of transparency of the gases in the reaction tube being recorded by means of a selenium cell and galvanometer. An account is also given of experiments on the use of selenium cells for wireless telephonic and telegraphic purposes, for determining the position of hostile artillery, for the telegraphic transmission of illustrations and pictures, and for recording variations in the intensity of the light emitted by the sun during an eclipse. Selenium has also been used in place of sulphur for vulcanising rubber, and in glass to obtain a pale violet colour.—E. H. R.

Decarbonation of dolomite. Eakins. *See* IX.

Ammonia from liquid manure etc. Lemmermann and Wiessmann. *See* XVI.

Calomel. Duret. *See* XX.

Precipitation of sulphates. Koelsch. *See* XXIII.

Patents.

Sulphuric acid; Chambers used in the manufacture of ——. W. G. Mills, C. T. Packard, and E. Packard and Co., Ltd., Ipswich. Eng. Pat. 124,852, 15.1.18. (Appl. 872/18.) Addition to Eng. Pat. 12,067, 23.5.13.

The lead chamber of the shape of a frustum of a cone or a pyramid for the manufacture of

sulphuric acid described in Eng. Pat. 12,067 of 1913 (this J., 1914, 692) is fitted with one or more vertical cooling shafts open both at the top and bottom. The walls of the shaft slope inwards from top to bottom and are supported by a framework in a similar manner to the walls of the chamber. Water is caused to flow down the sides of the shaft and of the chamber, and the lead rings supporting the sides to the framework form troughs out of which the water flows through orifices into a gutter beneath with a notched edge, thus causing an even distribution. Gases are led into the chamber through a sloping inlet directed towards the floor, and pass out by a pipe at the top.—L. A. C.

Hydrogen fluoride; Process of making —. R. M. Catlin, Franklin, N.J., Assignor to Catlin Shale Products Co., Wilmington, Del. U.S. Pat. 1,293,703, 11.2.19. Appl., 9.6.17.

Solutions containing fluorine in combination with silicon are treated with an iron oxide and filtered. The ferric fluoride, obtained from the filtrate by crystallising, is treated with superheated steam and the evolved hydrogen fluoride absorbed in water.—B. V. S.

Hydrofluoric acid; Apparatus for condensing and utilising —. R. S. Sherwin, East St. Louis, Ill., Assignor to Aluminium Co. of America, Pittsburgh, Pa. U.S. Pat. 1,294,546, 18.2.19. Appl., 13.1.15.

The apparatus comprises two or more absorption towers of material resistant to hydrofluoric acid, which are fitted with transverse baffle-plates placed successively further apart from the top downwards. Absorbing liquid is introduced at the top of each tower, flows over the baffle-plates, and is discharged from the bottom of the tower, which stands in a liquid seal to exclude air. The inlet and outlet are provided with independent means of cooling the liquid as it enters and leaves the tower. Gas is admitted near the bottom of the first tower and is withdrawn, by a suction apparatus placed at the end of the series, from an outlet near the top, whence it is conveyed to the bottom of the second tower. The liquid drawn from the bottom of the second tower is collected for recirculation through the tower.—S. S. A.

Ammonia; Production of — from cyanamide. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. Eng. Pat. 120,034, 23.7.18. (Appl. 12,000/18.) Int. Conv., 4.10.17.

In the production of ammonia by heating calcium cyanamide and sodium carbonate with water in an autoclave, the water is preheated to at least 40° C. before it is brought in contact with the calcium cyanamide.—L. A. C.

Aluminium hydroxide and ammonium sulphate; Production of pure —. J. P. A. Larson and W. D. Bergman, Stockholm. Eng. Pat. 120,550, 26.5.18. (Appl. 13,873/18.) Int. Conv., 9.10.17.

Aluminous material containing also silicon and iron compounds is treated with sulphuric acid, the solution treated with sulphurous acid or other suitable reducing agent, heated to about 100° C., and mixed with the calculated quantity of ammonium sulphate. The resulting solution of ammonium alum is freed from undissolved matter and allowed to crystallise, with stirring, so as to separate the alum as a fine powder. This is washed and treated with ammonia and the aluminium hydroxide and ammonium sulphate separated by the usual means.—B. V. S.

Sulphate of ammonia; Manufacture of —. J. T. Sheard, Birley Carr. Eng. Pat. 124,946, 13.5.18. (Appl. 7972/18.)

The free acid content of ammonium sulphate is reduced to 0·14% by directing a spray of water on to the mass as it is discharged from the saturator on to the drainer, thereby diluting the acid mother liquor enveloping the crystals.—S. S. A.

Mercuric oxide; Manufacture of —. Elektrizitätswerk Lonza, Assignees of E. Kuhn, Basle, Switzerland. Eng. Pat. 122,195, 6.1.19. (Appl. 388/19.) Int. Conv., 7.1.18.

Mercury is dropped into liquid N_2O_4 contained in a closed cast iron vessel provided with a reflux condenser and agitator, and oxygen is passed in simultaneously, mercurous nitrate being formed. On completion of the reaction the condenser is disconnected, and the excess of N_2O_4 is distilled over to a similar vessel. The remaining mercurous nitrate is decomposed by heat, with agitation, and the NO_2 evolved collects as N_2O_4 in the second vessel.—S. S. A.

Zinc oxide furnaces or kilns. A. T. Mirza, Bombay, India. Eng. Pat. 124,038, 11.3.18. (Appl. 4272/18.)

Metallic zinc is placed on an iron plate which forms the bottom of an oven heated from below, the zinc being kept at about its melting point. A stream of air, heated by passing through pipes in the upper part of the furnace chamber, is directed across the surface of the hot zinc. A rotary stirrer keeps the mass in motion and ensures complete oxidation.—B. V. S.

Potassium salts; Separation and recovery of — from commercial nitrate of soda containing such salts. F. A. Freeth, Great Crosby, and H. E. Cocksedge, London. Eng. Pat. 124,513, 25.2.16. (Appl. 2817/16.)

Crude sodium nitrate containing potassium salts is digested with sufficient water or liquor from a previous extraction to dissolve the potassium salts and to yield a solution saturated or nearly saturated with the potassium salts. The temperature of digestion should be as high as practicable. The solution is separated from the undissolved sodium nitrate at the temperature of digestion, and, if saturated with potassium salts, it is diluted with sufficient water to keep the sodium nitrate in solution at the temperature to which the solution is to be cooled; it is then cooled to the desired temperature, when pure potassium nitrate crystallises out. If the solution is not saturated with potassium salts, it is concentrated until it is saturated at a high temperature, *e.g.*, 100° C., and, after removal of any sodium nitrate which crystallises out, it is treated as before.—L. A. C.

Potassium nitrate; Separation of — from sodium nitrate. C. W. Bailey, H. S. Denny, and A. T. Jefferis, Langwith. Eng. Pat. 124,960, 5.6.18. (Appl. 9283/18.)

Crude Chile saltpetre is lixiviated with a hot solution of sodium and potassium nitrates, thereby extracting potassium nitrate from the crude salt and obtaining a liquor which on cooling deposits a mixture of sodium and potassium nitrates from which sodium nitrate is removed by treatment with water, leaving a residue of potassium nitrate practically free from sodium salt. For example, the crude nitrate is lixiviated at about 65° C. so as to obtain a liquor containing 100 parts by weight of sodium nitrate, 100 parts of potassium nitrate,

and 50 parts of water, which on cooling deposits 20 parts by weight of sodium nitrate and 50 parts of potassium nitrate. The precipitated salts on treatment with 10 parts by weight of water, yield a liquor containing 20 parts by weight of sodium nitrate, 10 parts of potassium nitrate, and 10 parts of water, leaving a residue of 40 parts of potassium nitrate. The united filtrates are used for the lixiviation of further quantities of crude nitrate.—S. S. A.

Sodium nitrate and potassium nitrate; Process for separating ——. G. C. Given and R. H. Barteaux, Tamaqua, Pa., Assignors to Atlas Powder Co., Wilmington, Del. U.S. Pat 1,294,788, 18.2.19. Appl., 11.7.18.

A SOLUTION of the two salts is evaporated under reduced pressure at a temperature between 80° C. and 95° C. to effect fractional crystallisation of the two salts.—S. S. A.

Alumina, sodium and potassium aluminates, sodium and potassium carbonates, and potassium chloride; Process for the manufacture of ——. E. E. and P. C. Dutt, Jubbulpore, India. Eng. Pat. 124,553, 22.3.18. (Appl. 5072/18.)

THE process is a combination of the processes described in Eng. Pats. 116,438, 118,155, and 118,156 (this J., 1918, 466 A, 580 A), a duplex rotary furnace consisting of two rotary chambers connected by a flue being used for carrying out the reactions. Arsenious oxide vapour is led into the first chamber which is charged with a mixture of 800 parts of calcined clay containing 30—35% Al_2O_3 and 350 parts of sodium chloride or 450 parts of potassium chloride. The arsenious chloride generated passes into the second chamber which is filled with small pieces of felspar, and the arsenious oxide regenerated passes out with the waste gases and is condensed in a series of flues. The residues from the chambers are treated separately as described in the previous patents.—L. A. C.

Alumina, sodium and potassium carbonates, sodium and potassium aluminates, magnesia, and calcium chloride; Process for the manufacture of ——. E. E. and P. C. Dutt, Jubbulpore, India. Eng. Pat. 124,554, 22.3.18. (Appl. 5073/18.)

IN the process described in Eng. Pat. 124,553 (see preceding abstract), the second chamber is charged with dolomite instead of with felspar, and the arsenious chloride generated in the first chamber is mixed with steam as it passes along the flue connecting the two chambers, with the formation of hydrochloric acid and arsenious oxide. The dolomite, which is heated to 450°—650° C., is converted into magnesia and calcium chloride.

—L. A. C.

Potash; Process for obtaining water-soluble ——. W. D. Richardson, Chicago, Ill. U.S. Pat. 1,295,601, 25.2.19. Appl., 28.8.15.

INSOLUBLE silicate rock containing potash is mixed in the presence of water with a fluoride-bearing mineral and an acid capable of decomposing the fluoride, the interaction of the ingredients being maintained without the external application of heat.

—S. S. A.

Calcium nitrate; Manufacture of —— from calcium chloride and sodium nitrate. J. G. Gillbert, London. Eng. Pat. 124,780, 27.3.16. (Appl. 4483/16.)

EQUIVALENT amounts of calcium chloride and sodium nitrate are dissolved in the concentrated mother liquor from a previous operation, the quantities being adjusted to yield a solution saturated with respect to calcium nitrate and sodium chloride at as high a temperature as may be practicable, *e.g.*, 80° C. The precipitate of sodium chloride is removed at or slightly above that temperature, and sufficient water added to the liquor both to adjust the ratio of sodium chloride to water to that in the original solution and also to provide four mols. of water for the excess calcium nitrate present. Calcium nitrate tetrahydrate is precipitated when the solution is cooled below 30° C., and is removed and washed with a little water or calcium nitrate solution. The mother liquor is then concentrated sufficiently to remove the water added to adjust the ratio of sodium chloride to water and used again in the cycle of operations.

—L. A. C.

Manganese dioxide; Manufacture of ——. E. E. and P. C. Dutt, Jubbulpore, India. Eng. Pat. 124,977, 25.6.18. (Appl. 10,478/18.)

A MIXTURE of manganese ore (*e.g.*, pyrolusite) and sodium or potassium hydroxide is roasted at 600°—750° C. in a current of air in a reverberatory furnace, thereby producing sodium or potassium manganate. On dissolving the cooled mass in water, the alkali manganate passes into solution, and any ferrite present is decomposed yielding ferric and alkali hydroxides. The manganate solution is decanted from the insoluble matter (iron and silica), evaporated to dryness, and heated at 500° C. in a current of steam in a retort. A mixture of manganese dioxide and alkali hydroxide is produced which is lixiviated with water, and the residual manganese dioxide is washed free from alkali and dried.—S. S. A.

Acid alkali sulphates; Recovery of acid from ——. G. S. Rogé, Madras, India. Eng. Pat. 124,988, 9.7.18. (Appl. 11,253/18.)

ABOUT 5% of pulverised charcoal or sawdust is incorporated with acid sodium sulphate and the mixture is formed into lumps or slabs which are burned in a kiln with free access of air, the acid gases being collected in the usual manner. S. S. A.

Hydrogen; Apparatus for the manufacture of ——. T. D. Mackie, Pulham St. Mary, Norfolk. Eng. Pat. 124,798, 5.4.16. (Appl. 5036/16.)

A WATER-GAS generator is surrounded by an annular cast iron chamber containing iron ore or iron oxide, around which are flues in which waste gases from the generator circulate freely, the heating of the chamber being regulated by secondary air supplies. Heat regenerators, worked on the Siemens principle, for heating the air required for blowing the generator and the secondary air, and a steam superheater are also built around the generator. The annular chamber is provided at the bottom with inlet valves for the admission of water-gas and steam, and with outlet pipes for hydrogen at the top. The water-gas passes at first into a holder, and when sufficient has been made and the iron ore is at 700°—800° C., water-gas is admitted at the bottom of the ore chamber until the ore is reduced, when the supply of water-gas is shut off and steam is admitted, the hydrogen generated being led into a holder. Reduction of the ore and production of hydrogen are carried out alternately until the water-gas is used up, the necessary temperature within the ore chamber being maintained by the heat from the generator.

—L. A. C.

Hydrogen/nitrogen mixture; Manufacture of a ——. E. B. Maxted and G. R. Ridsdale, Walsall. Eng. Pat. 124,824, 27.4.16. (Appl. 6026/16.)

COMMERCIAL water-gas is freed from carbon dioxide, moisture, and other less volatile impurities by

suitable means, and is then cooled to about −195° C. During the earlier stages of the cooling the last traces of moisture etc. separate out and are removed; on cooling below −190° C. a considerable proportion of the carbon monoxide is also removed as liquid. The residual gas is then passed into a separating column in which it is subjected to the action of a descending stream of liquid nitrogen which liquefies the last traces of carbon monoxide. The liquid carbon monoxide collects at the bottom of the apparatus and a mixture of pure hydrogen and nitrogen issues from the top. The process is applicable to the separation of hydrogen from other gases, *e.g.*, methane.—L. A. C.

Nitrogen from air; Process for obtaining ——. N. C. Tommasi, Basle, Assignor to Usines Electriques de la Lonza, Gampel, Switzerland. U.S. Pat. 1,295,635, 25.2.19. Appl., 15.6.17.

See Ger. Pat. 302,671 of 1916; this J., 1918, 335 A.

Tank for transporting acid. Eng. Pat. 124,997. *See* I.

Copper or nickel sulphates. Eng. Pat. 116,263. *See* X.

Removing nitrous and nitric acids from sulphuric acid. Eng. Pat. 17,541. *See* XXII.

VIII.—GLASS; CERAMICS.

Selenium and its applications. Ancel. *See* VII.

Patents.

Furnaces for glass manufacture and like purposes. T. B. Kilson, Leeds. Eng. Pat. 124,273, 20.3.18. (Appl. 4922/18.)

A glass furnace is connected to one or more auxiliary furnaces each heated by separate gas burners supplied with air which is preheated by passing it through a flue above the auxiliary furnace or through a regenerator connected to the main furnace. Each auxiliary furnace has one or more gathering troughs which are heated by passing the waste gases from the auxiliary furnaces over the outflowing glass so as to keep it properly fluid. By this means, the working of the main furnace is largely independent of the auxiliary furnaces provided that sufficient glass is supplied to the latter. The temperature of the glass in each trough can be independently regulated.—A. B. S.

Glass-melting furnaces. H. C. Ghijsen, and Naaml. Vennoots. The Vitrite Works, Middelburg, Holland. Eng. Pat. 124,307, 9.4.18. (Appl. 6057/18.)

A glass-melting furnace has a melting chamber with an inclined floor, the lower end of the floor being less steeply inclined than the upper portion; the roof of the chamber is also inclined and is stepped internally and provided near its lower end with gas-burners for melting the lower part of the charge. The molten glass is discharged continuously and portions are cut off at equal intervals of time by a pair of blades operated by suitable gearing.—A. B. S.

Glass furnace. W. Westbury, Assignor to L. S. Skelton, Okmulgee, Okla. U.S. Pat. 1,294,581, 18.2.19. Appl., 26.6.17.

The forehearth of a glass-drawing furnace is provided with a drawing opening in its top wall and with a "conductor" embedded in the top wall and extending around the rear and sides of the drawing opening, the ends of the "conductor" projecting outwards at the front of the forehearth.—A. B. S.

Glass. H. P. Gage, Corning, N.Y., Assignor to Corning Glass Works. U.S. Pats. (A) 1,295,298 and (B) 1,295,299, 25.2.19. Appl., 21.7.16.

A glass for use as a filter to produce daylight effects from artificial light sources consists of (A) a potash borosilicate glass containing copper and nickel and free from soda or (B) a potash or potash-lead glass containing copper, cobalt, and manganese.—A. B. S.

Glass cylinders; Methods of drawing hollow ——. W. L. Monro, Assignor to Window Glass Machine Co., Pittsburgh, Pa. U.S. Pat. 1,295,348, 25.2.19. Appl., 24.7.15.

A hollow bait, slightly cooler than the molten glass and having an internal grooved flange the inner wall of which is at an angle of at least 45°, is immersed in, and then held in or adjacent to, the molten glass sufficiently long for the glass to enter the groove and solidify therein, to form a hooked portion by means of which the glass can be withdrawn on raising the bait.—A. B. S.

Glass-annealing furnace. B. F. Morton, Hoboken, Pa. U.S. Pat. 1,295,564, 25.2.19. Appl., 13.9.18.

A glass-annealing furnace has a combustion chamber with several upper and lower arches and a muffle supported on the arches.—A. B. S.

Agglomerates of various materials [electrodes etc.]; Manufacture and utilisation of ——. T. Rouse, Stamford Hill. Eng. Pat. 124,262, 18.3.18. (Appl. 4776/18.)

The materials which are to form the electrodes or other agglomerates are mixed in a finely divided condition with from 4 to 7% of ferro boro silicate as described in Eng. Pat. 21,563 of 1910 (this J., 1911, 956). The mixture is treated with steam until it becomes plastic and is then moulded into suitable shapes. The moulded articles are subsequently submitted to a baking treatment at 600°—800° C. to render them hard and resistant to moisture.—W. H. C.

Kilns [for refractory materials]. W. Donald, Glasgow. Eng. Pat. 124,909, 12.4.18. (Appl. 6233/18.)

A gas-fired kiln of the continuous chamber type for burning magnesite bricks and other highly refractory goods has chambers arranged in two parallel rows with two main waste gas flues between them, one for each row of chambers. A mixture of gas and preheated air is introduced along either side of each chamber at as many points as there are flues connecting the successive chambers, so that each chamber is heated from both sides simultaneously. The general character of the heating in each chamber is "down-draught," the flames rising up each side of the chamber, passing downwards and through the perforated floor into a connecting flue beneath and into the "bags" of the succeeding chamber or into one of the main flues and thence to the chimney. The air for combustion is blown through a pipe placed longitudinally in the main waste gas flue, then into the flues under the floors of the chambers and up into the "bags" of the chamber where it is required. Alternatively, air may be blown through the coolest unopened chamber and thence through succeeding chambers until it reaches the one which is being fired.—A. B. S.

Kiln. H. Webster, Clinton township, Ohio, Assignor to Wester and Kincaid, Cincinnati, Ohio. U.S. Pat. 1,295,650, 25.2.19. Appl., 24.2.17.

A BRICK kiln of the continuous chamber type has a central main flue between the two series of chambers and valve-controlled branches from this flue to the sole of each chamber. The soles are provided with intersecting longitudinal and transverse grooves, which act as fuel-troughs, and with openings into the branch flues. The fuel is supplied through feed-holes in the top of each chamber.
—A. B. S.

IX.—BUILDING MATERIALS.

Dolomite limestone; Decarbonation of —— in the rotary kiln. E. E. Eakins. J. Ind. Eng. Chem., 1919, **11**, 340.

IN a rotary kiln, 150 ft. long and 6·5 ft. diameter inside the lining, and making one rotation in 1 min. 40 secs., the first decomposition took place about 100 ft. from the discharge end; this decomposition was entirely that of magnesium carbonate and increased gradually up to a point 30 to 40 ft. from the discharge. At this point, calcium carbonate commenced to decompose, giving free lime. The production of calcium oxide took place entirely in the last 30 or 40 ft. of the kiln and was not complete until the last 10 ft. had been reached. It was not possible to measure the temperature inside the kiln, but the gas at the port just before it entered the kiln had a temperature of 1500°—1600° F. (about 820° to 870° C.) whilst the flue gases varied from 1100° to 1300° F. (about 590° to 700° C.).—W. P. S.

Leaching cement mill flue dust. Anderson. *See* VII.

PATENTS.

Kilns. J. P. Scheffers and M. A. Van Roggen, Paris. Eng. Pat. 115,232, 16.4.18. (Appl. 6444/18.) Int. Conv., 26.4.17.

A VERTICAL kiln of the continuous type, for burning limestone, cement, gypsum, etc., is narrow and rectangular in horizontal cross section and is provided at the top with a loading chamber also rectangular in cross section and flaring upwards from the upper edge of the burning chamber. The walls of the burning chamber are provided with side openings and burners are placed in the upper openings. Two such kilns may be arranged side by side in a setting so that between and adjacent to the outer sides of the burning chambers, air chambers containing the supply pipes for the burners are formed. Cooling air may be supplied from these chambers through the lower side openings to cool the material as it passes downwards from the burning zone to the discharge opening. The heated air in the air chambers passes upwards through conduits in the dividing walls of the loading chambers, and is discharged into an annular space at the top which is provided with an inclined perforated wall through which the hot air passes into and then through the material in a storage chamber above the kilns.
—W. F. F.

Mineral [slag] wool; Manufacture of ——. G. A. Herdman, Redcar. Eng. Pat. 124,650, 26.6.18. (Appl. 10,538/18.)

AN apparatus for making mineral wool comprises a modified Willow or Teaser machine in which a drum provided with prongs revolves in a casing also provided with prongs on part of its inner surface and with an opening at the bottom. The slag wool passes between the drum and casing and falls on to a vibrating screen which separates the "shot" or slag pellets. Alternatively, the wool is passed through an inclined rotating cylinder of wire gauze or perforated metal, provided with baffles and a sufficient number of prongs to carry the wool round whilst the cylinder rotates very slowly and to allow it to drop when it reaches the highest point in its path. The material is discharged from the cylinder on to a vibrating screen as before. Owing to the more complete separation of the slag pellets, the product is much lighter than ordinary mineral wool without having lost any of its characteristic properties.—A. B. S.

Pavement, road-making and the like materials; Waterproofing ——. J. Baker, jun., Chicago, Ill., U.S.A. Eng. Pat. 121,851, 7.12.17. (Appl. 18,171/17.)

MATERIALS for pavements, roads, etc., are thoroughly saturated with a waterproofing agent which is also a binder, the mass being heated *in vacuo* during the mixing operation until the moisture has been expelled, after which steam under pressure is introduced until the waterproofing agent such as bitumen, paraffin, tar, or tar products has permeated the materials to the desired extent. The product is more durable than when only the surface has been made waterproof.—A. B. S.

Wood; Process of treating ——. C. H. Teesdale, Madison, Wis. U.S. Pat. 1,295,828, 25.2.19. Appl., 20.1.17.

WOOD is preserved by saturating it with a fluid preservative and removing the latter from the exterior of the wood by means of heat and partial vacuum.—A. B. S.

Lime-sand bricks; Manufacture of mixtures for ——. C. F. Neumann, Geesthacht. Ger. Pat. 309,708, 6.11.17.

GROUND lime is mixed mechanically with a portion of the sand and with water; the mixture is transferred to an open vessel or a slowly moving conveyor in which the slaking of the lime is completed, after which the remainder of the sand is added and the product mixed thoroughly. It is claimed that less lime is required by this method of mixing.
—A. B. S.

Mixing concrete etc. Eng. Pat. 124,961. *See* I.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Coal washing; Advantages of efficient —— as reflected in the manufacture of iron and steel. W. H. Graham. Trans. Canadian Min. Inst., 1918, **21**, 231—239.

BY the use of coal in which the proportions of pyrites, shale, etc. have been reduced to fairly low and definite limits by efficient washing, coke of uniform sulphur and ash content is obtained, and the capacity of coke-oven plant is increased by reason of the greater gas value per unit of coal charged. In the iron blast-furnace, better results are obtained with such coke than with coke produced from raw coal; less lime is required for fluxing, the quality of the pig is better and more uniform as regards silicon and sulphur contents, and a greater output is obtained by reason of the higher calorific value of the fuel. In the open-hearth furnace, the time necessary to finish the steel is determined to a large extent by the quality and uniformity of the pig charged.—W. E. F. P.

"Nicu" steel and its manufacture. G. M. Colvocoresses. Trans. Canadian Min. Inst., 1918, 21, 48—75.

HITHERTO, Sudbury ore, containing (average for 1916) Ni 3·25, Cu 1·7, Fe 40, S 25, SiO_2 20, Al_2O_3, CaO and MgO 10%, has been treated mainly as a nickel-copper ore, with the result that the whole iron content has been wasted, while only about 80% of the nickel and 83% of the copper have been recovered. Most of the nickel obtained has been subsequently recombined with iron for the production of nickel steel. In the "Nicu" process the ore is treated as an iron ore containing nickel and copper, for the direct production of an alloy pig-iron which is subsequently refined to produce nickel-copper ("Nicu") steel. The ore, the composition of which is adjusted by proper mixing of the various grades, is crushed to about ½ in. size and roasted, and the product (containing not more than 0·5% S) is smelted with coke and limestone. Up to the present the smelting has been conducted only in electric furnaces, but successful blast-furnace operation is anticipated. The pig produced was at first converted into steel in an electric furnace; but later an ordinary open-hearth furnace was employed, under ordinary steel-making conditions, with complete success. In a trial on weathered, low-grade ore containing Fe 46·0, Ni 1·3, Cu 0·28, SiO_2 19·0, and S 8·0%, a pig was produced containing Ni 2·20, Cu 0·40, Mn 0·18, Si 1·75, C 3·0, S 0·09, and P 0·07%, from which a steel containing Ni 2·13, Cu 0·40, C 0·20, Mn 0·51, S 0·03, Si 0·03, and P 0·006% was produced in the open-hearth furnace. This steel practically fulfilled the conditions required by the British Government standard 2% nickel case-hardening steel as regards chemical composition and physical tests. Similar agreement was obtained in comparative tests on 3·5% nickel+copper (Nicu) steels and various commercial 3·5% nickel steels; while Nicu steel containing 2·25% Ni and 0·75% Cu was found equal in all respects to commercial nickel steels containing 3% Ni. Nicu steels in which the proportion of copper does not exceed ⅓ or ¼ of the nickel present are the most satisfactory in practice, and the copper content should preferably not exceed 1% if the steel is to be used for the same purposes as the corresponding nickel steel. By the Nicu process, 98% of the nickel, 98% of the copper, and 96% of the iron in the ore are recovered. Without considering the sulphur, of which a recovery of 80% is anticipated, it is estimated that Nicu steel equivalent to 3% nickel steel could be produced at $30.00 (£6 5s.) per ton, whereas the selling price of the latter in normal times is more than twice that figure.—W. E. F. P.

Ferro-molybdenum; Manufacture of — in Canada. J. W. Evans. Trans. Canadian Min. Inst., 1918, 21, 154—160.

SINCE March 1916, 100,000 lb. of 70% ferro-molybdenum has been produced for the Imperial Munitions Board by the direct smelting of molybdenite concentrate at the works of the Tivani Electric Steel Co., Bellville, Ont. Vertical cylindrical furnaces of the single-phase type are employed, requiring 3000—4500 amp. at 50 volts per furnace. Each consists of an iron shell, lined with red brick, firebrick, silica brick, and carbon in succession, and resting on a concrete foundation. The lower electrode consists of a water-cooled bronze or copper block from which iron rods project upwards into the furnace bottom, and the upper electrode of a graphite or carbon rod. For the production of 70% alloy from concentrate containing MoS_2 75 and Fe 9%, the charge consists of concentrate 100, lime 120, coke 10, and scrap steel 5 lb. Each furnace is tapped every 4 hrs., the output being 1050 lb. of alloy per 24 hrs. During the two years in which the plant was operated for the production of ferro-molybdenum containing Mo 70, S 0·4, C 4·0%, the average composition of the product was Mo 70·43, S 0·38, and C 3·56%. Details of the methods employed in the analysis of the alloy and concentrate are appended. —W. E. F. P.

Uranium; Determination of — in alloy steels and ferro-uranium. G. L. Kelley, F. B. Myers, and C. B. Illingworth. J. Ind. Eng. Chem., 1919, 11, 316—317.

Two grms. of the sample is dissolved in 75 c.c. of hydrochloric acid (1:1), the solution is oxidised with nitric acid, diluted, boiled, filtered to remove tungsten, and the filtrate evaporated and the silica and remaining traces of tungsten separated in the usual way. The solution is then evaporated to a syrupy consistence and the greater portion of the iron separated by extraction with ether. The residual liquid is diluted to 150 c.c., boiled with an excess of saturated sodium carbonate solution, and the precipitated chromium, iron, aluminium, manganese, cobalt, nickel, and copper hydroxides, together with traces of silica, titanic oxide, phosphorus and vanadium compounds are filtered off; if a large quantity of precipitate is obtained, it should be dissolved in hydrochloric acid and reprecipitated. The filtrate is acidified with sulphuric acid, boiled to expel all carbon dioxide, ammonia free from carbonate is added in slight excess, and the solution boiled. Uranium, with much of the vanadium, is precipitated; if much phosphorus is present, the precipitate should be dissolved in nitric acid, and the phosphoric acid separated by means of molybdic acid reagent. The filtrate from the ammonium phosphomolybdate precipitate is treated with a few drops of sulphuric acid and a small amount of ammonium persulphate, then rendered ammoniacal, and boiled. The precipitated uranium mixed with vanadium is transferred to a beaker, a small quantity of water is added followed by solid ammonium carbonate, the mixture is warmed, filtered, the filtrate acidified with sulphuric acid, boiled to expel carbon dioxide, treated with a slight excess of ammonia, and the precipitated uranium and vanadium collected, ignited in a platinum basin, and weighed as U_3O_8 and V_2O_5. To correct for the amount of vanadium (the quantity thus precipitated is only a small proportion of that contained in the metal), any of the usual methods for determining vanadium may be used; *e.g.*, reduction with hydrochloric acid and titration with permanganate solution, or oxidation with ammonium persulphate and silver nitrate followed by electrometric titration.—W. P. S.

Stellite [cobalt-chromium-tungsten alloys]; Production and uses of —. S. B. Wright. Trans. Canadian Min. Inst., 1918, 21, 272—277. (See also this J., 1915, 1058; 1917, 1238.)

STELLITE is prepared by melting cobalt, chromium, and tungsten together in electric tilting furnaces of the arc type, in which the lower electrode is in contact with the metal bath. Current at 50 volts is employed at starting; and, when the furnace is running smoothly, the voltage is increased to 100, the average ampèrage being about 80. The charge is poured, at about 1550° C., into graphite moulds, and the bars or shapes are first trimmed and then ground on alundum and carborundum wheels. For cutting tools the alloy is made in three grades of hardness; a special grade, which has been employed recently with marked success for boring cylinders used in aeroplanes, is to be placed on the market shortly. In addition to the above uses, for which the alloys have been found superior to high-speed tool steels, stellite is largely employed in the manufacture of automobiles, and a malleable form, of modified composition, is used for making cutlery, surgical instruments, and similar articles.—W. E. F. P.

***Metallurgical furnaces; Heating of* ——.** L. Lecocq. Chim. et Ind., 1919, **2**, 260—270.

COMPARATIVE experiments have been made on the use of (*a*) mixed gas (producer gas) and (*b*) coke-oven gas for firing metallurgical reheating furnaces, the experimental furnace used being an iron and steel reheating furnace of the simple recuperative type. It is shown by means of thermal balance sheets and cost calculations that the use of coke-oven gas offers considerable advantages both to the metallurgist and the coke manufacturer.—E. H. R.

Reduction of oxides by carbon; Equilibria in the ——. R. E. Slade and G. I. Higson. Chem. Soc. Trans., 1919, **115**, 205—214.

A SMALL quantity of a metal was heated in a vacuum to a suitable temperature and carbon monoxide was admitted until the equilibrium pressure was exceeded, when the gas entered into reaction with the metal forming carbon and the metallic oxide until the equilibrium pressure was attained; some of the carbon monoxide was then removed, when the reverse action occurred until the equilibrium pressure was restored. If the carbon liberated in the first stage separated as an independent phase the final pressure would be the same in both cases, but if it formed a carbide or a solid solution with the metal, the system would possess two degrees of freedom and the two equilibrium pressures would be of different magnitude. In order to avoid complications arising from the balanced action between carbon monoxide and carbon dioxide it was necessary to have an appreciable equilibrium pressure, but not greater than 50 mm., at 850° C. From thermodynamic considerations elements satisfying these conditions must have a heat of oxidation between 75,000 and 111,000 calories, and the only elements of which the heat of oxidation lies definitely within this range are silicon, boron, and manganese, whilst vanadium, tantalum, and chromium might also meet the requirements. For vanadium and carbon monoxide the equilibrium pressure was approximately 1·45 mm. at 1340° C., whether the equilibrium was attained from a pressure above or below. With tantalum the equilibrium pressure was only 0·1 mm. even at 1270° C. With chromium a definite equilibrium pressure was observed at each temperature, the value 9·2 mm. being recorded at 1339° C., whereas at 1292° C. two different values, *viz.* 4·4 and 6·2, were obtained according to whether the reagents had previously been heated to 1339° C. or not; this behaviour must be due to the substances in equilibrium being different in the two cases, the metal, indeed, probably being converted into a new form between 1292° and 1339° C. and retaining its new form after cooling. The apparatus used has already been described (Slade, this J., 1913, 31).—D. F. T

PATENTS.

Copper or nickel; Production of sulphates of* —— *from ores and minerals. F. Rigaud, Paris. Eng. Pat. 116,263, 18.3.18. (Appl. 4774/18.) Int. Conv., 12.5.17.

COPPER- or nickel-bearing minerals are made to pass, manually or mechanically, along a trough composed of several successive portions, some horizontal and some differently inclined, so as to admit of a slow flow of liquid and methodical lixiviation and draining. The mineral travels in a direction opposed to the flow of liquid, which contains sulphuric acid produced by the interaction of sulphur dioxide, steam, and air in presence of a portion of the solution obtained by lixiviation of the mineral, in a coil pipe. The solution containing copper or nickel sulphate is delivered to a heap of faggots arranged above an evaporating pan and flows into the evaporating pan and then into a crystallising pan.—T. H. B.

Brass; Recovery of —— from foundry ash and the like. C. H. White, Coventry. Eng. Pat. 124,019, 14.2.18. (Appl. 2653/18.)

THE residual ash left after pouring molten brass from crucibles is heated to 1050°—1250° C., and stirred. The metallic globules agglomerate and may be collected. A flux may be employed, if desired, to form a fusible slag on the surface to prevent oxidation.—C. A. K.

Metals [readily oxidisable]; Treatment of ——. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 125,046, 2.1.19. (Appl. 113/19.)

A READILY oxidisable metal (iron, copper, and the like) is heated under non-oxidising conditions in contact with aluminium powder to cause the aluminium to alloy with the metal at the surface. The metal is then heated further, *e.g.*, for about 6 hours at 1000° C., to cause the aluminium to diffuse throughout the metal, and afterwards again heated under non-oxidising conditions, in presence of aluminium powder, to cause a concentration of aluminium alloy at the surface.—T. H. B.

Rustproofing; Zinc-vapour —— . D. Daponte and T. F. Newman, London. Eng. Pat. 124,283, 21.3.18. (Appl. 5023/18.)

IRON or steel articles are coated with copper by a galvanoplastic process or by dipping in a suitable bath and are then subjected to a zinc vapour rust-proofing process.—T. H. B.

Galvanising; Dry —— . D. R. Ward, Assignor to The Ward Nail Co., Struthers, Ohio. U.S. Pat. 1,294,001, 11.2.19. Appl., 25.5.17.

ARTICLES are placed in a mixture of not more than 25% of finely divided graphite and 75% of pulverulent zinc, and heated in a closed container.

—C. A. K.

Zinc; Manufacture of —— . C. W. Crocker, Irvine. Eng. Pat. 124,621, 4.5.18. (Appl. 7505/18.)

ABOUT 1·5% of sodium carbonate (soda ash) is introduced as a flux into the charge in zinc distillation furnaces, in place of the sodium chloride commonly used. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 22,361 of 1896, 16,388 of 1898, and 10,915 of 1900; this J., 1897, 1021; 1899, 770; 1901, 724.)—T. H. B.

Zinc; Reverberatory furnaces for use in the recovery of —— from dross. J. Wilkes and H. E. Harris, Stockton-on-Tees. Eng. Pat. 124,978, 26.6.18. (Appl. 10,553/18.)

THE furnace has two fire-grates, the flame from one playing over the dross and the flame from the other playing on the metal which flows from the dross.—T. H. B.

Ores; Furnaces for roasting ——. R. Martin and J. I. Richards, Swansea. Eng. Pat. 124,540, 21.1.18. (Appl. 1174/18.)

IN a furnace for roasting ore, more particularly zinc ore, rabble-bars are arranged in groups, the blades of one group only being operative during

one stroke, and the blades of the other group during the succeeding stroke. The blades are of triangular form, obliquely set to the floor or shelf of the furnace, and the groups of rabble-bars are respectively attached to two slides having relatively opposed vertical movements, the slides being carried on a frame which is reciprocated to and fro horizontally, and suspended by links from a centrally pivoted cross-head. The swinging movement of the centrally pivoted cross-head takes place against the pressure of a buffer-like yielding device so that the slides may be set or locked in their adjusted positions.—T. H. B.

Tin; Process for melting — — and apparatus for use therein. G. H. Forrester, Iver, Bucks. Eng. Pat. 124,594, 3.4.18. (Appl. 5696/18.)

Tin, particularly that obtained from de-tinning processes, is fed into a vessel containing grease heated to the melting point of tin, in a vessel the lower portion of which is smaller than the upper portion and extends into a furnace the heat of which is prevented from acting directly upon the sides of the upper portion of the vessel.
—T. H. B.

Aluminium alloy. H. C. Hall, and Rolls-Royce, Ltd., Derby. Eng. Pat 124,683, 28.10.18. (Appl. 17,579/18.)

An alloy especially suitable for pistons of internal combustion engines consists of aluminium 91% or more, copper 4·5—6%, nickel 0·5—0·8%, zinc 0·8—1·2%, antimony 0·7—1·0%. The aluminium is of ordinary commercial purity containing, for instance, from 0·5%—0·9% of iron, and preferably less than 0·1% each of manganese, magnesium, and tin.—T. H. B.

Alloy. B. Hauss, Administratrix of D. J. Hauss, Aurora, Ind., Assignor to F. W. Galbraith. U.S. Pat. 1,293,426, 4.2.19. Appl., 26.6.16.

An alloy composed of aluminium 72 parts, zinc 24 to 25 parts, and copper 3 parts, and practically free from the oxides of these metals.—W. F. F.

Tungsten and similar metals; Process of extracting — from their ores. D. J. and J. E. Giles, McKeesport, Pa. U.S. Pats. (A) 1,293,402, (B) 1,293,403, and (C) 1,293,404. 4.2.19. Appls., (A), (B) 11.2.18., (C) 15.3.18.

(A) Tungsten ores are heated with a solution of sodium hydroxide with the formation of soluble sodium tungstate. A calcium salt is added to the clear solution at a fairly high temperature and calcium tungstate is precipitated and recovered. (B) The sodium tungstate solution is diluted, cooled, treated with a calcium compound to precipitate insoluble compounds of calcium, silica, and phosphorus, and after removing the precipitate calcium tungstate is precipitated by a further addition of the calcium salt to the heated solution. (C) After the removal of the calcium compounds of silica and phosphorus, an insoluble acid compound of the metal may be precipitated by the addition of an acid to the residual liquor.—C. A. K

Precious metals [platinum]; Recovery of —. R. E. Lyons, Bloomington, Ind. U.S. Pat. 1,293,828, 11.2.19. Appl., 20.3.13.

Platinum amalgam is obtained from platiniferous material associated with gangue by bringing the material into contact with mercury, zinc, and a substance capable of attacking zinc in the presence of the other materials.—C. A. K.

Solid castings; Process for producing —. J. B. Walker, Birmingham, Ala. U.S. Pat. 1,294,209, 11.2.19. Appl., 22.1.18.

A vent pipe is introduced into the head of the molten ingot or casting. The lower end of the pipe is of fusible metal and is filled with thermit and fluxing material, so as to increase the fluidity of the molten core of the ingot. Occluded gases are allowed to escape through the upper part of the pipe, which remains frozen in the ingot.
—C. A. K.

Metallic oxides; Process of treating —. J. W. Moffat, Toronto, Canada. U.S. Pat. 1,294,514, 18.2.19. Appl., 30.4.18.

Oxide ore is reduced without fusion and oxidising gases are excluded from the reduced material while its temperature would permit re-oxidation. The reduced charge is then placed in a separate electric furnace and fused in an inert or reducing atmosphere.—T. H. B.

Metals; Refining of —. J. B. Murray, Brooklyn, N.Y. U.S. Pat. 1,295,568, 25.2.19. Appl., 3.8.18.

The metal is heated to a welding temperature, under pressure, and the source of heat is then removed, but the pressure is maintained until after the metal has cooled below its critical temperature of structural change.—T. H. B.

Metal dust; Apparatus for manufacturing —. M. H. Newell, Assignor to The Alloys Co., San Francisco, Cal. U.S. Pat. 1,295,573, 25.2.19. Appl., 6.8.18.

The metal is vaporised in a retort attached to a condensing chamber; a hood forming part of the condensing chamber surrounds the mouth of the retort, the upper wall of the hood being spaced from the mouth of the retort so as to permit the vapour to cool before coming into contact with it.
—T. H. B.

Ore materials; Process for separating — from each other. R. S. Towne, New York, and F. B. Flinn, Orange, N.J., Assignors to Bubble-Column Corporation. U.S. Pat. 1,295,817, 25.2.19. Appl. 5.2.13. Renewed 20.11.18.

A vessel is charged with a pulp consisting of crushed ore, water, and a froth-producing and mineral-selecting agent, and a gas is introduced through a fine-texture porous medium into the pulp; certain mineral particles adhere to the bubbles rising through the pulp, and form a column above the pulp, the mineral thus floated being separated at the upper part of the column.—T. H. B.

Metallurgical furnaces; Roofs for —. P. J. Griffin, Toronto, Canada. Eng. Pat. 124,125, 17.6.18. (Appl. 9962/18.)

Tin and terne plates and other like metal-coated plates or sheets; Manufacture of — and machinery to be employed in said manufacture. H. S. Thomas, Llandaff, W. R. Davies, Whitchurch, and R. B. Thomas, London. U.S. Pat. 1,294,970, 18.2.19. Appl., 13.5.18.

See Eng. Pat. 28,450 of 1913; this J., 1915, 89.

Zinc; Extraction of —. H. L. Sulman and H. F. K. Picard, Assignors to The Metals Extraction Corporation, Ltd., London. U.S. Pat. 1,295,080, 18.2.19. Appl., 20.1.17.

See Eng. Pat. 104,697 of 1916; this J., 1917, 508.

XI.—ELECTRO-CHEMISTRY.

Electrical precipitation of tar fog. Davidson. *See* IIA.

Selenium and its applications. Ancel. *See* VII.

PATENTS.

Electric-arc furnace. I. Rennerfelt, Djursholm, Sweden. U.S. Pat. 1,291,830, 18.2.19. Appl., 24.8.16.

SEE Eng. Pat. 101,412 of 1916; this J., 1917, 1016.

Gas reactions. U.S. Pat. 1,291,745. *See* I.

Agglomerates [*electrodes*]. Eng. Pat. 124,262. *See* VIII.

XII.—FATS; OILS; WAXES.

Oil-bearing seeds; [Proteolytic] enzymes of ——. O. Fernandez. Anal. Fis. Quím., 1918, **16**, 728–741.

THE amino-acids formed by the autolysis of the macerated seeds in water at 37° C. were determined by measuring the nitrogen evolved on treating the solution with a solution of nitrosyl chloride in sodium chloride. By this method the existence of proteolytic enzymes in poppy, almond, filbert, peanut, hemp, walnut, pine kernel, and castor seeds was indicated. An alternative method was also applied. The macerated seed was mixed with water and toluene and the acidity of a portion determined by titration with *N*/20 barium hydroxide. To an equal volume of the extract formaldehyde was added, and after a time the acidity was again determined. The difference in the acidity is due to the amino-acid present. Enzyme action was especially marked in the case of poppy seeds.—W. S. M.

Fatty acids from lignite tar oil. Harries. *See* III.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Coumarone resins; Technical ——. J. Marcusson. Chem.-Zeit., 1919, **43**, 109–111, 122–123. (See this J., 1919, 295 A.)

COUMARONE resins dissolve completely or almost completely in acetone, whereas coal tar pitch, lignite pitch, wood tar pitch, and petroleum pitch are only sparingly soluble. They may be distinguished from phenol-aldehyde resins by their ready solubility in petroleum spirit, and by not yielding phenol when heated with soda-lime. Natural resins, such as colophony, sandarac, etc., melt at a higher temperature than coumarone resins, and have much higher acid, saponification, and iodine values, besides being optically active, whereas coumarone resins are optically inactive. The consistency is determined by determining the time in seconds taken by a wire nail 130 mm. long and 23 to 24 grms. in weight to sink vertically from the point to the head in the resin at 20° C. A resin which softens below 30° C. is classified as "soft" when the nail takes at least 500 secs. to penetrate the mass, and as "viscid" when the time is at least 100 secs. When the latter value is not reached the resin is classified as "fluid." Products which when distilled in a current of steam yield less than 35% of coumarone resin are termed coumarone resin residues. Distillation is necessary whenever the nail test gives 5 secs. or less. Free sulphuric and sulphonic acids are determined by Wolff's method (Farben-Zeit., 1917, 919), in which 10 to 20 grms. of the resin is dissolved in neutral benzene or xylene, the solution repeatedly extracted with warm water, and the aqueous extract filtered, acidified, and treated with barium chloride. The resinous constituents may be fractionated by successive treatment of the sample with alcohol-ether and with acetone. Three grms. of the resin is dissolved in 15 c.c. of ether, and the solution treated, drop by drop, with 45 c.c. of 96% alcohol. After being chilled for 30 mins. with ice-water the liquid is filtered, the precipitate washed with 15 c.c. of chilled 96% alcohol, the filtrate evaporated, and the residue weighed. The precipitate which contains the resinous constituents insoluble in alcohol and any asphaltic substances present is dried at a low temperature, and treated with acetone. The solution on evaporation leaves the resin, whilst the asphaltic substances are dissolved off the filter by means of chloroform or benzene, the solution evaporated, and the residue weighed. In the samples examined the amount of substances insoluble in acetone varied from 3·6 to 16·3%. With the exception of one abnormal sample, the amount of resins soluble in acetone but insoluble in ether-alcohol was 52 to 53% in the case of very hard resins, 12 to 44% in hard resins, 32 to 34% in resins of medium hardness, 15 to 30% in soft resins, and 5 to 7% in fluid resins. The method thus affords a means of confirming the tests of consistence and softness. Treatment of a solution of 5 grms. of coumarone resin in 50 c.c. of carbon tetrachloride with 3 c.c. of strong sulphuric acid effects a partial separation of oily and asphaltic substances from resinous constituents, but the unattacked portions are often still soft and viscid. Hence coumarone resins may contain two kinds of oil, one of which is readily attacked by sulphuric acid, whilst the other is resistant. Three modifications of polymerised indene may be present in coumarone resins, the first of which (m.pt. 210° C.) is sparingly soluble in ether, the second, melting at about 165° C., being readily soluble in ether, but sparingly soluble in ether-alcohol, whilst the third (m.pt. below 100° C.) is readily soluble in ether-alcohol. It is to the presence of this last modification and of other by-products that the relatively low melting-point (not above 65° C.) of technical coumarone resins is due. Of the oily constituents, the presence of styrol condensation products tends to make the product viscous. To improve the manufacture of coumarone resins and obtain a more uniform product a first essential is to remove as completely as possible the resin acids formed by the action of sulphuric acid on the tar distillate. An accumulation of oily substances in the coumarone resin may be prevented, if only that fraction of solvent naphtha boiling between 160° and 180° C. which contains coumarone and indene is used, and if the constituents which do not react with sulphuric acid are removed completely by treatment with steam, if necessary with the aid of reduced pressure. To avoid the formation of the modification of polymerised indene melting below 100° C., the polymerisation of the coumarone and indene may be effected by means of metallic salts instead of, as at present, by means of sulphuric acid. In this way light-coloured coumarone resins melting at 160° C. can be obtained.—C. A. M.

Resinous substances. Paul. *See* IV.

PATENTS.

Paint. J. C. Benneche, Christiania, Norway. Eng. Pat. 124,046, 13.3.18. (Appl. 4458/18.)

A PAINT which is water- and oil-proof, and resistant to high temperatures (*e.g.*, 180° C.) is prepared as follows. Four preliminary mixtures are prepared: —(1) 16 kilos. of resin dissolved in 10 litres of boiled linseed oil; (2) 75 kilos. of dry colour (not white lead) with linseed oil and petroleum to form a paste; (3) 5 kilos. of lime slaked with water to a paste; (4) 10 kilos. of yellow soap dissolved in boiling water and cooled so as to form a jelly. Nos. (2) and (3) are mixed with part of the remainder of an original quantity of 40 litres of boiled linseed oil and 40 litres of petroleum, mixture (4) is added, then the remainder of the linseed oil and petroleum, and finally, in turn, mixture (1) and 5 litres of terebine.—E. W. L.

Zinc oxide; Preparing pigment — —. L. E. Wemple, St. Louis, Mo., Assignor to American Zinc, Lead and Smelting Co., Boston, Mass. U.S. Pat. 1,292,976, 28.1.19. Appl., 9.1.18.

CRUDE zinc oxide, containing excess of zinc sulphate, together with lead or cadmium as sulphate and not appreciably as oxide, is prepared by treating zinc-bearing materials in the presence of sulphur, and the excess of zinc sulphate is then eliminated by treatment with a combining agent which converts it into insoluble zinc compounds, whilst remaining, under the conditions, inert towards lead or cadmium.—E. W. L.

Ore [yellow ochre] roasting furnace. Method of making paint-bodies. E. T. Goldthorpe, Assignor to F. von Nessen and W. H. Dicks, Chicago, Ill. U.S. Pats. (A) 1,295,729 and (B) 1,295,730, 25.2.19. Appl., (A) 17.7.16 and (B) 28.1.18.

A FURNACE, for roasting and agitating yellow ochre in a limited supply of air, consists of a grate above which is an inclined track. The ore is charged into cylindrical containers which are adapted to roll down the track; near the lower end of the track is a removable stop adapted to intercept the container next to the lowermost one, whilst the latter passes through a discharge door on to a tilting support and discharges its contents into a closed cooling chamber from which the material is finally discharged.
—W. E. F. P.

Resins; Manufacture of synthetic —. R. E. Dior, Boulogne sur Seine, France. Eng. Pat. 124,010, 10.1.19. (Appl. 2272/18.)

IN the preparation of synthetic resins by the condensation of phenols with aldehydes, the catalyst employed is the ammonium salt of a volatile organic acid, or of an organic acid which can be decomposed to form phenol or cresols, or ammonium bicarbonate. The process may be carried out in the following manner. Formaldehyde (40%), 3 galls., is added to commercial carbolic acid, 5·5 galls., and ammonium bicarbonate, 6 lb., in a steam-jacketed digester provided with a reflux condenser. The reaction begins in the cold and is completed by heating to 50°—100° C., in about ½—1 hr. The apparatus is then cooled by passing water through the jacket. The upper aqueous layer is decanted, the condensation product left for 2—3 hrs., and the water which separates removed. The product is heated *in vacuo* or at normal pressure to 110°—120° C., until all traces of water and catalyst are removed. Other phenols, cresols, or aldehydes may be used, and other substances incorporated, *e.g.*, fatty acids (stearic) and their salts, waxes, crude or vulcanised rubber. Lime, baryta, or magnesia may be added during the third stage to assist removal of the catalyst.—E. W. L.

Resin size; Process for making —. J. A. De Cew, Montreal, Canada. U.S. Pat. 1,292,721, 28.1.19. Appl., 21.2.14. Renewed 20.6.18.

ROSIN soap is heated in a closed vessel and forced by pressure applied to the interior of the vessel through a perforated screen, whilst a current of hot water is directed against the perforations in the screen in a direction substantially opposite to the flow of the rosin soap.—C. A. M.

Turpentine still. G. Burton, Duncanville, Ala. U.S. Pat. 1,293,027, 4.2.19. Appl., 17.11.17.

THE distillate from a turpentine still passes into a container and the distillate from the container passes to a second container through an ascending pipe connecting the lower end of the first to the upper portion of the second container. When water alone passes into the second container it is automatically discharged through a normally open discharge, but when turpentine is received therein means are operated by which a normally closed valve-controlled discharge opening is opened to permit discharge of the turpentine.—E. W. L.

Drier. A. Schwarcman, Assignor to S. Kellogg, S. Kellogg, jun., and H. Kellogg, Buffalo, N.Y. U.S. Pat. 1,291,185, 14.1.19. Appl., 2.5.10. Renewed 5.10.17.

A MIXTURE of about 1000 parts of oil, 50 of black manganese oxide, 50 of lead oxide, and 500 of water is agitated and heated to 260°—320° F. (127°—160° C.) at a pressure of 150—175 lb.

Drier and process of making the same. A. Schwarcman, Buffalo, N.Y. U.S. Pat. 1,291,186, 14.1.19. Appl., 21.2.11. Renewed 13.10.17.

FATTY acids are heated to a temperature below their boiling point, and then treated successively with a solution of less than their chemical equivalent of a metallic salt, and with caustic alkali.—E. W. L.

Japan; Process for making and applying —. W. P. Davey, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,294,627, 18.2.19. Appl., 18.8.17.

SEE Eng. Pat. 121,533 of 1918; this J., 1919, 81 A.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Mechanical coagulation of —. G. J. Zuyderhoff. Indische Mercuur, 1918, **61**, 620—621. Bull. Agric. Intell., 1918, **9**, 1494.

A CURRENT of air is passed over the surface of the warm latex, the temperature of which is raised either by applying heat at the bottom of the containing vessel or by preheating the air. In order to avoid the formation of a skin which would prevent the action of the air on the deeper layers of latex, the mass is kept stirred, *e.g.*, by rocking the containing vessel. The crêpe obtained from the final coagulum has a light colour and in quality appears comparable with rubber prepared by the customary process of coagulation with acetic acid.
—D. F. T.

Selenium and its applications. Ancel. *See* VII.

PATENTS.

Vulcanisation of rubber and similar materials. Dunlop Rubber Co., Ltd., London, and D. F. Twiss, Sutton Coldfield. Eng. Pat. 124,276, 20.3.18. (Appl. 4944/18.)

BY adding a relatively small quantity of a solution of sodium or potassium in an aromatic amine such

as aniline to a rubber mixing, the rate of vulcanisation can be increased to a much greater extent than by the use of the aromatic amine alone, the result probably being due to the formation of the hydroxide of the alkali metal in a uniformly dispersed condition throughout the mass.—D. F. T.

Vulcanising rubber articles; Process of —. R. B. Price, Mishawaka, Ind., Assignor to Rubber Regenerating Co. U.S. Pat. 1,295,594, 25.2.19. Appl., 19.6.11.

ARTICLES composed of layers of rubber and fabric built up on a form, are provided with an impervious coating on their exterior surface and are then subjected to a reduced pressure for the purpose of removing the air enclosed between the layers; they are then vulcanised.—D. F. T.

Rubber composition; Adhesive —. E. M. Slocum, Medan, Sumatra, Assignor to General Rubber Co. U.S. Pat. 1,293,957, 11.2.19. Appl., 8.1.17.

A NON-DRYING oil which assumes a gummy condition when exposed, *e.g.*, castor-oil, is dissolved in a volatile solvent with rubber-containing latex, and the mass is coagulated.—E. W. L.

Caoutchouc; Producing substances resembling —. H. S. A. Holt and G. Steimmig, Assignors to Badische Anilin und Soda Fabrik, Ludwigshafen, Germany. U.S. Pat. 1,294,662, 18.2.19. Appl., 22.8.12.

SEE Fr. Pat. 440,173 of 1912; this J., 1912, 735.

XV.—LEATHER; BONE; HORN; GLUE.

Gelatin; Determination of copper and zinc in —. G. S. Jamieson. J. Ind. Eng. Chem., 1919, **11**, 323—325.

FROM 20 to 50 grms. of the sample is digested with 100 c.c. of water and 15 to 30 c.c. of hydrochloric acid for 2 hrs. on a water-bath, then cooled to 40° C., rendered slightly ammoniacal, and treated with hydrogen sulphide. In the case of high-grade gelatins, a few mgrms. of ferrous sulphate should be added before the addition of ammonia. The precipitated sulphides are collected, washed with very dilute ammonium sulphide solution, dissolved in hot dilute nitric acid, and the solution evaporated with sulphuric acid to expel the nitric acid. The residual acid solution is diluted to 30 c.c., heated to 50° C., treated with hydrogen sulphide, the copper sulphide collected, washed with hot water saturated with hydrogen sulphide, ignited to oxide, and weighed. The filtrate containing the zinc is rendered ammoniacal, 15 c.c. of 50% formic acid is added, and the solution is treated with hydrogen sulphide; the zinc sulphide formed is collected, washed with 2% ammonium thiocyanate solution, dried, ignited to oxide, and weighed.—W. P. S.

Amphoteric colloids [gelatin]; Volumetric analysis of ion-protein compounds: the significance of the isoelectric point for the purification of —. *Amphoteric colloids. II.* J. Loeb. J. Gen. Physiol., 1918, **1**, 237—254.

THE influence of univalent ions such as Ag, Br, and CNS on the swelling, osmotic pressure, and viscosity of gelatin is determined by chemical or stoichiometrical and not by "colloidal" properties. Gelatin is practically undissociated at its isoelectric point. On the alkaline side of this point it can combine only with cations and on the acid side it can combine only with anions. (See further J. Chem. Soc., June, 1919.)—J. C. D.

Gelatin; Chemical basis of the influence of acid upon the physical properties of —. *Amphoteric colloids. III.* J. Loeb. J. Gen. Physiol., 1919, **1**, 363—385.

EXPERIMENTS on the combining power of gelatin and hydrobromic acid show that the curves representing the changes in the physical properties of gelatin are approximately parallel to those indicating the amount of bromine bound. (See preceding abstract; further J. Chem. Soc., June, 1919.)—J. C. D.

Gelatin; The influence of the valency of cations upon the physical properties of —. *Amphoteric colloids. IV.* J. Loeb. J. Gen. Physiol., 1919, **1**, 483—504.

TWICE as many univalent cations as divalent cations combine with the same mass of gelatin. Curves representing the influence of several univalent cations on the physical properties of gelatin are closely similar to each other. The curves for the gelatinates of Ca and Ba are similar but differ from those of the univalent metal gelatinates. The conductivity curves for both types are, however, almost identical. An explanation of these results is advanced. (See further J. Chem. Soc., June, 1919.)—J. C. D.

PATENTS.

Leather substitute; Waterproof — *and process for making the same.* F. Rast-Rüttimann, Assignee of R. O. Crist-Déss, Lucerne, Switzerland. Eng. Pat. 117,628, 11.7.18. (Appl. 11,375/18.) Int. Conv., 18.7.17.

ANIMAL bladders are cut open, dried, dyed, tanned with a vegetable tannin, stretched and dried, and finally so treated by "fattening," fulling, and rolling or pressing that they become supple. To increase the thickness of the product two or more pieces may be glued together and pressed.—E. W. L.

Leather substitute. M. Scheuer, Assignor to C. Scheuer, New York. U.S. Pat. 1,291,180, 14.1.19. Appl., 23.11.17.

A LEATHER substitute is prepared by building up successive layers of a supple pyroxylin composition on a suitable support, until an integral structure of sufficient thickness to be removed intact from the support is produced.

Hides; Plant used in the treatment of — *during soaking, liming, tanning, chroming, or like processes.* A. N. Walker, Bolton. Eng. Pat. 124,992, 12.7.18. (Appl. 11,417/18.)

HIDES are suspended on lifting frames in pits constructed with a central partition the top of which is below the level of the liquid in the pits. The partition has an adjustable aperture at the bottom, and by the introduction of compressed air, gas, etc., circulation of the liquor in both sections can be set up in either direction. The compressed air is conveyed to the pit by a single pipe which before entering branches into two, one to each section, and by means of a two-way valve the gas can enter one section of the pit only at a time. The gas is conveyed to perforated pipes arranged along the bottom of each section. The pits can be emptied by means of compressed air into troughs running the whole length of a series of similar pits so that the liquors can be changed or strengthened without removing the hides from the pits.—D. W.

Chrome leather waste; Utilisation of —. A. Wolff, Hamburg. Ger. Pat. 310,309, 13.2.17.

THE waste is dissolved in sufficient sulphuric acid (about 5% concentration) at 80°—90° C., and after

removal of the separated fat the chromium is precipitated as hydroxide, together with calcium sulphate, by the addition of an excess of lime and is then converted into chrome alum. The gelatin is recovered from the solution after precipitating the dissolved lime and calcium sulphate by treatment with carbon dioxide and barium carbonate. For trimmings as obtained in chrome tanneries the weight of 5% acid used is equal to that of the waste, whereas for waste from shoe factories the proportion of 5% acid is approximately three times as great.—D. F. T.

Tanning fish skins or the like; Process of ——. K. Bendixen, Copenhagen. Eng. Pat. 120,398, 26.10.18. (Appl. 17,186/18.) Int. Conv., 29.12.14.

See U. S. Pat. 1,235,543 of 1917; this J., 1917, 1056.

XVI.—SOILS; FERTILISERS.

Nitrogen including nitric nitrogen; Determination of total —— [*in soils*]. E. S. Davisson and J. T. Parsons. J. Ind. Eng. Chem., 1919, **11**, 306—311.

Two hundred c.c. of the soil extract is placed in a Kjeldahl flask, together with sufficient 50% sodium hydroxide solution to make the alkalinity approximately *N*/10, 4 drops of oil, and 1 grm. of Devarda's alloy (Al 45, Cu 50, Zn 5; this J., 1893, 550). The flask is connected with an absorption tower containing 35 c.c. of sulphuric acid (4 : 1), and the contents of the flask are boiled for 20 mins.; the flame is then removed and the acid solution in the tower allowed to flow into the flask. The boiling is continued for a few mins., the tower is rinsed with water, the rinsings are added to the flask, and the solution evaporated until charring commences. Five grms. of potassium sulphate is then added, the mixture is digested in the usual way, and the ammonia distilled after the addition of sodium hydroxide and sodium sulphide.—W. P. S.

"Electro-potash," a Swedish potash fertiliser, and its action on mineral soils. P. Ehrenberg, O. Nolte, E. Haslinger-Hahn, and I. P. van Zyl. J. Landw., 1918, **66**, 209—240.

"Electro-potash" contains 11% of potassium as silicate which is almost completely soluble in warm hydrochloric acid (20%). It is obtained in the reduction of potash minerals in the electric furnace (see Eng. Pat. 23,898 of 1912; this J., 1913, 364) as a dark coloured slag, which is ground and sifted for the market. Experiments were made extending over two years comparing "electro-potash" with potassium salts as fertilisers on sand and loam soils. Spring wheat and buckwheat were the crops grown and six crops were grown in succession in each experiment. It was found that "electro-potash" produced very poor results, even when lime was applied along with it. About 12% of the potash from the "electro-potash" was recovered in the crop, whereas about 74% of the potash in potassium sulphate and chloride was recovered. The results on a loam soil were similar to those on a sandy soil.—J. H. J.

Barium and strontium; Effect of certain compounds of —— on the growth of plants. J. S. McHargue. J. Agric. Res., 1919, **16**, 183—194.

In the absence of calcium carbonate, both barium and strontium carbonates exert a toxic effect on plants, the former more so than the latter. In the presence of calcium carbonate they both appear to exert a distinct stimulating influence on the growth of the plants studied. The root growth of the plants was accelerated in all cases where either of these carbonates was added to the sand in which the plants were growing. Neither barium nor strontium can replace calcium as a plant food. Barium sulphate is much more toxic than barium carbonate. Increasing the amount of strontium nitrate added to the sand gave a corresponding increase in the nitrogen content of wheat grown therein.—W. G.

Ammonia; Extraction of —— from liquid manure, urine, and other ammoniacal liquids. O. Lemmermann and H. Wiessmann. Mitt. Deuts. Landw.-Ges., 1918, **33**, 16—21. Biedermann's Zentr., 1919, **48**, 8—10.

By blowing air into liquid manure, 95% of the ammoniacal nitrogen can be expelled. Temperature and proportion of air are important; the concentration of the solution and the height of the column of liquid are subordinate. Raising the temperature to 59° C. assists the expulsion of ammonium carbonate from dilute solution.—J. H. J.

Wheat; Effect of manganese on the growth of —. A source of manganese for agricultural purposes. J. S. McHargue. J. Ind. Eng. Chem., 1919, **11**, 332—335.

Manganese, in suitable dilution, stimulates the growth of wheat, and increases the size and nitrogen content of the grain. In pot cultures, the best results were obtained by the addition of 5 grms. of manganese carbonate per 8·5 kilos. of soil, a quantity equivalent to 0·028% of manganese. Basic slag contains about 5% of manganese and it is possible that some of the benefit to crops resulting from the use of this fertiliser, on certain soils, may be due to the presence of manganese.—W. P. S.

Dextrose and lævulose; Utilisation of —— by the higher plants. H. Colin. Comptes rend., 1919, **168**, 697—699.

From an examination of etiolated leaves of beetroot, artichoke, and chicory the author produces further evidence in support of the view that the plant cell utilises lævulose more rapidly than dextrose.—W. G.

Maize cultivated and sheltered from bacteria; A purely mineral solution capable of assuring the complete evolution of ——. P. Mazé. Ann. Inst. Pasteur, 1919, **33**, 139—173.

The results of water culture experiments indicate that boron, aluminium, fluorine, and iodine, in addition to nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, chlorine, silicon, manganese, and zinc are essential to the complete development of maize. Organic substances, excluding the organic reserves of the seed, although not indispensable, exert a beneficial influence on the growth of the plant, when added to the mineral nutrient solution. The iron should be present in the ferric state.—W. G.

Plants; Action of coal gas on ——. V. Action on trees. Hydrocyanic acid as the most detrimental constituent of coal gas. C. Wehmer. Ber. deuts. botan. Ges., 1918, **36**, 460—464. (See also this J., 1918, 745 A.)

In many instances, the detrimental effect of coal gas on the root systems of trees is not immediately noticeable but becomes apparent after the period of winter rest, when the trees almost invariably die. The most toxic constituent of the gas is hydrocyanic acid.—H. W.

Weeds; Eradication of —— by sprays and manures. W. E. Brenchley. J. Bd. Agric., 1919, **25**, 1474—1482.

CHEMICAL substances used as weed killers may be divided into two groups: (1) Those that destroy the weeds and have no beneficial action on the crops; they are usually applied in solution as sprays. (2) Those that destroy the weeds and exercise a manurial action on the crops, such as finely ground manures applied as dry powders when the plants are wet. The most common sprays are copper sulphate, iron sulphate, and sulphuric acid. Copper sulphate is used in a 4–5% solution and 50 galls. applied per acre. It has proved effective for charlock, spurry, and poppy. Nickel sulphate has proved to be an efficient substitute. Iron sulphate is used in 15% solution and 40 galls. applied per acre. It is effective for charlock, poppy, and corn buttercup. Sulphuric acid is the most powerful spray used. In 5% solution it has destroyed bracken on grass land. It is effective on most annual and biennial weeds. The results obtained with finely ground manures have been variable and uncertain. Calcium cyanamide, kainit, salt, and lime have been tried.—J. H. J.

Nitrate and nitrite assimilation. Pandisch. *See* VII.

Seaweeds. Albert and Krause. *See* VII.

Powdery mildews. Eyre and others. *See* XIXB.

PATENTS.

Calcium cyanamide; Process and apparatus for making ——. G. E. Cox, Niagara Falls, N.Y., Assignor to American Cyanamid Co., New York. U.S. Pat. 1,292,715, 28.1.19. Appl., 3.12.17.

CALCIUM cyanamide is prepared by the interaction of calcium carbide and nitrogen in a furnace containing a perforated chamber for the calcium carbide, and a heat insulating slab or partition to prevent the escape of a substantial portion of the heat from the upper surface of the carbide in the chamber.—C. A. M.

Fertiliser materials; Process of producing —— and the products obtained therefrom. P. H. Carter, Savannah, Ga. U.S. Pat. 1,293,029, 1.2.19. Appl., 23.3.17. Renewed 20.11.18.

THE fertiliser comprises cyanamide, nitre cake, and "fertiliser stick" in dry form. (See also U.S. Pat. 1,279,838; this J., 1919, 24A.)—J. H. J.

Fertiliser material; Manufacture of ——. P. McG. Shuey, Savannah, Ga. U.S. Pat. 1,293,220, 4.2.19. Appl., 4.8.17.

GROUND phosphate-bearing material and molten nitre-cake are mechanically mixed together, and discharged from the mixing machine before solidification. The mass is allowed to age, and then disintegrated.—J. H. J.

XVII.—SUGARS; STARCHES; GUMS.

Sucrose; Determination of —— in cane molasses by direct polarisation after destruction of the reducing sugars. P. L. Lohr. Archief Suikerind. Nederl.-Indië, 1917, **25**, 1779—1786. Int. Sugar J., 1919, **21**, 196.

THE author has examined the method proposed by Muller (this J., 1910, 858) for the determination of sucrose in cane molasses by direct polarisation, after destroying the reducing sugars by heating with a reagent containing bismuth subnitrate, Rochelle salt, and sodium hydroxide. It was found that under the conditions specified the bismuth reagent has no influence on the sucrose, and that the products formed from invert sugar exhibit no optical rotation, but when the content of reducing sugars is high a large volume of bismuth reagent is required, and a correspondingly large volume of basic lead acetate is subsequently required for clarification, while a very voluminous precipitate is produced. When the content of reducing sugars is high, therefore, dilution is necessary, and the error in making the polarimetric reading is increased. It is concluded that, although the method may be useful for the rapid routine examination of sugar products containing less than 20% of reducing sugars, it can hardly be recommended, without modification, for factory control purposes.—J. P. O.

PATENT.

Decolorising carbon. Eng. Pat. 124,638. *See* IIB.

XVIII. FERMENTATION INDUSTRIES.

Fermentation of fruit wines; Influence of addition of nitrogenous substances on the ——. H. Müller-Thurgau and A. Osterwalder. Landw. Jahrbuch der Schweiz, 1917. Chem.-Zeit., 1919, **43**, Rep., 40.

THE spontaneous fermentation of apple- and pear-juices is very sluggish. The commencement of fermentation may be hastened by the use of pure yeast, and its progress much accelerated by addition of nitrogenous substances such as ammonia or ammonium chloride or phosphate. Such addition does not accelerate the fermentation of grape must in the same degree. Ammonia itself, however, has the disadvantage of reducing the acidity of the juices; chemically pure ammonium chloride is recommended, *e.g.*, in quantities of 15–50 grms. per hectolitre.—J. H. L.

Alcohol from lichens. Ellrodt and Kunz. Brennerei-Zeit., 1918, 6171. Chem. Zeit., 1919, **43**, Rep., 40.

Cladonia rangiferina (reindeer moss), which contains hemicelluloses convertible into sugar by acid hydrolysis, was found to contain 11·7% of water, 0·66% of nitrogen, 4·87% of ash, and 1·60% of ether extract. By suitable acid treatment it yielded 71·7% of extract containing 54·5% of sugar, and after fermentation 282 c.c. of alcohol was obtained per kilo of the plant. The maximum yield of alcohol was obtained by steaming the plant for one hour under 3 atm. pressure, then adding 2·5% of 25% hydrochloric acid, steaming again for one hour under 3 atm., and finally neutralising and fermenting. The growth of yeast is normal, and fermentation may be accelerated by addition of phosphoric acid.—J. H. L.

[Proteolytic] enzymes of oil-seeds. Fernández. *See* XII.

PATENTS.

Organic salts [pyruvates and acetates] and acids [and acetone]; Manufacture of certain ——. A. Fernbach, Paris, and E. H. Strange, London. Eng. Pat. 14,607, 15.10.15.

STERILISED mashes containing starch or sugars, or both, are fermented by *Amylomyces Rouxii* in presence of an alkaline-earth carbonate, and

aerated meanwhile with sterilised air or oxygen. From the filtered product a mixture of salts, consisting mainly of pyruvates and acetates, may be obtained, *e.g.*, by concentration, or precipitation with alcohol. The mixture of salts or the free acids may be oxidised entirely to acetates or acetic acid, which may be used for the production of acetone; or acetone may be produced by destructive distillation of the salt mixture without preliminary oxidation, a limited amount of air or oxygen being admitted during the process, if desired.—J. H. L.

Yeast contained in fermented molasses; Extraction of the ——. L. J. P. M. J. Dupire, Ramecourt, France. Eng. Pat. 123,711, 26.7.18. (Appl. 12,259/18.) Int. Conv., 23.2.18.

THE yeast is separated from fermented molasses, in a state of high vitality, by passing the molasses through a centrifugal apparatus of the cream separator type with a non-perforated bowl, and by so adjusting the position and section of the outlet orifices, the speed of rotation, and the supply of liquid, that the yeast is deposited on the walls of the bowl, whilst the impurities, owing to their lower density, are carried away in the molasses.
—J. H. L.

Acetone; Process for the production of ——. J. H. Northrop, Assignor to The Rockefeller Institute for Medical Research, New York. U.S. Pat. 1,293,172, 4.2.19. Appl., 8.7.18.

CARBOHYDRATE material is fermented by means of *Bacillus aceto ethylicum*.—J. H. L.

Carbonating and filling liquids; Process of and apparatus for ——. H. M. Smith, Chicago, Ill., U.S.A. Eng. Pat. 124,907, 10.4.18. (Appl. 6098/18.)

Yeast, mucorini, moulds, bacilli, and micro-organisms; Pure-culture apparatus for ——. C. A. Jensen, London. From J. H. P. Magné, Mexico City. Eng. Pat. 124,237, 21.1.8. (Appl. 1195/18.)

SEE U.S. Pat. 1,212,656 of 1917; this J., 1917, 399.

Non-alcoholic malt beer; Manufacture of ——. L. Block, Mamaroneck, N.Y., U.S.A. Eng. Pat. 124,330, 30.5.18. (Appl. 8925/18.)

SEE U.S. Pat. 1,271,269 of 1918; this J., 1918, 633A.

XIXA.—FOODS.

Dough; Influence of electrolytes upon the viscosity of ——. L. J. Henderson, W. O. Fenn, and E. J. Cohn. J. Gen. Physiol., 1919, **1**, 387—397.

QUANTITATIVE measurements of the viscosity of dough at 30° C. were made in a torsion viscometer. The influence of the hydrogen ion concentration upon the viscosity of dough prepared from different flours was studied. The viscosity in all cases showed a minimum value a little on the acid side of $p_H=5$, the value which has been found to be the best hydrogen ion concentration for bread-making (see this J., 1912, 405) and for the rising of dough. The addition of a small amount of salt tends to diminish the viscosity. As the concentration of the salt increases, however, there is commonly a rise. The influence of salts upon viscosity is variable with the hydrogen ion concentration. The significance of these results in the light of practical bread-making is discussed.
—J. C. D.

Bread; Control of rope in ——. E. J. Cohn, S. B. Wolbach, L. J. Henderson, and P. H. Cathcart. J. Gen. Physiol., 1919, **1**, 221—230.

THE investigation was carried out on a strain of *B. mesentericus* isolated from ropy bread. The morphological and cultural characteristics of the organism are described. Its relationship to the production of characteristic rope has been proved beyond question. A hydrogen ion concentration sensibly higher than $10^{-5}N$ completely inhibits the growth of the organism. For this reason the hydrogen ion concentration of bread should, when possible, be maintained near that value. Methyl red is recommended as a convenient indicator for ascertaining when the acidity of bread is of that order.—J. C. D.

Gluten; Study of the action of acid and alkali on ——. L. J. Henderson, E. J. Cohn, P. H. Cathcart, J. D. Wachman, and W. O. Fenn. J. Gen. Physiol., 1919, **1**, 459—472.

STUDIES were made of the acid-base equilibrium in systems containing gluten suspended in solutions of hydrochloric acid and sodium hydroxide. The results appear to show that simple chemical phenomena are most important in such systems. (See further J. Chem. Soc., June, 1919.)—J. C. D.

Sausages and meat pastes; Estimation of the approximate quantity of meat in ——. G. Stubbs and A. More. Analyst, 1919, **44**, 125—127.

A METHOD used in the Government Laboratory for estimating meat in sausages etc. is based upon the fact that beef and pork (free from fat) contain on the average 3·75 and 4·0% of nitrogen respectively, whilst the usual filling materials contain about 40% of water, and, with the exception of soya meal, about 50% of carbohydrate and crude cellulose and 1% of nitrogen. Fat is determined by drying 5 grms. of the sample for 30 mins. on the water-bath, and extracting the fat by macerating the dried mass with ether, whilst nitrogen is determined by the Kjeldahl method. The amount of carbohydrate and crude cellulose is found by deducting the quantity of proteins and ash from the amount of non-fatty solids. The result multiplied by 2 gives the approximate amount of bread or cereal filling material containing 40% of water. The nitrogen derived from the meat is obtained by deducting 1% of the weight of the "filler," and the percentage of fat-free meat is calculated by multiplying the meat nitrogen by $\frac{100}{3\cdot75}$ in the case of beef or mutton, $\frac{100}{4\cdot0}$ in the case of pork, or by $\frac{100}{3\cdot87}$ in the case of mixtures. The amount of fat is added to that of the fat-free meat to obtain the total amount of meat. Only when a large amount of maize meal is present is a correction required. The additional water (*i.e.*, water other than that naturally present in the meat or in the "filler" containing 40% water) is obtained by deducting from 100 the sum of the percentages of the "filler" and the total meat. The total percentage of water directly determined should be equal to the sum of 40% of the filling material, 75% of the fat-free meat, and the additional water calculated as described. The difference should not exceed 2%, unless a meal such as soya meal, richer in nitrogen than ordinary cereals, has been used.—C. A. M.

Sausages, meat pastes, and army rations; Analysis of ——. A. W. Stokes. Analyst, 1919, **44**, 127—132.

THE following method of analysis has been devised to determine whether sausages complied with the

"Food Control Regulations" which prescribed two grades containing respectively 50% and 67% of meat:—Total solids, water, and ash are determined on 5 grms. of the material, and the ash examined for boric acid. Fat-free meat and starch are determined by boiling 10 grms. of the sample for an hour with 5% alcoholic sodium hydroxide solution beneath a reflux condenser. This dissolves the meat, forms a soap with the fat, and leaves the starch unaltered. After collecting the starch on a slag-wool filter and washing it with hot alcohol, the filtrate and washings are cooled, made up to 250 c.c. with water, 25 c.c. evaporated to about 15 c.c. to remove alcohol, and the fatty acid in this is determined by the Schmid method, as in milk analysis. The slag-wool filter and starch are returned to the original flask and treated with 100 c.c. of a cold 5% aqueous solution of sodium hydroxide, the flask being left for an hour, with occasional shaking. The resulting solution of starch is made up to 500 c.c. with cold water, filtered through a plug of slag-wool, and the starch precipitated from 50 c.c. of the filtrate by adding 100 c.c. of 90% alcohol, and, after standing for 30 minutes, it is collected on counterpoised filters, washed with alcohol, dried, and weighed. It is assumed that the quantity of fatty acids equals 95% of the actual fat. The "dry meat" is obtained by deducting the starch and fat from the total solids. To this is added 2·33 times its weight of water to find the amount of fat-free flesh. An addition of 0·66 times its weight of water is added to the starch to obtain the amount of bread. Frequently the water is in excess of this allowance owing to the fact that crusts are soaked in water before incorporation with the sausages, but it is exceptional for less than the allowed proportion of water to be present. The ash consists mainly of salt, and usually averages about 2%. Typical analyses of sausages, meat pastes, and army rations are cited. In the case of sausages and meat pastes the excess of water not natural to the meat or bread reached about 24% and 35% respectively.—C. A. M.

Seaweeds. Albert and Krause. *See* VII.

[*Proteolytic*] *enzymes of oil-seeds.* Fernández. *See* XII.

Reduction of methylene blue by milk. Harvey. *See* XXIII.

PATENTS.

Drying edible pastes; Process of ——. K. Gammel, Assignor to The Cleveland Macaroni Co., Cleveland, Ohio. U.S. Pat. 1,284,305, 12.11.18. Appl., 1.9.11. Renewed 5.4.18.

EDIBLE paste in short sections is fed on to a travelling band to form a mass several layers deep, and is subjected to an air current until the outer layer is partially dried. It then falls on to a lower band travelling in the opposite direction to the first, so that the dried layer is buried and a fresh layer is exposed. This process is repeated until the sections are dried and slightly polished. The velocity of the air current may be reduced in the earlier stages of the process.—J. H. J.

Dryer [*for food products*]. E. C. Horst, San Francisco, Cal. U.S. Pats. (A) 1,294,804 and (B) 1,294,805, 18.2.19. Appls., 25.4.18 and 24.6.18.

(A) AN apparatus for drying food products consists of a tunnel through which air is forced in one direction whilst the products to be dried are advanced step by step in the opposite direction. By means of baffles the air is caused to pass upward and downward through the product and under and over it alternately. Means are provided for increasing the temperature and humidity of the air during its passage through the tunnel. (B) The dryer comprises a housing through which extend a number of inclined perforated cylinders each with an independent feed and discharge opening. The cylinders are revolved and hot air is passed between, and longitudinally and transversely through them.—J. H. P.

Preserving matter; Process for ——. F. S. Benenati, Syracuse, N.Y. U.S. Pat. 1,292,401, 21.1.19. Appl., 31.5.18.

THE animal or vegetable matter to be preserved is saturated with an agent containing a germicidal oil of a plant of the *Allium* family and then dried. On immersing the dried matter in water it is restored to its original condition.—J. H. J.

XIXB.—WATER PURIFICATION; SANITATION.

Effluent from the Miles acid process of sewage treatment; De-oxygenating effect of the ——. F. W. Mohlman. J. Ind. Eng. Chem., 1919, **11**, 325—327.

THE effluent from the Miles acid process of sewage treatment (this J., 1918, 439A) contains sulphur dioxide and sulphites which are oxidised at the expense of the dissolved oxygen in the water into which the effluent is discharged. The sulphur dioxide and sulphites may, however, be oxidised by aeration for a short time (30 mins.) with a relatively small volume of air (about 0·1 cb. ft. per gall.) before the effluent is discharged.
—W. P. S.

Stenches and odours; Investigation [*use*] *of* —— *for industrial purposes.* V. C. Allison and S. H. Katz. J. Ind. Eng. Chem., 1919, **11**, 336—338.

SUBSTANCES possessing a strong odour are used for detecting leaks in boilers, drains, etc., and the authors describe an apparatus for determining the suitability of various substances for this purpose. A number of Venturi type flow meters were so arranged that a measured volume of air could be passed at a uniform rate through or over the substance and then mixed with another volume of pure air also flowing at a uniform rate. The concentration was found from the loss in weight of the substance. The air mixture was passed through a rubber tube with a glass funnel at the open end, and one inhalation was taken to determine the intensity of the odour. The odours were classified as "detectable," "faint," "quite noticeable," "strong," and "very strong." Of the 24 substances examined, artificial musk had the strongest odour, 0·00004 mgrm. being detectable in 1 litre of air; then followed amyl thioether and phenyl isocyanide (0·001 to 0·002 mgrm. per litre of air).—W. P. S.

Mildews; Powdery —— *and the ammonium polysulphide wash.* J. V. Eyre, E. S. Salmon, and L. K. Wormald. J. Bd. Agric., 1919, **25**, 1494—1497. (See this J., 1916, 378.)

AMMONIUM polysulphide wash can be used to kill powdery mildews, such as American gooseberry-mildew, when the fruit is ripening, since the wash leaves no visible deposit on the fruit. A stock solution of the wash is prepared by saturating 1 gall. of concentrated ammonia with hydrogen

sulphide and adding 2 galls. of concentrated ammonia and 112·5 oz. of flowers of sulphur; more hydrogen sulphide is then passed in until the sulphur dissolves. This stock solution is diluted for use with 0·5% soap solution. The wash is applied as a fine spray, either in one application of a 1 in 50 dilution of the stock solution or in two applications of a 1 in 100 dilution.—J. H. J.

"Perocide"; Analysis of ———. F. Mach and P. Lederle. Chem.-Zeit., 1919, **43**, 117—118.

The following method is recommended for the determination of the cerite earths in "perocide," which consists chiefly of the sulphates of these earths (see this J., 1918, 348 A); its efficacy as a fungicide depends on the latter. Ten grms. of the sample is boiled for 15 mins. with 500 c.c. of water, cooled, diluted to 500 c.c., and filtered; 50 c.c. of the filtrate is treated with 5 c.c. of 10% sulphuric acid and 5 c.c. of 5% ammonium acetate solution, boiled, and excess of saturated oxalic acid solution is added. After standing for 18 hrs., the precipitate is collected, washed with hot water, ignited, and weighed. Slight variations in the amount of free sulphuric acid present or large differences in the volume of the total solution do not affect the results obtained. Samples examined by the authors contained from 43 to 47% of cerite-earth oxides.—W. P. S.

Arsenical poisoning in the industries of coal and its derivatives (arsenical coal poisoning). A. Bayet and A. Slosse. Comptes rend., 1919, **168**, 704—706.

A careful examination of the symptoms of workmen engaged in the briquette industry and suffering from an illness known as "maladie du brai" ("pitch cancer"; see this J., 1913, 416; 1914, 741, 895) shows that they resemble in every respect those exhibited by a person suffering from chronic arsenical poisoning. Further, arsenic was found to be present in the pitch used, in the dust in the air of the factories, and in the hair, urine, and blood of the workmen. These remarks apply similarly to the illnesses occurring amongst the workmen in a number of industries connected with coal and its derivatives, and presumably the poisoning arises from the presence in the coal of arsenical pyrites.—W. G.

Chloropicrin; High toxicity of ——— towards certain lower animals and the possibility of using this substance as a parasiticide. G. Bertrand. Comptes rend., 1919, **168**, 742—744.

The effect of chloropicrin on caterpillars, the larvæ of *Lepidoptera* and *Hymenoptera*, and on aphis has been examined and the results show that exposure for 5—10 minutes in an atmosphere containing 0·01—0·02 grm. per litre is sufficient immediately to kill the larvæ and aphis. Even lower concentrations are effective against the larvæ, if the duration of exposure is increased. In aqueous solution chloropicrin is also very toxic to infusoria and amœbæ.—W. G.

Patents.

Separator and filter for purifying water for use in steam generators and for manufacturing purposes. W. R. Austin, Monkseaton. Eng. Pat. 124,130, 28.6.18. (Appl. 10,639/18.)

Water to be purified is passed upwards through a spiral channel or coil situated in a settling chamber. The coil has openings along the lower side for the passage of sediment into the settling chamber, where it falls to the bottom and is removed through a drain cock. The coil has also openings along the upper side for the passage of oil and other light matter into the settling chamber where they rise to the surface and can be removed. The coil is kept fully immersed in the water in the settling chamber. From the top of the coil the water passes through a valve into a filter, or set of filters, within which is a stand pipe carrying a lantern-shaped (hexagonal or octagonal) frame holding the filtering medium. The water passes inwards through the medium to the stand pipe, in which are openings for the escape of the water to a collecting channel below the filter.

—J. H. J.

Filtering apparatus [for water]. C. S. Smith, Brooklyn, N.Y. U.S. Pats. (A) 1,293,649, (B) 1,293,650, and (C) 1,293,651, 4.2.19. Appls., (A) 10.5.13, (B) 7.8.13, (C) 6.4.14. Renewed (A) 6.6.18, (B) 13.6.18, (C) 26.6.18.

(A) A tank is provided with a series of transverse partitions of ring form carrying wire mesh screens of different metals with the edges of each pair of screens in contact with each other, forming galvanic couples. The metals in the screens alternate in character throughout the series. (B) The apparatus is made in portable form. A frame supports the filter tank with a water reservoir above. A pump is connected with the reservoir and delivers measured quantities of water under pressure to the filter. (C) The partitions consist of perforated dish-shaped members of different metals with their edges in contact. A separator comprising crossed members is placed between the perforated members.—J. H. J.

Liquid-sterilising device. W. B. Fenn, Assignor to The Wedoit Co., Columbus, Ohio. U.S. Pat. 1,292,742, 28.1.19. Appl., 16.6.13.

The liquid to be sterilised flows under pressure through a perforated tube whereby it is broken up. Steam under pressure surrounds the tube, and the commingled liquid and steam are discharged through a regulated opening which maintains the desired pressure and temperature.—J. H. J.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Alkaloids; Method for the evaluation of ———. Rapp. Apoth.-Zeit., 1918, **33**, 463. Chem. Zentr., 1919, **90**, II., 210.

The alkaloids are precipitated from acid aqueous solution by the addition of an alkali and are then extracted by means of chloroform; for the latter operation the aqueous solution is converted into a thick mud by the addition of plaster of Paris, so that the chloroform separates readily. The alkaloids in the combined chloroform extracts are then dissolved out by *N*/10 or *N*/100 hydrochloric acid and the excess acid is measured by titration of an aliquot portion using methyl red as indicator. The method possesses the advantage of economy in time and material.—D. F. T.

Alkaloids; Rapp's method for the determination of ———. K. Dieterich. Pharm.-Zeit., 1918, **63**, 628—629.

Rapp's method (see preceding abstract) has given extremely satisfactory results, but it is important that the quantity of plaster added should be such

that the mixture does not harden but remains as a soft paste. In the original method it is necessary to make sure by an extra shaking with 10 c.c. of chloroform that all the alkaloid has been extracted from the mass. This uncertainty may be avoided by dissolving the alkaloid in chloroform before adding the plaster and then using an aliquot portion of the filtered extract for the determination. For instance, in the valuation of cinchona bark, the substance is treated with the quantity of liquid recommended by Rapp and then shaken in the same flask with 50 c.c. of chloroform, made alkaline, and shaken with 25 grms. of plaster of Paris. The chloroform is then filtered off, and the filtrate (42—45 c.c.) shaken with *N*/10 acid. The plaster paste in this method may be of any degree of stiffness, as it does not have to be washed out, all the alkaloid having been dissolved by the chloroform before the addition of the plaster. It is suggested that the principle of Rapp's method might be extended to other extraction operations besides those with alkaloids, since the plaster has a clarifying effect and assists the separation of the extract.—J. F. B.

Plants; Microchemistry of ——. *VII. Large silicious bodies in the leaf of Arundo donax. XIII. Behaviour of cystolites towards salts of silver and other metals.* H. Molisch. Ber. deuts. botan. Ges., 1918, **36**, 474—481.

ALL the cystolites examined possess the property of reducing silver nitrate or silver sulphate so strongly that they become blackened after a short time. The deposition of silver is due to calcium carbonate which encrusts the cystolites, and the action provides a confirmatory microchemical method of detecting calcium carbonate in the plant. Cystolites become coloured red to bluish-violet in gold chloride solution, rust-red in ferrous sulphate, pale green in nickel sulphate, and lilac or pink in cobalt chloride or cobalt sulphate; the colorations are due to the precipitation of the corresponding hydroxides by calcium carbonate. (See also J. Chem. Soc., 1919, i, 113 and 242.)—H. W.

Glucoside, loroglossin; Discovery of a new —— *Application of the biochemical method to the study of several species of indigenous orchids.* E. Bourquelot and M. Bridel. Comptes rend., 1919, **168**, 701—703.

A NUMBER of species of orchids, when examined by the method previously described (this J., 1901, 1244), were found to contain sucrose, one or more glucosides hydrolysable by emulsin, and a considerable amount of a dextro-rotatory substance not attacked by enzymes. From one of these species of orchids, *Loroglossum hircinum*, Rich., a new glucoside loroglossin, m.pt. 137° C. (corr.), $[\alpha]_D = -42{\cdot}97°$, was isolated.—W. G.

Odorous principles of plants; Distribution and characters of some of the ——. F. B. Power. J. Ind. Eng. Chem., 1919, **11**, 344—352.

A DESCRIPTION is given of some of the more important odorous substances obtained from plants, including their distribution, preparation, and chemical characters. The plants dealt with are:—*Coniferæ, Gramineæ, Palmæ, Liliaceæ, Iridaceæ, Zingiberaceæ, Orchidaceæ, Aristolochiaceæ, Anonaceæ, Myristicaceæ, Lauraceæ, Cruciferæ, Rosaceæ, Geraniaceæ, Myrtaceæ, Umbelliferæ, Ericaceæ, Labiatæ*, and *Compositæ*.—W. P. S.

Scammony and its substitutes. W. L. Scoville. J. Ind. Eng. Chem., 1919, **11**, 335—336.

SEVERAL botanical species, closely allied, are now sold as scammony or scammony substitutes. A specimen of a Mexican plant, *Resina drastica*, received by the author closely resembled the drug known as Mexican scammony, *Ipomœa orizabensis*, but the resin extracted from it differed from that of the latter. The characters of the resins, together with that of true scammony resin, *Convolvulus scammonia*, are as follows:—

—	True scammony resin	Mexican scammony resin	*Resina drastica* resin
Yield, %	About 8	9 to 20	19·2
Colour	Yellowish-brown	Straw	Lemon yellow
Ash	Trace	Trace	Trace
Solubility in:			
Petroleum spirit	3·5 %	2·5 %	1·0 %
Ether	Soluble	Soluble	72·6 %
Ethyl acetate	Soluble	Soluble	Soluble
10 % ammonia	Cloudy soln.	Cloudy soln.	9·4 %
10 % KOH soln.	Cloudy soln.	Cloudy soln.	Cloudy soln.
Acid value	20	23·5	28
Saponif. value	198	140	136
Optical rotation	−17·3	−24·8	−32·4
Colour with $FeCl_3$	Dark green	Faint green	Dark green

—W. P. S.

"Mustard gas" [dichloro-ethyl sulphide]; Continuous vacuum still for ——. E. D. Streeter. J. Ind. Eng. Chem., 1919, **11**, 292—294.

THE crude dichloroethyl sulphide $(CH_2Cl.CH_2)_2S$, was passed upwards through a preheater consisting of a coil made from 50 ft. of ¾ in. lead pipe and surrounded by an oil bath at 150° C.; a gas separator also heated at 150° C., placed above the preheater, removed the hydrochloric acid and other vapours from the liquid, and these vapours were conducted to a series of absorption, scrubbing, and condensing vessels. The liquid portion collecting in the gas separator flowed down a vaporising tube, consisting of a vertical iron pipe 9½ ft. long and 3 in. in diameter and surrounded by an oil jacket heated at 183° C.; the lower end of the vaporising tube entered a chamber heated at 150° C., where non-volatile substances were separated and drawn off, whilst the "mustard gas" vapour passed to a condenser and receiver. Suitable valves on the connecting pipes enabled the flow of liquid to be regulated, and the distillation was carried out under reduced pressure, the average pressure in the system being 60 mm.—W. P. S.

Salicylic acid; Volumetric determination of —— *in the presence of salicylaldehyde.* R. Berg. Chem.-Zeit., 1919, **43**, 129.

A COLOURLESS solution of salicylaldehyde yields a yellow coloration when treated with a trace of alkali; the colour is destroyed by acids and even by carbon dioxide. The aldehyde may, therefore, be used as the indicator in the titration of salicylic acid in a solution also containing salicylaldehyde. To determine salicylic acid in an ethereal solution containing both substances, the solution is extracted several times with *N*/20 sodium bicarbonate solution and then with water; the last aqueous extract must give a yellow colour with a drop of alkali solution. If this is not the case, all the acid has not been removed and the extraction must be repeated. The united extracts are titrated with *N*/20 sulphuric acid; this is added in small quantities at a time and the solution boiled to expel carbon dioxide. The final disappearance of the yellow colour denotes the end-point of the titration.—W. P. S.

Vanillin; New method for the determination of —— *in vanilla extract.* A. W. Dox and G. P. Plaisance. Amer. J. Pharm., 1919, **91**, 167—170.

THE method depends on the condensation of vanillin with thiobarbituric acid to form 3-methoxy-4-hydroxybenzalmalonylthiourea (this J., 1916, 1182,

1234). To the weight of the precipitate obtained as previously described is added 2·6 mgrms.; this solubility correction is constant and does not depend on the amount of vanillin present. A sensitive test for caramel consists in treating the extract, after clarification and removal of excess of lead chloride, with phloroglucinol; in the presence of caramel a brown precipitate is formed. If caramel is absent, the vanillin gives a pink precipitate.—W. P. S.

Monomethylaniline; Preparation of ——. P. F. Frankland, F. Challenger, and N. A. Nicholls. Chem. Soc. Trans., 1919, **115**, 198—205.

Reduction of the condensation product of aniline and formaldehyde with zinc dust and concentrated aqueous sodium hydroxide gives rise to monomethylaniline, yields up to 55% of the theoretical being obtainable; the monomethylaniline thus formed contains only traces of dimethylaniline but is rich in aniline which, however, can be removed easily as its zincichloride; a large excess of formaldehyde causes an increase in the proportion of dimethylaniline present, probably on account of the further interaction of the monomethylaniline and formaldehyde with subsequent reduction by the zinc and sodium hydroxide. By heating aniline hydrochloride with methyl alcohol in an autoclave at 180°—200° C., a 55% yield of monomethylaniline is obtainable, the yield being hardly altered by the presence of glacial acetic acid. The demethylation of dimethylaniline by heating with aniline hydrochloride for six hours at 200° C. is capable of giving a 55% yield of monomethylaniline. Aniline in monomethylaniline can be fairly accurately estimated by treatment with an aqueous solution of anhydrous zinc chloride, the resulting zincichloride precipitate being washed with light petroleum and weighed; the monomethylaniline is conveniently estimated by conversion into the corresponding nitrosoamine which can be separated by extraction with ether.—D. F. T.

Carbonyl chloride; Identification and estimation of ——. A. Kling and R. Schmutz. Comptes rend., 1919, **168**, 773—775.

Carbonyl chloride readily reacts with aniline in aqueous solution, provided the aniline is in excess: $COCl_2+4C_6H_5NH_2=CO(NHC_6H_5)_2+2C_6H_5NH_2,HCl$. The diphenylurea is insoluble in water and may be readily separated and identified by its crystalline structure and melting point. Thus if air is bubbled at the rate of 1 litre in 5 mins. through a saturated aqueous solution of aniline, the presence of the carbonyl chloride in the air is indicated by formation of a precipitate of diphenylurea. In this way carbonyl chloride may be detected in air at a dilution of 1 in 100,000. For the estimation of carbonyl chloride in solution in organic solvents, a definite volume of the solution containing 0·2—0·35 grm. of the chloride is added to 150 c.c. of aqueous aniline solution (containing 26 grms. of aniline per litre) and after two hours the mixture is heated on a water-bath for one hour to drive off the organic solvent. The liquid is allowed to cool and the next day the diphenylurea is collected in a Gooch crucible, dried at 70° C., and weighed.
—W. G.

Selenium compounds; Meta-substituted aromatic ——. F. L. Pyman. Chem. Soc. Trans., 1919, **115**, 160—175.

By the action of an ethereal solution of magnesium phenyl bromide on selenium, a mixture of diphenyldiselenide and selenophenol is obtained which on oxidation with nitric acid yields phenylselenious acid, $C_6H_6SeO_2H$; oxidation with potassium permanganate converts the mixture into potassium phenylselenate, $C_6H_5SeO_3K,2H_2O$, whereas treatment with sulphuric acid and potassium nitrate causes nitration with formation of *m*-nitrophenylselenious acid, $NO_2.C_6H_4.SeO_2H$, yellow prismatic needles, m.pt. 156°—157° C. (corr.). This acid is oxidised by alkaline potassium permanganate to *m*-nitrophenylselenic acid, $NO_2.C_6H_4.SeO_3H,2H_2O$, which when anhydrous melts at 146° C. (corr.), whilst reduction of the nitrophenylselenious acid with aqueous sodium bisulphite produces di-*m*-nitrophenyl diselenide $(NO_2.C_6H_4.Se)_2$, yellow spears melting at 83° C.; this can be further reduced by sodium sulphide with formation of di-*m*-aminophenyl diselenide $(NH_2.C_6H_4.Se)_2$, the hydrochloride of which forms yellow needles melting at 291°—292° C. (corr.) with decomposition. On oxidation with cold nitric acid of sp. gr. 1·4, the diacetylaminophenyl diselenide is converted into *m*-acetylaminophenylselenious acid, $C_2H_3O.NH.C_6H_4.SeO_2H$, colourless needles melting at 209° C. (with decomposition), which is oxidised by ammoniacal potassium permanganate to *m*-acetylaminophenylselenic acid, $CH_3.CO.NH.C_6H_4.SeO_3H$; this was isolated as the barium and sodium salts, the former salt on treatment with sulphuric acid undergoing hydrolysis with formation of *m*-aminophenylselenic acid, $NH_2.C_6H_4.SeO_3H$. The meta-position of the nitrogenous substituent group in the benzene ring was confirmed by the production of a diaminophenyl diselenide, identical with that described above, by reduction of the *m*-nitrophenyl selenocyanate prepared from *m*-nitroaniline.—D. F. T.

Catalytic dehydrogenation by nickel in the presence of hydrogen. P. Sabatier and G. Gaudion. Comptes rend., 1919, **168**, 670—672.

Hydrocarbons of the benzene series and terpenes when passed with hydrogen over nickel at 180° C. are hydrogenised, but if the temperature is raised to 350°—360° C. dehydrogenation also occurs. Thus at the higher temperature pinene, limonene, and camphene yield a mixture of cymene with some cumene; menthene gives cymene; cyclohexene gives benzene. The reaction may also be applied to oxygenated derivatives of the hydrocarbons. Cyclohexanol yields phenol; pulegone gives a mixture of cresol and thymol; eucalyptol, terpin, and terpineol undergo dehydration as well as dehydrogenation. The mixture obtained by the destructive distillation of oil of turpentine, which is poor in benzenoid hydrocarbons, when passed with hydrogen over nickel at 350°—360° C. gives a liquid in which the proportion of benzenoid hydrocarbons is notably increased.—W. G.

Ether vapour; Spontaneous inflammation of mixtures of air and ——. E. Alilaire. Comptes rend., 1919, **168**, 729—730.

The mixture of ether vapour and air was led into a U-tube heated in an oil-bath, one limb of the U-tube being provided with internal projections similar to a Vigreux tube (this J., 1919, 200 A). Under these conditions, it was found that spontaneous inflammation of a mixture of air and ether vapour occurred at about 190° C., when the amount of ether in the gaseous mixture reached 1 grm. per litre. Ordinary catalysts (iron oxides, copper, nickel, etc.) had no influence on the phenomenon. No reaction took place at the ordinary temperature.
—W. G.

Calomel; Preparation of a very voluminous ——. P. Duret. Ann. Inst. Pasteur, 1919, **33**, 174—176.

Calomel may be obtained in a light, voluminous form, which is three times as bulky as the samples

prepared either by sublimation or by the usual precipitation methods, if the following procedure is adopted. Three solutions are prepared containing (1) 11·5 grms. of mercuric chloride and 10 drops of hydrochloric acid in 100 c.c. of water, (2) 6 grms. of sodium bicarbonate and 10 grms. of dextrose in 80 c.c. of water, (3) 7·5 grms. of crystalline magnesium chloride in 20 c.c. of water. Solutions (2) and (3) are mixed and then added to (1). After the reaction has finished the mixture is heated on a water-bath until no more carbon dioxide is evolved, and the finely-divided precipitate is then collected and washed with cold water. In this form the calomel has much greater germicidal properties when used in prophylactic ointments or antisyphilitic injections, than in the form as it is usually prepared.—W. G.

PATENTS.

Chlorhydrins; Process of making —— [*from oil-gas*]. K. P. McElroy, Washington, D.C., Assignor to Chemical Development Co. U.S. Pat. 1,295,339, 25.2.19. Appl., 8.2.17.

GASEOUS olefinic hydrocarbons, in the form of oil-gas, mixed with chlorine, are passed up a heated vertical tower which is spanned by a succession of perforated plates and down which a hot current of aqueous liquid flows. The flow of aqueous liquid is sufficiently copious to maintain the vapours substantially free from hydrochloric acid and the vapours are removed for condensation at the top of the tower.—D. F. T.

Mercury solutions suitable for injection; Production of —— by means of succinimide. Chinoin Fabrik Chem.-pharm. Produkte A.-G. von Kereszty und Wolf. Ger. Pat. 310,213, 30.3.17.

THE sparingly soluble mercury derivatives of phenolsulphocarboxylic acids, such as sulphosalicylic acid and of phenol mono- and di-sulphonic acids or their halogen substitution products can be dissolved in water if succinimide is added; the resulting solutions on treatment with dilute acids give a precipitate of the original mercury compound. Solutions prepared in the described manner are very stable and cause no pain or local effect when injected.
—D. F. T.

Crystallisation of [*phenacetin*]. Eng. Pat. 124,324. *See* I.

Organic salts etc. Eng. Pat. 14,607. *See* XVIII.

Acetone. U.S. Pat. 1,293,172. *See* XVIII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

PATENT.

Toning process for photographic silver prints. Graphikus-Ges., Hamburg. Ger. Pat. 309,447, 6.10.17.

BY successive application of gold and selenium toning baths so that the metallic silver in the print is almost completely replaced by gold and red selenium, a tone is produced equal to that previously obtained only by platinum toning or a combined gold-platinum toning, and in permanency the prints are superior to those obtained by the latter processes.—D. F. T.

XXII.—EXPLOSIVES; MATCHES.

Smokeless powder; Analysis of ——. C. F. van Duin, L. P. F. van der Grinten, and P. van der Woude. Rec. Trav. Chim. Pays-Bas, 1919, **38**, 163—169.

DETAILS are given for the estimation of nitroglycerin, guncotton, acetone, humidity, stabiliser (diphenylamine), vaseline, graphite, sodium bicarbonate, dinitrotoluene, and resin. 5 grms. of the finely divided powder is extracted for five hours with ether, and the ether allowed to evaporate. The extract is dried and weighed. It consists, from nitrocellulose powders, of diphenylamine, a portion of the resin, and dinitrotoluene if present. From nitroglycerin powders the extract consists of diphenylamine, a portion of the resin, nitroglycerin, and vaseline if present. For the first type of powder the resin in the extract is dissolved in 8% sodium hydroxide and estimated by the method described by Kast (*Anleitung zur chem. und physik. Untersuchung der Spreng- und Zundstoffe*, Braunschweig, 1909) and the diphenylamine is estimated in a fresh portion of the powder (see Kast, *loc. cit.*). The dinitrotoluene is obtained by difference. The ether extract obtained from a nitroglycerin powder is extracted with 85% acetone, which dissolves all but the vaseline, which is weighed. The acetone is evaporated from the filtrate, and the residue examined as described for the extract from nitrocellulose powder. Graphite is estimated in another portion of the powder (not crushed) by boiling the powder with 25% sodium hydroxide, filtering through a Gooch crucible, and washing the residue in turn with water, alcohol, ether, and benzene, and weighing the residue after ignition. For the estimation of sodium bicarbonate 5 grms. of the powder is carefully gelatinised with 50 c.c. of acetone and then diluted with 30 c.c. of alcohol. 100 c.c. of water is then added, drop by drop at first, and finally an excess of dilute standard hydrochloric acid. After one hour, the mixture being shaken at intervals, the excess acid is titrated with *N*/10 sodium hydroxide. For the estimation of the resin present in the residue after extracting the original powder with ether, the residue is treated as described for the estimation of sodium bicarbonate and finally boiled with 25 c.c. of 25% hydrochloric acid for half-an-hour. After cooling, the residue is filtered off, dried, and again extracted with ether. For the estimation of acetone, 20 grms. of the powder is distilled with steam, and the distillate after standing overnight is filtered and made up to 300 c.c. From 100 c.c. of this the acetone is converted into iodoform, which is filtered off and weighed. Moisture is estimated by drying the powder for fifteen hours in a current of dry air.
—W. G.

Detonator compositions; Analysis of ——. A. Wogrinz. Z. angew. Chem., 1919, **32**, 79—80.

FROM 0·8 to 2 grms. of the material is weighed in a small closed glass vessel, which is then opened and exposed in a vacuum desiccator over sulphuric acid for 24 hours, to determine the moisture. The dry residue is transferred to a small Erlenmeyer flask containing 4 to 5 c.c. of water. This flask has a ground-in stopper, through which passes a tube connected at its upper end with an enlargement below the tap of a thistle funnel, whilst another tube passes from the enlargement into a second open Erlenmeyer flask containing water. From 25 to 30 c.c. of strong hydrochloric acid is slowly introduced into the decomposition flask, which is then heated for about 10 mins. over a small flame, until only sulphur and any powdered glass remain undissolved. After cooling, the contents of the flask are treated with about 5 grms.

of crystallised tartaric acid and filtered, and the insoluble residue ignited and weighed. The filtrate is diluted to 250—300 c.c., and the antimony and mercury precipitated with hydrogen sulphide. The precipitate is collected on a dried weighed filter and washed with hydrogen sulphide water slightly acidified with acetic acid. Iron (from the antimony sulphide) and potassium are determined in the filtrate and the chlorate calculated from the potassium. The precipitate is heated on the water-bath for about 15 mins. with about 200 c.c. of dilute ammonium sulphide (1 : 1), and the undissolved mercury sulphide is washed successively with dilute ammonium sulphide, water, alcohol, ether, carbon bisulphide, ether, and alcohol, and dried at 100° C. and weighed. Each 1 grm. of mercuric sulphide is equivalent to 1·2625 grm. of mercury fulminate.
—C. A. M.

Mixed acid control Hearsey and Joyce. *See* XXIII.

PATENTS.

Picric acid; Manufacture of ——. N. H. Graesser and A. W. Titherley, Ruabon, Denbigh. Eng. Pat. 14,367, 11.10.15.

DURING the nitration of sulphonated phenol the temperature is maintained for approximately 8 hours between the limits of 110° C. and 118° C. either by external regulation or by commencing the reaction at 80° to 95° C. An increased yield is thus obtained and undue loss of nitric acid prevented. T. St.

Explosives. W. Rintoul, D. Cross, and Nobel's Explosives Co., Ltd., Stevenston, Ayrshire. Eng. Pat. 14,656, 16.10.15.

A SMALL proportion (0·1 to 1% calculated on the nitroglycerin) of aromatic nitro-compounds dissolved in nitroglycerin has the effect of gelatinising completely in the cold all classes of nitrocellulose from the soluble variety up to guncotton containing 13% of nitrogen, and gelatinisation so carried out takes place more quickly than when nitroglycerin alone is used at 60° to 70° C. Suitable nitro-compounds are mono-, di-, or trinitrotoluene, mononitronaphthalene, dinitrobenzene, and nitroxylenes, and they may be used singly or in mixtures of two or more. In the manufacture of nitroglycerin-nitrocellulose blasting explosives containing more than 50% of nitroglycerin, the aromatic nitro-compound is dissolved in the nitroglycerin, and the nitrocellulose and any other ingredients are then stirred in. The mixing is completed in the usual manner but without elevation of temperature.—T. St.

Explosives. W. Rintoul, D. Cross, and Nobel's Explosives Co., Ltd., Stevenston, Ayrshire. Eng. Pat. 14,655, 16.10.15.

OTHER materials capable, when dissolved in nitroglycerin, of effecting the gelatinisation of nitrocellulose in the cold (see previous abstract) are:—urethanes, or esters of carbaminic acid; anilides; substituted ureas; condensation products of glycerol and other polyhydric alcohols with aldehydes; homologues of oxanilic ester; the well-known solvents of nitrocellulose such as acetone, ethyl acetate, and amyl acetate. These substances, the first five classes of which act also as stabilisers, are used singly, or as mixtures of two or more, in the proportion of 0·1 to 1% calculated on the nitroglycerin.—T. St.

Explosive. W. Rintoul, E. G. Beckett, and Nobel's Explosives Co., Ltd., Stevenston, Ayrshire. Eng. Pat. 14,706, 18.10.15.

DICYANODIAMIDINE perchlorate, $C_2H_6N_4O.HClO_4$, may be used alone or in mixtures as a blasting or military high explosive. A suitable blasting explosive is composed of dicyanodiamidine perchlorate 69, sodium nitrate 29, woodmeal 2%; and a suitable shell-filling composition is ammonium nitrate 80, trinitrotoluene 10, dicyanodiamidine perchlorate 10%. Dicyanodiamidine perchlorate may be prepared by adding a solution of barium, strontium, or calcium perchlorate to a solution of dicyanodiamidine sulphate (obtained from dicyanodiamide), filtering, and evaporating the filtrate. It may also be prepared by adding a hot concentrated solution of sodium perchlorate to a solution of dicyanodiamidine hydrochloride; on cooling, dicyanodiamidine perchlorate crystallises out.
—T. St.

Explosives; Manufacture of ——. Perchlorate Safety Explosives, Ltd., and H. Harris, London. Eng. Pat. 14,932, 21.10.15.

POWDERED ammonium or potassium perchlorate capable of passing through a 60-mesh sieve is gradually added to molten paraffin wax in a suitable mixing machine, until the mixture contains about 82% of ammonium perchlorate or 83½% of potassium perchlorate. The waxy mass obtained on cooling may be pressed to any desired shape or used in the form of powder or granules.
—T. St.

Explosive. A. J. Marin, Stockholm, Sweden. U.S. Pat. 1,293,154, 4.2.19. Appl., 6.8.17.

A COMPRESSED solid safety explosive, detonating freely in the open air with a No. 6 detonator, is prepared by mixing ammonium perchlorate, sodium nitrate, and a nitro-hydrocarbon with a small quantity of water, and compressing the mixture to give it a density of 1·25—1·6 after drying.
—T. St.

Gunpowder; Process of manufacturing ——. J. Buxbaum, Georgetown, Wash. U.S. Pat. 1,293,326, 4.2.19. Appl., 28.12.17.

BLACK gunpowder is mixed with spirits of camphor into a plastic mass which is then thoroughly dried.
—T. St.

Explosive and process of manufacturing the same. K. V. Nielsen and J. P. Larsen, Aarhus, Denmark. U.S. Pat. 1,293,882, 11.2.19. Appl., 20.1.15.

THE explosive contains sulphur, potassium and ammonium nitrates, glycerin, a starchy substance, resin, and pyrolusite.—T. St.

Sulphuric acid [spent nitrating acid]; Process of removing nitrous and nitric acids from ——. D. Tyrer, Stockton-on-Tees. Eng. Pat. 17,541, 15.12.15.

THE acid is treated in the presence of an oxidising agent with a substance capable of being nitrated to a nitro-compound insoluble in sulphuric acid. For example, spent nitrating acid containing 70% or less of sulphuric acid and 1—10% of nitrous and nitric acids is introduced at about 110° C. along with air and toluene vapour, at the top of a tower packed with coke. The mixture issuing from the bottom of the tower is run into a separation tank, from which the purified sulphuric acid, containing less than 1% of nitric acid, is drawn off to the concentrators, whilst the residual mixture of toluene and nitrotoluene is used for making trinitrotoluene. Acid fumes and any toluene vapour escaping from the bottom of the tower pass through a pipe to coolers and scrubbers.—S. S. A.

Nitrocellulose; Process of recovering solvent from colloided ——. W. F. Nash, Kenvil, N.J., Assignor to Hercules Powder Co., Wilmington, Del. U.S. Pat. 1,293,515, 4.2.19. Appl., 7.3.18.

THE ether-alcohol solvent remaining in colloided nitrocellulose is recovered by first displacing the ether by means of alcohol and then displacing the alcohol by means of water.—T. St.

Frictionally-ignitible material [e.g., match composition]; Apparatus for powdering ——. C. L. Pfersch, Barberton, Ohio, Assignor to The Diamond Match Co., Chicago, Ill. U.S. Pat. 1,293,188, 4.2.19. Appl., 20.9.17.

A CONTAINER, capable of being vibrated, has a floor portion in which are spaced screen sections. Groups of reducing bars, alternating with the screen sections, are loosely mounted so as to permit of their independent movement without contact with each other when the container is vibrated, and of their operating directly upon material on the floor portion. Means are provided for giving a relative jarring action between the container and the bars, certain of which in each section are maintained above the surface of the floor.—T. St.

XXIII.—ANALYSIS.

Solubility; Rapid determination of ——. T. J. Ward. Analyst, 1919, **44**, 137.

ABOUT 3 c.c. of the solvent is heated in a test-tube immersed in water at 10° to 20° C. above the temperature at which the solubility is to be determined, and small quantities of the substance are added, with frequent shaking, until a portion remains undissolved. The test-tube is then transferred to a beaker containing water at the required temperature, and after about 10 mins. a thimble of folded filter paper is pushed down into the liquid, so that filtration proceeds inwards. From 0·5 to 2·0 c.c. is then withdrawn from the interior of the thimble, and transferred to a weighed dish, which is covered and again weighed. The solvent is evaporated, and the residue dried and weighed.
—C. A. M.

Standard alkali for mixed acid control. E. Hearsey and C. M. Joyce. J. Ind. Eng. Chem., 1919, **11**, 341.

THE authors confirm Hendrixson's recommendations (this J., 1915, 1118) as to the suitability of potassium acid phthalate in standardising alkali solutions.—W. P. S.

Starch-iodine reaction. I. M. Kolthoff. Pharm. Weekblad, 1919, **56**, 391—404.

THE sensitiveness of the starch iodine reaction is increased by the presence of acids and salts, being a maximum in potassium iodide solution. The sensitiveness is diminished by rise in temperature and the presence of organic substances such as alcohols, albumin, etc. In the titration of dilute iodine solutions (*N*/1000) with equivalent thiosulphate solutions, or *vice versâ*, a correction is required. This correction was determined for various conditions and found to be a minimum in presence of hydrochloric acid to which potassium iodide had been added.—W. S. M.

Sulphates; Precipitation of —— in the presence of iron. H. Koelsch. Chem.-Zeit., 1919, **43**, 117.

THE following average results were obtained on the analysis of barium sulphate precipitates obtained in the determination of sulphur in zinc blende. In 800 specimens precipitated from solutions after the iron had been removed:—Barium sulphate, 90·90; barium soluble in hydrochloric acid, 3·70; chlorine, 2·55; sulphide sulphur, 0·51; copper, 0·04; lead, 0·06; zinc, 0·09; iron, 0·14%. In 500 specimens precipitated in the presence of iron:—Barium sulphate, 89·10; barium soluble in hydrochloric acid, 4·16; chlorine, 2·87; sulphide sulphur, 0·50; copper, 0·07; lead, 0·28; zinc, 0·26; iron, 0·47%. The chief impurity was barium chloride. The presence of iron seems to have caused larger quantities of copper, lead, and zinc to be occluded in the barium sulphate. Insufficient oxidation during ignition of the barium sulphate led to the production of barium sulphide by reduction of the sulphate.
—W. P. S.

Mercury; Electrolytic estimation of —— without platinum electrodes. J. Guzmán and P. Poch. Anal. Fís. Quím., 1918, **16**, 742—755.

SATISFACTORY results are obtained in nitric acid solution with the use of a silver-plated copper cathode and a graphite anode. Electrolysis is carried out in cold slightly acid solution, the voltage not exceeding 3 volts. The same cathode may be used for several repetitions of the analysis, but the silver and mercury deposits must be removed each time. An ammoniacal mercury solution is electrolysed with an iron anode and copper cathode on which first nickel and then silver have been deposited. This cathode cannot be used for repetition analyses even after replating. A copper cathode on which mercury has been deposited can be used for repeated determinations if polished by brushing after each analysis. In alkaline cyanide solution a silver-plated copper cathode and an iron anode are used. The temperature is maintained at 50° C., and a voltage of 2·5 volts is applied. The method is accurate to 0·2%. With alkaline sulphide solutions the best results are obtained with an amalgamated copper cathode and an iron anode. Repeated use of the same cathode, even after brushing, leads to inaccuracies.—W. S. M.

Mercury; Gravimetric and volumetric determination of —— precipitated as mercury zinc thiocyanate. G. S. Jamieson. J. Ind. Eng. Chem., 1919, **11**, 296—297.

A SOLUTION containing a mercuric salt is treated with a reagent prepared by dissolving 39 grms. of ammonium thiocyanate and 29 grms. of zinc sulphate in 1 litre of water; 25 c.c. of this reagent is sufficient to precipitate a quantity of mercury not exceeding 0·14 grm. After the reagent has been added, the mixture is diluted to 75 c.c., stirred, set aside for 1 hr., and the precipitated mercury zinc thiocyanate then collected, washed with water containing a small quantity of the reagent (water, 450, reagent, 5 c.c.), dried at 105° C. for 1 hr., and weighed. The weight obtained multiplied by 0·40258 gives the amount of mercury. Alternatively, the moist precipitate may be transferred to a stoppered bottle, treated with a cold mixture of 35 c.c. of concentrated hydrochloric acid and 10 c.c. of water, 7 c.c. of chloroform added, and the mixture titrated with standardised potassium iodate solution until the iodine first liberated disappears. The contents of the bottle must be shaken during the titration. The solution of the mercuric salt should be neutral or only slightly acid and must not contain copper, bismuth, nickel, or cobalt, as these are precipitated with the mercury zinc thiocyanate.
—W. P. S.

Sodium pyrogallate solution as an absorbent for oxygen. G. W. Jones and M. H. Meighan. J. Ind. Eng. Chem., 1919, **11**, 311—316.

TESTS made with solutions of widely differing concentration showed that the rate of oxygen absorption by sodium pyrogallate solutions increases with the dilution of the sodium hydroxide, but is proportional to the pyrogallol concentration for any given sodium hydroxide concentration. All sodium pyrogallate solutions prepared with sodium hydroxide solution of sp. gr. less than 1·30 evolve carbon monoxide, the quantity of the latter

increasing with the dilution; if the sample of oxygen being absorbed contains more than 95% of oxygen, carbon monoxide is evolved no matter what is the concentration of the sodium hydroxide solution. A reagent which gives a minimum amount of carbon monoxide and has a fairly high rate of absorption is prepared as follows:—Pyrogallol is dissolved in water in the proportion of 1 grm. per 3 c.c.; 2 parts of this solution is then mixed with 5 parts of 50% sodium hydroxide solution.

—W. P. S.

Milk; Relation between the oxygen concentration and rate of reduction of methylene blue by ——. [*Determination of oxygen in gaseous mixtures.*] E. Harvey. J. Gen. Physiol., 1919, **1**, 415—419.

A METHOD for determining oxygen in gaseous mixtures is based upon the reduction of methylene blue by milk and acetaldehyde. (See further, J. Chem. Soc., June, 1919.)—J. C. D.

Acetone, alcohol, and benzene; Determination of small quantities of —— in air. Elliott and J. Dalton. Analyst, 1919, **44**, 132—136.

THE air is aspirated through four absorption vessels consisting of narrow measuring cylinders fitted with Folin tubes (J. Biol. Chem., 1912, **11**, 493) and connected, by long lengths of rubber tubing, with Winchester quart bottles fitted with siphons, the amount of water siphoning over affording a measure of the air drawn through the apparatus. At least 10 litres of air must be aspirated to obtain a sufficient quantity of the vapours for analysis. Acetone:—Messinger's method (this J., 1889, 138) was found to give accurate results, and so long as the temperature was kept low the error due to the formation of iodoform by the alcohol vapour in the air was negligible. Twenty c.c. of *N*/10 iodine solution and 5 c.c. of 20% sodium hydroxide solution are placed in one of the absorption cylinders and after passage of the measured volume of air the liquid is acidified with hydrochloric acid, and the excess of iodine titrated with thiosulphate solution. Alcohol:—A modification of Szeberényi's method (this J., 1915, 683) enables alcohol to be determined, without appreciable error being introduced by any acetone present. Twenty-five c.c. of a cold mixture of 100 c.c. of *N*/2 potassium bichromate solution, 100 c.c. of strong sulphuric acid, and 50 c.c. of water are introduced into another of the absorption cylinders, and a plug of cotton-wool placed in the inlet tube to prevent access of dust to the bichromate. After the absorption the liquid is transferred to a flask, the residue being washed in with 45 c.c. of water, so as to bring the volume of the liquid up to 75 c.c. The solution is boiled for 15 mins. under a reflux condenser, then cooled, treated with 100 c.c. of 2% sodium iodide, and the liberated iodine, corresponding to the bichromate left after oxidation of the alcohol to acetic acid, is titrated with *N*/10 thiosulphate solution (1 c.c. = 0·00115 grm. alcohol). Benzene:—Pfeiffer's method (Chem.-Zeit., 1909, **28**, 884) is more suitable for determining traces of benzene in air than the differential pressure method of Davis and Davis (this J., 1918, 644 A). The air is passed through 15 c.c. of a mixture of equal volumes of fuming nitric and strong sulphuric acids placed in one of the absorption cylinders fitted with a cork saturated with paraffin wax, whilst the fourth cylinder, containing 20 to 25 c.c. of 20% sodium hydroxide solution, is interposed between this cylinder and the siphon bottles to prevent corrosion of the rubber tubing. After the absorption the mixture of the acids is heated on the water-bath for 15 mins. to ensure complete nitration, cooled, diluted with water, rendered faintly alkaline to litmus by the addition of 50 c.c. of 40% sodium hydroxide solution, and then faintly acid with hydrochloric acid. After dilution to about 500 c.c. it is extracted with three successive portions of ether, and the ether treated with about 0·5 c.c. of sodium hydroxide solution, then separated and distilled, and the residue of nitrobenzene heated on the water-bath to remove oxidation products of alcohol and acetone, and dissolved in 10 c.c. of alcohol. The alcoholic solution is heated for 10 mins. with 10 c.c. of a standard solution of stannous chloride, and after cooling the excess is titrated with *N*/10 iodine solution (1 c.c. = 0·00065 grm. benzene). The following amounts of these substances per million c.c. were found in the air of factories:—Acetone, min., 0·02; max., 1·86; mean, 0·31 grm. Alcohol, min., 0·02; max., 3·00; mean, 0·65 grm. Benzene, min., 0·01; max., 0·90; mean, 0·26 grm.—C. A. M.

Absorption by turbid media. Application to the estimation of suspensions. C. Chéneveau and R. Audubert. Comptes rend., 1919, **168**, 766—768.

THE amount of material present in fine suspensions, where immediate sedimentation does not occur, may be determined by using the formula, $1 - I/I_0 = e^{-B\,m^{\beta}}$, where I/I_0 is the coefficient of transmission of light for the suspension, M is the mass of the particles in the suspension, and B and β are constants depending on the nature of the particles and the wave length of the light used. The formula has been verified for certain heterogeneous suspensions of mastic and for suspensions of silver chloride and barium sulphate.

—W. G.

Natural gas. Anderson. *See* IIA.

Magnesite. Macri. *See* VII.

Bromate and iodate. Kolthoff. *See* VII.

Uranium in steels etc. Kelley and others. *See* X.

Copper and zinc in gelatin. Jamieson. *See* XV.

Ion-protein compounds. Loeb. *See* XV.

Nitrogen [*in soils*]. Davisson and Parsons. *See* XVI.

Sucrose in molasses. Lohr. *See* XVII.

Sausages etc. (1) Stubbs and More. (2) Stokes. *See* XIXA.

"*Perocide.*" Mach and Lederle. *See* XIXB.

Alkaloids. (1) Rapp. (2) Dieterich. *See* XX.

Vanillin. Dox and Plaisance. *See* XX.

Salicylic acid. Berg. *See* XX.

Monomethylaniline. Frankland and others. *See* XX.

Carbonyl chloride. Kling and Schmutz. *See* XX.

Smokeless powder. Van Duin and others. *See* XXII.

Detonator compositions. Wogrinz. *See* XXII.

PATENTS.

Chemical apparatus [for gas absorption]. E. Hart, Easton, Pa. U.S. Pat. 1,293,423, 4.2.19. Appl., 24.9.18.

A VESSEL is provided with a stopper, and with gas inlet and outlet tubes connected to the bottom and top of the vessel respectively. The two tubes are brought to a position where they are adjacent to one another and are there controlled by a single valve or stopcock.—W. F. F.

Fabrics and other materials; Process and apparatus for testing [wearing qualities of] ——. Schweizerische Versuchsanstalt für Textilindustrie, Assignees of Kontroll und Versuchsstelle für Textilindustrie an der Handelshochschule, St. Gallen, Switzerland. Eng. Pat. 124,183, 10.7.18. (Appl. 11,303/18.) Int. Conv., 13.3.18.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

August. Rotary muffle furnaces. 11,499. May 8.

Bentall and Bingham. Grinding and kibbling mills. 10,976. May 2.

Boberg, and Techno-Chemical Laboratories. Drying. 11,092. May 3.

British Thomson-Houston Co. (General Electric Co.). Automatically removing gases. 10,770. Apr. 30.

Cooper. 10,842. *See* V.

Cruse. Separation of pulverised material from air. 10,980. May 2.

Du Pont de Nemours and Co. Recovery of solvents. 11,182 and 11,183. May 5. (U.S., 8.8.18.)

English and Hannan. Stills etc. 11,412. May 7.

Fawcett, Preston, & Co. (Taylor). Vacuum etc. pans. 11,042. May 3.

Fletcher & Co., and Miller. Filters. 11,142 May 5.

Hardinge. 10,602. *See* X.

Loring. Apparatus for disseminating liquids in pulverised solids or mechanically breaking up liquids for drying them etc. 10,891. May 1.

MacLachlan. Apparatus for granulating etc. pasty or semi-fluid materials etc. 10,619. Apr. 29.

Millar and Reavell. Plant for leaching etc. 11,564. May 8.

Wade (Fours et Procédés Mathy Soc. Anon.). Furnaces. 11,113. May 3.

COMPLETE SPECIFICATIONS ACCEPTED.

15,084 (1916). Weir and Weir. Heating boiler feed water and its treatment to prevent corrosion in boilers. (126,014.) May 14.

9683 (1917). Hinchley. Apparatus for expressing liquid from materials. (125,672.) May 7.

1495 (1918). Barclay. Apparatus for removing suspended particles from gases. (125,681.) May 7.

6805 (1918). Smallwood. Furnaces. (125,744.) May 7.

7059 (1918). Hardinge. *See* X.

7382 (1918). Fox. Dehydrating and desiccating apparatus. (126,135.) May 14.

9319 (1918). Hoffmann. Means for spraying liquids and mixing therewith other liquids or gases. (125,809.) May 7.

11,229 (1918). Turner and Eames. Apparatus for automatically recording the supply of liquid to chemical and other plant. (126,209.) May 14.

115 (1919). Naaml. Vennoots. Vereen. Nederlandsche Rubberfabrieken. Filtering apparatus particularly applicable for use with thick liquids, plastic and colloidal materials. (122,627.) May 14.

3520 (1919). Miller, and Fletcher and Co. Filter presses and the like. (126,265.) May 14.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING, LIGHTING.

APPLICATIONS.

Andersson, Brady, and Deacon. Furnaces for distilling coal etc. 10,624. Apr. 29.

Beswick and Rambush. Destructive distillation of solid fuels. 10,883. May 1.

Coune. Gas washer and purifier. 10,713. Apr. 30.

Cowburn and Cowburn. Production of gases under pressure. 11,212. May 5.

Coxon and Williams. Renewal of filaments in metal-filament electric lamps. 11,338. May 7.

Dayton Metal Products Co. Fuel for internal-combustion engines. 11,438, 11,440, 11,441, 11,442. May 7. (U.S., 1 and 5.10.18, 1, 2 and 10.3.19.)

Doherty. Coal-carbonising furnaces. 11,774. May 10. (U.S., 7.9.18.)

Foster and Illingworth. Coke ovens. 11,807. May 10.

Joubert. Distillation of fuels. 11,901. May 2.

Machaurin. Manufacture of lubricating-greases. 11,633. May 9.

Marks (U.S. Industrial Alcohol Co.). Liquid fuel. 10,712, 11,177, 11,178, 11,418. Apr. 30, May 5 and 7.

Marks (U.S. Industrial Alcohol Co.). Non-freezing fuel. 11,419. May 7.

Marks (U.S. Industrial Alcohol Co.). Production of liquid fuel. 11,420. May 7.

Mason and Newbury. Ray filter for cutting out heat rays of arc lamps etc. 11,762. May 10.

Quigley Furnace Specialities Co. Apparatus for production, transportation, and combustion of pulverulent fuel. 11,386. May 7. (Fr., 8.5.18.)

Roos. Production of explosive mixtures for internal-combustion engines. 10,951. May 2.

Ross and Young. Production of violet and ultra-violet light. 11,579. May 8.

Southcombe and Wills. Lubricating etc. oils. 10,593. Apr. 29.

West and Wild. Retorts for distillation of carbonaceous materials. 11,413. May 7.

COMPLETE SPECIFICATIONS ACCEPTED.

9780 (1915). Ciselet and Deguide. Purification of distillation gases of coal. May 7.

12,262 (1916). Dellwick and Cutler. *See* VII.

9906 (1917). Thomsen. Production of light mineral oils from petroleum. (126,089.) May 14.

2132 (1918). Stewart. Gas producers. (125,686.) May 7.

5014 (1918). Mulliner and Kent. Treatment of carbonaceous substances. (125,698.) May 7.

5704 (1918). Cross. Transforming heavy hydrocarbon oils into lighter oils. (126,103.) May 14.

7131 (1918). Bancroft and Hansford. Gas retorts. (126,121.) May 14.

7246 (1918). Stobart. Washers for coal and the like. (125,781.) May 7.

7435 and 8296 (1918). Parker and Abrahams. Apparatus for generating from incandescent carbonaceous material, fuel gas for use in internal-combustion engines. (126,140 and 126,172.) May 14.

8583 (1918). Marks (Soc. Franco-Belge de Fours à Coke). Horizontal coke ovens. (126,180.) May 14.

26,941 (1918) and 195 (1919). Dempster and Ballingall. See VII.

III.—TAR AND TAR PRODUCTS.

Applications.

Craddock. 10,761. *See* XXIII.

Marks (Soc. Franco-Belge de Fours à Coke). Continuous distillation and fractionation of crude benzols etc. 10,864. May 1.

Stephenson. Dealing with acid sludge produced in purification of benzol and recovering benzol and sulphuric acid therefrom. 10,918. May 2.

Complete Specifications Accepted.

13,423 (1916). Tyrer. Separating phenol or its homologues from aqueous liquid. (125,625.) May 7.

15,960 (1916). Comp. des Prod. Chim. d'Alais et de la Camargue. Preparation of benzenemonosulphonic acid. (126,039.) May 14.

16,843 and 17,377 (1916). Macdonald and Calvert. Manufacture of nitrophenols. (126,062 and 126,084.) May 14.

11,072 (1918). Gibbs, Lewis, and Selden Co. Purification of anthraquinone. (125,836.) May 7.

IV.—COLOURING MATTERS AND DYES.

Applications.

A'Brassard and Crawford, and Buckle. Manufacture of indophenolic substances. 11,101. May 3.

British Saccharine Manufacturing Co., and Harding. Manufacture of colouring matters from *p*-toluenesulphochloride or *p*-toluenesulphamide. 10,560. Apr. 29.

British Saccharine Manufacturing Co., and Harding. Manufacture of colouring matters from *p*-toluenesulphochloride. 10,648. Apr. 30.

Ellis (Chem. Works formerly Sandoz). Manufacture of yellow disazo dyestuffs. 10,887. May 1.

Thompson (Poulenc Frères, and Meyer). Manufacture of diaminoacridine etc. 10,797. May 1.

Complete Specification Accepted.

7009 (1918). Morton, Dandridge, and Morton Sundour Fabrics, Ltd. Production of a colouring-matter. (126,112.) May 14.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Cooper. Drying fibrous, granular, etc. material. 10,842. May 1.

Dunville and Co., and Gilmour. Production of solutions of cellulose acetates and nitrates, including celluloid, for use as varnishes, lacquers, and dopes. 11,077. May 3.

Henderson. Fibrous compositions. 10,734. Apr. 30.

Murray. Preserving and waterproofing medium. 10,841. May 1.

Schofield. Wool lubricants. 10,839 and 11,078. May 1 and 3.

Skinner. Preparation of pulp or fibrous material for making paper, papier mâché, string, fabrics, etc. 10,599. Apr. 29.

Thiry. Paper-making machines. 11,787. May 10.

Complete Specifications Accepted.

12,917 (1916). Vickers, Ltd., and McKechnie. Manufacture of fabrics for airships, balloons, etc. (125,617.) May 7.

13,354 (1916). Perkin, Mandleberg, and Mandleberg and Co. Impregnated and coated fabrics. (125,622.) May 7.

13,685 (1916). Vickers, Ltd., and McKechnie. Fabrics for the gas bags of aircraft. (125,636.) May 7.

8342 (1918). Cross and Bevan. Treatment of fibrous cellulose for the production of hydrated derivatives. (126,174.) May 14.

2129 (1919). Dubot. Funnels or thread-guides for use in making artificial threads. (126,263.) May 14.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Ashworth. Machines for dyeing etc. yarns in hanks, skeins, or bundles. 10,822. May 1.

Lascot. Printed designs on textile fabrics. 10,941. May 2.

Complete Specification Accepted.

10,298 (1918). Calico Printers' Assoc., and Fourneaux. Production of black on vegetable textile fibres, silk fibres, or mixtures of the same. (126,201.) May 14.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Bergve. Decomposition of alkaliuous and aluminous minerals. 11,651. May 9. (Norway, 27.5.18.)

Catlett. Oxysalt compositions. 11,621. May 9. (U.S., 9.5.18.)

Craig. 10,836. *See* X.

Desachy. Manufacture of anhydrous zinc sulphide. 11,181. May 5. (Fr., 19.10.17.)

Desachy. Manufacture of mixtures of barium sulphate and zinc sulphide. 11,185. May 5. (Fr., 19.10.17.)

Desachy. Manufacture of anhydrous zinc sulphide for use as a pigment. 11,186. May 5. (Fr., 19.10.17.)

Desachy. Conjoint manufacture of zinc sulphide and barium sulphate. 11,187. May 5. (Fr., 19.10.17.)

Jones, and Newell and Co. 11,019. *See* XVI.

Langwell. Manufacture of finely-divided barium carbonate. 11,793. May 10.

Levin. 11,436. *See* XI.

Marks (American Lead Pencil Co.). Manufacture of pencil lead. 11,422 and 11,423. May 7.

Mooney. Manufacture of chromium sulphate. 11,215. May 5.

Rogers (Bhisey). Compound for washing, cleaning, etc. 10,730. Apr. 30.

White (Becker Bros.). 10,648. *See* XI.

Complete Specifications Accepted.

12,262 (1916). Dellwick and Cutler. Recovering hydrogen from a mixture of hydrogen and air. (125,596.) May 7.

12,405 (1916). Washburn. Manufacture of nitric acid and other products. (125,601.) May 7.

12,566 (1916). C.I. Syndicate and others. *See* XI.

12,567 (1916). C.I. Syndicate, Jenkins, Blackmore, and Howard. Manufacture of chlorates of the alkalis. (125,609.) May 7.

12,914 (1916). Leitch. Manufacture of highly concentrated nitric acid. (125,616.) May 7.

13,297 (1916). Tyrer. Manufacture of ammonium nitrate. (125,621.) May 7.

16,668 and 17,322 (1916). Scott and Howles. *See* XI.

17,368 (1916). Maxted and Ridsdale. Manufacture of nitric acid and oxides of nitrogen. (126,083.) May 14.

1058 (1918). Bailey, Denny, and Dunk. Production of ammonium perchlorate. (125,677.) May 7.

6383 (1918). Ashcroft. Removal of oxygen from gaseous mixtures. (125,714.) May 7.

8025 (1918). Utheim. Manufacture of acetic acid. (116,279.) May 7.

15,389 (1918). Gregory. Recovery of tin compounds. (125,879.) May 7.

26,941 (1918). Dempster and Ballingall. Reducing operations in hydrogen-making plants. (126,251.) May 14.

195 (1919). Dempster and Ballingall. Manufacture of hydrogen. (126,256.) May 14.

VIII.—GLASS; CERAMICS.

COMPLETE SPECIFICATIONS ACCEPTED.

9297 (1918). Wade (Carborundum Co.). Manufacture of refractory articles. (126,192.) May 14.

12,896 (1918). Dressler Tunnel Ovens, Ltd., and Rushton. Kilns or ovens for firing bricks, pottery, etc. (126,218.) May 14.

14,542 (1918). Kraus. Manufacture of refractory material. (126,229.) May 14.

674 (1919). Haddan (Corning Glass Works). Borosilicate glass for use as a filter to produce daylight effects. (125,920.) May 7.

675 (1919). Haddan (Corning Glass Works). Potash glass for use as a filter to produce daylight effects. (125,921.) May 7.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Ambrose and Mathews. Manufacture of a plastering material or constitutional cement 10,884. May 1.

Convert-Villejean, Lécorché, et Cie. Manufacture of wood substitutes. 11,166. May 5. (Fr., 2.5.14.)

Henderson. Bituminous binders. 10,735. Apr. 30.

Otto. Seasoning wood. 10,605 Apr 29.

Watson. Manufacture of bricks. 10,609. Apr. 29.

COMPLETE SPECIFICATIONS ACCEPTED.

11,904 (1918). Otto. Seasoning wood. (125,846.) May 7.

12,896 (1918). Dressler Tunnel Ovens, Ltd., and Rushton. *See* VIII.

14,625 (1918). Wingvist Rotating kilns for burning cement etc (126,230.) May 14.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Ballantine and Sulman. Production of ferro-alloys. 11,688. May 9.

Bates. Fusible alloy. 10,847. May 1.

Coles. Continuous process for coating metal plates with other materials. 11,006. May 3.

Coles. Coating wire etc. with metals by electro-deposition. 11,008. May 3.

Coles. Electro-deposition of copper-zinc alloy. 11,168. May 5.

Collins. Recovery of tin from tin ores, residues, etc. 10,601. Apr. 29.

Comp. des Forges de Chatillon-Commentry et Neuves Maisons. Manufacture of basic pig iron. 10,744. Apr. 30. (Fr., 20.2.19.)

Craig. Recovering potash and other salts from blast-furnace gases. 10,836. May 1.

Electrolytic Zinc Co. Treatment of zinc ores for recovery of zinc by electrodeposition. 10,490. Apr. 28. (Australia, 27.4.18.)

Elliott Removal of tin from tin plate. 11,197. May 5.

Elmore. Extraction of lead and zinc from their ores. 10,885. May 1.

Hardinge. Grinding or disintegrating ores etc. 10,602. Apr. 29.

Hyde. Electric welding. 10,857 and 10,858. May 1.

Lenoir. Manufacture of manganese and its alloys in electric furnaces. 10,755. Apr. 30. (Fr., 8.1.14.)

McKechnie, and McKechnie Bros. Separating or recovering nickel from cupro-nickel alloys, scrap, etc. 11,725. May 10.

Musser. Centrifugal amalgamator and method of obtaining metal from ore. 11,655. May 9.

Owen. Electroplating. 11,332. May 6.

Partington, Taylor, and Vivian. Treatment of ores. 11,093 and 11,094. May 3.

Soc. Anon. Commentry-Fourchambault et Decazeville. Alloy. 10,604. Apr. 29. (Fr., 22.5.18.)

Sundberg and Thomasson. Manufacture of pure electrolytic copper from cement copper. 11,312. May 6.

White (Becker Bros.). 10,618. *See* XI.

COMPLETE SPECIFICATIONS ACCEPTED.

13,568 (1916). Hyde, Jude, and Belliss and Morcom. Impregnating and coating metals with other metals. (125,630.) May 7.

13,853 (1916). Mohr and Heberlein Treatment of copper-nickel matte to separate the metals. (125,642.) May 7.

14,830 (1916). Whyte Case-hardening. (125,666.) May 7.

15,278 (1916). Vautin and others. *See* XXII.

16,307 (1916). Jarvis. Manufacture of iron and steel. (126,046.) May 14.

16,389 (1916). Hadfield. Manufacture of steel. (126,049.) May 14.

16,459 (1916). Hadfield. Alloys. (126,053.) May 14.

7059 (1918). Hardinge Conical tube mills for grinding ores etc. (126,114.) May 14.

7311 (1918). Burr Production of alloys from volatile substances or metals, and other metals. (125,785.) May 7.

7648 (1918). Stabilimenti Biak Ing. A. Pouchain Process for refining alloys. (116,277.) May 14.

7665 (1918). Clevenger. Electrolytic production of zinc. (115,846.) May 14.

12,219 (1918). Berglund. Extraction of zinc in electric furnaces. (120,549.) May 7.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Bell and Brearley. Water cooler and electrode economiser for electric furnaces. 11,492. May 8.

Coles. 11,168. *See* X.

Colquhoun and Niblett. Electrolytic treatment of liquid, granulated, or solid substances. 11,507. May 8.

Electrolytic Zinc Co. 10,490. *See* X.

Hazlehurst, and Lithanode, Ltd. Primary electric batteries. 10,881. May 1.

Hyde. 10,857 and 10,858. *See* X.

Imbery. Electric muffle furnaces. 11,466. May 8.

Lemaire Electric accumulators. 11,694. May 9.

Lenoir. 10,755. *See* X.

Levin. Electrolytic gas-generators. 11,436. May 7. (U.S., 22.5.17.)

Oldham and Oldham. Galvanic batteries. 11,206. May 5.

Owen. 11,332. *See* X.

White (Becker Bros.) Electrolytic cell, and method of operating same to produce oxides and powders of metals and alloys. 10,618. Apr. 29.

COMPLETE SPECIFICATIONS ACCEPTED.

12,566 (1916). C. I. Syndicate, Jenkins, Blackmore, and Howard. Electrolytic oxidation process, and apparatus therefor. (125,608.) May 7.

16,008 (1916). Scott and Howles. Electric furnaces for fixation of nitrogen. (126,058.) May 14.
17,332 (1916). Scott and Howles. Nitrogen fixation furnaces. (126,080.) May 14.
7387 (1918). Hawkins. Electric accumulator cells. (115,635.) May 14.
7065 (1918). Clevenger. *See* X.
12,219 (1918). Berglund. *See* X.
14,859 (1918). Fuller Accumulator Co., and Jones. Electrodes for primary and secondary batteries. (125,871.) May 7.

XII.—FATS; OILS; WAXES.

Applications.

Davis and Whatnall. Wax-hardening process. 10,475. Apr. 28.
Dayton Metal Products Co. 11,439. *See* XX.
Downs and Hawley. Extraction of oils and fats from seeds, nuts, etc., by means of a solvent. 10,833. May 1.
Hydro-Sewage Contractors, and Reynard. Dehydrating and purifying wool fat. 11,208. May 5.

Complete Specification Accepted.

1849 (1919). De Raedt. Apparatus for extracting oils, fats, sugar, etc. (126,262.) May 14.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Clark. Damp-proof washable distemper. 11,596. May 9.
Desachy. 11,184 -11,187. *See* VII.
Dunville and Co., and Gilmour. 11,077. *See* V.

Complete Specification Accepted.

18,253 (1918). Kohler. Production of a shellac substitute. (120,729.) May 7.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Complete Specification Accepted.

4941 (1918). Dunlop Rubber Co., and Twiss. Vulcanisation of rubber and similar materials. (125,696.) May 7.

XV.—LEATHER; BONE; HORN; GLUE.

Complete Specification Accepted.

15,702 (1918). Schlackmann. Dressing, fleshing, and unhairing skins. (126,234.) May 14.

XVI.—SOILS; FERTILISERS.

Applications.

Jones, and Newell and Co. Manufacture of superphosphates and like manures. 11,019. May 3.
Watson and Young. Utilisation of sewage sludge etc. for producing manure etc. 10,592. Apr. 29.

Complete Specification Accepted

6445 (1918). Marks (Soc. Anon. Ital. Ansaldo & Co.). Production of fertilisers. (125,714.) May 7.

XVII.—SUGARS; STARCHES; GUMS.

Complete Specification Accepted.

1849 (1919). De Raedt. *See* XII.

XVIII.—FERMENTATION INDUSTRIES.

Applications.

Marsan and O'Sullivan. 10,715. *See* XIX.
Takamine. Diastatic composition, and process of making same. 11,673. May 9. (U.S., 20.8.18.)

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Allport and Vickers. Preparation of preserved meats. 10,809. May 1.
Ames. Apparatus for aerating sewage etc. 10,489. Apr. 28.
Loring. Preparation of foods. 10,890. May 1.
Marsan and O'Sullivan. Treatment of yeast to obtain a food resembling extract of meat. 10,715. Apr. 30.
Watson and Young. 10,592. See XVI.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Commercial Research Co. Manufacture of chlorhydrins of gaseous olefines etc. 10,923. May 2. (U.S., 3.5.18.)
Dayton Metal Products Co. Hydrogenation. 11,439. May 7. (U.S., 5.10.18.)

Complete Specifications Accepted.

10,211 (1918). Pegram. Manufacture of preparations of addition compounds of iodine and hexamethylenetetramine. (117,451.) May 14.
3542 (1919). Crosfield and Sons, and Hilditch. Manufacture of acetaldehyde. (125,926.) May 7.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Application.

Tarlton. Plates for making photographs in colours. 10,831. May 1.

Complete Specification Accepted.

7641 (1918). Kerotype, Ltd., and Middleton. Photographic printing paper and transfer processes. (126,149.) May 14.

XXII.—EXPLOSIVES; MATCHES.

Application.

Marks (Du Pont de Nemours & Co.). Composition for detonators. 11,417. May 7.

Complete Specifications Accepted.

12,404 (1916). Howles. Explosive. (125,600.) May 7.
14,814 (1916). Blackmore, Cooke, and Jenkins. Explosives. (125,663.) May 7.
15,062 (1916). Marks (Spica). Manufacture of ballistite. (126,013.) May 14.
15,278 (1916). Vautin, and Produce Mortgage Trust. Use of aluminium waste in the manufacture of explosives etc. (126,021.) May 14.
16,616 (1916). Rintoul, and Nobel's Explosives Co. Explosives. (126,056.) May 14.
17,328 (1916). Graesser and Williams. Drying picric acid. (126,077.) May 14.
17,329 (1916). Graesser and Williams. Separation and recovery of picric acid. (126,078.) May 14.
18,906 (1917). Adde. Explosives. (112,618.) May 14.
9137 (1918). Tisell. Explosive. (116,890.) May 14.
9832 (1918). Tisell and Pillaume. Explosives. (126,196.) May 14.

XXIII.—ANALYSIS.

Application.

Craddock. Penetration machines for testing viscous substances. 10,761. Apr. 30.

I.—GENERAL; PLANT; MACHINERY.

Agglomeration of granular masses. F. G. Donnan. Trans. Faraday Soc., 1919, **14**, 12—13.

The principal factors causing the agglomeration of masses are stated to be (1) unequally distributed stress, (2) unequal size of granules, (3) existence of unstable or metastable forms, and (4) sheared or "flowed" crystal surfaces, these factors resulting in solution or re-solution in one portion of the material and precipitation in another.—B. N.

PATENTS.

Cooling apparatus [for liquids and gases]. J. H. West, Blundellsands. Eng. Pat. 125,101, 16.5.16. (Appl. 6949/16.)

The liquid, gas, or vapour to be cooled is passed through one or more upright U-pipes with limbs long in proportion to their diameter. The limbs are freely exposed to the air and are further cooled by allowing water or other cooling medium to trickle down in a thin film on the outside of the pipes. The apparatus may be used for cooling concentrated sulphuric acid and condensing nitric acid.—B. M. V.

Drying granular, pulverulent and pasty materials; Apparatus or kilns for —. H. Alexander, Leeds. Eng. Pat. 125,235, 18.4.18. (Appl. 6613/18.)

To allow for expansion of the vertical shaft of the apparatus described in Eng. Pat. 123,646 (this J., 1919, 241 A), the feeding device at the top of the shaft is carried in a bearing which allows for axial sliding as well as rotation.—B. M. V.

Drying moisture-bearing substances; Apparatus for —. J. H. Beebee, Rochester, N.Y. U.S. Pat. 1,295,259, 25.2.19. Appl., 16.8.18.

The drying chamber is provided with a perforated partition forming an air space adjoining the drying space, and another chamber containing dehydrating material in horizontal trays is connected to the air space. A fan is placed in the connecting conduit so that the same air is continuously circulated from the chamber containing the dehydrating material into the air space, and then through the drying space back to the dehydrating material.—W. F. F.

Dryer and evaporator. D. Hill and J. A. Meroney, sen., Assignors to F. E. Tiscornia, San Francisco, Cal. U.S. Pat. 1,296,519, 4.3.19. Appl., 8.10.17.

The material to be dried and evaporated is contained in a tier of horizontal trays in an externally heated oven. Warm dry air is passed between the layers from one side to the other, and is then dried and returned to the oven. Means are provided for reversing the direction of the air and for "sulphurating" it before delivery to the oven.
—W. F. F.

Dryer. G. E. Shatto, Cleveland, Ohio. U.S. Pat. 1,297,409, 18.3.19. Appl., 21.8.15.

A dryer comprises a horizontal cylindrical shell rotating about its axis, which is slightly inclined to the horizontal. A number of longitudinal shelves project radially inwards from the shell and are inclined at such an angle that material progresses axially through the shell as it is rotated. Hot drying gas is introduced by a wide tube projecting axially into one end, and withdrawn from the shell at the other end, while the material travels through in the opposite direction.—W. F. F.

Dryer. W. E. Petty, Storm Lake, Iowa. U.S. Pat. 1,297,727, 18.3.19. Appl., 12.7.18.

The material to be dried is supported on horizontal racks in the upper part of a vertical cylindrical casing; a heating chamber in the lower part of the casing is separated from the drying chamber by a horizontal partition having an annular opening between its periphery and the wall of the casing. Part of the wall is hinged to give access to the drying compartment. The entire cylindrical surface of the casing is surrounded with an outer casing forming an annular air space which has openings at the bottom communicating with the atmosphere, and screened slots in its inner wall communicating with the drying chamber. Hot gas from the heating chamber passes around the edge of the partition into the drying chamber and is discharged from the latter by a ventilator at the top. Air enters the bottom of the annular space and passes into the drying chamber through the slots, and is discharged with the gas.—W. F. F.

Gas-heated furnaces. J. King, W. Gregson, and Tandevin and Gregson, Ltd., Sheffield. Eng. Pat. 125,258, 10.5.18. (Appl. 7832/18.)

The tendency to fracture of the upstanding tiles employed for the protection of the side passages for gas, in gas-heated furnaces of the usual construction, is obviated in the following manner. The sides of the heating chamber are composed of refractory blocks abutting on the insulating brickwork both at the sides and bottom of the furnace, but not forming part of the main or structural walls. The lower ends of the blocks are below the level of the slab floor of the furnace, while the upper ends reach to the spring of the roof of the furnace, but do not form part of the support thereof. The heating gases pass through the blocks *via* horizontal passages below the slab floor, continued into vertical passages leading through inclined ports into the heating chamber. The lower ends of the vertical passages are continued below the level of the horizontal passages, and serve as pockets for the reception of débris.—J. S. G. T.

Furnaces. A. Smallwood, London. Eng. Pat. 125,515, 23.4.18. (Appl. 6804/18.)

A non-muffled type of recuperative furnace in which the goods are run into the furnace on a movable carriage. Combustion chambers extend longitudinally through the body of the carriage and the partially burnt gases pass through heating flues also extending through the body of the carriage. Secondary air is preheated in a recuperative system in the crown of the furnace. Secondary air and partially burnt gases are brought together in the goods chamber at the sides of the carriage through several ports which can be regulated independently. The waste gases from the goods chamber pass through the recuperative system in the crown of the furnace and thence to the chimney. Gas for combustion is supplied either from an external source or from a fire box or gas producer combined with the furnace.—B. M. V.

Tunnel-kiln; Continuous —. G. H. Benjamin, New York. U.S. Pat. 1,295,955, 4.3.19. Appl., 1.2.17. Renewed 16.7.18.

A tunnel oven through which the goods pass horizontally is provided with separate longitudinal heating chambers within and spaced from the side walls of the main chamber. The heating chambers on the opposite sides of the main chamber are connected across the top, and discharge their combustion products into a common vertical flue. Gas

and air for combustion are delivered into the bottom of each chamber. Air passes into the main chamber at the bottom of the longitudinal spaces between the heating chambers and the adjacent side walls of the main chamber, then upwards through these spaces where it is heated, and finally downwards over the goods in the chamber to a central discharge outlet in the floor.—W. F. F.

Treating air or other gases to remove excess moisture; Apparatus for ——. L. Dunker, Rugby. Eng. Pat. 125,280, 18.6.18. (Appl. 10,050/18.)

Air that has been cleaned in wet cleaning apparatus, *e.g.* that described in Eng. Pat. 112,653 (this J., 1918, 114 A), contains too much free moisture to be safe for many purposes, *e.g.* cooling electrical machinery. To remove this excess moisture the air is passed through an eliminator consisting of a number of closely arranged dry baffle plates, and provided with a rotating or reciprocating shutter or a number of hinged flaps for shutting off portions of the eliminator in succession, so that accumulated water may drain off.
—B. M. V.

Air-washing apparatus. W. D. Phillips, Brooklyn, N.Y. U.S. Pat. 1,296,315, 4.3.19. Appl., 15.6.17.

A casing containing water is provided with a rotating horizontal shaft passing through it above the water and carrying spaced parallel discs dipping into the water. Each disc carries on its sides, near the edge, buckets of conical shape with flaring mouths, arranged tangentially. The air is passed through the casing. The discs may have serrated edges, the buckets being arranged between the serrations.—W. F. F.

Filter presses. W. O. Mason, Leeds. Eng. Pat. 125,304, 21.8.18. (Appl. 13,557/18.)

In filter-press plates of the type made in several sections held together by bolts, the latter are protected from the corrosive action of liquor leaking through the joints by enclosing them, at points opposite the joints, in sleeves of non-corrodible material, *e.g.*, lead. The sleeves are of larger diameter than the bolts and are set in annular recesses cut in the material of the plates.—B. M. V.

Filter. G. Moore, Joplin, Mo. U.S. Pat. 1,296,685, 11.3.19. Appl., 11.12.14.

Liquid to be filtered passes under pressure from a supply vessel tangentially into the bottom of a filtering vessel provided with a transverse horizontal filter through which the liquid passes upwards. The top of the filtering vessel is closed, so that the enclosed body of air maintains the pressure on the filtered liquid; when the pressure in the supply chamber is reduced, the filtered liquid may pass in the reverse direction through the filtering medium to a tangential outlet passage. The space below the filter contains a buoyant solid material which under the action of the inflowing unfiltered liquid scrubs the surface of the filtering medium.—W. F. F.

[*Wet*] *separators for the treatment of coal, clays, ores, etc.* J. M. Draper, Bridgend. Eng. Pat. 125,344, 23.12.18. (Appl. 21,529/18.)

The patent relates to improvements in the upward current washing apparatus described in Eng. Pats. 1849 of 1915 and 111,826 (this J., 1915, 1196 and 1918, 45 A), the lighter material being permitted to overflow round the whole circumference of the outer vessel (thus increasing output), and the area of overflow being adjustable by a tapering collar surrounding the central feed tube, which is itself independently adjustable as to height. The water which supplies the upward current enters at a tangent to the wall of the outer vessel, so that a gyratory as well as an upward motion is produced.
—B. M. V.

Liquid and gas contact apparatus. A. M. Webb, Charlotte, N.C. U.S. Pat. 1,293,270, 4.2.19. Appl., 19.6.18.

A filler unit, for gas and liquid contact towers, comprises a cylinder having a helical flange projecting from the inner wall. The flange is of less width than the radius of the cylinder, so that a continuous central opening is formed extending lengthwise through the cylinder.—B. N.

Refrigeration apparatus. E. R. Sage, Jersey City, N.J., Assignor to R. S. Broas, East Orange, N.J. U.S. Pat. 1,296,012, 4.3.19. Appl., 21.1.16.

A condensing chamber is contained in the base of the apparatus, a separating chamber is mounted on the condensing chamber, and a rotary compressor on the separating chamber. Condensing tubes pass horizontally through the condensing chamber, and water circulates through them to the water jackets in the cylinder heads of the compressor. Lubricant from the compressor is collected and passes by gravity to a reservoir in the base through a pipe which terminates below the liquid level. The lubricant is returned to the compressor by a pipe from a point below the liquid level. The liquid refrigerant is withdrawn by a pipe dipping into the condenser and passes through an automatic expansion valve for use as required.—W. F. F.

[*Crushing*] *mill.* T. J. Sturtevant, Wellesley, Mass., Assignor to Sturtevant Mill Co., Harrison Square, Mass. U.S. Pat. 1,296,134, 4.3.19. Appl., 6.8.17.

A crushing mill consists of a casing through which passes a horizontal rotating shaft carrying hammers which co-operate with a crushing surface. The casing is closed at top and bottom by horizontal plates, the upper plate being carried by a vertical pivot at one corner so that it may be swung open to give access to the hammers and crushing surface.
—W. F. F.

Mixing or impregnating one liquid with another; Apparatus for ——. J. W. Walker, Assignor to G. L. Hogan, New York. U.S. Pat. 1,296,241, 4.3.19. Appl., 30.7.18.

An apparatus for mixing one liquid with another, *e.g.*, oil with water, consists of a porous material saturated with one liquid, and means, such as a pipe outlet embedded in it, for passing the other liquid through the material.—W. F. F.

Mixing-machine. F. H. Webster, Oakland, Cal., Assignor to C. L. Brown, San Francisco, Cal. U.S. Pat. 1,296,445, 4.3.19. Appl., 21.9.14.

A mixing drum has a longitudinally corrugated shell forming cups which are provided with inclined transverse division plates extending partly across them. Alternatively, the division plates may be at right angles to the longitudinal axis of the cups but out of alinement in successive cups.—W. F. F.

Raising or forcing liquids; Method and apparatus for ——. H. A. Humphrey, London, and W. J. Rusdell, Dudley, Assignors to Humphrey Gas Pump Co. U.S. Pat. 1,294,271, 11.2.19. Appl., 11.5.12.

See Eng. Pats. 11,818 and 13,342 of 1911; this J., 1912, 707.

Gaseous reactions under high pressure; Apparatus for carrying out ——. C. Medgyes, Budapest, Hungary. U.S. Pat. 1,295,917, 4.3.19. Appl., 26.9.13.

SEE Ger. Pat. 274,538 of 1913; this J., 1914, 822.

Dryer. M. Wittenberg, Portland, and R. W. King, The Dalles, Assignors to Pacific Evaporator Co., Portland, Oreg. U.S. Pat. 1,295,946, 4.3.19. Appl., 30.6.16.

SEE Eng. Pat. 111,994 of 1917; this J., 1918, 46A.

[Grinding] machine. Eng. Pat. 124,646. *See* X.

Rotary furnaces. Eng. Pat. 125,484. *See* X.

Desiccating fluids. U.S. Pat. 1,297,496. *See* XIXA.

Distilled water in power plant. Ger. Pat. 305,381. *See* XIXB.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal ash; Fusibility of ——. W. A. Selvig, W. C. Ratliff, and A. C. Fieldner. Chem. and Met. Eng., 1919, **20**, 274—276.

LABORATORY determinations of fusibility, in which the impurities are intimately mixed, are not directly comparable with the conditions existing when coal is burned in a furnace. The atmosphere in which the ash is heated is of special importance when testing ashes which contain relatively large amounts of iron, as ferric iron is readily reduced to the ferrous condition, and gives a more fusible slag than would obtain in an oxidising atmosphere. Ashes softening above 2830° F. (1555° C.) have such a low iron oxide content that the nature of the atmosphere in the furnace has little influence on the fusibility. The point taken as the softening temperature is that at which the ash, when moulded into triangular pyramids ¾ in. high with a ¼ in. base, has fused down into a spherical bead (see this J., 1919, 125A). In general the softening temperature of coal ash from the various coal fields of the United States ranges from 1900° to 3100° F. (1040° to 1710° C.) and a classification is made for convenience into:—refractory ashes, softening above 2600° F. (1400° C.); ashes of medium fusibility, softening between 2200° F. (1200° C.) and 2600° F. (1400° C.); and easily fusible ashes softening below 2200° F. (1200° C.). Tables are given showing the average softening points of a large number of coals from the interior coal province (Great Lakes, Mississipi Valley, Texas) and of West Virginian coals. The former, with only few exceptions, have average fusibility values between 1900° F. (1040° C.) and 2200° F. (1200° C.) and different samples taken in the same mine show little variation. The low softening temperature is due to pyrites, gypsum, and calcite. The West Virginian coals include representatives of all three classes of fusibility.—C. A. K.

Pulverised coal; Use of —— with special reference to its application in metallurgy. L. C. Harvey. Iron and Steel Inst., May, 1919. [Advance copy.] 73 pages.

As compared with hand-fired and hand-poked producers, at least four times the heat equivalent of coal can be delivered to open-hearth furnaces per single operator when using pulverised fuel. A central pulverising plant is advisable when a number of furnaces are in use, but self-contained pulverising units are recommended if the coal consumption is below 20 tons per day. Combustion may be maintained with a maximum of 20% of excess air, and the ash and clinker contain less than ½% of carbon, as compared with 25—35% of carbon in the clinker from mechanically stoked grates. The conveyance of coal dust by means of an air current is condemned; it is preferable to distribute the dust into containers at the furnace. Thorough drying of the fuel is necessary for satisfactory operation as well as to enable the highest temperature of combustion to be attained. Simplicity of equipment is a feature of modern German plant, slow running grinding plant, principally of the ball and tube mill type, being used, but American practice favours the use of high-speed grinding machinery on the grounds of less power consumption. In order to avoid contamination of molten metal or other materials by coal ash, the fuel must be finely ground, so as to remain in suspension in the gaseous current, and be removed from the furnace. A degree of fineness which will ensure the passage of 95% through a sieve having 100 meshes per linear inch, and of 85% through a sieve having 200 meshes per linear inch is satisfactory in this respect. Lignite and pitch may be burned in the pulverised state, but special grinding mills must be used for the latter, and only pitch with a melting point above 150° C. can be successfully treated in this way. By means of centrifugal force, pitch can be reduced to shot of any size, and this process is more readily accomplished than direct pulverisation. A mixture of 30% of pulverised coal and 70% of fuel oil, together with a fixative to prevent the separation of the dust by settling, has been recently used as a fuel under the name of "colloidal oil."—C. A. K.

Colloidal fuels. Report of Committee of the Submarine Defence Association, New York. Gas J., 1919, **146**, 195

BY admixing about 1% of a protective colloid, 30 to 40% of coal pulverised so that 95% passes a 200-mesh sieve, can be maintained in suspension in mineral oil, alone or with tar, over a period of several months. If 20% of tar also be used, the mixed fuel contains less than 50% of mineral oil, great economies of which are therefore possible. The mixture can be treated in storage, transport, and use just like oil. It was also found possible to blend coal tar with mineral oil without the formation of sediments. (See also this J., 1919, 165R.)—H. J. H.

Steaming horizontal and inclined [gas] retorts, or "constructive distillation." H. J. Toogood. Gas. J., 1919, **146**, 22.

IN the usual practice of continuous steaming of horizontal gas retorts, a large volume of gas containing much water vapour is evolved during the early period, and a small volume of exceedingly hot gas towards the end of the steaming. Reduction of retort temperature, choking of the ascension pipes, and low yields are among the adverse results of such conditions of evolution. Using heavy charges, good "heats," and superheated steam, the author proposes to eliminate the adverse factors by coupling retorts in widely different stages of carbonisation, seals or valves being provided in the respective ascension pipes so that by their operation in suitable manner the adverse influence of the gas from one retort is compensated by an opposite tendency on the part of the gas evolved during the same period from the partner retort. The retort mouthpieces are furnished with suitable steam jets. Considering

any pair of coupled retorts, the coal in the one is subjected to an initial "drying" process lasting two hours, both ascension pipes being opened. During the second period of four hours the coke residue in the partner retort is gently steamed, the ascension pipe of this retort being closed so that the water-gas produced passes into the first retort and aids the distillation of the coal therein. A third period of two hours' duration follows during which both ascension pipes are opened, and the temperature of the coke in the first retort is raised above normal whilst a fresh charge of coal is undergoing the "drying" process in the partner retort. In the fourth period, lasting four hours, the coke in the first retort is steamed, and the water-gas passed into the partner retort. Increased yields of gas and liquor are amongst the advantages claimed for the process.—J. S. G. T.

Carbonisation of coal in gas-works; Use of low temperatures in the ——. Andersou. J. Gasbeleucht., 1919, **62**, 56—59.

THE author compares the results obtained by the "coalite" process with those obtained in Dessau vertical retorts and concludes that the former process possesses no advantages to justify its adoption. The increased yields of products obtained by the introduction of steam into Glover-West continuous vertical retorts (compare Blundell, this J., 1917, 860, 1172; West, 1917, 1264; 1918, 26A) are referred to, and experiments along these lines with the Dessau retorts are advocated.

Ammonia; Increasing the yield of —— *in coal-distillation.* F. Sommer. Stahl u. Eisen, 1919, **39**, 261—266, 294—298, 349—353.

THE Kjeldahl method of determining nitrogen in coal has been found inaccurate, giving low results with Westphalian coals. In determining the distribution of nitrogen among the products of carbonisation it was found necessary to use Simmersbach and Sommer's method based on combustion with copper oxide (this J., 1916, 102). The nitrogen balance has been established for a number of typical German coals at varying temperatures and for each sample the temperature of maximum yield of ammonia was found. It always lay between 800° and 900° C.; while the corresponding yields of ammonia were from 16·5 to 20·5% reckoned on the original nitrogen of the coal, the main bulk of the nitrogen—up to 79%—remaining in the coke. The yields mentioned are not reached in normal practice, where various factors may operate adversely. The presence of steam tends to conserve ammonia—the author suggests the possible formation of a more stable hydroxide NH_4OH. A shortened time of contact with the hot charge by rapid removal of the gas to a cooler part of the plant is advantageous. These conditions are realised in the inclined chamber oven and the author sees therein an advantage over the vertical retort. The same advantage is realised by increasing the size of coke ovens and by lowering the level of the upper collecting flue so as to avoid overheating the gas leaving the ovens. Benzol as well as ammonia is thereby conserved, especially in the latter half of the distillation period when the moisture in the coal has all been evaporated. In the carbonisation of coal free oxygen is always produced and this, quite apart from any extraneous air drawn into the charge, has a powerful destructive action on the ammonia and benzol, both of which have very low ignition temperatures. It is shown that the oxidation of ammonia by air is detectable at 150° C. while at higher temperatures it is considerable. At 250° C. 5·86% of the ammonia (2·3% NH_3 in dry air) was oxidised. Moisture acts preservatively, for in air saturated at 20° C. only 0·89% was oxidised. At 450° C. the corresponding percentages of the ammonia destroyed were 12·89% in dry and 2·01% in moist air. Against the attack of oxygen, hydrogen sulphide, which is always present in distillation gases, has a marked protective action, because it is still more readily oxidised. At 100° C. 25% of the H_2S (0·26% in dry air) was oxidised and at 425° C. 95·3% of the H_2S (1·48% in dry air) was destroyed. In contrast with ammonia, the presence of moisture if anything accentuates the oxidation. The presence of moisture also conduces to the liberation of hydrogen sulphide from the coke. The ignition temperature is also low (361° C.) and thus hydrogen sulphide by its more ready reaction with the free oxygen in the crude gas conserves the ammonia and heavy hydrocarbons. The considerable amount of thiosulphate and sulphate in fresh gas liquor indicates how extensive this action may be. The moisture of the coal coked in ovens or the introduction of steam into the retort promotes this effect. The desirability of careful sealing of doors to exclude air and the avoidance of "overpulling" is apparent, for even if the oxygen is removed by the sulphur it results in the formation of corrosive acid products. The presence of steam in the charge inhibits the conversion of ammonia into hydrocyanic acid, and consequent loss of yield. The carbonisation of the coal in the wet state as in coke ovens results in a smaller production of cyanogen compounds. Methods are described for the determination of hydrogen cyanide in gas liquor and crude gas—both adaptations of Feld's methods (this J., 1903, 1068). The fresh gas liquor is neutralised with *N*/1 sulphuric acid, and 5 times the equivalent of *N*/1 lead acetate is added. The mixture is distilled carefully into 10% ammonia which is then titrated with *N*/10 silver nitrate. Hydrocyanic acid is washed from the crude gas by an alkaline solution of ferrous sulphate, but the tarry matter collected retains a portion if it is not carefully extracted by boiling the tarry precipitate with caustic alkali The cyanides—now as ferrocyanide—are determined by the Feld method (*loc. cit.*).—H. J. H.

Carbonisation and by-product recovery; Some features of ——. [*Testing lead for saturators.*] J. Thorp. Coke Oven Managers' Assoc., Apr. 26, 1919. Gas J., 1919, **146**, 247—248.

THE objects of coal carbonisation—metallurgical coke, town's gas, smokeless fuel, etc.—are so divergent that there is no uniformity of practice, nor is this probable in the future. Analyses are given of samples of tar from horizontal retorts with low heats; from horizontal retorts with high heats, and from Dessau vertical retorts using the same coal; and from coke ovens. The vertical retort and low temperature tars differed from the others in having a high percentage of tar acids (10% and 14% respectively) mainly cresols. The content of free carbon and light oils was also low.

To test the quality of the lead used in the construction of saturators, 5 grms. should be heated with 0·8 c.c. of mercury to 130° F. (54° C.). Lead of good quality forms a silvery amalgam, and lead of inferior quality one with a bluish tint, while the dross is more abundant and separates badly.

The introduction of benzol recovery from coal gas is ascribed to W. Irwin, who scrubbed Manchester gas in 1881 and obtained a yield of 3 gallons per ton.—H. J. H.

Asphalt and coal. J. Marcusson. Z. angew. Chem., 1919, **32**, 113—115. (See this J., 1919, 98A.)

THE iodine values of coal and various asphalt products determined by Hart's method (Chem.-

Zeit., 1906, 30, 1204), using Hübl's solution, were:—Asphaltenes from Trinidad asphalt, 51; from petroleum pitch, 30; carbenes, 39; carboids, 38; and coal, 25·6. Chlorosulphonic acid compounds were prepared by shaking 1 grm. of finely powdered coal etc. with a mixture of 1 c.c. of chlorosulphonic acid and 6 c.c. of chloroform, and, after standing over-night, treating the mixture with ether to separate the excess of chlorosulphonic acid, filtering the liquid, and washing the residue first with ether and then with water. The product obtained from coal contained 1·3% chlorine and 9·1% sulphur, whilst an analogous compound from carbenes contained 1·4% Cl and 9·1% S. The calcium salts of the nitro derivatives of asphaltic substances and coal contained from 5·29 to 3·97% CaO. The fact that all asphaltic substances combine readily with sulphuric acid indicates that the oxygen and sulphur in asphaltenes, carbenes, and carboids are in ring formation. Lignite, unlike coal, contains no carboids, but waxy and resinous constituents, which, by decomposition and polymerisation and oxidation of the products of decomposition, yield carboids. The main constituents of lignites are furan resins, which differ from the furan resins of coal in having a lower molecular weight and in being more readily attacked by chemical agents. Lignite forms an addition compound with sulphuric acid, containing *e.g.* 5·3% S in the case of a lignite with 1·4% S. The yield calculated on the anhydrous ash-free material was 103%. Chlorosulphonic acid, sulphuric acid with ammonium persulphate, and methylal with sulphuric acid act in a similar way upon lignite and on coal. A sample of lignite had an iodine value of 42·6. A brown resin with properties analogous to those of lignite resin was obtained by the condensation of furfural with strong hydrochloric acid. All the chemical facts indicate that there is no fundamental difference between lignite and coal. The swelling up of coal when heated is due to the presence of carboids, which are not present in lignite. On mixing finely divided lignite with a small amount of carboid it swells up on heating exactly in the same way as coal. Anthracite also behaves in a similar manner to coal when treated with reagents, and yields similar compounds with sulphuric acid. The nitro derivative has a molecular equivalent of 565. The series peat, lignite, coal, and anthracite is thus analogous to the series petroleum resins, asphaltenes, carbenes, and carboids, which are all derivatives of petroleum.

—C. A. M.

Roumanian Navy fuel oil; Suitability of —— as burning oil. R. von Walther. Chem.-Zeit., 1919, **43**, 193.

Large amounts of this oil have been set free owing to the cessation of hostilities. The oil is dark brown, has sp. gr. 0·8675, and possesses a slight smell. Only a trifling reactivity is displayed to strong sulphuric acid. On distillation in an Engler flask, it gave the following fractions: 135°—175° C., 1·02; 175°—195°, 1·79; 195°—225°, 8·07; 225°—255°, 16·41; 255°—285°, 29·74; 285°—315° C., 21·28; residue, 21·79%. The specific gravities of the fractions are higher than for corresponding fractions of American and Russian oils. The distillate up to 265° C. (45% of the oil, with sp. gr. 0·840) was suitable for a burning oil and possessed good capillarity. In spite of the high sp. gr. the flame was normal. The residue from the burning oil fraction was viscous and suitable for the manufacture of lubricating oils. Cracking experiments at 15 atm. pressure showed that an increased yield of light fractions was obtainable together with a small amount of coke and a gas loss of 15%. The residue after cracking was mobile. The total yield of burning oil from straight distillation combined with the cracking of heavy fractions was 65%.—A. E. D.

Carbon dioxide in gases. Hargreaves. *See* XXIII.

Patents.

Artificial fuels and processes for manufacturing the same. A. M. L. Arkell, Cadoxton, Glam. Eng. Pat. 125,256, 9.5.18. (Appl. 7803/18.)

The fuel is composed of a mixture of small steam coal, washery settlings, anthracite settlings, and pitch or similar bituminous substance. These are crushed, mixed with sufficient water to produce a plastic mass, and the mixture is pugged and then moulded to any desired size and shape under the least pressure necessary to obtain a firm mass. The mass retains some water, which is subsequently removed by passing the blocks through a dryer at 600°—650° F. (about 315°—340° C.), the bituminous materials then melting, serving to bind the mixture into a porous mass.—J. S. G. T.

Coke-oven door. L. Wilputte, Assignor to A. A Wilputte, New Rochelle, N.Y. U.S. Pat. 1,296,892, 11.3.19. Appl., 12.4.18.

The end of a coking chamber of a horizontal coke oven is formed with a groove in the face of the oven structure extending upwards from the coking chamber. The door is enclosed in a metallic frame having a rim which enters the end of the coking chamber. Flanges, projecting laterally from the sides of the rim, overlap the portions of the oven structure at the sides of the coking chamber, and the top portion of the rim, projecting inwards beyond the sides, is seated against the bottom of the groove, and is provided with a luting surface.

—B. N.

Retorts for gas production; Heating of horizontal ——. H. J. Toogood, and R. Dempster and Sons, Ltd., Elland, Yorks. Eng. Pat. 125,189, 11.3.18 (Appl. 4203/18.)

Horizontal or inclined gas retorts are arranged in a setting with parallel vertical heating conduits adjacent to their sides. Producer gas is generated in a furnace below and passes through a burner at the bottom of each vertical conduit, in which it is burnt while passing upwards in contact with the retort walls. Suitable openings are arranged in the setting so that both upper and lower faces of the burner openings are accessible for inspection or cleaning.—W. F. F.

[*Gas*] *retorts.* R. J. Rew, Exeter. Eng. Pat 125,496. (Appls. 6313, 13.4.18, and 8438, 21.5.18.)

A coal-gas retort is provided with means for admitting highly superheated steam during or after the final stages of carbonisation as described in Eng. Pat. 124,217 (this J., 1919, 316A), the steam being admitted to the retort from a conduit extending along the bottom. The conduit may be formed by making a channel in the floor of the retort and covering it with a porous or perforated plate, or inverted perforated channel member. The inverted member may have a longitudinal ridge containing the perforations, projecting into the retort, to avoid choking of the orifices. The channel may be provided in a channel member below the retort floor which is perforated. The steam may be superheated practically to the final carbonisation temperature by passing it through two concentric tubes projecting into the furnace.—W. F. F.

Coal-gas; Method of stripping the illuminants from and of purifying —— by means of charcoal. F. Soddy, Aberdeen. Eng. Pat. 125,253, 8.5.18. (Appl. 7698/18.)

ABSORPTION of ethylene from coal-gas by charcoal at the ordinary temperature ceases when the ethylene absorbed amounts to rather more than 1% by weight of the charcoal. The volume of gas subsequently expelled by heating the charcoal is about 1000 cub. ft. per ton of charcoal, the expelled gas being composed of one-third ethylene, one-third other illuminants such as ethane and propylene, and one-third other gases. The absorption of benzene continues until the charcoal contains 10—15% of its weight of benzene. The process is best applied to coal-gas which has undergone the usual purification process for removal of hydrogen sulphide, carbon bisulphide, carbon dioxide, water vapour, tar, and ammonia. These are absorbed by the charcoal and diminish the efficiency of the charcoal as an absorbent of illuminants. Benzene should likewise be removed by a preliminary absorption by charcoal. The benzene and absorbed illuminants are subsequently completely expelled by heating the charcoal to 300°–400° C. The charcoal is employed in layers about 4″ thick, and 3—5 minutes contact between gas and charcoal is ample. The process of absorption and subsequent expulsion may be either intermittent or continuous, or a combination thereof. In both processes, a short cycle with rapid heating and cooling is desirable, the deterioration of the charcoal being reduced by an occasional slower cycle with increased heating. Apparatus for carrying out the various processes is described.—J. S. G. T.

Oils; Cracking hydrocarbon ——. Gasoline Corporation, New York, Assignees of C. J. Greenstreet, St. Louis, Mo., U.S.A. Eng. Pat. 115,014, 3.8.17. (Appl. 11,212/17.) Int. Conv., 17.4.17.

THE apparatus consists of several cracking units heated in a common furnace and having a common oil supply. Each unit consists of a coil of 400 ft. of 2 in. pipe, and an expansion drum on the discharge side to equalise fluctuations of pressure in the coil. The several expansion drums are connected to a common water-cooled condenser. Any uncondensed vapour passes to an absorption tower down which naphtha is made to flow, and the product is mixed with the main distillate. Oil and steam are passed under pressure into the coils, which are so heated that the oil is just about at its vaporising point when it has traversed half the total length, more steam being admitted at the mid-point. The first half of each coil thus acts as a preheater, and the second half as the cracking tube proper. The total steam admitted amounts to about one-fifth of the oil, half being supplied with the oil at the entrance to the coils and half at the mid-point. The pressure in the coils (regulated by valves between the pressure drums and the condenser) may be 80 to 125 lb. per sq. in., and the temperature 800°–1500° F. (about 420°—820° C.) according to the oil being treated. Each coil is made to deliver approximately 1733 gallons per minute. The oil to be treated may have sp. gr. 0·7795 to 0·8655. The product is a cherry-red oil which on distillation yields a colourless gasoline substitute having a substantially uniform distilling range up to 410° F. (210° C.) and a gravity range of 0·7710 to 0·7795. Any carbon formed in the coils may be removed without injury to the apparatus by blowing air and steam through the heated pipes.—T. St.

Nitro compounds; Separation of —— from natural oils. S. Dreyfus, Denton, Lancs. Eng. Pat. 124,475, 19.1.16. (Appl. 849/16.)

MIXTURES of paraffins and aromatic nitro compounds, such as are obtained by the nitration of Borneo petroleum oils, are treated with a quantity of strong sulphuric or nitric acid approximately equal in weight to the nitro compound present, and the mixture agitated at the ordinary temperature for about 10 minutes. The nitro compound dissolves in the strong acid which is finally allowed to settle, and the paraffin is then run off. The nitro compound may be made to separate from the acid by the addition of water, or the acid and nitro compound may be used direct for further nitration.—T. St.

Oils; Means for purifying and vaporising ——. L. Wirtz, Birmingham. Eng. Pat. 124,895, 4.4.18. (Appl. 5816/18.)

CRUDE oil containing water which will not separate by gravity is placed in a shallow tank through which an endless belt of gauze or openwork fabric passes. After leaving the tank the oil-covered gauze is subjected to currents of air, under the influence of which the contained water is partly vaporised and partly caused to run off in drops into channels which carry it away. The belt, at a later stage, passes over a scraper and at this point is subjected to a downward current of air. The oil is thus detached from the gauze and passes through pipes to boilers or engines. Atomisation of the oil is assisted by placing gauze sleeves etc. in the conveying pipes and admitting compressed air.—T. St.

[*Mineral*] *oil refining apparatus.* H. C. Leete, Cushing, Okla. U.S. Pat. 1,288,934, 24.12.18. Appl., 24.11.17.

THE apparatus comprises a separator, two pumps, and four stills arranged in series. The hot residue (fuel oil) from the last still passes through a pipe leading to one of the pumps and serves to preheat the crude oil, which is forced by the other pump through tubes extending through the fuel oil pipe and leading to the separator. The heated crude oil enters the separator under pressure and impinges against a deflecting plate, whereby it is atomised and gasoline is liberated. From the separator the oil, freed from gasoline, passes to the stills.

[*Petroleum*] *oils; Process of refining, fractionating, and reducing ——.* W. C. and F. E. Wells, Columbus, Ohio. U.S. Pat. 1,296,244, 4.3.19. Appl., 2.12.13. Renewed, 8.7.18.

CRUDE petroleum is floated on a heated non-evaporable fluid bath, and a permanent gas is passed through the bath and thence through the oil. The oil is thus evaporated to a "dry residue." The distillate is recovered by passing the gas saturated with petroleum vapours through a condenser. —T. St.

Hydrocarbons; Process and apparatus for cracking and distilling ——. A. Cochran, Brooklyn, N.Y., Assignor to T. Cochran, New York. U.S. Pat. 1,296,367, 4.3.19. Appl., 8.4.16.

A CYLINDRICAL retort, containing heat-conducting metallic balls, is rotated within a furnace on hollow trunnions fixed to the two ends. The outer ends of the trunnions are closed, but apertures are provided which register with apertures in the bearings. Hydrocarbon oils with steam or water are admitted to the retort through one of the trunnions and the resulting gases and vapours pass away through the other.—T. St.

Fuel for internal-combustion engines. T. Midgley, jun., Dayton, Ohio, Assignor to The Dayton Metal Products Co. U.S. Pat. 1,296,832, 11.3.19. Appl., 7.1.18.

A FUEL for hydrocarbon engines of a predetermined compression value consists of a mixture of two hydrocarbons having compression values respectively higher and lower than the predetermined value, in suitable proportions.—T. St.

Fuel; Liquid ——. A. A. Backhaus, Baltimore, Md., Assignor to U.S. Industrial Alcohol Co. U.S. Pat. 1,296,902, 11.3.19. Appl., 12.10.17.

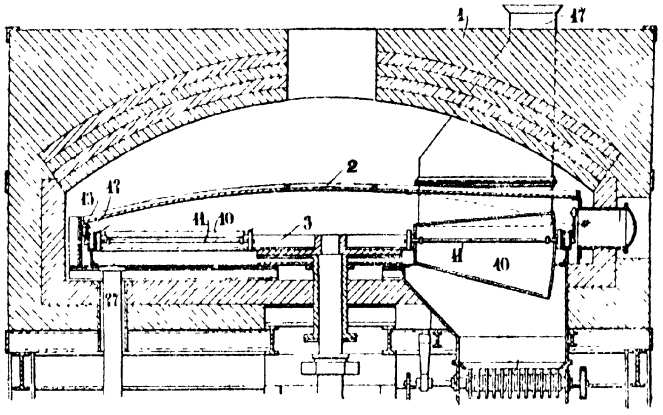
The fuel consists of gasoline, kerosene, and an alcohol, blended together into a homogeneous mixture by a relatively small proportion of castor oil. —T. St.

Oil; Obtaining —— from shale. F. G. Shreves, Denver, Colo. U.S. Pat. 1,297,022, 11.3.19. Appl., 25.2.18.

A retort contains a number of independently heated chambers each provided with a conveyor so that shale is worked forwards and downwards from upper to lower chambers, the connections being such as to prevent the passage of matter from lower to upper chambers. Above each conveyor is a vapour dome connected with a condenser.—T. St.

Lubricants; Process of treating used ——. J. O. Handy, Assignor to Pittsburgh Testing Laboratory, Pittsburgh, Pa. U.S. Pat. 1,295,308, 25.2.19. Appl., 16.2.18.

Used lubricants are subjected to clarifying and decolorising treatments, and any moisture is removed by treatment with a dry dehydrating agent. The



lubricants are afterwards treated with sulphuric acid, then with a base, and finally the base and its products are removed.—T. St.

Gas-heated furnaces. Eng. Pat. 125,258. *See* I.

Separator for coal. Eng. Pat. 125,311. *See* I.

Carbonisation. Eng. Pat. 124,039. *See* IIb.

Distilling apparatus. U.S. Pat. 1,297,590. *See* III.

Hydrogen. Eng. Pats. 125,112 and 125,410. *See* VII.

Water-resisting admixtures for cement. Ger. Pat. 308,874. *See* IX.

Lampblack. Eng. Pat. 124,557. *See* XIII.

Detecting gases. Eng. Pat. 124,453. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Wood; Course of destructive distillation of —— in a vacuum. O. Aschan. Finska Kemistsamfundets Meddelanden, 1918. Chem. Zentr., 1919, 90, II., 198—199.

Birch wood was subjected to destructive distillation under reduced pressure (6—8 mm.). The yield of acetic acid was 6·9% of the dry substance, which is about the same as is obtained under ordinary pressure. The yield of wood charcoal was at least 45%, as compared with about 33% in the ordinary way. Instead of the usual birch wood tar a much "milder" tar was obtained which had some of the characters of spruce wood tar, *e.g.*, odour and solubility in caustic soda; this tar was quite suitable for the preparation of disinfectant fluids soluble in water.—J. F. B.

Estimation of methoxyl. Hewitt and Jones. *See* XXIII.

Patents.

Coal, shale, peat, wood and other bituminous or organic materials; Carbonisation of —— and apparatus therefor. G. T. Bellby, London. Eng. Pat. 124,039, 12.3.18. (Appl. 4287/18.)

The material is fed by a hopper, 17, into a series of shallow trays, 10, carried by a horizontal rotating frame, 3. The plane of the lower edge of the hopper is horizontal and just above the tray, so that a thin uniform layer of material is deposited on the tray. The trays are pivoted on radial arms, 11, and carry rollers, 12, bearing on a circular rail so that when a gap at one point in the rail is reached, the tray tips into a vertical position and discharges the carbonised material. The speed of revolution of the trays is such that the carbonisation is completed in less than a complete revolution. Each tray is brought back to its horizontal position by an upturned portion of the rail which engages with the roller. The frame carrying the trays rotates within a flat gas-tight metal casing, 2, having an outlet, 27, for the distillation products and enclosed in a heating chamber of brickwork, 1, so arranged that the heating gases pass round the upper and lower surfaces of the casing. —W. F. F.

Decolourizing-carbon; Production of ——. The Tai-Koo Sugar Refining Co., Ltd., London. From M. Obrembski and H. C. Resker, Victoria, Hongkong. Eng. Pat. 125,230, 16.4.18. (Appl. 6427/18.)

Materials such as wood chips, sawdust, coconut husks, straw and hay, etc., are mixed with an equal weight of calcium chloride dissolved in a sufficient quantity of water to give the mixture the consistency of thin porridge, and then evaporated to dryness under vacuum. The resulting product is carbonised in retorts for 1 to 2 hours at 600°—800° C. The carbonised mass is washed, acidified with hydrochloric acid, boiled, filtered, re-washed, and finally ground.—J. S. G. T.

Charcoal from wood; Manufacture of ——. A. B. Roxburgh, Monkseaton, T. Sanderson, Gosforth, and F. H. Sanderson, Felton. Eng. Pat. 125,430. (Appls. 10,439, 25.7.16, and 798, 16.1.17.)

Wood is caused to pass by gravity through an externally heated vertical or inclined retort. The temperature of the retort increases from its upper end downwards to a maximum value, and then decreases. After subjection to the maximum temperature, the hot mass is cooled, either in the lower part of the retort, or in a separate discharge chamber out of contact with the air. This cooling

is accelerated by a current of air surrounding the cooling region, such air being subsequently utilised as a hot-air supply for the fire-chamber of the retort. Water or steam may also be employed as cooling agents. The fire-chamber is preferably heated by the distillation gases.—J. S. G. T.

Distilling oil from coal and the like. W. H. Wise, Falmouth. Eng. Pat. 125,528, 24.5.18. (Appl. 8624/18.)

Coal is distilled from the floor of a long retort of rectangular cross-section with arched roof, the maximum temperature not exceeding 450° C. The material is moved through the retort by a number of balance-weighted spades actuated in unison by a reciprocating frame. The spades are free to swing only in one direction so that on the reverse journey they pass freely over the material.

—J. S. G. T.

Rare earth [fluorides]. Ger. Pat. 310,305. *See* VII.

III.—TAR AND TAR PRODUCTS.

Pitches and bituminous materials, with special reference to stearing pitches. H. M. Langton. Proc. Oil and Colour Chem. Assoc., 1919, 2, No. 7. 29 pages.

The author describes fully the characters and uses of the various pitches and bituminous materials. Methods for the examination of fat pitches are given embodying determination of ash content, specific gravity (glycerin-water or alcohol-water method), melting-point (by Mansbridge's method, this J., 1918, 183 T), free fatty acids, saponification and iodine values, and solubility. Ultimate analyses, physical and chemical constants, and properties of fat pitches from whale oil fatty acids and palm oil fatty acids are given.—A. de W.

Patents.

[*Tar, mineral, vegetable and other oils:*] *Distilling apparatus [for —].* J. Plette, St. Gilles, Belgium. U.S. Pat. 1,297,590, 18.3.19. Appl., 7.4.17.

An apparatus for distilling tar, mineral, vegetable or other oils comprises a series of sets of tubes, arranged in cascade, each set in a separate chamber which is supplied with hot gas from a common furnace. Steam and oil are admitted to the first set of tubes, and steam to each successive set, and the volatile products are collected.—W. F. F.

Anthracene; Production of high percentage —. Soc. d'Eclairage, Chauffage, et Force Motrice, Paris. Eng. Pat. 119,855, 23.7.18. (Appl. 12,014/18.) Int. Conv., 28.9.17.

Crude anthracene is dissolved by warming it in phenol, cresol, xylenol, or similar homologues of phenol, separate or mixed. The crystals which separate on cooling are removed by filtration and washed with benzene or other organic solvent, or with an aqueous alkaline solution and then with water. The treatment may be repeated if desired, and the anthracene finally purified by crystallisation from pyridine.—L. A. C.

Tar acids or phenols; Process for extracting — from coal or wood tar or coal or wood tar oils in the distillation or vaporisation of same. H. P. Hird, Hipperholme, Yorks. Eng. Pat. 125,445, 2.8.16. (Appl. 10,885/16.)

Separation of tar acids (phenol, etc.) from coal or wood tar or tar oil is effected by running or spraying a solution of caustic soda into the vapours generated during the distillation of the tar or tar oil as they pass from the still to the condenser. The condensed liquid is run into a receiving tank and the sodium carbolate or cresylate sinks to the bottom.—L. A. C.

Cracking hydrocarbons. U.S. Pat. 1,296,367. *See* IIA.

Waterproof compound [from tar]. Eng. Pat. 125,492. *See* IX.

Lampblack. Eng. Pat. 124,557. *See* XIII.

Paint. U.S. Pat. 1,296,770. *See* XIII.

IV.—COLOURING MATTERS AND DYES.

Indican; Improved method of preparing — from indigo-yielding plants. B. M. Amin. Agric. Res. Inst. Pusa, Indigo, Pub. 5.

The method, which is far more rapid than any of the methods hitherto described, gives an excellent yield (70—80%) and can be applied to any species of plant. By its use pure indican has, for the first time, been prepared in large quantities from Java indigo (*Indigofera arrecta*). The fresh leaves are extracted with hot water, so as to dissolve the indican, and freshly slaked lime is added to the extract to precipitate the impurities, such as amino-acids, tannins, gums, etc. After filtration the purified liquor is evaporated to a pasty syrup, from which the indican is extracted with acetone. The wet extract is evaporated to remove the acetone, and on cooling the remaining aqueous solution in ice, indican hydrate separates out. The crude hydrate is dissolved in alcohol, and from this solution, on the addition of benzene, pure anhydrous indican crystallises out.—W. G.

Curcumin. P. C. Ghosh. Chem. Soc. Trans., 1919, 115, 292—299.

An extended study of the condensation products of curcumin with benzaldehyde and nitrosodimethylaniline and also of the bromo-derivatives of curcumin and its derivatives has led the author to assign a formula to curcumin identical with that suggested by Milobendzki, Kostanecki, and Lampe (this J., 1910, 1002) and subsequently confirmed by Lampe (this J., 1918, 763 A). It is shown that the acetyl derivative prepared by Jackson by the action of acetic anhydride and sodium acetate on curcumin is, in reality, diacetylisocurcumin and that isocurcumin can be obtained from it by de-acetylation by sulphuric acid in acetic acid solution. Heller's suggestion (Ber., 1918, 47, 887) that curcumin and isocurcumin are geometrical isomerides thus receives confirmation.—H. W.

Patents.

Dyestuffs; Preparation of monoazo —. Farbenfabr. vorm. F. Bayer und Co., Leverkusen. Ger. Pat. 309,951, 26.7.17.

Amides of 5-nitro-2-aminobenzene-1-carboxylic acid in which both hydrogen atoms of the amide group are replaced by alkyl or aryl groups, are diazotised and coupled in acid solution, with sulphonic acids of β-naphthylamine or its derivatives. The products dye wool from an acid bath in red to violet shades, of good fastness to milling and light, and are level dyeing. The amides may be obtained by the condensation of nitro-isatoic acid with secondary aliphatic or aromatic amines. The

methylanilide of 5-nitro-2-aminobenzene-1-carboxylic acid melts at 183°—184° C., the ethylanilide at 144°—to 145° C., the dimethylamide at 213°—214° C., the piperidide at 163°—164° C., and the ethyl-*o*-toluide at 147°—148° C.—L. L. L.

Picric acid. Eng. Pats. 16,607, 17,525, and 124,490. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Wool; Elasticum reaction of ——. W. Herbig. Z. angew. Chem., 1919, 32, 120.

The phenomena which Von Allwörden (this J., 1916, 416) found to be produced on the surface of wool by the action of chlorine water are produced in a much more pronounced fashion by saturated bromine water. The bromine stains the fibre, and thus renders the characteristic pearl-like formation on the surface much more visible. As was observed by Von Allwörden and subsequently by Naumann (this J., 1917, 706), one fibre may show the phenomenon over its whole surface, whilst an adjoining fibre may only show it in places.—C. A. M.

Cellulose acetates; Chloroform-soluble and acetone-soluble ——. H. Ost. Z. angew. Chem., 1919, 32, 69—70, 76—79, 82—89.

The cellulose acetates are divided into two classes: (1) primary products of the acetylation of cellulose or hydrocellulose, which are soluble in chloroform, preferably with the addition of a little alcohol; (2) secondary acetates derived from the primary products by mild processes of hydrolysis or saponification. The primary acetates show a partial and fugitive solubility in acetone and, whilst their films from chloroform are good, those from acetone are poor and can only be partially re-dissolved by acetone. The acetone films from the secondary acetates are good and the complete solubility in acetone is a permanent characteristic. The catalysts available for acetylation fall into two groups: (1) those containing no sulphuric acid, of which class zinc chloride is the only representative studied by the author; (2) sulphuric acid or dissociable compounds capable of liberating sulphuric acid, such as the sulphates of organic bases. A suitable acetylating mixture of the first group consists of 40—50 grms. of acetic anhydride, 40—50 of glacial acetic acid, and 5—10 of fused zinc chloride for 10 grms. of cellulose. Acetylation with this mixture at the ordinary temperature (10°—20° C.) requires from 3 weeks to 3 months and yields primary products of good quality having a composition corresponding closely with that of cellulose triacetate. The process may be shortened to 8—24 hours by performing the acetylation at 60°—70° C., but at this temperature there is a considerable breakdown of the cellulose molecule and the films are of little value. All these preparations are infusible at 250° C. In acetylation with sulphuric acid suitable proportions of the catalyst range from 5 to 10% of the weight of the cellulose. In no case is the primary product free from sulphuric acid in organic combination with the cellulose. Nevertheless, the amount of combined sulphuric acid is very variable, depending on the composition of the acetylating mixture and the time and temperature of the acetylation. It would appear that the more prolonged the acetylating reaction at a low temperature, the more complete is the displacement of the combined sulphuric acid by the acetyl radical, but the risk of damage to the cellulose molecule by acetolysis is greater. With 5—10% of sulphuric acid, the time of acetylation may extend to 2—4 days at 10° C. With methylamine sulphate, in the proportion of 5—10% of the cellulose, the time of acetylation may be prolonged to 6 or 9 days and the temperature raised to 35° C.; at 65°—70° C acetylation is complete in 3 hours but a prolongation of the time at this elevated temperature lead to the destruction of the cellulose. The percentage of combined sulphuric acid in the primary acetate prepared with methylamine sulphate is considerably higher than that in corresponding acetates prepared with free sulphuric acid; it is generally over 1% and sometimes over 3%. When the quantity of sulphuric acid in the acetylating mixture is reduced to a minimum, *e.g.* 1—2% on the cellulose, acetylation may be smoothly effected at 35°—40° C. in a few hours. With these small quantities of catalyst the best results are obtained by steeping the cotton in an excess of an acetic acid solution of sulphuric acid and pressing out to the required limit. Even with a total quantity of only 1% of sulphuric acid on the cellulose, the primary acetate still contains substantial proportions of combined sulphuric acid. All the above trials were made with a large excess of acetic anhydride equal to 4—5 times the weight of the cellulose. When the amount of anhydride was reduced to 2·4—3 times the weight of the cellulose, products of ill-defined composition containing large percentages of combined sulphuric acid were obtained, nevertheless these approximated more to the normal acetates, but with a breakdown of the cellulose, when the time of acetylation was prolonged to about 4 days at 20° C. These mixed acetates, however, when prepared at low temperatures with a short time of acetylation, are well suited, on account of the ease with which they undergo saponification, for the preparation of modified secondary acetates soluble in acetone. Primary acetates prepared from previously hydrolysed cellulose differ in no essential respect from those prepared from ordinary cellulose; the films are apparently just as good, but the solutions have generally a lower viscosity and the precipitated products are more pulverulent. Hydrocellulose, however, is acetylated more easily than cellulose, the acetylation proceeding more rapidly, with smaller quantities of catalyst and at a lower temperature. Secondary acetates, permanently soluble in acetone, are produced by a modification of the primary acetates by various processes, which substantially amount to a regulated saponification by acid hydrolysis. In all cases this modification takes place with the elimination of a portion of the combined acetic acid and the whole or the greater part of the combined sulphuric acid. At the same time the optical lævo-rotation of the primary acetate is considerably reduced and the melting point may be lowered. According to Bayer's Ger. Pat. 252,706, the primary acetylation is performed with 15% sulphuric acid and a restricted quantity of acetic anhydride. The primary products obtained by acetylation for a short time (1 day) at a low temperature retain much combined sulphuric acid (over 3%). If acetylation be allowed to proceed for a longer time, the combined acetic acid increases and the sulphuric acid decreases; but this takes place with a profound breakdown of the cellulose. According to the patent a little water is added to the primary syrup and the solution is allowed to "ripen." In this process there is no breakdown of the cellulose and the viscosity of the syrups is maintained. The percentage of combined acetic acid shows a progressive decrease during the ripening and that of the combined sulphuric acid falls to 0·25% after 1—2 days and to 0·17% after 4 days. The acetic acid values, for instance, showed 57·4% after 1 day, 54·0 after 2 days, 50·9% after 4 days at 20°—23° C., all these secondary acetates being soluble in acetone and giving good films. A method which gives secondary acetates of best quality consists in heating the primary acetates, or the primary syrups after neutralisation of the

sulphuric acid, with 95% acetic acid at 98° C. for many hours. Saponification takes place in the same manner as above, the range of complete solubility in acetone corresponding with a period of heating from 24 to 96 hours and an acetic acid value between 56·2 and 50·8%. Heating in the presence of small quantities of catalysts, such as sodium bisulphate, leads to a similar result; heating with aniline or with phenol also brings about partial saponification and conversion into the acetone-soluble modification. In the case of phenol a little water must be present; the same remark applies when glacial acetic acid is employed; the necessary saponification does not occur in the absence of water. The limits of solubility in acetone show a fairly wide range, between 57·6 and 50·9% of combined acetic acid, nevertheless it is not every kind of saponification which leads to solubility in acetone and it must therefore be inferred that the different hydroxyl groups of cellulose are not all equivalent in this respect.

—J. F. B.

Paper-pulp in Australia; Possibilities of manufacture of ——. G. Lightfoot. Commonwealth of Australia, Advisory Council of Sci. and Ind., Bull. No. 11, 1919. 37 pages.

THE various studies which have been made in connection with the production of paper pulp in Australia are summarised and discussed in their technical and economic aspects. So far as wood pulp is concerned a serious difficulty is that, in the main, the Australian forests are mixed as regards species and the costs of collection and transport are high. Of four Tasmanian species investigated, the "stringy bark" showed the best results for yield by the soda process, but at the time of the investigation the economic factors could not be regarded as favourable to the establishment of a wood pulp industry with Tasmanian trees. The only successful attempt hitherto made to produce wood pulp in Australia on a commercial scale is that of the Queensland Pine Co., treating hoop and bunya pines by the soda-sulphate process, but this undertaking is only on a limited scale, and as a subsidiary operation to the lumber business, in order to utilise the lumbering waste and the saw-mill off-cuts. There is, however, a possibility of extending the manufacture of pulp from these sources, using "thinnings" from Government plantations and knotty pine tops, which are at present discarded, and of which about 20,000 tons are available per annum within transportable distance from a pulping centre. Another species which deserves attention and which grows rapidly is the candlenut (*Aleurites moluccana*); this wood appears to be equal to poplar for general purposes. In New South Wales a number of tests have been undertaken and a species of mountain gum (*Eucalyptus goniocalyx*) appears to be of interest. Various proposals to utilise the woods of certain "mixed" forests and scrubs in the neighbourhood of abundant water supply and cheap power have been discussed. In Victoria certain species of eucalyptus ("mountain ash" and silver top) were at one time worked in a paper mill. These woods are abundant in Eastern Gippsland and might be developed. In S. Australia the "remarkable pine" (*P. insignis*) is planted in considerable quantities. Water supply and transport are not favourable, but good rail facilities exist in the neighbourhood of the forests. This pine grows well and matures in 20—25 years, and this reserve of timber capable of serving for the manufacture of pulp by the sulphate process is likely to be extended. In W. Australia tests have been carried out on certain eucalyptus species, from which it would appear that superior results are obtained in the case of Tasmanian "blue gum" if the trees are cut in an immature stage. Similar remarks apply to "Karri" timber, wood from 8-year-old trees being very much superior in yield and consumption of soda to logs from older trees. "Karri" would appear to be well worth a systematic development in 8-year cycles. A survey of the whole question reveals no material of sufficient uniformity of growth and quality to serve for the manufacture of mechanical wood pulp, and experiments have been carried out on the planting of the Norwegian spruce. The results are not as yet conclusive, but it is possible that a profitable planting of pulp spruce might be established in the mountainous parts of Victoria and Tasmania. As regards materials other than wood, investigations have been made with "blady grass" or lalang, narram grass, and bamboo grass, the results of which are not quite conclusive. A sedge (*Gahnia decomposita*) which is abundant in the "Karri" timber-growing districts of W. Australia, has been found to be very suitable for the manufacture of pulp for blending with the "karri" pulp. Lastly, reference is made to the proposal for establishing the manufacture of pulp from cereal straw in S. Australia (this J., 1917, 27).—J. F. B.

Soda pulp manufacture. E. Sutermeister. Pulp and Paper Mag., 1919, 17, 215—218, 243—246, 263—264, 289—292, 309—314, 327—330, 351—354, 375—378.

THE author deals comprehensively with the manufacture of wood pulp by the soda process, describing in detail the preparation of the cooking liquor (caustic soda solution), the cooking operation, practice at various mills with data relative to the types of wood employed, by-products of cooking, types of digesters used, washing the pulp, black liquor and its treatment, and treatment of the fibre prior to bleaching.

[*Wood*] *pulp; Testing moisture in* ——. E. B. Sluck. Techn. Committee Canadian Paper and Pulp Assoc. Pulp and Paper Mag., 1919, 17, 265—270.

IN an earlier report, the method recommended for sampling wet lap pulp was to cut a strip 3 in. wide the full length of the sheet. The accuracy of this method has been verified by taking the strip sample cut clean across the face of the roll and comparing it with the remainder of the lap. Average of strip method, 39·79% of air dry pulp; average of whole lap, 39·82%. The same method has been applied to the testing of pulp made into sheets on Rogers' wet machine: average of strips, 46·58%; average of whole sheets, 46·68%. In the case of hydraulic pressed pulp in laps the strip method has been compared with the wedge method, with the result that the wedge method has been found to be far more accurate. In this case 2-in. strips were cut from the centre of the lap to the outer edge, the cut portions forming a cross in every four samples. Results: wedge method, 54·39%; entire lap, 53·78%: strip method, 56·23%; entire lap, 54·11%. Another series of tests was carried out with pulp run over drying cylinders and made up in rolls about 18 in. in diameter. Three rolls are made from the machine roll which is slit direct from the dryers. The method employed is to cut a strip 3 in. wide across the face of each roll as it is made up and collect these strips in an air-tight box. This method has been tested by cutting strips from 19 other layers of the same roll after cutting it through to the core. Average results from top layer strips, 71·80%; average of 19 other layers, 71·90%. The above method serves to establish the correct quantity of air-dry pulp in the roll, but of course would not be suitable for sampling rolls which have been in transit or store.

For testing such rolls, the following procedure is advised: A test strip 3 in. wide is taken across the face of the roll from the second layer and four other similar strips from layers situated at least 1½ in. or further from the outside layer. Trials made by this method have shown very consistent results.—J. F. B.

Paper sizing. O. Aschan. Meddelanden från Industrins Centrallab., 1917, Nr. 4. Chem. Zentr., 1919, **90**, II., 190.

In the sizing of paper with rosin size and alum, as much as two-thirds of the weight of the alum may be lost in the back-water. The running of the stuff on the machine with circulation of the back-water is an important factor in obtaining resistance to ink. The sizing deposit itself consists of a mixture of aluminium resinate with free resin acids which can be extracted with ether; there is also a small amount of free aluminium hydroxide. An excess of free resin acid is not an effective substitute for a deficiency of aluminium resinate. Experiments made with resinate precipitates without the presence of paper fibre indicated that ferric and chromium salts could probably be used to produce sizing effects, and certainly aluminium sulphate containing iron salts as an impurity is a useful sizing agent. The percentage of free resin acids in the sized paper appears to stand in definite relationship to the total alumina in the ash.—J. F. B.

Chrysalis fat. Tagliani. *See* XII.

Decomposition of cellulose. Hutchinson and Clayton. *See* XVI.

PATENTS.

Impregnation of [*balloon*] *fabrics or materials. Impregnation and coating of fabrics and the like.* J. H. Mandleberg, and J. Mandleberg and Co., Manchester. Eng. Pats. (A) 124,494 and (B) 124,495, 5.2.16. (Appls. 1755 and 1756/16.)

(A) To increase the impermeability to hydrogen or other gas of fabrics used in the manufacture of balloons etc. the uncoated side of the fabric is impregnated with petroleum jelly or soft paraffin. (B) A mixture of rubber, ceresin wax, litharge, and sulphur is worked on the rolls until the nerve or texture of the rubber is wholly or partially destroyed. The fabric is impregnated or coated with this composition dissolved in a suitable solvent, dried, and vulcanised at 285°–295° F. (140°–146° C.). The finished material may be coated with petroleum jelly as in (A).—L. L. L.

[*Coating*] *fabrics used in the manufacture of balloons and dirigible airships.* R. T. Glazebrook, Teddington, W. M. Rouse, London, and A. Johnston, Edinburgh. Eng. Pat. 124,520, 3.3.16. (Appl. 3217/16.)

The coating consists of gelatin, in place of, or in addition to, the layers or coatings of rubber, oil, cellulose preparations, etc. The gelatin is used alone in separate sheets applied as a lining, or placed between plies of fabric, or compounded with pigments, or with dyeing materials, and preferably treated so as to render it insoluble. The loss of hydrogen through the fabric is reduced to a negligible quantity, and deterioration of the fabric by the action of light and moisture is greatly retarded by the use of gelatin.—L. L. L.

Cellulose; Digesters for use in the manufacture of —— and like operations. E. Schauffelberger, London. Eng. Pat. 124,676, 27.9.18. (Appl. 15,772/18.)

In vertical stationary cellulose digesters the circulation of the liquid is arranged so that it takes place mainly in an upward direction through the charge, but to a minor extent, in the upper part of the digester, the liquid flows downward to the outlet, thus ensuring the efficient digestion of the upper part of the charge. Circulation is effected by means of an external centrifugal pump, which discharges most of the liquor into the bottom of the digester and at the same time delivers a certain proportion to a circular distributing pipe situated in the top of the digester. The liquor flows to a main outlet in the upper portion of the digester, connected with the suction orifice of the circulating pump.—J. F. B.

Resins, fats, and oils from cellulose, wood pulp, and paper pulp; Process of extracting ——. O. Brune. Ger. Pat. 310,551, 22.5.17.

The material suspended in liquid is subjected to the action of a finely divided stream of compressed air or gas, forced in from the bottom of the container. The separation of the resin and fat is then effected by raising the level of the liquor in the container so that the surface layer carrying the separated resin and fat overflows.—S. S. A.

Leather imitations, felt, and Japanese paper; Process of making products having closed structures, such as ——. J. Foltzer, Horn, Switzerland. U.S. Pat. 1,295,148, 25.2.19. Appl., 30.8.16.

A cellulose solution is applied to a web of felted fibres, the application being heavier at intervals than at intermediate portions of the web, and the cellulose is afterwards hardened.—L. L. L.

Plastic composition and method of preparing the same. H. A. Levey, New Orleans, La. U.S. Pat. 1,295,533, 25.2.19. Appl., 10.4.17.

Cellulose acetate (85 parts) is mixed with China wood (tung) oil (3 parts) and cellulose nitrate (12 parts), and the mixture is dried or hardened at a temperature sufficient partially to oxidise or polymerise the tung oil.—L. L. L.

Paper; Manufacture of — [*of increased combustibility*]. C. R. Harrison and W. Bacon, London. Eng. Pat. 124,516, 29.2.16. (Appl. 3012/16.)

In order to increase the combustibility of paper to facilitate the destruction of documents, books, and the like, nitrocellulose, guncotton, or nitro-starch is incorporated with the ordinary fibre stock in the beater, in proportions which may vary according to the degree of combustibility desired. In the case of masses of sheets a more rapid combustibility may be imparted to the paper containing nitrocellulose by incorporating insoluble compounds of calcium or magnesium, *e.g.* the carbonates, whereby access of oxygen to the mass of sheets is facilitated.—J. F. B.

Paper; Waterproof ——. K. Konagai, Tokyo. Eng. Pat. 124,689, 22.11.18. (Appl. 19,203/18.)

Paper is painted with a vegetable paste, preferably bracken paste, and immersed in a gelatin solution until completely impregnated. It is then coated with a mixture of chrome alum and ammonia solution to render the gelatin insoluble. The prepared paper is subsequently painted with a first coat consisting of a mixture of 5 parts of castor oil with

5 of lead oxide which has been boiled and mixed with 40 parts of tung oil, heated for about 1 hour below 200° F. (93·5° C.), treated with 5 parts of iron oxide, and again heated for about ½ hour. Afterwards, the paper is painted with a second coat prepared by mixing 5 parts of castor oil with 5 of white lead, heating for ½ hour below 200° F., adding to the mixture 10 parts of zinc oxide, 20 of tung oil, and 15 of boiled linseed oil, and subsequently heating for about 2 hours. Both these paints may be thinned with pine oil.—J. F. B.

Parchmentised paper, "vulcanised fibre," and the like; Manufacture of ——. The Manchester Oxide Co., Ltd., R. H. Clayton, J. Huebner, and H. E. Williams, Manchester. Eng. Pat. 124,979, 27.6.18. (Appl. 10,568/18.)

Paper is passed through a bath of thiocyanate solution at 130° C., washed, and dried. By treating several sheets simultaneously and pressing together, "vulcanised fibre" may be produced. Suitable baths are a solution of calcium thiocyanate of b.pt. 157° C., the paper being in contact with the heated solution for about 30 seconds; a solution in the proportion of 1 part of mercuric thiocyanate to 2 of magnesium thiocyanate, at a concentration such that the boiling point is 145° C., the paper being in contact with the liquid for 15 seconds; or a solution of equal parts of calcium thiocyanate and calcium chloride having a boiling point of 157° C. The baths may be acidified by the addition of 4% of acetic acid by volume.—J. F. B.

Paper-making machine. G. McAulay, Rumford Falls, Me., Assignor to International Paper Co. U.S. Pat. 1,296,299, 4.3.19. Appl., 7.12.17.

A suction-box is fitted transversely under a travelling belt which supports the pulp layer, and is fixed at one end whilst the other end is arranged to move periodically in the direction of travel of the belt.
—S. S. A.

Paper-making machine. J. H. Le Roy and R. G. Repman, Shawano, Wis. U.S. Pat. 1,297,192, 11.3.19. Appl., 18.9.18.

A paper machine is provided with upper and lower couch rolls, upper and lower press rolls, a drying cylinder, a pressure roll below the dryer, a suction roll, and a single endless felt passing between the couch rolls and the press rolls, between the pressure roll and the drying cylinder and also engaging the suction roll.—J. F. B.

Canvas or other ground or surface for receiving an impression in one or more colours; Process for preparing ——. J. A. D. Leurquin, Brussels. Eng. Pat. 124,843, 23.10.16. (Appl. 15,059/16.)

Canvas or other surface is coated with successive coats of compositions of pigments ground with linseed oil and mixed with thickened linseed oil, each coat being dried and subjected to a pouncing operation before the application of the next coat. In each of the successive coats there is employed an increasing proportion of thickened oil and an increasing proportion of volatile diluent, such as naphtha. Suitable compositions are: First coat, powdered pigments, 40 parts; natural oil, 10; thickened oil, 20; volatile diluent, 10; drier, 1 part. Second coat, pigments 46; natural oil, 14; thickened oil, 30; volatile diluent, 20; drier, 1 part. Third coat, pigments, 46; natural oil, 14; thickened oil, 40; volatile diluent, 186; drier, 1 part. Amber oil may be mixed with the last coat to modify the colour.—J. F. B.

Rattan, etc.; Process for removing natural enamel from the surface of ——. A. Franck-Philipson, Chicago, Ill. U.S. Pat. 1,296,553, 4.3.19. Appl., 31.5.16. Renewed 25.1.19.

The material is treated with a solution of an alkaline hydroxide containing sodium silicate.—S. S. A.

Lignin; Method of precipitating —— *from waste sulphite liquor.* I. Söraas, Aalvik, Norway. U.S. Pat. 1,297,028, 11.3.19. Appl., 24.9.17.

The liquor is heated by indirect heating to a temperature somewhat below the precipitation temperature of the lignin substance, and is then transferred to a second vessel where it is further heated by direct heating to a temperature sufficient to cause the lignin to be precipitated.—T. St.

Silk fibres; Process for treating [degumming] ——. T. Muto, Kobe, Assignor to Kanegafuchi Boseki Kabushiki Kwaisha, Tokyo-Fu, Japan. U.S. Pat. 1,296,601, 4.3.19. Appl., 25.4.17.

See Eng. Pat. 106,503 of 1917; this J., 1917, 959.

Cellulose acetates; Process of transforming ——. H. Dreyfus, Basle, Switzerland. U.S. Pat. 1,286,172, 26.11.18. Appl., 21.1.16.

See Addition of 7.7.11 to Fr. Pat. 432,016 of 1911; this J., 1912, 225.

Cellulose esters with over 20% of bound fatty acid; Process for making ——. A. Polotsky, Assignor to Deutsche Gasglühlicht-A.-G. (Auerges.), Berlin. U.S. Pat. 1,296,847, 11.3.19. Appl., 8.2.15.

See Eng. Pat. 75 of 1915; this J., 1916, 39.

Electrical conductors embedded in cellulose. Ger. Pat. 308,016. *See* XI.

Dopes. Eng. Pat. 124,515. *See* XIII.

Dissolving shellac. Eng. Pat. 124,684. *See* XIII

Cellulose acetate varnishes. Eng. Pat. 124,807. *See* XIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Cotton textiles; Bleaching of —— *with warm hypochlorite solutions.* M. Freiberger. Färber-Zeit., 1919, 30, 77—80.

In a continuous bleaching system where the goods are progressively moved forward through the baths, which are themselves also kept in motion in counter-current circulation, the necessary acceleration of the action of the liquor is obtained by raising the temperature short of the point where spontaneous decomposition of the hypochlorite sets in. The choice of the hypochlorite employed, calcium or sodium, is important, and the influence of the temperature on the dissociation constant is different according to whether the solution is neutral, acid, or alkaline. Dilute, warm calcium hypochlorite solutions have a more energetic action than sodium hypochlorite solutions prepared by the action of sodium carbonate on calcium hypochlorite solutions. The action of warm electrolytic sodium hypochlorite solutions, owing to the absence of excess of alkali, is probably at least as rapid as that of calcium hypochlorite. Using a solution of sodium hypochlorite prepared by double decomposi-

tion, cotton goods bleached warm show a purer white than corresponding goods bleached cold, not only at the time of bleaching but even after a period of 8 years. The drawbacks generally associated with the use of calcium hypochlorite liquors are minimised when the liquors are used warm, first because the calcium carbonate is not deposited as a crust but as a loose powder, and secondly because the liquors are employed at a much higher dilution than in cold bleaching and mechanical circulation is essential.—J. F. B.

PATENTS.

Dyeing red for skins to silver for shade; Process for ——. A. Woiskoff, Berlin. Ger. Pat. 310,425, 5.5.18.

THE skin is treated on the surface first with a mixture of weak milk of lime with ferrous sulphate and alum, then with ferrous sulphate solution alone. A solution of ferrous sulphate, ammonium chloride, and potash mixed with litharge and argol is then beaten into the skin, which is afterwards treated first superficially with an infusion of burnt nut-gall to dye the end portions or surface of the long wool or hair, and then more thoroughly with a weaker infusion of nut-gall in order to dye the under or lower portion of the hair. At the end of the third stage the skin has completely lost its red tone and appears of a pale yellow shade.—L. L. L.

Fabrics having the property of invisibility; Production of [printed] ——. F. Cochrane, Cheadle Hulme. Eng. Pat. 125,093, 8.5.16. (Appl. 6587/16.)

THE fabric is padded in a solution of a dyestuff which will produce two or more colours by after-treatment with metallic salts. Thus, cotton, woollen or other material is padded in a cold solution of logwood, sumac, or fustic, and a uniform ground colour is then developed by passing the fabric through a boiling bath of an aluminium salt. The second colour is developed in patches on the ground colour by the application of other metallic salts such as potassium bichromate or iron salts. The fabric is folded and allowed to stand so that the patches may spread and mark off on the ground colour, and is finally dried at a high temperature further to develop and to fix the colours.—S. S. A.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitrous acid and nitrites; Determination of ——. J. S. Laird and T. C. Simpson. J. Amer. Chem. Soc., 1919, 41, 521—531.

THE volumetric methods described in the literature for the estimation of nitrites are unsatisfactory. The following method gives reliable results. The nitrite solution is run into an excess of standard permanganate acidified with sulphuric acid (1 : 4), with constant shaking. The excess permanganate is reduced by the addition of an excess of standard ferrous sulphate, sodium oxalate, or hydrogen peroxide, and the excess of reducing agent titrated with potassium permanganate. The estimation is not affected by moderate amounts of chloride or small amounts of bromide. Silver nitrite is not a satisfactory material for use as a standard in nitrite estimations. Sodium nitrite solution titrated with potassium permanganate by the method described above is a satisfactory standard solution, or sodium nitrite solution may be standardised gravimetrically by the reduction of silver bromate to silver bromide by Busvold's method (this J., 1914, 104).—J. F. S.

Boric acid; Selection of an indicator for use in the acidimetric titration of ——. J. Prescher. Z. Unters. Nahr. Genussm., 1918, 36, 283—286.

FOR the titration of boric acid in a solution containing glycerol or mannitol, the most suitable indicator is phenolphthalein.—W. P. S.

Ammonium nitrate; Effecting and controlling crystallisation of ——. J. E. Bolling. Chem. and Met. Eng., 1919, 20, 401—405.

THE ammonium nitrate liquor leaves the filter presses at a temperature not lower than 64° C., and is slightly cooled in the dilution tank. The temperature is then reduced to about 38° C. by passing through a battery of double pipes comprising a 2-in. inside pipe for cooling water, enclosed in a 3-in. pipe through which the liquor is passed; a metal spiral is wound round the inner pipe so as nearly to fill the annular space. Each unit is provided with two batteries of pre-coolers consisting of five "banks" and a spare "bank." The cooling water is used at a temperature above that of the water in the mains, and therefore a large proportion is recirculated, the small quantity of cooler water required being introduced from the mains through a three-way tap automatically regulated to maintain a temperature which will prevent crystallisation in the pipes. To this end also, the flow of the cooling water is controlled by thermostats placed in the liquor outlets. From the pre-cooler the liquor is delivered through looped pipes into an equalising tank, and when it is necessary to interrupt the delivery to the crystallisers, the liquor is rapidly circulated by independent pumps from the equalising tank, through the looped pipes, and back to the tank, sufficient hot liquor being added from the dilution tank to maintain the circuit above the crystallising temperature. If necessary, the system can be rapidly drained. The air in the pre-cooler room is circulated by means of a fan, and a regulated proportion of outside air is introduced to maintain the temperature at 90° F. (32° C.). The crystalliser plant comprises two units, each consisting of four rooms containing 480 pans, each of 40 cub. ft. capacity, and the air supply per minute for the complete installation is 600,000 cub. ft. The liquor run into the pans in the crystallising rooms is diluted with distilled water to prevent crystallisation of sodium nitrate and sodium sulphate. To minimise evaporation and thereby prevent excessive surface cooling, a vapour pressure is maintained in the room with a dew point of 35° F. (1·7° C.) and a dry bulb temperature of 45° F. (7·2° C.). Each unit of the crystallising plant is provided with two ammonia compressors, which are connected to operate independently or separately. The apparatus supplies cold brine to dehumidifiers where it is sprayed into a mist chamber through which air is drawn. The temperature and humidity of the air leaving the dehumidifiers is regulated by thermostats. The author describes in some detail the operation of the refrigeration plant and the precautions necessary to ensure uniform distribution of air in the crystallising rooms.—S. S. A.

Polyhalite; Occurrence of — — in the older Zechstein potassium salt deposits in relation to van't Hoff's conclusions. M. Rosza. Z. anorg. Chem., 1919, 105, 167—170.

THE author discusses the occurrence of polyhalite, $Ca_2K_2Mg(SO_4)_4,2H_2O$, in different parts of the salt deposits, and shows that the facts are in good agreement with what was to be expected from the work of van't Hoff. Besides being found as a primary deposit, it also occurs as a secondary formation, the result of the metamorphosis of other deposits. In some cases the polyhalite itself has been decomposed and can only be recognised by its

transformation products, anhydrite, kieserite, sylvine, and carnallite, formed through infiltration of liquors rich in magnesium chloride. (See also J. Chem. Soc., June, 1919.)—E. H. R.

Javel extracts [alkali hypochlorite solutions]; Stability of ——. Fonzes-Diacon. Bull. Soc. Chim., 1919, **25**, 206–208.

ALKALI hypochlorite solutions, containing 5 grms. of active chlorine per 100 c.c., lose very little of their activity during four months, if stored in bottles of dark yellow glass, even when exposed to light. In clear bottles the loss is very marked, alkali hypochlorite solutions of varying strengths tending towards a common limit of about 1 grm. of active chlorine per 100 c.c.—W. G.

Lime burning in a gas-fired continuous kiln. W. D. Mount. Chem. and Met. Eng., 1919, **20**, 428–430.

THE kiln is of the shaft type, 8 ft. in diam. inside the brickwork, and 60 ft. in height to the charging floor. The limestone is charged in batches of 1000 lb. at intervals of 15 mins., the production being at the rate of 25 tons per 24 hours. The ratio of coal to lime is 1 to 5 or 6 according to the quality of the coal. The charge is fired by producer-gas made from bituminous coal low in sulphur. The gas is passed through water-cooled balanced valves, and is introduced into the kiln at the top of the cooling zone, through tuyères designed to give even distribution of the gas through the mass of limestone. Induced draught is used as it is independent of the height of the kiln and the size of the limestone blocks, and is easily controlled. The kiln is operated so as to be cold at the top and bottom, and the temperature of the intermediate burning zone is carefully controlled by a pyrometer. To prevent "dead burning" and to utilise fully the heat of the gases, the rate of passage of the limestone through the reaction zone should be regulated according to the size of the limestone blocks fed to the kiln, the amount of preheating of the charge before it reaches the reaction zone, and the nature of the fire. Emphasis is laid on the importance of the kiln being so designed as to facilitate chemical and mechanical control and mechanical continuity of the process.—S. S. A.

Isotungstic acid; Existence of ——. P. Barbe. Monit. Scient., 1919, **63**, 73–75.

DURING several years' work on tungsten the author has never met with a specimen of the metal having a higher atomic weight than 184, and doubts the existence of neotungsten as described by Gerber (see this J., 1917, 1181). Further, isotungstic acid does not appear to exist, and the ammonium isotungstate obtained by Gerber was actually ammonium sodium tungstate. (See also J. Chem. Soc., June, 1919.)
—W. P. S.

Carbon oxysulphide; Attempted synthesis of ——. F. González and E. Moles. Anal. Fís. Quím., 1919, **17**, 55–59.

PURE carbon monoxide was passed over the surface of sulphur heated to 110° and 260° C. in a sealed apparatus and the gas mixture formed subjected to the action of the electric spark. No formation of carbon oxysulphide was observed.—W. S. M.

Radium emanation; Chemical action produced by ——. *I. Combination of hydrogen and oxygen.* S. C. Lind. J. Amer. Chem. Soc., 1919, **41**, 531–551.

THE velocity of combination of hydrogen and oxygen under the influence of radium emanation is the same in spherical and cylindrical vessels; it depends only on the quantity of emanation and the gaseous pressure. The velocity constant is decreased by increasing the volume of the vessel. Excess of oxygen increases the velocity, the increase becoming greater the greater the excess of oxygen. An excess of hydrogen has the opposite effect. For each pair of ions produced 3·9 mols. of water are formed. (See also J. Chem. Soc., June, 1919.)
—J. F. S.

Radium emanation; Chemical action produced by ——. *II. Chemical effect of recoil atoms.* S. C. Lind. J. Amer. Chem. Soc., 1919, **41**, 551–559.

THE action of radium emanation in causing the combination of hydrogen and oxygen in spheres of small volume is 6–7 times greater than the normal value. This is due to the ionisation caused by the recoil atoms. (See also J. Chem. Soc., June, 1919.)
—J. F. S.

Double salts and complex salts; Cryoscopic investigation of —— in aqueous solution. E. Cornec and G. Urbain. Bull. Soc. Chim., 1919, **25**, 131–136.

A DETERMINATION of the lowering of the freezing-point of a solution of two salts together in water gives an indication of the formation of a double salt. A difference between the values observed and calculated indicates the existence of a double salt in solution, and this difference is at its maximum when the two salts are present in the molecular proportions in which they occur in the double salt itself. The cases studied were cadmium iodide and the alkali iodides, cadmium bromide and alkali bromides, and cadmium chloride and alkali chlorides.—W. G.

Selenium; Colloidal ——. J. Meyer. Z. Elektrochem., 1919, **25**, 80–82.

COLLOIDAL selenium is obtained by the action of dilute sulphuric acid on very dilute solutions of sodium selenosulphate: $Na_2SeSO_3+H_2SO_4=Se+SO_2+H_2O+Na_2SO_4$. The solutions are orange-yellow to dark red in colour and on filtration through a Zsigmondy ultra-filter give colourless solutions which are very stable. (See also J. Chem. Soc., June, 1919.)—J. F. S.

Temperature coefficients of catalysed and non-catalysed reactions. N. R. Dhar. Ann. Chim., 1919 [ix], **11**, 130–223.

A MORE detailed account of work already published. (See Trans. Chem. Soc., 1917, 707.)—W. G.

Electromotive activity of carbon monoxide. Auerbach. *See* XI.

Dakin's solution. Cullen and Hubbard. *See* XIXB.

Densities of mixed acids. Pascal and Garnier. *See* XXII.

Phosphoric acid. Winkler. *See* XXIII.

Phosphoric acid. Karaoglanow. *See* XXIII.

PATENTS.

Nitric acid and ammonium sulphate; Manufacture of ——. A. T. Cocking, and Kynoch, Ltd., Birmingham. Eng. Pat. 125,444, 1.8.16. (Appl. 10,852/16.)

POWER for the operation of an electric arc furnace for the production of nitric acid from the

atmosphere is obtained by burning solid fuel in a gas producer. The ammonia recovered from the gas is combined with the nitric acid produced to obtain ammonium nitrate. The nitric acid is subsequently regenerated for use in nitration processes by heating with excess of sulphuric acid (waste acid may be used), under reduced pressure in a continuously operated plant. The quantity of acid used for the decomposition is in greater or less excess according to whether it is desired to obtain an acid solution of ammonium sulphate for use in the manufacture of nitrophosphate fertiliser, or a slightly acid solution for the production of ammonium sulphate crystals.—S. S. A.

Sulphuric acid; Method and apparatus for concentrating ——. A. B. Newman, Langeloth, Pa. U.S. Pat. 1,294,525, 18.2.19. Appl., 28.10.16.

The distillate obtained in concentrating sulphuric acid is recovered in the Glover tower or in the succeeding chambers, being maintained above its condensation temperature meanwhile by contact with the flue system between the roasting furnace and the Glover tower.—W. E. F. P.

Sulphuric acid; Apparatus for and method of concentrating ——. J. Patten, Baltimore, Assignor to S. M. Shoemaker, Eccleston, Md. U.S. Pat. 1,294,827, 18.2.19. Appl., 24.10.17.

In an apparatus comprising a connected series of concentrators arranged at successively lower levels above a furnace, means are provided for introducing the acid at the upper end of the series and for applying the highest degree of heat at the same end.—W. E. F. P.

Sulphur dioxide in burner gases; Apparatus for the automatic determination and recording of ——. A. Abramski, Königstein. Ger. Pat. 309,981, 15.12.17.

The apparatus contains three electric circuits, the first of which includes a selenium resistance, the second operates the valves through which the gas to be tested and a standard iodine solution are supplied to and discharged from the reaction vessel, and the third actuates the recording device. When the selenium cell is sufficiently illuminated, a galvanometer needle, provided at its point with a sliding contact, swings over to the stop and closes the second circuit. The selenium cell is illuminated by light which passes through the iodine solution, and hence receives more and more light as the iodine solution is decolorised by sulphurous acid.—T. St.

Electrolysing salt solution; Apparatus for ——. T. Matsushima, Kanagawaken, Japan. Eng. Pat. 114,623, 28.3.18. (Appl. 5479/18.)

The apparatus comprises an outer tank containing the anodes and an inner tank with cathode. The inner tank is provided with a thin horizontal layer of mercury supported by a porous disc forming the base of the tank, so that the sodium is taken up by the lower surface of the mercury layer and recovered at the upper surface as caustic soda. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 17,169 of 1892 and 24,274 of 1893; this J., 1893, 277; 1894, 404.)—B. N.

Sulphuryl chloride; Manufacture of ——. A. Boake, Roberts and Co., Ltd., London, and T. H. Durrans, Oxford. Eng. Pat. 124,542, 26.1.18. (Appl. 1520/18.)

Sulphur dioxide and chlorine are caused to react in the presence of one, or more, of the following substances: terpene hydrocarbons; esters which are compounds of saturated alcohols or of monohydroxyphenols with monobasic aliphatic acids containing carbon, hydrogen, and oxygen only, and also triphenyl phosphate and tricresyl phosphate; ethers which are the mixed or simple saturated aliphatic ethers or the simple saturated aromatic ethers and also the terpene ether cineol (eucalyptol) and the saturated monohydroxyphenols which contain one benzene ring only, the ethers, phenols, and esters being limited to those which contain carbon, hydrogen, and oxygen only but no substituting group or groups other than radicles containing carbon and hydrogen only. Reaction occurs without the aid of light or pressure. The gases may be passed into the reaction vessel either together or alternately and either continuously or intermittently. The temperature should be sufficiently low to prevent the catalyst and the sulphuryl chloride formed from volatilising but sufficiently high to prevent the catalyst from solidifying. The following catalysts have been found to be particularly advantageous: pinene and limonene; methyl acetate, isoamyl formate, ethyl butyrate, phenyl acetate, phenyl ethyl acetate, glycerol triacetate and oils which are esters of glycerol; ethyl ether, isobutyl ether, benzyl ether, cresyl ether; triphenyl phosphate, tricresyl phosphate.—H. W.

Sodammonium sulphate from nitre cake or other acid sodium sulphates; Production of ——. H. M. Dawson, Leeds. Eng. Pat. 125,311, 11.9.18. (Appl. 14,756/18.)

Nitre cake and sulphuric acid are dissolved in water or in the mother liquor obtained in a later stage of the process, and the acid is neutralised with ammonia. The proportion of nitre cake and acid is such that after neutralisation the solution contains ammonium sulphate in excess of sodium sulphate (*e.g.*, in the molecular ratio of 2·5 to 1·5). The concentration of the hot solution is adjusted by the addition of water or by evaporation, to contain 100–110 molecules of salt per 1000 molecules of water. On cooling, sodammonium sulphate crystallises. Equivalent quantities of sodium sulphate and sulphuric acid in the form of nitre cake and acid are added to the mother liquor, the concentration of the hot solution obtained is adjusted, and a further quantity of sodammonium sulphate crystals produced by cooling. (See also this J., 1919, 98 T.)—S. S. A.

Alkaline nitrates; Process for the production of —— by oxidation of ammonia. F. Bensa, Genoa, Italy. Eng. Pat. 125,453, 4.8.16. (Appl. 11,036/16.) Int. Conv., 4.8.15.

A mixture of steam, ammoniacal gases, and a considerable quantity of air or oxygen is introduced into a retort maintained at 600°—800° C., in which the gases come in contact with, first a layer of platinised or palladiumised asbestos, and then separate layers of copper oxide, iron oxide, and oxides of rare earths. The gases issuing from the retort are led directly through a series of receptacles containing solid alkali carbonates heated to 300°—350° C. The alkali nitrate formed fuses and is drawn off.—L. A. C.

Sodium carbonate and ammonium sulphate from bisulphate of soda; Manufacture of ——. G. N. Vis, Paris. U.S. Pat. 1,294,526, 18.2.19. Appl., 21.9.17.

An aqueous solution of sodium bisulphate is treated with ammonia and then saturated with carbon dioxide under slight pressure.

—W. E. F. P.

Ammonia; Process for the production and purification of ——. W. S. Landis, Assignor to American Cyanamid Co., New York. U.S. Pat. 1,296,820, 11.3.19. Appl., 5.11.18.

AN impure compound (*e.g.*, a cyanamide or cyanide), is mixed to a thin paste with water, and after removing some of the impurities by blowing with an inert gas, it is heated under pressure. —S. S. A.

Potash and the like; Method of extracting ——. A. B. Andrews, Assignor to H. F. Kelley, Auburn, Me. U.S. Pat. 1,296,035, 4.3.19. Appl., 6.3.18.

POTASH-BEARING silicate, *e.g.*, felspar, is treated with an alkaline-earth hydroxide (*e.g.* lime), in a series of fractional digestions in counter-current, each fresh charge of felspar and lime being treated with the liquor separated from the sludge of the previous extraction.—S. S. A.

Potassium compounds; Process of obtaining ——. G. F. von Kolnitz, Stockertown, Pa. U.S. Pat. 1,296,141, 4.3.19. Appl., 1.7.18.

NATURAL potassium-bearing material is exposed at about 350° C. to the action of gaseous hydrogen chloride and the potassium chloride formed is recovered as such.—S. S. A.

Potassium salts; Process of extracting —— from felspar. Process of extracting potassium [salts] from minerals. Process of producing potassium salts. H. Blumenberg, jun., Assignor to Chemical Construction Co., Los Angeles, Cal. U.S. Pats. (A) 1,296,457, (B) 1,296,458, and (C) 1,296,459, 4.3.19. Appl., (A) 23.7.17, (B) (C) 4.12.17.

(A) FELSPAR is mixed with an acid sludge and an alkaline-earth sulphate, heated in presence of air, and the soluble potassium salt thus formed is extracted. (B) A mineral containing potassium compounds is mixed with a nitrate, *e.g.*, lead nitrate, which evolves nitric acid when heated, and the mixture heated until it fuses and all the nitrogen oxides are expelled. The residue is treated with an acid and the soluble potassium salt extracted. (C) A powdered mineral containing potassium compounds is fused with a reagent capable of rendering the potassium compounds soluble, *e.g.*, sodium carbonate; the fused mass is extracted with water, treated with sulphur dioxide, dehydrated to render the silicates insoluble, and potassium sulphite extracted from the product. —A. B. S.

Potassium nitrate [from gases from cement kilns]; Process of producing ——. H. Blumenberg, jun., Los Angeles, Cal. U.S. Pat. 1,296,460, 4.3.19. Appl., 2.1.18.

GASES containing potassium compounds and cement dust in suspension are passed through a solution of a metallic nitrate, *e.g.*, sodium nitrate, the solution being afterwards evaporated to dryness to render the silicates insoluble; potassium nitrate is then extracted from the product with water. —A. B. S.

Potassium chloride [from cement-kiln gases]; Process of making ——. H. Blumenberg, jun., Los Angeles, Cal. U.S. Pat. 1,296,461, 4.3.19. Appl., 28.1.18.

WASTE gases containing potassium compounds and cement dust are treated with an aqueous solution of sodium chloride, so as to form potassium chloride, which is afterwards separated from the solution.—A. B. S.

Potassium salts; Apparatus for recovering —— from cement kilns. Process of recovering compounds from waste gases of cement kilns and the like. H. Blumenberg, jun., Oro Grande, Cal. U.S. Pats. (A) 1,296,462 and (B) 1,296,463, 4.3.19. Appl., 15.3.18.

(A) AN apparatus for recovering potassium compounds carried in suspension in hot gases, comprises two precipitating chambers, and means for bringing a precipitating liquid into contact with the gases in the chambers; a large portion of the potassium compounds and practically all the other solids are precipitated in the first chamber and the remainder of the potassium compounds in the second chamber. The solutions from the two chambers are collected independently. (B) Hot gases from cement kilns are passed successively through two precipitating chambers. In the second chamber the precipitating liquid is sulphuric acid, and a clear solution of potassium sulphate is formed.—A. B. S.

[Potassium compounds;] Process of treating cement-kiln gases [to recover ——]. Process for recovering potassium compounds from waste gases of cement kilns or the like. H. Blumenberg, jun., Oro Grande, Assignor to Chemical Construction Co., Los Angeles, Cal. U.S. Pats. (A) 1,296,465 and (B) 1,296,466, 4.3.19. Appl., 21.4 and 20.5.18.

(A) HOT gases from cement kilns are cooled and freed from most of the suspended cement dust, then treated with a liquid to extract the remainder of the cement dust and a portion of the potassium compounds, and afterwards passed through an aqueous mixture containing a compound having an affinity for carbon dioxide, whereby the remaining potassium compounds are converted into bicarbonate. (B) Hot gases from cement kilns are cooled to 200° F. (93° C.) and saturated with aqueous vapour and then cooled to 40° F. (5° C.) by passing through a refrigerator whereby the vapour is condensed and collects the potassium compounds.—A. B. S.

Potassium sulphate; Process of producing ——. H. Blumenberg, jun., Los Angeles, Cal. U.S. Pat. 1,297,638, 18.3.19. Appl., 2.1.18.

POTASSIUM sulphate is prepared by passing waste gases containing potassium compounds in suspension and carbon dioxide through an aqueous mixture containing an alkaline-earth sulphate and then separating potassium sulphate from the solution.—A. B. S.

Potassium compounds from cement-kiln gases; Apparatus for recovering ——. H. Blumenberg, jun., Oro Grande, Cal. U.S. Pat. 1,297,639, 18.3.19. Appl., 15.3.18.

AN apparatus for separating potassium compounds from cement-kiln gases comprises a dust-precipitating chamber, a precipitating tower, means for circulating an aqueous mixture through the tower to precipitate the cement dust and potassium compounds, a condenser connected to the tower and provided with vertical tubes open at both ends, and means for collecting and concentrating the aqueous solution of the potassium compounds. —A. B. S.

Potassium nitrate; Process for making ——. H. Blumenberg, jun., Assignor to Chemical Construction Co., Los Angeles, Cal. U.S. Pat. 1,297,640, 18.3.19. Appl., 8.7.18.

A MINERAL containing potassium in an insoluble form is heated with a nitrate until fusion occurs

but below the temperature at which nitric oxide is evolved, and the resulting potassium nitrate is recovered.—A. B. S.

Potassium compounds; Process of producing ——. H. E. Brookby, Evanston, Ill. U.S. Pat. 1,297,078, 18.3.19. Appl., 7.10.18.

A HYDROUS potassium-containing silicate is mixed with a non-volatile alkali and a metallic chloride, the mixture heated to a temperature sufficient to dehydrate the silicate but not sufficient to produce sintering, maintained at this temperature for 30 to 60 minutes, and the soluble potassium compounds formed are recovered by leaching.—A. B. S.

Zinc arsenite; Method of producing ——. C. D. Vreeland, Upper Montclair, N.J. U.S. Pat. 1,296,344, 4.3.19. Appl., 28.8.18.

ZINC arsenite is prepared from arsenious oxide and zinc oxide by heating one of the oxides and causing it to react with the other oxide in water.
—S. S. A.

Lead arsenate; Process of making ——. G. R. Riches and W. C. Piver, Hoboken, N.J. U.S. Pat. 1,296,557, 4.3.19. Appl., 3.2.17.

To a solution of lead nitrate (900 gallons of sp. gr. 1·02), lead oxide (1000 lb.) is added, then sufficient arsenic acid to combine with the basic lead nitrate formed, the temperature throughout the process being maintained at 30°—35° C.
—S. S. A.

Lead acetate; Preparation of ——. E. Camus, R. Duchemin, and G. Criquebœuf, Paris. U.S. Pat. 1,297,792, 18.3.19. Appl., 30.10.17.

LEAD oxide is mixed with ethyl acetate in the presence of water, and heat is applied to the mixture to start the reaction.—S. S. A.

Calcium or other metal nitro-carbide [cyanamide]; Process of making ——. J. H. Reid, Newark, N.J., Assignor to International Nitrogen Co. U.S. Pat. 1,297,246, 11.3.19. Appl., 28.6.15.

A MOLTEN metallic carbide, *e.g.*, calcium carbide, is introduced into an atmosphere of nitrogen under pressure, and kept in contact with the gas until combination is complete.—L. A. C.

Waste gases [containing fluorine compounds]; Recovery process for ——. I. Hechenbleikner, Assignor to Chemical Construction Co., Charlotte, N.C. U.S. Pat. 1,297,464, 18.3.19. Appl., 26.10.18.

WASTE gases containing fluorine compounds are passed through a solution containing a hydrosilicic acid.—L. A. C.

Silica gel and process of making same. W. A. Patrick, Baltimore, Md. U.S. Pat. 1,297,724, 18.3.19. Appl., 7.12.18

SUFFICIENT hydrochloric acid is added to a well stirred solution of sodium silicate to liberate the whole of the silica. The gel thus formed is allowed to set, washed, dried in a current of air at 75°—120° C., and then subjected to a vacuum.
—L. A. C.

Salt; Process of extracting —— from natural brines. A. E. Schaefer, Saginaw, Mich. U.S. Pat. 1,297,737, 18.3.19. Appl., 3.3.16.

FINE-GRAIN salt is added to an unsaturated brine until the liquid is saturated; the solution is then slowly evaporated to produce a coarse-grain salt. After separating the salt the liquor is rapidly evaporated until fine-grain salt is deposited.
—L. A. C.

Bleaching powder chamber; Mechanical ——. J. L. C. Eckell, Berlin. Ger. Pat. 310,271, 3.3.18.

A BLEACHING powder chamber, of the type in which the inside fittings can be renewed, has openings at the side provided with covers, and removable shelves to receive the lime, arranged in tiers, and over which move scrapers attached to rods extending through the chamber.—C. A. M.

Titanic acid; Preparation of practically iron-free —— from titanium solutions containing iron. Titan Co. A.-S., Christiania. Ger. Pat. 310,304, 27.4.17. Int. Conv., 9.8.16.

BY precipitating titanic acid by heating a solution of quadrivalent titanium containing also trivalent titanium, oxidation of ferrous salts is prevented, and products practically free from iron are obtained. Since only about 5% of the quadrivalent titanium is converted into the trivalent form, neutralisation of the strong mineral acid in the solution prior to the precipitation is unnecessary.
—C. A. M.

Rare earth metals; Process of preparing insoluble or sparingly soluble compounds [fluorides] of ——. Gebr. Siemens und Co., Berlin-Lichtenberg. Ger. Pat. 310,305, 17.5.14.

INSOLUBLE compounds of rare earth metals are obtained by heating together the reacting salts containing water of crystallisation, or in solution, at temperatures above the b.pt. of the solvent, either at atmospheric pressure, or, if necessary, under pressure. For example, fluorides prepared in this way from chlorides at a red heat or lower temperature have a fairly high density, and are applicable, without further treatment, in the arc-light industry.—C. A. M.

Radio-active potassium chloride; Preparation of ——. E. Penkala, Zagreb, Croatia. Ger. Pat. 310,481, 5.10.16. Int. Conv., 19.7.16.

POTASSIUM chloride, moistened with hydrochloric acid, is placed on the lower of two horizontal insulated metal plates arranged in an air-tight box. The two plates are connected to an electric circuit, the lower plate forming the cathode and the upper plate the anode. Attached to the side of the box is a retort containing a highly active radium preparation, the emanation from which passes through the neck of the retort on to the negatively charged potassium chloride. In order to drive off the emanation completely the retort is heated, but not above 200° C. By decomposition of the emanation, solid radio-active bodies are formed on the surface of the potassium chloride and are converted by the hydrochloric acid into the corresponding chlorides.—L. A. C.

Hydrogen; Manufacture of ——. E. B. Maxted and G. R. Ridsdale, Walsall. Eng. Pat. 125,112, 22.5.16. (Appl. 7286/16.)

IRON oxide is reduced at a red heat by a gas of high reducing and calorific power, which has been modified either in the process of manufacture or by suitable additions, so as to contain less than 10% by volume of diluents such as nitrogen, and more than 10% of carbon dioxide, the remainder of the gas consisting substantially of hydrogen and carbon monoxide, and the volume of the carbon monoxide being not substantially less than that

of the dioxide. On reoxidising the iron by steaming in the usual way, hydrogen of improved quality, *i.e.*, with less carbon monoxide, is obtained. The reducing gas should be free from steam and contain as small as possible a percentage of diluting gases.—S. S. A.

Hydrogen; Manufacture of ——. E. B. Maxted, Walsall. Eng. Pat. 125,410, 5.7.16. (Appl. 9481/16.)

In the manufacture of hydrogen by alternate reduction and oxidation of a reaction mass such as iron oxide, the speed of reduction is increased by incorporating with the reaction mass a small percentage of an alkali or an alkaline-earth either alone or in admixture with a small quantity of copper or a copper compound, the activitating addition being fixed by heating the mass to a high temperature.—S. S. A.

Cooling apparatus. Eng. Pat. 125,101. *See* I.

Treating cement mixtures. U.S. Pat. 1,296,464. *See* IX.

Roasting zinc sulphide ores. Eng. Pat. 124,266. *See* X.

Manganese dioxide. U.S. Pat. 1,293,161 *See* XI.

Ammonia in gases etc. Ger Pat. 309,733. *See* XXIII.

VIII.—GLASS; CERAMICS.

Optical glass melting; Technique of ——. C. N. Fenner. J. Amer. Ceram. Soc., 1919, **2**, 102—145.

In making optical glass, the purity of the materials is of paramount importance. Potassium sulphate and chloride are objectionable as sources of potash, and nitre should not be used in such a proportion that it can segregate and attack the pot unduly. The replacement of potash by an equal weight of soda has no serious effect on the refractive index of the glass, but may increase the colour. As a source of lead, either red lead or litharge may be used. All the materials, but especially the sand, should pass through a 35-mesh sieve. The cullet should be crushed and the iron removed by magnets. The batch is well mixed in a long open box by means of wooden paddles, the material being moved at least three times from one end of the box to the other, and the mixture is passed through a 4- or 6-mesh sieve. Meanwhile the pot is heated rapidly to 1400° C., and maintained at that temperature for one hour. The pot is then glazed by pouring cullet around the inside and allowing it to flow to the bottom so as to fill any pores, and is kept at 1400° C. for another hour, after which it is half filled with batch. When this has melted, the remainder of the batch is added in smaller quantities until the pot is filled to 1½ in. below the rim with molten glass. During the melting the furnace atmosphere must remain fully oxidising, the visible flames not extending much above the crown of the pot. The surface of the glass should be skimmed with an iron blade on a long handle, applied with smooth and regular strokes so as to avoid forcing the scum into the molten metal. As little material as possible should be removed during skimming. After resting for 1 hour the glass should be stirred thoroughly first by hand before the melting is complete, and later mechanically with a thick-walled clay tube, water-cooled internally, which is held vertically, and moved in a series of circles and simultaneously up and down, the speed of the stirrer being varied as required from 4 to 28 revs. per min. When the mechanical stirrer is first introduced the radius of the stirring-circle should be very small; it is gradually increased later, a maximum radius of 7 in. in a 25 in. pot being satisfactory. When the melting is finished and the glass is cooling the radius of the stirring circles is again reduced. The stirring is continued until the pot is withdrawn from the furnace at 900°—1200° C. Considerable importance is attached to the details of the stirring and several charts are shown. A block of wood or a potato may be added when the glass has reached an "open boil" in order to free it from persistent bubbles. A small quantity of ammonium nitrate wrapped in paper, immersed and held near the bottom of the pot by an iron rod, is stated to be specially suitable for plaining optical glasses. The filling and melting usually require 8—10 hours after which the glass remains quiescent for 2—3 hours to "fine." The melting and fining may usually be effected at 1400° C., but if sulphates or chlorides are present a temperature of 1420°—1430° C. should be employed. The temperature should not rise more than 20° C. above the one specified or excessive volatilisation of alkalis and corrosion of the pot will occur. Care must be taken that the pot does not leak and to avoid leakage of water from the water-cooled stirrer. After the stirring has stopped, the stirring rod should be drawn to the side of the pot and held there by means of an inverted U-bar. If the stirrer is lifted out of the glass its removal tends to produce striæ. The pot should then be removed as rapidly as possible, less than five minutes being usually required. It should not be allowed to cool quickly or "vacuum bubbles" may occur. They may be eliminated by reheating the glass to the softening point.—A. B. S

Optical glass manufacture; An improved method of ——. G. W. Morey. J. Amer. Ceram. Soc., 1919, **2**, 146—150.

The time required to fill, melt and fine a charge of optical glass may be reduced to 24 hours, thus practically doubling the output of glass, by commencing the stirring by hand as soon as the pot is half full of molten glass, continuing until the pot is withdrawn from the furnace. This procedure avoids the separation of the fluxes, lessens their corrosive action, facilitates an early escape of bubbles, and avoids the necessity of a fining period.—A. B. S.

Porcelains; Possible cause of dielectric failure of ——. C. Treischel. J. Amer. Ceram. Soc., 1919, **2**, 96—101.

Porcelain insulators which are free from mechanical defects may fail dielectrically by the current rupturing the crystals or glassy magma (the converse of Kelvin's piezo-electric effect; compare this J., 1919, 159 R) or leaking through the voids in the mass. In the case of failure due to the former cause, the dielectric strength might be increased by replacing the flint or quartz crystals in the porcelain by talc, pyrophyllite, sillimanite, or other material which is piezo-electrically inert and less brittle than felspar.—A. B. S.

[Fireclay] stove-tiles; Resistance of —— to sudden changes of temperature. G. Heinstein. Keram. Runds., 1919, **27**, 29.

Tiles containing burned fireclay (grog) resist a sudden change in temperature (as when placed on a tripod and heated with a Bunsen burner, the top of the flame of which is in contact with the tile)

better than those in which a more silicious non-plastic material is used, though the difference is small in tiles which have been fired at a low temperature. The size of the particles of grog or quartz is not very important though a coarse-grained grog or quartz appears to be better than a fine-grained one. The larger the proportion of grog or quartz the better. Bodies with a very high silica-content tend to crack in the burning. Chalk greatly reduces the resistance of the body to changes in temperature and thus acts in an opposite manner to felspar.—A. B. S.

Refractories for the zinc industry. M. G. Babcock. J. Amer. Ceram. Soc., 1919, **2**, 81—95.

RETORTS for the distillation of zinc should have a minimum porosity (5%) at 1300°—1400° C. The bonding clay should be low in metallic oxides (other than alumina) and devoid of free silica if the ore is basic, though a little free silica is an advantage when using silicious ore. The grog should preferably be made of calcined flint clay. Grog from old zinc retorts should not be used extensively as it contains a large proportion of zinc spinel, and retorts made from such grog are weak at high temperatures. The use of coke-dust (up to 10%) in the retort material produces smooth walls of great density and good working properties, and tends to reduce the absorption of zinc vapour and corrosion. When sand is used in the retort mixture, the cost of the retorts is reduced and they can be made thinner in the walls. The retorts are made of well-pugged and matured clay paste which is shaped in auger machines or by hydraulic presses working at 1800—2000 lb. per sq. in., dried in steam-heated chambers at 52°—54° C. for 50—120 days, and annealed at 750°—800° C. in kilns resembling glass-pot arches. To reduce absorption of zinc, retorts are sometimes glazed with a mixture of fluorspar and zinc sulphate or of soda, flint, and fluorspar. Condensers and receivers are moulded by hand from a material inferior to that used for the retorts, dried for 2—3 days, and burned at 900°—1000° C. —A. B. S.

PATENTS.

Ovens and kilns for pottery and the like; Fuel economiser or heat regulator for ——. A. and T. Tilstone, Burslem. Eng. Pat. 125,486, 14.3.18. (Appl. 4493/18.)

A FUEL economiser or heat regulator for ovens and kilns consists of one or more fireclay grids placed on the outlet of the flues of the oven or kiln, each grid having slots or circular holes whereby the exit of the waste gases is throttled and the heat more efficiently utilised. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 4610 of 1891; this J., 1892, 434.)—A. B. S.

Clay working. J. J. F. Brand, Roseville, Ohio. U.S. Pat. 1,296,472, 4.3.19. Appl., 17.1.18.

CLAY or the like is pugged *in vacuo*.—A. B. S.

Refractory article. F. J. Tone, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,296,715, 11.3.19. Appl., 27.9.18.

A REFRACTORY article is composed of fireclay, grog, and crystalline carborundum, the major part of the carborundum being "coarser than No. 60" and constituting less than 60% of the mixture. —A. B. S.

Glass, Apparatus for delivering molten ——. W. C. Blank, San Francisco, Cal., U.S.A. Eng. Pat. 125,560, 17.10.18. (Appl. 16,973/18.)

Separator for clay. Eng. Pat. 125,344. *See* I.

Tunnel-kiln. U.S. Pat. 1,295,955. *See* I.

Hollow objects of compressed powder. U.S. Pat. 1,286,089. *See* X.

IX.—BUILDING MATERIALS.

Portland cement; Effect of the addition of slag to ——. P. C. H. West. Trans. Faraday Soc., 1919, **14**, 44—45.

THE addition of slag in the manufacture of cement is stated to be of no advantage as a general rule, except in reducing the cost, though the cement containing slag may still be quite a good one, and in some cases the addition of slag may be of advantage in reducing the quick-setting character of the cement.—B. N.

Agglomeration of granular masses. Donnan. *See* I.

Lime burning. Mount. *See* VII.

PATENTS.

Waterproof compound [from tar] for roofing or other purposes. S. G. Kelsey, London. Eng. Pat. 125,492, 12.4.18. (Appl. 6248/18.)

A WATERPROOF preparation for roofing or other purposes consists of 2½ galls. of cold tar (or pitch and tar oil) mixed with 11 lb. of cotton or wool fibre or hair, or of 156 lb. of animal or vegetable fibre, 36 lb. of silica, 40 lb. of magnesium chloride, 40 galls. of gas tar or gas-tar pitch, and 10 galls. of gas-tar oil.—A. B. S.

Cement mixtures; Process of treating —— for the recovery of potassium compounds. H. Blumenberg, jun., Oro Grande, Cal. U.S. Pat. 1,296,464, 4.3.19. Appl., 15.3.18.

A SMALL percentage of a nitrate, *e.g.*, 1—2% of sodium nitrate, is added to cement mix so as to increase the volatility of the potassium compounds in the latter.—A. B. S.

Portland cement; Process of treating —— and the resulting product. H. Blumenberg, jun., Oro Grande, Cal. U.S. Pat., 1,296,467, 4.3.19. Appl., 31.5.18.

HYDRAULIC cement is treated with an ammonium salt the acid radical of which is capable of forming insoluble compounds with the magnesium, aluminium, and iron bases present.

Toxic cement. H. Blumenberg, jun., Oro Grande, Cal. U.S. Pat. 1,296,468, 4.3.19. Appl., 31.5.18.

A MIXTURE of hydraulic cement and not more than ½% of copper sulphate.—A. B. S.

Concrete and similar cementitious materials; Method of and apparatus for mixing ——. H. P. Brown, New York. U.S. Pats. (A) 1,297,080 and (B) 1,297,081, 11.3.19. Appl., 24.12.14.

(A) SUPERHEATED steam is supplied to the concrete ingredients during mixing, which is effected under

pressure. (B) The concrete is mixed under the pressure of superheated steam, then discharged from the mixer, granulated by means of a steam blast independent of the pressure applied during mixing, and the granules impelled away from the mass.—A. B. S.

Cement making process [and production of magnesium and ferrosilicon]. W. McA. Johnson, Hartford, Conn. U.S. Pat. 1,297,297, 11.3.19. Appl., 12.2.15.

An acid mineral and a basic mineral, *e.g.*, lime and aluminium silicate (shale), are heated separately to incandescence, then brought together in an electric furnace, and heated further, whereby they form a fusible slag which is converted into "wool" by blowing and the "wool" ground to form a pulverulent cementitious material. If the minerals contain magnesium, the latter is volatilised and recovered as a by-product, whilst if iron and silicon are also present, fused ferrosilicon is also obtained.—A. B. S.

Cement-fibre board. J. E. Lappen, Winona, Minn. U.S. Pat. 1,297,480, 18.3.19. Appl., 5.8.16.

Cement-fibre board is made by disintegrating mineral fibrous material in water, collecting the fibres in the form of a wet film, sprinkling the surface of this film with cement, folding the film upon itself until sufficiently thick, and applying pressure.—A. B. S.

Water-resisting admixtures for hydraulic cement; Preparation of ——. Reckord-Zement-Industrie G.m.b.H., Berlin. Ger. Pat. 308,874, 20.10.16.

Bituminous earths such as aluminiferous ozokerite, asphalt, bituminous shale or brown coal are subjected to slow destructive distillation, the residue is strongly ignited, and the porous material thus obtained is impregnated with the oily or tarry distillate, whereby a dry, stable, and readily pulverisable product is formed which is ground up with the cement. Lime may be added to the material before or after distillation, and if desired ignition may follow distillation as a direct continuation of the process.—G. F. M.

Cement etc.; Emulsion for waterproofing ——. Rekord-Zement-Industrie Ges., Berlin. Ger. Pat. 310,893, 20.10.15.

An emulsion of lime and shale oil or a mixture of bituminous matter and cement clinker, ground cement, or lime is added to cement, cement-mortar, lime, or lime mortar as a waterproofing agent. —A. B. S.

Bituminous composition [cement]. R. Illemann, Glasgow. U.S. Pat. 1,296,083, 4.3.19. Appl., 10.10.17.

See Eng. Pat. 105,202 of 1916; this J., 1917, 552.

Wood; Process for treating ——. W. Powell, London, Assignor to Powell Wood Process (North America), Inc., New York. U.S. Pat. 1,297,491, 18.3.19. Appl., 17.6.16.

See Eng. Pat. 9044 of 1915; this J., 1916, 842.

Potassium salts from cement-kiln gases. **U.S. Pats. 1,296,460—3, 1,296,465—6, and 1,297,638—9. *See* VII.**

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron-carbon diagram; The liquidus in the ——. G. Cesaro. Iron and Steel Inst., May, 1919. [Advance copy.] 9 pages.

The author has plotted the temperatures at which molten iron-carbon alloys commence to solidify, as determined by Carpenter and Keeling (this J., 1904, 608), against the number of carbon atoms contained in a unit of 100 atoms of the alloy, and also against the number of mols. of cementite per 100 mols. of alloy, assuming the molecule of iron to contain two atoms. Whether Raoult's law or a more general formula due to Le Chatelier and Schroeder be adopted, the intermediate temperatures calculated from Carpenter and Keeling's extreme determinations agree better with the measured temperatures on the assumption that molten iron-carbon alloys are composed of iron and cementite and not of iron and carbon. The best agreement is obtained by the assumption of a rectilinear variation, which is afforded by the Fe_3C—Fe_2 hypothesis. It is impossible to obtain a rectilinear variation for the system Fe_3C—Fe_m, if m has any other value than 2, and from the hypothesis that the alloys are composed of the system Fe_m—C, it is impossible to obtain rectilinear variation with any value of m.—T. H. Bu.

Iron-carbon alloys; Graphitisation in ——. K. Tawara and G. Asahara. Iron and Steel Inst., May, 1919. [Advance copy.] 16 pages.

A series of alloys was prepared from charcoal iron containing practically negligible amounts of impurities, the carbon content varying between 2·95 and 3·92%, and the experiments were so devised that only one factor differed in each case. As the material used contained practically nothing but iron and carbon, graphitisation was almost entirely due to the slow cooling of the metal at or near its solidification point. It was found that the amount of carbon when ranging from 2 to 4% is not a decisive factor in graphitisation. It causes no change in the species of microscopical constituents but influences the quantity of graphite produced in that, under favourable conditions, the excess of carbon above the limit of saturation of primary austenite (2%) separates as graphite. The maximum temperature reached has apparently no effect on graphitisation. Graphitisation took place when the temperature of the mould was 1000° C., but 1100° C. was found to be the most favourable temperature. It did not take place at 900° C., even when this was maintained for 7½ hours. When the mould was kept at 1125°—1128° C. for 1½ hours the eutectic being unable to solidify could not deposit graphite, and the metal quenched in water contained no graphite. The time of annealing, or rate of cooling of the mass in the earlier stages, does not have any appreciable effect on graphitisation. It is concluded that graphitisation takes place at a certain early stage of cooling covering some length of time (at least 1½ hours); after this the different conditions corresponding to slow cooling and to water quenching cause simply a change in the method of decomposition of the primary austenite. Quenching after a shorter time results in partial graphitisation. The theory of graphitisation put forward by the authors is that in molten alloys the cementite is probably dissociated to a slight extent, with formation of atoms of free carbon. These may serve as nuclei for the crystallisation of graphite. The dissociated atoms of carbon being thus deposited from the molten alloy further dissociation of cementite occurs in order to re-establish equilibrium and this process

is repeated as the graphite crystals are developed. The mechanism of the development of graphite flakes is also discussed in the paper.—T. H. Bu.

Iron; Carburisation of —— at low temperatures. A. McCance. Iron and Steel Inst., May, 1919. [Advance copy.] 5 pages.

An insight into the reactions taking place during the carburisation of iron at low temperatures can be obtained from consideration of the variation of the equilibrium conditions with temperature. Pure carbon monoxide in contact with iron is decomposed according to the equation, $2CO = CO_2 + C$. The composition of the gas at atmospheric pressure in equilibrium with carbon has been calculated and a curve drawn showing the percentage of carbon dioxide plotted against temperature. As the gas in contact with the iron undergoes slow enrichment with carbon dioxide other reactions are possible. The reactions are: $3Fe + 2CO = Fe_3C + CO_2$, $Fe + CO_2 = FeO + CO$, and $3FeO + 5CO = Fe_3C + 4CO_2$, and on the diagram the equilibrium percentages of carbon dioxide at different temperatures are plotted as before for each of these reactions. From the curves it is found that only in the early stages of the process can cementite be formed from iron direct through the action of pure carbon monoxide, and above 550° C., ferrous oxide is more easily converted than pure iron into carbide. In applying the calculations to blast-furnace gases allowance must be made for the presence of air which assures the presence of ferrous oxide, whilst the nitrogen lowers the partial pressure of the gaseous carbon oxides and thus the equilibrium value of the carbon dioxide is reduced.—T. H. Bu.

Steel metallurgy; Modern —— C. H. F. Bagley. Iron and Steel Inst., May, 1919. [Advance copy.] 49 pages.

The author describes a simple method for calculating the consumption of materials and the technical results in the manufacture of steel from any kind of pig iron and by any standard process. The character and the formation of slags are discussed and a table is given showing the percentage composition and the proportion of acid and basic constituents of normal steelworks tapping slags for what is considered good practice. Starting from typical pig irons of given analysis, the method consists in first calculating an oxidation table for the impurities in the raw pig iron. The products of oxidation pass into the slag and from the total weight of acidic oxides present the average production of slag can be determined by reference to a schedule of tapping slags. The burnt lime required is also found from the average production of slag. Having calculated the total production of slag its composition is stated in percentages of constituent oxides and its value as a fertiliser otherwise determined. An approximate balance sheet may then be drawn up, though some of the losses have to be assumed from known results in actual practice; a table of mechanical losses in the various processes is given. The processes are divided into "hot metal," "scrap and cold pig," and "duplex," and a detailed calculation is made for each process, using an appropriate iron, and the results, together with those for other possible irons, are tabulated for comparison. A final table showing a general summary of results is added. The effect of slag production on the output of open-hearth furnaces is discussed. If the normal slag production be reduced by 1% the steel production will be increased about 2½%; excessive slag production is therefore a serious hindrance to output and economy. In basic open-hearth furnaces, the production of slag per ton of steel is large and the slag should be removed as early as possible. The existing processes are inefficient or expensive in this respect and the author has patented an improved process for removing slag from fixed furnaces by blowing it off (Eng. Pat. 116,663; this J., 1918, 472 A). In routine work the calculations can be translated into operating orders, and are useful for working the furnace or converter. Another use of the method is in its application to the problems of phosphate slag production. The conditions for higher grade slags and maximum output of steel are shown not to be opposed to each other, if the silicon of the iron and also extraneous silica are kept low and the content of total acidic oxides not below the normal 28% standard. The paper concludes with a consideration of the general quality of steel, the author holding that with proper working conditions as good a yield of sound steel from the ingot can be realised by one process as another.—T. H. Bu.

[*Steel furnace;*] *The acid hearth —— and slag.* J. H. Whiteley and A. F. Hallimond. Iron and Steel Inst., May, 1919. [Advance copy.] 44 pages.

The acid open-hearth slags described consist principally of FeO, MnO, and SiO_2, with relatively small quantities of other oxides. When the slag is slowly cooled, tridymite, cristobalite, fayalite, and rhodonite are present. The silica minerals solidify first, and are followed by fayalite or rhodonite as determined by the ratio of iron oxide to manganese oxide. Acid slags contain free tridymite after being heated at 1300° C. for 18 hours, and resemble the furnace hearth in structure. Large quantities of slag were found in the hearth, the silica content having been reduced from 96% originally to 67%. The upper portion consists chiefly of interlacing plates of tridymite with interstitial slag and the stability of the hearth depends on the rigidity of the tridymite network and the viscosity of the enclosed fluid slag. Oxidation of the impurities in the molten metal is effected partly by the addition of ore, and partly by the oxygen content of the gases in the furnace. This occurs to some extent by direct oxidation of the surface of globules of metal continually thrown up into the slag during the "boil," and also by the catalytic action of ferric oxide in the slag. Throughout the "boiling" period the content of ferric oxide remains very low (0·3%), but increases up to 3% with the diminution of the reducing action of the metal in the finishing period. It is estimated that one half of the carbon is removed by the ore addition, one quarter by gas oxidation through the slag, and one quarter by direct contact between metal and gas. The bases present are regulated by the viscosity of the slag. The effect of lime additions is to lower the ferric oxide content, and this action is probably of great value during "dead melting" in that the metal is protected from oxidation by the inhibition of the catalytic oxidation due to ferric oxide.—C. A. K.

Wrought iron and mild steel; The refining process in the manufacture of . B. Osann. Chem.-Zeit., 1919, **43**, 105.

In the refining of wrought iron ferrous oxide present in the slag is not reduced, but reduction occurs at the higher temperature attained in the refining of mild steel by the Bessemer or open-hearth process. Hence, if iron ore or hammer scale be added to the charge of a puddling furnace it passes into the slag, but the slag becomes inactive so soon as the iron oxide is reduced to the ferrous state. If the charge be then transferred to an open-hearth furnace the slag again acts as an oxidising agent, and at the highest temperature attained nearly all the ferrous oxide is reduced to metallic iron. In

all refining processes, even in the Bessemer converter, oxidation of the impurities is effected by means of iron-oxygen compounds and never by gaseous oxygen. In mild steel production ferrous oxide is dissolved by the molten iron and oxidises the impurities, and at the end of the process greater or smaller quantities of oxide are always present in the iron, so that the addition of deoxidising agents is necessary. In the case of wrought iron, on the other hand, oxidation of the impurities is effected entirely by the slag, and iron crystals separate successively from the crude iron bath (mother liquor), till the latter has entirely disappeared. Wrought iron consequently never contains oxide apart from that due to slag inclusions.

Electric steel refining furnaces. J. Bibby. Trans. Faraday Soc., 1919, **14**, 79–89.

THE general metallurgical requirements in designing electric furnaces for refining steel are stated to be: (1) The shape of the hearth must be hemispherical or elliptical; (2) the openings through the roof and sides must be as few as possible, whilst sufficient for repairs, fettling, and survey of the hearth; (3) the roofs and walls must be protected against high temperature rays, and the heat must be directly absorbed by the metal; (4) a mechanical circulation of the metal in the vertical plane is necessary for maintaining a uniform temperature, facilitating the chemical reactions, and aiding the absorption of added alloys; (5) the furnace must be capable of raising the bath to any desired temperature and maintaining it; (6) it should be possible to have an oxidising, neutral, or reducing atmosphere at will; (7) the amount of refractories should be regulated to that necessary for retaining the heat. For steel making, the arc resistance furnace is stated to be better than the induction type. The various types of arc furnace are described, *e.g.*, the Héroult, Girod, and Electro-Metals furnaces, and preference is given to the last-named form, as it more completely satisfies the conditions in (4) above. The ideal furnace is stated to be a two-phase one, with one phase connected to each upper electrode, and the third lower electrode forming a common return. A three-phase current may be transformed to a balanced two-phase system by using a Scott transformer. A description is given of a 20-ton two-phase Electro-Metals furnace and the mode of operating it in producing steel. For steel making it is probable that larger furnaces with four upper electrodes will be used, and the four-phase system developed for the large Electro-Metals furnaces meets the electrical and metallurgical conditions.—B. N.

Steel; "Flakes" in ——. H. Styri. Chem. and Met. Eng., 1919, **20**, 342–351.

ORDINARY chemical analysis of the metal does not indicate whether flakes will occur or not. The presence of "flakiness" in nickel-steels which had been subjected to different heat-treatments shows that different kinds of micro-structure (and therefore of heat-treatment) have no influence on the actual occurrence of "flakes." The non-occurrence of nickel silicate inclusions is confirmed, and the examination of a number of nickel-steels showed a general connection between the number of slag inclusions and the elongation and contraction, though the elastic limit and tensile strength were not affected. In all the good test-bars examined, either no slag particles, or only very small rounded particles were found. Some of the worst fractures can hardly be explained by the small number of slag inclusions and the cracking, or incipient cracking of the steel, due to unequal contraction during cooling or to expansion during re-heating, is apparently the cause. A similar conclusion is arrived at in the case of carbon steels in which "flakiness" is less pronounced. (See also this J., 1919, 289 A.) —C. A. K.

[*Steel;*] *Macro-etching and macro-printing* [*of* ——]. J. C. W. Humfrey. Iron and Steel Inst., May, 1919. [Advance copy.] 14 pages.

A KNOWLEDGE of the macro-structure of steel affords information of changes occurring in the ingot mould and during forging operations. In a cast metal the macro structure is essentially due to segregation during solidification. The macro-structure of a metal may be observed by either sulphur printing or etching. Dilute nitric acid is particularly useful in revealing fine flaws or cracks, and carbon segregates show more distinctly than those of phosphorus or sulphur. Heyn's reagent (12% aqueous solution of copper ammonium chloride) is not sufficiently delicate to reveal minor segregations of phosphorus. The author uses a solution prepared by the addition of hydrochloric acid to Heyn's reagent, the most satisfactory solution for general use containing 120 grms. of copper-ammonium chloride and 50 c.c. of concentrated hydrochloric acid per litre of water. The result of this etching is to produce a marked relief effect on the surface of the specimen, the portions which solidified first being attacked to a greater extent than the more impure metal. The deposit of copper is made non-adherent by starting the etching with the neutral reagent until a thin covering of flocculent deposit is formed, and the acidity of the attacking reagent is then gradually increased to the maximum. After the deposited copper is wiped away, and the surface lightly polished, the relief portions show in strong contrast. Macro-etchings produced in this way may be printed directly by applying a film of printers' ink to the surface and subjecting it to pressure on a smooth paper. Satisfactory prints of the longitudinal section of ingots have been obtained. Phosphorus is believed to be the principal impurity which determines the dendritic structure of steels and it is suggested that the portion of the etching in relief might be scraped away, the specimen re-etched and re-scraped, until sufficient material was obtained for analysis. One analysis by this method showed 0·016% P in the relief portion of the etching as compared with 0·040% P in the average drillings.—C. A. K.

High-speed steel; Manufacture and working of ——. J. H. Andrew and G. W. Green. Iron and Steel Inst., May, 1919. [Advance copy.] 32 pages.

NORMAL forging operations to which high-speed steel is subjected were accompanied by an examination of the metal at the different stages, beginning with an ingot 6 in. square. Little difference in micro-structure is shown whether reduction is effected by hammering or rolling, but the extent of reduction effected between the cast state and the finished bar is important. A reduction below 88% of a 6 in. square ingot will leave distorted carbide laminations of "massive" form, which do not enter solution during prolonged soaking at a temperature between 1150° C. and 1200° C. The hardness (Brinell) of the metal increases progressively with the decrease in cross-section during cogging operations. Annealing is effected best by raising the steel to a temperature (900° C.) slightly above the critical point, and allowing it to cool slowly to 700° C. Rapid cooling may then be allowed. The temperature limits for efficient hardening are within 10° C., and the process should be carried out between 1310° C. and 1320° C., the minimum time consistent with adequate soaking being allowed.—C. A. K.

***Ferro-alloys and alloy steels; Manufacture and uses of* ——.** Advisory Council of Sci. and Ind., Australia. Bull. No. 9, 1918. 46 pages.

A COMPILATION of modern knowledge of ferro-alloys and their manufacture, together with an account of the occurrence of the ores concerned in Australia. The production of ferro-chromium and ferro-tungsten from native material, in an experimental furnace of the Héroult type is described in an appendix. During smelting of the former an excess of 25% of carbon over the theoretical was necessary to give effective reduction of the chromium and the smelted metal gave on analysis: 63·6% Cr, 26·4% Fe, and 10% C. The carbon content was reduced to 2·8% by a refining process. Reduction of tungsten ore, mixed with iron oxide and carbon, in an electric furnace having a bottom electrode proved the best method of obtaining crude ferro-tungsten, and the impure alloy was afterwards refined in a Héroult furnace with the addition of iron oxide, lime, and fluorspar.—C. A. K.

Oxygen in iron and steel; Critical study of the Ledebur method for determining ——. J. R. Cain and E. Pettijohn. U.S. Bureau of Standards, Technol. Paper No. 118, 1919. 33 pages.

LEDEBUR'S method of determining oxygen in iron and steel by heating in a current of hydrogen is subject to many errors, and the precautions required are so great that it cannot be regarded as of practical value. The principal sources of error are impurities in the hydrogen used; too low a temperature, though there is no advantage in working up to the limits of a porcelain tube; failure to remove completely air from the combustion tube; moisture condensed on the sample; and the rate of passage of the hydrogen. Unless the current of hydrogen is maintained at not less than 60 c.c. per min., part of the iron oxide is reduced by carbon in the metal with the formation of carbon monoxide and dioxide. The greatest possibility for error lies in the inclusion of localised oxide spots or slag lines in the sample. The maximum thickness of drillings is given as 0·15 mm., and they should be produced under a protective layer of oil or other suitable liquid in order to avoid surface oxidation during the cutting. The method determines all the oxygen present in steel as FeO, Ni_2O, and WO_3, or in the higher oxides of these metals, in oxides of manganese higher than MnO, and in oxides of titanium and vanadium higher than Ti_2O_3 and V_2O_3, but none of the oxygen present in SiO_2, Al_2O_3, or Cr_2O_3. The reduction of carbon monoxide and dioxide by hydrogen also occurs to a variable extent under the conditions of the determination. If the oxides mentioned occur in combination as silicates, as is most probable in steels, reduction by hydrogen does not take place. Oxygen determinations by this method show no distinguishing features for steels produced by different methods, or for steels which have been deoxidised with a variety of deoxidisers. (See also Pickard, this J., 1913, 659.)—C. A. K.

Gold; Volatilisation of ——. T. K. Rose. Inst. Min. and Met., Mar. 20, 1919. [Advance copy.]

TRUE volatilisation of gold is negligible at the temperatures of industrial furnaces (1000°—1300° C.) and cannot be measured with accuracy. The nature of the atmosphere in the furnace, if it remains unchanged, has no effect on volatilisation. Gold, particularly when alloyed with copper or silver, absorbs considerable quantities of gases when molten, and if the furnace atmosphere changes to oxidising conditions when the molten alloy contains a reducing gas, combination between the gases results, and showers of metallic globules are thrown up, and carried away in the gaseous current. The action ceases as soon as the metal becomes saturated with oxygen, but is set up again if reducing conditions then arise in the furnace atmosphere. The loss by spirting of globules is reduced if the metal is covered with a layer of slag.

—C. A. K.

Copper ores; Ammonia leaching of ——. L. Eddy. Chem. and Met. Eng., 1919, **20**, 328—334.

A DESCRIPTION of the process as carried out at Kennecott, Alaska, on an ore containing copper mostly as chalcocite and covellite and also oxidised copper as malachite, together with a limestone gangue. No native metal is present. Treatment of the ore on concentrating tables gives a good recovery of the heavy sulphides, but 40% of the malachite passes into the tailings. Before leaching with ammonia, the mill tailings are de-slimed, as material which will pass a sieve with 200 meshes per linear inch causes the ore to set in the tanks. The ore is allowed to drain thoroughly before lixiviation in order to avoid dilution and subsequent evaporation. Ammonia solution is then admitted through the bottom of the tank and is allowed to remain in contact with the ore for 12 hours without agitation. Further extraction of the ore by a circulating stream of weak copper-ammonia solution follows, and the ore is finally washed, and heated by means of a steam jet, ammonia being recovered from the vapours. The leaching tanks consist of cylindrical riveted steel chambers with domed tops. Leakage at the seams gives considerable trouble and electrically welded tanks are suggested to overcome the difficulty. All fittings are of iron and under certain conditions, occurring chiefly in the pipe lines, the ammonia solution has a deleterious effect on this metal, and copper is deposited. The hard copper oxide scale which tends to form on the interior surfaces of the evaporator has been a difficulty in evaporator construction and operation, and the design at present in use is an upright cylindrical chamber with a steeply inclined conical lower portion. Horizontal and slightly inclined surfaces are thereby avoided. Two of these evaporating vessels are used in series. Both are half-filled with strong ammonia-copper solution and steam is admitted into one by means of a pipe extending to the bottom of the cone. Vapours from the first evaporator are passed into the second and forward through a condensing system and an ammonia absorber. Carbon dioxide is evolved below the boiling point, and later ammonia is expelled, during which period the liquor shows a strong tendency to foam. Green copper carbonate deposits after 5 to 6 hours' boiling and is converted into the black oxide by raising the pressure in the chamber to 10 lb. or over. When precipitation is completed the contents of the first evaporator are filtered, and steam is admitted directly to the second, the vapours being passed to the first chamber, which has been charged with a fresh quantity of liquor. The filtrate from the evaporators contains sufficient dissolved copper quickly to destroy iron valves and piping, and the most satisfactory method of treatment is to apply steam pressure to the filter tanks so as to force the liquor through the filter cloths and away to the settling tanks, in which it may be treated with scrap iron.—C. A. K.

Copper leaching. P. R. Middleton. Chem. Eng. and Min. Rev., Australia, 1919, **11**, 133.

THE difficulty experienced in smelting flotation concentrates has caused a reaction in favour of hydrometallurgical treatment of ores. Crushing and grinding should be sufficiently fine to separate the mineral particles from gangue, and it is rarely necessary to grind Australian ores finer than to pass a 40-mesh sieve. Chalcopyrite is converted to

cuprous sulphide, ferrous and copper sulphates, and sulphur dioxide at temperatures below 590° C., and below 650° C., cuprous sulphide and ferrous sulphate interact with the formation of copper sulphate and ferric oxide. At temperatures above 650° C., cuprous sulphide is converted into copper oxide. The calcined ore is leached with an acid solution in a series of tanks provided with filter bottoms, or in Dorr agitators and thickeners arranged on the counter-current decantation system. The copper-bearing solution produced may be treated either with scrap iron or by electrolysis. In the latter process, insoluble anodes of lead, graphitised carbon, or magnetite are employed, and the acid solution produced may be utilised for the extraction of a fresh quantity of calcined ore. A current density of 8–10 amps. per sq. ft. is generally applied, and for satisfactory working the electrolyte must contain above 1·5% of copper. The presence of arsenic in the electrolyte reduces the purity of the deposited copper.—C. A. K.

Aluminium alloys for aeroplane engines. F. C. Lea. Royal Aeronautical Soc., Apr., 1919. [Advance proof.] 15 pages.

ALUMINIUM alloys are used for aeroplane cylinders and pistons in order to reduce the weight and at the same time retain the rigidity of a thick casting. The cooling effect may be increased, as aluminium has a conductivity coefficient more than three times that of cast iron. An alloy, known as L5, containing 2½–3% Cu and 12–14% Zn can be cast reasonably well, though cracking during machining is a source of trouble. Steel liners are usually employed as aluminium alloys have apparently a high coefficient of friction, and sufficient negative clearance should be allowed to prevent the heating of the alloy above 300° C., and to avoid cracking by expansion of the liner. A number of types of aluminium pistons showed a small growth due to heating and in certain cases "burning" of the piston crown occurred; possibly the softened eutectic was exuded from between the purer crystals. The hardness (Brinell) of the alloys (at 15° C.) becomes greater as the copper content increases, irrespective of other metals present, and the difference in hardness diminishes with increasing temperature until at 400° C. the Brinell hardness number is practically independent of the copper content. No definite connection was found between the results obtained by the Wöhler repetition test and the elastic properties of the alloys. Aluminium castings are porous to fluids and are treated with a hot alkaline solution of sodium silicate (water-glass) under pressure to seal the pores. The tensile strength at ordinary temperatures is not the chief physical property required in an alloy and more work is needed to determine the best resisting alloy at the higher temperatures to which it is subjected in use.—C. A. K.

Lead sulphide and the products of the roasting process; Chemical equilibrium between ——. R. Schenck and A. Albers. Z. anorg. Chem., 1919, **105**, 145–166.

THE reaction between lead sulphide and lead sulphate occurring in the roasting process is generally represented by the equations: (1) $PbSO_4+PbS=2Pb+2SO_2$; (2) $2PbO+PbS=3Pb+SO_2$. In reality, however, the reactions are much more complicated, as the existence of three basic lead sulphates must be recognised: $PbSO_4.PbO$; $PbSO_4.2PbO$; and $PbSO_4.3PbO$. Thus, according to the phase rule, seven solid phases are possible and there are thirteen possible monovariant systems, each containing three solid phases in equilibrium with the vapour phase, SO_2. The authors have investigated the conditions of existence of nine of these systems between 500° and 820° C., and have plotted the temperature-pressure curves on an equilibrium diagram. Only those systems in which lead sulphide is present as a solid phase could be realised experimentally; other systems are apparently very unstable. Owing to the volatility of lead sulphide, the vapour phase was always saturated with PbS, which was often deposited in the apparatus in well-formed crystals. The vapour pressure of lead sulphide was found to increase from 2 to 17 mm. between 850° and 1000° C. Lead sulphide distils readily in a vacuum at 900° C. Since all silicate-containing materials are attacked by lead compounds, the experiments were carried out in containers of calcium phosphate made by calcining bones cut to the desired shape.—E. H. R.

Lead; Separation of —— in the analysis of metallic calcium and "lurgie" metal. J. König. Chem.-Zeit., 1919, **43**, 135.

Two grms. of the metal is dissolved in nitric acid (sp. gr. 1·2), the solution boiled to expel some of the acid, then diluted with 100 c.c. of warm water, neutralised with ammonia, and treated with 300 c.c. of bromine-water; the precipitated lead hydroxide dissolves. The solution is then rendered ammoniacal, cooled, diluted to 500 c.c., and filtered, the first portion of the filtrate being rejected; 250 c.c. of the clear filtrate is boiled and the calcium precipitated as oxalate. In the case of "lurgie" metal, the filtrate must be treated with 20 c.c. of sulphuric acid (sp. gr. 1·5), boiled for 15 mins., the barium sulphate collected on a filter, and the calcium then determined in the filtrate.—W. P. S.

Cinnabar ores; Working of —— at Monte Amiata. K. Oschatz. Glückauf, 1918, **54**, 513–519, 533–539, 545–553, 566–570, 580–584, 595–598, 604–611, 617–625, 633–639. Chem. Zentr., 1919, **90**, II., 252.

THE high percentage of moisture, averaging 15%, in the clayey portions of Monte Amiata cinnabar ores necessitates a preliminary drying, for which purpose drying machines of the drum type are more suitable than the older shaft or tunnel dryers. The danger of poisoning owing to escaping mercury vapour during the roasting of the ores is minimised as far as possible by central ventilation and also by regular medical supervision of the workers, by vapour baths etc. In the case of fine ores roasting in rotary tube furnaces has proved perfectly satisfactory both from the point of view of health and economic working.—G. F. M.

Magnesium; Reaction between sodium chloride solution and metallic ——. W. Hughes. Chem. Soc. Trans., 1919, **115**, 272–277.

THE reaction between magnesium and water is very slow at the ordinary temperature but is greatly accelerated in presence of neutral and alkaline salts, such as sodium chloride, sodium bicarbonate, sodium carbonate, and magnesium sulphate. Experiments with sodium chloride solutions at 25° C. have shown that the initial rate at which hydrogen is evolved depends on the concentration of the dissolved salt. The reaction velocity has a maximum value for a solution containing 32 mols. H_2O per mol. NaCl. This maximum cannot be satisfactorily interpreted in terms of the physical properties of sodium chloride solutions, and is regarded as evidence in favour of the specific nature of the catalytic action of the electrolyte present.—H. M. D.

Pulverised coal. Harvey. *See* IIA.

Refractories for zinc industry. Babcock. *See* VIII.

Electric furnace methods. Etchells. *See* XI.

PATENTS.

Steel; Manufacture of ——. C. Dear, and The Miris Steel Co., Ltd., Sheffield. Eng. Pats. (A) 124,463 and (B) 124,465, 12.1.16. (Appls. 531 and 533/16.)

(A) STEEL is immersed hot in a solution containing nitric acid, sulphuric or sulphurous acid, and an ammonium compound, *e.g.*, ammonium chloride, preferably with the addition of ammonia. The proportions of the materials are: 3 cwt. of nitric acid, 2 cwt. of sulphuric or sulphurous acid, 2½ cwt. of ammonium chloride, and 2¼ cwt. of strongest liquid ammonia per 1000 gallons of water. (B) Freshly cast ingots, as soon as they can be stripped from the mould and while the interior of the ingot is still in a molten condition, are immersed in water or in a solution which will generate hydrogen on the surface of the ingot. The ingot remains submerged sufficiently long to prevent recalescence of the steel when withdrawn.—C. A. K.

Steel; Manufacture of ——. C. Dear, and The Miris Steel Co., Ltd., Sheffield. Eng. Pat. 124,464. (Appls. 532, 12.1.16 and 11,426, 12.8.16.)

AN appliance for the convenient carrying out of the process described in Eng Pat. 124,465 (see preceding abstract) consists of a tank provided with a grating on which an ingot may rest. Two reservoirs, at such a height that liquids can gravitate from the first to the second and then to the tank, contain the required solution, which can be pumped from the tank back to the reservoirs for further use.—C. A. K.

Iron and steel; Manufacture of ——. S. Whyte, Redhill. Eng. Pat. 124,816, 19.4.16. (Appl. 5755/16.)

SILICON is partially or completely eliminated from high-silicon cast iron by melting the metal under a layer of borax and adding carbon, preferably as graphite, to the molten iron. A current of air may be forced through the bath in order to aid the process.—C. A. K

Manganese steel; Manufacture of ——. R. A Hadfield, Westminster. Eng. Pat. 124,817. (Appls. 5765, 19.4.16 and 8803, 22.6.16.)

A TOUGHER steel is produced by increasing the silicon content of manganese steel to from 0·6% to 2·5%; other constituents are 10 to 17% Mn, and up to 2% C. Silicon may be partly or completely replaced by aluminium, and additions of chromium, nickel, cobalt, vanadium, tungsten, and titanium may also be made in order to vary the properties of the metal. —C. A. K.

Manganese steel; Manufacture of ——. R. A. Hadfield, Westminster. Eng. Pat. 125,157, 19.6.16. (Appl. 8655/16.)

A MANGANESE steel or iron alloy of resistant quality contains 10—17% Mn, 1—4% Cu, up to 2% C, and up to 2% Si. The alloy may be toughened by heating it to 1050° C. or above, and quenching in water. —C. A. K.

Steel or other metal wire; Method of hardening and tempering ——. H. Alexander and W. T. Vint, Leeds, and A. Imbery, Halifax. Eng. Pat. 125,180, 5.3.18. (Appl. 3825/18.)

WIRE is caused to travel, under oil, between two pairs of rollers, the distance between the first and second pair being adjustable. Electrical conductors are attached to the rolls, and the circuit is completed by the portion of the travelling wire between the two pairs of rollers. Heating of the wire is accomplished by this means out of contact with air, and the length of the oil bath is such as to allow cooling to take place without oxidation of the surface of the wire. The temperature of the bath may be kept within required limits by circulation of the oil.—C. A. K.

Steel; Treating for aircraft ——. D. J. Mooney, London. Eng. Pat. 125,541, 8.7.18. (Appl. 11,148/18.)

RIGIDITY is imparted to thin high-grade steel strip by passing the heated metal between revolving water cooled dies or rollers. By this means the strip is suitably shaped, and at the same time is hardened to the necessary degree. Subsequent heat-treatment, which promotes distortion, is unnecessary. C. A. K.

Steel smelting furnace. W. G. Perkins, San Francisco, Cal., and W. H. Fitch, Pittsburgh, Pa. U.S. Pat. 1,295,586, 25.2.19. Appl., 22.12.17. Renewed 21.1.19.

HOT gases from a steel furnace pass through exit ports at the end of the furnace into a chamber in which expansion of the gases and precipitation of dust take place, and then through the regenerator to the chimney. Slag pockets are provided at each end of the furnace. C. A. K.

Iron oxides; Method for reducing ——. H. W. Lash, San Francisco, Cal. U.S. Pat. 1,296,973, 11.3.19. Appl., 4.9.17.

A MIXTURE of iron oxide and carbonaceous material in a finely divided condition is placed within a bundle of scrap ferrous material and the whole heated.—T. H. B

Iron articles; Method of removing rust from ——. Badische Anilin u. Soda Fabrik, Ludwigshafen. Ger. Pat. 310,261, 13.11.17.

RUSTY articles are treated with dilute acids (hydroferrocyanic and hydroferricyanic acids excepted) and simultaneously, or later, with an oil- or fat-emulsion. They are thus quickly freed from rust and left with a slight coating of oil which protects them against subsequent rusting.—T. St.

Iron; Manufacture of highly carburised spongy ——. H. Poetter, Düsseldorf. Ger. Pat. 310,559, 12.3.16.

A MIXTURE of powdered coke and pyrolusite is formed into balls and roasted in a furnace, whereby the surfaces of the balls become mechanically strong and porous, and the interiors become spongy. Scrap steel is then fed into the furnace, and melting, runs down and is absorbed by the balls. The resulting highly carburised spongy iron may be used in place of pig iron in smelting processes. —T. St.

Ore; Machine for reducing [grinding] ——. R. P. Park, South Melbourne, Australia. Eng. Pat. 124,646, 15.6.18. (Appl. 9882/18.)

A GRINDING pan consists of a revolving grinding ring which drives an inner floating ring supported on guide-rollers, and capable of independent vertical movement. The floating ring drives a series of inclined, tapering, crushing, and grinding rollers, arranged in stepped relation to the grinding ring. Pressure on the rollers may be varied by means of an adjustable spring which passes through a central ballast holder.—C. A. K.

Furnaces; Liquid sealed —— [*for heat-treatment of metals*]. D. C. Bolton, Stoke-on-Trent. Eng. Pat. 125,015, 10.10.18. (Appl. 16,471/18.)

At the entry end of an inclined furnace chamber is a liquid-sealed charging chamber provided with a perforated platform which may be raised to the level of the furnace chamber. Articles to be treated are transferred from the platform to the furnace by means of a plunger, and an auxiliary inclined plunger may be employed to move the articles through the furnace. The exit end of the furnace is extended into a liquid seal.—C. A. K.

Blast furnaces. A. Frankignoul, The Hague, Holland. Eng. Pat. 125,194, 22.3.18. (Appl. 5117/18.)

Iron ore is reduced in a shaft furnace by means of gas generated in a separate gas-producer, and the spongy metal produced is further refined on the hearth by electrical resistance heating. Hot air (800° C.) from the recuperating stove is led to the tuyères of a gas-producer, and the producer gas is conveyed to the tuyères of the blast furnace at a temperature of 1500° C. The exit gases from the blast furnace are utilised in generating electrical power, which is used for the final melting of the metal on the hearth of the furnace.—C. A. K.

Furnaces [*for heating bars, shells, etc.*] A. Smallwood, London. Eng. Pat. 125,224, 12.4.18. (Appl. 6229/18.)

In a furnace adapted to heat the ends of articles which project into a heating chamber through holes in one wall of the chamber, a heat distribution chamber, a hot air flue, a waste gas flue, and (optionally) a regenerator used to transfer heat from the waste gases to the air are combined with the heating chamber in the same mass of brickwork. The heating chamber may be divided into a number of compartments each fed from the heat distribution chamber and hot air flue by ducts which can be individually controlled by dampers and exhausting into the waste gas flue. The heat distribution chamber may be fed from a combined or separate gas producer or fire-box.—B. M. V.

Rotary furnaces [*for carburising and case-hardening*]. W. O. Garbutt, and The British Carbonizing Co., Ltd., Gloucester. Eng. Pat. 125,484, 4.1.18. (Appl. 246/18.)

A substantially horizontal rotating chamber, surrounded by a fixed heating chamber, is permanently closed at the hotter end and is provided inside with helical ribs of comparatively small pitch and low depth. During the heating period the inner chamber is revolved slowly in such a direction that the articles to be treated are moved away from the cooler end of the furnace (which has a removable door) and continuously piled up against the hot closed end of the chamber. For discharging (which it is often desirable to do quickly) the cooler end is opened and the chamber revolved rapidly in the other direction. The furnace is specially suitable for carrying out the carburising and case-hardening process described in Eng. Pat. 114,446 (this J., 1918, 307 A).—B. M. V.

Roasting furnace or kiln; Muffled chamber suitable for use as a ——. *Roasting complex zinc sulphide ores or concentrates, particularly in conjunction with the manufacture of sulphuric acid.* F. W. Harbord, London. Eng. Pats. (A) 124,265 and (B) 124,266, 19.3.19. (Appls. 4853 and 4854/18.)

(A) In a muffle furnace consisting of an inclined, rotary cylinder, within which a central chamber is heated by flues parallel to its length, the chamber is practically triangular in cross-section, the angles being supported by the lining of the cylinder, and is constructed of bricks having a cross-section resembling the axial section of a truncated cone. (B) By means of a blast of air, regulated to oxidise the required proportion of sulphur, the finely divided ore is projected into the upper part of an externally heated, vertical or inclined, muffle chamber; so that the proportion of sulphur expelled in the upper and wider part of the chamber is sufficient to prevent caking of the charge in the lower part where the roasting is completed. Further quantities of air may be injected into the chamber at lower levels; and the ore may be re-treated in the same chamber. Alternatively, the latter may be employed in combination with the rotary muffle chamber described under (A).—W. E. F. P.

Roasting or drying ores; Apparatus for ——. J. Molnar, Goose Bill, Mont. U.S. Pat. 1,296,834, 11.3.19. Appl., 3.10.18.

A roaster contains a number of superimposed platforms in which openings are provided for intercommunication between the sections. Rabble arms attached to a central rotary shaft agitate the material on each "shelf." By means of suitable gearing the rabble arms are caused to swing in a circle whilst rotating.—C. A. K.

Furnaces; Puddling, reheating, and similar metallurgical ——. R. Cliff, Sheffield. Eng. Pat. 125,546, 15.7.18. (Appl. 11,553/18.)

In order to improve the harmful working conditions due to unusual atmospheric conditions, two adjoining sides of a furnace are provided with fire-grates. Flue gases are removed through open-topped vertical flues built against the opposite walls of the furnace and near the charging doors, the flues communicating with a common flue under the furnace. One fire-grate only is used, together with the corresponding flues on the opposite side of the furnace, and the choice of grate is dependent on the direction of the wind prevailing at the time. The other fire-grate and flues are shut off by means of a damper. —C. A. K.

Furnace; Electric metallurgical ——. W. E. Moore, Pittsburgh, Pa. U.S. Pat. 1,293,164, 4.2.19. Appl., 30.7.17.

A chamber or crucible adapted to contain metal, heated by an electric arc, is provided with an extension projecting downwards to form a loop, with a loop-channel therein, U-shaped in longitudinal section, communicating with the main chamber. The extension is in inductive relation to and looped around an electrical heating element, the U-shaped extension being elongated in transverse section, and expanding gradually in an upward direction from a point substantially midway of the heating element.—B. N.

Furnace; Electric —— *and method of melting metals and smelting ores.* P. and I. B. Wright, Seattle, Wash. U.S. Pat. 1,296,896, 11.3.19. Appl., 21.11.17.

A resister is placed in the lower portion of the furnace chamber, and magnetic lines of force, extending longitudinally of the chamber, are produced by electro-magnetic means whereby the downward movement of a magnetisable body of metal and ores is retarded and the metal and ore are held suspended above and spaced from the resister. Alternating currents are passed through the suspended material, from the secondary of a transformer, to produce an electric arc between the suspended material and the resister and thus melt the metal.—B. N.

Open-hearth furnace. M. Hvid, Chicago, Ill. U.S. Pat. 1,296,189, 4.3.19. Appl., 21.10.18.

An open-hearth furnace is provided with a slag-pocket below the hearth, and from the lower part of the slag-pocket, a flue, having a downward inclination, conveys the products of combustion into a shallow dust chamber situated under a checker-work regenerator chamber.—C. A. K.

Muffle for roasting zinc blende and other sulphurous ores. W. Hommel, Zürich. Ger. Pat. 309,651, 9.9.15.

The ore in its passage through the muffle is heated by the hot gases from two furnaces arranged in juxtaposition. The gases from the principal furnace completely surround the ore-chamber, above and below, except for a portion situate about the middle of same. This portion is heated above by the gases from the principal furnace, and below by those from the subsidiary furnace alone. The principal furnace is kept in uniform operation, whereas the subsidiary one is well fired to begin with, the firing being subsequently decreased to suit the ore. The ore is fed at a uniform rate into the muffle, and the mechanical work necessary, as well as the time of roasting, are reduced to a minimum.—J. S. G. T.

Nickel; Extraction of —— from silicate ores. H. W. C. Annable, Egham, and Nickel Concentration, Ltd., London. Eng. Pat. 125,119, 27.5.16. (Appl. 7562/16.)

See U.S. Pat. 1,289,072 of 1918; this J., 1919, 118 A. The ore may be heated with a sulphur-yielding material, such as pyrites, in presence of steam instead of with moist hydrogen sulphide, and a small quantity of sodium or potassium chloride or sea-water is preferably added to the charge. The nickel sulphide may be oxidised to sulphate, any basic nickel sulphate formed being dissolved by means of hydrochloric acid obtained from the furnace gases.

Electrical welding; Methods of and apparatus for ——. T. E. Murray, Brooklyn, U.S.A. Eng. Pat. 120,906, 9.11.18. (Appl. 18,396/18.) Int. Conv., 9.11.17.

One of two bodies to be welded is heated electrically till it is plastic and is then brought in contact with the second body which is not heated. The two bodies are subjected to pressure in a transverse direction, to cause them to unite. An electrically operated device for supporting the bodies and for pressing them together is claimed.—L. L. L.

Metals of unequal fusibility; Process for welding two ——. C. Kohler, Zürich, Switzerland. U.S. Pat. 1,296,815, 11.3.19. Appl., 28.12.17.

A layer of the more fusible metal is welded to the less fusible metal by a reducing flame, which heats the metals to the welding temperature and reduces any oxides, and a body of the more fusible metal is afterwards welded to the layer.—T. H. B.

Casting metals, and apparatus therefor. J. P. Auld and P. M. Tennick, Philadelphia, U.S.A. Eng. Pat. 124,232, 21.12.17. (Appl. 18,986/17.)

Fluid metal is caused to pass over a rotating surface before entering the mould, and is thereby cooled and its fluidity reduced to such a degree that it quickly solidifies in the mould and the effects produced by a slowly solidifying liquid core are avoided. The surface is preferably of funnel shape and may be cooled by air or by water. The cooled stream of metal is delivered from a nozzle, and the rotary motion of the appliance causes it to assume the form of a hollow cone as it enters the mould.—C. A. K.

Ores; Process of recovering values [graphite] from their ——. W. O. Arzinger, Nashville, Tenn. U.S. Pat. 1,282,730, 29.10.18. Appl., 12.6.18.

Finely-divided ore is introduced into a separating vessel through an opening in the dome-shaped cover and is forced downwards into a mixture of oil and water by jets of air under high pressure (over 2 lb., and up to 150—200 lb. per sq. in.). The values float up inside a perforated annular partition in the separating vessel, pass through the perforations, and overflow into an annular launder. Only a very small quantity of oil (1 drop to a gallon of water) is required, and 96% of the graphite present in crude graphite ore can be recovered in the form of a concentrate containing 80–88% of pure graphite.

Ore-separating process. A. J. Moxham, Wilmington, Del. U.S. Pat. 1,294,519, 18.2.19. Appl., 24.2.12.

Solids such as ore particles having different specific gravities are separated by means of a dense liquid upon which a relatively light liquid is superposed, the particles of material being first coated with the latter and then caused to pass beneath the surfaces of the upper and lower layers in succession. The denser liquid has a sp. gr. between those of the solids to be separated, and the lighter liquid is such that the coating is retained by the particles when in the denser liquid. The separated solids are treated with solvents and centrifuged for the recovery of the denser and lighter liquids in succession.—W. E. F. P.

Ores and the like; Process and apparatus for the treatment of — — [by flotation]. G. S. A. Appelqvist and E. O. E. Tydén, Stockholm. Ger. Pat. 309,088, 7.1.17. Addition to Ger. Pat. 277,847 (Eng. Pat. 402 of 1913; this J., 1913, 430).

The ore, the oil or tar, and water are first mixed together and then delivered by a pump in the form of one or several jets against a fixed or movable wall, plate, dish, or the like, which is so situated over the vessel in which the separation is to be effected that the mixture falls into the vessel or can be conducted to it. The particles of oil or tar are thereby beaten up and finely divided in the mixture.—J. F. B.

Ores; Process of treating —— by the flotation method. G. S. A. Appelqvist, Stockholm. Ger. Pat. 309,859, 2.12.16.

The froth which separates in the treatment of ores by the flotation method is treated with an agent such as oil which breaks down the froth and liberates the entangled ore particles.—C. A. M.

Hollow objects of compressed metallic powder; Method of producing ——. C. A. Pfanstiehl, Highland Park, Ill., Assignor to Pfanstiehl Co., Inc., Chicago, Ill. U.S. Pat. 1,286,089, 26.11.18. Appl., 4.11.16.

Dishes or the like for chemical operations prepared by compression of finely divided tungsten or tantalum or their oxides, magnesia, or thoria are non-uniform, and weak and porous at places, because these substances resist flow during compression. To overcome this difficulty a core of copper is embedded in the powder. At the pressures employed, *viz.*, 130—160 tons per sq. in., copper flows sufficiently to equalise the compression pressure but not sufficiently to be forced into the pores of the compressed powder. The copper core can be removed from the finished article by means of nitric acid or the like.

Metals; Electrolytic refining of —. B. Bart, Newark, N.J. U.S. Pat. 1,295,100, 25.2.19. Appl., 12.12.17.

The metal is deposited upon an anode core composed of solid portions and connecting necks, bordering on and alternating with open spaces not greatly smaller in area than the solid portions, until the open spaces are partly closed. The composite body, or grid, thus produced, is used as the anode in the final plating.—B. N.

Electric dissolution and precipitation of metals; Apparatus for the —. E. R. Holden, Los Angeles, Cal. U.S. Pat. 1,295,752, 25.2.19. Appl., 17.4.17.

An apparatus for treating solutions containing metals comprises a cylindrical tank, in which rotates a vertical non-conducting shaft carrying a number of agitator arms arranged in sets one above the other. A cathode is arranged at the bottom of the tank, and a number of independent electric conductors convey current to the sets of agitator arms acting as the anodes, one conductor for each set, with means for independently controlling the E.M.F. of the current delivered to each set of anodes.—B. N.

Oxidation of rolled material [metal]; Method of and means for preventing —. B. P. Hazeltine, Wheeling, W. Va., Assignor to National Tube Co., Pittsburgh, Pa. U.S. Pat. 1,295,986, 4.3.19. Appl., 5.10.16.

Metal from the finishing rolls is allowed to cool in an atmosphere of steam to a temperature below that at which oxidation of the metal occurs.

—C. A. K.

Ores and metals; Process for treating — *in reverberatory furnaces.* G. C. Carson, San Francisco, Cal. U.S. Pat. 1,296,478, 4.3.19. Appl., 4.10.16.

The material to be treated, *e.g.*, copper ores or concentrates containing sulphur and iron, is charged so as to form a sloping embankment along the walls of a furnace, through which tuyères are fixed. The ore is smelted by utilising the heat of oxidation of the contained sulphur, and the liquid copper matte and slag run on to the bed of the furnace on which the matte is "bessemerised."

—C. A. K.

Ores; Treatment of [cupriferous] —. J. Irving, Bisbee, Ariz. U.S. Pat. 1,296,523, 4.3.19. Appl., 27.1.17.

Cupriferous ores, compounds, or products containing precious metals, are subjected to the action of an iron-containing electrolyte from the copper depositing tanks; after removal of the electrolyte, the ore is treated with a solution containing iron and chlorides which is afterwards passed over metallic iron, to reduce iron and precipitate copper and precious metals. The precipitate is removed and used to treat the electrolyte from the ore treatment in order to reduce the iron therein, copper being simultaneously dissolved. Precious metals are recovered from the residual sludge, and copper is deposited electrolytically from the solution.—T. H. B.

Copper from ores; Process of extracting —. N. Evans, Assignor to C. F. Schader and W. H. Heady, Los Angeles, Cal. U.S. Pat. 1,297,670, 18.3.19. Appl., 11.9.18.

Ore containing copper is treated with an aqueous solution of nitre-cake, the proportion of nitre-cake being 50% of the copper content of the ore. The metal is subsequently recovered from the copper sulphate solution.—C. A. K.

Sulphides; Process of desulphurising metal —. A. B. Foster, Washington, D.C., Assignor to Sulphur Syndicate, Ltd., London. U.S. Pat. 1,296,585, 4.3.19. Appl., 1.5.15.

Metal sulphides are roasted to produce gases containing sulphur dioxide, and the gases are made to react with a further quantity of metal sulphides heated to at least 700° C., until the major portion of the sulphur dioxide is reduced.

—T. H. B.

Platinum substitute; Composition of matter for —. F. A. Fahrenwald, Cleveland, Ohio, Assignor to The Rhotanium Co., Cleveland, Ohio. U.S. Pat. 1,296,938, 11.3.19. Appl., 13.7.16.

An alloy for use as a platinum substitute contains palladium (10—40 atoms %) and silver (10—80 atoms %), together with one or more of the other metals of the gold series in the periodic table, having atomic weights between one hundred and two hundred times that of hydrogen.—T. H. B.

Zinc-lead alloy. H. Falkenberg, Weetzen. Ger. Pat. 309,955, 26.8.16. Addition to Ger. Pat. 300,111 (this J., 1919, 292 A).

Claim is made for a zinc-lead alloy as previously described characterised by an iron content of more than 1·6% and less than 3%. With gradually increasing melting temperature and iron content, the crushing strength increases.—T. St.

Aluminium; Method of casting — *in iron or metal moulds.* Metallindustrie Schiele u. Bruchsaler, Hornberg, Schwarzwaldbahn. Ger. Pat. 310,404, 19.2.18.

The surfaces of the moulds and cores are coated with aluminium bronze varnish and the organic matter removed by slowly heating to about 400° C. The coating of aluminium bronze which is left permits of the moulds being heated to the melting point of aluminium before the metal is poured, and prevents the casting from sticking to the moulds.—T. St.

Bearing metals; Manufacture of white — *containing silicon.* C. Hassler, Aalen. Ger. Pat. 310,507, 20.7.17. Addition to Ger. Pat. 297,290 (this J., 1917, 889).

The manufacture of white bearing metals as described in the original patent is simplified by the replacement of pure tin, lead, and antimony, by hard lead and tin containing lead. Preliminary alloys (A) or (B) are first prepared as follows: — (A) Hard lead (with 13—25% Sb) 56—76, tin (with 20—80% of Pb) 20—40, copper 1—4, and 30% silicon-copper 0·2—1·5 parts. (B) Hard lead 50—55, tin alloy (Sn 80—84, Sb 11—12, Cu 5—8 parts) 35—48, copper 1·5—8·5, and 30% silicon-copper 0·5—1·5 parts. The final alloy is composed of alloy (A) 60—95 and soft lead 5—40%, or alloy (B) 15—35% and the remainder either equal parts of hard and soft lead, or soft lead alone.—T. St.

Zinc; Electrolytic recovery of — *[from solutions containing iron and manganese].* E. Langguth, Frankfort. Ger. Pat. 310,846, 13.10.15.

Ferrous sulphate is oxidised to ferric sulphate in an anode compartment by the action of the manganese salts present in the solution. Determinations of iron and manganese must be made to ensure that sufficient manganese salts are present for the purpose, and the electrolysis should be conducted under conditions favourable to the formation of the more highly oxidised manganese

compounds, *e.g.*, high acid strength, zinc content maintained high in comparison with manganese content, presence of the sulphates of alkalis, ammonium, magnesium, or aluminium, and high anodic current density. The ferric sulphate is removed by zinc oxide in the usual way.—T. St.

Grey cast-iron; Manufacture of ——. W. B. Hamilton, Sheffield. U.S. Pat. 1,296,384, 4.3.19. Appl., 20.12.17.

SEE Eng. Pat. 14,328 of 1917; this J., 1918, 271 A.

[*Tungsten;*] *Treatment and circulation of hydrogen in connection with the reduction of tungsten trioxide* [*to* ——]. H. A. Gill, London. From Fansteel Products Co., North Chicago, Ill., U.S.A. Eng. Pat. 125,310, 9.9.18. (Appl. 14,614/18.)

SEE U.S. Pat. 1,286,088 of 1918; this J., 1919, 135 A.

Metals [*aluminium*]; *Process of securing* —— *from their compounds* [*aluminium chloride*]. V. M. Weaver, Harrisburg, Pa., Assignor to Weaver Co. U.S. Pat. 1,297,946, 18.3.19. Appl., 11.1.15.

SEE Fr. Pat. 481,056 of 1916; this J., 1917, 144.

Separator for ores. Eng. Pat. 125,344. *See* I.

[*Magnesium and ferrosilicon.*] U.S. Pat. 1,297,297. *See* IX.

Metal paste or sludge. Eng. Pat. 124,006. *See* XI.

Electrodes for smelting. Eng. Pat. 124,116. *See* XI.

Arc-welding electrode. U.S. Pat. 1,294,250. *See* XI.

XI.—ELECTRO-CHEMISTRY.

Electric furnace methods; Application of —— *to industrial processes.* H. Etchells. Trans. Faraday Soc., 1919, **14**, 71—78.

A DESCRIPTION is given of the Greaves-Etchells furnace (Eng. Pat. 106,626; this J., 1917, 891), and the advantages accruing from it. Dealing with electric conditions it is stated that regulation, phase balance, and wave distortion have not received the attention which they deserve. Specimens of wave form obtained by means of the oscillograph in different types of furnaces are shown. In the case of the Electro-Metals furnace there is definite indication of a prolonged period of inertia while the current changes polarity, and this must be reflected to some extent in the primary system. The iron of the current transformer has the effect of softening the wave distortion. The Héroult method of transformer grouping is particularly susceptible to the setting up of circulating currents, which may account for the curious wave forms obtained with this furnace. Recent experiments have demonstrated that very appreciable losses may occur in transmitting power from the transformer to the furnace, not entirely through eddy-current losses set up in surrounding inductive circuits, but because of the skin resistance of the furnace leads. These losses may assume considerable proportions with large currents, and in large installations special precautions should be taken to minimise them. Possible sources of electrode losses should receive consideration. Carbon electrodes made from pitch-coke, anthracite, and petroleum-coke are most suitable for ore reduction, but for steel-making, graphite electrodes, which can be run at four times the current density, are preferable. Continuous-feeding electrodes provided with jointing nipples are common, but the only satisfactory method of jointing amorphous carbons is to use a graphite nipple.—B. N.

Electric furnaces; Control of ——. F. E. Hill and A. P. M. Fleming. Trans. Faraday Soc., 1919, **14**, 90–98.

THE two principal methods of furnace regulation are (1) variation of voltage; (2) variation of current. The methods of varying the voltage are dealt with in detail, *viz.*, alteration of the ratio of the main transformer by tappings or by an auxiliary winding, or the use of a primary or secondary booster transformer, or control of a motor generator; a comparison is made of these methods of control. The control by current regulation is accomplished by raising or lowering the electrodes, which may be effected by hand or by electrical or hydraulic power under manual control, or by an automatically controlled motor, and these methods of control are discussed.—B. N.

Carbon monoxide; Electromotive activity of ——. F. Auerbach. Z. Elektrochem., 1919, **25**, 82—84.

THE E.M.F. given by Hofmann (this J., 1918, 765 A) for the element O_2/CO cannot be directly compared with that calculated from the free energy of the reaction, $2CO+O_2 \rightleftarrows 2CO_2$, because in alkaline electrolytes carbon monoxide is oxidised to carbonate and not to carbon dioxide.—J. F. S.

Dielectric failure of porcelain. Treischel. *See* VIII.

Dakin's solution. Cullen and Hubbard. *See* XIXB.

Electrical precipitator. Tolman and others. *See* XXIII.

PATENTS.

Electric heating by high frequency currents; Method of and apparatus for —— . The Ajax Metal Co., Philadelphia, Assignees of E. F. Northrup, Princeton, N.J. Eng. Pat. 119,220, 19.3.18. (Appl. 4868/18.) Int. Conv., 19.9.17.

ELECTRIC furnaces of the induction type are operated by circulating about the resistor an oscillating current having its oscillations maintained in amplitude, as distinguished from the usual damped oscillations proceeding from an ordinary condenser when discharged through a gap. The oscillatory current discharge through the operating circuit is uninterrupted, and the operating circuit contains inductance and capacity proportioned so as to tune the circuit to approximately the frequency of the alternating current supplied to the circuit, the proportion between the inductance and capacity being adjustable to compensate for different operating conditions. The discharge is made through a metallic circuit containing the furnace coil for heating different resistors, thereby avoiding the necessity of a discharge gap, and the furnace coil circuit has a greater current than that of the supply circuit. (See Eng. Pat. 111,841; this J., 1919, 225 A; also this J., 1919, 292 A.)—B. N.

Electric furnace. F. von Schlegell, Evanston, Ill., and C. B. Fletcher, Indianapolis, Ind. U.S. Pat. 1,294,837, 18.2.19. Appl., 25.11.18.

IN an electric furnace heated by a direct arc between the charge and an electrode above it, the melting chamber has a deep and relatively narrow,

inclined well, whereby excessive volatilisation of the molten charge is prevented, owing to the small area of the surface exposed. When melted, the charge is heated by an indirect arc, for which purpose a supplemental electrode is provided.
—W. E. F. P.

Furnace; Electric —— and method of operating the same. J. R. Harbeck, New York, and E. G. Norton, Chicago, Ill. U.S. Pat. 1,295,309, 25.2.19. Appl., 24.4.17.

A HIGH pressure and high temperature electric furnace comprises a casing formed of concentric shells with hemispherical ends and means for closing the opposite ends, with electric heating means within the casing. The furnace temperature is equalised by convection of heat in a static body of liquid, and the temperature may be lowered by means of a flowing body of liquid. The pressure in the static body of liquid is balanced and equalised against the pressure of the gases in the furnace.
—B. N.

Induction furnace; Electric ——. O. Brophy, Philadelphia, Pa. U.S. Pat. 1,296,752, 11.3.19. Appl., 12.6.18.

THE furnace comprises a substantially rectangular core, on the central portion of which is mounted a primary winding. The body of metal to be treated includes a main portion, a tubular portion, forming the secondary in an auxiliary cavity, partially surrounding and co axial with the primary winding, together with oppositely-placed branches connecting the portions. The winding exerts a repulsive action on the metal in the auxiliary cavity and forces it into the main portion, magnetic lines of force cutting through the metal at definite points in the auxiliary cavity, thereby causing relatively intense circulation of the metal at these points.
—B. N.

Metals or alloys; Electrolytic preparation of —— in the form of paste or sludge. B. Leech, Macclesfield, and H. and L. Slater, Ltd., Manchester. Eng. Pat. 124,006, 28.12.17. (Appl. 19,170/17.)

AN apparatus, for the electrolytic preparation of metals or alloys in the form of paste or sludge, is provided with anodes formed partly of the active metal and partly of a material, *e.g.*, hard graphite, which resists or withstands the conditions of electrochemical action and does not disintegrate nor pass into solution. Means may be provided for varying or adjusting the ratio of the areas of the active and resistant portions of the anode immersed in the electrolyte. A group of vats may be used through which the same electrolyte is circulated, the vats being electrically connected in series or in parallel, or supplied with current independently. Anodes of active material may be used in some vats and anodes of resistant material in others. The flow of electrolyte may be controlled or regulated through any vat or group of vats, and the electrolyte may be circulated through a cooling or heating coil.
—B. N.

Electrodes, particularly for use in electric smelting and like purposes. S. C. Hazard, Jarrow, and H. S. Morris, Hebburn-on-Tyne. Eng. Pat. 124,116, 4.6.18. (Appl. 9226/18.)

DISTORTION of electrodes during the baking process is prevented by filling the socket, at the end serving as a base, with a plug of moulders' loam, clay, or other suitable material in a liquid or plastic condition.—B. N.

Electrode; Arc-welding ——. C. V. Elliott, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,294,250, 11.2.19. Appl., 22.7.18.

THE electrode is composed of ferrous metal, with a coating of a calcium compound of inappreciable thickness having a high power of emitting electrons when heated.—B. N.

Electric dry cells; Resuscitating spent ——. K. Horii, Hokkaido, Japan. Eng. Pat. 124,137, 12.7.18. (Appl. 11,464/18.)

SPENT dry cells are resuscitated by boring a hole in the cell from the top and filling it with a mixed solution of ammonium and sodium chlorides and oxalic acid. The cell is then heated and finally plunged into cold water.—B. N.

Accumulators; Electric ——. W. G. Pearson, Woodford Green, and General Electric Co., Ltd., London. Eng. Pat. 124,378, 6.9.18. (Appl. 14,530/18.)

THE absorbent for the electrolyte is composed of a mixture of sawdust, fibrous asbestos, and celluloid chamferings or the like.—B. N.

Depolariser; Polymerised manganese dioxide ——. A. A. Wells, Montclair, N.J., Assignor to National Carbon Co., Inc., Cleveland, Ohio. U.S. Pat. 1,293,272, 4.2.19. Appl., 25.10.15.

AN artificial active form of manganese dioxide is prepared by converting the natural dioxide into carbide, treating the product with water to form manganous hydroxide, and roasting the latter in an oxidising atmosphere containing steam to convert it into manganese dioxide.—B. N.

(A) *Manganese dioxide; Preparing ——* [*for galvanic cells*]. (B), (C) *Galvanic cell.* M. L. Kaplan, Brooklyn, N.Y. U.S. Pats. (A) 1,293,461, (B) 1,293,462, and (C) 1,293,463, 4.2.19. Appl., (A) 4.5.17, (B), (C) 11.7.18.

(A) ARTIFICIAL manganese dioxide is prepared by heating manganese carbonate, treating the residue first to yield a product containing manganese dioxide, and then with nitric acid, and heating the resulting powder to dry it and drive off excess of acid and decompose any manganese nitrate. (B) An electrode material for galvanic cells is prepared by incorporating sufficient nitric acid with manganese peroxide to combine with the basic substances present, decomposing the manganese nitrate formed, and removing the residual nitrates. A conducting material is added to the compound at any convenient stage. (C) An electrode material is prepared by converting manganese carbonate into a product containing a high percentage of the dioxide, a smaller percentage of manganous oxide, and a still smaller percentage of carbon dioxide. The product is treated to remove the carbonic acid and introduce the hydroxide group, the resulting product being oxidised and a conducting material added.—B. N.

Pyrolusite electrodes; Process for regenerating spent ——. F. Müller, Vienna. Ger. Pat. 310,866, 20.6.17.

THE electrode is employed as anode in a salt solution through which a current 0·05—0·1 ampère per sq. decimetre of electrode surface is passed for a considerable period. The time during which the current is passed depends upon the amount of material surrounding the carbon core. For very small electrodes, the current is passed for five or six days, medium electrodes require 7 to 12 days, and large electrodes still longer. In no case should large bubbles of oxygen stream off from the electrode.—J. S. G. T.

Electrolytic cell. G. Charbonneaux, Le Magnou, France. U.S. Pat. 1,296,046, 4.3.19. Appl., 8.3.17.

The electrodes consist of alternating right and left hand plates with ends overlapping at the middle of the cell. Terminal members pass through the walls of the cell, and means are provided for clamping the terminals and overlapping ends together. —B. N.

Battery; Primary ——. O. E. Ruhoff, Assignor to French Battery and Carbon Co., Madison, Wis. U.S. Pat. 1,296,700, 11.3.19. Appl., 9.6.17.

A depolarising mixture for electric batteries contains "deflocculated" conductive material, and some other form of carbonaceous material, the former forming about 20% of the total carbonaceous matter.—B. N.

Electrodes for galvanic cells; Metallic ——. R. Boehringer, Potsdam. Ger. Pat. 310,838, 19.9.17.

The electrode is composed of porous material such as textile fabric, saturated with electrolyte, one face of the fabric being covered by the insoluble electrode metal. With such electrodes the use of gelatin etc. in dry cells is rendered unnecessary. The metal, *e.g.*, zinc, is applied to the fabric by a spraying process, and the uncoated side of the fabric then saturated with electrolyte and tightly pressed against or wound around the carbon electrode. The electrode on account of its pliability is readily adapted to various forms of carbon electrodes, so that the resistance of the cell may be made very small. J. S. G. T.

Electrical conductors embedded in squirted cellulose; Manufacture of ——. V. Planer, Berlin-Lankwitz. Ger. Pat. 308,016, 29.10.16.

Cellulose is heated in an oil bath, and then, together with any oil it may retain, is mixed with bitumen to obtain a mass suitable for squirting. The strength of the material is increased by incorporating with the cellulose textile fibres similarly heated in oil before the admixture of bitumen. —J. S. G. T.

Sodium; Manufacture of electrical conductors of ——. L. Luckhardt, Cassel. Ger. Pat. 308,787, 2.6.17.

A thread of sodium on emerging from the die is encased by a protective envelope composed of fine threads closely plaited or wound spirally, and is then enclosed within one or more protecting sheaths. The operation is carried out in the absence of air, preferably in a bath of petroleum.—J. S. G. T.

Carbon electrodes; Manufacture of protective sheaths for ——, *particularly those used in electric furnaces.* Ges. für Teerverwertung m.b.H., Duisburg-Meiderich. Ger. Pat. 309,832, 5.6.15.

Carbon electrodes are enclosed in thin sheets of porous material which is unaffected by oxidising gases, and then raised to incandescence. Metals can be used, if all parts of the surface of the electrode are to possess good conducting power. In other cases, quartz, slate, magnesite, carborundum, etc., may be employed. An adhesive or binding material may be used to cause the sheets to adhere to the "unburnt" electrode.—J. S. G. T.

***Anodes of solid manganese peroxide; Process for making* ——. M. Huth, Assignor to Siemens und Halske A.-G., Berlin. U.S. Pat. 1,296,188, 4.3.19. Appl., 3.11.14. Renewed 24.7.18.**

See Ger. Pat. 282,225 of 1914; this J., 1915, 622.

Electric-arc furnace. J. L. La Cour, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,296,194, 4.3.19. Appl., 22.11.15.

See Fr. Pat. 480,302 of 1915; this J., 1917, 146.

Electrolysing apparatus. Eng. Pat. 114,623. *See* VII.

Lampblack. Eng. Pat. 124,557. *See* XIII.

XII.—FATS; OILS; WAXES.

Coconut and palm oils; Determination of the acidity of ——. Vizern and Guillot. Ann. Chim. Analyt., 1919, [ii], 1, 116–119.

In calculating the acidity of these oils from the amount of alkali used for neutralisation, the factors employed should be the mean molecular weights of the fatty acids of the respective oils. For coconut oil the factor is 208 and for palm oil 222.—W. P. S.

Chrysalis fat; Application of —— in the textile industry. G. Tagliani. Färber-Zeit., 1919, **30**, 65–67.

Large quantities of silkworm chrysalides are obtained each year in Italy. The dried chrysalides contain from 30–40% of extractable fatty matter. The fat is a dark thick oily mass, which on standing separates into about equal parts of solid and liquid. Cold extraction of 1500 grms. of chrysalides with 8500 grms. of benzene gave 575 grms. of fat; hot extraction of the same weight of material with 7500 grms. of carbon tetrachloride gave 620 grms. of fat. The solid and liquid fats are easily saponified. The extracted material is suitable as a cattle food, as a manure, or for briquette making. The application of the soaps or emulsions obtained from these fats in the scouring of cotton and wool has not yet been practically carried out.—L. L. L.

Resin for soap making. Goldschmidt and Weiss. *See* XIII.

Patents.

Oil; Method of extracting —— from vegetable seeds and nuts. C. Downs, R. A. Bellwood, and T. W. Turnill, Kingston-upon-Hull. Eng. Pat. 124,856, 31.1.18. (Appl. 1783/18.)

Vegetable seeds and nuts, especially those rich in oil, *e.g.*, copra and palm kernels, are ground or cut up and subjected to dry heat and agitation, without the addition of water, until a large proportion of the moisture is expelled, and a semi-solid mass is obtained. The exuding oil is separated from this in a centrifugal separator or by means of a filter-press, and the residue is subjected to further expression or extracted with a solvent. The preliminary heating may be carried out in a steam-jacketed conveyor or series of conveyors provided with agitators.—C. A. M.

Oils; Apparatus for treating [deodorising and hardening] ——. H. Schlossstein, Chicago, Ill. U.S. Pat. 1,296,013, 4.3.19. Appl., 21.1.18.

An apparatus for deodorising and hardening oils comprises a vessel with means to effect the circulation of the oil in a closed circuit through the apparatus, and separate means to force a deodorising agent or a hardening agent through the oil in both sides of the circuit so as separately to deodorise and to harden the oil.—A. de W.

[*Hydrogenation of oils;*] *Nickel formate catalyst [for ——], and process of making same.* C. Ellis, Montclair, N.J. U.S. Pat. 1,296,496, 4.3.19. Appl., 15.11.17.

Nickel formate substantially free from catalyst poisons is prepared by dissolving a freshly-precipitated basic nickel compound in formic acid. The formate is dried as far as possible short of blackening and is then ground and heated, with stirring, to 240°—250° C. "in a sealing vehicle" under reduced atmospheric pressure in the absence of a reducing gas, to obtain a catalyst suitable for use in the hydrogenation of oils.—A. de W.

Fatty acids obtained by hydrolysing fats by means of petroleum sulpho acids; Process of bleaching ——. W. Happach, Malmö, and Sudfeld und Co., Melle, Hannover. Ger. Pat. 310,387, 2.12.13.

Fatty acids obtained by hydrolysis of fats by means of petroleum sulpho acids are bleached by blowing air through them while hot. The use of this process obviates the necessity of preliminary purification of fats before the hydrolysis and of excluding air during the decomposition.—C. A. M.

Soap-like masses; Manufacture of ——. G. Bethmann, Frankfort. Ger. Pat. 310,266, 6.6.16.

Vaseline, with or without powdered talc, is kneaded with a solution of glue or other equivalent binding medium, with the addition of alkalis if desired, preferably at 40°—100° C. Plastic masses are obtained which slowly solidify on cooling to products resembling soap.—J. F. B.

Fats or oils; Process of separating liquid —— from solid fatty materials. W. P. Schuck, and Superior Oil and Process Co., Portland, Oreg., U.S.A. Eng. Pat. 127,327, 4.11.18. (Appl. 18,032/18.)

See U.S. Pat. 1,288,223 of 1918; this J., 1919, 186 A.

Distilling apparatus. U.S. Pat. 1,297,590. *See* III.

Plastic composition. U.S. Pat. 1,295,533. *See* V.

Fats from wood pulp etc. Ger. Pat. 310,554. *See* V.

Animal carcases. Ger. Pat. 309,722. *See* XV.

Waste products. Eng. Pat. 121,576. *See* XIXB.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Resins; Action of alcoholic potash on ——. P. Nicolardot and C. Collignier. Bull. Soc. Chim., 1919, **25**, 200—206.

In each case 1 grm. of the resin was heated for one hour under a reflux condenser with 25 c.c. of *N*/2 alcoholic potash, and then 50 c.c. of water was gradually added, and the insoluble portion was filtered off and weighed. Of the 27 types of resins examined only one, "Kauri busch récolte," was completely soluble in the *N*/2 alcoholic potash. The resins could be divided into three classes, namely:—(1) Resins, with which the addition of water neither increased nor decreased the insoluble material. There was only one example found in this class, namely Cameroon resin. (2) Resins with which the addition of water caused a total or partial disappearance of the insoluble matter. With one exception, all the resins in this class were semi-hard. (3) Resins with which the addition of water caused a more or less marked increase in the insoluble matter. The resins in this class belonged to all three types, hard, semi-hard, and soft. There was no correlation between the acid value of the resin and the amount of insoluble matter it gave in the above test.—W. G.

Resin; Suitability of German —— for soap-making. F. Goldschmidt and G. Weiss. Z. angew. Chem., 1919, **32**, 96. (See this J., 1919, 226 A.)

The solubility of resin in petroleum spirit affords no useful evidence as to the suitability of the resin for soap-making. As regards the formation of insoluble substances in the presence of trichloroethylene (*loc. cit.*), comparative experiments with carbon tetrachloride showed that with this solvent the useful constituents of the resin remained unaffected when the aeration was carried out in the absence of a catalyst; a slight decrease in the amount of these constituents occurred when iron filings was added.—W. P. S.

Pitches etc. Langton. *See* III.

Patents.

Lampblack; Manufacture of ——. T. W. S. Hutchins, Middlewich. Eng. Pat. 124,557, 22.3.18. (Appl. 5092/18.)

A disc or the like adapted to pick up a film of material rotates vertically in a trough of tar or oil, and the resulting film is subjected to the intense heat of one or more electric arcs, whereby it is decomposed, giving a high yield of comparatively pure lampblack. A magnet may be used for directing the arc on to the rotating disc, which may be made of graphite, whilst the process may be carried out in a closed chamber having a pipe connected with a fan at the bottom, through which the gas and lampblack are drawn off. The latter is separated by a bag, or similar filter, whilst the gas is returned to the chamber, whence the excess is drawn off through a valve. C. A. M.

Printers' roller composition and analogous substances or compositions; Process for the reclaiming of used —— and apparatus therefor. T. H. Grozier, Longueville, N.S.W. Eng. Pat. 121,941, 28.6.18. (Appl. 10,668/18.) Int. Conv., 3.1.18.

Used printers' roller composition is treated with superheated steam at a low pressure in a closed vessel so as to liquefy and separate the liquefiable portion, whilst the excess of moisture from the composition together with the water of condensation in the apparatus is vaporised to prevent its admixture with the recovered portion. In one type of apparatus claimed, perforated cages are used to separate the liquefiable from the non-liquefiable portion, whilst the vessel has a cover containing a trough with a series of openings to catch the condensed water, and having an opening at the top to allow the steam subsequently produced from this water to escape.—C. A. M.

Dopes; Manufacture of ——. The British Emaillite Co., Ltd., and J. N. Goldsmith, London. Eng. Pat. 124,515, 25.2.16. (Appl. 2879/16.)

A dope with increased strength, and in which the toxic properties are reduced or eliminated, is obtained by adding to a cellulose ester solution from about 5 to 100% (on the weight of cellulose ester) of triacetin or acetanilide or a mixture thereof, such addition conferring properties which have hitherto only been obtained by the use of tetrachloroethane or other chloro-hydrocarbons. A

suitable preparation giving a rigid coating on aeroplane wings contains:—Cellulose acetate, 21 grms.; triphenyl phosphate, 1·8 grms.; acetone, 25·5 c.c.; triacetin, 3 c.c.; and acetanilide, 2·7 grms. The addition of triacetin or acetanilide to a dope containing chloro-hydrocarbons increases the adhesiveness and glossiness of the coating, and gives freedom from white patches.—C. A. M

Cellulose acetate compositions for use as varnishes, lacquers and for other purposes. A. A. A. Zimmer, J. A. Bryce, and G. L. Davies, London. Eng. Pat. 124,807, 12.4.16. (Appl 5387/16.)

A NON-TOXIC varnish, particularly suitable as a dope for the wings of aeroplanes, is prepared by mixing together approximately equal parts of cellulose acetate (10 parts) and cresylic acid (10 parts), with acetone, alcohol, benzene, or the like, or a mixture of such solvents (80 parts).—C. A. M.

Shellac; Dissolving and "breaking down" —— for use in hat-manufacture and other purposes. T. Mackenzie, Gilberton, S. Australia. Eng. Pat. 124,684, 28.10.18 (Appl. 17,592/18.) Int. Conv., 11.6.18.

A SOLUTION of shellac obtained by adding about 6 lb. of common salt to 20 lb. of shellac can be used in much greater dilution than the usual preparations. For example, 20 lb. of shellac is boiled with a solution of 4 lb. of sodium carbonate or borax or equivalent alkaline substance, with or without the addition of rosin, linseed oil, or other "gums" or oils, a solution of 6 lb. of salt added, and then 3 lb. more borax or sodium carbonate, and the boiling continued for about 2 hours, after which the solution is "broken down" to the required consistence by stirring it with cold water.—C. A. M.

Japan; Non-inflammable —— and process of making same. W. P. Davey, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,294,122, 18.2.19. Appl., 14.11.17.

OILY material capable of forming a japan is heated with concentrated alkali until it softens, and the product is diluted with water until a uniform emulsion is obtained, access of air being meanwhile prevented. For example, a japan which can be applied mechanically or by cataphoresis, and which is converted by heat into a hard, adherent coating, consists of an emulsion of a saponifiable oil, asphaltic material, ammonia and water, with or without copal.—C. A. M.

Paint or varnish and paint or varnish ingredient. M. Darrin, Wilkinsburg, Pa., Assignor to H. Koppers Co., Pittsburgh, Pa. U.S. Pat. 1,296,776. 11.3.19. Appl., 29.6.18.

A PAINT or varnish comprises a coal-tar pitch and crude solvent naphtha which has been subjected to an autoclave treatment and to a distillation process.—A. de W.

Printing and stamping colours; Process for the preparation of ——. T. Goldschmidt A.-G., Essen. Ger. Pat. 309,911, 15.4.17.

THE application of glycol as hygroscopic agent in the preparation of printing and stamping inks is claimed. Glycol is more hygroscopic than glycerol, and consequently a much smaller quantity of it suffices to keep the printing compositions moist for a long period.—L. L. L.

Paint or varnish and method of making the same. F. W. Sperr, jun., Oakmont, and M. Darrin, Wilkinsburg, Assignors to H. Koppers Co., Pittsburgh, Pa. U.S. Pats. 1,292,907 and 1,292,908, 28.1.19. Appl., 10.8 and 5.11.17.

SEE Eng. Pat. 118,079 of 1917; this J., 1919, 46 A.

Preparing surfaces on canvas etc. Eng. Pat. 124,843. *See* V.

Resins from wood pulp etc. Ger. Pat. 310,554. *See* V.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

PATENTS.

Rubber; Process for treating ——. J. Porzel, Buffalo, N.Y., U.S.A. Eng. Pat. 124,887, 4.4.18. (Appl. 5758/18.)

BY mechanically comminuting old or used vulcanised rubber, then adding rubber solution containing new rubber to the extent of 2½—3 lb. per 100 lb. of old rubber and further grinding until the limit of practical mechanical division is reached, a mass is obtained, which after the removal of the rubber solvent can be moulded and vulcanised with satisfactory results.—D. F. T.

Vulcanising rubber and similar substances; Method and machine for ——. J. Porzel, Buffalo, N.Y., U.S.A. Eng. Pat. 124,888, 4.4.18. (Appl. 5759/18.)

RUBBER and similar substances are vulcanised by a continuous process involving compression of the material between two flat converging surfaces travelling at equal speeds and simultaneously raising the temperature of the material. The converging surfaces consist of two metal belts above and below each of which is arranged a plane rigid heated surface which supplies the heat and imparts the necessary pressure.—D. F. T.

Rubber; Accelerator for the vulcanisation of ——. C. R. Boggs, Arlington Heights, Mass., Assignor to Simplex Wire and Cable Co., Boston, Mass. U.S. Pat. 1,296,469, 4.3.19. Appl., 16.3.14

β-NAPHTHYLAMINE is added to rubber before vulcanisation.—L. A. C.

[Balloon] fabrics. Eng. Pats. 124,494—5. *See* V.

Fabrics for balloons etc. Eng. Pat. 124,520. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

Tannins; Furfural condensation products of —— and their use in tannin analysis. R. Lauffmann. Ledertech. Rundsch., 1918, **10**, 97—98. Chem. Zentr., 1919, **90**, II., 299—300.

LIKE formaldehyde, furfural gives condensation products with tannins on boiling in hydrochloric acid solution, and the reaction may be used for discriminating between and evaluating various kinds of tannin. The procedure is to boil for half an hour, under a reflux condenser, 50 c.c. of standard tannin solution with 20 c.c. each of 7% furfural solution and 20% hydrochloric acid, the brownish or blackish brown precipitate is collected on a tared filter paper, washed, and dried till of constant weight, and calculated to the basis of 100 part of dry tannin. The "furfural precipitation numbers" thus obtained show close agreement with similar numbers given by formaldehyde precipitation of the same variety of tannin (see this J., 1918, 342 A). If, to the filtrate obtained above, a few drops of 1% iron alum solution and solid sodium acetate are added, a bright green zone

is formed above the latter by protocatechuic tannins, and a violet zone by pyrogallol tannins which is visible when only a small proportion of the latter is present, so that by means of the reaction pyrogallol tannins may be detected in presence of protocatechuic tannins.—G. F. M.

Leather; Extractor for water-soluble in ——. H. C. Reed and J. B. Churchill. J. Amer. Leather Chem. Assoc., 1919, **14**, 133—140.

In a large cylindrical copper container, 15 in. deep, are fitted 12 glass tubes 9 in. long, each closed at the top by a one-hole rubber stopper and narrowing at the bottom into a small tube which, passing through a stopper in the bottom of the container, is attached to a rubber tube leading to a flask which receives the extract. The leather sample is placed between two layers of absorbent cotton, the tubes are two-thirds filled with distilled water, the pinch-cocks on the rubber tubes closed, and the apparatus is allowed to stand over-night. It is then filled with distilled water and brought to 50° C. The percolation is started and for each drop of extract leaving the tube a drop of water is forced to enter through the hole in the rubber stopper owing to the slight vacuum created. The results obtained by this extractor are somewhat higher than by others, probably due to the leather being completely surrounded with water at 50° C.—D. W.

Leather; Extraction of grease and oil from ——. J. A. Wilson. Report of a committee of the American Leather Chemists' Association. J. Amer. Leather Chem Assoc., 1919, **14**, 140—178.

Extractions were made on 15 samples of leather ranging from shoe upper to sole leather and including chrome, vegetable, and combination tannages both fat-liquored and stuffed. Five solvents were tried on each leather and it was shown that the order of relative efficiency was chloroform, ether, carbon tetrachloride, carbon bisulphide, petroleum spirit. Analyses of leather fat-liquored with moellon degras containing 15% of oxidised fatty acids on the total fatty matter showed 22·28% of fat with petroleum spirit and 27·32% with chloroform. Petroleum spirit extracted 5·93% of fat and chloroform 9·30% from a chrome-tanned kip fat-liquored with sulphonated oil. Clearly petroleum spirit is unable to remove oxidised fatty acids and certain portions of sulphonated oil from leather containing them. The committee conclude that chloroform is the most efficient and they recommend it as the official solvent.—D. W.

Leather; Effect of grease on the tensile strength of strap and harness ——. L. M. Whitmore, R. W. Hart, and A. J. Beck. J. Amer. Leather Chem. Assoc., 1919, **14**, 128—133.

The tensile strength of strips of leather cut from the backs of 52 different tannages was determined as received, after degreasing, and again after re-stuffing with different mixtures.

Samples	Relative tensile strength	Percentage of grease
As received	114·8	13·7
Degreased	100·0	0·0
Re-stuffed with petrolatum and paraffin mixture, m pt. 42 °C.	119 5	28·0
Re-stuffed with tallow ...	108·4	28·0
,, ,, {30 tallow ... 30 cod oil ... 20 wool grease}	119·9	26·2
,, ,, {petrolatum ... rosin ... ... mineral oil ...}	113·9	21·4

The increase in the tensile strength due to the presence of grease is probably attributable to the lubrication and strengthening of the fibres. Tests with increasing amounts of petrolatum showed that 14% of grease is quite sufficient to ensure perfect lubrication and maximum tensile strength.—D. W.

Patents.

Animal carcases; Apparatus for the utilisation of —— [for recovery of glue, fat, etc.]. H. Goslar, Aachen. Ger. Pat. 309,722, 14.12.17. Addition to Ger. Pats. 308,152 and 308,753 (this J., 1919, 23 A, 189 A).

At the edge of the heating plate on the under side of the floor two adjacent chambers in connection with supply and exhaust conduits for compressed air are arranged, into which several superposed annular channels surrounding the heating plate open. A good utilisation of the heat stored up in the heating plate is thus ensured and the drying of the flesh meal on the floor of the apparatus is considerably accelerated. Moreover, more heat is withdrawn from the heating plate at the edges, *i.e.* from the place where the meal chiefly lies during the drying, so that damage due to overheating of the product is less liable to take place. Further, it is possible to measure the temperature of the air leaving the plate and thus to regulate the temperature of the plates themselves.—J. F. B.

Leather imitations. U.S. Pat. 1,295,118. *See* V.

Dyeing fox skins. Ger. Pat. 310,425. *See* VI.

XVI.—SOILS; FERTILISERS.

Lime, magnesia and potash in such minerals as epidote, chrysolite, and muscovite; Solubility of ——, especially in regard to soil relationships. R. F. Gardiner. J. Agric. Res., 1919, **16**, 259—261.

The minerals were finely powdered and from 0·1 to 1·0 grm. of the fine powder was, in each case, left in contact with 25 c.c. of a slightly acid soil extract for two months at 25° C. It was found that, on the average, 1·6% of the total lime in the epidote, 0·21% of the total magnesia in the chrysolite, and from 11 to 21% of the total potash in the muscovite was dissolved.—W. G.

Cyanamide and dicyanodiamide; Decomposition of —— in the soil. G. A. Cowie. J. Agric. Sci., 1919, **9**, 113—136.

Field trials with barley, pot cultures with mustard, barley, and rye, and laboratory experiments on soil bacteria were made to determine the behaviour of cyanamide and dicyanodiamide in soil. It was found that cyanamide increased plant growth, being decomposed with formation of ammonia which underwent nitrification. The decomposition is slower than that of ammonium sulphate, owing to the time required for the conversion of the cyanamide into ammonia. Dicyanodiamide underwent no decomposition. It had a depressing effect on plant growth; in large quantities it was toxic, and in small quantities it failed to produce any stimulation. Using mixtures of the two substances, it was found that dicyanodiamide had no harmful effect on the ammonification of cyanamide, but it prevented nitrification. **Using 3 parts of cyanamide and 1 part of dicyanodiamide, only 22% of the nitrogen was nitrified, and with 1 part of cyanamide and 3 parts of dicyanodiamide, only 5%. In these cases, however, the plant utilised much**

of the nitrogen that had not been nitrified. Dicyanodiamide only slightly retarded the rate of ammonification of protein, but the nitrification of ammonium sulphate was reduced almost to nothing. The total number of soil bacteria growing on gelatin was not affected. (See also J. Chem. Soc., June, 1919.)—J. H. J.

Cellulose; Decomposition of —— [in soil] by an aerobic organism (Spirochaeta cytophaga, n.sp.). H. B. Hutchinson and J. Clayton. J. Agric. Sci., 1919, **9**, 143—173.

Inoculations of Rothamsted soil into a mineral culture solution containing a strip of filter paper gave rise under aerobic conditions to the growth of a curved thread organism which resembled the spirochetes rather than the bacteria and was named *Spirochaeta cytophaga*. In old cultures the threads change into an oval or spheroidal form and resemble spores. Its optimum temperature is 30° C., but it does not grow on the ordinary media, growth being inhibited by 0·25% of peptone. It grows best in a solution of nutritive salts with cellulose and simple nitrogenous substances, such as nitrates, ammonium salts, amides, and amino-acids in low concentration. All carbonaceous compounds except cellulose are inhibitory to growth. Cellulose in any form is rapidly decomposed at 25°—30° C., producing a mucilage which is of a pectin character. When a cellulose culture of the organism was added to a mannitol culture of Azotobacter, an increased fixation of nitrogen was observed.—J. H. J.

Superphosphate; Absorption of ammonia by ——: "ammonium superphosphate." C. Briqux. Comptes rend. Acad. d'Agric. de France, 1918, **4**, 632—638. Bull. Agric. Intell., 1918, **9**, 1113—1114.

Calcium superphosphate has been made in Germany during the war with the aid of sodium bisulphate obtained as a waste product from explosives works. This superphosphate has been used to absorb ammonia obtained from sewage, gas-liquor, and cyanamide, the product being called ammonium superphosphate. When calcium superphosphate is treated with ammonia gas, ammonium sulphate and tricalcium phosphate are formed. Analysis of the product gave: total P_2O_5, 15·8%; P_2O_5 soluble in ammonium citrate, 13·1%; P_2O_5 soluble in 2% citric acid, 14·1%; P_2O_5 soluble in water 1·53%; ammoniacal nitrogen, 4·97%.—J. H. J.

Nitrogenous fertilisers; Possibility of obtaining —— by utilising waste materials for the fixation of nitrogen by nitrogen-fixing bacteria. C. I. T. Dorvland. Abs. Bacteriol., 1918, **2**, 2. Bull. Agric. Intell., 1918, **9**, 1413.

Molasses, orange, lemon and grape-fruit juices, and straw were found to serve as sources of energy for nitrogen-fixing bacteria. Nitrogen may be fixed by bacteria more economically than by chemical methods. The essential conditions for this result are the use of waste materials as sources of energy, symbiotic bacteria of active nitrogen-fixing strains, mechanical manipulation, and evaporation by solar heat.—J. H. J.

Patent.

Peat; Treatment of —— for making useful products [manure, fodder, etc.]. W. B. Bottomley, London. Eng. Pat. 124,629, 21.5.18. (Appl. 8434/18.) (See also this J., 1917, 95, 614.)

A layer of peat is alternately sprinkled with a 5—10% solution of sodium chloride and turned over, until either 2% or 10% of salt has been absorbed. It is then transferred to a tank into which steam is blown under 60 lb. pressure, until the temperature is slightly above 100° C. The peat treated with 10% of salt is now ready to be used for the extraction of nucleic acid. The peat treated with 2% of salt is used as a manure or a feeding stuff. To enhance its value it is inoculated with ammonia-producing and nitrogen-fixing organisms, and kept at 26°—28° C. for 3 days. Before use as a feeding stuff it is sterilised in the steam tank at 120° C. To produce a phosphatic manure, finely ground mineral phosphate is added before inoculation.

—J. H. J.

XVII.—SUGARS; STARCHES; GUMS.

Furfuroids (furfurosans); Determination of —— in products of beet sugar factories. R. Gillet. Bull. Assoc. Chim. Sucr., 1918, **35**, 93—102.

In continuation of previous work (this J., 1918, 315 A), it has been found that in the determination of pectic substances in beet-sugar factory products by the Tollens-Councler procedure, satisfactory results are obtained by first destroying the hexose sugars by fermentation, after which the liquid is distilled with hydrochloric acid, and the phloroglucide precipitated and weighed in the usual manner. The amount of pentosans and "pectic substances" in beet molasses, per cent. of the non-sugars present, was found to average 2·10 and 6·70 respectively. In first and second grade sugars, the proportions were considerably higher, from which the author concludes that a large part of the so-called furfuroids, or furfural-yielding substances, present in the clarified syrups are retained by the sugar after drying in the centrifugals.—J. P. O.

Aldose sugars; Determination of —— by titration with iodine in alkaline medium. H. Colin and O. Lévin. Bull. Assoc. Chim. Sucr., 1918, **35**, 107—110.

In using Bougault's method of determining aldose sugars by oxidation with iodine (this J., 1917, 899), the secondary reaction can be inhibited sufficiently to obviate the necessity of making a series of readings, by carrying out the oxidation in the presence of sodium bicarbonate or potassium iodide, or, preferably, a mixture of sodium carbonate and sodium hydrogen phosphate. In the determination of dextrose in admixture with lævulose, for example, to every 10 c.c. of *N*/10 iodine solution used, 25 c.c. of a solution containing 50 c.c. of *N*/1 sodium carbonate and 35 grms. of sodium hydrogen phosphate per litre is added. The iodine (using three times the amount corresponding to the dextrose present) and alkaline phosphate solutions should be added to the neutralised sugar solution contained in a flask, which is immediately well stoppered. At the end of an hour, an aliquot portion of the liquid is removed, acidified, and titrated with *N*/100 thiosulphate. Determinations of dextrose in the presence of lævulose by this method gave results in close agreement with those calculated from the cupric-reducing value and optical rotation.—J. P. O.

Reducing sugars; Volumetric determination of —— by Schindler's modification of Bertrand's method. Bettinger. Bull. Assoc. Chim. Sucr., 1918, **35**, 111—113.

Bertrand's volumetric method of determining reducing sugars (this J., 1907, 60), in which the precipitated cuprous oxide is dissolved in ferric sulphate solution and the liquid titrated with permanganate, has been rendered more rapid by using the same flask throughout and by replacing the

filter-tube by a Gooch crucible. Reduction is effected in a conical flask, and the cuprous oxide washed quickly by decantation through a Gooch crucible provided with an asbestos pad. Standardised ferric sulphate solution is added to the precipitate remaining in the reduction flask, which is immediately connected by means of a rubber stopper and funnel with the Gooch crucible, and also with a tube leading to a filter-pump. A further known volume of the ferric sulphate solution is added to the Gooch crucible to dissolve the cuprous oxide remaining on the asbestos pad, and the liquid is drawn into the flask. After washing with warm water, the solution is titrated with permanganate.
—J. P. O.

Glucose [dextrose] and fructose [lævulose]; Mutarotation of ——. J. M. Nelson and F. M. Beegle. J. Amer. Chem. Soc., 1919, **41**, 559–575.

NEW values have been determined for the specific rotation of α-glucose, β-glucose, and β-fructose; these are respectively +111·2°, +17·5°, and −130·8°. The values are the same at the temperatures 0·15° C., 15° C., 25° C., and 37° C. The equilibrium rotation of glucose is not affected by temperature, but that of fructose varies with the temperature of the solution, and it is concluded that the mutarotation of glucose is due simply to racemisation, whilst that of fructose is not. (See also J. Chem. Soc., June, 1919.)—J. F. S.

"Artificial honey" [invert sugar, its examination and manufacture in Germany]. A. Behre and H. Ehrecke. Chem.-Zeit., 1919, **43**, 153—155.

OWING to the variable consistence of invert sugar sold as artificial honey, it has been stipulated in Germany that the product should be supplied in the solid form. The liquid state is due sometimes to a high water content, but more usually to incomplete hydrolysis of the sucrose. Samples containing 20% of water and 5% of sucrose were always solid, but when the amount of sucrose was above 15% they were liquid. Generally the water content was fairly constant, viz., 17—20%, but the sucrose content fluctuated between 2 and 60%. Laboratory experiments showed that solid invert sugar is obtainable when hydrolysis is effected by dissolving 50 grms. of sucrose in 15 c.c. of water, and hydrolysing by heating with at least 0·05% of hydrochloric acid, or 0·10% of formic acid, for half-an-hour at 80°—85° C. In the factory, products of constant composition were obtained with closed steam-jacketed converters provided with stirrers, ordinary open boiling pans proving much less satisfactory.
—J. P. O.

PATENTS.

Decolorising carbon. Eng. Pat. 125,230. *See* IIB.

Fermented molasses. Eng. Pat. 124,364. *See* XVIII.

XVIII.—FERMENTATION INDUSTRIES.

Cholam (Andropogon Sorghum) as a substitute for barley in malting operations. B. Viswanath, T. L. Row, and P. A. R. Ayyangar. Mem. Dep. Agric. India, 1919, **5**, 117–129.

CHOLAM or great millet is better suited for malting purposes than various other common South Indian cereals investigated and cholam malt extract hydrolyses soluble starch at a greater rate than barley malt extract, the ratio of dextrin to sugar being greater with cholam than with barley malt. The products of the hydrolysis consist largely of maltose and dextrin.—T. H. P.

Alcoholic fermentation; Changed course of —— in an alkaline medium. A. Oelsner and A. Koch. Z. physiol. Chem., 1919, **104**, 175—181.

ALCOHOL and carbon dioxide are produced when dextrose is fermented in an alkaline phosphate medium. The fermentation is delayed. This does not confirm Wilenko (this J., 1917, 1283) who stated that no carbon dioxide was produced under these conditions. (See further J. Chem. Soc., June, 1919.)—J. C. D.

Bacterium; Water —— living in bitter wines that can dehydrate glycerol; glycero-reaction. E. Volsenet. Ann. Inst. Pasteur, 1918, **32**, 476—510. Bull. Agric. Intell., 1918, **9**, 1489—1490.

A BACTERIUM was isolated from water which had the property of converting glycerol into acrolein. The organism was identical with one previously isolated from wine affected with "bitter disease." It is considered that wine becomes infected through water containing the organism gaining access to it. On inoculation into a vinous medium the organism isolated from water produced acrolein, which is characteristic of "bitter disease." The organism was named *Bacillus amacrylus*. It is capable of growing in 1% phenol broth at 42° C. In many of its reactions it resembles Escherisch's bacillus. A special reaction is described called the "glycero-reaction," depending on the production of acrolein from glycerol, which can be used to distinguish *B. amacrylus* from other organisms in water.
—J. H. J.

Wine; Detection of cider etc. in —. C. Schätzlein. Z. Unters. Nahr. Genussm., 1918, **36**, 253–261.

A REACTION described by Medinger and Michel (cider giving a brown coloration with sodium nitrite solution whilst genuine wine remains bright yellow; see this J., 1918, 386 A) is found by the author to be unreliable.—W. P. S.

Cider. W. I. Baragiola, O. Schuppli, F. Braun, and J. B. Kléber. Z. Unters. Nahr. Genussm., 1918, **36**, 225—253.

ANALYSES of 28 samples of cider are recorded. The alcohol content varied from 3·25 to 5·18; total solids, 17·0 to 29·0; invert sugar and sucrose, 0·38 to 7·9; ash, 2·37 to 3·28 grms. per litre; total acid, 55 to 90 c.c. *N*/1 per litre. The amount of volatile acids was not more than that found in wines, whilst the amount of non-volatile acids was less than 2 grms. per litre. About one-half of the amount of lactic acid in the ciders was present in the combined state; citric acid was absent. The "unidentified" acid stated by Schulte (this J., 1919, 114 A) to be present in wine is probably lactic acid.—W. P. S.

Utilisation of the root of Anthriscus sylvestris (cow-parsley). H. Colin. Bull. Assoc. Chim. Sucr., 1918, **35**, 106—107.

ANALYSIS of the root of cow-parsley (*Anthriscus sylvestris*) showed its carbohydrate content to be: starch, 14·5; sucrose, 5·64, and reducing sugars, 0·96%. The roots are not suitable as cattle food, owing to the disagreeable odour; but they might advantageously be utilised for the production of alcohol. *Anthriscus* is a biennial, its carbohydrate content being highest at the end of the first year.
—J. P. O.

Methyl alcohol [in ethyl alcohol]; Detection of ——. E. Salkowski. Z. Unters. Nahr. Genussm., 1918, **36**, 262—270.

A TEST for methyl alcohol depends on its oxidation, and detection of the resulting formaldehyde. The ethyl alcohol to be tested is diluted with 9 vols. of water and 0·5 c.c. of this mixture is treated with

3 c.c. of dilute sulphuric acid and 3 c.c. of 1% potassium permanganate solution. After 8 mins., the solution is decolorised with saturated oxalic acid solution, distilled, and the distillate heated to boiling with the addition of 0·08 grm. of peptone, 3 drops of 3% ferric chloride solution, and its own volume of hydrochloric acid (sp. gr. 1·19). If the original alcohol contained as little as 1% of methyl alcohol, a bright violet coloration develops. This, and other tests which are based on the formation and detection of formaldehyde are reliable when dealing with methyl and ethyl alcohols alone, since the latter does not yield formaldehyde on oxidation. Higher alcohols, such as propyl, isobutyl, and isoamyl alcohols, yield distinct traces of formaldehyde when treated as above, and the presence of these alcohols in commercial ethyl alcohol might lead to the erroneous conclusion that methyl alcohol was present. In the deliberate adulteration of alcohol with methyl alcohol, quantities of less than 10% of the latter are not likely to be used; the strong coloration given by this proportion of methyl alcohol would be almost conclusive evidence of adulteration since the colorations yielded by the small quantities of higher alcohols which might be present in ethyl alcohol would be much less intense. —W. P. S.

Spirits; Detection of renatured alcohol in ——. L. Wolfrum and J. Pinnow. Z. Unters. Nahr. Genussm., 1918, **36**, 270–273.

THE removal of pyridine from denatured alcohol is not a difficult matter; the resulting spirit would still contain methyl alcohol, acetone, allyl alcohol, empyreumatic substances, etc., but it is possible that it might be used to adulterate brandy etc. Fendler and Mannich's reaction (conversion of the methyl alcohol into formaldehyde and detection of the latter by means of morphine dissolved in concentrated sulphuric acid) may be used for detecting the presence of such renatured alcohol, since it will indicate with certainty 6% of methyl alcohol in ethyl alcohol. If ethyl alcohol containing a small percentage of methyl alcohol is distilled until its volume is reduced to one-half, the distillate will contain 70% of the methyl alcohol.—W. P. S.

Glycerin; Production of —— from sugar by fermentation. Report of Chemistry Division of the U.S. Bureau of Internal Revenue, May 8, 1918.

OF a number of yeasts examined, the Steinberg variety of *Saccharomyces ellipsoideus* is found to give the highest yields of glycerol, into which 20—25% of the total sugar originally present is converted under the most favourable conditions. The latter vary somewhat with the nature of the saccharine liquor employed. The sugar solution should be rendered alkaline by addition of 5% of sodium carbonate, the alkali being introduced in the solid state and in portions as large, and as frequently, as the yeast is able to withstand. The yeast is previously acclimatised to sodium carbonate. A vigorous fermentation should be maintained throughout; a little ammonium chloride appears to help in this direction. The most favourable temperature is 30°—32° C., and the concentration of sugar should be 17·5—20 grms. per 100 c.c. The results of several experiments on a commercial scale are given. (See also this J., 1919, 175 B.)—T. H. P.

Methyl alcohol and denatured alcohol [in milk analysis]. Prescher. *See* XIXA.

Methyl and ethyl alcohols. Sabalitschka. *See* XX.

PATENTS.

Yeast; Extraction of — from fermented molasses. L. J. P. M. J. Dupire, Ramecourt, France. Eng. Pat. 124,364. 27.7.18. (Appl. 12,255/18.) Int. Conv., 22.3.18. Addition to Pat. 123,711 (this J., 1919, 334 A).

IN the centrifugal separation of yeast from fermented molasses, the separated yeast is washed by adding it to highly diluted molasses of density 0·5° B. (sp. gr. 1·003) kept at 31° C., and containing 0·1 grm. of sodium phosphate per litre. When fermentation commences, the mixture is centrifuged at a high speed. The separated yeast is thus obtained in a clear liquid of low density, and is very active.—J. H. J.

Proteolytic enzymes; Process of producing an extract of ——. T. Muto, Kobe, Assignor to Kanegafuchi Boseki Kabushiki Kwaisha, Tokyo-Fu, Japan. U.S. Pat. 1,296,600, 4.3.19. Appl., 14.12.18.

COCOON-FORMING insect material is digested with a solution containing sodium chloride at a temperature below 50° C., an antiseptic is added, and the solution is separated from the undissolved matter, and treated for the recovery of the enzyme therein.

Proteolytic enzymes, Process for producing an extract of —. T. Muto, Kobe, Assignor to Kanegafuchi Boseki Kabushiki Kwaisha, Tokyo-Fu, Japan. U.S. Pat. 1,296,599, 4.3.19. Appl., 25.4.17.

SEE Eng. Pat. 105,501 of 1917; this J., 1918, 437 A.

XIXA.—FOODS.

Wheat kernel and its milling products; Nutritive value of —. T. B. Osborne and L. B. Mendel. J. Biol. Chem., 1919, **37**, 557–601.

THE proteins of the wheat kernel as a whole possess a relatively high nutritive value. Those of the bran are, when utilised, slightly superior to those of the embryo, which are superior to those of the endosperm. The water-soluble vitamine appears to be localised in the endosperm, not in the embryo. No confirmation of the presence of a toxic substance in wheat was obtained. The question of the degree to which it is desirable to mill flour for general use is discussed. (See further J. Chem. Soc., June, 1919.)—J. C. D.

Meat; Chemistry of spoiled ——. K. G. Falk, E. J. Baumann, and G. McGuire. J. Biol. Chem., 1919, **37**, 525—546.

THE action of certain organisms, isolated from meat which was suspected of causing poisoning, on meat and a meat extract was studied. In every case the ammonia nitrogen showed an increase. *B. coli*, *B. enteritidis*, *B. subtilis*, and *Streptococcus brevis* cause a decrease in the creatine-creatinine value. *B. proteus* and *B. paratyphosus β* cause a slight decrease of purine nitrogen, but *B. subtilis* and *Streptococcus brevis* bring about an increase.—J. C. D.

Meat; Ammonia test for spoiled ——. K. G. Falk and G. McGuire. J. Biol. Chem., 1919, **37**, 547—550.

THE aeration method described by Folin and Bell (J. Biol. Chem., 1917, **29**, 329; this J., 1917, 572) is used to estimate the ammonia present in meat. When meat decomposes at the ordinary temperature (15°—25° C.) it becomes unfit for food when the

ammonia nitrogen content reaches 0·3—0·4 mgrm. per grm. of meat. At low temperatures the ammonia figure may be much higher, 1—3 mgrms. per grm. of meat, before the meat is unfit.—J. C. D.

Drying processes of to-day [for foodstuffs]. R. Schmidt. Z. angew. Chem., 1919, **32**, 108—113.

An outline is given of the various methods used for drying natural and artificial products. The accepted belief that drying *in vacuo* is cheaper and more rapid than drying in air has not been definitely proved. In the case of fruit and vegetable products reduction of the moisture to 8—12% is sufficient to obtain a stable preparation, and better results are obtained when the humidity of the air used in the drying is not allowed to fall below a definite degree. Discoloration of the product takes place not only towards the end of the drying but also through oxidation when the material is first cut up. To prevent this a short boiling or steaming ("blanching") is necessary, or preservation of the material in salt water or suitable acid solutions. All vegetables, with the exception of spinach, must be "blanched" to destroy enzymes. Steaming for 10 minutes does not effect any material change in the composition, whilst the same effect can be obtained by immersing the sliced vegetable in boiling water for not more than 1 to 2 mins., but immersion for 5 to 6 mins. causes a material loss of nutritive constituents. "Sulphuring" immediately after slicing will also protect potatoes etc. from discoloration. In processes in which the products of combustion from a coke fire and air are passed through the material to be dried, the sulphur dioxide in the gases improves the colour of the final product. Only about 0·0125 grm. of SO_2 per 1 cb. m. of the mixture of air and gases comes in contact with the material, and the permissible (German) limit for sulphur dioxide in dried vegetables and fruits is 0·125%.—C. A. M.

Tin-plate containers [for foodstuffs]; Substitutes for —. Advisory Council of Sci. and Ind., Commonwealth of Australia, Bull. No. 10, 1919. 78 pages.

Owing to the war, a shortage of tin-plate for making containers for foodstuffs arose in Australia and an inquiry was held into what local materials could be used as substitutes. Cardboard was found to be the most suitable. For holding liquids and hygroscopic solids, it is necessary to treat the containers with a waterproofing material. Investigation was made into the properties of metallic films, waxes, casein, viscose and synthetic resins as waterproofing materials, and it was found that paraffin wax was successful, except that it was acted upon by oily and spirituous substances. For these substances it was found necessary to use a synthetic resin. The best resin was made as follows: 4 vols. of carbolic acid, 3 vols. of formalin, and ½ vol. of concentrated ammonia are boiled under a reflux condenser until separation into two phases takes place; steam and volatile bodies are then distilled off, when the residue separates into two layers, an upper aqueous layer and a lower oily layer. The upper layer is removed and the lower boiled with fresh water several times. The washed oily resin is dissolved in half its volume of warm methylated spirit or rectified spirit. For use, the resin is diluted with alcohol to the consistency of linseed oil. The name of "magramite" was given to this varnish. The cardboard containers are sized, dipped in magramite, allowed to dry, and heated at 130° C. for 3 hrs. If the containers are not to be used for foodstuffs nor oily substances, the final heating may be omitted. The magramite containers were tested with jam and condensed milk, and were found to be unacted upon and the foodstuffs to be without any acquired odour.
—J. H. J.

Methyl alcohol and denatured alcohol; Use of — in place of ethyl alcohol [in milk analysis]. J. Prescher. Z. Unters. Nahr. Genussm., 1918, **38**, 286—287.

The use of methyl alcohol in place of ethyl alcohol in the Rose-Gottlieb method for determining fat in milk etc. is not recommended owing to the imperfect separation of the ethereal and aqueous layers of liquid obtained in the process. Provided that it has been distilled from alkali and is neutral, denatured alcohol may be used in place of ethyl alcohol for determining the freshness of milk by methods which depend on the quantity of alcohol required to coagulate the milk.—W. P. S.

Palm kernel and other feeding cakes; Rancidity of —. J. R. Furlong. J. Agric. Sci., 1919, **9**, 137—142.

Freshly prepared palm kernel cake has a characteristic odour due to a trace of volatile fatty acid being liberated during manufacture. On storing the cake in presence of moisture, it becomes rancid, owing to an increase in the volatile fatty acids which have an unpleasant odour. This increase in acidity was investigated in the case of palm kernel oil and was found not to be due to bacteria nor to hydrolysis, but to lipase. The action did not take place if the kernels were kept dry. Palm kernel cake and meal developed less acidity than some other oil cakes, such as cotton seed, linseed, coconut, etc., but in the case of the latter the acidity was not due to the production of volatile acids.
—J. H. J.

Coconut globulin and coconut press-cake; Nutritive value of —. C. O. Johns, A. J. Finks, and M. S. Paul. J. Biol. Chem., 1919, **37**, 497—502.

Normal growth was shown by rats fed upon artificial dietaries in which the sole source of protein was coconut globulin. This is in agreement with the observation that this protein contains all the amino-acids known to be essential for growth (J. Biol. Chem., 1919, **37**, 149). Good growth was shown by rats fed upon a diet containing 75% of coconut press-cake, in spite of the relatively low protein content of the diet (13·1%). These experiments show that coconut press-cake has a high nutritive value. The cake contains an adequate amount of the water-soluble vitamine, but an insufficient quantity of the fat-soluble vitamine, for the nutrition of the growing rat.—J. C. D.

Straw fodder; Preparation of — without using heat. E. Beckmann, O. Liesche, H. Netscher, and K. Platzmann. Z. angew. Chem., 1919, **32**, 81—82.

The straw is treated with about 8 times its weight of 1% sodium hydroxide solution for about 48 hrs. at the ordinary temperature, and is then washed. If desired, the sodium hydroxide may be replaced, after a time, by a further quantity, the first solution being treated with a quantity of sodium hydroxide sufficient to bring its alkalinity up to 1%, and then used for extracting a fresh charge of straw. The treated straw tends to become acid in reaction if kept for some time in a moist state.
—W. P. S.

Patents.

Meal or flour and milling products; Treating —. E. C. Sutherland, Deventer, Holland. Eng. Pat. 121,943, 12.9.18. (Appl. 14,863/18.) Int. Conv., 2.1.18.

In order to render inert the enzymes in flour which are capable of destroying hydrogen peroxide, a

small quantity of chlorine or of a substance containing active chlorine is added to flour, which is then treated with a peroxide by the process described in Eng. Pat. 102,967 (this J., 1918, 71A). —J. H. J.

Flour; Treatment of ——. H. Greville, Birkenhead. Eng. Pat. 124,298, 3.4.18. (Appl. 5671/18.)

To impart a slight acid reaction to dough made from wheaten flour, a mixture of ½ oz. of hydrogen peroxide (10 vols.) and 4 oz. of an acid substance, such as phosphoric acid (50%), is added to the water used in making the dough from a sack of flour. In the case of acid flours calcium peroxide may be used in the mixture.—J. H. J.

Eggs; Treating powdered or other dried —— to render them emulsifiable. W. Crossley, London. Eng. Pat. 124,968, 13.6.18. (Appl. 9736/18.)

In order to render dried granulated egg and coagulated liquid egg emulsifiable with water, they are submitted to enzyme action. The enzymes used are pancreatin, 18 parts, in an alkaline medium, pepsin, 25 parts, in an acid medium, or papain, 25 parts, in an acid, alkaline, or neutral, medium, at 40° C.; or diastase, 35 parts, in an acid or neutral medium at 50° C., to 5000 parts of egg and 10,000 parts of water.—J. H. J.

Food products; Method of manufacturing —— from fruits and vegetables, and the products. P. R. Welch, Assignor to The Welch Grape Juice Co., Westfield, N.Y. U.S. Pat. 1,295,943, 4.3.19. Appl., 31.8.17.

For the preparation of fruit and vegetable products, the juice is separated from the pulp, concentrated, again added to the pulp, and the mixture heated. —L. A. C.

Desiccating fluids [milk]; Apparatus for and method of ——. C. E. Rogers, Detroit, Mich. U.S. Pat. 1,297,496, 18.3.19. Appl., 8.5.15.

Milk or other liquid is concentrated at 140°—145° F. (60°—63° C.) and applied in a thin film to a rotating cylinder which is subjected to a current of air at a temperature not above 145° F. (63° C.) The partly dried film is removed from the cylinder and subjected to the same current of air till dry, when it is passed through a "tumbler" having a screen of the desired mesh through which it is discharged.—W. F. F.

Fodder from corn-cockle seeds; Process for preparing a ——. K. Hornbogen, Klotzsche. Ger. Pat. 309,987, 1.7.17.

The seeds are steeped for several days at a low temperature and with exclusion of air in water which is changed several times, then rapidly dried, at first with a strong current of air at 50°—60° C. and afterwards at 90°—110° C. The germination of the seed is inhibited by the low temperature of the steeping water and the exclusion of air, and the poisonous saponin is washed away. If the seeds contain no more than about 30% of vetch it is not economical to separate the vetch. Such a mixture is best treated by the addition of about 0·25% of alkali to the steeping water.—J. F. B.

Animal carcases. Ger. Pat. 309,722. *See* XV.

Treating peat. Eng. Pat. 124,629. *See* XVI.

XIXB.—WATER PURIFICATION; SANITATION.

Water; Significance of B. coli in judging the character of ——. E. Quantz. Diss., Göttingen, 1915. Chem. Zentr., 1919, **90**, II., 158—159.

From results obtained in tests for *B. coli*, in comparison with observations of the source of supply and the ordinary bacteriological and chemical examination of water, the following conclusions have been drawn: The occurrence of *B. coli* in water indicates surface contamination or insufficient filtration. A large number of bacteria in the water does not necessarily indicate pollution, as does the presence of *B. coli*. On the other hand, failure to detect *B. coli* is not a certain proof of the purity of well water. All that can be said is that, if, on repeated examination, even after heavy rain-fall, no *B. coli* is found, the water cannot be polluted to such a degree as to be immediately dangerous. The presence of *B. coli* is not conclusive proof of faecal contamination; hence percolations which have introduced that organism into the water, need not also have introduced typhus bacilli. In general, it may be assumed that the more numerous the *Coli* bacilli in water, and the more typical their behaviour in producing acid, the closer to the well is the source of pollution, and the more dangerous must the water be considered. The *B. coli* test is a valuable adjunct to an examination of the source of a water supply, but is not a substitute for it. It is also a good indicator of insufficient filtration, but, here again, certain proof of dangerous pollution can only be obtained by an examination of the deposit. —C. A. M.

Dakin's solution; Stabilisation of dilute sodium hypochlorite solutions. G. E. Cullen and R. S. Hubbard. J. Biol. Chem., 1919, **37**, 511—517.

Dakin's solution for clinical use may be efficiently stabilised by means of buffer salts (carbonates or borates) or by small amounts of sodium hydroxide. (See further J. Chem. Soc., June, 1919.)—J. C. D.

Dakin's solution; Electrolytic preparation of ——. G. E. Cullen and R. S. Hubbard. J. Biol. Chem., 1919, **37**, 519—523.

The curve representing the production of sodium hypochlorite per unit of time has an optimum point which may be raised by raising the initial temperature of the brine, the current being maintained constant at 20 amps. An increase in the concentration of the brine results in an increased production of sodium hypochlorite per unit time. More concentrated solutions than the 6% often recommended may be used, and with them higher concentration of hypochlorite and increased current efficiency may be obtained. It is pointed out that cells should not be operated beyond the peak of the production curve. The solution, as it comes from the cell, decomposes quickly and must be stabilised (see preceding abstract).—J. C. D.

Alkali hypochlorite solutions. Fonzes-Diacon. *See* VII.

Water bacterium. Volsenet. *See* XVIII.

PATENTS.

Distilled water; Process for the production of —— in power plant, more particularly steam turbine plant. E. Josse and W. G. Gensecke, Berlin. Ger. Pat. 305,381, 21.6.14.

The still is contained within the exhaust steam-conduit of the power plant, or in a branch thereof, and a higher vacuum is maintained therein than

in the principal condenser. The steam is distilled into a special condenser cooled by water at a lower temperature than that used in the principal condenser, so that a higher vacuum is maintained in the former than in the latter. In this manner the distillation may be effected by the waste heat of the turbine plant.—J. S. G. T.

Sewage sludge; Process and plant for the treatment of —. G. Förster, Saarbrücken. Ger. Pats. (A) 306,601, 22.10.15, and (B) 309,612, 8.8.16.

(A) In a plant in which the sludge is transferred from the settling chamber to an independent treatment chamber divided into compartments, the fresh sludge is introduced into the bottom of a compartment or compartments in which the sludge has attained its most active condition, and the mixed sludge is withdrawn from the top of the compartment or compartments and led into the remaining compartments. (B) In order to reduce the number and length of the connecting pipes required, mixing of the active sludge with fresh sludge is always effected in the same compartment, and the pipes through which the treated sludge is discharged from the compartments on to the drying beds are utilised also for the introduction of fresh or mixed sludge or sewage into the treatment chambers.

Waste products; Manufacture of useful substances from organic — —. G. Wolff, Paris. Eng. Pat. 121,576, 21.3.18. (Appl. 5021/18.) Int. Conv., 21.12.17.

Slaughter-house refuse is treated with alkali to produce ammonia, soap and alkali salts of organic acids of high molecular weight having detergent properties being obtained as by-products. (Reference is directed in pursuance of Sect. 7, Sub-sect. 1, of the Patents and Designs Act, 1907, to Eng. Pats. 2790 of 1873, 3493 of 1884, 15,887 of 1886, 8582 of 1900, 17,965 of 1904, and 5620 of 1909; this J., 1885, 232; 1887, 553; 1900, 753; 1905, 626; 1910, 889.)—J. H. J.

Feed water; Treatment of — in systems for condensing steam and heating feed water in steamships. G. & J. Weir, Ltd., and W. Weir, Glasgow. Eng. Pats. 125,149 and 125,150, 17.6.16. (Appls. 8560 and 8561/16.)

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Nicotine; Detection of —. O. Tunmann. Apoth.-Zeit., 1918, **33**, 485–486. Chem. Zentr., 1919, **90**, II., 227.

A few crystals of *p*-dimethylaminobenzaldehyde are dissolved in a drop of strong hydrochloric acid on a microscope slide and a drop of a solution of the alkaloid in water is placed by its side. Immediately the drops touch one another, a rose-coloured band appears at the place of contact; this changes to reddish-violet, and finally the whole liquid assumes the same shade. The colour gradually becomes deeper, and persists for 10–24 hours. Coniine, pyridine, and acetone give no coloration on similar treatment, and pyridine, coniine, and other alkaloids, if present, do not affect the colour due to nicotine. Aniline, in not too dilute solution, gives a red coloration, but the colouring matter separates out immediately in long red spear-shaped crystals. With 0·2 mgrm. of nicotine, the reaction commences in less than a minute, and it is possible by this means to detect the presence of nicotine in cigar smoke. A saturated solution of picric acid with 10% of hydrochloric acid also gives a very sensitive microchemical reaction with nicotine. With 0·01 mgrm. of nicotine, a yellow, amorphous precipitate separates immediately and rapidly splits up into crystals. With 0·005 mgrm., the precipitate does not appear, but the crystals are formed; these are usually visible to the naked eye, and can always be distinguished by means of a lens. The reaction can be detected with as little as 0·003 mgrm. of nicotine, in which case the crystals take from 2 to 3 minutes to appear. The crystals are coloured yellow and green under crossed nicols, and have an oblique extinction. Aniline, coniine, and dilute pyridine give no crystals, but pure pyridine gives similar crystals, with, however, no amorphous precipitate.—L. A. C.

Alkaloids; Precipitation of — by liquorice. J. W. Plenderleith. Pharm. J., 1919, **102**, 236.

The addition of infusion of liquorice to 1% solutions of strychnine hydrochloride, quinine hydrochloride (neutral), morphine hydrochloride, cocaine hydrochloride, heroine hydrochloride, atropine sulphate, and codeine sulphate caused the immediate formation of heavy yellow precipitates in the case of the first two alkaloids and no immediate precipitation or only a faint haze in the other instances. The B.P. solution of morphine hydrochloride gave a precipitate due to hydrochloric acid, and diluted tincture of opium and meconic acid solution also yielded dense precipitates. Solutions of caffeine alkaloid gave no precipitate whilst slight precipitates were formed with tinctures of digitalis and strophanthus. The precipitate probably consists of the glycyrrhizinate of the alkaloid. Liquorice is not a suitable agent for masking the bitterness of strychnine or quinine.—H. W.

Hydrastinine and its homologues; New synthesis of —. K. W. Rosenmund. Ber. deuts. pharm. Ges., 1919, **29**, 200–206.

The technical preparation of hydrastinine suffers under the disadvantage that the initial material, homopiperonylamine, is difficult to prepare; the author describes the synthesis of certain homologues of hydrastinine from the more readily accessible methylenedioxyphenylisopropylamine and also a new method of converting homopiperonylamine into hydrastinine. Methylenedioxyphenylisopropylamine is condensed with chloromethylalcohol to methylenedioxyphenylisopropylaminomethanol, $CH_2O_2.C_6H_3.CH_2.CH(CH_3).NH.CH_2OH$, which, when treated with aqueous hydrochloric acid, yields 3-methyldehydronorhydrastinine, colourless leaflets, m.pt. 57°—58° C.; methylation of the latter with formaldehyde gives 3-methyldehydrohydrastinine, m.pt. 85°—87° C., which is oxidised by potassium bichromate and sulphuric acid or by iodine to 3-methylhydrastinine, m.pt. 107°–108° C. 1-Benzyl-3-methylhydrastinine is obtained as a yellow syrup by the action of phosphoric oxide on phenylacetylmethylenedioxyphenylisopropylamine. Homopiperonylamine reacts with chloromethyl alcohol to yield homopiperonylaminomethanol, $CH_2O_2.C_6H_3.CH_2.CH_2.NH.CH_2OH$; the latter, like all members of the class, is unstable but is readily converted by warm 10% aqueous hydrochloric acid into dehydronorhydrastinine, identical with the base described by Decker (Annalen, 1911, **395**, 282; see also J. Chem. Soc., June, 1919).—H. W.

Digitalis; Chemical evaluation of —. A. Tschirch and F. Wolter. Schweiz. Apoth.-Zeit., 1918, **56**, 469–474, 495–498, 512–514. Chem. Zentr., 1919, **90**, II., 307–309.

All the known chemical methods for the evaluation of digitalis were compared with the so-called physiological method, the minimum toxic dose per gram of

frog being taken as the basis for the latter values; but no definite relationship could be traced. This is due to the fact that no chemical method determines the whole of the physiologically active substances such as digitoxin, digitalin, gitalin, etc., present in digitalis leaves, and these substances are not present in different leaves in the same proportions. It was eventually found that acetone extracted the whole of the active principles of digitalis, and by its means a chemical determination of these was possible. The leaves were first extracted with ether to remove chlorophyll, fat, etc., and then percolated with absolute alcohol. After purification of the extract with lead, the glucosides were removed from the clear filtrate by shaking with acetone, and separating the acetone layer by addition of sodium chloride. The active substance thus isolated was termed pandigiton, and the physiological value per gram weight of frog was about 1·2 mgrm. Even with this method agreement was not found between chemical and physiological values, and the conclusion was drawn that substances are present, in themselves inactive, which are nevertheless capable of influencing the activity of the drug. The colour reactions of digitalis are reactions characteristic of the pure glucosides, but these cannot be separated by simple extraction with different solvents.—G. F. M.

Glucosides of digitalis leaves; Adsorption of the ——. C. Mannich. Ber. deuts pharm. Ges., 1919, **29**, 206—213.

Experiments with gitalin showed the latter to be readily adsorbed from aqueous solution by blood charcoal (the latter can adsorb at least 20% of its weight), less readily from alcoholic solution, and still less readily from solution in chloroform. A specimen of charcoal containing 20% of gitalin did not lose glucosides when treated with water and only a portion when alcohol was used, but practically all of the gitalin was removed by chloroform. Other substances, such as fullers' earth, the sulphides of lead, copper, and zinc and particularly those of arsenic and antimony, have the power of adsorbing the bitter principles from an aqueous extract of digitalis leaves. Attempts to isolate the glucosides by treatment of infusion of digitalis with animal charcoal and subsequent extraction of the latter with chloroform did not lead to the desired result, possibly because the principles are not free in the aqueous solution but in complex compounds with other substances such as tannins. The author considers that the readiness with which the digitalis glucosides are adsorbed by the powdered drug explains the difficulty of their complete extraction and also the better results which are obtained when water, as solvent, is replaced by alcohol.—H. W.

Strophanthus and digitalis tinctures of different origin; Pharmacological evaluation of ——. G. Joachimoglu. Ber. deuts. pharm. Ges., 1919, **29**, 170—199.

The value and permanence of the tinctures is determined by observing the lethal dose for the male frog according to Heffter's method (Berl. klin. Wochenschr., 1916, **54**, 669). The strophanthus tinctures were prepared from ordinary and fat-free seeds of the three strophanthus varieties. That derived from *Strophanthus Kombé* proved to be the most active. The tincture obtained from fat-free *S. Kombé* seeds was only about half as active as the ordinary tincture, but no such difference was observed with the tinctures of *S. gratus*. After two years, a small decrease in activity was observed with tinctures from the ordinary seeds, whilst those made from fat-free seeds remained practically unaffected. Digitalis tinctures prepared with absolute or with 68—69% alcohol (according to the Deutscher Arzneibuch 5) proved equally active. In the preparation of these tinctures only 75% of the digitalis substances which can be removed by extraction in a Sohxlet apparatus are obtained. After four months both tinctures retained their activity which, however, was lost to some extent after eleven months, possibly owing to a high summer temperature, since direct experiment showed that increase in temperature causes a more rapid diminution in activity. Light appears to have little influence. Examination of a number of commercial samples of digitalis tincture showed them to vary greatly in pharmacological action, some being almost three times as potent as others. This is attributed to a difference in activity of the different specimens of digitalis leaves.—H. W.

Aspirin [acetylsalicylic acid] and aspirin tablets; Purity of commercial ——. A. J. Jones. Chem and Drug., 1919, **91**, 402—404.

For the detailed examination of samples of aspirin a determination of acid, ester, and bromine values, the free salicylic acid, the melting point, and the odour and colour in soda solution, are suggested. The bromine value is obtained by adding a solution of bromide and bromate to the aspirin solution, acidifying, and determining the residual bromine by addition of iodide and titration with thiosulphate, whilst for the estimation of free salicylic acid the following procedure is recommended: 0·6 grm. of aspirin is dissolved in 9 c.c. of alcohol and diluted with water to 90 c.c., of which solution portions of 60 c.c. and 30 c.c., with 3 c.c. of alcohol, are placed in two similar Nessler glasses, and the smaller volume is adjusted to equal the larger so that there is a difference of 0·2 grm. of aspirin in mixtures containing the same quantities of alcohol and water. 1 c.c. of 1% iron alum is then added to each solution and the colours matched by adding the requisite quantity of 0·01% salicylic acid. When the test is carried out by the method described in the British Pharmacopœia, crystalline condition and surface effects will often conceal free salicylic acid, as will also the depressing effect of alcohol on the coloration when the test is performed in dilute alcoholic solution. In soda solution yellow to pale straw colours were observed with commercial aspirin, and in certain cases objectionable odours were developed. The author suggests as a standard that the acid and ester values should not differ by more than 0·3 c.c. of *N*/5 soda per grm., free salicylic acid should not exceed 0·15%, the melting point should not be lower than the present official standard, and only a pale straw colour and no odour should be developed in soda solution. With aspirin tablets a determination of the free salicylic acid by iron, and the total by bromine, is the most satisfactory method of investigation.

—G. F. M.

Sodium salicylate. J. W. Plenderleith. Pharm. J., 1919, **102**, 236.

It is known that solutions of sodium salicylate, 1 in 1, are liable to deposit crystals of the salt containing 6 mols. H_2O. Under certain conditions or with some samples of sodium salicylate crystals may be deposited from a 1 in 2 or even a 1 in 3 aqueous solution.—H. W.

Eugenol, triacetin, and benzyl alcohol; Analysis of a mixture containing ——. H. Perperot. Ann. Chim. Analyt., 1919, [ii], **1**, 112—114.

The amount of triacetin present is calculated from the saponification value of the mixture. To determine the eugenol, the iodine value of the mixture is determined by Hübl's method; exactly 0·5 grm. of the sample is taken for the determination and the time of contact with the Hübl reagent should be

2 hrs.; the number of c.c. of thiosulphate solution (24 grms. per litre) corresponding with the iodine absorbed is multiplied by 1·64 to obtain the percentage of eugenol. Another portion of the sample is boiled for 2 hrs. with sodium acetate and an excess of acetic anhydride, and the saponification value of the acetylated product is determined. After deducting the saponification values due to the triacetin and acetylated eugenol, the remainder is a measure of the benzyl alcohol.—W. P. S.

Thymol; Estimation of ——. E. Moles and M. Marquina. Anal. Fís. Quím., 1919, **17**, 59–83.

A solution of thymol in water is added to sodium bicarbonate solution. A measured quantity of standard iodine is added in excess. After addition of sulphuric, or preferably, hydrochloric acid, the excess of iodine is titrated with thiosulphate solution. With varying values of the ratios thymol: bicarbonate and thymol: iodine added, the mean quantity of iodine consumed per molecule of thymol was found to be 3·60 atoms.—W. S. M.

Dichlorocthyl sulphide [*mustard gas*]. *III. Solubility and hydrolysis of dichlorocthyl sulphide, with a new method for estimating small amounts of the same.* E. F. Hopkins. J. Pharmacol., 1919, **12**, 393–403.

The solubility of dichlorocthyl sulphide in water has been determined and, at 10° C., has been found to be approximately 0·07%. The velocity of hydrolysis of dichlorocthyl sulphide has been measured at 0·6° C., 10° C., 20° C., 30° C., and 37·5° C.; the data are graphically represented in a series of curves. Hydrolysis is found to follow the equation for a unimolecular reaction. Dichlorocthyl sulphide in admixture with air may be rapidly estimated by bubbling the gas through a series of two tubes containing water at 35° C.; the gas is rapidly absorbed and hydrolysed and the hydrogen ion concentration of the solution is then measured, methyl red being used as indicator. It is necessary that all the glass ware used should be unaffected by water.
—H. W.

Cacodyl compounds; Estimation of arsenic in volatile ——. L. C. Maillard. Bull. Soc. Chim., 1919, **25**, 192–200.

A suitable weight of the cacodyl compound, in a sealed bulb if liquid or in a narrow tube if solid, is introduced into a 150 c.c. flask containing 3 grms. of ammonium persulphate, 30 c.c. of water, and 10 c.c. of sulphuric acid. The flask is quickly closed with a ground-in stopper and thoroughly shaken, until the air in the flask, which becomes cloudy at first, is quite clear. The arsenic is now in the form of cacodylic acid and is subsequently oxidised to arsenic acid by means of nitric acid and precipitated as magnesium ammonium arsenate, either with or without an intermediate precipitation as arsenic sulphide. The method was applied to cacodyl chloride and found to be quite accurate and preferable to the usual dry oxidation method.—W. G.

Methyl alcohol and absolute alcohol; Simple method of distinguishing between ——. T. Sabalitschka. Ber. deuts. pharm. Ges., 1919, **29**, 214–219.

The sample (2 c.c.) is frequently shaken during ten minutes with powdered crystalline copper sulphate (0·1 grm.) and the solution is filtered. The filtrate is treated with water (5 c.c.) and ammonia solution (10%, 3 c.c.); with methyl alcohol, a deep blue to blue coloration is developed whilst with ethyl alcohol the solution is only coloured a faint, pale blue. The method may also be used to obtain an approximate estimation of methyl alcohol in mixtures of the latter with absolute alcohol providing the content is not less than 20%; if this is the case, 20 c.c. of the specimen is distilled and the test is performed on the first 2 c.c. of the distillate (compare Fendler and Mannich, this J., 1905, 1128), but the results are only reliable when affirmative. In the presence of water, even in small quantities, the process is useless since the solutions of hydrated salts in alcohol are unstable and the presence of water promotes separation of the salt. Instead of copper sulphate crystalline ferrous sulphate may be used. The test is performed in a similar manner but, owing to the greater instability of the solutions, agitation should be restricted to five minutes. The presence of iron in the filtrate is detected by addition of water (5 c.c.) and 2·5% potassium ferricyanide solution (2 c.c.), the colorations obtained varying from dark blue with pure methyl alcohol to pale green with ethyl alcohol.—H. W.

Patents.

Acetaldehyde; Manufacture of ——. J. Crosfield and Sons, Ltd., Warrington, and T. P. Hilditch, Grappenhall. Eng. Pat. 124,702, 25.4.18. (Appl. 3541/19.)

The sludge of mercurous sulphate and mercury formed during the conversion of acetylene into acetaldehyde by passing the gas into a solution of mercuric sulphate and sulphuric acid at 60° C., is oxidised and its activity restored by the addition of a small quantity of manganic acid, permanganic acid, or a salt of one of these acids. The revivification of the sludge can be effected repeatedly until the accumulation of aldehyde by-products and resins renders it necessary to wash the sludge free from organic matter before re-oxidation in the presence of fresh sulphuric acid. It is advisable to maintain the concentration of the mercuric salt in the solution at from 0·5–1·5% expressed as mercuric oxide and to prevent any possibility of contact of the solution with metallic fittings. By passing acetylene through a solution of 40 parts of sulphuric acid (sp. gr. 1·84), 5 parts of crystallised ferric sulphate, and 2 parts of mercuric oxide in 153 parts (by weight) of water at 60° C., approximately 41 parts by weight of acetaldehyde can be produced in two hours, after which the reaction becomes sluggish but can be restored by the addition of one part of potassium permanganate, when 26 parts of acetaldehyde may be obtained in the next 2 hours. The quantity of permanganate used was 3·8% of the acetaldehyde produced and this was 96·9% of the theoretical quantity demanded by the observed absorption of acetylene.—D. F. T.

Tetranitromethane; Manufacture of ——. K. J. P. Orton, Bangor. Eng. Pat. 125,000, 3.8.18. (Appl. 12,714/18.)

Acetylene is passed into 90—97·5% nitric acid, preferably at a temperature of about 40° C.; absorption occurs more readily in the presence of mercury or a mercury salt, for instance mercuric nitrate added to the extent of 0·2–0·6% of the weight of the nitric acid, and the yield is increased at 30°–40° C., though not at the ordinary temperature. The product is mixed with sulphuric or fuming sulphuric acid under conditions excluding rise of temperature (the proportion of acid should be about twice the weight of the nitric acid used since, with small proportions, explosion is liable to occur) and the mixture is gently heated till the tetranitromethane distils or, preferably, gently heated under a reflux condenser until gas ceases to be evolved and then distilled. Apparently the chief product of the action of acetylene on nitric acid is an intermediate compound which is converted into tetranitromethane when the solution is heated with sulphuric acid.—H. W.

[Sodium salicylate;] Apparatus for treating chemicals [in manufacture of ——]. J. D. Sartakoff, New York. U.S. Pat. 1,284,468, 12.11.18. Appl., 5.6.17.

An apparatus for the manufacture of sodium salicylate by the action of carbon dioxide on sodium phenoxide according to the Bayer process, consists of a number of drums heated in an oil bath, a cooling device through which the oil can be circulated in order rapidly to reduce its temperature, and a thermostatic device by means of which the oil can be kept at the desired temperature at each stage of the treatment with carbon dioxide.

Benzoylation of organic amido compounds; Process for the ——. F. Reverdin, Geneva, Switzerland, Assignor to Newport Chemical Works, Inc., Milwaukee, Wis. U.S. Pat. 1,296,602, 4.3.19. Appl., 16.7.18.

Benzoylation is effected at a moderate temperature, without the use of a solvent, by the action of benzoyl chloride in presence of a small amount of concentrated sulphuric acid. (See also this J., 1918, 715 A.)

Hydantoins; Preparation of ——. Chem. Fabr. von Heyden A.-G., Radebeul. Ger. Pats. (A) 309,508, 5.5.14, and (B) 310,426, 13.5.14.

(A) Aryl-alkyl-hydantoins are obtained by the action of hypochlorite or hypobromite solutions on CC-aryl-alkylcyanacetamides. Thus phenylethylcyanacetamide (m.pt. 116° C.) obtained from ethyl iodide and sodium phenylcyanacetamide dissolves in sodium hypobromite solution, and, on warming, gives phenylethylhydantoin which forms glistening needles, m.pt. 201°—202° C. Phenylallylhydantoin is obtained in an analogous manner. The arylalkylhydantoins are useful as soporifics. (B) Hydantoins are obtained by the action of hypochlorites or hypobromites on disubstituted malonamides. Thus diethylmalonamide and potassium hypobromite give diethylhydantoin. phenylethylmalonamide (m.pt. 124° C. with decomp.) prepared from phenylethylcyanacetamide and concentrated sulphuric acid at 125° C., gives, after standing for several hours with sodium hypobromite, phenylethylhydantoin, whilst in an analogous manner sodium hypochlorite converts diallylmalonamide into CC-diallylhydantoin. The first action of hypochlorite is the formation of monochloramides which may be isolated by acidifying immediately after the amide has dissolved.

—G. F. M.

Hypophysis gland; Extractive product from the ——. Salts of the extractive product from the hypophysis gland. F. Flaecher and B. Reuter, Assignors to Farbw. vorm. Meister, Lucius, u. Brüning, Höchst, Germany. U.S. Pats. (A) 1,296,063 and (B) 1,296,064, 4.3.19. Appl., (A) 25.9 and (B) 23.12.12. (B) Renewed 19.11.15.

See Eng. Pat. 23,655 of 1912; this J., 1913, 450.

Treating peat. Eng. Pat. 124,629. *See* XVI.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Radio-photography; Negative plate substitutes for ——. E. E. Burnett, Hayes Town, Middlesex. Eng. Pat. 125,490, 18.9.18. (Appl. 5810/18.)

A negative plate substitute for use in radio-photography is prepared by coating paper with calcium tungstate emulsified in gelatin or other suitable medium, and then with a sensitive photographic emulsion.—L. A. C.

Photochemical etching process. J. Rieder, Berlin-Steglitz. Ger. Pat. 309,376, 18.1.18.

The surface to be etched is covered with a sensitised film of caoutchouc and asphalt, exposed below a negative, developed with acetone or a similar substance, dusted over either at once, or after a light etching, with a powdered low-melting resin, and gently warmed until the powder melts. The surface may then be deeply etched by the usual means; the resin is firmly held on the exposed and developed portions and protects these from corrosion.

—G. F. M.

Platinum toning of printing out paper. B. Ehrenberg, Elbing. Ger. Pat. 310,445, 17.12.16.

A deep print is made, and is bleached in a 15% salt solution, preferably after washing out the chloride. It is then placed in a preliminary bath of ammonia, or an alkaline ammonium salt, toned in a gold bath, and finally fixed in a concentrated sodium thiosulphate bath (at least 15%) until the blue and red tone of the gold is destroyed. A pure platinum tone of great brilliance even with thin negatives, is thus obtained without the use of platinum. The best results are attained by using a buff coloured paper ("chamoiscelloidin papier") as otherwise the ground colour of the paper interferes somewhat with the purity of the platinum tone.—G. F. M.

XXII.—EXPLOSIVES; MATCHES.

Sulphuric and nitric acids; Densities of mixtures of ——. P. Pascal and Garnier. Bull. Soc. Chim., 1919, **25**, 142–145.

Tables are given showing the densities of sulphuric and nitric acids at varying concentrations, and of mixtures of these acids in different proportions and with varying proportions of water added. The results indicate that, in the zone of mixtures used for nitrating cotton, the density is almost entirely a function of the water content.—W. G.

Mercury fulminate; Analysis of ——. A. Langhans. Z. anal. Chem., 1918, **57**, 401–445.

The method proposed depends on the volumetric determination of the hydroxylamine formed when mercury fulminate is dissolved in hydrochloric acid. Three grms. of the sample is dissolved in 12 to 15% cold hydrochloric acid and the solution is diluted with the acid to 100 c.c., 5 c.c. of this solution is mixed with 50 c.c. of iron alum solution (iron alum, 5 grms., 30% sulphuric acid, 25 c.c., water to 100 c.c.), the mixture is boiled for 18 mins., then diluted with a mixture of dilute sulphuric acid (1 : 4), 30, and water, 50 c.c., and titrated at 60° C. with *N*/20 potassium permanganate solution. With the above quantities of sample, reagents, etc., 84·48 c.c. of permanganate solution is equivalent to 100% of mercury fulminate. Attempts to determine the formic acid produced at the same time as the hydroxylamine were unsuccessful. (See also this J., 1918, 637 A.)—W. P. S.

Ammonium nitrate. Bolling. *See* VII.

Patents.

Picric acid; Manufacture of ——. A. G. Green, Leeds. Eng. Pat. 16,607, 24.11.15.

Benzene is converted successively into chlorobenzene, dinitrochlorobenzene, and dinitrophenol, and the latter is nitrated to picric acid by treatment with one molecular proportion (or slightly more)

of nitric acid in the presence of concentrated sulphuric acid. When the reaction is complete, the mixture is cooled to about 40° C., run into cold water contained in a wooden vat, and the liquor run on to a suction filter. Alternatively, water may be added to the mixture after nitration, the picric acid allowed to crystallise by cooling, and the waste acid filtered off through a filter-bed composed of tiles or other acid-resistant material. An almost theoretical yield is obtained, the operations can be conducted in large charges in cast-iron nitrating vessels, the evolution of nitrous fumes is very small, and the waste sulphuric acid can be readily reconcentrated as it contains no by-products. In nitrating the dinitrophenol the nitric acid may be replaced by an equivalent amount of dry sodium nitrate, but in this case the recovery of the sulphuric acid presents difficulties.—T. St.

Picric acid; Process of manufacturing — and apparatus employed therewith. D. B. Macdonald, Leicester. Eng. Pats. 17,525, 15.12.15, and 5551, 15.4.16.

PICRIC acid, prepared either from benzol by the action of mercury and nitric acid, or by the nitration of sulphonated phenol by means of alkali nitrates, is dissolved in benzol, and the solution separated from the other products of the reaction. A suitable portion of the benzol is driven off and the residue allowed to crystallise, after which the mother liquor is run off, and the remaining benzol driven off by heat. Detailed working directions are given with reference to apparatus in which the various operations are conveniently and economically carried out.—T. St.

Picric acid; Manufacture of —— from dinitrophenol in crystal form and the elimination therefrom of the sulphate of lead. L. B. Holliday and L. G. Badler, Huddersfield. Eng. Pat. 124,490, 31.1.16. (Appl. 1442/16.)

AFTER the last addition of mixed acid in nitrating dinitrophenol, the mass is heated to about 85° C., and hot water at about 85° C., or steam, is added in sufficient quantity to raise the temperature to 122° C. or over. The mass is then agitated, cooled to 25°—30° C., and filtered, and the picric acid crystals washed with weak sulphuric acid free from lead sulphate. Any lead sulphate contained in the strong sulphuric acid used in nitrating is by this means almost entirely left in solution when the picric acid crystallises, and the subsequent washing removes any lead sulphate retained by the crystals.—T. St.

Nitration process and apparatus therefor. Chance and Hunt, Ltd., and A. E. Holley, Oldbury, and O. E. Mott, Woolwich. Eng. Pat. 124,461, 7.1.16. (Appl. 317/16.)

APPARATUS designed more particularly for the production of trinitrotoluene consists of eight or more jacketed pots in series through which the organic matter being nitrated and the acid pass in opposite directions. Each pot is divided by a vertical partition into mixing and separation compartments which are in direct communication through a hole provided at about the centre of the partition. Alternatively, communicating but independent mixing and separator pots may be used. Except in the case of the end members of the series, the bottom of each separator is connected to the bottom of the adjacent mixing pot on one side, and the top of the separator to the top of the adjacent mixing pot on the other side. The pots may all be at the same level, the flow of acid and nitrated substance being caused solely by the head produced in the separators. Sulphuric acid (92—94%) is fed into the pot from which the finished product is taken and nitric acid is introduced as required into the intermediate pots.—T. St.

Trinitrotoluene; Purification of ——. The Clayton Aniline Co., Ltd., A. Scheller, and E. N. Marchant, Manchester. Eng. Pat. 124,803, 8.4.16. (Appl. 5178/16.)

TRINITROTOLUENE still containing excess of sulphuric acid from the nitration process is heated with water and a suitable quantity of sodium hypochlorite solution at 80°—85° C. for 20 to 30 minutes. After settling, the trinitrotoluene is run off, washed until neutral, and dried.—T. St.

Guncotton; Means for nitrating ——. G. Fussell, Lockport, N.Y. U.S. Pat. 1,296,280, 4.3.19. Appl., 1.3.17.

A VERTICAL hollow screw is mounted in a perforated cylindrical basket which, in turn, is mounted within a casing provided at its bottom with an annular acid-receiving gutter, and means are provided for rotating the screw and the basket at different speeds. One edge of the hollow screw, below the thread, is cut away to form an opening for the passage of cotton, the lower edge of the screw thread engaging the bottom of the basket. Means are provided for feeding saturated cotton to the interior of the screw, and means within the casing and below the top of the basket for receiving and conveying the guncotton from the top of the screw.—T. St.

Explosive. A. J. Marin, Stockholm, Sweden. U.S. Pat. 1,297,213, 11.3.19. Appl., 29.5.18.

A COMPRESSED solid safety explosive, capable of being detonated freely in the open air by a No. 6 detonator, is prepared by mixing in a damp state 28—34% of a nitronaphthalene with 72—66% of an oxidising mixture composed of ammonium perchlorate 47, and sodium nitrate 34 parts by weight, and compressing the mixture so that the specific gravity shall be between 1·3 and 1·62 after drying. T. St.

Mixing explosive compounds; Plant for —— and for simultaneously charging a plurality of shells or the like. J. L. Musgrave and R. G. Crittall, London. Eng. Pat. 125,477, 24.8.16. (Appl. 12,023/16.)

Nitration process. A. E. Holley, Oldbury, and O. E. Mott, Woolwich, Assignors to Chance and Hunt, Ltd., Oldbury. U.S. Pat. 1,297,170, 11.3.19. Appl., 5.12.17.

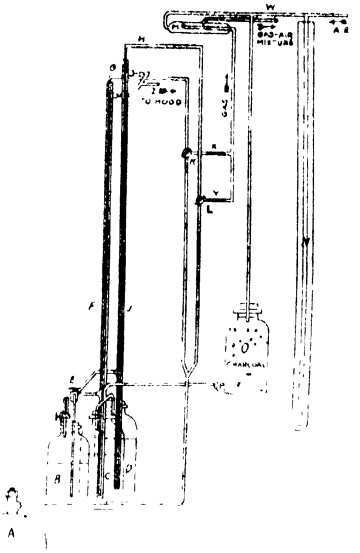
SEE Eng. Pat. 124,461 of 1916; preceding.

XXIII.—ANALYSIS.

Meter; Automatic compensating flow ——. G. G. Oberfell and R. P. Mase. J. Ind. Eng. Chem., 1919, 11, 294-296.

IN the apparatus described, a varying pressure is maintained on the inlet of a capillary tube such that the pressure difference between the inlet and outlet is always constant; it is an advantage to use two such devices, since the concentration of the gas in a gas-air mixture can be changed from one concentration to another almost instantly, and the apparatus can also be used in maintaining the con-

centration of binary gas-air mixtures. Referring to the diagram, *C* and *D* are levelling bottles of about 3 qts. capacity; the height of the liquid in these bottles determines the constant pressure difference on the inlet and outlet of the capillaries. *B* is a supply reservoir for *C* and *D*. *F* and *J* are glass tubes of about ⅜ in. diameter; *G* and *H* are small glass tubes through which the excess of gas escapes and these tubes reach nearly to the bottom of *C* and *D*. *X* and *Y* are the capillaries which admit the gas into the gas-air mixture line at the mixing chamber, *W*. The three-way capillary taps,



K and *L*, direct the flow of gas through the capillaries and overflow tubes, *G* and *H*. The line, *W*, is connected with the gas-air mixture line just ahead of the gas inlet by a T-tube; it passes through a bottle, *O*, filled with charcoal (to absorb gas which might escape from the liquid in *C* and *D*) and thence into the levelling bottles, *C* and *D*. When the apparatus is in use, the pressure in the gas-air line is communicated to the bottles, *C* and *D*, and forces the liquid up into the tubes, *F* and *J*, until the difference in level counterbalances the pressure in the gas-air line. This line pressure is that which is against the outlets, *X* and *Y*, at all times, consequently, the height of the liquid in *F* and *J* above the levels of the liquid in *C* and *D* affords a measure of the pressure against the outlets of the capillaries. The gas flowing slowly from the cylinder, *A*, is conducted through a T-tube to the taps, *K* and *L*; one of these is closed to the capillary not in use whilst the other is so turned that the gas flow divides, part of it passing through the capillary and the remainder through the overflow tube. The overflow gas bubbles out against the height of liquid in *F* or *J* above the level in *C* or *D*; hence the pressure difference on the inlet and outlet of the capillary in use is always constant and equal to the pressure afforded by the height of the liquid in *C* or *D*. The proper size for the capillaries must be determined experimentally.

—W. P. S.

Electrical precipitator for analysing smokes. R. C. Tolman, L. H. Reyerson, A. P. Brooks, and H. D. Smyth. J. Amer. Chem. Soc., 1919, **41**, 587—589.

A MODIFIED Cottrell precipitator for removing the solid particles from smoke is described. It consists of a glass tube, ½ in. diam. and 10 in. long, inside which is a thin aluminium foil cylinder, 0·001 in. thick, which constitutes the anode. A cathode of No. 25 platinum wire threaded with a jeweller's die passes centrally down the aluminium cylinder. Entrance and exit tubes for the smoke are attached at the ends. The electrodes are connected to a source of high voltage current (15,000 volts) and a corona discharge is produced; sparking must be avoided. The smoke is admitted at the rate of 5 litres per minute, the negatively charged particles being deposited on the aluminium foil. The weight of the particles is determined by weighing the anode before and after the precipitation. J. F. S.

Anions; Indirect electrolytic estimation of —— without platinum electrodes. E. Lasala. Anal. Fis. Quim., 1919, **17**, 88—95.

CHLORIDE, bromide, and iodide ions are precipitated by means of silver nitrate, the silver halide is dissolved in 20% solution of potassium cyanide, caustic soda is added, and the solution is electrolysed with a nickel-plated copper cathode and a rotating iron anode. Towards the end of the electrolysis the electrolyte is heated nearly to boiling. The results are excellent.—W. S. M.

Carbon dioxide in gases; Rapid determination of ——. W. A. Hargreaves. Chem. Eng. and Min. Rev., Australia, 1919, **11**, 142—143.

A SAMPLE of gas to be examined is drawn into a 100 c.c. calibrated burette by means of a close-fitting plunger, and is adjusted to atmospheric pressure by opening the tap momentarily. The burette is fixed over, and connected by means of a capillary tube to, a stoppered bottle filled with a solution of sodium hydroxide. The gas is forced out of the burette into the bottle, and some of the reagent is thereby caused to pass into a second bottle, and after absorption of carbon dioxide is completed, the plunger is raised carefully until the solution is drawn back to a predetermined mark on the capillary tube. The percentage by volume of carbon dioxide is represented by the difference in position of the plunger base. Technically accurate results are given by this apparatus, the average error in a number of analyses being 0·3% on the volume of gas taken.

—C. A. K.

Phosphoric acid; Gravimetric determination of ——. L. W. Winkler. Z. angew. Chem., 1919, **32**, 99—101.

A CRITICAL examination of the determination of phosphoric acid by precipitation as ammonium magnesium phosphate. The phosphate solution, measuring 100 c.c. and containing about 0·1 grm. of P_2O_5, is treated with 2·5 grms. of ammonium chloride, boiled, 10 c.c. of 10% ammonia is added, followed by 0·5 c.c. of magnesium sulphate solution (magnesium sulphate, 10, ammonium chloride, 5 grms., water, to 100 c.c.). The hot mixture is stirred until the precipitate becomes crystalline, a further 9·5 c.c. of the magnesium sulphate solution is added slowly, and when the mixture is quite cold, the precipitate is collected, washed with 1% of ammonia, dried, and weighed. The precipitate may be converted into magnesium pyrophosphate by ignition before being weighed With quantities of magnesium pyrophosphate varying from 0·05 to 0·25 grm., the weight found is about 0·3 mgrm. too high. Potassium and sodium chlorides do not interfere when the precipitate is weighed as ammonium magnesium phosphate, but the presence of potassium chloride causes the result to be too high if the precipitate is ignited to pyrophosphate before being weighed. The figures obtained are

slightly too high when the phosphoric acid has been precipitated previously as ammonium phosphomolybdate in order to separate it from iron, calcium, etc.—W. P. S.

Phosphoric acid; Gravimetric determination of ——— *as magnesium pyrophosphate.* Z. Karaoglanow. Z. anal. Chem., 1918, **57**, 497—541.

INVESTIGATION of the various methods for the precipitation of ammonium magnesium phosphate showed that the results obtained are to some extent dependent on the temperature of precipitation, method of precipitation (slow or rapid), and proportion of magnesium chloride, ammonium chloride, etc., present. In most cases, however, the differences are very small. The presence of potassium chloride in the solution causes the results to be too high owing to the inclusion of potassium in the precipitate. (See also J. Chem. Soc., June, 1919.)—W. P. S.

Methoxyl group; Estimation of the ———. J. T. Hewitt and W. J. Jones. Chem. Soc. Trans., 1919, **115**, 193—198.

ZEISEL'S method is modified by the use of a rectifying column in place of the inclined condenser (compare Hewitt and Moore, this J., 1902, 195) and by collecting the methyl iodide vapour in pyridine (compare Kirpal and Bühn, this J., 1914, 570); the resulting mixture of pyridine and its methiodide is then diluted with water, acidified with nitric acid, and treated with a known amount of silver nitrate; the excess of the last reagent may then be determined by Volhard's method with thiocyanate. For the preparation of the hydriodic acid it is recommended to saturate an aqueous suspension of iodine with hydrogen sulphide, whilst the pyridine is obtained from commercial pyridine bases by distilling with two-thirds their weight of water and collecting the fraction between 93° and 97° C.; this is then shaken with one-third its weight of solid sodium hydroxide, and the fraction boiling between 114° and 117° C., obtained on distillation of the upper layer, is collected for use. The method may be applied to the examination of the products of wood distillation or other mixtures containing methyl alcohol as follows: A suitable amount (*a*, *infra*) of the liquid is heated with 20 c.c. of hydriodic acid (sp. gr. 1·7) for one hour and the mixture diluted with water to 100 c.c.; to an aliquot portion (*b*, *infra*) are added to 70 c.c. of water, 25 c.c. of *N*/10 silver nitrate, and 30 c.c. of 10*N* nitric acid, the liquid is shaken for 5 mins., and 5 c.c. of concentrated ferric alum indicator is added *N*/10 Thiocyanate solution is now added until further addition of one drop produces a permanent orange colour. Suitable amounts to be used are: (i) Pyroligneous acid, *a*, 5 c.c.; *b*, 40 c.c.; (ii) Crude wood naphtha, *a*, 5 c.c. of 10% aqueous solution; *b*, 40 c.c. (iii) Methyl alcohol and mixtures of methyl alcohol with acetone, *a*, 5 c.c of 10% solution; *b*, 20 c.c. The weight of methyl alcohol in 100 c.c. of the liquor is found by deducting from 25 the volume of thiocyanate used and multiplying by (i) 0·16, (ii) 1·6, or (iii) 3·2. The method gave results averaging 1% low when tested on artificial mixtures containing methyl alcohol and other products of wood distillation. The authors consider that when precautions are taken to eliminate, prior to analysis, substances other than methyl alcohol, yielding methyl iodide, the errors due to losses outweigh the error introduced through ignoring their presence.—D. F. T.

Nessler solution; Regeneration of ———. D. Pullman. Analyst, 1919, **44**, 124—125.

A MODIFIED Nessler solution in which a double iodide of zinc and mercury replaces the potassium mercury iodide gives as good results as the ordinary reagent. It is prepared by heating a suspension of 431 grms. of mercuric iodide in 500 c.c. of water to boiling point on the water-bath, adding 31 grms. of zinc, and heating the mixture, with stirring, for 5 mins., after which the hot solution of zinc mercuric iodide is filtered, the precipitated mercury washed with boiling water, and the filtrate and washings made up to 3000 c.c. with warm water. After cooling, a saturated solution of mercuric chloride is added, a few c.c. at a time, until a permanent red precipitate appears. A solution of 540 grms. of sodium hydroxide in 1000 c.c. of water is added, and the whole made up to 5000 c.c. In practice the best results are obtained by adding 3 c.c. of the reagent to 50 c.c. of the water to be tested. Should the finished solution throw down a red precipitate the smaller effective amount of potassium iodide should be added The metallic mercury precipitated, as described, is dissolved in 100 c.c. of strong nitric acid and the solution made up to 1000 c.c. In regenerating used Nessler solution prepared by this method the liquid is slightly acidified with sulphuric acid, and for every 5 c.c. of the original reagent present one c.c. of the mercuric nitrate solution is added, and the precipitated mercuric iodide is washed and dried for the preparation of the modified solution.—C. A. M.

Elasticum reaction of wool Herbig. *See* V.

Moisture in [wood] pulp. Slack. *See* V.

Boric acid. Prescher. *See* VII.

Nitrites. Laird and Simpson. *See* VII.

Oxygen in iron. Caln and Pettijohn. *See* X.

Analysis of calcium and "lurgie" metal. Könlg. *See* X.

Acidity of coconut and palm oils. Vizern and Guillot. *See* XII.

Tannins. Lauffmann. *See* XV.

Extractor. Reed and Churchill *See* XV.

Grease in leather. Wilson. *See* XV.

Beet sugar products. Gillet. *See* XVII.

Aldose sugars. Colin and Liévin. *See* XVII.

Reducing sugars. Bettinger. *See* XVII.

Cider etc. in wine. Schützlein. *See* XVIII.

Methyl alcohol. Salkowski. *See* XVIII.

Renatured alcohol in spirits. Wolfrum and Pinnow. *See* XVIII.

Spoiled meat. Falk and McGuire. *See* XIXA.

Methyl alcohol and denatured alcohol [in milk analysis]. Prescher. *See* XIXA.

Nicotine. Tunmann. *See* XX.

Digitalis. Tschirch and Wolter. *See* XX.

Aspirin. Jones. *See* XX.

Eugenol, triacetin, and benzyl alcohol. Perperot. *See* XX.

Thymol. Moles and Marquina. *See* XX.

Dichloroethyl sulphide. Hopkins. *See* XX.

Cacodyl compounds. Maillard. *See* XX.

Methyl and ethyl alcohols. Sabalitschka. *See* XX.

PATENTS.

Gases; Apparatus for the detection and measurement of ——. G. A. Shakespear, Birmingham. Eng. Pat. 124,453, 4.1.16. (Appl. 112/16.)

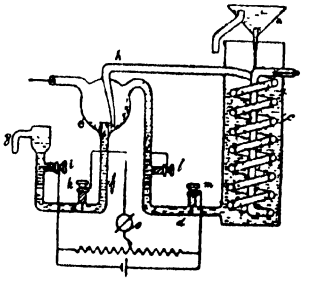
Two similar electrically heated wires are arranged in cavities in a metal block so that one is exposed to the gas to be tested and the other is surrounded by a standard gas such as air. The two wires form part of a Wheatstone bridge system which is thrown out of balance by any difference in the rate of loss of heat of the two wires, and the deflection of a galvanometer or the adjustment necessary to restore a state of balance is employed to give a measure of a known constituent, such as hydrogen, in the gas to be tested.—T. St.

Density of gases; Apparatus for measuring the ——. Naturgas, G.m.b.H., Lemberg. Ger. Pat. 309,577, 13.4.16.

A GLASS vessel is provided with inlet and outlet tubes and a connection to a mercury manometer, each tube being fitted with a stopcock. Platinum contacts are sealed into the arms of the manometer, the contact in the arm attached to the vessel being near the bottom, and that in the other arm being about the middle of the height. The contacts are connected to a battery and to an electrically controlled chronometer. The gas under examination is passed into the vessel under a pressure sufficiently high to force the mercury in the manometer below the level of the lower contact and above the level of the other contact. On closing the inlet and opening the outlet tube the gas passes out and the time taken for a definite volume to leave the apparatus is registered by means of the chronometer. From the time recorded, the density of the gas can be readily calculated, the temperature of the gas being registered by means of a thermometer within the vessel.—L. A. C.

Ammonia content of gases and waste liquors; Apparatus for measuring and continuously recording the ——. J. H. Reineke, Weitmar. Ger. Pat. 309,733, 15.11.16.

WATER or acid drops at a constant rate from *a* into the vessel, *c*, and passes out through the tube, *d*, into the vessel, *e*. The liquid leaves the bottom



of this vessel by the tube, *f*, and escapes through *g*. The gas containing the ammonia is led through a coil contained in the vessel, *c*, and into the vessel, *e*, by means of the tube, *h*. Into the tubes *d* and *f* are sealed electrodes, *i*, *k*, *l*, and *m*, which are connected with a galvanometer *o*, an adjustable resistance, and an alternating current generator as shown in the diagram. The resistance is adjusted so that when no ammonia is passing through, the galvanometer registers zero; when ammonia is bubbled through the alteration in the resistance of the column of liquid between *i* and *k* causes a deflection of the galvanometer, the extent of the deflection depending upon the quantity of ammonia absorbed. An automatic recorder may also be attached to the galvanometer.—L. A. C.

Sulphur dioxide in gases. Ger. Pat. 309,981. *See* VII.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Allen and Co., and Coles. Apparatus for mixing, circulating, and agitating materials in liquid or semi-liquid state. 12,588. May 19.

Brayshaw, Brayshaw, and Yates. Furnaces 12,747. May 21.

Cloudsley. Drying apparatus. 12,602. May 19.

Dressler, and Dressler Tunnel Ovens, Ltd. Tunnel ovens etc. 12,714. May 14.

Hall and Searle. Rotary machines for treating air etc. with liquids etc. 13,050. May 24.

Harris. Drying apparatus. 12,554. May 19.

Harris. Mixing and/or agitating machines. 13,032. May 23.

Haviland and Morris. 12,254. *See* XI.

Henning. Agents for refrigeration plants, and process of making same. 13,104. May 24.

Lemoine. 12,211 and 12,344. *See* XVII.

Morison. Condensing plant under vacuum. 12,918. May 22.

Piccard. 12,292. *See* VII.

Plumbridge. Recovery of volatile solvents. 12,103. May 14.

Robinson, Stevenson, and Robinson and Son. Apparatus for separating solid particles from air. 12,323. May 16.

Short. Drying machinery. 12,335 and 12,338. May 16.

Urruty. Composition for preventing incrustation in boilers etc. 12,046. May 14. (Fr., 20.12.17.)

COMPLETE SPECIFICATIONS ACCEPTED.

2013 (1917). Du Pont. *See* XXII.

2746 (1917). Adams, Partington, and Rideal. Catalysts, and the manufacture thereof. (126,715.) May 28.

51 (1918). Loewenstein. Drying apparatus. (126,748.) May 28.

7583 (1918). Milner and Beeby. Apparatus for filtering and straining liquids (126,447.) May 21.

7875 (1918). Rudge, and United Alkali Co. *See* VII.

8114 (1918). Smith. Grinding-machines. (126,484.) May 21.

10,910 (1918). Whitham. Grinding or reducing machines. (126,854.) May 28.

17,124 (1918). Joubert. Furnaces. (120,212.) May 21.

18,008 (1918). Ten Winkel. Filtering tanks. (126,574.) May 21.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Appleby and Bentley. Gas-producers. 12,396. May 16.

Armstrong. Manufacture of fuel. 12,621. May 20.

Beswick and Rambush. Working of gas-producers 13,123 May 24

Bildt. Producer-gas furnace. 12,923. May 22.

Davies. Distillation of coal, shale, peat, wood, etc. 11,959. May 13.

Dilley. Suction-gas plants. 12,278. May 15.

Dressler, and Dressler Tunnel Ovens, Ltd. Treatment of coal etc. 12,175. May 14.

Jackson (Fuel Saving Co.). Apparatus for burning pulverised fuel. 13,033. May 23.

Jennings. Apparatus for washing coke etc. 12,983. May 23.

Markle. Fuel, and process of forming same. 12,393. May 16. (U.S., 11.9.17.)

Merz and McLellan, Mitchie, and Weeks. Retorts etc. 12,111. May 14.

Soc. de Fours à Coke. 11,862. *See* III.

Wells. Production of charcoal etc. 12,585. May 19.

Complete Specifications Accepted.

1802 (1917). Heape and Grylls. Manufacture of carbons for electric arc lamps. (126,673.) May 28.

5974 (1918). Beswick. Gas generators or producers. (126,120.) May 21.

7862 (1918). Boissier. Solid fuel. (115,645.) May 28.

14,673 (1918). Mantle. Treating waste and other lubricating oils to eliminate sulphur etc. (126,882.) May 28.

III. TAR AND TAR PRODUCTS.

Applications.

Barnett. Manufacture of nitronapthalene. 12,480. May 17.

Ponchon. Recovery of gaseous or atomised phenol or its homologues from gases. 12,028. May 13. (Fr., 10.5.18.)

Soc. de Fours à Coke d'Entreprises Industrielles. Extraction of hydrocarbons from oil. 11,862. May 12. (Fr., 13.5.18.)

Complete Specifications Accepted.

17,778 (1916). Datta and Varma. Production of nitrophenols from amido-compounds. (126,321.) May 21.

346 (1917). Clayton Aniline Co., Schedler, and Vuilleumier. Continuous nitration of organic liquids. (126,355.) May 21.

673 (1917). British Dyes, Ltd., and others. *See* XXII.

1875 and 1876 (1917). Macdonald. *See* XXII.

2049 (1917). Ellis. Production of aromatic nitrohalogen compounds. (126,685.) May 28.

9603 (1918). Harding. *See* XX.

IV.—COLOURING MATTERS AND DYES.

Application.

Imray (Soc. Chem. Ind. in Basle). Manufacture of azo dyestuffs and intermediate products. 11,891. May 12.

Complete Specifications Accepted.

11,068 (1917). Harbottle and Sivertson. Vegetable dyes. (126,742.) May 28.

2652 (1918). Hart. Production of dyes. (126,754.) May 28.

4585 (1918). Perkin. Manufacture of N-dihydro-1.2.2′.1′-anthraquinone-azine. (126,764.) May 28.

4586 (1918). Perkin. Manufacture of a dibenzanthrone colouring matter. (126,765.) May 28.

7816 (1918). Imray (Soc. Chem. Ind. in Basle). Manufacture of mordant-dyeing azo dyestuffs and metal compounds thereof, and their application in dyeing. (126,460.) May 21.

10,787 (1918). Holliday and Co., and Law. Chlorination of purpurine and similarly constituted anthraquinone compounds. (126,527.) May 21.

10,788 (1918). Holliday and Co., and Law. Chlorination of alizarine and its substitution products. (126,528.) May 21.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Bellwood and Downs. 12,434. *See* XII.

Dreyfus. Manufacture of cellulose derivatives. 12,369, 12,915, 12,916. May 16 and 22.

Fawcett. Machines for carbonising wool and rags. 12,627. May 20.

Feary. Manufacture of fabric for aircraft. 12,265. May 15.

Herald. Apparatus for treating cotton etc. with liquids or gases. 13,072. May 24.

Complete Specifications Accepted.

10,616 (1918). Van Wessem. Manufacture of fibrous pulp suitable for paper-making from sawdust and wood waste. (117,086.) May 28.

11,767 (1918). Lancaster. Treatment of paper articles with paraffin waxes etc. (126,541.) May 21.

13,612 (1918). Brummer. Production of textile fibres. (120,199.) May 21.

14,170 (1918). Clark (Jespersen Paper Co.). Removal of printers' ink from paper stock and preparation of paper pulp. (126,879.) May 28.

21,049 (1918). Dixon. Paper-making machines. (126,916.) May 28.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Calico Printers' Assocn., and Schofield. Producing colour effects on textiles etc. 13,083. May 24.

Lumsden, Mackenzie, and Robinson. Mercerising piece goods. 12,470. May 17.

McMyn. Dyeing and printing. 11,958. May 13.

Complete Specifications Accepted.

1183 (1918). Marks (Du Pont de Nemours and Co.). Production of coated fabrics. (126,750.) May 28.

7816 (1918). Imray (Soc. Chem. Ind. in Basle). *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Amsterdamsche Superfosfaatfabriek. Manufacture of salts of ammonia. 13,108. May 24. (Holland, 10.2.19.)

Cataldi. Electrolytic decomposition of chlorides. 12,695. May 20. (Ital., 20.5.18.)

Cocksedge and Freeth. Manufacture of ammonium nitrate. 12,642. May 20.

Hood. Preparation of alumina salts. 12,698. May 20.

Hood. Preparation of solid aluminous materials. 12,699. May 20.

Krotoff. Combustion of sulphur etc. 12,716. May 20. (Fr., 15.6.18.)
Minton, and United Alkali Co. Apparatus for making flaked caustic soda etc. 13,009. May 23.
Morel. Manufacture of alumina. 12,494. May 17.
Morel. 12,495. *See* XVI.
Piccard. Separating a salt from its solution by evaporation. 12,292. May 15. (Swiss, 14.9.18.)
Tyrer. Manufacture of alumina from silicious aluminiferous materials. 13,125. May 24.

COMPLETE SPECIFICATIONS ACCEPTED.

17,757 (1916). Chance and Hunt, Calder, and Fox. Condensing the acid fumes evolved during concentration of sulphuric acid. (126,320.) May 21.
1888 (1917). Freeth and Cocksedge. Manufacture of ammonium nitrate. (126,678.) May 28.
2426 (1917). Maxted and Smith. Manufacture of highly concentrated nitric acid. (126,704.) May 28.
2703 (1917). Wareing, and United Alkali Co. Purification of sulphuric acid. (126,714.) May 28.
2746 (1917). Adams and others. *See* I.
2748 (1917). Adams, Partington, and Rideal. Oxidation of ammonia. (126,716.) May 28.
2749 (1917). Adams, Partington, and Rideal. Production of nitrogen-oxygen compounds. (126,717.) May 28.
3064 (1917). Jackson (Bombrini-Parodi-Delfino). Preheating apparatus for use in the catalytic manufacture of sulphuric acid. (126,396.) May 21.
2255 (1918). Norton Co. Products containing β-alumina. (113,960.) May 28.
2744 (1918). Jenkins and Woolner. Manufacture of permanganates. (126,756.) May 28.
7875 (1918). Rudge, and United Alkali Co. Apparatus for subjecting matter to the action of gases and vapours, especially for use in making bleaching powder. (126,773.) May 28.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Dressler, and Dressler Tunnel Ovens, Ltd. 12,714. *See* I.
Rhead. Underglaze decoration for pottery and porcelain. 11,869. May 12.
Smith. Treatment of clays and manufacture of articles therefrom. 12,025. May 13.

COMPLETE SPECIFICATIONS ACCEPTED.

19,311 (1917). Danner. Forming sheet glass. (126,747.) May 28.
2255 (1918). Norton Co. *See* VII.
2256 (1918). Norton Co. Aluminous abrasive and process of making same. (118,591.) May 21.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Austin. Manufacture of concrete etc. for building. 12,251. May 15.
Cuming. Treatment of wood waste etc. and utilising it as heat-insulating material. 12,927. May 22.

COMPLETE SPECIFICATIONS ACCEPTED.

7919 (1918). Hadfield and Hadfield. Manufacture of concrete. (126,472.) May 21.
8395 (1918). Bellonby. Curing concrete products. (126,813.) May 28.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Adams. Prevention of corrosion. 12,017. May 13.
Angel. Treatment and reduction of complex sulphide etc. ores. 12,851. May 22.
Bingham. Blast furnaces. 12,013. May 13.
Cadenhead and Goodwin. Recovery of vanadium from iron ores. 12,415. May 16.
Catterall and Cohen. Furnaces for melting and refining metals. 12,907 and 12,908. May 22.
Coles. Manufacture of finely-divided metals. 12,178. May 14.
Harris. Dezincing lead. 12,372. May 16.
Keller. Manufacture of cast iron. 12,293. May 15. (Fr., 20.3.18.)
Perez. Method of decomposing mercury. 11,868. May 12. (Spain, 15.5.18.)
Richards. Distillation of zinc ores etc. 12,824. May 21.
Whyte. Case hardening etc. 12,796. May 21.

COMPLETE SPECIFICATIONS ACCEPTED.

519 (1917). Hadfield. Iron-nickel alloys. (126,362.) May 21.
818 (1917). Hadfield. Treatment of iron and steel turnings, scrap, etc. (126,369.) May 21.
1003 (1917). Alexander. Recovery of tin and other metals and alloys. (126,377.) May 21.
11,003 (1918). O'Gorman and Thomas. Indicating the condition of steel etc. when under heat treatment. (126,856.) May 28.
11,004 (1918). Pope and Thomas. Indicating the condition of steel etc. when under heat treatment. (126,532.) May 21.
14,575 (1918). Poetschke. Cleaning or purification of powdered or comminuted alloys. (126,881.) May 28.
20,080 (1918). Metals Disintegrating Co. Process of disintegrating metal. (121,599.) May 28.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Antonoff. Electric batteries. 13,017. May 23.
Cataldi. 12,695. *See* VII.
Haviland and Morris. Electrical precipitation of particles from gases. 12,254. May 15.
Marconi. Electric storage batteries. 12,009. May 13.
Stockel. Accumulators. 12,952. May 23.
Svenska Ackumulator Aktiebolaget Jungner. Electrodes for primary cells and storage batteries. 13,029. May 23. (Sweden, 13.6.18.)

COMPLETE SPECIFICATION ACCEPTED.

4689 (1918). Baur and Treadwell. Electric cells or batteries. (126,766.) May 28.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Bellwood and Downs. Extracting oil, fat, grease, etc. from oily or greasy bags, waste wool, etc. 12,434. May 17.
Firth. Treatment of soya beans to recover oil and produce synthetic milk and flour. 12,268. May 15.
Jackson (Twitchell Process Co.). Process for splitting fats and oils. 12,287. May 15.
Longbottom. Soap. 11,871. May 12.

COMPLETE SPECIFICATIONS ACCEPTED.

2528 (1917). Lemmens and Fryer. Production of glycerin. (126,706.) May 28.
16,150 (1917). Soc. Industrielle de Produits Chimiques. Regenerating catalysts containing nickel and its compounds which have been used for hydrogenating fatty or other organic products. (111,840.) May 21.
14,673 (1918). Mantle. *See* II.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Grant. Flat oil. 13,048. May 24.
Kuroki and Nakayama. Waterproof paint. 12,343. May 16.

Complete Specification Accepted.

15,414 (1918). Hutchins. Manufacture of lamp-black. (126,560.) May 21.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Application.

Dunlop Rubber Co., Hyde, and Worthington Treatment of raw rubber. 12,928. May 22.

Complete Specification Accepted.

5768 (1917). Spence. Devulcanisation of rubber. (12,639.) May 21.

XV.—LEATHER; BONE; HORN; GLUE.

Applications.

Pickerden. Artificial leather. 12,185. May 15
Walpole. Manufacture of glue. 11,917. May 12

Complete Specification Accepted.

10,792 (1918). Johnson, Gregory, and Morrison. Tanning. (126,853.) May 28.

XVI.—SOILS; FERTILISERS.

Applications.

Hawker, and Hawker and Botwood. Manufacture of fungicide, insecticide, soil steriliser, and/or fertiliser. 12,397. May 16.
Morel. Manufacture of assimilable phosphates. 12,495. May 17.
Rossi. Manufacture of fertilisers. 11,913 May 12. (Ital., 9.8.18.)

XVII.—SUGARS; STARCHES; GUMS.

Applications.

Dupire. 12,020. *See* XVIII.
Lemoine. Separating liquor and remelted syrup in remelting centrifugal machines. 12,211 and 12,344. May 15 and 16.

XVIII.—FERMENTATION INDUSTRIES

Application.

Dupire. Manufacture of yeast from fermented musts of molasses and sugar-beet pulp etc. 12,020 May 13.

Complete Specification Accepted.

16,840 (1918). Kanegafuchi Boseki Kabushiki Kwaisha. Production of an extract of proteolytic enzymes. (126,896.) May 28.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Firth. 12,268. *See* XII.
Greville. Treatment of flour. 13,087. May 24.
Hawker. 12,397. *See* XVI.
Melhuish. Blending milk. 12,659. May 20.
Urruty. 12,046. *See* I.

Complete Specifications Accepted.

7997 (1918). Calvert. *See* XX.
13,157 (1918). Terwen and Van Hoogenhuyze. Manufacture of decolorised, odourless, and tasteless albumins from blood. (123,971.) May 21.
14,940 (1918). Manufacture of cattle-cake from yellow mustard seed. (121,586.) May 21.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Comp. des Prod. Chimiques d'Alais et de la Camargue. Preparation of trichlorethylene from tetrachlorethane. 12,120. May 14. (Fr., 28.1.19.)
Comp. des Prod. Chimiques d'Alais et de la Camargue. Preparation of symmetrical tetrachlorethane. 12,787. May 21. (Fr., 21.3.19.)
Nordiske Fabriken De-No-Fa Aktieselskap. Polymerising unsaturated organic acids at low temperature. 12,598. May 19. (Norway, 4.6.18.)
Verley. Manufacture of nerol. 12,815. May 21. (Fr., 3.5.18.)

Complete Specifications Accepted.

346 (1917). Clayton Aniline Co., and others. *See* III.
2019 (1917). Ellis. *See* III.
16,150 (1917). Soc. Indus. de Prod. Chimiques. *See* XII.
2001 and 2002 (Commercial Research Co.). Manufacture of chlorhydrins. (113,954 and 113,955.) May 21.
7997 (1918). Calvert. Apparatus for producing formaldehyde. (126,479.) May 21.
9603 (1918). Harding. Manufacture of chlorinated hydrocarbons. (126,511.) May 21.

XXII.—EXPLOSIVES; MATCHES.

Applications.

Delpech. Production of powder. 12,777, 12,812, 12,819. May 21. (Fr., 30.4 and 15.6.18, and 8.3.19.)

Complete Specifications Accepted.

673 (1917). British Dyes, Ltd., Turner, and Badier. Manufacture of picric acid. (126,368.) May 21.
1875 and 1876 (1917). Macdonald. Manufacture of picric acid. (126,675 and 126,676.) May 28.
2013 (1917). Du Pont. Recovery of solvent from materials such as smokeless powder. (126,682.) May 28.
2117 (1917). Chiaraviglio, and Bombrini-Parodi-Delfino. Explosive substances. (126,687.) May 28.
2329 (1917). Bradley. Explosive compound. (126,698.) May 28.

XXIII.—ANALYSIS.

Applications.

Brown and Pickston. Apparatus for automatic and continuous analysis and recording of gases. 12,317. May 16.
Stewart. Apparatus for indicating or recording quantity of oxygen in respirable gases in chambers, tunnels, mines, etc. 12,356. May 16.

Complete Specification Accepted.

7825 (1918). Richardson and Avery. Means for testing the hardness of materials. (126,463.) May 21.

I.—GENERAL; PLANT; MACHINERY.

Drying; Counter current ——, *the temperature of the air current being raised at intervals.* K. Wagner. Gesundheitsing., 1918, **41**, 461—464. Chem. Zentr., 1919, **90**, II., 401.

THE relative weights of water evaporated from materials moving in counter current to, and in the same direction as, the drying current of heated air are respectively 12 grms. and 22 grms. per kilolitre of air employed. This difference disappears if the temperature of the air in the counter-current method is raised from time to time, as it passes from one end of the system to the other. According to this method, in the drying of grain 1900 heat units are required per kilo. of water, compared with 4000—5000 heat units required in most dryers.—J. S. G. T.

Chemical stoneware. Nielsen. *See* VIII.

PATENTS.

Liquid; Apparatus for the treatment of one —— with another. Chance and Hunt, Ltd., and A. E. Holley, Oldbury, and O. E. Mott, Woolwich. Eng. Pat. 125,426, 14.7.16. (Appl. 9928/16.)

THE general arrangements described in Eng. Pats. 124,461 (this J., 1919, 390 A) and 125,140 (this J., 1919, 442 A) are used for bringing about physical or chemical interactions between two liquids (including suspensions, emulsions, and solutions) of different specific gravities and not completely miscible. Provision may be made for heating or cooling the liquids.—T. St.

Furnaces; Liquid-fuel heated ——. D. Wright, Ulverston, Lancs. Eng. Pat. 125,629, 25.9.16. (Appl. 13,548/16.)

A FURNACE heated by liquid fuel, and an auxiliary chamber, are arranged side by side and separated by a vertical wall having two ports converging into the auxiliary chamber. An oil-gasifying tube passes through the auxiliary chamber, and projects through the division wall into the furnace where its outlet is contracted. The tube is provided with internal longitudinal blades and with transverse baffles. Oil is supplied by a sight feed device to a tube terminating within the gasifying tube and provided with a rotary atomiser at its outlet. Any unevaporated oil is compelled by the baffles to take a tortuous course. Air for combustion is supplied through a pipe passing round the periphery of the auxiliary chamber, and opening into the gasifying tube and surrounding the oil supply pipe. When in use, the hot gases from the furnace chamber pass back through the converging ports into the auxiliary chamber to heat the air and gasify the oil. Outlets are provided from the furnace and auxiliary chamber.—W. F. F.

Expressing liquid from materials containing the same; Apparatus for ——. J. W. Hinchley, London. Eng. Pat. 125,672, 5.7.17. (Appl. 9683/17.)

THE material to be treated, *e.g.*, clay, peat, lead paste, etc., is contained within a cylindrical chamber wherein it may be subjected to pressure. The pressed material is extruded from the chamber by way of nozzles furnished with dies of such size that the necessary pressure may be maintained within the chamber. Prior to passage through the nozzles, the material comes into contact with filtering surfaces in the form of plates of rigid porous material, such as pottery, suitably supported, through which liquid is expressed from the material. A separate chamber is provided for the passage of the expressed liquid, and if desired, the material within the chamber may be heated before or while undergoing the filtering action.—J. S. G. T.

Removing suspended particles from gases [air]; Apparatus for ——. S. F. Barclay, Sheffield. Eng. Pat. 125,681, 25.1.18. (Appl. 1495/18.)

THE gas is passed through a conduit, wherein it is subjected to a high-tension discharge by passage through an electrified network furnished with a number of discharge points, and suitably insulated. The field is such that the particles are impelled in the direction of the gas current. The high-tension current may be either direct or alternating, and in the latter case, two or more networks, insulated and suitably disposed in the channel, are employed. The electrified suspended particles are collected on plates sprayed with water, arranged so that the gas current passes between them, eddies being produced by changes of direction of the gas current. Alternatively a mist of spray may be employed for the collection of the particles. Eliminators furnished with curved lips are employed to remove any free moisture carried over from the wet plates.
—J. S. G. T.

Separator; Electric ——. C. W. J. Hedberg, New Britain, Conn., Assignor to Research Corporation, New York. U.S. Pat. 1,297,159, 11.3.19. Appl., 7.2.18.

AN apparatus for separating and grading material comprises an electrode arranged to form a vertical passage, which is surrounded by a vertical series of receiving chambers. A discharge electrode extends centrally into the passage for producing a transverse electric stress, by means of which the material is separated. The contents of the several receiving chambers are collected separately.—B. N.

Separating finely-divided materials; Process and apparatus for ——. W. A. Schmidt, Assignor to International Precipitation Co., Los Angeles. U.S. Pat. 1,298,409, 25.3.19. Appl., 17.10.16.

A CURRENT of gas containing suspended matter is caused to flow with such velocity that the coarser particles in suspension are separated from the gas by the mechanical action of a force dependent on the mass of the particles, the finer particles remaining in suspension being subsequently removed by electrical precipitation.—D. F. T.

Spraying liquids; Means for —— and mixing therewith other liquids or gases. R. E. Hoffmann, London. Eng. Pat. 125,809, 6.6.18. (Appl. 9319/18.)

THE injector of a spraying device is situated below the level of the surface of the liquid to be mixed, and is supplied with liquid under pressure. The induced current of liquid passes through a straining plate, and thence, with the inducing liquid, through a pipe connected to the sprinkling head situated above the level of the liquid surface. The device may be provided with air induction chambers, with ports or orifices surrounding the liquid jet. The entrances for air to such chambers are situated above the level of the surface of the liquid.—J. S. G. T.

Filter presses and the like. J. Miller, and G. Fletcher and Co., Ltd., Derby. Eng. Pat. 126,265, 13.2.19. (Appl. 3520/19.)

THE end plate of a horizontal filter press is connected to the ram of a hydraulic press on the same axis by means of a rod which is pivoted on a horizontal axis adjacent to the hydraulic cylinder and counterweighted so that it may be rotated in a

vertical plane out of line with the axis of the ram. The other end of the rod is screw-threaded and provided with a hand-operated nut forming a pressure head which may bear against the end plate of the press. The apparatus provides a means for rapidly closing the press by moving up the end plate, and swinging the rod into line and screwing up its pressure head to apply a preliminary pressure, after which the hydraulic ram is brought into operation for the final pressure.—W. F. F.

Drying apparatus. H. Bogaty, Assignor to The Philadelphia Textile Machinery Co., Philadelphia, Pa. U.S. Pat. 1,298,285, 25.3.19. Appl., 11.9.18.

A series of cars is moved by a differential screw through a horizontal drying chamber in which air is circulated.—W. F. F.

Drying process [for carbonaceous materials]. S. E. Seaman, Brooklyn, N.Y., Assignor to Seaman Waste Wood Chemical Co., New York. U.S. Pat. 1,299,791, 8.4.19. Appl., 4.6.17.

Finely divided material and hot gases from a furnace are introduced into one end of a horizontal drying chamber at adjacent points so as to be mixed together. The mixture is drawn through the drying chamber by suction, and the waste gases and steam are separated from the dried material at a distance from the chamber beyond the reach of sparks. The dried material is fed directly to a retort.—W. F. F.

Centrifugal machine. T. A. Bryson, Troy, N.Y., Assignor to Tolhurst Machine Works. U.S. Pat. 1,298,451, 25.3.19. Appl., 14.5.15.

The lower end of a vertical rotating shaft carrying a separating basket is supported below the basket on a spherical bearing. An annular guard is provided between the bearing and the openings in the bottom of the basket and comprises a concentric conical member, to the bottom of which an annular member is attached extending upwards towards the openings in the basket.—W. F. F.

Evaporating apparatus. S. M. Dick, Assignor to F. E. Mick, Minneapolis, Minn. U.S. Pat. 1,298,470, 25.3.19. Appl., 13.12.17.

Liquid is sprayed into the top of a casing and hot air is supplied through spaced openings in the upper part of the side wall of the casing. Air at a higher temperature enters through openings at the bottom of the casing, and outlets are provided at various points in the wall at different levels. A number of circular currents of hot air are thus formed in the casing to evaporate the sprayed liquid.—W. F. F.

Evaporator. W. E. Garrigues, New Orleans, La., Assignor to W. Garrigue and Co., New York. U.S. Pat. 1,298,925, 1.4.19. Appl., 28.9.17.

A series of vertical tubes is arranged between horizontal tube-plates in the lower part of a vertical casing leaving a central space free from tubes. A heating medium is introduced into the bottom of the central space and circulates outwards over the tubes, the circulation being assisted by baffles between the tubes and above the upper tube-plate. Liquid to be evaporated is caused to circulate downwards through the outer tubes, through the slightly conical space below the lower tube-plate towards the centre, and then upwards through the inner tubes. Precipitated matter is removed at the centre of the lower conical space.—W. F. F.

Liquids; Apparatus for evaporating or concentrating ——. E. Shaw, Toronto. U.S. Pat. 1,299,793, 8.4.19. Appl., 31.5.17.

A vertical annular steam jacket surrounds an inner concentric tube tapering downwards and provided with a helical rib on its outer side so as to form a helical passage of gradually increasing cross-section downwards. The inner tube terminates a short distance from the bottom of the jacket, and the liquid to be concentrated passes downwards through the helical passage and then continues to flow over the inner wall of the steam jacket to the outlet at the bottom. Vapour from the liquid passes upwards through the lower open end of the inner tube and thence to the outlet.—W. F. F.

Aqueous fluids [steam]; Method and apparatus for measuring the rate of flow of ——. E. G. Bailey, Newton Highlands, Mass., Assignor to Bailey Meter Co. U.S. Pats (A) 1,299,539 and (B) 1,299,540, 8.4.19. Appl., 28.12.17 and 16.7.15. (B) Renewed 25.10.18.

Carbon dioxide is introduced at a known rate into a closed conduit through which steam is flowing, and a sample of the mixture then taken. The sample is passed into a separating chamber where it is heated to 100° C. and the steam removed by condensation. The ratio of steam to gas in the sample is thus ascertained and from this the rate of flow of steam in the conduit.—W. F. F.

Pump; Vacuum fluid ——. W. von Dallwitz, Heidelberg. Ger. Pat. 308,313, 17.11.14.

The combustion of a combustible mixture operates a freely moving piston to and fro in such manner that a vacuum is produced, which can be employed to effect ventilation, or for the removal of slimy masses.—J. S. G. T.

Evaporator for refrigerating machines. C. Schmitz, Hagen. Ger. Pat. 310,880, 5.12.16.

Hollow ribs functioning as surfaces of evaporation are arranged within a vessel forming a gas-liquid separator, and are proportioned so that the free cross-sectional area of the vessel increases from below upwards. A brisk exchange of heat takes place between the cold medium and the material to be cooled. The relative increase of area from below upwards is proportioned to the capacity of the machine. The velocity of the liquid-vapour mixture is much diminished as it passes upwards through the separator, and a perfect separation of liquid from vapour is thereby secured, the vapour passing over to the condenser, the liquid returning to the lowest point of the vessel.—J. S. G. T.

Desiccating-machine. J. W. Stamp, Melbourne, Australia. U.S. Pat. 1,299,254, 1.4.19. Appl., 15.7.18.

See Eng. Pat. 114,700 of 1917; this J., 1918, 321 A.

Evaporator. R. C. Jones, Garden City, N.Y., Assignor to The Griscom-Russell Co. U.S. Pat. 1,299,955, 8.4.19. Appl., 1.2.16.

See Eng. Pat. 103,820 of 1916; this J., 1917, 995.

Fire-extinguisher. Ger. Pat. 310,890. *See* V.

Extracting oils etc. Eng. Pat. 126,262. *See* XII.

Mixing apparatus. Eng. Pat. 125,094. *See* XXII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Nitrogen in coal and coke; Determination of ——. E. Terres, H. Fleischer, H. Hansen, J. Köchling, and O. Malsch. J. Gasbeleucht., 1919, **62**, 173—177, 192—200.

In spite of the known limitations of the Kjeldahl method, its convenience has led to its universal adoption for the analysis of fuels, without, however, direct proof of reliability. Simmersbach and Sommer (this J., 1916, 102) recommend the substitution of a modification of the Dumas method. The authors have compared the three methods in question. The Dumas method was modified so as to permit the generation in the tube of a supply of oxygen. A mixture of potassium chlorate and manganese dioxide was introduced into the tube containing sodium bicarbonate. By heating the mixture a combustion with oxygen of the residual coke-copper oxide mixture was effected when the visible evolution of nitrogen had ceased, and a further evolution of nitrogen obtained. This necessitates an analysis of the gas collected to determine the oxygen, carbon monoxide, methane, etc. which are always found even if the combustion is most carefully carried out. The Simmersbach-Sommer modification was followed substantially as described by those authors but an after-combustion of the coke residue was found necessary also. The Gunning modification of the Kjeldahl method was used in general—1 grm. of coal to 50 c.c. of sulphuric acid and 10 grms. of potassium sulphate without catalyst—heating being continued until a clear solution was obtained. The results were variable according to the conditions and always lower than those given by the other two methods, which were in substantial agreement. It was shown by heating ammonium sulphate with the potassium sulphate sulphuric acid mixture for 20 hours that the cause was not an oxidation of the ammonia once formed. A modification of the Kjeldahl method was devised whereby it was possible to collect the gases evolved in the oxidation of the coal and determine their nitrogen content. With this comparative experiments were made on a number of typical fuels, and the results are tabulated:

Method	Temp. of oxidation	Peat	Lignite	Saar coal	Ruhr coal	Anthracite
	°C	% N_2	% N_2	% N_2	% N_2	% N_2
Kjeldahl	250	1·70	0·80	1·31	1·33	1·35
,,	275	1·56	0·76	1·23	1·26	1·34
,,	300	1·46 (14 hrs.)	0·62 (35 hrs.)	1·15 (14 hrs.)	1·20 (74 hrs.)	1·24 (52–59 hrs.)
,,	325	1·36	0·58	1·00	1·07	1·13
Kjeldahl + free nitrogen	—	1·77	1·20	1·76	1·58	1·84
Dumas with after-combustion	—	1·72	1·08	1·73	1·55	1·72
Kjeldahl + HgO	300	1·66 (2·5 hrs.)	0·97 (3 hrs.)	1·35 (6·5 hrs.)	1·35 (7·5 hrs.)	1·31 (11 hrs.)
Kjeldahl + HgO + CuO	300	1·56 (4 hrs.)	0·93 (4·8 hrs.)	1·25 (7 hrs.)	1·36 (8 hrs.)	1·38 (10 hrs.)
		Peat coke	Lignite coke	Saar coke	Ruhr coke	Anthracite coke
Kjeldahl	275	0·82	0·55	1·11	1·53	1·49
,,	300	0·73	0·52	1·01	1·46	1·27
,,	325	0·71	0·44	0·98	1·34	1·22
Dumas with after-combustion	—	0·89	0·62	1·43	1·59	1·79
Kjeldahl + free nitrogen	—	0·95	0·73	1·48	1·68	1·85

The simple Kjeldahl method gives results which are lower than those of the modified Dumas method to a degree varying with the time and temperature of the oxidation process, and also with the fuel taken. The lower the temperature the less is the loss of nitrogen, and if allowance is made for this the results agree with those of the Dumas method. The discrepancy is less with coked products. In the presence of catalysts higher results (though still too low) are obtained owing to the reduced time and temperature of the oxidation. The production of ammonia is a process of hydrolysis.

—H. J. H.

Coal; Action of chemical reagents on ——. S. Hilpert, K. Keller, and R. Lepsius. Ges. Abhandl. zur Kenntnis der Kohle, 1917, **1**, 22—25. Chem. Zentr., 1919, **90**, II., 441–442.

Bituminous coal (Osterfeld Mine) when heated with acetic anhydride and zinc chloride in a sealed tube gives a coal-like substance without coking properties and yielding acetic acid when heated. By nitration with sulphuric and nitric acids (1 : 1) the nitrogen content of the outwardly unchanged coal increased from 1·8 to 8%. The "nitro-coal" is soluble in acetone and acetic acid, insoluble in benzene and other hydrocarbons. The dissolved substance closely resembles the insoluble residue and decomposes on heating. It is soluble in aqueous alkalis with partial saponification and is re-precipitated by acid. The coal when heated with fuming sulphuric acid gives no sulphonic acids, which together with the ready saponification of the nitro-products does not suggest the presence of aromatic hydrocarbons (cf. Pictet and Bouvier, this J., 1913, 1098). Extraction with dichlorobenzene or pyridine yielded substances of the same composition as the insoluble residue. Treatment with bromine gave carbonaceous products which on heating evolved much hydrobromic acid, leaving a powdery coke. The absorbed bromine could be removed by alcoholic potash.—H. J. H.

Coal and similar substances, Conversion of — into soluble products by ozone. F. Fischer and H. Niggemann. Ges. Abhandl. zur Kenntnis der Kohle, 1917, **1**, 30–42. Chem. Zentr., 1919, **90**, II., 442.

The method of ozonisation (this J., 1916, 1001) has been applied to all types of coal, including samples freed from bitumen by extraction under pressure, and also peat and humic acid. The coal or the like, suspended in water, was exposed for twenty hours to the action of ozone. The products obtained were easily soluble in water and alcohol, and slightly soluble in other neutral solvents, black or brown in colour, strongly acid in reaction, hygroscopic, soft at 100° C., brittle at the ordinary temperature, had a caramel-like odour, and decomposed at about 100° C. with the liberation of carbon dioxide. Cellulose, graphite, coke, and charcoal were only slightly attacked by ozone and yielded products of different character. The reactivity to ozone is therefore

characteristic of humic substances. Among coals it was found that the quantity of soluble products increased with decreasing coke yield. The frothing which accompanies ozonisation increased in the same order. Peat gave a smaller yield of products than lignite. Cannel coal yielded only a small amount of ozonised product in spite of its low yield of coke. Anthracite gave 48% of water-soluble products after treatment with ozone for 300 hours and lost 86% in weight. Coals free from bituminous constituents behaved towards ozone similarly to the raw coal. The bituminous matter is therefore not the constituent which becomes soluble. The yield of product from lignite was not diminished by the removal of humic acid. Ozonisation was accompanied by the liberation of carbon dioxide. The ozonised products began to decompose slowly at about 115° C., becoming gradually insoluble in water. At 250° C. the products were completely insoluble in water, but still soluble in alkalis. The ozonised product dried at 110° C. contained 3% hydrogen, 50·3% carbon, 0·8% sulphur, traces of nitrogen, the original coal containing 5% hydrogen, 84·4% carbon, 0·9% sulphur. The product apparently dissolves in water to a colloidal solution. On evaporating the solution acid vapours are evolved, which contain small quantities of the lower fatty acids. Mellitic acid is apparently not formed. The yield of oxalic acid seems to depend on the conditions of ozonisation, and perhaps the temperature of solution and crystallisation of the oxalic acid from the product. On boiling the brown solution with animal charcoal most of the substance is removed by adsorption, but the solution does not lose its colour and smell.—H. J. H.

Coal; Extraction of previously heated ——. F. Fischer and H. Gröppel. Ges. Abhandl. zur Kenntnis der Kohle, 1917, **1**, 68—77. Chem. Zentr., 1919, **90**, II., 442—443.

THE low yields obtained in extracting coal by inert solvents can be increased by preheating the coal for a short time at a suitable temperature. The structure of the coal is somewhat broken down so that the tar-forming products can be completely extracted. By rapid cooling further decomposition is prevented (cf. Harger, this J., 1914, 391). The temperature necessary was fixed at 550°—600° C. The liberation of tar was a maximum at 440°—550° C. The preheated coal was rapidly cooled, powdered, and extracted in succession with petroleum spirit, benzene, and chloroform. The solvents were removed by heating the extracts on the water-bath at slightly reduced pressure. The petroleum spirit extract is yellowish and leaves a dark brown oil of butter-like consistency. A cream-coloured mass, probably paraffins, separates when this is dissolved in alcohol. On extraction with acids bases are removed smelling of pyridine, while phenols are extracted by alkalis. The benzene extract is deep brown with greenish fluorescence and leaves a tarry residue. The residue of the chloroform extract, which is green by reflected light and reddish-brown by transmitted light, solidifies to a resin-like mass. Cannel coal gives a distillate resembling vaseline. The yield of coke from the extracted residue amounts to 80—86%. Specially good results were obtained with the gas coals and cannel coals.—H. J. H.

Town's gas; Effect of inert constituents on the efficiency of ——. R. Lessing. Gas J., 1919, **146**, 489—493.

THE nitrogen content of coal-gas derived from the coal may vary with a make of 12,500 cub. ft. per ton, from 0·6 to 1·1%. The residual nitrogen derived from the steam used in water-gas making does not exceed 0·03%. The air required for combustion of various gaseous mixtures, containing up to 50% of inert constituents, is calculated and it is shown that the percentage of combustible gas in the resulting mixture varies very little. The size, form, and temperature of the flame produced depend upon the percentage of combustible gases present, non-combustibles lowering the flame temperature considerably. The efficiency of heating as affected by flame temperature is discussed in relation to low temperature heating, high temperature heating, and the use of gas in gas engines. Gas engine efficiency is not dependent upon high calorific value of the gas or freedom from non-combustible gases. The author considers that the limit of admixture of blue water-gas should be about 30%. The volume increase in the yield of gas per ton of coal carbonised at higher temperatures is due to the degradation of the gas, accompanied by a deposition of carbon, whereby the carbon : hydrogen ratio is lowered, and the use of such high temperatures is not regarded as desirable. By complete "stripping" of coal gas of its benzene, toluene, xylene, etc. the calorific value is lowered 6·3%. The author concludes that town's gas should be made and sold on the calorific value basis. Aromatic hydrocarbons including naphthalene should be extracted. The calorific value need not exceed 550 B.Th.U., and for 90% of the gas supplied may fall well below this figure. A high calorific value should not be obtained by carburation, but by such means as increasing the methane content of the gas. The yield of gas per ton of coal should be approximately 12,000 cub. ft. The percentage of non-combustible constituents should be reduced to a minimum.

—J. S. G. T.

Gasification process [in gas producers]; Theory of the ——. W. Ostwald. Chem.-Zeit., 1919, **43**, 229—231.

THE process of gas production utilising coal, water, and air is resolved into three fundamental processes represented by the thermochemical equations: —

(1) $C+O_2=CO_2+97{\cdot}6$;
(2) $C+2H_2O=CO_2+2H_2 \quad 18{\cdot}8$;
(3) $C+CO_2=2CO-38{\cdot}8$.

Assuming that relative proportions, a, b, and c of the coal employed undergo these relative changes, the author shows how, utilising the analysis of the resulting gas, the complete process may be represented by means of a diagram employing triangular co-ordinates after the manner introduced by Gibbs. The area of the triangle of reference is divided into two fields, viz., a region of combustion and gasification and a region of regeneration of combustible gas from combustion products. The characteristics of various technical producer gases are examined by means of the areas so defined. The method allows the effects of alteration of working upon the course of the reactions involved, to be followed, as well as the general thermochemical and volumetric characteristics of the process. (See also J. Chem. Soc., July, 1919.)—J. S. G. T.

Benzol extraction [from gas]; Heavy oil for ——. St. Claire Deville. J. Usines à Gaz. Gas J., 1919, **146**, 431.

THE best oil for benzol extraction from coal gas is similar to that found suitable for naphthalene extraction and is prepared as follows:—Anthracene oil is distilled to 270° C. and the residue strongly cooled. The liquid portion is filtered off and used for benzol extraction. No ordinary cooling causes it to thicken and on the other hand it yields only the products (benzol and naphthalene) extracted from the gas when distilled at a temperature con-

siderably below 270° C. The oil prepared as above with the addition of 4% of benzol represents the German oil called "Bueb" used for naphthalene extraction. The added benzol in this case prevents the stripping of that constituent from the gas.
—T. F. E. R.

Toluol recovery [from gas]. R. S. McBride, C. E. Reinicker, and W. A. Dunkley. U.S. Bureau of Standards. Technol. Paper 117, 1918. 60 pages.

THE paper comprises a description of American toluol-recovery plant construction and methods of operation, with a discussion of the results which can be obtained, and a brief outline of the cost of the process (see this J., 1917, 1265); a discussion of the relation of toluol recovery to standards of quality for gas service (see this J., 1918, 171 A); and a typical form of contract for use in connection with the operation of toluol-recovery plants in gas works.

Fuel gases; Efficiency of different industrial ——. E. Dolensky. J. Gasbeleucht., 1919, **62**, 137—141, 152—156, 162—166.

THE various factors which require consideration in comparing the efficiency in industrial practice of various fuel gases are discussed. The cost of the unit of heat is not in itself decisive, as the unit of heat in different forms of fuel is not necessarily of equal value. Special adaptability to the purpose in view may outweigh disadvantages. High flame temperature is very conducive to efficient heating, and in this respect water-gas is superior to other fuel gases. Rapidity of ignition and propagation of flame are important. These are influenced by the degree of dilution of combustible by inert constituents in the theoretical mixture of fuel gas and air. The dilution is greatest in rich coal gas and least in water-gas, and thus it is found that rapid and complete combustion of the latter is attained with a minimum excess of air. The various thermal and physical quantities necessary for the study of a number of typical fuel gases are tabulated and set out graphically so as to show the relationship between conditions of use and attainable efficiencies. The temperature of the flue gases is here dominant, and this can, and in the case of the low-grade gases often must, be lowered by recuperation or regeneration of heat. In practice about 50%, or at best about 60% only, of the waste heat can be recovered in this way, and in general it does not seriously alter the order of the relative efficiency of the various gases. The high-grade gases can almost invariably be used with a higher thermal efficiency than producer gases. The latter if not cooled may carry such a water content as to render nugatory the advantages of regeneration, whereas richer gases are always clean and approximately free from water. Although it is usually assumed for low-grade producer gas that no gas-holder is required, in practice this is often a doubtful advantage, as it is attended by irregularities of pressure, composition, and water content. The ultimate thermal efficiency can only be ascertained when the fuel consumption is referred back to the original coal from which the gas was made, and here the high-grade gases show to advantage.—H. J. H.

Oil; Production of —— from mineral sources. F. M. Perkin. J. Inst. Petroleum Tech., 1919, **5**, 75—93. (See also this J., 1918, 471 R.)

A SCOTTISH peat with 14·6% of moisture yielded per ton:—spirit 1·9 galls., fuel oil 13·8 galls., paraffin wax 21·0 lb., phenols 1·6 galls., and retort carbon 50·0 lb. The lignites and brown coals of Devonshire have yielded from 33 to 35 galls. of crude oil per ton of air-dried material retorted. The coke remaining was tested on a suction-gas plant with very satisfactory results. The quantity of oil and of ammonium sulphate yielded by shales varies considerably. The yield of oil may be as high as 30–40 galls. per ton of shale, but is sometimes as low as 17–18 galls. The present average yield in Scotland is 23 galls. per ton. The amount of shale treated in the Scottish retorts is over 3,000,000 tons per annum, yielding (before the war) 275,000 tons of crude oil, or over 70,000,000 galls. The Bryson retort generally used is long and narrow and is specially designed to yield the maximum amount both of oil and ammonia. The oil is produced in the upper cooler portion of the retort and the ammonia in the lower hotter portion, where the shale which has been freed from the main portion of the volatile matter is acted upon by superheated steam. Thus the retorting of shale is a low temperature process as regards the production of oil, and moderately high for the production of ammonia. Coal tar pitch may be made to yield over 20 galls. per ton of fuel oil by heating to 600°—650° C. and re-distilling the heavy tar distillate. It is estimated that if all the coal employed for domestic purposes were to be partially carbonised, and the yield of crude oil be reckoned at the very low rate of 20 galls. per ton, the production of oil would be 700,000,000 to 900,000,000 galls. (2,900,000 to 3,750,000 tons) per annum, and taking the yield of ammonium sulphate at 10 lb. per ton of coal carbonised, the production would be 156,000 tons per annum. In addition to coal suitable for domestic purposes, there are large amounts of coal dust and coal with high ash which also might be profitably treated by the low temperature process. In low-temperature carbonisation either good or poor coal can be employed but in high-temperature practice it is always advisable to use the best. Other sources from which small quantities of oil are obtained are blast furnaces and producer-gas plants in which coal is used. Blast furnaces yield a heavy tar from which heavy and light fuel oils are obtained. The oils appear to be intermediate between true low-temperature oils and the products obtained at the high temperatures of the gas retorts. They contain sometimes as much as 25% of tar acids. The production amounts to only a few million galls. per annum. Producers using coal yield a tar which on distillation gives fuel oils. This is a low-temperature product as the temperature at the top of the producer does not as a rule exceed 600° C. and may be lower. Brief descriptions are given of the methods used in the recovery of oil from the Scottish shales, and of various types of retort designed for low-temperature distillation of coal.—T. St.

Russian masut; Cracking of ——. Improved methods for the rational utilisation of petroleum. O. Aschan. Öfversigt af Finska Vetenskaps-Soc. Förhandlingar. Reprint. Pp. 70.

AT the present time after distilling off the benzine and kerosene from Russian crude oil there is left a residue, masut, of which about 10% is worked up for gas oil and lubricants and the remainder used as fuel, the calorific value of which averages 10,000 to 11,000 cals. Balachany crude oil yields 4% of benzine (up to 150° C., sp. gr. 0·770), 33% of kerosene (150°–300° C., sp. gr. 0·825), and 62% of masut (above 300° C., sp. gr. 0·912). The masut on being distilled in a current of superheated steam yields: 30% of gas oil (sp. gr. 0·870—0·875), 7·5% of light and heavy spindle oils (sp. gr. 0·875—0·905), 24·0% of machine oil (sp. gr. 0·905—0·912), 1·5% of light cylinder oil (sp. gr. 0·912—0·920), and 35·0% of tar (goudron) (sp. gr. 0·920—0·950). The tar may

be refined by means of acid and alkali and then on steam distillation yields heavy cylinder oils (viscosines). The products represent more than double the value of the same quantity of the crude oil. Seeing that the markets for the fully refined products only account for 10% of the masut, the author's attention was turned to the possibility of destructive distillation. The initial stage of cracking sets in about 250° C. The more complicated molecules are decomposed but there is no profound decomposition. True cracking begins at about 300°- 400° C and hydrogen is eliminated, whilst the molecules of intermediate complexity undergo scission, partly forming light products (benzine and kerosene) and partly tars. The former bodies result from analytical and the latter from synthetic changes. If the process is carefully conducted under high pressure the point of scission is directed more towards the middle of the molecule with the formation of a preponderance of fluid products, mainly light oils. There is also a smaller gas yield and the high-boiling tough residues are poor in hydrogen. If, on the other hand, the pressure is diminished, the point of rupture is displaced more and more towards the ends of the molecule. This results in the production of much heavier and also of much lighter molecules. Typical of the latter case is the production of oil gas from the destructive distillation of gas oil at 700° to 800° C. The oil gas has a very high calorific and illuminating value and is accompanied by much tar and low-boiling hydrocarbons which may be removed by compressing and cooling. Extreme cases of the destructive distillation under the conditions just specified are the cracking of aromatic hydrocarbons at temperatures above 800°- 900° C. Here the gas yield is greater but the calorific value is lower than that of oil gas. At still higher temperatures ranging from 1000° to 1200° C., methane, hydrogen, and carbon are the chief products. The yields and analyses from a large number of gas oils are tabulated. The oil gas was compressed at 10 to 18 atmospheres pressure and the condensed liquid examined. On fractionation isoprene, benzene, and toluene were identified, also condensation products on treatment with aluminium chloride. The author recommends the pyrogenetic formation of isoprene and aromatic hydrocarbons from the liquid condensed from oil-gas as a better method of utilising masut. At the Åbo oil-gas works the gas from 200,000 kilos. of masut gas oil yielded a condensed liquid containing 324 kilos. of pure isoprene, 3050 kilos. of benzene, 1120 kilos. of toluene, and 2969 kilos. of oil-gas benzine. The value of the products obtained from the working up of masut in this way is 2¼ times that yielded by the usual method. The author suggests that the total masut should be treated as follows: 10% for fully refined products (lubricating oils, etc.), 45% for fuel, 45% for cracking. In this case there would be formed from 2,584,000 tons of masut, after cracking: 1,196,746,000 cub. m. of oil gas, 4,186,080 kilos. of isoprene, 68,463,080 kilos of benzene, 12,558,240 kilos. of toluene, and 11,498,800 kilos. of oil-gas benzine.

—A. E. D.

Petroleum oils; Cracking — to obtain petroleum spirit and aromatic hydrocarbons. A. P. Lidoff. Petroleum, 1917, **12**, 413–427. Chem. Zentr., 1919, **90**, II., 290.

IN "cracking" solar oil in the presence of ferric chloride or aluminium chloride it is advantageous to form the anhydrous catalyst during the process. For this purpose the oil is mixed with iron or aluminium and a current of hydrogen chloride gas passed through the mixture, whereby the resulting nascent hydrogen promotes the formation of saturated compounds. The process takes from 2 to 3 hours at 250°—280° C. In this way solar oil treated with iron as catalyst yielded 65% of distillate of sp. gr. 0·865, whilst with aluminium as catalyst the yield was 70%. The decomposition products are saturated compounds of pleasant odour, and do not alter in the air. The highest yield of aromatic compounds is obtained by cracking at 600° C. under a pressure of 18 atmos.

—C. A. M.

Bitumen; Concentration of the optically active constituents of — by means of ozone. J. Tausz. Chem.-Zeit., 1919, **43**, 225.

WHEN crude petroleum is treated with ozone, ozonides are precipitated. By more prolonged treatment with ozone, other products are formed which, unlike the normal ozonides, are not completely insoluble in petroleum spirit, but may be converted into insoluble products by addition of caustic soda or anhydrous tin tetrachloride. Experiments have been carried out with two kinds of asphalt, a crude oil, and a bitumen. The solution thereof in petrol spirit was evaporated, the residue dissolved in chloroform, and ozonised. The ozonisation was stopped when the liquid cleared. Thereafter the oil was treated with anhydrous tin tetrachloride, then with caustic soda, and considerable petroleum spirit and filtered. The optical activity of the filtered oil was determined after evaporation of the petroleum spirit. The process of solution, ozonisation, etc. was repeated a number of times. The process did not yield well-defined products, resins alone being invariably obtained. Syrian asphalt yielded an oil which in a tube 20 cm. long gave an optical rotation at 30° C. $\alpha = 1\,40'$, the corresponding values for the oils derived from Val de Travers asphalt, and a crude petroleum from Alsace being respectively $\alpha = 3\,4'$ at 30° C. and $\alpha = 1\,8'$ at 20° C. A fraction from Wels bitumen (b.pt. 270°–275° C. at 14 mm. mercury pressure) and possessing an optical activity in a 20 cm. tube of 20·8 saccharimeter degrees yielded an oil with a rotation of 40 saccharimeter degrees in the same tube. —J. S. G. T.

Tar lubricating oil Bruhn. *See* III.

PATENTS.

Coal and the like; Washers for W. R. Stobart, Bishop Auckland, Durham. Eng. Pat. 125,781, 30.4.18. (Appl. 7246/18.)

A HOPPER mounted on a weighbridge is charged at the top with coal to be washed and the washing water enters at the bottom. The material is agitated by a revolving stirrer and the washed coal discharged at the top at another point. The weighbridge tips with a predetermined amount of heavy material in the hopper and completes an electric circuit which operates mechanism to discharge the material in the hopper. After discharge, the current is interrupted till the weighbridge tips again.

—W. F. F.

[*Furnace*] *apparatus for burning powdered fuel.* A. S. Mann, Schenectady, N.Y., by E. D. Mann, Administratrix, Assignor to General Electric Co. U.S. Pat. 1,298,530, 25.3.19. Appl. 20.7.16.

A FURNACE is provided with a series of burners across the front for burning powdered fuel. Each burner is closed at its outer end, and powdered fuel and air are fed into it tangentially. The tangential inlets of adjacent burners are on opposite sides so as to produce rotation in opposite directions.

—W. F. F.

Coke ovens; Horizontal ——. E. C. R. Marks, London. From Soc. Franco-Belge de Fours à Coke, Brussels. Eng. Pat. 126,180, 23.5.18. (Appl. 8583/18.)

In horizontal coke ovens with by-products recovery, heat regenerators are provided under the ovens. Each half of the pier walls of the ovens is furnished with a combination of vertical and horizontal flues, together with suitable floor flues forming a symmetrical arrangement of two distinct and equal circuits, each connected at one end to one of the heat regenerators, which are arranged in pairs. The respective circuits are provided with burners, and the products of combustion pass to the other heat regenerator of the several pairs. The two circuits are traversed in reverse directions during the same period by currents of gas in combustion. Dampers are provided in the various flues, that in the floor flue operating also as a shutting off device.

—J. S. G. T.

Gas retorts. F. J. Bancroft and J. B. Hansford, New Barnet, Herts. Eng. Pat. 126,121, 27.4.18. (Appl. 7131/18.)

Coal or other material is fed into the lower end of a vertical retort of the intermittent or continuous type, and is forced upwards by means of a suitable device such as a screw conveyor. Definite quantities of oxygen or air and steam are introduced into the top of the retort, and pass downwards through the heated carbonaceous mass, the temperature of which increases from bottom to top. The gases generated are removed through exits in the bottom of the retort, which is the coldest zone in the retort.—J. S. G. T.

Gas producers and method of working the same. J. Stewart, Glasgow. Eng. Pat. 125,686, 6.2.18. (Appl. 2132/18.)

A multiple-chamber gas producer comprises one or more horizontal down-draught chambers, and a vertical up-draught chamber. If desired, the down-draught chambers may be inclined at an angle to the horizontal. The outlet ends of the horizontal chambers open into the vertical chamber near the upper end. The operation of a sliding grate at the rear end of the horizontal chambers controls the supply of heated fuel from the horizontal chamber to the vertical chamber. The horizontal chambers are provided near the outlet ends with gas outlets connected with tuyères opening into the lower part of the vertical chamber. J. S. G. T.

Fuel gas; Apparatus for the generation from incandescent carbonaceous material of — for use in internal combustion engines. J. W. Parker, Harrow, and E. Goldsmid Abrahams, London. Eng. Pats. 126,140, 3.5.18, and 126,172, 17.5.18. (Appls. 7435 and 8296/18.)

A gas generator of the vertical or inclined type, through which steam and air are passed, is mounted on hollow trunnions so that it may be brought to a substantially horizontal position, and is provided with a removable fire-grate enabling the clinker and ash to be removed from the generator without risk of extinction of the fire. An ash-pan is connected with the fire-grate, and is removable therewith. The air supply to the fire-box is preheated in a jacket surrounding the same, and communicating with the upper end thereof by way of a row of holes in the fire-box wall. A similar row of holes opens from the lower end of the jacket into the space below the fire-grate. A steam supply is derived from small boilers furnished with jets, mounted in the fire-box, or in or on the fire-box wall on its lower side, and movable therewith. The supply of water to the boilers is controlled by means of float valves. In operation the maximum temperature is attained in about the middle region of the generator, and the fuel gas is withdrawn from this region. In a modification a J-shaped generator, not mounted on trunnions, is used.

—J. S. G. T.

Light mineral oils [turpentine substitute]; Method and apparatus for producing —— from petroleum. A. L. Thomsen, Esbjerg, Denmark. Eng. Pat. 126,089, 3.5.18. (Appl. 9906/17.)

A mixture of petroleum (*e.g.*, 100 kilos. of "water white" grade) and an aqueous alkaline solution (*e.g.*, 3 kilos. of soda and 300 kilos of water) is distilled in a vessel heated to a constant temperature between 95° and 110° C. for 5 to 10 hours, *i.e.*, until about 80% of the petroleum is converted into a light oil. A globular still fitted with a steam jacket on the outside and with an internal steam coil is used, and a direct steam supply to the still is also provided. The refined oil has sp. gr. 0·772–0·790, and may be employed as a turpentine substitute. L. A. C.

Oil; Apparatus for dehydrating —. F. W. McNear, Menlo Park, and P. E. Bowles, jun., Reward, Calif. U.S. Pat. 1,297,378, 18.3.19. Appl., 2.10.16.

Oil is electrically dehydrated in a tank which has a conductive inner surface and is provided with a number of annular electrodes spaced axially and connected to one side of a source of electric energy and also to the conductive surface. Between the annular electrodes is a series of disc electrodes spaced axially from the annular electrodes and connected to the other side of the source of electric energy, leaving a space for the flow of liquid through the successive annular electrodes and round the successive discs. The spaced electrodes of opposite polarity may be arranged closer together at the top than at the bottom of the tank.

—C. A. M.

Emulsion-oils; Treatment of —. F. M. Rogers, Assignor to Standard Oil Co., Whiting, Ind. U.S. Pat. 1,299,385, 1.4.19. Appl., 26.1.18.

The sodium salt of a sulphonic acid produced by sulphonating a mineral oil is added to an emulsion of mineral oil and water (*e.g.*, "bottom settlings") at the rate of ½ to 4 lb. of the salt per barrel of oil, and the mixture is maintained at a raised temperature until it separates into layers.—L. A. C.

Associated liquids [mineral oil emulsions]; Method of separating —. *Method of and means for separating water from heavy-oil emulsions.* C. W. McKibben, Houston, Tex. U.S. Pats. (A) 1,299,589 and (B) 1,299,590, 8.4.19. Appl., 14.12.17 and 24.10.18.

(A) An oil-water emulsion is passed through a relatively long conduit in which it is subjected to the action of a continuous uniform electric field between electrodes within the conduit, the velocity of the emulsion being sufficient to break up the chains of polarised water globules which tend to form between the electrodes. The oil which separates out is led away. (B) A heavy-oil emulsion is heated to vaporising point, and the liquid is then passed continuously through an intensified electric field. The vapours are condensed, the liquids are cooled below the vaporising point, and the water, after settling to the bottom of the vessel, is automatically discharged.—L. A. C.

Motor fuel. C. L. E. Mueller, Joliet, Ill. U.S. Pat. 1,297,388, 18.3.19. Appl., 21.10.18.

A FUEL oil comprises a mixture of anthracene oils dissolved in the light oils derived from the fractional distillation of coal tar, with the products of the distillation of crude petroleum up to 350° C.
—B. N.

Solidified liquid fuel; Infusible —— and process of making the same. F. E. Poulton, Boston, Mass., Assignor to S. Sternau and Co., Brooklyn, N.Y. U.S. Pat. 1,299,108 1.4.19. Appl., 16.4.15.

A SOLID infusible fuel comprises colloidal pyroxylin and alcohol, or alcohol and ether, the pyroxylin being in sufficient quantity to retain the alcohol, under normal conditions of commercial handling and use.—J. S. G. T.

[Mineral oil] stills; Apparatus for removing deposits from ——. N. W. Thompson, Oakland, Assignor to Shell Co. of California, San Francisco, Cal. U.S. Pat. 1,298,602, 25.3.19. Appl., 27.8.17.

IN a vertical still the oil under treatment flows down the inner walls and the vapours formed pass away through holes in an axial hollow column. Scraping devices arranged to remove deposits from the inner walls of the still are mounted on the hollow column which is rotated during the distilling operation.—T. St.

Mineral oils; Process of treating ——. C. J. Greenstreet, Webster Groves, Mo., Assignor to Gasoline Corporation, New York. U.S. Pat. 1,299,172, 1.4.19. Appl., 31.3.13. Renewed 10.8.18.

HEAVY mineral oil together with steam is run through a continuous unobstructed coil of pipe maintained at 900°—1200° F. (about 480°—650° C.) at such a rate that 52 galls. pass through a pipe 1½ ins. in diameter and 100 ft. long in 6–9 mins. Solid and semi-solid ingredients of the oil are broken down, and the resulting oil, of density about 48° B. (sp. gr. 0·786), and richer in olefines than the untreated oil, is volatile without residue at ordinary temperatures.—L. A. C.

Gasoline; Process of obtaining —— from hydrocarbon gases. J. B. Garner, Assignor to Hope Natural Gas Co., Pittsburgh, Pa. U.S. Pat. 1,299,455, 8.4.19. Appl., 18.1.17. Renewed 26.8.18.

HYDROCARBON gases containing gasoline are treated at first under normal pressure, then under a pressure considerably greater than that of the atmosphere, with a solvent capable of dissolving gasoline. The pressure is then reduced somewhat, whereby constituents lighter than gasoline which have been absorbed by the solvent are removed. The gasoline is subsequently recovered from the solvent.—L. A. C.

Paraffin wax; Process and apparatus for purifying crude — —. A. L. G. Dehne, Halle. Ger. Pat. 310,850, 17.3.18.

THE paraffin wax left in the filter-press after the removal of the heavy oil is washed out by means of a light oil (benzine or the like), which is preferably cooled to at least 0° C. The filter-press used in the process has special outlet channels for the light oil in addition to those for the heavy oil.
—C. A. M.

Sulpho acids from mineral oils and petroleum distillates; Process of obtaining — —. W. Happach, Malmö, Sweden, and Sudfeldt und Co., Melle. Ger. Pat. 310,925, 24.6.13. Addition to Ger. Pat. 264,785/13.

THE products prepared as described in the chief patent by means of fuming sulphuric acid are washed with water, and the solution containing the sulpho acids is treated with a small quantity of methyl or ethyl alcohol or acetone. The petroleum hydrocarbons separate and form an upper layer whilst the sulphonic acids remain in solution.
—C. A. M.

Pulverulent fuel; Fire-boxes for burning ——. E. C. R. Marks, London. From Fuel Saving Co., New York. Eng. Pat. 125,768, 26.4.18. (Appl. 7060/18.)

SEE U.S Pat. 1,266,088 of 1918; this J., 1918, 404 A.

Distillation gases of coal; Purification of ——. E. Ciselet and C. Deguide, Brussels. Eng. Pat. 9780, 5.7.15. Int. Conv., 6.7.14.

SEE Ger. Pat. 297,101 of 1915; this J., 1917, 637.

Hydrocarbon oils; Process for transforming heavy —— into lighter hydrocarbon oils. R. Cross, Kansas City, Mo., U.S.A. Eng. Pat. 126,103, 3.4.18. (Appl. 5704/18.)

SEE U.S. Pat. 1,255,138 of 1918; this J., 1918, 200 A.

Liquid-fuel furnace. Eng. Pat. 125,629. *See* I.

Hydrogen. Eng. Pats. 126,251 and 126,256. *See* VII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Reflecting power of tungsten and stellite. W. W. Coblentz and W. B. Emerson. Bull. Bureau of Standards, 1918, **14**, 307—316.

IT has already been observed that the curve representing the radiation from incandescent tungsten filaments corresponding to various wave lengths as abscissæ, showed elevations in the region 0·8μ—0·9μ. The reflecting power of four samples of tungsten has since been measured in the region of the spectrum from 0·5μ to 6·0μ, employing a mirror spectrometer, fluorite prism, and a vacuum thermopile of bismuth-silver. The reflecting power of the tungsten was determined by comparison with a freshly silvered glass mirror, or, for the region 0·5μ to 1·2μ by comparison with the reflecting power of the hypotenuse face of a right-angled glass prism. The reflecting power curves of all the samples showed a marked depression at 0·8μ, and a similar indentation occurs at 1·3μ in the reflectivity curve of the pure metal, but is absent from that of an impure sample. The reflecting power rises abruptly from 50% at 0·5μ to 90% at 2μ, and thereafter increases gradually to 96% at 6μ. The depression at 0·8μ indicates that selective emission must occur in this region of the spectrum. The reflectivity curves indicate that the luminous efficiency of an alloy of tungsten in which the minimum at 1·3μ is obliterated is higher than that of pure tungsten. The reflectivity of stellite (an alloy of chromium, cobalt, and molybdenum) increases gradually from 65% at 0·6μ to 88% at 9μ.
—J. S. G. T.

PATENTS.

Carbonaceous substances; Treatment [distillation] of ——. H. H. Mulliner, London, and A. T. Kent, Sutton, Surrey. Eng. Pat. 125,698, 21.3.18. (Appl. 5014/18.)

CARBONACEOUS material, *e.g.*, cannel coal or shale, is subjected to distillation within a vertical retort of the continuous or semi-continuous type, wherein respective temperatures of 500° C. and 200° C. are maintained at the bottom and top. Steam, coal-gas, or water-gas, at low pressure is continuously supplied at the bottom of the retort and passes upwards through the charge.—J. S. G. T.

Vacuum electric discharge apparatus for lighting. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 125,201, 6.4.18. (Appl. 5917/18.)

A VACUUM electric discharge apparatus comprises a sealed vessel containing solid elongated metal electrodes, mounted side by side and spaced apart to form discharge gaps. The atmosphere of rare gas of good conductivity, such as neon or helium, is at a pressure of about 1 mm. of mercury, so that a potential of 220 volts will establish and maintain a luminous discharge from the electrodes, consisting almost solely of the negative glow. The electrodes may be mounted concentrically about the longitudinal axis of the bulb, alternate electrodes being of opposite polarity; or the positive electrode may be mounted near the axis of the bulb, with the negative electrode formed from a number of metallic members mounted concentrically with and parallel to the positive electrode; or a central glass hub may be provided with radial arms, and the elongated electrodes mounted on them.—B. N.

Electric [arc] lamps; Fume-absorber for ——. W. R. Mott, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,297,387, 18.3.19. Appl., 27.1.17.

THE electrodes of electric arc lamps are adapted to form an arc containing glass-etching fluorides and a fume absorber containing fused boric oxide, the latter combining with the fluorides to form complex borofluorides, or hydrofluoboric acid, which are inactive towards glass.—B. N.

Electric incandescence lamp; Metal filament ——. L. Hamburger, D. Lely, jun., and Naaml. Vennoots. Philips' Gloeilampenfabrieken, Eindhoven, Holland. Ger. Pat. 311,054, 6.1.16.

SEE Eng. Pat. 113,626 of 1916; this J., 1918, 234 A. Instead of calcium fluoride, sodium oxide, sodium phosphate, or sodium tungstate may be used. Prevention of blackening of the bulb is probably due to the formation of a colloidal solution of the vaporised metal at the surface of the salt layer.

Electric incandescence lamps; Carbon filament filled with gas containing hydrocarbons. C. Schlesinger, Strassburg. Ger. Pat. 311,101, 10.5.17.

THE bulb of a carbon filament lamp is filled with a mixture of nitrogen, argon, or similar indifferent gas, and a hydrocarbon. The useful life of the lamp is about 800 "lighting" hours, and the current consumption is from 40 to 80% of that of the unfilled carbon filament lamp.—J. S. G. T.

Drying process. U.S. Pat. 1,299,791. *See* I.

III.—TAR AND TAR PRODUCTS.

Tar lubricating oil. K. Bruhn. Stahl u. Eisen, 1919, **39**, 402—406, 469—474.

BY treatment of the anthracene oil fraction in the distillation of coal tar a good lubricating oil has been produced in Germany during the war period, and it is calculated that 150,000 tons should be available annually. Crude anthracene oil (b.pt. 300°—360° C.) is cooled to a low temperature, filtered, freed from the more volatile constituents, again cooled and filtered, and then treated in various ways to modify its viscosity. Diagrams are given showing the viscosity of a number of samples at different temperatures in comparison with mineral oil. Its setting or solidifying point is below −10° C. It is rather difficult entirely to remove water, and also to overcome its tendency to deposit sediment at low temperatures, but care in the distillation process has led to a considerably improved product. At ordinary temperatures it is with difficulty miscible with mineral oil, but good admixture is obtained at higher temperatures. It is composed of a mixture of fluid and dissolved solid hydrocarbons of the anthracene and phenanthrene series and their hydro-derivatives, together with complex aromatic nitrogen and oxygen compounds. Methods of sampling are described and transportation and storing are considered. A diagram is given illustrating that the viscosity of a mixture of mineral oil and tar lubricating oil is below the mean of its components. Laboratory and industrial lubrication tests are described. Comparative tests on a railway wagon axle loaded to imitate running conditions showed that the tar lubricating oil maintained as low bearing temperatures as mineral oil. Similar successful results were obtained in a steam engine and an alternator. It has been adopted by a works in Bochum, a large steel works in Rhenish Westphalia, and the State Railways, and is now used for nearly all kinds of lubrication.—T. H. Bu.

Benzol extraction. St. Clair Deville. *See* IIA.

Toluol recovery. McBride and others. *See* IIA.

Cracking petroleum Liddow. *See* IIA.

PATENTS.

Phenol or its homologues; Separating —— from an aqueous liquid. D. Tyrer, Stockton-on-Tees. Eng. Pat. 125,625, 21.9.16. (Appl. 13,423/16.)

WATER containing phenol or its homologues in solution is agitated with nitrobenzene, or a solution of nitrobenzene in a suitable diluent, *e.g.*, 20% of nitrobenzene in a mixture of equal parts of solvent naphtha and crude benzol. The resulting phenol solution is treated with alkali solution for removal of the phenol etc., and the extracting liquid is used again.—B. V. S.

Carbolic acid [phenol]; Method of making ——. H. H. Dow, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pat. 1,274,394, 6.8.18. Appl., 10.7.16.

SODIUM phenoxide is produced when bromobenzene is heated in closed vessels with a dilute alkali hydroxide solution under a pressure of 20 atmospheres. On acidification phenol of high purity is obtained.—G. F. M.

Benzene-monosulphonic acids; Preparation of ——. Comp. des Produits Chimiques d'Alais et de la Camargue, Salindres, France. Eng. Pat. 126,039, 7.11.16. (Appl. 15,960/16.) Int. Conv., 25.2.16. Addition to Eng. Pat. 101,973 (this J., 1917, 705).

BENZENE vapour is passed through a steam superheater on its way to the sulphuric acid, which is kept at a temperature of 160°–200° C. Apparatus is described for both intermittent and continuous working, in the latter case on the counter-current principle.—B. V. S.

Sulphonic acids; Manufacture of aromatic ——. *Manufacture of benzene sulphonic acids.* J. A. Ambler, Norwich, Conn., and H. D. Gibbs, San Francisco, Cal. U.S. Pats. (A) 1,300,227 and (B) 1,300,228, 8.4.19. Appl., 16.1.18 and 26.1.18. (Dedicated to the public.)

(A) A CONTINUOUS process in which the vapours of the hydrocarbon and of sulphuric acid are allowed to react, any excess of hydrocarbon along with the water formed by the reaction being

removed as vapour and any excess of sulphuric acid along with the sulphonic acid being withdrawn as liquid. (B) The process is particularly applied to benzenesulphonic acids. B. V. S.

Nitrophenols; Manufacture of ——. D. B. Macdonald and J. Calvert. Eng. Pat. 126,062, 24.11.16. (Appl. 16,843/16.)

In the manufacture of nitrophenols by the interaction of benzene, nitric acid, and mercuric nitrate, the process is carried out in the presence of carbon dioxide, large quantities of 2.4-dinitrophenol are formed. The gas, under a pressure of about 1 atm., may either be passed into a mixture of the three reagents, or first through either the benzene or nitric acid contained in a separate vessel, the mixed vapours being led into the mixture of nitric acid and mercuric nitrate, or benzene, mercuric nitrate, and a portion of the nitric acid respectively. In the examples given 1 grms. of mercury, 90 grms. of nitric acid (sp. gr. 1·42), 40 grms. of benzene, and 22 grms. of carbon dioxide are used, and the reaction is allowed to proceed for 6 hours at 40°—50° C., at the end of which time the dinitrophenol is isolated from the upper layer by the evaporation or steam distillation of the volatile constituents.—G. F. M.

Nitrophenols; Manufacture of ——. D. B. Macdonald and J. Calvert. Eng. Pat. 126,084, 4.12.16. (Appl. 17,377/16.)

The formation of 2.4-dinitrophenol by the interaction of benzene, nitric acid, and mercuric nitrate is facilitated by passing air or oxygen, or mixtures of air and/or oxygen with carbon dioxide, into the reaction mixture in the same manner as that described in Eng. Pat. 126,062 (see preceding abstract).—G. F. M.

N-Methyl-p-aminophenol; Process of manufacturing ——. R. N. Harger, Washington, D.C. U.S. Pat. 1,297,685, 18.3.19. Appl., 10.12.18. (Dedicated to the public.)

N-Methyl-*p*-aminophenol is prepared by heating together quinol and methylamine at 150° C. for five hours.—G. F. M.

Nitrated coal-tar derivatives; Treating liquor from reducing processes of ——. I. Kitsee, Philadelphia, Pa. U.S. Pat. 1,298,513, 25.3.19. Appl., 26.1.18.

Liquor which has been used to reduce nitrated coal-tar derivatives is electrolysed, both the metal and the acid being recovered.—B. V. S.

Anthraquinone; Purification of ——. H. D. Gibbs, Cherrydale, Va., H. F. Lewis, Urbana, Ill., and The Selden Co., Pittsburgh, Pa., U.S.A. Eng. Pat. 125,836, 5.7.18. (Appl. 11,072/18.)

See U.S. Pat. 1,293,610 of 1919; this J., 1919, 280 A.

Motor fuel. U.S. Pat. 1,297,388. *See* IIA.

Resin from solvent naphtha. U.S. Pat. 1,297,328. *See* XIII.

IV.—COLOURING MATTERS AND DYES.

Tetrahydronaphthalene; Preparation and properties of derivatives of and dyestuffs from ——. F. M. Rowe. J. Soc. Dyers and Col., 1919, **35**, 128—134.

ar-Tetrahydro-α-naphthylamine, together with a small amount of *ac*-tetrahydro-α-naphthylamine, is obtained by the action of sodium and amyl alcohol on α-naphthylamine at the boiling temperature. With ethyl or butyl alcohol no *ar*-tetrahydro-α-naphthylamine is obtained even in presence of sodium amalgam, mercurous chloride, a nickel catalyst, or dextrose. The process is conveniently carried out by adding a solution of α-naphthylamine in amyl alcohol to boiling solvent naphtha or toluene containing metallic sodium. Under these conditions substitution of butyl or ethyl alcohol for amyl alcohol yields dihydro-α-naphthylamine, large colourless rhombic plates, m.pt. 37·5° C., which can be diazotised and coupled with amines and phenols giving azo dyes differing considerably in shade from similar azo dyes derived from α-naphthylamine or *ar*-tetrahydro-α-naphthylamine. A large number of derivatives of *ar*-tetrahydro-α-naphthylamine have been prepared and their properties determined, particularly their effect when substituting the corresponding non-hydrogenated derivatives in azo dyes and in the sulphide fusion.—T. C.

Patents.

Colouring matter [Indanthrene]; Production of a ——. J. Morton, A. G. Dandridge, and Morton Sundour Fabrics, Ltd., Carlisle. Eng. Pat. 126,112, 25.1.18. (Appl. 7009/18.)

N-Dihydro-1.2.2'.1'-anthraquinoneazine (Indanthrene) is obtained from 2-aminoanthraquinone and potassium hydroxide in much purer condition and in better yield than is possible by the method described in Eng. Pats. 3239 and 22,762 of 1901 (this J., 1902, 249, 1391) by carrying out the fusion in the presence of potassium chlorate. In the example given 7·5 parts of potassium chlorate is added to 120–200 parts of fused potassium hydroxide, the temperature is allowed to fall to 200° C. and 40 parts of 2-aminoanthraquinone is added. After heating for ½ hour at 250° C., the melt is run into 1000 parts of water, and boiled until the dyestuff is completely precipitated. The substance prepared in this way gives bright blue shades on cotton.
—G. F. M.

Picric acid. Eng. Pats. 125,160 and 125,461. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Wool; Cleaning [scouring] of —— with volatile solvents. H. Hey. J. Text. Inst., 1919, **10**, 118—123.

The author gives a brief survey of the scouring or cleaning of wool by organic solvents, noting the more important points of practical value. The solvent containing the grease should be evaporated at a low temperature to prevent darkening the grease, this being particularly necessary when the wool and solvent contain water. The finer qualities of raw wool, those generally containing most grease, are more likely to be damaged by ordinary scouring than by solvent extraction. With a modern plant, the grease may be removed to any desired extent, but most of the suint and dirt must be removed by an after-treatment with warm water. The solvent must be removed from the extracted wool before washing, or emulsions, which cause considerable trouble, will be produced; this difficulty has perhaps hindered the solvent scouring process more than anything else. The most modern plant consists of an outer casing of iron for containing the solvents, and an inner cage of steel, with a periphery of perforated steel plates, which is carried on a strong steel shaft. The cage is divided into four compartments, each fitted with

a door, which may be brought opposite to a door in the outer casing. The inner cage is made to revolve slowly when washing and very quickly when centrifuging. The drying arrangements consist of large pipes or ducts leading from the top of the machine through a cooler and centrifugal air-tight fan to a heater, and then to the centre of the machine where the hot gases are distributed through the material. The whole of the operations are carried out in an inert atmosphere, such as carbon dioxide or washed flue gases. The application of solvent scouring to carbonised greasy wool is said to give better results than the carbonising of scoured wool. The raw wool is treated with acid, dried, extracted with solvent, and then the burrs crushed and shaken out. The treated material is then neutralised and washed as usual.

—L. L. L.

Flax; Retting of — by means of bacteria. R. Loeser. Umschau, 1918, **22**, 685–686. Chem. Zentr., 1919, **90**, II., 283.

In carrying out Rossi's process of retting (this J., 1917, 79), flax was boiled for 40 mins. and then treated with a cultivation of *B. Comesii* (which is closely allied to the butyric acid bacteria) in large vats aerated from below. After fermentation for 36 to 40 hours at 30°–32° C. the flax had only a slight brown colour and was nearly odourless.

—C. A. M.

Vegetable textile fibres; Comparative examination of —. R. Haller. Färber Zeit., 1919, **30**, 29–33, 43–47.

The author gives a fairly full account of the action of certain reagents upon many of the vegetable fibres, and points out the necessity of studying the behaviour of fibres towards reagents when viewed under the ultramicroscope. The production of Prussian blue, by the action of some fibres on ferric chloride and potassium ferricyanide, which Cross and Bevan declared was due to the so-called lignocellulose content of the fibres, has been shown by the author (this J., 1915, 1047) to occur in the case of certain kinds of cotton which do not contain lignocellulose. Kakhi cotton, a variety of *Gossypium hirsutum*, which is grown in Malta, gives an intense blue with ferric chloride and potassium ferricyanide; it also reacts abnormally with ruthenium red with which it gives a deep red colour. The deep blue colour produced by Methylene Blue on jute has been ascribed to the presence of tannin-like substances. Jute, however, does not give a colour reaction with titanium chloride, whereas tannin gives a deep orange colour. Interesting observations were made under the microscope of the action of ammoniacal copper oxide upon fibres, the fibres, in most cases, having been isolated by the Schulze method (nitric acid and potassium chlorate). With isolated jute fibres this action is at first slow; gradually the cells separate, bending sideways, and splitting into two portions. Raw jute, treated in a similar manner, leaves a brown tubular residue, the cellulose passing into solution. The residue no longer gives a blue colour with ferric chloride and potassium ferricyanide; it is not changed by the action of caustic soda, nor is it dyed by Methylene Blue; it gives a blackish colour with zinc chloride and iodine. The isolated hemp fibre on treating with ammoniacal copper oxide leaves a membrane which gives a violet colour with zinc chloride and iodine or a brown colour with sulphuric acid and iodine; it is insoluble in caustic soda, and gives a dark olive-green with ferric chloride and potassium ferricyanide. Linen, examined under the ultramicroscope, turns dull and then almost completely dissolves when treated with ammoniacal copper oxide; nettle fibre, under similar conditions, rapidly turns dull and then opaque. Bast fibres of the bulrush type have lately found commercial use. The cells of the fibres isolated by the Schulze method often measure 0·7 mm. in length, each end of the cell being pointed. Under the action of ammoniacal copper oxide the raw fibres separate into single cells; these change similarly to cotton. Iodine in sulphuric acid gives a dark blue colour, iodine in zinc chloride a violet, phloroglucinol in hydrochloric acid shows only a very slight lignocellulose reaction, whereas "ruthenium red" gives an intense coloration. The fibres of broom give cells of 5 to 6 mm. in length. The fibres are striped, and the ends of the cells rounded. During treatment with ammoniacal copper oxide, the fibres begin to swell and separate, and the cuticular-like membrane dissolves, the latter being spiral-shaped around the cells. The fibre is free from lignocellulose but gives a reaction with "ruthenium red." Hop fibres appear very similar to hemp fibres; the cells are about 10 mm. long, the ends being very sharp. The isolated fibres (Schulze method) of lupins have cells of 0·8 to 2 mm. length. The ends are both pointed and round; ammoniacal copper oxide attacks the fibre only slowly. Cotton grass (*Eriophorum*) has found little application on account of its brittle nature; it very strongly withstands the action of ammoniacal copper oxide.

The following table gives the reactions of different groups of fibres:—

	Reaction with iodine solution	Reaction with "ruthenium red"	Phloroglucinol test	Maule's reaction	Reaction with $FeCl_3 + K_4Fe(CN)_6$
Cotton	Cellulose reaction	No colour	no colour		
Nettle, Flax, Broom, Hemp, Bulrush, Lupin	"	red colour	"		—
	"	"	pale rose		—
Cotton-grass (*Eriophorum*)	yellowish brown colour				pale blue
Kakhi cotton	"	red colour			+
Jute	"	"	red colour	+	+

The above reactions are those of the raw fibres. With the isolated fibres the reactions would be different; for example the separation may produce oxycellulose and this would give a reaction with "ruthenium red," whereas cellulose does not.

—L. L. L.

Vegetable fibrous raw materials and cellulose prepared from them; Scheme for analytical examination of —. C. G. Schwalbe. Z. angew. Chem., 1919, **32**, 125–126. (See this J., 1918, 685A.)

For the determination of moisture the method of distilling with toluene or petroleum hydrocarbon is recommended, since errors due to volatile oils etc. are thereby avoided and larger quantities of the sample may be employed in the case of materials which are not uniform. In the determination of the fat and resin, the result varies with the solvent employed; in view of accumulated data the usual extraction with ether, followed by alcohol, should be retained. Many materials, including straw and sulphite wood pulp, yield almost double the quantity of fat or resin to organic solvents if they are first subjected to acid hydrolysis. It is suggested that

values should be recorded before and after breaking down the cell structure with acids. The calculation of the methyl value in terms of lignin is not possible on account of the variable constitution of the latter. It is not considered likely that methylpentosans would influence the results of the methoxyl estimations, but pectins in materials other than wood may contribute substantially to the methoxyl value, since they yield methyl alcohol on treatment with dilute acids. The methods for the direct estimation of lignin as a residue from the treatment with highly concentrated hydrochloric or sulphuric acids require further investigation and may give useful results. Possibly the determination might be performed with greater accuracy after breaking down the cell structure by acid hydrolysis. As regards the furfural value, since small quantities of furfural are derived from hexoses apart from pentosans, it is preferable not to calculate in terms of pentosans. As a rule, especially in the case of unknown materials, the methylfurfural value should be expressed separately from the furfural value. The cellulose should be determined by Cross and Bevan's method with a correction for the furfural value of the product; König's proposal for a preliminary hydrolysis of the material does not afford sufficiently precise data, owing to the attack on the cellulose itself. The "acetic acid value" as described by Schorger (this J., 1917, 867) would appear to be a valuable factor in the characterisation of fibrous materials. The nitrogen content may also play an important part in the characterisation of vegetable fibres other than wood and in the determination of the purity of celluloses derived from them. In the examination of celluloses the estimation of the "copper value" is an accepted standard method, which is used to express the degree of bleaching of the cellulose. The quantity of cupric hydroxide adsorbed by the cellulose from cold Fehling's solution has been called the "hydrate copper value"; more recently, the term "degree of swelling" has been preferred. The "wood gum" value is a complex expression used for indicating the portions of the cellulose and its impurities which are soluble in strong sodium hydroxide. This estimation is preferably replaced by a determination of the α, β, and γ-cellulose fractions, according to the method of Cross and Bevan. J. F. B.

Flax and hemp sprits; Chemical composition of —. C. G. Schwalbe and E. Becker. Z. angew. Chem., 1919, **32**, 126–129.

THE scutching wastes, consisting mainly of particles of flax and hemp woods ("sprit" or "sheave"), were analysed according to Schwalbe's scheme (see preceding abstract). The ash was free from manganese. The fat and wax were estimated in two ways with different results, viz., by extraction with ether, followed by alcohol, and by extraction with a mixture of equal volumes of alcohol and benzene. It would appear that alcohol alone is capable of extracting certain substances other than fat, wax, and resin. In both materials the cholesterol test for resin was positive. Attempts to estimate the lignin according to König's method by dissolving out the cellulose with sulphuric acid did not give very reliable results. The following method with preliminary disintegration of the structure by hydrolysis gave concordant values, but too great reliance should not be placed on their interpretation: 1 grm. of substance was moistened with strong hydrochloric acid (sp. gr. 1·19) in a stoppered bottle and heated for some time; the stopper was then removed and the material in the bottle dried on the water bath. The hydrolysed product was collected on an asbestos filter, washed, and the material, together with the asbestos, was digested with 50 c.c. of 72% sulphuric acid at the ordinary temperature for 1–2 days. The residue was collected in a Gooch crucible, dried, weighed, ignited, and the lignin calculated by difference. Pectin was estimated by von Fellenberg's method (this J., 1917, 1190) by means of the methyl alcohol produced on heating with dilute acids. Pentosans were estimated from the furfural value according to Tollens and Kröber, the phloroglucide precipitate being afterwards extracted with alcohol to give the methylfurfural value, the results of which, however, were somewhat variable. Cellulose was estimated by Sieber and Walther's modification of Cross and Bevan's method (this J., 1913, 974), and since the cellulose retained the greater portion of the pentosans, these were deducted from the cellulose results. A substantial amount of acetic acid was formed on distillation with dilute sulphuric acid according to Schorger's method. The analytical results are summarised in the table below, together with the values of spruce wood for comparison. It is to be noted, however, that the woody portions of flax and hemp show a closer similarity to the dicotyledonous woods than to coniferous woods, particularly as regards their high content of pentosans and the substantial yield of acetic acid. The sum of the proximate constituents calculated from the analytical results amounts to considerably over 100% and the authors propose to reject the direct lignin values, substituting for them the average value of 20–21% which has been established for the wood of foliage trees.

Calculated on dry substance

	Flax sprit	Hemp sprit	Spruce wood
Ash	1·40	1·20	1·00
Wax and Fat (a) Ether extract	1·38	1·20	0·6
(b) Alcohol extract	1·31	1·95	0·38
(c) Sum of (a) and (b)	2·69	3·15	0·98
Resin (d) Alcohol-benzene extract	2·34	2·23	—
Methyl value	2·68	2·55	2·33
Pectin (according to von Fellenberg)	2·68	0·98	0·14
Acetic acid (Schorger's method)	1·79	1·04	1·6
Protein, N × 6·25	2·70	2·85	1·2
Furfural	13·81	13·03	—
Pentosan	23·59	22·15	11
Methylpentosan	0·47	0·51	—
Cellulose containing pentosan	62·99	71·13	60
" corrected for pentosan	46·35	50·52	53
Lignin (residue from 72% sulphuric acid)	23·77	30·13	30

—J. F. B.

Gas mask fabrics; Effect of exposure to weather on rubber —. G. St. J. Perrott and A. E. Plumb. J. Ind. Eng. Chem., 1919, **11**, 438–443.

FABRICS of different manufacture and consisting of finely-woven cotton sheeting covered with a rubber layer from 0·01 to 0·025 in. thick, deteriorated very slowly over a period of 100 days. There was a general relation between the amount of acetone extract and the permeability, and deterioration was more rapid in the summer months than in winter. Fabrics exposed rubber side downwards showed no appreciable deterioration over the whole period; those exposed rubber side upwards, but shielded from ultra-violet light, deteriorated at about the same rate as those exposed to the direct rays of the sun. There was no apparent relation between the results of weather ageing and an accelerated ageing test at 130° C. The tensile strength of all the fabrics decreased by 15% during the exposure. Both the fabric and rubber rotted when exposed to high concentrations of phosgene for 15 hrs. Analysis of the fabrics indicated that over 10% of bitumen

was undesirable and that as high as 20% of carbon tended to preserve the fabric, especially when exposed to direct sunlight. Fabrics with a high percentage of gum (rubber) were more resistant than those containing a large amount of filler.
—W. P. S.

Mercury vapour lamps; Use of —— for testing fabrics, films, etc. M. Entat. Ann. Chim. Analyt., 1919, 1, 142–153.

A SILICA mercury vapour lamp is useful for determining the effect of ultra-violet rays on fabrics, rubber-proofed fabric, cellulose acetate sheets and films, etc. The effective area covered by the ultra-violet rays may be determined photographically and the exposure of the fabric is entirely under control. From 2 to 4 hrs.' exposure to the rays corresponds with the effect of exposure to sunlight for 30 days; the effects are analogous and can be determined by the usual physical tests.—W. P. S.

Sulphite-cellulose. Yocum and Nelson. *See* XV.

PATENTS.

Coated fabrics; Impregnated and —. W. H. Perkin, Oxford, J. H. Mandleberg, and J. Mandelberg and Co., Ltd., Manchester. Eng. Pat. 125,622, 20.9.16. (Appl. 13,354/16.)

THE production of impregnated or coated fabrics with compositions containing rubber, litharge, and sulphur, alone, or in some cases along with other substances (see Eng. Pat. 121,495; this J., 1919, 357A), gives a highly inflammable coating; these coatings are rendered non-inflammable by the addition of hydrated aluminium oxide or asbestos, or a mixture of these ingredients.—L. L. L.

Animal offal; Process of obtaining a waterproof material with properties similar to those of raw silk fabrics from ——. F. Schmidt, Würzburg. Ger. Pat. 310,450, 16.8.17.

ANIMAL offal, *e.g.* ox-gullet, is dried, immersed for 3 to 8 days in 35% formaldehyde solution at 15° C., thoroughly washed, and again dried.—C. A. M.

Willow bark; Process of obtaining white ——. H. Oexmann, Berlin. Ger. Pat. 310,545, 15.11.16.

WILLOW bark is treated with alkalis to neutralise the tannic acid. By using more alkali a part of the bark is dissolved, enabling the fibres to be separated in the usual way.—C. A. M.

Waste liquors containing paper pulp and alkaline substances; Clarification of ——. H. Höfer, Sillein, Hungary. Ger. Pat. 309,406, 18.11.16.

THE liquor is treated with zinc salts, especially zinc sulphate, which reacts with the alkaline substances present (resin size, calcium hydroxide, etc.) to form a precipitate which carries down with it the suspended paper pulp. The clarifying effect of zinc salts is better than that of the aluminium compounds commonly employed. The zinc salts may be partly replaced by magnesium salts.

Sulphite-cellulose waste liquors; Purification of ——. H. Achenbach, Nussdorf. Ger. Pat. 309,563, 20.4.18. Addition to Ger. Pat. 306,898 (this J., 1918, 764A).

THE process described in the chief patent is applied to sulphite-cellulose waste lyes which have received a preliminary chemical or other treatment. The treatment with flue-gases is repeated several times, and air is excluded during the process.

Fire-extinguisher [from sulphite-cellulose waste lyes]. L. Elkan Erben G.m.b.H., Charlottenburg. Ger. Pat. 310,890, 10.5.17.

SULPHITE-CELLULOSE waste liquor is used as a fire-extinguisher or as a constituent thereof. A dry fire-extinguisher may be produced by mixing concentrated sulphite waste liquor with powdered material.—J. S. G. T.

Artificial thread; Funnels or thread-guides for use in the manufacture of ——. E. Dubot, Bagnolet, France. Eng. Pat. 126,263, 28.1.19. (Appl. 2129/19.)

Hydrolysis of esters. Eng. Pat. 125,153. *See* XII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Bleaching with hypochlorites containing free acid or free alkali, and water from different supplies. M. Freiberger. Färber-Zeit., 1919, 30, 89–94.

DIFFERENT solutions of bleaching powder were prepared and analysed. These solutions were then used to bleach both thin and thick materials produced from Egyptian and other cottons. The results are shown in the following table.

	Active Cl, grms. per litre	H_2O_2 grms. per litre	Ratio of free to combined HClO	Result: thick material	Result: thin material	Cellulose number (Schwalbe)	Corrected copper number (Schwalbe)	Methylene Blue colour %
1	1·0	0·1508	1·10	worst	good	—	—	0·036
2	1·2	0·208	1·8·8	medium	worse than (3)	0·25	0·22	0·043
3	1·2	0·1	1.17·8	best	good	0·25	0·23	0·043

Nos. 1 and 3 were made with distilled water, No. 2 with spring water containing iron and manganese. The bleaching was carried out at 37° C. with 35 minutes' immersion; the pieces were then washed with distilled water, soured, washed, and dried. A second set of experiments was made using sodium and calcium hypochlorite solutions and mixtures of these; they all contained 0·8 grm. of active Cl per litre. Results are shown in the table.

	Hypochlorite	Excess per litre	Thin material: White	Thin material: Methylene Blue colour	Thick material: White	Thick material: Methylene Blue colour
				%		%
4	Na	0·15 g. Na_2CO_3	7> 4> 6	0·042	7 > 1 > 6	0·035
5	Na	0·053 g. "	5 <6	0·042	5 > 6	0·028
6	80 %Na 20 %Ca	0·0052 g. HClO	6 <7	0·036	6 < 7	0·029
7	50 %Na 50 %Ca	0·016 g. HClO	7 <8	0·034	7 < 8	0·03
8	Ca	0·036 g. HClO	best	0·032	best	0·033

Experiments on the influence of different amounts of sodium carbonate on the bleaching effect showed that up to a certain limit excess of sodium carbonate is beneficial. Under the experimental conditions increase of the free sodium carbonate beyond 2 grms. per litre reduced the bleaching effect. The method of bleaching with warm hypochlorite solutions containing both calcium and sodium hypochlorite has been used commercially for some time; it gives better results than the cold bleaching and, when dilute solutions are used, does not damage the cellulose. With bleaching powder solutions the

best results are obtained in an acid solution (HClO), while with sodium hypochlorite the solution should be slightly alkaline. The author considers that the electrolytic bleach should be better than alkali hypochlorite solutions prepared from bleaching powder on account of the varying amounts of sodium carbonate present in the latter, whereas the electrolytic bleach if properly made should have a constant alkali content. (See also this J., 1919, 358 A.)—L. L. L.

PATENTS

Bleaching process. G. Ornstein, New York, Assignor to Electro Bleaching Gas Co. U.S. Pats. (A) 1,298,552, (B) 1,298,553, and (C) 1,298,554, 25.3.19. Appl., (A, B) 2.12.16, (C) 4.12.16. Renewed 15.2.19.

(A) BLEACHING is effected with a solution of chlorine in water containing not more than about 0·01% of chlorine. The chlorine is said to be hydrolysed, with formation of hypochlorous acid, all of which is present in the free state. (B) Chlorine is passed into sufficient water to convert it completely into hypochlorous acid and hydrochloric acid, the hydrochloric acid formed being neutralised by addition of the necessary amount of a basic material, which will combine with hydrochloric acid but not with hypochlorous acid. The material to be bleached is treated with the solution at or soon after the time of its preparation. (C) Sodium carbonate in proportion required for formation of sodium chloride and bicarbonate is used as basic substance in the process described under (B).—L. L. L.

Dyeing and like apparatus; Perforated beam for —. T. Brandwood, Walshaw. U.S. Pat. 1,298,287, 25.3.19. Appl., 19.7.17.

SEE Eng. Pat. 103,772 of 1916; this J., 1917, 335.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Ammonia; Oxidation of — [to nitric acid]. W. S. Landis. Chem. and Met. Eng., 1919, **20**, 470–477.

AN account of the development of the commercial oxidation of ammonia to nitric acid in Germany is given up to the beginning of 1915, followed by a description of the progress made in the industry in America since the beginning of 1916. The catalyst used is platinum gauze of rather less than 2½ oz. per square foot. The ammonia is obtained from cyanamide and it has been found that, once activated, the catalyst will work quite regularly for as long as two years without special purification of the ammonia. A peculiar feature is that on changing from cyanamide-ammonia to specially purified ammonia or coke oven ammonia a new period of as much as ten days is required for re-activation of the catalyst before the former efficiency is restored. The best rate of working seems to be about 5½—6 lb. of ammonia per square foot of catalyser per hour. The Government plant at Muscle Shoals, Ala., has 700 catalysers capable of a normal production of 250 tons of equivalent 100% nitric acid per day with an efficiency from cyanamide to acid of 87% and from ammonia to acid of practically 90%. Where ammonia can be obtained of suitable quality at the price of equivalent nitrogen in sodium nitrate the catalytic process is as cheap as the nitre pot process. The consumption of power on the Government plant for electrical heating of the catalyser was less than 1·7 kilowatt hour per lb. of nitric acid.—W. H. P.

Platinum gauze used as catalyst for the oxidation of ammonia; Data on —. Table of weights and active surface of platinum, air space, etc., shown for unit of one square inch of gauze of given mesh and diameter of wire. A. A. Campbell. J. Ind. Eng. Chem., 1919, **11**, 468–469.

THE data recorded are given in the following table:—

Mesh	Diam. of wire. In.	Wt. per sq. in. Grm.	Air space per sq. in. of gauze. Sq. in.	Surface per sq. in. of gauze. Sq. in.	Surface per grm. of platinum. Sq. in.
80	0·0026	0·33815	0·6272	1·3873	4·148
80	0·0030	0·46592	0·5774	1·5841	3·401
100	0·0026	0·42268	0·5676	1·6951	4·013
120	0·0020	0·29863	0·5715	1·4748	4·962
150	0·0015	0·21009	0·5990	1·4821	7·058
150	0·0020	0·37392	0·4886	1·9573	5·243

An alloy consisting of platinum, 99, and iridium, 1%, is as efficient as pure platinum and has the mechanical advantage that a finer wire may be drawn.—W. P. S.

Hypochlorous acid and chlorine monoxide. S. Goldschmidt. Ber., 1919, **52**, 753–761.

AQUEOUS solutions of hypochlorous acid, containing 25% of the acid, are readily obtained by distilling a mixture of chlorine hydrate and yellow mercuric oxide in a good vacuum; attempts to prepare a more concentrated solution or the anhydrous acid by distillation of this acid in a moderate vacuum and condensation of the distillate in receivers maintained at 0° C., −20° C., and −80° C., respectively, led to an unexpected result, since aqueous hypochlorous acid (25%) was collected in the first two vessels, whilst pure chlorine monoxide was condensed in the third vessel. It therefore appeared that the aqueous acid contains two equilibrium systems (1) $HClO \rightleftarrows H^+ + OCl^-$ and (2) $2HClO \rightleftarrows H_2O + Cl_2O$. The latter system has been investigated by determining the partition coefficient of chlorine monoxide between the solution and carbon tetrachloride. The equilibrium lies greatly in favour of hypochlorous acid so that an approximately *N*/5 solution contains only 0·02% of the anhydride. It is suggested that the well-known superior oxidising power of hypochlorous acid in acid as compared with alkaline solution is due to free chlorine monoxide.—H. W.

Arsenic acid; Gravimetric determination of —. L. W. Winkler. Z. angew. Chem., 1919, **32**, 122–124.

ARSENIC acid may be determined as arsenic sulphide after reduction with potassium thiocyanate. The solution, containing 0·01—0·15 grm. As_2O_5, is treated with 10 c.c. of hydrochloric acid and 5 c.c. of 20% potassium thiocyanate solution; hydrogen sulphide is then passed through the mixture for 1 hr., and, after about 18 hrs., the precipitate of arsenic trisulphide and sulphur is collected, washed, dried at 100° C., and weighed. $As_2O_5 + 2KCNS = 2KOCN + As_2O_3 + S_2$; $As_2O_3 + 3H_2S = As_2S_3 + 3H_2O$. If desired, the arsenic trisulphide may be dissolved in ammonia, oxidised with hydrogen peroxide, and precipitated as ammonium magnesium arsenate, and weighed as such or after ignition to magnesium pyroarsenate. When arsenic acid is precipitated directly as magnesium ammonium arsenate, the solution, measuring about 100 c.c., is treated with 2·5 grms. of ammonium chloride, and 10 c.c. of magnesium sulphate reagent (magnesium sulphate, 10, ammonium chloride, 5 grms., water, to 100 c.c.) is added slowly; after standing overnight, the preci-

pitate is collected, washed, dried, and weighed, or ignited to magnesium pyroarsenate before being weighed.—W. P. S.

Boric acid; Determination of ——. P. Jannasch and F. Noll. J. prakt. Chem., 1919, **99**, 1—33.

THE authors recommend the use of an alcoholic solution of sodium ethoxide for the titration of boric acid solutions; glycerol is added to prevent dissociation. To determine boric acid in minerals a portion of the sample is fused with sodium phosphate and metaphosphoric acid and the melt distilled with the addition of phosphoric acid and methyl alcohol; the distillate is treated with a definite volume of sodium hydroxide solution, evaporated to expel all methyl alcohol, then treated with a quantity of hydrochloric acid equivalent to the alkali added, the solution boiled to expel carbon dioxide, and the boric acid titrated as described.
—W. P. S.

Nelson electrolytic chlorine cell. C. F. Carrier, jun. Amer. Electrochem. Soc., Apr., 1919. (Advance copy.) 11 pages.

A HISTORY is given of the commercial development of the Nelson cell, which was used for the U.S. Government plant at Edgewood, Baltimore, the largest single chlorine plant in the world. 3500 cells were used to give 100 tons of gas per 24 hours. The cell is described in U.S. Pat. 1,149,210 of 1915 (this J., 1915, 969). It is of ¼ in. steel plate, with U-shaped cathode plate of perforated sheet steel supporting an asbestos diaphragm, and anodes of graphite 1 × 1 × 17 in. held by lugs 2½ in. diam. and 12 in. long. The top of the cell is made of slate slabs. The diaphragm has to be renewed once in six or eight months. The cells are operated at 1000 ampères, and the commercial guarantee specifies an output of 60 lb. of chlorine and 68 lb. of sodium hydroxide from 120 lb. of salt in 24 hours. The cell can be shut down as desired for short or long periods without damage, and does not require much floor space. A new process of treating the anodes has been perfected which increases the life of the electrode to over two years. W. H. P.

Sodium hydrosulphite; Chemical decomposition and electrolytic formation of ——. K. and E. Jellinek. Z. physik. Chem., 1919, **93**, 325—367.

IN aqueous solutions and in solutions of sodium bisulphite, sodium hydrosulphite is decomposed according to the equations, $2Na_2S_2O_4 = Na_2S_2O_5 + Na_2S_2O_3$; $Na_2S_2O_4 + H_2O = 2NaHSO_3$. The reaction is dimolecular; the reaction constant is proportional to the square of the bisulphite concentration, and increases normally with temperature. The electrolysis of sodium hydrosulphite has been investigated, particularly in respect of those factors which influence the hydrosulphite formation. Solutions containing 7%—8% of hydrosulphite were obtained, but this constitutes a very poor current yield. The poor yield is due to decomposition of the hydrosulphite by local acidity produced at the point where sulphur dioxide is led into the cathode liquid; to electrolytic reduction of hydrosulphite to thiosulphate, and to the fact that the current is partly transported by S_2O_4'' ions, which thus pass to the anode compartment and are lost. The loss occasioned by the migration of S_2O_4'' ions can be entirely avoided by the insertion of a concentrated solution of sodium chloride between the anode and cathode cells; the Cl' ions then carry the current instead of the S_2O_4'' ions. The loss due to local acidity may be avoided by leading the sulphur dioxide into the solution in very fine streams and in several places. Electrolytic reduction is avoided by choosing electrodes of a metal which positively catalyses the hydrosulphite formation and negatively catalyses the reduction to thiosulphate. Some varieties of lead appear to have this influence.—J. F. S.

Sodium permanganate; Electrolytic process for production of —— from ferromanganese. R. E. Wilson and W. G. Horsch. Amer. Electrochem. Soc., Apr., 1919. (Advance copy.) 14 pages.

THE necessity of providing pure and cheap sodium permanganate for use in the canisters of box respirators led the authors to investigate the possibility of making this substance electrolytically. The only widely available anode material is ferromanganese, which on account of its great brittleness is very difficult to cast. Suitable anodes have however been obtained by casting in long bars, adding certain deoxidisers, and cooling slowly in kieselguhr. The only catholyte suitable is sodium hydroxide and it is desirable that this should be used in a solution of maximum conductivity (about 18% NaOH). The best anolyte is a 12·14% solution of sodium carbonate, which must be kept cool either by a coil within the cell or by circulating the liquid outside the cell. The anodes gradually accumulate a skin of oxides of iron, manganese, and silicon which cannot be avoided by the use of addition agents, and must therefore be removed every 24 hours by sand blasting. On a "semi-plant" scale the best material for the cells was found to be sheet iron with diaphragms of asbestos paper supported on iron strips. The end walls of the cells act as cathodes. The best temperature is about 20° C., and the best current density about 7 amp. per sq. dm. It is not economical to carry the process beyond the production of an 8% solution of sodium manganate, but this can be concentrated to 30%, in which form the cost of sodium permanganate under war conditions is estimated at 60 cents per lb.—W. H. P.

Boronatrocalcite, Treatment of ——. E. Longobardi and N. Camus. Anal. Soc. Quím. Argentina, 1919, **7**, 12—21.

THE following process was devised by the authors for the treatment of an impure boronatrocalcite occurring in the Andes territory of the Argentine. The powdered mineral is added in small quantities, alternately with small quantities of sulphuric acid (90%), to 4—5 times its weight of hot water contained in a lead-lined tank provided with efficient mechanical agitation. The amount of acid used is just sufficient to saturate the calcium and sodium oxides present in the mineral, leaving not more than 0·1—0·25% excess of free acid, and the temperature is maintained at 80°—90° C. After passing through a filter-press the clear hot liquor is allowed to crystallise, the mother liquor being used again in the acid treatment tank. The crystals of boric acid are washed with cold water on a filter bed of perforated lead or earthenware and redissolved in hot water so as to give a solution of sp. gr. 1·04—1·05 at 90° C. The solution is acidulated with sulphuric acid to 0·05%—0·1% strength. The boric acid crystallises in prisms. In order to obtain the acid in scale form the sp. gr. of the crystallising solution must not exceed 1·01 at 90° C. The crystals are dried in a centrifuge. A perfectly white product is obtained if all operations are carried out in lead or earthenware vessels. Contact with iron or wood must be avoided.—W. S. M.

Hydrogen sulphide; Modification in the technique of Fischer's reaction for ——. L. P. J. Palet and A. Fernandez. Anal. Soc. Quím. Argentina, 1918, **6**, 49—51.

To a drop of dimethylaniline are added 2 c.c. of water, 3—4 drops of 1% solution of sodium nitrite, and 5 drops of 10% hydrochloric acid. The mixture is neutralised with saturated sodium carbonate solution and the free base extracted with ether. The ethereal solution is decanted and reduced with zinc powder and a few drops of concentrated hydro-

chloric acid. When the green colour disappears the ether layer is rejected. 2 c.c. of water and the solution to be tested are added, then concentrated hydrochloric acid and a few drops of 10% ferric chloride solution. The methylene blue formed is rendered more distinct by adding alcohol. Excess of hydrochloric acid must always be present.
—W. S. M.

Sulphur-oxygen compounds; Method for the identification of ——. A. Sander. Chem.-Zeit., 1919, **43**, 173.

THE following reactions are obtained when the sodium salts named are treated with an excess of mercuric chloride solution:—

Compound	Reaction in the cold	Reaction towards methyl orange	Behaviour of mixture when boiled	Reaction after boiling
Sulphate ..	No ppt.	Remains neutral	No change	Neutl.
Sulphite ..	No ppt.	Remains alkaline	Ppt.	Acid
Bisulphite ..	No ppt.	Becomes acid	Ppt.	Acid
Sulphide ..	Ppt.	Remains neutral	No change	Neutl.
Thiosulphate	Ppt.	Becomes acid	No change	Acid
Polythionate	Ppt.	Becomes acid	No change	Acid

Thiosulphate solutions decolorise iodine solution and give a precipitate of sulphur when acidified; polythionate solutions remain clear when acidified and do not decolorise iodine solution. Sulphites and polythionates cannot exist together in the same solution. (See also J. Chem. Soc., 1919, ii., 241.)
—W. P. S.

Ferric oxides; Hydrated ——. E. Posnjak and H. E. Merwin. Amer. J. Sci., 1919, **47**, 311–318.

THERE is only one naturally occurring hydrate of ferric oxide, namely the monohydrate; this occurs in two crystalline forms, goethite and lepidocrocite, and one amorphous form, limonite. The mineral turgite is probably a solution of goethite in hæmatite with adsorbed water. Attempts to prepare crystalline hydrates of ferric oxide were unsuccessful. There are two amorphous hydrates of ferric oxide, one a yellow substance which is essentially the monohydrate, and the other a reddish-brown substance which holds its water in the dissolved or adsorbed condition. (See also J. Chem. Soc., 1919, ii., 235.)—J. F. S.

Silicon tetrachloride. O. Hutchins. Amer. Electrochem. Soc., Apr., 1919. (Advance copy.) 12 pages.

SILICON tetrachloride can be made practically continuously on the large scale by the action of dry chlorine on carborundum at about 1200° C. The electric furnace used is of firebrick (6 in. thick), with a sheet iron shell. The cylindrical reaction chamber (3 ft. by 1 ft.) has an axial resistor of 1¼ in. carbon rod for preliminary heating. The top of the cylinder has an outlet for the tetrachloride and a charging hole for carborundum. The bottom has a narrow inlet for the chlorine. Discharge of the residue takes place from a 6 in. horizontal tube near the bottom of the furnace. Such a furnace produces 20–30 lb. of silicon tetrachloride per hour, and requires recharging about every four hours. For heating the charge power is supplied at 125 volts, the consumption being 15 kilowatts, but when the reaction is in progress no heating is necessary. Condensation of the product requires some care, and a trap is necessary for iron and aluminium chlorides produced from impurities in the carborundum. The tetrachloride is useful for producing smoke clouds, but no extensive non-military use has yet been found for it.
—W. H. P.

Silicon and titanium tetrachlorides; Rôle played by —— during the past war. G. A. Richter. Amer. Electrochem. Soc., Apr., 1919. (Advance copy.) 9 pages.

A STUDY of the efficiency of the two chlorides as smoke producers for military purposes. Neither was used extensively except with other materials, especially liquid ammonia. Although titanium chloride gives a cloud of greater obscuring power the overall efficiency of silicon chloride is usually quite as great, since the slowness of evaporation of titanium chloride gives rise to disadvantages such as gumming of nozzles etc.—W. H. P.

Nitrides of nickel and cobalt; Normal ——. A. C. Vournasos. Comptes rend., 1919, **168**, 889–891.

NICKEL nitride, Ni_4N_2, is readily obtained if a mixture of anhydrous nickelous oxide and anhydrous nickel cyanide in the proportion of 1 : 0·74 is dropped, in small quantities at a time, through an arc between two carbon electrodes in an atmosphere of nitrogen, providing the temperature of the arc is near 2000° C. The nitride so obtained burns in oxygen, is decomposed when heated in chlorine, and is attacked by nitric and hydrochloric acids. It is not decomposed by boiling water, but molten sodium hydroxide decomposes it with the evolution of ammonia. Cobalt nitride, Co_3N_2, may be similarly prepared and has similar properties.
—W. G.

Cerium nitride P Fabaron. Ann Chim. Analyt., 1919, **1**, 156.

WHEN metallic cerium is heated to redness in a closed copper tube, the oxygen of the air in the tube combines with the copper, whilst 20% of the nitrogen combines with the cerium to form cerium nitride, CeN_2; this is a grey-black substance, which decomposes water with the formation of ammonia and cerous oxide.—W. P. S.

Carbon monoxide, carbon dioxide, carbon oxysulphide and similar gaseous mixtures; Analysis of mixtures of vapours containing ——. A. Stock and P. Seelig. Ber., 1919, **52**, 672–680.

THE methods adopted depend on the differing readiness with which the components of the mixture are absorbed. Two procedures are described. In the first, all constituents are estimated in a single sample. A measured volume of the mixture is shaken with sodium hydroxide (30%, 1 c.c.) and the volume observed each minute during several minutes to determine the carbon dioxide. The solution is then diluted with water (4 c.c.) thus yielding an approximately 5% solution which absorbs carbon oxysulphide fairly rapidly. The mixture is occasionally shaken, and the volume read off after 10, 20, 30, 40, and 60 minutes to determine the carbon oxysulphide. To determine carbon bisulphide, potassium hydroxide solution (30%, 1 c.c.) is added and the volume of gas determined after 1, 2, 3, etc. days. The residue is carbon monoxide which must be completely absorbed by cuprous chloride solution. The second method is more rapid and accurate, but requires more material. A known volume of the sample is shaken with aqueous sodium hydroxide (30%, 1–2 c.c.) and the volume measured at minute intervals to determine the carbon dioxide. A second sample is shaken with sodium hydroxide solution (50%, 2–3 c.c.) at intervals during 15–30 minutes and then continuously until the volume becomes constant. This gives the carbon dioxide plus carbon oxysulphide; carbon bisulphide is practically not absorbed. In a third sample carbon oxysulphide, carbon dioxide, and carbon bisulphide are determined together by

agitating occasionally with potassium hydroxide solution (5%, 2—3% c.c.) and measuring the volume at intervals during 3—4 days. The residual carbon monoxide is tested for purity by ammoniacal cuprous chloride solution. Alternatively, the carbon bisulphide may be estimated as follows: the residue from the determination of carbon dioxide and carbon oxysulphide is immediately treated with a few drops of carbon bisulphide and the increase in volume caused by saturation with carbon bisulphide vapour is determined. The methods have been tested with artificial mixtures of widely varying composition and found to give satisfactory results. The paper also contains vapour tension-temperature tables for aqueous sodium hydroxide solutions between 5% and 50% and between 10° C. and 25° C. and for carbon bisulphide between −80° C. and +30° C.—H. W.

Carbon oxysulphide; Thermal decomposition of ——. A. Stock, P. Seelig, and W. Ottmann. Ber., 1919, **52**, 681—694.

THE thermal decomposition of carbon oxysulphide leads to the formation of carbon monoxide and sulphur on the one hand and of carbon dioxide and carbon bisulphide on the other: (i) $2COS \rightleftarrows 2CO+S_2$, and (ii) $2COS \rightleftarrows CO_2+CS_2$. The equilibria have been investigated by passing the gas through an electrically heated quartz tube, condensing the sulphur in a small U-tube maintained at 130° C. and analysing the gases by the methods described in the preceding abstract. At 800° C., reaction (ii) proceeds very slowly whilst (i) is very rapid; carbon oxysulphide is decomposed at atmospheric pressure to the extent of about 61%. At 950° C. the degree of dissociation is at least 76%. Preliminary experiments on the action of heat on carbon dioxide and bisulphide on the one hand and of carbon monoxide and sulphur on the other hand show that the same products are formed as when carbon oxysulphide is heated and that a true case of equilibrium is presented. Similarly, the combustion of carbon bisulphide with an insufficiency of oxygen or of oxygen in carbon bisulphide vapour yields a mixture of unchanged carbon bisulphide, carbon dioxide, sulphur dioxide, carbon oxysulphide, and carbon monoxide. (See also J. Chem. Soc., 1919, ii., 230.)—H. W.

Silicon hydrides. VI. Chlorination and methylation of monosilane. A. Stock and C. Somieski. Ber., 1919, **52**, 695—724.

IN the presence of aluminium chloride, monosilane reacts with hydrogen chloride in much the same manner as with hydrogen bromide (this J., 1918, 578A) yielding monochlorosilane, SiH_3Cl, and dichlorosilane, SiH_2Cl_2. The former has m.pt. −118° C., b.pt. −30·5° C., sp. gr. at −113° C. (as liquid) 1·145, and is converted by gaseous zinc methyl into methylmonosilane, $SiH_3(CH_3)$, b.pt. −5° C., m.pt. −156·5° C., which is scarcely attacked by water in the absence of alkali, but which is slowly decomposed by alkali in accordance with the equation: $SiH_3(CH_3)+2H_2O=[SiO(OH)CH_3]_x+3H_2$. Dichloromonosilane has m.pt. −122° C., b.pt. +8·5° C., and is particularly sensitive to moisture and fat. (See also J. Chem. Soc., 1919, i., 260.) —H. W.

Oxygen; Preparation of — from air. R. C. A. Banfield. Schweiz. Chem.-Zeit., 1919, **1**, 9—18.

A PRELIMINARY cooling of the compressed air in the preparation of oxygen is useful, but not indispensable, but Linde's rectifying plant is now always provided with refrigerating machines. Preliminary cooling shortens the initial period before the production of liquid oxygen, enables a lower pressure to be used, and by condensing part of the moisture in the air in the refrigerating machine increases the duration of working. The power required ranges from about 2·4 h.p. per hour for the production of 1 cb. m. (=1 unit) of oxygen per hour in small plants to 1·8 h.p. per hour per unit of oxygen in the case of larger plants producing 17 cb. m. of oxygen per hour. For the liquefaction of the air about 1 h.p. per hour is required for the production of 0·5 to 0·65 litre. The amount of compressed oxygen consumed in Switzerland rose from 250,000 cb. m. in 1913—1914 to 540,000 cb. m. in 1917—1918.—C. A. M.

Fluorine; [Electrolytic] preparation of ——. W. L. Argo, F. C. Mathers, B. Humiston, and C. O. Anderson. Amer. Electrochem. Soc., Apr., 1919. (Advance copy.) 11 pages.

FLUORINE can be prepared in quantity by the electrolysis of fused potassium hydrogen fluoride. A stout cylindrical copper cell (3½ in. diam. by 8 in. deep), heated electrically by a nichrome winding, is used. The cell itself acts as cathode and a graphite rod as anode. It is necessary to electrolyse at a low current density for some time in order to eliminate water, after which the evolution of fluorine takes place at a temperature of 240°—250° C. with a current of 10 ampères at 12 volts. Electrolysis of anhydrous hydrofluoric acid in a cell of the Moissan type is not suitable for commercial work, as the platinum anode is too rapidly corroded and graphite anodes are disintegrated by the hydrofluoric acid. Lead tetrafluoride, which can be readily prepared by heating lead peroxide with potassium hydrogen fluoride and crystallising from hydrofluoric acid, yields only traces of fluorine when heated. For the preparation of anhydrous hydrofluoric acid sodium hydrogen fluoride is preferable to the potassium salt.—W. H. P.

Silver sulphide Vinal. *See* XI.

Ammonia distillations Davisson. *See* XXIII.

PATENTS.

Nitric acid; Manufacture of highly concentrated ——. J. W. Leitch, Huddersfield. Eng. Pat. 125,616, 12.9.16. (Appl. 12,914/16.)

A MIXTURE of weak nitric acid or sodium nitrate and weak sulphuric acid (*e.g.*, 80% H_2SO_4) is heated in a still and the vapours are passed through a dephlegmating column the temperature of which can be regulated. Distillation may be effected under vacuum or reduced pressure. Acid of high boiling point, *i.e.*, weak acid, condenses in the dephlegmator and returns to the still, while the stronger acid passes over and is condensed.—L. A. C.

Nitric acid and oxides of nitrogen; Manufacture of ——. E. B. Maxted and G. R. Ridsdale, Walsall. Eng. Pat. 126,083, 1.12.16. (Appl. 17,368/16.)

A MIXTURE of ammonia and oxygen is passed between plates or through round or flattened tubes of 1 to 5 mm. diameter, constructed of iron, nickel, cobalt, or other catalytic material, and heated to a uniform temperature. The tubes may be prepared on the inside surface with an activating agent and protected externally by means of an outer tube of silica, porcelain, or the like. The rate of flow of the gases through the tubes is so regulated that the duration of contact with the tubes is just sufficiently long to complete the reaction.—S. S. A.

Acetic acid; Manufacture of ——. S. Utheim, Christiania, Norway. Eng. Pat. 116,279, 13.5.18. (Appl. 8025/18.) Int. Conv., Norway, 1.6.17.

ACETALDEHYDE and oxygen are fed separately and continuously in controlled small quantities into reaction chambers consisting of narrow silver or aluminium tubes, in which the acetaldehyde is maintained as vapour and in which the reaction takes place at a pressure between 3 and 15 atmospheres, and a temperature between 70° C. and 30° C. The acetic acid is withdrawn continuously as produced.—S. S. A.

Ammonium nitrate; Manufacture of ——. D. Tyrer, Stockton-on-Tees. Eng. Pat. 125,621, 19.9.16. (Appl. 13,297/16.)

Two molecular proportions of sodium nitrate and one of ammonium sulphate are dissolved in as little water as possible and the filtered solution is concentrated until it boils at about 120° C. The liquor is filtered hot, 60 to 70% of the theoretical amount of sodium sulphate remaining on the filter, and then a little water and sufficient calcium nitrate solution to precipitate about 60% of the remaining sulphate are added to the filtrate. After removal of the calcium sulphate, the liquor is concentrated until it boils at 120°—125° C., allowed to cool, and the ammonium nitrate which crystallises out is separated by filtration, washed, and dried. The diluted mother liquor is used for dissolving fresh quantities of sodium nitrate and ammonium sulphate and the process is repeated.—L. A. C.

Ammonium perchlorate; Production of ——. C. W. Bailey, H. S. Denny, and A. J. Dunk, Langwith. Eng. Pat. 125,677, 18.1.18. (Appl. 1058/18.)

AMMONIUM sulphate is treated in solution at 30°—35° C. with sodium perchlorate, thereby precipitating crystalline ammonium perchlorate, which is collected on a vacuum filter and washed at 30° C. with hot water. The mother liquor is treated with sodium perchlorate at a temperature between 30° C. and 90° C., and the mixture heated to 100° C. The sodium sulphate which separates is collected on a heated vacuum filter and washed free from mother liquor with hot water. The residual solution of sodium perchlorate from this operation is used for treating a further quantity of ammonium sulphate. The wash waters after suitable treatment are also returned to the system.—S. S. A.

Tin compounds; Recovery of ——. A. W. Gregory, Greenwich. Eng. Pat. 125,879, 21.9.18. (Appl. 15,389/18.)

BY treating tin solutions (*e.g.*, sodium sulphostannate) with an ammonium salt in sufficient quantity to form, for example, ammonium sulphostannate, and heating the solution in contact with air, tin is precipitated as oxide and sulphide in a dense, easily separable form. By oxidising the solution by blowing in air or by other means, tin oxide and oxyacids of sulphur are obtained. The precipitation may also be effected with the addition of carbon dioxide or bicarbonate during oxidation. The ammonia evolved during the process is recovered as ammonium sulphate, and used for the treatment of further quantities of tin solution.—S. S. A.

Chlorates; Apparatus for manufacturing —— by an electrolytic process. T. Oiwa, Tokyo Fu, Japan. U.S. Pat. 1,297,395, 18.3.19. Appl., 23.7.18.

THE apparatus comprises a number of cells, each of which is provided with one electrode arranged on the inner surface of the tubular or cylindrical body of the cell, whilst the other electrode is in the form of a solid or hollow cylinder placed concentrically within the cell, the terminals of the electrodes being connected in parallel. The electrolyte is made to flow upwards from below the electrodes in each cell, the liquid overflowing from the upper part of one cell and passing to the bottom of the next. Several series of crystallising tanks are connected to the apparatus for the separation of the chlorate.—B. N.

Cement-kiln dust; Leaching process for —— [to recover potassium salts]. E. Anderson, Assignor to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,298,154, 25.3.19. Appl., 4.6.17.

POTASSIUM compounds soluble with difficulty, present in cement-kiln dust, are extracted by digesting the dust with water and passing in steam under a pressure greater than that of the atmosphere, raising the temperature of the water above 100° C. A readily soluble potassium salt is thus formed.—L. A. C.

Nitrogen; Method of fixing —— [as a cyanogen compound]. F. D. Lindquist, New York, Assignor to Nitrogen Products Co., Providence, R.I. U.S. Pat. 1,298,363, 25.3.19. Appl., 15.4.16.

Two varieties of briquettes are fed into the top of a retort, both consisting of carbon, finely divided iron, and an alkaline substance which supplies the base of the cyanogen compound to be formed, but one variety containing a higher percentage of the alkaline substance than the other. The briquettes with the lower percentage of alkali are placed in contact with the walls, and as the charge passes down the retort, which is heated to a temperature sufficiently high to liquefy the alkali, at least partially, and render the briquettes plastic, any alkali which may exude from the briquettes in the centre is absorbed by the outer layer and is thus prevented from adhering to the walls, at the same time leaving a passage for the nitrogen which is also passed through the retort. The charge passes out of the bottom of the retort, is broken up, and the cyanogen compound separated.—L. A. C.

Magnesium carbonate; Process of producing ——. B. B. Grunwald, Assignor to A. J. Merle, Alameda, Cal. U.S. Pat. 1,298,932, 1.4.19. Appl., 5.7.18.

BITTERN containing magnesium sulphate and magnesium chloride is treated with a material containing sodium carbonate and bicarbonate, thereby precipitating magnesium carbonate.—S. S. A.

Hydrogen peroxide; [Electrolytic] process for making ——. D. Levin, Buffalo, N.Y., Assignor to Commercial Electrolytic Corporation, New York. U.S. Pat. 1,299,485, 8.4.19. Appl., 3.2.16. Renewed 14.8.18.

IN a continuous process for making hydrogen peroxide, a solution of sodium bisulphate is electrolysed to produce a 15% solution of sodium persulphate. The hydrogen peroxide is then separated and the electrolyte is purified by treatment with hydrogen sulphide and re-electrolysed.—S. S. A.

Alumina; Production of ——. A. G. Betts, Asheville, N.C. U.S. Pat. 1,300,110, 8.4.19. Appl., 9.2.18.

ALUMINOUS material is heated with a solution of ammonium fluoride, or other suitable salt of a volatile base. A solution of aluminium fluoride is produced which is treated with the ammonia evolved during the process, whereby alumina is precipitated and ammonium fluoride is regenerated.—S. S. A.

Hydrogen; Method of recovering —— from a mixture of hydrogen with air. C. Dellwik and S. Cutler, jun., London. Eng. Pat. 125,596, 30.8.16. (Appl. 12,262/16.)

A MIXTURE of hydrogen and air (*e.g.*, the waste mixture containing 80% of hydrogen and 20% of air discharged from balloons) is passed through a retort containing a heated mass of iron ore, iron oxide, or other suitable material. The hydrogen combines with oxygen from the ore and with oxygen from the air contained in the mixed gases. The resulting mixture is passed through a condenser to remove water, and re-circulated through the furnace until the proportion of hydrogen in the mixture is too low for it to be effective in the reaction. Steam is passed over the reduced material in the retort, thereby re-oxidising it and yielding an amount of pure hydrogen equivalent to that removed from the mixture of air and hydrogen during the reduction. The apparatus is provided with means for circulating and collecting the gases and vapour, and with suitable safety devices to minimise danger from explosion.—S. S. A.

Hydrogen-making plants; Process relating to reducing operations in ——. R. and J. Dempster, Ltd., and J. M. Ballingall, Manchester. Eng. Pat. 126,251, 16.12.18. (Appl. 20,941/18.)

IN the earlier part of the process in which iron oxide is reduced by water-gas, previously used gas is employed. Fresh reducing gas is then passed through the retorts for the completion of the reduction, and is then either passed away or conditioned for use in the earlier part of the process.—S. S. A.

Hydrogen; Apparatus for carrying out a process involved in the manufacture of ——. R. and J. Dempster, Ltd., and J. M. Ballingall, Manchester. Eng. Pat. 126,256, 3.1.19. (Appl. 195/19.)

THE apparatus is provided with pipes and valves so that reducing gas (*e.g.*, water-gas), which has been once used and subsequently freed from water, can be employed in the first stage of the reduction, being passed through the retorts and then to waste (see preceding abstract). Fresh reducing gas is then passed through the retorts, and thence through condensers to collecting chambers from which it is used for the earlier part of the process. When more than one group of retorts is employed, a continuous flow of fresh reducing gas is maintained for use in the different groups.—S. S. A.

Oxygen; Removal of —— from gaseous mixtures containing it. E. A. Ashcroft, London. Eng. Pat. 125,714, 15.4.18. (Appl. 6383/18.)

A MIXTURE of gases containing oxygen is passed over an alloy of magnesium and lead at the ordinary temperature in presence of water vapour. An alloy of 15% of magnesium and 85% of lead is suitable. The process is applicable to the production of nitrogen from atmospheric air.—S. S. A.

Nitric acid and other products; Process of making ——. F. S. Washburn, New York. Eng. Pat. 125,601, 1.9.16. (Appl. 12,405/16.)

SEE U.S. Pat. 1,217,247 of 1917; this J., 1917, 503. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 19,074 of 1900, 8300 of 1902, 18,594 of 1903, 19,189 of 1905, 1204 of 1906, and 6155 of 1908; this J., 1901, 1209; 1903, 420; 1904, 787; 1906, 536, 1044; 1908, 810.)

Nitre-cake; Method for the utilisation of ——. J. Grossmann, Manchester. U.S. Pat. 1,298,334, 25.3.19. Appl., 2.9.16.

SEE Eng. Pat. 12,832 of 1915; this J., 1916, 1059.

Mercury oxide; Process for the manufacture of ——. E. Kuhn, Basle, Switzerland. U.S. Pat. 1,299,581, 8.4.19. Appl., 30.1.19.

SEE Eng. Pat. 122,195 of 1919; this J., 1919, 322 A.

Separating certain substances [aluminium chloride and silicon tetrachloride from clay]; Process of producing and separating ——. V. M. Weaver, Harrisburg, Pa., Assignor to Weaver Co. U.S. Pat. 1,300,205, 8.4.19. Appl., 7.1.15.

SEE Fr Pat 481,056 of 1916; this J., 1917, 144.

VIII.—GLASS; CERAMICS.

Chemical stoneware; Standardisation of ——. H Nielsen. Trans. Ceram. Soc., 1918—19, **18**, 182—229.

FURTHER detailed suggestions for the standardisation of chemical stoneware are given (see this J., 1918, 57 A, 207 A). Standardisation is especially needed in Woulff's bottles and similar pieces of apparatus. Storage jars should have curved bottoms, which are stronger than flat ones. Their dimensions cannot be conformable to a simple formula, but suggested dimensions for the more important sizes are given. The ordinary condensing and cooling coils are inefficient and should be replaced by flattened coils in the form of a grid. Gas-cooling pipes should be provided with internal spirals which split up the gas current and increase the cooling effect by 20—30%. Precautions to be taken in fitting up chemical stoneware apparatus and some suggestions for making the various pieces of apparatus are given.—A. B. S.

Porcelain; Effect of time and temperature [in burning] on the microstructure of ——. A. B. Peck. J. Amer. Ceram. Soc., 1919, **2**, 175—194.

A FELSPATHIC porcelain body was burned under normal conditions, the temperature rising 200° C. per hour above 1150° C. Samples were drawn at 1290° C. and 1350° C., and were afterwards reheated to the same temperature and maintained there for 5 hrs. Samples were again taken and reburned as before, three burns being made exclusive of the original one, and the samples were maintained at 1290° C. and 1350° C. respectively for 15 hrs. in all. At 1290° C. the first sample showed outlines of the original clay grains, some of these being composed of sillimanite needles and others of amorphous sillimanite. The quartz grains were still sharp. After reheating at 1290° C. for 5 hrs. the sillimanite was better developed and some of the quartz had dissolved. After reheating for 10 hours, the ground mass was composed of felspar glass thickly filled with minute crystals of sillimanite; the quartz was noticeably dissolved. On reheating for 15 hrs. in all the sample showed a similar structure, but more quartz was dissolved. At 1350° C. the first sample showed glass containing minute crystals of sillimanite with a few larger ones; the quartz was noticeably dissolved. On reheating at 1350° C. for 5 hrs. the crystals of sillimanite were much larger and more quartz was dissolved. After again reheating for 5 hrs. at 1350° C. the ground mass was composed of glass with sillimanite crystals and much of the quartz was dissolved. After reheating for 15 hrs. in all, the sillimanite crystals had

still further increased in size and the quartz was almost wholly dissolved. There appear to be two types of sillimanite, *viz.*, the amorphous or fibrous type formed by the direct decomposition of the clay and the type consisting of well-formed crystals embedded in felspar glass and apparently formed by recrystallisation from solution. Comparison of mixtures of felspar and kaolin heated to 1400° C. for 3 hrs. and then quenched in water with similar mixtures treated at the same temperature in a kiln under normal conditions and cooled slowly showed that similar crystals of sillimanite were present in both cases and indicated that these are formed during the heating and not during the cooling of the ware. In the presence of molten felspar the clay appears to dissolve and sillimanite crystallises out, the size of the crystals depending on the amount of felspar or other glass present, the mobility of the glass, and the length of time of firing. The longer the duration of the firing the greater is the amount of sillimanite and the larger are the crystals. Owing to the influence of the other factors, however, the duration and temperature of firing cannot be judged from the amount or size of the sillimanite crystals present. Prolonged burning tends to produce more glass and sillimanite and therefore to increase the translucency of the porcelain.—A. B. S.

Crucibles; Behaviour under brass foundry practice of —— containing Ceylon, Canadian, and Alabama graphites. R. T. Stull. J. Amer. Ceram. Soc., 1919, **2**, 208—266.

A PRELIMINARY investigation showed that by using Canadian graphite in place of part (up to 25%) of the Ceylon graphite the durability of the crucible was reduced. This may be due partly to the Canadian graphite being finer and more flaky and so requiring more clay to bind it; an increase of 5% in the ball clay gave better results. Crucibles containing 55% of Canadian graphite and no Ceylon graphite were almost identical with those containing 41·25% of Ceylon graphite and 13·75% of Canadian graphite. Increased durability was obtained by replacing the Ceylon graphite by Alabama graphite either flake or granular (coked) form, neither form being better than the other, but the results were irregular and though promising require further investigation. For larger crucibles, the particles of graphite should be larger than for small crucibles. If these are not obtainable (as when Alabama graphite is used) it may be necessary to employ sand and pot shell to avoid the slipperiness and lamination caused by fine graphite.—A. B. S.

Glaze of casseroles; Soluble lead in the ——. H. Masters. Analyst, 1919, **44**, 164—165.

SEE this Journal, 1919, 140 B.

PATENTS.

[*Tunnel*] *kilns or ovens for firing bricks, pottery, and the like, and for other purposes.* Dressler Tunnel Ovens, Ltd., Stoke-on-Trent, and H. J. Rushton, Southfields, Surrey. Eng. Pat. 126,218, 8.8.18. (Appl. 12,896/18.)

A TUNNEL oven of the Dressler type (this J., 1916, 539) but having only one combustion chamber placed centrally instead of two—one on each side of the oven. The goods or materials to be heated are carried on trucks on either side of the combustion chamber, the air in the oven being circulated through vertical and horizontal passages in the upper part of the cars and between the sides of the cars and the walls of the oven. Air in contact with the sides of the combustion chamber is heated, rises vertically to the roof of the oven and is then divided into two streams which flow in opposite directions, returning through the passages mentioned and being reheated when they again reach the combustion chamber. By placing the combustion chamber in the position indicated a larger proportion of the heat generated is utilised, the temperature of the goods more nearly approaching that of the combustion chamber than when two chambers are arranged along the walls of the oven. The path of the circulating hot air is correspondingly reduced. In addition, by this construction the wheels of the cars are more accessible for inspection and repair, apertures, which are normally closed, being provided in the side walls of the oven.—A. B. S.

Refractory material; Manufacture of ——. L. P. Kraus, jun., New York. Eng. Pat. 126,229, 6.9.18. (Appl. 14,542/18.)

SEE U.S. Pat. 1,289,049 of 1918; this J., 1919, 177 A. The material is prepared by grinding a non-plastic refractory substance, such as bauxite, mixing it with carbonaceous material, *e.g.*, ground wood, roasting the mixture in an oxidising atmosphere at a clinkering temperature, and then crushing the product to obtain spongy grains free from definite cleavage planes.

Ceramic and similar material; Method of and apparatus for treating ——. J. T. Underwood, Dayton, Ohio, Assignor to Underwood Engineering Co., Detroit, Mich. U.S. Pat. 1,298,125, 25.3.19. Appl. 3.11.17.

A KILN has two concentric annular flues in the sole, the inner flue being covered completely whilst the outer one has a perforated covering. A mixture of gas and air is forced through the inner flue into the kiln chamber and out through the outer flue to the chimney. Partial combustion occurs as the gaseous mixture enters the chamber, and is completed by additional air admitted separately under pressure.—A. B. S.

Quartz tubes; Method of manufacture of ——. Oesterreichischer Verein für chemische u. metallurgische Produktion, Aussig. Ger. Pat. 310,831, 8.1.16. Int. Conv., 11.5.14 and 25.2.15.

A HOLLOW space of the necessary length extending between the two electrodes of an electric arc is formed in the furnace by embedding and burning out a tubular combustible conductor composed, *e.g.*, of prepared paper or wood. Alternatively, a tube composed of quartz or similar material, which will fuse to the furnace material, may be embedded between the electrodes. The method described permits of tubes of given dimensions being produced in less time and with less difficulty than do methods in which the electrodes are drawn apart.—T. St.

Brick making; Apparatus for mixing pulverised dry earths for ——. A. H. E. Butler, Brunswick, Victoria. Eng. Pat. 126,217, 6.8.18. (Appl. 12,782/18.)

Glass; Borosilicate —— for use as a filter to produce daylight effects. Potash glass for use as a filter to produce daylight effects. A. J. H. Haddan, London. From Corning Glass Works, Corning, N.Y., U.S.A. Eng. Pats. 125,920 and 125,921, 9.1.19. (Appls. 674 and 675/19.)

SEE U.S. Pats. 1,295,298—9 of 1919; this J., 1919, 324 A.

Refractory articles; Manufacture of ——. H. Wade, London. From The Carborundum Co., Niagara Falls, N.Y., U.S.A. Eng. Pat. 126,192, 5.6.18. (Appl. 9297/18.)

SEE U.S. Pat. 1,277,227 of 1918; this J., 1918, 700 A.

IX.—BUILDING MATERIALS.

Plaster; Setting of ——. C. H. Desch. Trans. Ceram. Soc., 1918—19, **18**, 15—26. (See also this J., 1918, 89 A.)

The setting of plaster is due to the crystallisation of gypsum from a solution which is saturated with regard to the hemihydrate $2CaSO_4,H_2O$ but strongly supersaturated with regard to gypsum, $CaSO_4,2H_2O$. The resultant interlocking mass consists of submicroscopic crystals. If the setting be retarded by addition of alcohol larger crystals are produced. The strength of the plaster after setting is partly due to the interlocking of the lath-shaped crystals and partly to the boundaries between neighbouring crystals being surfaces of strength. The conversion of the hemihydrate into gypsum is accompanied by a decrease of 7% in the volume of the crystals but the mass as a whole expands. Davis (this J., 1907, 727) has attributed this to the production of an orthorhombic modification of the dihydrate and the subsequent conversion of this into the stable monosymmetric gypsum. The author prefers to regard the expansion as solely due to the outward thrust of the gypsum crystals during their growth. Overheated or "dead burnt" plaster contains a form of anhydrite which sets slowly and very hard without expansion. Recent work suggests that the supposed modifications of the anhydrite are largely due to mere differences in the fineness of the particles. The customary inertness of anhydrite is not exhibited by the very finely ground material. The production of a sintered material (a basic sulphate which glazes the particles) may also account for some of the properties of overheated plaster. The formation of a highly porous plaster is facilitated by fine grinding both before and after burning and by avoiding overheating. To secure rapid setting a little gypsum must be present to provide nuclei for crystallisation. Gypsum and other soluble sulphates in the plaster accelerate the setting; anhydrite retards it. Old plaster moulds might be used after being finely ground, washed to remove soluble salts, burnt, and then ground very finely.

—A. B. S.

Portland cement. E. Candlot. Chim. et Ind., 1919, **2**, 371—384.

The author gives an outline of the industry, and describes the manufacture and composition of Portland cement. Illustrations are given of the various furnaces, mills, etc., used in the industry.

—W. P. S.

PATENTS.

Wood; Process and apparatus for seasoning ——. M. P. Otto, Paris. Eng. Pat. 125,846, 20.7.18. (Appl. 11,904/18.)

Wood is seasoned by subjecting it either alternately or simultaneously to the action of a gentle heat and a current of ozonised air for a period of 3 to 4 weeks; the latter solidifies (resinifies) the contents of the cells, increasing the strength of the wood and making it more sonorous. The heating is effected by steam passing through pipes in the interior of the seasoning chamber, and the ozonised air is circulated by means of fans. The volatile products of oxidation may be removed by passing a current of plain air through the chamber.

—A. B. S.

Wood preservative; Manufacture of ——. F. Moll, Berlin-Südende. Ger. Pat. 310,875, 24.11.14.

Arsenious acid and mercuric chloride are dissolved in strong hydrochloric acid and the solution diluted considerably with water before use. The precipitation of arsenious acid from the strong solution can be avoided by the addition of beechwood tar. The mixture protects the wood against vegetable and animal pests such as termites.—H. J. H.

Cement and the like; Rotating kilns for burning ——. N. Winqvist, Tollarp, Sweden. Eng. Pat. 126,230, 9.9.18. (Appl. 14,625/18.) Int. Conv., 12.6.18.

The walls of the preheating zone of a rotary kiln are provided with projections consisting of iron gates or frames open in the direction of rotation, and so formed that they cut through the material but do not carry it along, formation of dust being thus prevented. In the part of the preheating zone where iron frames might be destroyed, they may be replaced by annular projections of refractory material. A. B. S.

Leaching cement kiln dust U.S. Pat. 1,298,154. *See* VII.

X. METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron; Thermo-electric measurement of critical ranges of pure ——. G. K. Burgess and H. Scott. Bull. Bureau Standards, 1918, **14**, 15—21. (See also this J., 1916, 841.)

By a modification of the method used by Le Chatelier the thermo-electric power of the iron-platinum couple between 0° and 1000° C. *in vacuo* was determined, observations being made at intervals of 2° C. The iron used contained 99·968% Fe. The A_1 or "allotropic" transformation was indicated by a marked discontinuity in thermo-electric power, Ac_1 being slightly above 910° and Ar_1 just below 900° C. as found by the thermal, crystallographic, magnetic, electrical resistance, and dilatation methods. The A_2 transformation was indicated by a break at 768° C., but no discontinuity was observed below this temperature. The results are regarded as showing that A_2 and A_1 are critical points delimiting α, β, and γ iron. W. E. F. P.

Gray iron; Improving the quality of —— *by the electric furnace.* G. K. Elliott. Amer. Electro-Chem. Soc., Apr., 1919. [Advance copy.] 7 pages.

The two qualities most generally wanted in high-grade gray cast iron are strength and solidity, and without exception, strong irons have high melting points and minimum fluidity. The cupola furnace is more efficient for preheating and melting than either the air-furnace or regenerative open-hearth furnace, but its thermal limitations do not allow of adequate superheating of the molten metal. A supplementary basic electric-arc furnace is suggested to effect the superheating and to refine the iron at the same time; the sulphur content of the metal is considerably reduced, and the total carbon can be regulated to any extent, so that gray iron of the so-called semi-steel quality may be obtained of uniform quality. The duplex process is commercially practicable only for castings which are required to possess physical properties of a high order.—C. A. K.

Steels; Formation of troostite at low temperature in carbon —— and the influence of the temperature of emersion in interrupted quenching. Portevin and Garvin. Comptes rend., 1919, **168**, 731—733.

With velocities of cooling (quenching) considerably higher than the critical velocities, it is possible, by interrupting the quenching, and then cooling in air,

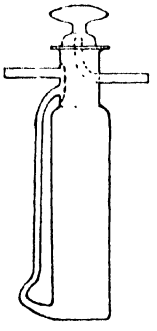
to observe very marked recalescence (to the extent of 80° C.) at temperatures down to 450° C. and to obtain troostite after cooling. This formation of troostite at these relatively low temperatures is always accompanied by characteristic, pronounced recalescence. The troostite is formed directly and immediately from the solid solution of carbon in γ-iron at temperatures much lower than those at which it is formed during continuous quenching. With this rapid cooling it is possible, without marked alteration of the hardness, to stop the quenching at temperatures in the neighbourhood of 350° C. Working at a velocity near to the critical velocity of quenching, it has been possible to observe the commencement of the direct reaction by formation of troostite at still lower temperatures (380° C.). With velocities lower than the critical velocity, recalescence having occurred at high temperatures during the period of rapid cooling, troostite is always obtained and the temperature of emersion from the quenching bath has no appreciable effect on the structure and hardness. This limitation of the duration of quenching by removing the steel whilst still hot from the quenching bath is one of the most effective methods of preventing the formation of cracks.—W. G.

Steels; Experimental investigation of the influence of the rate of cooling on the hardening of carbon ——. A. M. Portevin and M. Garvin. Iron and Steel Inst., May, 1919. (Advance copy.) 91 pages.

A DETAILED description of the apparatus and method of working by which the results previously described (this J., 1919, 179A, and preceding abstract) were obtained. It has been possible with some carbon steels to obtain actual doubling of the point of transformation, with the consequent co-existence of troostite and martensite. The critical rate of cooling with conditions otherwise identical varies with the composition of the steel, presenting a minimum near the eutectic point. Conclusions have been reached by various authors relating to such subjects as the effect of the mass of the samples and agitation of the quenching liquid on the duration of quenching, and to the influence of the quenching temperature and temperature of the liquid on surface hardness. These conclusions are only valid when the field of operations does not include the critical rate for the particular samples.
—W. H. P.

Carbon in steel; Determination of ——. L. J. Rogers. Canadian Chem. J., 1919, **3**, 122—123.

SODA-ASBESTOS, a new absorbent mixture for carbon dioxide (this J., 1916, 1237), serves as its own drier, will absorb nearly 10% of its weight of carbon



Midvale Absorption Bulb (Stetser and Norton Modification)



Nesbitt Tube

dioxide, and can be used while the gas is flowing at a rate of 250—300 c.c. per minute. With this material the absorption apparatus may be greatly simplified, and two new bulbs are described (see Fig.). The Midvale bulb modified according to Stetser and Norton is very simple and inexpensive. The Nesbitt tube may be shut off from the air by a slight turn of the large stopper which also permits easy filling. There are no rubber portions to catch dust, etc., and the exposed glass area is small. The use of the soda-asbestos bulb permits such a rapid flow of gas that a full factor weight of steel may be burned to fusion without altering the rate. To ensure accurate results steel of the proper fineness must be used and silicious bedding in the boats should be avoided. Nickel boats, which are among the most durable, have now been obtained of a very low carbon content and after short treatment in a muffle they give up no further carbon.
—T. H. Bu.

Sulphur; Determination of —— *in iron and steel.* A. Marinot. Ann. Chim. Analyt., 1919, **1**, 153—155.

IN the method of determining sulphur in iron etc. by treating the sample with hydrochloric acid and collecting the evolved hydrogen sulphide in iodine solution, the hydrogen sulphide should be passed through a small quantity of water before it enters the iodine solution. The gas is thus freed from traces of hydrochloric acid which tend to react with the thiosulphate solution used for titrating the excess of iodine and cause the results to be too high.—W. P. S.

Iron and its compounds with non-metals; Laws of the chemical action of gases on —— *at high temperatures.* F. Schmitz. Stahl u. Eisen, 1919, **39**, 373—381, 406—413.

IN pure hydrogen at high temperatures the non-metals contained in ingot-iron, pig-iron, ferro-alloys, and steel are converted into the corresponding hydrides. These compounds partly dissociate at higher temperatures and the hydrogen set free is capable in the nascent condition, of reducing silicic acid to hydrogen silicide at 700° C. in the absence of oxygen. At high temperatures hydrogen decomposes iron salts and forms the corresponding acid with separation of metallic iron. Iron heated in presence of a gaseous compound of hydrogen and a non-metal combines with the non-metal, which diffuses into it. Special reference is made to cementation with silicon in this way. Under given conditions there is for each non-metal a certain composition of gas consisting of hydrogen and a compound of the non-metal with hydrogen, which is neutral, *i.e.*, the non-metal neither passes into, nor is removed from, the iron. In pure hydrogen or nitrogen at high temperatures carbon and silicon in the solid state diffuse into iron. If a compound of iron with a non-metal is heated in oxygen a compound of iron, oxygen, and the non-metal is formed. If the non-metal is carbon, sulphur, or arsenic, the compound decomposes at a higher temperature with formation of a gaseous compound of the non-metal with oxygen, iron oxide remaining. If iron is heated in a gaseous compound of oxygen and a non-metal a compound is first formed of iron, oxygen, and the non-metal. If the non-metal is phosphorus or silicon the compound is stable; if carbon, sulphur, arsenic, or hydrogen, it decomposes at slightly higher temperatures with formation of iron oxide and a gaseous compound of the non-metal with oxygen. Nitrogen is inert to non-metals in solid or liquid iron. In considering how far the results can be applied in practice, the cost and danger of using hydrogen on a large scale at high temperatures are serious disadvantages. The results can, however, be applied to the chemical analysis of iron, and a table is given showing the accuracy of sulphur determinations by heating in hydrogen.—T. H. Bu.

***Steels under X-rays; Testing the absorbing power of* ——.** R. A. Hadfield, S. A. Main, and J. Brooksbank. Faraday Soc., Apr. 29, 1919. (Advance proof.) 5 pages.

The X-ray tube used had a 12″ spark gap, the interrupter being of the Mackenzie-Wardson mercury type. The negatives were intensified. Examination on a fluorescent screen is not sufficiently sensitive to differentiate steels of different densities. Taking pure Swedish charcoal iron (S.C.I.) as standard, the following results were obtained by photographing on one plate the standard and a series of discs of the steel of increasing thickness.

Analysis	Sp.gr.	Thickness of specimen	Relative equivalent thickness of S.C.I.
0·19 % C, 2·45 % Al	7·07	½ in.	0·9
0·55 % C, 2·79 % Cr	8·77	½ in.	2
0·65 % C, 2 % Cr, 2 % Ni	—	0·0309 in.	1 oil quenched
0·65 % C, 2 % Cr, 2 % Ni	—	0·0315 in.	0·9 annealed

The oil-quenched nickel-chrome-steel is an exception to the general rule that the opacity to X-rays increases with the density of the steel.—F. C. Th.

Hair cracks in steel; Detection of* —— *by X-rays. C. F. Jenkin. Faraday Soc., Apr. 29, 1919. (Advance proof.) 1 page.

The detection of hair cracks in aeroplane crank shafts by radiography is not possible.—F. C. Th.

High-speed steel; Molecular constitutions of —— and their correlation with lathe-efficiencies. J. O. Arnold and F. Ibbotson. Iron and Steel Inst., May 9, 1919. (Advance copy.) 24 pages.

The carbides present in six well-annealed steels were determined electrolytically. The chromium present in the isolated residues varied from 27·27 to 62·20% of that present in the steel, the tungsten from 84·67 to 92·68%, the molybdenum from 85·29 to 94·21%, and the vanadium from 75·86 to 94·64%. The same carbides appear to be present in these complex steels as were previously found in the corresponding steels containing one special element only.

Analysis of steel					Constitution of carbides	Lathe tests on tools hardened at 1300° C. Lb. of steel removed
C	Cr	W	Mo	V		
0·75	2·79	Abs.	5·79	1·29	$9Fe_3C+4Cr_4C+3V_4C_3+10Fe_3Mo_3C$	111·9
0·72	2·79	Abs.	5·72	Abs.	$10Fe_3C+3Cr_4C+7Fe_3Mo_3C$	47·0
0·76	2·82	12·12	2·06	1·28	$10Fe_3C+8Cr_4C+6V_4C_3+7Fe_3Mo_3C+23WC+42Fe_2W$	96·1
0·62	2·80	12·00	2·06	Abs.	$10Fe_3C+6Cr_4C+16WC+5Fe_3Mo_3C+27Fe_2W$	72·0
0·55	2·62	15·93	Abs.	1·16	$2Cr_4C+3V_4C_3+16WC+30Fe_2W$	109·8
0·60	2·78	15·54	Abs.	Abs.	$3Fe_3C+2Cr_4C+8WC+12Fe_2W$	66·6

In the annealed condition the micro-structures consisted of a matrix of sorbitic pearlite, with globules of carbide. After hardening at 1300° C. the structures were austenitic with or without excess carbide. The heating curve of the steel with 2·8% Cr and 15·5% W showed absorption of heat at 812° C. and large absorption at 1067° C. On cooling, a single recalescence point was detected at 408° C.—F. C. Th.

***Metals; Industrial X-ray examination of* ——.** E. Schneider. Faraday Soc., Apr. 29, 1919. (Advance proof.) 4 pages.

A Coolidge tube was used with a spark gap of 25 cm., the rays from which were capable of penetrating steel to a depth of 40 mm. In investigations into the heterogeneity of steel particles, those of less than 0·2 mm. diam. cannot be detected. Holes drilled in the specimens are filled with lead to prevent secondary rays fogging the plate and for the same reason the samples under examination are cased in lead. Blow-holes in castings are readily seen. The diminution in the size and number of these as a result of deoxidation by aluminium is clearly revealed. It was possible radiographically to check the casting conditions of such articles as the brackets of gun waggons to obtain a sound product. The addition of tungsten to steel produces a marked increase in the opacity to X-rays. It is thus possible to apply radiography to replace rapid analysis in particular cases. If carbon steel bars have been mixed up inadvertently with tungsten-steel bars they can be sorted out speedily by radiography. Bars of compound metals can be investigated and the presence and distribution of the metal of greater density shown radiographically. The maximum thickness of steel which can at present be examined by X rays is about 45 mm.—F. C. Th.

***Penetration of metals by X-rays; Principles governing* ——.** G. Respondek. Faraday Soc., Apr. 29, 1919. (Advance proof.) 20 pages.

A general discussion of the properties of X-rays, their wave lengths, coefficients of absorption, distribution of energy in the spectrum, and the changes produced when they fall upon metals and upon a photographic plate. The photographic arrangement suggested by the author for radiography of metals makes use of the resonance properties of an element of high atomic weight such as lead. The rays first penetrate the substance under test, then the glass of the photographic plate and the silver emulsion, and then they excite the resonance radiation of lead foil. The rays are best produced for this purpose by means of a Coolidge tube. It is found quite feasible to detect faulty places of 1½% of the total thickness of a layer of iron. Lead can be examined without difficulty up to 8 mm. in thickness. The method is also very convenient for the examination of reinforced concrete to detect rusting of the iron reinforcing bars. W. H. P.

Metallic coatings for rust proofing iron and steel. I. H. S. Rawdon, M. A. Grossman, and A. N. Finn. Chem. and Met. Eng., 1919, **20**, 458–464.

A description of the various metallic coatings and the methods of application, used commercially for the protection of iron and steel, is given. When the object is merely protection against corrosion the best coating is zinc, and with large regular objects the "hot dipping" method is entirely satisfactory. Heavy coatings are, however, not reliable on objects with sharp angles and other processes (*e.g.* sherardising, electroplating) may have to be used. These are not so convenient in operation, but may be more economical of zinc. One oz. zinc per sq. foot of surface is usually sufficient for normal purposes.

"Hot dipping" and sherardising cannot be used for hardened steel. Plating or sherardising is recommended for accurately machined parts and sherardising for threaded portions. "Spray" coatings may be necessary for large parts which must be treated *in situ*. The use of oil is always advantageous in prolonging the life of metallic coatings. The best general method for testing the protection given is by spraying with a very finely atomised solution of salt (20%) and examining for rust. Ordinary samples should last from 48 to 72 hours without rusting, and those for special exposure 96—144 hours.—W. H. P.

Iron vessels; An explosion during the welding of ——. A. Beythien. Pharm. Zentr., 1919, **60**, 155—156.

An explosion involving loss of life occurred during the autogenous welding of iron containers. An investigation showed the presence of a dark brown substance on the inner walls which on fractional distillation in steam passed over chiefly between 210° and 230° C., and left a residue of naphthalene and heavy aromatic oil. During heating for the welding, this decomposed with evolution of inflammable gases which exploded. It is suggested that during the welding of iron containers with unknown contents the vessels should be filled with water to exclude air.—F. C. Th.

Cyanide solutions; Estimation of oxygen in working ——. H. A. White. J. Chem. Met. and Min. Soc., S. Afr., 1919, **19**, 177—178.

In the author's colorimetric method (this J., 1918, 547A), under certain conditions a violet coloration is produced, which does not rapidly change to the usual brown tint. This is believed to be due to complex ferrous or ferric salts with tartaric acid or organic compounds containing the hydroxyl group, arising from the use of mine water containing iron. It is suggested that the water should be rendered alkaline, and then oxidised by exposure or by the addition of an oxidising agent (*e.g.*, bleaching powder).—C. A. K.

Copper; Gases from ——. H. M. Ryder. J. Franklin Inst., 1919, **187**, 508-509.

Five grams of copper was heated electrically *in vacuo* for 12-hour periods, the temperature being increased by 50° C. for each period. The gas evolved in each period was collected and analysed. The evolution of carbon dioxide shows a maximum at 350° C., similar to that obtained under similar conditions from iron and steel, various glasses, and porcelain. A large quantity of oxygen is released at 800° C., which is the temperature of decomposition of cuprous oxide. The hydrogen evolution shows a maximum near 600° C., at which temperature copper becomes permeable to hydrogen.

Brass ingots from swarf; Analysis of ——. R. H. Deakin. Chem. News, 1919, **118**, 193—194.

Copper is determined iodometrically on 0·5 grm., 2 c.c. of a 20% sodium phosphate solution being added to the solution. Zinc is estimated volumetrically by the ferrocyanide process after the removal of the copper as cuprous thiocyanate, the latter after ignition serving as a useful check on the volumetric determination of the copper. Nickel, which is present only in very small amounts, is detected after the removal of iron during the determination of the zinc. Lead, which may occur up to 2·0%, is determined by converting it into sulphate, dissolving in ammonium acetate, and precipitating as molybdate. The method for tin is to dissolve 5 grms. of the brass in *aqua regia*, dilute to 200 c.c., and add 2 grms. of ammonium chloride and 40 c.c. of ammonia. The boiling solution is filtered, the precipitate washed with 5% ammonia, then extracted with hot hydrochloric acid (1 : 1) and re-precipitated with ammonia. The diluted second filtrate is treated hot with hydrogen sulphide, the tin sulphide filtered off and ignited to stannic oxide. The filtrate from the tin sulphide is boiled free from hydrogen sulphide, oxidised with nitric acid, and the iron and aluminium precipitated as hydroxides.—F. C. Th.

Electric furnace: its introduction into foundry practice. W. E. Moore. Amer. Electro-Chem. Soc., Apr., 1919. (Advance copy.) 6 pages.

The electric furnace has become the most economical means for producing suitable steel for castings. Since the atmosphere of the furnace may be readily controlled, no oxidation of metal occurs during the melting operation and light scrap including "machine shop turnings" may be utilised. Degasification of the molten metal is accomplished by the use of smaller quantities of ferro-alloys, as little loss of the latter occurs. The charge may be superheated to any desired extent and this enables thin castings to be produced, of predetermined chemical composition. An acid lining is preferred owing to the simpler technique of the operations, and the cost of refractories is found to be practically half of that required in the converter process. The melting losses in the electric furnace are given as ½—⅓ of the loss in the open-hearth process, and ⅓—⅛ of the loss in the converter process.—C. A. K.

Lead; Softening, desilverising, distillation and cupellation of ——. F. von Schlippenbach. Metall und Erz, 1918, **15**, 323—331.

The author describes the 60-ton softening furnaces in use at Binsfeldhammer, and draws special attention to the subject of cooling jackets which are considered to be in general too thickly lined. The use of large capacity furnaces is advised, preferably 120 tons, the construction of which is described and working details given. The formation of and method of dealing with crusts are considered at some length. They are skimmed into iron pans with conical bottoms, the excess lead separating at the bottom. The Parkes process of desilverising, using 60-ton kettles, is discussed. Mechanical stirring is advised, but the author does not favour the use of the Howard press, as the separation of rich skimmings should be done in a refining furnace. The separation of zinc from the desilverised lead is considered and the material, repair, and manipulation of kettles discussed. Instead of the poor oxide usually obtained, the author has worked out a process producing oxide containing 63% Zn. Electrolytic treatment of the crusts has not proved satisfactory. They are distilled in graphite retorts or tilting furnaces, the upkeep and operation of which are discussed. With oil or gas firing the results are improved, and tilting furnaces are the better. A cheap and convenient form of receiver designed by the author is described. The zinc recovered should be 85% of the amount in the charge. The silver in retort residues may be recovered by addition of liquated works lead. The German cupellation furnaces with fixed hearths are not much used except when litharge low in silver is required in large quantities. The author describes a simple and practical cupel of rectangular shape made of stamped concrete in an iron frame; also a refining furnace with a large movable hearth, with which he obtained the best results in melting argentiferous litharge with waste metal scrapings and the desilverised residue from distillation. The refined lead with 7 to 8% silver goes forward for cupellation and the black litharge partly desilverised can be worked in the blast furnace.—T. H. Bu.

Cuprodescloizite; Treatment of —— for extraction and recovery of vanadium, lead, and copper. J. E. Conley. Chem. and Met. Eng., 1919, **20**, 465—469.

CUPRODESCLOIZITE is a lead-copper-vanadium mineral which has been located in quantity in Arizona. Attempts to obtain $VOCl_3$ by volatilisation with chlorine or hydrochloric acid did not prove very encouraging. The method recommended is first to fuse with nitre-cake and after extraction with water to treat with strong sulphuric acid. The residues (slimes) contain the bulk of the lead as easily recoverable lead sulphate. A portion of the free acid in the extract is neutralised with caustic soda and then strips of scrap iron are added. These yield iron vanadate and displace metallic copper. After standing for some time and removing the copper, the solution is carefully neutralised with caustic soda and boiled for several hours. The resulting precipitate is a high-grade iron vanadate. W. H. P.

Zirconium ores and alloys; Analysis of ——. A. Travers. Chim. et Ind., 1919, **2**, 385—392.

THE ore is fused with sodium peroxide in a nickel crucible, the melt treated with boiling water, and filtered; the insoluble portion is boiled with an excess of hydrochloric acid, the solution rendered ammoniacal, and filtered, the precipitate being washed with hot ammoniacal 10% ammonium chloride solution. The precipitate is dissolved in hydrochloric acid, the solution nearly neutralised with ammonia, and boiled with the addition of sodium thiosulphate; the precipitate formed is collected, ignited, and weighed. It consists of zirconium oxide with titanium oxide, traces of silica, iron, and nickel; silica is separated by treatment with hydrofluoric and sulphuric acids, and the titanium oxide is determined colorimetrically after the precipitate has been fused with potassium bisulphate. The total silica is determined in a separate portion of the ore by fusion with sodium peroxide, evaporation with hydrochloric acid, filtration, separation of traces of silica from the filtrate by means of ammonia, and igniting. The ignited precipitate is treated with hydrofluoric acid and any non-volatile residue (zirconia) deducted from the total weight. Iron is determined by titration with titanium trichloride after the ore has been fused with sodium peroxide and dissolved in hot hydrochloric acid; manganese is determined by the persulphate method, and rare earths by precipitation as oxalates, zirconium oxalate being soluble. Zirconium-iron alloys usually contain aluminium; the latter may be determined by dissolving the alloy in nitric acid, evaporating the solution with hydrochloric acid, filtering, evaporating the filtrate to a syrup, extracting the iron with ether, and then precipitating the aluminium and zirconium with thiosulphate. Aluminium and zirconium are separated by fusion with alkali.—W. P. S

Platinum gauze catalyst. Campbell. *See* VII.

Brass foundry crucibles. Stull. *See* VIII.

Carbon electrodes. Hadfield and Main. *See* XI.

PATENTS.

Iron and steel; Manufacture of ——. G. A. Jarvis, Wellington, Salop. Eng. Pat. 126,046, 14.11.16. (Appl. 16,307/16.)

SCRAP material such as steel turnings or swarf is coated or treated with tar mixed with lime, prior to melting. If iron is to be produced, silicon carbide or carborundum waste is added to the mixture. —T. H. Bu.

Steel; Manufacture of ——. R. A. Hadfield, London. Eng. Pat. 126,049, 15.11.16. (Appl. 16,389/16.)

PLATES, sheets, and shields for resisting penetration by projectiles are made of steel containing: C, up to 0·5%, Si, 0·7—2%, Mn, 0·12—0·6%, Cr, 1·5—3·0%, and Ni, 2·5—5·5%. They are heated to between 800° and 900° C., preferably 830° C., and cooled in air or other cooling medium. They may be reheated to 300°—400° C., and again cooled. —T. H. Bu.

Steel and high-phosphorus slag; Producing —— [from pig iron]. W. R. Walker, New York. U.S. Pat. 1,299,072, 1.4.19. Appl., 7.10.14.

PIG iron is de-siliconised without substantially reducing the phosphorus content. The siliceous slag is then run off and the metal refined with a basic slag, which is removed before the end of the refining operation when it contains the maximum percentage of phosphorus.—C. A. K.

Ferromanganese of low phosphorus content; Method of producing slags rich in manganese for the preparation of —— from slags, ores, etc., containing manganese and of high phosphorus content. A. Sonnenschein, Witkowitz. Ger. Pat. 310,552, 11.4.17.

Phosphoric ores etc. are smelted in a blast furnace with the formation of phosphoric ferromanganese or spiegeleisen etc., and this is then treated in a converter with an acid lining for the production of manganese-rich slag free from phosphorus. This slag by further treatment yields ferromanganese etc. of low phosphorus content.—T. St.

Case-hardening. S. Whyte, Redhill. Eng. Pat. 125,666, 19.10.16. (Appl. 14,830/16.)

A CASING of white iron is formed by heating iron or steel articles in a bath of borax, *e.g.*, at 1200°—1400° C., in the presence of graphitic carbon. A current of air is preferably passed through the bath. If an electric current is applied to the bath, using the article to be coated as one electrode, the casing is produced more rapidly, and if the work is made the anode, a casing of high carbon content (with Fe_3C as the limit), is produced, and the sharp edges of the article are rounded off. If the work is used as cathode a casing of approximately eutectic composition (0·9% C) is produced, and the angles of the article remain well defined. An alternating current may be employed. Where a thicker casing is required, the article may be dipped into molten iron-carbon alloys, or other metallic alloys, under molten borax.—C. A. K.

Zinc; Electrolytical production of ——. G. H. Clevenger, Palo Alto, Cal., U.S.A. Eng. Pat. 115,846, 7.5.18. (Appl. 7665/18.) Int. Conv., 7.5.17.

SEE U.S. Pat. 1,283,077 of 1918; this J., 1919, 79 A. A manganate or permanganate is used as oxidising agent, and a soluble manganese salt is added to the electrolyte if not already present in sufficient quantity.

"Blue-powder"; Production of ——. F. F. Farnham, Fairoaks, Pa., Assignor to National Metal Molding Co., Pittsburgh, Pa. U.S. Pat. 1,299,445, 8.4.19. Appl., 4.12.16.

HIGHLY heated zinc fume is condensed continuously in a closed chamber, and cooled below the temperature of ignition in air. The blue powder is agitated on removal in order to free it from entrapped carbon monoxide.—C. A. K.

Alloys; Process for refining ——. Stabilimenti "Biak" Ing. A. Pouchain, Assignees of P. Peynetti, Turin, Italy. Eng. Pat. 116,277, 7.5.18. (Appl. 7648/18.) Int. Conv., 7.5.17.

THE mechanical properties of alloys having a copper, aluminium, or zinc basis are improved by introducing a small quantity of one or more of the metals composing the alloy—preferably the metal having the greatest affinity for oxygen—in the form of a fine powder enclosed in a metallic envelope of low melting point, into the mould for the ingot or casting.—T. H. Bu.

Impregnating and coating metals with other metals. A. C. Hyde, London, and A. Jude, and Belliss and Morcom, Ltd., Birmingham. Eng. Pat. 125,630, 25.9.16. (Appl. 13,568/16.)

A CORE of metal (*e.g.*, steel) is enclosed within an envelope of a more fusible metal (*e.g.*, copper) and heated to about the fusing temperature of the coating metal in an atmosphere of hydrogen or carbon monoxide. The composite metal is then subjected to a wire-drawing or other equivalent mechanical operation. When steel or iron is employed as a core, a coating of oxide on the metal is an advantage, as a spongy iron film is produced in the reducing atmosphere, and a better interpenetration of the metals results. The process is applicable to a core of powdery material (*e.g.*, tungsten) enveloped by a more ductile metal, and a second coating of a still more fusible metal may be applied to the first. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 1924 and 1928 of 1906; this J., 1906, 852.)—C. A. K.

Coating with metals. F. J. Metzger, Assignor to Air Reduction Co., Inc., New York. U.S. Pat. 1,299,988, 8.4.19. Appl., 30.10.18.

THE coating metal is fed to the flame of a coating torch supplied with a combustible gas consisting of ethylene and oxygen.—T. H. Bu.

Copper-nickel matte; Treatment of —— *to separate the metals.* B. Mohr and C. Heberlein, London. Eng. Pat. 125,642, 29.9.16. (Appl. 13,853/16.)

FINELY ground copper-nickel matte is roasted, and then reduced and leached with 10% sulphuric acid at 80°—90° C. A deposit of nickel is obtained by electrolysing the dilute solution of nickel sulphate so produced, and the resulting acid solution is used for leaching a fresh quantity of the reduced matte.—C. A. K.

Alloys from volatile substances, or metals, and other metals; Method and apparatus for producing ——. E. G. Burr, Montreal, Canada. Eng. Pat. 125,785, 1.5.18. (Appl. 7311/18.)

A METAL (*e.g.* copper) is heated in a crucible and the heat of the molten metal is used to vaporise a volatile metal or other substance (*e.g.* phosphorus), contained in a closed retort, constructed of material of low thermal conductivity, and placed above the level of the molten metal in the crucible. A central tube conducts the vapour from the space above the surface of the material in the retort into the molten metal in the crucible near its base. The rate of evaporation of the volatile metal varies with the pressure set up by the head of molten metal in the crucible, and means may be provided for adjusting the distance between the retort and the molten metal in the crucible according to the boiling point of the volatile substance.
—S. S. A.

Alloys. R. A. Hadfield, London. Eng. Pat. 126,053, 16.11.16. (Appl. 16,459/16.)

IRON-NICKEL-MANGANESE alloys high in nickel for electrical and other purposes are composed of nickel 32—40%, manganese 0·3—8%, carbon 0·05—1·5%, and the remainder iron. A preferred composition is iron 63%, nickel 36%, manganese about 0·9%, carbon 0·05—1%. The alloys may be made by adding molten metallic manganese and nickel or their alloys to decarbonised and desiliconised iron.
—T. H. Bu.

Alloy. C. Van Amburgh, Tacoma, Wash. U.S. Pat. 1,300,058, 8.4.19. Appl., 2.10.17.

AN alloy consisting chiefly of aluminium with smaller proportions of copper, tin, and silicon.
—T. H. Bu.

Furnace for heating metal articles and other like uses. Gibbons Bros., Ltd., and R. Masters, Dudley. Eng. Pat. 126,163, 14.5.18. (Appl. 8040/18.)

A FURNACE of similar kind to that described in Eng. Pat. 7203/12 (this J., 1913, 294) but less expensive in construction consists of a dome-shaped chamber, fitted with a number of charging doors at the floor level. Heating gases, from a fire-grate, or gas-producer situated below the hearth, are introduced through a central port in the furnace bed and the waste gases pass down vertical flues between the charging doors. Zig-zag horizontal regenerator passages are provided near the sides of the fuel chamber or gas-producer and the heated secondary air meets the combustible gases before passing through the central port into the furnace.
—C. A. K.

Blast furnace [tuyère]. F. O. Miller, Portsmouth, Ohio. U.S. Pat. 1,298,761, 1.4.19. Appl., 8.8.18.

THE discharge opening of the tuyère is at an angle to the main portion, and the angular section is lined with refractory material at the place where the direction of the blast is deflected.—C. A. K.

Electric furnace for smelting ores. A. E. Bookwalter, Coeur d'Alene, Idaho. U.S. Pat. 1,297,611, 18.3.19. Appl., 26.4.17.

THE furnace comprises a shell, polygonal in cross-section, resting on a rectangular base, the latter having along its central portion a relatively narrow well provided with an outlet for molten metal. Two electrodes lying on the base on opposite sides, spaced from, but parallel to the well, and abutting against the side walls, extend from one end to the opposite end of the furnace. The base is inclined downwards from the electrodes to the well, thus forming a support for the ore, which is melted by the current passing between the electrodes.—B. N.

Furnace; Melting —— *with crucibles of quartz or quartz-glass.* Westinghouse Metallfaden-Glühlampenfabrik, G.m.b.H., Atzgersdorf, Austria. Ger. Pat. 308,308, 11.4.17.

QUARTZ crucibles may advantageously be used for foundry work in furnaces heated by gas and wholly or partially lined with quartz.—T. St.

Open-hearth furnaces; Method and apparatus for shortening the treatment period in ——. W. Mathesius, Charlottenburg. Ger. Pat. 310,574, 19.9.17.

IN the early stages of the reaction the heating gas is supplied to the furnace by the upper port so that the air comes into direct contact with the charge,

and at a later stage the gas and air are changed over with respect to the regenerators. The reversing gear consists of a stationary plate with a superposed rotating bell. In the underplate the gas and air channels belonging to the right or left side of the furnace are placed diametrically opposite to each other, and the passage to the chimney is connected to the centre. At any given time two of the diametrically opposed passages are connected with the chimney while the other two serve for the supply to the furnace of gas and air respectively.—T. St.

Zirconium ores; Process of purifying ——. W. R. Loveman, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,297,371, 18.3.19. Appl., 1.9.15.

Crude zirconium and titanium ores are heated with an excess of hot concentrated sulphuric acid practically to dryness, the dried mass crushed, and its soluble constituents extracted with dilute sulphuric acid. The solution is treated with sodium thiosulphate at about 100° C., to precipitate hydrated zirconium oxide, and the precipitate filtered off, and calcined to remove water and adhering sulphur.—C. A. M.

Malleableizing cast metal; Method of ——. W. G. Webster, Highland Park, Mich., Assignor to H. Ireland, Detroit, Mich. U.S. Pat. 1,298,607, 25.3.19. Appl., 9.1.18.

A metal casting is placed in a container, capable of being hermetically sealed, together with a quantity of combustible material sufficient to combine with the oxygen present, and to produce a positive pressure of gas in the container. The sealed container is subjected to heat, and the contents are allowed to cool before removal.

—C. A. K.

Flotation; Device for the aeration and emulsifying of pulp for ——. C. Taylor, Nogales, Ariz. U.S. Pat. 1,299,059, 1.4.19. Appl., 8.11.17.

Pulp for flotation treatment is caused to pass through a pipe, and air is drawn in at different points in the length of the pipe so as to cause admixture of air with the pulp before the latter enters the flotation tank.—C. A. K.

Molybdenum; Method of extracting and recovering — from ores and concentrates. H. A. Doerner, Denver, Colo. U.S. Pats. (A) 1,299,559 and (B) 1,299,560, 8.4.19. Appl., 18.1.17 and 15.3.18.

(A) Molybdenum-bearing material is heated to fusion and treated with free chlorine to combine with, and volatilise the molybdenum as chloride. The reaction may be carried out by electrolysing a bath of fused alkali chlorides containing the molybdenum ore. (B) Molybdenum ore is briquetted with sodium chloride together with a material capable of yielding sulphur, and the briquettes are fed into a heated vertical chamber through which a downward current of air is maintained. Chlorine is liberated in the furnace and volatile molybdenum chlorides are conveyed away by the air current, and condensed.—C. A. K.

Nickel scrap and sludge; Process for treating —— [*to recover platinum*]. W. McA. Johnson, Hartford, Conn. U.S. Pat. 1,299,577, 8.4.19. Appl., 3.8.17.

The residues from the electrolysis of commercial nickel, which are comparatively rich in platinum, are classified into coarse and fine particles. The fine particles are subjected to a further settling treatment and separated into heavy sludge and fine slimes. The latter contain most of the platinum.

—C. A. K.

Muffled ore-converting apparatus. A. M. Beam, Assignor to The American Continuous Retort Co., Denver, Colo. U.S. Pat. 1,299,661, 8.4.19. Appl., 10.12.17.

Two horizontal chambers are arranged one above the other so that heating gases may circulate around them. Ore charged into one end of the upper chamber is moved by scrapers to the opposite end and is conveyed by a shoot into the lower chamber in which it is moved by oppositely inclined scrapers to the discharge end. The scrapers are connected to frames mounted on slideways on opposite sides of the oven, and move in unison.

—C. A. K.

Metal briquette F. A. Vogel, Assignor to General Briquetting Co., New York U.S. Pat. 1,299,878, 8.4.19. Appl., 26.10.18.

Dirt and foreign substances are destroyed and cutting oil removed from metal waste such as turnings and borings, by crushing the metal, annealing the pieces produced, and then cooling them under non-tempering conditions, preparatory to briquetting.—T. H. Bu.

Sintering ignition process. C. W. Adams, Jun., Murray, Utah, Assignor to American Smelting and Refining Co. U.S. Pat. 1,299,892, 8.4.19. Appl., 19.1.17.

A uniform layer of red-hot ore is spread on the top of a charge of the ore to be sintered and subjected to a downward current of air. For ores containing sulphur the temperature of the layer of red-hot ore should be high enough to ignite the charge, but not high enough to distil more than a small amount of the sulphur.—T. H. Bu.

Powdered ores, flue dust, etc.; Furnace for drying, calcining, and sintering ——. W. Schumacher, Berlin. Ger. Pat. 310,573, 19.5.17. Addition to Ger. Pat. 306,032 (this J., 1918, 629A).

To prevent the possibility of the roasted material adhering to the inclined iron plates of the furnace originally described, vertical tubes are placed at short intervals from each other, either in front of, or embedded to a depth of somewhat more than half their cross-section in the iron plates.—T. St.

[*Copper*] *sulphide ores containing ferric salts; Method of leaching* ——. Hofbaer St. Stefan Gewerkschaft, Budapest. Ger. Pat. 310,525, 18.12.15.

The ore is roasted at not higher than 300° C. under the greatest possible concentration of sulphur dioxide, so that the iron and sulphur remain as ferrous sulphate. The mass is then leached to remove the greater part of the soluble compounds, and subjected to an oxidising roasting to produce sufficient ferric sulphate to allow of the recovery, in the final leaching, of precious metals.—T. St.

Metal sulphides [pyrites]; Treatment of — with silicon or silicon alloys with recovery of the sulphur combined with the metals. Det Norske Aktieselskab for Elektrokemisk Industri Norsk Industri-Hypotekbank, Christiania. Ger. Pat. 310,526, 26.8.15.

Pyrites containing copper is heated with silicon, preferably in an electric furnace, to about 1500° C. out of contact with air. Ferrosilicon is formed, sulphur is distilled off, and the copper is concentrated in a matte.—T. St.

Alloys and metals [zinc]; Method of melting ——. M. Lissauer u. Co., and W. Venator, Cologne. Ger. Pat. 310,971, 18.3.17.

OXIDATION of the metal is avoided by maintaining an atmosphere of inert gas inside an air-tight melting vessel at a pressure exceeding atmospheric. —T. St.

[*Double*] *plating metallic articles [wire blanks]; Machine for —— by electrolytic action.* M. O. Anthony, Englewood, N.J., Assignor to A. Klinball Co., New York. U.S. Pat. 1,298,155, 25.3.19. Appl., 4.8.16.

Silver; Process of extracting —— from ore. M. H. Caron, Weltevreden, Java, Assignor to Research Corporation, New York. U.S. Pat. 1,298,454, 25.3.19. Appl., 16.7.17.

SEE Eng. Pat. 101,665 of 1916; this J., 1916, 1161.

Volatile metals; Method of refining ——. S. Huldt, Stockholm. U.S. Pat. 1,298,722, 1.4.19. Appl., 7.8.16.

SEE Eng. Pat. 101,211 of 1916; this J., 1917, 460.

Metal [tungsten] and its manufacture. A. Pacz, Cleveland, Ohio, Assignor to General Electric Co. U.S. Pat. 1,299,017, 1.4.19. Appl., 25.5.14.

SEE Eng. Pat. 15,961 of 1914; this J., 1915, 875.

Zinc-bearing materials; Electrolytic refining of metallic ——. C. H. Aldrich and J. K. Bryan, Baltimore, Md., Assignors to Electrolytic Zinc Co., Inc., New York. U.S. Pat. 1,299,414, 8.4.19. Appl., 26.7.16.

SEE Eng. Pat. 108,312 of 1917; this J., 1918, 518A.

XI. ELECTRO-CHEMISTRY.

Carbon electrodes used in electric steel-making furnaces; Radiographic examination of ——. R. A. Hadfield and S. A. Main. Faraday Soc., Apr. 29, 1919. (Advance proof.) 10 pages.

CARBON electrodes are made of amorphous carbon or of graphite. The former are the more heterogeneous and give more trouble in use. The X-ray examination was carried out with a Coolidge tube of 6 in. spark gap distant 20 in. from the plate, using a current of 2 milliamps. and an exposure of 1 minute. The impurities could be easily seen on the fluorescent screen. Stereoscopic examination was used. The results threw little light on the behaviour of the electrodes. It is not easy to identify the individual fragments of retort-carbon, anthracite, etc., which compose the electrodes. The graphite electrodes give structureless radiographs in which cracks are readily seen. The physical and radiographic properties of a few of the electrodes examined are tabulated.—F. C. Th.

Silver sulphide; Some electrical properties of ——. G. W. Vinal. Bull. Bureau of Standards, 1918, **14**, 331—339.

A STRIP of silver sulphide rolled at room temperature possesses a large negative temperature coefficient of resistance. A wire of the sulphide drawn through a draw-plate at about 200° C. possesses a zero temperature coefficient of resistance. The strip simultaneously conducts the current metallically and electrolytically, whereas the wire is a metallic conductor only. The resistance of the strips, using alternating current, was nearly always higher than when direct current was used. The resistance of the sulphide was temporarily increased by the passage of an alternating current as small as 8·8 milliampères, of a frequency as low as 60 cycles, whereas a small direct current produced the opposite effect. Employing a strip of dimensions 5·5×0·3×0·01 cm. with silver-plated ends soldered to copper leads, a visible discoloration of the plating of the anode end was obtained when a current of 200 milliampères was passed. Shiny silver crystals appeared in the middle of the strip, and up to within a small fraction of a mm. of the anode terminal, when a current less than 300 milliampères was passed. No visible decomposition occurred when alternating current up to 600 milliampères was employed. The specific resistance of the wire at 25° C. was 17,300 microhm-cm.—J. S. G. T.

Dielectric liquids; Decomposition of —— under the influence of an electric arc. E. Urbain and C. Seal. Comptes rend., 1919, **168**, 887—889.

AN arrangement is described by means of which an arc started in a dielectric liquid with a high frequency current between two electrodes may be continued by a current of sufficient intensity but low voltage. Under these conditions the tetrachlorides of titanium, tin, and carbon are decomposed, chlorine being evolved; saturated liquid hydrocarbons give acetylene, ethylene, and hydrogen, and carbon is deposited; pinene gives the same gases and there is marked formation of isoprene; ketones yield carbon monoxide and various hydrocarbons. In the case of organic dielectric liquids the process of decomposition is different according as the liquid is maintained at 15° C. or at its boiling-point, the decomposition being more complete in the latter case.—W. G.

Nelson chlorine cell. Carrier, jun. *See* VII.

Sodium hydrosulphite. Jellinek. *See* VII.

Sodium permanganate. Wilson and Horsch. *See* VII.

Silicon tetrachloride. Hutchins. *See* VII.

Fluorine. Argo and others. *See* VII.

Electrical filter. Lamb and others. *See* XIXB.

PATENTS.

Electric furnaces. J. Bibby, London. Eng. Pat. 125,179, 2.9.18. (Appl. 3726/18.)

THE opening in the top of the furnace through which the electrode passes, is sealed by means of superposed rings divided into segments. The rings are of curvilinear form in cross-section with a comparatively thin inner portion, so that they adjust themselves to the electrode and prevent the passage of flame. The rings are contained in a casing, the space between the casing and the rings being charged with loose refractory material, and a guard ring closely fitting the casing also bears upon the superposed divided rings.—B. N.

Electric arc furnaces. F. H. A. Wielgolaski, Christiania, Norway. Eng. Pat. 125,516, 24.4.18. (Appl. 6875/18.)

AN arc furnace, for the treatment of gases, is of the type in which double or multiple arcs are stretched out into an elongated or U-shaped form,

comparatively cold and electrically badly-conducting reaction gases being blown into the space between the arc legs and through openings along the whole length of the furnace space. The gases, owing to their poor electrical conductivity and their movement, prevent the arc bight from being withdrawn towards the electrodes and prevent short-circuits, whilst also assisting in a high degree in forcing the arc bight towards the gas outlet end of the furnace. The furnace may be divided into two or more parallel compartments (according to the phase number) connected together by slots, and the gas inlet may be between the two compartments with a projecting surface opposite, the latter dividing the current of gas and directing each portion into its own compartment, or the inlet openings may be arranged tangentially to each compartment. Auxiliary electrodes may be arranged in the slots between the compartments. In a further alternative form, the gases are admitted at suitable points so that they sweep over a wider or smaller part of the inner wall faces of the furnace compartments before passing between the arc legs. Each compartment is provided with a central outlet for the reaction products, or a common central outlet is arranged, which is situated in the elongation of a slot connection between the different furnace compartments.—B. N.

Electric furnaces: Control of power absorbed in ——. C. C. Gow and D. F. Campbell, London. Eng. Pat. 125,522, 11.5.18. (Appl 7957/18.)

THE power absorbed in an electric furnace is maintained at a predetermined value, by moving the electrodes by means of a supply of fluid pressure controlled by an electromagnetic device energised by current from a source independent of the load circuit, the strength of the current being regulated by means of variable resistances automatically adjusted according to the power supplied to the load circuit. This adjustment is accomplished by a solenoid or other equivalent device energised by the secondary winding of a transformer, of which the primary winding is traversed by the whole or a portion of the current supplied to the electrodes of the furnace, or the solenoid may be connected in parallel across a low resistance traversed by the load current. Other resistances may be arranged in parallel with the automatically adjusted variable resistance, and are adapted to be operated manually in order to adjust the predetermined value of the current maintained in the movable electrode. For the purpose of adjusting the predetermined value of the power supplied to the furnace, tappings may be taken from the secondary windings of the current transformer to the solenoid, either in lieu of or in combination with the resistances operated by hand. The solenoid may be provided with an additional winding, energised by a current dependent upon the voltage between the electrode and the charge.—B. N.

Electric furnace. A. E. Greene, Seattle, Wash. U.S. Pat. 1,297,149, 11.3.19. Appl., 12.10.17. Renewed 9.8.18.

THE furnace comprises a horizontal cylindrical steel shell lined with refractory material, and with a dished and flanged steel head riveted to each end. An opening extending along the top of the cylinder is closed by an arched roof, and electrodes pass through the roof and the hearth of the furnace. Suitable openings are arranged for charging and discharging material, the furnace being supported on a track on which the shell may be rolled for tilting to the required angle.—B. N.

Electrolytic cell. J. Harris, Lakewood, Ohio, Assignor to J. R. Rose. U.S. Pat. 1,297,157, 11.3.19. Appl., 29.9.17.

SEVERAL cells are arranged within a tank, each of the cells having openings in opposite walls and electrodes arranged within the openings. A bar of conducting material is interposed between the electrodes in each unit, with means, mounted in one of the walls of the tank and co-operating with the side of the unit adjacent to it, for exerting pressure upon such electrodes, so as to hold the units in an assembled position.—B. N.

Chemical changes, Production of —— by oscillatory discharge. E. F. Northrup, Princeton, N.J., Assignor to The Ajax Metal Co., Philadelphia, Pa. U.S. Pat. 1,297,393, 18.3.19. Appl., 13.7.17.

NITROGEN in air is converted into nitric acid, by passing an oscillatory current across a gap between a solid electrode and mercury in the presence of air. The mercury nitrate, which is produced, is subsequently treated to decompose it into nitric oxide, nitric acid, and mercury.—B. N.

Electrolytic baths: Method of handling anodes in ——. H. M. Stuart, Baltimore, Md., Assignor to Electrolytic Zinc Co., Inc., New York. U.S. Pat. 1,299,519, 8.4.19. Appl., 26.7.16.

SEE Eng. Pat. 108,311 of 1917; this J., 1918, 96A.

Electric furnace and transformer for use therewith. F. E. Berry, Hayes. U.S. Pat. 1,299,664, 8.4.19. Appl., 19.1.18.

SEE Eng. Pat. 115,247 of 1917; this J., 1918, 380A.

Removing suspended particles. Eng. Pat. 125,681. *See* I.

Electric separator. U.S. Pat. 1,297,159. *See* I.

Separating finely-divided materials. U.S. Pat. 1,298,409. *See* I.

Dehydrating oil. U.S. Pat. 1,297,378. *See* IIA.

Separating emulsions. U.S. Pats. 1,299,589-90. *See* IIA.

Treating liquor from reduction of nitrated derivatives. U.S. Pat. 1,298,513. *See* III.

Chlorates. U.S. Pat. 1,297,395. *See* VII.

Hydrogen peroxide. U.S. Pat. 1,299,485. *See* VII.

Quartz tubes. Ger. Pat. 310,831. *See* VIII.

Ozonising substances. U.S. Pat. 1,297,716. *See* XIXB.

XII.—FATS; OILS; WAXES.

Fats; Hydrolysis of —— by means of sulpho-aromatic fatty acids. L. Ubbelohde and W. Roederer. Seifenfabr., 1918, **38**, 425—429, 449—453, 475—476. Chem. Zentr., 1919, **90**, II., 365.

COMPARATIVE experiments in which fats were hydrolysed under the same conditions with five

different agents (viz., the naphthalene-sulpho compounds of oleic acid, of castor oil and its fatty acids, and of hydrogenated castor oil and its fatty acids) showed that there was no difference in the speed or degree of hydrolysis effected by any of them. On the other hand, the colour of the fatty acids and of the glycerin water is much lighter when hydrogenated castor oil compounds are used than with the other reagents. The view formerly expressed that the velocity of the reaction varies with the hydrolytic agent employed must be attributed to the preparations having contained different proportions of free sulphuric acid. The use of a larger amount of the hydrolytic agent causes the emulsion to be more persistent, and this results in greater hydrolysis.—C. A. M.

Arachis oil; Hydrogenation of ——. F. Heim, A. Job, and H. Sturzwage. Bull. de l'Office Coloniale, 1918, **11**, 355—361. Bull. Agric. Intell., 1919, **10**, 108—109.

Arachis oil hydrogenated to a hard fat, with nickel formate as catalyst, melted at 58° C., solidified at 47·8° C., and had iodine value 13·5.—C. A. M.

Seeds of the evening primrose [*Oenothera biennis*]; *Fatty oil from the* ——. *A new linolenic acid.* A. Helduschka and K. Lüft. Arch. Pharm., 1919, **257**, 33—69.

The air-dried seeds of the evening primrose contain water 13·95%, crude proteins 13·38%, fat 16·93%, fibre 14·56%, nitrogen-free extractives 35·63%, and ash 6·15%. The oil was obtained by extraction of the crushed seeds with ether and formed a golden-yellow liquid resembling poppy oil in taste and smell; it remained completely liquid at 0° C., but a few solid particles separated at −11° C. It had sp. gr. at 15° C., 0·9283; n_D^{40} = 1·4722; acid value, 0; saponification value, 195·2; Reichert-Meissl value, 2·61; Polenske value, 0·57; iodine value, 148·92; Hehner value, 94·94; acetyl value, 13·9. It was optically inactive and a member of the class of drying oils. The volatile fatty acids consisted mainly of caprole acid (0·81%). Separation of the unsaturated and saturated fatty acids was effected in the usual manner by means of the lead salts and the former were brominated in ethereal glacial acetic acid solution. Under these conditions a sparingly soluble hexabromo-γ-linolenic acid, microscopic needles, m.pt. 195°—196° C. (decomp.), separated which, when treated with zinc and alcohol, yielded γ-linolenic acid as a yellow substance of unpleasant odour. Tetrabromo-α-linolic acid, tetrabromo-β-linolic acid, and dibromo-oleic acids were identified in the filtrates from hexabromo-γ-linolenic acid. The unsaturated fatty acids contain γ-linolenic acid (2·50%), α-linolic acid (30·20%), β-linolic acid (38·11%), and oleic acid (29·19%). Oxidation of the unsaturated fatty acids with permanganate yielded dihydroxystearic acid, a mixture of tetrahydroxystearic acids, and γ-hexahydroxystearic acid, minute needles, m.pt. 245° C. (decomp.). Fractionation of the saturated fatty acids from alcohol or by means of their magnesium salts led to the isolation of palmitic acid and a substance the properties of which agreed with those of daturic acid; theoretical considerations caused the authors to doubt the natural occurrence of the latter acid, and experiments on the fractional distillation of the substance with steam showed that the "daturic acid" obtained from the evening primrose at any rate was a mixture of palmitic acid (and possibly stearic acid) with acids of greater molecular weight. The unsaponifiable matter of the oil contained phytosterol (2·27%).—H. W.

Prune kernels; Analysis of ——. L. Fordyce and D. M. Torrance. Chem. News, 1919, **118**, 242—243.

Prune kernels extracted with ether yielded 42% of oil, about a third of which was deposited as a solid mass on cooling the liquid to −5° C. The solid portion resembled palm-kernel oil and had sp. gr. 0·9055 and saponification value 239·8. The liquid portion had sp. gr. 0·9119 and saponification value 207·4. The original kernels contained 2·47% of nitrogen, whilst the fat-free residue contained 2·21%. When extracted with water the kernels yielded 37·42% of sugars, mainly lævulose and dextrose.—C. A. M.

Dogwood oil. W. Normann. Chem Umschau, 1918, **25**, 49—50. Chem. Zentr., 1919, **90**, II., 365—366.

The fruit pulp of the dogwood tree, *Cornus sanguinea*, when dried yielded 30·7 and 35·3% of oil, whilst the kernels of the seeds yielded 8·76 and 12·26%. The fruit oil was of a dark colour, had a pleasant aroma, and gave the following results:—Acid value, 4·2—37·5; saponif. value, 192—194; iodine value, 115·5—195·4; refractometer reading at 25° C., 65·8—68·8; and unsaponifiable matter, 1·65—2·9%. The kernel oil had the following characters:—Acid value, 2·5—108; saponif. value, 193—197; iodine value, 143·8—147·8; refractometer reading, 75·4—75·7; and unsaponifiable matter, 0·4—1·1%. The berries of the white dogwood, *Cornus stolonifera*, contained 21·23% of oil with the following characters:—Acid value, 7·8; saponif. value, 197; iodine value, 114·2; refractometer reading, 68·5; and unsaponifiable matter, 0·67%.—C. A. M.

"Benefing" oil, a substitute for linseed oil. Bull. de l'Office Coloniale, 1918, **11**, 345—370. Bull. Agric. Intell., 1919, **10**, 109.

"Benefing" seed from a plant which grows wild in the Niger district and also in Madagascar, where the natives term it "voa matavy," contains a drying oil which can replace linseed oil for industrial purposes. The oil, extracted from the seeds by primitive methods, is used in all the workshops of the Kayes railway in the Niger district. In Madagascar it is used as an edible oil.—C. A. M.

Ether; Recovery of —— in fat determinations. J. Grossfeld. Z. Unters. Nahr. Genussm., 1919, **37**, 81—82.

Apart from the recovery of ether by distilling the contents of the extraction flask, a considerable further quantity of the solvent may be recovered by distilling the extraction thimbles in a suitable apparatus. If the thimble contains much extracted material and is itself thick and porous, some 50% of the ether used in the extraction may remain in the thimble.—W. P. S.

Fatty residues from the Gerber process [*of determining fat in milk*]; *Use of —— for soap-making.* F. Reiss. Milchw. Zentr., 1919, **48**, 75—77.

The fat separated in the Gerber process for the determination of fat in milk etc. may be collected, washed with water to remove sulphuric acid, and then saponified to form a soap. The average saponif. value of the fat is 220·4; the fat contains about 22% of amyl esters, and, if desired, the quantity of alkali used for the saponification may be restricted to four-fifths of that required for total saponification so as to leave these esters unsaponified and available for perfuming the soap.

—W. P. S.

Utilisation of yeast. Schweizer. *See* XVIII.

Fat-soluble vitamines. Drummond. *See* XIXA.

PATENTS.

Oils, fats, sugar, and so forth; Apparatus for use in the extraction of —— from materials yielding the same. J. de Raedt, Court St. Etienne, Belgium. Eng. Pat. 126,262, 24.1.19. (Appl. 1849/19.)

A HORIZONTAL cylindrical drum adapted to oscillate on trunnions is provided with charging doors for the material at the side, the charging being effected by turning the drum through 90° to bring the doors to the top. The drum is divided into compartments by porous or perforated horizontal plates, and near the bottom of the drum is a filter consisting of filtering medium enclosed between two perforated horizontal plates. The drum is provided along the top and bottom with a number of domes or openings to which the flexible inlet and outlet mains for the solvent are connected. When the extraction process involves heating, steam-circulating pipes are provided just below each of the perforated partitions. An arrangement of pipe connections and valves may be provided whereby after the material has been charged into the drum, the air may be exhausted and the material warmed by hot solvent vapour and then washed with the solvent as desired. The residual solvent may then be recovered by injecting steam generated from air-free water.—W. F. F.

Drying machine [for copra]. A. B. Starr, Brooklyn, N.Y. U.S. Pat. 1,297,926, 18.3.19. Appl., 7.11.16.

A MACHINE for drying copra contains a chamber with a perforated bottom to which heated air is delivered. The material is passed through the chamber on a series of superposed endless conveyors arranged in two sets driven at different speeds, each conveyor, excepting the lowest in each set, being provided with means for delivering its contents to the one immediately below it, whilst the lowest conveyors discharge the material into shoots.—C. A. M.

Polyoxy fatty acid esters; Process for the production of ——. E. H. Zollinger, commonly known as E. Zollinger-Jenny, Zurich, Switzerland. Eng. Pat. 112,624, 8.1.18. (Appl. 483/18.) Int. Conv., 8.1.17.

HYDROXY-FATTY acids or their glycerides (*e.g.* castor oil) are converted into polyoxy-fatty acids by the action of heat, condensation agents or the like, and these fatty acids are converted into esters by means of hydroxy-fatty acid esters. For example, castor oil is heated for several hours with water at a pressure of 8 to 10 atmos. in an autoclave. The fatty acid, which is to a large extent polymerised, is separated and heated to about 180° C., until it has been largely converted into triricinoleic acid. This is mixed with half its quantity of castor oil and heated to 220°—230° C. *in vacuo*, in the presence of metallic zinc as catalyst, until the mixture is practically neutral. The product consisting largely of the triglyceride of tetraricinoleic acid is a thick oil having the technical properties of castor oil. By using the methyl or ethyl ester of ricinoleic acid instead of castor oil products more fluid than the glyceride are obtained.—C. A. M.

Esters; Processes of hydrolysis or saponification of ——. C. F. Cross and C. Dreyfus, London. Eng. Pat. 125,153, 19.6.16. (Appl. 8635/16.)

GLYCERIDIC oils or fats are treated in a methyl or ethyl alcohol medium with a fractional equivalent of alkali or base so that the alcohol of the medium takes part in the decomposition of the ester. The process may be carried out at the ordinary temperature in the case of oils or at about the m.pt. of the glyceride in the case of solid fats. Alternatively the glyceride may be treated with a fractional equivalent of caustic soda or other alkali (not exceeding one-third of the combined acid) dissolved in alcohol (the weight of which must not exceed that of the glyceride, and preferably should not exceed one-third of that weight). After mixing and emulsification the mixture may be transferred to another vessel to complete the reaction. The same processes may be used in the hydrolysis of cellulose acetates. For example, by such controlled hydrolysis a thread of cellulose acetate artificial silk may be brought to any degree of approximation to cellulose, and its textile uses and dyeing properties correspondingly modified.—C. A. M.

Fats and oils; Method of hydrolysing —— into glycerin and fatty acids. W. Happach, Malmö, Sweden, and Sudfeldt und Co., Melle. Ger. Pat. 310,455, 29.11.11.

SULPHO acids of petroleum or its distillates are used as hydrolytic agents for the decomposition of oils and fats. For example, sulphonated petroleum hydrocarbons are separated from the deposit of tarry matter, and washed with alkali solution, the uncombined hydrocarbons extracted from the soap solution by means of benzene, etc., and the purified sulpho acids liberated by the addition of an excess of sulphuric acid. From 0·5 to 1% is required to hydrolyse fats, and the resulting fatty acids are of better colour than those obtained by Twitchell's process.—C. A. M.

Saponaceous compositions and process of manufacturing the same. W. Feldenheimer, London, and W. W. Plowman, East Sheen. Eng. Pat. 125,491, 11.4.18. (Appl. 6170/18.)

CLAY (1 cwt.) is suspended in water (120 to 125 lb.) containing a deflocculating electrolyte (about 1¼% of the weight of clay of 98% sodium hydroxide) so as to bring the clay into the sol condition. After thorough agitation the mixture is incorporated with fluid soap (2½ to 8 cwt.) and preferably at about the same temperature (*e.g.*, 120° F., 49° C.) as the soap. Under these conditions more clay can be incorporated with soap than has hitherto been possible. —C. A. M.

Saponifying glycerides; Process of ——. B. E. Reuter, Assignor to Reuter Process Co., Chicago, Ill. U.S. Pat. 1,298,563, 25.3.19. Appl., 9.4.14.

SEE Eng. Pat. 9393 of 1915; this J., 1916, 1163.

Dehydrating oil. U.S. Pat. 1,297,378. *See* IIA.

Sulpho acids from mineral oils. Ger. Pat. 310,925. *See* IIA.

Plastic material. Eng. Pat. 125,607. *See* XIII.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Imitation amber for mouthpieces of tobacco pipes etc.; Composition of —— from a hygienic point of view. N. Tarugi and G. Cioni. Boll. Chim. Farm., 1919, 58, 101—106.

CERTAIN specimens of imitation amber which when used as mouthpieces had caused pronounced irritation of the mucous membrane were found to have

the following composition:—Water, 6·32; calcium phosphate, 8·38; casein (N × 6·25), 56·25; formaldehyde, 28·47; colouring matter and loss, 0·58%. Formaldehyde was liberated from the casein compound by the action of tobacco smoke, and also by the hydrolytic action of saliva. It is suggested that the sale of mouthpieces of such composition should be prohibited.—C. A. M.

PATENTS.

Lead products [white lead]; Process of manufacturing certain ——. W. P. Thompson, Liverpool. U.S. Pat. 1,297,931, 18.3.19. Appl., 6.2.15. Renewed 5.2.19.

LEAD monoxide dust manufactured as described in Eng. Pat. 100,069 of 1916 (this J., 1917, 385) is cooled, and treated, with agitation, at 90°—140° F. (32°—60° C.) with carbon dioxide and the vapours of acetic acid, together with sufficient water vapour to yield hydrated white lead.—C. A. M.

Shellac-substitute; Process of producing a ——. J. R. Köhler, Stockholm. Eng. Pat. 120,729, 7.11.18. (Appl. 18,253/18.) Int. Conv., 23.10.17.

NATURAL resin, preferably old material or resin which has been submitted to oxidation, *e.g.*, by ozone, is powdered and treated with petroleum spirit, benzol, oil of turpentine, or similar solvents which extract the crystalline resin acids and leave the amorphous oxidised resin acids; these can be separated from impurities such as bark fragments by extracting with methyl or ethyl alcohol, the resulting solutions being capable of use as substitutes for solutions of shellac and of yielding a solid shellac substitute on evaporation. D. F. T

Colophony of high quality; Process of producing —— *from old natural resins of conifers.* J. R. Köhler, Stockholm. Eng. Pat. 122,407, 6.1.19. (Appl. 369/19.) Int. Conv., 15.1.18.

THE crystalline resin acids in old natural resins, which may be first finely divided, are extracted by means of a solvent, such as oil of turpentine, petrol or benzene, which will dissolve such acids, but will not dissolve to more than a slight extent the amorphous products consisting mainly of oxidised resin acids. On evaporating the solvent a residue of light-coloured colophony of high quality is obtained.—C. A. M.

Resin and process for manufacturing the same from crude solvent naphtha. M. Darrin, Wilkinsburg, Assignor to H. Koppers Co., Pittsburgh, Pa. U.S. Pat. 1,297,328, 18.3.19. Appl., 6.9.18.

CRUDE solvent naphtha is treated with a solution containing sulphuric acid in sufficient strength to polymerise the dark resin-forming constituents without material polymerisation of the coumarone-indene compounds. The mixture is distilled to separate the dark resins, the distillate treated with stronger sulphuric acid to polymerise the coumarone-indene compounds, and, after neutralisation of the excess of acid, redistilled, and the resulting light coloured resin freed from volatile oils by blowing a gas through it.—C. A. M.

Resin; Obtaining —— *from parts of plants.* C. Bauer, Berleburg. Ger. Pat. 310,504, 29.4.17.

PARTS of plants containing resin are heated in an aqueous solution of a salt, such as calcium chloride to extract the resin. The process may be carried out by placing the material in a porous vessel, which is immersed in the salt solution.—C. A. M.

Varnish; Apparatus for manufacturing ——. C. H. Bennett, Chicago, Ill. U.S. Pat. 1,298,159, 25.3.19. Appl., 18.5.16.

A VARNISH composition is cooked in a movable vessel and is then transferred in the vessel to a blending vessel situated at a distance from the heating medium. The contents of the heating vessel are transferred, by means of a pump, to the blending vessel, which is closed and fitted with a stirrer and with a reflux condenser, and as the liquid flows into the vessel it is mixed with a solvent led in through another pipe.—L. A. C.

Plastic material for use in gas checks for gun breech blocks and other purposes. Schneider et Cie., Paris. Eng. Pat. 125,607, 5.9.16. (Appl. 12,560/16.) Int. Conv., 18.5.16.

FOR making gas check rings for gun breech blocks, a mixture of asbestos with an insoluble soap, such as lime soap, and an oleaginous substance such as petroleum jelly is used. The soap is prepared by saponifying colza oil with 13% of its weight of slaked lime, and then colza oil is added to reduce the proportion of lime to 8%. The soap or both the soap and the petroleum jelly are dissolved in a volatile solvent to facilitate mixing with the asbestos, the solvent being removed by subsequent evaporation.—D. F. T.

Turpentine substitute. Eng. Pat. 126,089. *See* IIA.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Caoutchouc; Synthesis of ——. H. Staudinger. Schweiz. Chem.-Zeit., 1919, 1, 1—5, 28—33, 60—64.

IN polymerising isoprene compounds of the terpene series are simultaneously produced, in quantities varying with the conditions of polymerisation, and these influence the character of the final product. Synthetic preparations although very similar to the natural product are not yet identical, as has been shown by Steimmig (this J., 1914, 267). In order to obtain a tougher synthetic rubber attempts have been made to mix the isoprene with styrol, linseed oil, and especially tung oil, but the products are all more or less sticky. The ordinary inorganic and organic peroxides such as sodium peroxide and benzoyl peroxide, do not accelerate the polymerisation to such an extent as pure oxygen, but, like ozone, are used in technical processes as catalysts. The varieties of rubber obtained by polymerising butadiene and dimethylbutadiene differ in characteristics from the isoprene product, and methyl-caoutchouc from dimethylbutadiene is now an important synthetic product in Germany. The yield of isoprene from oil of turpentine is increased by carrying out the process *in vacuo* (this J., 1911, 1023). By using limonene instead of oil of turpentine the yield is increased from about 25% to 65%. Essential oils, however, cannot be obtained in sufficient quantity to be practicable sources of isoprene. The production of butadiene from phenol and of isoprene from cresol would be too expensive, whilst these substances are required for other purposes. Coke-oven gases are a cheaper source of benzene, and synthetic rubber has been successfully prepared in Germany by converting this benzene successively into cyclohexane, chlorocyclohexane, and tetrahydrobenzene, which, on heating, gives butadiene and ethylene. The amount of butadiene and isoprene in coal tar would only furnish a small fraction of the amount required, whilst the conversion of alcohol into butadiene would be too expensive, apart from the fact that the most favourable conditions for the reactions have yet to be

discovered. If impure butadiene hydrocarbons are used sticky products are formed. American petroleum contains at least 1% of a mixture of the three pentanes (boiling at 9°, 30°, and 38° C.), which at the present time is practically a worthless constituent of the gases. About 370,000 tons per annum of these compounds would be available in the United States. It has been shown by Holt (this J., 1914, 364) that they could be converted into isoprene, but this synthesis would only be practicable in America. Acetone prepared from acetylene was used in Germany during the war as the source of synthetic rubber. It was reduced by means of aluminium to pinacone which was then converted into dimethylbutadiene and dimethyl-caoutchouc. The plant is capable of producing about 2000 tons of rubber per annum, but under normal conditions the process would be too expensive.—C. A. M.

Gas-mask fabrics. Perrott and Plumb. *See* V.

PATENTS.

Vulcanisation of rubber and similar materials. Dunlop Rubber Co., Ltd., London, and D. F. Twiss, Sutton Coldfield. Eng. Pat. 125,696, 20.3.18. (Appl. 4941/18.)

THE glycerol or glycol used as a solvent for caustic potash or soda for the purpose of ensuring a uniform introduction of the alkali into a rubber mixing (see Eng. Pat. 110,059; this J., 1917, 1185) can be replaced by other organic hydroxy-compounds such as butyl alcohol, amyl alcohol, or phenol.—D. F. T.

Coated fabrics Eng. Pat. 125,622. *See* V

XV.—LEATHER; BONE; HORN; GLUE.

Anthrax; Formic acid and mercuric chloride treatment of hides affected by ——. V. Gegenbauer Arch. Hyg., 1918, **87**, 289—315. Chem. Zentr., 1919, **90**, II., 132—133.

THE Seymour-Jones process for the sterilisation, by means of formic acid and mercuric chloride, of hides affected with anthrax, has been subjected to a series of trials. Experiments were made following the technique of Ottolenghi with mercuric chloride solutions of 0·1, 1·0, and 2·0% strength, which effected sterilisation only after 80 days, and with a 0·01% solution which required 100 days. A solution of 0·02% strength in combination with 1, 2, or 5% of formic acid did not sterilise in 40 days. Growth was obtained in albumin bouillon after 100 days' action of a 1% solution of mercuric chloride. Growth was also obtained from anthrax spores (from which all traces of mercuric chloride had been carefully removed by centrifuging and decanting, but without treatment with sulphides) after the spores had been subjected to a 0·01% solution for 20 days, to a 0·1 or 1% solution for 8 days, and to a 2% solution for 2 days. In the same series of experiments growth of the spores could still be observed after 8 days' action of 0·025—0·10% solutions of mercuric chloride, and 4 days' action of a 1% solution in combination with 1% formic acid. After the action of hydrogen sulphide solution on the spores and subsequent washing, 1% and weaker solutions of mercuric chloride together with 1% formic acid did not effect sterilisation even after 14 days. Anthrax spores treated by the Seymour-Jones method proved pathogenic when introduced into guinea-pigs. The conclusion is that for practicable concentrations and times of action the method is in no way effective.—F. C. T.

Tannin and the synthesis of similar substances. E. Fischer and M. Bergmann. Ber., 1919, **52**, 829—854.

THE removal of acetyl groups from substances such as the acetates of galloyl- and digalloyl-glucose, previously effected with cold alkali or with warm sodium acetate solution, can also be effected at the ordinary temperature by a moderate amount of concentrated aqueous hydrochloric acid in methyl-alcoholic solution. If the acetyl derivative is too sparingly soluble in methyl alcohol, a mixture of the latter with acetone may be used. The penta-(*m*-digalloyl) α- and β-glucoses obtained in this manner from the acetates are optically purer than those previously described. The method can also be applied with good results to simpler substances such as acetylsalicylic acid and triacetylgallic acid. The use of the potassium salt for the purification of tannins was recommended by Berzelius; the authors find the most convenient method of preparation to consist in mixing alcoholic solutions of the natural or synthetic tannins and potassium acetate, but the precipitates contain small amounts of the latter. The salts appear to be suitable for the purification of artificial tannins but not for their identification. Attempts to extend the method used in the preparation of 1-monogalloyl-β-glucose (this J., 1919, 17A) to other 1-acylglucoses gave disappointing results, the acyl-group being frequently removed simultaneously with the acetyl groups. This is the case, for example, with 1-benzoyltetra-acetyl α-glucose, but not with the corresponding *p*-hydroxybenzoyl-derivative. The catalytic action of sodium alkoxide on esters in alcoholic solution has been applied for the removal of acetyl groups. Thus, for example, for the elimination of the five acetyl groups of *p*-acetoxybenzoyl-tetra-acetylglucose dissolved in alcohol, one molecule of sodium ethoxide is sufficient at the ordinary temperature and the presence of a small quantity of water in the alcohol does not hinder the reaction; these conditions are particularly advantageous for securing good yields. The method has also been applied to the isolation of glucose from its penta-acetate and of α-methylglucoside from its tetra-acetate. The galloyl-derivatives of the sugars differ considerably in their behaviour towards gelatin solutions. The penta- and tri-galloyl compounds precipitate the latter from aqueous solution in the same manner as do the tannins, but this property is not shown by the various monogalloyl-glucoses nor by monogalloylfructose. Since similar differences were to be expected among poly-hydroxy-alcohols, the derivatives of glycol, trimethyleneglycol, glycerol, erythritol, and mannitol have been prepared and examined. The crystalline ethylene-glycol digallate is so sparingly soluble in water or alcohol that its reaction with gelatin or arsenic acid could not be investigated. With trimethyleneglycol digallate the gelatin test is not characteristic but distinct gelatinisation is caused by arsenic acid in alcoholic solution. Erythritol tetragallate is readily soluble in water and coagulates gelatin, but the alcoholic solution is too dilute to be tested with arsenic acid. The amorphous glyceryl trigallate and mannitol hexagallate yield colloidal solutions in water and behave like tannins towards both reagents. (See also J. Chem. Soc., 1919, 1., 278.)—H. W.

Depsides, lichen substances and tannins; Synthesis of ——. E. Fischer. Ber., 1919, **52**, 809—829.

A résumé of the progress made in this field by Fischer and his co-workers since the year 1913.

—H. W.

Chestnut bark; Colour tests of ——. T. G. Greaves. J. Amer. Leather Chem. Assoc., 1918, **13**, 467—469.

COLOUR tests of tanning infusions made by the tintometer or colorimeter have the advantages that they may be expressed numerically and that results obtained by different operators are in fair agreement. Tanning tests made with skivers cannot be numerically expressed but give an idea of the probable colour of the leather produced in actual manufacture. The two methods, however, do not give mutually consistent results. As measured by the colorimeter, chestnut bark infusion is three to six times darker per unit of tannin than the infusion of the chestnut wood, whereas skivers tanned with the bark are lighter in colour than those tanned with the wood. There is therefore no advantage in peeling the wood for extract manufacture unless the colour is to be tested by the colorimeter, as in Europe. F. C. T.

Chestnut [tanning] extract; Sugar in ——. C. T. Galey and O. Riethof. J. Amer. Leather Chem. Assoc., 1918, **13**, 170—176.

SOME chestnut extracts do not ferment readily and hence do not produce sufficient acid for the plumping of heavy leather. This the authors thought might be due to a low content of sugars. Extraction experiments were carried out with a battery of six autoclaves to determine the effect of temperature on the sugar content of the resulting extract. An extract prepared at 290° F. (143° C.) contained four times as much sugar as one prepared at 210° F. (99° C.), and more than twice as much per unit of tannin. This is thought to be due to the breaking up of cellulosic constituents of the wood. Analyses of commercial extracts also showed that those prepared in autoclaves contained considerably more sugar than those prepared in open leaches.—F. C. T.

Sulphite-cellulose [in tanning extracts]; Procter-Hirst test for ——. J. H. Yocum and E. S. Nelson. J. Amer. Leather Chem. Assoc., 1918, **13**, 395—396.

80 GRMS. of ground spruce wood was heated with 300 c.c. of a 25% solution of caustic soda for 6 hrs. at 100° C. After the addition of 150 c.c. of water, the solution was filtered through cloth, then nearly neutralised with hydrochloric acid and filtered through paper. The solution gave no precipitate in the Procter-Hirst test until 24 hrs. had elapsed, but there was immediate precipitation if a small quantity of sodium bisulphite was added to the solution, with or without heating. The lignones appear therefore not to react of themselves but need the presence of a sulpho group in an organic complex.—F. C. T.

Yeast growing in tan liquors. Physiological researches on a new film-forming ——. T. Asai. J. Coll. Sci., Imp. Univ., Tokyo, 1918, **39**, Art. 37. 42 pp.

A SPECIES of mycoderma discovered in a tannery in Senju, Tokyo, causes dark brown surface discolorations on leather which cannot be removed by acids or bleaching treatment. The mycoderma develops rapidly and in 3 or 4 weeks forms a thick red-brown skin on the liquor. The cells of the organism are ellipsoidal, 3·2—4μ wide and 8—11μ long. Usually there are two or three highly refractive bodies attached to the cell wall or in the vacuole, together with, occasionally, 2, 3, or 4 oil droplets. Spores are not formed and reproduction is by budding. A large colony, grown in a single day on soy-agar, was grayish-white, net-like in the centre, and radially folded at the periphery, which was irregularly toothed. A colony on wort-agar was thin with very many radial folds, but smooth and without folds at the edge. In liquid media the organism forms a folded grayish-white skin which covers the whole surface, and which within a week mostly settles as a flocculent precipitate rendering the solution turbid. The precipitate formed in a week from 30 c.c. of medium weighed 0·176 grm. when dry. Soji (yeast extract) forms the best medium. The yeast grows rapidly when incubated with certain carbohydrates (*e.g.* dextrose, lævulose) and with 1% ethyl alcohol; other strengths of alcohol from 0·1 to 10% allow less rapid growth. Tannin permits no growth at 3% strength, and little in weaker solutions, but there is considerable growth with gallic acid even in the presence of tannin. Ammonium salts are good sources of nitrogen for the organism, but not nearly so good as amino-acids and peptone. The mycoderma ferments dextrose, lævulose, mannose, maltose, sucrose, but not galactose, lactose, or dextrin. The production of acids in the tan-liquor is hindered by this organism, as it assimilates both acids and alcohols, with the exception of oxalic acid, which it produces and which is undesirable. In the presence of other sources of carbon, the organism will use up as much as 60% of the lactic acid in a 3% solution. The stains produced on leather by this mycoderma have no connection with the "mimosa stain" mentioned by Eitner (Gerber, 1898, **24**, 4).—F. C. T.

Shark skin leather. A. Rogers. J. Amer. Leather Chem. Assoc., 1918, **13**, 528—530.

SHARK skins cannot be limed in the ordinary way as they disintegrate. They are best treated for two days in a 0·2% solution of caustic soda after soaking, and then should be well washed and fleshed. The grain side should be worked with a blunt knife to remove shagreen as much as possible. After baiting with ammonium chloride, the skins are tanned by the two-bath chrome process using sodium bisulphite for the reducing bath. They may be finished direct, but are best re-tanned with quebracho, after which they are fat-liquored or stuffed. Leather of exceptional durability results from this process.—F. C. T.

Gelatin solutions; Setting point of ——. A. Coblenzl. Chem.-Zeit., 1918, **42**, 533—534.

SETTING points of 5% gelatin solutions were determined by the use of a thermometer, graduated in tenths of a degree, inserted through a cork in a measuring cylinder nearly filled with the solution, which was kept in constant gentle motion. Cooling was very slow, especially when within 2° or 3° of the expected setting point. Three temperatures were noted, *viz.*, the point of first solidification, recognisable by a wave-like surface at the walls of the cylinder and by a slight cessation in the fall of temperature, sometimes even by a slight rise; the point at which only small air bubbles (1 mm.) move with the liquid whilst larger ones (10 mm.) still slowly rise; and the point of complete solidification. Results were easily reproducible by this method over a period of 5 years with an accuracy of two or three tenths of a degree. Long standing of jellies, especially at higher temperatures, causes a depression of the setting point, and a diminution of the rigidity of the gelatin. The same effect is caused by additions of organic acids and of alkali. Alcohol keeps the solution more fluid and lowers the setting point considerably, but increases the rigidity of the gelatin. Basic aluminium and chromium solutions raise the setting point of gelatin solutions and also the rigidity of the gelatin, and ultimately render the gelatin insoluble. In

this case also long warming of the solution lowers the setting point. The addition of acid to a solution containing alum lowers the setting point but does not affect the rigidity of the gelatin on drying. Formaldehyde in small quantities does not affect the setting point, the hardening effect not being perceptible before drying.—F. C. T.

Leather; Examination and valuation of military ——. E. Seel, K. Hils, and K. Reihling. Z. angew. Chem., 1919, **32**, 1—7.

GERMAN military leathers and others from prisoners' camps in Germany were analysed in considerable numbers. Only Russian leathers proved to be under-tanned; French and Serbian as well as German leathers were well-tanned. The combination colour reaction described by Hundeshagen (Chem. Zentr., 1902, II., 752) is considered superior to the usual glacial acetic acid test for detecting under-tanning. None of the leathers examined proved to be weighted with inorganic materials, the mineral ash ranging from 0·5 to 1·5%. Sulphates were present only in traces. Little sugar was found in the leathers, the highest amount being 1·4% after inversion. A feature of the analyses is the large number of positive tests for artificial tannins, in particular for Neradol D; only in three cases was artificial tannin absent from the German leathers. Ordoval G, a product introduced by the Badische Company during the war, was not once detected. A comparison was made between Neradol D, Neradol ND, and Ordoval G as follows:

	Litmus	Congo Red	$BaCl_2$	$HCl + BaCl_2$	Filtrate from previous ppte. boiled 2 hrs. under reflux.
Neradol D	red	blue-violet	ppt.	considerable ppt.	ppt
Nor'dol ND	red	pure blue	ppt.	extremely slight ppt	no ppt.
Ordoval G	red	blue-violet	ppt.	very slight ppt.	no ppt.

The authors make several observations on the necessity for the absence from military leathers of free sulphuric acid, which was found in several instances.—F. C. T.

PATENTS

Leather; Manufacture of ——. D. McCay, Calcutta. Eng. Pat. 122,084, 19.3.18. (Appl. 4837/18.)

HIDES or skins after the usual wet work are treated for periods up to 12 or 24 hrs. with mercuric chloride solution of 5% strength or less, after which they are thoroughly washed in water or very weak alkali. The washed skins are treated with formaldehyde solution containing from 1% to 10% of 40% formalin until they are "leathery." This is effected in less than 24 hrs. even with weak solutions. The skins must be oiled or fat-liquored before drying. The process may be combined with vegetable tanning.—F. C. T.

Chrome tanning; Solutions for ——. E. Meyzonnier, jun., Annonay, France. Eng. Pat. 123,785, 3.12.17. (Appl. 17,879/17.)

BICHROMATES are reduced by sodium sulphite and sulphuric or hydrochloric acid and the solution rendered basic by a further addition of sulphite. —F. C. T.

Tanning process. S. Saxe, New York. U.S. Pat. 1,297,255, 11.3.19. Appl., 4.3.18.

RELATIVELY heavy leather, such as sole leather, is prepared by partially tanning hide in relatively weak vegetable tan liquor, and then completing the tanning in a drum by means of a stronger liquor containing osage orange wood extract.—C. A. M.

Plastic masses; Process of preparing —— from casein. E. Zillich, Berlin. Ger. Pat. 310,388, 26.1.15.

CASEIN, with or without the addition of pigments, is mixed with hydrogen peroxide into a homogeneous mass, and pressed in moulds. Glycerin or fatty or mineral oils may also be added to the mixture. The pressed material is hardened by means of formaldehyde to which it is advisable to add some hydrogen peroxide to prevent unequal shrinkage.—C. A. M.

XVI.—SOILS; FERTILISERS.

Soils; Injurious actions of potassium and sodium salts upon the structure of — and their causes. G. Hager. J. Landw., 1918, **66**, 241—286.

AN extensive series of experiments was made with saline solutions flowing through soils having base-exchanging properties. The saline solution was afterwards washed out with water, and the effects of the application upon the physical properties of the soil were observed. It was found that the base-exchanging properties of a soil were dependent upon the presence of weak acids the compounds of which undergo hydrolysis liberating the combined bases as hydroxides. If the base is divalent, the action on the soil is favourable, but if it is monovalent the action is unfavourable. The hydrolysis of compounds of weak acids is prevented by the presence of a dissociated salt with the same cation, and therefore when alkali salts are present in the soil solution there is no separation of alkali hydroxide and no deterioration of soil structure. This explains why soils which had been inundated with sea water showed no deterioration until after the sodium chloride had been washed out, whereupon hydrolysis of the soil zeolites set in and alkali hydroxides appeared in the soil solution. These alkali hydroxides caused the soil particles to form a dense mud, in contradistinction to the granular condition of the particles when in association with calcium compounds. Sodium salts were more injurious in this respect than potassium salts.—J. H. J.

Fluorine in soils, plants, and animals. L. A. Steinkoenig. J. Ind. Eng. Chem., 1919, **11**, 463—465.

THE fluorine content of soils (average 0·03%) is derived from such minerals as biotite, tourmaline, muscovite, apatite, fluorite, and phlogopite; larger quantities are found in soils containing mica. Roots of plants absorb the fluorine and the latter is transmitted to animals consuming the plants (see Gautier and Clausman, this J., 1916, 271). Animals also obtain fluorine from spring water.—W. P. S.

Ammonification of manure in soil. H. J. Conn and J. W. Bright. J. Agric. Res., 1919, **16**, 313—350.

A STUDY of soil before and after manuring with animal manure was carried out in order to determine the species of bacteria which brought about the ammonification process. It was found that in a manured soil the organisms multiplying most

largely were non-sporing bacilli; whereas in the same soil before being manured, spore-bearing bacilli were numerous. This pointed to non-spore-bearing bacilli being the active agents in ammonification rather than spore-bearing. Experiments were made with pure cultures of two organisms of the former class, namely, *Bacillus fluorescens liquefaciens* and *B. caudatus*, and one organism of the latter class, *B. cereus*, in sterile manured soils. The results confirmed the general conclusion given above. A detailed study of the characters of *B. fluorescens liquefaciens* and *B. caudatus* is given.—J. H. J.

Stable runnings; Preservation of —— by the addition of various substances. O. Lemmermann and H. Wiessmann. Landw. Jahrb., 1918, **52**, 297—341. Chem. Zentr., 1919, **90**, II., 346—347.

It is estimated that the value of the nitrogen escaping into the air from stables etc. in Germany exceeds M. 500,000,000 per annum. The urea and hippuric acid in the urine are rapidly converted by bacterial action into ammonium carbonate, from which the ammonia escapes. In experiments with various substances it was found that lignite of a humic character fixed 5·12% of ammonia, forming a product which lost part of its nitrogen at 100° C., but was very stable at the ordinary temperature. The addition of 50 to 60% of dried lignite (containing 80% of dry substance) acted as a complete preservative, and the preparation gave better results as a fertiliser than ammonium sulphate fertilisers containing the same amount of nitrogen. Peat also fixed the ammonia, the combined nitrogen not being completely volatile at 100° C., but, using 20% of peat, the loss of nitrogen after 62 days amounted to 62%. The addition of 1·5 to 2% of sulphuric acid (66° B., sp. gr. 1·84) prevented any loss of nitrogen, whilst sodium bisulphate (35·01% H_2SO_4) was effective when added in the proportion of 7%. After the addition of 10% of superphosphate the loss of nitrogen after 62 days was 27·48%. Kainite was ineffective, but gypsum diminished the loss of nitrogen. The addition of 0·25% of formalin to fresh cow's urine inhibited the fermentation of the urea, whilst the addition of 6% and upwards to the stable runnings reduced the loss of nitrogen to 1·7% after 62 days. Small quantities of zinc chloride and copper sulphate checked the fermentation of the urea, but other salts, including sodium chloride, sodium sulphite, and sodium tetrathionate, were useless, even in the proportion of 10—12·5%.

—C. A. M.

Oxidising enzymes. Onslow. *See* XVIII.

PATENT.

Fertilisers; Production of —. E. C. R. Marks, London. From Soc. Anon. Ital. Gio. Ansaldo & Co., Genoa, Italy. Eng. Pat. 125,718, 16.4.18. (Appl. 6445/18.)

See U.S. Pat. 1,282,385 of 1918; this J., 1919, 48A.

XVII.—SUGARS; STARCHES; GUMS.

Granulated white beet sugar and plantation white cane sugar. H. C. Prinsen Geerligs. Int. Sugar J., 1919, **21**, 227—231.

Unrefined plantation white cane sugar contains reducing sugars or "glucose," gummy substances, and insoluble matter, from which unrefined washed beet sugar is free, or practically so. Although the small amount of "glucose" that is present in plantation white sugar is without effect in the manufacture of jam, condensed milk, mineral waters, etc., its presence appears to be detrimental in the preparation of certain kinds of confectionery, causing the product to become soft and sticky after a short time. Gummy substances and insoluble matter are objectionable impurities in sugars used by jam and preserve manufacturers, who demand a product giving a brilliant solution, the colour of which within limits may not be of importance. In the ordinary method of clarification followed in cane sugar factories, in which the juice is treated with lime, heated, and allowed to subside, the supernatant liquid passing to the evaporators contains a greater or less amount of gummy, silicious, and fibrous matters, which ultimately during graining are held between the lamellæ of the crystals, and cannot be removed by washing in the centrifugals. On the other hand, in the carbonatation process of clarification, the voluminous precipitate produced occludes the gummy substances and insoluble matter, leaving a juice that can be filtered through cloth, and yields a sugar which does not differ in composition from granulated beet sugar except for the small amount of "glucose" that remains. Plantation white sugar containing gummy substances and insoluble matter may be submitted to a partial refining process to adapt it for use by jam, chocolate, and biscuit manufacturers by treatment with decolorising carbon and filtration.—J. P. O.

Beet sugars; Insoluble matter in standard white granulated ——. C. G. Leonis. Sugar, 1918, **20**, 357. Int. Sugar J., 1919, **21**, 249—250.

Beet sugar factories in the United States produce a granulated white sugar which is sold for direct consumption without refining. Occasionally on dissolving this product in water a white turbidity is produced. This may be due to lack of care during sulphitation, calcium bisulphite passing into the filtered syrups, and being subsequently decomposed to calcium sulphite during boiling in the pan or drying in the granulator. Again, if the sulphited syrups are insufficiently heated amorphous calcium sulphite is formed, and passes through the filter-cloths. It may sometimes happen that such white beet sugars show a slight turbidity when recently made, but less after storage for 90 days or more. This is explained by the presence in the sugar of free sulphurous acid, which slowly transforms the calcium sulphite into the acid salt; on boiling solutions of such products a white precipitate may be formed, whereas the liquor previously was comparatively clear. The phenomenon may also be due to the oxidation of calcium sulphite into calcium sulphate.—J. P. O.

Sugar products; Measuring the colour of ——, particularly liquors treated with decolorising carbon. F. W. Zerban. Louisiana Planter, 1918, **61**, 282—283. Int. Sugar J., 1919, **21**, 250—251.

Treatment of sugar liquors by decolorising carbon removes different colouring matter in different proportions. Thus, in the case of a particular sugar product it was found that the decolorising carbon "Norit" removed 82·5% of green, 80·0% of red, 78·5% of yellow, and 80% of the total colouring matters originally present; whereas "carbon 15" prepared by the author removed practically all the green, 90% of the red, 96% of yellow, and 97% of the total colouring matters.—J. P. O.

"Carbrox," the decolorising carbon prepared from rice hulls [; its use in refining sugar]. H. M. Shilstone. Louisiana Planter, 1917, **58**, 364—365. Int. Sugar J., 1919, **21**, 249.

With the object of producing white sugar directly from cane juice, experiments have been made in Louisiana both with "norit" and the rice hull

decolorising carbon known as "carbrox" (this J., 1918, 599 A). It is claimed that 1 lb. of "carbrox" will decolorise a liquor containing 100 lb. of washed sugar, eliminating the "tannins" (this J., 1918, 778 A; 1919, 192 A), and ultimately producing a sugar of good keeping quality. The efficiency of "carbrox" is stated to increase the more frequently it is used, owing to the fact that revivification by treatment with sodium hydroxide dissolves out a further portion of the silicious skeleton, exposing a further area for decolorising purposes. It is not necessary to use "carbrox" in acid solution, as in the case of most of the vegetable carbons, so that clarified filtered juice may be treated directly.—J. P. O.

Bagasse furnace design and control [in the cane sugar factory]. A. Gartley. Int. Sugar J., 1919, **21**, 232—236.

In burning bagasse as fuel in the cane sugar factory, an effort should be made during milling to produce a material having as low a water content as possible; at present 35% would appear to be the lowest attainable limit. The furnace should be so designed that the water in the fuel can be evaporated at least partially before reaching the grate upon which it is burned, while care should be taken to distribute the bagasse evenly over the grate in order to avoid the formation of air holes. There is a limit to the size of grate which can be operated efficiently and uniformly covered, and also apparently to the amount of air which can be admitted through the grate without blowing the fine bagasse off the bars, thus destroying the fuel bed. Not more than 50% of air in excess of what is required for complete combustion should be employed.—J. P. O.

Starch; Composition of — . Precipitation by colloidal iron and by iodine and electrolytes. J. Mellanby. Biochem. J., 1919, **13**, 28—36.

Amylogranulose may be divided into three fractions, amylogranulose α, β, and γ, according to their behaviour with colloidal iron. Starch in solution is negatively charged. Starch reacts chemically with iodine, but the starch iodide formed may carry down further amounts of iodine in the adsorbed condition. (See further J. Chem. Soc., June, 1919).—J. C. D.

PATENTS.

Bagasse; Apparatus for macerating —. W. S. Herriot, Glasgow. From N. Deerr, Brooklyn, N.Y., U.S.A. Eng. Pat. 126,093, 27.2.18. (Appl. 3471/18.)

The apparatus consists essentially of two sets of drums, an upper pair in which a stationary unperforated drum with a longitudinal opening is encased by a rotary perforated drum, and a lower pair in which a rotary perforated drum is encased in a stationary unperforated drum with a longitudinal opening. In each set the only communication through the pair of drums is through the perforations which are brought opposite to the longitudinal openings as the rotary drum revolves. Bagasse from the mill rollers is supplied to the drums, driven in opposite directions, and is brought into contact with water or dilute sugar cane juice under pressure, and then delivered on to a blanket which carries it to the next rollers. A series of such sets of drums is operated on the counter-current system, the strongest juice being supplied to the first set and water to the last set.—S. S. A.

Adhesive [from starch] and process for making the same. J. B. B. Stryker, Lansdale, Pa., Assignor to Perkins Glue Co. U.S. Pat. 1,299,809, 8.4.19. Appl., 18.7.17.

Root starch having a viscosity of less than 150 at 20 to 1 and over 18 at 9 to 1, is mixed in excess with a degenerated starch having a viscosity of less than 80 and above 18 at 9 to 1, and with a quantity of water equal to 3 to 6 times the total weight of starch. The mixture is treated with caustic alkali to form a homogeneous colloidal adhesive which can be spread by the machinery ordinarily used for glue and will flow through pipes of 2 in. diameter.—S. S. A.

Extracting sugar etc. Eng. Pat. 126,262. *See* XII.

XVIII.—FERMENTATION INDUSTRIES.

Formaldehyde; Supposed diastatic properties of — . H. Sallinger. Ber., 1919, **52**, 651—656. (Compare Woker, this J., 1916, 1268.)

The author considers that the only valid methods of examining the supposed diastatic properties of formaldehyde towards starch consist in observations of the optical activity of the starch solutions and of their reducing power towards Fehling's solution. With regard to the first point, a solution of amylodextrin (Lintner) was found to retain its optical activity unchanged after digestion with formaldehyde during 14 hours at 37° C. With regard to the second point, a solution of soluble starch (Wolff-Fernbach), after treatment with formaldehyde and removal of the latter as completely as possible, only showed slight reducing power towards Fehling's solution, attributable to traces of residual formaldehyde. Further, in a comparative series of experiments in which formaldehyde solutions of differing concentration were mixed with starch solution and water respectively and subsequently treated with Fehling's solution, a greater reduction was not found in any instance in the solutions containing starch than in those from which it was absent. The author therefore considers formaldehyde to be enzymatically indifferent to starch.—H. W.

Mineral [ammonium] salts; Use of — in brewing. C. Schweizer. Schweiz. Chem.-Zeit., 1919, **1**, 5—7.

The use of light worts in the brewing of beer tends to cause flocculation of part of the yeast before the fermentation is complete, with the result that subsequent fermentations with this immature yeast are still more unsatisfactory. In experiments to determine whether ammonium salts could replace the deficiency of nutriment in light worts comparative fermentations were carried out with 2 litres of wort (8% extract) to which quantities of 0·1 to 0·4 grm. of an ammonium salt and 10 c.c. of yeast were added. After 8 days the wort to which the salt had not been added had attenuated to 2·93% extract and had a head of 32 c.c. of yeast, whilst that containing 0·3 grm. of ammonium salt had attenuated to 3·3% extract and had a head of 43 c.c. In similar experiments with 0·4 grm. of ammonium salt the extract was 3·4% and the head of yeast 30 c.c., as compared with an extract of 4% and 22 c.c. of yeast in the blank test. The amount of ammonium salt added must not exceed 0·1 grm. to 2 litres to prevent a slight saline taste in the beer, but an experiment cited in which that proportion of the salt was used showed no appreciable difference in the degree of attenuation or the development of the yeast with or without the addition.—C. A. M.

Yeast; Utilisation of — . K. Schweizer. Schweiz. Chem.-Zeit., 1919, **1**, 33—36, 69—72.

In breweries about 5 kilos. of waste yeast (about 1½ kilos. of dry yeast) is obtained by the use of 100 kilos. of malt, whilst in the nutrient yeast factories 60 kilos. of dried yeast is obtained by the use of 100 kilos. of sugar. If the yeast is not to be

used at once it is necessary to reduce its water content to 10 to 20%. For this purpose the pressed yeast (containing about 70% of water) is mixed with water to a thin paste, in which is made to rotate a hollow drum with internal steam heating. The layer of yeast withdrawn at each revolution is dried on the surface and removed by means of a scraper, and is finally ground to a fine powder. In the case of beer yeast a preliminary treatment with dilute alkali is necessary to remove the bitterness due to the hops. Dried yeast prepared in this way contains about 53% of albumin, 3% of fat and 27% of carbohydrates, and has a nutrient value of about 3500 cals. per kilo. For the preparation of a nutrient meal fermenting yeast is treated with 2% of an organic solvent (such as ether, benzene, or glycerin) or of salts (sodium chloride or carbonate) and, when liquefied, it is heated to 70°—80° C., mixed with starch or flour and, after hydrolysis of the starch, the mixture is converted into a powder. An aromatic yeast condiment is made by roasting pressed yeast at about 60° C. until the water is reduced to about 30%, and then closing the air-regulators of the apparatus and completing the roasting at 100° C. A fluid condiment is obtained by mixing pressed yeast with about 10% of sodium chloride and leaving the mass for some hours in a cool cellar and then for 3 hours at 50° C., after which it is boiled with water and pressed, and the liquid concentrated and filtered. Lindner's process of obtaining fat by cultivating *Endomyces vernalis* on a nutrient medium of dilute molasses and mineral salts yielded a yellow oil-cake containing about 18% of fat, 31% of proteins, and 43% of carbohydrates. The oil was suitable for food and yielded a hard soap. Yeast preparations are extensively used for the medicinal treatment of digestive troubles, and in diseases of the skin, eyes, etc. As the vitamines are not destroyed by a short heating at 100° C., the yeast, after being killed, is used as a remedy for beri-beri, rickets, etc. Plastic masses are made by treating waste yeast with formaldehyde, and drying and grinding the mixture, with or without the addition of tar, tar oils, sulphur, pigments, etc. It is then compressed in moulds at 90° C. or above, and under a pressure of at least 200 atmos. The product which is termed "ernolith" can be used as a substitute for bakelite, celluloid, etc.—C. A. M.

Enzymes; Oxidising . Nature of the "peroxide" naturally associated with certain direct oxidising systems in plants. M. W. Onslow. Biochem. J., 1919, **13**, 1–9.

THE direct oxidase system in the pear fruit or potato tuber is due to the presence of a peroxidase (which gives a blue colour with guaiacum only on the addition of a peroxide) and an aromatic substance giving the characteristic reactions of the catechol grouping. On injury of the tissues, the peroxidase activates the oxidation of the aromatic substance with the formation of a peroxide. The peroxide-peroxidase system so formed is then able to produce the blue colour with guaiacum. (See further J. Chem. Soc., July, 1919.) J. C. D.

Alcohol-water mixtures; Determination of the freezing point curves and densities of denatured —. C. E. Davis and M. T. Harvey. J. Ind. Eng. Chem., 1919, **11**, 443—448.

THE freezing points of denatured alcohol-water mixtures were determined by measuring the electrical resistance and observing, by a series of readings at slowly increasing temperatures, the break in the curve which indicates the change from the solid to the liquid phase. The denatured alcohol consisted of ethyl alcohol, 100, methyl alcohol, 10, benzoline, 0·5 vols. The following freezing points are selected from those recorded for various mixtures containing different proportions of the denatured alcohol: 5%, −2·8°; 10%, −4·0°; 15%, −6°; 20%, −8·5°; 25%, −11·5°; 30%, −14·8°; 40%, −22·1°; 50%, −31·1°; 60%, −38·9°; 70%, −43·6°; 80%, −53·7°; 90%, −73·7° C. The sp. gr. of these mixtures is also given.—W. P. S.

Yoghurt. O. Laxa. Ber. Lactol. Anstalt K.K. Böhm. Techn. Hochschule in Prag, 1918. Chem. Zentr., 1919, **90**, II., 432—433.

A PURE culture from native Bulgarian "Maya" has been cultivated for three years without renewal. It produces an excellent yoghurt and thickens milk in 2—2½ hours. The best results are obtained by using milk sterilised while quite fresh, otherwise decomposition products are formed which soon cause a weakening of the culture. The length of life of the culture depends upon the prevailing temperature and upon the proportions of the different micro-organisms. The observation of Pavlâk, that the presence of Saccharomyces (Torulæ) lengthens the life of the culture has been confirmed, although their presence is not necessary for the production of good yoghurt, and moreover they impart an unpleasant yeasty flavour. The following defects are noted: Weakening of the acid-forming power of the culture as a result of cultivation at higher temperatures; decrease in congulating power as a result of over-acidification; separation of whey; over-acidification; bitter flavour; yeasty flavour; separation of flocculent precipitate; formation of gas.—L. A. C.

Yeast in tan liquors. Asal. *See* XV.

Action of cold on micro-organisms. Ruata. *See* XIXB.

Bac. coli. Wyeth. *See* XIXB.

PATENT.

Pressed yeast; Continuous process of obtaining vigorous —. A. Wohl and S. Scherdel, Danzig-Langfuhr. Ger. Pat. 310,580, 16.1.15.

BY replacing about 10 to 15% of the organic nitrogen in the culture medium by ammoniacal nitrogen, yeast may be cultivated for several successive generations without any material depreciation in its reproductive or fermentative powers. This is not possible by the use of ammonium salts as the only source of nitrogen. If the proportion of ammonium salts used be added in two or more fractions the resulting yeast can be pressed more readily.—C. A. M.

XIXA.—FOODS.

Milk; Electrical conductivity of —. J. H. Coste and E. T. Shelbourn. Analyst, 1919, **44**, 158—164.

THE temperature coefficient of the electrical conductivity of milk in the region of 15° C. is 0·000093, or about 2·3% of the total conductivity; this agrees fairly with the normal value of 0·026K for neutral salts. The conductivity of presumed genuine milks may vary from K_{15}=0·0035 to 0·0047, but is usually between 0·0040 and 0·0042. It increases, up to a certain point, with increase of acidity, but, owing to the lessened dissociation of the acids formed as their concentration increases, it reaches an almost constant value, whilst the amount of acid is increasing. There is no correlation between conductivity and total solids or total ash, but there is a marked correlation between the

conductivity and chlorine content of milk. The specific conductivity of a mixture of milk and water decreases with increasing dilution, but the specific conductivity of the milk in the solution increases considerably as the dilution becomes greater, probably owing to dissociation of phosphates and citrates. The electrical conductivity of milk is not sufficiently well defined to make the determination generally useful for the detection of added water in milk.—W. P. S.

Citric acid in milk; Determination of ——. R. Kunz. Arch. Chem. u. Mikroskop., 1915, [4]. Chem. Zentr., 1919, **90**, II., 279—280.

THE following method is based upon the results previously described (this J., 1915, 974): Fifty c.c. of the milk is shaken with 10 c.c. of sulphuric acid (1 : 1), and after the addition of 2 c.c. of 40% potassium bromide solution and 20 c.c. of phosphotungstic acid solution (120 grms. sodium phosphate and 200 grms. of sodium tungstate dissolved in 1 litre of water and treated with 100 c.c. of sulphuric acid [1 : 3]), the liquid is made up to 200 c.c. and filtered. 150 c.c. of the filtrate is heated for 5 mins. to 48° to 50° C., with 25 c.c. of freshly saturated bromine water, and then treated slowly with 10 c.c. of 5% potassium permanganate solution, and the remainder of the determination effected as previously described (*loc. cit.*). In calculating the amount of pentabromo-acetone into citric acid it is necessary to allow 3·7 c.c. for the volume of the precipitate. The weight of pentabromo-acetone multiplied by 1·215 gives the amount of citric acid + 1 mol. H_2O in 100 c.c. of the milk. The amounts present in milk from the same cow rose from 0·1980 grm. to 0·1992 grm. and then fell to 0·1806 grm. per 100 c.c. during the course of milking. On standing, and especially when it becomes sour, milk shows a pronounced decrease in its citric acid content (*e.g.* from 0·1707 grm. to 0·1206 grm. per 100 c.c. in 24 hours, and to 0 in 48 hours). This decrease is due to bacterial action and may be practically inhibited by adding 1 c.c. of toluene to the milk.
—C. A. M

Butter; Relation between the Kirschner, Reichert Meissl, and Polenske values of ——. H. D. Richmond. Analyst, 1919, **44**, 166—167.

BOLTON and Revis (this J., 1912, 553) and Cranfield (*ibid.*, 1915, 1109) have shown that there is a relation between the Kirschner value (*K*) and the Polenske value (*P*) of butter. The author finds that the formula $P = 0·26\ (K - 14)$ gives results agreeing with the mean figures; coconut oil is certainly present if the Polenske value is greater than $0·26\ (K - 10)$. From the results of over 100 experiments it is found that the relation between the Reichert-Meissl value (*R*) and the Polenske value (*P*) may be expressed approximately by the formula $R \times 0·033 - 0·6155 = \log. 10(P - 0·48)$.—W. P. S.

Casein. L. A. Maynard. J. Phys. Chem., 1919, **23**, 145—153.

DIGESTION of casein at 25° C. with 1% sodium hydroxide converts the whole of the phosphorus and sulphur into a soluble inorganic form. The addition of acids to the product precipitates a white substance which in many of its properties is very like casein, but in some, especially its solubility in different reagents, is quite different. The white colour of milk is shown to be due in all probability to the peptisation of calcium phosphate by the colloids present in the milk. (See also J. Chem. Soc., July, 1919.)—J. F. S.

Cacao products; Detection of excess of shell in ——. K. Hoepner. Z. Unters. Nahr. Genussm., 1919, **37**, 18—31.

IF the crude fibre content exceeds 6·0%, the iron oxide 0·1%, and the acid-insoluble ash 0·5%, all calculated on the dry, fat-free, and sugar-free substance, the cacao product under examination contains an excess of shell. For example, if a sample contains 10·1% of crude fibre, the difference between this and 6% is multiplied by 10 to obtain the actual excess of shell present; in this case it will be 41%. A microscopical examination will often indicate the presence of an unusual amount of shell.—W. P. S.

"Brick tea," tea tablets, tea extracts, etc. Utz. Ber. deuts. Pharm. Ges., 1919, **29**, 5—24.

ANALYSES are given of brick tea, tea tablets, tea extracts, mate tablets, etc. Brick tea is prepared by compressing tea offal (broken leaves, stalks, etc.) and its composition does not differ greatly from that of ordinary tea. A sample of a dry tea extract examined contained: Moisture, 7·25; ash, 9·45; caffeine, 6·67; tannin, 28·86%. Other samples contained added sugar and milk. W. P. S.

Antiscorbutic factor; Rôle of —— *in nutrition.* J. C. Drummond. Biochem. J., 1919, **13**, 77—80.

AN adequate supply of the antiscorbutic vitamine is necessary for the growth and well-being of the higher animals. J. C. D.

Vitamine; Fat-soluble ——, *its nature and properties.* J. C. Drummond. Biochem. J., 1919, **13**, 81—91.

THE vitamine present in certain oils and fats, as for example butter and whale oil, is relatively thermolabile. It may be destroyed by prolonged exposure to temperatures as low as 37° C. Destruction is rapid at 100° C., and does not appear to be due to oxidation or hydrolysis. The vitamine could not be separated in a pure state, and it has not been identified with any known constituent of the oils examined. (See further, J. Chem. Soc., July, 1919.)
—J. C. D.

Vitamine; Rôle of the fat-soluble —— *in nutrition and its influence on fat metabolism.* J. C. Drummond. Biochem. J., 1919, **13**, 95—102.

THIS vitamine is necessary for the adult as well as for the growing child. No direct relationship of the necessary factor to fat metabolism could be traced. (See further, J. Chem. Soc., July, 1919.)
—J. C. D.

Straw; Value of digested —— *as a fodder.* F. Hansen. Biedermann's Zentr., 1919, **48**, 110—117.

THE author gives his experience with an experimental plant for treating straw by the Colsman process of digestion with sodium hydroxide. Analyses of the straw before and after treatment are given. The washing may be responsible for a considerable loss of certain food components. Apparently the value of the process lies chiefly in the higher starch value which the final product possesses. The prepared straw was well absorbed by cows, and milk production was satisfactory. It may be of the greatest service in feeding horses, but its value for pigs is hypothetical.—J. C. D.

Straw digested with hydrochloric acid; Food value of ——. F. Hansen. Biedermann's Zentr., 1919, **48**, 118—121.

ANALYSES of the treated straw and estimations of the food components present are given. Feeding tests

with cows indicate that the nutritive value of straw prepared by the hydrochloric acid process is not as high as that of good chaff. The process is not as valuable as the Colsman process of digestion with sodium hydroxide (See preceding abstract.)
—J. C. D.

Prune kernels. Fordyce and Torrance. *See* XII.

Fatty residues from Gerber process. Reiss. *See* XII.

White beet and cane sugars. Prinsen Geerligs. *See* XVII.

Utilisation of yeast. Schweizer. *See* XVIII.

Yoghurt. Laxa. *See* XVIII.

Action of cold on micro-organisms. Ruata. *See* XIXB.

PATENTS

Milk food products and methods of making same. C. S. Stevens, Sheboygan, and C. A. Baumann, Jefferson, Wis., U.S.A. Eng. Pat. 125,172, 3.8.17. (Appl. 11,263/17.)

SKIMMED milk at 60° C. is mixed with coconut oil at 32° C. by the aid of superheated steam introduced by jets into the body of the mixture. When the temperature of the mixture has been raised to 100° C., emulsification is complete. The emulsion is evaporated to the consistence of cream in vacuum pans with agitation, passed through a homogeniser, and rapidly cooled to 4° C. It is then filled into tins and sterilised for an hour at 100°–126° C. Immediately after the conclusion of the sterilising process, the tins are placed in a mechanical shaker for 5 mins. to prevent the formation of a jelly.
—J. H. J.

Artificial milk; Manufacture of —. K. Ersley, Nijmegen, Holland. U.S. Pat. 1,297,668, 18.3.19. Appl., 3.1.19.

COMMINUTED vegetable matter containing protein, fat, sugar, and lecithin is extracted with a fat-solvent to remove all fat, and also with a solvent for lecithin and sugar, *e.g.*, alcohol. The residue is extracted with an alkali to dissolve protein. The alcoholic extract is purified to remove bitter principles, and the residue containing lecithin and sugars added to the foregoing alkaline solution. The fatty material is purified to remove disagreeable flavours, and the whole or part of it added to the mixture of alkaline solution and alcoholic extract.—J. H. J.

Pectous substances; Production of —. B. T. P. Barker, Long Ashton, Somerset. Eng. Pat. 125,330, 14.11.18. (Appl. 18,668/18.)

VEGETABLE tissues containing pectous substances, *e.g.*, apple residues from cider manufacture, are disintegrated and washed with water to remove acids. The pulp is then treated with steam at 60 lb. pressure in order to render the pectous substances soluble; these are then extracted with water and the extract concentrated if necessary. The extract may be stored under sterile conditions, or sugar may be added as a preservative without causing the extract to set. The use of the extract in the preparation of jam from fruits which are poor in pectous substances leads to the formation of a good jelly. (See also this J., 1918, 243 T.)—J. H. J.

Lupin seeds; Removal of the bitter and poisonous constituents of —. L. Surason, Charlottenburg. Ger. Pat. 299,686, 7.5.15.

THE bitter and poisonous constituents of lupin seeds are removed by soaking the seeds, in the pods if desired, in a stream of acidified water through which an electric current is passed. The food value of the seeds is also increased by this treatment.
—L. A. C.

Dehydrating; Apparatus for —. *Process of and apparatus for preparing potatoes for dehydration.* M. F. Mangelsdorff, Union Hill, N.J., Assignor to H. Bentz, Montclair, N.J. U.S. Pats. 1,299,492 and 1,299,493, 8.4.19. Appl., 15.11 and 14.12.17.

SEE Eng. Pats. 120,501 and 121,405 of 1918; this J., 1919, 2 A, 89 A.

XIXB.—WATER PURIFICATION; SANITATION.

Ammonia; Test for albuminoid —. E. A. Cooper and J. A. Heward. Biochem. J., 1919, **13**, 25–27.

HIGH values for albuminoid ammonia in samples of water of high standard cast suspicion upon the purity of the reagents employed. Potassium permanganate may contain a nitrogenous impurity which cannot as a rule be removed by boiling with alkali. The impurity appears to be slowly decomposed with the evolution of ammonia when the permanganate-alkali reagent is boiled in the diluted condition, but it is practically impossible to purify the reagent by this method. The error introduced may be very serious and sufficiently great to vitiate the value of the test altogether. The presence of this oxidisable impurity may be one explanation of the observed decomposition of about 5% of the permanganate in the control distilled water test carried out in the determination of the oxygen absorbed in 4 hours at 27° C. The importance of testing the reagents is emphasised.—J. C. D.

Bacillus coli; Effects of acids, alkalis, and sugars on growth and indole formation of —. F. J. S. Wyeth. Biochem. J., 1919, **13**, 10–24. (See also this J., 1919, 197 A.)

DETAILS are given of the influence of the initial reaction of the medium upon the growth and activities of *B. coli*. The approximate limits of initial reaction are P_H 1·27–9·87. The final reaction is dependent upon the initial reaction and composition of the medium. Fermentation in a glucose-peptone medium results in formation of acid and the proteolytic activities of the organism are inhibited. In a peptone medium the proteolytic action results in the formation of acids and ammonia. Indole formation is inhibited by the presence of free acid or alkali and certain sugars. (See further, J. Chem. Soc., July, 1919.)—J. C. D.

Micro-organisms; Action of cold on —. G. Q. Ruata. Riv. del Freddo, 1913, **4**, 120–126. Bull. Agric. Intell., 1919, **10**, 116–117.

FACTS observed in the application of artificial cold in the cold-storage industry are opposed to the commonly accepted theory that the micro-organisms which attack food materials are not destroyed when subjected to low temperatures, although their development is suspended. Experiments were therefore made in which the influence of refrigerating temperatures (+3° to −12° C.) upon the organisms was studied in a dry environment. The growth of *B. coli* was retarded, and the action of the cold was progressively germicidal, the culture showing signs of destruction in 4 to 6 days, and

being completely destroyed in 115 to 120 days. *B. pyocyaneus* was also progressively destroyed, but the formation of pigment was unaffected so long as traces of vitality remained. The power of this organism to liquefy gelatin was inhibited by prolonged cold, whilst this property of *Staphylococcus pyogenes aureus* was progressively delayed, but not destroyed, as was also the case with its hæmolytic capacity. The liquefying power of *B. proteus vulgaris* was destroyed by cold, but no modification was observed in the course of six months' exposure in the power of this organism and that of *B. bulgaricus* to coagulate milk. The amylolytic power of *B. clavatus*, Bilfi, was completely destroyed by the prolonged action of cold, and the spores of this organism, which are among the most resistant known, were gradually destroyed. The cholera vibrio offered but little resistance to cold, but its agglutinating power was not affected while it remained alive. Analogous results were obtained in experiments on the vitality of organisms isolated from putrefying meat, including *B. fluorescens non liquefaciens*, *B. coliformis*, a liquefying *Streptococcus* which coagulated milk, *B. prodigiosus*, and *B. proteus vulgaris*.—C. A. M

Filter for smokes and bacteria; Portable electrical ——. A. B. Lamb, G. L. Wendt, and R. E. Wilson. Amer. Electro-Chem. Soc., Apr., 1919. (Advance copy.) 9 pages.

An apparatus in which very finely divided particles in suspension in air, such as occur in smoke attacks in war, could be removed by means of an electric discharge was constructed of four glass tubes, 1·5 cm. in diameter and 12 cm. long, each wrapped in a strip of copper gauze. Down the centre of each tube was passed a spiral of fine copper gauze cut from a piece of copper wire cloth and including only two long strands with the cross strands cut short. The ends of the long strands of the spiral were insulated from the outer wire gauze. Current was supplied from an induction coil worked from a small lead storage battery furnishing ½ ampère at 6 volts. The apparatus was tested by passing air containing fumes of ammonium chloride through it at the rate of 5 litres per min., when all the ammonium chloride was removed. Air charged with bacteria had all the bacteria removed and also killed by the apparatus.—J. H. J.

Gas-mask absorbents. A. B. Lamb, R. E. Wilson, and N. K. Chaney. J. Ind. Eng. Chem., 1919, **11**, 429—438.

The absorbent used in the British and American gas-mask canisters consisted of a mixture of charcoal and soda-lime. That in the American canisters consisted of coconut shell charcoal (6- to 14-mesh), 60, and soda-lime-permanganate granules (8- to 14-mesh), 40%. Another mixture, claimed to be better, consisted of specially impregnated coconut charcoal, 75, and soda-lime, 25%. The authors describe the properties required in a charcoal intended to be used for the purpose and methods for its preparation. Investigation showed that a mixture containing sodium hydroxide, 4, kieselguhr, 4, moisture, 12% and the remainder lime, would be a hard and efficient absorber for practically all industrial gases.—W. P. S.

Formaldehyde; Disinfection with ——. *Practical efficiency of some substitutes for the permanganate-formalin method.* M. A. Pozen and L. V. Dieter. J. Ind. Eng. Chem., 1919, **11**, 448—451.

The chlorinated lime-formalin method (see this J., 1918, 191A) was found to be the most practical method for the routine disinfection of rooms. The comparison was made with the sodium chlorate-formalin, lime-sulphuric acid-formalin, and permanganate-formalin methods.—W. P. S.

Volatile substances; Comparative toxic action of certain —— *on different insects.* G. Bertrand and M. Rosenblatt. Comptes rend., 1919, **168**, 911—913.

Using the method previously described (this J., 1919, 336A) the authors have examined the toxic effect of a number of substances coming under the heading of anæsthetics, lachrymators, and lachrymators and suffocants, respectively. The substances examined may be arranged in ascending order of toxicity as follows:—ether, chloroform, carbon bisulphide, carbon tetrachloride, benzyl bromide, monochloroacetone, hydrocyanic acid, and chloropicrin. There is no marked difference for a given substance in its toxicity towards different species of insects.—W. G.

Treatment of anthrax Gegenbauer. *See* XV.

Opacimeter Lambert and others. *See* XXIII.

PATENTS.

Centrifugal separators [for purification of water]. R. A. Sturgeon, Portsmouth. Eng. Pat. 125,502, 16.4.18. (Appl. 6408/18.)

A drum in the form of a truncated cone is mounted on a rotary vertical spindle, the bottom of the drum being closed by a plate mounted on the spindle. Inside the drum a tube mounted on the spindle carries a series of horizontal flexible discs, alternate discs not reaching to the sides of the drum and intermediate ones having apertures near the tube. Water to be treated enters at the top of the drum, passes between the discs, and escapes at the bottom. A solution of a coagulant is introduced through the tube, which has openings opposite the spaces between the discs. For cleaning purposes the machine is stopped, the bottom of the drum and the discs are lowered slightly, so that a clear space is left down the sides of the drum, and a flush of water is passed through.—J. H. J.

Ozonising substances; Process of ——. A. J. Molsant, New York, Assignor to General Research Laboratories. U.S. Pat. 1,297,716, 18.3.19. Appl., 4.8.16. Renewed 7.6.18.

Liquid to be ozonised is introduced in a finely divided state into a stream of gas under pressure, containing ozone, and the mixture thus formed is forced through an apparatus, so as to break it up into finely divided particles. The mixture is allowed to expand into a closed chamber to a pressure greater than atmospheric, then mixed with a further quantity of gas containing ozone, and finally expanded to atmospheric pressure.—B. N.

Water; Heating of boiler feed —— *[on steamships] and its treatment [de-aeration] with a view to preventing corrosion in the boilers.* G. and J. Weir, Ltd., and W. Weir, Glasgow. Eng. Pat. 126,014. 24.10.16. (Appl. 15,084/16.)

Waste liquors. Ger. Pat. 309,406. *See* V.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Morphine; Diazo-reaction of ——. L. Lautenschläger. Arch. Pharm., 1919, **257**, 13—18.

MORPHINE and its salts couple with diazonium compounds in alkaline solution to yield dyes, the most suitable reagent being diazobenzenesulphonic acid. For qualitative work, an approximately 2% aqueous solution of the latter is added to the solution of the morphine salt, which is then made alkaline with sodium carbonate or bicarbonate; a deep-red to pale-red coloration, according to the concentration of the alkaloid, is immediately developed which becomes orange after acidification with dilute acid. The limit of sensitiveness for the alkaline solution is less than 1 in 10,000. The dye has little affinity for fibres in an acid bath. Morphine is the only member of the opium alkaloids which yields a true dye with diazonium compounds; its synthetic derivatives (dionin, heroin, peronin) do not give the reaction whilst, of the commoner pharmacological alkaloids only a few (emetine, sparteine, physostigmine, piperidine, coniine, nicotine) give dyes. The reaction can be used for the toxicological detection of morphine in the presence of its substitutes and of other alkaloids. For quantitative purposes, a definite volume of the morphine solution is treated with 1 c.c. of a freshly prepared solution of diazobenzenesulphonic acid (3 grms.) in water (100 c.c.) and 10 c.c. of concentrated sodium carbonate solution; the intensity of the coloration is compared with that given by morphine solutions of known alkaloidal content. The most suitable concentration of morphine is 0·5—0·05 mgrm. per c.c. The results are not affected by the presence of other opium alkaloids. The method can also be applied to the estimation of the morphine content of ripe poppy heads and the results agree well with those determined by the iodic acid process. (See also J. Chem. Soc., July, 1919.) H. W.

Morphine and cocaine; Resistance of —— *to putrefaction.* L. P. J. Palet. Anal. Soc. Quím. Argentina, 1919, **7**, 22—26.

Two cases are described in which the presence of morphine in the viscera was demonstrated seven months and two years and six months respectively after death. In the former case cocaine or its decomposition products were also detected. As a test for the presence of morphine the following procedure is recommended: 100—120 grms. of the visceral pulp is warmed at 50°—60° C. with 100 c.c. of water and 5 c.c. of sulphuric acid (1 : 4) for two hours. The liquid assumes a blood-red colour which is especially marked on filter paper.

—W. S. M.

Digitalis purpurea. G. P. Koch and J. R. Butler. Amer. J. Pharm., 1919, **91**, 211—221.

THE variation in the viability of digitalis seeds, which with different samples ranged from 7·5—91% viable, was successfully determined by allowing the seeds to germinate between moistened blotting paper for about 9 days. Inorganic fertilisers applied to a clay loam soil were effective in increasing the yield of digitalis, a fertiliser containing $CaCO_3$, 1000; $Ca(H_2PO_4)_2.2H_2O$ 800, K_2SO_4 400, $NaNO_3$ 600, $MgSO_4$ 100 parts giving the best results. Sodium nitrate seemed to be the most essential single fertiliser for this type of soil, and calcium phosphate in sand. Neither ferrous nor manganese sulphates encouraged a larger growth of digitalis, but 150 lb. of the latter per acre increased the activity of the digitalis by 17%. Digitalis leaves are best either dried at 100° C., or heated at 100° C. for an hour, and then dried at 55°—60° C. The activity is diminished by drying entirely at the lower temperature.—G. F. M.

Hydrastis canadensis; Rhizome of ——. E. Belloni. Boll. Chim. Farm., 1919, **58**, 81—91.

COMMERCIAL samples of *Hydrastis canadensis* contained from 48 to 71·4% of rhizome and from 2·7 to 5·8% of leaves, stalks, etc., whilst the rootlets accompanying the rhizomes varied from 22·5 to 52%. The moisture ranged from 10 to 14·87%, and did not differ materially in the rhizomes and the rootlets, whilst the ash varied from 3·78 to 6·03% in the rhizomes and from 7·31 to 10·5% in the rootlets. The amount of hydrastine in the commercial drug varied from 2·97 to 3·45%, the rhizomes containing 3·55 to 3·93% and the rootlets 2·30 to 2·96%. The method of Dieh gans (this J., 1914, 1025) was found the most suitable for determination of the hydrastine. The rhizomes contained from 2·45 to 3·35% of berberine determined by Gordin's method (this J., 1902, 142).—C. A. M.

Linamarin and glycollonitrilecelloside; Syntheses of ——. E. Fischer and G. Anger. Ber., 1919, **52**, 854—868.

THE synthesis of linamarin has been effected on lines similar to those followed by Fischer and Bergmann (this J., 1917, 1288) in the syntheses of mandelonitrileglucoside and sambunigrin. Ethyl tetra-acetylglucosido-α-hydroxyisobutyrate is prepared from acetobromoglucose, ethyl α hydroxyisobutyrate, and dry silver oxide and is converted successively into glucosido-α-hydroxyisobutyramide, tetra-acetylglucosido-α-hydroxyisobutyramide, and tetra-acetyllinamarin; the latter, when de-acetylated, yields linamarin, $C_6H_{11}O_5.O.C(CH_3)_2.CN$, colourless needles, m.pt. 142°—143° C. (corr.), $[\alpha]_D^{18}$ = +29·1° in water. Except for the somewhat higher specific rotation, the synthetic glucoside is identical with the natural linamarin isolated by Jorissen and Hairs (Bull. Acad. Belg., 1891, [3], **21**, 529) from flax seed and with phascolunatin obtained by Dunstan and Henry from *Phascolus lunatus* (this J., 1903, 1255). The synthetic, like the natural glucoside, is slowly hydrolysed by emulsin, more rapidly by phascolunatase. It appears to be a β-glucoside. Since amygdalin, the most important member of the cyanogenetic glucosides appears to be the derivative of a disaccharide, the authors have attempted the synthesis of a similar substance in the manner adopted for linamarin. Thus, ethyl hepta-acetylcellosidoglycollate, $(C_2H_3O)_7C_{12}H_{14}O_{3}.O.CH_2.CO_2C_2H_5$, is prepared from acetobromocellose, ethyl glycollate and dry silver oxide and is transformed successively into cellosidoglycollamide, hepta-acetylcellosidoglycollamide, hepta-acetylcellosidoglycollonitrile, and cellosidoglycollonitrile, $CN.CH_2.O.C_{12}H_{21}O_{10}$; the latter could not be obtained in the crystalline state but appears to have been prepared in an almost pure state, since, on re-acetylation, it gave the original hepta-acetyl compound in good yield. It had $[\alpha]_D^{18}$ = −28·74° in water. It was comparatively easily hydrolysed by emulsin yielding hydrocyanic acid and dextrose. (See also J. Chem. Soc., 1919, **1**, 256.)—H. W.

Organic bases; Tungstic and molybdic complexes as precipitants of ——. L. Guglialmelli. Anal. Soc. Quím. Argentina, 1918, **6**, 57—64.

THE reagents were prepared by dissolving the sodium salt of the following acids in dilute hydrochloric acid: tungstic, arseno-, silico-, and phosphotungstic, molybdic, arseno- and phospho-molybdic.

arsenotungstomolybdic, and arsenovanadotungstic. The reactions given by these precipitants with dilute hydrochloric acid solutions of the following organic bases are tabulated: α- and β-naphthylamine, benzidine, antipyrine, pyramidone (dimethylaminoantipyrine), caffeine, pyridine, nicotine, quinoline, cinchonine, cocaine, and auramine. (See also this J., 1919, 55 A.)—W. S. M.

Antitoxin and its associated proteins; Separation of —— from heat-denatured sera. A. Homer. Biochem. J., 1919, **13**, 45—55.

For complete recovery of antitoxin during the concentration of sera, showing a heat-denaturation of 35% or less, by fractional methods employing the use of ammonium sulphate, it is advisable to precipitate the second fraction between 30 and 45% of saturation with the salt. The lower limit of saturation should be raised to 33 or 36% in the precipitation of the second fraction from sera in which a denaturation of 25% or less has been induced. The bulk of the antitoxin is associated with the proteins precipitated between 36 and 45% of saturation with ammonium sulphate. The further fractionation of the protein precipitated between these limits indicated that the percentage of the total antitoxin precipitated between progressively increasing percentages of saturation with ammonium sulphate is directly proportional to the percentage precipitation of protein at the respective stages. For the complete recovery of antitoxin means other than the fractional precipitation of the serum proteins must be employed.
—J. C. D.

Antitoxin; Increased precipitability of pseudoglobulin and associated — from heat-denatured solutions. A. Homer. Biochem. J., 1919, **13**, 56—64.

The increased precipitability of pseudoglobulin from its heat-denatured solutions at concentrations of ammonium sulphate ranging from 26—47% of saturation is a function of the heat-denaturation. The increased precipitation of pseudoglobulin at 30% saturation with ammonium sulphate is accompanied by an increased precipitation of antitoxin. In the concentration of antitoxic sera by the fractional precipitation of the serum with ammonium sulphate, there is no need for a preliminary prolonged heating of the serums. The results now obtained by the isolation of the protein fraction precipitated from heated serum between 30 and 44% of saturation with ammonium sulphate could be obtained from the unheated serum between 36 and 50% of saturation. The heating reduces the toxicity of the cresylic acid-protein complex. In order to isolate antitoxin as a separate entity, means other than the fractional precipitation of pseudoglobulin solutions by salts must be employed. (See preceding abstract.)—J. C. D.

Pinene vapour; Action of finely divided metals on ——. P. Sabatier, A. Mailhe, and G. Gaudion. Comptes rend., 1919, **168**, 926—930.

When pinene vapour is passed over finely divided copper, nickel, cobalt, or iron at 350° C. there is no evolution of gas, but a liquid is obtained, which is less volatile than the original pinene and consists of terpenes isomeric with pinene, and a small amount of polyterpenes. At higher temperatures the action is more complex and there is an evolution of a gas, the amount and composition of which varies with the temperature and the nature of the metallic catalyst used. With copper at 500° C. there is an abundant evolution of a gas, which is a mixture of hydrogen and ethylenic hydrocarbons. If the temperature is raised to 600°—630° C., there is a still more marked evolution of gas, whilst the liquid product consists of a mixture of isoprene, ethylenic and diethylenic hydrocarbons, terpenes, and aromatic hydrocarbons such as toluene, *m*-xylene, cymene, cumene, and methylethylbenzene. In a trial on a commercial scale with several tons of pinene using copper at 550° C. as a catalyst, the yield of aromatic hydrocarbons was about 21% of the pinene employed. With reduced nickel at 600° C. a very energetic decomposition of the pinene occurs, a gas being evolved which is rich in hydrogen. The catalyst quickly becomes covered with a carbonaceous deposit, but very little liquid product is obtained. Iron is about as effective as nickel, whilst the effect of cobalt as a catalyst is intermediate between those of copper and nickel. W. G.

Menthol dissolved in eugenol and phenol; Optical activity and quantitative estimation of ——. O. von Friedrichs. Arch. Pharm., 1919, **257**, 72—78.

Mixtures of menthol, eugenol, and phenol are used as local anæsthetics, particularly in dentistry, and a solution of menthol (40%), phenol (40%), and eugenol (20%) is described in the latest edition of the Swedish Pharmacopœia under the name "tinctura antiodontalgica." For the estimation of the menthol content, the author has determined the specific rotation, at 18° C., of solutions of menthol in phenol (p. 25—50), in eugenol (p. 10—50), and in mixtures of phenol and eugenol (2 : 1, 1 : 1, and 1 : 2), and has derived formulæ by which the menthol content may be directly calculated from the optical activity. H. W.

Alcohols; Isolation and characterisation of —— as allophanates. A. Béhal. Comptes rend., 1919, **168**, 945—947.

The method of preparation of the allophanates consists in passing a current of cyanic acid gas through the alcohol, filtering off the product, washing it with ether and re-crystallising from absolute alcohol, benzene, or acetone. The alcohol is characterised by the m.pt. of its allophanate, which is then saponified and the physical constants of the resulting alcohol determined. The method is applicable to tertiary alcohols. The terpenic alcohols, except linalool, and the cyclic alcohols, except terpinol, give normal allophanates. The presence of a phenolic group in a cyclic alcohol interferes with the reaction, and this group must first be esterified, when the reaction proceeds normally. Alcohols, either cyclic or acyclic, containing an ethinoid linking give normal allophanates.—W. G.

Carbonyl chloride; Estimation of traces of —— in air. A. Kling and R. Schmutz. Comptes rend., 1919, **168**, 891—893.

Using the method previously described (see this J., 1919, 338 A) the carbonyl chloride may be estimated gravimetrically if the weight of diphenylurea exceeds 10 mgrms., by dissolving the precipitate off the filter with alcohol and evaporating the alcoholic extract in a weighed platinum dish at 60° C., the residue being dried at this temperature for two hours. Alternatively a colorimetric method may be employed, by digesting the precipitate and filter paper with sulphuric acid and mercuric sulphate and proceeding as in the ordinary Kjeldahl process, the ammonia passing over in the final distillation being collected in 25 c.c. of *N*/250 hydrochloric acid and estimated by means of Nessler's reagent.—W. G.

***Extractions** [of organic acids] with ether; Systematic ——.* J. Pinnow. Z. Unters. Nahr. Genussm., 1919, **37**, 49—65.

THE distribution coefficient of glycollic acid and formic acid between water and ether at 15° C. (32 for glycollic acid and 2·4 for formic acid) and at 26° C. (38 and 2·5, respectively) have been determined, and the extraction of succinic, oxalic, malic, and monoethylcitric acid from half-saturated solution has been investigated. Lactic acid and citric acid in half-saturated solution can be identified and determined by extraction and application of the distribution coefficients. A substance which is not readily extracted can be determined, without complete extraction, if a number of successive and similar extractions are made.—W. P. S.

Tannin and similar substances Fischer and Bergmann. *See* XV.

Utilisation of yeast Schweizer. *See* XVIII.

PATENTS.

Aldehydes; Manufacture of aromatic ——. G. Blanc, Paris. Eng. Pat. 115,244, 27.4.18. (Appl. 7119/18.) Int. Conv., 27.4.17.

AROMATIC aldehydes free from any trace of carboxylic acid are produced by boiling aromatic chloromethylene derivatives with an aqueous solution of an alkali bichromate, preferably with the addition of an alkali hydroxide or carbonate $3R.CH_2Cl + Cr_2O_7Na_2 + NaOH = 3NaCl + 3R.CHO + Cr_2O_3 + 2H_2O$. Thus a mixture of 41 parts of *p*-chloromethyltoluene, 30 of sodium bichromate and 6 of sodium carbonate in 150 parts of water on boiling under a reflux condenser for 20 hours gives a nearly quantitative yield of *p*-toluic aldehyde which is isolated from the reaction mixture by distillation in steam.—G. F. M.

Acetaldehyde; Manufacture of ——. J. Crosfield and Sons, Ltd., Warrington, and T. P. Hilditch, Grappenhall. Eng. Pat. 125,926, 25.4.19. (Appl. 3512/19.)

IN the production of acetaldehyde by passing acetylene into an aqueous solution (200 parts) containing mercuric oxide (2 parts), crystallised ferric sulphate (5 parts) and sulphuric acid (sp. gr. 1·84, 40 parts) at 60° C., the reaction slackens after about 2 hours in which 41 parts of acetaldehyde can be produced, because the mercuric salt becomes reduced to a mixture of mercurous sulphate and mercury; by the addition of 0·3 part by weight of hydrogen peroxide the mixture may be re-converted into mercuric sulphate and the passage of acetylene resumed. This treatment may be repeated several times until the total weight of acetaldehyde produced exceeds one hundred times the weight of the mercuric oxide taken, the whole operation occupying 15 hours; after this the accumulation of by-products renders the solution incapable of further satisfactory absorption of acetylene and the sludge is therefore removed, washed free from organic matter, and again oxidised.—D. F. T.

Playing-ball [; Use of lead alkyl sulphate in making ——]. R. C. Schlipphaus, Brooklyn, N.Y. U.S. Pat. 1,298,410, 25.3.19. Appl., 30.6.15.

A BALL is constructed with a core composed of a mixture of a basic lead salt of an alkyl sulphuric acid, *e.g.*, ethylsulphuric acid and water forming a stable homogeneous liquid of great density.

—D. F. T.

Hydantoins; Preparation of ——. Chem. Fabr. von Heyden A.-G. Radebeul. Ger. Pat. 310,427, 29.5.14. Addition to Ger. Pats. 309,508 and 310,426 (this J., 1919, 389A).

HYDANTOINS are prepared by condensing compounds of the type $R.R_1.C(NH.CO.NH_2).COOH$, $R.R_1.C(NH.COOH)CO.NH_2$, and $R.R_1.C(NH_2).CO.NH.COOH$, where R represents an alkyl group and R_1 an aryl or alkyl group with the exception of methyl and ethyl, either in the presence of a condensing agent, or by heating with or without a solvent or diluent. Several examples are given illustrating the preparation of different members of the series.—L. A. C.

Benzoic acid; Preparation of —— by oxidation of toluene with chromic and sulphuric acids. O. Dieffenbach, Darmstadt, and F. Alefeld, Rodach. Ger. Pat. 311,051, 9.12.13.

IN the oxidation of toluene to benzoic acid by means of chromic acid in the presence of sulphuric acid, sulphuric acid of at least 40% strength is used, and the temperature is not allowed to rise above 30° C. With sulphuric acid of 50 to 60% strength and by maintaining the temperature below 30° C., a yield of 60—63% of benzoic acid is obtained; the presence of suitable catalysts, *e.g.*, iron, manganese, or cerium sulphates, hinders oxidation of the nucleus, and the yield is raised to 70 to 73%.—L. A. C.

Tablets for medicinal and similar purposes; Preparation of friable ——. Farbenfabr. vorm. F. Bayer und Co. Ger. Pat. 311,148, 1.9.17.

THE material to be made into tablet form is mixed with finely divided cellulose, or one of its derivatives, which has lost its fibrous structure and has been converted to the amorphous form. For example, 4 parts of acetylsalicylic acid is mixed with 1 part of cellulose hydrate, prepared by treating artificial silk waste with 10% caustic soda, or of acid cellulose, prepared by treating wood cellulose with 50% caustic soda, or of oxycellulose.

—L. A. C.

Hexamethylenetetramine; Manufacture of preparations of addition compounds of iodine and ——. G. B. Pegram, New York. Eng. Pat. 117,451, 20.6.18. (Appl. 10,211/18.) Int. Conv., 23.6.17.

SEE U.S. Pat. 1,255,335 of 1918; this J., 1918, 223A.

Acetic anhydride and acetaldehyde, Production of ——. J. Koetschet and M. Bendet, Lyon, Assignors to Soc. Chim. des Usines du Rhône (anc. Gilliard, P. Monnet et Cartier), Paris. U.S. Pat. 1,298,356, 25.3.19. Appl., 11.6.18.

SEE Eng. Pat. 110,906 of 1917; this J., 1918, 282A.

Aliphatic acids containing an arsenoarylamine group. K. J. Oechslin, Paris. U.S. Pats. 1,299,214 and 1,299,215, 1.4.19. Appl., 4.3.15.

SEE Eng. Pats. 17 and 18 of 1915; this J., 1916, 275.

Willow bark. Ger. Pat. 310,515. *See* V.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Colour values in monochrome and a new viewing filter to assist in obtaining them. F. F. Renwick. Phot. J., 1919, **59**, 158—169.

COLOUR-SENSITIVE plates are used for two very different classes of work. In the first, chiefly represented by three-colour processes, separate records are obtained through differently coloured filters

with the object of obtaining coloured reproductions; for these processes a plate which had uniform sensitiveness to the normal spectrum of average daylight would be approximately ideal. In the second class a record in monochrome is required in which the tone values of the original should be preserved in the reproduction; in this case an ideal plate would be one in which the colour sensitiveness corresponds with that of the normal eye. The paper gives a résumé of the results obtained by previous workers in this subject. The curve of sensitiveness of the eye shows a maximum at about $\lambda = 555\mu\mu$ and falls off symmetrically on each side of this point. There is not at present any plate whose colour sensitiveness even approximates to this ideal, so that for correct reproduction in monochrome of coloured objects a correction filter must be used. The colour of the ideal filter for this purpose depends on the actual colour-sensitiveness of the plate used; its absorption curve is the difference between the curve of plate-sensitiveness and that of visual luminosity. If the plate is uniformly sensitive to the spectrum the absorption curve of the filter is the inverse of the luminosity curve; this latter is worked out, for the open arc, from the figures given by Abney, applying corrections to allow for Abney's arbitrary spectrum scale and for the fact that he used a slit of constant width and not of a constant range of wave-lengths. It is not easy by visual inspection alone to estimate correctly the relative tone values of the different parts of a coloured subject or exactly how a colour-sensitive plate with or without a filter, will reproduce it; if however the subject be viewed through a filter of complementary colour to the ideal correction filter the apparent tone-values will be the same as in the reproduction by the plate. If the viewing filter be used in conjunction with a taking filter the appearance is that of the reproduction by the plate through this taking filter. The blue viewing filter described and shown by the author was worked out to correspond as nearly as practicable with this theoretical filter for the Ilford Panchromatic plate.—B. V. S.

Drying [photographic plates and papers] by alcohol. L. P. Clerc. Bull. Soc. Franç. Phot., 1919, **6**, 85–91.

A WHITE opalescence occurring on negatives the drying of which was hastened by treatment with spirit was found to be due to precipitation in the film, or between the film and the glass support, of calcium bicarbonate, and to a less extent, of calcium sulphate. The salt was supplied by the washing water, the trouble occurring chiefly in districts where the water supply is very hard. The effect can also be produced by other salts insoluble in alcohol, for example sodium bicarbonate. It may be avoided by washing in salt free water (distilled or rain-water) before immersion in the spirit bath, but more easily by a short preliminary treatment with a weak solution of hydrochloric, nitric or acetic acid, the calcium salts of these acids being soluble in alcohol. The time taken in drying plates and papers after treatment with spirit is independent of the length of time in the spirit, provided this is enough, about 10 minutes, to allow the attainment of equilibrium between the film and the bath; it varies considerably, however, with the final strength of the spirit bath. Curves are given showing the effect of the strength of the spirit on the time of drying for both plates and papers, the effect being much less in the latter case.—B. V. S.

PATENTS.

Photographic printing paper and transfer processes. Kerotype, Ltd., and T. P. Middleton, London. Eng. Pat. 126,149, 7.5.18. (Appl. 7641/18.)

THE waxed paper support for the transfer process described in Eng. Pats. 29,616/12 and 12,001/15 (this J., 1914, 221; 1916, 1035) is prepared for coating with the gelatin emulsion by a matt substratum coating obtained from a solution of two resinous substances having different solubilities in mixed solvents. A suitable solution consists of gum sandarac (90 grains) and gum mastic (20 grains) in methylated ether (sp. gr. 0·720, 3 oz.) and methylated spirit (90%, 3 oz.) or in alcohol (90%, 4½ oz.) and anhydrous ethyl acetate (1½ oz.). The waxing, substratum coating and coating with sensitive emulsion may be carried out in one continuous operation, or the last process may be separately carried out. In the apparatus described, the paper, after applying the substratum coating, is dried in a partially exhausted chamber.—B. V. S.

Colour photography. I. Kitsee, Philadelphia, Pa. U.S. Pat. 1,298,514, 25.3.19. Appl., 22.9.16. Renewed 5.2.19.

DIFFERENTIA coloured chromated gelatin films on either side of a suitable support are simultaneously exposed through filters of the same colour as the films.—B. V. S.

[Photographic] transfer process. F. W. Kent, London, and T. P. Middleton, Farnham, Assignors to Kerotype, Ltd., London. U.S. Pat. 1,299,479, 8.4.19. Appl., 17.6.16.

SEE Eng. Pat. 12,091 of 1915; this J., 1916, 1035.

N-Methyl-p-aminophenol. U.S. Pat. 1,297,685. *See* III.

XXII.—EXPLOSIVES; MATCHES.

Picric acid and trinitrobenzene; Potential energy of ——. E. von Herz. Z. ges. Schiess- u. Sprengstoffw., 1918, **13**, 368–370, 385–386. Chem. Zentr., 1919, **90**, II., 294.

THE potential energy of aromatic nitro-hydrocarbons is increased by the introduction of hydroxyl groups. A study of the thermochemical processes involved in the formation and explosive decomposition of picric acid gave results about 416 cals. per kilo. higher than in the case of trinitrobenzene. The maximum increase of energy obtainable by hydroxylation is reached with the introduction of one hydroxyl group, whilst the introduction of further groups causes a progressive decrease of energy, owing mainly to the progressively increasing heat of formation of the polyhydric phenols, *e.g.*, trinitroresorcinol and trinitrophloroglucinol. The cause of the increase in energy produced by the hydroxyl group is the primary formation of carbon monoxide from the hydroxyl oxygen and its subsequent oxidation to carbon dioxide, a far greater amount of heat being developed in this oxidation than in the formation of carbon dioxide from the elements.

—C. A. M.

Highly-explosive nitro compounds; Relationship between the explosive force and constitution of ——. A. Stettbacher. Schweiz. Chem.-Zeit., 1919, **1**, 95–97.

IN comparative experiments in which from 1½ to 50 grms. of different nitro compounds were exploded over iron plates (3 to 8 mm. in thickness) it was found that, contrary to expectation, compounds containing the methylnitro-amino group, such as trinitrophenylmethylnitramine, had more explosive power than those containing a hydroxyl group, such as trinitrophenol, whilst aromatic compounds with four nitro groups in the nucleus (*e.g.* tetranitroaniline) were still more violent in action. The tetranitro derivatives show complete parallelism with the tri-nitro derivatives. Just as trinitro-aniline (picramine) is less explosive than trinitrophenol, so is tetranitro-aniline weaker than tetranitro-

phenol, and the latter than tetranitrophenylmethylnitro-aniline. The superior explosive power of the methyl-nitro-amino group is due to the destabilising influence of the nitramine group as the fifth substituting group in the benzene molecule. Owing to their instability and sensitiveness to shock the tetranitro derivatives (with the possible exception of tetranitro-anisol) are unsuitable for practical purposes. Tetranitro aniline is more stable than nitroglycerin at 70° C., but at lower temperatures the reverse is the case, and it slowly emits nitrous acid. Trinitro dimethyldinitro-aminobenzene and trinitromethylnitro amino-phenol are both powerful explosives, but owing to the cost and trouble of preparing them are not in use.—C. A. M.

Mercury fulminate; By-products in the preparation of —. Laughans, Z. ges. Schless- u. Sprengstoffw., 1918, **13**, 345–349, 389–391, 406. Chem. Zentr., 1919, **90**, II., 295.

As a rule an after-reaction takes place in the filtered liquor from the retorts, so that cautious neutralisation is necessary. Fresh liquor is yellowish-green and has an odour of nitric and nitrous acids. At 40° C. it yields 0·15–0·18% of mercury fulminate (0·10–0·12% Hg) per litre in 24 hours. From 1900 to 2000 c.c. of liquor is obtained from 1070 c.c. of nitric acid, 1800 c.c. of alcohol, 1000 c.c. of water, and 150 grms. of mercury. Phenolphthalein should be used as indicator in determining the acidity. An old liquor (650 c.c.) which had been kept for a year in a stoppered vessel in the dark contained no mercurous salt, but 37·5 grms. of metallic mercury, and 7 grms. of impure mercuric oxide (total Hg 0·661%). Liquors obtained by condensation contain mercurous salts, and both kinds of lye contain nitrous acid. The residue obtained on evaporating unneutralised mother liquor consists of 90 to 95% of oxalic acid, the remainder being a mercury compound. Nitrogen compounds are not present. Neutralised liquor contains glycollic acid, nitrates, acetates, and formates.

—C. A. M

PATENTS.

Nitroglycerin; Manufacture of —. J. G. Baxter, Gravesend. Eng. Pat. 125,091, 6.5.16. (Appl. 6523/16.)

A CYLINDRICAL nitrating vessel is divided into two compartments by an annular wall which permits of communication between the two compartments at top and bottom. Both compartments are provided with cooling coils, and the inner compartment has also air agitation coils. Mixed nitrating acid and glycerin are run continuously in the correct proportions into the inner compartment and pass away through an overflow placed near the top of the outer compartment to a separator which is of such a size that the inflowing stream causes little disturbance. The lower part of the separator is provided with cooling coils, and in the upper part is an observation window. Nitroglycerin is discharged from an opening in the upper part and the waste acid passes away by a pipe reaching to the bottom of the separator and extending to the height of the nitroglycerin outlet. The relative rates of flow of the two liquids are regulated by raising or lowering an indiarubber pipe fitted to the nitroglycerin outlet.

—T. St.

Nitrating, mixing, and similar apparatus; Feed control of —. Nobel's Explosives Co., Ltd., Glasgow, and J. N. Lyall, A. Wilson, J. H. O'Connor, and J. McKillop, Pembrey, Carmarthen. Eng. Pat. 125,094, 9.5.16. (Appl. 6652/16.)

IN apparatus where one liquid is run into another liquid which must be kept agitated during the process, means are provided for deflecting the stream of incoming liquid into an overflow tank when the agitating mechanism is not working. In the case of mechanical stirring, governor balls on the main or a secondary shaft actuate, through a bell-crank lever and a link, a swivelling bend which forms the exit end of the liquid-supply pipe. The amount of liquid passing to the mixing or nitrating tank is thus dependent on the position of the governor. Liquid seals are provided at the supply and delivery ends of the swivel connection to allow of the necessary movement while preventing the escape of harmful fumes. Where agitation is produced by compressed air, the supply pipe is controlled by a piston sliding in a cylinder, the piston being acted upon on one side by a spring and on the other side by the compressed air.—T. St.

Trinitrotoluene and such like bodies; Process for the purification of —. S. Dreyfus, Manchester. Eng. Pat. 125,110, 20.5.16. (Appl. 7203/16.)

A CLOSED cylindrical vessel with valve-controlled inlets and outlets has a conical lower part and is provided with a central tube passing nearly to the bottom. A suitable quantity of trinitrotoluene or similar substance which is to be freed from acid is admitted into the vessel and water under pressure at 100°—120° C., or at atmospheric pressure at 90°–120° C. is then supplied through the central pipe. A continuous current of hot water thus passes upwards through the trinitrotoluene and runs away through an outlet near the top. The purified trinitrotoluene is run or blown off through an outlet at the bottom, the vessel being left filled with the most recently admitted water, and a fresh quantity of trinitrotoluene is admitted through an inlet near the top of the vessel.—T. St.

Trinitrotoluene and other nitro compounds; Process for the washing of —. Chance and Hunt, Ltd., and A. E. Holley, Oldbury, and O. E. Mott, Woolwich. Eng. Pat. 125,140, 10.6.16. (Appl. 8234/16.)

ACID molten trinitrotoluene and water pass in opposite directions through a series of vessels so that the fresh water comes into contact with the nearly finished product. Each vessel contains communicating mixing and separation compartments, and the flow of liquids is brought about entirely by the head produced in the separation compartments, the vessels being at the same level. The general arrangements are similar to those described in Eng. Pat. 124,461/16 (this J., 1919, 390A).—T. St.

Explosives; Manufacture of —. F. G. L. Johnson, London. Eng. Pat. 125,128, 2.6.16. (Appl. 7857/16.)

MIXED ammonium and potassium perchlorates, powdered to pass through a 60-mesh sieve, are added gradually to molten paraffin wax in a suitable mixing machine, to produce an intimate mixture of 82—83% of mixed perchlorates and 18—17% of paraffin wax. The relative proportions of the two perchlorates may vary widely, but good results have been obtained with the mixture:—ammonium perchlorate 41, potassium perchlorate 41, paraffin wax 18%.—T. St.

Picric acid and other products of nitration; Manufacture of —. J. G. Baxter, Gravesend. Eng. Pat. 125,160, 22.6.16. (Appl. 8773/16.)

PHENOLSULPHONIC acid and mixed nitric and sulphuric acids are run continuously in the correct proportions into a mixing vessel in which are cooling coils, and the mixture then passes through a second vessel, provided with obstructions, where nitration is completed. The mixing vessel is divided into inner and outer compartments which communicate at the bottom. The reacting materials are run into the inner compartment, in

which are means for agitation, and the mixture passes under the dividing wall and away to the second vessel by an overflow situated near the top of the outer compartment. The second vessel is provided with a cover over which cold or hot water is poured to control the action.—T. St.

Picric acid; Process for manufacturing ——. P. Ramy, London. Eng. Pat. 125,461, 12.8.16. (Appl. 11,411/16.)

NITRE-CAKE and sodium or potassium nitrate are heated to dull redness and the evolved gases are passed through a series of vessels containing heated benzene and a catalyst, picric acid mixed with dinitrophenol and nitrobenzene being formed. The vessels containing benzene are heated by steam to nearly 105° C., and are provided with reflux condensers. The catalyst may consist of metallic silver, copper, or mercury, or their salts, or aluminium salts.—T. St.

Explosives; Propellant ——. E. I. du Pont de Nemours and Co., Assignees of A. S. O'Neil, Wilmington, Del., U.S.A. Eng. Pat. 125,482, 9.6.17. (Appl. 8263/17.) Int. Conv., 17.8.16.

GRAINS of colloided nitrocellulose powder are tumbled with a dinitrotoluene (preferably the 1.2.4-isomer) in powder form, and are then heated to melt the dinitrotoluene and thus cause it to adhere to the powder grains. These are then immersed for some hours in hot water to cause the coating to impregnate the grains to an appreciable depth. Camphor or/and diphenylamine may be mixed with the dinitrotoluene to produce a coating of lower melting point.—T. St.

Explosive. F. Howles, Manchester. Eng. Pat. 125,600, 1.9.16. (Appl. 12,104/16.)

PICRIC acid in solution is treated with hydrogen sulphide in the presence of an alkali, preferably ammonia, whereby one nitro group is reduced, and the resulting amino compound, after being separated from the sulphur formed in the reaction, is made into a paste with water and treated with sodium nitrite and hydrochloric, or preferably, nitric acid. The chloride or nitrate of dinitrodiazophenol thus produced, though less sensitive than mercury fulminate, is efficient as a detonator or primer for high-explosive projectiles.—T. St.

Explosives. W. Blackmore, London, R. T. Cooke, Annfield Plain, Durham, and F. W. Jenkins, London. Eng. Pat. 125,663, 18.10.16. (Appl. 14,814/16.)

CLAIM is made for explosives of the perchlorate class which contain both anthracite and carborundum. Examples of suitable explosives of this class are given containing anthracite 0·5 to 4% and carborundum 0·5 to 7%.—T. St.

Noxious or like material [benzyl chloride] for use in operations of war. W. Hill, Birmingham. Eng. Pat. 125,589, 26.8.16. (Appl. 12,095/16.) Addition to Eng. Pat. 8422/15.

BENZYL chloride incorporated with light magnesium carbonate to cause it to remain suspended in the air is incorporated in explosive shells, bombs, or the like.

Explosive. W. Rintoul and E. G. Beckett, Assignors to Nobel's Explosives Co., Ltd., Stevenston, N.B. U.S. Pat. 1,298,793, 1.4.19. Appl., 3.1.19.

SEE Eng. Pat. 14,706 of 1915; this J., 1919, 340 A.

XXIII.—ANALYSIS.

Viscometers; Standard substances for the calibration of ——. E. C. Bingham and R. F. Jackson. Bull. Bureau Standards, 1918, **14**, 59—86.

As liquids of greater viscosity than water, solutions of sucrose and mixtures of ethyl alcohol and water are suitable and convenient for use in calibrating viscometers. The viscosities of ethyl alcohol-water mixtures have been determined by several observers, with fairly concordant results, but the accuracy of existing data relating to sucrose solutions has been questioned. The viscosities of 20% and 40% solutions of sucrose (by weight) were determined at temperatures from 0° to 100° C., and that of a 60% solution from 10° to 95° C., with results generally somewhat higher than those obtained hitherto. Existing data relating to the viscosity of water were also reviewed and corrected, the viscosity and fluidity being calculated for every degree from 0° to 100° C. In discussing the relative merits of absolute and specific units for expressing viscosity, the centipoise (cp., the one-hundredth part of the c.g.s. unit) is favourably considered. By the use of this unit the absolute and specific viscosities of a liquid are practically the same, provided that water at 20° C. be taken as the standard. The most probable value for the viscosity of water at 20° C. was found to be 1·005 cp.

—W. E. F. P.

Potash absorption apparatus; Efficiency of ——. *A new form of helical absorption apparatus.* J. Friedrichs. Z. angew. Chem., 1919, **32**, 129—132.

ABOUT 60 different types of potash absorption apparatus have been described. A number of the best known of these have been tested and their specific absorption-capacity determined, in order to compare their efficiency with that of a new type devised by the author and constructed on the helical principle. This new pattern consists of outer and inner cylindrical vessels with fused connections. The gas enters the inner cylinder which occupies the major portion of the capacity of the outer vessel. It emerges through a hole in the bottom and escapes upwards through the annular space between the two cylinders. A helix is moulded on the outer surface of the inner cylinder in three convolutions in such a way that the apex of the helix does not quite touch the wall of the outer cylinder. The bubbles of gas are thus forced to travel in a spiral path but sufficient clearance is afforded for the free circulation of the liquid. A bent calcium chloride tube is attached by a ground glass joint to the exit orifice of the outer cylinder. The whole apparatus when charged weighs about 38 grms. and contains about 10 c.c. of potash solution. The capacity of the inner vessel is ample to accommodate the whole of this liquid if sucked back. The path traversed by the bubbles of gas is about 25 cm. but the back pressure is only equivalent to about 5 cm.—J. F. B.

Micro-elementary [organic] analysis. E. Müller and H. Willenberg. J. prakt. Chem., 1919, **99**, 34—44.

AN apparatus for the elementary analysis of organic substances (benzene, acetanilide, bromobenzene, phthalimide, etc.) is described, from 2 to 5 mgrms. of substance being used for the analysis. The oxygen required for the combustion is obtained by the action of Caro's acid on potassium bichromate; a single burner is used to heat the combustion tube, and the various parts of the apparatus are connected by ground-in joints, rubber connections not being employed.—W. P. S.

Ammonia distillations; Scrubber for ——. B. S. Davisson. J. Ind. Eng. Chem., 1919, **11**, 465—466.

A STILL-HEAD of the bulb type, the bulb having a

capacity of about 200 c.c., has a tube at the top leading to the condenser, whilst the lower tube, connecting the bulb with the distillation flask, extends upwards into the bulb and is then bent downwards ending in a small perforated bulb. The first steam condenses in the bulb and the condensed water surrounds the perforated bulb and acts as a scrubbing solution for the remaining vapours. The apparatus should be made of "Pyrex" glass to avoid errors due to the extraction of alkali from soft glasses. The use of a bulb adapter on the lower end of the condenser is recommended; the end of this adapter is also provided with a small perforated bulb.—W. P. S.

Ferrous iron: Estimation of —— by means of the oxidation potential. I. M. Kolthoff. Chem. Weekblad, 1919, **16**, 450–461.

The ferrous solution, acidified with sulphuric or hydrochloric acid, is titrated with a standardised potassium bichromate solution. The E.M.F. between a platinised platinum electrode immersed in the solution and a normal calomel electrode is determined after successive additions of the bichromate solution. The measurements obtained are plotted in a curve against the volume of the titrating solution added. Near the end-point the E.M.F. increases rapidly, the exact end-point being given by the middle point of the nearly vertical curve section. Titration with potassium bromate yields satisfactory results, the end-point being sharper in hydrochloric than in sulphuric acid solution. With potassium permanganate variable readings of the E.M.F. are obtained.—W. S. M.

Platinum and alcohol: Recovery of —— from potash determinations. A. E. Smoll. J. Ind. Eng. Chem., 1919, **11**, 466–467.

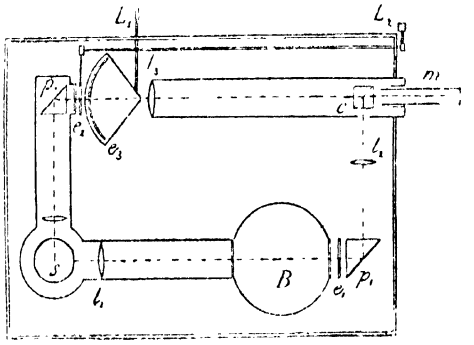
Filtrates and washings from potassium determinations are collected and distilled until the vapours distil at 100° C.; platinum black and water remain in the distillation flask, whilst the distillate consists of alcohol containing a considerable quantity of aldehyde. To remove aldehyde, the distillate is heated under a reflux condenser through which a current of water at 58° C. is passed; this condenser is connected with an ordinary condenser and the heating is continued until the distilled liquid is free from aldehyde. A sensitive test for aldehyde consists in dissolving a few crystals of phenol in 5 c.c. of concentrated sulphuric acid and then adding 3 c.c. of the distillate; if aldehyde is present, a reddish-brown colour is obtained, otherwise the mixture remains colourless. After the aldehyde has been expelled, the alcoholic solution is treated with sodium hydroxide and distilled until the distillate has a sp. gr. of 0·8615, the alcoholic strength of the solution required for washing potassium chloroplatinate precipitates.—W. P. S.

Low temperatures: Measurement of —— with thermocouples. T. Spooner. J. Franklin Inst., 1919, **187**, 509–510.

Temperatures below 0° C. down to that of liquid air can be measured by copper-"advance" couples. The author has tested the alloys which are called in the trade chrome-alumel but finds no appreciable advantages in this region over the copper-"advance" couple.—W. H. P.

Opacimeter for bacterial estimations. Lambert, Vlès, and De Watteville. Comptes rend., 1919, **168**, 797—799.

The apparatus is so constructed that from one source of light, *S*, two beams pass out at right angles, one of which passes through a bath of water, *B*, in which the bacterial suspension, in a containing cell, may be plunged, and then through the colour screen e_1, prism, p_1, and lens, l_2. The other beam is filtered through a coloured screen, e_2, and passes through a photographic film, e_3, progressively darkened and arranged to move over a scale. The two beams are then directed through the telescope, *m*, by the prism arrangement, *c*, which is so arranged that the two illuminated fields



adjoin and at the same time the image of the scale of the photographic plate is in the field of vision. This scale is calibrated for each particular type of bacterial suspension to be examined, either in terms of dry weight of bacteria per c.c. of emulsion or in number of bacteria per c.c. By simply moving the photographic plate until the two fields have an equal intensity the concentration of the emulsion may then be read directly from the scale.

Nitrogen in coal and coke. Terres and others. *See* IIA.

Vegetable fibres. Haller. *See* V.

Vegetable fibrous materials. Schwalbe. *See* V.

Arsenic acid. Winkler. *See* VII.

Boric acid. Jannasch and Noll. *See* VII.

Sulphur oxygen compounds. Sander. *See* VII.

Hydrogen sulphide. Palet and Fernandez. *See* VII.

Carbon monoxide, dioxide, oxysulphide, etc. Stock and Seelig. *See* VII.

Carbon in steel. Rogers. *See* X.

Sulphur in iron and steel. Marinot. *See* X.

Oxygen in cyanide solutions. White. *See* X.

Brass ingots. Deakin. *See* X.

Zirconium ores and alloys. Travers. *See* X.

Recovering ether in fat determinations. Grossfeld. *See* XII.

Sulphite-cellulose. Yocum and Nelson. *See* XV.

Citric acid in milk. Kunz. *See* XIXA.

Cacao products. Hoepner. *See* XIXA.

Albuminoid ammonia. Cooper and Heward. *See* XIXB.

Morphine. Lautenschläger. *See* XX.

Morphine. Palet. *See* XX.

Organic bases. Guglialmelli. *See* XX.

Menthol. Von Friedrichs. *See* XX.

Alcohols. Béhal. *See* XX.

Carbonyl chloride. **Kling and Schmutz. *See* XX.**

Extractions with ether. **Pinnow. *See* XX.**

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Aubé. Pulverising apparatus. 14,888. June 12.

Boake, Roberts, and Co., and Durrans. Stillheads. 13,754. May 30.

Boberg, and Techno-Chemical Laboratories. Drying. 13,339. May 27.

Boberg, and Techno-Chemical Laboratories. Drying processes. 14,433. June 6.

Corbett. Grinding-mills of the rotating-disc type. 14,249. June 5.

Goubert. Drying substances. 13,367. May 27.

Hansen. Apparatus for mixing liquids in closed vessels. 14,460. June 6. (Denmark, 21 3.17.)

Imperial Trust for the Encouragement of Scientific and Industrial Research, and Piqué. Cooling-apparatus. 13,492 and 13,493. May 28.

Ironside. Crystallisation of salts. 14,995. June 13.

McIntyre. Centrifugal machine for filtering or extracting liquids, semi-liquids, etc. 13,706. May 30.

Marks (Fours et Procédés Mathy Soc. Anon.). Apparatus for cooling materials. 14,442. June 6.

Merz. Treating liquids. 14,097. June 4.

Merz. Concentrating, drying, etc. 14,098. June 4.

Naaml. Vennootsch. Brons 13,350. *See* XIX.

Orchardson. Hot-air drying apparatus. 14,664. June 10.

Ransford (Davis). Filters. 14,210. June 4.

Russell. Evaporating apparatus. 14,278. June 5.

Tucker. Moulds for casting chemical etc. sticks. 13,871. May 31.

Union Espagnole de Fabr. d'Engrais, de Produits Chimiques, et de Superphosphates. Centrifugal pumps for acids and corrosive liquids etc. 14,405. June 6. (Spain, 5 6 18.)

Watson. Apparatus for separating comminuted material in dry state. 15,000. June 14.

Whitfield. Drying apparatus. 14,816. June 12.

Complete Specifications Accepted.

3893 (1917). Maxted and Ridsdale. Activation of catalysts and contact masses. (127,025.) June 4.

5089 (1917). Daniel and Bregeat. *See* XX.

6420 (1918). Bowman. Evaporating apparatus. (127,071.) June 4.

8357 (1918). Rose. Filters and the like. (127,089.) June 4.

9005 (1918). Kirkham, Hulett, and Chandler, and Hersey. Apparatus for effecting intimate contact between liquids and gases. (127,705.) June 18.

9195 (1918). Huntington, Heberlein, and Co., Bush, and Burns. Means for separating suspended particles from gases. (127,119.) June 4.

10,116 (1918). Barbet. *See* XX.

2331 (1919). Klevits, and Kynoch, Ltd. *See* X.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Adams and Adams. Manufacture and use of specific refractory material in coke ovens for resisting the action of volatile alkalis. 14,710 and 14,711. June 11.

American Linseed Co. Artificial fuel. 13,496. May 28. (U.S., 17.7.17.)

Andrews and Averill. Treating hydrocarbons. 13,374. May 27.

Blair, Campbell, and McLean, Blair, and Ferguson. Preparing oxidising gases for removing carbon and sulphur deposits in hydrogen manufacture. 14,713. June 13.

Campbell. Manufacture of gas. 13,606 and 13,607. May 29.

Coke and Gas Ovens, Ltd., and Gunderson. Coke and gas ovens. 14,459. June 6.

Courtoy. Coal washers. 14,817. June 12.

Gibson and Wyman. Producing enriched water-gas. 13,733. May 30.

Griggs. 14,942. *See* VII.

Groundstroem. Gas producers. 14,475. June 6.

Lymn and Rambush. Generation and utilisation of water-gas. 14,121. June 4.

Milton. Gas producers. 13,225. May 26.

Raworth (Combustion Rationnelle Soc. Anon.). Combustion of pulverulent fuel. 13,949. June 2.

Roberts. Coke ovens etc. 14,208. June 4.

Rousseau. Production of hydrocarbon liquids from carbon. 14,086. June 4. (Fr., 9 9 18.)

Sauer. Production of decolorising carbon. 1477. June 11.

Smith. Gas producers. 14,211. June 4.

Soc. Franco Belge de Fours à Coke. Horizontal coking ovens. 13,593. May 29. (Fr., 29 5.18.)

Steel. Manufacture of fuel from anthracite duff. 14,848. June 12.

Thompson (Fours et Procédés Mathy Soc. Anon.). Coke ovens. 14,105. June 4.

Complete Specifications Accepted.

14,210 (1916). Roth and Vincent. Manufacture of coke. (126,997.) June 4.

2973 (1917). Comp. Gén. d'Electro Chimie de Bozel. *See* VII.

3885 (1917). Hughes and Lovell. Fuel. (127,021.) June 4.

4103 (1917). Berger. Obtaining fumes or vapours by combustion of mixtures of chemicals. (127,031.) June 4.

6007 (1917). Harger and Terrey. *See* VII.

6892 (1917). Bassett. *See* XXIII.

6361 (1918). Marks (Soc. Anon. Ital. Ansaldo & Co.). Production of gases from water or oil. (127,383.) June 12.

7315 (1918). Corthesy and Castelli. Distillation of liquid hydrocarbons. (127,690.) June 18.

8440 (1918). Davis. Treatment of flue gases. (127,695.) June 4.

9880 (1918). Anderson. *See* VII.

10,287 (1918). Adam. Purification of coal gas. (127,131.) June 12.

13,670 (1918). Piette, and Soc. Franco-Belge de Fours à Coke. Coking-ovens. (127,165.) June 4.

16,503 (1918). Taylor. Artificial fuels. (127,775.) June 18.

16,711 (1918). Dempster and Ballingall. Plant for manufacture of water gas. (127,179.) June 4.

III.—TAR AND TAR PRODUCTS.

Applications.

Andrews and Averill. 13,374. *See* II.

Davies and Tchernlac. Reduction of aromatic nitro-compounds. 13,619. May 29.

Complete Specifications Accepted.

6097 (1917). Barbet et Fils et Cie. Sulphonation of benzene. (127,614.) June 18.

7315 (1918). Corthesy and Castelli. *See* II.

8813 (1918). Wilton. Continuous dehydration and distillation of tar and other liquids. (127,700.) June 18.

9894 (1918). Rintoul, Thomas, and Nobel's Explosives Co. Preparation of amines. (127,740.) June 18.

10,260 (1918). Reid. Tar still. (127,133). June 4.

5930 (1919). Imrie (Geigy Soc. Anon.). Manufacture of 2-aminoanthraquinone. (127,223.) June 4.

IV.—COLOURING MATTERS AND DYES.

Applications.

Barnett and Morden. Packing of aniline dyes etc. 13,917. June 2.

Brotherton and Co., Ehrhardt, Lloyd, and Smith. Manufacture of azo colouring matters. 14,035. June 4.

Complete Specification Accepted.

11,215 (1918). Brotherton, Ehrhardt, and Kay. Manufacture of black sulphur colours. (127,143.) June 4.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Aktiebolaget Vaporackumulator, and Ruths. Sulphite boilers. 13,654. May 29.

Dreyfus. Manufacture of solutions of cellulose esters and celluloid-like masses, films, etc. 14,688. June 10. (Fr., 4.3.14.)

Greeves, and Portadown Weaving Co. Retting and drying flax etc. 14,798. June 12.

Griffiths, Nolan, Rintoul, and Nobel's Explosives Co. Manufacture of nitrocellulose plastics and solutions. 14,856 and 14,857. June 12.

Havness. Manufacture of thread of cellulose, paper, etc. 14,784. June 11. (Norway, 22.6.18.)

Hollis and Woodmansey. Cleaning wool etc. 15,007. June 14.

Johnston and Sutherland. Preparing or degumming stalk and leaf fibres. 13,828. May 31.

Kashitani. Treatment of cotton yarn or cloth. 13,529. May 28.

Milne. Stationary digesters etc. used in paper-making etc. 14,028. June 4.

Schlichten. Treating fibre-bearing plants. 14,032. June 4.

Complete Specifications Accepted.

10,793 (1916). Nauton Frères. *See* XIII.

4015 (1917). Huebner. Solutions of cellulose acetate. (127,027.) June 4.

5039 (1917). Cochrane. Production of fabrics having the property of invisibility. (127,301.) June 12.

6099 (1917). Dreyfus. Cellulose acetate compositions. (127,615.) June 18.

7500 (1917). Dreyfus. Cellulose acetate compositions. (127,678.) June 18.

9126 (1918). Dydynski (Gaszynski and Ashourkoff). Separation of fibres from fibrous plant stems. (127,714.) June 18.

12,513 (1918). Courtaulds, Ltd., and Criggall. Squirting-nozzles for making strips etc. from viscose etc. (127,155.) June 4.

15,244 (1918.) Broadhurst, Lamble, Peachey, and United Alkali Co. Manufacture of a substitute for celluloid, leather, etc. (127,481.) June 12.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Calico Printers' Assoc., Nelson, and Rouse. Printing cotton fabrics. 14,231 and 14,232. June 5.

Cuyck and Kerr. 14,223. *See* XIII.

Gaston and Rushton. Dye jigs. 14,599. June 10.

Mandleberg and Co., and Pilkington. Proofing fabrics. 13,226. May 26.

Complete Specification Accepted.

14,147 (1918). Calico Printers' Assoc., and Roberts. Bleaching, dyeing, or similarly treating textile and other fabrics in the open state. (127,474.) June 12.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Bergve. Production of alkali sulphides or sulphosilicates from silicates. 14,950. June 13. (Norway, 8.7.18.)

Blair, Campbell, and McLean, and others. 14,713. *See* II.

Chrystal. Recovery of ammonia. 13,816. May 31.

Clark. Plants for treating sulphuric acid etc. 13,660. May 29.

Griggs. Apparatus for producing hydrogen. 14,942. June 13.

Hedstrom. Production of compounds of radium. 14,439. June 6.

Hutchinson and Richards. Recovery of soluble nitrogen compounds from solutions. 15,045. June 14.

Ironside. 14,995. *See* I.

Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Nitroxylsulphuric acid. 14,958. June 13. (Norway, 9.8.18.)

Riiber. Purification of alkaline chloride solutions. 14,875. June 12.

Union Espagnole. 14,405. *See* I.

Wade (Koppers Co.). Manufacture of ammonium sulphate. 13,757. May 30.

Complete Specifications Accepted.

11,867 (1916). Hulin. Extraction of chlorine. (126,992.) June 4.

2973 (1917). Comp. Gén. d'Electro-Chimie de Bozel. Production of hydrogen. (127,018.) June 4.

4397 (1917). Taylor and Scott. Manufacture of sulphuric acid. (127,047.) June 4.

5857 (1917). Maxted. Production of concentrated nitric acid from ammonia. (127,343.) June 12.

6007 (1917). Harger and Terrey. Treatment or purification of mixtures of hydrogen and carbon monoxide to separate the latter. (127,609.) June 18.

6831 (1917). Morgan. Concentrating sulphuric acid and other liquids. (127,652.) June 18.

7465 (1917). Dawson. Production of Glauber's salt and sulphuric acid solutions from nitre cake etc. (127,677.) June 18.

1559 and 1560 (1918). Cederberg, Backstrom, and Kylberger. Production of ammonia. (127,063 and 127,064.) June 4.

8812 and 10,452 (1918). Wilton. Manufacture of sulphate of ammonia. (127,398.) June 12.

9128 and 9129 (1918). Linder. Manufacture of sulphate of ammonia. (127,715 and 127,716.) June 18.

9888 (1918). Anderson. Recovery of cyanogen compounds and/or sulphur from spent oxide. (127,128.) June 4.

11,379 (1918). Norton Co. Producing crystalline alumina. (118,606.) June 12.

11,531 (1918). Pratt Engineering and Machine Co. Sulphur-burning. (118,097.) June 12.

17,814 (1918). Grayson. Manufacture of sodium nitrite. (127,183.) June 4.

VIII.—GLASS; CERAMICS.

Applications.

Adams and Adams. 14,710 and 14,711. *See* II.

Corning Glass Works. Glass. 13,508. May 28. (U.S., 28.5.18.)

Ferguson. Apparatus for making glass. 13,500 and 13,501. May 28.

Hatfield. Working glass. 13,268. May 27.

Muslol. 14,455. *See* XIII.

Riley. Gas-heated glass-melting furnaces. 13,318. May 27.

IX.—BUILDING MATERIALS.

Applications.

Clark. Stone composition. 14,584. June 10.

Concrete Construction Co. Building materials etc. 14,750. June 11.

Grönroos. Production of artificial stone or slabs of marble-like appearance. 14,182. June 4.

Lambert. Hardening and preserving impregnable soft woods. 14,789. June 11.

Williams. Effecting colour change in wood. 14,855. June 12.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Barfield and Wild. Crucible furnaces. 14,193. June 4.

British Cellulose and Chemical Manufacturing Co., Hotz, and Soller. Coating lead linings or surfaces of vessels or apparatus for use in chemical processes. 15,034. June 14.

British Thomson-Houston Co. (General Electric Co.). Annealing metal sheets. 14,154. June 4.

Coles. Continuous electrolytic production of copper wire. 13,247. May 26.

Commercial Electrolytic Corporation. Compound for cleaning guns etc. 13,372. May 27. (U.S., 21.9.18.)

Cooke and Tipler. Separating antifriction white metal from bronze cuttings. 14,712. June 11.

Cunningham. Repairing aluminium or its alloys for electro-plating. 14,111. June 4.

Eleuteri. Alloy. 13,860. May 31.

Farmer. Alloy. 14,094. June 4.

Frei and Wurstenberger. Protection of selective corrosion of tubes and machinery parts of copper and copper alloys. 14,001. June 2. (Swiss, 1.6.18.)

Gaunt, Van Marle, and Gibbons Bros. Furnaces for heat treatment of metals. 14,517. June 7.

Greenley, and Vickers, Ltd. Treatment or production of nickel. 14,357. June 5.

Hardy, Hunt, and Wigglesworth. Furnaces for heat treatment of metal articles. 14,245. June 5.

Hurter. Manufacture of iron and steel. 13,157. May 26.

Jarvis. Manufacture of steel. 14,161. June 4.

Leathart, and Locke, Blackett, and Co. Refining lead. 13,597. May 29.

Marks (Luckenbach Processes, Inc.) Mineral selective agent. 14,332. June 5.

Squire. Utilising blast furnace slag. 14,036. June 4.

Tainton. Roasting ores or concentrates. 14,989. June 13.

Complete Specifications Accepted.

5048 and 6038 (1917). Hadfield. Manufacture of steel. (127,302.) June 12.

6546 and 11,348 (1917). Elmore. Extraction of lead and zinc from their ores. (127,641.) June 18.

7120 (1917). Hyde, Jude, and Belliss and Morcom. Impregnating and coating metals with other metals. (127,664.) June 18.

2970 (1918). Stobie. Electric steel manufacture. (127,066.) June 4.

9028 (1918). Clark, and Edison Swan Electric Co. Treatment of refractory metals and their alloys. (127,708.) June 18.

9267 (1918). British Thomson-Houston Co. (General Electric Co.). Production of steel alloys and the constituents thereof. (127,415.) June 12.

14,662 (1918). Lea. Rendering castings and other metal articles non-porous. (127,772.) June 18.

15,944 (1918). British Thomson-Houston Co. (General Electric Co.). Electroplating steel articles. (127,177.) June 4.

17,068 (1918). Harvey Gas Furnace Co., and Harvey. Gas furnaces for heating or melting metals. (127,181.) June 4.

18,810 (1918). Mate and Rourke. Furnaces for rendering metal articles non-oxidisable. (127,781.) June 18.

21,542 (1918). Bloxam (Stabilimenti Blak, Ing. A. Pouchain). Metallurgical furnaces. (127,206.) June 4.

21,550 (1918). Griggs. Open-hearth and like furnaces. (127,785.) June 18.

2331 (1919). Klevits, and Kynoch, Ltd. Pyrometers for measuring the temperature of molten non-ferrous metals. (127,534.) June 12.

XI.—ELECTRO-CHEMISTRY.

Applications.

Barfield and Wild. Electric furnaces. 14,192 and 14,879. June 4 and 12.

Coles. 13,247. *See* X.

Greenley, and Vickers, Ltd. Secondary batteries. 14,348. June 5.

Hooydonk. Secondary dry battery. 13,980. June 2.

Lewis. Impregnation of electric cables, transformers, etc., and fibrous material used therein, with insulating medium. 14,033. June 4.

Palmer. Electric storage batteries. 13,485. May 28.

Pouchain. Negative plate for electric batteries. 14,462. June 6.

Pouchain. Negative plate for electric accumulators. 14,463. June 6.

Complete Specifications Accepted.

2970 (1918). Stobie. *See* X.

8162 (1918). Oldham and Oldham. Galvanic batteries. (127,376.) June 12.

10,183 (1918). White (Industrial Electric Furnace Co.). Electric furnaces. (127,131.) June 4.

13,024 (1918). Rondelli. Electric furnaces. (127,458.) June 12.

15,944 (1918). British Thomson-Houston Co. *See* X.

XII.—FATS, OILS; WAXES.

Applications.

Pellerin. 13,476. *See* XIX.

Sauer. 14,771. *See* II.

Stevenson. Liquid soap. 13,727. May 30.

Thornber. Manufacture of soaps. 14,265. June 5.

Usines de Kenkelaere Soc. Anon. Presses for oil extraction etc. 14,901. June 12. (Belg., 29.1.16.)

Whitham. 13,819. *See* XIX.

Withers (National Electric Products, Ltd.) Hydrogenating oils. 14,340. June 5.

Complete Specifications Accepted.

9291 (1918). Soc. Franç. des Glycerines. Distilling glycerine. (125,302.) June 12.

9432 (1918). Soc. Franç. des Glycerines. Distilling glycerine. (125,571.) June 18.

13,097 (1918). Jackson (Twitchell Process Co.). Refining of oils. (127,459.) June 4.

14,537 (1918). Phillips. Extraction of oil from cotton seed. (127,478.) June 12.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Bloxam (Durand et Huguenin). 13,356. *See* XX.

Cuyck and Kerr. Manufacture of water-colours, and method of fixing them on fabrics etc. 14,233. June 5.

Koppers Co. Manufacture of paint or varnish and their ingredients. 14,845. June 12. (U.S., 29.6.18.)

Muslol. Enamels and enamelling. 14,455. June 6.

Niven. Production of paints with metal base. 13,732. May 30.

Schmidt. Writing inks. 14,768. June 11. (U.S., 25.7.18.)

Wright. Paints for use as undercoats etc. 14,346. June 5.

Complete Specifications Accepted.

10,793 (1916). Nauton Frères et de Marsac, and Tesse. Coating composition, particularly for aeroplane cloths. (126,989.) June 4.

3275 (1918). Soar. Producing direct permanent natural colour effects by the action of light rays on chemical matter. (127,683.) June 18.

14,022 (1918). Curbishley. Manufacture of lamp-black. (127,770.) June 18.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATIONS.

Feldenheimer, Plowman, and Schidrowitz. Manufacture of rubber. 13,992. June 2.

Nielson. Rubber compounds. 13,980. June 2. (U.S., 31.5.18.)

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATION.

Knowles and McArthur. Manufacture of tar-derivative tanning materials. 14,495. June 7.

COMPLETE SPECIFICATION ACCEPTED.

15,244 (1918). Broadhurst and others. *See* V.

XVI.—SOILS; FERTILISERS.

APPLICATIONS.

Dederich. Manufacture of fertilising-material. 13,686. May 30.

Fitzgerald. Utilisation of certain waste products in the manufacture of concentrated fertiliser. 14,412. June 6.

Fry and Wolf. Treatment of seeds. 13,774. May 30.

Thompson (Comp. des Phosphates de Constantine). Mechanical treatment of tricalcic phosphates. 15,026. June 14.

XVII.—SUGARS; STARCHES; GUMS.

APPLICATION.

Sauer. 14,771. *See* II.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATIONS.

Bedford and Rogers. 13,338. *See* XX.

Gnocchi. 13,734. *See* XIX.

Wade (Heuser). Manufacture of alcohol-reduced beverages. 14,218. June 4.

Weygang. Production of fermented liquors. 14,158. June 4.

COMPLETE SPECIFICATION ACCEPTED.

17,193 (1918). Stoll. Manufacture of peroxydase preparations. (120,571.) June 4.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Ersley. Adapting oil-cakes etc. to human food. 14,729. June 11. (Holland, 1.8.17.)

Fitzgerald. Utilisation of certain waste products in the manufacture of concentrated foodstuff. 14,413. June 6.

Fry and Wolf. 13,774. *See* XVI.

Gnocchi. Production of yolk-of-egg wines or liqueurs. 13,734. May 30.

Naaml. Vennootsch. Brons. Drying vegetables etc. 13,350. May 27. (Holland, 13.6.18.)

Pellerin. Manufacture of margarine etc. 13,476. May 28.

Porter and Smythe. Preserving perishable food etc. during storage or transit. 14,000. June 2.

Scanes. Apparatus for testing water. 13,166. May 26.

Vernon. Storage of flour. 14,531. June 7.

Whitham. Manufacture of cocoa and chocolate and treatment of oil seeds for recovering oil and by-products etc. 13,819. May 31.

COMPLETE SPECIFICATIONS ACCEPTED.

12,582 (1917). Linden. Complete treatment of sewage or contaminated liquid. (127,353.) June 12.

6184 and 10,913 (1918). Saint, Saint, and Saint. Manufacture of chocolate. (127,362.) June 12.

8705 (1918). Molassine Co., and de Whalley. Manufacture of food for cattle and other animals. (127,388.) June 12.

8891 (1918). Fyers and Watkins. Preservative treatment of fish. (127,404.) June 12.

9744 (1918). Linden. Apparatus for treating sewage. (127,419.) June 12.

10,765 (1918). Ellis and Gardner. Apparatus for producing powders from milk etc. (127,752.) June 18.

13,158 (1918). Terwen and Hoogenhuyze. Manufacture of decolorised, odourless and tasteless albumins from blood. (127,766.) June 18.

16,131 (1918). Beer. Recovery and making cheese of the food matters in whey. (127,484.) June 12.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Bedford and Rogers. Manufacture of alcohol. 13,338. May 27.

Bloxam (Durand et Huguenin Soc. Anon.). Manufacture of condensation products from formaldehyde and aromatic derivatives. 13,356. May 27.

Davies and Tcherniac. 13,619. *See* III.

Davies and Tcherniac. Manufacture of alkyl sulphates. 13,620. May 29.

Dreyfus. Manufacture of fatty acid derivatives. 15,033. June 14.

Hedstrom. 14,139. *See* VII.

Imray (Soc. Chem. Industry in Basle). Manufacture of allyl ester of 2-phenylquinoline-4-carboxylic acid. 13,502. May 28.

Soc. Chim. des Usines du Rhône. Manufacture of derivatives of aminobenzoic esters. 13,760—2. May 30. (Fr., 20.6.18.)

Soc. Chim. des Usines du Rhône. Manufacture of mono- and di-β-oxyethylaminophenol derivatives. 13,763. May 30. (Fr., 25.6.18.)

Soc. Chim. des Usines du Rhône. Manufacture of ethereal salts of ethylenic halogenhydrins. 14,549. June 7. (Fr., 26.6.18.)

Soc. Chim. des Usines du Rhône. Manufacture of substituted benzoic esters. 14,550. June 7. (Fr., 26.6.18.)

Taylor. Emulsification of oil of lemon etc. and water. 14,227. June 5.

Thompson (Poulenc Frères). Production of benzoic acid. 13,293. May 2.

COMPLETE SPECIFICATIONS ACCEPTED.

5089 (1917). Daniel and Bregeat. Recovery of ether, alcohol, and acetone from gaseous mixtures. (127,309.) June 12.

10,116 (1918). Barbet et Fils et Cie. Recovery of waste ether and alcohol vapours from the atmosphere of factories etc. (117,259.) June 12.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

Blount and Payne. Photographic sensitised paper. 13,314. May 27.

Greene and O'Malley. Colour photography. 14,631. June 10.

Larsen. Producing screens for the production of half-tone negatives. 14,906. June 13. (Ger. 29.6.18.)

COMPLETE SPECIFICATION ACCEPTED.

3275 (1918). Soar. *See* XIII.

XXII.—EXPLOSIVES; MATCHES.

COMPLETE SPECIFICATION ACCEPTED.

4219. (1918). British Dyes, Ltd., Turner, and Dean. Treatment of waste acid liquors from explosive works. (127,039.) June 4.

XXIII.—ANALYSIS.

APPLICATION.

Scanes. 13,166. *See* XIX.

COMPLETE SPECIFICATION ACCEPTED.

6892 (1917). Bassett. Detecting the presence of hydrogen in gaseous mixtures. (127,656.) June 18.

I.—GENERAL; PLANT; MACHINERY.

Furnace; High temperature ——, *with oxidising atmosphere.* E. Podszus. Z. angew. Chem., 1919, **32**, 146—147.

THE walls of the furnace chamber are built of fairly large blocks of fused zirconia freed from iron. Volatile impurities are readily removed from the zirconia during the operation of the furnace. The space between the blocks and the outer cylindrical iron casing is filled in with lumps of zirconite earth or zirconia, to which about one-third of the finely powdered material is added. About 1% of boric acid is added to facilitate the binding together of the lumps at a fairly low temperature. The bottom part is filled in with coarse sand. The heating gas is delivered to a number of burners—4 or 8—arranged within the material surrounding the chamber in such manner that the flames have a circulatory motion imparted to them. The burner orifices are made of exceedingly well-burnt zirconium oxide, this being produced by heating zirconia in an electric or blast furnace through which a current of air passes. The burners are likewise supplied with air or oxygen under pressure, heat recuperation being achieved by coiling the supply pipes in the space surrounding the furnace chamber. They are easily removed and renewed when necessary. If the diameter of the furnace chamber exceed 10 cm. the cover should preferably be composed of a number of thin segments of zirconia supported by means of thin rods of zirconia from a cover of fireclay arranged above. For smaller furnaces a one-piece cover of zirconia, 2·5 cm. thick, may be employed. The furnace is operated at first with gas and air, and ultimately the air is entirely replaced by oxygen. Ordinary lighting gas or hydrocarbon vapours may be employed, and a temperature approaching 2500° C. can be attained.—J. S. G. T.

Diesel engine. Neumann. *See* IIA.

PATENTS.

Furnace. L. Joubert, Paris. Eng. Pat. 120,212, 19.10.18. (Appl. 17,124/18.) Int. Conv., 19.10.17.

A FURNACE designed for the combustion of finely divided fuel is constituted of a stepped grate contained within a chamber, the upper end of which is closed. The powdered fuel is placed upon the grate, which occupies the lower part of the chamber, and the air necessary for combustion is brought into contact with the bottom face of the grate. The distillation gases pass downwards through the mass of fuel and burn under the grate. The combustion products are discharged into a chimney, preferably after passing through a jacket enclosing the furnace.—J. S. G. T.

Filtering-apparatus, particularly applicable for use with thick liquids, plastic and colloidal materials. Naaml. Vennoots. Vereenigde Nederlandsche Rubberfabrieken, Doorwerth, Holland. Eng. Pat. 122,627, 2.1.19. (Appl. 115/19.) Int. Conv., 25.1.18.

THE filter-plate is formed of a number of concentric rings, mounted within a casing and provided with projections, so that when the rings are in position concentric passages are formed between them. One side of each ring may be wholly or partly cylindrical and the other side conical, the projections being formed on the conical face and abutting against the cylindrical portion of an adjacent ring; or, both the inner and outer faces of the rings may be conical, but of different inclination, so that by relative axial displacement of the rings the concentric passages are reduced or enlarged.—W. H. C.

Filtering and straining liquids [e.g., petrol]; Apparatus for ——. H. L. Milner and A. R. Beeby, London. Eng. Pat. 126,447, 6.5.18. (Appl. 7583/18.)

A NUMBER of discs with central annular bosses projecting upwards and annular rims projecting downwards are clamped tightly, together with interleaved chamois leather or other filtering medium, between a stronger bottom disc and the top cover of the containing vessel by means of a vertical perforated hollow stem. The outer containing vessel is larger than the discs, and passages are provided so that the liquid to be filtered can pass from the hollow stem up through the chamois leather and out of the bottom of the vessel or *vice versâ*.—B. M. V.

Filter-press for sludge [peat], operated by compressed air. G. Doering, Berlin. Ger. Pat. 309,942, 19.10.17.

A GRAVEL filter-bed is arranged upon a table, above which is a bell which is moved up and down vertically by a piston. An endless band provided with shovelling and brushing arrangements passes over the surface of the filter bed. At either end of the table are vertical plates which move up and down, being operated by a cog wheel and lever arrangement, horizontal sliding plates serving to seal the chamber during the motion. By means of this press large masses of sludge can be dehydrated economically and rapidly.—J. S. G. T.

Filters with movable filter masses; Flushing of ——. H. Reisert Ges.m.b.H., Cöln-Braunsfeld. Ger. Pat. 311,128, 27.1.18.

THE flushing water is delivered under pressure to a chamber underneath the filter bed. A vertical channel, increasing in cross-section upwards, extends the length of the long axis of the filter and serves to deliver the flushing water to the filter bed, the water flowing in parallel courses to right and left.—J. S. G. T.

Refrigerating machines; Separation of oil from the refrigerant in ——. B. S. McClellan, Chicago, Ill., U.S.A. Eng. Pat. 126,092, 24.1.18. (Appl. 1392/18.)

PART of the oil is removed from the refrigerant in the condenser (see U.S. Pat. 1,201,208 of 1916; this J., 1916, 1206) under the influence of the cooling medium. A sealed siphon pipe allows the liquefied refrigerant to be withdrawn from the upper part of the layer of condensed liquid, while the oil is drawn off from below. A further quantity of oil is separated in an expansion valve, where a portion of the condensed refrigerant is allowed to vaporise by expansion, the cooling effect thus produced causing the oil to separate.—W. H. C.

Tube-mills for grinding ores and other materials; Conical ——. H. W. Hardinge, New York. Eng. Pat. 126,114, 26.4.18. (Appl. 7059/18.)

A TRANSVERSE screen is provided midway between the apex and the base of the conical discharge end of the tube-mill. In order that the action of the screen may not be hindered, the fine material which passes through is at once removed, either by suction through a pipe which projects through the hollow trunnion, or by lifting blades attached to the inner side of the cone between the screen and the discharge trunnion. Another method of effecting the discharge is by perforating the cone just beyond the screen so that as the mill rotates the sifted material passes out through the perforations into a receptacle placed below.—W. H. C.

Grinding or reducing suitable minerals or materials; Machines for ——. F. E. Whitham, Sowerby Bridge. Eng. Pat. 126,854, 3.7.18. (Appl. 10,910/18.)

In a disc grinder (see Eng. Pat. 18,716 of 1901; this J., 1902, 1155) the discs are provided with rings of diamond or other shaped teeth engaging with each other so that the passage for the material to be ground is zigzag in shape and gradually decreasing in size. The material is discharged by the fanning action of vanes provided on the rotating bottom disc, which is not mounted on a shaft, but is supported on a ball bearing and driven by bevel gears protected by a flange on the boss of the bottom disc. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 1722 of 1878.)—B. M. V.

Grinder. C. R. Jolitz, Denver, Colo. U.S. Pat. 1,301,449, 22.4.19. Appl., 13.3.18.

Horizontal perforated drums closed at one end are driven comparatively slowly by solid shafts; the material is moved forward and ground by spiral conveyors mounted on sleeve shafts revolving the reverse way to and faster than the drums. The shafts and drums are contained in and supported by a casing, outside which is the necessary gearing. —B. M. V.

Grinding mill. J. A. Bair, Tampa, Fla. U.S. Pat. 1,301,637, 22.4.19. Appl., 1.3.18.

A shaft inclined to the vertical carries a tapered rotor, engaging with a tapered shell, the smaller diameter being lower; both rotor and shell are formed of several rings provided with spiral cams, so that any turning movement binds the parts together more firmly. Alternatively, or in addition, the parts of the shell may be connected by vertical bars which are also engaged by the spiral cams in such a way that the parts are held more firmly together if the rings rotate.—B. M. V.

Pulveriser. H. J. Shelton, St. Louis, Mo. U.S. Pat. 1,302,232, 29.4.19. Appl., 4.11.18.

In a pulveriser of the type in which revolving hammers are mounted in a cylindrical grinding chamber, a pocket for foreign material is formed between the walls of the inlet duct and the grinding chamber, opening into the former.—B. M. V.

Dehydrating and desiccating apparatus. R. J. Fox, London. Eng. Pat. 126,135, 2.5.18. (Appl. 7382/18.)

The trays on which the material is supported are provided on both sides with a hinged or pivoted member to operate the flaps which act as dampers controlling communication of the trays with the air supply and discharge chambers.—W. H. C.

Drying apparatus. M. F. Loewenstein, New York. Eng. Pat. 126,748, 2.1.18. (Appl. 51/18.)

A number of endless conveyors are arranged one above the other in a casing, and between the carrying and idle portions of each conveyor is arranged a horizontally coiled pipe conveying hot gases of combustion. The pipe coils are enclosed by upper and lower plates, forming chambers through which pure air can be blown, the air passing out through perforations in the upper plates immediately under the material to be dried. By means of pipes with branches and partitions the combustion gases are caused to flow in series through all the coiled pipes, and the material to be dried also travels in series over all the conveyors, but the pure air, which may be heated beforehand, passes through the chambers in parallel.—B. M. V.

Evaporator [or dryer]. U. G. Stover, Waynesboro, Pa. U.S. Pat. 1,285,832, 26.11.18. Appl., 5.1.18.

The apparatus consists of a hollow base divided into compartments each provided with a heating unit. Above and communicating with each compartment of the base are three chambers, the two outer ones being inclined to the vertical in opposite directions. The material to be dried is placed on removable trays in the three chambers, the trays in the intermediate chamber having a greater capacity than those in the outer ones. Air heated in the hollow base passes upwards through the chambers, each of which is provided with a damper. The fresh material is placed on the trays in the outer chambers, and when partly dried is transferred to the trays in the intermediate chamber.

Dryer; Rotary oven and ——. A. Johnson, Battle Creek, Mich. U.S. Pat. 1,298,955, 1.4.19. Appl., 23.4.18.

Each end of a cylindrical drying oven is provided with a hollow trunnion supported on rollers. The open ends of the hollow trunnions are closed by baffle-plates, supported independently. The material is introduced into the oven through an inclined shoot, which projects through one trunnion, and is discharged through the other trunnion.—W. H. C.

Drying apparatus. C. W. Hottmann, Philadelphia, Pa. U.S. Pat. 1,302,165, 29.4.19. Appl., 8.12.17.

A horizontal drying chamber of annular cross-section is mounted on anti-friction devices. The ends of the drying chamber are closed by plates provided with a series of ports which, by the rotation of the dryer, are brought into register with discharge passages in a stationary member. Fluid may be passed through the central space enclosed by the inner wall of the dryer.—J. S. G. T.

Dehydration; Apparatus for electro-osmotic —. Electro-Osmose A.-G. (Graf Schwerin Ges.), Berlin. Ger. Pat. 311,053, 21.10.17.

In electro-osmotic dehydration apparatus, *e.g.*, of the filter-press type, blocking up of conduits etc. outside the dehydration region proper occurs owing to the deposition of dehydrated matter. Such stoppages are prevented by electrically insulating the conduits etc. which come into contact with the material to be dehydrated.—J. S. G. T.

Recording the supply of liquid to chemical or other plant; Apparatus for automatically ——. J. Turner and R. O. Eames, Huddersfield. Eng. Pat. 126,209, 9.7.18. (Appl. 11,229/18.)

The liquid is discharged from a tank through a siphon, which is of larger bore than the liquid inlet pipe. When the liquid has risen sufficiently to cause the siphon to act, a float operates a switch so as to close an electric circuit. This actuates a pen on a recording drum and indicates each discharge of the tank by a short line. As the level of the liquid falls, the float drops again and the circuit is broken. As the siphon is of larger bore than the inlet pipe, the tank empties itself at each discharge and the siphon is stopped until the tank is full again. The quantity of liquid flowing out at each discharge is measured, and this figure, multiplied by the number of marks on the drum, gives the quantity discharged. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 22,351 of 1911.)—W. H. C.

Surface condenser for condensing steam and other vapours and method of operating the same. E. Morterud, Torderöd, Norway. Eng. Pat. 126,565, 1.10.18. (Appl. 15,960/18.)

Condensers of the type wherein the vapour to be cooled flows in a tube surrounded by a jacket of cold liquid, suffer from the defect that the velocity of the vapour to be cooled diminishes from intake to outlet, owing to condensation. This

defect is removed by operating the condenser with a little more steam or other vapour than can be condensed in a single flow, and conducting the uncondensed steam or vapour from the outlet end, back to one or more points between the inlet and outlet of the condenser. The steam or vapour to be returned is withdrawn from the outlet end of the condenser by means of a fan or similar device. —J. S. G. T.

Catalysing material. E. Weintraub, New York, Assignor to General Electric Co. U.S. Pat. 1,299,641, 8.4.19. Appl., 26.3.18.

THE claim is for a catalyst formed of "fibrox" (silicon oxycarbide, this J., 1915, 615) impregnated with nickel.—W. H. C.

Heat insulation; Method of and apparatus for — —. R. A. Fessenden, Brookline, Mass. U.S. Pat. 1,301,675, 22.4.19. Appl., 6.3.16.

A HEAT insulator for a high-temperature chamber consists of a coating formed by heating an alloy composed of a metal of high melting point, such as a metal of the iron group, and a metal such as chromium, whose oxide is a good thermal insulator at high temperatures.—J. S. G. T.

Distilling apparatus. F. A. Graham, Harbor Springs, Mich. U.S. Pat. 1,302,363, 29.4.19. Appl., 14.9.18.

AN air compressor is arranged within a tank containing the liquid to be vaporised. The liquid is vaporised by heat from the air compressor and the vapour is condensed in a coil cooled by the compressed air expanding through a jet.—B. M. V.

Temperature changes in gases; Method of obtaining — —. *Apparatus for exchanging heat.* A. S. Ramage, Detroit, Mich. U.S. Pats. (A) 1,302,430 and (B) 1,302,431, 29.4.19. Appl., 3.12.15. Renewed 26.3.19.

(A) IN the fractional liquefaction of a mixture of two or more gases, the gaseous mixture is expanded adiabatically in successive charges, the charge undergoing expansion being surrounded with the next succeeding unexpanded charge, a heat exchange being thereby effected between the respective charges. As a result of the cumulative cooling effect the temperature of the mixture is reduced in stages in such manner that the various gaseous constituents may be separately liquefied and recovered. (B) In an apparatus for the adiabatic expansion of gases, the gas compressor is surrounded with a cooling chamber, through which the compressed gas is caused to circulate, passing thence to the expansion device which is surrounded by a tank adapted to contain a temperature-changing fluid, an outlet being provided for the cooled gas.—J. S. G. T.

Reaction column. C. Otto und Co. Ges.m.b.H., Dalhausen-Ruhr. Ger. Pat. 309,975, 8.2.18.

THE column is composed of two co-axial hollow cylinders, the inner of which rotates about a vertical axis, and is built up of a number of cylindrical sections. Cups, hoods, and scrapers are carried upon the outer surface of the inner cylinder, and some may, if desired, be attached to the inner surface of the outer cylinder.—J. S. G. T.

Rendering liquids homogeneous; Process and apparatus for* —— *with simultaneous concentration therein of gases. **W. G. Schröder, Dinkersbühl. Ger. Pat. 309,976, 30.10.17.**

THE liquid to be rendered homogeneous is contained within a closed vessel provided with a stirrer which preferably rotates along with the vessel. Air or other gas under pressure is in contact with the liquid, which is thereby forced through fine fissures. Concentration of gas in the liquid and homogeneity of the latter are thereby simultaneously achieved. —J. S. G. T.

Evaporation of liquids; Apparatus for the —. Elektrizitätswerk Lonza A.-G. in Basel, and H. Danneel, Basle, Switzerland. Ger. Pat. 310,242, 26.9.17.

EVAPORATION is effected in a vessel having the form of an inverted cone, to which the liquid is supplied from a reservoir, through a pipe connecting the reservoir with the apex of the cone. An electric heating coil is arranged over the surface of the liquid within the evaporator. In consequence of the conical form of the evaporation vessel, an increase in the distance between the heating coil and the surface of evaporation is accompanied by a diminution of the area of the surface and the process is thereby rendered more regular.—J. S. G. T.

Boiler scale; Method for diminishing the deposition of — — *in steam boilers, preheaters, etc., by electrolysis.* O. Rummel, Berlin. Ger. Pat. 310,812, 25.4.18.

CONDUCTING substances which are not decomposed by electrolytic action, and which do not attack the walls of the boiler, are added to the water employed in the boiler. For this purpose colloidal solutions of metals, such as zinc or aluminium, or of graphite or carbon may be used. J. S. G. T.

Electrical purification of gases; Process for the —. Siemens Schuckertwerke Ges. m. b. H., Berlin. Ger. Pat. 311,111, 10.4.18.

THE usual procedure for the electrical deposition of fine particles from gases is improved by suitable adjustment of the gas pressure to the electric tension employed. The higher the electrode potential employed, the smaller should be the gas pressure. J. S. G. T.

Filtering tanks [for separating oil and water]. H. Ten Winkel, New York. Eng. Pat. 126,574, 4.11.18. (Appl. 18,008/18.)

Evaporating [drying] moisture-containing materials; Process of —. *Apparatus for evaporating [drying] moisture-containing materials. Evaporating [drying] system for moisture-containing materials.* G. D. Harris, Bayonne, N.J. U.S. Pats. (A) 1,296,508, (B) 1,296,509, and (C) 1,296,510, 4.3.19. Appl., 11.11.15. (B) and (C) Renewed 16.7 and 4.11.18.

SEE Eng. Pat. 23,291 of 1914; this J., 1916, 241.

Furnace. H. Batchelor, Sheridan, Wyo. U.S. Pat. 1,296,906, 11.3.19. Appl., 28.5.15.

SEE Eng. Pat. 120,522 of 1918; this J., 1919, 1 A.

Apparatus for subjecting matter to the action of gases. Eng. Pat. 126,773. *See* VII.

Apparatus for treating substances. **U.S. Pat. 1,298,790.** *See* **XII.**

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Banded bituminous coal; The four visible ingredients in ——. Studies in the composition of coal, No. I. M. C. Stopes. Proc. Roy. Soc., 1919, B, **90**, 470–487.

As a contribution towards a more exact knowledge of the "physiography of coal sections," details are given of the macroscopic and microscopic features of the four constituents of which British palæozoic "streaky" bituminous coal was found to be composed. Although not actually homogeneous or analogous to the crystals in a rock section, the components were sufficiently well characterised for separation in a comparatively pure state by hand, and also showed marked differences in appearance and structure under the microscope, in effect on a photographic plate, and in behaviour towards various solutions. The constituents are provisionally designated "fusain" (the equivalent of "mother of coal" and "mineral charcoal"), "durain" ("dull" hard coal), "clarain" (bright coal) and "vitrain" (brilliant, with conchoidal fracture).—W. E. F. P.

Ammonia production by the gasification of coal and coke in the presence of steam and air. H. Salmang. Dissertation, Aachen, 1914. Z. angew. Chem., 1919, **32**, 148.

When coke containing 1·01% nitrogen and 0·89% hydrogen was gasified in an atmosphere of carbon dioxide, of the nitrogen content of the coke gasified, 2·1% was converted into ammonia when thoroughly dried carbon dioxide was used, the corresponding figures for ordinarily dried and moist carbon dioxide being respectively 3·4% and 17·1%. The effect of steam alone is shown in the following table:—

Temperature, °C.	Grams of steam to 1 grm. of gasified carbon	Percentage of gasified nitrogen present as NH_3
1,050	considerable	35·9
1,100	62·5	8·1
1,100	191·1	10·3
1,100 with addition of 5% $CaCO_3$	38·0	27·0

The following table gives the percentage of the gasified nitrogen present as ammonia, when the gasification was carried out in an atmosphere of steam and air, calcium carbonate or ferric oxide being in some cases added to the coke:—

Substance added to the coke	Atmosphere corresponding to 1 grm. carbon		Percentage of gasified nitrogen present as NH_3
	Steam, grms.	Air, litres	
0	76·1	2·80	59·0
5% $CaCO_3$	19·1	8·24	62·8
5% $CaCO_3$	42·0	5·78	96·3
5% Fe_2O_3	21·6	7·18	70·0
0	7·3	8·91	7·9
5% $CaCO_3$	32·5	9·47	16·6

Under given conditions of ammonia concentration and duration of heating, the velocity of decomposition of ammonia in the presence of steam is about $\frac{1}{4}$th—$\frac{1}{20}$th of what it is in the presence of nitrogen and absence of steam. The yield of ammonia is increased by the presence of steam and a considerable excess of air. Calcium carbonate has a similar effect. Addition of lime in general increases somewhat (from 0 to 12%) the percentage of the gasified nitrogen present as ammonia when coal is gasified at 900° C. In the presence of steam and air. A table of results obtained with various coals is given, the percentage of the nitrogen gasified as ammonia varying from 73—95% in the absence of lime, to 81%—96% in the presence of lime. The steam present was usually 10 kilos. per 1 kilo. of coal gasified. Less of the gasified nitrogen was present in the form of ammonia in the case of peat coke than was the case with coke derived from coal. The addition of lime however increased the yield about 100%. The carbon-nitrogen ratio in the coke was the same at the end as at the commencement of the gasification process.—J. S. G. T.

Hydrocarbons; Contributions to the chemistry of ——. I. Occurrence of ethylene in nature. J. Tausz. Z. angew. Chem., 1919, **32**, 139—140.

The gases from a Pechelbronn petroleum well are shown to contain 0·004—0·005% of ethylene. The latter was separated by absorption in mercuric acetate solution and after liberation from its mercury compound its composition was determined by the method of Ubbelohde and de Castreau (this J., 1911, 1091). As a proof that no propylene or butylene was present, the action of the gas in inhibiting the absorption of oxygen by phosphorus was determined. A mixture containing 0·4% of the olefine immediately caused the appearance of phosphorescence in the phosphorus pipette, which agreed with the limit at which synthetic ethylene allowed phosphorescence to appear at the same temperature (18° C.). The presence of 0·01% of propylene inhibited the oxidation, whilst the same effect was obtained by the action of a trace of the three butylenes.—C. A. M.

Diesel engine; Investigation of the ——. Thermodynamic study of the production of oil gas and the mixture. K. Neumann. Z. Ver. Deuts. Ing., 1918, **62**, 706—711, 722—726, 763–768. Chem. Zentr., 1919, **90**, II., 480—481.

The vapour pressure curves of various oils were determined. Tar oils derived from lignite and coal were vaporised in a steel cylinder containing air, and the constitution of the oil-gas and its dependence upon pressure, temperature, and time determined. The results indicate that oil-gas derived from tar oil is composed principally of methane, ethane, hydrogen, heavy hydrocarbons, and carbon monoxide; carbon dioxide and nitrogen are almost negligible. The concentrations are functions of the temperature and pressure, the proportion of heavy hydrocarbons decreasing and the proportions of methane and hydrogen increasing with rise of temperature. The valuation of oils for power purposes on the basis of their hydrogen content is not decisive. Oils with low hydrogen content may yield oil-gas containing much hydrogen and methane. The formation of the gas-air mixture in the Diesel engine is dependent upon the injector action and the velocity of vaporisation of the oil. The production of the mixture is facilitated by fine atomisation of the oil. The velocity of vaporisation is greater in proportion as the specific gravity and latent heat of vaporisation of the oil are smaller and the saturation pressure greater. The greater the variation of vapour pressure with temperature, the greater the velocity of vaporisation. However, oils with too steep a vapour pressure curve and high vapour pressure at low temperature, are not suitable for use in Diesel engines, as by their turbulent evaporation, the air necessary for combustion may be displaced, and a poor mixture result. Cracking of the heavy hydrocarbons into simpler constituents is, in

general, accompanied by brisk oil-gas formation. Oils derived from lignite are more suitable for use in Diesel engines than those derived from coal, owing to the fact that formation of oil-gas from the former oils commences at a lower temperature. The respective velocities of formation of oil-gas from paraffin oil, heavy coal tar oil, and anthracene oil are in the ratio 10 : 2 : 1.—J. S. G. T.

Mineral oils; Soap content of refined —. J. Marcusson. Mitt. k. Materialprüf., 1918, **36**, 279—280.

ALTERATIONS in the methods of refining mineral oils which have been introduced during the last four years have caused the refined products to contain a considerable amount of alkali soap. As a rule the amount of soap in mineral oil can be determined volumetrically, but this method was not applicable to marine engine oil prepared from German crude oil. This oil had sp. gr. 0·9250 at 15° C., and contained 0·01% of acid (as SO_3), and 0·029% ash. It was completely soluble in petroleum spirit and the soap was not decomposed by shaking the solution with hydrochloric acid. To determine the soap the following gravimetric method was used:—A solution of 50 grms. of the oil in 3 vols. of petroleum spirit was shaken with successive portions of 22 c.c. of 50% alcohol (7 times in all), until the extract left no appreciable residue. The united alcoholic extracts were shaken with petroleum spirit, to remove dissolved oil, evaporated, and the residue of soap (0·17%) was dried at 105° C. and weighed. The combined acid in the soap had iodine value 8·2 and acid value 157·5, and contained a considerable proportion of sulphur. From the ash in the oil the amount of soap was calculated to be 0·15%, corresponding with the molecular weight (356·6) of the acid. As a rule when the amount of ash is small its weight multiplied by 5·2 gives, with sufficient accuracy, the amount of soap.—C. A. M.

Paraffin wax; Determination and fractionation of —— *by means of butanone.* F. Schwarz. Mitt. k. Materialprüf., 1918, **36**, 241—248.

A METHOD of determining paraffin wax is based on the observation (this J., 1912, 63) that a hot solution of mineral oil in methyl ethyl ketone (butanone) yields a deposit of paraffin wax on cooling. Pure anhydrous butanone dissolves a considerable amount of paraffin wax, even at low temperatures, and it is necessary to add about 1·3% of water, which raises the sp. gr. of the butanone from 0·806 to 0·812 at 20° C.:—From 1 to 5 grms. of the distillate (or less when a large amount of paraffin wax is present) is dissolved in the smallest possible amount of butanone (sp. gr. 0·812 at 20° C.) in a test-tube 25 to 35 mm. in diameter, and the solution cooled to about −20° C., and treated with a sufficient quantity of the same chilled butanone to precipitate the paraffin wax, without causing any oil to separate. The precipitate is transferred to a filter previously chilled with a mixture of ice and salt, washed with the butanone, the temperature of which must not exceed −15° C., and continually stirred with the thermometer during the filtration. When free from oil it is dissolved off the filter by means of benzene or petroleum spirit, the solvent evaporated, and the residue weighed. As a rule duplicate results agree within 0·1 to 0·2%. By fractional precipitation of the paraffin wax with butanone (sp. gr. 0·812) first at −10° C., and then at −15° C., results more comparable with works' practice are obtained. For example, a dark machine oil which yielded 6·1% of paraffin wax (m.pt. 40°—42° C.) in a single precipitation as described above, gave 5·3% (m.pt. 42°—45·5° C.) at −10° C. and 1·7% (m.pt. 32·5°—35° C.) at −15° C. The sum of the two precipitations invariably exceeds the amount obtained in a single precipitation. Precipitation with butanone (sp. gr. 0·812) at −5° C. affords a good means of determining the proportion of hard and soft wax in paraffin candles. —C. A. M.

Asphalts; Composition of natural and artificial —. J. Marcusson. Mitt. k. Materialprüf., 1918, **36**, 209—230. (See this J., 1916, 1099; 1918, 403 A.)

Natural asphalts.—The asphaltogenic acids in natural asphalts are brown tarry products containing variable proportions of sulphur. They form sparingly soluble sodium salts. By long-continued heating at 200° C. they are converted into anhydrides, whilst at higher temperatures substances resembling asphaltenes are formed. Asphaltogenic acids from Trinidad crude asphalt closely resemble the acids obtained by heating Texas petroleum oil in the air. In the true asphalts the amount of asphaltenes is less than that of the petroleum resins and oily substances together. For example in the case of Trinidad asphalt it was 37% as against 54% of oil and resin, and in Bermuda asphalt 35·3% as against 53%. The proportion of mineral matter also influences the character of natural asphalt, increasing the firmness and giving a matt surface, whilst pure bitumens show a polished surface. The mineral matter in Trinidad asphalt ranges from 33 to 55%. *Fat distillation residues.*—The sulphur compounds in the residues from the distillation of fats, unlike those in natural and petroleum asphalts, are not precipitated by mercuric bromide solution, and this reaction may be used for detecting petroleum pitch in fat pitch. The following table shows the composition of typical fat pitches:—

	M.pt. (Kramer-Sarnow)	Free acid: Acid value	Free acid: As oleic acid	Saponif. value	Total saponifiable constituents
	°C.		%		%
Stearine pitch (*a*)	74	25	13	102	87
,, (*b*)	41	23·1	11·6	55	38
,, (*c*)	—	17·2	8·8	50	24
Wool fat pitch	33	6·5	3·3	41	29

The test of Donath and Margosches will show whether a fatty acid or wool fat distillation residue is present:—10 grms. of the sample is boiled for 30 mins., beneath a reflux condenser, with 50 c.c. of *N*/2 alcoholic alkali: if a crystalline deposit is formed above the insoluble pitchy constituents the presence of wool-fat pitch is indicated. The crystalline substance consists, not, as supposed by Donath and Margosches, of a cholesterol compound, but of the alkali salts of hydroxy-acids. A so-called "pitch-gum" prepared by heating a fat distillation residue with about 10% of sulphuric or nitric acid at 240°—250° C. (Ger. Pat. 817,299), to obtain an elastic mass, consisted of 65% saponifiable matter, mainly oxidised fatty acids, whilst the unsaponifiable matter was a heavy oil. Asphaltenes were not present. An elastic insulating mass made by heating stearine pitch with sulphur at about 155° C. (Eng. Pat. 3045 of 1894; this J., 1894, 531) contained 35% of substances soluble in chloroform. The soluble portion was a soft pitch with an acid value of about 10 and contained 66% of saponifiable substances. It contained sulphur, but did not give the mercuric bromide reaction of natural and petroleum asphalts. The insoluble portion consisted of about 25% of saponifiable matter, the remainder being barium sulphate added

as a filling material. *Coal-tar pitch.*—A sample of hard coal-tar pitch contained:—Substances insol. in chloroform, 27; benzene-soluble tar resins, 21; chloroform-soluble tar resins, 4·5; pyridine-soluble tar resins, 2·5; phenols, 1; and hydrocarbons and neutral substances, 44%. The resins of coal-tar pitch soluble in benzene and chloroform melt when heated, whereas those soluble in pyridine swell up like the asphaltenes of natural asphalt. All three consist largely of carbon, with some hydrogen and oxygen, together with traces of sulphur, but no nitrogen. When heated with strong sulphuric acid they yield water-soluble sulpho acids, whereas petroleum resins and asphaltenes form insoluble acids. They also yield sparingly soluble formolites on treatment with sulphuric acid and formaldehyde. The iodine value of the resins soluble in benzene and chloroform is about 26 (approximately the same as that of asphaltenes). On treating the benzene solution of the resin with an ethereal solution of ferric chloride a dark precipitate of a double compound of the resin and ferric chloride is produced; it is soluble in pyridine. Similar precipitates are given by petroleum resins and asphaltenes. When the benzene solution of the benzene-soluble resin is heated to 100°–110° C. the colour changes from red-brown to deep brown or black, and a large proportion of the resin becomes insoluble in benzene and in chloroform. On this reaction depends the resinification of coal tar. The insoluble constituents of coal tar, which consist mainly of elementary carbon, also contain tar resins. Coal comes nearest to the pyridine-soluble resin in colour, solubility, and elementary composition, whilst the chloroform-soluble resin is intermediate. The reactions of the coal-tar resins, and the behaviour of their nitro derivatives, points to their having a cyclic or polycyclic structure, with the oxygen probably combined in bridge formation.
—C. A. M.

Washing cyanogen compounds from gases. Bertelsmann. *See* VII.

PATENTS.

Lignin fuel from sulphite-cellulose waste lyes; Plant for the preparation of ——. E. Mürbe, Görlitz. Ger. Pat. 310,808, 21.1.14.

THE lignin is discharged from the autoclave by means of a jet of water into a filtering arrangement of the nature of a funnel with a perforated plate, after which the partially drained mass is transported by a bucket and band conveyor to a plant of known type for drying and transporting moist material whilst exposing it to the action of moving flue gases. The solid lignin precipitate as it comes from the autoclave is in the correct condition to form its own filtering bed and allows the waste liquor to flow away rapidly.—J. F. B.

Stills; Scraping apparatus for [*oil* ——]. A. A. Ashworth, Coffeyville, Kans. U.S. Pat. 1,300,547, 15.4.19. Appl., 18.2.18.

SCRAPING elements are provided in contact with the fire-plate of the still. The scraper oscillates and is retained within the transverse area of the fire-plate.—A. E. D.

Stills [*; Oil* ——]. A. A. Ashworth, Coffeyville, Kans. U.S. Pat. 1,300,548, 15.4.19. Appl., 2.3.18.

A ROTATING agitating device maintains an annular coating of oil in a horizontal tubular still. An oil outlet is provided which serves to define the thickness of the oil layer.—A. E. D.

Crude-oil still. T. E. Murray, New York. U.S. Pat. 1,302,200, 29.4.19. Appl., 7.11.16.

A VERTICAL tubular coking still for crude oil registers at the lower end with a coke receptacle, which extends horizontally and projects through the wall of a casing, the projecting part being provided with a removable door.—A. E. D.

Desulphurising petroleum oils; Process of ——. E. B. Cobb, Jersey City, N.J., Assignor to Standard Oil Co. U.S. Pat. 1,300,816, 15.4.19. Appl., 11.9.15.

ELEMENTARY sulphur is removed from petroleum by heating the oil with an alkali sulphide for 1 to 3 hrs. at 160°–190° F. (71°–88° C.).—A. E. D.

Lubricating oils; Treating waste and other —— for the elimination of sulphur and in the case of waste oils for the elimination of other impurities. J. L. Mantle, Merry Hill, Staffs. Eng. Pat. 126,882, 10.9.18. (Appl. 14,673/18.)

WASTE and other lubricating oils containing sulphur are treated at about 100° C. with barium chloride in the proportion of 1 oz. of the salt to 1 gallon of oil. Prior to heating, the water and heavy impurities are settled out. The temperature is maintained until the surface of the oil is clear and free from scum; the oil is then filtered through asbestos.
—A. E. D.

Power production; Use of solid fuel for ——. A. C. Michie, Newcastle-upon-Tyne, and E. G. Weeks, Northumberland, Assignors to C. H. Merz and W. McLellan, London. U.S. Pat. 1,301,960, 29.4.19. Appl., 2.3.18.

SEE Eng. Pat. 117,290 of 1917; this J., 1918, 490 A.

Gas-producer. E. S. Huntley, Friezland, Queensland, Assignor to The Hampden Cloncurry Copper Mines, Ltd., Melbourne, Australia. U.S. Pat. 1,300,839, 15.4.19. Appl., 23.2.16.

SEE Eng. Pat. 100,631 of 1916; this J., 1917, 447.

Gas-producer. T. R. Wollaston, Manchester. U.S. Pat. 1,303,527, 13.5.19. Appl., 19.1.18.

SEE Eng. Pat. 113,025 of 1917; this J., 1918, 176 A.

Distilling crude oil and other hydrocarbons; Process of and apparatus for ——. A. F. G. P. J. von Grocling, Coffeyville, Kans., Assignor to Atlas Process Co., Inc., New York. U.S. Pat. 1,295,088, 18.2.19. Appl., 23.4.15.

SEE Eng. Pat. 16,713 of 1914; this J., 1915, 1045.

[*Lubricating*] *oil; Process of separating* —— [*from impurities*]. C. J. Skidmore, Brooklyn, N.Y., and P. F. Conerty, New York. U.S. Pat. 1,302,094, 29.4.19. Appl., 21.10.14.

SEE Eng. Pat., 14,781 of 1915; this J., 1916, 528.

Mixing apparatus [*for refining mineral oils with acid*]. J. Bogaerts, Sutton. U.S. Pat. 1,302,294, 29.4.19. Appl., 21.10.18.

SEE Eng. Pat. 116,765 of 1917; this J., 1918, 405 A.

Filtering petrol. Eng. Pat. 126,447. *See* I.

Filter-press for peat. Ger. Pat. 309,942. *See* I.

Detergents. U.S. Pats. 1,301,662—3. *See* XII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

PATENTS.

Heating of gaseous fluids. A. C. Ionides, jun., London. Eng. Pat. 126,477. (Appls. 7958, 11.5.18, and 19,827, 30.11.18.)

THE invention comprises a combustion chamber, wherein supplies of gas and air in correct proportions for complete combustion are burnt. The products of combustion are passed through an external tubular member and discharge at a lower level than that of the combustion zone. The combustion chamber and tubular member are enclosed within a duct in which the gaseous fluid to be heated flows in general in counter-current to the products of the gaseous combustion. The products of combustion may if desired be passed from the tubular member into an outlet pipe contained within a flue through which the air or other fluid to be heated flows. In a modification, the fluid to be heated passes upwards through an annular duct which is connected at its upper end with a co-axial outlet pipe passing through the combustion chamber, the products of combustion passing downwards over both surfaces of the annular duct. A number of heaters may be arranged within a common casing, through which the air or the gas to be heated passes.—J. S. G. T.

Tungsten [incandescence] filaments; Connecting —— to electrical conductors. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 126,441, 4.5.18. (Appl. 7511/18.)

A TUNGSTEN filament is connected to a conductor of softer metal by pinching a portion of the filament so as to embed it in the conductor, and applying a paste comprising powdered tungsten, water glass, and a "getter," containing phosphorus, to the joint.—B. N.

Filament lamps; Electric [incandescence] ——. A. Copelin, Enfield, and The Edison Swan Electric Co., Ltd., London. Eng. Pat. 126,483, 14.5.18. (Appl. 8094/18.)

A SUPPORT is arranged to project within the lamp bulb from the usual glass stem, the end of the support carrying red phosphorus or other substance employed for neutralising the occluded gas, the phosphorus or the like being located centrally and in close proximity to the points of connection between the filament and the leads.—B. N.

Carbons for electric arc lamps; Manufacture of ——. W. Heape, London, and H. B. Grylls, Weybridge. Eng. Pat. 126,673, 5.2.17. (Appl. 1802/17.)

CARBONS for electric arc lamps are impregnated with an organic salt of calcium by immersion in a solution for 2 to 5 hours, the strength of the solution being such that the finished carbons will contain between 0·5 and 1% by weight of calcium oxide. The carbons are submitted to a further action of the impregnating solution in a vacuum for about 5 hours, after which they are surface-washed and dried. They are finally warmed to a moderate temperature in an oven, and subsequently baked in airtight retorts at about 1000°—1100° C. Sugar or a colloid is added to the calcium salt solution to prevent exudation of the calcium salt during drying of the impregnated carbons. The treated carbons are specially useful for searchlights, the efficiency in regard to concentration and production of light and consumption of power being considerably increased.—B. N.

Electric lamps and other vacuum tubes; Leading-in conductors for incandescence ——. K. Ohtani, Tokyo, Japan. Eng. Pat. 126,859, 12.7.18. (Appl. 11,485/18.)

LEADING-IN conductors, for electric lamps and other vacuum tubes, are manufactured from nickel, by heating the metal to about 1400° C., *i.e.*, above the temperature necessary to remove occluded gases, in an atmosphere of nitrogen, or one in which oxygen is absent, or in a vacuum for about 10 minutes. The nature of the metal is changed so as to render it impervious to attack by sintered glass.—B. N.

Heating liquid by means of heat produced by chemical reactions in closed vessels; Proceeding and apparatus for ——. H. Turrettini, Geneva, Switzerland. U.S. Pat. 1,303,618, 13.5.19. Appl., 23.3.18.

SEE Eng. Pat. 117,601 of 1918; this J., 1919, 248A.

Waste wood pulp liquors. U.S. Pats. 1,298,476—1,298,481 and 1,298,594. *See* V.

III.—TAR AND TAR PRODUCTS.

Dimethylnaphthalenes of coal tar. R. Weissgerber and O. Kruber. Ber., 1919, **52**, 316—370. R. Weissgerber, *ibid.*, 370—371.

THE heavy oil fraction, b.pt. 260° 265° C., is purified by alternate fractionation and agitation with small quantities of cold, concentrated sulphuric acid, and then stirred with 60% of its weight of 98% sulphuric acid for 8—10 hours at about 40° C. The pasty mass of sulphonic acids is separated and mixed with a little water, when a solid sulphonic acid is deposited. This is crystallised from 33% sulphuric acid and hydrolysed by steam at 130°—140° C., when 1.6-dimethylnaphthalene distils over as an oil, b.pt. 262° 263° C., sp. gr. 1·0056 at 15° C. The non-crystalline sulphonic acids are heated at 150°—160° C. for a few hours, causing some desirable isomerisations, and submitted to steam distillation as above, when a mixture of solid and liquid hydrocarbons passes over. The solid mixture usually has m.pt. about 50°—60° C., and is often so rich in 2.6-dimethylnaphthalene that this may be isolated by fractional crystallisation. Generally, however, the solid is sulphonated at 135°—140° C. and the product poured on ice, when a sparingly soluble sulphonic acid soon crystallises. This is hydrolysed by steam as before, giving the known 2.6-dimethylnaphthalene, m.pt. 110°—111° C., b.pt. 261°—262° C., already prepared by Baeyer and Villiger from ionone. The liquid sulphonic acids are also hydrolysed, when another mixture of solid hydrocarbons is obtained. This is again sulphonated at about 40° C. and the pasty product crystallised from 30% sulphuric acid, when two sulphonic acids are obtained which yield 2.7-dimethylnaphthalene on steaming, m.pt. 96°—97° C., b.pt. 262° C. On one occasion, a sulphonic acid was accidentally obtained from the liquids accompanying the 2.6-dimethylnaphthalenesulphonic acid, which gave 2.3-dimethylnaphthalene (the guaiene of guaiacum resin), m.pt. 104°—105° C., on steaming. The coal tar fraction of b.pt. 220°—290° C. is usually regarded as being deficient in solid constituents, but it now appears from this investigation that β-methyl- and 1.6-dimethylnaphthalenes are the only genuine oils present. (See also J. Chem. Soc., 1919, 1., 315, 318.)—J. C. W.

Diesel engine. Neumann. *See* IIA.

Asphalts. Marcusson. *See* IIA.

PATENTS.

Aromatic nitro-halogen compounds; Production of ——. C. Ellis, Montclair, N.J., U.S.A. Eng. Pat. 126,685, 10.2.17. (Appl. 2049/17.)

SEE U.S. Pat. 1,220,078 of 1917; this J., 1917, 499.

Nitration. Eng. Pat. 126,355. *See* XXII.

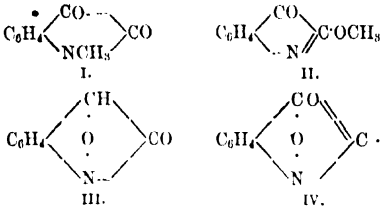
IV.—COLOURING MATTERS AND DYES.

Azo dyes; A method for the purification of certain ——. H. A. Lubs. J. Ind. Eng. Chem., 1919, **11**, 456.

THE dye, containing mineral matter from the salting-out process, is dissolved in a little water and the solution is filtered, boiled, and mixed with solid sodium acetate until the dye is almost completely precipitated, and then the precipitate is sucked as dry as possible on a filter and boiled with 95% alcohol, when the remaining sodium acetate is extracted. The method has been satisfactorily employed in the case of Brilliant Congo R, Congo Red, Azorubin, etc., and it is designed for the preparation of dyes for pharmacological experiments. —J. C. W.

Isatin series; New isomerides in the ——. G. Heller. Ber., 1919, **52**, 437—446.

WHEN the methyl ether of the lactim form of isatin (II) is heated with benzene at 200°—205° C., it is partly converted into the isomeride (I), and partly demethylated and transformed into a new isomeride, (III), designated "isatinone," crystallising in dark honey-coloured prisms, m.pt. 226° C. (decomp.). This is a feeble base but it dissolves slowly in *N*/2 sodium hydroxide, and from the solution 50% acetic acid precipitates another isomeride, "isatinol," (IV), in orange-yellow flocks (m.pt. 255° C.).



(See further J. Chem. Soc., 1919, i., 282.)—J. C. W.

Isonitrosoacetanilides and their condensation to isatins. T. Sandmeyer. Helv. Chim. Acta, 1919, **2**, 234—242.

WHEN a freshly prepared solution of hydroxylamine sulphate, made from sodium bisulphite and sodium nitrite by Raschig's method, is boiled with anilines and chloral hydrate, isonitrosoacetanilides are formed, NHAr.CO.CH:N.OH. The majority of these compounds, if the ortho-position is unoccupied, give excellent yields of isatins when heated with concentrated sulphuric acid at temperatures ranging from 55° to 100° C. and then diluted with water. A large number of examples are tabulated. (See further J. Chem. Soc., 1919, i., 318.)—J. C. W.

Diacetylindigotin. D. Vorländer and J. von Pfeiffer. Ber., 1919, **52**, 325—329.

N-ACETYLINDOXYL yields diacetylindigotin when oxidised by the requisite amount of permanganate but produces acetylanthranilic acid if an excess of the oxidising agent is employed. This proves that the acetyl groups in the red dye are attached to nitrogen, which helps to explain the divergence in colour from indigo. O-Acetylindoxyl forms indirubin when oxidised by perhydrol in acetic acid solution. By acetylating *o*-tolylindigo-white and oxidising the product by nitrous fumes, diacetyl-*o*-dimethylindigotin has been obtained. This crystallises in orange-yellow tablets, m.pt. 178° C. (See further J. Chem. Soc., 1919, i., 225.)—J. C. W.

Triphenylmethane dyes; Vat like reduction products of the ——. H. Wieland. Ber., 1919, **52**, 880—886.

THE basic triphenylmethane dyes are readily reduced by sodium hydrosulphite in aqueous alkaline solution to colourless salts which are re-oxidised to the dyes with extraordinary rapidity by air; the property is shared by the acid dyes such as Aurin, the phthaleins, and Fluorescein, which, however, are somewhat more slowly attacked by the reducing agent. The pure sodium salts have been isolated in the cases of Crystal Violet and Malachite Green, and that of the former appears to have the constitution $[(CH_3)_2NC_6H_4]_3C.SO_2Na$ or $[(CH_3)_2NC_6H_4]_2C.O.SO.Na$. The first phase of the reaction probably consists in the addition of SO_2Na groups at either end of the quinonoid system, followed by elimination of sodium chloride and sulphur dioxide. When the sulphinates are heated with an excess of alkali, the solutions lose their autoxidisability and the leuco compounds are formed, the sulphinic group being eliminated as sulphite. In the autoxidation the main portion of the sulphoxyl-group is eliminated as sulphite and the precipitate which is formed contains considerable quantities of carbinol which, however, is not a primary product of the change.—H. W.

Photosensitising dyes; Intermediates used in the preparation of ——. *I. Quinoline bases.* L. A. Mikeska, J. K. Stewart, and L. E. Wise. J. Ind. Eng. Chem., 1919, **11**, 456—458.

THE parent bases for the production of the photosensitising dyes, Pinaverdol, Pinacyanol, and Dicyanin are quinoline, 2-methylquinoline, and 2.6- and 2.4-dimethylquinolines. The well-known reactions by which these are obtained from aniline or toluidine have been studied and certain modifications introduced so that they may be prepared on a fairly large scale in the laboratory. The chief innovation is that extractions with ether are employed instead of steam distillations.—J. C. W.

Photosensitising dyes; Intermediates used in the preparation of ——. *II. Quaternary halides.* C. H. Lund and L. E. Wise. J. Ind. Eng. Chem., 1919, **11**, 458—460.

THE quinoline bases mentioned in the preceding abstract are treated with an equimolecular quantity of methyl or ethyl iodide in a round-bottomed flask connected to a reflux condenser, care being taken to modify the reaction by cooling when it has once set in, except in the case of the bases with methyl in position 2, which require prolonged heating on a water bath.—J. C. W.

Photosensitising dyes; Synthesis of ——. *Pinaverdol and Pinacyanol.* L. E. Wise, E. Q. Adams, J. K. Stewart, and C. H. Lund. J. Ind. Eng. Chem., 1919, **11**, 460—463.

THE authors have prepared about 15 dyes of this type by following the instructions of the original German patents. Their product *Pv I* is identical with the German Pinaverdol or the Sensitol Green

of the Ilford Co. It is made by slowly adding sodium methoxide solution to a solution of dry quinoline methiodide and 2.6-dimethylquinoline methiodide in boiling methyl alcohol, and allowing to cool slowly. Another product, *Pc IX*, is identical with Pinacyanol or Sensitol Red. It is obtained by adding a mixture of sodium hydroxide and formalin to a boiling, alcoholic solution of quinoline and quinaldine ethiodides, air being first expelled, then diluting somewhat with boiling water, and allowing to cool slowly, when lustrous, bluish-green needles are deposited. There is no real evidence that quinoline ethiodide enters into the reaction at all, and if it is replaced by potassium iodide, a dye, *Pc X* is formed, though in poor yield, which is very probably identical with *Pc IX*. *Pc IX*, like *Pc I*, is a quaternary iodide. If transformed into the chloride by reaction with silver chloride in concentrated hydrochloric acid, it gives *Pc XII*, which is more soluble than the iodide.—J. C. W.

Congo dyes and adsorption as the preliminary phase of chemical union. E. Wedekind and H. Rheinboldt. Ber., 1919, 52, 1013—1021. (Compare Wedekind and Rheinboldt, this J., 1914, 787.)

THE behaviour of the blue solution obtained by treating Congo Red with acids towards various colloids has been examined. Acid gels which are free from electrolytes (silicic, metastannic, titanic, tungstic, molybdic, and vanadic acids) neither adsorb the Congo dye acid nor cause any change in colour on heating; on the other hand basic gels (oxides of zirconium, thorium, aluminium, lanthanum, zinc, beryllium, iron, and chromium) adsorb the dye acid and, when heated, assume the red colour which is characteristic of the salts. It appears probable that the Congo acid belongs to the weakest class of acids and that aqueous solutions of Congo Red, in consequence of hydrolysis, always contain a greater or less amount of the red, azoid, free Congo acid which is transformed by hydrogen ions into the blue insoluble isomeride. The adsorption of the Congo acid is attributed to the formation of a primary adsorption compound of the free blue acid which, when warmed or preserved, becomes converted (probably through the red acid) into a complex salt of acid and base. The phenomenon thus gives an experimental confirmation of the hypothesis that, particularly in heterogeneous systems, chemical action is preceded by the production of an adsorption compound (Bayliss, this J., 1911, 1093). Similar behaviour is observed with other dyes such as Benzopurpurine 4 B, Benzopurpurine 10 B, Naphthalene Red, Benzo-Orange R, Congo-Corinth G, and Congo-Corinth B.—H. W.

Colour research; Some possibilities in ——. A. E. Everest. J. Soc. Dyers and Col., 1919, 35, 144—148.

Now that acenaphthene, phenanthrene, and carbazole are obtainable commercially they offer in their derivatives a wide and little studied field for colour research. The author indicates the general lines of development already recorded in the patent literature and elsewhere, and the possibilities for future investigation.—G. F. M.

PATENTS.

Azo-dyestuffs and metal compounds thereof, and their application in dyeing; Manufacture of mordant-dyeing ——. O. Imray, London. From Society of Chemical Industry in Basle, Switzerland. Eng. Pat. 126,460, 9.5.18. (Appl. 7816/18.)

MORDANT-DYEING azo-dyestuffs, which are also suitable for the production of metallic compounds, are manufactured by diazotising compounds of the general formula $\begin{matrix}(1)HO\\(2)NH_2\end{matrix}\!\!>\!R-SO_2.NH.X$ and coupling the diazo-compound with a coupling component. X is a hydrogen atom or a substituted or unsubstituted aryl residue; or it may be an amino-substituted aryl group and the tetrazo compound produced from it coupled with two molecular proportions of a coupling component or one molecular proportion each of two coupling components; or it may be a residue of the type $-SO_2.R^1\!<\!\begin{matrix}OH(1)\\NH_2(2)\end{matrix}$ in which the aryl residue R^1 may be identical or not with the residue R. The production of the metallic compounds may be carried out in substance or on the fibre according to Eng. Pats. 26,460/12, 1611/15, 15,127/15, 15,456/15, 16,803/15, or 104,045 (this J., 1913, 905; 1916, 301, 1104, 1255; 1917, 78, 542).

—L. L. L.

Copper compound of substantive ortho-[hydr]oxyazo dyestuff and process of making same. E. Anderwert, H. Fritzsche, and H. Schobel, Assignors to Society of Chemical Industry in Basle, Switzerland. U.S. Pat. 1,292,385, 21.1.19. Appl., 4.11.15.

A SOLUTION of a substantive *o*-hydroxyazo cotton dyestuff containing a 2.5.7-aminonaphtholsulphonic component is treated with a copper compound. (See also Eng. Pat. 12,932/15; this J., 1917, 382.)

Purpurine and similarly constituted anthraquinone compounds; Chlorination of ——. L. B. Holliday and Co., Ltd., Huddersfield, and H. D. Law, Rastrick, Yorks. Eng. Pat. 126,527, 2.7.18. (Appl. 10,787/18.)

CHLORO-DERIVATIVES of hydroxyanthraquinones are obtained by the action of sulphuryl chloride, in presence or in absence of iodine, on Purpurine, Alizarine Cyanine R, Alizarine Green G, Anthracene Blue W.R. or the sulphonated derivatives of these compounds. The chlorination is carried out by heating in nitrobenzene solution under a reflux condenser. The nitrobenzene is removed by steam and the product filtered off and washed. With the sulphonated compounds, the nitrobenzene is distilled off from the reaction mass and the product precipitated by salt or potassium chloride. According to the conditions one or more of the hydroxyl groups is replaced by chlorine. The following table gives examples of the dyeing value of the products when applied to wool:

Chlorinated product from:	Mordant	Chlorinated with sulphuryl chloride alone	Chlorinated with sulphuryl chloride in presence of iodine
Purpurine ..	Chrome	Dull Bordeaux red	Brownish-red
Alizarine Cyanine ..	,,	Greyish-blue	Does not dye
Anthracene Blue W.R.	,,	Blue	Dull violet
Acid Alizarine Green G. ..	Alumina	Yellowish-green	Deep bluish-green
,, ,,	Chrome	Greenish-black	Black
,, ,,	,,	—	Yellowish-green

—L. L. L.

Alizarine and its substitution products; Chlorination of ——. L. B. Holliday and Co., Ltd., Huddersfield, and H. D. Law, Rastrick, Yorks. Eng. Pat. 126,528, 2.7.18. (Appl. 10,788/18.)

ALIZARINE is chlorinated to give monochloroalizarine by action of sulphuryl chloride in presence or absence of a catalyst (see preceding abstract). By

e further action of sulphuryl chloride with the dition of a catalyst polychloro derivatives are pro- ced. The reaction is applicable to alizarine de- vatives, such as flavopurpurine, anthrapurpurine, lizarine Bordeaux, α- and β-nitroalizarine, alizar- e sulphonate, rufigallol, and Alizarine Garnet. ie following table gives their dyeing properties hen applied to wool:

Chlorinated roduct from:	Mordant	Chlorinated with sulphuryl chloride alone	Chlorinated with sulphuryl chloride in presence of iodine
lizarine ..	Alumina	Bright yellow ish-red	Bright orange red
„ R.G.	„	„ „	Bright reddish- orange
„ SX.	„	Dull orange	Bright orange
„ Orange R.	„	Orange	Brownish- orange
„ Garnet	„	Brownish- orange	—
„ Red S.	„	Bright yellow- ish-red	Reddish- orange
„ Bordeaux	„	Claret	Reddish-violet
nthragallol	„	Brown	Greyish-brown
rweco Alizar- ine Acid Red B.S.	„	Bright yellow- ish-red	Red
uligallol ..	„	Reddish-brown	Reddish-brown

—L. L. L.

l-Dihydro-1 : 2 : 2' : 1'-anthraquinonazine [*Indanthrene*]; *Manufacture of* ——. A. G. Perkin, Leeds. Eng. Pat. 126,764, 15.3.18. (Appl. 4585/18.)

y fusion of β-aminoanthraquinone with caustic otash in presence of sucrose, glucose, lactose, or ke compound the yield and purity of the vat dye- tuff are said to be improved. After fusion the melt : dissolved in a large quantity of water, boiled, nd the Indanthrene filtered off and washed.

—L. L. L.

Dibenzanthrone [*rat*] *colouring matter; Manufacture of* ——. A. G. Perkin, Leeds. Eng. Pat. 126,765, 15.3.18. (Appl. 4586/18.)

THE production of dibenzanthrone by fusion of benz- nthrone with caustic potash is improved by the ddition of sucrose, glucose, lactose, or similar com- ound to the melt. The by-products, obtained by he ordinary method, appear to be the result of ex- essive oxidation during fusion. The dyestuff is eparated by dissolving the melt in water, boiling, ltering, and washing.—L. L. L.

Dyes; New vegetable —— R. Harbottle and S. Sivertson, Durban, Natal. Eng. Pat. 126,742, 1.8.17. (Appl. 11,068/17.)

THE bark and roots of certain indigenous South African trees and also indigenous bulbs, furnish by extraction products that are useful dyestuffs. The extracts may be used with or without mordants for the dyeing or colouring of wool, silk, cotton, linen, leather, paper, wood, foodstuffs, or confectionery. The shades obtainable are pink, dark red, khaki, brown, green, blue, and black. The extracts are obtained by hot maceration and expression by means of suitable crushers; the filtered extracts being then concentrated in vacuum vessels. The by-products consist of excellent fibre and cellulose and may be used for the manufacture of paper or linoleum, or as fuel. The leaves of some of the plants contain tannin in sufficient quantities to make extraction remunerative.—L. L. L.

Dyes; Production of ——. A. M. Hart, Croydon. Eng. Pat. 126,754, 14.2.18. (Appl. 2652/18.)

INDIGO is sulphonated and mixed with alum and tartar, or with alum, tartar, and cudbear. The indigosulphonic acid may be neutralised before mixing, and the cudbear may be any soluble form, such as alcohol-extracted, ammoniated, or sulphonated cudbear.—L. L. L.

Gallocyanine series; Manufacture of blue to greenish-blue colouring matters of the ——. E. Walder, Assignor to Chemical Works formerly Sandoz, Basle, Switzerland. U.S. Pat. 1,299,070, 1.4.19. Appl., 13.12.16.

A GALLOCYANINE dye is condensed with an amino- benzamide, other than *o*-aminobenzamide, in pre- sence of an oxidising agent, and the product is reduced to a leuco-compound.—L. L. L.

Picric acid. Eng. Pats. 126,077—8, 126,368, and 126,675—6. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Paper sacks. W. Herzberg. Mitt. k. Material- prüf., 1918, **36**, 230—237.

RESULTS are given of tests applied to sacks made from strong paper pasted together with good adhe- sive. Sacks accepted for packing superphosphates were made of three thicknesses of paper showing a mean breaking strain of 4·48 kilos., when tested in strips 180 mm. long, 15 mm. wide, at 19° C. and in air with 65% moisture, whilst its resistance to folding (*i.e.*, the number of double folds by Schopper's method) was 186. Sacks for table salt were made of three thicknesses of paper show- ing a breaking strain of 4·84 kilos., and folding resistance of 518, whilst those for cement were of paper with an average breaking strain of 4·5 kilos. and resistance to folding of 1598.—C. A. M.

PATENTS.

Textile fibres; Process for producing — [*from grass, reeds, straw, etc.*]. A. F. W. Brummer, Utrecht, Holland. Eng. Pat. 120,199, 21.8.18. (Appl. 13,612/18.) Int. Conv., 20.10.17.

THE raw material (grass, reed, rushes, straw, etc.) is treated with a boiling aqueous solution of an alkali or an alkaline earth (*e.g.*, with a solution of sodium sulphide of about 2% strength, for 15—25 mins.). The treated mass is then washed with a boiling solution of alum or of sodium thiosulphate to which a little sulphuric acid has been added, separated from the liquors, and dried. The strength of reagent in each bath and the duration of treatment vary according to the material and the season. Each bath may be used several times.

—S. S. A.

Drying machine [*for fabrics*]. P. A. Parkes, Assignor to The Philadelphia Drying Machinery Co., Philadelphia, Pa. U.S. Pat. 1,301,594, 22.4.19. Appl., 21.9.16.

THE apparatus comprises a conveyor on which the material is arranged in festoons during its passage through a drying chamber, and nozzles through which air is directed against the festoons.—S. S. A.

Cellulose; Treatment of fibrous —— *for the production of hydrated derivatives.* C. F. Cross and E. J. Bevan, London. Eng. Pat. 126,174, 17.5.18. (Appl. 8342/18.)

FIBROUS cellulose is treated with caustic soda lye of concentration insufficient to produce mercerisa- tion, *e.g.* containing 6—11% of sodium hydroxide.

The treated cellulose is exposed either simultaneously or subsequently to the action of carbon bisulphide for 6—10 hours and is afterwards treated with water. The cellulose fibres are thereby considerably hydrated or swollen to an extent depending on the proportion of alkali to cellulose in the original treatment and on the temperature at which the alkali was caused to act. Example:—Raw cotton fibre is treated with 2·5—3·0 times its weight of caustic soda lye containing about 9% of sodium hydroxide and exposed in a closed vessel to the action of about 15% of carbon bisulphide calculated on the weight of the cellulose. The hydration effect is then developed by washing the treated fibre with water or it may be deferred by washing with brine, the hydration effect being then developed by treating with water at a later stage.—J. F. B.

Cellulose [sulphite pulp]; Process for the manufacture of —. E. Mollerud, Torderöd, Norway. U.S. Pat. 1,299,597, 8.4.19. Appl., 6.12.18.

In the manufacture of cellulose by the sulphite process the chemicals required for the digestion operation are introduced in a concentrated form, stronger than is required for the digestion. Diluting liquid is then introduced into the digester in the form of preheated water, waste digestion liquor, or other liquid in the quantity necessary to obtain the desired acid concentration.—J. F. B.

Pyroxylin composition. F. Sparre, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,301,187, 22.4.19. Appl., 10.3.17.

A mixture containing nitrocellulose and titanium oxide is claimed.—S. S. A.

Printed paper; Process for removing ink and colouring matter from —. W. M. Osborne, Carthage, N.Y. U.S. Pat. 1,298,779, 1.4.19. Appl., 30.9.18.

Printed paper is heated in a digester with sulphurous acid and sodium carbonate. The paper is caused to circulate slowly at first, the temperature and pressure are then gradually raised, and the contents of the digester are rapidly cooked.—J. F. B.

Paper stock; Machine for treating —. W. J. Herrbold and C. Keelan, Kalamazoo, Mich. U.S. Pat. 1,298,207, 25.3.19. Appl., 23.11.18.

A washing tank is provided with a stock inlet at one end and a discharge conduit at the other, which delivers the stock to a stock tank below the washing tank. The washing tank is provided with a screen which discharges into a waste pipe, and a circulating pump is arranged to withdraw stock from the stock tank and deliver it to the stock inlet of the washing tank.—J. F. B.

Sulphite [wood pulp] liquors; Process of treating waste —. V. Drewsen, Brooklyn, N.Y., Assignor to West Virginia Pulp and Paper Co., New York. U.S. Pats. (A) 1,298,476 and (B) 1,298,477, 25.3.19. Appl., 9.1.14 and 12.12.17.

(A) Waste sulphite pulp liquor is mixed with an excess of caustic soda and the mixture is heated for several hours under pressure; the lignin compounds thus produced are precipitated and the liquid containing lactonic acids or other converted material in solution is separated, dried, and the residue subjected to distillation with steam to produce acetone, ketones, and other volatile products. (B) The waste liquor is boiled with an excess of alkali under pressure until the constituents are transformed into a precipitate comprising lignin and a solution of organic salts; the solution is separated from the precipitate and the organic salts are subjected to dry distillation with strong bases.—J. F. B.

Soda [wood pulp] waste liquors; Process for the production of acetates from —. *Process for the treatment of waste soda [wood pulp] liquors.* V. Drewsen, Brooklyn, N.Y., Assignor to West Virginia Pulp and Paper Co., New York. U.S. Pats. (A) 1,298,478 and (B) 1,298,481, 25.3.19. (A) Appl., 19.8.16. Renewed 22,11.17. (B) Appl., 10.6.14. Renewed 10.8.18.

(A) Waste soda liquor from the manufacture of wood pulp is concentrated to a sp. gr. about 1·30 and mixed with about 10% of caustic soda and 50% of powdered caustic lime to form a strong, porous causticised organic material. This product is heated to about 250° C., cooled in the absence of air, and extracted with hot water to obtain a strong, crude acetate liquor of a density about 30° B. (sp. gr. 1·246) Carbon dioxide is percolated through the liquor to precipitate and remove sodium bicarbonate, acetic acid is added to the purified acetate liquor to the extent of about 6% of the solids therein, to neutralise residual carbonate, and about 5% of powdered lime is incorporated. The solution is filtered, the filtrate is concentrated, and sodium acetate crystallised out. The mother liquor is treated with sulphuric acid and acetic acid is recovered by distillation. (B) The waste liquor is concentrated by evaporation until the proportion of water in the concentrated material is not more than about 60%. The major portion of the lignin is then precipitated together with sodium bicarbonate by treatment with carbon dioxide, while heating the liquor under pressure to promote the collection of the precipitated material. The treated liquor is filtered, and the filtrate concentrated and mixed with about half its weight of powdered quicklime to produce a causticised, substantially dry, powdered "lime organic material." The hydrated lime particles are aggregated by treating the material with carbon dioxide and moisture and the product is heated to about 160°–200° C. The material is then leached with relatively small proportions of cold water to extract the sodium acetate from the undesirable organic material and the liquor is concentrated in order to crystallise out the sodium acetate. —J. F. B.

Soda pulp processes; Process for the treatment of waste liquors from — [*manufacture of acetone*]. *Causticised ligneous acetate material and process of making the same.* V. Drewsen, Brooklyn, N.Y., Assignor to West Virginia Pulp and Paper Co., New York. U.S. Pats. 1,298,479 and 1,298,480, 25.3.19. Appl., 23.7.18.

The waste liquor is concentrated and powdered quicklime is incorporated therewith to transform the resulting mixture into a substantially dry condition and to produce a causticised ligneous acetate material which remains permanently solid under dry distillation conditions. This is subjected to distillation to recover acetone and allied volatile products.—J. F. B.

Causticised organic material [wood pulp waste liquor] and process of making the same. N. Statham, Hastings-upon-Hudson, N.Y., Assignor to West Virginia Pulp and Paper Co., New York. U.S. Pat. 1,298,591, 25.3.19. Appl., 5.3.18.

A mixture is claimed comprising acetate compounds, a large proportion of ligneous material from wood pulp waste liquor, and about 50% of incorporated lime, calculated as calcium oxide. This mixture should be mechanically strong, porous, and uniformly permeable, having a weight not exceeding 40 lb. per cub. ft. and a crushing resistance of several hundred lb. per sq. in. It is adapted for the production of acetone by destructive distillation with steam and remains permanently solid during

the distillation without melting or foaming. (See U.S. Pat. 1,298,479; preceding.)—J. F. B.

Pyroxylin-coated fabrics; Production of ——. E. C. R. Marks, London. From E. I. du Pont de Nemours and Co., Wilmington, Del., U.S.A. Eng. Pat. 122,681, 21.1.18. (Appl. 1182/18.)

A MACHINE for carrying out the process described in U.S. Pat. 1,267,785 of 1918 (this J., 1919, 319 A) is claimed.

Pyroxylin-coated fabrics; Method of producing ——. E. C. R. Marks, London. From E. I. du Pont de Nemours and Co., Wilmington, Del., U.S.A. Eng. Pat. 122,680, 21.1.18. (Appl. 1180/18.)

SEE U.S. Pat. 1,267,785 of 1918; this J., 1919, 319 A.

Coated fabrics; Production of ——. E. C. R. Marks, London. From E. I. du Pont de Nemours and Co., Wilmington, Del., U.S.A. Eng. Pat. 122,677, 14.1.18. (Appl. 830/18.)

SEE U.S. Pat. 1,247,610 of 1917; this J., 1918, 66 A.

Cellulose; Process of treating ——. R. H. Clayton, Manchester, J. Huebner, Cheadle Hulme, and H. E. Williams, Assignors to The Manchester Oxide Co., Ltd., Manchester. U.S. Pat. 1,301,652, 22.4.19. Appl., 4.1.19.

SEE Eng. Pat. 123,784 of 1917; this J., 1919, 282 A.

Impregnation of fabrics for balloons and the like. Composition for impregnating and coating balloon and like fabrics. J. H. Mandleberg, Manchester. U.S. Pats. 1,302,064 and 1,302,065, 29.4.19. Appl., 18.1.19.

SEE Eng. Pats. 124,494-5 of 1916; this J., 1919, 357 A.

Lignin-fuel. Ger. Pat. 310,808. *See* IIA.

Vegetable dyes. Eng. Pat. 126,742. *See* IV.

Artificial pearls. Eng. Pat. 23,137. *See* XV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

PATENTS.

[*Aniline*] *Black; Production of* —— *upon vegetable textile fibres, silk fibres, or mixtures of same.* The Calico Printers' Association, Ltd., and E. A. Fourneaux, Manchester. Eng. Pat. 126,201, 22.6.18. (Appl. 10,208/18.)

ANILINE Black is produced upon silk, vegetable fibres, or mixtures of these, by the use of prussiate baths in which a portion, usually the larger portion, of aniline salt is replaced by aniline metaphosphate, or by aniline along with boric acid and metaphosphoric acid. The black develops much more slowly than an ordinary "prussiate black," but the development may be regulated by the addition of catalysts. The bath cannot be prepared as strong as the usual baths on account of the limited solubility of aniline metaphosphate and of the fact that concentrated solutions of it are readily precipitated by the addition of small quantities of aniline hydrochloride or somewhat less readily by the addition of aniline nitrate.—L. L. L.

Dyeing and the like; Apparatus for ——. J. J. Tracy, Cleveland, Ohio. U.S. Pat. 1,298,832, 1.4.19. Appl., 7.2.16.

A CONTAINER for use in dye-vats comprises a cylindrical frame, with the sides covered with foraminous material. The container is divided into two chambers by means of a horizontal foraminous partition, and is also provided with an impervious vertical partition mounted in the frame. By means of hinged end covers either of the two chambers may be opened. A bail pivoted to opposite sides of the container at its longitudinal centre is provided with suitable connections for lifting by a hoist.—L. L. L.

Dyeing machine. T. Allsop and W. W. Sibson, Assignors to The Philadelphia Drying Machinery Co., Philadelphia, Pa. U.S. Pat. 1,300,233, 15.4.19. Appl., 22.10.17.

THE machine comprises a vat, with means for passing the goods into and out of the liquor in the vat, and also a device for completely enveloping the goods in a spray of liquid, when withdrawn from the dye liquor, to protect them against injurious effects of atmospheric exposure.—L. L. L.

Dyeing machine. H. M. Dudley, Philadelphia, Pa. U.S. Pat. 1,301,920, 29.4.19. Appl., 2.2.18.

A FORAMINOUS cylinder, upon which the fabric is wound, is provided with a series of inner and outer sliding members, and with "toggle means" for causing these members to abut upon the edges of the fabric wound upon the cylinder and for maintaining them in position. The inner members are capable of closing a portion of the openings in the cylinder.—L. L. L.

Dyeing yarn and the like; Method of ——. W. A. Ainsworth, Grand Rapids, Mich. U.S. Pat. 1,299,811, 8.4.19. Appl., 10.5.18.

A CONTINUOUS length of yarn or similar fibrous material is passed rapidly by and in proximity to a member saturated with colouring matter, and is intermittently pressed into contact with the member as it passes the latter.—L. L. L.

Azo dyes. Eng. Pat. 126,460. *See* IV.

Vegetable dyes. Eng. Pat. 126,742. *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Chromic acid; Iodometric estimation of ——. I. M. Kolthoff and E. H. Vogelenzang. Pharm. Weekblad, 1919, **56**, 511–521.

IF sufficient acid is present, a mixture of chromate and iodide may be titrated with thiosulphate solution immediately, even if the chromate solution is dilute. In presence of insufficient acid excess of thiosulphate is consumed owing to the occurrence of a side reaction. The side reaction is not due to the oxidation of the hydriodic acid by the air. It is accelerated by sunlight, especially in presence of ammonium molybdate. The reaction between chromic and hydriodic acids is retarded by ammonium molybdate. Ferrous salts also retard the reaction in strongly acid solution; in weakly acid solutions their effect is accelerative.—W. S. M.

Magnesium hydroxide; Influence of different ammonium salts on the precipitation of ——. E. Brunner. Helv. Chim. Acta, 1919, **2**, 277—279.

If the usual explanation of the function of ammonium chloride in preventing the precipitation of magnesium salts is correct, namely, that its influence is due to the active mass of its ammonium ions in depressing the ionisation of the ammonium hydroxide, then a less completely dissociated salt like ammonium sulphate should have a weaker effect. The contrary is the case. Under equivalent conditions more precipitate is given by mixtures of the two chlorides than by mixtures of magnesium chloride and ammonium sulphate, and mixtures of the two sulphates give still less magnesium hydroxide. Even in the absence of an ammonium salt, magnesium sulphate gives less precipitate than the chloride. The explanation is that magnesium sulphate is not so completely dissociated as the chloride, being ionised largely as follows: $2MgSO_4 \rightleftarrows Mg^{\cdot\cdot}+[Mg(SO_4)_2]''$. The addition of ammonium sulphate still further depresses the normal dissociation.—J. C. W.

Sulphates; Method for the volumetric estimation of —. A. C. D. Rivett. Chem. News, 1919, **118**, 253—254.

The method depends on double decomposition between moist, precipitated barium oxalate and certain dissolved sulphates, whereby soluble oxalates are produced which may be titrated with potassium permanganate. An amount of solution, preferably containing the equivalent of 1—2 grms. of anhydrous sodium sulphate, is diluted to 150 c.c. and boiled for 5 mins. with about 3 times the theoretical quantity of barium oxalate, then cooled and diluted to 250 c.c. A portion is then filtered and an aliquot part of the 250 c.c. titrated, an approximate correction being made for the volume occupied by the precipitate in the flask. The solubility of barium oxalate is negligible if the solution contains more than 0·75 grm. of sodium sulphate, while longer boiling is required if the latter exceeds 2 grms. in amount. Using pure sodium sulphate under the above conditions, the percentage error varied between −0·5 and +0·4. The method is not applicable to acid liquors, to the sulphates of metals forming insoluble oxalates, or in presence of radicals (other than SO_4) capable of forming insoluble barium salts. High results are obtained in the presence of other soluble salts; but if the proportion of the latter remains fairly constant (as in a works liquor) and does not greatly exceed the amount of sulphate present, an empirical correction may be introduced with sufficient accuracy for works purposes.—W. E. F. P.

Chlorine—hypochlorous acid—sodium hypochlorite; The system ——. De Mallmann. Comptes rend., 1919, **168**, 1114—1117.

If x be the quantity of free chlorine, y the chlorine as hypochlorous acid, and z that as sodium hypochlorite in an aqueous solution, the values of x, y, and z may be determined as follows. The total active chlorine, α, is estimated iodometrically, the mixture with potassium iodide being acidified with a known volume of $N/5$ hydrochloric acid. After decolorising the solution with sodium thiosulphate the residual acidity is determined by titration with $N/10$ alkali. Then if β is the loss in acidity, expressed as chlorine, $x+2y+2z=\alpha$ and $y+2z=\beta$. The value of x may be determined by bubbling air through a known volume of the original solution for five minutes and estimating the chlorine carried over iodometrically. If sodium chloride is also present in the solution the value of x is slightly too high, as a portion of the chlorine present as hypochlorous acid is also carried over.—W. G.

Cyanogen compounds; Washing —— *from gases.* W. Bertelsmann. J. Gasbeleucht., 1919, **62**, 205—207.

The paper contains a historical survey of the subject. The production of double cyanides of heavy metals by washing with solutions of heavy metals and alkalis is the idea underlying most of the processes proposed. The production of alkali ferrocyanide by washing with ferrous hydroxide suspended in a solution of alkali is considered to be the only practicable method. Even when the profit on cyanogen recovery is negligible, there is an indirect gain due to the preservation of meters and the lessened load on oxide purifiers. The war has drawn attention to new applications of cyanogen compounds of great potential value—viz. the destruction with hydrocyanic acid of vermin of all kinds—including body parasites, pests of fruit trees, vegetables, and corn.—H. J. H.

Ferrocyanogen compounds; Behaviour of certain —— *towards chlorine and bromine, and their application to analysis.* F. F. Werner. Z. anal. Chem., 1919, **58**, 23—24.

Manganese ferrocyanide is white and only slightly soluble in water; it becomes grey when treated with chlorine-water and is converted by bromine-water into brown manganese ferricyanide. Nickel ferrocyanide is bluish-green; it is not attacked by chlorine-water, but concentrated bromine-water converts it into brown nickel ferricyanide. Cobalt ferrocyanide is a dirty green unstable compound; chlorine-water converts it into cobalt ferricyanide, whilst bromine-water decomposes the molecule, black hydrated cobalt oxide being formed. Mercurous ferrocyanide is a greyish-white, sparingly soluble compound; the colour changes to green when the substance is treated with chlorine-water and to greenish-yellow with bromine-water. There is no formation of ferricyanide. Mercuric ferrocyanide is white; the colour is changed to green by chlorine-water and to brown by bromine-water. Bismuth ferrocyanide is a yellowish-green insoluble substance; it is not attacked by chlorine-water or bromine-water. The precipitation of nickel and bismuth as ferrocyanide is quantitative.—W. P. S.

Copper oxide; Blue — —. H. E. Schenck. J. Phys. Chem., 1919, **23**, 283—285.

Copper oxide, precipitated together with alumina by a slight excess of sodium hydroxide from a solution of copper and aluminium sulphates, is light blue in colour after drying at 110° C. On heating successively in a Bunsen flame and a blowpipe flame, the colour changes to light greyish-blue if the mixture does not contain more than 5% of copper oxide. With 10% of copper oxide the mixture shows signs of blackening in the blowpipe flame. The view is expressed that alumina stabilises the blue oxide and that the change from blue to black is due to an agglomeration of the particles.—J. F. S.

Patents.

Sulphuric acid; Purification of ——, *and the obtainment of useful products, and apparatus to be used therein.* A. E. Wareing, and The United Alkali Co., Ltd., Liverpool. Eng. Pat. 126,714, 23.2.17. (Appl. 2703/17.)

Sulphuric acid is heated by live steam to about 160° F. (71° C.), treated with hydrogen sulphide, and thoroughly agitated with a liquid hydrocarbon such as paraffin oil (½—2½ galls. of oil per ton of acid). The agitating vessel communicates with one end of a horizontal tray, into which the mixture flows. The scum, containing arsenious sulphide, which separates at the surface, is mechanically

removed by scrapers which carry it over an inclined shelf at the other end of the tray, and on to an inclined shoot where it is washed with water. The purified acid leaves the tray through an outlet situated under the inclined shelf, is filtered, if necessary, and run into storage tanks. The scum and wash water are collected and separated, thereby recovering most of the acid, and the scum is treated with an alkaline solution which dissolves the arsenious sulphide forming a solution of alkali sulpharsenite, from which the oil separates and is recovered for re-use. The sulpharsenite solution is filtered and utilised as such, or acidified to obtain arsenious sulphide.—S. S. A.

Ammonia; Production of —— from atmospheric nitrogen. Verein chemischer Fabriken in Mannheim. Ger. Pat. 311,231, 12.7.14. Int. Conv., 19.7.13.

Barium nitride and hydrogen form addition compounds which react with hydrogen producing ammonia. A lower hydride or compound containing barium, nitrogen, and hydrogen is produced, which being subsequently treated with nitrogen absorbs as much nitrogen as that previously expelled in the form of ammonia. A product is obtained which according to the experimental conditions is either pure barium nitride or a compound of barium, hydrogen, and nitrogen in variable proportions, but richer in nitrogen than the product obtained after the treatment with hydrogen. The quantity of ammonia obtained depends upon the temperature and pressure conditions. A cycle of operations, including suitable alterations of temperature, enables the process to be operated continuously.
—J. S. G. T.

Electrolytic oxidation process and apparatus therefor. Manufacture of chlorates of the alkalis. C.I. (1914) Syndicate, Ltd., H. C. Jenkins, W. Blackmore and A. Howard, London. Eng. Pats. (A) 125,608, and (B) 125,609, 5.9.16. (Appls. 12,566 and 12,567/16.)

(A) In electrolytic oxidation processes such as the manufacture of sodium perchlorate from sodium chlorate, the electrolyte is passed during electrolysis in a thin stream alternately downwards and upwards through a series of jacketed water-cooled cathode chambers, and over water-cooled surfaces between the chambers acting as the cathodes. The anodes nearly fill the chambers, each anode, consisting of a U-shaped platinum plate supported on a carrier, being maintained at a distance from its cathode by insulating shoes passing over the vertical and bottom edges of the anode, the shoe serving also to hold the plate on its carrier. (B) Sodium chlorate is obtained by the electrolysis of brine in a non-mercurial cell of the type described in Eng. Pats. 25,415/13 and 22,867/14 (this J., 1914, 1096; 1916, 55), the weir outlet liquor, mixed with the cathode liquid, being treated with gaseous chlorine in a jacketed or heated tower, and the resulting liquid is afterwards electrolysed in a similar cell.
—B. N.

Electrolysis [for manufacture of chlorates]; Process of conducting ——. E. A. Le Sueur, Ottawa, Ontario. U.S. Pat. 1,300,420, 15.4.19. Appl., 19.7.18.

Chlorates are produced by the electrolysis of chloride solutions, the cathode having a coating of lime, and the electrolyte containing a salt of chromic acid in solution.—B. N.

Permanganates; Process for the manufacture of ——. H. C. Jenkins and H. Woolner, London. Eng. Pat. 126,756, 15.2.18. (Appl. 2744/18.)

Manganese dioxide is mixed with excess of soda, together with an oxidising agent (*e.g.*, sodium chlorate), and a potassium salt, and the mixture is fused at a dull red heat in presence of air. The melt is dissolved in a liquor obtained from a later stage of the process, and the manganese mud is filtered off, preferably through biscuit porcelain, and used in a subsequent melt. The solution of sodium manganate is electrolysed, and from the solution of sodium permanganate thus obtained, potassium permanganate is precipitated by the addition of potash or other potassium salt (*e.g.*, potassium chloride). The mixture is allowed to settle and cool for three or four days at about 10° C. The potassium permanganate which crystallises is removed and recrystallised. The liquor is filtered through biscuit porcelain. Any alkali carbonate in the filtrate is separated and causticised, and excess of chloride is eliminated by allowing the liquor to cool and settle, and decanting it. The liquor is then evaporated to half its bulk and used in preparing the soda lye for a subsequent fusion, or for dissolving the melt.—S. S. A.

Bleaching powder; Apparatus for subjecting matter to the action of gases, or vapours, especially intended for use in making ——. A. Rudge, and The United Alkali Co., Ltd., Liverpool. Eng. Pat. 126,773, 10.5.18. (Appl. 7875/18.)

The material is fed from a hopper, by a screw conveyor, into one end of a long, horizontal, thin metal, rotary cylinder, and is carried forward by feeding lifters; a clearance space is left between the lifters and the wall of the cylinder. Gas is passed into the cylinder at the other end. Means are provided for cooling the whole or part of the cylinder, in order to lessen the action on the metal of the substances under treatment, and to cool the product to a temperature suitable for packing. The apparatus is applicable to the production of bleaching powder by the action of chlorine on lime.
—S. S. A.

(A) *Ores or minerals [phosphate rock]; Electric-furnace apparatus for ——.* (B) *Method of treating gases.* I. Hechenbleikner, Charlotte, N.C., Assignor to Southern Electro-Chemical Co., New York. U.S. Pats. (A) 1,299,336, and (B) 1,299,337, 1.4.19. Appl., 29.12.17.

(A) An inclined rotary kiln is connected at its lower end with a mixing chamber which communicates with and forms an extension of an electric furnace. Ore or rock is fed into the kiln at the upper end, passes through the kiln, and is discharged into the mixing chamber. A coke hopper, independent of the kiln, supplies coke direct to the mixing chamber, and stoker mechanism operating in the latter chamber feeds the complete charge into the electric furnace. Means are associated with the kiln for oxidising the gases passing from the furnace to the kiln. (B) A mixture of phosphate rock and siliceous material containing potash, such as felspar, is passed through a rotary kiln (see A) to preheat it, and then mixed with coke at its point of entrance to the electric furnace. The mixture is subjected to the heat of the furnace to volatilise it, the resulting gases are oxidised, and certain impurities, such as silica and silicon fluoride, are eliminated, whilst the potash and phosphatic substances are maintained in the gaseous form. The gases are freed from dust, and the potash and phosphatic substances are subsequently condensed.—B. N.

Alumina; Process of preparing ——. Process of preparing iron-free alum. F. Laist, F. F. Frick, and R. S. Oliver, Assignors to Anaconda Copper Mining Co., Anaconda, Mont. U.S. Pats. (A) 1,300,417 and (B) 1,300,418, 15.4.19. Appl., (A) 10.4.18, (B) 24.4.18.

(A) The aluminous raw material, containing iron, is treated with sufficient sulphuric acid to convert

the bases into sulphates, and these are dissolved, the ferric iron being reduced to the ferrous state. Potassium sulphate is added in amount sufficient to form potash alum, which is crystallised and ignited to form alumina, potassium sulphate, and sulphur oxides. The alumina is recovered and the potassium sulphate used again for the formation of potassium alum. (B) The aluminium is recovered in the form of an alkali metal alum, substantially free from ferric or ferrous iron, without decomposing the alum as in (A).

Alunite; Process for treating —. R. Cross, Assignor to F. H. Thwing, Kansas City, Mo. U.S. Pat. 1,301,394, 22.4.19. Appl., 23.2.18.

ALUNITE in admixture with salt is calcined in the presence of steam.—S. S. A.

Metallic oxides; Making —. T. J. Vollkommer, Pittsburgh, Pa. U.S. Pat. 1,300,522, 15.4.19. Appl., 26.12.16.

A FURNACE with a porous or perforated bottom and perforated side walls, and provided with a charging hopper and with an outlet flue for the oxide produced, is surrounded by a chamber into which an oxidising gas is introduced under pressure. The whole is enclosed in a heating chamber.—S. S. A.

Magnesium [ammonium] chloride; Preparation of anhydrous —. C. C. Wallace, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,301,766, 22.4.19. Appl., 22.4.16.

A GAS, unsaturated with moisture, is passed through hydrous ammonium magnesium chloride heated to a temperature high enough to cause dehydration, but considerably below the temperature at which dissociation of the double salt becomes appreciable. —S. S. A.

Lead arsenate; Method of making —. I. P. Lihme, Lakewood, Ohio, Assignor to The Grasselli Chemical Co., Cleveland, Ohio. U.S. Pat. 1,302,186, 29.4.19. Appl., 7.11.18.

THE process is based on the interaction of lead oxide and arsenic acid in the presence of formic acid.—S. S. A.

Potassium salts; Separation and recovery of — *from commercial nitrate of soda containing such salts.* F. A. Freeth, Great Crosby, and H. E. Cocksedge, London. U.S. Pat. 1,300,947, 15.4.19. Appl., 12.2.17.

SEE Eng. Pat. 124,513 of 1916; this J., 1919, 322 A.

Hydrogen-nitrogen mixture; Manufacture of a —. E. B. Maxted, Walsall. U.S. Pat. 1,296,992, 11.3.19. Appl., 16.11.17.

SEE Eng. Pat. 124,824 of 1916; this J., 1919, 323 A.

Acetates from wood pulp liquors. U.S. Pats. 1,298,478 and 1,298,481. *See* V.

Nitrogen-fixation furnaces. Eng. Pats. 126,058 and 126,080. *See* XI.

VIII.—GLASS; CERAMICS.

Glass [making]; Provisional specifications for refractories for —. The Refractories Research and Specifications Committee of the Council of the Society of Glass Technology. J. Soc. Glass Technol., 1919, 3, 1—14.

Tank blocks.—The analysis of the material should include silica, alumina, iron oxide, titanium oxide, lime, magnesia, potash, and soda. The refractoriness should not be less than Seger cone 30. The blocks should be of regular texture, free from holes and flaws, with reasonably sharp arrisses and all surfaces sufficiently true and plane. They should be uniformly burned, free from patches of ironstone or other segregated impurity, and any dark cores present should be of the minimum size practicable. The volume porosity should not exceed 18% for flux line blocks, 23% for replacement flux-line blocks, 25% for bottom side blocks, and 30% for tank bottom blocks. The linear contraction or expansion of test-pieces, 3 in. by 1—2 in. by 1—2 in., cut from the blocks, after being reheated for two hours at cone 14 and then cooled, should not exceed 2%. The crushing strength of the blocks (tested on a 4 in. cube) should not be less than 1600 lb. per sq. in. *Silica bricks.* The bricks should contain not less than 94% of silica nor more than 2% of lime. The refractoriness should not be less than cone 32. The linear expansion after reheating at cone 12 for 2 hours and then cooling should not exceed 0·75%. The bricks should be uniformly burned and have a regular texture with no holes or flaws. All surfaces should be reasonably true and no dimensions should vary more than ± 2% from that specified. *Silica cement* should be finely ground, contain not less than 92% of silica and have the same refractoriness as the bricks. *Raw clays and grog.* Clay mixtures for glasshouse pots should consist of at least three portions: (*a*), blind clay; (*b*), base clay; and (*c*), grog. The blind clay should be a fat, plastic, weathered clay; the base clay should consist of specially selected lumps of highly refractory clay from which pyrites has been removed by hand picking; the grog should be prepared from selected refractory clay and show no sign of stoning or black core. Ordinary firebricks should not be used for grog. At the request of the purchaser samples true to bulk should be supplied, with the following information: Analysis, squatting temperature with and without a load. A sample of any clay or grog when fired at 1400° C. should not show any decided speckling due to iron. A fracture of each portion, fired at 1400° C., should show a dense structure, especially the blind clay. The clays and grog should be delivered in bags.

The committee makes the following recommendations and suggestions: -

Tank blocks should be made of (*a*) a fat, aluminous blind clay containing little silica, 36—40% alumina, less than 2·5% of total alkalis and less than 4·5% of total fluxes, and having a low sintering temperature, and a refractoriness not less than cone 31; (*b*) a strong refractory base clay containing 25—32% of alumina, and less than 1·4% of total alkalis, with refractoriness not less than cone 31; (*c*) grog made by mixing (*a*) and (*b*) in a finely ground state, tempering, and burning to cone 14. The following proportions are suggested:

Tank bottoms: (i) A mixture is made by grinding in the dry state blind clay 1 vol., base clay 3 vols. (ii) Grog is made by tempering a portion of the above mixture, making into slabs, 12 × 12 × 4 in., firing to cone 10, and crushing the product so as to yield sharp edged grains with a minimum of fine powder. For blocks the following are mixed dry, tempered with a minimum of water, pugged or treated in a pan-mill with raised rolls, and matured for at least a month. Above clay mixture, 5 vols., grog passing ¼ in. and held by ⅛ in. mesh, 1 vol., grog passing $\frac{1}{16}$ in. and held by $\frac{1}{32}$ in. mesh, 1 vol. The blocks should be dried slowly and burned to cone 10. *Bottom side blocks.* —(i) Clay mixture to consist of equal volumes of blind and base clay. (ii) Grog to be made of the same mixture (treated as described under tank bottoms) and burned to cone 12. For these blocks the following proportions are suggested: Clay

mixture, 5 vols.; grog passing ¼ in. and held by ¼ in. mesh, 1 vol.; grog passing ¼ in. and held by $\frac{1}{16}$ in. mesh, 2 vols.; grog passing $\frac{1}{16}$ in. and held by $\frac{1}{32}$ in. mesh, 1 vol. The blocks should be burned to cone 12. *Top side (flux-line) blocks.*—(i) Clay mixture: bind clay 2 vols., base clay 1 vol. (ii) Grog made by burning this mixture to cone 14. These blocks should be made of clay mixture, 5 vols.; grog passing ¼ in. and held by $\frac{1}{16}$ mesh, 1 vol.; grog passing $\frac{1}{16}$ in and held by $\frac{1}{32}$ in. mesh, 2 vols. The blocks should be burned to cone 14. *Replacement (flux-line) blocks.*—(i) Clay mixture: fat plastic clay, 1 vol.; lower-grade plastic clay (containing when fired, alumina 34—38%, alkalis not exceeding 3·5%, total fluxes not exceeding 6·5%; refractoriness not less than cone 26), 1 vol.; base clay, 1 vol. (ii) Grog made by burning above mixture to cone 6—8. Tank blocks should not have any face with an area greater than 4 sq. ft. The blocks should be stored above the floor in a warm, dry room. Tank furnaces containing new blocks should be maintained at the maximum working temperature for at least 12 hours before use. *Glass-house pots.*—Three grades of clays are suggested of which the lowest corresponds to materials now in use. The following limits are suggested:—

	MgO & CaO	SiO_2	Al_2O_3	Fe_2O_3	Na_2O & K_2O	Fusion test cone	Mech. division	Firing temp.
	%	%	%	%	%			
Grade 1.								
Bind clay	1*	60*	31†	1·8*	1·8*	32	After blunging, the residue on an 80-mesh sieve not to exceed 10%.	—
Base clay . ..	0·5*	55*	40†	1*	1·5*	35	Ground to pass 80-mesh ..	—
Grog	0·5*	50*	40†	1*	1·5*	35	Ground to pass 12-mesh ..	Cone 14 +
Grade 2.								
Bind clay ..	1*	65*	30†	2*	2*	30	After blunging, the residue on a 50-mesh sieve not to exceed 10%	
Base clay .	0·6*	60*	35*	2*	1·8*	32	Ground to pass 50-mesh ..	—
Grade 3.								
Grog	0·6*	60*	35*	2*	1·8*	32	—	Cone 12 +
Bind clay ..	1*	70*	25†	2·5*	2·5*	28–29	Ground to pass 12-mesh ..	—
Base clay .. .	1*	70*	25†	2*	1·8*	30–31	Ground to pass 12-mesh ..	—
Grog	1*	70*	25†	2*	1·9*	31	Ground to pass 12-mesh .	Cone 9 +

* = not more than. † = not less than. —A.B.S.

Bottle-glass and glass-bottle manufacture. W. E. S. Turner. J. Soc. Glass Technol., 1919, **3**, 37–49.

THE following batch mixtures are suggested:

—	I	II	III
	Parts	Parts	Parts
Sand	75·5	100	100
Limespar	12·5	22	18
Soda ash .	27·6	33	33
Antimony oxide ..	0·5	0·3	—
Saltpetre . ..	—	3	1?
Saltcake .	—	1	—
Cobalt oxide .	—	0·0005	—
Arsenic	—	—	0·2
Manganese .. .	0·5	0·3	0·2

Mixture I is calculated from the analysis of a siphon bottle imported from Bohemia, II is a mixture actually used in Germany for siphon bottles, and III is a mixture recommended by the author for use in coke-fired furnaces. There is an increasing tendency to add an excess of alkali to flint glass batch-mixtures so as to shorten the time of preparation or to facilitate the use of automatic feeding devices; this excess of alkali reduces the durability of the glass, especially on boiling it in water. In common bottle glass the alumina and other impurities increase the durability of the glass. Bottles for medicinal and pharmaceutical preparations, milk bottles, feeding bottles, and white flint bottles should be tested for durability, after being cleaned by sterilising in steam for half an hour or by washing with acetic acid and then with water. The bottles should show the reactions mentioned after exposure for 24 hours to the following solutions: (i) 1—2% of morphine hydrochloride—colourless or at most pale yellow, (ii) 0·5—1% of strychnine nitrate—no separation of crystals, (iii) 1% of mercuric chloride—no precipitate of coloured oxide, and (iv) water containing a few drops of phenolphthalein—colourless. A better method consists in placing a measured quantity of pure water in the bottle to be tested, heating it in an autoclave at 120° C. for 2 hrs., and afterwards determining the alkalinity of the water by titration with *N*/100 sulphuric acid using methyl orange as indicator. In a lime-soda glass used for bottle-making the soda ash in the batch should not exceed 28%. For easy working the following limits should not be exceeded: 14% lime (on the finished glass) in lime-soda glasses; 9% magnesia in magnesia-soda glasses, and 9% alumina in alumina-soda glasses. The amounts may be increased by the addition of other oxides or reducing the proportion of silica. Lime is a valuable constituent, imparting tensile strength and thermal conductivity to the glass. Glass containing it has the advantage of being cheap and setting quickly. The proportion of lime which may be present in a glass batch is surprisingly high. In some bottles examined it exceeds 20% on the finished glass. Glasses containing lime have a high viscosity until a fairly high temperature is reached, after which the viscosity diminishes rapidly. Within a temperature range of 150° C. (1050°—1200° C.) the glass may be either too stiff or too fluid to be worked. Magnesia has a similar action to lime but at 1250°—1300° C. the viscosity of a glass containing magnesia is less than that of a lime glass; above 1300° C. the difference diminishes. Hence, the replacement of lime by magnesia softens the glass and gives wider working limits, though glasses containing 10% of magnesia are "stringy" when worked. Glasses containing both magnesia and lime are tough and do not set so quickly as lime-glasses. A glass with a high alumina content may have a higher softening point, but may be more fluid than a glass high in silica. Highly silicious glasses appear to be stiffer than highly aluminous ones. Soda softens glass to which it is added, making it more fluid and reducing the rate of setting. Potash resembles soda but is less effective.—A. B. S.

Basic refractories for open hearths. J. S. McDowell and R. M. Howe. Blast Furnace and Steel Plant, 1919, **7**, 227—229.

THE hearths of open hearth furnaces are usually built of magnesite bricks and covered with dead-burned granular magnesite to a depth varying from ¼ in. in some parts to 12—18 in. at the centre of the hearth. The granular material is heated until

it sinters in the hearth. After each time of using, burned dolomite is thrown against the banks as high as it will adhere and all holes in the bottom of the hearth are filled with the same material. Dolomite is also used for temporary patching, as it sets more rapidly than magnesite. Magnesite from Grenville, Canada, is finely crystalline and high in lime, due to dolomitic inclusions. It is mixed with iron oxide and burned to clinker in rotary kilns and has been found to be suitable for furnace bottoms. Magnesite from Washington is fine to coarsely crystalline and very variable in colour. It is used extensively, being obtained more cheaply than Californian magnesite. Since 1914 calcined dolomite has largely substituted for magnesite on account of the shortage of the latter, but steel makers are now returning to the use of high-grade magnesite, which does not air slake so readily and is more adherent when in use. Several dolomitic materials have been treated so as to reduce the air-slaking by coating the grains with basic slag, iron ore, etc., and burning the mixture in a rotary kiln. The properties of basic refractory materials which chiefly affect their value for furnace use are: resistance to slaking; resistance to erosion; and resistance to the chemical action of impurities in the ore etc. Comparative tests were made with (A) dead burned Washington magnesite, (B) dead burned Canadian magnesite, (C) a preparation supposedly made by coating dolomite granules at a high temperature with open-hearth slag, (D) a product similar to C in which the dolomite granules are reported to be coated with iron ore, (E) a calcined impure dolomite, and (F) a calcined pure dolomite. The analysis of the materials showed:

—	A	B	C	D	E	F
Magnesia	81·60	66·40	32·10	34·73	31·5	34·85
Lime	3·12	18·91	47·92	48·70	19·84	51·00
Silica	7·56	4·56	11·16	9·81	6·68	2·16
Alumina and iron oxide	7·14	9·96	8·32	6·40	5·58	2·09
Moisture and ignition loss	0·43	0·33	0·47	1·00	3·70	9·90

To estimate the resistance to slaking the samples were moistened intermittently, samples were taken at intervals of five days, and the loss on ignition determined:—

—	A	B	C	D	E*	F*
Loss at beginning of test	0·02	0·20	0·08	0·95	1·55	1·29
Loss after five days	0·48	0·69	1·20	5·67	12·81	16·43
Loss after ten days	0·95	1·52	1·62	8·35	15·80	21·51
Loss after fifteen days	1·24	1·91	2·39	10·10	17·09	
Loss after twenty days	1·36	1·92	3·01	10·92	-	
Loss after twenty-five days	2·09	2·65	6·50	12·00		

* E and F had been recalcined at the laboratory before the test.

To ensure a high resistance to air-slaking the lime should be low and the iron oxide, alumina, and silica should not be excessive. The granules in C appear to have been well protected, but D slaked badly. The effect of phosphorus and silicon compounds in ore and slag was studied by means of (I) a mixture of ferrophosphide 1 part, ferric oxide 2 parts, containing 6·1% P, and (II) a mixture containing 0·65% P, 5·20% SiO_2, 2·60% Mn, and the remainder metallic iron and rather more ferric oxide than would be required to oxidise the impurities. These mixtures were heated at 1350° C. for equal lengths of time in crucibles made of the several refractories, and the composition of the melts then determined. The following results were obtained:

Material	Series I.—High P melt.				Series II.—High Si melt.		
	SiO_2	CaO	MgO	Total	CaO	MgO	Total
A	0·10	0·10	0·83	1·03	Trace	0·81	0·81
B	0·32	0·16	1·44	1·92	0·33	3·58	3·91
C	1·41	1·11	1·14	3·69	1·97	2·33	4·30
D	5·31	3·02	4·16	12·49	4·73	3·59	8·32
E	1·17	0·98	1·11	3·26	23·10	13·60	37·00
F	0·92	3·58*	3·30	7·80*	-	-	-

* Approximate.

The superiority of A (a magnesite low in lime) is clearly shown. The impure dolomite E was badly corroded by a mixture high in silicon but not seriously affected by one rich in phosphorus. The specially treated dolomites resisted the siliceous mixture better than untreated dolomites. Except material D, the purest dolomite showed the least resistance to erosion, though this may be associated with its high loss on ignition. Magnesites low in lime were the most resistant of all the materials. Materials A and B were made into bricks and heated under a load of 25 lb. per sq. in. at a temperature rise of 250° C. per hr. At 1555° C. A failed by shearing, B softened and settled and at 1450° C had been reduced by 12·5% of its original length. A. B. S.

Calibrating burettes. English. *See* XXIII.

PATENTS.

Sheet glass; Method of and apparatus for forming —. E. Danner, Toledo, Ohio, U.S.A. Eng. Pat. 126,747, 31.12.17. (Appl. 19,311/17.)

SHEET glass is formed by passing molten glass through a heated chamber containing an adjustable inclined or vertical slab over which the glass flows continuously and is cooled sufficiently for it to be drawn off in the form of a sheet, which is then subjected to a continuous longitudinal stretching stress in order to reduce it to the required thickness.—A. B. S.

Glass furnace. H. Douchamp, Assignor to Smethport Glass Co., Smethport, Pa. U.S. Pat. 1,208,474, 25.3.19. Appl., 20.9.16.

THE furnace has a drawing portion comprising tiles constructed to form a drawing opening, the tiles being adjustable vertically to vary the level of the opening.—J. F. B.

Hollow glass articles; Method of drawing —. O. A. Wells, Arnold, Pa., Assignor to Window Glass Machine Co., Pittsburgh, Pa. U.S. Pat. 1,301,771, 22.4.19. Appl., 7.10.14.

IN drawing hollow glass articles from a molten bath by means of a hollow bait, any movement between the engaging portions of the bait and the glass is prevented by keeping the bait partially immersed in the molten glass until it is heated to a temperature sufficiently high to make its radial contraction during the drawing equal to that of the glass "novel," but not high enough to prevent the adhesion of the glass.—A. B. S.

Furnace lining materials; Process of making —. A. P. Meyer, Assignor to A. S. Davison Co., Pittsburgh, Pa. U.S. Pat. 1,300,631, 15.4.19. Appl., 29.3.17.

GRANULAR refractory material is made by heating a mixture of granules of highly refractory material

and a less refractory material in a rotary kiln under such conditions that the less refractory material is taken up by the more refractory material without any further clinkering.—A. B. S.

Glass tubes; Method and apparatus for forming ——. K. Kneppers, Aachen, Germany. U.S. Pat. 1,301,714, 22.4.19. Appl., 9.9.13.

SEE Eng. Pat. 20,192 of 1913; this J., 1914, 921.

[*Refractory*] *products containing β-alumina and processes of preparing the same.* Norton Co., Worcester, Mass., Assignees of L. E. Saunders and R. H. White, Niagara Falls, N.Y., U.S.A. Eng. Pat. 113,960, 7.2.18. (Appl. 2255/18.) Int. Conv., 2.3.17.

SEE U.S. Pat. 1,263,708 of 1918; this J., 1918, 419 A.

Aluminous abrasive and process of making same. Norton Co., Worcester, Mass., Assignees of L. E. Saunders and R. H. White, Niagara Falls, N.Y., U.S.A. Eng. Pat. 118,591, 7.2.18. (Appl. 2256/18.) Int. Conv., 2.8.17.

SEE U.S. Pat. 1,263,709 of 1918; this J., 1918, 418 A.

IX.—BUILDING MATERIALS.

PATENTS

Concrete; Manufacture of ——. A. J. and J. W. Hadfield, Sheffield. Eng. Pat. 126,472, 11.5.18. (Appl. 7918/18.)

CONCRETE specially suitable for foundations which are to support asphalt pavings is made by adding 2 galls. or more of tar or bituminous mixture to each cubic yard of ordinary concrete. Alternatively, the cement in the concrete may be wholly replaced by pitch, tar, or bituminous mixture. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 15,993 of 1906, 8275, 9021, 24,948, and 28,745 of 1907.) —A. B. S.

Concrete products; Curing ——. L. A. Bellonby, Rome, Ga., U.S.A. Eng. Pat. 126,813, 21.5.18. (Appl. 8395/18.)

CONCRETE products are cured by placing them in moulds and subjecting them to dry steam for 30 mins., then immersing them in boiling water for 3 hrs., and finally subjecting them to currents of heated air for 30 min. The apparatus used for this purpose consists of a series of covered tanks each having a steam heating coil in the lower part so arranged that part of the coil is immersed whilst part projects above the surface of the water. Above the coil is a metal plate with an aperture through which steam may pass upwards to the goods supported on shelves in the tanks, the shelves having openings to facilitate the circulation of the steam around the goods. At one end of each tank is a duct which connects its upper and lower portions and allows of circulation of the water therein. Water is passed from one tank to another as required, by means of a pump, the circulation being controlled by valves.—A. B. S.

Keene's cement; Manufacture of quick-setting ——. W. Hoskins, Chicago, Ill., Assignor to The Best Bros. Keene's Cement Co., Medicine Lodge, Kans. U.S. Pat. 1,300,269, 15.4.19. Appl., 13.5.18.

QUICK-SETTING Keene's cement is made by mixing finely ground calcined gypsum with a catalyst consisting of a salt containing more acid than is necessary for forming a normal salt but not exceeding half that required to form an acid salt.—A. B. S.

Agglomeration of cement. Ger. Pat. 309,533. *See* X

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Furnaces; Electric iron and steel ——. J. Bibby. Inst. Elect. Eng., and Iron and Steel Inst., May, 1919. Engineering, 1919, 649—654.

THE manufacture of pig iron in an electric blast furnace is dealt with, and it is stated that there is a saving of 70% in the coke used as compared with ordinary blast-furnace methods; other conditions being equal, the ordinary blast-furnace method is balanced against the electrical method in cost, when 1 h.p.-year is obtained for the price of 2·3 tons of coke. Electric pig iron contains less impurities than blast-furnace iron, and a more basic slag may be obtained at the higher temperature, thus favouring the elimination of sulphur. An electric blast furnace is described, about 30 ft. high, with a wide shallow hearth or crucible at the bottom replacing the narrow blast-furnace hearth. The electrodes project through the roof of the crucible and are embedded in the charge, and the crucible forms the melting and refining chamber, the whole of the oxygen required for reduction being obtained from the ore. It is of importance to develop a uniformly high temperature throughout the central and lower portions of the crucible, and the larger the furnace, the greater will be the number of electrodes required to distribute the heat sufficiently. The following table is given for the number of electrodes used on various

Horse power	Number of electrodes	Yearly output, tons
2,500	4	7,000
4,000	6	11,500
6,000	8	18,000
10,000	12	31,000

sizes of furnaces and the outputs. It is stated that the 6000 h.p. furnace with 8 electrodes is destined to be the most popular, and the method of transforming three-phase current into eight equal phases consecutively at 45° is described and illustrated. To avoid destruction of the roof through the high temperature developed, a portion of the outgoing gases is extracted, passed through coolers and dust extractors, and blown against the internal portion of the roof. Heavy induction losses in the low-tension leads, which may be taking a current of 20,000 ampères each, are chiefly due to the leads having to pass near the structural ironwork of the furnace; by rearranging the leads and interleaving the bars, the induction losses may be reduced from 315 kw. to 50 kw. The power consumption, per ton of pig iron produced, depends on the percentage of iron in the ore and of carbon dioxide in the waste gases, and the average obtainable, with 22% of carbon dioxide and 60% iron content, is stated to be about 1500 kw.-hours per ton, the consumption of coke being about 6 cwt. per ton of pig iron. Electric steel-refining furnaces are also dealt with, and a small furnace of ½-ton capacity is described, suitable for melting ferro-manganese, in which a great saving in manganese is effected. Larger furnaces of the 20-ton Electro-Metals four-phase type are also described (this J., 1919, 368 A).—B. N.

[Steel] furnace; A new type of electric ——. A. Sahlin. Inst. Elect. Eng., and Iron and Steel Inst., May, 1919. Engineering, 1919, 655.

The furnace is designed to embody the advantages of both the direct arc and free-burning arc furnaces. It is provided with one pair of water-cooled electrodes with a 3 ft. 6 in. diameter hearth, up to 6 pairs of electrodes with a hearth from 9 to 11 ft. diameter, and is supplied with direct current, or with one-, two-, or three-phase alternating current according to the number of pairs of electrodes. Each pair of electrodes enters the furnace in the same vertical plane, but at different and adjustable angles. The furnace, whilst empty, is heated by the free-burning arc, and after the charge has been introduced and the material melted, the lower electrode is drawn back and the upper one advanced, so as to form a direct arc between the upper electrode and the slag, thus producing a rapid circulation of the bath. A bottom electrode, embedded in the hearth, may be employed, and this and the lower electrodes are earthed.—B. N.

Phosphorus; Rapid determination of —— [*in iron and steel*]. M. Schmidt. Z. angew. Chem., 1919, **32**, 138—139.

The method in which phosphorus in steel etc. is determined by precipitation as phosphomolybdate, solution in ammonia, and precipitation with magnesia mixture, may be accelerated by making the precipitation from a hot solution (65°–75° C.) and centrifuging the liquid. For this purpose a special centrifuge has been devised by Hütter, with receptacles to hold the beakers containing the precipitates.—C. A. M.

Phosphorus in phosphor-tin; Determination of ——. W. Lord. Chem. News, 1919, **118**, 254.

The following process is a modification of Oettel's method for determining phosphorus in phosphor-bronze, and has been found very accurate and rapid for commercial phosphor-tin containing up to 6% P. 1 grm. of the finely divided metal is heated with concentrated nitric acid in a large porcelain crucible, until complete oxidation is effected, when the mass is evaporated to dryness. The residue is mixed with 6 times its weight of pure potassium cyanide and the mixture heated to dull redness for 15 mins., whereby potassium phosphate and metallic tin are produced. When cool, the melt is extracted with hot water (steam), and the filtered solution is successively acidulated with hydrochloric acid, boiled to expel hydrogen cyanide, treated (hot) with hydrogen sulphide to remove residual tin, filtered, treated with bromine water, evaporated to about 50 c.c., and cooled. The solution is then made slightly ammoniacal (any precipitate formed being filtered off, redissolved and reprecipitated, and the filtrate added to the main solution) and treated with magnesia mixture to precipitate the phosphorus as usual.—W. E. F. P.

Bell-metal; Changes of concentration during the electrolysis of ——. E. Pfann. Oesterr. Chem.-Zeit., 1919, **22**, 10—11. Chem. Zentr., 1919, **90**, II., 472.

Changes in composition of the electrolyte during electrolysis with bell-metal anodes are caused by the metals other than copper which undergo secondary reactions with the electrolyte. To maintain constant conditions it is desirable to add sulphuric acid to compensate for the copper sulphate which is consumed in the formation of stable sulphates (*e.g.* Zn, Cu, Ni, Pb), and also copper in quantity equivalent to the foreign metals which pass into solution. This copper converts into copper sulphate the added sulphuric acid and also that produced by the hydrolysis of unstable sulphates.—W. H. P.

Refractories for open hearths. McDowell and Howe. *See* VIII.

X-ray photographs through metals. Slade. *See* XXI.

PATENTS.

Clayey [iron] ores; Process of clearing ——. E. F. Goltra, T. S. Maffitt, and J. D. Dana, St. Louis, Mo., and R. W. Erwin, Waukon, Iowa, Assignors to Mississippi Valley Iron Co., Wilmington, Del. U.S. Pat. 1,301,684, 22.4.19. Appl., 5.1.14.

The ore is heated to drive off the free moisture, tumbled to break up the ore and gangue, then heated to drive off the combined moisture, crushed, tumbled to loosen the gangue from the ore, and subjected to a blast which removes the gangue from the ore.—T. H. Bu.

Steel or other magnetisable metal; Method of indicating the condition of —— *when under heat treatment.* P. C. Pope and G. H. Thomas, London. Eng. Pat. 126,532, 4.7.18. (Appl. 11,004/18.)

The specimen is heated in a magnetic field and its motion under the influence of gravity or of a spring, when the magnet ceases to act on it, indicates the recalescence point.—T. H. Bu.

Steel or other magnetisable metal; Method of indicating the condition of —— *when under heat treatment.* M. O'Gorman and G. H. Thomas, London. Eng. Pat. 126,856, 4.7.18. (Appl. 11,003/18.)

The metal is contained in a crucible of refractory material which is heated electrically by a coil of resistance metal. The heating coil forms one arm of an induction bridge and the recalescence point is indicated by the consequent variation of reactance in the circuit. The change point is also detected by the variation in voltage across the heating coil the reactance of which varies with the magnetic change.—T. H. Bu.

Steels; Heat treatment of castings of special ——. *Process of heat treatment of steel.* F. Giolitti, Turin, Assignor to Soc. Anon. Ital. Gio. Ansaldo & Co., Genoa, Italy. U.S. Pats. (A) 1,279,533, 24.9.18, and (B) 1,296,649, 11.3.19. Appl., 4.6.17 and 14.10.14.

(A) Cast steel having strong thermal hysteresis is heated slowly to about 100°–200° C. above the Ac3 point, kept at this temperature for a time, cooled slowly to about 100°–150° C. above the Ar3 point, and then cooled rapidly. (B) Steel is heated to a temperature near that at which diffusion of the different components of the steel takes place with the greatest rapidity, *i.e.*, to at least 100° C. above the Ac3 point and the temperature is then lowered to at least 30° C. below that necessary for effecting the ordinary uniform hardening, *i.e.*, to a point at least 50° C. above the Ar3 point.

Zinc; Extracting —— *in electric furnaces.* E. S. Berglund, Trollhättan, Sweden. Eng. Pat. 120,549, 26.7.18. (Appl. 12,219/18.) Int. Conv., 22.10.17.

The zinc powder which collects on the bottom of the condenser is subjected to a rubbing and pressing action by means of a screw immersed in the

mixture of molten zinc and zinc powder and which drives it through an opening. The yield of molten zinc is thus increased.—B. N.

Disintegrating metal; Process of ——. Metals Disintegrating Co., Inc., New York, Assignees of E. J. Hall, Parsaic, N.J. Eng. Pat. 121,599, 4.12.18. (Appl 20,080/18.) Int. Conv., 20.12.17.

Molten metal is sucked through a disintegrating nozzle by a rotating convergent jet of gas under pressure which strikes the nozzle at a point just to the rear of the orifice.—T. H. Bu.

Aluminium waste; Employment of —— in the manufacture of explosives and for other purposes. C. Vautin, and The Produce Mortgage Trust, Ltd., London. Eng. Pat. 126,021, 26.10.16. (Appl. 15,278/16.)

Aluminium scrap or swarf in the form of turnings, shavings, or very thin strips is fed into a rotary disintegrating machine run at high peripheral speed. The powder so produced, although it may contain only about 90% of aluminium, is suitable for the manufacture of explosives, "thermit," and light- and smoke-producing compounds.—L. A. C.

Electrodes for arc welding and the like. J. H. Garbett, Hadley, Salop. Eng. Pat. 126,215, 8.11.18. (Appl. 18,339/18.)

The electrode comprises a metallic core having an absorbent covering, the whole having been soaked in a solution of borax, 3½ oz., salt, 1/8 oz., soda, 1/12 oz., water, 1 pint.—B. N.

Electric arc welding. A. Smith, Assignor to Smith Metal Perforating Co., San Mateo, Cal. U.S. Pat. 1,298,590, 25.3.19. Appl., 17.8.14.

The article is preheated to a red heat, and the metal parts to be welded are brought approximately to the point of fusion in an electric arc. Two non-consuming fluid-cooled metal electrodes are used, one of which can be oscillated, and a third, fusible metal electrode, which is adapted to supply fused metal to the joint, and is provided with means for replenishing the metal as the electrode is consumed.—B. N.

Tin and other metals and alloys; Process and appliances for the recovery of ——. R. E. Alexander, Newcastle-on-Tyne. Eng. Pat. 126,377, 20.1.17. (Appl. 1003/17.)

The scrap or other material is introduced at the top of a furnace and subjected to a temperature exceeding the fusion point. The molten metal passes downwards through the fuel, which is maintained incandescent by injecting air through tuyères at different levels, the temperature decreasing downwards to the hearth.—T. H. Bu.

Sulphide ores and raw ore products; Differential flotation concentration of ——. C. C. Freeman, Broken Hill, N.S.W. U.S. Pat. 1,301,551, 22.4.19. Appl., 30.3.16.

Mixed sulphide ore pulp is subjected to agitation-aeration flotation in a dilute solution of alkaline carbonate, one sulphide being floated while others are excluded from the float concentrate. Contact of the flotation bath with metallic copper, metals electro-negative to copper and soluble salts of these metals is excluded.—T. H. Bu.

Metallurgical smoke filter. W. H. Bates, jun., Boston, Mass. U.S. Pat. 1,302,281, 29.4.19. Appl., 30.11.17.

Spaced rotary baffles and reticulated conical filters are mounted in a closed tank through which fumes and liquid are circulated.—T. H. Bu.

Agglomeration of blast-furnace dust, finely divided ores, cement, etc. —— in rotary kilns. Stahlwerk Thyssen A.-G., Hagendingen, Lorraine Ger. Pat. 309,553, 30.11.15.

The materials to be agglomerated are led through a kiln consisting of two cylindrical end sections connected by a passage way provided with an enlargement, and whose longitudinal section is a frustrum of a cone. The end components may be either stationary or in rotation, and the middle section can be separately set in slow or quick rotation, and it may, if desired, be set at a greater or less inclination than the end components. In the middle enlarged section, the material is subjected to appropriate physical and chemical treatment.—J. S. G. T.

Dressing ores; Method of ——. G. S. A. Appelqvist and E. O. E. Tydén, Stockholm. Ger. Pat. 311,196, 23.2.18. Int. Conv., 13.9.13 and 15.9.15. Addition to Ger. Pat. 277,847.

According to the chief patent (Eng. Pat. 402 of 1913; this J., 1913, 430) the ore, oil, and tar, etc. were thoroughly stirred and mixed together, liquid jets under high pressure being employed for this purpose. The liquid jets producing the stirring entered the separator quite distinct from the ore, and first came into contact with the latter at the injectors. In certain cases it has been found desirable to introduce the ore, oil, tar, etc. into the liquid which is then sprayed through one or more jets. The oil, ore, tar, etc. and the liquid may be delivered to the jets by means of a centrifugal pump which serves to mix the various constituents together. In certain cases, air may be employed in place of the liquid jets. The air is compressed, and the current of air is best delivered under the surface of the liquid in the stirring vessel.—J. S. G. T.

[Silver-tin dental] alloys; Purification of powdered or comminuted ——. P. Poetschke, Milford, Del., U.S.A. Eng. Pat. 126,881, 7.9.18. (Appl. 14,575/18.)

See U.S. Pat. 1,278,744 of 1918; this J., 1918, 740 A.

Metals; Apparatus for carrying out processes of winning ——. V. M. Weaver, Harrisburg, Pa., Assignor to Weaver Co. U.S. Pat. 1,296,575, 4.3.19. Appl., 9.8.15.

See Fr. Pat. 481,056 of 1916; this J., 1917, 144.

Sulphide ores; Separation of mixed ——. R. T. D. Williams, Broken Hill, N.S.W., Assignor to Minerals Separation North American Corporation. U.S. Pat. 1,300,516, 15.4.19. Appl., 20.7.15.

See Eng. Pat. 10,478 of 1915; this J., 1916, 895.

Aluminium; Process of soldering ——. A. H. Alexandre, Levallois-Perret, Assignor to E. H. Moll et Cie., Paris. U.S. Pat. 1,301,633, 22.4.19. Appl., 2.11.17.

See Eng. Pat. 110,758 of 1917; this J., 1918, 185 A.

Casting metals; Apparatus for ——. H. Talla, Heilbronn, Assignor to Prilzisionsgüsswerke System Schmidt-Reichhardt-Ges., Frankfort, Germany. U.S. Pat. 1,302,450, 29.4.19. Appl., 21.5.15.

See Eng. Pat. 7466 of 1915; this J., 1916, 639.

Furnace for the heat treatment of metals. C. M. Walter, Birmingham. U.S. Pat. 1,303,429, 13.5.19. Appl., 6.8.17.

See Eng. Pat. 117,903 of 1916; this J., 1918, 589 A.

Grinding ores. **Eng. Pat. 126,114.** ***See*** **I.**

Heat insulation. **U.S. Pat. 1,301,675.** ***See*** **I.**

XI.—ELECTRO-CHEMISTRY.

Conductivity of insulating materials at high temperatures; Methods of measuring ——. F. B. Silsbee and R. K. Honaman. J. Wash. Acad. Sci., 1919, **9**, 252—266.

The results obtained by the use of an alternating current method on a number of types of samples are given below, *b* and *c* being constants of the material and independent of the shape and size of the specimen used. As one of these constants depends markedly upon the other, it has been found convenient to compute an "effective temperature" (T_e), which is defined as the temperature at which the material has the arbitrarily selected resistivity of one megohm per cubic centimetre, and is obtained from the equation: $T_e = \frac{c-6}{b}$.

Resistivity of insulating materials.

Material	*c*	*b*	T_e	ρ at 500° C.
Fused silica ..	11 8	0 0065	890° C.	340×10^6
Best porcelain tested	11 2	0 0066	790° C.	80×10^6
Typical mica plug .	12 1	0 0085	720° C.	70×10^6
Average 3 aviation porcelains ..	11 5	0 0085	650° C.	40×10^6
Average automobile porcelain	10 2	0 0085	490° C.	$0\,8\times10^6$

The figures show a wide variation in the resistance of the different materials, but a surprising similarity in the constant, *b*, which is a measure of the temperature coefficient of their resistance, whilst successive measurements with alternating current on a single specimen gave results agreeing within a small amount, yet measurements on different specimens of material, supposed to be identical, showed wide variations in resistivity, amounting in some cases to a factor of 10. This tends to indicate that the conduction is due to a considerable extent to the presence of small amounts of impurities, which may vary greatly in amount without appreciably affecting the composition of the material as a whole.—B. N.

Patents.

Accumulator cells; Electric —— and method of making the same. H. S. Hawkins, San José, Cal., U.S.A. Eng. Pat. 115,635, 2.5.18. (Appl. 7387/18.) Int. Conv., 2.5.17.

Several plates are supported and spaced apart in a container, the spaces being partially filled with sugar, which is then baked at a sufficiently high temperature to produce ebullition and form a highly porous mass of carbon adhering closely to the plates. The carbonaceous mass acts as an insulating and bracing material, preventing disintegration of the plates.—B. N.

Battery; Storage ——. T. A. Edison, West Orange, N.J. U.S. Pat. 1,299,693, 8.4.19. Appl., 10.8.14.

The positive element of the battery contains nickel and the negative element a mixture of finely-divided ferrous material with a small percentage of mercury and a stannic material, in an alkaline electrolyte containing lithium hydroxide.—B. N.

Electric cells or batteries. E. Baur and W. D. Treadwell, Zürich, Switzerland. Eng. Pat. 126,766, 16.3.18. (Appl. 4689/18.)

A cell for generating electrical energy comprises a combustible electrode, and an electrode which is depolarised by air, both electrodes being in contact with a refractory diaphragm or diaphragms saturated with molten salt, the contact between the electrodes and the diaphragms extending along the whole effective surface of the electrodes, which remain in a dry state. For example, a layer of broken coke in an iron container may serve as combustible electrode. A diaphragm of burnt magnesia saturated with melted soda rests on the coke and above this is an air electrode consisting of iron wire gauze supporting a layer of hammer slag or the like and surmounted by a gas bell of fireproof material with an inlet and outlet for air. The cell is placed in a heating chamber at 900° C. In an alternative form, two magnesia pipes, closed at the bottom, dip into melted soda in an iron receiver. Each pipe is lined inside with iron wire gauze and encloses a gas-supply pipe; through one pipe air is blown and through the other an inflammable gas (hydrogen, carbon monoxide, water-gas, or coal-gas) to serve as the combustible electrode. The cell is placed in a heating chamber at 900° C.—B. N.

Furnaces; Electric —— for the fixation of nitrogen. Nitrogen fixation furnaces. E. K. Scott, Farningham, Kent, and F. Howles, Manchester. Eng. Pats. (A) 126,058, 21.11.16, and (B) 126,080, 2.12.16. (Appls. 16,668 and 17,332/16.)

(A) A high-frequency high-tension pilot spark discharge is produced between converging electrodes and a central pilot wire placed beneath the gap between the lower ends of the electrodes, by means of step-up and oscillation transformers interposed between the source of the alternating current for the pilot spark and the pilot spark gap. (B) The furnace proper is divided into three parts, each carrying an electrode, the latter being supported by three blocks of refractory material, having apertures for the passage of water conduits and electric connections of the electrodes, and for the adjustable fins at the base of the electrodes, each fin being supported by a holding and adjusting means; sighting apertures are also arranged in the blocks. The furnace is disposed between a base chamber containing the air supply pipe in which the pilot spark wire is arranged, and a gas cooler and steam generator above the furnace.—B. N.

Furnace; Electric ——. W. K. Booth, Assignor to Booth-Hall Co., Chicago, Ill. U.S. Pat. 1,299,110, 1.4.19. Appl., 4.4.18.

A wall contact in an "acid" furnace is formed by mixing silica and carbonaceous material and heating the mixture in the electric arc to form a monolithic mass of silicon carbide as a matrix, carrying excess of carbon, and with a facing of silica. An open-work metal grid is embedded in the mass with a shank extending through the refractory wall, the grid and shank being composed of sections of small area.—B. N.

Furnace; Electric ——. H. A. Greaves and H. Etchells, Sheffield. U.S. Pat. 1,301,932, 29.4.19. Appl., 18.2.19.

An electric furnace installation is provided with two or more sets of transformer windings, with improved connections comprising the inversion of polarity or the rotation of phase of 90°, 120°, 180°, 240° or 270° of one group of transformer windings, relatively to the phase or phases of the other group or groups of transformer windings.—B. N.

Chemical reactions; Method and apparatus for carrying out —— by means of magnetically spread-out electric arcs. A. V. Lipinski, Zürich, Switzerland. U.S. Pat. 1,281,604, 15.10.18. Appl., 6.3.18.

In carrying out the process described in Eng. Pat. 105,135 of 1916 (this J., 1917, 602), curved blades are

provided in the pipe through which one of the currents of gas is supplied in order to impart to this current a revolving movement about the axis of the flame sheet between the electrodes in addition to its movement in the direction of the shortest path between the electrodes.

Electric resister; Zigzag carbon — —. J. Thomson, New York. U.S. Pat. 1,298,121, 25.3.19. Appl., 16.4.18.

An electric resister is produced by squirting a mixture containing carbon through a die, cutting slots in the band of squirted material so as to give it a zigzag form, filling the slots with relatively electrically non-conducting material, such as fused aluminium oxide and silicon carbide in crystalline form, then enclosing the whole in moist material, partly drying the latter, and finally passing an electric current through the member, so as to heat it progressively until the temperature reaches a point higher than that at which the resister is to be used. —B. N.

Resistance; Variable — *Resistance element.* T. W. Case, Scipio, N.Y. U.S. Pats. (A) 1,298,157 and (B) 1,298,627, 25.3.19. Appl., 19.2. and 16.5.17.

The resistance element is formed of (A) a material, or (B) a compound, containing lead, antimony, and sulphur. B. N.

Resistance; Variable — —. T. W. Case, Scipio, N.Y. U.S. Pat. 1,301,227, 22.4.19. Appl., 9.10.17.

A resistance element comprising a compound of thallium and sulphur.—B. N.

Electrolysis of fused electrolytes. H. C. M. Ingeberg, Sandviken, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,299,947, 8.4.19. Appl., 30.10.17.

A diaphragm, for use in the electrolysis of fused electrolytes, is made of a non-porous material substantially insoluble in the electrolyte, and which is practically non-conducting at atmospheric temperatures but becomes conductive at the temperature of the fused electrolyte.—B. N.

Electrolysis; Device for carrying out chemical processes by — —. V. Gerber, Baden, Switzerland. U.S. Pat. 1,301,832, 29.4.19. Appl., 14.1.19.

A receptacle is divided into cells, with positive and negative electrodes arranged respectively in the cells at opposite ends. Metallic rolls are provided between adjacent cells, and are adapted to act as carriers for substances adhering thereto when the current is passed. Means are provided for moving or rotating the rolls, so that the part of each roll situated in one cell is alternately brought into the adjacent cell during the movement.—B. N.

Chemical reactions; Method and apparatus for carrying out — — *by means of magnetically spread-out electric arcs.* A. V. Lipinski, Zürich, Switzerland. U.S. Pat. 1,290,600, 7.1.19. Appl., 15.3.16.

See Eng. Pat. 105,135 of 1916; this J., 1917, 602.

Electrical energy; Supply of — *to furnaces or other appliances.* W. Travis, Sheffield. U.S. Pat. 1,301,887, 29.4.19. Appl., 13.2.19.

See Eng. Pat. 118,233 of 1918; this J., 1918, 591A.

Electro-osmotic dehydration. Ger. Pat. 311,053. *See* I.

Electrical purification of gases. Ger. Pat. 311,14- *See* I.

Electrolytic oxidation. Chlorates. Eng. Pats. 125,608—9. *See* VII.

Electric furnace apparatus. U.S. Pats. 1,299,336—7 *See* VII.

Electrolysis. U.S. Pat. 1,300,420. *See* VII.

Electrode for welding. Eng. Pat. 126,245. *See* X.

Catalysts. U.S. Pat. 1,299,565. *See* XII.

XII.—FATS; OILS; WAXES.

Potassium; Determination of available — *in beetroot vinasses ash intended for soap-making.* M. Benoist and S. Bregnoni. Ann. Falsif., 1919, **11**, 72—78.

To ascertain the quantity of potassium carbonate in beetroot vinasses ash, determinations should be made of total potassium, chlorine, sulphate, and total alkalinity. It may be assumed that one-quarter of the chlorides, sulphates, and alkalinity consists of the respective sodium salts, and, taking this into consideration, the actual quantity of potassium carbonate may be calculated approximately. During the present shortage of potassium salts, beetroot vinasses ash could be used more advantageously as a fertiliser than as an alkali for making soft soap. W. P. S.

Glycerin; Specific gravity and refractive power of solutions of —. H. Wolff. Z. angew. Chem., 1919, **32**, 148.

The author has determined the sp. gr. and refractive indices of solutions in water of an extremely pure sample of glycerin with the following results: The sp. gr. (referred to water at 15° C.) of a solution containing 86% of glycerin is 1·2294 at 15° C., and that of a solution containing 76·77% of glycerin is 1·2043 at 13·8° C., 1·1998 at 22° C., and 1·2036 at 15° C. The coefficient of expansion of the latter solution is 0·0004603. The results agree very closely with those contained in Gerlach's table. The refractive indices of the two solutions were: 86% solution, n_D 1·4545 at 12·5°, 1·4537 at 15°, and 1·4533 at 17·5° C.; 76·72% solution, 1·4401 at 12·5°, 1·43945 at 15°, and 1·4388 at 17·5° C. The change in refractive index per 1° C. was $2·8\times10^{-4}$ for the 86% solution and $2·6\times10^{-4}$ for the 76·72% solution. —J. S. G. T.

Asphalts. Marcusson. *See* IIA.

PATENTS.

Copra; Apparatus for drying — *and treating other substances.* F. A. Rich, Sydney, N.S.W., Assignor to D. W. Kirk, Whakatane, N.Z. U.S. Pat. 1,298,790, 1.4.19. Appl., 18.3.16.

The upper side of an open-meshed endless conveyor is enclosed in a hot-air oven, the conveyor being supported beneath its upper side on rollers within and without the oven. The walls of the oven have an inlet and an outlet for hot air and also an inlet and outlet, fitted with flexible flaps, for the conveyor.—A. de W.

Hydrogenation of fatty bodies or other organic compounds; Process for regenerating catalysers containing nickel and its compounds which have been employed for the ——. Soc. Industrielle de Produits Chimiques, Paris. Eng. Pat. 111,840, 5.11.17. (Appl. 16,150/17.) Int. Conv., 2.12.16.

Catalysts containing nickel or its compounds which have been employed for hydrogenation of fatty bodies are freed wholly or partly from adhering organic products, transformed into nickel oxide by heating the mass with access of air and with constant stirring, washed in water, and then heated to about 300° C. for several hours in oil and in a current of hydrogen, whereby nickel suboxide is obtained. Alternatively the washed nickel oxide may be reduced to nickel at a low temperature.

—A. de W.

Catalysts for hydrogenation; Process of electrically preparing ——. C. Ellis, Montclair, N.J. U.S. Pat. 1,299,565, 8.4.19. Appl., 14.11.16.

Finely divided nickel in a spongy condition is deposited upon charcoal by passing a current of high density from a nickel electrode to a mass of charcoal material, both electrode and charcoal being immersed in a liquid electrolyte.—C. A. M.

Glycerin; Production of ——. G. J. Lemmens, Wateringbury, and P. J. Fryer, Tonbridge. Eng. Pat. 126,706, 21.2.17. (Appl. 2528/17.)

Oil or fat is subjected in an autoclave to the conjoint action of heat and pressure (about 100 lb. per sq. in.) in the presence of an emulsifying and accelerating agent, *e.g.*, zinc oxide or hydroxide, for a lesser period than the normal time for ordinary treatment (*e.g.*, for 8 hours). The strong solution of glycerin formed is withdrawn and replaced by a quantity of clean, hot, and preferably distilled water equal to about one-third to one-fourth of the weight of the original charge of oil or fat, and the treatment continued for the remainder of the usual period (*e.g.*, for 4 hours). The dilute glycerin obtained from the latter part of the process is drawn off and used for the initial treatment of a further charge of oil or fat.

—A. de W.

Sulphonated mineral-oil-sludge product [detergent] and process of making ——. *Product and process of producing an alkali-metal sulphonate having the properties of a detergent.* R. E. Divine, Cincinnati, Ohio. U.S. Pats. (A) 1,301,662 and (B) 1,301,663, 22.4.19. Appl., (A) 16.4.17 and (B) 8.12.17.

(A) The acid sludge formed by "sulphonating a portion of the contents of a mineral oil distillate" is dissolved in water, the free oil separated, and the aqueous solution neutralised with a substance capable of forming a water-insoluble sulphate, whilst forming a water-soluble sulphonate, *e.g.*, an alkaline-earth compound. The precipitate is filtered off and the water-soluble sulphonate salted out. The sulphonate is claimed to be substantially colourless, neutral, more soluble in water than in oil or ether, and to have detergent properties. (B) The sulphonate from (A) is dissolved in water, decomposed with sodium carbonate, and the precipitated alkaline-earth sulphate (*e.g.*, calcium sulphate) separated.—A. de W.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Lead; Oxides, carbonates, and sulphates of —— [*as pigments*]. C. A. Klein. J. Oil and Colour Chem. Assoc., 1919, **2**, No. 8, 1—21.

The author gives brief descriptions of the preparation and properties of the oxides, carbonates, and sulphates of lead used as pigments. "New process" lead oxide, obtained by violent agitation of molten lead in cast iron containers in a current of air, is of brown to yellow colour and may contain from 4% to 7% of metal. Sublimed oxide, an American product, is obtained by oxidising lead and subliming the resulting oxide, using natural gas as a source of heat. Orange lead differs from red lead in its higher content of PbO_2, the theoretical of 34·94% however never being obtained. It is suggested that Pb_3O_4 possibly consists of a solid solution of PbO and PbO_2. In the formation of white lead from the basic acetate, probably $PbCO_3$, $Pb(OH)_2$ is first formed, and is then converted into $2PbCO_3$, $Pb(OH)_2$, which in turn can be converted into $PbCO_3$, the three reactions proceeding simultaneously but at different rates. Basic lead sulphate obtained by sublimation of galena has found extensive application in the United States as a constituent of paints. Typical analyses of a number of commercial lead paint products are given.—A. de W.

Austrian and American rosin. W. Fahrion. Chem. Umschau, 1919, **26**, 65—67.

Determinations of the constants of Austrian (*Pinus austriaca*) and American (*P. longifolia*) rosin were carried out as follows, a fairly light-coloured sample (grade K) of Austrian rosin from Piesling being compared with a somewhat darker grade of American rosin: 2·3 grms. of the powdered rosin was dissolved in alcohol and titrated with alkali (acid value A). Slight excess of alkali was then added, the solution boiled a short time, cooled, and titrated back with acid (saponif. value A). More alkali was added, the solution diluted with water to 180 c.c., extracted with ether, and the unsaponifiable matter weighed. Acid value B and saponif. value B were then calculated on the pure resin acid. The pure resin acid was then liberated from the soap, freed from unsaponifiable matter by the usual method, and acid value C and saponif. value C directly determined. Finally the resin acid was isolated from the soap solution and the insoluble oxyabietic acid separated by means of petroleum ether. Iodine values were determined by reaction with Wijs' solution for one hour.

	Austrian rosin	American rosin
Iodine value	124·8	122·3
Acid value A	154·7	164·5
,, ,, B	173·6	174·6
,, ,, C	175·3	172·3
Saponif. value A	162·1	169·3
,, ,, B	181·9	179·7
,, ,, C	183·0	176·9
% Unsaponifiable	10·9	5·8
,, Resin acids	86.6	92·7
,, Oxyresin acids	6·9	6·9

This shows that the acid as well as the saponification values of Austrian rosin are definitely lower than those of American rosin, the cause being merely the higher content of unsaponifiable matter in the former, since the values for the pure acids B and C are actually higher. The author considers that the neutral substances of rosin do not consist entirely of hydrocarbons but may contain proportions of difficultly saponifiable abietic anhydride, small proportions, 0·4% and 0·7% respectively having been isolated from Austrian and American rosin. The high saponif. value and low content of unsaponifiable matter in French rosin has been attributed to the careful method of distillation, but in consideration of the relatively high content of unsaponifiable matter (10·9%) in the rosin from the Piesling plant with modern equipment in comparison with the low content in American rosin

which is generally understood to be produced in very primitive installations, such conclusion would hardly seem correct. On the other hand, from the author's published experiments on the autoxidation of rosin, it is probable that the neutral substances originate from the resin acids during distillation, since the iodine values of both constituents lie close together and fall in sympathy during oxidation.—A. de W.

Rosins; Some constituents of French and American ——. E. Knecht and E. Hibbert. J. Soc. Dyers and Col., 1919, **35**, 148—154.

By repeated crystallisation from acetic acid and alcohol two pimaric acids, $C_{20}H_{30}O_2$, showing opposite optical rotations were obtained from French and American rosins respectively. On heating *in vacuo*, or in a stream of carbon dioxide, they are converted into rosin-like anhydrides, which on crystallisation from acetic acid or alcohol revert to inactive pimaric acids. The rosins themselves probably consist mainly of anhydrides, hydration being preliminary to the crystallisation of the resin acids, and it is suggested that this is the cause of the whitening of surfaces varnished with rosin when subjected to the prolonged action of water. (See further J. Chem. Soc., 1919, 1., 338.)—G. F. M.

Patents.

Lampblack; Manufacture of ——. T. W. S. Hutchins, Middlewich. Eng. Pat. 126,560, 23.9.18. (Appl. 15,444/18.) Addition to 124,557, 22.3.18.

One or more oxyhydrogen, oxyacetylene, or other high-temperature flames is used in place of the electric arc in the process described in the chief patent (this J., 1919, 378A).—A. de W.

Moulding composition. J. P. A. McCoy, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,300,218, 8.4.19. Appl., 12.4.15.

A filling material, vegetable oil which expands when polymerised, and a resinous binder containing at least one of a group of substances, including indene, coumarone, and their partially polymerised products, which shrink on polymerisation, are incorporated in such proportions that the expansion is substantially neutralised by the shrinkage during the polymerisation process.—C. A. M.

Impregnating porous materials; Compositions for ——. W. V. Lander, Newton, Mass, U.S.A. Eng. Pat. 126,871, 15.8.18. (Appl. 13,272/18.)

See U.S. Pats. 1,277,322 and 1,278,943 of 1918; this J., 1918, 663A; 1919, 8A.

Cellulose-ester dope or varnish. J. N. Goldsmith, Assignor to The British Emaillite Co., Ltd., London. U.S. Pat. 1,298,199, 25.3.19. Appl., 13.6.17.

See Eng. Pat. 124,515 of 1916; this J., 1919, 378A.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Patents.

Vulcanisable composition. W. T. Hale, Dodge City, Kans. U.S. Pat. 1,300,263, 15.4.19. Appl., 25.5.18.

A vulcanisable composition is prepared with the ingredients unvulcanised rubber, a rubber solvent, lead oxide, lead acetate (or acetic acid), mercuric sulphide, asphalt, and sulphur.—D. F. T.

Rubber compositions; Process of producing —— an vulcanisation product therefrom. R. C. Harton, Assignor to Goodyear Tire and Rubber Co Akron, Ohio. U.S. Pat. 1,301,693, 22.4.19. Appl 30.3.17.

Barium sulphate formed by precipitation in th presence of a colloidal gel such as animal glue i introduced whilst still wet into raw rubber, th moisture being eliminated during the mixing pr cess or subsequently. Animal glue may be intr duced alone into rubber by previously forming i into a gel by treatment with water, the water bein expelled as in the previous case. The mixture ca be vulcanised in the usual way by means of sulphur —D. F. T.

Rubber; Process for the devulcanisation of —— D. Spence, Norwalk, Conn., U.S.A. Eng. Pat 126,397, 21.4.17. (Appl. 5768/17.)

See U.S. Pats. 1,235,850 and 1,235,852 of 1917; this J., 1917, 1055, 1056.

XV.—LEATHER; BONE; HORN; GLUE.

Hide powder; Use of unchromed —— [in tannin analysis]. R. H. Wisdom and W. A. Felder. J. Amer. Leather Chem. Assoc., 1919, **14**, 239—243.

Experiments showed that chromed powder does not absorb more colouring matter than unchromed powder. Tannin analyses were made with dry unchromed hide powder using the official method with a slightly more acid liquor and shaking for a longer period of time. The non-tannin solution passed the gelatin-salt and soluble hide tests, but contained appreciable amounts of sodium chloride. The results compared very favourably with those obtained with the wet chromed powder.—D. W.

Leather; Determination of total, soluble, and insoluble ash in —— J. M. Seltzer. Report of a committee of the American Leather Chemists' Association. J. Amer. Leather Chem. Assoc., 1919, **14**, 243—255.

Direct incineration gives lower results than those obtained by adding together the ash of the water-soluble matter and of the extracted leather. It is suggested that the excess carbon reduces the salts to oxides in direct incineration. It is recommended that 30 grms. of leather be extracted in a water extraction apparatus. The extracted leather should be removed from the apparatus, dried slowly at a low heat, then at 98°—100° C. for 16 hours, and finally weighed. One-third of the well mixed product should be ignited in a tared dish at a dull red heat until all the carbon has been consumed, and the residue weighed as insoluble ash.—D. W.

Leather; Effect of long soaking on the composition of sole ——. J. B. Churchill. J. Amer. Leather Chem. Assoc., 1919, **14**, 237—238.

A piece of sole leather recovered after 54 years' immersion in water was pliable and dark red in colour, but when dried out became nearly black and very brittle. The dry leather contained 74·3% of hide substance, 11·7% of combined tannin, and 1·79% of water-soluble matter. Long soaking had removed the greater proportion of the combined tannin. —D. W.

Gelatin; Effect of hydrogen ion concentration on liquefaction of ——. H. E. Patten and A. J. Johnson. J. Biol. Chem., 1919, **38**, 179—190.

Gelatin behaves as an aggregate of amino-acids acting amphoterically. The setting of gelatin is influenced by the hydrogen ion concentration. (See further J. Chem. Soc., 1919, 1., 300.)—J. C. D.

PATENTS.

Tanning. R. Johnson, W. Gregory, and J. A. S. Morrison, Warrington. Eng. Pat. 126,853, 2.7.18. (Appl. 10,792/18.)

FOR strengthening lime, tanning and other liquors, a thin paste of lime or tanning material respectively is run into an autoclave and air blown in to agitate the mixture. The paste is blown by means of compressed air along a valved distributing main leading to the pits containing the liquor to be strengthened.—D. W.

Artificial pearls; Process for covering articles with a nacreous coating, particularly applicable to the manufacture of ——. J. Paisseau, Paris. Eng. Pat. 23,137, 26.11.14.

AN object is coated with a solution containing dehydrated fish scales suspended in an agglutinant, such as an aqueous solution of gelatin or a solution of a cellulose ester or ether in an appropriate organic solvent. The coated object is then immersed in a coagulating liquid which extracts the solvent from the agglutinant and precipitates the coating without evaporation of the solvent.—J. F. B.

Proofing materials [glue] for treating the walls of porous vessels. G. H. Hadfield, Mitcham, and A. E. Bawtree, Sutton. Eng. Pat. 126,097, 25.3.18. (Appl. 5225/18.)

A RAPIDLY setting composition for treating the walls of porous vessels is made by treating a solution of a colloid (glue) with a substance, such as potassium bichromate, which tends to render the surface impermeable, and with an excess of a substance, such as chrome alum, which raises the melting point or accelerates the setting. Finally, the mixture is treated with liquor ammonia or other agent which will render it more fluid or facilitate its melting. If the colloid already contains a sufficient quantity of one class of substances the other class only is added.—C. A. M.

Adhesive and the like. Adhesive and process of making same. J. Alexander, New York. U.S. Pats. (A) 1,300,096, and (B) 1,300,097, 8.4.19. Appl., 9.7.14 and 30.11.17.

(A) FINELY divided glue (50 parts with a jelly test of 50) is mixed with a hygroscopic metallic chloride, the action of which with water is exothermic (*e.g.*, 17 parts of dry finely powdered calcium chloride), with the object of inhibiting the formation of gel, and causing the adhesive to dissolve in cold water. (B) Glue is mixed with a substance which will control its gelatinisation to a predetermined extent. —C. A. M.

Artificial leather; Process for producing ——. E. C. R. Marks, London. From E. I. du Pont de Nemours and Co., Wilmington, Del., U.S.A. Eng. Pat. 122,678, 21.1.18. (Appl. 1178/18.)

SEE U.S. Pat. 1,257,756 of 1918; this J., 1918, 315 A.

Artificial leather; Methods of producing ——. E. C. R. Marks, London. From E. I. du Pont de Nemours and Co., Wilmington, Del., U.S.A. Eng. Pat. 122,679, 21.1.18. (Appl. 1179/18.)

SEE U.S. Pat. 1,269,339 of 1918; this J., 1918, 709 A.

Vulcanisable composition of matter having comminuted leather as a base, and method of preparing same. J. S. Campbell, London. U.S. Pat. 1,302,463, 29.4.19. Appl., 17.9.17.

SEE Eng. Pat. 109,530 of 1916; this J., 1917, 1141.

Vegetable dyes. **Eng. Pat. 126,742.** ***See*** **IV.**

Fertiliser [from tannery liquors]. U.S. Pat. 1,298,960. *See* XVI.

XVI.—SOILS; FERTILISERS.

Soil biological data; Can we predict probable fertility from ——*?* P. S. Burgess. Soil Sci., 1918, 6, 449—462.

AN attempt to ascertain whether it is possible, in the case of Hawaiian soils, to correlate fertility or relative crop-producing powers with the results from ammonification, nitrification, or nitrogen-fixation tests or with the power of the soils to render organic nitrogen water-soluble. Ammonification tests are not suitable for differentiating between average soils, although they may show differences between very poor and very good soils. Similarly the ability of a soil to render organic nitrogen water-soluble is no measure of its fertility. Nitrification seems to be the most accurate biological soil test for predicting soil fertility and there is also a close correlation between the amounts of nitrogen fixed in mannitol solution cultures and the known fertilities of the soils studied.—W. G.

Lime requirement of soils; Relation of the —— *to their retention of ammonia.* L. P. Howard. Soil Sci., 1918, 6, 405—411.

A NEW method for the determination of lime requirements is suggested. 25 grms. of soil is left in contact with 50 c.c. of *N*/5 ammonia solution in a dish for one hour with occasional stirring. The solution is then evaporated to dryness on a water bath, and the soil rubbed up with a pestle and left on the bath for 1½ hours. The soil is washed into a flask with 100 c.c. of ammonia-free water, 5—10 grms. of sodium carbonate is added, and the ammonia estimated by the aeration method (Potter and Snyder this J., 1915, 438). A blank determination is made with each soil. Within reasonable limits the results obtained are independent of the concentration of the ammonia added, the time of contact, and the temperature of evaporation, and are about 25% lower than those obtained by the Veitch method (see this J., 1904, 762). Sodium, ammonium, and potassium from solutions of their hydroxides and carbonates are retained in practically equivalent amounts by soils.—W. G.

"Alkali" salts [in soils]; Toxicity of ——. T. M. Singh. Soil Sci., 1918, 6, 463—477.

THE salts examined, arranged in order of descending toxicity, were sodium chloride, nitrate, carbonate, and sulphate, their effects on ammonifying, nitrifying, and nitrogen-fixing organisms and on the germination and growth of wheat and peas being tested. The percentage of the anion and not of the cation is the determining factor. Small amounts of the different salts used stimulated both crop growth and bacterial activity, the amount varying with the crop grown. The toxic point found when salts were used in combination, as under field conditions, agreed very closely with the points found when single salts were used. The toxic points of the combined salts depended on the percentages of the chlorides, nitrates, carbonates, and sulphates present and the combinations in which they existed. Calcium sulphate tended to lower the toxicity of the chloride, carbonate, and nitrate of sodium.—W. G.

Soils containing rather large amounts of nitrates; Determination of total nitrogen in ——. **R. S. Snyder. Soil Sci., 1918, 6, 487—490.**

IF the organic matter of the soil is within the usual average (0·8—3·0%) the Hibbard method (this J.,

1910, 1412) or digestion with mercury and sulphuric acid gives quite accurate results for total nitrogen, even if 10% of the nitrogen is present as nitrate. If, however, the organic carbon content is below 0·5%, methods for total nitrogen, modified to include nitrate nitrogen, such as Ulsch's method (reduction of nitrate with iron and sulphuric acid, *Z. angew. Chem.*, 1891, 241) must be used.—W. G.

Soil; Soluble non-protein nitrogen of — —. R. S. Snyder and R. S. Potter. *Soil Sci.*, 1918, **6**, 441—448.

From a further study of the method previously described for the estimation of soluble non-protein nitrogen in soil (this J., 1916, 645) the authors find that, in order to obtain the maximum results from basic soils, they should be extracted with 1% hydrochloric acid until the wash water is free from calcium. It is not necessary to extract acid soils with the acid. Nitrates present in the acid extract may be reduced with Devarda's alloy (this J., 1893, 550) after making the extract faintly alkaline. The results from a number of soils, limed and unlimed, show that the soluble non-protein nitrogen is usually decreased by an application of lime, though there are exceptions.—W. G.

Soil reaction; Effect of organic matter on —. R. E. Stephenson. *Soil Sci.*, 1918, **6**, 413—439.

The results of pot experiments with a silt loam fairly rich in organic matter and a sandy loam poor in organic matter are given. The substances applied to the soil were albumin, casein, and dried blood; starch and dextrose; alfalfa (lucerne) and ammonium sulphate, and two series were run, one receiving lime and the other without lime. Optimum moisture conditions were provided as nearly as possible by daily watering and no crops were grown. None of the organic materials increased the lime requirements, the highly nitrogenous substances tending rather to reduce the acidity. The carbohydrates had a small and inconsistent effect upon the soil reaction, but ammonium sulphate caused a marked increase in the lime requirement of both soils. The nitrogenous organic substances, whilst protecting the carbonates at first, tended to exhaust the soil of calcium carbonate after several weeks. Ammonification was greater in the absence of lime on both acid soils and was probably due in part to the activity of moulds. Casein and albumin are ammonified more rapidly than dried blood. Ammonia does not accumulate in the presence of either carbohydrates or lucerne. In the presence of carbohydrates no nitrates were found until the end of fifteen weeks, probably because they were consumed by the organisms of the soil.—W. G.

Farmyard manure; Influence of — on the clover crop. E. J. Russell. J. Bd. Agric., 1919, **26**, 124—130.

A comparison of the residual manurial effects of ordinary farmyard manure, dung from cake-fed cattle, shoddy, guano, rape-cake, superphosphate, bone meal, and basic slag, on clover following wheat, and introduced into a rotation on land on which it had not been grown for at least twelve years. The manures had been applied either one, two, three, or four years previous to the clover crop. None of the manures except farmyard manure (both the ordinary manure and that from cake-fed cattle) had any marked effect in increasing the clover crop. Dressings of farmyard manure applied two, three, or even four years beforehand produced notable increases in the clover crop. There was also a distinct effect on a following wheat crop, the higher clover crop being followed by a higher wheat crop. It was noticeable that, whatever the action of the farmyard manure, it only affected the yield of the first cut of clover, the aftermath being much the same on the farmyard manure plots as on the others.—W. G.

Fluorides; Influence of — on vegetation. A. Gautier and P. Clausmann. Comptes rend., 1919, **168**, 976—982.

For trials, with wood charcoal as a culture medium the necessary nutrients being added, show that fluorine in the form of potassium fluoride, applied at the rate of 0·245 grm. per 100 grms. of charcoal, exerted a favourable influence on the growth of cabbage, cress, *Spergula arvensis*, eschscholtzia, spinach, viper's bugloss, onion, and hemp, had no effect on peas, rye, and convolvulus, and caused a lower crop yield in the case of sweet peas and centaury.—W. G.

Citric acid; Recovery of — from the residues of basic slag analyses. M. Popp. Chem.-Zeit., 1919, **43**, 247.

A preliminary treatment with magnesium chloride is necessary to remove phosphoric acid; 15 litres of the solution is then mixed with 750 grms. of calcium chloride dissolved in 1·5 litres of water, and the mixture is boiled until all ammonia has been expelled. The precipitated calcium citrate is collected while hot, washed free from chlorides with boiling water, and dried. The calcium content is determined in a small portion and the main quantity of the precipitate is treated with an equivalent quantity of sulphuric acid (1 : 1 by weight); the mixture is kept in a cool place for 24 hrs., then filtered, and the calcium sulphate washed several times with cold water. The filtrate, on standing, deposits a further quantity of calcium sulphate which is filtered off and the remaining quantity in solution is separated by boiling the filtrate with the addition of barium carbonate in quantity just sufficient to precipitate the sulphuric acid (a sulphate determination must be made on a small portion of the filtrate). After filtration, the solution is evaporated, any silica which separates is filtered off, and the evaporation continued until crystallisation commences. It may be necessary to seed the solution with a crystal of citric acid. At least 90% of the citric acid in the residues may be recovered. Traces of iron in the recovered acid do not interfere with its use for phosphate determinations.
—W. P. S.

Seed disinfection by formaldehyde vapour. C. C. Thomas. J. Agric. Res., 1919, **17**, 33—39.

The seeds were placed on trays in a steamer and a current of steam carrying with it atomised formalin was passed in. The condition found most effective was treatment for 2 hours with 20 oz. of formalin per 1000 cb. ft. The treatment killed bacteria and mould spores, and did not injure any of the seeds tested.—J. H. J.

Potassium in beet vinasses ash. Benolst and Bregnoni. *See* XII.

Patent.

Fertiliser material [from waste tannery liquors]; Continuous process of forming —. V. H. and H. L. Kadish, Milwaukee, Wis. U.S. Pat. 1,298,960, 1.4.19. Appl., 27.4.18.

Waste tannery sulphide liquor is run at a regulated speed into a mixing chamber, where it encounters a measured supply of acid or other precipitant, and after thorough admixture in the course of a tortuous passage through the chamber or by agita-

tion at the point of discharge, the solid constituents are allowed to separate, whilst the hydrogen sulphide is collected.—C. A. M.

XVII.—SUGARS; STARCHES; GUMS.

Sugar; Preparation of —— from plants. E. Winterstein. Z. physiol. Chem., 1919, **104**, 217—219.

The preparation of sucrose from *Sapindus utilis* and horse chestnut is described. (See further J. Chem. Soc., July, 1919.)—J. C. D.

Sucrose; Inversion of — by mechanical ionisation of water. J. E. Abelous and J. Aloy. Comptes rend., 1919, **168**, 1125—1128.

If a 5% aqueous solution of sucrose is passed through a Richardson pulveriser a certain amount of the sucrose is inverted (*e.g.*, 1·2% of the sugar after 5 passages). This amount is greater if the sucrose is dissolved in *N*/10 sodium or potassium chloride. It is still greater in a solution of several electrolytes, *e.g.*, as in Ringer-Locke solution or Raulin's solution. On the other hand the presence of traces of potassium cyanide, hydrocyanic acid, or silver nitrate inhibits the inversion. (See further J. Chem. Soc., 1919, i., 311.)—W. G.

XVIII.—FERMENTATION INDUSTRIES.

Yeast; Nitrogenous constituents of ——. J. Meisenheimer. Z. physiol. Chem., 1919, **104**, 229—283.

Glycine, alanine, valine, leucine, proline, phenylalanine, aspartic acid, glutamic acid, tyrosine, and tryptophane were isolated from the products of autolysis of both bottom and top fermenting yeasts. Serine and cystine were recognised with less certainty and it is believed that aminobutyric acid was present. Glucosamine was detected in the cell residue.—J. C. D.

Enzymes; Fixation of formaldehyde by ——. T. Bokorny. Biochem. Zeits., 1919, **94**, 69—77.

The author concludes from experiments on the combination of emulsin and formaldehyde that this enzyme possesses a protein nature. (See further J. Chem. Soc., 1919, i., 361.)—J. C. D.

Wine; Rapid determination of tartaric acid in — —. L. Mathieu. Ann. Falsif., 1919, **11**, 80—81.

The method described was proposed originally by Pasteur in 1873. Twenty c.c. of the wine is treated with a quantity of ammonium *l*-tartrate equivalent to the total tartaric acid content of the wine (as potassium bitartrate), say 3 grms. per litre; the mixture is then neutralised with calcium hydroxide solution, and the precipitated calcium racemate collected on a filter. Two equal portions of the filtrate are placed in separate test-tubes and one, *A*, is treated with a few drops of ammonium *d*-tartrate solution, and the other, *B*, with ammonium *l*-tartrate solution. If, after 1 hr., the mixtures remain clear the wine contains 3 grms. of potassium bitartrate per litre. Should a precipitate form in *A*, the quantity of potassium bitartrate is less than 3 grms. per litre, whilst a precipitate in *B* indicates more than 3 grms. of potassium bitartrate per litre of wine. In case a precipitate is obtained in either portion of the filtrate, further similar tests are made on fresh quantities of the wine, using more or less of the ammonium *l*-tartrate solution until the filtrate does not show the presence of *l*- or *d*-tartaric acid, indicating that the amount of ammonium *l*-tartrate added was exactly equivalent to the quantity of potassium bitartrate present. In these tests the total tartaric acid is expressed as an equivalent amount of potassium bitartrate.
—W. P. S.

Potassium in beet vinasses ash. Benoist and Bregnoni. *See* XII.

PATENT.

Proteolytic enzymes; Process of producing an extract of — —. Kanegafuchi Boseki Kabushiki Kwaisha, Tokyo Fu, Japan. Eng. Pat. **126,890**, 15.10.18. (Appl. 16,840/18.) Addition to **106,504**, 16.5.16 (this J., 1918, 437A).

See U.S. Pat. 1,296,600 of 1919; this J., 1919, 383A. Glycerin may be used in place of sodium chloride.

XIXA.—FOODS.

Milk; Quantity and composition of ewes' — —. R. E. Neidig and E. J. Iddings. J. Agric. Res., 1919, **17**, 19—32.

Sheep of six breeds were selected with their lambs and were kept under observation for 50 days, during which period the quantity of milk yielded by the ewes was determined every tenth day. A complete analysis of the milk was also made to determine that the milk was of average quality in each case. The results are tabulated in detail. Of the milk constituents, the fat was found to vary most, while the lactose was least variable.—J. H. J.

Milk; Simplified molecular constant for detecting added water in — —. M. Sirot and G. Joret. Ann. Falsif., 1919, **11**, 88—92.

The authors have determined the simplified molecular constant (see Mathieu and Ferré, this J., 1916, 613) of some hundreds of samples of milk and find that the value lies between 70 and 80 and that in most cases it is between 72 and 76. It forms a useful constant for detecting added water in milk, especially when considered in conjunction with the usual analytical data. Milk from diseased cows sometimes shows a high molecular constant and a low percentage of non-fatty-solids (less than 8%).
—W. P. S.

Milk preserved with potassium bichromate; Determination of lactose and proteins in — —. P. Defrance. Ann. Falsif., 1919, **11**, 78—79.

The optical rotation of lactose in milk preserved with potassium bichromate decreases gradually until, after about 70 days, it is only one-half of the original value; consequently, lactose cannot be determined polarimetrically in such milk. The cupric-reducing power of the lactose is not, however, altered. Whilst the quantity of total proteins remains unchanged when milk preserved with potassium bichromate is kept, the casein diminishes to the extent of about 20% in 40 days.—W. P. S.

Meat extracts, their composition and identification. J. A. Emery and R. R. Henley. J. Agric. Res., 1919, **17**, 1—17.

Commercial meat extracts of known preparation, as well as extracts made in the laboratory, were analysed to determine any differences which might serve for identification. The total nitrogen was very low in liver extracts as compared with other extracts, and was highest in muscle extracts. Liver

extracts were low also in "meat-base" nitrogen. Spleen extracts also were low in meat-base nitrogen, but they had a higher total nitrogen. On the other hand, liver extracts were extraordinarily high in non-nitrogenous organic matter. The total creatinine content gave the most uniform differences between the extracts: all the flesh extracts except pickle extract (prepared from the pickle in which the meats were cured) contained more than 5% of total creatinine, whereas liver and spleen extracts did not exceed 2·58%. The ratio of inorganic phosphorus to total phosphorus gave differences which were characteristic also: liver extracts were lowest with a ratio of 0·65, spleen extracts next with 0·7, and muscle and other extracts gave a ratio of 0·75 and over. Pickle extracts and cured meat extracts were identified by the presence of nitrates. Commercial bone extracts resembled muscle extracts. A few qualitative tests were found to be of value. The addition of an equal volume of 10% acetic acid to a 10% solution of a spleen extract always gave a bulky yellowish-white precipitate. Mollsch's test for carbohydrates (with α-naphthol and sulphuric acid) was given by liver extracts, and this test could be used to detect added carbohydrates in muscle extracts. The presence of copper in the ash of an extract was typical of liver extract. A quantitative and qualitative analysis on the foregoing lines is sufficient to differentiate between the various meat extracts.—J. H. J.

Crude fibre etc. [in feeding stuffs]; Rapid filter for use in determinations of ——. F. Mach and P. Lederle. Chem.-Zeit., 1919, **43**, 251.

THE filter is constructed by placing a disc of fine platinum gauze on a perforated porcelain filter plate and then introducing asbestos pulp so that a layer of asbestos is formed above the gauze. The gauze should have 16 to 17 meshes per cm., the diameter of the meshes being about 0·5 mm.
—W. P. S.

Alfalfa (lucerne) saponin. C. A. Jacobson. J. Amer. Chem. Soc., 1919, **41**, 640–648.

WHEN lucerne hay is extracted with hot alcohol and the solution is cooled, a green precipitate is deposited, from which ether removes in a Soxhlet extractor two ketones, myristone and alfalfone, leaving a gummy residue which is very soluble in water. This contains a saponin which can be isolated by dialysing the solution and pouring into alcohol. The saponin, $C_{27}H_{42}O_{12}N$, with about 3% of ash, is a brown, amorphous powder, which only dissolves freely in water and glycerol. It is harmless when taken *per os* and has an enormous foaming power, and might therefore be useful in the preparation of aerated beverages and the like. Unlike most saponins, it contains nitrogen and does not haemolyze blood. (See further, J. Chem. Soc., July, 1919.)—J. C. W.

Yeast. Meisenheimer. *See* XVIII.

PATENTS.

Grapes; Method of treating ——. P. R. Welch, Assignor to The Welch Grape Juice Co., Westfield, N.Y. Reissue 14,636, 15.4.19, of U.S. Pat. 1,258,627, 5.3.18. Appl., 18.2.19.

SEE this J., 1918, 280 A.

Flour; Treating ——. H. Greville, Birkenhead. U.S. Pat. 1,300,604, 15.4.19. Appl., 9.7.18.

SEE Eng. Pat. 117,917 of 1917; this J., 1918, 603 A.

XIXB.—WATER PURIFICATION; SANITATION.

Water; Determination of free carbon dioxide in ——. R. Czensny. Z. anal. Chem., 1919, **58**, 1–12.

IN the titration of dissolved carbon dioxide with sodium carbonate solution, using phenolphthalein as indicator, the quantity of the latter added must be proportional to the amount of sodium carbonate, since pure sodium bicarbonate is acid towards a small quantity of phenolphthalein and alkaline towards a large quantity. The solution used for the titration should contain sodium carbonate, 2·6525, and phenolphthalein, 2·5 grms. per litre; 100 c.c. of the water is titrated with this combined solution until a permanent pink coloration is obtained, and 0·52 c.c. is deducted from the quantity used, the remainder being multiplied by 1·22 to give the free carbon dioxide in mgrms. per 100 c.c. of water.—W. P. S.

Water; Determination of free carbon dioxide in ——. H. Klut. Ber. deuts. pharm. Ges., 1919, **29**, 341–359.

ONE hundred c.c. of the water is treated with 25 drops of 33% Rochelle salt solution (to eliminate the action of ferrous salts) and 3 drops of 1% phenolphthalein solution, and then titrated with sodium carbonate solution. A portable set of apparatus for carrying out the determination at the place where the water is sampled is described.
—W. P. S.

Disinfectants. Relative disinfecting power of elements and chemical compounds. H. Friedenthal. Biochem. Zeits., 1919, **94**, 47–68.

THE absolute disinfecting power was measured by the volume of nutritive medium which could be maintained sterile by 1 grm. of the disinfecting agent. A large number of disinfectants are classified in the order of their disinfecting action per unit cost. Formalin, colloidal mercury preparations, mercuric chloride, and hydrogen peroxide head this list, whilst amongst the relatively expensive agents are found the phenol derivatives. The relative disinfecting power of the elements of each of the groups of the periodic classification are given. Particularly powerful were certain mercury preparations. Amongst the organic disinfectants, formalin and naphthol are the best and phenol and lysol are relatively low down in the list. The relative disinfecting actions of the toxic dose of a very large number of substances for the kilogram frog are given. On this basis hydrogen peroxide and mercuric chloride are the two most powerful, whilst the relatively toxic disinfectants include sodium salicylate and phenol.—J. C. D.

Confined air and unhealthy atmospheres; Apparatus for the rapid analysis of ——. E. Kohn-Abrest. Comptes rend., 1919, **168**, 1019–1022.

THE apparatus consists essentially of a 5-litre aspirator from which issues a tube with four branches each closed by a tap and to each of which an absorption bulb can speedily be connected. For the estimation of carbon dioxide in the air, 5 c.c. of baryta water is used in the absorption bulb and the air is bubbled through at the rate of 2 litres per hour. The liquid is turbid after 20 minutes with air containing 5 parts of carbon dioxide per 10,000, in 10 minutes if there is 1 part per 1000, and in less than 2 minutes if there is 4 parts per 1000. Exact determinations may be made by allowing the air to bubble through for 60, 30, or 10 minutes respectively, and then estimating the barium carbonate volumetrically by a double titration. For the detection of carbon monoxide the air is first

bubbled through a baryta bulb, then through a tube containing iodic acid, heated electrically to 100° C., and then through another baryta bulb. At the end of the aspiration the barium carbonate and the iodine fixed by the baryta in the second bulb are determined. To prove the absence of other injurious gases 2 litres of the air is bubbled through 5 c.c. of a mixture of *N*/100 silver nitrate and *N*/500 potassium permanganate. If the liquid remains pink and is free from turbidity injurious gases are absent or present only in traces. The whole apparatus is portable.—W. G.

PATENT.

Sewage; Apparatus for purification of ——. O. Estner, Dortmund, and H. Schubert, Radebeul. Ger. Pat. 310,326, 13.1.17.

THE sewage travels downwards in a zigzag path over the surfaces of a series of parallel plates, preferably of concrete, inclined alternately to the left and right respectively at an angle of 20°—30° with the horizontal. Owing to the angle chosen, the liquid does not drop off on turning the corner. A number of such zigzag surfaces are united to form a purifying system, each element being strengthened by two ribs. The liquid is delivered to channels situated at the upper end of the several elements, and trickles therefrom over the latter. The air or oxidising medium is introduced into the channels between the surfaces of successive elements.

—J. S. G. T.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES, ESSENTIAL OILS.

Isopelletierine; Natural occurrence of ——. *Alkaloids of the pomegranate tree. VII.* K. Hess. Ber., 1919, **52**, 1005—1013.

DURING the preparation of large quantities of the pomegranate alkaloids, the author has found that after removal of ψ-pelletierine by freezing and of the bulk of the pelletierine as the hydrobromide and subsequent distillation of the residue and treatment of the distillate with ethyl chloro-formate, a small fraction, b.pt. 150°—163° C. at 13 mm., is obtained which consists of a mixture of the urethanes of pelletierine and isopelletierine; from this, the latter can be isolated by hydrolysis with aqueous-alcoholic sodium hydroxide solution, since, under these circumstances, the pelletierine is completely resinified. The urethane of isopelletierine thus obtained forms an oil, b.pt 102°—107° C. at 11 mm. and is identical with the product α-piperidylpropane-α-one formed by demethylation of methylisopelletierine by ethyl azodicarboxylate. The yields of the various alkaloids from 100 kilos. of the bark are approximately as follows: pelletierine, 52·5 grms.; ψ pelletierine, 179 grms.; methylisopelletierine, 22 grms.; isopelletierine, 1·5 grms.; α-1-methylpiperidylpropane-β-one, about 1 grm. (See also J. Chem. Soc., 1919, i., 348.)—H. W.

Guvacine. K. Hess and F. Leibbrandt. Ber., 1919, **52**, 206—212. (Compare this J., 1918, 559 A.)

HESS explains the discrepancies between his view as to the constitution of guvacine and that expressed by Freudenberg (*loc. cit.*), and agrees with the latter. It is now established, therefore, that, of the areca nut alkaloids, guvacine is 1.2.5.6-tetrahydropyridine-3-carboxylic acid, guvacoline is its methyl ester, arecaidine its N-methyl derivative, and arecoline the methyl ester of this, whilst arecaine is the same as arecaidine. (See further, J. Chem. Soc., 1919, i., 220.)—J. C. W.

Digitalis glucosides. XXXIX. H. Kiliani. Ber., 1919, **52**, 200—205.

DIGITOGENIC acid (J. Chem. Soc., 1902, i., 46) has been hydrolysed to a lactone, $C_{24}H_{32}O_9$ (?), m.pt. 93° C., $[\alpha]_D = -79{\cdot}5°$, and a monobasic acid, $C_{24}H_{32\ (or\ 34)}O_{9,\frac{1}{2}}H_2O$, m.pt. 112° C., $[\alpha]_D = -79{\cdot}8°$. (See also J. Chem. Soc., 1919, i., 214.)—J. C. W.

Glucosides; Synthetic ——. *III. Constitution of internally complex salts.* P. Karrer, C. Nägeli, and H. Weidmann. Helv. Chim. Acta, 1919, **2**, 242—265.

SILVER anthranilate reacts with ethyl iodide to form a mixture of N-ethylanthranilic acid and ethyl anthranilate, and the silver salts of salicylic, glycollic, lactic, mandelic, and anthranilic acids react with acetobromoglucose to give mixtures of tetra-acetylglucosides and tetra-acetylglucose esters, the latter predominating. The bearing of these results on the constitution of internally complex salts is discussed. (See further, J. Chem. Soc., 1919, i., 338.)—J. C. W.

Rumex crispus; Proximate analysis of ——, *and a comparison of its hydroxymethylanthraquinones with those from certain other drugs.* G. D. Beal and R. E. Okey. J. Amer. Chem. Soc., 1919, **41**, 693—706.

THE alcoholic extract of the dried root of the curly dock, made by cold percolation, contains emodin and a phytosterol, rhamnol, identical with those in cascara (*Rhamnus purshina*) and also chrysophanic acid, fatty acids, and sugars. The yield of emodin is about 0·1% and that of chrysophanic acid somewhat less, which compares favourably with the quantities obtainable from rarer drugs. (See further, J. Chem. Soc., July, 1919.)—J. C. W.

Nucleic acid; Optically inactive salt of ——. R. Feulgen. Z. physiol. Chem., 1919, **104**, 189—210.

THE author has prepared an alkaline sodium salt of thymus nucleic acid which is optically inactive and which will not gelatinise. On the addition of acids the optical activity and power of gelatinisation return. The change is reversible. Theories are advanced to explain this change. (See further, J. Chem. Soc., 1919, i., 360.)—J. C. D.

Vanillin; Occurrence of ——. E. O. von Lippmann. Ber., 1919, **52**, 905.

VANILLIN can be extracted from the fresh bluish blossoms of the potato plant; it does not appear to be present in the white flowers. It disappears fairly rapidly from the gathered blossoms.—H. W.

Iodoform; Action of reducing agents on ——. A. Gutmann. Ber., 1919, **52**, 212—215.

IODOFORM oxidises alkali arsenites, antimonites, stannites, and sulphides. With an alkaline solution of sodium arsenite, for example, it reacts almost quantitatively according to the equation, $CHI_3 + Na_3AsO_3 + NaOH = CH_2I_2 + NaI + Na_2AsO_4$.

—J. C. W.

Tetranitromethane; Constitution of ——. E. Schmidt. Ber., 1919, **52**, 400—413.

THE reactions between tetranitromethane and aqueous potassium hydroxide have been studied quantitatively. The compound decomposes in two ways, according to the equations, (1) $C(NO_2)_4 + 2KOH = KNO_2 + KC(NO_2)_3 + H_2O$, and (2) $C(NO_2)_4 + 6KOH = 4KNO_2 + K_2CO_3 + 3H_2O$. The course of the reaction depends on the concentration of the alkali,

the quantities reacting according to equations (1) and (2) varying from 2 : 1 with *N*/10 alkali to 12 : 1 with 14 *N*-alkali. These facts can be explained on the assumption that tetranitromethane exists in the tautomeric forms, $NO_2.O.N<\begin{matrix}C(NO_2)_2\\|\\O\end{matrix}$, and $NO.O.C(NO_2)_3$. The first form reacts according to equation (1) and is the more stable in the presence of alkalis, whilst the second form reacts in the alternative way. The paper describes in detail the analytical control of the reaction. Nitroform is estimated by precipitation with nitron, and the nitrate by means of nitron after reducing the nitroform by hydrogen in the presence of palladinised barium sulphate. (See further, J. Chem. Soc., 1919, i., 248.) J. C. W.

Nitroethylene. H. Wieland and E. Sakellarios. Ber., 1919, **52**, 898–904.

NITROETHYLENE can be prepared in 50% yield by the dehydration of β-nitroethyl alcohol by phosphoric oxide or sodium bisulphate; it is an almost colourless, mobile liquid, b.pt. 98·5° C., sp. gr. 1·073 at 13·8° C., the vapours of which violently attack the eyes and throat. It polymerises slowly when kept, more rapidly on exposure to light. The process is remarkably catalysed by water, so that a freshly-prepared aqueous solution of the substance becomes cloudy almost immediately and the separation of the polymeride is complete in a few minutes. The product cannot be depolymerised to nitroethylene by heat. Polymerisation is retarded by acids, but, under these circumstances, water is gradually added with formation of β-nitroethyl alcohol. With alkali, polymerisation occurs with explosive violence. Reduction with stannous chloride and hydrochloric acid yields acetaldehyde and hydroxylamine, whilst, with zinc dust and acetic acid, ethylamine is produced. Nitroethylene combines immediately with bromine in ethereal solution, yielding nitroethylene dibromide, a colourless liquid, b.pt. 97° C. at 21 mm., and with aniline giving N-β-nitroethylaniline, $C_6H_5NH.CH_2.CH_2NO_2$, colourless leaflets, m.pt. 37° C. (See also J. Chem. Soc., 1919, i., 307.)—H. W.

Alkyl iodides; Preparation of ——. R. Adams and V. Voorhees. J. Amer. Chem. Soc., 1919, **41**, 789–798.

THE usual laboratory methods for the preparation of the alkyl iodides are unsuitable when dealing with large quantities of material. The rapid preparation of methyl, ethyl, *n*-butyl and isoamyl iodides (in quantities of 3–4 kilos.) according to a modification of Walker's method (Chem. Soc. Trans., 1892, **61**, 717) is fully described along with a detailed account of the apparatus employed. *n*-Propyl iodide was prepared in smaller amount. The suitable alcohol is heated in a large round-bottom flask of about 12 litres capacity with a mixture of approximately equal amounts of red and yellow phosphorus. The vapours evolved are condensed in contact with iodine and are then returned to the flask. The use of a certain amount of yellow phosphorus is particularly advantageous, the reaction then being instantaneous and the colour of the iodine disappearing immediately upon reaching the reaction flask. During the subsequent distillation of the alkyl iodides the troublesome frothing which occurs when only red phosphorus is employed is absent. Further quantities of iodine can be introduced without dismantling the apparatus, and it is possible to prepare 6 kilos. of crude iodide in a day, using enough phosphorus and alcohol for four portions of iodine of 1½ kilos. each. Five such apparatus can easily be run simultaneously, producing 30 kilos. of crude product in a day. In the case of butyl and amyl alcohols the reaction proceeds extremely readily owing to the great solvent action of these compounds on iodine at their boiling point. A small amount of yellow phosphorus is always left behind, but phosphonium compounds do not appear to be formed. The yields are in every case 90–100% of the theoretical. In the preparation of the lower alkyl halides a large excess of alcohol may be used, but in the case of the higher alcohols this must be avoided, as otherwise difficulties arise in the purification of the product.—F. C.

Alkali and alkaline-earth methylsulphates; Action of heat on ——. J. Guyot and L. J. Simon. Comptes rend., 1919, **168**, 1054–1056.

SODIUM and potassium methylsulphates decompose at 220° – 280° C. giving, as the principal products, methyl ether and alkali pyrosulphate. The alkaline-earth methylsulphates and lithium methylsulphate decompose at a lower temperature giving dimethyl sulphate and metallic sulphate.—W. G.

Oxalic acid; New method for the estimation of ——. H. Krause. Ber., 1919, **52**, 426–432.

WITH the exception of formic acid, oxalic acid is the only common organic acid which yields carbon monoxide when heated with acetic anhydride at 100° C. It decomposes briskly and quantitatively and therefore may be estimated gasometrically. Soluble oxalates are first evaporated in the reaction tube with an excess of hydrochloric acid and insoluble oxalates are decomposed by a mixture of acetic anhydride and sulphuric acid (9 : 1). In the latter case, however, the results are not so good, as the mixture alone evolves some gas which does not dissolve in caustic potash, and of course the reaction is no longer confined to oxalic acid.
—J. C. W.

p-Cymene. II. Utilisation of cymene for the preparation of photographic developers. H. A. Lubs. J. Ind. Eng. Chem., 1919, **11**, 455–456.

CYMENE is nitrated and the nitro-derivative reduced to 4-isopropyl-*o*-toluidine (this J., 1918, 486 A) which is converted through the diazo-reaction into carvacrol. This is transformed into the *p*-nitroso-compound by the addition of sodium nitrite to an alcoholic solution saturated with hydrogen chloride, and the product is reduced to *p*-aminocarvacrol [OH : CH_3 : NH_2 : C_3H_7 = 1 : 2 : 4 : 5]. This is a better developer than *p*-aminophenol, and gives as good tones as metol, but does not keep quite so well as this in the bath. Thymoquinol may also be made from sulphonated carvacrol but the yields are poor and it offers no advantages over quinol.
—J. C. W.

Oils of Eucalyptus tereticornis and E. crebra. T. P. Ghose. Perf. and Ess. Oil Rec., 1919, **10**, 145.

THE oils were obtained from the leaves and young twigs of mature trees growing at Kaunil, Dehra Dun, India, by distillation in steam at 35–40 or 50–60 lb. pressure. *E. tereticornis.* The material contained 22·75% of moisture, and yielded 0·86% (on the dry material) of oil. The redistilled oil was yellow, had sp. gr. 0·903 at 16° C., n^{16}_D = 1·4905, α_D = −22·26° in 100 mm. tube. The fraction distilling at 170°–190° C. (53%) had sp. gr. 0·874 at 16° C., n^{16}_D = 1·4865, and α_D = −8·56° in 100 mm. tube. The fraction 170°–190° C. contained about 10·4% of eucalyptol, and the whole oil contained about 8·4% of aldehyde, but no phellandrene; alcohols and esters were also present. The oil dissolved in 1·9 parts of 80% and in 16 parts of 70% alcohol. *E. crebra.* The material contained 33·0%

of moisture, and yielded 0·46% (on the dry material) of oil. The redistilled oil had sp. gr. 0·899 at 16° C., n^{16}_D=1·4673, and α_D= −3·24° in 100 mm. tube. The fraction distilling at 170°—190° C. (43%) had sp. gr. 0·851 at 16° C., n^{16}_D=1·4685, and α_D= −21·04° in 100 mm. tube. This oil contained no phellandrene and practically no eucalyptol, aldehyde, or ketone. It gave an opalescent solution with 15 parts of 80% alcohol. The oils are useless for medicinal purposes, but their odour is pleasant and they may find application in perfumery.—J. C. W.

Odour and chemical constitution; Relationship between —— . T. H. Durrans. Perf. Ess. Oil Rec., 1919, **10**, 104—136.

From a systematic survey of various classes of chemical compounds, containing only carbon, hydrogen, and oxygen, or only two of these elements, and from a knowledge of their odour or lack of it, whilst recognising that other factors may play a part the author concludes that the presence of unsatisfied partial valencies or residual affinities is the prime cause of a chemical substance having an odour. (See further, J. Chem. Soc., 1919, 1., 364.)—W. G.

Lucerne saponin. Jacobson. *See* XIX A.

Patents.

Chlorhydrins; Processes of making —— . Commercial Research Co., New York, Assignees of K. P. McElroy, Washington, D.C., U.S.A. Eng. Pat. 113,955, 4.2.18. (Appl. 2002/18.) Int. Conv., 8.2.17.

See U.S. Pat. 1,295,339 of 1919; this J., 1919, 339 A.

Isoprene; Producing —— . O. Graul and G. Hanschke, Ludwigshafen, and F. Webel, Mannheim, Assignors to Allen Property Custodian. U.S. Pat. 1,298,929, 1.4.19. Appl., 5.2.12.

See Fr. Pat. 435,312 of 1911; this J., 1912, 409.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

X-ray photographs; Contrast and exposure in —— *through metals.* R. E. Slade. Faraday Soc., Apr., 1919. (Advance copy.) 6 pages.

The relation between the density, D, and the exposure E, in a photographic film is the same for X-rays as for ordinary light, and to obtain a true photograph this relation should be expressed by D=A+B log E, where A and B are constants. The actual relation diverges from this for high and for low exposures, but owing to the very thick layer of emulsion on X-ray plates it is usually found convenient to work in the upper part of the region of under-exposure. To get the maximum photographic effect for a given exposure when photographing through metal the hardest possible radiation should be used. If radiations of different wave lengths are used it is the hard radiations which, by virtue of their greater photographic effect, determine the contrast obtained, though the contrast would actually be greater with softer radiations. It is unlikely, however, that the wave length will be such that insufficient contrast will be obtained. In photographing through iron with a nickel anticathode (characteristic K radiation of wave length $1·66\times10^{-8}$ cm.) differences in the thickness of the iron of the order of 4×10^{-4} cm. should be evident if sufficient exposure is given. In practice a wave length of 0·3 to $0·45\times10^{-8}$ cm. should be sufficient for ordinary use. This can be obtained by using a platinum or tungsten anticathode with as large a spark gap as possible.—W. H. P.

Photosensitising dyes. (1) Mikeska and others. (2) Lund and Wise. (3) Wise and others. *See* IV.

Patents.

Colouring cinematograph and like long films; Method of and machine for —— . E. C. R. Marks, London. From J. L. Lasky, New York. Eng. Pat. 126,745, 14.11.17. (Appl. 16,730/17.)

A negative of the film is prepared so that its unexposed parts correspond with those parts of the positive which are to be coloured and the gelatin of the exposed parts is further hardened, *e.g.*, by treatment with a solution of bichromate. This negative is passed through a solution of a suitable dye, which is absorbed only by the unexposed portions, and then brought into register with the slightly damped positive for a sufficient length of time to allow the transfer of the dye from one film to the other. In the machine described the two films in contact pass over a drum moving at the requisite speed to maintain contact for the required length of time, and means are provided for stretching the positive film to compensate for the extra elongation of the negative film by absorption of water and also for giving sufficient tension to ensure complete contact of the two films on the drum. Several machines can be arranged side by side for successive treatment of the same positive with differently coloured negatives and one dye treatment of a negative will serve for the colouring of several positives.—B. V. S.

Photographic image; Coloured —— *and method of producing same.* F. E. Ives, Philadelphia, Pa. U.S. Pat. 1,300,616, 15.4.19. Appl., 9.10.17.

See Eng. Pat. 113,617 of 1918; this J., 1918, 607 A.

Photographic and cinematographic pictures; Colouring of —— . H. Shorrocks, Chorlton-on-Medlock. U.S. Pat. 1,303,506, 13.5.19. Appl., 16.5.18.

See Eng. Pat. 111,051 of 1917; this J., 1917, 1200.

XXII.—EXPLOSIVES; MATCHES.

Cellulose; Viscosity as a criterion of the suitability of —— *for the manufacture of nitrocellulose.* W. Will. Z. angew. Chem., 1919, **32**, 133—136.

The use of a determination of the viscosity of cellulose in cuprammonium solution has been suggested, *e.g.*, by Ost (this J., 1911, 1247), Piest (this J., 1909, 746), and Schwalbe (Z. angew. Chem., 1918, **31**, 50, 57) as a means of determining the suitability of the material for conversion into nitrocellulose. In the author's experiments, using Ost's method (*loc. cit.*), it was found that different portions of the same sample of cellulose frequently showed greater variations in viscosity than the average values of different samples. The average values, however, of celluloses of different origin and mode of preparation differed to a certain extent from one another both in the case of fresh cuprammonium solutions and of those which had stood for some time, but no definite parallelism could be traced between the average viscosity of cellulose and its properties after nitration. The ready incorporation of the constituents of smokeless powder depends upon other conditions than the viscosity of either the cellulose or its nitrated product, such as, *e.g.*, the fineness of the grinding of the nitrocellulose.—C. A. M.

PATENTS.

Picric acid; Method of and apparatus for drying ——. N. H. Graesser, and E. Williams, Ruabon, Denbigh. Eng. Pat. 126,077, 2.12.16. (Appl. 17,328/16.)

MOIST picric acid is fed through a hopper on to a travelling belt arranged within a casing fitted with steam pipes, and through which heated air can be circulated. The belt is supported by a series of rollers which are of slightly varying diameters in order to cause a disturbance of the picric acid during its passage through the apparatus.—L. A. C.

Picric acid; Process for the separation or recovery of ——. N. H. Graesser, and E. Mather, Ruabon, Denbigh. Eng. Pat. 126,078, 2.12.16. (Appl. 17,329/16.)

To recover picric acid from waste picric acid, picric wash liquors, etc., benzol, preferably at 70°—75° C., or other organic solvent, is added to the material under treatment, the solution of picric acid in benzol is drawn off, and the solvent removed by evaporation. In the recovery of picric acid from acid liquors, excess nitric acid is first removed and the liquor diluted until the ratio of sulphuric acid to water does not exceed 2 to 1.—L. A. C.

Picric acid; Process of manufacture of ——. British Dyes, Ltd., J. Turner, and L. G. Badier, Huddersfield. Eng. Pat. 126,368, 13.1.17. (Appl. 673/17.)

PHENOL (158 lb.) at about 60° C. is added to a mixture of 840 lb. of 95% sulphuric acid and 160 lb. of 70% oleum at the same temperature. When the mixture, which rises at first to 130°—140° C., has cooled to 20° C., a mixture of 470 lb. of 86% nitric acid and 470 lb. of sulphuric acid (66° B., sp. gr. 1·84) is run in slowly, the liquid being cooled so that the temperature rises only to about 100° C. When the addition is complete, steam or water is passed in; picric acid settles out as the temperature rises to 140° C. The liquid is then cooled to 20° C. and the picric acid separated by filtration on an asbestos cloth and purified.—L. A. C.

Picric acid; Manufacture of ——. D. B. Macdonald, Leicester. Eng. Pats. 126,675 and 126,676, 15.12.15. (Appls. 1875 and 1876/17.)

FOUR parts of mercury by weight is added to 5 parts of nitric acid, and the solution is boiled and added to a further 95 parts of nitric acid (sp. gr. 1·42); 32 parts of benzol is then run in, either as a thin stream or in three separate portions, in three hours. The mixture is kept at about 35° C., but not above 40° C., for about ten hours, and is then boiled for one hour. Steam (preferably dry) is then passed through the liquid to remove nitrobenzene, after which the picric acid is separated by means of benzol as described in Eng. Pat. 17,525 of 1915 (this J., 1919, 390 A).—L. A. C.

Organic liquids [benzene, toluene, etc.]; Process of and apparatus for the continuous nitration of ——. The Clayton Aniline Co., Ltd., A. Schedler, and V. Vuilleumier, Manchester. Eng. Pat. 126,355, 8.1.17. (Appl. 346/17.)

A SET of tanks is provided for sulphuric acid, nitric acid, and the organic liquid to be nitrated (*e.g.*, benzene, toluene, etc.); these are of uniform cross-section and of base area proportional to the amount of each liquid required. The sulphuric acid and nitric acid flow into a mixing pot, and the mixed acid overflows into the first of a series of nitration pots, into which also flows the liquid to be nitrated. The rate of flow of each liquid is so adjusted that the level in the three tanks remains the same, and a duplicate set of tanks is provided so that while one set is running, the other set can be filled, and the flow of liquid is not interrupted. The mixture passes down the series of nitration pots, each of which is provided with an agitator and a coil for water or steam, or other means for cooling or heating the contents, and the number of pots, rate of flow, and temperature of each pot are so adjusted that nitration is complete in the last of the series, into which water may also be passed if necessary. From the last pot, the liquid passes into a separator in which the nitrated liquid settles to the top and is withdrawn.—L. A. C.

Explosive mixture. R. L. Hill and A. J. Strane, Tamaqua, Pa., Assignors to Atlas Powder Co., Wilmington, Del. U.S. Pat. 1,299,942, 8.4.19. Appl., 1.11.18.

COPPER sulphate, from which the water of crystallisation has been wholly or partially removed, is added to an explosive mixture containing ammonium nitrate and an organic nitrate.—L. A. C.

Nitrocellulose; Dryer for ——. F. I. du Pont, Wilmington, Del. U.S. Pat. 1,301,409, 22.4.19. Appl., 18.7.17.

IN a dryer for nitrocellulose consisting of a cylinder arranged within a heating chamber, the upper part of the cylinder is formed of relatively light material so that it will rupture readily in the event of explosion, and a relatively heavy support extends over the cylinder.—D. F. T.

Nitrated cellulose products; Manufacture of ——. W. B. Thomson, W. D. Severn, and G. Twyeross, Cape Town, S. Africa. U.S. Pat. 1,302,455, 29.4.19. Appl., 18.4.18.

CLAIM is made for nitrated baobab wood or fibre.
—D. F. T.

Explosives; Process for preparing gelatinised propellent ——. F. L. Nathan and W. Rintoul, Stevenston, N.B., and F. Baker (by H. Baker, administrator, Windsor), Assignors to Nobel's Explosives Co., Ltd., Glasgow. U.S. Pat. 1,302,202. 29.4.19. Appl., 26.2.14.

SEE Eng. Pat. 12,745 of 1912; this J., 1913, 991. Two urea derivatives are used, one of which is capable of gelatinising nitrocellulose to a smaller extent and of stabilising nitric esters, *e.g.*, nitroglycerin, to a larger extent, than the other.

Incendiary compositions. Vickers, Ltd., Westminster, and G. W. C. Webb, Dartford. Eng. Pat. 126,394, 29.1.17. (Appl. 1442/17.)

INCENDIARY mixtures of the type in which granulated or powdered metal is used together with an oxidising agent, are blended with a suitable proportion of magnesium oxide or carbonate which acts as a binding material and also serves to retard combustion; the mixture is compacted by compression or by the addition of water. Calcium or barium oxides and carbonates may be used to replace the magnesium compounds.—D. F. T.

Smoke-producing compositions. Vickers, Ltd., Westminster, and F. G. L. Johnson. Eng. Pat. 126,740, 14.3.17. (Appl. 3724/17.)

A SMOKE-PRODUCING composition contains powdered or granulated zinc (or a mixture of aluminium and zinc) amounting to not less than about 20% of the composition, together with a perchlorate or perchlorates (preferably a mixture of the ammonium and potassium salts) forming the bulk of the remaining ingredients, and a suitable organic binding agent such as asphaltum varnish; mineral jelly may be added and also a small proportion of sulphur to facilitate ignition.—D. F. T.

Smokeless powder; Process and apparatus for recovering solvent from materials such as ——. F. I. du Pont, Wilmington, Del., U.S.A. Eng. Pat. 126,682, 9.2.17. (Appl. 2013/17.) Int. Conv., 4.1.17.

See U.S. Pat. 1,294,066 of 1919; this J., 1919, 305 A.

Explosive compound. F. R. and J. G. Burrows, Port Arthur, Ontario. U.S. Pat. 1,301,646, 22.4.19. Appl., 13.10.17.

See Fr. Pat. 472,371 of 1914; this J., 1915, 378.

Pyroxylin composition. U.S. Pat. 1,301,187. *See* V.

Aluminium waste for explosives. Eng. Pat. 126,021. *See* X.

XXIII.—ANALYSIS.

Burette tubes; Apparatus for accurate calibration of ——. S. English. J. Soc. Glass Technol., 1919, 3, 34—37.

The burette tube is connected through a tap-tube to an elevated mercury reservoir and to an accurately calibrated 10 c.c. pipette fitted with a 3-way tap. The burette tube is nearly filled with mercury and about 1 c.c. of water is then poured in so as to wet the sides as the mercury is withdrawn into the pipette. The position of the water-meniscus in the burette after each successive 10 c.c. has been withdrawn is made to coincide with the cross wire in a short-focus telescope mounted on a vertical support which is exactly parallel to the burette. A mark is then made on the tube with a fine needle pivoted near the front of the telescope in such a manner that this mark exactly coincides with the level of the cross-wire in the telescope. By this means it is impossible to make a mark in a wrong position or with an error due to parallax. It is essential to use the same background in each case and to fix it at the same distance from the burette. If the apparatus faces a window or light, a screen of ground glass is recommended, but if the apparatus faces away from the light a white tile is preferable. The mean difference per 10 c.c. in calibrating a 50 c.c. burette as described and by weighing successive lots of 10 c.c. of water is 0·0004 grm. The calibration of five sections of 10 c.c. each may be completed in less than five minutes.—A. B. S.

Starch and oxalic acid solutions; Preparation of stable —— by means of metallic mercury. A. Junk. Chem.-Zeit., 1919, 43, 258.

Growth of moulds etc. in starch solution and in dilute oxalic acid and citric acid solutions etc. may be prevented completely by adding a small quantity of mercury, boiling the solution, and then shaking it thoroughly so as to disintegrate the mercury. The latter is left in the bottle and the solution so treated may be kept for years without undergoing any change. (See also J. Chem. Soc., July, 1919.)
—W. P. S.

Adsorption by precipitates [of barium sulphate]. I. H. B. Weiser and J. L. Sherrick. J. Phys. Chem., 1919, 23, 205—252.

One hundred grm.-mols. of barium sulphate adsorb the following amounts (expressed in grm.-equiv.-ions) of the anions indicated: 0·056 I'; 0·220 CNS'; 0·310 CN'; 0·831 Br'; 1·760 Cl'; 2·695 $Fe(CN)_6''$; 2·847 MnO_4'; 5·837 ClO_3'; 7·467 NO_3'; 8·482 NO_3'; 13·201 $Fe(CN)_6'''$. The amount of adsorption in the case of chlorate and permanganate ions is decreased by an excess of sodium sulphate. Changes in the experimental conditions change the amounts of anions adsorbed, but the order in which they are adsorbed remains the same. Colloidal solutions of barium sulphate are usually electropositive on account of the strong preferential adsorption of barium ions. (See also J. Chem. Soc., July, 1919.)—J. F. S.

Nitrogen; Continuous method for the determination of —— *by Dumas' method.* L. Dexheimer. Z. anal. Chem., 1919, 58, 13—19.

As soon as one determination is finished, the current of carbon dioxide is passed through the combustion tube in the reverse direction, the boat and adjacent copper oxide layer are withdrawn, a fresh boat containing the next sample is introduced into the tube together with more copper oxide, and the operation proceeded with in the usual way, the boat being pushed gradually, by means of a wire passing through the stopper, into the hot part of the tube. The necessary arrangements of tubes and taps is described in detail, and provision is made for re-oxidising the reduced copper oxide when required.—W. P. S.

Halogens; Estimation of —— *in organic compounds.* D. Vorländer. Ber., 1919, 52, 308.

Baubigny and Chavanne's method (this J., 1904, 136) is recommended. In the absence of iodine, mercurous or mercuric nitrate may be employed instead of silver nitrate.—J. C. W.

Soap in mineral oils. Marcusson. *See* IIA.

Paraffin wax Schwarz. *See* IIA.

Chromic acid. Kolthoff and Vogelenzang. *See* VII.

Magnesium hydroxide precipitation. Brunner. *See* VII.

Sulphates. Rivett. *See* VII.

Chlorine, hypochlorous acid, and hypochlorite. De Mallmann. *See* VII.

Ferrocyanogen compounds in analysis. Werner. *See* VII.

Phosphorus [in iron and steel]. Schmidt. *See* X.

Phosphor-tin. Lord. *See* X.

Potassium in beet vinasses ash. Benoist and Bregnoni. *See* XII.

Tannin analysis. Wisdom and Felder. *See* XV.

Ash in leather. Seltzer. *See* XV.

Lime requirement of soils. Howard. *See* XVI.

Nitrogen in soils. Snyder. *See* XVI.

Soluble non-protein nitrogen of soil. Snyder and Potter. *See* XVI.

Citric acid from residues. Popp. *See* XVI.

Tartaric acid in wine. Mathieu. *See* XVIII.

Water in milk. Sirot and Joret. *See* XIXA.

Milk preserved with bichromate. Defrance. *See* XIXA.

Meat extracts. Emery and Henley. *See* XIXA.

Crude phic Mach and Lederle. *See* XIXA.

Carbon dioxide in water. Czensny. *See* XIXB.

Carbon dioxide in water. Klut. *See* XIXB.

Air analysis. Kohn-Abrest. *See* XIXB.

Oxalic acid. Krause. *See* XX.

PATENTS.

Hardness of materials; Means for testing the —. L. J. Richardson, London, and W. and T. Avery, Ltd., Birmingham. Eng. Pat. 126,463, 10.5.18 (Appl. 7825/18.)

AN apparatus by means of which the file test may be executed mechanically and automatically calibrated records obtained.

Gas analysing apparatus. O. Rohde, Assignor to Aktiebolaget Ingeniörsfirma F Egnell, Stockholm. U.S. Pat. 1,302,224, 29.4.19. Appl., 29.1.17.

SEE Eng. Pat. 103,812 of 1916; this J., 1918, 447A.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY

APPLICATIONS.

August. Muffle furnaces. 15,175. June 17.

Cloudsley. Drying-apparatus. 15,782. June 23.

Conte. Separating solids from liquids. 16,015. June 25. (Spain, 27.6.18.)

Conte. Hydro-extractors. 16,016. June 25. (Spain, 27.6.18.)

Cumpsty. Furnace linings. 15,522. June 20.

Delfwik, and Techno-Chemical Laboratories, Ltd. High-temperature reducing-operations. 15,318. June 18.

Derneden. Rotary furnaces. 16,148. June 26.

Dressler Tunnel Ovens, Ltd., and Williamson. Muffle ovens. 16,247. June 27.

Gibson. Furnace regulation. 15,780. June 23.

Hall. High-speed compression plant for refrigerating etc. 15,061. June 16.

Hamer and Hamer. Producing high temperatures in heat-energy carrying fluids. 15,197. June 17.

Hodgson and West. Continuous kilns. 16,063. June 26.

Kermode. Furnaces etc. 15,543. June 20.

Lindsay and Ritchie. Coating, covering, or lining internal surface of casks etc. 15,265. June 18.

Logan. Means for detection of presence of substances in product and automatic control of production of product. 15,285. June 18.

Lundberg and Wahlberg. Steam inlet and water outlet connexions for drying-cylinders. 15,999. June 25.

Lundén and Thorssell. Process for carrying out chemical reactions between gases and solid substances at high temperatures. 15,560. June 20.

Lundén and Thorssell. Process for carrying out chemical reactions in presence of finely-divided metals. 15,561. June 20.

McDougall. Tube mills. 16,208. June 28.

Marks (Catlin Shale Products Co.). Decolorising materials, and methods of making same. 15,325. June 18.

Morison. Condensers. 15,615. June 20.

Oehterbeck. Crushing-machines. 15,928. June 24 (U.S., 12.1.14.)

Peck. Filter leaves. 16,240. June 27.

Sauer. 15,601—6. *See* XIX.

Sharples. Centrifugal machine. 15,792. June 23.

Smallwood. Furnaces. 15,841-2. 15,844—5. June 24.

Stockel. Refrigerating-machines. 15,388. June 19.

Vlessing. 15,535. *See* XIX.

COMPLETE SPECIFICATIONS ACCEPTED.

9005 (1917). Pooley, and Scott and Son. Recovery of volatile solvents. (127,909.) June 25.

9209 (1918). Thorold and Sinclair. Apparatus for dissolving chemicals and elevating resulting solutions. (128,351.) July 2.

9228 (1918). Morton. Evaporator coil and fitting for the same. (121,581.) June 25.

9230 (1918). Calvert. Manufacture of vegetable extracts. (127,950.) June 25.

9298 (1918). Salt Union, and Malcolm. Evaporating or drying apparatus. (127,954.) June 25.

9309 (1918). Kearton and Hann. Mixing and moving concrete and other materials. (127,956.) June 25.

9515 (1918). Cleworth. Apparatus for wet filtering or otherwise treating air or gas with liquid. (127,977.) June 25.

9623 (1918). Yeadon. *See* II.

9633 (1918). Fox and Fox. Oil filter. (128,360.) July 2.

9641 (1918). Alexander, Vint, and Imbery. Method of and means for heating oils, fats, and other liquids or compounds by electricity for distillation or other purposes. (127,987.) June 25.

9689 (1918). Green, and Levinstein, Ltd. Method and apparatus for separating the constituents of mixtures of volatile liquids. (128,362.) July 2.

9876 (1918). Smith. Apparatus for measuring and mixing liquids. (128,370.) July 2.

9948 (1918). Colombo and others. *See* II.

10,061 (1918). Fullagar, Reavell, and Kestner Evaporator and Engineering Co. Evaporators. (128,015.) June 25.

10,279 (1918). Allen. Apparatus suitable for use as centrifugal mixers, washers, and the like. (128,019.) June 25.

10,605 (1918). Norton Grinding Co. Grinding-machines. (117,808.) June 25.

12,894 (1918). De Preville. Apparatus for raising acids or other liquids. (128,061.) June 25.

13,463 (1918). Ten Bosch. *See* II.

13,964 (1918). Davis. Pulverisers. (128,071.) June 25.

15,893 (1918). Rafn. Processes and apparatus for cooling viscous liquids. (121,117.) June 25.

16,021 (1918). Evans (Lourtie). Filters. (128,094.) June 25.

17,369 (1918). Chambers. Grinding-machinery. (128,107.) June 25.

21,062 (1918). Johansson. Separators. (128,126.) June 25.

1923 (1919). Smith. Apparatus for separating

solids or semi-solids such as sewage, paper-pulp, or the like from liquids. (128,144.) June 25.

3596 (1919). Roots, Roots, and Falconer. Oil filters. (128,151.) June 25.

II.- FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

British Thomson-Houston Co. (General Electric Co.). Electric incandescent lamps. 15,880. 16,230 June 24. June 27.

British Thomson-Houston Co. (General Electric Co.). Manufacturing incandescent lamps. 16,125. June 26.

Climie. Gas producers. 15,536 15,538 June 20

Coke and Gas Ovens, Ltd., and Wright. Coke-ovens. 15,613. June 20.

Dellwik, and Techno-Chemical Laboratories. Heat treatment of carbonaceous material. 15,573. June 20.

Engel. Clarifying and refining crude oils. 15,349. June 18.

Franklin. Suction-gas generators. 15,295. June 18.

Galusha. Gas-producers. 15,916. June 24. (U.S., 15.7.18.)

Heathcote, and Rudge-Whitworth, Ltd. 15,716 *See* XXIII.

Ljusne-Woxna Aktiebolag. Method of producing gas for driving gas-engines. 16,127. June 26 (Sweden, 27.6.18.)

McEwen, and Underfeed Stoker Co. Carbonisation or destructive distillation. 15,324. June 18

Marks (Catlin Shale Products Co.). 15,323. *See* I.

Meade. Manufacture of water-gas. 16,311. June 28.

Mellersh Jackson (Koppers Co.). Coking retort ovens. 15,803. June 23.

Pedrisat. Apparatus for carburetting lighting and heating gas 15,899 June 24.

Perry. Apparatus for distilling carbonaceous material. 15,985. June 25.

Rock. Extracting hydrocarbons from coal etc 15,272. June 18.

Sauer. 15,601-6. *See* XIX.

Tullis Combustion. 15,423. June 19.

U.S Industrial Alcohol Co Aeroplane motor fuel. 15,124—6. June 16. (U.S., 25.6.18.)

Complete Specifications Accepted.

8477 (1916). Maxim and Crosse. Production of light mineral oils from heavier oils. (128,227.) July 2.

4866 (1917). Grylls and Heape. Electric arc lamps. (128,234.) July 2.

8693 (1917). Elborne. Treatment of solid paraffins (128,239.) July 2.

9598 (1917). Forwood and Taplay. Treatment and production of hydrocarbons (128,255.) July 2.

9896 (1917). Prins. *See* VII.

9942 (1917). Helps and Harger. Manufacture of producer gas. (127,916.) June 25.

10,327 (1917). Tinker. Production of fuel oil from crude oils. (128,288.) July 2.

16,584 (1917). Hassall. Means for completing or promoting the combustion of gases in boiler furnace flues. (128,325.) July 2.

17,640 (1917). Wynne. Treatment of petroleum and like oils. (127,918.) June 25.

18,688 (1917). Carper. Production of mineral oils. (128,326.) July 2.

7710 (1918). Corthesy and Castelli. Means to generate gas or gases from coal-dust or/and the like. (127,933.) June 25.

8969 (1918). Davies. Preparation of fuel in briquetted form for utilisation in carbonisation, gasification, and the like. (127,940.) June 25.

9473 (1918). Francart. Gas generators or producers, and the method of working such gas generators or producers. (127,974.) June 25.

9509 (1918). Aktiebolaget Ingenjörsfirma Egnell. *See* XXIII.

9515 (1918). Cleworth. *See* I.

9623 (1918). Yeadon. Design of vertical retort. (127,986.) June 25.

9633 (1918). Fox and Fox. *See* I.

9641 (1918). Alexander and others. *See* I.

9948 (1918). Colombo, Cazaban, and Fernandez. Furnaces, gas-producers, and the like. (128,375.) July 2

10,208 (1918) Holmes. Treatment of liquor from plants for purifying gases from producers or the like (128,101.) July 2

12,100 (1918) Imray (Golcille). Apparatus for generating and burning oil gas or vapour. (128,054.) June 25.

12,661 (1918) Heape and Grylls Carbons for electric arc lamps (128,057.) June 25

13,463 (1918) Ten Bosch. Method of and means for removing water from peat and similar substances. (128,064.) June 25

16,809 (1918) Bibb Process for the manufacture of fuel briquettes. (128,485.) July 2

17,395 (1918) Sinding Larsen Method of and apparatus for utilising the thermic effect of cathode rays. (121,280.) June 25

3596 (1919). Roots and others. *See* I.

III. TAR AND TAR PRODUCTS

Applications.

Burt, Boulton, and Haywood, and Miles. Manufacture or isolation of carbazole. 15,440. June 19.

Jones and Stephen Separation in pure state of ortho- and para-isomerides obtained in manufacture of benzenoid compounds. 15,819. June 24.

Perkin. Manufacture of anthranol. 16,042. June 26.

Complete Specifications Accepted.

7842 (1917). Soc Anon des Etablissements Egrot. Process and apparatus for rectifying benzoles. (127,853.) June 25.

9598 (1917). Forwood and Taplay. *See* II.

IV.- COLOURING MATTERS AND DYES.

Complete Specifications Accepted.

16,381 (1918) Halvorsen and Horbye. Manufacture of sulphur dyes. (128,099.) June 25.

20,256 (1918) Imray (Geigy Soc. Anon.). Production of isatine, and its substitution derivatives, and intermediate products therefor. (128,122.) June 25.

V.- FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Chadwick Apparatus for drying textile etc. fabrics. 15,737. June 23

Clarke. Machines for drying varnished and gummed sheets etc. 15,664 June 21.

Colebrook, Lamelois, Moncorget, and Tebbitt. Retting textile plants 16,309. June 28.

Dreyfus. Manufacture of cellulose derivatives. 15,191. June 17.

Flatters. Processes for doping and fire-proofing fabrics. 16,073. June 26.

Marks (Acushnet Process Co.). 15,121. *See* XIV.

Raymond. Powdered mixtures for cleaning textile materials. 15,177. June 17.

Sandeman. Fabric and method of producing same. 15,400. June 19.

Soc. Anon. des Etablissements Hutchinson. Adhesive composition for waterproofing fabrics and rendering same impermeable. 15,551. June 20. (France, 6 7 18.)

COMPLETE SPECIFICATIONS ACCEPTED.

9963 (1917). Dreyfus. Fabric for aircraft or other uses. (128,274.) July 2.

6346 (1918). Borzykowski. Processes for the production of articles from viscose. (116,268.) July 2.

9633 (1918). Wade (Barrett Co.). Manufacture of paper felt for roofing and the like. (127,994.) June 25.

10,681 (1918). Van Wessem. Manufacture of fibrous pulp from wood and other ligno-cellulosic substances. (122,812.) June 25.

10,985 (1918). Milne. Fourdrinier paper-making machines. (128,425.) July 2.

14,104 (1918). Rinman. Process of retting fibrous substances. (128,464.) July 2.

1923 (1919). Smith. *See* I.

VI.—BLEACHING, DYEING; PRINTING; FINISHING.

APPLICATIONS.

Crompton. Calico printing. 16,193. June 27.

McMyn. Application of colouring matters containing sulphonamide group in dyeing and printing. 15,092. June 16.

Textilmaschinen Fabrik A.-G. Automatic yarn-hank dyeing-machine. 15,611. June 20. (Switz., 20.6.18.)

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

British Thomson-Houston Co. (General Electric Co.). Process of making nitric acid. 15,201-15,205. June 17.

Carborundum Co. (Hutchins). Process for purifying aluminous materials. 15,296. June 18.

Marks (Nitrogen Products Co.). Apparatus for fixation of nitrogen. 15,765. June 23.

Nitrogen Corporation. Process of synthesising ammonia. 16,001. June 25. (U.S., 25.6.18.)

Phillips and Rose. Manufacture of soluble silicates. 15,406. June 19.

Rollason. Production of ammonia. 15,149. June 17.

Southern. Calcining carbonates of calcium and zinc etc. 16,039. June 26.

COMPLETE SPECIFICATIONS ACCEPTED.

7655 (1917). Minted and Smith. Catalytic oxidation of ammonia. (127,845.) June 25.

7814 (1917). Elektrizitätswerk Lonza. Process for obtaining nitrogen from air. (127,852.) June 25.

9232 and 9233 (1917). Hutchins. *See* XI.

9896 (1917). Prins. Process for preparing hydrogen from carbon or carbon-containing substances by the action of water or water vapour thereon. (128,273.) July 2.

10,803 (1917). Morgan. Utilisation of nitre cake. (128,302.) July 2.

467 (1918). Huhn. Preparation of anhydrous magnesium chloride. (128,327.) July 2.

10,127 (1918). Davis. Apparatus for the concentration of sulphuric and other acids. (128,396.) July 2.

12,894 (1918). De Preville. *See* I.

18,135 (1918). Norsk Alkali Aktieselskabet. *See* XI.

381 (1919). Mellersh-Jackson (Air Reduction Co.). Extraction of cyanides. (128,507.) July 2.

VIII.—GLASS; CERAMICS.

APPLICATION.

Cumpsty. 15,522. *See* I.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Ford. Asbestos composition etc. roofing-sheets. 15,156. June 17.

Illemann. Dust-proof and waterproof road etc. covering, and method of making same. 15,534. June 20.

Scott. Cement. 15,154. June 17.

Windsor-Richards. Manufacture of moulded articles from acid-proof cement. 15,909. June 24.

COMPLETE SPECIFICATIONS ACCEPTED.

9309 (1918). Kearton and Hann. *See* I.

9633 (1918). Wade (Barrett Co.). *See* V.

10,213 (1918). Bottomley. *See* XIII.

12,478 (1918). Mulligan. Non-porous cement. (128,452.) July 2.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

August. Furnaces for heat treatment of steel, iron, etc. 15,174. June 17.

Belais. Gold alloys. 16,133. June 26.

Brace, Brace, and Brace and Son. Cleaning metal. 16,290. June 28.

Clegg. Treating tin scruff produced in process of making tin and terne plates. 15,946. June 25.

Compagnie des Forges et Aciéries de la Marine et d'Homécourt. Heating air supplied to blast furnaces. 15,471. June 19. (France, 20.6.18.)

Cowper-Coles. Process for hardening steel and iron. 15,464. June 19.

Elmore. Treatment of argentiferous sulphide ores. 15,783. June 23.

Fisk. Method of treating metal. 15,213. June 17.

Gush. Furnace for hardening high-speed steel etc. 16,270. June 28.

Harris and Harris. Coating metal upon metal etc. surfaces for electrotyping etc. 16,295. June 28.

Jacombs. Electro-deposition of metals. 15,823. June 24.

Kissock. Process of making alloy steel. 15,772. June 23. (U.S., 28.8.18.)

Lines. Furnaces for roasting, calcination, or heat treatment of ores etc. bearing sulphur. 16,032. June 25.

McCarthy, Martin, and Steele. Electric welding. 16,232. June 27.

Martin. Water concentration of ores. 15,109. June 16.

Odam. Production of metallic powders. 15,686. June 21. (France, 10.7.18.)

Readett. Method of electrically treating steel etc. and hardening same. 15,251. June 18.

Soc. des Ateliers d'Aviation Bréguet. Tin soldering aluminium or aluminium alloy and articles made by such means. 15,461. June 19. (France, 27.7.18.)

Woodburn. Electric welding. 16,188. June 27.

COMPLETE SPECIFICATIONS ACCEPTED.

10,576 (1917.) Imperial Trust for the Encouragement of Scientific and Industrial Research, Institute of Metals, Bengough, and Hudson. Process for protecting copper or its alloys from attack by atmospheres or liquids. (128,297.) July 2.

19,313 (1917). Marks (United States Alloys Corporation). Method of treating iron or steel. (127,921.) June 25.

19,314 (1917). Marks (United States Alloys Corporation). Manufacture of an alloy of iron, titanium, and silicon, and process for the production thereof. (127,922.) June 25.

6097 (1918). Cooper Co. Alloys. (127,930.) June 25.

6274 (1918). Vereinigte Hüttenwerke Burbach-Eich-Dudelingen A.-G. Production of copper alloys. (114,852.) June 25.

9379 (1918). Goold (MacDonald and Claflin). Ore-reduction apparatus. (127,964.) June 25.

9577 and 10,924 (1918). Hadfield. Manufacture of iron silicon alloys. (127,981.) June 25.

9622 (1918). Rogers and Walter. Electrolytic apparatus for the treatment of tinned scrap and tinned articles. (127,985.) June 25.

9729 (1918). Gibbons Bros., and Timmins. Furnaces for the heat treatment of metal bars, tubes, rods, and other articles. (128,001.) June 25.

10,105 (1918). Morton. Process of and apparatus for electric welding. (128,394.) July 2.

10,155 (1918). Thomas and Davies. Process of pickling iron and steel plates or sheets and apparatus to be employed therein. (128,398.) July 2.

10,763 (1918). Morfett. Furnaces for melting lead and other soft metals and for other purposes. (128,417.) July 2.

XI ELECTRO-CHEMISTRY.

Applications.

Boyer. Storage-battery separators. 16,134 June 26.

British Thomson-Houston Co. (General Electric Co.). Control for electric furnaces etc. 15,439. June 19.

Campbell, Gifford, Waite, and Campbell, Gifford, and Waite. Electrodes of electric furnaces. 16,302. June 28.

Efandem Co., and Hooper. Electric dry batteries. 15,533. June 20.

Harris and Harris. 16,295. *See* X.

Jacombs. 15,823. *See* X.

McCarthy and others. 16,232. *See* X.

Palmer. Dry-cell batteries. 15,770. June 23.

Smith, and Van Raden and Co. Grids for plates of electric storage batteries. 16,024. June 25.

Tucker. Composition for insulating and waterproofing electrical elements. 16,268. June 28.

Withers (National Electro-Products, Ltd.). Apparatus for electrolysing liquids. 16,154. June 26.

Woodburn. 16,188. *See* X.

Complete Specifications Accepted.

9232 and 9233 (1917). Hutchins. Electrolytic cells for the production of chlorine. (127,914. 127,915.) June 25.

11,081 (1917) and 3660 (1918). Antonoff. Electric batteries. (128,316.) July 2.

4866 (1918). Mellersh-Jackson (Burgess Battery Co.). Dry electric batteries and the method of making the same. (128,332.) July 2.

8207 (1918). Levin. Electrolytic gas generators. (127,937.) June 25.

8273 (1918). Bockman. Electric induction furnaces. (120,030.) July 2.

9622 (1918). Rogers and Walter. *See* X.

9641 (1918). Alexander and others. *See* I.

9906 (1918). Portable electric batteries or cells. (128,012.) June 25.

10,031 (1918). Peto. Electric storage batteries or accumulators. (128,386.) July 2.

10,105 (1918). Morton. *See* X.

10,187 (1918). Zorzi. Electrode for an electrolytic cell. (117,450.) June 25.

11,739 (1918). Marks (Stuart). Electrolytic cells. (128,436.) July 2.

13,607 (1918). Hoofnagle. Method of and apparatus for treating gases and vapours electrically. (128,066.) June 25.

18,135 (1918). Norsk Alkali Aktieselskabet. Apparatus and process for the electrolysis of chlorides of the alkaline metals. (121,460.) June 25.

18,507 (1918). Siemens Bros. and Co., and Perry. Galvanic cells. (128,117.) June 25.

4110 (1919). Palmer. Electric storage battery separators and insulators, and process of making same. (128,152.) June 25.

XII. FATS; OILS; WAXES.

Applications.

Blair, Campbell, and McLean, Blair, and Ferguson. Apparatus for hydrogenising oils etc. 15,419. 15,422. June 19.

Engel. 15,349. *See* II.

Samolloff. Manufacture of soap. 15,307. June 18.

Complete Specifications Accepted.

16,149 (1917). Soc. Industrielle de Produits Chimiques. Process for regenerating oxide of nickel catalysers employed in the hydrogenation of fatty bodies. (112,768.) July 2.

9633 (1918). Fox and Fox. *See* I.

9641 (1918). Alexander and others. *See* I.

10,129 (1918). Powling and Powling. Apparatus for extracting fat from bones and other material. (128,397.) July 2.

3596 (1919). Roots and others. *See* I.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Crocker and Major. Manufacture of carbon blacks. 15,475. June 19.

Koppers Co. Manufacture of resin. 15,860. June 24. (U.S., 6.9.18.)

Schneider. Manufacture of paints. 15,373. June 19.

Complete Specifications Accepted.

6270 (1918). New Jersey Zinc Co. Zinc lead pigments and the method of manufacturing the same. (120,194.) July 2.

10,213 (1918). Bottomley. Priming or paint for concrete or cement surfaces and other surfaces. (128,402.) July 2.

15,449 (1918). Scott. Compositions containing phenol formaldehyde condensation products. (128,477.) July 2.

16,334 (1918). Morris. Manufacture of antimony colours. (128,482.) July 2.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Avon India Rubber Co., and Reid. Vulcanisation of rubber etc. 15,479. June 19.

Davidson. Treatment of rubber. 15,530. June 20.

Dunlop Rubber Co., and Strathern. Machinery for incorporating powdered etc. substances with rubber etc. 15,677. June 21.

Marks (Acushnet Process Co.). Processes for reclaiming rubber and cotton from waste. 15,121. June 16.

Complete Specification Accepted.

1008 (1919). Van Hasselt. Process for vulcanising rubber with aid of an accelerator. (126,606.) July 2.

XV.—LEATHER; BONE; HORN; GLUE.

COMPLETE SPECIFICATIONS ACCEPTED.

7585 (1918). Smith. Composition of matter, particularly for use as a substitute for leather. (127,932.) June 25.

7694 and 18,305 (1918). Kay and Platt. Tanning, liming, and like operations on hides and skins. (128,339.) July 2.

12,445 (1918). Owen. Liming hides or skins. (128,451.) July 2.

16,175 (1918). Doran. Process for the manufacture of leather. (126,938.) June 25.

XVI.—SOILS; FERTILISERS.

APPLICATION.

Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Ammonium nitrate fertilisers. 16,021. June 25. (Norway, 19.7.18.)

XVII.—SUGARS; STARCHES; GUMS.

APPLICATION.

Marks (Industrial Apparatus Corporation). Process for continuous defecation of sugar solutions. 15,766. June 23.

XVIII.—FERMENTATION INDUSTRIES.

COMPLETE SPECIFICATION ACCEPTED.

10,219 (1918). Desborough, Reilly, Thaysen, and Henley. Manufacture of acetone and other products by fermentation. (128,403.) July 2.

XIX. FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Greville. Manufacture of flour confectionery containing egg products. 16,067. June 26.

Greville. Treatment of flour. 16,189. June 27.

Kano, Mizusawa, and Yamamoto. Process of deodorising and decolorising bean flour. 15,904. June 24.

Lloyd. Preservation of milk. 15,219. June 17.

Morison. Water-purifiers. 15,221. June 17.

Morton and Remington. Production of cereal food. 15,480. June 19.

Sauer. Process for purification and separation or filtration of liquids or liquors. 15,601. June 20.

Sauer. Process for regeneration of decolorising carbon. 15,602. June 20.

Sauer. Process for sterilisation and purification of water. 15,603. June 20.

Sauer. Sterile decolorising carbon for sanitary and medicinal use. 15,604. June 20.

Sauer. Filtering, decolorising, or purifying processes, and decolorising carbons therefor. 15,605. June 20.

Sauer. Filtering, decolorising, and purifying processes for liquids etc. 15,606. June 20.

Vlessing. Drying vegetables etc. 15,535. June 20.

COMPLETE SPECIFICATIONS ACCEPTED.

9487 (1918). Palmer. Process of treating potatoes to obtain potato flakes or potato flour or meal. (127,975.) June 25.

15,507 (1918). Goodwin. Treatment of semolina. (128,089.) June 25.

1923 (1919). Smith. *See* I.

3937 (1919). Fano. **Bread making.** (123,535.) July 2.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Commercial Research Co. Manufacture of chlorhydrins of unsaturated hydrocarbons etc. 15,376. June 19. (U.S., 20.6.18.)

Compagnie des Produits Chimiques d'Alais et de la Camargue. Process for preparation of ethyl alcohol from acetaldehyde. 15,877. June 24. (France, 26.2.18.)

Jones and Stephen. 15,819. (*See* III.)

Marks (U.S. Industrial Alcohol Co.). Methods of forming esters. 15,774. June 23.

U.S. Industrial Alcohol Co. Continuous process for manufacture of esters. 15,775. June 23. (U.S., 7.8.18.)

U.S. Industrial Alcohol Co. Apparatus for manufacture of esters. 15,776. 15,777. June 23. (U.S., 7.8.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

9815 (1917). Durrans, and Boake, Roberts, and Co. Preparation of organic acid chlorides. (128,270.) July 2.

10,196 (1917). Durrans, and Boake, Roberts, and Co. Preparation of acetic anhydride and acetyl chloride. (128,282.) July 2.

9895 (1918). Rintoul, Thomas, and Nobel's Explosives Co. Preparation of amines. (128,372.) July 2.

XXI. PHOTOGRAPHIC MATERIALS AND PROCESSES.

COMPLETE SPECIFICATIONS ACCEPTED.

6723 (1918). Agnew, Renwick, and Ilford, Ltd. High-temperature development of photographic materials. (128,337.) July 2.

9293 (1918). Middleton. Pigment or carbon printing by silver. (127,953.) June 25.

9436 (1918). Hess-Ives Corporation. Colour photograph or film and method of producing same. (119,851.) June 25.

XXII.—EXPLOSIVES; MATCHES.

COMPLETE SPECIFICATIONS ACCEPTED.

8260 (1917). Du Pont de Nemours and Co. Process of making propellant powder. (127,871.) June 25.

8261 (1917). Du Pont de Nemours and Co. Process of producing propellant powder. (127,872.) June 25.

8262 (1917). Du Pont de Nemours and Co. Process of producing propellant explosives. (127,873.) June 25.

9722 (1917). Clayton Aniline Co., and Schedler. Method of and apparatus for drying trinitrotoluene. (128,263.) July 2.

10,271 (1917). Marin Explosives. (108,853.) July 2.

10,811 (1917). Brookes Chemicals, Ltd., and Brooke. Continuous process and plant for the production of picric acid or other products of nitration. (128,303.) July 2.

9952 (1918). Hodgkinson. Production of azides. (128,014.) June 25.

XXIII.—ANALYSIS.

APPLICATIONS.

Heathcote, and Rudge-Whitworth, Ltd. Means of ascertaining composition and effect of gases etc. 15,716. June 23.

Logan. 15,285. *See* I.

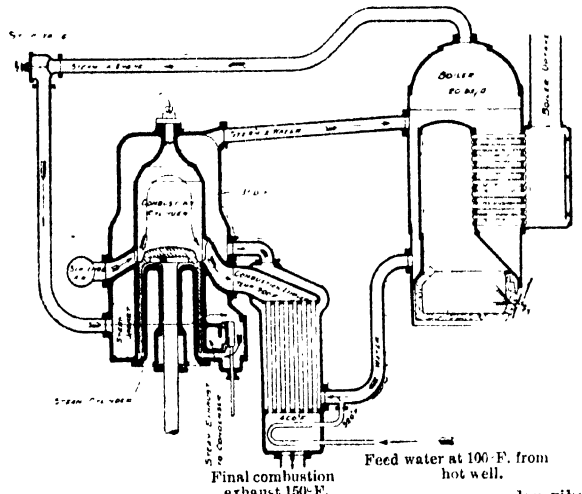
COMPLETE SPECIFICATION ACCEPTED.

9509 (1918). Aktiebolaget Ingeniörsfirma Egnell. Gas-analysing apparatus. (116,715.) June 25.

I.—GENERAL; PLANT; MACHINERY.

***Prime mover of high efficiency and British origin; A new* ——.** F. E. D. Acland. J. Roy. Soc. Arts, 1919, **67**, 463—482.

THE thermal efficiency of the gas engine is 28%; that of the best steam turbine is 18·5%. A new prime mover, developed by W. J. Still, utilises either liquid or gaseous fuel in its main working cylinder. The recoverable heat which passes through the walls of the combustion chamber (see fig.), and that contained in the exhaust gases is used for the production of steam. The cylinder wall is about one-third or one-fourth of the usual thickness, and is ribbed externally. A cooling jacket surrounds the cylinder, and this together with the cooling water therein form part of the circulating system of a steam generator. The exhaust gases are similarly utilised for steam-raising purposes, and subsequently are employed in preheating the water circulating in the steam generator system. The steam generated by means of the recovered heat is expanded in the combustion cylinder on one side of the main piston, the force due to combustion of fuel operating on the opposite side of the piston so that one piston stroke out of two is due to steam, the other being due to fuel combustion. The steam exhausts at a slight superheat above the normal expansion temperature, usually to a condenser. Trials with a four stroke, constant-volume type of Still engine gave the following, amongst other results:—The shaft horse power (compared with that yielded by the engine operating purely as an explosion engine) was increased by 29%, the steam not being condensed. With condensation an increase of 40% was obtained. The steam evaporated by the waste heat gave a pressure of 14 lb. per sq. in. m.e.p. on every return stroke, equivalent to 118 lb. per sq. in. m.e.p. in a normal four-stroke engine. This latter was increased to 234 lb. per sq. in. m.e.p. by admission of additional steam generated by fuel. The efficiency of the first Still gas engine was 31·3%, corresponding to a consumption of 15 cub. ft. of gas (cal. value 540 B.Th.U.) per b.h.p. An indicated efficiency of 41% is possible, and the engine will maintain a good efficiency at 100% overload. The brake thermal efficiency of a single cylinder petrol engine, operating on the Still system, and fitted with condenser was 36%. The best result obtained with a six-cylinder Still engine using heavy oil indicates a consumption of 0·302 lb. of Admiralty shale oil per b.h.p. The thermal brake efficiency was maintained at about 40% from below quarter load to full power. For locomotive purposes an efficiency at the rails of 30% over 90% of the running time is claimed for the Still engine, the efficiency during the accelerating period being 15%. Amongst the general advantages of the Still engine are the following:—mechanical stresses are diminished; the piston is maintained cool; the engine can be started against load, and is unaffected by atmospheric conditions; at normal loads the efficiency is at least 25% above that of any known combustion engine of similar proportions; in Still engines using heavy oil the compression pressures ensuring ignition can be reduced by 50% as compared with the Diesel system. In the discussion W. J. Still stated that he had never had any lubrication difficulties. A series of trials indicated a lubricant consumption equal to 1·4% of the fuel oil used over a long trial at three-quarters load. The maximum steam pressure developed was 250 lb. per sq. in.—J. S. G. T.



Leaching; Continuous counter current ——. H. Bueler de Florin. Metall u. Erz, 1919, **16**, 141—147.

THE leaching plant described was designed to be mechanically strong and permit the use of any liquid, being constructed of acid-proof stoneware on an iron framework. The material is raked up an inclined plane, in the opposite direction to the flow of liquid, by vanes carried on an endless chain. The earthenware parts, which alone come in contact with the liquor, are easily changed, so that stops are few and short. By varying the slope of the plane, the speed of the vanes, and the supply of liquid and material to be leached, liquor of any desired concentration may be obtained. Results obtained on four different materials with the apparatus showed a leaching efficiency of 80, 90, 97, and 92%. The inclined planes may be used in series or arranged one above the other to save space. The author has treated 150 kilos of material per hour with a combination of three planes. To obtain a clear outflowing liquor the flow of liquid must be less than the velocity of fall of the smallest particles. A comparison of installations consisting of 48 leaching vats and 32 three plane systems shows that the installation cost of the latter is the greater, but the running costs are lower, so that in 3¼ years the extra first cost will be repaid. A lixiviating apparatus with filters is described, consisting of a series of horizontal or slightly inclined troughs each provided with a filter. The liquor is sucked through the filter and pumped to the trough before it. The apparatus permits the use of mixed fine and large grain material. A cascade lixiviating apparatus with filters, in which the material is transferred from one compartment to the other by wheels provided with scrapers of stoneware, is also described. The troughs may be of stoneware in one piece. The course of the liquor is as before, except that it is carried to the next but one trough. A vat lixiviating apparatus without filters consists of a number of acid-proof vessels with perforated bottoms, which are carried by a continuous chain first under hoppers delivering successively large, medium, and small grain material, then under sprinklers of liquor from the previous vat, finally under washing sprays of acid and water, after which they are emptied by tilting. The movement is automatic under the weight of the vats.

—T. H. Bu.

PATENTS.

Drying granular, pulverulent, and pasty materials; Apparatus or kilns for ——. H. Alexander, Leeds. Eng Pat. 119,198, 18.4.18. (Appl. 6614/18.)

THE trays in the drying tower or apparatus described in Eng. Pats. 123,646 and 125,235 (this J., 1919, 241 A, 317 A) are supported at one end by a projection from the tower and at the other by a ring or its equivalent so that the trays can be easily removed. W. H. C.

Drying apparatus. L. W. Goold, London. From The American Laundry Machinery Co., Cincinnati, Ohio, U.S.A. Eng. Pat. 127,502, 27.11.18. (Appl. 19,537/18.)

THE door of the drying chamber is provided with a system of levers etc., by means of which the door of the air-heating chamber is closed when the door of the drying chamber is opened and the current of air is diverted to the outside of the apparatus. W. H. C.

Dryer. R. Douglas, Assignor to Douglas Packing Co., Inc., Rochester, N.Y. U.S. Pat. 1,301,112, 22.4.19. Appl., 16.1.18.

THE annular space between the two concentric cylinders of a rotary dryer is subdivided into a number of pockets formed respectively on the outer surface of the inner cylinder and the inner surface of the outer cylinder. As the cylinders rotate, the material being dried is transferred backwards and forwards from one set of pockets to the other. Openings for the transverse circulation of air are provided between the pockets.—W. H. C.

Drying materials; Method of and apparatus for ——. H. E. Hollister, Irvington, Assignor to Kalbperry Corporation, Elizabeth, N.J. U.S. Pat. 1,301,130, 22.4.19. Appl., 17.7.17.

THE materials are heated, and the evaporated moisture is removed from the heating chamber by a current of warm air, the function of the warm air being only to remove and not to vaporise the moisture. The moisture-laden air is passed through an interchanger where it gives up heat to the incoming air.—W. H. C.

Evaporator [dryer]. R. W. King and H. G. Miller, The Dalles, Oreg. U.S. Pat. 1,303,209, 6.5.19. Appl., 14.4.17.

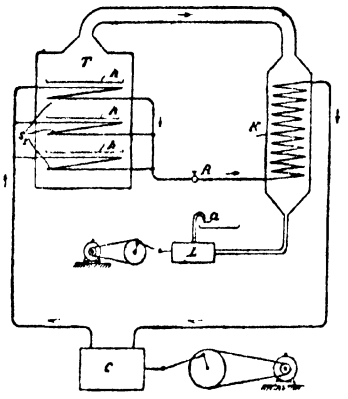
THE apparatus consists of a vertically superposed series of rotary cylindrical screens inclined alternately in opposite directions and surrounded by a casing. The material to be dried passes downwards through the screens and a current of heated air passes upwards through the casing and is directed through the screens by baffles.—W. H. C.

Dryer; Continuously-operating. W. N. Stevens, Brooklyn, N.Y., Assignor to Stevens Aylsworth Co., New York. U.S. Pat. 1,303,982, 20.5.19. Appl., 14.4.17.

THE material to be dried is fed by gravity through a valve into an inclined vacuum cylinder in such a manner that the vacuum is not destroyed. The material is retained at the lower end of the vacuum cylinder until it has partially lost its moisture. —W. H. C.

Drying; Process of ——, *utilising the heat of condensation of the vapours from the material to be dried.* A.-G. Kummler und Matter, Aarau, Switzerland. Ger. Pat. 310,352, 28.11.16. Int. Conv., 8.12.15 and 24.8.16.

THE vapours from the dryer, T, are condensed in K, the condensed liquid and uncondensed gases being discharged by the water- and air-pump, L, through the outlet, *a*. The material on the trays, *h*, is dried by means of the heat liberated by the condensation of a heat-transmitting fluid in the



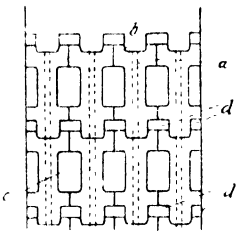
coil, S_2; this fluid then passes through the regulating valve, R, to the condenser K, where it serves as cooling agent and is vaporised. The vapours pass to the compressor, C, are liquefied and again delivered to the coil S_2. Air may be circulated through the apparatus, and the process is applicable to vacuum dryers. The heat developed by the compression is of secondary importance in the process.—J. S. G. T.

Dryers; Steam-heated rotary ——. A. Huwiler, Basle, Switzerland. Ger. Pat. 310,353, 1.2.17.

ELECTRICAL conductors conveying currents are arranged within the drying chamber so that loss of heat due to contact of the steam with the chamber walls is compensated for and deposition of water prevented or considerably reduced. Any water that may be condensed is collected in a scoop and passes from the chamber by way of a hollow trunnion to a suitable channel.—J. S. G. T.

Heat recuperator for air or gas. Soc. Franco-Belge de Fours à Coke, Brussels. Eng. Pat. 122,396, 21.10.18. (Appl. 17,388/18.) Int. Conv., 17.1.18.

ONE gas flows vertically through narrow flat holes, *a*, in special bricks, *b*, and the other gas flows horizontally through larger channels, *c*, formed by recesses in the sides of the bricks. The bricks are

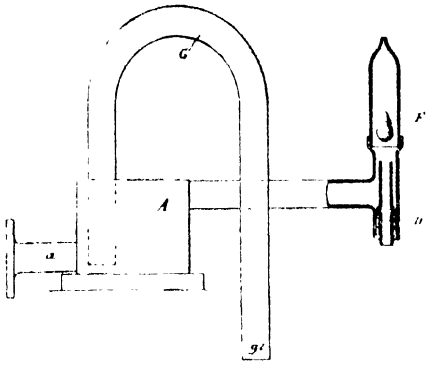


all uniform and of strong construction, and to ensure gas tightness the jointing surfaces are as broad as possible, the vertical joints above and below the horizontal passages being covered with flat tiles, *d*, in suitable recesses.—B. M. V.

Distribution or separate delivery of liquids according to their differing specific gravities; Means for effecting ——. J. Arnott, Stockport. Eng. Pat. 126,375, 19.1.17. (Appl. 989/17.)

SPENT nitrating acid or other liquid enters the closed box, A, through the pipe, *a*, and as long as the specific gravity of the liquid remains above a

predetermined figure it buoys up the float valve, F, and itself flows away through D into the strong acid or liquor main. As soon as the specific gravity falls below the desired point the liquid ceases to

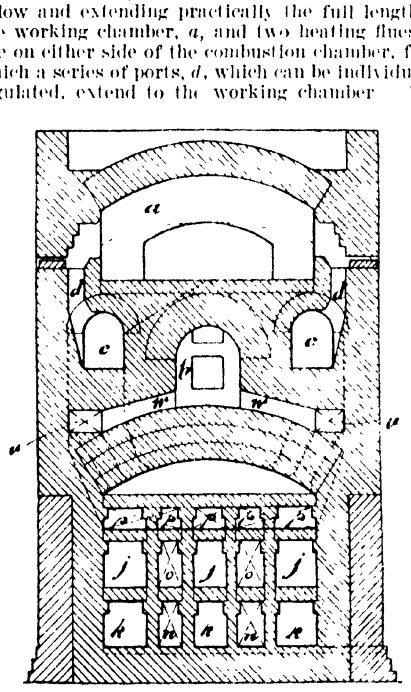


buoy up the float valve, which drops and closes the discharge pipe, D. The liquid fills the box, A, and the siphon, G, comes into operation, discharging the liquid from g^2 into the waste main. The apparatus is specially useful in the manufacture of nitrocellulose by the displacement process.

—W. H. C.

Furnaces. A. Smallwood, London. Eng. Pat. 125,744, 23.4.18. (Appl. 6805/18.)

A FURNACE comprises a combustion chamber, *b*, below and extending practically the full length of the working chamber, *a*, and two heating flues, *c*, one on either side of the combustion chamber, from which a series of ports, *d*, which can be individually regulated, extend to the working chamber. The



air for combustion is heated by passage through a recuperator situated below the combustion chamber and supplied with the waste gases from the working chamber. The recuperator comprises flues, *j*, *k*, for the waste gases, and *n*, *p*, for the air, the heated air then passing to a distributing chamber and thence to conduits, *v*, communicating by ports, *w*, with the combustion chamber.

—J. S. G. T.

Furnaces; Gas-fired ——. Smeeton-Wright Furnaces, Ltd., and T. Wright, London. Eng. Pat. 127,378, 17.5.18. (Appl. 8309/18.)

A FURNACE is made with a double crown as well as a cover or roof, thus forming two distributing chambers above the hearth, air for combustion being supplied to the upper and gas to the lower chamber. Ports or conical nozzles are provided (each pair in line) in both crowns so that the air on its way downwards to the combustion and heating chamber passes through the gas chamber and draws gas with it, forming a flame with (at first) excess of air in the middle, which is found to give better combustion than the opposite arrangement of gas in the middle of the flame. By slight modifications of the nozzles either air or gas or both may be under slight pressure, or suction alone may be relied on.—B. M. V.

Reduction-furnace; Continuous ——. W. D. Richardson, Assignor to Swift and Co., Chicago, Ill. U.S. Pat. 1,303,111, 6.5.19. Appl., 22.10.15.

THE reduced material from the furnace is forced down a vertical discharge passage, the lower end of which is sealed by a liquid contained in a receiver.

—W. H. C.

Shaft-kiln. E. Schmatolla, New York. U.S. Pat. 1,304,514, 20.5.19. Appl., 18.7.14. Renewed 11.10.18.

THE kiln is provided with a short cooling shaft or draw-pit having vertical walls extending from the fire-arches to the draw openings, and horizontal partitions projecting from the centre of the draw-openings beyond the lining of the shaft, leaving a wide opening in the centre.—W. H. C.

Evaporating apparatus. R. Bowman, Warrington. Eng. Pat. 127,071, 16.4.18. (Appl. 6420/18.)

THE liquid to be evaporated is caused to flow through a series of two or more V shaped troughs and is evaporated by steam which passes in the opposite direction through a pipe which lies loosely in the bottom of the trough.—W. H. C.

Evaporator. G. H. Benjamin, New York. U.S. Pat. 1,302,625, 6.5.19. Appl., 29.12.17.

A VERTICAL cylindrical evaporator contains a number of vertical steam coils connected above and below with manifolds, which pass through the wall of the evaporator at points near to two steam connections fixed to the casing. Means are provided for connecting the steam inlets to the manifolds when required.

Evaporation of lyes and brine; Process for ——. H. Ebel, Hannover. Ger. Pat. 310,982, 26.8.16.

THE vapours mixed with air from open or not hermetically closed evaporating pans are forced through a heating device by means of a reciprocating pump, water or other liquid in the form of drops or spray being preferably added. The steam produced is used as heating agent in a vacuum evaporator, the heating system of which is provided with means for escape of air from the steam.—J. S. G. T.

Centrifugal separator. D. B. Weston, Sharon, Mass. U.S. Pat. 1,279,056, 17.9.18. Appl., 14.11.12.

IN an apparatus for separating comparatively small quantities of both heavy and light solid matter from liquid, the muddy liquor is fed by means of a removable pipe to the inside of a truncated conical baffle extending to near the bottom of the rotating

basket. The baffle is combined with an annular disc or other device for closing the bottom central outlet (for mud) and the whole can be lifted out of the way when the machine is stopped. The liquor rises within the basket, which has vertical radial vanes attached to its inner periphery, and discharges as clear liquid over the top rim of the basket into an outer fixed vessel. To catch the solid matter lighter than the liquid, another truncated conical baffle is provided near the top of the basket, the outer edge of the baffle being of larger diameter than the inside of the top rim of the basket; pipes fitted with cocks are provided to draw off this lighter material into an annular compartment of the outer fixed vessel separate from that which receives the clear liquid. While the basket is rotating at full speed these cocks are kept closed, but when the basket is full of separated heavy sludge the speed is reduced and the cocks opened by means of adjustable cams, thus discharging the lighter solid matter together with a little liquor. The machine is then stopped and the heavy mud discharged through the bottom after lifting clear the feed pipe, bottom baffle, and door.—B. M. V.

Gas reactions; Process and apparatus for effecting —. L. Bradley, East Orange, N.J., Assignor to Research Corporation, New York. U.S. Pat. 1,291,745, 21.1.19. Appl., 30.1.18.

THE reacting gases are circulated through a closed circuit, so that excess of one gas may be used and the temperature and velocity may be easily controlled. From a blower the gas passes into a main reaction chamber (substantially horizontal and fitted with a screw conveyor in the bottom to remove solid products of reaction), then up through an electrical precipitator and down a sloping pipe back to the blower. Non-gaseous material may be introduced at the blower and gaseous material at any part of the circuit. The solid products of reaction may be removed by the screw conveyor to an adjacent chamber for further treatment, *e.g.*, heating to remove excess gas which is returned to the main circuit; this chamber may also be fitted with a valved pipe for charging or exhausting the apparatus. The apparatus may be used for the separation of sulphur dioxide from smelter fumes by the injection of ammonia to form ammonium bisulphite, the latter being separated and then heated to expel ammonia, which is used again; for the recovery of potassium chloride from dust from cement kilns or blast-furnaces by injecting the dust into gaseous hydrogen chlorides; for chloridising ores, and for the preparation of ammonium bromide by injecting bromine into a circulating atmosphere containing ammonia. B. M. V.

Digesting apparatus. H. D. Rankin, San Francisco, Cal., Assignor to Corrosion Extraction Co. U.S. Pat. 1,300,875, 15.4.19. Appl., 24.4.16.

A VERTICAL discharge passage formed at the bottom of the digester is provided with a screw by means of which any material that may have collected in the discharge passage can be returned to the digester.—W. H. C.

Hot air; Device for producing —. J. Schlatter, Assignor to Schlatter, Frorath, & Co., Zürich, Switzerland. U.S. Pat. 1,301,324, 22.4.19. Appl., 29.11.18.

A RECEPTACLE having a filter at the bottom is heated by a furnace, and the furnace gases are admitted to the space above the filter. By means of a suction device, flue gases and fresh air are drawn through the filter and from below the receptacle, respectively, into a mixing chamber.—W. E. F. P.

Dust-separator [; Wet —]. C. E. Sargent, Assignor to Midwest Engine Co., Indianapolis, Ind. U.S. Pat. 1,302,716, 6.5.19. Appl., 13.7.18.

THE gas to be washed is supplied to the inside of a perforated rotating drum dipping into liquid, and passes out through the unsubmerged part of the drum.—B. M. V.

Fluids; Apparatus for treating — [*e.g., for removing solids from gases*]. G. F. Goerner, Los Angeles, Cal. U.S. Pat. 1,302,913, 6.5.19. Appl., 22.9.17.

THE gas is passed through conical liquid sprays which discharge the liquid together with the removed solids into an annular launder, while the gas passes straight through to other cleaning chambers. The sprays are of sufficient power to induce the current of gas.—B. M. V.

Preheating uncalcined material prior to its entry into the kiln; Apparatus for —. H. McCaig and W. C. Stevenson, Cement, Cal. U.S. Pat. 1,303,088, 6.5.19. Appl., 23.4.17.

THE hot waste gases from the upper end of a rotary kiln are delivered into a chamber and conveyed thence by means of a pipe or flue to another chamber where they pass on their way to the stack, through vertical pipes extending through a charging box which has conical ends and is fixed within the chamber.—W. H. C.

Distillation-tube. F. W. Sperr, jun., Oakmont, Pa., Assignor to H. Koppers Co., Pittsburgh, Pa. U.S. Pat. 1,303,980, 20.5.19. Appl., 25.1.17.

THE apparatus consists of an outer tube one part of which serves to hold the material to be distilled, the other part being provided with a removable inner tube or lining which serves to collect at least part of the products of distillation.—W. H. C.

Separating mixed gas [e.g. air]; Method of —. C. F. Crommett, Molden, Mass., Assignor to G. L. Cabot, Boston, Mass. U.S. Pat. 1,304,027, 20.5.19. Appl., 31.5.18.

THE mixture of gases, *e.g.*, air, is compressed and cooled, and a portion of the compressed and cooled gas is expanded so as to liquefy the remainder. The expanded gas is cooled by the waste gas or vapours from a subsequent rectification process. The cooled gas is then liquefied by evaporating the liquid resulting from the rectification process, in which quantities of the liquefied gas descend in countercurrent to the gases or vapours arising from the evaporation of the liquid.—W. H. C.

Filter; Suction —. C. A. Beringer, Charlottenburg. Ger. Pat. 309,716, 23.5.17. Addition to Ger. Pat. 309,016.

IN a suction filter built up of plates as in a filter-press, auxiliary plates are fitted between the filter-plates and carry filter cloths for the purpose of covering the filter cake as described in the chief patent (this J., 1919, 210 A). The filter can be rotated for emptying, and compressed air blown through for loosening the cake from the cloths. A movable frame is fitted between each filter plate and auxiliary plate, and as the filter is turned over for emptying this falls down and widens the distance between the filter cake and the covering cloth, thus facilitating the removal of the cake.
—L. A. C.

Cooling towers; Operation of —. T. Fethke, Breslau. Ger. Pat. 310,428, 2.6.17.

THE current of warm water is automatically controlled in such manner that it is delivered in larger

quantities to those parts of the cooling tower where the cooling effect is greater. Distance thermometers inserted at different points in the current of cooled water operate electrically to control the distribution of the warm water. In this manner the maximum efficiency of the cooler is developed.—J. S. G. T.

Refrigerating machines; Process of compression for ——. H. Worgitzky, Nuremberg. Ger. Pat. 310,995, 11.11.17.

THE moist vapour produced in the evaporator is separated into dry vapour and liquid, and the former is withdrawn by the compressor. The separated liquid is atomised into the dry vapour in the compressor at the end of the suction stroke and is mixed therewith, the resulting mixture being subsequently compressed and delivered to the condenser. A compressor whereby these operations may be effected is also claimed.—J. S. G. T.

Muffles. J. B. Farquhar, Vancouver, B.C. Eng. Pat. 127,153, 26.7.18. (Appl. 12,204/18.)

SEE U.S. Pat. 1,269,270 of 1918; this J., 1918, 537 A.

Conveyors for furnaces; Material ——. T. B. Cram, and Ferguson Furnace Co., Toledo, Ohio, U.S.A. Eng. Pat. 127,462, 13.8.18. (Appl. 13,153/18.)

SEE U.S. Pat. 1,272,918 of 1918; this J., 1918, 506 A.

Drying chamber. O. H. Abbott, London. U.S. Pat. 1,302,490, 6.5.19. Appl., 21.11.18.

SEE Eng. Pat. 120,635 of 1917; this J., 1919, 61 A.

Drying liquids; Machine for ——. A. Glidic, Håkenbol, Sweden, Assignor to Drying Products Co., Ltd. A./S., Christiania. U.S. Pat. 1,302,786, 6.5.19. Appl., 10.11.17.

SEE Eng. Pat. 110,753 of 1917; this J., 1918, 755 A.

Centrifugal separation of solid substances from liquids; Method of and means for the ——. J. Hughes, London, W. O. Travis, Hampton, and R. A. Sturgeon, Bodeuron. U.S. Pat. 1,303,203, 6.5.19. Appl., 9.10.14.

SEE Eng. Pat. 24,038 of 1913; this J., 1915, 263.

Grinding or crushing machine. D. J. G. Miller, Bootle, and R. A. Lloyd, Liverpool. U.S. Pat. 1,304,345, 20.5.19. Appl., 21.5.18.

SEE Eng. Pat. 117,281 of 1917; this J., 1918, 495 A.

Catalysts. Eng. Pat. 126,715. *See* VII.

Furnaces. Eng. Pat. 124,714. *See* X.

Furnaces. Eng. Pat. 126,319. *See* X.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Gas retort systems; Comparison of ——. K. Bunte. J. Gasbeleucht., 1919, 62, 221—226, 237—243.

THE characteristic features of the newer forms of retort systems—inclined, Dessau vertical, Pintsch-Bolz vertical retorts, Münich chamber retorts (vertical and inclined), and Glover-West are briefly reviewed. The Verein von Gas- und Wasserfachmännern, at the request of the various interested parties, has investigated how the performances—actual and reputed—of various of these new types of retort systems may be evaluated. The basis of guarantee for any new installation of retorts customarily embraces a statement of the yield of gas per 100 kilos. of coal, the calorific value of the gas, charge and make of gas per retort and per day, cost of firing per 100 kilos. of coal, and steam required for production of water-gas. A certain margin should be allowed in the values of the yield of gas, and in its calorific value, the product of these two being the really significant factor. A table gives the total thermal energy contained in various mixtures of coal gas and water-gas, which finds application in evaluating the performance of retort systems such as the Glover-West, Dessau, and Pintsch-Bolz. The kind of coal employed, its ash and water content are customarily specified. It is suggested that the results should be specified in terms of air-dried coal, attention being paid to the ash content. It is pointed out that a false interpretation is frequently given to the guarantee concerning the retort charge. The gas made per retort and per day is of the highest importance. Particulars are given as to how the cost of firing per 100 kilos. of coal can be easily ascertained. As regards steam requirements, according to Bunte 0·5 to 0·8 kilo. of steam is required per kilo. of coke gasified, and 5·5 to 9% additional coke is required for such steam-raising purposes. Attention is directed to the importance of the number of workers necessary, the cost of labour, and the time the plant is idle, and finally the characteristics of the coke produced and the yield of ammonia and tar are mentioned as factors requiring attention.

—J. S. G. T.

Lignites; Carbonisation of — . *II. Large-scale laboratory tests.* E. Stansfield and R. E. Gilmore. Trans. Roy. Soc. Canada, 1918—9, [III.], **12**, III., 121—130.

THE carbonisation was carried out in a tubular retort, made of seven one-foot lengths of 2-in. boiler tubing mounted in a cast-iron head, which would carry a charge of 2300 grms. of pea-size lignite with about 35% moisture content. The retort was heated in an electrically heated lead bath. The hot gases issuing from the retort were passed through a scrubber jacketed with superheated steam, and here the heavy tar oils condensed in a practically water-free condition. The gases then passed on through a simple tubular condenser, where the lighter oils and steam condensed and in the receiver separated in two layers. The cool gases issuing from here were passed along with steam through a scrubber filled with glass beads, the bottom half being water-cooled. This completely removed any tar fog and the gases leaving this scrubber were cooled, passed through a gas meter and on into a gas holder. The results determined were the yield and calorific value of the carbonised residue; the yield, composition, and calorific value of the gas; the yield, calorific value, and economic value of the tar oils; and the yield of ammonium sulphate. The influences of the final temperature to which the charge was heated and of the rate of heating were also examined. The results show less difference than was expected between rapid and slow carbonisation. The yields of gas were low, probably too low to provide the heat and power necessary to run a carbonising and briquetting plant, unless the carbonising is carried out at a temperature distinctly above that at which the residue of maximum calorific value is obtained. The tar yields were also low, and the pitch obtainable therefrom only amounted to some 2—2½% of the corresponding carbonised residue. Probably 10% would be necessary for satisfactory briquettes. The yields and calorific values of the carbonised residues are in satisfactory agreement with the results of the small

scale tests (this J., 1919, 67 A). In an appendix it is shown that carbonised lignite rapidly occludes oxygen, and possibly to a less extent nitrogen. The oxygen then gradually oxidises the material with a corresponding slow reduction of the calorific value. The oxidation does not appear to be confined to the mineral impurities. In a second appendix the results of comparative extraction tests on Shand lignite and Alfred peat are given. Benzene in a Soxhlet apparatus dissolves 0·6% of the dry lignite and 4·5% of the dry peat, while carbon bisulphide dissolves 0·5% of the lignite and 3·3% of the peat. Heated with benzene in an autoclave at 300°—310° C. and 50 atmos. for one hour, the lignite loses 1·3% and the peat 11·0%, the lignite appearing unchanged after the treatment, whereas the peat was much darker in colour, smaller in volume, and showed an unaccounted-for loss of 21% by weight.

W. G.

Montan wax; Increase in the yield of —— by the extraction of lignite under pressure. F. Fischer and W. Schneider. Ges. Abhand. zur Kenntnis der Kohle, 1917, 1, 201–210. Chem. Zentr., 1919, 90, II., 519.

THE yield of montan wax can be appreciably increased by extracting lignite with benzene (see this J., 1916, 1001) at high pressures and temperatures as shown in the following table:

	Press. Atm.	Temp. C.	Montan wax %
Rhenish lignite	1	80	3·3·5
" "	10	155	4·4
" "	50	240	7
Saxon-Thuringian lignite	1	80	11
" " "	60	260	25

The extracts are hard, brittle substances with softening points varying from 83° C. for the first to 67·5° C. for the last portion extracted. No substances soluble in benzene appear to be freshly formed at the temperatures employed; therefore lignite seems to contain twice the content of montan wax hitherto assumed. This explains the fact that lignite extracted by the ordinary process always gives a remarkably high yield of tar.—H. J. H.

Coke; Use of —— for raising steam. A. Stober. Stahl u. Eisen, 1919, **39**, 525–531, 567–570.

THREE types of water-tube boilers with chain-grate stokers were adapted to the use of lump coke, which was fed down a shaft upon the grates, the intention being to secure ignition of the coke before it reached the combustion chamber. At the back of the grate stops were arranged to arrest and delay the passage of coke and clinker from the grate. Owing to war-time difficulties the fuel actually available was unscreened coke of all grades up to 7 cm., containing breeze in proportions varying up to 50%. This led to irregularities owing to segregation in the bunkers with consequent slow steaming when an excess of fine fuel arrived on the grate. The maximum duty obtainable was considerably below that obtained with coal, even when the fire was forced to an extreme impossible in practice. Under practicable conditions the rate of steaming was only about 50% of that with coal, while the thermal efficiency was about 60%. Extra trouble with clinker and attendance render the cost of steam much greater than with coal. A fixed-grate stoker fitted with special (so-called "Evaporator") bars gave better results. These bars consist of corrugated plates pierced with holes, with the space below divided by longitudinal partitions into chambers to ensure uniform distribution of a forced draught induced by a jet of steam. The secondary air supply was furnished by adjustable openings in the door. With this arrangement coke of mixed grades (up to 7 cm.), breeze, and low-grade coals were successfully burned. The rate of steaming, however, was less and the coke must be more than correspondingly cheaper than the coal to obtain the steam at the same price.—H. J. H.

Waste gases; Interpretation of analyses of —— from producer-gas firing installations and suction gas engines. Wa. Ostwald. Stahl u. Eisen, 1919, **39**, 625–626.

THE waste gases may be regarded as composed of combustion products, excess of air, and unburnt gas. These constituents may be arranged at the apices of a Gibbs triangular diagram, with the base representing mixtures of air and unburnt gas. The position of any point may be fixed from an analysis of the waste gases with the aid of function scales. For example the percentage of excess air is proportional to the oxygen content and that of unburnt gas to the carbon monoxide content; and the corresponding sides of the triangle may be divided respectively into 21 parts (as air contains 21% of oxygen) and into as many parts as the unburnt gas contains percentage units of carbon monoxide. The composition of the waste gases in terms of unburnt gas, excess air, and combustion products may then be read directly from the diagram. The method is superior to that proposed by Clare (this J., 1918, 51 T), in accuracy and in ease of using, and moreover Clare's method gives only the percentage of unburnt gas present in the waste gases.—A. B. S.

Pitch and tar oils; Process for the direct recovery of —— from crude coke-oven or coal gas. W. Emmanghaus. J. Gasbeleuchtg., 1919, **62**, 226–229.

THE process introduced by W. Feld, in which the crude gas is subjected to cooling in stages, accompanied by simultaneous mechanical washing, has been in successful operation for 3 years in connection with an installation of 60 Koppers coke ovens, briquette pitch and tar oil being recovered. The tar oil resembles the crude oil obtained in tar distillation. The gas from the ovens is led into a Feld centrifugal washer, supplied with steam. Condensed tarry matter is used as washing fluid, and is employed in the form of a fine spray. About 70% of the tar is recovered in the washer. The gas enters the washer at about 180° C. and leaves at about 120° C. to an impact purifier (tower packed with Raschig rings), wherein the gas is again washed with some of the condensed products, the remainder of the tar and some oil being recovered. The tar and oil are removed at intervals of from 8 to 12 hours. The gas passes from the washers to cooling towers where it is cooled to atmospheric temperature, oil and water being condensed, and collected in a separate vessel, where the ammoniacal liquor is separated from the tar as usual. The cost of operation of the plant, including interest and amortisation, over 1¼ years (1916–1917), amounted to M 2·55 per ton of recovered products. The advantages accruing to the process of fractional condensation include economy of fuel and material.—J. S. G. T.

Lubricating oil; Production of —— from coal. F. Fischer and W. Gluud. Ges. Abhand. zur Kenntnis der Kohle, 1917, **1**, 114—142. Chem. Zentr., 1919, **90**, II., 519—521.

VISCOUS lubricating oils such as were obtained by extraction with benzene or sulphur dioxide (this J., 1916, 1001) can also be obtained by the low-temperature carbonisation of coal at 400° to 550° C. The conditions essential to the conservation of low-

temperature tar—avoidance of excessive heating and also rapid removal from the distillation chamber, are obstacles to the technical development of low-temperature processes. Favourable conditions are often met with in the upper zones of gas producers where the hot producer gas carbonises the upper layers of coal, removing at the same time the products of distillation. The producer gas can be withdrawn from the gasification chamber through an annular enclosing space and collected separately from the products distilled from the upper zone, superheating of these being thereby avoided. The tar so obtained closely resembles low-temperature tar, and is quite different from ordinary gas-producer tar. The plant necessary is so simple that the process is at once applicable in practice. The distillate gases are stripped and returned to the hot producer gas, whereby the sensible heat of the latter is not lost and the visibility of the flame and calorific value of the gas are not affected. The yield of lubricating oil amounts to 0·5 to 1% of the coal employed. *Low-temperature tar.* By using a revolving furnace the superheating of products of distillation was avoided and considerable quantities of tar (3 to 15% from 20 kilos. of coal) were quickly obtained. Bituminous coal and also a gas coal and a cannel were used. The tars were characterised by the presence of naphthenes, highly viscous oils, and paraffin wax and by the absence of aromatic compounds, thereby resembling crude mineral oil rather than coal tar. The gas coal yielded 10%, *i.e.*, three times as much tar as the older bituminous coal, the tar of which also contained smaller proportions of phenolic and acid substances. Phenol itself is present in traces only. The tar was treated by extraction with sodium hydroxide and then distilled in superheated steam. The distillate was dissolved in acetone, and paraffin and high boiling oils were separated on cooling. The oil remaining after evaporating the acetone was distilled with steam again and fractionally condensed. The oils obtained are deep orange with a green fluorescence, having a pleasant aromatic fatty smell, and are usually heavier than water. The composition of the tar is as follows:—

Tar	Bituminous coal	Gas coal	Producer tar
	%	%	%
Viscous oils (lubricants)	1·2	10·0	11·3
Paraffin (solid)	0·1	1·0	0·8
Oils—not viscous	3·5	1·0	17·7
Phenols	11·0	70·0	37·8
Resins	1·2	1·0	0·7
Pitch	19·2	6·0	1·0
Loss and water	13·9	17·0	16·7

The cannel coal gave 14% of tar, which was rich in viscous oils, tar acids, and paraffin. *Producer tar.* For comparison the producer tar from gas coal was distilled in steam and the individual fractions separated. The yield of tar was about 15%. The same coal by low-temperature carbonisation gave 10% of tar, which was of the same character as the producer tar.—H. J. H.

Lignite producer tar. Schneider. *See* III.

Patents.

Fuel, and the manufacture of the same. C. M. C. Hughes, Birmingham, and R. G. Lovell, Eastbourne. Eng. Pat. 127,024, 17.3.17. (Appl. 3885/17.)

A relatively small amount of pitch, molasses, glucose, or the like, together with soot or charcoal, is mixed with waste carbonaceous materials such as coke breeze dust, sawdust, destructor ash, etc. Calcium carbonate or other similar material containing oxygen is preferably also added. Pitch and soot or charcoal are used in the approximate proportion of two parts of pitch to one of soot or charcoal. Molasses or glucose is employed in the proportion of ten parts to four parts of soot or charcoal. The materials are thoroughly dried, mixed and baked for about half-an-hour at 240° F. (116° C.) until they fuse into a stiff paste, which is discharged to set without being compressed. The mass is then broken up as desired. Creosote oil may be added to the pitch prior to admixture with the soot. J. S. G. T.

Coke; Process of manufacturing ——. J. Roth and J. L. Vincent, Paris. Eng. Pat. 126,997, 6.10.16. (Appl 14,210/16.) Int. Conv., 29.4.16.

Carbonaceous material such as anthracite, peat, lignite, etc., is mixed with the calculated quantity of tar, pitch, petroleum residues, or other hydrocarbon required to produce a mixture analytically similar to natural coking coal. The mass is crushed, mixed into a slightly pasty mass, and pressed into briquettes in the cold state. The blocks are exposed to the air for about 24 hours and are subsequently coked, the volatile constituents being collected as tar, which may be employed for mixing with other material to be coked. The coke obtained has the special properties of metallurgical coke.—J. S. G. T.

Coking-ovens. O. Piette, and Soc. Franco-Belge de Fours à Coke, Paris. Eng. Pat. 127,165, 22.8.18. (Appl. 13,670/18.)

In horizontal coking ovens with vertical flues and transverse regenerators of the Reichel type (Eng. Pat. 343 of 1910; this J., 1910, 1193), the products of combustion after being partially cooled in the primary channels of the regenerators are heated by passing through secondary channels, the vaults of which are situated near the sole of the oven. To avoid the loss of heat so produced, the height of the secondary regenerators is diminished and part of the air necessary for combustion is forced through channels arranged between the vaults of the secondary regenerators and the oven sole, the remainder of the air passing through channels situated below the regenerators.—J. S. G. T.

[*Petroleum*] *oils; Refining of* ——. W. J. Mellersh-Jackson, London. From The Twitchell Process Co., Cincinnati, Ohio. Eng. Pat. 127,159, 12.8.18. (Appl. 13,097/18.)

The oil is treated with strong sulphuric acid and the sludge is withdrawn. The remaining oil contains a small percentage of soluble sulphonic acids which are neutralised with alkali and then extracted by means of an aqueous solution of a solvent such as acetone or methyl alcohol.—A. E. D.

[*Oil*] *stills; Method of operating* —— *and removing coke therefrom.* C. B. Buerger, Assignor to Atlantic Refining Co., Philadelphia, Pa. U.S. Pat. 1,302,761, 6.5.19. Appl., 7.2.18.

A number of blocks of metal or the like are placed in the still so that they become embedded in the deposit formed on the wall of the still. On withdrawing the blocks horizontally in succession, the coke deposit is removed in sections.—A. E. D.

Filter apparatus [*for paraffin wax*]. H. M. Nicholls, Swarthmore, Pa., Assignor to Atlantic Refining Co., Philadelphia, Pa. U.S. Pat. 1,302,832, 6.5.19. Appl., 25.2.18.

A closed filter chamber formed of a filter medium of low heat capacity is supported with its inner and

outer surfaces free of contact with other bodies. Chilled wax-bearing oil is introduced into the filter-chamber, and provision is made for melting the wax which collects on the inner surface of the chamber and removing the melted wax without dismantling the apparatus.—A. E. D.

Lubricating oils; Manufacture of ——. H. F. Grant, Franklin, Pa. U.S. Pat. 1,303,292, 13.5.19. Appl., 11.10.18.

A CRUDE oil of rich green colour, density about 31·3° B. (sp. gr. 0·867) of 130 flash point, and viscosity approximately 100° Sayboll at 100° is filtered and heated with steam to a temperature not exceeding 400° F. (204° C.) to increase its viscosity whilst only slightly reducing its specific gravity.
—A. E. D.

Hydrocarbon oils; Process for treating ——. M. J. Trumble, Alhambra, Cal., Assignor to Shell Co. of California. U.S. Pat. 1,304,125, 20.5.19. Appl., 27.6.16.

THE oil is heated by means of incandescent gases, the vapours being separated and mixed with the gases, whilst the liquid oils are kept out of contact with the gases. The vapours are subsequently condensed.—A. E. D.

Hydrocarbons; Apparatus for treating [cracking] ——. F. L. Slocum and C. C. Stutz, Assignors to Synthetic Hydrocarbon Co., Pittsburgh, Pa. U.S. Pat. 1,304,211, 20.5.19. Appl., 13.4.16.

OIL is cracked in a heating tube provided with apparatus for removing deposits. Material discharged from the tube is collected in a vessel wherein separation of liquid from solid matter is effected. The temperature of the vessel is reduced below that of the boiling point of part of the product discharged from the heater. Provision is made for the return of liquid to the separating vessel to ensure removal of solids therefrom.
—A. E. D.

Hydrocarbons; Apparatus for treating [cracking] ——. F. L. Slocum and C. C. Stutz, Assignors to Synthetic Hydrocarbon Co., Pittsburgh, Pa. U.S. Pat. 1,304,212, 20.5.19. Appl., 13.4.16.

A CLEANING head is reciprocated in the cracking tube by the fluid pressure generated in the tube.
—A. E. D.

Hydrocarbon liquids for use in internal combustion engines; Manufacture of ——. C. F. Winch, New York. U.S. Pat. 1,304,433, 20.5.19. Appl., 7.3.17.

PETROLEUM is exposed to the lighter gases resulting from the heating of the carbonised products of vegetation.—A. E. D.

Emulsions; Method and apparatus for dehydrating ——. M. J. Trumble, Los Angeles, Cal., Assignor to Shell Co. of California. U.S. Pat. 1,304,121, 20.5.19. Appl., 16.8.15.

AN oil-water emulsion is passed through porous diaphragms of progressively increasing area to allow the time of separation also to be progressively increased.—A. E. D.

Bituminous composition and process of making same. L. Kirschbraun, Evanston, Ill. U.S. Pat. 1,302,810, 6.5.19. Appl., 8.5.15.

AN aqueous paste containing a substantial proportion of colloidal mineral matter is mixed with fluid asphalt and incorporated with comminuted fibrous material. A thin sheet of the composition is dried, when the bitumen coalesces with the fibre.—A. E. D.

Gas-fired furnaces. Eng. Pat. 127,378. *See* I.

Spent oxide. Eng. Pat. 127,128. *See* VII.

Chlorhydrins from oil-gas. Eng. Pat. 113,954. *See* XX.

Chlorinated hydrocarbons. Eng. Pat. 126,511. *See* XX.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Coal mixed with alkalis; Distillation of ——. F. Fischer and W. Gluud. Ges. Abhand. zur Kenntnis der Kohle, 1917, **1**, 171—175. Chem. Zentr., 1919, **90**, II., 516—517.

WHEN coal is heated with alkalis (sodium hydroxide) a pleasant odour resembling that of terpenes is produced. The character of the tar products is not appreciably affected by the sodium hydroxide, but the phenolic and acid substances which are abundantly formed in carbonisation at 450°–550° C. appear to be mainly retained in the residue. The yield of tar is therefore smaller; it is strongly alkaline, and contains ammonia. The quantity of gas is increased by the action of alkalis on carbon. The coke residue is not coherent and is pyrophoric.—H. J. H.

Cellulose and wood mixed with alkali; Distillation of ——. F. Fischer and H. Niggemann. Ges. Abhand. zur Kenntnis der Kohle, 1917, **1**, 176—183. Chem. Zentr., 1919, **90**, II., 521.

THE influence of sodium hydroxide on the distillation of cellulose and wood is shown by the following table:

	100 grms. of cellulose	100 grms. of cellulose with 100 c.c. of 5*N* NaOH	100 grms. of cellulose with 200 c.c. of 5*N* NaOH	100 grms. of cellulose with 200 c.c. of 10*N* NaOH
Tar ...	5·5%	8·5%	15%	13%
Charcoal	20·0%	16·0%	15%	—
Gas ...	19 l.	36 l.	20 l.	39 l.

The addition of alkali caused an increase in the yield of gas and tar and a corresponding decrease in that of the charcoal residue. A similar influence was observed on sawdust, which yielded 16·5% of tar. The simultaneous introduction of steam or coal gas to accelerate the removal of distillation products diminished the yield of tar. An odour of peppermint, which was more marked on increasing the amount of alkali, was characteristic of these tars. They contain no paraffin hydrocarbons and are partly soluble in petroleum spirit. By the distillation of wood with zinc chloride, little tar and much charcoal are obtained, probably on account of the dehydrating action of the reagent.—H. J. H.

PATENTS.

Distillation [of wood liquor]; Process of — — and apparatus therefor. E. J. Hudson and H. C. Merriam, Marquette, Mich., Assignors to The Cleveland-Cliffs Iron Co., Cleveland, Ohio. U.S. Pat. 1,303,321, 13.5.19. Appl., 7.2.17.

NEUTRALISED "wood liquor" is subjected to distillation in a continuous column still to concentrate the acetate solution and drive off vapours containing

methyl alcohol and a relatively large amount of water. The vapours are fractionally condensed, the aqueous condensed liquid being collected separately from the concentrated acetate solution.—J. S. G. T.

Gas; Apparatus for generating —— from vegetation. F. Pfeifer, Assignor to Straw Gas and Creosote Distilling Co., Minneapolis, Minn. U.S. Pat. 1,303,385, 13.5.19. Appl., 24.6.18.

Waste vegetable material is subjected to distillation in a retort arranged longitudinally within a flue leading from a furnace and heated by a burner beneath the flue. A gas washer is connected, on the one hand, to the retort and, on the other, to a gas reservoir, and the latter is connected to the burner, so that the gas delivered from the gas reservoir to the burner is automatically controlled by the pressure in the reservoir.—J. S. G. T.

Squirted metallic wire filaments; Heating device for —— to obtain "crystal filaments." G. Moeller, Berlin. Ger. Pat. 310,364, 6.4.18.

The filament (*e.g.* tungsten) after being drawn through a capillary die is carried past the white hot anode of a vacuum tube furnished with an incandescent cathode. The filament itself may be employed as anode, and the parts thus directly exposed to the cathode rays are raised to a most intense heat.—J. S. G. T.

Rontgen tube; Metallic ——. L. Wolfrum, Augsburg. Ger. Pat. 310,368, 5.9.17.

The glass cathode tube and a quartz window are each provided with tapering portions which fit in openings in the metal tube, the joints being sealed by means of an alloy composed preferably of bismuth (50), lead (26), cadmium (10), tin (13), and mercury (33 parts). The alloy, which melts at 50° C., is run in molten and solidifies on cooling.—J. S. G. T.

III.—TAR AND TAR PRODUCTS.

Tars from producers using lignite as fuel. W. Schneider. Ges. Abhand. zur Kenntnis der Kohle, 1917, **1**, 197—203. Chem. Zentr., 1919, **90**, II., 517—518.

Further investigations (*cf.* this J., 1916, 1146) of lignite producer tars gave the following results:—The content of water and impurities insoluble in boiling benzene differed widely, but the sum of the two was fairly constant amounting to 20—25%. The coke residue varied from 26 to 29%, excepting for a thin tar which gave 15%. The fraction extracted by light petroleum, which serves as a substitute for whale oil in leather manufacture, amounted to 45—55% of the pure tar, and to as much as 75% of the sample of thin tar, while the setting point was 33°—34° C., and 31° C. for thin tar. The peculiar odour of these extracts, which may be transmitted to the leather, can be lessened by treatment with steam without appreciable loss of oil, while the setting point is thereby raised to 35° C.—H. J. H.

Lubricating oils from coal. Fischer and Gluud. *See* IIA.

Patents.

Nitrophenols; Production of —— from amido-compounds by means of nitrous gases. R. L. Datta and P. S. Varma, Calcutta. Eng. Pat. 126,321, 11.12.16. (Appl. 17,778/16.)

The *o*- or *p*-sulphonic acids of aniline or its homologues, having a free ortho or para position, or both, to the amino group, are converted into di- or tri-nitrophenols on treatment in aqueous solution or suspension with nitrous gases. Thus aniline-*o*-sulphonic acid, or aniline-*p*-sulphonic acid, or in practice the crude sulphonic acid obtained by sulphonating aniline, if suspended in four times its weight of water, and treated, without cooling, with nitrous gases until no further absorption takes place gives a 90% yield of 2-4-6-trinitrophenol (picric acid). Similarly the acid obtained by sulphonating *o*-toluidine is converted into 3-5-dinitro-*o*-cresol; that from *m*-toluidine gives 2-4-6-trinitro-*m*-cresol; and that from *p*-toluidine 3-5-dinitro-*p*-cresol.—G. F. M.

Aromatic hydrocarbons; Sulphonation of ——. A. Bender, Bogota, N.J., Assignor to E. S. Beach, Ridgefield, Conn. U.S. Pat. 1,301,360, 22.4.19. Appl., 12.9.18.

A reaction mixture containing benzenesulphonic acid, sulphuric acid, and water, and having a ratio of water to free sulphuric acid of about 22 : 78, is heated in vacuum to 130°—180° C., thereby reducing the ratio of water to free sulphuric acid to below 22 : 78, and making the sulphuric acid remaining in the mixture available for further reaction with benzene.—G. F. M.

Hydrocarbons; Sulphonation of ——. C. R. Downs, Cliffside, N.J., Assignor to The Barrett Co. U.S. Pat. 1,301,785, 22.4.19. Appl., 13.5.18.

Sulphonic acids are isolated by subjecting the mixture of sulphonic acid and sulphuric acid to distillation under a high vacuum at a temperature below that at which the sulphonic acid decomposes, but sufficient to distil the sulphuric acid from the mixture.—G. F. M.

Anthraquinone; Process for the manufacture of ——. C. Conover, Philadelphia, Pa., and H. D. Gibbs, San Francisco, Cal. U.S. Pat. 1,303,168, 6.5.19. Appl., 7.6.17.

See Eng. Pat. 119,518 of 1917; this J., 1918, 684 A.

IV.—COLOURING MATTERS AND DYES.

Nitrotriphenylmethanes and related compounds; Absorption and constitution of the coloured alkali salts of ——. A. Hantzsch and F. Hein. Ber., 1919, **52**, 493—509.

The alkali salts of the mono-nitrotriphenylmethanes are yellow, and quinonoid in structure, thus, $(C_6H_5)_2C:C_6H_4:NO.ONa$, but the salts of dinitro- and trinitro-triphenylmethanes are violet. *p*-Nitrodiphenylamine also gives simple quinonoid-aci salts, but salts of *p.p'*-dinitrodiphenylamine and the nitrodiazoaminobenzenes are violet. These contain a powerful auxochrome, therefore, which is the conjugated system of the metal of the quinonoid-aci chromophore with a second nitro or similar group. (See further J. Chem. Soc., July, 1919.)—J. C. W.

Triphenylmethane and azo dyes and related compounds; Absorption and constitution of the simplest ——. A. Hantzsch. Ber., 1919, **52**, 509—530.

The maximum effect on the colour of the salts of an aminotriphenylmethane, as in the case of the alkali salts of the nitrotriphenylmethanes, is reached when there are two salt-forming groups present. Furthermore, the fuchsins closely resemble the reddish-violet salts of the aminoazobenzenes. The three classes are therefore characterised by a quinonoid salt complex as chromophore and a powerful

auxochrome comprising a second salt-forming group in conjugation with the quinonoid group. (See further J. Chem. Soc., July, 1919.)—J. C. W.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Wool and cloth; Action of atmospheric influences on — A. Kertesz. Z. angew. Chem., 1919, **32**, 168–170.

An investigation of the causes of the characteristic deterioration of old uniforms after exposure in active service showed that it was entirely attributable to the extreme exposure to normal atmospheric influences. Experiments have shown that prolonged exposure to the weather has a most injurious action on the wool fibre, ending in complete destruction. Undyed wool is more rapidly destroyed than dyed wool, the difference being plainly discernible in the case of mottled fabrics. Acid salts, aluminium and iron salts exert a certain protective influence but not to the same extent as chromium salts (see Ger Pat. 286,340; this J., 1915, 1140). Cloths with a soft texture or finish are more rapidly destroyed than hard cloths; those finished with oil or lanolin are less resistant than plain finished cloths. The three atmospheric factors: moisture, ozone, and actinic light have been investigated separately. Ozone causes the tendering of wool but does not produce the peculiar hardening and loss of woolly character which has been noted in the case of the cloths exposed to atmospheric influences; moreover, chromium salts have no protective effect against ozone. On the other hand, the destructive effects under investigation may be reproduced exactly by exposure to the rays of a quartz mercury lamp, so that the destruction is attributed to the action of actinic light. The presence or absence of moisture appears to have no effect upon the result. The deterioration, which takes the form of a complete destruction of the nap, is best measured by the strength of the biuret reaction shown after extracting the cloth with 1% sodium carbonate for 1 hour at 60°–65° C. The attacked wool also shows an increased affinity for Methylene Blue. Chromium oxide is the most powerful protective agent and should be present to the amount of about 1% of the dry weight of the wool. It should be applied in the form of a chromium salt of an organic acid, *e.g.* a solution of chromium acetate at 3°–5° B. (sp. gr. 1·02–1·03). —J. F. B.

Wood; Proximate analysis of — W. H. Dore. J. Ind. Eng. Chem., 1919, **11**, 556–563.

The following analyses are recorded:—

	Red-wood	Yellow pine	Sugar pine	Live oak	Blue gum
	%	%	%	%	%
Loss at 100° C.	8·53	8·98	9·84	7·72	10·12
Benzene extract	0·29	2·02	2·56	0·30	0·06
Alcohol extract	4·11	1·36	1·71	4·00	2·24
Water soluble	0·80	1·54	1·98	3·52	1·81
Soluble in 1% NaOH	7·84	10·47	9·13	7·15	12·25
Cellulose	47·58	48·38	48·67	47·52	51·18
Lignin	27·62	23·60	23·23	13·59	13·28
	96·80	96·35	97·12	83·80	91·24

The benzene and alcohol extracts were determined by extracting the dried wood (in the form of sawdust) for 6 hrs. successively with benzene and alcohol. The wood was then dried again and boiled for 3 hrs. with water to obtain the water-soluble constituents, and next boiled for 1 hr. with 1% sodium hydroxide solution. The washed wood remaining after these treatments was, while still moist, transferred to a flask and the cellulose determined by a modification of Cross and Bevan's method. The chlorination was carried out *in vacuo*; the air was exhausted from the flask and chlorine then admitted slowly, the rate being judged by bubbling the gas through a wash-bottle. The flask was cooled in a bath of water and the flow of chlorine stopped when the saturation point was reached as indicated by the gas almost ceasing to bubble through the wash-bottle. Lignin was determined by König's method; in the case of the hard woods this method appeared to fail as shown by the low results obtained. Cutin was not found in appreciable amount.—W. P. S.

Patents.

Gas bags or containers; Manufacture of hydrogen or other — — and sheets applicable therefor. C. Dreyfus, London. Eng. Pat. 126,347, 29.12.16. (Appl. 18,636/16.)

Sheets of non-fibrous cellulose, such as that prepared from viscose, are used for the construction of gas bags or containers, for which purpose the cellulose sheets are applied to or attached by adhesives or other means to carriers or supports of textile fabrics, cords, or paper. The container composed of cellulose sheets may be enclosed in an outer container of cotton or other fabric and the bag may be coated with oil or other varnish.

—J. F. B.

Artificial-silk waste; Treating — for spinning into yarn. Spinning imitation-mohair yarn. (A) W. R. D. Hall, Narberth, Pa., (B) W. R. D. Hall, Assignor to S. Feather Co. U.S. Pats (A) 1,303,301 and (B) 1,303,302, 13.5.19. Appl., 26.6.18.

(A) Artificial-silk waste is kept in a conditioning room until it has the required moisture content and prior to its removal from the room is treated with a substance to prevent loss or absorption of moisture outside the room. (B) Artificial-silk waste, conditioned as in (A), is treated with 6·5–7·5% of a vegetable oil to prevent the absorption of moisture and blended with wool for the production of artificial mohair.—D. W.

Sawdust and wood waste; Manufacture of fibrous pulp suitable for papermaking from — — J. C. Van Wessem, Bloemendaal, Holland. Eng. Pat 117,086, 27.6.18. (Appl 10,616/18.) Int. Conv., 23.12.15.

Sawdust, or other wood waste previously reduced to the fineness of sawdust, is moistened with a regulated quantity of water not exceeding 60% of the dry weight of the wood and fed by a screw conveyor into a grinding mill in which it is ground to a fibrous pulp which is not in a pasty condition. The heat generated in the grinding mill should be such as to raise the pulp to a temperature not exceeding 90° C. and to evaporate the moisture to such an extent that a fibrous pulp is manufactured containing not more than 30% of moisture. The pulp is discharged from the mill to a cyclone separator, which cools the mass and removes the excess of vapour, and then passes into a sorting apparatus which removes the unground particles.

—J. F. B.

Paper stock; Removal of printers' ink from ——, *and the preparation of paper pulp.* W. Clark, London. From Jespersen Paper Co., New York. Eng. Pat. 126,879, 31.8.18. (Appl. 14,170/18.)

Waste printed paper, such as newspaper printed with an ink containing a mineral oil vehicle, is treated in a beater with finely screened milk of lime in the proportion of about 50 lb. of quicklime to 1 ton of paper. The beating is continued until

the mineral oil containing the pigment rises to the surface, whence it is removed by washing through rotary screens. The treated pulp may be neutralised before sizing by the addition of sulphuric acid. —J. F. B.

Paper making machines. W. H. Dixon, Grimsby. Eng. Pat. 126,916, 17.12.18. (Appl. 21,049/18.)

The steam generated during the drying of the paper as it passes over the drying cylinders is withdrawn through pipes, tubes, or chambers disposed within the spaces or pockets formed between the felts and the paper, the vapour being aspirated by means of a fan connected with the tubes and discharged at a point remote from the machine.—J. F. B.

Paper pulp; Process of treating [sizing] ——. J. A. De Cew, Montreal, Canada. U.S. Pat. 1,300,357, 15.4.19. Appl., 25.9.17.

Paper stock is treated in the beating engine with sodium aluminate and separately with rosin soap solution containing free resin acids in the colloidal state.—J. F. B.

Cellulose solutions; Squirting nozzles for use in the manufacture of strips and the like from viscose or other similar ——. Courtaulds, Ltd., London, and J. E. Crigg al, Coventry. Eng. Pat. 127,155, 31.7.18. (Appl. 12,513/18.)

Conditioning and drying machine [for yarn etc.] T. Andrew, Manchester. U.S. Pat. 1,303,009, 6.5.19. Appl., 11.4.17.

See Eng. Pat. 105,789 of 1916; this J., 1917, 640.

Celluloid substitute. Eng. Pat. 127,481. *See* XV.

Ligno-tanning materials. U.S. Pats. 1,303,176-7. *See* XV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Dyeing of cotton with Benzopurpurin 4B; Influence of some salts on ——. J. Böeseken, G. W. Tergau, and A. C. Binnendijk. Proc. K. Akad. Wetensch., 1919, **21**, 893–906.

The action of various salts on the dyeing of cotton with Benzopurpurin 4B at 65° C. has been investigated. In a series of salts of similar metals (alkalis and ammonium; magnesium and the alkaline-earth metals; zinc, cadmium, and mercury; iron, manganese, nickel, and cobalt) the precipitating power is not connected directly with the atomic weight of the elements but with a peculiar chemical property, for instance the electro-affinity; apparently, however, some other property is also involved. In all cases, the quantities of salt necessary for the exhaustion of the dye-bath are much greater than the equimolecular amounts.—H. W.

Patent.

Bleaching textile goods; Apparatus for ——. C. Tütsch, Winterthur, Switzerland. Ger. Pat. 309,974, 3.10.17.

The material to be bleached is placed within a vessel surrounded by an outer jacket, and the bleaching liquor is circulated through the material by means of pipes connected with the inner vessel at the top and bottom. Automatic valves are fixed on these pipes and are so adjusted that when the desired pressure is reached in the inner vessel, the excess liquor passes through the valves into the outer jacket. The jacket space thus serves as a heating chamber, a reservoir for the bleaching liquor, and an expansion chamber.—L. A. C.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitric acid; Commercial oxidation of ammonia to ——. C. L. Parsons. J. Ind. Eng. Chem., 1919, **11**, 541–552.

A survey, historical and modern, is given of processes which have been suggested or adopted for the oxidation of ammonia to nitric acid. A most satisfactory converter consists of a firebrick-lined cylinder containing platinum gauze arranged in four superimposed cylindrical layers; the gauze is of 80-mesh, 0·0026 in. wire, and is 13 in. wide and 113·5 in. long. The converter has a capacity of about 2·5 tons of 100% nitric acid per day, the efficiency being over 90% with a gas flow of 200 cub. ft. per min. of 10 to 11% ammonia-air mixture. Fresh gauze must be activated when first used by exposing it for some hours at 800° C. to rather rich ammonia-air mixture. The heat of reaction supplies all the heat required, and, once started, the reaction will continue without interruption for months if the converter is supplied with a pure gas mixture. The chief catalytic poison to be avoided is phosphine; iron oxide and oil also interfere with the activity of the platinum; acetylene is not harmful, whilst cyanogen and hydrocyanic acid are oxidised to nitric acid as readily as is ammonia itself. At the present price of ammonia, nitric acid of 36° B. (sp. gr. 1·33) can be made by the apparatus as cheaply as from sodium nitrate, and, with a small drop in the price of ammonia, concentrated nitric acid also could be made competitively by the oxidation process. W. P. S.

Acid salts of dibasic acids; Rearrangement of —— in aqueous solutions into normal (neutral) salts and free acids. II. T. Sabalitschka. Ber., 1919, **52**, 567–584.

Four kinds of experiments are described which prove that acid salts are converted to a greater or lesser extent in aqueous solutions into normal salts and free acids. I. Dialysis. The diffusates of solutions of sodium and potassium bisulphates contain an excess of free sulphuric acid, and the diffusate of potassium hydrogen camphorate an excess of the normal salt. II. Crystallisation. A 32% solution of potassium bisulphate, left at 5°—10° C. for a few days, deposits neutral crystals. A 50% solution of the acid sodium salt, left at 5°—10° C., gives crystals containing 91·75% of the normal salt (technical sodium bisulphate always contains some normal salt). Potassium bicamphorate solution deposits camphoric acid. III. Precipitation with alcohol. A solution containing 20 grms. of technical sodium bisulphate in 50 c.c., mixed with 200 c.c. of alcohol, gives a precipitate of pure sodium sulphate, leaving only 4·2% of the acid salt in solution. IV. Ether extracts free acid from solutions of potassium hydrogen camphorate. —J. C. W.

Carbonate- and chloride fusions. P. Niggli. Z. anorg. Chem., 1919, **106**, 126–142.

Sodium and potassium carbonates form a continuous series of mixed crystals with a minimum melting point at 712° C. with 46 mol. % K_2CO_3. The ternary system, Na_2CO_3—K_2CO_3—$CaCO_3$, has been studied and the results are represented on a triangular equilibrium diagram. An investigation has also

been made of portions of the system, Na_2Cl_2—Na_2CO_3—$CaCO_3$—$CaCl_2$, including the binary systems $CaCl_2$—$CaCO_3$, Na_2Cl_2—Na_2CO_3, and the ternary system Na_2Cl_2—Na_2CO_3—$CaCO_3$. The results are represented diagrammatically and their petrological significance is discussed. (See also J. Chem. Soc., July, 1919.)—E. H. R.

Pyridine in ammonium nitrate; Studies on the official method for [the determination of] ——. R. M. Ladd J. Ind. Eng. Chem., 1919, **11**, 552—555.

THE ambiguity of the directions for carrying out the official (U.S.) method is discussed and the following procedure is recommended in order to obtain concordant results by the process. A solution of 250 grms. of the sample in 300 c.c. of water is neutralised with sodium hydroxide solution, using methyl orange as indicator, 15 c.c. of 10% sodium hydroxide solution is added and the mixture is distilled (without a condenser) into a flask containing 300 c.c. of sodium hypobromite solution heated at 70° C. (sodium hydroxide, 100, bromine, 25 grms., and water to 1 litre); this flask is connected with a condenser and receiver containing 25 c.c. of *N*/10 sulphuric acid. The distillation is continued until 100 c.c. of distillate has collected. At first the heating should be slow until the ammonia has been driven off and decomposed by the hypobromite; the hypobromite solution may then be heated to boiling. The contents of the receiver are titrated with *N*/10 sodium hydroxide solution, using methyl orange as indicator; phenolphthalein is then added and the titration continued until a red coloration persists for 30 secs. The difference between the two titrations is multiplied by 0·0079 to obtain the amount of pyridine in grms.—W. P. S.

Ammonium silicate. II. Ammonia and silicoformic acid. R. Schwarz. Ber., 1919, **52**, 601–606.

SILICOFORMIC anhydride (dioxodisiloxane) made by leading silicon-chloroform vapour into water, reacts with ammonia solution according to the equation, $Si_2H_2O_3+4NH_4OH=2(NH_4)_2SiO_3+2H_2+H_2O$. This is analogous to the effect of the caustic alkalis, but in the case of ammonia the evolution of hydrogen is not violent and most of the silicic acid present in the parent substance as an impurity remains undissolved. The reaction affords confirmation of the existence of ammonium silicate stable in aqueous solution (see this J., 1917, 135). (See further, J. Chem. Soc., July, 1919.)—J. C. W.

Mineral waters and brines; Determination of iodide in ——. W. F. Baughman and W. W. Skinner. J. Ind. Eng. Chem., 1919, **11**, 563—568.

THE permanganate method gives accurate results under the following conditions. A quantity of the water or brine, containing not more than 0·1 grm. of iodine as iodide or more than 10 grms. of total salts, is adjusted to a volume of 100 c.c., boiled with sufficient sodium hydroxide and sodium carbonate to precipitate the lime and magnesia, and filtered. The filtrate is neutralised with dilute sulphuric acid, 1 c.c. of 4% sodium hydroxide solution is added, the mixture heated to boiling, treated with an excess of potassium permanganate, and the heating continued until the precipitate coagulates. After cooling, the excess of permanganate is destroyed by the addition of alcohol, the mixture then placed on a steam-bath to allow the precipitate to settle, and the latter collected on a filter and washed with hot water. The filtrate is treated with 1 or 2 grms. of potassium iodide, acidified with hydrochloric acid, and the liberated iodine titrated with standardised thiosulphate solution. The number of c.c. of thiosulphate used is divided by 6 to obtain the quantity corresponding with the iodine originally present in the sample. If bromides are present and it is desired to determine the bromine, the iodine may be separated by distillation with ferric sulphate. A portion of the sample, containing not more than 0·1 grm. of iodine, is adjusted to a volume of 75 c.c., neutralised or rendered just acid, and distilled with the addition of 2 grms. of ferric sulphate. The distilled iodine is collected in 10% potassium iodide solution and titrated with thiosulphate solution.—W. P. S.

[*Silica.*] *The system SiO_2.* A. Smits and K. Endell. Z. anorg. Chem., 1919, **106**, 143—148.

To explain the cristobalite portion of the SiO_2 equilibrium diagram, the authors assume the presence of three pseudo-components, of which two are supposed to be in a state of invariable equilibrium. (See also J. Chem. Soc., July, 1919.)—E. H. R.

Phosphine; Thermal decomposition of ——. M. Trautz and D. S. Bhandarkar. Z. anorg. Chem., 1919, **106**, 95—125.

THE decomposition of phosphine, $4PH_3=P_4+6H_2$, is a reaction of the first order. Above 945° C. the reaction is quite uninfluenced by the walls of the containing vessel (glazed porcelain was used) and proceeds as a pure gas reaction. Below this temperature the influence of the surface gradually increases and below about 720° C. the reaction is purely a surface one. (See also J. Chem. Soc., July, 1919.)—E. H. R.

Charcoal; Adsorption of electrolytes by ——. P. Rona and L. Michaelis. Biochem. Zeits., 1919, **94**, 240—260.

SEE J. Chem. Soc., 1919, ii., 269.—J. C. D.

Iodine solutions. Von Kaufmann and Lewite. *See* XVII.

PATENTS.

Sulphuric acid; Process for condensing the acid fumes evolved during the concentration of ——. Chance and Hunt, Ltd., Oldbury, W. A. S. Calder, Birmingham, and C. A. O. Fox, Langley. Eng. Pat. 126,320, 9.12.16. (Appl. 17,757/16.)

BY means of a constriction in the main or pipe, the gases containing the acid fumes, while at a temperature between 95° and 135° C., are caused to travel at a speed of at least 20 or 40 ft. per second with or without change of direction, respectively. By thus increasing the velocity of the gases, the sulphuric anhydride content may be reduced to 1 grain per cub. ft. or less. The constriction may consist of a tube of smaller diameter than the main or it may be formed by inserting rods of glass etc. or other packing into the main at a suitable point.—W. E. F. P.

Sulphuric acid; Pre-heating apparatus for use in the catalytic manufacture of ——. W. J. Mellersh-Jackson, London. From Bombrini Parodi-Delfino, Rome. Eng. Pat. 126,396, 1.3.17. (Appl. 3064/17.)

IN the manufacture of sulphur trioxide by catalysis, the gases to be treated are caused to pass through a system heated by the gas which has already reacted, or/and by external means, before proceeding to the reaction chamber.—W. E. F. P.

***Sulphuric acid; Manufacture of* ——.** G. Taylor, Rotherham, and E. K. Scott, Farningham. Eng. Pat. 127,047, 27.3.17. (Appl. 4397/17.)

THE oxides of nitrogen required in the chamber process are produced by passing the air going to the pyrites burners through flame arcs or through a "Kilburn Scott" three-phase alternating current electric furnace. Alternatively the air containing sulphur dioxide may be treated as it leaves the burners, or if the content of sulphur dioxide is high, a suitable quantity of air containing oxides of nitrogen may be added at a point between the burners and the gas fan.—S. S. A.

Sulphuric acid [98%]; Making —. H. M. Weber, East Orange, N.J., Assignor to Ellis Foster Co. U.S. Pat. 1,291,306, 14.1.19. Appl., 23.6.17.

SULPHURIC anhydride is led into cooled and stirred 100% sulphuric acid until at least 5% of the anhydride has been absorbed; dilute sulphuric acid is then added to the product until the acid is of the desired strength, *i.e.*, 98%. In this way the difficulties encountered when sulphur trioxide is passed into weak acid are avoided and iron vessels may be used without danger of attack of the metal.
—L. A. C.

Nitric acid; Manufacture of highly concentrated ——. E. B. Maxted and T. A. Smith, Walsall. Eng. Pat. 126,704, 19.2.17. (Appl. 2426/17.)

IN the manufacture of nitric acid by the interaction of liquid nitrogen peroxide or trioxide with water and excess of oxygen at practically atmospheric pressure and temperature, a large excess of the oxide of nitrogen is employed (to effect the displacement of equilibrium of the reaction towards concentrated nitric acid), and the excess is afterwards removed by distillation. By employing 5 and 7 times the theoretical quantity of nitrogen peroxide required by the water present, nitric acid of 90 and 94·5% concentration, respectively, is obtained. (Reference is directed, in pursuance of Sect. 7, Sub-sect 4, of the Patents and Designs Act, 1907, to Eng. Pat. 4345 of 1915; this J., 1916, 537.)—W. E. F. P.

Ammonia; Process for the oxidation of ——. *Production of nitrogen-oxygen compounds and apparatus therefor. Catalysts and the manufacture thereof.* H. E. F. Goold-Adams, London, J. R. Partington, Lostock Gralam, Cheshire, and E. K. Rideal, London. Eng. Pats. (A) 126,716, (B) 126,717, and (C) 126,715. 24.2.17. (Appls. 2748, 2749, and 2746/17.)

(A) A MIXTURE of ammonia and air is passed over heated chromium oxide prepared by gently igniting ammonium chromate or bichromate. (B) The temperature of the catalyst (preferably electrically heated platinum gauze) employed in the production of nitrogen-oxygen compounds by oxidation of ammonia is gauged and regulated by comparison with a standard source of light. (C) In the preparation of catalysts such as are employed in the oxidation of ammonia etc., the material is precipitated in a finely divided state, preferably by means of ammonia, and the precipitate is washed, partly dried, and extruded through dies to produce rods, threads, or filaments which are subsequently broken into pieces of suitable length.—W. E. F. P.

Nitric acid; Production of concentrated* —— *from ammonia. E. B. Maxted, Walsall. Eng. Pat. 127,343, 26.4.17. (Appl. 5857/17.)

THE products obtained by the oxidation of ammonia are subjected to fractional condensation in two or more stages. The first stage, in which the bulk of the water is condensed, is carried out between 50° C. and 100° C. (*e.g.* 60° C.), and subsequent stages are effected below 0° C. (*e.g.* −10° C.). The condensed products are separately concentrated.
—S. S. A.

Ammonium nitrate; Process for the manufacture of ——. F. A. Freeth, Great Crosby, Lancs., and H. E. Cocksedge, London. Eng. Pat. 126,678, 7.2.17. (Appl. 1888/17.)

A SOLUTION of ammonium sulphate and sodium nitrate of suitable concentration is treated to produce a precipitate of sodium sulphate and a mother liquor saturated with ammonium nitrate, sodium nitrate, and sodium sulphate. After separation of the precipitate, the solution is diluted with sufficient water to enable the sodium salts to remain in solution at a predetermined lower temperature, and the liquid is then cooled to this temperature to effect the deposition of ammonium nitrate, which is separated and washed. The mother liquor is then concentrated to the original strength before dilution, when quantities of ammonium sulphate and sodium nitrate equivalent to the ammonium nitrate removed are added, and the cycle is repeated.—W. E. F. P.

Ammonium sulphate; Manufacture of ——. N. Wilton, Hendon. Eng. Pat. 127,398. (Appls. 8812, 28.5, and 10,152, 25.6.18.)

ACID ammonium sulphate from the saturator is dried in a centrifugal hydro-extractor, and then treated in the machine with a saturated, or almost saturated, slightly ammoniacal solution of ammonium sulphate, prepared by heating a quantity of ammonium sulphate liquor from the saturator with lime, absorbing the ammonia produced in water, and adding sufficient of this solution to the drainings from the sulphate plant to obtain an alkalinity of about 1%, which is sufficient to neutralise the acidity of the crude crystals. The necessary tanks, ammonia producer, and centrifuge may be built as part of the ammonium sulphate plant, or may be constructed independently, and made available for use in connection with plants situated at various works by being mounted on a suitable wheeled vehicle, the engine of which is also used to drive the centrifuge.—S. S. A.

Cyanogen compounds and/or sulphur from spent oxide; Recovery of —. W. Anderson, Helensburgh, Dumbarton. Eng. Pat. 127,128, 15.6.18. (Appl. 9888/18.)

SPENT oxide is charged into a centrifugal machine, which may be of the hydro-extractor type. With the centrifuge in motion, steam is passed through the material, and partly condensing, dissolves the thiocyanates and other water-soluble matters, which are recovered from the liquor by crystallisation. The material is then treated with carbon bisulphide vapour, or with a mixture of the vapours of carbon bisulphide and benzene, together with steam, thereby extracting sulphur, which is recovered from its solution in the condensed liquid, by evaporation of the solvent. Further treatment with ammonia vapour dissolves ferrocyanide, and the ammonium ferrocyanide produced may be recovered as such or converted into the sodium or potassium salt. The residual iron oxide is available for further use.—S. S. A.

Sodium nitrite; Manufacture of ——. J. Grayson, Huddersfield. Eng. Pat. 127,183, 31.10.18. (Appl. 17,814/18.)

NITROUS fumes and nitric acid are converted to nitric oxide by treatment with sulphur dioxide.

For example, sulphur dioxide is passed into a retort in which nitric acid is being produced by the action of sulphuric acid on sodium nitrate. On leaving the retort, the gases are passed through a condenser to remove sulphuric acid, and are treated in scrubbers first with water and then with a dilute solution of soda ash to remove sulphur dioxide. Air is then admitted to obtain a mixture having approximately the composition N_2O_3, and this is absorbed in a concentrated solution of soda ash, which is strengthened as the reaction proceeds in order to obtain a concentrated solution of sodium nitrite free from sodium nitrate.—S. S. A.

Calcium hypochlorite and process for making same. A. Hoffman, Brooklyn, and A. H. Kropff, Kew Gardens, N.Y. U.S. Pat. 1,288,587, 24.12.18. Appl., 20.6.18.

A PRODUCT is prepared by mixing together, fresh calcium hypochlorite, calcium hypochlorite partly converted into calcium chloride by heating in a closed container to about 50° C. for 4–5 weeks, and calcium hypochlorite partly converted into calcium carbonate by exposure to air for 1–2 weeks. The product contains approximately 65% of calcium hypochlorite, 5% of calcium carbonate, and 30% of calcium chloride. It is neither dusty nor sticky and is of suitable quality as regards content of active chlorine, moisture, and insoluble matter for use in the purification of drinking water and for other purposes.—S. S. A.

Hydrofluoric acid and salts thereof; Production of ——. R. S. Sherwin, East St. Louis, Ill., Assignor to Aluminium Co. of America, Pittsburgh, Pa. U.S. Pat. 1,301,325, 22.4.19. Appl., 28.7.15.

HYDROFLUORIC acid is passed through water, and of the unabsorbed portion part at least is absorbed in a liquid containing a base. All the operations are conducted under reduced pressure.—W. E. F. P.

Sodium and potassium salts; Process of separating ——. C. G. Leonis, Rocky Ford, Colo. U.S. Pat. 1,302,937, 6.5.19. Appl., 11.9.18.

A MIXTURE of sodium and potassium hydroxides, free from carbonates and sulphates, is treated with a chloride-producing reagent, and the potassium chloride formed is separated from the solution obtained.—S. S. A.

Potassium salts; Process of recovering —— from saline mixtures containing the same. J. H. Reeve, Salt Lake City, Utah. U.S. Pat. 1,304,097, 20.5.19. Appl., 26.9.18.

LOW-GRADE potassium salts are digested in a hot solution of magnesium chloride, which effects selective solution of the potassium salts. The liquor is filtered from the undissolved salts and cooled; carnallite is precipitated and is subsequently treated for the recovery of potassium chloride.—S. S. A.

Ammonium perchlorate; Manufacture of ——. E. Collett, Christiania, Norway. U.S. Pat. 1,303,167, 6.5.19. Appl., 14.11.18.

SODIUM perchlorate is treated with ammonium nitrate, and from the sodium nitrate which results ammonium nitrate is regenerated by the action of ammonium bicarbonate.—S. S. A.

Manganese; Process of extracting ——, and of making sulphuric acid and manganese dioxide. G. D. Van Arsdale and C. G. Maier, New York. U.S. Pat. 1,304,222, 20.5.19. Appl., 18.4.18.

GROUND manganese ore is suspended in water, and acid is added to dissolve oxides of manganese other than the dioxide. The mixture is treated with sulphur dioxide, with agitation, and the resulting liquor is separated from the residual ore, heated, and electrolysed, whereby manganese dioxide is deposited at the anode, and sulphuric acid, substantially free from manganese, is produced. By making the electrolysis discontinuous as to the anode, desirable physical properties in the separated manganese dioxide may be produced.—S. S. A.

Sulphur burning. Pratt Engineering and Machine Co., Atlanta, Ga., Assignees of G. F. Hurt, New York. Eng. Pat. 118,097, 13.7.18. (Appl. 11,531/18.) Int. Conv., 14.7.17.

SEE U.S. Pat. 1,289,783 of 1918; this J., 1919, 135 A.

Alumina; Producing crystalline ——. Norton Co., Worcester, Mass., Assignees of R. H. White, Niagara Falls, N.Y., U.S.A. Eng. Pat. 118,606, 11.7.18. (Appl. 11,379/18.) Int. Conv., 18.8.17.

SEE U.S. Pat. 1,269,141 of 1918; this J., 1918, 545 A.

Aluminium compounds; Process of producing ——. O. Ravner and V. M. Goldschmidt, Assignors to Det Norske Aktieselskab for Elektrokemisk Industri, Norsk Industri-Hypotekbank, Christiania. U.S. Pat. 1,302,852, 6.5.19. Appl., 19.3.17.

SEE Eng. Pat. 113,278 of 1918; this J., 1919, 133 A.

Ammonium nitrate; Manufacture of ——. F. A. Freeth, Sandiway, and H. E. Cocksedge, London. U.S. Pat., 1,301,047, 15.4.19. Appl., 16.9.18.

SEE Eng. Pat. 126,678 of 1917; preceding.

Base-exchanging bodies; Process of making ——. G. Rudorf, London, Assignor to The Permutit Co., New York. U.S. Pat. 1,304,206, 20.5.19. Appl., 21.12.16.

SEE Eng. Pat. 108,773 of 1916; this J., 1917, 1047.

Chlorine; Process for the extraction of ——. P. L. Hulin, Grenoble, France. Eng. Pat. 126,992, 21.8.16. (Appl. 11,867/16.) Int. Conv., 17.7.15.

SEE U.S. Pat. 1,246,099 of 1917; this J., 1918, 57 A.

Gas reactions. U.S. Pat. 1,291,745. *See* I.

Separating air. U.S. Pat. 1,304,027. *See* I.

Evaporation of lyes. Ger. Pat. 310,982. *See* I.

Flue gases. Eng. Pat. 127,095. *See* IX.

VIII.—GLASS; CERAMICS.

Glass; Devitrification of ——. N. L. Bowen. J. Amer. Ceram. Soc., 1919, **2**, 261—281.

MANY silicates can be cooled quite slowly without crystallisation, but $MgSiO_3$, Al_2SiO_5, and $CaSiO_3$ crystallise unless cooled quite rapidly; this is almost impossible with large quantities, as molten silicates have a great thermal capacity and low thermal conductivity. To prevent crystallisation of a mixture of silicates the glass must be cooled rapidly to a point where the crystallising power of these substances is negligible. Similarly in reheating glass if the temperature is raised above that at which the crystallising power of these substances is negligible, this higher temperature should be

maintained only for a brief period. Devitrification may occur when the glass is cooled preparatory to working or prior to the final stirring in the case of optical glass. The composition of the glass must be such that it does not become supersaturated with any components at any temperature at which it may require to be maintained. The crystals formed by the devitrification of glass at this stage are usually large. A light barium crown (optical) glass was prevented from devitrifying by stirring it at a higher temperature, but the glass was then too fluid for the stirring to be satisfactory. Devitrification was due to separation of crystals of $BaSi_2O_5$ (this J., 1918, 303 A), and it was prevented by reducing the barium content of the glass, so that saturation with $BaSi_2O_5$ did not occur at the temperature found satisfactory for the final stirring. When the glass is cooled from the plastic to the rigid state, as during blowing, drawing, casting, and particularly when optical glass is being cooled in the melting pot, devitrification may occur through the separation of spherulites or minute crystals uniformly disseminated through the glass, making it opalescent. In most of the cases investigated these crystals are tridymite or cristobalite. Their formation is facilitated by "mineralisers" such as sulphur trioxide and chlorine; arsenic acts similarly when in excess, and fluorine may do so. The crystal constituents of the spherulites are readily determined microscopically, and, if the heat-treatment during cooling cannot be varied to prevent their formation, the composition of the glass may be altered so as to prevent its saturation at the given temperature. Spherulites of tridymite were prevented from forming in one glass by partially replacing soda by potash. In reheating for working or annealing, the upper limit of temperature at which devitrification can occur is important. It may be determined by maintaining a piece of devitrified glass at a certain temperature for 1 hr., chilling it rapidly, and examining it. This operation is repeated at successively higher temperatures until one is found at which the last traces of crystals have disappeared. Where practicable, the moulding of the glass should be conducted at a temperature slightly above that found by this method. When glass is reheated prior to annealing, the temperature must be sufficiently high to remove all internal strains, and the rates of devitrification and of annealing must be known. In glasses in which annealing and freedom from devitrification are mutually incompatible, the composition of the glass should be changed so as to increase the rate of annealing or decrease the rate of devitrification or to change both these rates simultaneously. Devitrification is frequently more marked at the free surface of the glass.—A. B. S.

Gold ruby glass; Development of improved —. H. T. Bellamy. J. Amer. Ceram. Soc., 1919, **2**, 313—322.

A SERIES of ruby glasses was prepared to match a French glass, the proportion of gold chloride added to the batch mixture varying from 1 part in 10,000 to one part in 3000. Owing to the scarcity of potash, soda was substituted. The glasses had the following formulæ:

Glass	PbO	K_2O	Na_2O	CaO	B_2O_3	Al_2O_3	SiO_2	Sb_2O_5	SnO_2
French glass	0·791	0·209	—	—	0·0175	-	2·05	0·0075	—
Ruby No. 1	0·583	—	0·117	- -	0·0038	—	1·95	0·0071	—
Opalescent red No. 1 ...	0·502	—	0·342	0·156	—	0·0134	1·46	0·0134	—
Opalescent red No. 2	0·668	—	0·332	—	0·0028	-	2·17	—	0·0831
Ruby No. 2	0·536	—	0·464	—	0·029	—	1·96	—	0·107

Opalescent red No. 1 had the desired colour and opalescence, but shattered when heated in the blowpipe and when subjected to rapid blows. Opalescent red No. 2 fulfilled all requirements, but was rather light in colour. On increasing the percentage of tin oxide a dark red glass was produced, but the colour was lightened by reducing the proportion of gold. Ruby No. 2 matched the imported French glass perfectly and its colour was reliable, quite uniform, and unaffected by the temperature to which the glass was reheated. The tin oxide not only acts as an opacifier, but precipitates the gold in a colloidal state and stabilises it. When ruby glass is at the melting temperature the particles of gold are in solution and colourless and remain so when the glass is suddenly chilled, but if the glass is reheated to the softening point the subcolloidal particles are precipitated. In glasses free from tin oxide further heating tends to produce light blue, purple, and rose colours, but this change in colour does not occur in the presence of tin oxide.—A. B. S.

Porcelain bodies; Comparative value of kneading and pugging in the preparation of —. L. E. Barringer and C. Treischel. J. Amer. Ceram. Soc., 1919, **2**, 306—312.

THE centre of a clot of pugged clay contains rather more air than the surface portion, on account of the greater pressure which has been exerted on the latter. The amount of air in the centre of a clot of clay kneaded in an edge-runner pan mill may be less than in a part nearer the surface; the amount of air depends on the duration of the kneading and the amount of water in the body. A pan mill removes air more efficiently than a pug-mill, but excessive treatment in the pan-mill may re-introduce air. With hard bodies treatment for 20 minutes in the pan mill is desirable; with medium bodies treatment for 10 minutes is preferable.—A. B. S.

Dolomite; Experiments in dead-burning —. H. G. Schurecht. J. Amer. Ceram. Soc., 1919, **2**, 291—305.

A DOLOMITE from Cedarville, Ohio, was screened through an 8-mesh sieve, mixed with varying percentages of "impurities," made into briquettes, calcined at cone 18 in a Hoskin's electric furnace, weighed at once, after standing in air, and after intervals of 2, 5, 10, 18, 28, 38, 50, 65, 80, 100, and 125 days. A mixture of 10 parts of coal tar and 90 parts of dolomite calcined under oxidising conditions disintegrated readily in water, but the same mixture after calcining under reducing conditions (packed in graphite) did not disintegrate after standing in water for 2 months, but was too porous without the addition of a flux. Some mixtures of flue-dust and dolomite when calcined showed "dusting," due to the conversion of β to γ calcium orthosilicate at 675° C., this change being accompanied by an increase in volume of 10% which shatters the material. A calcined mixture of iron ore (30) and dolomite (70 parts) had not disintegrated in air at the end of 100 days. It had a softening point corresponding to cone 31. A calcined mixture of basic open-hearth slag and dolomite showed some dusting. A mixture of 30 parts of slag and 70 parts of dolomite had a softening point of cone 31 and disintegrated after 85 days. A calcined mixture of blast-furnace slag dusted excessively, due to the

high silica-content of the slag being conducive to the formation of orthosilicate. A mixture of 30 parts of blast-furnace slag and 70 parts of dolomite disintegrated in 70 days. A calcined mixture of shale and dolomite showed excessive dusting, due to the formation of calcium orthosilicate. Briquettes containing the highest percentage of shale showed the most dusting. A mixture of 10 parts of shale and 90 parts of dolomite disintegrated at the end of 60 days; it had a softening point of cone 31. Briquettes made of kaolin and dolomite showed less dusting than those containing shale and were impervious to slag. When less than 3% of kaolin was used the briquette disintegrated in a short time, but with a larger proportion a longer time was required. A mixture of 10 parts of kaolin and 90 parts of dolomite disintegrated at the end of 85 days and had a softening point of cone 31. A calcined mixture of roll scale and dolomite dusted very slightly and resisted disintegration better than any other mixture. A mixture of 10 parts of calcium chloride and 90 parts of dolomite calcined to cone 14 was very resistant to slaking but very porous, and if used without a flux would have low resistance to molten slag. Coarse dolomite which passed through 4- and 8-mesh sieves was more resistant than the intermediate particles passing through a 20-mesh sieve, and the finest particles were more resistant than the intermediate portion. Hence, the best results, for a rammed furnace lining, appear to be produced by using very coarse (4-mesh) or very fine (40-mesh) dolomite and discarding the intermediate portions, but for bricks it is preferable to grind the dolomite with iron oxide before calcination. The coarse material when reground does not resist water as well as the 40-mesh material. Tests with dolomite mixtures burned at cones 14, 22, and 26, showed that with the higher temperature the product required a longer time to disintegrate in water and had a lower porosity.—A. B. S.

Silica. Smits and Endell. *See* VII.

PATENTS.

Refractory article. F. J. Tone, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,303,993, 20.5.19. Appl., 26.7.18.

A REFRACTORY article containing graphite, sintered magnesia, and clay.—A. B. S.

Lampblack; Process for purifying —— and making carbon articles. W. R. Mott, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,303,362, 13.5.19. Appl., 1.11.17.

LAMPBLACK or other form of carbon is purified by heating it in the presence of carbon tetrachloride at a temperature high enough to volatilise the products formed by the reaction of the carbon tetrachloride and the impurities. For example, carbon articles are made by mixing the carbon with a binder consisting of a chlorinated hydrocarbon (carbon tetrachloride), making the mixture into the desired shape, and calcining.—A. B. S.

Glass or like material; Method of separating quantities of molten —— from mass. O. M. Tucker and W. A. Reeves, Columbus, Ohio, U.S.A. Eng. Pat. 105,564, 10.4.17. (Appl. 5038/17.) Int. Conv., 10.4.16.

Carbon blocks; Manufacture of ——. T. W. S. Hutchins, Middlewich. U.S. Pat. 1,304,053, 20.5.19. Appl., 15.10.18.

SEE Eng. Pat. 120,255 of 1917; this J., 1918, 768 A.

IX.—BUILDING MATERIALS.

Wood; Impregnation of —— with limited amounts of mercuric chloride. R. Nowotny. Oesterr. Chem.-Zeit., 1918, 21, 215—217. Chem. Zentr., 1919, 90, II., 521.

THE quantity of mercuric chloride absorbed by poles of pine and fir trees in a limited time was determined experimentally. Pine trees absorb in three days about 60% of the quantity absorbed in the usual treatment and fir trees in four days about 50%. From the previously determined relation between antiseptic power and the life of preserved wood, the life of the pine so treated is estimated at 15 years and of the fir at 13 years.—H. J. H.

PATENTS.

Flue gases [from cement kilns etc.]; Treatment of ——. F. W. Davis, Magheramorne, Ireland. Eng. Pat. 127,095, 21.5.18. (Appl. 8440/18.)

WATER is sprayed into flue gases charged with steam, such as those from cement kilns and from furnaces used for dehydrating aluminium hydroxide, or gases containing sodium or potassium salts, so that their temperature is reduced below 100° C. without any substantial quantity of steam being condensed. The gases are passed first into a dust-depositing chamber, then into a smaller chamber where they are subjected to horizontal sprays of water and then through baffles to a fan and into the air. The water may be circulated through the apparatus as often as required before being drawn off to recover the dissolved solids, *e.g.*, sodium and potassium salts.—A. B. S.

Heat-insulating chambers, walls, floors, and ceilings; Manufacture of ——. J. Davies, Liverpool, and W. H. Jones, Wallasey. U.S. Pat. 1,304,267, 20.5.19. Appl., 2.3.16.

SEE Eng. Pat. 103,839 of 1916; this J., 1917, 340.

Gas reactions. U.S. Pat. 1,291,745. *See* I.

Preheating. U.S. Pat. 1,303,088. *See* I.

Bituminous composition. U.S. Pat. 1,302,810. *See* IIA.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Steel; Mechanical properties of ——. W. H. Hatfield. Inst. Mech. Eng., May 2, 1919. Engineering, 1919, 615—618, 634—636, 686—688.

IN the examination of steel which has failed in service considerable assistance is given by a corresponding examination of examples which have done good service, as many features of failure may be cancelled out by the same features being discovered in excellent samples. Failures seem to be of two types, one in which the material as supplied has not been free from actual or incipient defect, and the second due to too empirical treatment in design with regard to the stresses involved in service. The tensile and torsion tests are fundamental and give clear indication in most cases of the suitability of the metal; all the mechanical tests now employed provide auxiliary information of value when the material is to be used under special conditions. As regards impact testing, data from steels when in diverse conditions are now available and the values obtained by the Charpy and Fré-

mont tests are of similar order. The Arnold and Sankey tests indicating similar specific properties of the metal seem to bear no relationship to the values brought out under the static, or notched bar, impact test. The Stanton test is regarded as offering useful information as it approximates to some extent to the conditions existing in some slightly over-stressed parts. Single blow impact tests, which depend upon the energy absorbed in plastic deformation above the elastic limit, yield results of little value. The influence of the shape of the notch is important, and with increasing sharpness of notch the discriminating value of the test is increased. It would appear that a governing factor in determining the energy absorbed in the test is the degree to which the material can be plastically deformed before the formation of a crack, but this is only approximately true, the distribution of the stresses being also a factor. "True" brittleness as distinguished from much more prevalent "apparent" brittleness occurs particularly in low-carbon rolled steel, and it is considered that tensile and other mechanical tests will reveal it. The mechanical properties of heat-treated steels are so susceptible to modifications of time and temperature that a certain amplitude of variation occurs even during investigation by different observers, but generally the mechanical condition of alloy steels so treated is indicated by their hardness. A comprehensive bibliography is appended. —C. A. K.

Aluminium and its light alloys. Circ. No. 76. U.S. Bureau of Standards, 21.4.19. 120 pages.

The circular is a compilation of the available data on the physical properties of aluminium and its light alloys and the effects of temperature, different manufacturing operations, and impurities on these properties. In an appendix there are definitions of physical terms; specifications for aluminium and its alloys; and a full bibliography.

Metals; Measurement of vapour pressures at very high temperatures with some observations on the solubility of carbon in ——. O. Ruff and B. Bergdahl. Z. anorg. Chem., 1919, **106**, 76–94.

A new method has been devised for measuring vapour pressures and determining boiling points at very high temperatures. A small quantity of the metal to be examined is placed in a very small quartz or carbon crucible which is suspended from a special spring balance. The crucible hangs inside a resistance furnace which can be heated at a uniform rate to beyond the boiling point of the metal. The furnace is gas-tight and can be filled with an indifferent gas at any desired pressure, which is read by means of a manometer. The crucible and its contents are heated in the furnace and as the temperature rises the gradual loss of weight due to volatilisation of the metal is observed on the spring balance. Loss of weight is plotted against temperature and from the resulting curve the boiling point at the pressure employed is deduced. The following results are recorded for the boiling points at atmospheric pressure: mercury, 357°; cadmium, 785°; zinc, 930°; arsenic, 568°; antimony, 1330°; bismuth, 1490°; lead, 1555°; tin, 2270°; copper, 2305°; silver, 1950°; gold, 2600° C. In the cases of antimony, bismuth, lead, tin, copper, silver, and gold the determinations were made in carbon crucibles and at the same time the solubility of carbon in each of these metals was determined. Antimony and lead had the greatest solvent action, the solubility in each case being 0·094% at the boiling point. In the other cases little more than a trace of carbon was dissolved by the metal. (See also J. Chem. Soc., July, 1919.)—E. H. R.

Counter-current leaching. Büeler de Florin. *See* I.

Platinum and gold. Quennessen. *See* XXIII.

Platinum substitutes. Gurevich and Wichers. *See* XXIII.

Electro-analysis of gold. Guzmán. *See* XXIII.

PATENTS.

Iron and steel turnings, scrap, and the like; Treatment of ——. R. A. Hadfield, Westminster. Eng. Pat. 126,369, 16.1.17. (Appl. 818/17.)

Iron and steel scrap may be remelted in acid-lined open-hearth furnaces without the addition of pig or cast iron, by covering the furnace bottom and banks with a mixture of equal quantities by weight of 50% ferrosilicon and crushed anthracite, before the metal is charged. The furnace lining is thereby protected from serious erosion by the oxide present as a coating on the light scrap metal.—C. A. K.

Iron-nickel alloys. R. A. Hadfield, Westminster. Eng. Pat. 126,362, 10.1.17. (Appl. 519/17.)

Two classes of alloys are prepared by the addition of nickel to molten cast iron (2—5% C). In one class the nickel content may be from 5 to 20%, and the alloy may be made by the addition of nickel or ferro-nickel to molten foundry metal. A second series of alloys containing 20—38% of nickel, or particularly 32—38% (37%) of nickel, is more difficult to prepare and a high grade of nickel must be used. Other alloying metals may be introduced to vary the properties of the alloy, with nickel as the preponderating addition. The alloys have a lower ball hardness than cast iron and are capable of withstanding a higher transverse breaking load. The fluidity of the molten metal is increased and the resistance to corrosion is considerable.—C. A. K.

Electric steel manufacture. V. Stobie, Dunston-on-Tyne. Eng. Pat. 127,066, 20.2.18. (Appl. 2970/18.)

The metal is melted under oxidising conditions in an electric furnace reserved entirely for this process, and the molten metal free from slag is transferred to a second smaller electric furnace for the deoxidising or finishing process.—C. A. K.

Electro-plating steel articles. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 127,177, 1.10.18. (Appl. 15,944/18.)

A tempered or strain-hardened steel article may be prevented from deterioration during electro-plating by first coating it with a metal which is impermeable to nascent hydrogen, and which has a melting point below the temperature at which the steel has been hardened. For example, steel springs may be cleaned by means of a sand blast and dipped into molten tin in the presence of a suitable flux (resin). A coating of another metal may then be given by electrolysis without impairing the properties of the tempered steel.—C. A. K.

Steel; Manufacture of ——. R. A. Hadfield, Westminster. Eng. Pat. 127,302. (Appls. 5048, 10.4.17 and 6038, 28.4.17.)

Steel containing 0·3—1% or more carbon and practically free from manganese, is made by decarburising, desiliconising, and demanganising molten metal by the open-hearth or other known process. The resulting metal is deoxidised by the addition

of silicon or aluminium, or a mixture of these metals, and the carbon content is adjusted by the addition of a carburising agent. Other constituents, *e.g.*, nickel, chromium, copper, may be present, and the physical properties of the steel may be improved by quenching from 850° C., afterwards re-heating to about 615° C., and allowing the steel to cool slowly in air.—C. A. K.

Steel alloys and the constituents thereof; Production of ——. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 127,415, 5.6.18. (Appl. 9267/18.)

A SMALL quantity of a compound which is acid to the oxide of at least one component of the alloy metals is intimately mixed with the alloy metal before addition to the steel. Among the compounds which may be used are silicic, titanic, vanadic, niobic, and tantalic acids, and good results are obtained by mixing the alloy metal and the acid component in a ball mill. The acid compound is said to purify the metal at the moment of alloying, effecting the elimination of oxides and a more intimate combination of the metals.
—C. A. K.

Alloy steel; Process of making ——. A. Kissock, Tucson, Ariz. U.S. Pat. 1,300,279, 15.4.19. Appl., 28.8.18.

A SUITABLE salt of an alloying metal is introduced directly into a bath of molten steel, in which it is reduced to the metallic state by the silicon and carbon contained in the steel.—C. A. K.

Steel-making process [using lead or copper blast-furnace slags]. W. McA. Johnson, Hartford, Conn. U.S. Pat. 1,300,410, 15.4.19. Appl., 3.5.15.

IRON values are recovered from copper or lead furnace slags by subjecting the molten slag to reducing conditions to precipitate matte, then blowing air through the molten slag to oxidise sulphur, and finally heating the slag under reducing conditions to recover the iron.—C. A. K.

Iron or steel or other articles; Treatment of ——. H. C. Baines, Springfield, Mass., Assignor to The Cleveland Metal Products Co., Cleveland, Ohio. U.S. Pat. 1,303,627, 13.5.19. Appl., 10.8.16.

METAL articles immersed in a phosphate solution are subjected to a pressure greater than atmospheric, and an electric current is passed through the solution and the articles to be coated. A solution capable of combination with the coating may then be applied to the metal article to alter the colour or texture of the surface.—C. A. K

Spectrum analysis; Quantitative determination of the constituents of molten steel and other molten materials by means of ——. W. Corsalli, Berlin. Ger. Pat. 310,439, 14.10.13.

THAT portion of the spectrum of the light emitted by the molten mass which includes the Fraunhofer lines of the constituent to be determined, is caused to act in a photo-electric cell, a light filter being employed in many cases. The variations in the electric current thus produced are utilised to control or regulate automatically the operation of the process. The apparatus can be applied to the determination of carbon and other constituents, and may be furnished with a signalling device, or may be connected with the converters in such manner that they are tilted automatically at the proper time.—J. S. G. T.

Iron of low carbon content; Production of —— in blast-furnaces. H. Thaler, Niederdreisbach. Ger. Pat. 311,020, 12.3.18.

THE solubility of carbon in iron is lowered by silicon, but increased by manganese; in order, therefore, to produce iron of low carbon content in a blast-furnace, the charge is so arranged that the slag consists of bi- or trisilicate and is equal in weight to the iron produced, and also the ratio silicon % : manganese % in the pig iron is greater than unity.—L. A. C.

Furnaces burning powdered combustible [; Regenerative metallurgical ——]. Soc. Anon. La Combustion Rationnelle, Paris. Eng. Pat. 124,714, 24.12.18. (Appl. 21,649/18.) Int. Conv., 26.3.18.

POWDERED fuel suspended in air is introduced into a combustion chamber with a sloping bottom, and complete combustion is effected with additional air previously heated in the vertical passages of a regenerator under the heating chamber or hearth. The burnt gases pass from the combustion chamber to the hearth, and after leaving the latter pass three times horizontally through the regenerator (in separate passages to the air) and thence to the chimney.—B. M. V.

Furnaces; Liquid fuel —— *[for melting brass].* W. M. Burdon, Bellshill, N.B. Eng. Pat. 126,319. (Appls. 17,721, 9.12.16, and 4717, 2.4.17.)

THE combustion and melting chambers are separated by a bridge-wall, and a separate heating chamber, connected separately with the combustion chamber, is formed below the melting chamber.
—W. H. C.

Furnaces; Construction of roof of open-hearth and reverberatory ——. G. C. Carson, San Francisco, Cal. U.S. Pat. 1,302,307, 29.4.19. Appl., 26.6.15.

THE walls of an open-hearth or reverberatory furnace are protected by feeding the ore or fettling materials into the upper part of the furnace chamber in such a manner as to form a sloping embankment along the walls.—C. A. K.

Bessemer converter. A. Rommelaere, South Vancouver, B.C. U.S Pat. 1,299,034, 1.4.19. Appl., 2.4.18.

A PORTION of the casing and refractory lining of a Bessemer converter is removable, and is fitted with a number of tuyères. A wind-box communicating with the tuyères is provided with a detachable front in order to permit access to the removable section of the converter.—C. A. K.

Coated metals; Process of treating ——. B. Dewey, Assignor to American Sheet and Tin Plate Co., Pittsburgh, Pa. U.S. Pat. 1,297,807, 18.3.19. Appl., 12.12.12.

GALVANISED metal is heated at 410°—600° F. (210°—315° C.) for a period of from ten minutes to six hours, the time interval varying inversely with the temperature at which the metals are maintained.
—C. A. K.

Metal; Apparatus for recovering —— from scrap metal. J. W. Brown, Lakewood, Ohio. U.S Pat. 1,301,374, 22.4.19. Appl., 15.7.14.

SCRAP metal is heated and stirred in a melting pot and the metal vapours evolved are drawn into a chamber in which the larger particles are condensed. The finer particles are collected in a second chamber, provided with means affording a large contact surface between the fume and a condensing liquid.
—C. A. K.

Separating minerals; Method of and apparatus for ——. H. W. Allen, Earlysville, Va. U.S. Pat. 1,301,532, 22.4.19. Appl., 3.7.18.

Froth carrying pulverulent mineral is treated to disintegrate the froth bubbles so that the liquid will drain therefrom, the residual solids are partly dried by heating, and then subjected to reduced pressure to produce a dry powder.

Magnetic ore-separator. L. G. Rowand, Brooklyn, N.Y., Assignor to The New Jersey Zinc Co., New York. U.S. Pats. (A) 1,303,396, (B) 1,303,397, and (C) 1,303,398, 13.5.19. Appls., (A, B) 21.6.17, (C) 1.4.18.

(A) An electro-magnetic unit situated entirely above an ore-conveying belt has a number of narrow air gaps in its magnetic circuit. The field strength of the air gaps may be independently altered and the magnetic particles lifted at each air gap are conveyed away separately by belts running transversely to the ore-conveying belt. (B) A magnetic ore separator has opposed magnetic poles one above and one below an ore-conveying belt. Magnetic ore is removed as in (A), the shape and size of the air gaps being adjustable. (C) An electro-magnetic unit consists of a pair of coils each with a magnetisable core and a pole situated between the coils so as to form a pair of elongated magnetic air gaps. The cores and intermediate pole are held in proper spaced relation by non-magnetic material.—C. A. K.

Soldering alloy. L. J. Gurevich and R. W. Woodward, Washington, D.C. U.S. Pat. 1,301,688, 22.4.19. Appl., 16.7.18.

An alloy for soldering metals consists of 10% of cadmium, 10% of tin, and 80% of lead.—C. A. K.

Iron and steel; Manufacture of ——. G. A. Jarvis, Wellington. U.S. Pat. 1,303,799, 13.5.19. Appl., 19.9.17.

See Eng. Pat. 126,046 of 1916; this J., 1919, 421 A.

Gas reactions. U.S. Pat. 1,291,745. *See* I.

Electric arc soldering. Eng. Pat. 127,315. *See* XI.

XI.—ELECTRO-CHEMISTRY.

Lead accumulator; The chemical process in the ——. C. Fery. Bull. Soc. Chim., 1919, **25**, 223—234. (See this J., 1916, 1119.)

As a result of further work the author now gives the equation, $2Pb+H_2SO_4+Pb_2O_5=Pb_2SO_4+H_2O+2PbO_2$, as representing the reaction during normal discharge, the insoluble subsulphate being formed at the negative electrode. For the production of 1 ampère-hour 11 grms. of lead is necessary, of which 7·72 grms. furnishes the current, 0·77 grm. is used up locally, and 2·51 grms. is unattacked. The active material detached from the positive electrode has the composition, Pb_2O_3; it is a black, endothermic substance and a powerful oxidising agent. The lower sulphate Pb_2SO_4 is also black in colour and unlike the normal sulphate, $PbSO_4$, possesses a certain conductivity.—W. G.

Lime requirement of soils. Lynde. *See* XVI.

Electrical conductivity as indicator. Villumbrales. *See* XXIII.

Electro-analysis of gold. Guzmán. *See* XXIII.

Patents.

Electrodes for arc soldering. E. H. Jones, London. Eng. Pat. 127,315, 13.4.17. (Appl. 5260/17.)

Asbestos yarn, or other suitable non-conducting material, preferably passed through a bath of sodium silicate solution, is wound spirally on an electrode wire. A compound of a basic nature, such as a mixture of 40% of iron oxide, 10% of fluorspar, 40% of felspar, and 10% of soda, together with sufficient lime to neutralise the silica present, is then extruded upon the prepared wire.—C. A. K.

Electric furnace. H. A. Greaves and H. Etchells, Sheffield. U.S. Pat. 1,302,788, 6.5.19. Appl., 12.2.19.

See Eng. Pat. 121,563 of 1918; this J., 1919, 80 A.

Gas reactions. U.S. Pat. 1,291,745. *See* I.

XII.—FATS; OILS; WAXES.

Sesamé oil; Refining of ——. W. Schaefer. Chem. Umschau, 1919, **26**, 7, 17—19.

The best method of refining sesamé oil and most other vegetable oils consists in treating the oil in the cold with sodium hydroxide lye (30° B., sp. gr. 1·26), then heating to 50° C., and allowing the sediment to deposit. The oil is then decanted, mixed with 0·4% of dilute hydrochloric acid (about 13·14% HCl) at 70° to 90° C., and again allowed to stand. Finally it is filtered, and decolorised with fullers' earth.—C. A. M.

Plum-kernel oil Utz. Chem. Umschau, 1919, **26**, 49—51.

Kernels from plum stones yielded 30·13% of oil with the flavour of bitter almonds. Its analytical values agreed with those given by Alpers (Z. Unters. Nahr. Genussm., 1917, **34**, 433) *viz.*:—Sp. gr. 0·9193—0·9213; refractometer reading at 25° C., 65·1 to 66·7; saponification value, 188·1—198·5; and iodine value, 103·6—121·1. Both this oil and two commercial samples gave an orange or brown coloration with Bieber's reagent, but did not show any pink coloration with Baudouin's reagent or Soltsien's stannous chloride reagent. The pink coloration obtained by Darvas (Pharm. Zentralh., 1917, **58**, 347) in the Baudouin test must be attributed to accidental contamination of the oil with sesamé oil.—C. A. M.

Fats; Determination of light hydrocarbons in ——. Normann and Hugel. Chem. Umschau, 1919, **26**, 19·20.

From 200 to 300 c.c. of the oil is heated in a current of dry (not superheated) steam, and the distillate received in a measuring cylinder. In this way light hydrocarbons, including petroleum oil of b.pt. up to 240° C., are completely distilled in from 15 mins. to 1½ hours, and may be quantitatively estimated within about 0·5%. The results are calculated into the gravimetric percentage by determining the sp. gr. of the distillate, or, if the quantity is insufficient, by taking 0·7 as the mean value. In this way samples of linseed cake yielded 0·2 to 3·5% of volatile hydrocarbons; rape seed cake, 0·1 and 4·0%; maize oil, 2·5%; and a maize germ extract, 11·5%. In most cases these hydrocarbons were attributable to residual solvent left in the oil-cake.—C. A. M.

Wax from Melaleuca uncinata bark. Smith. *See* XIII.

Hydrogenated fats. Fahrion. *See* XIXA.

PATENTS.

Cotton seed; Extraction of oil from ——. C. O. Phillips, Chappaqua, N.Y., U.S.A. Eng. Pat. 127,478, 6.9.18. (Appl. 14,537/18.)

SEE U.S. Pat. 1,278,073 of 1918; this J., 1919, 21A.

Dehydrating emulsions. U.S. Pat. 1,304,124. *See* IIA.

Oil preparations. U.S. Pats. 1,302,486—7. *See* XIXA.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Colophony; Iodine value of ——. A. Grün and J. Janko. Chem. Umschau, 1919, **26**, 20—22, 35—38.

THE iodine value of colophony determined by Wijs' method differs greatly from that obtained by the Hübl method, and in both cases varies widely according to the time of absorption and other conditions. For example, Smetham and Dodd (this J., 1900, 101) obtained by 18 hours' absorption with Hübl's solution iodine values ranging from 158 to 184·7, according to the kind of rosin. By the use of Wijs' solution both addition and substitution of the halogen takes place at once, the resin acids in some varieties of colophony being more susceptible to substitution than in others. The excess of halogen used is an important factor, for the degree of substitution rises with the excess used, and substitution can scarcely be avoided in the case of mixtures of fat and rosin. It is practicable, however, to make the determination under conditions in which simple substitution only occurs, and is not overstepped, 252·3 being then accepted as the theoretical iodine value of abietic acid, instead of 168·2. It was found that by the use of bromine solutions a reaction equivalent to simple substitution was effected more readily than by the use of an iodine solution, but by using *N*/3 iodine chloride solution (1 c.c. = 13 mgrms. I) and giving 2 hours' absorption an iodine value of 257 was obtained in close agreement with the theoretical 253·2 (= 3 mols halogen). A sample of colophony treated by McIlhiney's bromine-absorption method (this J., 1902, 1542) absorbed bromine corresponding with an iodine value of 255·3 in 2 mins., and with 338 (4 mols. I = 336·4) after 20 hours. The experiments described confirm McIlhiney's conclusion that half of the bromine absorbed by colophony in his method is at once liberated as hydrogen bromide, but do not support his view that the other half of the bromine combines by substitution. It is probable that 2 mols. of bromine are added, and then two split off, with the secondary formation of double compounds:

$$C_{20}H_{30}O_2+2Br_2=C_{20}H_{30}Br_4O_2$$
$$C_{20}H_{30}Br_4O_2=2HBr+C_{20}H_{28}Br_2O_2.$$

Then, according to the activity of the halogen solution and the time of absorption, substitution of the hydrogen takes place by direct combination with the bromine:

$$C_{20}H_{28}Br_2O_2+2Br_2=C_{20}H_{26}Br_4O_2+2HBr.$$

The final result would thus be the same as that obtained by a simple substitution of bromine, without any addition at all. The theory that abietic acid combines with halogens by addition and immediately liberates part of the combined halogen as a halogen acid has its analogy in the behaviour of cyclohexone, which on treatment with bromine forms an unstable addition compound, which decomposes spontaneously with the formation of phenol and the liberation of 2 mols. of hydrogen bromide.—C. A. M.

Resin [and wax] of the outer bark of Melaleuca uncinata. H. G. Smith. J. Proc. Roy. Soc. N.S. Wales, 1917, **51**, 232—237.

THE branches and stems of *Melaleuca uncinata* are covered with a thin outer bark which, when dry, can be readily peeled off. It contains 20—25% of a resin which can be extracted with hot alcohol. This resin resembles ordinary shellac in appearance and has sp. gr. 1·135 at 15° C. Its acetone solution makes a splendid cold lacquer, which dries quickly, becomes very hard, and adheres tenaciously to brass. About 70% of this resin consists of an acid resin, m.pt. 148°—150° C., giving a potassium and a silver salt, and 25% consists of neutral substances. In addition to the resin the outer bark contains a small amount of a vegetable wax, m.pt. 67°—68° C.—W. G.

Carbon bisulphide in black varnish. A. R. Ling and G. McLaren. J. Inst. Brew., 1919, **25**, 207—208.

ATTENTION is drawn to the danger of using varnishes containing carbon bisulphide for coating the interior of brewers' casks.—J. H. L.

PATENT.

Purifying lampblack. U.S. Pat. 1,303,362. *See* VIII.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

PATENT.

Leather substitute. Eng. Pat. 127,481. *See* XV.

XV.—LEATHER; BONE; HORN; GLUE.

Gallotannic acid and boric acid; Mutual influence on the electrolytic conductivity of —— *in connection with the composition of the tannins.* J. Böeseken and W. M. Deerns. Proc. K. Akad. Wetensch., 1919, **21**, 907—910.

THE researches of E. Fischer have shown that the tannin of the gall nut consists principally of a mixture of the pentadigalloyl ethers of α and β glucose, and, if this is the case, the influence of the conductivity of this substance on that of boric acid should be considerable. Experiments have therefore been performed on the conductivity of solutions of methyl gallate and of the tannin of the gall nut in the presence of boric acid; the increase in conductivity is very considerable, and markedly higher in the case of the tannin than in that of the methyl ester, thus agreeing with the presence in the tannin of ten pairs of favourably situated hydroxyl-groups in every molecule.—H. W.

Lignite producer tar. Schneider. *See* III.

PATENTS.

Leather; Manufacture of a material suitable for use as a substitute for celluloid or ——, *and for like purposes.* H. M. Broadhurst, A. Lamble, S. J. Peachey, and The United Alkali Co., Ltd., Liverpool. Eng. Pat. 127,481, 19.9.18. (Appl. 15,244/18.)

RUBBER, balata, or gutta percha is dissolved in benzene or a homologue thereof and treated with

chlorine, or bromine and chlorine, in stoneware, earthenware, leaden, or lead-lined vessels which may be cooled if necessary. The hydrochloric acid is removed by heating or by treatment with ammonia gas.—D. W.

Ligno-tanning material and process of producing same from waste sulphite liquor etc. V. Drewsen, Brooklyn, N.Y., Assignor to West Virginia Pulp and Paper Co., New York. U.S. Pats. (A) 1,303,176 and (B) 1,303,177, 6.5.19. Appl., 15.6.14 and 30.3.15. (B) Renewed 22.11.18.

(A) LIGNIN material precipitated from waste sulphite-cellulose liquor is "converted" by alkali, dissolved in sodium sulphite, and the solution cleared, concentrated, and treated with sulphuric acid to precipitate a ligno-tanning material. The precipitate dries to a yellowish powder, readily soluble in warm water, forming an effective tanning liquor. (B) Waste sulphite liquor from wood pulp manufacture etc. is boiled with lime, the precipitate separated and boiled with alkali to dissolve the ligneous matter. The solution of the latter is treated with acid to precipitate a ligno-tanning material.—D. W.

Hides and skins; Treating ——. R. Ribeiro da Silva, Rio de Janeiro, Brazil. U.S. Pat. 1,304,030, 20.5.19. Appl., 16.12.18.

RAW hides and skins are preserved by treating them with copper sulphate solution and subsequently drying out.—D. W.

Plastic composition. Plastic material. L. E. Weber, Brighton, Mass. U.S. Pats. (A) 1,302,739 and (B) 1,302,740, 6.5.19. Appl., 1.10.17.

(A) THE composition consists of glue, sulphonated fish oil, and formaldehyde. (B) The material is produced by adding sulphonated fish oil to an aqueous solution of glue, mixing therein a quantity of fibres, adding to the product a weak solution of formaldehyde and subjecting the product to pressure and heat.—D. W.

XVI.—SOILS; FERTILISERS.

Soils; Electrical method of determining the lime requirement of ——. C. J. Lynde. Trans. Roy. Soc. Canada, 1918—9, [iii.], **12** III., 21—26.

Two lots of 10 grms. each of soil are shaken respectively with 150 c.c. of distilled water and 150 c.c. of a solution of calcium bicarbonate for three hours as in the Hutchinson and MacLennan method (see this J., 1915, 595). The electrical resistance of the above two solutions after the shaking (r_1 and OR), and of the original calcium bicarbonate solution (r_2) are determined. Then the calculated resistance, r, of the calcium bicarbonate solution after being shaken with the soil, in order to give the observed value OR, assuming that the resistance of the aqueous soil solution remains constant, is given by $r = r_1 \times OR/(r_1 - OR)$, and the ratio r/r_2 should give a measure of the alkalinity or acidity of the soil. Comparing these results with those obtained by the Hutchinson-MacLennan method it is found that, if the ratio is less than 0·986 the soils are alkaline, and if the ratio is above 1·284 the soils are acid and require liming.

—W. G.

Nitrite and nitrate nitrogen; Determination of —— in the presence of other nitrogen compounds [e.g. in soil extracts]. T. Pfeiffer and W. Simmermacher. Landw. Versuchsstat., 1919, **93**, 65—76.

THE following methods are recommended for the determination of nitrites, nitrates, and other nitrogen compounds in such substances as soil extracts etc. The total nitrogen, minus nitrite and nitrate nitrogen, is determined by Kjeldahl's method, the digestion being made with the addition of 5 grms. of ferrous sulphate. Ammonia nitrogen is determined in the usual way by distillation with magnesia. After the ammonia has been removed, the residual solution is treated with 12 grms. of magnesium chloride and 3 grms. of finely divided copper-magnesium alloy (copper, 60, magnesium, 40%) and again distilled; the ammonia thus obtained is that formed by the reduction of the nitrites and nitrates. Nitrate nitrogen is determined by boiling 75 c.c. of the original solution for 1 hr. with 1·5 grm. of dextrose, 0·3 grm. of ferrous sulphate, and 5 grms. of sodium carbonate; ammonia and nitrous acid are thus expelled and the nitrate is then reduced with copper-magnesium alloy and the ammonia formed distilled. The nitrite is not completely reduced by the above treatment, and the nitrate nitrogen must be corrected by 1·102 mgrm.

—W. P. S.

Ammonium salts; Action of —— in plant physiology. H. G. Söderbaum. Biedermann's Zentr., 1919, **48**, 133—135.

AMMONIUM salts (sulphate, chloride, phosphate, nitrate, and carbonate) produced more or less marked symptoms of toxicity when added to sand cultures of barley. The toxicity thus appears to be mainly due to the ammonium ion. The limits of toxic action for ammonium sulphate were determined for rye, wheat, oats, and barley. The potato plant showed greater resistance to the toxic action of ammonium sulphate than these cereals.

—J. C. D.

Fertilisers; Field trials with by-product lime and marls containing magnesium as ——. Tacke. Biedermann's Zentr., 1919, **48**, 129—133.

EXPERIMENTAL field trials on newly cultivated moor and heath land indicate that no particular virtue is to be attached to the high magnesium content of by-product lime (this J., 1918, 744A). Its value lies in its content of basic substances, just as in the case of chalk or lime marls. The price of by-product lime is also very high in comparison with the other liming agents.—J. C. D.

Fertiliser; Experiments with "Kalikalk" as ——. H. G. Söderbaum. Biedermann's Zentr., 1919, **48**, 135—136.

"KALIKALK" is a product prepared from potash, felspar, limestone, and gypsum. It contains approximately 37% of silica, 9% of sulphuric acid, 5% of potassium, and 32% of calcium. Comparative trials in the manuring of oats were made with three preparations and with potassium sulphate. The results indicate that "Kalikalk" produced somewhat better results than potassium sulphate.

—J. C. D.

Fertilisers; Ten years' experience with manganese compounds and other stimulants as ——. H. G. Söderbaum. Biedermann's Zentr., 1919, **48**, 136—137.

MANGANESE carbonate used in conjunction with aluminium sulphate produced good results with oats, but the other substances tested (manganese

sulphate, pyrolusite, hydrated manganese peroxide, ferromanganese slag, calcium fluoride, potassium iodide, "*Engrais radioactif*," uranium acetate, and ferric hydroxide) produced neither stimulation nor inhibition of plant growth. The uranium salts were deleterious when administered in large amounts.—J. C. D.

Betaine; Decomposition of —— by bacteria of "Guanol," a fertiliser prepared from molasses waste. A. Koch and A. Oelsner. Biochem. Zeits., 1919, **94**, 139—162.

In the manufacture of "guanol" from molasses waste the betaine is decomposed by organisms derived from the compost. Amongst these are moulds, organisms which produce trimethylamine, and a bacterium named *Betainobacter α*, which splits off the whole of the nitrogen of betaine in the form of ammonia. It also produces carbon dioxide, probably by the intermediate formation of methyl alcohol and formic and acetic acids.—J. C. D.

PATENT.

Fertilisers. Ger. Pat. 311,122. *See* XIX.B.

XVII.—SUGARS; STARCHES; GUMS.

Starch; Supposed degradation of —— by formaldehyde. M. Jacoby. Ber., 1919, **52**, 558—562.

When mixed with formalin, starch soon loses the power of giving a blue colour with iodine, which fact has led Woker (this J., 1916, 1268) to declare that the aldehyde resembles diastase and causes hydrolysis. It is now shown that the addition of ammonium acetate is sufficient to restore this power.—J. C. W.

Starch; Nature of solutions of —— in formalin and the quantitative reconversion of formalin-starch into starch; also on the colour of iodine solutions. W. von Kaufmann and A. Lewite. Ber., 1919, **52**, 616—627.

As a final argument against Woker's assumption that starch is hydrolysed by formalin (see this J., 1916, 1268), the authors show that it can be recovered quantitatively, absolutely unchanged, from solutions in formalin which give no reaction with iodine, merely by precipitation with alcohol. The failure of the iodine reaction may be due to chemical union of the starch with the formaldehyde, but it may also be considered as a colloid chemical phenomenon. The colour of solutions of iodine in the halogen derivatives of methane and ethane varies from brown to violet as the number of remaining hydrogen atoms decreases. (See further, J. Chem. Soc., July, 1919.)—J. C. W.

Diastase; New theories of formation and action of ——. J. Wohlgemuth. Biochem. Zeits., 1919, **94**, 213—224.

The author cannot confirm the work of Biedermann (Fermentforsch., 1915, **1**, 385), or that of Woker (this J., 1916, 1268). Starch treated with formaldehyde does not give a blue coloration with iodine. This is not due, as Woker thinks, to a diastatic action, but to an inactivation of the groups which give the iodine reaction. Removal of the formaldehyde by means of phenylhydrazine restores the reactions of the starch.—J. C. D.

Betaine in molasses waste. **Koch and Oelsner.** ***See*** **XVI.**

PATENTS.

Sugar juices; Continuous process for the preheating and sulphitation of raw ——, and apparatus therefor. C. H. Fischer, Charlottenburg. Ger. Pat. 310,250, 19.2.18.

After raw (beet) juice leaves the measuring vessels its temperature is raised from 50° to 70° and then to 85° C. in stages, between which sulphur dioxide is introduced, so that when the required maximum temperature has been attained the juice can be filtered without first undergoing a special sulphitation process to complete the precipitation of proteins. The apparatus consists of a series of three preheaters (heated by coils), through which the juice passes in succession. A branched sulphur dioxide supply pipe communicates with the juice mains leading from the first preheater to the second and from the second to the third, so that the gas can be introduced as the juice passes from one to another. The second and third heaters are provided with stirring mechanism to prevent subsidence of precipitated matters.—J. H. L.

[*Bone-black;*] *Translating and cooling material* [——]. M. Sims, Llanerch, Pa., Assignor to Sims Automatic Conveyor Co. U.S. Pat. 1,300,784, 15.4.19. Appl., 4.9.15.

An apparatus for the revivification and cooling of bone-black in sugar factories comprises a kiln which discharges its contents intermittently, and means for securing a practically continuous inflow of the discharged hot material through a number of apertures into a pneumatic conveyor pipe of such length that the material, after being carried through the pipe and discharged on to a conveyor belt, arrives at the discharge end of the latter sufficiently cooled to be used again.—J. H. L.

XVIII.—FERMENTATION INDUSTRIES.

Aspergillus oryzæ; Influence of calcium salts on the starch-liquefying enzyme of ——. G. Kita Mem. Coll. Eng., Kyoto Imp. Univ., 1918, **2**, 1—5.

In experiments with takadiastase and potato-starch, the addition of small quantities of calcium sulphate or chloride accelerated the action of the liquefying enzyme, both at 25° and at 50° C., even in cases where it retarded the saccharifying action. In similar experiments with malt diastase, calcium salts retarded both liquefaction and saccharification at the ordinary temperature, but at 50° C. liquefaction was accelerated. It is concluded that where saccharification and fermentation are conducted simultaneously, as in Japanese brewing processes and in the Amylo process, the addition of small quantities of calcium salts helps to prevent any refractory starch particles from escaping dissolution, whilst its retarding influence on saccharification is of no serious importance.—J. H. L.

Beers; Some analyses of war-time German and Belgian ——. H. L. Hind and J. L. Baker. J. Inst. Brew., 1919, **25**, 205—207.

This paper comprises tabulated analytical data relating to some typical German and Belgian war beers, and some notes on brewing conditions in these countries during the war. The gravity of German beers was progressively, reduced during the war and did not exceed 1008 at the time of the Armistice. Even at this gravity, however, very palatable beers of light Pilsener character were produced, but the dark lager beers were decidedly sweet owing to addition of dulcin (1—10 grms. per hectolitre). Insufficiency of malt led to the production of large quanti-

ities of *Ersatz-* (substitute-) beer, made, for example, from dulcin, hops, and saponin, or in some cases from hop-extract and a re-mash of the grains. This *Ersatz*-beer was sometimes slightly fermented and stored for a day or two. In flavour it resembled a very sweet, rather nauseous hop-bitter. German brewing methods were not greatly modified during the war, though the duration of storage of beers was reduced; copper utensils and plant were replaced by iron. In Belgium all copper utensils were requisitioned, and many of the breweries were demolished; in most towns and districts only one brewery was left in working condition and the other brewers were obliged to have their beers brewed there. Many substitutes, *e.g.*, beans, millet, tapioca, vetches, etc., were employed to eke out the small supply of malt and sugar, but in spite of the low gravity of the beers their quality was remarkably good. Since the German withdrawal the permissible gravity has been raised from 1008 to 1014.—J. H. L.

Beers; Maladies of thin ——. W. Windisch. Woch. Brau., 1918, **35**, 310—312, 316—319, 322—325, 330—333, 335—342.

MANY cases of discoloration or unpleasant flavour in light beers may be attributed to the formation of nitrous acid, either by biochemical reduction of nitrates derived from the brewing water, or by bacterial decomposition of proteins. Nitrates may be reduced not only by certain bacteria but also by yeast deprived of suitable nutriment (*cf.* this J., 1919, 87 A). In some beers the odour of nitrous acid itself has been perceptible (*ibid.*), but the acid may also give rise to deleterious products by interaction with other substances such as amino-acids; *e.g.*, leucine yields hydroxycaproic acid, which has an unpleasant flavour, and tannins (whether derived from malt-husks or hops) are converted by nitrous acid into dark-coloured substances. If putrefactive bacteria gain access to beers, especially those of low acidity, they may produce malodorous substances such as indole and skatole which yield red coloured products when acted upon by nitrous acid. Bacteria of the same class also convert tyrosine into *p*-cresol, which has a "carbolic" odour, and in this reaction an intermediate product, *p*-hydroxyphenylacetic acid, is formed, which forms dark-coloured substances in presence of iron salts. Cloudiness in thin beers is most commonly due to tannin-protein compounds or hop-resins. The author considers that tannins serve no useful purpose in wort, and should be eliminated as completely as possible before fermentation, and to this end a copious precipitation of coagulable protein from the wort is desirable (*cf.* this J., 1918, 779 A). Such a copious "break" is promoted by the infusion method of mashing (as contrasted with the decoction method), by brewing worts at as high a gravity as possible and diluting subsequently to the required extent with water (not with hopped water, as this introduces hop-tannins into the beer), and by securing a high acidity in the copper wort. In worts deficient in acidity the tannins may be present as alkali salts and thus escape precipitation (see following abstract); in such cases increase of acidity due to fermentation or even carbonation may cause a tannin-protein haze in the finished beer. Discussing the influence of phlobaphen (see following abstract), the author points out that this substance is formed to some extent from hop-tannin when hops are stored under unsuitable conditions, with access of air. This transformation, however, is probably an advantage, since phlobaphen is more readily eliminated from wort than the tannin from which it is formed, its compounds with protein being insoluble even in hot wort (*ibid.*). Referring to iron-sickness in thin beers (see this J., 1918, 779 A), the author corrects a previous statement that the gradual intensification of colour in iron-sick beers is due to oxidation of ferrous to ferric tannates. Both forms of iron can produce coloration in beers deficient in acid. A high acidity is one of the most important safeguards against this malady.—J. H. L.

Hop boiling; Coloration produced in ——, *and the influence of tannin thereon.* W. Windisch. Woch. Brau., 1919, **36**, 9—12, 15—18.

THE red coloration which has been observed in hop extracts made with waters rich in carbonates or in hopped worts prepared with such waters (see this J., Krumhaar, 1918, 523 A; Bau, 1918, 524 A), is attributed by the author to the transformation of some of the hop tannin into phlobaphen. This substance, which like tannin is acid in character, forms soluble salts having a deep reddish colour. It is formed from tannin on heating with alkaline liquids (even with water containing alkaline-earth carbonates or dipotassium phosphate) in presence of air; in absence of air colourless or slightly coloured substances (leuco-compounds) are produced, which readily undergo oxidation to phlobaphen or its salts. Both phlobaphen and tannin, when in the free state, combine with protein, but whilst the compounds of protein with tannin are soluble in hot water and only separate out slowly on cooling, the phlobaphen-protein compounds are practically insoluble at all temperatures. In the form of salts neither tannin nor phlobaphen combines with protein, hence they may escape precipitation from worts deficient in acidity, but an increase of acidity during fermentation or afterwards may liberate them from their salts and enable them to form compounds with proteins, and thus give rise to turbidity.—J. H. L.

Yeast which ferments mannose. G. Mezzadroli. Staz. Sperim. Agrar. Ital., 1918, **51**, 300—311. Chem. Zentr., 1919, **90**, II., 506—507.

IN experiments on the fermentation of saccharified vegetable ivory extracts (see this J., 1919, 50 A) with various yeasts, the best results were obtained with a yeast from Apulia, Italy. From mannose solutions of 3—12% concentration this yeast produced yields of alcohol ranging from 1·75 to 6·85%; only a small quantity of ammonium phosphate was required in addition to the sugar. The yeast ferments dextrose, sorbose, sucrose, and maltose fairly well, and lactose, raffinose, and inulin less readily. Saccharine extracts from beets, maize, sugar cane, figs, and locust beans are fermented completely by it. It grows well on agar containing malt wort or beer, on faintly alkaline glucose-agar, on beets, and on potatoes, at the ordinary temperature.—J. H. L.

Fumaric acid; Formation of —— *by fermentation of sugar.* C. Wehmer. Ber., 1919, **52**, 562—564.

A REPLY to Ehrlich (this J., 1919, 300 A) denying that *Rhizopus nigricans* produces fumaric acid from sugar.—J. C. W.

Benzene; Determination of small amounts of —— *in ethyl alcohol.* F. W. Babington and A. Tingle. J. Ind. Eng. Chem., 1919, **11**, 555—556.

ONE hundred c.c. of the sample is mixed with 200 c.c. of water and distilled at the rate of 1 c.c. per min.; the first 20 c.c. of distillate is collected in a narrow graduated tube (*e.g.*, a 50 c.c. Eggertz tube) and to it is added 15 c.c. of potassium bichromate solution (one-sixth saturated) and 2 c.c. of hydrochloric acid (sp. gr. 1·12). The tube is closed

with a rubber stopper, the contents mixed, and, after 15 mins., shaken with exactly 10 c.c. of light petroleum. The mixture is allowed to separate into two layers and the increase in volume of the petroleum spirit is a measure of the amount of benzene present. If more than 0·75% of benzene is found, it is advisable to collect a further 10 c.c. of distillate and treat this as described. The presence of a large proportion of acetone in the alcohol would increase the apparent amount of benzene; pyridine would give a similar result but its interference may be prevented by increasing to 3 c.c. the quantity of hydrochloric acid added.—W. P. S.

Black varnish. Ling and McLaren. *See* XIII.

Diastase. Wohlgemuth. *See* XVII.

Nutrient media from yeast. Reiter. *See* XIXA.

PATENTS.

Worts from pressed yeast and brewery mashes; Process and apparatus for filtering ——. Metallwerke vorm. J. Aders A.-G., Magdeburg-Neustadt. Ger. Pat. 309,527, 7.1.16.

THE mash is forced over into a wide, shallow pressure chamber in which the thick wort is drawn off, without stirring up the mash, through a slowly travelling filter-bed, which removes the deposited material from the pressure chamber; when the pressure on the cake of grains is relieved, it swells and breaks up. In this way a complete extraction is obtained, since owing to the small depth of the mash, the layer of paste surrounding the small lumps of mash is torn away. Finally the washed cake is removed from the filter-bed by a grains conveyor. With this arrangement it is unnecessary to employ the usual breaking and stirring devices and a second filtration of the wort is not required.
—J. F. B.

Lactic acid bacteria; Manufacture of durable ferment preparations, especially of ——. M. Groll, Vienna. Ger. Pat. 308,962, 20.12.17. Int. Conv., 13.12.17. Addition to Ger. Pat. 282,296 (this J., 1915, 730).

CONFECTIONERY masses are mixed with bacterial cultures grown in whey (or in "*Klarer Schotte*"). In this way the presence of putrescible milk residues, especially casein, is avoided and the flavour of the preparations remains unimpaired on long keeping.—J. F. B.

Alcohol and feeding-stuffs [from reeds]; Production of ——. Verwertung Inländischer Produkte G.m.b.H., Charlottenburg. Ger. Pat. 311,217, 13.12.16.

ALCOHOL is produced from the roots of the common reed (*Arundo phragmites*), and the liquid remaining after distillation of the alcohol furnishes a feeding-stuff; 100 kilos. of roots yields 10·7—11·5 litres of alcohol.—J. H. L.

XIXA.—FOODS.

Milk calculations. H. D. Richmond. Analyst, 1919, **44**, 200—201.

A SERIES of papers by L. J. Harris (this J., 1918, 437 A, 712 A, 780 A) is criticised, the author being of the opinion that the calculations are based on somewhat erroneous assumptions.—W. P. S.

Hydrogenated fats; Digestibility of ——. W. Fahrion. Chem. Umschau, 1919, **26**, 22—25, 33—34.

AN outline is given of the methods of using hydrogenated fats in the manufacture of margarine and of previous experiments on the digestibility of such fats. The conclusion is drawn that hardened oils, including hydrogenated marine animal oils, can be used for food purposes without any hygienic drawback, but that the evidence is insufficient to show that they are as readily absorbed by the system as ordinary edible fats, and particularly butter and oleomargarine.—C. A. M.

Fruit preserves prepared in the cold, without the addition of sugar, alcohol, or antiseptic. G. Bertrand. Comptes rend., 1919, **168**, 1162—1164.

EXPERIMENTS were tried with cherries, red and white currants, raspberries, plums, and apricots whole or cut in halves. The fruit was well washed and placed in bottles filled with water, so that at the time of closing the bottle no air was included in the liquid. The bottles were closed with rubber stoppers and were kept through the summer, autumn, winter, and spring. In some of the bottles marked alcoholic fermentation occurred in the earlier days, whilst in others it occurred only after the lapse of several weeks. After eleven months 17 out of the original 42 bottles showed no signs of fermentation and there were 4 in which only slight change had occurred. In no case was any putrefaction or butyric fermentation detected. Distilled water was better than boiled tap water for the purpose. Cut apricots kept better than the whole fruit.—W. G.

Lead; Determination of small quantities of —— in foods and substances containing calcium phosphate. B. W. J. Warren. Analyst, 1919, **44**, 199—200.

TEN grms. of the substance is incinerated in a silica basin, the ash is dissolved in a small quantity of water with the addition of 1 c.c. of nitric acid, the solution filtered, the filtrate treated with a slight excess of ammonia, and again filtered. Any copper which may be present will be in the filtrate, whilst the lead will remain in the precipitate; the filtrate should, however, be tested for lead by the British Pharmacopœia method. The precipitate is rinsed into a cylinder with water, 5 c.c. of dilute acetic acid is added, followed by hydrogen sulphide solution, and the coloration obtained is compared with a standard.—W. P. S.

Yeast; Nutrient media from ——. H. Reiter. Deutsch. Med. Wochenschr., **43**, 1201—1202. Z. ges. Brauw., 1918, **41**, 266.

BREWERS' yeast, washed and carefully dried, yields a light powder which may be preserved indefinitely in closed vessels. A mixture of 1 part of the dried yeast with 100 parts of water is allowed to stand for an hour, then heated for an hour in an autoclave, and filtered first through cotton wool and afterwards through filter paper. The extract thus obtained forms, without addition of peptone, a satisfactory substitute for nutrient meat broth, and may be used for the preparation of agar media.
—J. H. L.

Gelatin; Biological value of nitrogenous substances of —— and bone preparations and extracts. H. Boruttau. Biochem. Zeits., 1919, **94**, 194—204.

EXPERIMENTS on dogs indicate that gelatin has a biological value of 59%, calculated on the Thomas formula. Certain commercial food products, consisting essentially of bone extracts, possessed a

value of the same order. An extract prepared from roots was much less nutritive, whilst a meat extract examined did not have quite as high a value as those prepared from bones. The biological value of bones for dogs was found to be of the same order as that of pure gelatin.—J. C. D.

Iodide in mineral waters. Baughman and Skinner. *See* VII.

Hydrocarbons in fats. Normann and Hugel. *See* XII.

PATENTS.

Cattle-cake; Manufacture of —— from yellow mustard seed. G. W. Lensvelt, Bussum, Holland. Eng. Pat. 121,586, 13.9.18. (Appl. 14,940/18.) Int. Conv., 21.12.17.

YELLOW mustard seed is crushed and treated with live steam until the allyl mustard-oil is driven off. The seed is then dried and pressed to remove the fatty oil. The resulting cake is non-injurious as a cattle food.—J. H. J.

Albumins from blood; Manufacture of decolorised, odourless, and tasteless ——. A. J. L. Terwen and C. J. C. van Hoogenhuyze, Amsterdam, Holland. Eng. Pat. 123,971, 13.8.18. (Appl. 13,157/18.) Int. Conv., 6.3.18.

DILUTE acid is added to blood and the mixture is allowed to stand for 24 hrs., during which period the red corpuscles are dissolved and the destruction of catalase commences. A 3% solution of hydrogen peroxide is then added and the mixture allowed to stand for a further 24 hrs. when the destruction of catalase is completed and decolorisation is commenced. A slight excess of alkali is added, and in a short time decolorisation is completed. The liquid may be evaporated in a vacuum, the albumin obtained remaining soluble.—J. H. J.

Fruit-juices and other organic food and vegetable products; Process of preserving ——. C. A. Kern, Mill Valley, Cal. Reissue, 14,633, 15.4.19, of U.S. Pat. 1,204,880, 14.11.16. Appl., 9.3.18.

FRUIT-JUICE or other liquid food is evaporated to a syrup, sterile cellulose material is added, and the evaporation continued to dryness.—J. H. J.

Dryer for evaporating fruits, vegetables, and the like. H. L. Shepard, Assignor to Pacific Evaporator Co., Portland, Oreg. U.S. Pat. 1,300,497, 15.4.19. Appl., 29.6.17.

Two sets of trays, containing the material to be dried, are arranged opposite to one another, and inclined in opposite directions, in a drying chamber, and a current of air is directed through the chamber past both sets of trays at an angle to the bottoms of the trays. Means are provided for reversing the current of air.—J. H. J.

Macaroni; Process of drying ——. K. Gammel, Assignor to The Cleveland Macaroni Co., Cleveland, Ohio. U.S. Pat. 1,300,718, 15.4.19. Appl., 25.3.11. Renewed 14.9.17.

THE material is subjected to the action of a current of air of high velocity and low humidity, and then to a current of low velocity and high humidity until the excess of moisture is removed. The drying is completed by passing a current of air of high humidity over the material alternately in different directions. The humidity of the air currents used is below the saturation point.—J. H. J.

Edible-oil preparation. Medicinal-oil preparation. H. V. Dunham, Mount Vernon, N.Y. U.S. Pats. (A) 1,302,486 and (B) 1,302,487, 29.4.19. Appl., 9.11. and 4.9.18.

(A) AN edible fatty oil is emulsified with a neutral solution of casein, the mixture is homogenised, and the product is dried at a low temperature. (B) An ingestible medicinal oil is treated as described under (A).—J. H. J.

Potatoes; Preparation of a stable dry product from raw ——. S. von Zórád, Budapest. Ger. Pat. 303,907, 28.12.15. Int. Conv., 28.8.15.

RAW potatoes are sliced, wetted with water, subjected to a mild treatment with sulphurous acid, washed to remove the latter, and then dried at a moderate temperature. The amount of sulphurous acid used is so small that whilst the enzymes near the surface of the slices are rendered inactive those in the interior remain uninjured. By grinding the dried product a light-coloured palatable flour is obtained.—J. H. L.

Fish; Preservative treatment of —— [by refrigeration]. A. Eyers and W. P. Watkins, London. Eng. Pat. 127,404, 29.5.18. (Appl. 8891/18.)

Feeding-stuffs [from reeds]. Ger. Pat. 311,217. *See* XVIII.

XIXB.—WATER PURIFICATION; SANITATION.

Gas masks and absorbents; Methods of testing ——. A. C. Fieldner, G. G. Oberfell, M. C. Teague, and J. N. Lawrence. J. Ind. Eng. Chem., 1911, **11**, 519–540.

THE tests described comprise absorbent tests, which are used in the development and control of absorbent production, machine canister tests, used in the development of canisters and in controlling the uniformity of filling the canisters, and actual man tests, in which men wear the masks in gas chambers to determine the life of the canister, maximum protection, leakage, etc. The physical and chemical methods employed for the purpose are given in detail.—W. P. S.

PATENTS.

Formaldehyde; Apparatus for producing ——. G. Calvert, Twickenham Park, Middlesex. Eng. Pat. 126,479, 13.5.18. (Appl. 7997/18.)

METHYL alcohol vapour is passed through a coil surrounding the hot portion of a burner tube containing a catalyst, and is then led into a jet within the burner tube where it is allowed to mix with an adjustable supply of air in close proximity to the catalyst. The device may be applied to a self-contained portable appliance for the production of formaldehyde for disinfecting purposes, in which case the methyl alcohol is vaporised by means of a small spirit lamp and the end of the burner tube is open to discharge the formaldehyde into the atmosphere. The arrangement in a large installation is substantially similar. The jet is replaced by a nozzle in the form of a truncated cone fitting into a corresponding seating in the burner tube, and the admission of air is regulated by advancing or withdrawing it in its seating. The other end of the burner tube is connected through a valve-box to a condenser and absorption apparatus similar to that described in Eng. Pat. 814 of 1915 (this J., 1916, 328).—G. F. M.

Disinfectants [and fertilisers]. Gewerkschaft Einigkeit, Ehmen. Ger. Pat. 311,122, 15.10.16.

A MIXTURE of hygroscopic salts, *e.g.*, kainite, with potassium permanganate and sodium formate or other salts of formic acid or its homologues is employed as a disinfectant in the treatment of fæces. With the addition of lime and phosphoric acid the mixture furnishes a good fertiliser.—G. F. M.

Calcium hypochlorite. U.S. Pat. 1,288,587. *See* VII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Aconitine; Reaction of ——. L. P. J. Palet. J. Pharm. Chim., 1919, **19**, 295–296.

BOTH amorphous and crystalline aconitine yield a violet coloration when heated with a 4% solution of sodium molybdate in concentrated phosphoric acid (sp. gr. 1·7); if the molybdate is omitted, only the crystalline variety gives a violet coloration, the amorphous form giving a grey colour. The violet coloration is not given by apomorphine, atropine, brucine, caffeine, cocaine, digitoxin, digitonin, emetine, morphine, napelline, narceine, narcotine, papaverine, strychnine, or theobromine. Aspidospermine and veratrine give a violet coloration with the test, but the action of oxidising substances on the former and of mineral acids on the latter permits their differentiation from aconitine.

—W. P. S.

Cocaine, heroine, and veronal; Detection and determination of —— *in viscera.* P. A. E. Richards. Analyst, 1919, **44**, 192—196.

ALIQUOT portions of the various organs and liquids are acidified with acetic acid and extracted with warm alcohol; the alcoholic extracts are concentrated, filtered, clarified, if necessary, with lead acetate, the excess of lead removed as sulphide, and the solutions then acidified with acetic acid and extracted with ether. The residues obtained from the ether extracts are weighed and examined for veronal (diethylbarbituric acid), sulphonal (diethylsulphonedimethylmethane), etc. The aqueous solutions, after the ether extraction, are rendered ammoniacal, extracted with chloroform, the chloroform extracts shaken with dilute hydrochloric acid, the acid extracts again rendered ammoniacal and re-extracted with chloroform. The residues from the chloroform extracts are tested for alkaloids; if cocaine is suspected to be present, the residues may be extracted with benzene in which this alkaloid is distinctly soluble. Trional (diethylsulphonemethylethylmethane), sulphonal, and tetronal (diethylsulphonediethylmethane) are best identified by their m.pts.; trional, 75° C.; sulphonal, 125° C.; tetronal, 85° C. Veronal has m.pt. 191° C.; it sublimes completely and the crystals obtained when the substance is evaporated with ammonia differ from those yielded by trional and sulphonal under the same conditions. Various tests for heroine (diacetylmorphine) and cocaine are discussed. The alum-potassium permanganate test for cocaine described by Hankin (this J., 1911, 151) was found to give excellent results.—W. P. S.

Alkaloids; Changes in —— *during sterilisation.* F. Zoccola. Giorn. Farm. Chim., 1918, **67**, 60–64, 90—96. Chem. Zentr., 1919, **90**, II., 532.

MORPHINE hydrochloride in 1—2% neutral aqueous solution is unchanged by sterilisation, but a yellowish coloration and precipitation of the base results in presence of 1% sodium hydroxide or even in heating in vessels of alkaline glass. A yellowish coloration is also produced in 0·5% hydrochloric acid solution, and a greenish-yellow in 25% hydrochloric acid, but only in the latter case could apomorphine be detected. To obtain colourless and unchanged solutions of apomorphine, they must be freshly prepared in boiled water, and stored in absolutely neutral glass vessels. Solutions of cocaine hydrochloride, even when quite neutral, undergo hydrolysis on heating to 100° C., but as this is only slight when the sterilisation is conducted in neutral glass vessels it is preferable to sterilise in this way rather than by the addition of phenol or salicylic acid. The presence of even minute amounts of alkali in cocaine solutions causes considerable hydrolysis in the cold, whilst on heating, as much as 50% of the alkaloid may be resolved into ecgonine and benzoic acid.—G. F. M.

Benzoic acid; An agricultural source of ——. P. J. Moloney and F. T. Shutt. Trans. Roy. Soc., Canada, 1918—9 [iii], **12**, III, 149—152.

THE authors calculate, from the results of solubility experiments, that, by acidifying fresh cow's urine with hydrochloric acid, cooling it to 0° C., and collecting the hippuric acid which separates out, the equivalent of 1 lb. of benzoic acid per 15 cows per day may be obtained. They consider that this process might be economically worked in Canada by the dairy farmers during the winter months.—W. G.

Oxalic acid; Determination of ——. E. Ott. Ber., 1919, **52**, 752—753.

THE quantitative decomposition of oxalic acid into carbon monoxide, carbon dioxide, and water when acted on by acetic anhydride containing a trace of sulphuric acid has been applied by Krause (this J., 1919, 478 A) to the estimation of oxalic acid and oxalates. The reaction has been observed and explained previously by the author (Annalen, 1913, **401**, 177), but has not been utilised by him for analytical purposes.—H. W.

PATENTS.

Chlorhydrins; Processes of making —— *[from oil-gas], and apparatus therefor.* Commercial Research Co., Assignees of B. E. Eldred, New York. Eng. Pat. 113,954, 4.2.18. (Appl. 2001/18.) Int. Conv., 8.2.17.

CHLORHYDRINS are produced from olefines or from oil-gas rich in unsaturated hydrocarbons made by cracking petroleum oils, by introducing such gases together with chlorine into a current of steam at successive spaced intervals in suitable vertical reaction chambers connected together in series, time being thus allowed for the reaction to occur before the vapours reach a point where a further addition of gas is made, and means being provided for the efficient mixing of the gases within the chambers, and for the removal of the hydrogen chloride produced, which would otherwise promote the formation of olefine dichloride. The steam is initially led in at the bottom and to ensure adequate mixing the chambers are divided into sections by perforated cross plates, and alternate sections are packed with granular manganese dioxide or broken pot etc., a fresh supply of chlorine and oil-gas together with steam to replace that condensed being injected into each unobstructed section. Hydrogen chloride is removed either by washing it out with the condensed water through a trap at the base of each chamber, or where manganese dioxide is employed it is re-oxidised to chlorine and manganese chloride is removed by the condensed liquid. The chlorhydrins

are recovered from the vapours by passing through a column into a condenser.—G. F. M.

Chlorinated hydrocarbons; Manufacture of ——. V. J. Harding, Montreal, Canada. Eng. Pat. 126,511, 11.6.18. (Appl. 9603/18.)

Dichloro-hydrocarbons of the paraffin series are produced from gaseous olefine hydrocarbons, particularly ethylene and propylene, or mixtures containing these gases, by leading them mixed with chlorine, and in the absence of steam or water, through chambers or tubes containing a contact substance such as brick, pumice, sand, coke, charcoal, ferric oxide, alumina, or magnesia, maintained at 50°—150° C. The dichloroparaffins obtained are practically free from higher substitution products, and under the conditions described no substitution of paraffin hydrocarbons, which may be present, occurs.—G. F. M.

Paracetaldehyde; Method of preparing ——. H. A. Morton and B. H. Nicolet, Pittsburgh, Pa., Assignors to Union Carbide Co., New York. U.S. Pat. 1,300,451, 15.4.19. Appl., 1.7.18.

Paracetaldehyde, substantially free from acetaldehyde, is prepared by treating acetaldehyde with sulphuric acid, neutralising the acid, separating the greater part of the unchanged acetaldehyde by distillation, resinifying that remaining behind by treatment with alkali, and purifying the paraldehyde by distillation after separating the resin.

—G. F. M.

Alkaloids and alkaloidal salts; Process of extracting, purifying, or "excluding" —. J. U. Lloyd, Cincinnati, Ohio. U.S. Pat. 1,300,747, 15.4.19. Appl., 6.7.15.

The alkaloidal substance is precipitated from a neutral or slightly acid solution by the addition of powdered "magnesium clay."—G. F. M.

Medicinal articles; Preparation of ——, *and products thereof.* E. Zueblin, Baltimore, Md. U.S. Pat. 1,301,210, 22.4.19. Appl., 5.8.14.

Additional medicinal properties are imparted to medicaments by exposing them to the influence of high-tension electricity until they become radioactive.—G. F. M.

Medicinal oil. U.S. Pat. 1,302,487. *See* XIXA.

Formaldehyde. Eng. Pat. 126,479. *See* XIXB.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patent.

Photographic positive-prints; Method of and article for making ——. J. G. Capstaff, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pat. 1,303,635, 13.5.19. Appl., 14.7.14.

A support is provided with two sensitive films, the lower one slow, the upper one rapid. After exposure sufficient to affect only the upper film, the plate is developed, then exposed through the negative to the lower film, the upper film removed, and the lower film developed and fixed as usual.

—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Explosive reactions; Determination of the temperatures reached in ——. H. Muraour. Comptes rend., 1919, **168**, 995—997.

In calculating the temperature reached in explosive reactions it is necessary to assume either that methane exists at the moment of the explosion or that it is formed during the cooling. The results may differ widely if one or other assumption is made. Experiments were made in an "erosion" bomb, the gases being cooled suddenly by passage through a narrow orifice into an exhausted vessel. From the results obtained with powders which gave gases rich in methane, the author finds that the greater part, if not the whole, of the methane contained in the products of combustion of powders is formed during the period of cooling. Hence, in calculating the temperature of explosion, the most accurate result will be obtained by reverting the whole of the methane to $CO+H_2$. The non-existence of methane at the moment of explosion implies, if there is no deposition of carbon, the constancy of the gaseous volume, and it therefore results that the temperature of explosion of powders does not increase when the density of the charge is increased. W. G.

Patents.

Explosives. S. Adde, Strängnäs, Sweden. Eng. Pat. 112,618, 20.12.17 (Appl. 18,906/17.) Int. Conv., 20.12.16.

A plastic explosive freezing with difficulty is composed of a gelatinised mixture of nitrocellulose with one or more fluid nitroderivatives of higher homologues of toluene (*e.g.* xylene or cymene), with or without nitroglycerin, methyl or ethyl alcohol, oxygen-containing or yielding substances, and carbonaceous matter. Substances adapted to raise the temperature of explosion, such as alloys of iron, aluminium, manganese, or silicon, in a finely divided state may also be introduced.—C. A. M.

Explosive and process for manufacturing it. C. I. Tisell, Stockholm. Eng. Pat. 116,890, 3.6.18. (Appl. 9137/18.) Int. Conv., 18.5.17.

Ferrosilicon of high silicon content is added to the ingredients of safety explosives of the type containing nitrohydrocarbons, ammonium perchlorate, or other oxygen-yielding compound, and aluminium powder, the heat evolved in the combustion being more rapidly transferred to the explosion gases than when ferrosilicon is used without aluminium. An explosive of this character may contain nitrocellulose gelatinised with a liquid nitrohydrocarbon or collodion. C. A. M.

Ballistite; Manufacture of ——. E. C. R. Marks, London. From G. Spica, Rome. Eng. Pat. 126,013, 23.10.16. (Appl. 15,062/16.)

Ballistite powder is manufactured by incorporating phenanthrene (0·5 to 1·25 part) with a paste (100 parts) composed of 50% of nitrocellulose and 50% of nitroglycerin. The phenanthrene combines with the decomposition products of nitric esters, and thus renders ballistite almost as stable as cordite. C. A. M.

Explosives. W. Rintoul, D. Cross, and Nobel's Explosives Co., Ltd., Stevenston, N.B. Eng. Pat. 126,056, 20.11.16. (Appl. 16,616/16.)

A small addition (about 0·1 to 1% calculated on the nitroglycerin) of one or more of the following substances (see Eng. Pats. 14,655 and 14,656 of 1915; this J., 1919, 340 A) is made to blasting explosives—urethanes or esters of carbaminic acid,

anilides, substituted ureas, condensation products of glycerols and other polyhydric alcohols with aldehydes, homologues of oxanilic ester, or aromatic substances soluble in nitroglycerin, such as nitrotoluenes, dinitrobenzene, nitroxylenes or mixtures of these substances. The nitrocellulose is stirred into the nitroglycerin solution, the other ingredients added, and the whole mixed at the ordinary service temperature (60° to 70° C.). Under these conditions the usual time for gelatinisation is considerably reduced, and the explosive is rendered more stable. —C. A. M.

Explosives. C. I. Tisell and E. J. Villaume, Stockholm. Eng. Pat. 126,196, 14.6.18. (Appl. 9832/18.)

MONO-, di-, or tri-nitrocymenes, separately or in admixture are incorporated with oxygen-yielding substances, such as nitrates, perchlorates etc., with or without the addition of substances such as pulverised carbon, wood-meal etc., and substances for raising the temperature of explosion, such as ferrosilicon, but without the addition of nitrocellulose dissolved and gelatinised in the nitro derivative. Suitable mixtures consist of 10 to 20 parts of nitrocymene and 80 to 90 parts of ammonium nitrate or perchlorate, or 15 to 20 parts of nitro-cymene, 70 to 80 parts of ammonium nitrate or perchlorate, 5 to 10 parts of ferrosilicon, and 1 to 5 parts of wood-meal.—C. A. M.

Explosive substances. D. Chiaraviglio, and Bombrini Parodi-Delfino, Rome. Eng. Pat. 126,687, 12.2.17. (Appl. 2117/17.)

EXPLOSIVES are made composed of particles not rigidly connected, the spaces between being filled with an elastic or partly elastic medium such as vaseline, which is insensitive to explosion and renders the explosive particles insensitive to the shock or changes of temperature occurring in the movement of the projectile, without interfering with the free movement of the particles with relation to each other when the pressure of shock affects the whole mass. For example, 70 kilos. of nitrocellulose is incorporated with 30 kilos. of nitroglycerin, the whole of which must be absorbed by the fibres, and about 4 kilos. of vaseline or other lubricant is added. Under these conditions it is possible to use an explosive very sensitive to priming without risk.—C. A. M.

Explosive compound. G. F. Bradley, Bolton. Eng. Pat. 126,608, 16.2.17. (Appl. 2329/17.)

A PLASTIC or semi-plastic explosive which is as powerful as nitroglycerin explosives, but safer to prepare and use, is made by mixing together ammonium nitrate (75 to 80%), trinitroxylene (15 to 20%, or 7½ to 15%), trinitrotoluene (5 to 7½%, or 5 to 15%), and aluminium powder (3 to 8%). —C. A. M.

Matches; Process of treating —— in order to render them immune to the action of moisture. F. Johnston, Assignor to A. Orr, Calgary, Canada. U.S. Pat. 1,301,418, 22.4.19. Appl., 4.3.18.

MATCHES are rendered waterproof by dipping them head downwards into a mixture of 2 parts by weight of rosin and 1 part of beeswax heated to a few degrees below its b.pt., whereby both the head and stem of the match receive an impervious coating. —C. A. M.

Picric acid; Manufacture of ——. A. G. Green, Leeds. U.S. Pat. 1,299,171, 1.4.19. Appl., 29.1.16.

SEE Eng. Pat. 16,607 of 1915; this J., 1919, 389 A.

Explosive. W. Rintoul and D. Cross, Assignors to Nobel's Explosives Co., Ltd., Stevenston, N.B. U.S. Pat. 1,303,115, 6.5.19. Appl., 24.9.17.

SEE Eng. Pats. 14,655—6 of 1915; this J., 1919, 340 A.

Delivery of liquids according to specific gravity. Eng. Pat. 126,375. *See* I.

Nitrophenols. Eng. Pat. 126,321. *See* III.

XXIII.—ANALYSIS.

Platinum and gold; Attack of —— by alkalis. L. Quennessen. Bull. Soc. Chim., 1919, **25**, 237—240.

A DISCUSSION of the results of Nicolardot and Chatelot (Bull. Soc. Chim., 1919, **25**, 4; this J., 1919, 201 A) and of results published in *Bull. des Usines de guerre*, 1918, No. 17, 134. The author considers that pure platinum shows the highest resistance to acid reagents and that silver vessels are the more convenient for laboratory purposes where alkalis are to be used, although certain alloys of gold and palladium show a high resistance to the action of alkalis.—W. G.

Palau and rhotanium ware; Comparative tests of —— as substitutes for platinum laboratory utensils. L. J. Gurevich and E. Wichers. J. Ind. Eng. Chem., 1911, **11**, 570—573.

THREE gold-palladium alloys were tested; these had the following composition:—palau metal, gold, 80, palladium, 20%; rhotanium A metal, gold, 90, palladium, 10%; rhotanium C metal, gold, 70, palladium, 30%. Rhotanium A ware is superior to platinum of both high and low iridium content in respect to its resistance to loss on heating; it is about equal to platinum as regards resistance to boiling hydrochloric acid, hydrofluoric acid, boiling 20% sodium hydroxide solution, and fusion with sodium carbonate and with potassium pyrosulphate. It is superior to platinum in resistance to boiling sulphuric acid, but inferior with respect to nitric acid, ferric chloride solution, and fusion with sodium hydroxide. It must not be heated above 1100° C. Both palau and rhotanium C ware behave in the same way towards reagents as does rhotanium A ware, except that they are not suitable for potassium pyrosulphate fusions. They are superior to platinum as regards resistance to loss on heating up to 1200° C. All three alloys may be used in electrolysis, but as cathodes only; as anodes they are useless.—W. P. S.

Gold; Electroanalysis of —— without platinum electrodes. J. Guzmán. Anal. Fís. Quím., 1919, **17**, 115—120.

EXCELLENT results are obtained by the substitution of an iron anode for platinum, the cathode being of platinum gauze. The electrolyte is prepared by dissolving about 0·1 grm. of gold in *aqua regia*, adding 3 grms. of sodium hydroxide in 20 c.c. of water, and 10 c.c. of a freshly prepared 10% solution of potassium cyanide. During electrolysis the electrolyte is agitated and the temperature is raised to 60° C.; voltage 1·9 volts. Removal of the nitric acid by evaporation of the solution of gold in *aqua regia* is recommended in order to avoid a slight disintegration of the iron anode. The cathode is freed from gold by electrolysis in dilute hydrochloric acid. Excellent results were also obtained with the use of a cathode of very fine copper gauze previously nickel-plated. If copper is present in the gold to be analysed, 1 grm. of potassium cyanide is added in excess of the quantity required for solution of the precipitate, and the voltage is kept below 1·9 volts. The deposit of gold on the cathode is washed with 2% sodium sulphite solution, water, and finally alcohol.—W. S. M.

Electrical conductivity as indicator in potassium permanganate titrations. V. Villumbrales. Anal. Fis. Quím., 1919, 17, 100—114.

In the titration of ferrous salts by means of potassium permanganate solution free acid is consumed, but as acid is added in great excess to dissolve the precipitated oxides, the conductivity of the solution shows no appreciable change during the titration. If, however, no acid or insufficient acid is present the conductivity of the mixture falls with addition of the permanganate until the oxidation is complete and thereafter remains practically constant. The end-point is thus indicated by a sharp angle in the curve. When manganous salts are oxidised by permanganate in neutral solution free acid is formed. The conductivity increases in this case and becomes constant after the end-point is reached.—W. S. M.

Antimony; Determination of small quantities of ——. W. Beam and G. A. Freak. Analyst, 1919, **44**, 196—199.

Modifications are suggested in a method described originally by Schildrowitz and Goldsbrough (this J., 1911, 449). The antimony is deposited on a strip of copper foil and, when deposition is complete, the foil is washed and at once immersed in a boiling alkaline permanganate solution. This consists of 15 c.c. of 1% potassium hydroxide solution and an amount of permanganate solution (1 c.c. = 0·01 grm. Fe) depending on the quantity of antimony; 1 c.c. of permanganate solution is sufficient for 0·5 mgrm. of antimony. After filtration, the solution is rendered just acid with dilute hydrochloric acid, treated with sulphur dioxide, boiled to expel excess of the latter, cooled, treated with 0·5 c.c. of 10% gum solution and then with hydrogen sulphide. The coloration obtained is compared with standards as described (*loc. cit.*).—W. P. S.

PATENTS.

Gaseous mixtures; Apparatus for quantitatively analysing ——. H. Gerdien, Assignor to Siemens und Halske A.-G., Berlin. U.S. Pat. 1,304,037, 20.5.19. Appl., 26.6.14. Renewed 3.10.18.

See Fr. Pat. 458,916 of 1913; this J., 1913, 1171.

Gases; Apparatus for the detection and measurement of ——. G. A. Shakespear, Birmingham. U.S. Pat. 1,304,208, 20.5.19. Appl., 15.10.18.

See Eng. Pat. 124,153 of 1916; this J., 1919, 393 A.

Spectrum analysis. Ger. Pat. 310,139. *See* X.

Filter plates; Preparation of highly porous, acid-resisting ——. W. Kill. Chem.-Zeit., 1919, **43**, 262.

The plates are prepared from kieselguhr, which has been treated so as to remove acid-soluble substances such as iron oxide and alumina, then mixed with a suitable binding material, and baked.
—W. P. S.

Fractionating column; New laboratory —— and the measure of its efficiency. M. H. Robert. Comptes rend., 1919, **168**, 998—1001.

The device consists of two columns arranged vertically one above the other. The lower one, which is in an ordinary bulb column, each bulb being partly filled with beads, is surrounded by a glass jacket in which a high vacuum is maintained. The upper column, sealed on to the lower one, is surrounded by an outer jacket through which air is caused to circulate, and is surmounted by the still-head. By regulating the heating and also the flow of air round the upper column the distillation is carried out at the rate of one drop per second. Equally satisfactory results were obtained with substances of high boiling point (acetic anhydride, b.pt. 139·5° C.) and with those of low boiling point (pentane, b.pt. 36° C.). The efficiency of the column was found to be 0·94 as compared with 0·73 for a Vigreux column (this J., 1919, 200 A) and 1·0 for the perfect column.—W. G.

Spectrophotometer; A new sector ——. S. J. Lewis. Chem. Soc. Trans., 1919, **115**, 312—319.

The spectrophotometer described has been designed with a view to increasing the accuracy attainable in the practice of ultra-violet absorption spectroscopy. The chief novelty lies in the design of the sector system, the aperture of which is made up of four sector-shaped openings arranged diagonally about the optic axis. This arrangement has the advantage of utilising all parts of the circular beam of light in proper proportion, whatever the magnitude of the effective aperture may be. In this it differs from the iris and other forms of stop which reduce the intensity of the light by cutting off the light on the assumption that every part of the field is equally illuminated.—H. M. D.

Zinc; Conditions affecting the precise determination of —— *as sulphide.* H. A. Fales and G. M. Ware. J. Amer. Chem. Soc., 1919, **41**, 487—499.

A hydrogen ion concentration between $10^{-2}N$ and $10^{-3}N$ is most favourable for the quantitative precipitation of zinc sulphide from formic acid solutions in a form suitable for rapid filtration and washing. The hydrogen ion concentration may be kept within the desired limits by the addition of ammonium citrate or a mixture of ammonium sulphate, ammonium formate, and formic acid. The precipitation of granular zinc sulphide is favoured also by a high concentration of an ammonium salt of a strong acid, by a zinc concentration of 1 grm. per litre, and by a temperature of 90° C.–100° C. Hydrogen sulphide should be passed into the solution under pressure to obtain rapid saturation and to avoid loss of formic acid by evaporation. The following procedure is recommended. The zinc solution, after the removal of copper, cadmium, and other metals likely to interfere, is evaporated to 125 c.c., treated with ammonia until the precipitate is permanent, 25 c.c. of a citrate solution (200 grms. of citric acid per litre of water neutralised by 15*N* ammonia) added, and the solution made neutral to methyl orange with ammonia. Then 25 c.c. of formic acid mixture (30 c.c. of 15*N* ammonia, 200 c.c. of 13·6*N* formic acid, and 250 grms. of ammonium sulphate in 1000 c.c. of water) is added, and the whole made up to 200 c.c. The solution is heated to 60° C., the containing flask being connected with a hydrogen sulphide generator, and the air expelled from the flask as the heating is continued. At 90° C.—100° C. the exit tube of the flask is closed and the solution as it cools saturated with hydrogen sulphide under increasing pressure. The flask is shaken repeatedly to ensure saturation, which is complete when the precipitate settles rapidly. The precipitate is filtered off and washed with a cold *N*/10 solution of formic acid saturated with hydrogen sulphide, transferred to a weighed porcelain crucible, and the filter paper charred. The completion of the ignition of the filter paper is carried out in an oxidising atmosphere in a Bunsen flame and the reaction should proceed so that the sulphide is converted into sulphate. After cooling, the precipitate is moistened with concentrated sulphuric acid, heated in an air bath until the excess of acid is expelled, and then over a Bunsen to remove the charred material. The mass is again moistened with sulphuric acid and heated in the air until the excess of acid is expelled, allowed to cool in a desiccator, and weighed. The last process is repeated until a constant weight is obtained. A

modification of the above process is described whereby zinc may be quantitatively separated from iron, manganese, nickel, and cobalt. The processes described are accurate to one part in a thousand.—J. F. S.

Hydrogen ion concentration; Colorimetric estimation of — in small quantities of solution. A. R. C. Haas. J. Biol. Chem., 1919, **38**, 49—55.

THE estimation is carried out by means of indicator papers, the preparation of which is described. —J. C. D.

Colloidal silica; Use of — in the titration of ferrous iron [with permanganate]. E. Diffler. Chem.-Zeit., 1919, **43**, 262.

As stated by Schwarz and Rolfes (this J., 1919, 179 A), the presence of colloidal silica prevents the action of permanganate or manganous salts on hydrochloric acid. In place of sodium silicate, a preparation sold under the name of "Osmosil," an iron-free silica gel prepared by the electro-osmotic process, is recommended. An ordinary colloidal silica solution does not contain more than 0·01% of silica and is too dilute for the purpose.—W. P. S.

Pyridine in ammonium nitrate. Ladd. *See* VII.

Iodide in waters etc. Baughman and Skinner. *See* VII

Vapour pressures at high temperatures. Ruff and Bergdahl. *See* X.

Hydrocarbons in fats. Normann and Hugel. *See* XII.

Lime requirement of soils. Lynde. *See* XVI.

Nitrite and nitrate. Pfeiffer and Simmermacher. *See* XVI.

Benzene in alcohol Babington and Tingle. *See* XVIII.

Lead in foods etc. Warren. *See* XIXA.

Gas masks and absorbents. Fieldner and others. *See* XIXB.

Aconitine. Palet. *See* XX.

Cocaine, heroine, and veronal. Richards. *See* XX.

Oxalic acid. Ott. *See* XX.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I. GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Aktieselskapet de Norske Saltwerker. Process of preventing formation of gypseous coverings on heating-surfaces. 17,151. July 11. (Norway, 14.8.18.)

Apthorpe, and Cambridge Scientific Instrument Co. Furnace control etc. 16,403. June 30.

Associated Portland Cement Manufacturers, and Baxter. Feeding granular or powdered material in measured quantities. 16,509. July 2.

Atkins and Atkins. Devices for filtering fluids. 17,059. July 8.

Barbet et Fils et Cie. Regulating operations in rectifiers for rectifying mixtures of liquefied gases. 17,221. July 9. (France, 9.7.18.)

Broadley. Machines for grinding ores, minerals, stones, etc. 17,060. July 8.

Bryan. Firing system for steam-boilers. 16,661. July 3.

Carnegie, Cook, Ford, and Parsons. Furnaces, and discharging-apparatus therefor. 16,800. July 4.

Duncan and Watson. Heating and cooling apparatus. 16,432. June 30.

Farrington. Barrel agitators. 17,086. July 8. (U.S., 28.8.18.)

Ford. Filters. 16,634. July 3.

Frei and Von Wurstemberger. 16,411. *See* X.

Gilmour. Manufacture of insulating-material for steam etc. pipes, boilers, etc. 16,665. July 3.

Gray. Compression systems of refrigeration. 16,752. July 4.

Green and Langley. Oxidation processes. 16,887. July 5.

Guye. Pulsometers for raising liquids. 16,967. July 7. (Switz., 9.7.18.)

Hall. Ball or tube mills. 17,113. July 8.

Hardingham (Redman). Furnaces. 17,309. July 10.

Harley. Mixer for fluids and semi-fluids. 16,539. July 2.

Hocking. Heat interchangers. 17,281. July 10.

Industrial Appliances, Ltd., and Robinson. 17,355. *See* I.

King's Patent Agency (Stone). Filter for oil etc. 16,594. July 2.

Liénart. Apparatus for purifying liquids. 16,383. June 30. (Belgium, 11.5.19.)

Loring. Separating constituents of gases or vapours. 17,006. July 8.

Marks (Troy Laundry Machinery Co.). Centrifugal extractors. 17,080. July 8.

Pease. Heat-interchanging apparatus. 16,906. July 5.

Rammage. 17,168. *See* VIII.

Ritson. 17,349. *See* X.

Smith. Method of measuring and recording flow of gases, steam, or liquids through mains. 16,549. July 2.

Soc. Anon. l'Oxyhydrique Française. Apparatus for mixing gases with liquids or solids. 17,428. July 11. (France, 19.7.18.)

Stacey. Grinding-machine. 17,160. July 9.

Whitfield. Evaporating liquids. 16,416. July 2.

Zack. Cooling or liquefying gases etc. 16,774. July 4. (Switz., 30.5.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

5591 (1917). **Wallich.** Apparatus for expressing liquid from materials containing the same. (128,964.) July 16.

11,994 (1917). **Bregeat.** Process for the recovery of volatile solvents used in manufacture. (128,640.) July 9.

13,874 (1917). **Craig, Robertson, Masson, and Drummond.** Recovery of ether and alcohol from vapour-laden air. (129,024.) July 16.

9956 (1918). **Marks (Merrill Process Co.).** Heat-conveying circuits. (128,709.) July 9.

10,659 (1918). **Brooks.** Regenerative oven or furnace. (128,740.) July 9.

17,352 (1918). **Knowles.** Gas-reversing valves for regenerative furnaces. (128,823.) July 9.

2870 (1919). **Lumsden.** Grinding-machines. (128,862.) July 9.

4482 (1919). **Mathy.** *See* X.

7528 (1919). Crompton and Gallagher. Apparatus for the calculation of the thermal efficiency and other data involved therein of steam-generating plant. (128,878.) July 9.

12,046 (1919). Urruty. Composition for preventing and removing incrustation in boilers and the like. (126,966.) July 9.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Beard, and Dempster and Dempster. Purifiers employed in gasworks. 16,363. June 30.

Calvert. Incandescent electric lamps. 16,629. July 2.

Conklin. Method of cleaning coal etc. 16,976. July 7. (U.S., 5.8.18.)

Duncan and Watson. 16,432. *See* I.

Dunstan and Thole. Treatment of heavy oils. 17,114. July 8.

Fairweather. 17,186. *See* VII.

Forwood and Taplay. Treatment of hydrocarbons. 16,961. July 7.

Harrison and Walstell. Electric arc lamps. 16,722. July 3.

Industrial Appliances, Ltd., and Robinson. Pulverised fuel for furnaces of steam-generators. 17,355. July 10.

Jackson (Sperry Gyroscope Co.). Flaming arc lamps. 17,441. July 11.

King's Patent Agency (Stone). 16,594. *See* I.

Lane and Williams. Fuel. 16,523. July 2.

Lesley. Utilisation of low-grade carboniferous material. 16,817. July 4.

Marriott 17,110 *See* IX.

Complete Specifications Accepted.

11,217 (1917). Mauclaire, Garbarini, and Gautier. Electric arc lamps with rotary arcs. (128,606.) July 9.

12,350 (1917). Perkin, and Nitrogen Products and Carbide Co. Destructive distillation of carbonaceous materials to increase the aromatic by-products thereof. (128,660.) July 9.

13,439 (1917). Spicer and Jackson. Liquid fuel for internal-combustion engines. (129,010.) July 16.

13,807 (1917). Cornu. Mercury vapour lamps. (129,022.) July 16.

10,759 (1918). Perkin, and Nitrogen Products and Carbide Co. Apparatus for the destructive distillation and carbonising of pitch. (129,091.) July 16.

11,738 (1918). West and Wild. Retorts for use in the destructive distillation of coal and the like. (129,139.) July 16.

11,761 (1918). Motala Verkstads Nya Aktiebolag. Feeding-devices for pulverulent fuel. (118,101.) July 16.

13,161 (1918). Beccari. Apparatus for the manufacture of charcoal and gas. (128,791.) July 9.

14,865 (1918). White (Sinclair Refining Co.). Process and apparatus for cracking hydrocarbons. (128,806.) July 9.

15,991 (1918). Evans. Artificial fuel. (128,815.) July 9.

19,378 (1918). Colson. Apparatus for completely gasifying combustible carbon matter. (121,124.) July 9.

19,616 (1918). Fuel Saving Co. Apparatus for feeding pulverised fuel. (129,199.) July 16.

III.—TAR AND TAR PRODUCTS.

Applications.

Barnett. Recovering aniline and toluidine from aqueous solutions thereof. 17,460. July 12.

Forwood and Taplay. 16,961. *See* II.

Silberrad. 17,280. *See* XXII.

Complete Specifications Accepted.

13,314 (1917). South Metropolitan Gas Co., and Evans. Alkali fusion of aromatic sulphonic acids. (129,002.) July 16.

10,759 (1918). Perkin, and Nitrogen Products and Carbide Co. *See* II.

14,865 (1918). White (Sinclair Refining Co.). *See* II.

IV.—COLOURING MATTERS AND DYES.

Complete Specifications Accepted.

10,461 (1918). Imray (Soc. of Chemical Industry in Basle). Manufacture of disazo-dyestuffs and process for dyeing therewith. (128,726.) July 9.

11,949 (1918). Soc. l'Air Liquide (Soc. Anon. pour l'Etude et l'Exploit. des Procédés G. Claude). Process for the manufacture of a blue sulphurised dye and the product thereof. (118,103.) July 9.

16,761 (1918). Ellis (Chemical Works formerly Sandoz). Process for the production of blue sulphur dyes. (129,182.) July 16.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Bradley. Fireproofing for aircraft. 17,078. July 8.

Carter. Waterproof covering for straw hats etc. 17,512. July 12.

Flaherty. Pyroxylin solvent, and compositions containing same. 17,082. July 8.

Golding, and United Alkali Co. Treatment and utilisation of residues from manufacture of paper etc. 17,103. July 8.

Mulligan. Waterproofing-composition. 17,287. July 10.

Nishimura. Manufacture of imitation hemp. 17,445. July 11. (Japan, 27.7.18.)

Picard. Extracting fibres from flax straws etc. 16,617. July 2.

Complete Specifications Accepted.

14,080 (1917). British Aeroplane Varnish Co., and Ward. Solutions of cellulose esters. (129,033.) July 16.

14,126 (1917). Mond. Means for doping aeroplane and like fabrics or materials. (129,035.) July 16.

10,513 (1918). Thompson (Underwood and Illston). Treatment of waste liquors such as those from wool scouring and the like. (128,730.) July 9.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Farrell. Textile-washing machines etc. 16,758. July 4.

Poulson. Sizing textile fabrics etc. 16,744. July 4.

Weidmann Dyeing Co. Apparatus for dyeing etc. textile fabrics. 16,684. July 3. (Switz., 18.7.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

10,461 (1918). Imray (Soc. of Chem. Ind. in Basle). *See* IV.

15,146 (1918). Jackson and Bro., and Fish. Open bleach kiers and the like. (129,171.) July 16.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Ashcroft. Production of anhydrous magnesium chloride or anhydrous double chlorides of magnesium. 17,246. July 9.

Ashcroft. Electrolytic decomposition of anhydrous magnesium chloride and production of magnesium or alloys thereof and chlorine. 17,247. July 9.

Duchemin. Manufacture of cyanamide. 16,359. June 30.

Fairweather. Treatment of ammoniacal liquor. 17,186. July 9.

Fleming. 16,940. *See* XIX.

Sherwin. Precipitating aluminium hydrate. 17,084. July 8.

Soc. l'Air Liquide (Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude). Method of purifying gases for synthetic production of ammonia. 16,986. July 7. (France, 15.2.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

11,643 (1917). Maxted and Smith. Construction of pressure furnaces particularly for use in the synthesis of ammonia. (128,623.) July 9.

11,021 (1918). Perrin. Concentration of sulphuric acid. (118,095.) July 16.

11,378 (1918). Norton Co. Process of purifying aluminous materials. (118,605.) July 9.

16,333 (1918). Morris. Production of antimonious oxide. (128,818.) July 9.

6089 (1919). Comment. Process for the preparation of anhydrous sulphide of zinc. (126,274.) July 16.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Adair. Drying china clay. 16,933. July 7.

Kennett, Kennett, and Kennett. Brick kilns. 17,203. July 10.

Langwell. Manufacture of glass. 17,226. July 9.

Mohn. Oil-fired furnaces for melting glass etc. 17,458. July 11.

Rammage. Acid-resisting pipes, cylinders for scrubbers, towers, etc. 17,168. July 9.

COMPLETE SPECIFICATIONS ACCEPTED.

10,572 (1918). Roirant. Glass melting furnaces. (117,452.) July 9.

11,380 (1918). Norton Co. Aluminous abrasive. (121,721.) July 9.

21,557 (1918). Marks (Kohler Co.). Process of marking enamelled ware and products thereof. (129,206.) July 16.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Decroué. Artificial stone. 17,322. July 10. (Belgium, 30.10.15.)

Marriott. Manufacture of artificial rock asphalt. 17,110. July 8.

Mulligan. 17,287. *See* V.

Riley. Preparation of paving-materials. 17,102. July 8.

COMPLETE SPECIFICATIONS ACCEPTED.

10,801 (1918). Akerman. Manufacture of Portland cement. (128,750.) July 9.

10,878 (1918). Revello. Cementing substance. (128,755.) July 9.

18,960 (1918.) Horn. Methods of making concrete resistant to moisture. (120,918.) July 9.

19,988 (1918). Mehta. Manufacture of preservative for wood or the like. (128,843.) July 9.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Annable and Janson. Extraction of tin from its ores. 17,052. July 8.

Ashcroft. 17,247. *See* VII.

Ashcroft. Production of magnesium or alloys of magnesium and by-products. 17,248. July 9.

August. Means for annealing, tempering, etc. metal bars etc. 16,641. July 3.

Backer. Metal alloys. 17,320. July 10.

Ballantine. Production of chrome iron or chrome steel alloys. 17,190. July 9.

Brettell (Snead & Co. Iron Works). Heat treatment of metals. 16,849. July 5.

Brettell (Snead & Co. Iron Works). Method of developing defects in metallic objects. 16,850. July 5.

Brettell (Snead & Co. Iron Works). Heat-treating structural members. 16,851. July 5.

Broadley. 17,060. *See* I.

Cohn. Alloys. 16,813. July 4.

Eenberg. Alloy, and process for its manufacture. 17,326. July 10.

Frei and Von Wurstemberger. Manufacture of protecting-fluid for preventing corrosion of tubes etc. of copper etc. 16,411. June 30. (Switz., 21.7.18.)

Holslag. Electric arc-welding etc., and electrodes therefor. 16,404. June 30.

Holslag. 17,516. *See* XI.

Hyde. Smelting iron. 16,439. July 2.

Luttenschlager. Process for cementation of iron and steel. 16,585. July 2.

Mellor. Reduction of metals to powder. 16,833. July 4.

Mordey. Heat treatment of articles of iron and steel and alloys thereof. 17,117. July 8.

Rhodin. Process for electrolytically depositing copper etc. on aluminium and its alloys. 17,443. July 11.

Ritson. Crucible etc. furnaces. 17,349. July 10.

Rouse. Manufacture of iron and steel. 16,514. July 2.

Schaufelberg. Preservation of surfaces of metals etc. 16,461. July 2.

Sinclair. Metal-smelting furnaces. 16,588. July 2.

Wild. Testing hardness of ferrous metals. 16,401. June 30.

COMPLETE SPECIFICATIONS ACCEPTED.

1473 (1916). Craig, Moore, and Mather. Means for ascertaining the hardness of metals or other materials. (128,894.) July 9.

15,629 (1917). Soc. de Metallurgie Electrolytique. Apparatus for the electrolytic production of zinc, copper, or other metals. (128,676.) July 9.

1003 and 2787 (1918). Vautin, and Thermalloy, Ltd. Ignitable metallic mixtures. (129,046.) July 16.

11,002 (1918). O'Gorman and Thomas. Method of and apparatus for indicating the condition of steel and other metals when under heat treatment. (128,756.) July 9.

11,901 (1918). Rushen (Shimer and Richards). Case-hardening of metal. (129,144.) July 16.

13,663 (1918). Morley. Preservative preparations for the protection of metal surfaces (128,797) July 9.

14,350 (1918). Poole. Electro-magnetic separator. (129,166.) July 16.

18,818 (1918). Gregory. Process for the recovery of tin from tinned metals. (128,833.) July 9.

19,168 (1918). Ryding and Allen. Manufacture of open-hearth steel. (128,836.) July 9.

4482 (1919). Mathy. Rocking crucible furnaces. (128,874.) July 9.

4837 (1919). Dendrinos. Method for protecting iron, steel, and like metals or tools or articles made therefrom from oxidation when heated to a high temperature. (128,876.) July 9

XI.—ELECTRO-CHEMISTRY

APPLICATIONS

Ashcroft. 17,247. *See* VII.

Holslag. 16,404. *See* X

Holslag. Electrodes for electric welding, cutting, reducing, etc. 17,516. July 12.

Mond and Rabinovich. Electric batteries. 16,843. July 5.

Nodon. Process for electro-treatment of vegetable matters. 16,515. July 2.

Rhodin. 17,443. *See* X.

Rolands. Electrical dry cells. 17,472. July 12.

COMPLETE SPECIFICATIONS ACCEPTED.

11,154 (1917). Antonoff. Electric batteries. (128,600.) July 9.

13,544 (1917). British Thomson-Houston Co. (General Electric Co.). Electric furnaces. (129,014.) July 16.

13,918 (1917). Spear & Jackson, and Marriott. Electrode holder for electric furnaces. (129,027.) July 16.

14,215 (1917). British Thomson-Houston Co. (General Electric Co.). Electric furnace control apparatus. (129,039.) July 16.

15,629 (1917). Soc. de Metallurgie Electrolytique. *See* X.

10,658 (1918). Jenkins, and C.I. Syndicate. Electrolytic cells. (129,083.) July 16.

10,877 (1918). Price. Electric batteries. (129,104.) July 16.

14,350 (1918). Poole. *See* X.

3558 (1919). Joseph. Ozone generators. (128,867.) July 9.

11,486 (1919). Levin. Electrolytic gas generators. (126,640.) July 9.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Baker and Bonsall. Detergents. 17,356. July 10.

Barbet et Fils et Cie. 17,222. *See* XVIII.

Howse. Nitration of tung or other vegetable oils. 16,741. July 4.

King's Patent Agency (Stone). 16,594. *See* I.

Pritchard. Apparatus for separating and reclaiming oil from waste materials. 17,035. July 8.

COMPLETE SPECIFICATION ACCEPTED.

6729 (1918). Desborough and others. *See* XVIII.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Bienenfeld. Paint. 17,508. July 12.

Curtis. Stain made from leather waste. 17,037. July 8.

Ivinson and Roberts. Anti-corrosive paint or composition. 17,490. July 12.

Micanite & Insulators Co., and De Whalley. Recovery of varnish etc. from waste micanite etc. 16,907. July 5.

COMPLETE SPECIFICATIONS ACCEPTED.

12,342 (1917). Ward. Application of varnishes containing volatile solvents. (128,658.) July 9.

12,349 (1917). Groves and Ward. Dopes or varnishes used in aeroplane construction. (128,659.) July 9.

12,807 (1917). British Aeroplane Varnish Co., and Groves. Dopes or varnishes for aircraft construction. (128,974.) July 16.

14,126 (1917) Mond. *See* V

XIV. INDIA-RUBBER; GUTTA-PERCHA.

APPLICATIONS.

Fitzgerald. 17,057. *See* XV.

Galsman and Rosenbaum. Process of vulcanising caoutchouc etc. and compounds thereof. 16,340. June 30.

COMPLETE SPECIFICATION ACCEPTED.

384 (1919). Mellersh-Jackson (American Rubber Co.). Apparatus and process for vulcanising rubber goods. (128,852.) July 9.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATIONS.

Boston and Sons, and Fairrie. Liming hides. 16,672. July 3.

Curtis. 17,037. *See* XIII.

Fitzgerald. Substitute for horn, ebonite, vulcanite, etc. 17,057. July 8.

COMPLETE SPECIFICATION ACCEPTED.

19,121 (1918). Randall. Pits used for liming and tanning hides. (128,835.) July 9.

2136 (1919). Ratcliffe. *See* XVII.

XVI.—SOILS; FERTILISERS.

APPLICATION.

Guillaume. *Apparatus for manufacture of superphosphates etc.* 17,007. July 8.

XVII.—SUGARS; STARCHES; GUMS.

COMPLETE SPECIFICATION ACCEPTED.

2136 (1919). Ratcliffe. Adhesive paste. (129,220.) July 16.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATIONS.

Barbet et Fils et Cie. Continuous distillation of glycerine from weak alcoholic liquors of fermented liquids. 17,222. July 9. (France, 11.7.18.)

Crossman. Apparatus for mash filtration. 16,421. June 30.

COMPLETE SPECIFICATIONS ACCEPTED.

6729 (1918). Desborough, Reilly, and Thaysen. Manufacture of lactic acid and its salts and the recovery of the volatile fatty acid by-products. (128,687.) July 9.

10,220 (1918). Desborough, Reilly, Thaysen, and Henley. Manufacture of fermentation products. (128,714.) July 9

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Chalas. Dry and soluble extract of raw meat. 17,070. July 8. (France, 10.7.18.)

Fleming. Borax, boric acid, and lard recovery. 16,940. July 7.

Liénart. 16,383. *See* I.

Soc. Wauquier et Cie. Process for preserving potatoes etc. 16,406. June 30. (France, 15.1.19.)

COMPLETE SPECIFICATIONS ACCEPTED.

10,513 (1918). Thompson (Underwood and Illston.) *See* V.

11,010 (1918). Wallace and Prescott. Method of garbage disposal (117,267.) July 16.

14,329 (1918). Rushen (Naaml. Vennoots A. Jurgens Vereenigde Fabrieken). Emulsifying agent especially intended for use in the manufacture of margarine. (129,165.) July 16.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Baumann and Grossfeld. Process of recovering lecithine from organic compounds. 17,418. July 11.

Marks (Union Carbide Co.). Process of preparing ethylene dichloride. 16,488. July 2.

Marks (Union Carbide Co.). Process of making propylene dichloride. 16,489. July 2.

Papeteries Bergès Soc. Anon. Process for production of halogenated quinonic products. 16,988. July 7. (France, 18.3.19.)

White. Production of acetylene, acetaldehyde, etc. 17,434. July 11.

COMPLETE SPECIFICATIONS ACCEPTED.

11,876 (1917). Kerfoot, Kerfoot, Irvine, and Haworth. Manufacture of chlorhydrins. (128,635.) July 9.

13,874 (1917). Craig and others. *See* I.

13,880 (1917). Ricard. Manufacture of furfurol. (129,025.) July 16.

6729 (1918). Desborough and others. *See* XVIII.

9258 (1918). Morris & Co., and others. *See* XXII.

13,076 (1918). Du Pont de Nemours & Co. Process and apparatus for purifying camphor. (124,413.) July 16.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATION.

Kelley. Motion-picture films. 17,002. July 7. (U.S., 8.7.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

12,591 (1918). Christensen. Process of producing coloured photographic pictures and apparatus therefor. (128,781.) July 9.

4312 (1919). Gilpin. Process for preparing screens of canvas fabric or the like material used for kinematograph or projected pictures (128,873.). July 9

XXII.—EXPLOSIVES; MATCHES.

APPLICATIONS.

Flaherty. 17,082. *See* V.

Silberrad. Nitration of phenols. 17,280. July 10.

COMPLETE SPECIFICATIONS ACCEPTED.

12,845 (1917). National Explosives Co., and Bate. Manufacture of gun-cotton. (128,978.) July 16.

12,960 (1917). Wicks, Gray, and Turner. Pyrotechnic and like compositions. (128,986.) July 16.

14,160 (1917). Marin. Explosives. (129,036.) July 16.

1003 and 2587 (1918). Vautin, and Thermalloy, Ltd. *See* X

9258 (1918). Morris & Co., Morris, and Sable. Decolourisation and purification of trinitrotoluol and other crystallisable organic compounds, and apparatus therefor. (129,074.) July 16.

12,881 (1918). Hodgkinson. Production of azides. (129,152.) July 16.

20,180 (1918). Marin. Explosives. (121,294.) July 16.

4645 (1919). Johnston and Orr. Process for moisture-proofing matches. (129,228.) July 16.

XXIII.—ANALYSIS.

APPLICATIONS.

Foster. Radiation pyrometers. 16,651. July 8.

Ormandy. Colorimeters. 17,241. July 9.

Schneidermann. Pyrometer. 17,001. July 7.

Smith. 16,549. *See* I.

Wild. 16,401. *See* X.

COMPLETE SPECIFICATIONS ACCEPTED.

1473 (1916). Craig and others. *See* X.

5528 (1919). Crompton and Gallagher. *See* I.

I.—GENERAL; PLANT; MACHINERY.

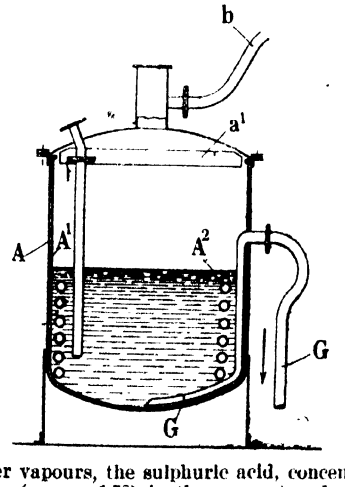
Kubierschky's [distilling, washing, etc.] apparatus. C. H. Borrmann. Z. angew. Chem., 1919, **32**, 149—155.

THE remarkably efficient results obtained by Kubierschky's system of treating gases or lighter liquids with heavier liquids, which was previously described (this J., 1915, 1232), have been confirmed in recent practice. The system has been applied to the washing of coke-oven gases, the separation of tar from producer gases (in which case it is advantageous to employ two washers in series working at different temperatures), the cooling of blast-furnace gases, and in Gay-Lussac towers. In the construction of condensers for evaporating vessels and steam engines, the mixing of the hot vapours and air with the cooling water is performed on a similar principle. Distillation columns constructed according to Kubierschky's system have had remarkable success. This is particularly notable in the case of bromine stills (this J., 1914, 135), where the yield of bromine has been increased from 55—60% up to 98%. In the distillation of coal tar and petroleum oils, the liquid is heated in a small external vessel and the vapours are passed into the distillation column which is heated at 315° C. with superheated steam. The formation of coke in the still is thus prevented and pitch can be obtained of any desired constant degree of hardness. The separation of the different fractions of oil is very sharp. For the extraction of liquids with liquids, the Kubierschky washing column (illustrated *loc. cit.*) is most efficient and can operate sharply at a difference in sp. gr. of only 0·022 between the two liquids. In the recovery of mixed volatile solvents extremely satisfactory results have been obtained in plants designed on Kubierschky's system, the solvents being regenerated in their original proportions in a continuous manner. Apparatus for the continuous manufacture of absolute alcohol by distillation with addition of benzene is also illustrated.—J. F. B.

PATENTS.

Ether and alcohol vapours; Process and apparatus for recovering waste — — from the atmosphere in factories and the like. E. Barbet et Fils et Cie., Paris. Eng. Pat. 117,259, 19.6.18. (Appl. 10,116/18.) Int. Conv., 20.6.17. Addition to Eng. Pat. 101,723 (this J., 1918, 45 A).

IN order to effect a more complete absorption of



the ether vapours, the sulphuric acid, concentrated to 53° B. (sp. gr. 1·58) in the apparatus described in the original patent, is run whilst hot into a lead-lined vacuum still, A, provided with a lead heating worm, A^2, and further concentrated *in vacuo* to 61° B. (sp. gr. 1·73) at a temperature not exceeding 130° C., and is then drawn off through G to a cooler and thence into the absorption apparatus previously described. The ether vapours leave the vacuum still through the pipe, *b*, and are either condensed or returned to the absorber. To prevent the lead lining, A^1, from being detached by the action of the vacuum, its upper edge is not inserted in the cover joint of the still, and to prevent splashes of acid entering between the lead lining and the plates of the still a circular drip collector, a^1, is provided which returns any splashings etc. to the interior.—G. F. M.

Ether, alcohol, and acetone; Recovery of one or more of the volatile bodies — from gaseous mixtures. A. Daniel and J. H. Pregent, Paris. Eng. Pat. 127,309, 11.4.17. (Appl. 5089/17.) Int. Conv., 8.7.16.

THE vapours of ether, alcohol, or acetone are recovered from gaseous mixtures by absorption in phenol or its homologues, preferably the crude cresol of commerce, by means of a systematic counter-current washing in three scrubbers arranged in series, the cresol being sprayed in at the top of each tower and pumped up from a reservoir at the base to the top of the next, whilst the gaseous mixture is drawn in the opposite direction by means of an aspirator. The volatile substances are recovered from the cresol, with which they form molecular compounds, by passing through a steam heater, and, to remove the last traces, injecting steam into the cresol under a distillation column. The ether, alcohol, or acetone vapours from the heater and the column are led into a condensing apparatus whilst the cresol is returned to the top of the first scrubber.—G. F. M.

Volatile solvents; Recovery of — —. H. J. Pooley, and G. Scott and Son (London), Ltd., London. Eng. Pat. 127,909, 22.6.17. (Appl. 9005/17.)

IN processes involving the removal of volatile solvents in a heated drying chamber, the whole of the air (or gas) in such chamber is circulated rapidly by a large fan, and a small proportion only is continuously removed by a smaller fan from that part of the chamber where the proportion of solvent is likely to be greatest, passed through a recovery plant, re-heated, and returned to the chamber. Heat is conveniently applied to the bulk of the air at a point in the suction pipe of the large fan.—B. M. V.

Separating suspended particles from gaseous bodies. Huntington, Heberlein, and Co., Ltd., and H. J. Bush, London, and H. A. Burns, Finchley. Eng. Pat. 127,119, 4.6.18. (Appl. 9195/18.)

IN an electrical dust separator, the gases to be freed from suspended particles are mixed with dust of an electro-conductive character so as to ensure that the deposit formed on the receiving electrode is electro-conductive and that a proper "corona" discharge is maintained. In treating blast-furnace gases an addition of 5—10% of the dust originally carried by such gases yields satisfactory results.—J. H. P.

Refrigerating apparatus. B. E. D. Kilburn, London. From Sulzer Frères Soc. Anon., Winterthur, Switzerland. Eng. Pat. 127,512, 19.12.18. (Appl. 21,205/18.)

A REFRIGERATING apparatus particularly suitable for breweries and dairies consists of two refrigerating machines in which the cooling water discharge

of the first machine is connected to the condenser and also to the evaporator of the second machine and the discharge of the cooled water from the evaporator of the second machine is in turn connected to the cooling water supply of the first machine. By this means the second machine can be utilised as a mechanical heat-generating plant to bring the condenser water from the first machine to a temperature such that it can be used for feed water or other useful purpose. Further, by this means the condenser water from the first machine is cooled in the evaporator of the second machine, so that it can be used again as cooling water in the first machine.—J. H. P.

Liquids and gases; Apparatus for effecting intimate contact between —— ——. Kirkham, Hulett and Chandler, Ltd., and S. Hersey, London. Eng. Pat. 127,705, 31.5.18. (Appl. 9065/18.)

In the apparatus described in Eng. Pats. 18,129 of 1908 (this J., 1909, 873, which see for fig.) and 7958 of 1913 (this J., 1914, 341) the scooping and spraying tubes, *g*, are extended above the trays, *d*, and splayed or perforated in any of various ways described in the present patent, thus increasing the effective depth of each spraying zone.—B. M. V.

Wet filtering or otherwise treating air or gas with liquid; Apparatus for ——. A. B. Cleworth, Hollinwood. Eng. Pat. 127,977, 10.6.18. (Appl. 9515/18.)

In the apparatus described in Eng. Pat. 115,521 (this J., 1918, 359A), instead of rotating the expanded metal screens in a trough of water or other liquid, moistening may be effected by means of sprays fed with liquid from an external source or returned by a circulating pump; the filter screens may then, if desired, be stationary, formed of such shape that material is not wasted, and placed at any angle; the current of gas may also pass through them at any angle.—B. M. V.

Evaporating or drying apparatus. The Salt Union, Ltd., and G. W. Malcolm, Winsford. Eng. Pat. 127,951, 5.6.18. (Appl. 9298/18.)

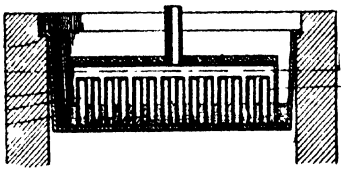
An evaporating pan (more particularly for brine) is made with inclined sides, so that the salt falls to the trough-like bottom, where it is pushed by a conveyor to one end of the pan and removed by an elevator. Heat may be applied by means of flues under the sloping sides, the hot gases passing first along the upper parts of the inclined sides, then returning (at the elevator end) along the lower parts, the extreme bottom not being heated at all, to avoid overheating the conveyor. This arrangement causes the liquid to circulate downwards in the centre, thus in many cases making hand or mechanical scraping unnecessary to push the salt to the bottom. By taking the flues not quite to the elevator end of the trough, the salt deposits more freely and is of better grain.
—B. M. V.

Dehydrating metal salts [evaporating dilute solutions to dryness]; Means for ——. M. J. Kermer, Assignor to Cannon-Swensen Co., Inc., Chicago, Ill. U.S. Pat. 1,303,682, 13.5.19. Appl., 13.12.17.

The solution is heated under pressure and sprayed into the mouth of an inclined, rotary cylinder through which the gaseous products of combustion from an adjacent furnace are drawn.—W. E. F. P.

Distilling hydrocarbons or other liquids; Apparatus for ——. S. E. Kelsey, Kansas City, Mo. U.S. Pat. 1,302,669, 6.5.19. Appl., 20.9.16.

A superheater (see fig.) for use in distillation consists of a vessel having an inlet and an outlet, and a removable inverted elongated duct or channel open at the bottom throughout its entire length,



the lower portion of the duct being sealed by means of liquid in the vessel.—L. L. L.

Drying room. F. A. Lippert, Assignor to Wenborne-Karpen Drying Co., Chicago, Ill. U.S. Pat. 1,303,078, 6.5.19. Appl., 22.4.16.

The articles to be dried are conveyed lengthwise through an elongated drying chamber through which heated air circulates transversely to the length of the chamber. The ends of the chamber are partly closed, openings approximating in shape and size to the articles to be dried and the conveyor being left.—J. H. P.

Drying materials; Apparatus for ——. H. E. Hollister, Irvington, Assignor to Kalbfleisch Corp., Elizabeth, N.J. U.S. Pat. 1,304,182, 20.5.19. Appl., 17.7.17.

The apparatus consists of a series of cars placed in a tunnel, with partitions arranged to form a continuous air passage leading through the cars successively in opposite directions across the tunnel. Heated air is forced through the passage and means are provided to prevent the formation of strata of cold and warm air in the passage.—J. H. P.

Powdered and granular material; Treatment of —— with liquids in a shaking-trough. H. Stegmeyer. Ger. Pat. 310,811, 12.4.16. Addition to Ger. Pats. 303,475 and 305,237.

In using the process and apparatus described in the earlier patents (this J., 1918, 401A, 427A), the return of the liquid to the shaking-trough or the addition of fresh liquid is effected by means of special devices such as pumps, injectors, or the like, the requisite valves, cocks, and piping and, if necessary, storage tanks being also provided.
—T. H. Bu.

Filter material; Process and apparatus for scouring granular —— by means of compressed air and water. K. Morawe, Berlin-Friedenau. Ger. Pat. 311,593, 5.10.16.

The volume and pressure of the scouring media are separately or jointly adjusted, manually or automatically, according to the varying resistance offered by the filter material, this depending upon the size of the grains and the thickness of the filter bed. The upward velocity of the scouring medium is such as to afford a thorough washing of the material, but is insufficient to carry over any of the filter material. The complete removal of slime from the filter material is considerably accelerated by the process.—J. S. G. T.

Mixing and moving concrete and other materials. C. Kearton, Canterbury, and E. L. Hann, Cardiff. Eng. Pat. 127,956, 6.6.18. (Appl. 9309/18.)

Oil filters. R. W. and S. Roots, Ballarat, Victoria, and J. Falconer, Wellington, N.Z. Eng. Pat. 128,151, 13.2.19. (Appl. 3596/19.)

Centrifugal machine. R. A. Sturgeon, Southsea. U.S. Pat. 1,304,621, 27.5.19. Appl., 10.2.19.

See Eng. Pat. 123,797 of 1918; this J., 1919, 276 A.

Furnace; Regenerative tipping ——. A. M. Aubert, Billancourt, France. U.S. Pat. 1,304,725, 27.5.19. Appl., 21.10.18

See Eng. Pat. 120,559 of 1918; this J., 1919, 224 A.

Filter medium or other article of manufacture. E. J. Sweetland, Montclair, N.J. U.S. Pat. 1,304,918, 27.5.19. Appl., 9.6.15.

See Eng. Pat. 7469 of 1915; this J., 1916, 729.

Distilling apparatus. E. A. Chenard, Cognac, France. U.S. Pat. 1,307,184, 17.6.19 Appl., 5.5.13.

See Fr. Pat. 443,499 of 1912; this J., 1912, 971.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Methoxyl content of —— F. Fischer and H. Tropsch. Ges. Abhandl zur Kenntnis der Kohle, 1917, II., 151—153. Chem. Zentr., 1919, **90**, II., 614.

Earlier attempts to identify the methoxyl group in coals failed owing to the lack of a suitable solvent. The authors have treated a number of coals in presence of phenol (Weishut, Monatsh. Chem., **33**, 165) to determine the methoxyl group, using pyridine to dissolve the methyl iodide Various types of bituminous coal, anthracitic coal, cannel, lignite, Rhenish lignite ("Union briquettes"), a lignite almost completely soluble in alkali, lignite from Riebeck's montan-wax works, and peat were examined. The true coals, including cannel, yielded no trace of methyl iodide and so contain no methoxyl groups The percentages of CH_3 split off from the other samples (moisture-free) were: Lignite 1·88%, Union briquettes 0·8%, alkali-soluble lignite 0·22%, Riebeck's lignite 0·1%, peat 0·84%. Low-temperature tars from Union briquettes, peat, and coal were all found to be free from methoxyl. It is concluded that there is a relation between the methoxyl content of coal and that of its distillation products.—H. J. H.

Pitch dust; Skin disease due to —— *in briquetting factories.* P. M. Grempe. J. Gasbeleuchtung, 1919, **62**, 243—244.

In briquetting factories where the pitch is used in a fluid condition, pitch disease is absent In the Fohr-Kleinschmidt briquetting process, soft pitch is used as binding medium. It is atomised in the fluid condition by means of air and steam, and the fine particles mixed with the other briquetting materials in a rotating chamber. About 20% of tar is added to the pitch A saving of pitch of at least 20% is effected by the process, and the briquettes possess the advantage over those manufactured from hard pitch in that the gases produced by the combustion escape more readily. (See also this J., 1919, 336 A.)—J. S. G. T.

Water-gas production in horizontal retorts. E. Goffin. J. Gasbeleuchtung., 1919, **62**, 253—261.

Particulars are given of the installation of five new settings of horizontal retorts at the Heddernheim gas-works of the municipality of Frankfort, whereby the output of gas was increased from 10,500 cub. m. to 20,200 cub. m. per 24 hours, with very little disturbance of the previously existing installations. The retorts could be steamed, and for this purpose a volume of 3·5 cub. m. of water per 24 hours was employed. The area of the heated surface of the boiler was 12·50 sq. m. and the steam was generated at 0·5 atmosphere excess pressure. The retorts were fully charged with from 420 to 450 kilos. of Saar coal, and the production of water-gas was continued over a period of 9½ hours. The electric power employed per ton of coal in charging and discharging was about 0·3 kilowatt per hour. The yield of gas due to steaming was 52·8 cub. m. (at 15° C. and 760 mm. pressure), of gross calorific value 4600 calories per cub. m. per 100 kilos. of coal. Steaming does not affect the life of a setting, for no repairs were necessary to the first setting steamed over a period of 1200 working days. There is very little retort carbon, and this is removed about 2 or 3 times per annum. The yield of ammonia is considerably increased, and the yield of tar is from 5 to 6 kilos. per 100 kilos. of coal gasified. The tar is very fluid and is composed of about 1·5% of water, 3·7% of light oil, 22·1% of middle and heavy oil, 16·4% of anthracene oil, with 56·3% of pitch (m.pt. 58° C.). Results obtained by E. Terres, operating the retorts with and without steaming respectively, are detailed. Without steaming the coal was heated for 8½ hours the first day and for 8 hours on each of two subsequent days. In the steaming experiments, the coal was heated for 10 hours on the first day, and for 9½ hours on each of three subsequent days, these periods including 7 hours' steaming on the first day, 4 hours on the second, 6 on the third, and 7½ on the fourth day. The coal employed in the steaming experiments (air-dried) contained 1·28% of water, 7·99% of ash, and 90·73% of combustible matter, whilst that employed in the experiments without steaming contained water 1·40%, ash 8·48%, and combustible matter 90·12%. The calorific value of the coal was 7200 calories per kilo. With steaming, the average composition of the gas was 5% of carbon dioxide, 2·6% of heavy hydrocarbons, 10% of carbon monoxide, 51·2% of hydrogen, 25·6% of methane, and 5·6% of nitrogen Without steaming, the gas contained 3·2% of carbon dioxide, 3·7% of heavy hydrocarbons, 8·3% of carbon monoxide, 48·6% of hydrogen, 31·0% of methane, and 5·2% of nitrogen. With steaming, the yield of gas (measured throughout at 15° C. and 760 mm. pressure) per setting per 24 hours was 4156 cub. m. and per retort per 24 hours 472 cub. m. The yield of gas was 48·35 cub. m. per 100 kilos. of air-dried coal The yield of coke was 66·20%. The coke used for firing amounted to 16·29 kilos. per 100 kilos. of raw coal. The specific gravity of the gas was 0·519, its gross calorific value 4642 calories. Without steaming the results obtained were:—Yield of gas per setting per 24 hours, 3610 cub. m., and per retort per 24 hours, 401 cub. m The yield of gas was 33·71 cub. m. per 100 kilos. of dried coal, the yield of coke 68·45%. The coke used for firing amounted to 10·22 kilos per 100 kilos of raw coal. The specific gravity of the gas was 0·490, its gross calorific value 5605 calories.—J. S. G. T.

"Tri-gas" process; Results obtained in long period working of the . *with recovery of low-temperature tar and ammonia.* A. Pott and E. Dolensky. J. Gasbeleuchtung., 1919, **62**, 261—263.

The direct conversion of bituminous coal into water-gas, or a gas resembling water-gas, is successfully achieved in the Dellwik-Fleischer "Tri-gas" process (this J., 1916, 538). In this process it is essential that the appropriate temperatures be maintained at specific parts of the producer. Subsequent to the erection of a "Tri-gas" producer in Vienna, the gas production of which was 80—150 cub. metres per hour, a plant comprising three producers, each of ten times this capacity,

and provided with revolving grates, was erected and was in practically continuous operation for five months from April 6, 1918, during which period the operation of the plant was eminently satisfactory. The plant was operated during this period with a strongly caking gas coal, employed either alone or in conjunction with lignite briquettes, coke, or with the addition of 25% of raw lignite. The coal employed yielded 11% of ash, 5·5% of water, and its calorific value was 6850 calories. The raw lignite contained 55% of water, its ash content was 3·15%, and its calorific value about 2300 calories. The producers were worked at a medium temperature, a gas of calorific value between 2800 and 3000 calories being produced together with a good quality low-temperature tar. The yield of gas was about 1·8 cub. metre per kilo. of fuel. The average composition of the gas was carbon dioxide 13·3%, sulphur compounds 0·3%, oxygen 0·4%, carbon monoxide 23·9%, methane 5·5%, hydrogen 51·5%, nitrogen 5·1%. The calculated calorific value is 2883 calories. When coal alone was employed, a gas of calorific value 3875 calories was produced, the producers being operated at a higher temperature. An increase in the calorific value of the gas is accompanied by a depreciation in the value of the low-temperature tar obtained. The "through-put" of each producer varied between 12 and 15 tons per 24 hours, hand stoking being employed throughout the period. Employing mechanical stokers, a "through-put" of from 15 to 20 tons could be realised. The tar obtained contains no naphthalene, and is port-wine red in colour by transmitted light. Its specific gravity is 1·01 at 15° C.; it is completely soluble in benzene, and to the extent of about 62% in benzine. It contains from 35 to 40% of phenols and resin acids. By vacuum distillation it yields 26·7% of fuel oil and lubricating (spindle) oil, 32·5% of a very viscous lubricating oil, 3·3% of solid paraffins, 11·5% of resin, and 26·0% of pitch. The yield of water-free tar from the mixture of coal and 25% of raw lignite was between 5 and 6%.—J. S. G. T.

Gas mains and services; Interim report on the internal corrosion of —. Life of Gas Meters Joint Committee of the Institution of Gas Engineers. Gas J., 1919, **146**, 622–624.

The report amplifies the information concerning the corrosion of the metal parts of meters, contained in an earlier report of the Committee (see this J., 1918, 759A). The dust found in mains, services, governors, and meters is chiefly composed of iron oxide. From analysis of a number of samples of such deposits it is concluded that they do not arise owing to oxide employed for purification being carried forward with the gas, but are to be attributed to corrosion. It is suggested that such corrosion arises partly from the absence of lime purification, hydrocyanic acid being carried forward with the gas, and partly from the impoverishment in oily constituents of modern gas. The primary agent producing corrosion is hydrocyanic acid, the prejudicial effect of which is much increased by the presence of oxygen, carbon dioxide playing a lesser part. The presence of moisture is essential to corrosion, and a test case in which water vapour was removed from the gas by compression to 50 lb. per sq. in., followed by cooling and subsequent expansion into the mains at 5 lb. pressure only, revealed complete absence of corrosion and naphthalene deposits. Hydrocyanic acid in the presence of steam and hot coke yields ammonia and carbon monoxide. This process, practised in the steaming of retorts, would afford some measure of protection against corrosion. Alternatively the dry gas meters should be lubricated with atomised paraffin oil as recommended in the previous report (*loc. cit.*). Tables showing the amount of water vapour contained in saturated gas between 32° F. (0° C.) and 100° F. (38° C.) and gauge pressures between 0 and 50 lb. per sq. in. are given.—J. S. G. T.

Gas; Relative efficiencies in use of different grades and compositions of —. Second report of the Research Sub-Committee appointed by the Gas Investigation Committee of the Institution of Gas Engineers. Gas J., 1919, **146**, 607–618. (See this J., 1918, 681A.)

The first section of the report deals with the results of tests carried out at the Uddingston gas-works using gas made by steaming continuous vertical retorts and washed for benzol recovery before use. It represented a yield of 30,000 cub. ft. of gas per ton of Lanarkshire coal carbonised, and varied in calorific value from 385 B.Th.U. to 394 B.Th.U. gross per cub. ft. Efficiency tests were made with ring burners and with upright and inverted incandescence burners. In all cases the only modification necessary to render existing appliances suitable for use with the gas consisted in broaching out the nipples so as to give a larger divergent orifice. The results obtained with ring burners showed that the gas in question gave as good a thermal efficiency as any other grade of gas hitherto experimented with, when used with a suitable modification of the burner; that there are no unusual difficulties in manipulating burners in which the gas is used, and that the value in ring burners of different gases is directly proportional to the potential heat units they carry. The candle powers with both the upright and inverted burners were determined in a horizontal direction only. It was found that burners correctly designed for gases of 500 B.Th.U. per cub. ft. and upwards, when modified by enlarging the nipple orifices, can be used without difficulty at pressures under 20/10ths water column for gas of 400 B.Th.U. gross per cub. ft., and with such modified burners no unusual manipulation troubles are encountered. With the "C" size mantle a thermal efficiency of about 29 B.Th.U. per candle-hour is obtained with the low-grade gas. The second section of the report is devoted to a direct continuation of the lighting section of the first report (*loc. cit.*), and deals with the relative efficiencies in use of different grades of gas. Tests were made employing mixtures of coal gas and blue water-gas in various proportions, the calorific values of the mixtures varying between the limits 618 B.Th.U. gross, 556 B.Th.U. nett, and 291 B.Th.U. gross, 267 B.Th.U. nett. These tests were carried out with an upright burner, fitted with "C" size mantle, and a plain cylindrical chimney 6 in. high by 1¼ in. diameter. No alteration of the burner was made to meet the requirements of any particular grade of gas. The normal gas supply to the burner is computed at about 2000 B.Th.U. per hour, and tests were made in which the energy supply to the burner was varied with different gases between the limits 1600 and 3600 B.Th.U. per hour. The anticipated efficiency of from 27 to 28 B.Th.U. per candle-hour was attained, and in some cases surpassed, but the experiments showed that completely satisfactory comparison of the different gases can only be attained when each is permitted to exercise its maximum duty in an appliance properly adapted to its use.—J. S. G. T.

Toluene and xylene; Isolation of — from petroleum fractions by means of liquid sulphur dioxide. J. Tausz and A. Stüber. Z. angew. Chem., 1919, **32**, 175–176.

The solubility in liquid sulphur dioxide of the saturated hydrocarbons in fractions of petroleum

oil free from aromatic hydrocarbons was determined, with the following results: American lamp oil, 1·8%; Russian lamp oil rich in naphthenes, 3·6%; and American ligroin (petroleum spirit), 10·1% calculated on the amount of oil. Since paraffin and naphthene hydrocarbons are soluble, although only to a small extent, in liquid sulphur dioxide, no sharp separation of these hydrocarbons is practicable by this method, as claimed by Edeleanu (this J., 1914, 343). It was found possible, however, to separate toluene and xylene from a Rumanian petroleum oil by the following physical method:—The distillation fractions corresponding with the respective hydrocarbons were dissolved in liquid sulphur dioxide at a low temperature (−80° C. for toluene and −15° C. for xylene), and repeatedly shaken with successive portions of petroleum spirit of low boiling point, previously chilled to −80° C. or −15° C. This dissolved the saturated hydrocarbons and a portion of the aromatic hydrocarbons. Finally the residual sulphur dioxide layer was separated, and after evaporation of the bulk of sulphur dioxide was fractionally distilled, and yielded fractions containing the bulk of the toluene or xylene in relatively pure condition.—C. A. M.

Hydrocarbons; Pyrogenic decomposition of —. W. Gluud. Ges. Abhandl. zur Kenntnis der Kohle, 1917, II., 261–294. Chem. Zentr., 1919, **90**, II., 616.

From a critical survey of the literature of the subject, including the decomposition of single compounds, complex mixtures, and condensation reactions, and from the author's own experience, it is concluded that naphthalene is not a primary product of coal distillation. The primary products of carbonisation in coke ovens are probably relatively simple molecules or molecular fragments which yield naphthalene by subsequent polymerisation or condensation.—H. J. H.

Fuel oils and motor spirits, Calorific values of various. S. Hilpert. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 269–270. Chem. Zentr., 1919, **90**, II., 621.

The following figures were obtained by the use of the Mahler calorimetric bomb:—Oil from lignite gas-producer tar obtained by distillation with superheated steam: fraction 200°–320° C., 9160 and 9110 cals.; hydrocarbon constituents of fraction 200°—320° C., 9960 and 9930 cals.; cresol constituents of same fraction 8390 cals. Marine fuel oil (Ges. für Teerverwertung) 9240 cals.; marine fuel oil (Krey) 10,350 cals.; lignite gas-producer tar 8140 cals.; middle oil from lignite tar 10,430 cals.; petroleum spirit (benzine) 10,840 cals.; oils from paraffin: light benzine 10,780 cals.; heavy benzine 10,850 cals.; middle oil 10,820 cals.—H. J. H.

Montan wax; Increasing yield of — *by extraction of lignite under pressure. Part* 2. W. Schneider and H. Tropsch. Ges. Abhandl. zur Kenntnis der Kohle, 1917, II., 57—64. Chem. Zentr., 1919, **90**, II., 619. (See also this J., 1916, 1001.)

By heating lignite from Central Germany to 250° C. a portion of the bitumen insoluble at ordinary pressures becomes soluble in benzene. This is probably due to an insoluble polymerised form of bitumen being "cracked" and thereby rendered soluble in benzene. The change is accelerated by the presence of benzene, no advantage resulting from a quantity greater than 20—30% of the weight of coal used. Rhenish lignite ("Union briquettes") behaved differently; heating to 250° C. did not produce the soluble modification, and even in the presence of benzene the increase in yield of soluble bitumen was less marked. The relation between the portion of bitumen extracted by boiling benzene at ordinary pressures and that extracted at increased pressure, from different lignites, was found to vary considerably.—H. J. H.

Emulsification of water [in kerosene] and solutions of ammonium chloride by means of lampblack. W. C. Moore. J. Amer. Chem. Soc., 1919, **41**, 940–946.

Weighed quantities of lampblack, both the commercial article and that previously extracted with benzene, were stirred for measured times with kerosene together with water or solutions of ammonium chloride of known concentration. The emulsions thus obtained, in which kerosene was the continuous phase, were examined under a micrometer microscope and the diameter of the aqueous drops measured. Various samples of lampblack have widely differing emulsifying properties. With a large quantity of lampblack smaller emulsified drops of water are obtained in kerosene than when less lampblack is used. Water wets commercial lampblack less readily than the extracted lampblack. Ammonium chloride in *N*/1 solution wets commercial lampblack more readily than the purified substance. Water wets purified lampblack more readily, but commercial lampblack less readily, than does ammonium chloride solution. The drops of emulsified water become larger the greater the concentration of ammonium chloride owing to the increasing surface tension of the ammonium chloride solution. The effect of changing the time of stirring is somewhat indefinite; a tendency is shown for the size of the drops to pass through a minimum as the time is increased.—J. F. S.

Kuhnerschkyi's apparatus. Borrmann. *See* I.

Tar oils for lubricating. Hilpert. *See* III.

Lubricants from naphthalene. Fischer. *See* III.

Ammonia from coke-oven. Fischer and Niggemann. *See* VII.

Carbon dioxide in coke oven ammonia liquor. Hilpert. *See* VII.

Crushing strength of firebricks. Emery and Mellor. *See* VIII.

Fusion point of coal ash. Lovejoy. *See* XI.

Micro-analysis. Strebinger and Radlberger. *See* XXIII.

PATENTS.

Fuels; Artificial —. J. E. Taylor, London. Eng. Pat. 127,775, 10.10.18. (Appl. 16,503/18.)

A fuel which burns slowly but brightly, producing but little smoke, is made from the following materials in the proportions stated. Palm nut shells and pericarp residues, 2 cwt.; potash (called "lubee") obtained by burning the trunk of the palm tree, 7 lb., making in solution with water, 14 gallons; coal dust, charcoal, or the like, 1 cwt.; clay or loam, 3 cwt. Sodium carbonate may be used instead of potash.—T. H. B.

Fuel; Preparation of —— in briquetted form for utilisation in carbonisation, gasification, and the like. W. E. Davies, Treorchy, Glam. Eng. Pat. 127,940, 31.5.18. (Appl. 8969/18.)

Coal containing 10—40% of volatile matter is mixed with up to 10% of its weight of a resinous binder, and the mixture is formed into briquettes, which are bored or perforated so as to increase their surface, and coked under a suction of 0·25 to 12 in. of mercury. The finished briquettes should contain 6–18% of total resinous matter.—T. H. B.

Fuel; Artificial — and process of making the same. A. W. Goulding, Trenton, N.J., Assignor to E. S. Mead, Philadelphia, Pa. U.S. Pat. 1,305,209, 27.5.19. Appl., 12.7.18.

Finely divided coal, sulphite pitch, and clay are mixed together in the proportion of 2000 lb. of coal to 70 lb. each of the other constituents.—T. H. B.

Fuel, and process of making the same. O. Meyers, Watts, Cal. U.S. Pat. 1,305,392, 3.6.19. Appl., 28.3.18.

Bituminous tarry material is heated until fluid, powdered limestone is then added, along with a finely divided carbonaceous material. The mass is cooled by adding water, again heated until soft, and moulded into briquettes.—T. H. B.

Coke oven. P. Plantinga, Cleveland, Ohio. U.S. Pat. 1,304,597, 27.5.19. Appl., 15.8.17.

The oven has a pair of inclined combustion chambers, with a partition wall between, the sides of the chambers contiguous to the wall being constructed of joined elements with the joints extending in the direction of general inclination of the chambers and at right angles thereto. The partition wall is also constructed of joined elements, the joints of the latter being horizontal and vertical. (See also U.S. Pat. 1,255,047; this J., 1918, 200 A.)
—T. H. B.

Retort carbon; Process and apparatus for loosening — — from retort walls. R. Krantz, Eibenstock. Ger. Pat. 311,496, 25.11.16.

The retort carbon is loosened more especially from the rear and mid portions of the retort by means of steam generated in a bowl-shaped vessel, the water contained therein being vaporised by heat derived from the walls of the retort. A water feed is connected to the steam-generating vessel. A canopy is arranged above the steam generator, and serves to cause the steam to penetrate as deeply as possible into the retort carbon.—J. S. G. T.

Ammonia; Process and apparatus for increasing the yield of — — in the gasification of air-dried fuel. T. Grethe, Hanover. Ger. Pat. 311,694, 23.1.17.

Any parts of the gas producer at which an unduly high temperature may be developed are kept cool by the introduction of moist fuel into the producer through channels or tubes arranged below a hopper, pistons being operated in the tubes to supply regulated quantities of moist fuel.—J. S. G. T.

Liquid hydrocarbons; Distillation of — — and apparatus therefor. J. H. Corthesy and S. T. S. Castelli, London. Eng. Pat. 127,690, 1.5.18. (Appl. 7315/18.)

Crude petroleum or other oil is fed into the top of a cylindrical still through a number of perforations; the unvolatilised portion is discharged at the bottom and the vapours pass out through a pipe at the top to a condenser. A portion of the vapour is drawn off from the outlet pipe by means of a suction fan, and, after passing through a superheater within the furnace, is led into an annular space around the still and thence into the still through a series of tangential slits, whereby a whirling or vortex action is produced within the chamber and unvolatilised particles are thrown by centrifugal force towards the walls. In place of a single cylinder, the still may contain a series of superposed cylinders in which the oil is heated to successively higher temperatures as it passes down the series, and each chamber is provided with a separate vapour outlet and fan which returns a portion of the vapour to its respective cylinder; or two or more separate cylinders may be provided, of which the first alone is heated by a furnace, and the vapour generated therein, after being superheated, is passed directly into the remaining cylinders.—L. A. C.

Briquettes or other moulded articles; Process of making —. C. Ellis, Montclair, N.J., Assignor to Ellis-Foster Co. Reissue 14,653, 27.5.19, of U.S. Pat. 1,246,805, 13.11.17. Appl., 21.3.19.

See this J., 1918, 48A.

Gas; Scrubber, cleanser, and cooler for — —. D. J. Smith, London. U.S. Pat. 1,307,321, 17.6.19. Appl., 29.11.18.

See Eng. Pat. 120,684 of 1917; this J., 1919, 5A.

Distilling hydrocarbons. U.S. Pat. 1,302,669. *See* I.

Hydrogen. Eng. Pat. 127,018. *See* VII.

Gas for welding etc. U.S. Pat. 1,303,891. *See* X.

Mineral oil sulphonic acid. U.S. Pat. 1,303,779. *See* XII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Coal; Distillation of —— in hydrogen at high pressures and temperatures. F. Fischer and K. Keller. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 148—154. Chem. Zentr., 1919, **90**, II., 517.

On heating coal in the presence of hydrogen under pressure the yield of coke decreased with rise of temperature and pressure. The yields of volatile hydrocarbons and tar were increased. A maximum yield of 30% of tar and ammonia liquor was attained, nearly 75% of the coal being converted into volatile products. The proportion of ammonia water in the mixture with tar was judged to be at the most one-third. When the formation of tar had ceased, the quantity of coke further decreased with the formation of hydrocarbons. This is in agreement with the results of Pring and Fairlie (this J., 1912, 862), who found that carbon was converted into methane when heated in hydrogen under pressure.—H. J. H.

Bituminous lignite; Distillation of —— in vacuo. W. Schneider and H. Tropsch. Ges. Abhandl. zur Kenntnis der Kohle, 1917, II., 28—35. Chem. Zentr., 1919, **90**, II., 617—618.

Samples of lignite (Riebeck's montan-wax works), both crude and extracted with benzene, and also the bitumen or crude montan wax, were distilled *in vacuo*. The products were fractionally con-

densed, cooling by air, ice-salt freezing mixture, and liquid air being employed. Distillation began at 155° and ended at 330° C. The bitumen could not be distilled without decomposition. The lignite, distilled under reduced pressure, gave a good yield of viscous oils, which is in contrast to its behaviour under normal pressure. The results with crude and extracted lignite were similar; in the latter case acid products were more prominent in the tar, owing to the absence of the decomposition products of montan wax. The crude lignite gave 30·1% of tar, 8·7% water, 46·8% coke, and 14·4% gas and loss. The vacuum tar was light brown and set at 53° C. By extraction with acetone, followed by cooling to 0° C., 30·6% of a light grey paraffin-like mass separated (setting point 57°–58° C.). The solution was freed from acetone by distillation, and the tar acids separated by extraction with alkali and acidification. Altogether the yield of viscous oils equalled 55% of the tar. By extraction of the crude lignite with benzene, 15·1% of bitumen was dissolved. By vacuum distillation of the extracted lignite at 215°—370° C. and 15 mm., the yields were: tar 22·2%, water 8·3%, coke 58·8%, gas and loss 10·7%. The vacuum tar set at 42°–44° C., 20% was insoluble in acetone at 0° C., while the yield of viscous oils was 58%, of which 17% consisted of tar acids. Crude montan wax distilled from 100°—315° C. at 4 mm., giving 81·9% tar, 5·5% water, 5·7% coke, and 6·9% gas and loss. The first part (69·4%) was a bright yellow solid setting at 61°—62° C.; the rest of the distillate (11·0%) was a brown pasty mass.—H. J. H.

Decolorising carbons; Preparation of ——. F. W. Zerban. Int. Sugar J., 1919, 21, 281—286.

According to the author's experience, the composition of the carbonaceous material used has little effect upon the efficiency of the decolorising carbon, though the presence of organic nitrogenous substances appears somewhat to increase it. Very finely divided materials, such as starch, give a better result than coarser ones, as sawdust; but the most important condition is the state of aggregation of the impregnating substance at the temperature of final carbonisation, *viz.*, about 900° C. Thus, substances that are either solid, as lime, or gaseous, as zinc or magnesium chlorides, at this temperature give good carbons; whereas those that are liquid, as sodium hydroxide and carbonate, produce an unsatisfactory result. Other conditions being equal, compounds having the greatest chemical energy form the best impregnating substances, anhydrous magnesium chloride, for example, being superior in this respect to zinc chloride (this J., 1918, 480 A), the heat of solution of which is only about two-thirds that of the former salt. In carbonising, the best results have been obtained by the two-stage process previously described by the author (this J., 1918, 778 A). It is stated that carbons of high decolorising power have been obtained from filter-press cake from sugar factories, and also from a mixture of bagasse and lime, though in both cases extraction with hydrochloric acid is necessary after heating. A very effective preparation is also said to have been produced from soil very high in organic matter, such as is found in parts of Porto Rico, by mixing it with calcium carbonate, and applying the two-stage process of carbonisation.—J. P. O.

Arc electrodes; Determination of the temperature of ——. A. Hagenbach and K. Langbein. Arch. Sci. phys. nat. Genève, 1919, 1, 48—54. Chem. Zentr., 1919, 90, II., 556—557.

The temperatures attained by a number of different metals when used as electric arc electrodes have been measured by an optical photometric method. The temperature of the carbon arc was measured to check the method employed, and was found to be 4200°±1°, in good agreement with other determinations. Variations in the current strength do not affect the temperature of the carbon arc, but in the cases of silver, copper, iron, and nickel, increase of current strength considerably increases the brightness of the light, and hence no doubt the temperature. With these metals, from a certain current strength upwards the temperature remains constant, and this temperature is taken as the boiling point of the metal. In the case of copper the temperature rises from 2235° Abs. with 2 amps. to 2430°–2450° with 10 amps., and then remains constant up to 18 amps. In the case of tungsten the temperature is constant at 4150°–4250° Abs. for all currents. The temperatures are generally lower at the cathode than at the anode. Thus copper shows 2430°–2450° at the anode, about 1450° at the cathode; iron, 2485°–2605° at the anode, 2430° at the cathode; nickel, 2430°–2450° at the anode, 2365° at the cathode; tungsten, 4150°–4250° at the anode, 3000° at the cathode. In the cases of aluminium, zinc, and magnesium unexpectedly high temperatures were recorded, Al 3350°–3450°, Zn 2350°, Mg 3000°, these being the same at both electrodes. These high temperatures are attributed to the oxides of the respective metals, since in an atmosphere of nitrogen much lower temperatures only were obtainable. Copper, iron, and nickel showed the same temperatures in an atmosphere of nitrogen as in air, so the effective electrode in these cases is probably pure metal.—E. H. R.

Hardwood oils for flotation. Hawley and Ralston. *See* X.

PATENT.

Leading-in conductors for electric lamp bulbs and the like. Nihon Denki Kogyo Kabushiki Kaisha, and T. Yamai, Tokyo, Japan. Eng. Pat. 127,756, 12.7.18. (Appl. 11,484/18.)

A leading-in wire is made of copper which, at the point of sealing into the glass, is tubular in form. The lead may be made by flattening one end of a copper wire, bending over the flattened part to form a tube with overlapping edges, inserting the end of a second copper wire into the end of the tube and pressing up to give a firm grip; the hollow part of the lead is then embedded in glass. In consequence of the flexibility of the tubular portion of the wire the joint remains gas-tight when subjected to changes of temperature notwithstanding the difference in the coefficients of expansion of glass and copper.—B. V. S.

III.—TAR AND TAR PRODUCTS.

Tar; Rapid estimation of water in ——. P. Suit. Chem. Weekblad, 1919, 16, 852—854.

The apparatus consists of a copper cylinder, 12 cm. high and 10 cm. in diameter, with brazed joints and connections. The cover is provided with two holes into one of which the copper stop-cock of a small cylindrical tar reservoir can be fitted. The other hole is provided with a short glass still-head, with thermometer, leading to a pipe condenser, 120 cm. long. 100 c.c. of tar is placed in the reservoir. Sufficient tar is run into the vessel to cover the bottom, heat is applied, and the remainder of the tar admitted rapidly in small portions. The reservoir may be emptied in 2—5 minutes. The temperature is then raised to 170° C. and the vessel

emptied ready for the next distillation. The distillate is collected in a measuring cylinder and the volume of the water determined. One complete estimation may be carried out in less than 10 minutes. Rapid admission of the tar to the vessel is essential. The temperature in the still-head should not rise much above 100° C.—W. S. M.

Tar oils; Increasing viscosity of —— for lubricating purposes. S. Hilpert. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 263–266. Chem. Zentr., 1919, **90**, II., 619–620.

TAR oils can be thickened considerably by heating while a current of air is blown through. Probably the oils are polymerised, even in the absence of air, to form pitchy substances. They are also much influenced by the absorption of oxygen, for thin films of tar oil dry completely in 8 weeks, whereas between glass plates, so that air is excluded, no change occurs. If rosin soaps are employed for thickening, the salts of lime, magnesium, zinc, lead, and iron may be used, but the products are very sensitive to moisture. Blown whale oil proved an excellent thickening agent. The blowing was effected at 150°–200° C. and the viscosity rose to 17·6 (20°) in 8 hours, to 111 in 18 hours, and to 324 after 24 hours. After further blowing an odourless residue resembling asphalt, when cold, was obtained, the weight being diminished 10%, by the volatilisation of evil-smelling constituents. By admixture of these blown products with tar oil, lubricants of any desired consistency can be prepared. The flash point of such products is relatively low.—H. J. H.

Cresols; Separation of —— from tar oils by treatment with water under pressure. F. Fischer and S. Hilpert. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 267–268. Chem. Zentr., 1919, **90**, II., 616–617.

WHEN 1 c.c. of cresol, 5 c.c. of middle oil or paraffin oil, and 5 c.c. of water are warmed and shaken together, the middle layer of aqueous cresol disappears, and on cooling the mixture separates into four layers. The top layer is oil containing cresol, then cresol containing water, then water containing cresol, and at the bottom a cresol-water mixture which owing to its high density will not mix with the second layer. It is concluded that cresols can be separated from tar oils by heating to as high a temperature as possible a mixture of the oil with more than its own weight of water. The latter takes up a portion of the cresol which separates out when the pressure is released and the temperature reduced. The formation of these cresol-water solutions and mixtures is considered to account for the occasional high content of water in tars and for the difficulty experienced in separating such water.—H. J. H.

Naphthalene; Conversion of —— into liquid substances by alkylation. F. Fischer and W. Schneider. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 227–230. Chem. Zentr., 1919, **90**, II., 585.

NAPHTHALENE can be largely converted into a dark brown crude oil with a greenish fluorescence by heating with about an equal weight of alcohol in presence of zinc chloride under pressure. Using methyl alcohol a similar oily product is obtained but with phenol at 290°–300° C. a considerable amount of charring takes place and the reaction product contains a considerable amount of unchanged phenol and naphthalene. Ethylene and acetylene do not appear to react with naphthalene at 100°–200° C. in presence of aluminium chloride, whilst acetone in presence of zinc chloride appears to condense with naphthalene with removal of water.—T. C.

Naphthalene; Conversion of —— into liquid products by hydrogenation under pressure. F. Fischer and H. Niggemann. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 231–236. Chem. Zentr., 1919, **90**, II., 585–586.

NAPHTHALENE when heated for 1 hour with 1% of iodine at 550° C. in presence of hydrogen at about 170 atm. pressure is completely liquefied to an oil with a bluish fluorescence with simultaneous separation of a "mirror" of carbon, the separation of carbon being favoured by an increase of pressure. Under 50 atm. hydrogen pressure separation of carbon begins above 800° C., with 50 atm. at 800° C., 100 atm. at 550° C., and 170 atm. below 550° C. The hydrogenised oils so prepared solidify after standing for several days.—T. C.

Naphthalene; Conversion of —— into liquid hydrocarbons by the action of aluminium chloride under pressure. F. Fischer, W. Schneider, and S. Hilpert. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 237–244. Chem. Zentr., 1919, **90**, II., 584.

WHEN boiled for 3 hours with 4 grms. of aluminium chloride under a reflux condenser and then distilled, 100 grms. of naphthalene yielded 47 grms. of naphthalene saturated with oil and 47 grms. of brittle pitch which on dry distillation gave a small amount of viscous distillate and much coke. 250 grms. of naphthalene heated for 20 minutes with 10 grms. of aluminium chloride in an autoclave at 330° C. at pressures up to 10 atm. yielded 124·5 grms. of oil containing naphthalene (92 grms. of oil after separating the solid substances by cooling), and 108 grms. of carbonaceous residue. A considerable quantity of oil prepared by this method after treating with quicklime to remove free hydrochloric acid was fractionated and gave 4% below 150° C., 79% at 150°–300° C. in the form of a colourless oil having a sweetish, balsamic smell, and 16% above 300° C. The middle fraction on standing in an ice chest deposited 27% of naphthalene; the residue formed 57%, of the total oil, equivalent to 18% of the naphthalene used, and possessed the following composition and properties: 8·4% H, 91·5% C, calorific value 9932 cals., viscosity in Engler viscosimeter 1·16 at 20° C., flash point (Pensky-Martens) 70° C., in open crucible 75° C. The oil could not be burnt in an ordinary lamp without smoking.—T. C.

Naphthalene; Conversion of —— into a thickening material for lubricating oils. F. Fischer. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 254. Chem. Zentr., 1919, **90**, II., 584.

WHEN aluminium chloride is allowed to react with naphthalene at comparatively low temperatures, the high molecular compounds formed remain undecomposed. 500 grms. of naphthalene heated for 15 minutes with 50 grms. of aluminium chloride at temperatures up to 55° C. and 2 atm. pressure in an autoclave yielded on subsequent steam distillation and hot filtration through cloth, a black, syrupy residue which on mixing with 3 parts of tar lubricating oil (this J., 1919, 405 A) formed a viscous, black product of high lubricating value.—T. C.

Naphthalene; Conversion of —— into liquid hydrocarbons. H. Niggemann. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 255–258. Chem. Zentr., 1919, **90**, II., 584–585.

WHEN boiled for 3 hours with 1 grm. of aluminium chloride, 25 grms. of xylene gave a

mobile dark brown and a viscous black oil, the former on distillation yielding 10 grms. of b.pt. 117°—134° C. and 13 grms. of b.pt. 134°—170° C. On passing hydrogen chloride into xylene containing dry aluminium hydroxide in suspension there was no apparent reaction. Solvent naphtha (b.pt. 150°—175° C.) similarly treated with aluminium chloride yielded 2 grms. of oil of b.pt. 145°—150° C., 15 grms. of b.pt. 150°—175° C., and 3 grms. of b.pt. 175°—205° C. Naphthalene boiled with xylene and with solvent naphtha in presence of aluminium chloride gave indefinite mixtures of various boiling points with no definite indication of methylation of the naphthalene at the expense of the other solvent. —T. C.

Coal tar pitch; Distillation of —. H. Niggemann. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 259—262. Chem. Zentr., 1919, **90**, II., 616.

460 grms. of coal tar pitch was distilled from an iron retort, the temperature of the vapours rising from 100° to 560° C. The total distillate formed a viscous mass at the ordinary temperature yield 43% with 50% coke residue. When dropped into the red-hot retort the pitch gave 65% of a plastic black distillate which on redistillation behaved like the original pitch. Distillation *in vacuo* either of pitch or its distillates is difficult owing to the rapid evolution of gas. Distillation by the dropping method was not noticeably affected by using an atmosphere of coal gas. Distillation of pitch or its distillates in a current of coal gas or hydrogen through an iron tube 150 cm. long, packed with iron filings heated to dull redness, gave a greenish black product which melted on the water-bath. Pitch, when distilled with a mixture of potassium hydroxide and water (1 : 1) or quicklime and water (1 : 1) gave a brownish-yellow soft butter-like product. A mixture of pitch, tar oil, and quicklime gave a viscous oily product. When pitch or its distillates were heated with water, calcium hydroxide and water, or quicklime no marked change occurred.—H. J. H.

Kabierschky's apparatus. Borrmann. *See* I.

Skin diseases due to pitch dust. Grempe. *See* II A.

Toluene or xylene from petroleum. Tausz and Stüber. *See* IIA.

PATENTS.

Tar, or other liquids; Continuous dehydration and distillation of — — and apparatus therefor. T. O. Wilton, Hendon. Eng. Pat. 127,700, 28.5.18. (Appl. 8813/18.)

COAL tar or the like is pumped under a pressure of 30 to 50 lb. per sq. inch through a coil heated to such a temperature, *i.e.*, 160°—190° C., that as the tar issues into an expansion chamber water and light oils are vaporised; the tar is then passed through a second coil at about the same pressure, but heated to 230°—300° C., and as it enters an expansion chamber, the first creosote fraction is vaporised; the second creosote fraction and anthracene oil are then removed from the residual tar by steam distillation in another vessel heated to about 300° C. The different vapour fractions, *i.e.*, light oils, first creosote, and second creosote and anthracene, are led away to separate condensers in which the crude tar acts as cooling medium, and the tar is further preheated by means of the pitch residues.—L. A. C.

2-Aminoanthraquinone; Manufacture of —. H. Imrie, London. From J. R. Geigy, Soc. Anon., Basle, Switzerland. Eng. Pat. 127,223, 10.3.19. (Appl. 5930/19.)

BY the addition of calcium chloride, along with either ammonium chloride, sodium chloride, or magnesium chloride or mixtures of these chlorides, to anthraquinone-2-sulphonic acid and ammonia for heating under pressure for the production of 2-aminoanthraquinone, yields of 80% of the theoretical yield are obtained, whereas when barium chloride is used the yield is only 73·7%. —L. L. L.

Benzene; Sulphonation of —. E. Barbet et Fils et Cie., Paris. Eng. Pat. 127,614, 30.4.17. (Appl. 6097/17.) Int. Conv., 1.5.16.

FUMING sulphuric acid is led through a heater into the top of a column containing a series of plates fitted with bubbling caps and heating coils, and benzene vapour is led into the bottom of the column. The benzenesulphonic acid formed passes out at the bottom of the column, through a vessel in which it heats the supply of benzene, and into a cooler. The process is particularly adapted for sulphonating benzene containing fractions of petroleums of the character obtained from Borneo and Malaya, and if such is employed, the unsulphonated petroleum vapour passes out of the top of the column and is led through a condenser and scrubber to a collecting tank.—L. A. C.

Aniline hydrochloride; Process of producing —. C. C. Ahlum, Chester, Pa., Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,303,624, 13.5.19. Appl., 21.9.17.

ANILINE hydrochloride is produced by the action of hydrochloric acid gas upon aniline.—L. L. L.

Hydrocarbons [crude anthracene]; Process of treating —. C. R. Downs, Cliffside, N.J., Assignor to The Barrett Co. U.S. Pat. 1,303,639, 13.5.19. Appl., 26.7.18.

PHENANTHRENE is removed from crude anthracene; the residue is treated with hydrocarbons to dissolve the remaining substances soluble therein, and the solution subjected to ultra-violet light; the precipitate which is deposited is recovered.—L. L. L.

Benzol and the like; Process and apparatus for the treatment of —. M. W. Blyth and T. V. Miles, Sheffield. U.S. Pat. 1,305,870, 3.6.19. Appl., 23.12.18.

SEE Eng. Pat. 123,839 of 1918, this J., 1919, 248 A.

Distilling hydrocarbons. U.S. Pat. 1,302,669. *See* I.

IV.—COLOURING MATTERS AND DYES.

PATENTS.

Sulphur colours; Manufacture of black —. Brotherton and Co., Ltd., Leeds, E. F. Ehrhardt and W. W. Kay, New Ferry, Cheshire. Eng. Pat. 127,143, 9.7.19. (Appl. 11,215/18.)

BLACK sulphur dyes are produced by heating sulphur and sodium sulphide with a mixture of an azo dye produced from diazotised picramic acid and phenol or cresol and free phenol or cresol or mixtures of phenol and cresol.—L. L. L.

Sulphur dyes; Process for the production of blue ——. O. Knecht, Assignor to Chem. Works, formerly Sandoz, Basle, Switzerland. U.S. Pat. 1,302,671, 6.5.19. Appl., 14.12.18.

BLUE sulphur dyes are produced by treating a mixture of leucoindophenols and *p*-nitroamino compounds of the benzene series, free from hydroxyl groups, with polysulphides.—L. L. L.

Dye recovery. E. J. Wall, Syracuse, N.Y., Assignor to Kalmus, Comstock, and Wescott, Inc., Boston, Mass. U.S. Pat. 1,303,426, 13.5.19. Appl., 18.5.17.

To recover dye from a dye solution, a metallic hydroxide which will produce a lake with the dye is precipitated in the solution, the lake is separated, and subsequently treated to recover the dye.—L. L. L.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Vegetable fibres; Determination of the degree of lignification of ——. P. Waentig and W. Gierisch. Z. angew. Chem., 1919, **32**, 173–175.

By measuring the action of chlorine under specified conditions upon fibres containing lignin it appears to be possible to determine the degree of lignification. The material to be chlorinated is placed in a small U-tube with ground-in stoppers, which is connected with an absorption vessel charged with 10% hydrochloric acid, through which the current of chlorine is passed and becomes saturated with moisture before entering the reaction tube. The outlet of the latter is connected with a second U-tube containing calcium chloride to retain the moisture from the reaction tube. The apparatus is weighed before the chlorination and again after the excess of chlorine has been removed by means of a current of air, and the percentage chlorine absorption is calculated from the increase in weight. Pine wood freshly ground to a powder gave in duplicate determinations chlorine values of 43·7 and 43·2. When treated by Willstätter and Zechmeister's method (this J., 1913, 822) of hydrolysis with hydrochloric acid and subsequent extraction with alcohol and ether, this pine wood yielded 28% of lignin free from chlorine and ash. On chlorination as described this lignin showed a chlorine value of 14·30. Finely-ground rye straw showed a chlorine value of 30·5, and when hydrolysed by the method of Willstätter and Zechmeister left 22·4% residue containing 1·81% chlorine and 13·05% of ash, corresponding with 19·1% of lignin. This had a chlorine value of 14·17 which was almost the same as that of pine wood lignin. From a comparison of the chlorine values of lignified fibres with those of the isolated lignins it appears probable that the "lignin" is relatively unchanged in the hydrolytic process. The specific action of chlorine makes it a more suitable reagent than alkalis or acids for the oxidation or decomposition of fibres.—C. A. M.

Bast fibres; Retting of ——. II. P. Krais. Z. angew. Chem., 1919, **32**, 160–162. (See also this J., 1919, 169 A.)

THE further investigation of the process of retting fibrous plants by means of bicarbonate solutions has shown good results with cultivated nettles. Attempts to conduct the process in the absence of bicarbonates or carbonates have led to negative or very inferior results. Sodium carbonate is in the end as effective as bicarbonate, at the optimum concentration equivalent to a *N*/10 solution, but the action is delayed until the second day. Hence it would appear that the bacteria first produce an acid which forms the bicarbonate before the fermentation can attain its maximum effect. Nevertheless the sodium carbonate appears to exert a softening influence on the bast tissue, so that when the bacterial action ultimately develops, the retting is as rapid as if the bicarbonate had been present from the start. The most favourable conditions for large-scale experiments were established by steeping nettles in 20 times their weight of *N*/10 sodium bicarbonate solution, the yield being 6·5% of fibre suitable for spinning. Positive results were obtained with chalk, provided the mixture was roused every 12 hours, retting being complete in 3 days with 1 grm. of chalk to 2 grms. of nettles in 10 times their weight of liquid. The reaction was, however, different from that when sodium bicarbonate was employed and, as the results were somewhat uncertain, the use of chalk was abandoned. The author discusses the retting from the bacteriological point of view and draws an analogy between this process and that of Rossi (this J., 1917, 79). It would appear that acidity is the principal inhibiting agency in the retting process and that in the water-retting of plants the function of the slow stream of water is to remove the acidity continuously. On the other hand, a more complete result is attained with much greater certainty by ensuring its neutralisation by the use of bicarbonate.—J. F. B.

Wood; The constituents of —— *and their economic utilisation.* J. König and E. Becker. Z. angew. Chem. 1919, **32**, 155–160.

FOUR methods were investigated for the estimation of the lignin by the destruction of the cellulose, *viz.*, by heating under a pressure of 6—7 atmos. for 6—7 hours with 1% hydrochloric acid; by treating the wood at the ordinary temperature with 72% sulphuric acid; by treating the wood with fuming hydrochloric acid, sp. gr. 1·21; and by the action of gaseous hydrogen chloride. According to the last method, 1 grm. of wood meal which has been extracted by alcohol-benzene is mixed with 6 c.c. of water and treated with gaseous hydrogen chloride, with cooling, until a thin fluid is obtained. After standing for at least 24 hours to complete the hydrolysis of the cellulose the residual lignin is collected in a Gooch crucible and the weight of ash free residue ascertained. In the case of deciduous woods the hydrochloric acid methods gave rather more consistent results than the sulphuric acid method. The composition of the lignins obtained ranged between the limits C = 67·31–71·35 and H = 5·07–7·80%. For the estimation of hemicelluloses, 4 grms. of wood powder is heated with 200 c.c. of 0·4% sulphuric acid for 4—5 hours under different pressures, *viz.*, 0·5—0·75 atm. for alder, ash, and poplar, 1 atm. for beech and willow, 2·25–2·5 atm. for birch and fir, and 3·5 atm. for pine wood. The extract is neutralised with calcium carbonate and the cupric-reducing value determined; it is then fermented and the fermentable sugar ×0·9 is calculated as hexosans, while the dissolved pentosans are calculated from the difference between the pentosans in the original material and in the residue from hydrolysis. The results obtained in general showed that the total pentosan of the coniferous woods was low (10—12% on the dry substance) as compared with the foliage woods (22—26%). The lignin of the coniferous woods was high (28—29%) as compared with the foliage woods (20—26%). As regards the hemicelluloses, the coniferous woods showed small quantities of pentosans (8—9%) and large quantities of hexosans yielding fermentable sugars (about 13%), while the foliage woods showed large quantities of pentosans (15—23%) and only small quantities of hexosans

(3—6%). The pure cellulose (corrected for pentosans) ranged between 39 and 45% for all the woods, with the exception of poplar, which showed 47—49%. Analyses were made of the sugars produced by the hydrolysis of the hemicelluloses of the woods. In the extracts from coniferous woods, xylose and dextrose were present in nearly equal proportions (21—26% of the total reducing sugars); small quantities of galactose and large quantities of mannose were also found, pine wood being particularly rich in mannan. In the extracts from foliage woods (beech and birch) xylose was the main constituent, the dextrose was approximately the same as in coniferous woods, the quantity of galactose was small, and that of mannose very much smaller than in coniferous woods. The waste liquors from sulphite wood pulp contain fermentable sugars equivalent to 4—5% of the wood, also hemicelluloses, since the sugars may be increased to 12-14% by the hydrolysis of the liquors with sulphuric acid. Experiments on the utilisation of sulphite liquor in fodder have given encouraging results, the main points to be noted being that the liquor must be completely neutralised with calcium carbonate and lime to a faintly alkaline reaction; it must also be strongly aërated, for instance, by trickling over galvanised wire netting, and it must be evaporated at a temperature which will avoid the caramelisation of the sugars. The dry basis of the fodder may be brewers' grains and hay meal, also bran, malt germs, or beet slices. 100—120 kilos. of the dry fodder may be mixed with 1 cub.m. of liquor containing 120—130 kilos. of dissolved solids. Provided it be neutralised and aërated, fermented spent wash from the sulphite liquors may be used. The sulphite fodder is readily eaten (*e.g.* by sheep) and the soluble constituents, including the lignin, show a high percentage of assimilation.—J. F. B.

Celluloid; Constitution and physical and chemical properties of —. A. Dubosc. Caoutchouc et Gutta Percha, 1919, **16**, 9863—9868.

A REVIEW of the colloidal behaviour of celluloid and a summary of its physical and chemical properties. Celluloid is regarded as containing nitrocellulose dispersed in a medium consisting of camphor; the stability and character of the product, despite its easy resolution by suitable solvents, suggests that the process of formation is one of adsorption somewhat similar to that occurring in the vulcanisation of rubber. Pseudo-celluloids containing camphor substitutes in place of camphor are lacking in rigidity and elasticity at the ordinary temperature, although they possess the desired plasticity when warm; the lack of rigidity is probably connected with the relatively low melting point of the camphor substitutes. The colloidal products obtained from the cellulose acetates are inferior to the nitrocellulose preparations in their colloidal characteristics, probably on account of a difference in molecular structure of the cellulose complex in the two sets of derivatives.—D. F. T.

Gas masks. Fieldner and Katz. *See* XIXB.

PATENTS.

Coating composition and process of applying same, intended more particularly for coating aeroplane cloths. Soc. Nauton Frères et De Marsac, St. Ouen, and T. F. Tesse, Paris, France. Eng. Pat. 126,989, 31.7.16. (Appl. 10,793/16.) Int. Conv., 1.5.16. Addition to 124,763, 3.1.16 (this J., 1919, 319A).

THE inert substances mentioned in the previous patent are preferably replaced by metallic powders, such as aluminium, bronze, copper, etc. The proportion of metallic powder may be about 3 parts for every 100 parts of an 8% solution of cellulose acetate. The use of metallic powders allows the addition of slightly increased proportions of high-boiling point substitutes for camphor, without the risk of causing the cloths to become slack. Moreover, the inflammability is further reduced, the visibility diminished, and the injurious effect of the sun's rays lessened.—L. L. L.

Cellulose acetate compositions. C. Dreyfus, London. Eng. Pats. (A) 127,615, 30.4.17, and (B) 127,678, 24.5.17. (Appls. 6099 and 7500/17.)

(A) A PLASTIC composition, suitable for producing a permanently soft coating on fabrics, and for use in the manufacture of cellulose acetate varnish and the like, is obtained by incorporating anhydrous lanoline with a solution of cellulose acetate in acetone or other suitable solvent; solvents of high boiling point may be used instead of, or in addition to, the other solvents. Camphor substitutes triacetin and other solvents, dyes, pigments, and other substances may be added to the mixture. (B) To obtain a material having good waterproofing and preserving properties, linseed oil or other drying oil is incorporated with a solution of cellulose acetate in acetone or other solvent, alone or together with lanoline and softening agents, and other additions as in (A).—S. S. A.

Cellulose acetate composition. J. M. Kessler, West Orange, N.J., Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,303,563, 13.5.19. Appl., 14.11.18.

THE composition contains 6 to 8% by weight of cellulose acetate, 10 to 20% by weight of acetaldol, and a volatile solvent consisting of a mixture of acetone, ethyl acetate, benzene, and denatured alcohol.—L. L. L.

Paper-making machine; Fourdrinier —. S. Milne, Edinburgh. U.S. Pat. 1,303,493, 13.5.19. Appl., 3.1.19.

IN a Fourdrinier machine of the usual type means are provided for vibrating the wire independently of the side-frames, tube rolls, and under-wire rolls.—J. F. B.

Paper and pulp; Sizing of —. [*Leather substitute*.] Zellkoll Ges.m.b.H., Berlin. Ger. Pats. (A) 306,688, 8.12.15, and (B) 311,390, 30.1.16.

(A) SIZING of paper etc. is effected directly by means of animal glue without the addition of rosin emulsion, the glue being in such gelatinised form that it melts during the subsequent heating. For this purpose hardening agents, such as formalin, chrome alum, etc., are added to the glue solution to yield a product melting at a lower temperature than that reached in the drying process. After solidification the mass is finely divided, and intimately mixed in a machine with the pulp, which is then pressed and treated in the usual way, the fibres becoming united to form a uniform product when the sheets are exposed in the drying room. By moistening the paper and exposing it to the vapours of formaldehyde a substitute for sole leather is obtained. (B) Filling materials, pigments or other substances in the form of a fine emulsion are incorporated with the glue solution prior to gelatinisation as in the main patent, and become intimately incorporated with the fibres during the melting of the glue in the drying process.—C. A. M.

Moulding powder and binding material for core sands [from waste lyes from cellulose manufacture]; Production of —. K. S. Fuchs, Heppenheim. Ger. Pat. 311,294, 3.3.18.

WASTE lyes from the manufacture of cellulose by the alkaline digestion of vegetable material are

treated with acid to remove silicates and organic materials decomposed by acids. The material thus separated may, after drying, be used as a moulding powder. The lye is then neutralised or again made alkaline, evaporated, and used as a core sand binder. The materials obtained by the use of the thickened lye with the addition of the ordinary moulding sands and, if necessary, of other vegetable substances are plastic when hot, become hard on drying, and produce by heating with exclusion of air, firm but friable cores with little shrinkage. T. H. Bu.

Recovering ether and alcohol vapours. Eng. Pat. 117,259. *See* I.

Recovering ether, alcohol, etc., vapours. Eng. Pat. 117,309. *See* I.

Bisulphate liquor. U.S. Pat. 1,303,311. *See* VII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

PATENTS.

Bleaching apparatus. A. G. Hinzke, Toronto, Canada, Assignor to A. G. McIntyre, New York. U.S. Pat. 1,303,315, 13.5.19. Appl., 14.4.16. Renewed 12.3.19.

A TANK is provided with a perforated bottom spaced above the base to form a chamber in which are situated means for admitting gases to the tank and for draining liquids therefrom. A shaft is provided in the tank having its lower end supported on the perforated bottom and a number of inclined tubular members are mounted on supports, carried by the shaft, with their ends disposed on opposite sides of the shaft.—J. F. B.

Bleaching, dyeing, or similarly treating textile and other fabrics in the open state. The Calico Printers' Assoc., Ltd., Manchester, and F. Roberts, Accrington. Eng. Pat. 127,474, 31.8.18. (Appl. 14,147/18.)

A MACHINE for bleaching, dyeing, and the like comprises a vat provided with a perforated false bottom of U or trough shape, made of highly glazed material to prevent frictional resistance to the travel of the fabric. The false bottom is removable and may consist of a number of rollers, or of an endless travelling creeper. A removable inner frame has two sides parallel with the sides of the vat, whilst its bottom conforms to the U or trough shape section of the false bottom, thus forming a channel extending the full length of the vessel. The fabric to be treated is pleated, by an ordinary pleating device, and fed into the channel on the entry side, and carried through it by rollers or by means of draw rollers. The inlet and outlet for liquor are inclined at suitable angles to aid the passage of the fabric through the vessel and to avoid drawing the fabric against the side of the vessel.—L. L. L.

Fabrics having the property of invisibility; Production of ——. F. Cochrane, Cheadle Hulme. Eng. Pat. 127,301, 7.11.16. (Appl. 5039/17.) Addition to 125,093, 8.5.16 (this J., 1919, 359 A).

FABRICS having the property of invisibility are obtained by fixing a metallic mordant uniformly upon the fabric, then passing the prepared cloth through a solution of dyestuffs capable of producing a number of colours by subsequent treatment with suitable metallic salts, one of the colours being fixed as ground colour, and the others produced upon the ground colour in promiscuous patches by applying the necessary metallic salts by hand or otherwise. The fabric is then dried at a high temperature. Colouring matters suitable for this purpose are fustic, cutch, and sumac.—L. L. L.

Plush, velvet, and similar materials; Process for the wet pressing of ——. F. H. Eydmann, jun. Hengelo, Holland. Ger. Pat. 311,309, 5.1.18. Int. Conv., 8.1.17.

BEFORE pressing, the material is saturated with an alkaline liquid with which fat, wax, or the like may have been emulsified. By suitable regulation of the alkalinity of the liquid, it is possible so to affect the plush during the pressing and subsequent dyeing that the pile is raised and any desired degree of "ageing" produced.

Fabrics having the property of invisibility; Production of ——. F. Cochrane, Cheadle Hulme. U.S. Pat. 1,306,213, 10.6.19. Appl., 18.6.17.

SEE Eng. Pat. 125,093 of 1916; this J., 1919, 359 A.

Dye recovery. U.S. Pat. 1,303,426. *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Ammonia from coke ovens; Absorption of —— *by means of sodium bisulphate.* F. Fischer and H. Niggemann. Ges. Abhandl. zur Kenntnis der Kohle, 1917, **1**, 285—288. Chem. Zentr., 1919, **90**, II., 559.

WHEN a current of air and ammonia is led into a saturated solution of sodium bisulphate at 85° C., after a short time crystals are precipitated in large quantities. By further addition of sodium bisulphate the conditions can be so regulated that the crystals contain 12·4% NH_4, corresponding to the double sodium ammonium sulphate. Either commercial or pure bisulphate may be used but the crystals must be filtered quickly hot, to prevent the formation of Glauber's salt. The supplementary bisulphate is best added as a solution, the strength of which can be so regulated that the original volume is kept constant. The process then approximates very closely to the usual sulphuric acid process. (See also Watson Smith, this J., 1896, 3; Dawson, this J., 1919, 98 T.) E. H. R.

Ammonia; Absorption of —— *in concentrated magnesium chloride solution.* H. Niggemann. Ges. Abhandl. zur Kenntnis der Kohle, 1917, **1**, 289—290. Chem. Zentr., 1919, **90**, II., 615.

WHEN an ammonia-air mixture was passed through a solution of 50 grms. $MgCl_2,6H_2O$ in 50 c.c. of water at 90° C., a precipitate of magnesium hydroxide appeared after about 15 minutes. The solution, when saturated with ammonia, still contained 40·5 grms. $MgCl_2,6H_2O$. When a mixture of ammonia and carbon dioxide was used precipitation of magnesium carbonate commenced at once. The reaction does not seem adapted to large-scale practice.—H. J. H.

Ammonia; Precipitation of —— *by means of carbon dioxide.* F. Fischer and S. Hilpert. Ges. Abhandl. zur Kenntnis der Kohle, 1917, **1**, 291—292. Chem. Zentr., 1919, **90**, II., 559.

To save sulphuric acid in the gas and coke industries, a process for precipitating ammonia by

means of carbon dioxide was suggested, the ammonia being obtained as bicarbonate which was to be applied as a manure. Experiments were made to determine to what extent the precipitation of the bicarbonate depends on the carbon dioxide content of the gases employed and on the strength of the ammonia solution. It was found that, to precipitate about 55% of the ammonia from a 10—25% solution, a considerable excess of pure carbon dioxide must be used, whilst with a mixture of four parts of air and one part of CO_2, about ten times the theoretical quantity of CO_2 is necessary. Much ammonia is carried away in the gas stream. Gases poor in CO_2 are therefore useless for the purpose. Further, ammonium bicarbonate is of little use as a fertiliser owing to its great volatility.—E. H. R.

Carbon dioxide in coke-oven ammonia liquor, Determination of —. S. Hilpert. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 293—294. Chem. Zentr., 1919, **90**, II., 543.

In a concentrated ammonia liquor examined calcium chloride dissolved readily and on warming the solution calcium carbonate equivalent to 0·023 grm. CO_2 (as carbamic acid) in 100 c.c. was precipitated. By adding ammonium bicarbonate the free carbon dioxide was determined as less than 0·03 grm. in 100 c.c. Cadmium acetate produced no deepening of the yellow colour of the liquor, though this reagent was shown to be sensitive to 0·0002 grm. H_2S in 100 c.c. of the liquor.—H. J. H.

Potash deposits, The formation of the German —. E. Jänecke. Z. angew. Chem., 1919, **32**, 178—181.

The potash deposits were produced by the evaporation of sea water contained in a basin which covered a large area, and were precipitated on Permian limestone in two stages, firstly, rock salt and calcium salts, and secondly, potassium salts. The order of the deposition of the first series was as follows: limestone, gypsum, rock salt with anhydrite, and polyhalite with rock salt, the gypsum being converted at a later stage into anhydrite. At the time of the separation of the deposits, a temperature varying between 15° C. and 35° C. prevailed in this region, and it has been shown (by van 't Hoff and others) that the order in which the potassium salts were originally deposited must have been in five strata as follows: astrakanite and reichardite, leonite and reichardite, kainite and $MgSO_4$, carnallite and kieserite, and bischofite. During the separation, a considerable subsidence of the basin towards the south took place, and the deposits sank into the earth to a depth of 3000 metres. At the temperature prevailing at this depth, water split off from some of the hydrated salts and formed a water-soaked mass in which kainite, leonite, and astrakanite respectively gave rise to sylvine, kieserite, langbeinite, and loeweite and van 't Hoffite, from which sylvine and kieserite were formed next to the rock salt. The appearance of calcium salts and rock salt in the kieserite, sylvine, and carnallite strata is probably due to the formation over the whole of the area, during the evaporation and subsidence, of larger and smaller basins, the latter, in which the evaporation and separation of the salts took place more rapidly, being filled up as subsidence occurred, by liquor from the larger basins, in which the separation of the salts was less advanced. During the subsequent upheaval of the strata the liquor remaining in contact with the deposits formed carnallite from the sylvine, whilst the upper unchanged layer of carnallite became to some extent agglomerated with immediately underlying strata. The author shows diagrammatically the transformation, by the above changes, from the original order of the strata to a series such as exists in the Stassfurt deposits. The admixture of salt, and carnallite formed from kainite, occurs in the deposits at Berlespschen and Teutschental, whilst the deposits at Solvay contain a double series of strata.—S. S. A.

Calcium oxide in milk of lime; Determination of —. G. Lenart. Z. Ver. Deuts. Zuckerind., 1919, 1—15. Chem. Zentr., 1919, **90**, II., 560—561.

The usual tables for the determination of the lime content of milk of lime from the specific gravity are inaccurate. The use of Blattner's table (Technical Methods of Chemical Analysis, Lunge and Keane, Vol. I., p. 484) is not a reliable method on account of inaccuracies in the determination of the density with the hydrometer by the process there recommended. The author determines the density by means of a crude pyknometer (500—1000 c.c.) and has drawn up a new table, of which the following is a summary, to be used in conjunction with the density.

Sp. gr.	CaO, grms. per litre	CaO, % by weight	Sp. gr.	CaO, grms. per litre	CaO, % by weight
1·0085	10	0·99	1·1255	170	15·10
1·0245	30	2·93	1·140	190	16·67
1·039	50	4·81	1·1545	210	18·19
1·0535	70	6·65	1·1685	230	19·68
1·0675	90	8·43	1·1835	250	21·12
1·0825	110	10·16	1·1975	270	22·55
1·0965	130	11·86	1·2125	290	23·92
1·111	150	13·50	1·2195	300	24·60

—E. H. R.

Fluorspar and basic slags containing fluorine; Method of analysis of —. G. R. Doyle. Chem. News, 1919, **118**, 304—305.

Half a gram of the finely powdered sample is weighed into a dish, converted into a paste with 5 c.c. of water, and evaporated nearly to dryness with 25 c.c. of glacial acetic acid. A further 25 c.c. of glacial acetic acid is added and the mass evaporated to dryness and then heated in a steam oven until all the acid has been expelled. The residue is transferred to a beaker, diluted to 80 c.c., boiled, and filtered. The filtrate contains available lime (CaO and $CaCO_3$), soluble silica, manganese, magnesia, and lead, whilst the residue contains all lime existing as CaF_2, silica, iron, and alumina. The residue is ignited in a platinum dish, cooled, weighed, treated with hydrofluoric acid, evaporated to dryness, ignited, and weighed. The loss in weight gives the amount of silica present. The remaining residue is treated with 5 c.c. of sulphuric acid and evaporated until fumes are evolved, then it is ignited and weighed. The gain in weight is due to the formation of calcium sulphate from calcium fluoride: $CaSO_4 \times 0{\cdot}5735 = CaF_2$. The residue is boiled for 20 minutes with 20 c.c. of hydrochloric acid, diluted, and precipitated by ammonium chloride and ammonia, boiled, filtered, ignited, and weighed. The weight is deducted from the weight of iron, aluminium, and calcium fluoride and gives the weight of calcium fluoride. If lead is present it must be removed before the iron and aluminium are precipitated. The filtrate is analysed in the usual way.—J. F. S.

Acid phosphates; Some properties of —. A. Joannis. Comptes rend., 1919, **168**, 1202—1203.

A further proof of the fact that the three acid functions of phosphoric acid are not of the same

value. After one has been neutralised it is impossible to neutralise the other two by gaseous or liquid ammonia in the absence of water.—W. G.

Selenic acid and copper selenate. [Detection of tellurium in presence of selenium.] L. M. Dennis and J. P. Koller. J. Amer. Chem. Soc., 1919, **41**, 949—970.

SELENIUM is prepared from smelter flue dust by fusing 300 grms. of flue dust with 200 grms. of anhydrous sodium carbonate and 775 grms. of sodium peroxide in a large nickel crucible until the mass melts quietly. After cooling, the mass is treated with water and insoluble material filtered off; it is then nearly neutralised with hydrochloric acid, which precipitates most of the zinc and aluminium. After filtration, a large volume of hydrochloric acid is added and the solution boiled for 30 minutes to reduce selenic acid to selenious acid; any silica present is precipitated at this stage, and the filtrate is then heated to 80° C. and treated with sodium sulphite in small quantities. The selenium separates and is converted into the grey modification by digesting it with the solution for several hours at 80° C. Anode slimes containing 96% selenium were also used to prepare pure selenium. The slime was added to concentrated nitric acid to which 1/5 of its volume of water had been added; a vigorous action ensued and when this had moderated the mixture was heated to complete the oxidation. The solution was filtered and a viscous dark green liquid obtained which was evaporated to dryness. The residue was treated with hydrochloric acid (3 : 1) and the selenium precipitated by sulphur dioxide or sodium sulphite. Selenium dioxide is prepared by dissolving selenium in nitric acid and evaporating the solution to dryness. The crude dioxide is placed in one end of a glass tube, 85 cm. long and 3·5 cm. diameter, which is covered with asbestos paper and placed in a 60 cm. combustion furnace; a 2-cm. plug of glass wool is placed in the middle of the tube. The tube is so arranged in the furnace that only a small length protrudes. On heating the oxide it sublimes and condenses in the protruding part of the tube and as this becomes full more of the tube is pushed out of the furnace. Selenious acid is prepared directly from anode slimes by oxidising with nitric acid and evaporating until a syrupy solution is obtained. On cooling large crystals separate and after four recrystallisations from water pure selenious acid is obtained. A yield of 1200 grms. of selenious acid was obtained from 3000 grms. of slimes. Tellurium may be detected in the presence of selenium by dissolving 10 - 20 grms. of the oxide in hydrochloric acid (sp. gr. 1·16), heating to 90° C., and saturating with sulphur dioxide. The precipitated selenium is filtered off and the filtrate diluted with an equal volume of water and saturated cold with sulphur dioxide. An immediate black precipitate of tellurium is formed if this element is present. Pure selenic acid has been prepared by the oxidation of silver selenite by means of bromine; by the oxidation of copper selenite by chlorine, and by the electrolytic oxidation of selenious acid. In the last case the most efficient yield is obtained when lead dioxide anodes, in thimbles, are used. Selenious acid may be detected in the presence of selenic acid on the basis of the reaction, $H_2SeO_3 + 4HI = Se + 4I + 3H_2O$. Concentrated selenic acid will also oxidise hydriodic acid, but if the solution is dilute, selenic acid will remain unchanged. If small quantities of potassium iodide are added to solutions containing both selenious and selenic acids a yellow colour of iodine will be produced, and when the colour of the iodine is discharged by the addition of a drop or two of sodium sulphite solution the red turbidity due to selenium is visible. If the selenic acid is more concentrated than 0·8%, it will also liberate iodine, but as the hydriodic acid is not concentrated the reaction will go no further. This reaction is capable of detecting 1 part of selenium dioxide in 18,400 parts of selenic acid, or 1 part of selenium dioxide in 2,500,000 parts of solution. Sulphuric acid in the presence of selenic acid may be detected by diluting the selenic acid to 4%, adding 10 c.c. of 90% hydrazine hydrate, and heating to 60° C. Sufficient concentrated hydrochloric acid (5%) is added to make the liquid distinctly acid and the mixture boiled for an hour. After cooling, the precipitated selenium is filtered off and the process repeated until no more selenium is deposited. The filtrate is then evaporated to 25 c.c. and 2 c.c. of 10% barium chloride solution added, and the mixture kept at 80° C. for an hour, when a white turbidity is produced if 1 mgrm. of sulphuric acid is present. This reaction is capable of detecting 1 part of sulphuric acid in the presence of 10,000 parts of selenic acid (See also J. Chem. Soc., Aug., 1919).—J. F. S.

Metal sulphide hydrosols; Coagulation of ——. Part I. Influence of distance between the particles of a sol on its stability. Anomalous protective action of dissolved hydrogen sulphide. J. N. Mukherjee and N. N. Sen. Chem. Soc. Trans., 1919, **115**, 461 - 472.

DILUTION with pure water increases the resistance of arsenious, mercuric, and cupric sulphide sols to coagulation by electrolytes, a fact which may be explained by the assumption that the distance between the particles of a sol is an important factor in determining its stability. Confirmation of this was found by comparing the stability of arsenious sulphide sols having the same colloid content but differing in the degree of dispersion. The sol having in the same volume the smaller number of larger particles coagulated more slowly than the sol having the larger number of small particles. Dissolved hydrogen sulphide stabilises arsenious and mercuric sulphide sols against coagulation by salts of univalent cations but diminishes the stability towards barium, strontium, and other divalent metal chlorides, and also that of cupric sulphide sols towards all electrolytes. Solutions of potassium and sodium sulphides and alkali hydroxides have a marked stabilising influence on sols of all the above three sulphides towards all electrolytes.—G. F. M.

Cadmium suboxide; Preparation of ——. H. G. Denham. Chem. Soc. Trans., 1919, **115**, 556—559.

EARLIER attempts to prepare cadmium suboxide were repeated. Tanatar's method (Z. anorg. Chem., 1901, **27**, 133), the decomposition of cadmium oxalate at 300° C. in a stream of carbon dioxide, gave a green heterogeneous substance containing cadmium. The metal was volatilised by distillation in vacuum at 350° C., and a small quantity of a green oxide, Cd_2O, free from cadmium was obtained. Morse and Jones' method (Amer. Chem. J., 1890, **12**, 488) gave a 5% yield of cadmium suboxide, but all other methods tried failed.—G. F. M.

Phosgenite; New synthesis of ——. W. A. Hamor and H. E. Gill. Amer. J. Sci., 1919, **47**, 430.

PHOSGENITE, $PbCO_3,PbCl_2$, may be synthesised by heating a mixture of lead hydroxide and phosgene at 175° C. for 1—4 hours. The product is crystalline and of a faint yellow colour and is identical in all respects with the natural mineral.—J. F. S.

Oxygen content of air; Simple form of apparatus for estimating the —— from the upper atmosphere. F. W. Aston. Chem. Soc. Trans., 1919, **115**, 472—475.

THE oxygen content of a sample of air is compared with that of normal air by deoxidising with phosphorus, and measuring the difference in pressure, before and after combustion in each case, by means of a barometer tube and micrometer screw. In order that the differences to be measured may be of the order of only a few millimetres, the measuring burette of the apparatus is so arranged that the pressure after deoxidation is read at a volume equal to 79% of the original volume, so that with normal air it will be practically identical with the initial pressure. The barometer tube is fused into the side of the burette which terminates below in an adjustable mercury reservoir and at the top is drawn out into a capillary leading through a stop-cock into a trough of mercury, through which the air under examination is drawn into the apparatus to be measured and passed out into a quartz test-tube containing phosphorus. —G. F. M.

Helium literature; Bibliography of —. E. R. Weaver. J. Ind. Eng. Chem., 1919, **11**, 682—688.

Kuhlerschky's apparatus. Bornmann. *See* I.

Gas masks. Fieldner and Katz. *See* XIXB.

Micro-analysis. Strebinger and Ridlberger. *See* XXIII.

Thiosulphate solutions. Kolthoff. *See* XXIII.

PATENTS.

Sulphur-oxidising process and apparatus therefor. A. G. McIntyre, Toronto, Canada. U.S. Pat. 1,303,348, 13.5.19. Appl., 28.1.16. Renewed 12.3.19.

IN a sulphur burner, a supply chamber is superimposed on a vertical series of communicating combustion chambers each having a separate air supply. Means are provided for adjusting the feed from the supply chamber to the uppermost combustion chamber and for withdrawing the gaseous products from the lowest chamber.—W. E. F. P.

Catalysts and contact masses; Activation of —. E. B. Maxted and G. R. Ridsdale, Walsall. Eng. Pat. 127,025, 17.3.17. (Appl. 3893/17.)

IN the synthesis of ammonia by the interaction of nitrogen and hydrogen at high temperatures and in the production of hydrogen from steam and a reducing gas such as carbon monoxide, in which an iron or other catalyst is used, the vapour of an alkaline oxide or hydroxide (*e.g.*, sodium or potassium hydroxide) is added to or mixed with the gases undergoing reaction. J. H. P.

Ammonia; Process of producing —. I. W. Cederberg, Lidingö-Brevik, H. M. Bäckström, Djursholm, and G. A. Kyhlberger, Stockholm, Sweden. Eng. Pats. (A) 127,063 and (B) 127,064, 26.1.18. (Appls. 1559 and 1560/18.)

(A) A MIXTURE of nitrogen and hydrogen, at a temperature below 400° C. and a pressure above 250 atmospheres, is passed over a heated catalyst containing at least one metal belonging to the second sub-division of the main groups I—V of the periodic system (*i.e.*, the copper-silver series). The catalyst may contain one or more of these elements in the metallic state or in combination with nitrogen or/and hydrogen. (B) Hydrogen and nitrogen are passed over the catalyst separately and alternately. —W. E. F. P.

Ammonium salts; Process for the production of —— *utilising compounds containing silicon, alkaline earths, and nitrogen.* Verein Chemischer Fabriken in Mannheim, Mannheim. Ger. Pat. 311,767, 15.12.14.

A MIXTURE of an alkaline earth (especially lime) with silicon or a silicide is heated in the presence of nitrogen or a gaseous mixture containing nitrogen, an alkaline-earth halide, or a mixture of such halides, or a halide producing an alkaline-earth halide during the reaction being added. Absorption of nitrogen begins just above 650° C. and at 850° C. the amount so absorbed corresponds in ammonia to about half the silicon used. In the absence of calcium chloride, absorption commences only above 900° C. and at 930° C. corresponds to only a few per cent. The nitrogen absorbed at the lower temperature is completely driven off as ammonia by heating to 100° C. with water or steam. The maximum absorption of nitrogen is achieved when the weight of lime employed is about three times that of the silicon used. If the temperature is raised to 1050° C. the amount of nitrogen absorbed in the presence of calcium chloride is considerably increased. Calcium fluoride has very little influence in this direction. The product obtained at 1050° C. yields about one-third of its nitrogen by boiling with water, and the remainder by means of dilute acids. In the technical application of the process, the mixture of silicide and excess of lime is heated to 800°—850° C., along with calcium chloride in the presence of nitrogen or a gaseous mixture containing nitrogen, and the ammonia is subsequently driven off by means of water. Hydrogen derived from the unused silicide can be recovered. Alternatively, the heating can be continued uninterruptedly up to 1050° C., and a part of the ammonia driven off and recovered by solution in water, the remainder being recovered by addition of acid and subsequent distillation with addition of lime. J. S. G. T.

Glauber's salt and sulphuric acid; Production of — from nitre cake and other acid sodium sulphates. H. M. Dawson, Leeds. Eng. Pat. 127,677, 21.11.17. (Appl. 7465/17.)

NITRE cake or other acid sodium sulphate is dissolved in water to obtain a liquor having a concentration predetermined according to the composition of the acid sodium sulphate and the temperature to which the liquor is to be cooled. The liquor is then cooled to a temperature below 0° C., which effects a separation of Glauber's salt, leaving a mother liquor having a maximum ratio of sulphuric acid to sodium sulphate. If a more concentrated solution is under treatment, cooled water is added during the cooling, in quantity dependent on the original composition of the solution and the degree of cooling. For example, in effecting the separation of Glauber's salt without the addition of water, sodium bisulphate is dissolved to produce a solution of 63° Tw. (sp. gr. 1·315) at 15° C., containing 36% sodium bisulphate, and approximately corresponding with the molecular formula, $H_2O : Na_2SO_4 : H_2SO_4 = 1000 : 42·5 : 42·5$. The liquor is refrigerated to −21° C., and the Glauber's salt which separates is removed and washed with cooled water, the wash liquor being used in the preparation of further solutions of sodium bisulphate. From 10 tons of sodium bisulphate, the process produces about 12 tons of Glauber's salt, and 15 tons of liquor containing 26·8% H_2SO_4 and 2·8% Na_2SO_4. —S. S. A.

Sulphate of ammonia; Manufacture of —. S. E. Linder, Buckhurst Hill. Eng. Pats. (A) 127,715 and (B) 127,716, 3.6.18. (Appls. 9128 and 9129/18.)

(A) To neutralise the acidity of commercial ammonium sulphate, an alkali or alkaline-earth hydroxide or carbonate is intimately mixed in suitable proportion with the ammonium sulphate. (B) Before removing the ammonium sulphate crystals from the mother liquor, gaseous ammonia, free from hydrogen sulphide, is passed into the liquor until it is substantially neutral. An ammonium salt (*e.g.*, ammonium sulphite or bisulphite), which by double decomposition with sulphuric acid will produce an acid volatile under the conditions of manufacture, is then added in suitable quantity.—S. S. A.

Potassium [compounds] from potassium-bearing silicates; Process for recovering —. A. Graucl, Kitchener, Ont., Canada. U.S. Pat. 1,289,736, 31.12.18. Appl., 6.8.17.

THE silicate, alone or mixed with a suitable compound, is heated to produce a fume which is conducted into a saturating fluid maintained at boiling temperature under pressure, the vapours from the latter being condensed. The form in which the potassium is recovered is determined by the nature of the saturating fluid (*e.g.*, water or calcium chloride to produce the hydroxide or chloride) and of the materials with which the silicate is mixed before heating (*e.g.*, gypsum to produce the sulphate).—W. E. F. P.

Potassium-compound recovering apparatus. H. M. Hiner, Fort Smith, Ark. U.S. Pat. 1,290,194, 7.1.19. Appl., 8.11.17.

AN apparatus for recovering potassium compounds from combustible material, such as cotton bolls, hardwood sawdust, etc., consists of a main shell containing a combustion chamber, grate bars, and an ashpit. At the upper part of the shell is an inlet pipe, through which the material is conveyed to the combustion chamber, and an outlet pipe through which the gaseous products of combustion are conducted into water before making their escape. The water tank has pipe connections whereby the contents are sprayed into the upper and lower zones of the combustion chamber, the object being to concentrate the potassium compounds in the ash of the material under treatment.—W. E. F. P.

Potassium salts etc.; Method of reclaiming — *from sugar refuse.* M. J. Kermer, Evanston, Ill., and H. A. Faber, Cincinnati, Ohio. U.S. Pat. 1,303,916, 20.5.19. Appl., 15.3.18.

WASTE waters from the Steffen's process of sugar refining are treated with sulphuric acid to invert the sugar and convert organic acid salts and carbonates into sulphates, and are then concentrated until potassium sulphate separates; the residue is further concentrated to recover nitrates.—J. H. L.

Bisulphite liquors; Manufacture of —. A. G. Hinzke, Toronto, Canada, Assignor to A. G. McIntyre, New York. U.S. Pat. 1,303,314, 13.5.19. Appl., 4.5.16. Renewed 12.3.19.

SULPHUROUS gases are caused to flow in a tortuous path through successive compartments; lime water is supplied to the compartments in intimate contact with the gases; the liquor is repeatedly circulated through each compartment and transferred progressively from one compartment to the next in a direction opposite to the general direction in which the gases flow through the compartments.—J. F. B.

Carbonic acid gas; Method of and apparatus for determining the purity of —. C. Spindler, San Francisco, Cal. U.S. Pat. 1,303,514, 13.5.19. Appl., 21.11.18.

IN the production of carbon dioxide, the stage at which the gas becomes practically free from air is determined by passing a portion of the product into a solution of caustic soda and observing the absence or presence of bubbles in the latter.—W. E. F. P.

Pyrolusite; Method of treating —. C. V. Jörgensen, Copenhagen. U.S. Pat. 1,303,911, 20.5.19. Appl., 14.12.18.

PYROLUSITE is rendered more reactive by powdering, heating to redness with a small quantity of an alkaline substance, and finally washing the product.—J. H. L.

Soluble bodies [salts]; Separating — *from mixed solutions.* C. L. Weil, Port Huron, Mich. U.S. Pat. 1,304,004, 20.5.19. Appl., 22.6.17.

SOLUBLE salts are separated from a mixed solution by precipitating quantities of both salts by evaporation and cooling, adding solvent to redissolve one of the salts, separating the undissolved salt, and then heating the solution and precipitating the other salt from the heated solution by reduction of pressure and consequent evaporation.—J. H. P.

Hydrogen; Process for the production of —. Comp. Générale d'Electro-Chimie de Bozel, Paris. Eng. Pat. 127,018, 28.2.17. (Appl. 2973/17.) Int. Conv., 17.11.15.

IN the production of hydrogen by the action of silicon or aluminium on water in the presence of an alkali hydroxide, the latter is replaced by a mixture of an alkaline-earth base with a small quantity of alkali hydroxide or alkali salt (*e.g.*, sodium carbonate, sulphate, phosphate, etc.) capable of reacting with the alkaline-earth to produce alkali hydroxide. A suitable mixture consists of silicon 20, lime 80, sodium carbonate 10, and water 225 parts.—W. E. F. P.

Hydrogen, Producing —. A. Mittasch, Ludwigshafen, Germany, Assignor to Alien Property Custodian. U.S. Pat. 1,301,151, 22.4.19. Appl., 25.6.14.

A MIXTURE of carbon monoxide and steam is passed over a heated catalyst containing cerium oxide.—W. E. F. P.

Roasting apparatus [for granular carbon]. W. J. Malcolmson, Cicero, and H. L. Ward, Chicago, Ill., Assignors to Western Electric Co., Inc., New York. U.S. Pat. 1,302,946, 6.5.19. Appl., 3.8.17.

IN an apparatus for roasting carbon granules, a vertical roasting chamber, through which the granules are caused to pass in a continuous and uniform stream, has a porous wall to permit the escape of gaseous products and is surrounded by an electrical heating element, the latter being embedded in an insulating body of porous material.—W. E. F. P.

Metal compounds and process of producing same [by means of hydrazine]. N. Sulzberger, New York. Reissue 14,656, 27.5.19, of U.S. Pat. 1,164,141, 14.12.15. Appl., 12.12.17.

SEE this J., 1916, 176.

Nitrogen; Process for obtaining —— from air. Elektrizitätswerk Lonza, Gampel, Switzerland. Eng. Pat. 127,852, 31.5.17. (Appl. 7814/17.) Int. Conv., 17.6.16.

See Ger. Pat. 302,671 of 1916; this J., 1918, 335 A

Soap substitute Ger. Pat. 311,160 *See* XII

VIII.—GLASS; CERAMICS.

Fire-bricks; Crushing strength of —— Report of the Refractory Materials Committee of the Institution of Gas Engineers. W. Emery and J. W. Mellor. Gas J., 1919, **146**, 619–620

Crushing tests were made on bricks composed of clay mixed with various proportions of fine, medium, and coarse-ground grog respectively. The analyses, surface factors, and squatting temperatures of the various clays employed, and the grog sizes are detailed. The crushing strengths were determined in accordance with the standard specification (this J., 1918, 693 A). It was found that the crushing strength is reduced by increasing the grain size of the grog when the proportion of grog is constant; and also by increasing the proportion of grog when the grain size is constant. Bricks tested with the load applied to the 4½-inch face gave higher crushing strengths than when the load was applied on the narrow side as in the standard specification. There is probably a close connection between the temperature coefficient of vitrification and crushing strength. It is also probable that the crushing strength reaches a maximum during the firing of the brick, and gradually diminishes when the brick is in use. The crushing strength of the newly fired brick is not necessarily at its maximum. The contractions of bricks made with hard-fired grog and fired first at cone 1 for about 50 hours, and subsequently at cone 10 for the same time, were found to be very small. The grog in these cases is apparently so well shrunk that it does not move with the contracting clay during the firing of the brick.—J. S. G. T.

Fusion point of fire-brick. Lovejoy *See* XI

Patents.

Glass ware; Machines for making hollow —— Method of and means for delivering molten glass. J. B. Graham, Evansville, Ind., U.S.A. Eng. Pats. 127,995 and 127,996, 12.6.18. (Appls. 9695 and 9696/18.)

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Deoxidation [of steel], and the influence of lime on equilibrium in the acid open hearth furnace. B. Yaneske. Iron and Steel Inst., May, 1919. [Advance copy.] 16 pages.

To produce certain kinds of special steel (*e.g.* nickel-chrome), the open-hearth furnace should contain a highly deoxidised bath. The author believes that more attention should be paid to the condition of the slag during preparation of a charge, as the quality of steel depends on the state of the slag. Samples of slag should be taken during the process, analysed, and the colour observed, metal samples being also taken periodically. It is essential that a highly silicious slag be formed during the period of addition of ore, and so a high temperature must be maintained. The silicon in the charge is controlled by judicious use of limestone. When, and not until, the reduction of silica occurs, limestone is added with the next ore charge. Each time holes occur in the metal samples taken, more limestone is added with the ore charges. As this is done, the slag—quenched in water—assumes a light green colour and then only iron ore is added. For equilibrium in the bath, the metal should be thoroughly deoxidised and when "dead melted" the metal will be perfectly sound. Different stages of oxidation are revealed by the condition of the surface of the metal samples, the best showing a quite smooth surface. The furnace must be quickly tapped when equilibrium is established. By consistently obtaining the same high degree of deoxidation with perfect equilibrium in the bath, there is a minimum oxidation loss from the alloys.—C. W.

Steel; Determination of uranium, zirconium, chromium, vanadium and aluminium in ——. C. M. Johnson. Chem. and Met. Eng., 1919, **20**, 523–524, 588–589.

The feature of the method is the separation of the elements to be determined from the bulk of the iron by fractional precipitation with ammonia, which enables larger weights of sample to be taken. For the determination of uranium in plain steel, 5 grms. of drillings is dissolved in sulphuric acid (1:3), filtered, and the insoluble residue ignited, cooled, heated with hydrofluoric and sulphuric acids, and the clear solution added to the first filtrate. This is then diluted and ammonia solution added until the precipitate turns blackish. The precipitate is filtered off, re-dissolved in hydrochloric acid (1:1) and oxidised with sodium peroxide until all the iron is precipitated and the solution is alkaline. After adding sodium and ammonium carbonates to keep the uranium in solution, the solution is boiled and the iron filtered off. Hydrochloric acid (1:1) is then added till the solution no longer turns turmeric paper faint brown, the solution is boiled to expel carbon dioxide, made acid with hydrochloric acid (1:1), cooled, treated with 5 grms. of diammonium phosphate and excess of ammonia, and acidified with acetic acid (1:1). The uranium is filtered off, re-dissolved in hot sulphuric acid (1:3), boiled, and potassium permanganate added till a permanent pink colour is produced. The uranium is reduced in a zinc "reductor" and titrated with a standard solution of permanganate. For uranium in chrome-tungsten steel 5 grms. of steel is dissolved as before, the solution filtered, diluted, and ammonia added till the precipitate turns bluish-white; after filtering, the determination of the uranium is finished as in plain uranium steel. The insoluble residue is washed off the filter with dilute sulphuric acid and oxidised with nitric acid (sp. gr. 1·20). The tungsten is filtered off, the filtrate peroxidised and after separation of the iron, finished as with plain steel. For the determination of aluminium and zirconium, the procedure is the same as above for uranium as far as the addition of sodium carbonate; the precipitate then contains the iron and zirconium and the filtrate the aluminium. Hydrochloric acid (1:1) is added and the precipitated aluminium is allowed to settle, filtered off, and re-dissolved in hydrochloric acid (1:1). Ammonia is added, the precipitated aluminium filtered off and ignited in a weighed platinum crucible. The iron and zirconium left on the filter are dissolved in sulphuric acid (1:3), a saturated solution of disodium phosphate added, then ammonia till a precipitate starts to form. After standing some hours the precipitate is filtered off and ignited in a weighed crucible. It is then evaporated with sulphuric and hydrofluoric acid till fumes of sulphur trioxide appear, in order

to remove silica. The zirconium phosphate is then filtered off and ignited to a constant weight. For aluminium in plain steel the procedure is the same as before until after peroxidation. Hydrochloric acid (1:1) is then added and the aluminium filtered off and washed with ammonium nitrate, re-dissolved in *hot hydrochloric acid (1:1)* and precipitated with *ammonia, then ignited* in a platinum crucible. For the *determination of chromium and vanadium*, 5 grms. of the steel is dissolved in sulphuric acid (1:3), filtered, and the insoluble residue washed off. The filter paper is incinerated, the ash dissolved in concentrated hydrochloric acid, evaporated with sulphuric acid (1:1), and added to the original solution. This is diluted and ammonia added till a black precipitate forms, filtered, the precipitate re-dissolved in sulphuric acid (1:3) and poured on the original insoluble residue. The mixture is heated, treated with nitric acid (1:20), and permanganate added till a brown precipitate of manganese oxide forms. The solution is boiled, filtered, and chromium and vanadium determined as usual with ferricyanide as internal indicator. Tables are given showing results obtained by the method on known steels. The method will probably answer for titanium and tantalum and small amounts of copper and nickel. T. H. Bu.

Phosphorus; Estimation of —— in presence of tungsten. G. W. Gray and J. Smith. Iron and Steel Inst., May, 1919. [Advance copy.] 4 pages.

In the determination of phosphorus in presence of tungsten low results are frequently noted. In methods in which tungstic acid is separated by evaporating to dryness with hydrochloric acid a large amount of phosphorus is precipitated with the tungstic acid as phosphotungstic acid and so escapes determination. The authors have devised a method of estimating phosphorus in ferro-tungsten, tungsten powder, and tungsten ore which has proved accurate during some years of use. Two grms. of the powdered sample is fused with 10 grms. of a mixture of sodium carbonate and potassium nitrate in molecular proportions in a platinum crucible, the melt is dissolved in the least possible quantity of water, filtered, and the residue washed free from tungstates with boiling water containing a little ammonium nitrate. The residue is ignited in the original crucible, dissolved in hydrochloric acid, and the solution evaporated to dryness. The filtrate is treated with 20 c.c. of hydrochloric acid and 2 c.c. of bromine, ammonia is added until the precipitated tungstic acid is dissolved, and then a further quantity equal to one-fourth of the original volume of the liquid. The phosphorus is then precipitated with magnesia mixture. This method may also be used for estimation of phosphorus in alloy steels with satisfactory results.—C. W.

Iron and steel; Metallic coatings for rust-proofing ——. H. S. Rawdon, M. A. Grossman, and A. N. Finn. Chem. and Met. Eng., 1919, **20**, 530–537, 591–592. (See this J., 1919, 368 A.)

Zinc differs from most metals used for coating iron and steel, as it alloys with the iron to such a degree that the coating is relatively complex in structure. Four structural layers are possible in a coating—an outer one of zinc with a small percentage of iron in solid solution; a matrix of the outer layer with embedded particles of a solid solution of $FeZn_7$ with some zinc; a layer of this solid solution, and a duplex layer of $FeZn_7$ and $FeZn_4$. These structural variations were found in an iron wire which had been kept in molten zinc for 4 hours. Variations in the microstructure of commercial castings are considered. In hot-dipped material the thickness of the layer of $FeZn_7$ is the same for thick and thin coats, the difference being in the outer zinc-rich layer. The structural features of sherardised coatings are described and the importance of the nature and composition of the zinc-dust mixtures discussed. The variations in sprayed coatings are of mechanical origin. Plated zinc coatings are essentially of pure zinc. Measurements are given showing the variation in thickness that may exist on irregularly shaped pieces or even on flat surfaces. Electrolytic copper coatings are also discussed. All coatings afford mechanical protection; zinc also protects from corrosion in a chemical way. A diagram constructed from e.m.f. measurements of the system $Zn-N/20ZnSO_4-Fe$-Zn alloys shows that all the alloys behave towards iron in the same general way as pure zinc. Coatings having excess of Fe-Zn alloys which have a lower potential difference with iron should have a longer life, but they are relatively brittle and hard. The preparation of the surface before coating and the accompanying effects on the mechanical properties of steel are discussed. The advantages and disadvantages of pickling are given. Electrolytic cleaning should be effected at the anode. A bibliography is given under the headings corrosion, microstructure, methods of coating, pickling, and methods of testing coatings.—T. H. Bu.

Hardwood tar oils; Flotation experiments with ——. L. F. Hawley and O. C. Ralston. Chem. and Met. Eng., 1919, **20**, 586–587.

The crude hardwood distillation products—wood oil, heavy tar, and dissolved tar were found to be better flotation oils than distilled heavy oil obtained by further distillation of the heavy tar. A heavy oil from crude wood alcohol storage tanks and a light oil from wood-alcohol refining were not as good as the tars and wood oil. Pitch dissolved in solvents of low flotation value added considerably to the flotation value of the solvents, but did not give an oil comparable with the tar from which the pitch was prepared. Experiments to determine how much pitch is necessary to give a maximum flotation value gave indecisive results, but crude settled tar was superior to the distillate up to 260° C. Removal of alkali-soluble material seems to improve the value of the oil for flotation purposes. Results obtained in commercial plant tests with hardwood oil and crude settled tars were very satisfactory in the treatment of some ores and compared favourably with those obtained from the use of pine oil and creosote.—T. H. Bu.

Sintering zinc residues. K. Stock. Chem. and Met. Eng., 1919, **20**, 525–528.

To recover values from zinc retort residues these are clinkered in heaps, producing an excellent porous blast-furnace material, with no fuel other than the excess carbon remaining after distillation. The residues are selected so that the resulting sinter shall have a lead content as much above 5% as possible. Analyses of typical residues and clinker are given, also an average metallurgical balance sheet over 2 years. In building the clinkering beds a series of air channels is made with loose bricks on a carefully levelled area, and coarse wood is deposited in the valleys between the channels. A layer of hot coals is then added and the heaps are built up with the residues. The fires are kindled by admitting air from a 30-in. main, and the combustion extends through the mass. Depressions are kept level by adding more residue, and the total in one heap mounts up to 500 or 600 tons. At the end of the operation, lasting about a month, the pile is sprinkled with water for 3 days. It is broken up with dynamite and moved with pick and shovel, then loaded by a crane. The plant consists of 17

kilns, with an output of 2100 tons of clinker monthly. The daily cost amounts to 1·5 dollars per ton. A low-pressure blast has proved better than a smaller quantity of air at higher pressure. For successful working the air channels must not be too far apart.—T. H. Bu.

Gallium and germanium; Extraction of — from zinc oxide. H. C. Fogg and C. James. J. Amer. Chem. Soc., 1919, **41**, 947—949.

Some zinc ores contain small amounts of germanium and gallium, and these metals being less volatile remain in the retorts when the zinc distils. The retort residues furnish a good source for the elements gallium and germanium, although the amounts obtainable vary enormously: for example, 100 lb. of one sample gave 8 grms. of pure gallium, whilst a second sample of 200 lb. yielded only the merest trace; the amount of germanium in the two samples was almost identical. One kilo. of the oxide prepared from the zinc residues was dissolved in 2400 c.c. of commercial hydrochloric acid, a little potassium chlorate added, and the liquid distilled. Two fractions were collected, *viz.*, up to 121° C. (thermometer in liquid), and 135°—140° C.; the latter contained practically the whole of the germanium. The distillates were saturated with hydrogen sulphide and the white germanium sulphide filtered off. The liquid left in the flask was diluted with a litre of water and lead chloride allowed to settle. The clear liquid was decanted from the sediment and treated with ammonia until a slight permanent precipitate was formed, metallic zinc was added, and the whole digested at the boiling point for several hours. The precipitation was considered complete when a portion of the supernatant liquid gave a precipitate of basic zinc chloride on dilution. The precipitated metals and basic salts were filtered off and the filtrate examined spectroscopically to ascertain that all the gallium had been precipitated. Ten such precipitates, corresponding to 30 kilos. of the zinc oxide, were united, dissolved in hydrochloric acid with the aid of a little potassium chlorate, boiled, and lead chloride allowed to separate. This was removed and the solution saturated with hydrogen sulphide. The precipitate was filtered off and the filtrate boiled, neutralised with dilute ammonia until a permanent precipitate just formed, and again digested with zinc at the boiling point. When the solution had become basic it was poured from the precipitate, diluted, and filtered. The operation was repeated with the filtrate until the basic precipitate ceased to show a gallium spectrum. The precipitates poor in gallium were added to those obtained from the crude zinc chloride. The precipitates rich in gallium were again dissolved in hydrochloric acid, the solution nearly neutralised, saturated with hydrogen sulphide, and filtered. The filtrate was treated with ammonium chloride, made alkaline to litmus with ammonia, and boiled until just acid. A gelatinous precipitate, consisting of gallium, aluminium, and iron hydroxides, was filtered off and washed. From 100 lb. of crude zinc oxide 60 grms. of the mixture of hydroxides was obtained. This was dissolved in the minimum quantity of hydrochloric acid, diluted with water and nearly neutralised with sodium hydroxide. After the addition of a little formic acid the liquid was treated with an excess of sodium formate, the precipitate filtered off and thoroughly washed to ensure the complete removal of zinc. The precipitate and filter paper were placed in water in a casserole, saturated with hydrogen sulphide and digested with cold 1% hydrochloric acid. The insoluble tin and cadmium sulphides were removed by filtration. The filtrate was made slightly alkaline with ammonia, boiled until slightly acid, and the gallium and aluminium hydroxides filtered off. These were dissolved in hydrochloric acid and an excess of sodium hydroxide added. The solution was then electrolysed by a current of 1·5 amps., using platinum electrodes. The gallium deposited on the cathode in shining globules which dropped off as they became larger. When no more gallium was deposited the solution was poured off and the metal washed several times with water and the globules then united by the addition of a few drops of concentrated hydrochloric acid. J. F. S.

Vanadinite; Treatment of — — for recovery of lead and vanadium. J. E. Conley. Chem. and Met. Eng., 1919, **20**, 514—518.

The ore used was in the form of concentrates consisting largely of vanadinite and quartz and containing PbO 53·88% and V_2O_5 12·60%. The concentrate was fluxed and reduced with caustic soda, soda ash, and charcoal. To obtain the highest oxide of vanadium the slag was heated or a small amount of a suitable oxidising agent (nitre) was added after the removal of the lead. Caustic soda was found more efficient than soda ash in rendering the vanadium water-soluble. The precipitation of vanadium from alkaline solution was readily effected with slaked lime, the resulting products being practically free from molybdenum. The highest grade of calcium vanadate that could be obtained, consistent with a satisfactory recovery, was about 16% vanadium pentoxide. It was used directly in the electric furnace for the preparation of ferro-vanadium with satisfactory results. The grade of calcium vanadate was slightly improved by igniting the first product and using again for precipitating a new lot of alkaline solution. An attempt was made to obtain the vanadium as oxide by neutralising the solution with excess of acid and evaporating to dryness, but the method proved too expensive. The method finally adopted was to precipitate the vanadium pentoxide by boiling in acid solution—preferably sulphuric acid. Trouble with silica was avoided by diluting the alkaline solution and adding to the acid. An experiment was made to determine the acidity most favourable for the formation of pyrovanadic acid. When an alkaline solution obtained by leaching the slag from the fusion was used, trouble was experienced due to the presence of molybdenum. By precipitating the vanadium from an alkaline solution with lime the molybdenum is eliminated; the most satisfactory acidity is probably about 0·6 N. The results showed 85 to 90% vanadium pentoxide in the final product. An estimate is made of the costs of the treatment which indicate that it should be a successful commercial undertaking.—T. H. Bu.

Metals; Process for extraction of —. H. Lohmann. Elektrochem. Zeits., 1918, **25**, 106—107. Chem. Zentr., 1919, **90**, II., 578.

In order to extract pure metal in one operation, chemical reduction is combined with centrifugal force. For melting tungsten by this method the author has designed an electric furnace that can be used as a centrifuge.—T. H. Bu.

Metallic sulphides; Reduction of — by aluminium. N. Parravano and P. Agostini. Gazz. Chim. Ital., 1919, **49**, I., 103—115.

The sulphides, PbS, Cu_2S, SnS, CdS, ZnS, Sb_2S_3, Ag_2S, Bi_2S_3, NiS, and CoS, are all largely and some completely desulphurised by molten aluminium. (See also J. Chem. Soc., Aug., 1919.) T. H. P.

Gas masks. Fleidner and Katz. See XIXB.

Erratum.—This Journal June 30, 1919, p. 419A, col. 1, line 6 from top, *for* "Wardson" *read* "Davidson."

Micro-analysis. Strebinger and Radlberger. *See* XXIII.

PATENTS.

Iron, steel and special metal cuttings; Preparation of — for hot briquetting. Deutsch-Luxemburgische Bergwerks- u. Hütten-A.-G., Bochum. Ger. Pat. 311,118, 27.1.18.

THE cuttings are heated to a temperature suitable for briquetting in a reducing atmosphere in a rotary furnace, in which they move in counter-current to combustion gases. With increasing temperature reduction of the oxygen and oxygen compounds of the metals first takes place. At higher temperatures the reducing gases adhere to the surface of the cuttings, and protect them against oxidation on removal from the furnace.—T. H. Bu.

Gas furnaces, Regenerative or recuperative — for heating or melting metals. E. W. Harvey Gas Furnace Co., Ltd., and E. W. Harvey, London. Eng. Pat. 127,181, 18.10.18. (Appl. 17,068/18.)

To restore full efficiency after recharging a regenerative or recuperative gas furnace, air or air enriched with oxygen is forced through the regenerator or recuperator from a specially adapted turn-over valve, or a combustible gas of high calorific value free from hydrogen and carbon dioxide is introduced into the producer gas, during and for some time after charging.—T. H. Bu.

Metallurgical furnaces. A. G. Bloxam, London. From Stabilimenti "Blak." Ing. A. Pouchain, Turin, Italy. Eng. Pat. 127,206, 23.12.18. (Appl. 21,542/18.)

THE furnace consists of a casing enclosing a crucible containing a portion of the material to be treated, and a movable head sliding on columns on the underframe and containing a chamber for receiving other material; this chamber communicates with the crucible through an opening which can be closed by a plug. The head is connected with a washing scrubber for receiving vaporised impurities and foreign matter, and may also be connected with a safety siphon for maintaining any desired pressure in the crucible. The casing of the crucible can be rocked for teeming.—T. H. Bu.

Furnaces [, Continuous —] for heating ingots, slabs, billets, bars, etc. E. J. W. Richards, Glasgow, and W. Kane, Port Talbot. Eng. Pat. 127,730, 12.6.18. (Appl. 9638/18.)

THE material is heated in three (or two) separate stages on the "charging," "intermediate," and "soaking" hearths respectively (or on the last two only), cold billets being pushed in at the top end of the charging hearth as hot billets are withdrawn from the soaking hearth. The first two hearths are slightly sloping (in the direction of travel of the billets) and are provided with skid-pipes, and the burnt gases can be led away (to the regenerator) through ports situated at the charging end and also between the charging and intermediate hearths, either or both sets being used. From these ports the burnt gases are led away by side flues and pass twice horizontally through a tubular regenerator situated under the hearths, thence to a chimney. Air for combustion is preheated by passing several times vertically over the regenerator tubes, then through (preferably three) passages situated between the regenerator and hearths and between the waste gas side passages. In a mixing chamber just beyond the end of the soaking hearth the air meets gas admitted through valved passages and ports and the burning mixture passes over the soaking, intermediate, and charging hearths in succession. In order to deflect the flames directly on to the billets the roof of the furnace is stepped. The regenerator is fitted with cleaning doors which also serve as explosion doors.—B. M. V.

Heating-chambers for use in heat treatment of metals. J. S. Thompson, Coventry. Eng. Pat. 127,755, 2.7.18. (Appl. 10,807/18.)

A CONTAINER for articles to be heated in a non-oxidising atmosphere is made of an alloy of Ni 67·9, Cr 20·1, Fe 10·53, Si 1·27, and Mn 0·2%. A form of furnace using an inner container made of the alloy, and gas heating, is described.—B. M. V.

Furnaces for use in rendering metal articles non-oxidisable. W. C. A. Mate and C. J. Rourke, Manchester. Eng. Pat. 127,781, 16.11.18. (Appl. 18,810/18.)

THE furnace has a metallic floor plate beneath which a series of Bunsen burners is arranged, and a metallic dome plate, the side walls being of refractory material. An outer casing of refractory material leaves a complete annular path round the furnace for the hot gases, the furnace being closed at opposite ends by sliding doors. The articles to be treated are arranged on a tray which is moved from a series of rollers on to a similar series inside the furnace, and after treatment on to a third series at the other end.—T. H. Bu.

Furnaces for the heat treatment of metal bars, tubes, rods, and other articles. Gibbons Bros., Ltd., Lower Gornal, and M. Timmins, Dudley. Eng. Pat. 128,001, 13.6.18. (Appl. 9729/18.)

A FURNACE provided with a hinged floor opening downwards, so that the contents can be quickly discharged into a quenching bath.

Furnaces, [Temporary repairs to] open hearth and like —. J. O. Griggs, Peoria, Ill., U.S.A. Eng. Pat. 127,785, 23.12.18. (Appl. 21,550/18.)

To avoid having to cool down a furnace and its charge when a wall needs repairing, shields adapted to slide down from above between the buckstays of the furnace are provided. The shields are faced with refractory material and are provided with sliding and hinged wings that can be unfolded behind the buckstays after the main shield is in position, thus completely screening from the heat any part of the wall of the furnace and enabling the wall to be rebuilt during the course of a "heat" if necessary.—B. M. V.

Blast-furnace. C. H. Bingham, London. U.S. Pat. 1,303,155, 6.5.19. Appl., 1.8.18.

THE furnace gas passes through an outlet channel, is cooled in a heat interchanger and then passes through a dust extractor. The air blast is heated by a hot stove fed by a portion of the cooled furnace gas, and then passes into a supply channel.—T. H. Bu.

Blast-furnace. J. Kennedy, Pittsburgh, Pa. U.S. Pat. 1,303,914, 20.5.19. Appl., 15.3.18.

A BLAST-FURNACE is provided with several uptake pipes extending above the top of the furnace proper, the upper ends of these pipes having restricted discharge openings communicating with the top of a downcomer pipe.—J. H. L.

Pyrometers for measuring temperatures of molten non-ferrous metals. J. E. Kievits, and Kynoch, Ltd., Birmingham. Eng. Pat. 127,534, 30.1.19. (Appl. 2331/19.)

A THERMO-COUPLE is enclosed in a protective sheath made of a non-corrosive alloy, the sheath being reduced to a minimum practicable thickness at the end, which is fixed in close contact with the hot junction, so that rapid indications of temperature are obtained.—T. H. Bu.

Lead and zinc; Process for extraction of —— from their ores. F. E. Elmore, Boxmoor, Herts. Eng. Pat. 127,641. (Appls. 6546, 8.5.17, and 11,348, 7.8.17.)

LEAD and zinc sulphide ores, concentrates, etc., are treated with strong sulphuric acid at about 100° C., and the lead sulphate formed is dissolved with hot strong solution of sodium chloride and separated from the unattacked zinc sulphide, the solution being cooled to produce a partial crystallisation of the lead salt. Alternatively, the ore is heated with a strong solution of sodium chloride or other suitable halogen salt, to which a sufficient quantity of sulphuric or hydrochloric acid or alkali bisulphate is added. The lead sulphate is smelted with lead sulphide to obtain metallic lead, any chloride produced being first converted into the sulphate. It is sometimes preferable to treat one portion of the ore with strong and another with weak sulphuric acid and to pass the sulphur dioxide from the first operation into the second mixture, which evolves hydrogen sulphide. Alternatively the latter gas may be used to make lead sulphide from the soluble lead compounds. T. H. Bu.

Metals; Impregnating and coating — with other metals. A. C. Hyde, London, A. Jude, and Belliss and Morcom, Ltd., Birmingham. Eng. Pat. 127,664, 17.5.17. (Appl. 7120/17.) Addition to 125,630, 25.9.16. (this J., 1919, 422 A).

A CORE of metal or alloy of relatively high melting point (*e.g.*, steel) is coated with a more fusible metal or alloy (*e.g.*, copper), and heated to a temperature at or just above the fusing point of the coating metal in an atmosphere of hydrogen or carbon monoxide for a time sufficient to enable the coating metal to impregnate the core substantially throughout. In some cases the coating metal is only applied to one or more faces of the core. The resulting composite metal may be finally subjected to a drawing or equivalent operation.
—T. H. Bu.

Refractory metals and their alloys; Treatment of. W. B. Clarke, Enfield, and The Edison Swan Electric Co., Ltd., London. Eng. Pat. 127,708, 31.5.18. (Appl. 9028/18.)

RODS or other articles of chromium, nickel, and cobalt, or their alloys are immersed in fused alkali cyanide and heated to a temperature between 750° and 850° C. By this means the alloys are annealed and the surfaces freed from scale, and the life of dies used in working the metals is thereby considerably increased.—T. H. Bu.

Castings and other metal articles; Process for rendering —— non-porous to water and other fluids. F. C. Lea, Birmingham. Eng. Pat. 127,772, 9.9.18. (Appl. 14,662/18.)

ARTICLES of aluminium or its alloys and other porous metals are made impervious to fluids by immersion in a solution of sodium silicate (waterglass) with or without the addition of sodium hydroxide, or by subjecting them to the solution under pressure. An insoluble deposit is formed in the pores.—T. H. Bu.

Minerals; Flotation of ——. C. L. Perkins, Pittsburgh, Pa., Assignor to Metals Recovery Co., New York. U.S. Pat. 1,302,966, 6.5.19. Appl., 12.10.17.

A SMALL amount of quinoline is added to the mineral pulp and the mixture subjected to a flotation operation.—T. H. Bu.

Concentrates; Process of treating [agglomerating] W. G. Swart, Duluth, Minn., and B. G. Klugh, Anniston, Ala. U.S. Pat. 1,303,411, 13.5.19. Appl., 17.11.17.

FUEL and metalliferous particles (ore concentrates) are mixed with water to obtain a fluid mixture, the excess water is then removed, and the mixture agglomerated. T. H. Bu.

Metallurgical process [Roasting sulphide ores.] C. M. Malsch and C. H. Gilson, Assignors to Soc. Metalurjica Chilena Cuprum, Valparaiso, Chile. U.S. Pat. 1,303,701. 13.5.19. Appl., 7.11.16.

IN the roasting of sulphide ores, nitrates or other oxidising agents in solution are introduced into a zone where the roasting is somewhat advanced. Sulphur dioxide is thereby oxidised to sulphuric acid, which reacts with the roasted ore to form sulphates of the metals present. The sulphates are removed by leaching and the metals precipitated from solution.—T. H. Bu.

Gas for cutting and welding purposes. Process of welding. J. Harris, Lakewood, Ohio. U.S. Pats. (A) 1,303,891 and (B) 1,303,892, 20.5.19. Appl., (A) 7.6.17, (B) 17.5.18.

(A) A MIXTURE of hydrogen and 10% by volume of acetylene, with substantially pure oxygen. (B) A conical flame produced by the combustion of a mixture of hydrogen, substantially pure oxygen, and a gas capable of imparting visibility to the flame is directed on to the metals to be welded. The gas has a flame temperature higher than that of hydrogen, and produces a flame envelope that protects the welded metal from oxidation.—T. H. Bu.

Alloy [; Aluminium uranium]. L. F. Vogt, Assignor to Standard Chemical Co., Washington, Pa. U.S. Pat. 1,304,224, 20.5.19. Appl., 11.3.18.

A STRONG and tough alloy consisting of aluminium with a small proportion of uranium.—T. H. Bu.

Metals, Method of utilising fuel in the treatment of. H. O. Breaker, Winthrop, Mass., Assignor to American Incandescent Heat Co., Inc., Boston, Mass. U.S. Pat. 1,304,258, 20.5.19. Appl., 19.7.17.

THE fuel is burnt under such conditions that no free oxygen remains in the products of combustion. The material is heated by the products of combustion and is then allowed to cool in a cooling chamber into which it is moved while surrounded by the products of combustion. T. H. Bu.

Ores; Treating fine. D. S. McAfee, New York, Assignor to The Dorr Co. U.S. Pat. 1,305,817, 3.6.19. Appl., 16.8.18.

THE slimes or sludges produced in metallurgical processes in which one of the operations is the sintering of fine ores, are added to the hot product of a sintering machine in order simultaneously to dry the slimes and quench the hot product.
—T. H. B.

Metals; Process of extracting — — from silicates. L. L. Jackson, Assignor to O. C. Horney, New York. U.S. Pat. 1,305,969, 3.6.19. Appl., 28.6.16.

SILICIOUS minerals mixed with an alkali and water are subjected to heat and pressure, the solution separated, and the residue treated to recover the heavier metals as soluble salts.—T. H. B.

Castings; Process for obtaining dense —. N. Bouschkoff and W. Kourbatov, Petrograd. Ger. Pat. 311,295, 15.6.13.

AN electromagnet is brought near to the surface of the metal and maintained there during cooling. By this means the formation of blow-holes is prevented.—T. H. Bu.

Magnetic ore separator. Donnersmarkhütte, oberschlesische Eisen u. Kohlenwerke A.G., Hindenburg. Ger. Pat. 311,387, 28.11.16.

A CONVEYING belt carries the material past the pole faces of an alternately polarised magnet. The conveying belt and catch bars are composed of non-magnetisable material, which results in efficient conveying, good working, and more complete concentration of the ore. The arrangement is such that the distance of the special charging belt from the pole faces and the conveying belt becomes gradually smaller and the effect of the magnet poles on the ore gradually greater. It is possible to separate effectively an iron ore which on account of the fineness of grinding cannot be dealt with on known types of separator.—T. H. Bu.

Iron or steel; Method of treating —. E. C. R. Marks, London. From United States Alloys Corporation, New York. Eng. Pat. 127,921, 31.12.17. (Appl. 19,313/17.)

SEE U.S. Pat. 1,252,023 of 1918; this J., 1918, 127 A.

Steel; Manufacture of —. C. Dear, Assignor to The Mirls Steel Co., London. U.S. Pats. 1,304,946—8, 27.5.19. Appl., 30.12.16.

SEE Eng. Pats. 124,463—5 of 1916; this J., 1919, 371 A.

Sheet metal. [Mild steel faced with "stainless" steel.] A. E. Gillespie, London. U.S. Pat. 1,306,690, 17.6.19. Appl., 31.7.18.

SEE Eng. Pat. 115,750 of 1917; this J., 1918, 378 A.

Iron sponge; Process for transforming — into solid iron. A. Sinding-Larsen, Vestre Aker, Norway. U.S. Pat. 1,306,928, 17.6.19. Appl., 21.3.17.

SEE Eng. Pat. 114,025 of 1917; this J., 1918, 247 A.

Alloy of iron, titanium, and silicon, and process for the production thereof. E. C. R. Marks, London. From United States Alloys Corporation, New York. Eng. Pat. 127,922, 31.12.17. (Appl. 19,314/17.)

SEE U.S. Pat. 1,260,037 of 1918; this J., 1918, 308 A.

Alloys. The Cooper Co., Cleveland, Ohio, U.S.A. Eng. Pat. 127,930, 10.4.18. (Appl. 6097/18.) Addition to 113,259, 14.5.17.

SEE U.S. Pat. 1,277,046 of 1918; this J., 1918, 705 A.

Ore reduction apparatus. L. W. Goold, Birmingham. From P. J. MacDonald, Goffs, Cal., and C. L. Claflin, jun., Los Angeles, Cal., U.S.A. Eng. Pat. 127,964, 7.6.18. (Appl. 9379/18.)

SEE U.S. Pat. 1,264,832 of 1918; this J., 1918, 427 A.

Lead; Extraction of —. E. S. Berglund, Trollhättan, Assignor to S. Huldt, Stockholm, Sweden. U.S. Pat. 1,306,942, 17.6.19. Appl., 11.3.18.

SEE Eng. Pat. 114,303 of 1918; this J., 1919, 78 A.

Moulding powder etc. from waste lyes from cellulose manufacture. Ger. Pat. 311,294. *See* V.

Electrolysis. U.S. Pat. 1,303,226. *See* XI.

Hardness of metals. Eng. Pat. 127,412. *See* XXIII.

XI.—ELECTRO-CHEMISTRY.

[Electric] furnace; Granular carbon resistance — for fusion point of coal ash and firebrick. C. H. Lovejoy. Chem. and Met. Eng., 1919, **20**, 538.

THE author describes a new furnace with improvements to facilitate operation and the replacement of worn parts. The current is introduced from a 110 volt a.c. line to two circular wrought iron terminals brought into close contact with the carbon by a set-screw. The central vertical tube is of alundum, and the thickness of the column of granular carbon is restricted in its middle portion by a ring of alundum cement. The test cones of coal ash and dextrin solution and the Seger cones are placed on a plunger and lowered very slowly into the hot furnace, the temperature of which is raised till the coal ash fuses. For this operation the furnace would last indefinitely. It is also used for determining the fusion points of firebrick up to temperatures of 1650°—1750° C. The ease of introducing and removing the cones is an advantage, and it is possible to raise or lower them at any time to the hottest level.—T. H. Bu.

Temperature of arc electrodes. Hagenbach and Langbein. *See* IIB.

PATENTS.

Furnaces; Electric —. A. E. White, London. From Industrial Electric Furnace Co., Chicago, Ill., U.S.A. Eng. Pat. 127,131, 20.6.18. (Appl. 10,183/18.)

AN electric furnace comprises an oscillating body and a tilting roof provided with one or more electrodes passing through it, the roof being lifted from the body for charging and recharging the furnace without disturbing the electrical connections. The roof is composed of refractory material surrounded by a band, which is rigidly connected with and supported by a crane, by means of which the roof can be lifted bodily and tilted through an angle of about 45°. Two electrodes may be supported by adjacent and parallel cranes, so that when the current passes through the electrodes in series, the inductance of the circuit through the cranes is a minimum. An air-tight joint is provided between the roof and the furnace body, so as to force the gas out of the furnace spout, whereby the gas thus trapped in the furnace prevents the entrance of air and consumption of the electrodes.—B. N.

Furnaces; Electric —. T. Rondelli, Turin, Italy. Eng. Pat. 127,458, 10.8.18. (Appl. 13,024/18.)

THE electric resistance furnace is of the type in which the main resistance element forms the furnace chamber, and the current is supplied to at least one of the poles of the element through a recessed part of low electric resistance, in the

recess of which a refractory material is placed. A layer of high resistance material is inserted between the main resistance element and the part through which the current is supplied, for the purpose of localising the development of heat and regulating the difference of potential between the poles of the furnace.—B. N.

Furnace; Electric [metallurgical] W. E. Moore, Pittsburgh, Pa. U.S. Pat. 1,304,350, 20.5.19. Appl., 11.6.17.

A METALLURGICAL furnace heated electrically comprises a retort mounted on rockers, with traction rollers supporting the rockers and carrying the entire weight of the furnace; means are provided for driving the rockers to tilt the furnace. B. N.

Furnace; Electric —. H. G. Weidenthal, Assignor to The James H. Herron Co., Cleveland, Ohio. U.S. Pat. 1,304,425, 20.5.19. Appl., 16.11.18.

THE bath of the furnace is surrounded by a number of upright resistance elements removable independently and arranged with their lower ends resting upon conductors. Other conductors are arranged to engage and connect together the upper ends of the resistance elements. B. N.

Electric melting furnaces. J. E. F. Schmarje, Hamburg. Ger. Pat. 310,811, 23.6.17.

AN electric furnace is provided with upper electrodes situated above the bath and lower electrodes built into the furnace walls and lining. The latter are of iron or other metallic wire, cable or strips, at different levels, and, no provision being made for cooling, are burnt out, when the furnace is first started up, as far as a particular temperature zone, the current being then carried by the incandescent lining. The furnaces may be externally cooled by means of an air-blast or an air or oil jacket.

—E. H. R.

Electric furnaces; Process for charging closed. Bosnische Elektrizitäts-A.-G., Vienna. Ger. Pat. 311,721, 17.12.14. Int. Conv., 17.1.14.

THE material is introduced in successive portions through the electrode, and falls therefrom through the furnace upon the heap already therein. For this purpose the material is fed to the electrode through a trap door valve, or along an inclined plane projecting into the furnace, or by a screw feed, cutter head, or other feeding device.

J. S. G. T.

Crucible furnaces heated by means of multi-phase electric current. A.-G. Brown, Boveri & Co., Baden, Switzerland. Ger. Pat. 311,802, 5.2.18.

HEATING is effected by a number of arcs produced below the bottom of the crucible, the number of arcs being at least equal to the phase number. A neutral annular electrode is arranged immediately beneath the crucible so as to enclose a portion of the arcs which are formed between it and movable rod electrodes situated below. The rod electrodes are surrounded by a jacket separate from and concentric with the outer furnace wall. The upper end of this jacket abuts against the annular electrode, and its lower end is closed by an insulator through which the rod electrodes are inserted. A flp is provided on the outer jacket of the furnace and this communicates with the crucible by means of a funnel-shaped arrangement so that the crucible can be emptied by tilting the whole furnace.

—J. S. G. T.

Electrodes; Production of —. W. K. Page, Chicago, Ill., Assignor to Chili Exploration Co., New York. U.S. Pat. 1,302,959, 6.5.19. Appl., 10.1.16.

AN electrode, for electrolytic purposes, comprises a core sheet of metal, and an outer coating, fused to the core, of material insoluble in the proposed electrolyte; the core and coating have substantially the same coefficient of thermal expansion.—B. N.

Storage battery [grids; Process of "pasting" —]. T. Spencer, Philadelphia, Pa., Assignor to National Carbon Co., Inc. U.S. Pat. 1,303,513, 13.5.19. Appl., 30.9.16.

A SOLUTION of sulphuric acid is atomised by means of a stream of air containing lead oxide in suspension, and the product is sprayed into the grid in layers, the strength of the acid being gradually increased as successive layers are deposited.

W. E. F. P.

Negative plate for lead storage batteries. W. Morrison, Chicago, Ill. U.S. Pat. 1,304,192, 20.5.19. Appl., 23.9.18.

LEAD is deposited electrolytically from solution in the pores of the active material, simultaneously with the reduction of the active material.—B. N.

Battery; Electric —. R. C. Benner and H. F. French, Fremont, Ohio, Assignors to National Carbon Co., Inc. U.S. Pat. 1,303,453, 13.5.19. Appl., 2.12.16.

THE negative element contains lead peroxide and sulphur in an alkaline electrolyte.—B. N.

Battery; Electric —. G. N. Antonoff, London. U.S. Pats. (A) 1,303,843 and (B) 1,303,844, 20.5.19. Appl., 12.8.18.

(A) AN electric cell is provided with an anode composed principally of zinc, and a depolariser mixture subjected to a pressure "in the region of the critical pressure giving an internal resistance to the cell about a minimum value." Means are provided for maintaining the internal resistance at about that value, the means being independent of the mechanical strength of the zinc anode. (B) The depolariser consists of a mixture containing manganese dioxide, carbon, and a substance which has little or no action on the manganese dioxide, and the ammonium and zinc salts of which are freely soluble in the battery solution. The depolariser is subjected to a pressure as stated in (A). (See also Eng. Pat. 108,892/16; this J., 1917, 1102.)—B. N.

Electrolysis; Process of —. H. I. Allen, Assignor to Electron Chemical Co., Portland, Me. U.S. Pat. 1,303,226, 13.5.19. Appl., 1.2.17.

A METAL, which in its atomic state does not combine with water, is recovered from an aqueous saline solution by causing a body of the solution in a cathode chamber to percolate through a diaphragm, and passing an electric current from an unsubmerged anode in contact with the diaphragm through the solution to a cathode immersed in the solution on the other side of the diaphragm. The cathode metal is deposited, whilst the anions are liberated as such or combine with the water of the solution according to the character of the salt in the electrolyte. B. N.

Electrolytic cell and electrode therefor. A. T. Stuart, Assignor to R. Blei, New York. U.S. Pat. 1,303,519, 13.5.19. Appl., 27.8.18.

THE electrode has a rigid back, to which is secured a number of equally spaced thin blades extending

at an angle therefrom, the back forming a closure for the spaces at one side of the entire length of the blades; or a flange may be provided along one longitudinal edge of each blade so as to engage the next adjacent blade and bridge the space at that edge of the blade, means being provided for securing the flange of one blade to the next adjacent blade. B. N.

Electrolytic cell. C. W. Marsh, Greenwich, Conn. U.S. Pat. 1,302,824, 6.5.19. Appl., 14.7.17.

The anode and cathode are arranged vertically and spaced from each other, the anode being composed of a number of members arranged one above the other and somewhat inclined to the vertical, so that the bubbles rising from the active surface of one anode member pass to the rear of the member above it. The cathode comprises a perforated sheet having longitudinal corrugations thereon, and horizontally stepped in conformity with the arrangement of the anode members. A flexible diaphragm is fitted against the cathode, with means for holding the diaphragm in position.—B. N.

Electro-osmotic dehydration of vegetable, animal, and mineral substances; Apparatus for the — —. Electro-Osmose A.-G. (Graf Schwerin-Ges.), Berlin. Ger. Pat. 311,663, 21.10.17.

The one or more passages for the supply of material to the dehydration chamber are arranged centrally or distributed symmetrically with regard to the electrodes. In this manner, a more uniform dehydration of the material than usual is secured, the various portions of the material being subjected to the same current for an equal time. J. S. G. T.

Aluminium coils; Process for the manufacture of coils of metallic conductors, more particularly for the manufacture of —. Specialfabrik für Aluminium-spulen und -leitungen, Berlin. Ger. Pat. 311,677, 18.7.16.

An insulating film of oxide or salt is produced upon the surface of the metal employed in the coil and the coil is then immersed in a bath of hot enamel. In order to ensure a strong union between the enamel and the layer of oxide or salt, a temporary softening of the enamel coating is produced by passing a strong electric current through the coil. —J. S. G. T.

Gases and vapours; Method of and apparatus for treating — electrically. W. T. Hoofnagle, Glen Ridge, N.J., U.S.A. Eng. Pat. 128,066, 21.8.18. (Appl. 13,607/18.)

See U.S. Pat. 1,280,471 of 1918; this J., 1918, 758 A.

Electric heating and melting furnace. V. Stobie, Dunston-upon-Tyne. U.S. Pat. 1,305,177, 27.5.19. Appl., 28.3.18.

See Eng. Pat. 110,109 of 1916; this J., 1917, 1239.

Separating suspended particles. Eng. Pat. 127,119. *See* I.

Roasting carbon. U.S. Pat. 1,302,946. *See* VII.

XII.—FATS; OILS; WAXES.

Oil from Hevea seeds. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9785—9786.

A litre of seeds weighing 364 grms. contains 52% of oil and at the first pressing yields 33% of oil of refractive index 1·472, saponification value 191·9, and iodine value 130·8. The oil is convertible into a good quality of dark factice, whilst with sulphur chloride it yields a "white" factice rather more coloured than those from colza and castor oils and comparable with the product obtainable from linseed oil. The semi-solid fatty acids obtained from the oil are yellow and have melting point 27° C., neutralisation number 185, average molecular weight 303, and iodine value 113. (See also this J., 1918, 381 A; 1916, 1089.)—D. F. T.

Fat of Bassia longifolia and Bassia latifolia [; Presence of palmitic acid in — —]. E. Winterstein. Z. physiol. Chem., 1919, **105**, 31—32.

Free palmitic acid may be isolated from the press-cake of the seeds of these two plants.—J. C. D.

Emulsification with lampblack. Moore. *See* IIA.

Patents.

Catalytic material; Process for the production of — — and the saturation of fatty acids or their glycerides with hydrogen. H. J. Morrison, Assignor to The Hydrogenation Co., Cincinnati, Ohio. U.S. Pat. 1,299,004, 1.4.19. Appl., 11.9.12.

A mixture of the material to be hydrogenated with a substantially non-catalytic compound of a catalytic metal is heated in an atmosphere containing hydrogen at about 250°—290° C., whereby a catalyst is formed and hydrogenation effected in one process. —C. A. M.

Catalysis [hydrogenation of fatty oils]; Art of — —. C. Ellis, Montclair, N.J. U.S. Pat. 1,300,144, 8.4.19. Appl., 6.9.16.

Oil is hydrogenated in presence of a catalyst consisting of a finely divided catalytic metal electrically deposited in a sponge-like condition on a base composed of a non-metallic substance containing a high percentage of carbon and capable of occluding hydrogen. C. A. M.

Glycerin; Process of and apparatus for distilling —. Soc. Française des Glycérines, Paris. Eng. Pat. 123,302, 5.6.18. (Appl. 9294/18.) Int. Conv., 14.2.18.

A constant supply of crude glycerin is introduced into a vessel in which is maintained a vacuum of about 64 cm. of mercury, and is heated to about 180° C. so as to remove water and impurities distilling below that temperature. It is then transferred to a second vessel in which a still higher vacuum is maintained and is heated to about 180° C. while atomised by jets of steam or air. This second vessel may be arranged concentrically within the first vessel, whilst means are provided for regulating the difference in pressure between the two vessels, each of which has a heating coil. —C. A. M.

Glycerin; Process of and apparatus for distilling —. Soc. Française des Glycérines, Paris. Eng. Pat. 125,574, 7.6.18. (Appl. 9432/18.) Int. Conv., 16.4.18. Addition to 123,302, 14.2.18.

In the process described in the chief patent (preceding), the crude glycerin is partially concentrated in the outer vessel at 180° C. under a vacuum of about 50 cm. of mercury, and the concentration is completed in the inner vessel at the same temperature but under a vacuum of about 72 cm. of mercury. The glycerin is drawn into the inner vessel through three atomisers by means of the difference in vacuum instead of being injected into the same by jets of steam or other gas.—L. A. C.

Mineral oil sulphonic acid and process of making. R. E. Divine, Assignor to The Twitchell Process Co., Cincinnati, Ohio. U.S. Pat. 1,303,779, 13.5.19. Appl., 16.4.17.

The sludge obtained when mineral oil is treated with sulphuric acid is treated with water, the aqueous solution of sulphonic acids separated from the oil, sulphuric acid separated as insoluble sulphate, and the sulphonic acids "salted out" with a suitable reagent. The recovered sulphonic acids are readily soluble in an equal volume of water, but less soluble in ether, and are not readily "salted out" from a concentrated solution. They form soluble calcium salts, combine with alkalis and alkaline-earth metals to form salts with detergent properties, and have the power of hydrolysing fats.—C. A. M.

Soap substitute. J. Perl und Co., Berlin. Ger. Pat. 311,160, 24.6.16. Addition to Ger. Pat. 308,609 (this J., 1919, 21 A).

Light magnesium oxide (*e.g.* 10 parts) is intimately mixed with magnesium carbonate (40 parts) and introduced at the ordinary temperature into a solution of magnesium chloride (110 parts of an 18% solution). Colouring matter, perfumes, etc., may be introduced at the same time, and the resulting viscous mass is cut into pieces or moulded.—C. A. M.

Detergent; Process of manufacturing a —. E. Prior, Rosenheim. Ger. Pat. 311,218, 15.10.16.

A sufficient quantity of tragacanth to form a viscous mass is dissolved in an aqueous extract of saponin, and the mixture is treated with water-glass containing a small percentage of rosin and a little ammonia in solution. A solution of the product in water froths when shaken and has good detergent properties. For such purposes as a shaving soap substitute the ammonia is omitted.—C. A. M.

Glycerin; Apparatus for distilling —. R. Boutet, Assignor to La Soc. Française des Glycérines, Paris. U.S. Pat. 1,306,941, 17.6.19. Appl., 22.5.18.

See Eng. Pat. 123,302 of 1918; preceding.

Fat etc. from conifer needles. Ger. Pat. 311,291. See XIII.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Colophony; Behaviour of an alcoholic solution of lead acetate towards the resinous substances of —. L. Paul. Kolloid-Zeits., 1919, **24**, 95—104, 129—138, 165—173. (See also this J., 1914, 429, 557; 1915, 1062; 1917, 557; 1918, 130 A, 215 A.)

The main conclusions of Tschirch (Die Harz und Harzbehälter, Berlin, 1906) are critically discussed. The effect of adding hydrochloric acid, sodium chloride solution, and alcoholic lead acetate solution to solutions of colophony is described. The starting material in all previous investigations is shown to be the colloidal substance, γ-pinic acid, m.pt. 75°—76° C. This substance is slowly decomposed by the bound colloidal water in boiling alcoholic solution. The colloidal behaviour of colophony components, particularly in their changes, is probably due to a special "holding power" which resinous substances are able to exert on one another and whereby an apparent formation of new chemical substances occurs. The residue from the soda-soluble KL substances (soluble colophony) furnishes an example of this type of derivative. These extraction residues must not be confused with the decomposition products, which are obtained on washing, through the changes occurring in β-pinic acid, m.pt. 98°—100° C., and which are probably the substances from which fossil resins are produced. Just as the resinous substances often form weak but well crystallised compounds with hydrocarbons by virtue of the holding power (see this J., 1915, 1153) mentioned above, so γ-pinic acid forms similar weak compounds with ethereal oils which constitute the turpentine resins. The methods used by Tschirch lead to new substances which are not present in the original material. This is particularly the case for a series of low-melting amorphous substances isolated by Tschirch from recent fossil resins. A method of separation, due to Tschirch, which leads to the acceptance of three abietic acids (α, β, γ) is to be regarded in the above sense. Although the use of alcoholic lead acetate does not destroy the colloidal condition of the substances treated with it, for example γ-pinic acid, yet a change in the so-called colloidal constitution is to be observed. True resinous substances differ from resin-like substances in their power of passing into the crystalline state, whilst the resin-like substances are non-crystallisable. The colophony substance is, in consequence of its colloidal nature, a "living substance" which does not come to rest until the colloidal water is used up and thereby a labile equilibrium is set up. The stable condition is probably realised in amber. (See also J. Chem. Soc., 1919, 1, 111.) J. F. S.

Lacquer coatings; Quick drying —. H. A. Gardner. Circular No. 65, Educational Bureau, Paint Manufacturers' Assoc., U.S.A., June, 1919.

Rapid-drying "dopes" for aeroplane wings used during the war were composed of either cellulose acetate or cellulose nitrate dissolved in volatile solvents with a composition such as the following:—Methyl acetate, 60; methyl ketone, 10; benzene, 15; acetone, 10; and diacetonealcohol, 5%. From 7 to 9 oz. of cellulose acetate, 1 oz. of triphenyl phosphate, and small quantities of *e.g.* benzyl acetate, benzyl benzoate, or urea were dissolved in 1 gall. of the solvent. The various additions of solid substances to increase the flexibility or fire resistance are not usually required when the dopes are to be used as protective varnishes for ordinary purposes. A cellulose nitrate dope consisted of 6 to 8 oz. dissolved in 1 gall. of a solvent composed of 20% of butyl acetate, 50% of ethyl acetate, and 30% of benzene. For a protective coating cellulose nitrate dope is greatly improved by the addition of 5 to 7% of casein or "treated" tung oil, which makes the film more elastic and reduces the speed of evaporation. Such preparations may be used as the base for metal finishes, and when mixed with aluminium powder or zinc powder form rapid-drying hard primers for metal. Mixed with pigments they dry to form a flat washable surface and may be used as substitutes for shellac in some kinds of work. They may be applied by means of a spray or brush, and the film will resist baking at a low temperature. Cellulose nitrate lacquers can be used as primers for certain types of cement floors before painting, and have the effect of preventing waterproofing greases etc. in the cement acting on enamels subsequently applied. On the other hand, cellulose lacquers are not as durable as those made with oil or varnish.—C. A. M.

Patents.

Lampblack; Manufacture of —. E. L. Curbishley, Cheadle Hulme. Eng. Pat. 127,770, 29.8.18. (Appl. 14,022/18.)

In order to render lampblack dustless, the material is placed in an enclosed mixer and sufficient water

is added to form a plastic mass; about 2 to 5% of resin oil is then added, and the product, after thorough mixing, is placed upon trays in a stove until the water has evaporated.—L. A. C.

Fatty and resinous substances; Method of obtaining —— from conifer needles. F. A. Richter und Co., Rudolstadt Ger. Pat. 311,291, 29.9.17.

Conifer needles are treated with boiling water, prior to the extraction of fat and resins, to effect better penetration of the solvent. A yield of up to 10% of fat and resin is thus obtained from pine needles.
—C. A. M.

Cellulose acetate compositions Eng. Pats. 127,615 and 127,678. *See* V.

Cellulose acetate composition. U.S. Pat. 1,303,563. *See* V.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Hevea latex; Coagulation of ——. G. Vernet. Caoutchouc et Gutta-Percha, 1919, **16**, 9835—9844.

In a critical review of the researches on latex coagulation, it is shown that results obtained with latex preserved by the addition of ammonia are likely to be very misleading and that it is necessary to use fresh latex; this fact may account for some of the results obtained by the supporters of the enzyme theory of coagulation. After reviewing the various theories that have been proposed, the conclusion is drawn that the protein constituents of the latex play the chief part in coagulation and that all the experiments, even those involving electrolysis, made in this connection can be explained by the reactions of these proteins; coagulation results from an "insolubilisation" of the proteins. Desiccation and centrifuging are not of themselves able to effect coagulation although they may aid separation in the presence of the ordinary coagulants; without these the processes named merely effect an alteration in concentration with subsequent gradual coalescence of the rubber globules, the proteins being almost entirely removable subsequently by washing the rubber. Although the possibility of the activity of enzymes during the spontaneous coagulation of latex cannot be denied, it is significant that their presence has not been directly demonstrated and that the phenomena can be explained entirely satisfactorily without assuming their existence. Latex below 4° C. can be preserved perfectly for more than a month, and by tapping with careful exclusion of micro-organisms and collecting in sterilised glass tubes it is possible to obtain samples which remain liquid for a month or more. Spontaneous coagulation can be satisfactorily obtained with ordinary latex by adding, if necessary, 1—10 grms. of sugar per litre, excluding air during coagulation and maintaining the temperature at 30°—45° C.; as a further aid, a little of the serum from a previous coagulation or of a selected growth of micro-organisms may be introduced. Latex thus treated will coagulate perfectly even if it has been diluted with several times its bulk of water.—D. F. T.

Rubber; Some considerations on the preparation of raw ——. E. de Wildeman. Caoutchouc et Gutta-Percha, 1919, **16**, 9826—9829.

A review of recent investigations on the production of plantation rubber. Fine hard Para rubber at present is generally not superior to plantation rubber. In the preparation of plantation rubber it is advisable to avoid too great a dilution of the latex, to employ a minimum quantity of coagulant, to use bisulphite, and to smoke the rubber at a temperature not exceeding 55° C., commencing one day after the rolling of the rubber and continuing for a fortnight after the rubber is dry. Sheet is superior to crêpe and crêpe is better prepared thick than thin. It is considered desirable that plantations should produce as few forms of rubber as possible and that the best form is smoked sheet.
—D. F. T.

Rubber; Turgescence of ——. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9781—9783, 9815—9819.

A small tube of vulcanised rubber, containing 36·8% by weight of rubber and of sp. gr. 1·662, cut from the tread of a motor tyre cover was immersed in petroleum spirit at 14° C. and its weight determined at regular intervals; absorption occurred rapidly at first, but the rate gradually decreased and immersion for more than 100 hours was necessary for saturation, when the specific gravity had attained a value of 1·065 and the volume had increased from 1·161 c.c. to 3·150 c.c. Examination of the final supernatant liquid showed that 9·69% of the rubber sample had gone into solution, this amount including 5·15% of rubber proper. For rubber the rate of swelling in a "solvent" depends on the nature of the liquid used, the origin and purity of the rubber, the coefficient of vulcanisation and the temperature. The rate and extent of swelling are believed to provide a more rapid and trustworthy indication of the "nerve" of rubber than is supplied by viscosity measurements; most of the materials likely to be present in technical raw rubbers, such as resins, do not interfere with the "turgescence curve," but the natural proteins retard the arrival at the critical point at which the rubber loses its tenacity and resistance to stretching, and it is claimed that their quantity can be estimated from this effect. With vulcanised rubber the greater the proportion of mineral fillers and of factice the more rapidly the "critical point of turgescence" is attained, whilst with decrease in the proportion of rubber and increase in that of sulphur the rate of swelling is diminished. The rate of swelling of rubber in a solvent may be measured gravimetrically or volumetrically, the latter being more convenient, and a modification of Justin-Mueller's apparatus for the examination of the behaviour of cotton during mercerisation (this J., 1914, 1201) is recommended for this purpose. Examination of the effect of various solvents at 15° C. shows that the swelling power (in terms of volume) towards vulcanised rubber falls in the order tetrachloroethane, carbon bisulphide, carbon tetrachloride, petroleum spirit (boiling at 70°—100° C.), and benzene; the rate of swelling in the boiling solvents or the vapours therefrom is much greater, but the results for the various solvents are less comparable on account of the differences in temperature. The advantage of tetrachloroethane over carbon bisulphide at the same temperature is only slight in terms of volume, but much greater if expressed gravimetrically, whereas the relative positions of petroleum spirit and benzene are reversed if the swelling is measured by the increase in weight. The values of the swelling constant, x, calculated by Kirchoff's formula $Q=KS^x$ where S is one hundred times the specific gravity of the solvent, K the volume before swelling, and Q the maximum volume, were found to be tetrachloroethane 2·107, carbon tetrachloride 1·872, carbon bisulphide 1·747, benzene 1·672, petroleum spirit 1·245, heptane 1·727, tetrachloroethylene 2·072, pentachloroethane 1·987.—D. F. T.

Rubber; Determination of sulphur in —. L. Rosenstein. Indiarubber J., 1919, **57**, 1100.

THE finely ground sample (0·5 grm.) is placed in a flask of 300 c.c. capacity and a saturated solution of arsenic acid (15 c.c.), fuming nitric acid (10 c.c.), and saturated bromine water (3 c.c.) are added. After boiling until the sample is completely oxidised, the neck of the flask being covered meanwhile with a watch-glass, the clear solution is evaporated to a syrupy condition; a few crystals of potassium chlorate are introduced and the evaporation is continued almost to dryness until the oxides of nitrogen are completely expelled. After cooling, 50 c.c. of 10% hydrochloric acid is added, the solution being then filtered and made up to 300 c.c. The precipitation of barium sulphate is effected in the usual manner. The function of the arsenic acid is to raise the boiling point of the solution and thereby expedite the oxidation process.—D. F. T.

Rubber compounds; Rapid electrolytic method for total lead and zinc in —. E. D. Donaldson. Indiarubber J., 1919, **57**, 1100.

THE ash obtained by incinerating 1 grm. of the rubber compound wrapped in an ashless filter paper is digested with 25 c.c. of concentrated nitric acid for 15 minutes; nitrous fumes are expelled by boiling and the solution after dilution to 125 c.c. is electrolysed at 70°—80° C. with a rotating cathode and a current of 2·3 ampères, using a large gauze anode; after 30 minutes the anode bearing the lead dioxide is washed successively with water and a mixture of alcohol and ether, then dried for 30 minutes at 170° C. and weighed; no metals ordinarily present in rubber mixings will interfere with this determination. The remaining solution is treated with 5 c.c. of concentrated sulphuric acid and evaporated to dryness to expel nitric acid; the residue is digested with 50–75 c.c. of water and the filtered solution (or one-fourth of it if the zinc oxide content of the rubber mixing exceeds 20%) is treated with a considerable excess of saturated sodium hydroxide solution and electrolysed at the ordinary temperature in a 200 c.c. beaker for 20 mins., using a rotating anode and a current of 2—2·5 amps. After washing as previously, the cathode is dried for a few minutes at 100° C. and the weight of the zinc deposit determined. Iron, if present, should be removed as the hydroxide, prior to the electrolysis, by filtration of the solution before the full amount of sodium hydroxide has been introduced.—D. F. T.

Oil from Hevea seeds. Dubosc. *See* XII.

PATENT.

Latex; Process for treating — *and product thereof.* E. M. Slocum, Medan, Sumatra, Assignor to General Rubber Co. U.S. Pat. 1,306,838, 17.6.19. Appl., 27.2.17.

SEE Eng. Pat. 116,324 of 1917; this J., 1918, 477 A.

XV.—LEATHER; BONE; HORN; GLUE.

Tannins; Artificial —. H. Bamberger. Chem.-Zeit., 1919, **43**, 318.

SCHIFF, in 1875, obtained, by the action of phosphorus oxychloride on phenolsulphonic acid, a substance which was capable of tanning hides; this substance was probably a mixture of didepside and polydepsides of phenolsulphonic acid. Later, Fischer and Zinckes prepared the pure didepside and tridepside; the didepside, although it precipitated gelatin from its solution, did not tan hides, but the tridepside, $HO.C_6H_4SO_2.O.C_6H_4.O.SO_2.O.C_6H_4SO_3Na$, was a true tannin. Other tanning substances have been prepared from phenol- and naphthol-sulphonic acids, by the action of formaldehyde on phenol- and naphthol-sulphonic acids and on salicylic and cresotic acids (see this J., 1917, 93), and by the action of formaldehyde and neutral sulphite on phenol. The author has also obtained tanning substances by condensation of dihydroxydiarylethanes with formaldehyde and neutral sulphite etc. (See this J., 1916, 1072.)—W. P. S.

Chrome [tanning] liquor; Composition of a two-bath —. E. Little and J. Howard. J. Amer. Leather Chem. Assoc., 1919, **14**, 325–330.

A NUMBER of examples of a proposed simplified method of calculating the composition of a chrome bath liquor from the results of titration with N/10 sodium hydroxide and N/10 thiosulphate are detailed.—E. W. L.

Tannage of hides with salts of iron. Part I. Y. Casaburi. J. Soc. Leather Trades Chem., 1919, **3**, 61–64.

THE author summarises published work on the iron tannage, beginning with that of Ashton in 1794. Bystron and Von Vietinghoff's process (Ger. Pat. 255,320; this J., 1913, 99, 638, 618) is based upon the oxidation of ferrous to ferric sulphate by means of oxides of nitrogen. The author is of opinion that the cyclic process described by the patentees is less likely to be successful in practice than one in which fresh tanning liquor is prepared for each batch of goods, as, *e.g.*, by aspirating air through a solution of ferrous sulphate (10° B., sp. gr. 1·074), to which ½–1% of sodium nitrite and sulphuric acid sufficient to liberate the nitrous acid have been added, until the whole of the ferrous salt is oxidised. The principal points resulting from the published investigations are that ferrous salts and normal ferric salts do not tan, and that if attempts be made to render a ferric salt sufficiently basic dissociation is too rapid and the resulting leather is thin, flat and brittle. Ferric salts in such a condition bring about catalytic oxidation of the fats which it is necessary to add to the leather.—E. W. L.

Leather samples for analysis, Preparation of —. L. E. Stacy. Report of 1919 Committee of Amer. Leather Chem. Assoc. J. Amer. Leather Chem. Assoc., 1919, **14**, 321–325.

RESULTS of analyses of identical samples of leather by a number of analysts have led to the conclusion that better samples can be prepared by sawing than by planing. In the author's opinion the best samples are prepared with saws of 8 in. to 10 in. diam., run at about 2000 r.p.m.—E. W. L.

Glue and similar substances, Quantitative separation of — *in vegetable glues.* W. Donsell. Z. Spiritusind., 1919, **42**, 14. Chem. Zentr., 1919, **90**, II., 590.

TEN grams of material is intimately mixed with 250 c.c. of warm water and boiled for 4–5 hours under a reflux condenser, 1–2 grms. of tartaric acid is then added and the boiling continued for a further 30 mins. The mixture is nearly neutralised with sodium hydroxide, the albuminous matter precipitated by the addition of a saturated solution of zinc or copper sulphate, and the solution made up to a definite volume and filtered. The nitrogen is then determined both in the residue and in the filtrate by Kjeldahl's method. To determine

the amino nitrogen an aliquot part of the filtrate is precipitated with dilute tannin solution acidified with acetic acid and the nitrogen again determined in the filtrate. This latter value subtracted from the value obtained before precipitation with tannin gives the true nitrogen value of the glue content.—T. C.

Gelatin, Influence of the valency of anions upon the physical properties of ——. *Amphoteric colloids.* V. J. Loeb. J. Gen. Physiol., 1919, **1**, 559—580.

FURTHER experimental proof of the validity of the author's theory of the influence of ions on the physical properties of gelatin (this J., 1919, 331 A). (See further J. Chem. Soc., 1919, i., 418.)—J. C. D.

PATENT.

Leather substitute. Ger. Pat. 306,688. *See* V.

XVI.—SOILS; FERTILISERS.

Heated soils; Influence of —— *on seed germination and plant growth.* J. Johnson. Soil Sci., 1919, **7**, 1—103.

PRACTICALLY all soils after being heated at 100°—115° C. produce a temporary retardation of seed germination and plant growth followed by increased rate of growth, the extent of this action varying with the soil, the seed or plant used, and with the experimental conditions. In order to obtain further information as to the factors concerned, seven different soils were heated at temperatures ranging from 115° to 800° C., and their action on various seeds and plants determined. In general there was a gradual increase in toxicity to seed germination and to early plant growth with rise in the temperature of heating, a maximum toxicity occurring in soils heated to 250° C., and the toxicity decreasing with further increase in temperature and practically disappearing in soils heated to 350° C. or above. The time required for recovery from this toxic action was usually directly proportional to the intensity of toxicity produced, and the final beneficial action was often greatest in soils exhibiting the greatest injurious action on early plant growth. Different soils vary greatly in the toxicity and subsequent beneficial action produced by heating, this variation being correlated apparently with the balance of all the soil factors concerned. Seeds vary greatly in their sensitiveness to the toxic action of heated soils, the degree of sensitiveness being roughly characteristic of their genetic relationship. The *Gramineæ* and *Cucurbitaceæ* are usually resistant and the *Leguminosæ* and *Solanaceæ*, as far as determined, more susceptible. Seeds classed as susceptible may, however, show accelerated germination on soils not productive of high toxicity or on soils heated at low temperatures only. Like seeds, growing plants differ markedly in their sensitiveness to the action of heated soils, but toxicity to seed germination is not always correlated with toxicity to plant growth and *vice versâ*. Furthermore, sensitiveness of seeds to the toxic agent in germination is not indicative of the behaviour of the same species in its growth in the same soil. The growth of fungi, especially of *Pyronema*, on heated soil is correlated with the toxicity to seed germination and plant growth on any one soil. The fungi and apparently bacteria also grow best in soil heated to 250° C., *i.e.* when the toxicity is at its maximum. The ammonia content and the concentration of the soil solution of a soil heated to different temperatures are highest on heating to about 250° C. and diminish gradually with higher and lower temperatures of heating, thus being correlated with the toxicity to seed germination and early plant growth, and with the beneficial action on later plant growth and on growth of lower micro-organisms. This correlation, however, only holds good for each particular soil. The absorptive capacity of a soil for the toxic agent, as well as other factors, apparently influence the toxicity of a soil, it being found that, in water extracts of different heated soils, the toxicity to seed germination is more directly proportional to the ammonia content. The author believes that much of the toxic action in heated soils is due to the ammonia produced and that the ammonia exists in the heated dry soils largely as ammonium carbonate, which is, however, gradually decomposed under normal growing conditions. The addition of ammonia as such to a soil in varying amounts may produce a condition similar in many respects to that produced by heated soils on seed germination and plant growth. Similar qualitative reactions can be produced with certain seeds on highly toxic, heated soils or their extracts and with certain strengths of ammonia, these reactions being apparently only reproducible by ammonia or ammonium salts. The toxic substance is destroyed or changed to non-toxic compounds in soils kept under normal growing conditions, this change being due to the activity of ordinary soil flora, which, however, may apparently at the same time increase the amount of ammonia present, but it is suggested that this ammonia is not present as such but rather as transition products which are broken down when the ammonia determinations are made. The temperature at which the soil is kept is an important factor in determining the extent of the toxic and beneficial action to plant growth. The toxic action disappears more slowly and is more destructive at low soil temperatures (below 25° C.) than at higher temperatures. The conclusions drawn are considered to apply particularly to highly heated soils, but it is not believed that any fundamental difference exists between soils partially sterilised by steam and highly heated soils re-inoculated with normal soil flora.—W. G.

Soils; Statement of acidity and alkalinity, with special reference to —— E. T. Wherry. J. Wash. Acad. Sci., 1919, **9**, 305—309.

THE author proposes a new scale in place of that usually employed for expressing acidity or alkalinity in terms of P_H. His scale giving values of X_H is such that neutrality is indicated by $X_H = 0$, the values of X_H being obtained by subtracting the P_H figures from 7.—W. G.

Potash; Determination of —— *[in fertilisers].* L. G. L. Steuerwald. Archief Suikerind. Nederl.-Indië, 1919, **27**, 435—436.

THE precipitate of potassium platinichloride obtained in the usual manner is reduced by means of sodium formate solution, and the resulting platinum, after washing with ammonium chloride solution, is ignited whilst still wet.—J. P. O.

Basic slags containing fluorine. Doyle. *See* VII.

PATENTS.

Soil; Method and apparatus for the treatment of ——. J. R. C. August, Halifax. U.S. Pats. (A) 1,303,149 and (B) 1,303,150, 6.5.19. Appl., (A) 21.11.18, (B) 25.3.19.

(A) FINELY ground soil is caused to travel in a long circuitous path in the opposite direction to a cur-

rent of hot gas, sufficient time being allowed for the destruction of injurious organisms without destruction of desirable organic matter. (B) Apparatus for the process consists of a vehicle capable of moving over the ground to be treated, and picking up the soil, which is passed through a rotary cylinder carrying beater arms rotating at high speed in an opposite direction to the cylinder. The vehicle carries also a heater.—J. H. J.

Fertiliser. T. C. Meadows, New York. U.S. Pat. 1,304,082, 20.5.19. Appl., 15.6.18.

ALKALI metal compounds are incorporated with a plastic and hydrated mass of calcium iron silicate.—J. H. J.

XVII.—SUGARS; STARCHES; GUMS.

Sugar; Manufacture of plantation white — by the sulphitation process. F. E. Coombs. Louisiana Planter, 1917, **58**, 235–236. Int. Sugar J., 1919, **21**, 301–302.

CLARIFICATION of the raw juice from the mills is effected by liming in the cold to a dull yellow colour, at which point a distinctly alkaline reaction to phenolphthalein is shown, and by sulphiting until only a very faint blue is indicated by litmus. Juice entering the evaporators should be quite bright, and concentration should be conducted with as high a degree of vacuum as possible, but not beyond 27°–28° B. (48·6°–50·6° Brix). In the pan the "strike" is started in the usual manner, the aim being to grain rather high for a small crystal; the temperature is subsequently raised to 71° C. (160° F.), and maintained at this point throughout the "strike," the mass being discharged at about 90–91% of solids. Boiling back of molasses is not attempted. Purging is carried out at as high a temperature and as rapidly as possible without previously cooling the mass in crystallisers, and washing is effected with low pressure steam. Molasses from the centrifugals is diluted to 35°–36° B. (64°–66° Brix) with the addition of a little phosphoric acid, heated until all the grain is dissolved, allowed to subside, and the clear liquor boiled in the pan to string proof at a low temperature. This second sugar is remelted in hot clarifier or press juice (with which are mixed the washings and steamings of the first sugar) to a liquor 28°–30° B. (50·6°–54·3° Brix), which is allowed to settle, or preferably filtered, and gradually drawn into the first body of the evaporator. Sugar made by this process is suitable for direct consumption, and is stated to keep as well as the refined product if well cooled by passing through a dryer or granulator previous to packing.—J. P. O.

Cane sugars; Deterioration of — in storage; its causes and suggested methods for its control. W. L. Owen. Louisiana Bull., No. 162, 1–121. Int. Sugar J., 1919, **21**, 277–281, 334–339.

As a result of the examination of a large number of sugars of different grades, the author agrees with Browne (this J., 1918, 275 A) as to the almost general validity of the factor of safety formulated by the Colonial Sugar Refining Co., of Australia, as a criterion of keeping quality during storage. Exceptions, however, are noticeable, since frequently a sugar with a factor less than 0·333 may undergo more or less rapid change under certain conditions. This discrepancy is most frequently to be observed in cases of plantation white sugars and low-grade sugars which have been washed with water in the centrifugals to give a polarisation of 96°. On the other hand, sometimes sugars having a factor higher than 0·333 may not deteriorate, examples of this exception being very low grade sugars, particularly "seconds." It appears, therefore, that the factor depends to some extent upon the purity as well as the density of the film of molasses surrounding the crystals of sugar, a lower factor than 0·333 in the case of washed sugars and a higher in that of seconds being applicable. On studying the changes that occur in the composition of raw sugars during deterioration, it was observed that the reducing sugars may successively increase and decrease at different periods, the moisture content at the same time either increasing or decreasing. Sometimes it was found that alteration was confined to the reducing sugars only, and this phenomenon is attributed to the suppression of the sucrose-destroying power of certain groups of micro-organisms by the density of the film. Micro-organisms taking part in the deterioration of sugars include bacteria closely resembling the so-called potato group, as *B. vulgatus*, *B. mesentericus*, *B. lodermus*, *B. mes. ruber*, and *B. mes. vulgatus*, the most striking points of resemblance being the very high resistance of their spores to heat and the ability to form gum, as well as their morphological and physiological characteristics. Torula are constantly present, and although active in destroying sugars only invert sucrose under certain favourable conditions. Moulds, as *Aspergillus fumigatus*, *A. niger*, a blue *Aspergillus*, and *A. penicilloides*, were identified, and owing to their strong inverting power, which they are able to exercise in highly concentrated solutions of varying reaction, they form the most dangerous class of micro-organisms to be found in raw sugars. Contrary to Shorey's statement that it is generally present (this J., 1898, 555), it was not possible to identify *Penicillium glaucum*, though a green mould belonging to the *Aspergillus* group was frequently encountered. In manufacturing raw sugars of 96° polarisation of good keeping quality, in order that the crystals shall retain films of low purity it is necessary that purging should be easily carried out in the centrifugals, a minimum amount of water being used for washing. To secure this, the grains must not be too small, and the molasses must not be too viscous, that is, clarification in the early stages must be thorough. Encouraging results have been obtained in factories in which special precautions have been taken to avoid infection, notably in the use of steam or sterilised water for washing in the centrifugals, and in the covering of machines, mixers, cooling bins, etc. Good warehousing is essential, and provision should be made for drying the air admitted when its humidity rises beyond a certain point, while the floors should be of concrete with a layer of boards to form an air-space between. Laboratory experiments on the possibility of cold storage have indicated that deterioration was slight compared with that occurring at higher temperatures. J. P. O.

Moisture; Loss of — from samples of sugar using different methods of packing. C. A. Browne and G. H. Hardin. Int. Sugar J., 1919, **21**, 274–277.

Raw sugar was packed in different ways, and the average daily loss of moisture per cent. was found to be as follows: tin can (holding about 400 grms.) with closely-fitting lid, 0·0215; the same, sealed with adhesive tape, 0·0163; the same, sealed with adhesive tape covered with a film of paraffin, 0·0122; and glass fruit jars (holding about 250 grms.), the covers being held in position against a rubber ring, 0·0140. Bottles closed by corks sealed with paraffin may be ineffective owing to the formation of air-holes, and should be dipped in the melted wax a second time. Stanek's method

of using seamless lead boxes (holding about 200 grms.), closed with a metal cover and sealed with "leucoplast" adhesive tape (this J., 1909, 720), showed a daily loss of only 0·0006%. Samples can be preserved indefinitely without loss of moisture in wide-mouthed bottles with ground-glass stoppers sealed with paraffin. J. P. O.

Sugar juices; Separation of scums from — by centrifuging. B. Block. Z. Ver. deut. Zuckerind., 1918, 383–422. Chem. Zentr., 1919, **90**, II., 592–593.

THE problem of separating carbonatation scums from sugar juices by centrifuging is discussed from the theoretical standpoint, some experiments on the subject are described, and the construction of several types of centrifugal separators explained. It is concluded that, provided the carbonatation process has been properly conducted, the centrifugal separation of the scums is practicable and economical. The most rational type of apparatus is a centrifugal separator with rotating discs, driven by electric motors or turbines. The washing of the scums in the centrifuge should entail no greater loss of sugar than occurs with filter-presses. The extra power required, in comparison with filter-press working, is compensated by a saving of fuel in the lime-kilns. J. H. L.

Sugar after products; Working of [beet —]. G. Schecker. Z. Ver. deut. Zuckerind., 1918, 359–372. Chem. Zentr., 1919, **90**, II., 593–594.

THE beneficial effect of high boiling temperatures, *e.g.*, 90° C., on the quality of sugar obtained from after-product massecuites, is much over-rated. Massecuites boiled at 80° C. will, if properly treated, yield sugars of high *rendement* which behave well in the centrifuges. If the ratio of water to non-sugars is known for a completely exhausted saturated molasses at the temperature of centrifuging, it is only necessary to continue boiling until this ratio has been attained in the massecuite. The author has compiled a table, arranged according to degrees Brix and purity-quotients of after-product massecuites, showing the temperatures at which the mother syrups of the massecuites possess (after crystallisation has ceased) the composition of completely exhausted saturated molasses. Below these "critical temperatures of massecuites" centrifuging can only be properly carried out after addition of water (the exact amount of which is shown in a second table), whilst above them it is impossible to obtain completely exhausted molasses. The table shows also to what degree Brix an after-product massecuite of given purity-quotient must be boiled in order to yield an exhausted molasses when centrifuged at a given temperature. J. H. L.

Sucrose; Determination of — in cane molasses and other products by double polarisation. L. G. L. Steuerwald. Archief Suikerind. Nederl.-Indië, 1918, **27**, 636–637. Int. Sugar J., 1919, **21**, 304.

OPERATING upon Java cane molasses, results in close agreement with each other were obtained by the following three methods of double polarisation: (1) Tervooren's (Archief Suikerind. Nederl.-Indië, 1904, 321), in which the influence of the basic lead acetate upon the optically-active non-sucrose substances in making the direct polarisation is obviated by the addition of acetic acid; (2) Walker's (this J., 1918, 239), in which phosphoric acid is used for this purpose after clarification by dry basic lead acetate; and (3) Steuerwald's (this J., 1913, 1025), in which inversion is carried out at the ordinary atmospheric temperature prevailing in the tropics (instead of 68°–70° C.).—J. P. O.

Xylose; Preparation of — from corn [maize] cobs. K. P. Monroe. J. Amer. Chem. Soc., 1919, **41**, 1002–1003.

THE following procedure, based on the methods of La Forge and Hudson (this J., 1919, 86A), and of Hudson and Harding (this J., 1918, 778A), is recommended. The broken maize cobs are digested with sodium hydroxide solution (1%) for 1½ hours at 100° C.; the cobs are then pressed as dry as possible and thoroughly washed with hot water. The residue is hydrolysed for 2 hours with boiling sulphuric acid (4%), filtered, and the filtrate is neutralised with barium carbonate. After filtration, the pale yellow filtrate and washings are acidified with a few drops of phosphoric acid and decolorised with bone black or, preferably, "norit." The solution is concentrated *in vacuo* to a pale yellow syrup from which the xylose almost immediately separates after addition of about half its volume of glacial acetic acid and seeding. The sugar solution is less coloured than that obtained by previous methods whilst crystallisation of the xylose takes place with uniform readiness. The yield of crystalline xylose is 8–10%.—H. W.

Decolorising carbons. Zerban. *See* IIB.

Constituents of wood. Königand Becker. *See* V.

Glue etc. in vegetable glues. Donselt. *See* XV.

Action of invertase. Colin and Chaudun. *See* XVIII.

PATENTS.

Sugar juices or syrups; Process for purifying —. P. L. Wooster, Yonkers, N.Y. U.S. Pat. 1,304,638, 20.5.19. Appl., 17.1.16.

RAW sugar juices or syrups, without addition of lime, are treated with a small quantity of "earthy filtering material" and passed through a filter.—J. H. L.

Molasses; Process for the de-saccharification of —. A. Gräntzdörffer, Magdeburg. Ger. Pat. 311,212, 19.4.17.

MOLASSES (second syrup) from first product sugar is mixed with dissolved sugar and added to first product massecuites after the formation of grain, boiling being continued after the addition.—J. H. L.

Potassium salts from sugar refuse. U.S. Pat. 1,303,916. *See* VII.

XVIII.—FERMENTATION INDUSTRIES.

Sucrase [invertase]; Law of action of —. Influence of viscosity on the velocity of hydrolysis. H. Colin and A. Chaudun. Comptes rend., 1919, **168**, 1274–1276. (See this J., 1918, 600A.)

THE velocity of hydrolysis of sucrose in aqueous solution, the amount of invertase remaining constant, is proportional to the fluidity of the solution, the ratio being $V = \alpha F$. It is further shown that α is a function of the first degree of the amount of invertase present.—W. G.

Kubierschky's apparatus. Borrmann. *See* I.

PATENTS.

Beer; Process for brewing ——. Manufacture of non-intoxicating hopped beverages. Manufacture of alcohol-reduced beer. Manufacture of alcohol-reduced beverages. H. Heuser, Chicago, Ill. U.S. Pats. (A) 1,302,549 to (D) 1,302,552, 6.5.19. Appl., (A) 2.8.15, (B) 8.7.18, (C) 4.11.18, (D) 9.12.18.

(A) BEER of low alcohol-content is produced by simultaneously boiling and fermenting wort in a vacuum until the content of fermentable matters has been reduced to a predetermined amount, and then completing the fermentation under atmospheric pressure. (B) Fermented wort is partially de-alcoholised, diluted to its original volume, cooled, and treated with *Krausen* and with a dextrin-rich solution which has been hopped at a temperature below its boiling point and cooled. (C) The alcohol-content of beer is reduced to less than 0·5%, and the beer is subjected to the action of fermenting wort in such a manner that the final alcohol-content is less than 0·5% by volume. The product is then artificially carbonated. (D) Claim is made to a step in the production of beers of reduced alcohol-content, which consists in raising the proportion of unfermented matter in a wort to the normal extract-content of "alcohol-reduced beer." J. H. L.

Peroxydase preparations; Process for the manufacture of ——. A. Stoll, Basle, Switzerland. Eng. Pat. 120,571, 21.10.18. (Appl. 17,193/18.) Int. Conv., 20.10.17.

PLANT materials rich in peroxydase, such as roots of horseradish, are sliced and steeped in dilute acid, *e.g.*, 0·3% oxalic acid, to render the peroxydase insoluble, and then washed with water to remove soluble inactive substances. The peroxydase is afterwards extracted with dilute alkali, *e.g.*, a saturated barium hydroxide solution, and recovered from the acidified and concentrated extract by fractional precipitation with alcohol. The activity of the product may be greatly increased by treating a concentrated aqueous solution with a mercury salt, *e.g.*, mercuric chloride, which precipitates a large amount of inactive matter. J. H. L.

Recovering alcohol vapours. Eng. Pats. 117,259 and 127,309. *See* I.

Refrigerating apparatus. Eng. Pat. 127,512. *See* I.

XIXA.—FOODS.

Margarine; Rapid determination of water in ——. L. Frank. Chem.-Zeit., 1919, **43**, 314–315.

A SMALL beaker, containing 2·5 grms. of coarsely powdered pumice, is counter-poised on a balance of the Westphal type, a 10-grm. weight is then removed from the right arm of the balance and 10 grms. of the margarine is weighed into the beaker. After the water has been expelled by heating the beaker over a flame, the beaker is again placed on the balance and the loss in weight found by means of the rider. Sand, kieselguhr, etc. cannot be used in place of pumice, as they do not prevent spirting.

W. P. S.

Fruits; Mechanism of the preservation of —— in cold water. G. Bertrand. Comptes rend., 1919, **168**, 1285–1288. (See this J., 1915, 510 A.)

SALTS, acids, sugars, enzymes, etc., slowly diffuse from the fruit into the water, and the water becomes more and more acid, a condition which is unfavourable to the development of most bacterial species, although yeasts and lactic ferments may develop. Then the oxygen dissolved in the water is consumed very rapidly by various oxidation processes set up by laccase etc., and the medium becomes strictly anaërobic, and thus fermentation is inhibited.

—W. G.

Straw-cellulose [fodder]. G. B. van Kampen. Chem. Weekblad, 1919, **16**, 805–810.

AN account of various processes, developed chiefly in Germany during the war, for the manufacture of cattle fodder from straw.—W. S. M.

Phospho-organic reserve principle of green plants; Two crystalline salts from the ——. S. Posternak. Comptes rend., 1919, **168**, 1216–1219.

THE two salts, prepared from seeds or from phytin itself, are a double calcium sodium salt, $C_6H_{12}O_{27}P_6Ca_3Na_6$ and the sodium salt, $C_6H_{12}O_{27}P_6Na_{12},4H_2O$. From the latter, corresponding copper and lead salts may be prepared and these on treatment with hydrogen sulphide yield the free acid.—W. G.

Constituents of wood. König and Becker. *See* V.

PATENTS.

Food for cattle and other animals; Manufacture of ——. The Molassine Co., Ltd., East Greenwich, and J. J. A. de Whalley, Lee, Kent. Eng. Pat. 127,388, 25.5.18. (Appl. 8705/18.)

PEAT moss or other cellulose material is treated in a jacketed autoclave with 5% of a hydrolysing agent, such as concentrated hydrochloric acid, and superheated steam at 148° C. for ½ hour. Little or no pressure is applied. If sulphuric acid is used as the hydrolysing agent, it is first diluted with water, and in this case a temperature of 168° C. is used. After treatment, the acid remaining in the product, which is nearly dry, is partly neutralised.—J. H. J.

Cheese; Recovering and making —— of the food matters in whey. W. J. Beer, Bristol. Eng. Pat. 127,184, 4.10.18. (Appl. 16,131/18.)

WHEY from a cheese press is passed into a jacketed vat and allowed to stand until further acidity is produced. The vat is then heated by steam to 150° F. (66° C.) and finally 200° F. (93° C.), between which limits coagulation takes place. The curd produced is removed and pressed.—J. H. J.

Milk and other liquids; Self-contained combination apparatus for the production of powders from ——. G. W. J. Ellis and C. E. Gardner, Gloucester. Eng. Pat. 127,752, 29.6.18. (Appl. 10,765/18.)

MILK is fed on to a number of revolving discs within a condenser and flows down into a receptacle below from which it is again raised to the top of the vessel by means of a central worm elevator. A water-jacket heated by gas jets is provided around the condenser, and a current of air is drawn through the apparatus. When the milk has been evaporated to the required density it is drawn off through adjustable valves to sets of mechanical feeders so devised that layers of uniform thickness are fed on to the surfaces of revolving cylinders heated internally by gas jets either directly or through jackets containing oil or water. The layer of milk remains on the surface of the cylinders,

the temperature of which does not exceed 210°—220° F. (99°—104° C.), for about 7 secs., and is removed by knives situated just below and behind the mechanical feeders. The dried product falls into a trough below, whence it is conveyed by mechanical conveyors to a combined sifting and mixing plant.—L. A. C.

Albumins from blood; Manufacture of decolorised, odourless, and tasteless —. A. J. L. Terwen and C. J. C. van Hoogenhuyze, Amsterdam, Holland. Eng. Pat. 127,766, 13.8.18. (Appl. 13,158/18.) Addition to 123,971, 13.8.18.

In the process described in the chief patent (this J., 1919, 511 A), in order to hasten decolorisation, the liquid is heated to about 60° C. immediately after addition of the alkali for neutralising the acid.—L. A. C.

Flour; Treatment of —. H. Greville, Liverpool. U.S. Pat. 1,306,333, 10.6.19. Appl., 29.3.19.

See Eng. Pat. 123,435 of 1918; this J., 1919, 266 A.

XIXB.—WATER PURIFICATION; SANITATION.

Alkalinity [of water]; Sulphite leuco derivatives of triaminotriphenylmethane as reagents for — *and for dissociation of salts.* I. Guareschi. Gazz. Chim. Ital., 1919, **49**, I., 115—123.

Magenta and other colouring matters of the triphenylmethane group, when reduced by sulphur dioxide or an acid sulphite, serve as good reagents for bromine and hypobromites (this J., 1912, 1149), and it is now shown that they are applicable also to the detection of alkalinity, especially in the case of potable waters, the sensitiveness of the reaction being so great that preliminary concentration of the waters by evaporation is unnecessary. (See also J. Chem. Soc., Aug., 1919.)—T. H. P.

Army gas masks; Use of — *in atmospheres containing sulphur dioxide.* A. C. Fieldner and S. H. Katz. Chem. and Met. Eng., 1919, **20**, 582—586.

An investigation of the possibility of using army masks for protecting workmen from sulphur dioxide fumes from smelters and sulphide roasters. Experiments with the early French type of mask, particulars of which are given, showed that it is effective in an atmosphere containing 0·16% of sulphur dioxide but of no practical value. The mouthpiece type of the U.S. army mask is described in detail. The canister contains coconut charcoal and "purple" soda-lime. Experiments in a gas chamber showed that there was no discomfort in atmospheres containing 0·46% and 1·17% of sulphur dioxide. In life tests of standard army F type masks in atmospheres containing 5% sulphur dioxide, 20 canisters removed all traces of sulphur dioxide for periods of time varying from 18 to 41 minutes, the variation being due to differences in filling and breathing rates. Practical tests made by the Anaconda Copper Mining Co. showed that the masks were of great value near sulphide roasters unless the concentration of gas was too high. Improved results were obtained by using soda-lime alone as the filling in the canisters, and it would be advantageous to have a larger canister for industrial use. It is believed that the later type of Tissot mask with a 100 cub. in. soda-lime canister will prove the most satisfactory. Other industrial uses suggested are in sulphite pulp and paper mills, sulphuric acid plants, and for protection against other acid gases. The limitations of gas masks are discussed.—T. H. Bu.

Patents.

Sewage or contaminated liquid; Process and apparatus for the complete treatment of —. *Apparatus for treating sewage by decantation and settling.* L. Linden, London. Eng. Pats. (A) 127,353 and (B) 127,419, 1.9.17. (Appls. 12,582/17 and 9744/18.)

(A) Sewage is passed into a separating tank in a downward direction and meets a series of baffles, placed at right angles to each other, which disintegrate it in its passage. At this stage the sewage may be mixed with a deodorising agent. The sludge settles to the bottom of the tank, and the liquid and fat rise and pass into a decanting tank which is so constructed as to permit of a longer time of sedimentation. Fat is removed also in the decanting tank. The effluent passes through a series of aerating and filtering chambers, in which air is injected into it and it passes in an upward direction through a filter composed of layers of iron fragments and pebbles. (B) The decanting tank referred to above is covered and constructed with inclined sides and pockets at the bottom. The sewage enters at the top of each side and the major portion passes down a continually narrowing passage between the wall and a partition to the pocket at the bottom, while the lesser portion passes to the pocket along a continually widening passage between the first partition and a second partition inclined at a different angle. Sludge is deposited in the pockets, and the liquid passes upwards into the body of the tank. Fat also rises upwards and is prevented from passing away with the effluent by vertical overlapping baffles. The fatty scum collecting on the surface is removed by closing the outlets and allowing the liquid to rise until the scum passes into collecting troughs.—J. H. J.

Disinfecting solutions etc.; Composition of matter adapted for use as —. C. Ellis, Montclair, N.J., Assignor to Chadeloid Chemical Co., New York. U.S. Pat. 1,302,905, 6.5.19. Appl., 2.11.17. Renewed 21.3.19.

The composition consists of 15 vols. of phenol dissolved in 70 vols. of monochlorobenzene and 10 vols. of carbon tetrachloride.—J. H. J.

Asphyxiating gas; Manufacture of —. E. Sernagiotto, Bologne, and G. Orsi, Rome, Italy. Eng. Pat. 127,650, 11.5.17. (Appl. 6756/17.)

Projectiles suitable for dropping from aerial machines are filled with a concentrated solution of hydrocyanic acid in chloroform and/or carbon tetrachloride.—L. A. C.

Fumes or vapours. Eng. Pat. 127,031. *See* XXII.

Clouds, fogs, etc. Eng. Pat. 127,289. *See* XXII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Hydrastine and berberine; Separate extraction of — *from golden seal [Hydrastis canadensis rhizome] on a large scale, and a review study of the two alkaloids.* E. Schmidt. Amer. J. Pharm., 1919, **91**, 270—275.

Golden seal, ground for percolation, is moistened with benzene containing a little ammonia, and macerated in benzene for 24 hours, after which

percolation is started and the drug is exhausted. The benzene percolate is extracted with 3% sulphuric acid and hydrastine is precipitated from the acid liquor on addition of ammonia. The drug, from which the hydrastine has thus been removed, is dried, and macerated for a few hours with hot water acidulated with acetic acid; percolation is then started and the percolate received in a vessel containing concentrated hydrochloric acid. Berberine hydrochloride is precipitated in an almost pure condition. The author reviews the properties, tests, uses, and methods of estimation of hydrastine and berberine.—G. F. M.

Porphyroxine. J. N. Rakshit. Chem. Soc. Trans., 1919, **115**, 455–461.

A NEW alkaloid, called porphyroxine, $C_{18}H_{23}O_4N$, and probably a constituent of the mixture to which this name was initially given by Merck in 1837, was isolated in the form of yellow prisms, m.pt. 134°–135° C., from Indian opium. It is appreciably soluble in water, and its solutions in mineral acids on exposure to the air assume a purple porphyry colour which is characteristic. Numerous salts have been prepared and their properties determined.—G. F. M.

Emetine hydrochloride. G. E Ewe. Amer J Pharm., 1919, **91**, 275–280

FIVE American samples of emetine hydrochloride were found to contain from 1 to 3% of cephaeline, which was estimated by treating 0·6 grm. of hydrochloride with sodium hydroxide, extracting the emetine by shaking with ether, acidifying the aqueous liquid with sulphuric acid, liberating the cephaeline with ammonia, extracting with ether, and weighing. Emetine is somewhat sensitive to heat, but sterilisation of the hydrochloride solutions in ampoules at 115° C., although causing a slight darkening, produced no material decomposition Metallic tin slowly precipitates the alkaloid from solutions of the hydrochloride. G. F. M.

Lavender oil adulterants; Ethyl esters as ——. M. S. Salamon. Perf. Ess. Oil Rec., 1919, **10**, 175.

THE ethyl esters obtained from the fatty acids of coconut oil are being at present used for the adulteration of lavender oil. They can only be detected with certainty by an examination of the fatty acids separated from the oil; a solid acid melting at about 30° C. can be isolated by the usual method when these esters are present in the oil. An indication of the presence of the esters is obtained by the production of a milky, instead of a clear solution, when liberating the fatty acids, but the usual constants of the oil reveal nothing abnormal even when as much as 3% of adulterant is present.—G. F. M.

Perilla; Essential oil of ——. Gattefossé. Perf. Ess. Oil Rec., 1919, **10**, 170.

Perilla arguta gives 0·045% of a red-brown volatile oil, the leaves alone giving a distinctly higher yield. The odour is somewhat nauseous, but when diluted with alcohol the oil has a pleasant hay-like perfume. It has sp. gr. 0·9320 at 25° C., and α_D −93°. On saponification an odour of geraniol is produced, and 55% of aldehydes is indicated by the sulphite method, consisting mainly of dihydrocuminic aldehyde. The oil gives a naphthyl-urethane, m.pt. 146° C., identical with that from the alcohol of gingergrass oil.—G. F. M.

Taste; New theory relating constitution to ——. *Simple relations between the constitution of aliphatic compounds and their sweet taste.* E. Oertly and R. G. Myers. J. Amer. Chem. Soc., 1919, **41**, 855–867.

THE taste of sweet aliphatic substances depends on two factors; the presence of a glucophore and an auxoglue. An auxoglue is an atom or radical which combined with any glucophore yields a sweet compound. A glucophore is a group of atoms which has the power to form sweet compounds by uniting with a number of otherwise tasteless atoms or radicals. In the sense of the theory the following are glucophores: $-CO.CHOH-(+H)$; $CO_2H.CHNH_2-$; CH_2ONO_2; $CH_2OH.CHOH$; $CH_2{}_xHal_x-$, $CH_3{}_xHal_x.CH_2{}_xHal_y-$. The following act as auxoglues forming sweet compounds with glucophores: hydrogen; the radicals C_nH_{2n+1} containing 1–3 carbon atoms; the radicals $C_nH_{2n-1}O$ of the monohydric alcohols where n 1 or 2, the radicals $C_nH_{2n-1}O^n$ of the polyhydric alcohols. The presence of the phenyl group tends to make an otherwise sweet compound bitter. Thus glycol is sweet, styrol is slightly bitter. Some exceptions to the rule are found in stereoisomeric substances, thus *l*-valine $(CH_3)_2.CH.CHNH_2.CO_2H$ is made up of the glucophore $-CH.NH_2.CO_2H$ and the auxoglue $(CH_3)_2.CH-$ and is slightly bitter, but *d*-valine and *dl*-valine are both sweet.—J. F. S.

Light-sensitiveness of [organic] chemical compounds; Cause of the —— J. Plotnikow. Chem.-Zeit., 1919, **43**, 321–323, 337–338.

PHOTOCHEMICAL reactions take place in the case of aliphatic compounds according to the schemes, 1. acids, $RCO_2H \rightarrow RH+CO_2$; 2. aldehydes, $RCOH \rightarrow RH+CO$; 3. alcohols, $RCH_2OH \rightarrow RH+CO+H_2$; 4. ketones, $R_1COR \rightarrow R_1R_1+CO$; 5. diazo-compounds, $R_1N_2R_2 \rightarrow R_1R_2+N_2$. Illumination of a compound containing a double bond leads either to the production of a stereoisomeride, or an intramolecular change or the formation of a saturated closed ring system. The first two changes may be regarded as the first intermediate stage of the action of light. All organic aliphatic compounds of the types mentioned may be decomposed by careful photolysis in the way indicated above. When there is no possibility of the formation of a more or less saturated system a photo equilibrium is set up which may be displaced in either direction by varying the wave length of the light J. F. S.

Dimethyl sulphate; Action of —— on the alkali and alkaline-earth sulphates. J. Guyot and L. J. Simon. Comptes rend., 1919, **168**, 1204–1206. (See this J., 1919, 478A.)

ALKALI and alkaline earth sulphates when heated in sealed tubes with dimethyl sulphate yield the pyrosulphate of the metal and dimethyl ether.
— W. G.

Hexanitrodiphenylamine Hoffman and Dame. *See* XXII.

PATENTS.

Monochloroacetic acid; Manufacture of ——. L. J. Simon and G. Chavanne, Paris. U.S. Pat. 1,304,108, 20.5.19. Appl., 23.7.17.

MONOCHLOROACETIC acid is prepared by heating trichloroethylene with sulphuric acid containing a small amount of water.—G. F. M.

Amyl acetate and its homologues; Manufacture of —— from chloro-hydrocarbons of the paraffin series. G. G. Oberfell and H. T. Boyd, Homer, Ohio, Assignors to The Ohio Fuel Supply Co., Pittsburgh, Pa. U.S. Pat. 1,302,583, 6.5.19. Appl., 22.1.18.

CHLORO-PARAFFINS are converted into acetic esters by treatment with an alkali acetate and acetic acid in presence of an alkali sulphate. G. F. M.

Physiologically active substances; Production of —— from ovaries, corpus luteum, or placenta. S. Fränkel and E. Herrmann. Ger. Pat. 309,482, 14.7.14. Int. Conv., 7.7.14. Addition to Ger. Pats 297,392 and 306,906 (this J., 1918, 717 A).

THE mother liquor from the precipitation of phosphatides is concentrated and fractionally distilled under a high vacuum. The mother liquor containing acetone is freed from most of the impurities by extraction with alcohol before distillation. Under a high vacuum the main fraction distils at 190°–210° C. and consists of hormones, with cholesterol and its esters. From it the hormones can be extracted with alcohol, while cholesterol and some of its esters crystallise out. The alcohol is removed by evaporation and a second distillation *in vacuo* yields the product in a pure form. It is a clear viscous oil, (C 81·33–81·62%, H 11·32–11·49%) showing a typical cholesterol reaction. The hormones alone are insoluble in water but soluble in the presence of phosphatides, *e.g.*, on extraction of the tissues in slightly acidulated water. The isolated insoluble hormones can be brought into aqueous solution or emulsion by addition of unsaturated phosphatides, in which form they are applicable for subcutaneous injections.—H. J. H.

Ethylidene diacetate; Manufacture of ——. J. Koetschet and M. Beudet, Lyon, France, Assignors to Soc. Chim. des Usines du Rhône, anc. Gilliard, P. Monnet, et Cartier, Paris. U.S. Pat. 1,301,989, 27.5.19. Appl., 7.12.17.

SEE Eng. Pat. 112,766 of 1917; this J., 1918, 606 A.

Ethylidene diacetate; Manufacture of ——. J. Koetschet and M. Beudet, Lyon, France, Assignors to Soc. Chim. des Usines du Rhône, anc. Gilliard, P. Monnet, et Cartier, Paris. U.S. Pat. 1,306,964, 17.6.19. Appl., 7.12.17.

SEE Eng. Pat. 112,765 of 1917; this J., 1919, 233 A.

Acetic anhydride and polymerised or non-polymerised acetic aldehyde or acetic acid; Process for the production of ——. J. Koetschet and M. Beudet, Lyon, France, Assignors to Soc. Chim. des Usines du Rhône, anc. Gilliard, P. Monnet, et Cartier, Paris. U.S. Pat. 1,306,963, 17.6.19. Appl., 28.8.17.

SEE Eng. Pat. 110,906 of 1917; this J., 1918, 282 A.

Recovering ether and alcohol vapours. Eng. Pat. 117,259. *See* I.

Recovering ether, alcohol etc. vapours. Eng. Pat. 117,309. *See* I.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

[*Photographic*] *development papers and desensitisers.* W. C. Mann. Phot. J., 1919, **59**, 184–187.

ONE of the chief defects in the raw paper base supplied for photographic purposes is the presence of small particles of a desensitiser, chiefly iron. Copper, generally as brass or bronze, is also met with, but only rarely; it comes chiefly from the heater-bars of the paper-making machinery or from defective sorting of the rags, at both of which points effective precautions are under the control of the paper maker; copper is also a much less powerful desensitiser than iron. The presence of iron particles is easily demonstrated by bathing the paper in a solution of potassium ferrocyanide and nitric acid or of potassium ferricyanide and hydrochloric acid, which show them as spots of Prussian blue; a more delicate test is with an acid solution of quinol containing a little silver nitrate. Iron particles may also occur in the baryta coating of the paper or in the sensitive film, but this is not common. The baryta coating acts as an insulator between the paper base and the sensitive film, but imperfectly owing to the "creep" of soluble salts, more pronounced in the case of print-out papers containing soluble silver salts. The precautions to be taken are selection of the baryta coating for its insulating properties and of emulsion for lack of sensitiveness to the desensitising action of the metallic particles, different emulsions varying considerably in this respect. This sensitiveness may also be reduced by the use of negative catalysts, such as mannitol, quinine, and oxalates, which counteract the effect of the desensitiser. A raw paper base containing numerous iron particles when coated with an emulsion treated in this way showed practical freedom from insensitive spots.—B. V. S.

Light-sensitiveness. Plotnikow. *See* XX.

PATENTS

Direct, permanent, natural, colour effects; Method of producing —— spontaneously by the action of light rays upon chemical matter. H. Soar, New Southgate. Eng. Pat. 127,683, 25.2.18. (Appl. 3275/18.)

A GLASS plate or other support is provided with a thin coating of a solution of ammoniacal copper sulphate or hydroxide or both and potassium or ammonium bichromate. While the coating is still liquid, the plate being held in a horizontal position, it is exposed to light in the presence of air, the first effect being the formation of a whitish film upon the surface which is then coloured by further light action according to the length of time of exposure and to the colour of the light. On drying the solution in darkness and then washing in water, a coloured record is obtained permanent to light and air but soluble in ammonia. Similar effects are obtained by exposing a glass plate to the combined action of light and hydrofluoric acid gas. —B. V. S.

Colour photograph or film and method of producing same. Hess Ives Corporation, and F. E. Ives, Philadelphia, Pa., U.S.A. Eng. Pat. 119,854, 7.6.18. (Appl. 9436/18.) Int. Conv., 9.10.17.

SEE U.S. Pat. 1,278,668 of 1918; this J., 1918, 784 A.

Colouring cinematograph films; Art of ——. Machine for and art of colouring cinematographic films. A. Wyckoff and M. Handschiegl, Los Angeles, Cal., Assignors to Famous Players-Lasky Corp. U.S. Pats. 1,303,836 and 1,303,837, 13.5.19. Appl., 20.11.16.

SEE Eng. Pat. 126,745 of 1917; this J., 1919, 479 A.

Photographic plates and cinematograph films; Anti-halation coating for ——. S. Cocanari, Vieux-Dieu, Belgium. U.S. Pat. 1,305,195, 27.5.19. Appl., 2.4.14.

SEE Fr. Pat. 469,218 of 1914; this J., 1915, 50.

XXII.—EXPLOSIVES; MATCHES.

Nitrocellulose from cotton wool and wood cellulose. C. G. Schwalbe and A. Schrimpff. Z. ges Schiess. u. Sprengstoffw., 1919, **14**, 41—44. Chem. Zentr., 1919, 90, II., 622—623. (See also this J., 1915, 152.)

A VARIETY of wood celluloses—Mitscherlich cellulose, Ritter-Kellner cellulose, soda cellulose, aspen cellulose—were compared with paper and cotton wool as regards suitability for making guncotton. The chemical properties before nitration were determined. After nitration, solubility, stability, nitrogen content, etc. were determined. All the wood celluloses yielded stable nitro products, but the nitrogen contents were lower, solubilities higher, yields lower, and nitric acid consumptions higher than with cotton wool under the same conditions. To obtain the same nitrogen content a stronger nitric acid is necessary. Specifications for celluloses for nitration should include limits for moisture, ash, portion soluble in alcohol and ether, lignin, oxycellulose. Absence of chlorine compounds and a good absorptive power for nitrating acids are prescribed.—H. J. H.

Hexanitrodiphenylamine; Preparation of — — from chlorobenzene. E. J. Hoffman and P. A. Dame. J. Amer. Chem. Soc., 1919, **41**, 1013—1020.

THE preparation is effected in the following stages: nitration of chlorobenzene to dinitrochlorobenzene by a mixture of nitric and sulphuric acids; formation of dinitrodiphenylamine by heating dinitrochlorobenzene with aniline; preparation of tetranitrodiphenylamine by the action of nitric acid on the dinitro-compound (compare Carter, Z. ges. Schiess- u. Sprengstoffw., 1913, **8**, 205, 251); and conversion of tetranitrodiphenylamin into hexanitrodiphenylamine by nitric-sulphuric acid, the latter procedure being a modification of Carter's method. The best experimental conditions for each stage are fully described. The yield of hexanitro-derivative is 68·62% of that theoretically possible, calculated on the basis of the chlorobenzene used. The authors' results lead them to the conclusion that the intermediate isolation of the tetranitro-compound is probably unnecessary and that the dinitro- can be converted directly into the hexanitro-derivative. The latter crystallises in fine yellow needles, m.pt. 240°—250° C. (decomp.). It is a very brisant explosive, scarcely suitable for explosive purposes except when mixed with other substances. It is much more poisonous than nitroglycerin and causes severe blisters, resembling burns, when it comes in contact with the skin. The fine dust especially affects destructively the mucous membranes of the mouth, nose, and lungs.—H. W.

Explosive; New — — from formaldehyde. A. Moreschi. Atti R. Accad. Lincei, 1919 [V], **28**, I., 277—280.

TREATMENT of formaldehyde solution with gaseous hydrogen chloride and nitration of the product thus obtained yields an explosive substance, which dissolves considerable proportions of nitrated cotton. (See also J. Chem. Soc., 1919, I., 385).—T. H. P.

PATENTS.

Explosive and process of producing same. A. M. Comey, Chester, Del., Assignor to E. I. du Pont de Nemours and Co. U.S. Pat. 1,301,105, 22.4.19. Appl., 28.6.12.

THE explosive contains a stabilised mixture of nitrated cane sugar and trinitro-glycerin.—C. A. M.

Acid liquors from explosive works; Method of treating —. British Dyes, Ltd., J. Turner, and H. Dean, Huddersfield. Eng. Pat. 127,039, 23.3.17. (Appl. 4219/17.)

WASTE acid liquors or washing waters from the manufacture of explosives such as picric acid etc. are treated with scrap iron or iron filings until neutralisation and reduction are practically complete. If desired, waste alkali, such as lime, soda, etc., or waste sulphite may then be added, and the mixture filtered, if necessary, to obtain a clear liquid suitable for running into a stream or sewer.—C. A. M.

Fumes or vapours; Obtainment of — — by the combustion of mixtures of chemical substances. E. E. F. Berger, Paris. Eng. Pat. 127,031, 21.3.17. (Appl. 4103/17.) Int. Conv., 21.11.16.

FUMES or vapours for concealing military operations or for destroying vermin etc. are produced by the combustion of mixtures of chlorides of metals or non-metals, or chlorinated hydrocarbon derivatives, with a metal, non-metal, or a sulphide, or with a mixture of oxide and reducing agent, or with a mixture of an oxide, an excess of a reducing agent, and an oxidising agent. For example, the mixture may contain: Tetrachloroethane, 40; zinc oxide, 20; zinc dust, 15; calcium silicide, 15; and sodium chlorate, 10%.—C. A. M.

Clouds, fogs, or mists; Production of intense artificial —. P. Weiss, Paris, and J. Verdier, Marcuil á Enghien. Eng. Pat. 127,289, 27.2.18. (Appl. 2868/18.) Int. Conv., 6.11.16.

A LIQUID anhydrous chloride, such as titanium tetrachloride, stannic tetrachloride, or silicon tetrachloride, is forced by means of compressed air etc. in a finely divided condition into a moist ammoniacal atmosphere, whilst gaseous hydrogen chloride or sulphur dioxide may also be introduced to increase the intensity of the fog. In one form of carrying out this process the two main components are contained in liquefied condition in steel flasks, the anhydrous chloride being atomised at the top of a chimney through the bottom of which is drawn a current of air by the action of the expanding ammonia gas injected through a nozzle connected with the other flask.—C. A. M.

Explosives. A. J. Marin, Stockholm, Sweden. Eng. Pat. 108,853, 16.7.17. (Appl. 10,271/17.) Int. Conv., 14.8.16.

SEE U.S. Pat. 1,297,213 of 1919; this J., 1919, 390 A.

Explosive. W. Rintoul and D. Cross, Assignors to Nobel's Explosives Co., Stevenston, N.B. U.S. Pat. 1,306,440, 10.6.19. Appl., 24.9.17.

SEE Eng. Pat. 14,656 of 1915; this J., 1919, 340 A.

Recovering ether and alcohol vapours. Eng. Pat. 117,259. *See* I.

Recovering ether, alcohol, etc. vapours. Eng. Pat. 127,309. *See* I.

Asphyxiating gas. Eng. Pat. 127,650. *See* XIXB.

XXIII.—ANALYSIS.

Micro-analysis; Practical application of quantitative —. R. Strebinger and L. Radlberger. Oesterr. Chem.-Zeit., 1919, **22**, 67—68.

The authors are of the opinion that Pregl's method of micro-analysis is suitable for use in technical laboratories, in spite of statements that have been made to the contrary. A sample of coal, for instance, weighing 3 mgrms. is just as likely to be a representative sample of several tons as the much larger quantity used for an ordinary analysis, and the sample must be prepared with the same care in both cases. Examples of analyses of several samples of coal by both macro- and micro-analytical methods are given, including estimations of moisture, carbon, hydrogen, and ash, and the agreement is very close. Two estimations of nickel in steel, by the dimethylglyoxime method, in which 7·830 and 12·991 mgrms. of steel were used, gave 0·0648 and 0·0610% nickel respectively. This shows that very accurate results can be obtained with very small quantities of material. As a further example, sulphur in pyrites was estimated by both methods, the macro-analytical method giving 48·67% and the micro-analytical method 48·37% sulphur.—E. H. R.

Sodium thiosulphate solutions; Stability of —. I. M. Kolthoff. Pharm. Weekblad, 1919, **56**, 878—888.

Solutions of sodium thiosulphate should be kept in the dark with as little access of air as possible. A layer of petroleum spirit on the surface may be applied to prevent oxidation. The addition of about 0·2 grm. of sodium carbonate is sufficient to stabilise the solution almost completely. The decomposition may also be prevented to some extent by the presence of 0·01 grm. of mercuric iodide.—W. S. M.

Water in tar. Smit. *See* III.

Vegetable fibres. Waentig and Gierisch. *See* V.

Fluorspar etc. Doyle. *See* VII.

Selenic acid etc. Dennis and Koller. *See* VII.

Oxygen content of air. Aston. *See* VII.

Uranium, zirconium, etc. in steel. Johnson. *See* X.

Phosphorus in presence of tungsten. Gray and Smith. *See* X.

Sulphur in rubber. Rosenstein. *See* XIV.

Lead and zinc in rubber goods. Donaldson. *See* XIV.

Leather samples for analysis. Stacy. *See* XV.

Vegetable glues. Donsell. *See* XV.

Statement of acidity and alkalinity. Wherry. *See* XVI.

Potash in fertilisers. Steuerwald. *See* XVI.

Sucrose in molasses. Steuerwald. *See* XVII.

Water in margarine. Frank. *See* XIXA.

Alkalinity. Guareschi. *See* XIXB.

Patents.

Hardness of metals; Machine for testing the —. B. W. Winder and W. Burgan, Sheffield. Eng. Pat. 127,412, 1.6.18. (Appl. 9045/18.)

In an apparatus of the kind in which a hard steel ball is forced under known pressure against the specimen to be tested, the indenting ball is carried by a pressing lever with which a weighted lever is connected. By means of a cam actuated by hand, the weighted lever is raised or lowered rapidly, so that the pressing lever is quickly brought into preparatory position and operated.—W. E. F. P.

Carbonic acid. U.S. Pat. 1,303,514. *See* VII.

Pyrometers. Eng. Pat. 127,534. *See* X.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Broadbridge, Edser, and Minerals Separation, Ltd. Treatment of emulsions etc. 18,038. July 18.

Delaporte. Surface condensers. 17,705. July 15. (France, 27.7.18.)

Elliott. Process for removal of gases from liquids. 17,931. July 17.

Fryer, McLellan, and Rowntree & Co. Machines etc. for thrashing liquids or materials in state of fine sub-division. 18,516. July 25.

Goodwin. Steam-boiler installations. 17,611. July 14.

Graham and Honeyword. Machinery for crushing or grinding ore, rock, cement, etc. 18,120. July 21.

Gush. Electrical apparatus for prevention of corrosion in steam-boilers etc. 17,601. July 14.

Hirt. 18,542. *See* VIII.

Kent. Apparatus for drying china clay etc. 17,986. July 18.

Loweison and Shaw. Apparatus for effecting drying of peat, sand, grain, rags, etc. 18,583. July 26.

Merz. Utilisation of natural thermal energy. 17,934. July 17.

Raymond Bros. Impact Pulverizer Co. Pulverising-mill roller and supporting structure for same. 18,258. July 22. (U.S., 15.8.18.)

Réol. Apparatus for dehydrating, reducing, calcining, or roasting minerals etc. 18,584. July 26. (France, 9.8.18.)

Slewart and Slewart. Operating furnaces. 18,531. July 25. (Switz., 29.7.18.)

Somerville. Kilns. 18,299. July 23.

Teisen. Furnaces. 17,817. July 16.

Zaeckel. Condenser for distilling-apparatus. 17,796. July 16.

Complete Specifications Accepted.

17,836 (1917). Brookes Chemicals, Ltd., and Brooke. Construction of acid-resisting tanks, conduits, and the like. (129,709.) July 30.

18,179 (1917). Gibbs, Gilderson, and Goold-Adams. Treatment of smoke and fume or other dust-laden gas. (129,721.) July 30.

18,536 (1917). Sperry Gyroscope Co. Electrodes for arc lamp projectors. (129,735.) July 30.

1873 (1918). Beeton, and Trufood, Ltd. *See* XIX.

6024 (1918). Bynoe. Superheaters for air, vapour, or gas. (129,391.) July 23.

9158 (1918). Walworth. Kilns for drying grain or the like. (129,401.) July 23.

9199 (1918). Radford and Wells. Tray for carrying fruit, vegetables, or other substances which are to be subjected to heat or air currents for cooking or drying and the like. (129,402.) July 23.

9604 (1918). Christensen. *See* XII.

9655 and 10,930 (1918). Testrup, and Techno-Chemical Laboratories, Ltd. Methods of and apparatus for conducting high-temperature reactions. (129,758 and 129,771.) July 30.

11,724 (1918). Chopin. Methods of and apparatus for determining and indicating heat losses in furnaces and the constituent elements of these losses. (129,804.) July 30.

11,730 (1918). Fraser and Peel. Machines for disintegrating and screening pulverulent material. (129,458.) July 23.

11,911 (1918). Topham. Furnaces. (129,816.) July 30.

12,304 (1918). Allin and August. Furnaces applicable for heating articles or pieces. (129,478.) July 23.

12,337 (1918). Roberts and Booth. Construction of furnaces and other heating appliances. (129,830.) July 30.

14,120 (1918). Olson and Becker. Composition of matter. (129,505.) July 23.

14,367 (1918). Stewart. Filtration apparatus. (129,859.) July 30.

15,281 (1918). Smallwood Apparatus for cooling liquids for subjecting them to the influence of air or gas. (129,521.) July 23.

15,392 (1918). Jones. Apparatus for utilising the kinetic energy of radio-active substances. (129,873.) July 30.

19,133 (1918). McCaskell. Continuous-pressure filtering process and apparatus. (129,905.) July 30.

2041 (1919). Rigby, Rigby, and Rigby. Drying cylinders. (129,577.) July 23.

3238 (1919). Shaw. Apparatus for evaporating or concentrating liquids. (129,584.) July 23

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Allan. Continuous distillation and fractionation of petroleum etc. 18,405. July 24.

British Thomson-Houston Co (General Electric Co.). Manufacture of metallic filaments. 17,686. July 15.

Cummins and Mooney. Combined coal and water gas plants. 17,654. July 15.

Dalley (Greenway). Distillation of hydrocarbon oils. 18,151. July 21.

Graham and Rickets. Vacuum tube or electronic discharge apparatus. 18,415. July 24.

Hargreaves. 18,483. *See* XXIII.

Hickman. Apparatus for washing and drying gas from blast-furnaces, gas-generating plants, etc. 17,912. July 17.

Hobson. Manufacture of gaseous fuels. 18,286. July 23.

Loweison and Shaw. 18,583. *See* I.

Marks (Combustion Economy Corporation). Apparatus for feeding and burning powdered coal. 18,128. July 21.

Monaghan. Means of oxidising paraffin-oil fuel for internal-combustion engines. 17,699. July 15.

Poore. Destructive distillation of wood, woody fibre, etc. 17,728. July 15.

Roberts. Process for extraction and recovery of by-products formed by destructive distillation of wood in suction gas plants. 17,547. July 14.

Ryan. Recovering bitumens from shale etc. 17,777. July 16. (U.S., 25.3.18.)

Soc. de Fours à Coke et d'Entreprises Industrielles. Ovens with regenerators. 17,805. July 16. (France, 16.7.18.)

Soc. de Fours à Coke et d'Entreprises Industrielles. Coke ovens. 18,252. July 22. (France, 9.8.18.)

Wade (Standard Oil Co.). Process of distilling petroleum. 18,162. 18,163. July 21.

Wallace. Apparatus for recovering oil from shale etc. 17,810. July 16. (U.S., 8.2.18.)

Wallace. Process for distilling carbonaceous materials. 17,811. July 16. (U.S., 26.3.18.)

Withers. Gas-producer plants for motor etc. traction. 17,874. July 17

Wollaston. 18,280. *See* XXIII.

Complete Specifications Accepted.

15,672 (1917). Forwood and Taplay. Removal of sulphur from oils. (129,349.) July 23.

15,774 (1917). Ralling and Angold. Electric arc lamps. (129,355.) July 23.

17,689 (1917). Cornu. Mercury vapour lamps. (129,702.) July 30.

18,262 (1917) Pattison. Apparatus for generating combustion products under pressure. (129,725.) July 30.

6280 and 8470 (1918) Pearson and Son, Smith, and Hackford. Treatment of coal-tar, pitch, and the like for the production of fuel, and apparatus for use in said treatment. (129,393.) July 23.

7764 (1918). Johnson Atomising and vaporising liquid fuels for burning. (129,398.) July 23.

10,162 (1918). Wyld. *See* VII.

11,256 (1918). Marr, Colquhoun, and Coke Oven Construction Co. Coke ovens or the like. (129,432.) July 23.

11,257 (1918). Colquhoun, Marr, and Coke Oven Construction Co. Coke ovens or the like. (129,433.) July 23.

11,729 (1918). Torazzi and Webb Generators for producing and utilising mixed steam and products of combustion. (129,806.) July 30

11,741 (1918). American Linseed Co. Artificial fuel and method of making same. (117,634.) July 23.

11,760 (1918). Motala Verkstads Nya Aktiebolag. Feeding-devices for pulverulent fuel. (118,100.) July 23

12,153 (1918). Wilson. Poking-apparatus for gas-producers and analogous purposes. (129,823.) July 30.

12,334 (1918). Liversedge and Davidson. Gas washers. (129,829.) July 30.

13,285 (1918). Pearson and Sons, Smith, and Hackford. Liquid fuel. (129,495.) July 23.

15,868 (1918). British Thomson-Houston Co. (General Electric Co.). Electric incandescent lamps. (129,524.) July 23.

19,322 (1918) Soc le Coke Industriel. Apparatus for the separation of coke or carbon from slag or the like. (120,932.) July 23.

7363 (1919). Wright and Fenton. Coke-oven doors and the like. (129,605.) July 23

13,033 (1919). Mellersh-Jackson (Fuel Saving Co.). Production and control of the draught in apparatus for burning pulverised fuel. (129,960.) July 30.

III.—TAR AND TAR PRODUCTS.

Applications.

Brett. Chemical product obtained from β-naphthol, and processes for obtaining same. 17,589. July 14.

Dalley (Greenway). 18,151. *See* II.
Moore. 17,568. 17,963. *See* IV.
Morgan. Manufacture of 4-nitro-β-naphthol. 17,849. July 17.

COMPLETE SPECIFICATION ACCEPTED.

6280 (1918). Pearson and Son, and others. *See* II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

Moore. Reduction of nitro, nitroso, and azo compounds etc. 17,568. July 14.

Moore. Processes for reduction of azo, nitro, and nitroso compounds 17,963. July 18.

Morgan. Manufacture of hydroxyazo dyes 17,848. July 17.

COMPLETE SPECIFICATIONS ACCEPTED.

9823 (1918). Vegas and Vegas. Colouring product and tinctorial mordant. (129,761.) July 30.

11,078 (1918). Marks (Sunbeam Chemical Co.). Dye compositions adapted for domestic use (129,417.) July 23.

11,458 (1918). Imray (Soc. Chem. Ind. in Basle). Manufacture of ortho oxy-azo-dyestuffs, chromium compounds thereof, and process of dyeing therewith. (129,782.) July 30.

13,618 (1918). Soc. Chimique des Usines du Rhône. Process for obtaining bromine derivatives of indigo and of its homologues (119,860.) July 30.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

British Cellulose and Chemical Manufacturing Co., and Lely. Apparatus for spinning artificial filaments. 18,323. July 23.

Lowelson and Shaw. 18,583. *See* I.

Robinson. Method of treating flax etc. and product 18,129. July 21. (U.S., Apr. 23.)

COMPLETE SPECIFICATIONS ACCEPTED.

17,631 (1917). Cellon, Ltd., and Barr. Means for doping aeroplane and like fabrics. (129,698.) July 30.

17,944 (1917). Cochrane. Production of fabrics having the property of invisibility. (129,712.) July 30.

11,607 (1918). Flatters. Process for rendering fabrics gas- and water-proof. (129,455.) July 23.

11,608 (1918). Flatters. Process for doping and fireproofing fabrics. (129,456.) July 23.

12,581 (1918). Pedersen. Separation of wood particles from the liquid in which they are contained or suspended (119,628.) July 30.

21,084 (1918). Pellerin. Manufacture of a filamentous material from viscose (121,734.) July 23.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Cowper-Coles. Process for decorating textile fabrics. 18,357. July 23.

Wilkinson and Yates. Machine for open scouring, washing, crabbing, etc. textile fabrics. 18,069. July 21.

COMPLETE SPECIFICATIONS ACCEPTED.

9823 (1918). Vegas and Vegas. *See* IV.

11,458 (1918). Imray (Soc. Chem. Ind. in Basle). *See* IV.

16,149 (1918). Macintyre. Machine for dyeing, bleaching, washing, and the like yarn and the like in hank. (129,532.) July 23.

VII.—ACIDS; ALKALIS; SALTS; NON METALLIC ELEMENTS.

APPLICATIONS.

Barbet et Fils et Cie. Process for purificat argon etc. 17,706. July 15. (France, 17.7.18.

Barnes. Process for preparing barium hydr from barium sulphide. 17,991. July 18.

Boyd and Durant. Roasting sulphide ores, ducts, etc., and manufacture of sulphuric sulphurous anhydride, and acid sulphites bisulphites therefrom. 17,642. July 14.

Collins. Process for separation of sulphur furnace gases. 18,255. July 22.

Kent. Bismuth compound. 17,838. July 1

Lessing. Method of applying nickel carbon, manufacturing processes. 17,709. July 15.

Lessing. Manufacture of sulphate of amm 18,058. July 21.

Petersson. Treatment of zinc solutions. 17 July 17.

Restucci. Separating gases from sea w 18,459. July 24.

COMPLETE SPECIFICATIONS ACCEPTED.

6549 (1917). Camus, Duchemin, and Criquebo Preparation of lead acetate. (129,300.) July 2

14,431 (1917). Cocking, and Kynoch, Ltd. M facture of nitric acid and ammonium sulph (129,305.) July 23.

17,670 (1917). Goold-Adams, Partington, Rideal. Production of nitrates. (129,6 July 30.

4532 (1918). Rideal and Taylor. Purification hydrogen. (129,743.) July 30.

10,162 (1918). Wyld. Apparatus for the dis lation or treatment of ammoniacal liquors and like. (129,765.) July 30.

11,637 and 13,384 (1918). Jephcott. *See* XX.

13,842 (1918). Oakbank Oil Co., and Wisha Manufacture of sulphate of ammonia. (129,85 July 30.

11,216 (1919). Mooney. Manufacture of chromi sulphate. (129,958.) July 30.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Crossley. Process for manufacture of non-frag glass. 18,217. July 22.

Harrison. Abrasive material and process making same. 17,560. July 14.

Hirt. Drying ceramic etc. objects. 18,5 July 25.

Kent. 17,986. *See* I.

Marlow. Gas-fired oven or kiln for manufactu of tiles, pottery, etc. 18,283. July 23.

COMPLETE SPECIFICATIONS ACCEPTED.

15,078 (1917). Holmes. Machines for the man facture of glass wool. (129,524.) July 23.

11,377 (1918). Macdonald, and Spicer and Son Manufacture of compound glass and membe formed therefrom. (129,778.) July 30.

12,093 (1918). Forster. Feeding or controlling the feed of molten glass from glass furnaces tanks. (129,822.) July 30.

12,811 (1918). Brooke and Twynam. Manufa ture of refractory bricks and blocks. (129,485 July 23.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Crozier. Making cementitious articles. 17,90 July 17.

Graham and Honeyword. 18,120. *See* I.

Slade. Process for colouring wood grey or black 17,638. July 14.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Armstrong. Stable surface alloy steel. 17,909. July 17. (U.S., May 24.)

Atkinson, and Stein and Atkinson. Furnaces for heat treatment of metallic etc. bodies. 17,886. July 17.

Boyd and Durant. 17,642. *See* VII

British Thomson-Houston Co. (Gen. Electric Co.). 17,686. *See* II.

Colvert. Method of using fluorspar in steel-making. 17,745. July 16.

Graham and Honeyword. 18,120. *See* I.

Grover, and Miralite, Ltd. Solder. 18,141 July 21.

Hickman. 17,912. *See* II.

Hough. Convertible heat-treatment furnace. 18,491. July 25.

Kemp, and Wellman Smith Owen Engineering Corporation. Continuous reheating-furnaces. 18,048. July 18.

Kemp, and Wellman Smith Owen Engineering Corporation. Walls etc. for continuous reheating-furnaces. 18,049. July 18.

Leathart, and Locke, Blackett & Co. Refining lead. 17,785. July 16.

Metals Extraction Corporation Treatment of zinc solutions. 17,929 July 17

Northall-Laurie, and Osmosis Co Extraction of tin from tin bearing ores. 18,340 July 23.

Ormandy, and Osmosis Co Extraction of gold 18,341. July 23.

Partridge, Thompson, and Thompson. Method for coating iron, steel, etc with aluminium etc. 18,498 July 25

Petersson. 17,929 *See* VII.

Read Wale. Composition for coating metals with tin or tin alloys. 17,573. July 14.

Réol 18,584. *See* I.

Robertson and Sheppard Manufacture of composite sheets of metal 18,474. July 25

Snell. Electro plating process and attachment 17,620 July 14.

Wiberg Reduction of ores 18,337 July 23 (Sweden, 23 7 18.)

Complete Specifications Accepted.

15,224 (1917). Macgregor and Balfour. Steel. (129,330.) July 23.

15,768 (1917) Jakova-Merturi Process of reducing iron ores (129,354) July 23.

15,888 (1917). Languepin. *See* XI.

17,031 (1917). Annable, and Nickel Concentration, Ltd. Recovery of nickel from its sulphide or oxide. (129,667) July 30.

17,243 (1917). Sellers Manufacture and treatment of steel. (129,676) July 30

18,178 (1917). Topley, Ratcliffe, and Goold-Adams. Annealing processes and apparatus. (129,720.) July 30.

6065 (1918). Nelson and White. *See* XIII.

9210 (1918). Marks (Driver-Harris Co.) Melting-pots or crucibles. (129,403.) July 23.

9469 (1918). Morgan Crucible Co, and Speirs. *See* XI.

11,126 (1918). Elmore. Process for the extraction of lead from its ores. (129,773) July 30.

11,198 (1918). Hadfield. Manufacture of low-carbon ferro-manganese. (129,426.) July 23.

12,304 (1918). Allin and August. *See* I.

12,384 (1918). Thompson, and Ferrotherm, Ltd. Rust-proofing of iron and steel articles. (129,831.) July 30.

12,960 (1918). Marino. Electrolytic method of cleaning iron or steel. (129,480.) July 23.

13,007 (1918). Read-Wale and Read-Wale. Flux for the coating of iron and other metals. (129,844.) July 30.

14,238 (1918). Alpha Products Co. Processes for producing metallic cerium and similar rare-earth metals or alloys thereof. (119,229.) July 23.

15,254 (1918). Mellersh-Jackson (Stein et Cie.). Furnace ends of the open-hearth type. (129,869.) July 30.

10,258 (1919). Berry. Copper alloy. (129,956) July 30.

10,744 (1919). Comp. des Forges de Chatillon Commentry et Neuves Maisons. Manufacture of basic pig iron. (129,957.) July 30.

XI.—ELECTRO-CHEMISTRY.

Applications.

Aktiebolaget Kvatveindustri Heating material or performing chemical processes in electrical furnaces. 17,821. July 16. (Sweden, Apr. 12.)

British Thomson Houston Co, and Hastings Electric arc furnaces. 17,902 July 17.

Clarke, and London Battery Co Electric storage etc. batteries. 17,968. July 18.

De Martis, and Universal Accumulators, Ltd. Plates for electric accumulators. 17,603. July 14

Electro Metals, Ltd, and Robertson. Electric furnaces. 18,016. July 18.

Gush. 17,601. *See* I.

Palmer. Dry-cell batteries. 18,127. July 21.

Piquerez Electric furnace. 18,004 July 18. (Switz, 2 9 18.)

Piquerez Resistance for electric furnaces. 18,005 July 18. (Switz, Feb. 20.)

Snell 17,620. *See* X.

Winne Electric furnace control apparatus. 17,988. July 18. (U S, Jan. 2.)

Complete Specifications Accepted.

15,888 (1917). Languepin. Electrodes for electric arc welding. (129,360) July 23.

6459 (1918) Bosch A G Electrodes for spark discharges (115,038) July 30.

9453 (1918). Watson. Electric heating apparatus for liquids. (129,406.) July 23.

9469 (1918). Morgan Crucible Co, and Speirs. Electrically heated crucibles, melting pots, and the like (129,407.) July 23

9822 (1918). Morgan Crucible Co, and Speirs. Electric furnaces. (129,760) July 30.

11,181 (1918). Rabinovitch and Mond. Electric batteries (129,423) July 23.

11,197 (1918). Williams. Electric accumulators. (129,425.) July 23.

11,304 (1918) Forrester (Burgess). Electric heating apparatus (129,438) July 23.

12,960 (1918). Marino *See* X.

XII.—FATS; OILS; WAXES.

Applications.

Macgregor, and Scott and Co. Extraction of fat, wax, oil, gelatine, etc from materials containing same. 17,880. July 17.

Nordiska Fabriker De-No-Fa Aktieselskap. Process for producing soap powders. 18,538. July 25. (Germany, May 31.)

Nordiska Fabriker De-No-Fa Aktieselskap. Process for polymerisation of unsaturated fatty acids. 18,541 July 25. (Germany, May 31.)

Complete Specifications Accepted.

9604 (1918). Christensen. Method of and means for producing emulsion. (129,757.) July 30.

11,733 (1918). Betjemann. Toilet soaps. (129,807.) July 30.

11,762 (1918). Martin. Apparatus for the hydrogenation of fats and oils. (129,461.) July 23.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Barbe. Product for manufacture of paint, and process for manufacture thereof. 18,392. July 24.

Bruhat. Process for manufacture of plastic materials. 17,797. July 16. (France, 4.11.16.)

COMPLETE SPECIFICATIONS ACCEPTED.

6065 (1918). Nelson and White. Manufacture of metallic lead powder and lead paints. (129,392.) July 23.

15,940 (1918). Kelly. Flexible waterproof antiseptic and antifouling composition. (129,526.) July 23.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATION.

Bruhat. 17,797. *See* XIII.

COMPLETE SPECIFICATIONS ACCEPTED.

11,686 (1918). North British Rubber Co., and Porritt. Vulcanisation of rubber and other like substances. (129,798.) July 30.

12,179 (1918). Peachey. Process for the vulcanisation of caoutchouc. (129,826.) July 30.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATIONS.

Haley and Co., and Hoefling. Machines for treating hides, skins, leather, etc. 17,977. July 18.

Macgregor, and Scott and Co. 17,880. *See* XII.

XVI.—SOILS; FERTILISERS.

APPLICATIONS.

Guillaume. Manufacture of superphosphates etc. 17,752. July 16.

Molassine Co., and De Whalley. Treatment of peat and production of preparation for use in horticulture and agriculture. 18,234. July 22.

Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Fertilisers containing nitrogen and phosphoric acid 18,536. July 25. (Norway, 13.9.18.)

COMPLETE SPECIFICATION ACCEPTED.

14,432 (1917). Cocking, and Kynoch, Ltd. Manufacture of nitro-phosphate fertilisers. (129,306.) July 23.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATIONS.

Takamine. Enzymic substance and process of making same. 18,128. July 24.

Wade (Schneible). Manufacture of ethyl alcohol and residue from fermented liquor. 18,041. July 18.

COMPLETE SPECIFICATIONS ACCEPTED.

19,095 (1918). Joseph (Ray and Symons). Denaturant for the purpose of rendering alcohol unfit for human consumption. (129,904.) July 30.

19,764 and 20,429 (1918). Wooldridge. Brewing. (129,549.) July 23.

6162 (1919). Timmermans. Filter for use in breweries and elsewhere. (129,599.) July 23.

XIX.—FOODS; WATER PURIFICATION: SANITATION.

APPLICATIONS.

Adams. Sewage purification plant. 18,310. July 23.

Adams. Collection and treatment of domestic sewage. 18,365. July 24.

Ferguson. Food product and means of manufacturing same. 17,767. July 16.

Fryer, McLellan, and Rowntree and Co. Manufacture of fondant chocolate etc. 18,512–5. July 25.

Lowelson and Shaw. 18,583. *See* I.

Pape. Preserving materials. 18,140. July 21.

COMPLETE SPECIFICATIONS ACCEPTED.

14,620 (1917). Reisert Ges. Producing materials for softening water. (110,363.) July 30.

1873 (1918). Beeton, and Trufood, Ltd. Drying of liquids, such as milk, into powders. (129,388.) July 23.

9158 (1918). Walworth. *See* I

9199 (1918). Radford and Wells. *See* I.

15,940 (1918). Kelly. *See* XIII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Boake, Roberts and Co., and Durrans. Preparation and manufacture of ethylidene diacetate and acetic anhydride. 18,116. July 21.

Kent. 17,838. *See* VII.

Marsh. Process for elimination of carboxyl groups. 17,633. July 14.

Moore. 17,568. 17,963. *See* IV.

COMPLETE SPECIFICATIONS ACCEPTED.

7325 (1917). Simon and Chavanne. Process for the manufacture of monochloracetic acid and of its esters. (129,301.) July 23.

11,637 and 13,384 (1918). Jephcott. Process for obtaining nicotine, potash, and other substances from tobacco, tobacco stalks, and offal tobacco. (129,791.) July 30.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

Brewster. Apparatus for colour kinematography. 18,020. July 18. (U.S., 29.6.18.)

Gorsky. Production of coloured diapositives. 18,585. July 26. (Norway, 9.11.18.)

Hargreaves. 18,483. *See* XXIII.

Middleton, Mills, and Zoechrome, Ltd. Production of kinematograph colour pictures. 17,889. July 17.

COMPLETE SPECIFICATION ACCEPTED.

18,141 (1917). Smith. Colour photography. (129,717.) July 30.

XXII.—EXPLOSIVES; MATCHES.

COMPLETE SPECIFICATION ACCEPTED.

16,431 (1917). Brooke. Method of and means for the continuous production of picric acid or other products of nitration. (129,375.) July 23

XXIII.—ANALYSIS.

APPLICATIONS.

Hargreaves. Photometers, actinometers, etc. 18,483. July 25.

Wollaston. Apparatus for continuous analysis of gases. 18,280. July 23.

COMPLETE SPECIFICATION ACCEPTED.

11,724 (1918). Chopin. *See* I.

I.—GENERAL; PLANT; MACHINERY.

Colloids; Flocculation of —— by salts containing univalent organic ions. S. B. Schryver and N. E. Speer. Proc. Roy. Soc., 1919, **90**, B., 400—414.

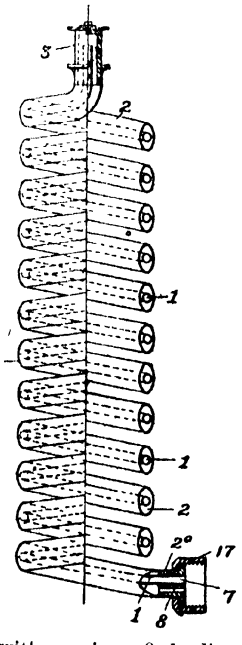
Is the flocculation of colloids by salts is due to neutralisation of the electrically charged colloidal particles by adsorption of ions of opposite sign derived from the salts, salts whose solutions possess the lowest surface tension should exhibit the greatest flocculating capacity. This deduction was not borne out by the authors' experiments, in which comparative measurements were made of the flocculating powers of sodium salts of various organic acids and of sodium chloride, ammonium chloride, and hydrochlorides of various organic bases, with respect to a number of positive and negative sols. The only case in which a relation was established between flocculating power and surface tension for a series of salts, was in the flocculation of mastic by chlorides and hydrochlorides of bases. It is suggested that suspensoid colloids may be subdivided into two classes, (1) "Exionic colloids," like ferric chloride, owing their charge to association of "active" ions derived from salts from which they have been prepared, these ions being removed during aggregation and flocculation; (2) "Endionic colloids," of which mastic (a resin acid) is probably an example, owing their charge to dissociation of the colloid itself, in which a rapidly diffusing ion (*e.g.*, hydrogen ion) forms the outer layer and is held electrostatically to a less diffusable ion.—J. H. L.

Utilisation of by-products. Frabot. *See* XIXB.

PATENTS.

Evaporator coil and fitting. J. C. Morton, Auckland, N.Z. Eng. Pat. 121,581, 4.6.18. (Appl. 9228/18.) Int. Conv., 21.12.17

An evaporator coil is made up of two tubes, one inside the other, and communicating with each other at the top end only by means of a cap, 3. The outer tube, 2, is preferably of oval cross-section. Steam supplied to the inner tube, 1, through the passage, 7, passes up this and down the outer tube, the hottest steam thus being applied to the upper part of the liquid to be evaporated, whereby priming is reduced. The lower end of the coil is provided with a tube end, 2ª, and union nut, 17, and a number of such coils are fixed to nipples on a fitting provided with inlet and outlet chambers for steam connected to the boiler and condenser respectively. The inlet chamber communicates by way of the nipples with passages, 7, leading to the inner tubes of the coils, and the outlet chamber similarly communicates with openings, 8, leading from the outer tubes of the coils.—B. M. V.



Evaporators [; Continuous removal of salt from ——]. L. A. Fullagar, Harborne, J. A. Reavell, Beckenham, and Kestner Evaporator and Engineering Co., Ltd., London. Eng. Pat. 128,015, 18.6.18. (Appl. 10,061/18.)

From the separator of a de-salting evaporator (*e.g.*, as described in Eng. Pat. 12,124 of 1914; this J., 1915, 823) the deposited salt with some mother liquor is allowed to fall down a pipe into a tank fitted with a stirrer and ploughs. The ploughs rake the salt to the foot of an elevator of the endless chain or other type, by means of which the salt is lifted out. The mother liquor in the tank is either held at a level corresponding to the vacuum in the separator or, if no vacuum is used, overflows through a pipe at a suitable level and is pumped back to the separator.—B. M. V.

Centrifugal mixers, washers, etc.; Apparatus suitable for use as - . P. R. Allen, Runcorn. Eng. Pat. 128,019, 21.6.18. (Appl. 10,279/18.)

In apparatus in which rotating discs are used, *e.g.*, to spray liquids, instead of using discs of rigid material, which are heavy and difficult to balance, thin light materials are used which are limp when at rest but become rigid when rotating at high speed. Threads, strips, or segments may be used instead of complete discs. Suitable materials mentioned are thin sheets of metal, sheet indiarubber, and fabric, with or without a metallised surface. The edges of fabric discs may be strengthened by a selvedge or by folding over a wire ring.—B. M. V.

Raising acids or other liquids; Apparatus for ——. C. de Preville, Paris. Eng. Pat. 128,061, 8.8.18. (Appl. 12,894/18.)

Acid or other liquid is admitted by gravity to a vessel through a non-return valve and expelled by compressed air through a second non-return valve. The pressure air is admitted or exhausted by means of two cocks which are rotated together by a 4-tooth ratchet in such a manner that one is open while the other is closed. The ratchet is rotated 90° at a time by means of a pawl operated by a piston which is pressed down by compressed air and returned by a counterweight. The movements of the piston are slow and are controlled in either direction, as is also the rate of expulsion of acid, by three air-regulating valves, an automatic valve being provided to permit the piston to rise again after reaching the bottom of its stroke. One motor may serve two sets of acid vessels and cocks, thus producing a fairly constant delivery of acid.—B. M. V.

Pulverisers. A. E. Davis, Birmingham. Eng. Pat. 128,071, 28.8.18. (Appl. 13,964/18.)

A rotary pulveriser is provided at one or both ends with a chamber, divided into two compartments by a screen or sieve. The finer particles are carried through the screen by a current of air and the coarser ones, which eventually return to the pulverising chamber, are prevented from blocking up the screen by a protecting disc which is provided with blades or vanes and is rotated in close proximity to the screen. The current of air produced by the vanes carries away the coarser particles from the screen surface.—W. H. C.

Grinding machinery. W. Chambers, Belfast. Eng. Pat. 128,107, 24.10.18. (Appl. 17,369/18.)

The ring of a ring roll mill is maintained in position by guide wheels, and the roll is suspended by rods and springs (arranged fanwise to ensure greater stability) and by tension rods. The ground

material is carried by a current of air through a rotary screen and all oversize returned to the mill.—W. H. C.

Pulverising and separating mill; Self-contained ——. J. M. Schutz, Assignor to Schutz Hawley Co., Chicago, Ill. U.S. Pat. 1,305,413, 3.6.19. Appl., 22.7.15.

The material is fed into a horizontal cylinder provided with a rotary beater, and having a tangential passage leading upwards from each side. The passages open tangentially into a similar superposed drum, so that the material suspended in air may circulate continuously around the two drums. An axial outlet is provided for the air at the ends of the upper drum.—W. F. F.

Separating solids or semi-solids such as sewage, paper-pulp, or the like from liquids; Apparatus for ——. P. Smith, London. Eng. Pat. 128,144, 25.1.19. (Appl. 1923/19.)

The pulp is fed on to an endless band which as it travels forward is pressed against a rotating drum by pressure rollers and is subsequently passed between a pair of compression rollers. The solid material is then scraped off the band, which travels forward to receive a fresh charge. Not only the drum but also all the rollers are provided with flanges at each end. The flanges are all arranged so as to permit the periphery of the rollers to be in contact with the endless band.—W. H. C.

Kiln. D. R. Bone, Oglesby, Tex. U.S. Pat. 1,303,760, 13.5.19. Appl., 9.9.18.

The space between a central wall and an outer wall surrounding it is divided into a series of burning chambers the floors of which are provided with a number of openings. A smoke tunnel connected by flues with these openings surrounds the outer wall, and means are provided for creating a draught in the tunnel.—E. W. L.

Furnace for evaporators. J. S. Clarke, Pinckneyville, Ky. U.S. Pat. 1,304,542, 27.5.19. Appl., 10.4.18.

The bottom of a rectangular container is provided with cross-bars spaced longitudinally, and also with intersecting diagonal bars. Both sets of bars project on each side of the container and their ends are perforated and so arranged one above the other that vertical spindles may pass through them. The upper ends of such spindles pass through brackets attached to the upper part of the walls of the container. The lower end of each spindle is threaded into the socket of a forked member carrying a supporting wheel for the container.
—W. F. F.

Sublimation apparatus. E. W. Kluchansky, New York. U.S. Pat. 1,304,572, 27.5.19. Appl., 2.8.17.

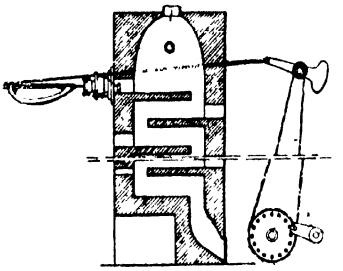
Perforated trays carrying the material to be treated are arranged in a tier and are spaced from one another. The frame carrying the trays is contained within a closed casing and is spaced from the vertical walls thereof. Hot air is admitted to the space surrounding the tier of trays and passes over and under the material on the trays.—W. F. F.

Drying and conditioning machine. T. Allsop and W. W. Sibson, Assignors to The Philadelphia Drying Machinery Co., Philadelphia, Pa. U.S. Pat. 1,304,645, 27.5.19. Appl., 19.2.19.

The apparatus comprises in one unit a drying and cooling compartment and a conditioning compartment. Each compartment is divided by a partition into two chambers and means are provided for circulating air between the two chambers and exhausting a part of this air.—W. F. F.

Furnace for effecting reactions between one or more solid substances and one or more gaseous substances [; Stirring device for ——]. O. F. S. Carlson, Ljungaverk, O. I. Carlson, Stockholm, and K. G. Boman, Ljungaverk, Sweden, Assignors to Aktiebolaget Nitrogenium, Stockholm. U.S. Pat. 1,305,441, 3.6.19. Appl., 29.7.16.

A device for stirring the solid material in the furnace comprises a member arranged to rotate at an opening in the furnace wall, and a stirring



implement projecting through the rotary member into the furnace (see fig.). Packing is provided between the implement and the rotary member, and between the latter and the furnace wall.
—W. F. F.

Dehydrating; Apparatus for ——. A. A. Goubert, Englewood, N.J. U.S. Pat. 1,305,600, 3.6.19. Appl., 25.6.17.

The apparatus consists of a stack of superposed trays combined with an air heater and means for driving a current of heated air through the perforated bottoms of the trays. The walls of the trays are provided with flanges to permit of each tray engaging with the one below it. The sides of the trays are provided with bars to permit of the stack being raised while the bottom tray is being removed. Opposite sides of the stack are provided with drums around which pass flexible bands provided with hooks to engage the trays.—J. H. J.

Separating device. N. A. Helmer, Cincinnati, Ohio. U.S. Pat. 1,304,681, 27.5.19. Appl., 25.4.18.

A mixture of gas and suspended liquid is separated by causing it to strike against and travel along, but not through, a foraminous member, with changes of direction.—W. F. F.

Gases; Apparatus for treating ——. W. D. Mount, Saltville, Va., Assignor to Nitrogen Products Co., Providence, R.I. U.S. Pat. 1,304,697, 27.5.19. Appl., 9.5.18.

Solid material for treating the gas is fed by a hopper into the top of a tower without admission of air, and the material is supported at the bottom by a rotating table which gradually removes it and feeds it into a surrounding trough. The gas is passed upwards through the material.—W. F. F.

Liquids in emulsion; Apparatus for [electrically] separating ——. C. W. McKibben, Houston, Tex. U.S. Pat. 1,304,786, 27.5.19. Appl., 26.7.18.

The emulsion is contained in a vessel having an inner concentric vertical tube projecting upwards through its base to about half its height, and open at the top. The vessel is closed at the top, and an

adjustable electrode projects vertically downward into the central tube. A valve is provided on the upper part of the vessel to allow gas to escape at a predetermined pressure.—W. F. F.

Filter. E. J. Sweetland, Montclair, N.J., Assignor to United Filters Corporation. U.S. Pat. 1,305,317, 3.6.19. Appl., 24.6.16.

A CYLINDRICAL casing is supported on horizontal trunnions, the axis of which is at right angles to the longitudinal axis of the casing. The cover of the cylinder carries a set of spaced parallel filter leaves which extend through the cylinder, parallel to the longitudinal axis and at right angles to the axis of the trunnions. The casing is rotated during the filtering operation.—W. F. F.

Distilling apparatus. J. E. Doubleday, Alexandria, Va. U.S. Pat. 1,306,687, 17.6.19. Appl., 19.8.18.

THE apparatus consists of a boiler having an open top into which a domed condenser fits by means of a flange on its lower end. The condenser has a conical top, a side wall which flares slightly from below upwards, and is open below to the boiler. It is surrounded by a jacket through which cooling water is circulated and has a gutter formed round the inside lower edge to collect the condensed distillate, which is discharged through a pipe passing through the water jacket.—W. H. C.

Treating solid-bearing solutions; Apparatus for ——. L. C. Trent, Los Angeles, Cal. U.S. Pat. 1,307,329, 17.6.19. Appl., 12.6.18.

THE material to be treated is delivered to a horizontal pan supported within a treating vessel and which serves to divide the latter into upper and lower compartments and to retard the downward movement of the material. The vessel is provided with a discharge outlet and an agitator.—W. H. C.

Regenerative furnaces; Gas reversing valves for ——. F. W. Knowles, Thornhill Lees. Eng. Pat. 128,823, 24.10.18. (Appl. 17,352/18.)

Gas and liquid contact apparatus. W. B. Davidson, Huddersfield. U.S. Pat. 1,308,338, 1.7.19. Appl., 15.3.18.

SEE Eng. Pat. 115,006 of 1918; this J., 1918, 290 A.

Concentration of liquids. Eng. Pat. 127,652. *See* VII.

Heating oils etc. Eng. Pat. 127,987. *See* XI.

Cooling viscous liquids. Eng. Pat. 121,117. *See* XIX A.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal analysis; Method of least squares applied to estimation of errors in ——. J. D. Davis and J. G. Fairchild. U.S. Bureau of Mines. Tech. Paper 171, 1918. 34 pages.

THE application of the theory of probability to obtain expressions for the accuracy of the proximate analysis of coal is complicated through the fact that the same methods are used for all kinds of coal, and for no two coals will the analytical results represent exactly the same quantities of constituents in the coal, *e.g.*, in coal ashes containing varying percentages of carbonates, the probable error of the ash determination will vary with the quantity of carbonate present. Analytical error is also a function of the quantity of the constituent determined and a rigid examination would require analysis of every class of coal. The limits of error have been worked out for a few typical coals and the results so obtained compared with numerous analytical data. When the error of which the probability is 1 in 1000 is taken as the limit determining rejection, the limits of error are as follows: In taking a 5 lb. gross sample, 0·20%; for ash determination, 0·40%; for moisture determination, 0·20%; and for heating value determination, 0·75%.—C. A. K.

Lignites; Classification of ——. R. Salvadori and Mondini. Annali Chim. Appl., 1919, **11**, 108–113.

THE calorific value of a lignite is composed of that due to the fixed carbon, to which the value 8100 is attributed, and of that due to the volatile constituents; the factor, *a*, representing the quotient obtained by dividing the calories given by the volatile matter by the percentage of the latter in the lignite, is suggested as a means of classifying these fuels. The method used to expel the volatile components consists in calcining 5–10 grms. of the lignite in small pieces in a platinum crucible with a cover having a turned-over edge. The crucible may be heated either in a muffle at a temperature approaching but not exceeding 500° C. or on an asbestos ring so that only the bottom of the crucible is brought to incipient redness; the heating is stopped when fumes or combustible gases cease to emerge from the crucible. The values of *a* obtained are: for peats and peaty lignites, less than 20; semi-pitchy and pitchy lignites, 30–50; paraffinoid and bituminous lignites, about 50; shales, above 50 and sometimes more than 80. When the value is below 50, the gaseous products contain carbon dioxide in larger or smaller proportion.—T. H. P.

Carbonising coal at low temperatures; New practical method of ——. F. Fischer and W. Gluud. Ber., 1919, **52**, 1035–1039.

DIFFICULTIES are encountered in carbonising considerable quantities of coal at low temperatures in a reasonable time, since, owing to the low thermal conductivity of the material, the heat penetrates so slowly into the interior of the charge that the outer portions readily become overheated. The authors consider that the conditions essential for success are that the volatile portions should not be heated to a temperature higher than that necessary for their volatilisation and that they should not be exposed to this temperature for an unnecessarily long period. They have constructed a cylindrical retort which can be rotated about a horizontal axis. The latter is hollow but is plugged in the middle; through the one end steam is admitted, and this carries off the volatile products through the other end to a condensing arrangement. The furnace is heated from underneath by a series of gas burners fed with air under pressure, whilst loss of heat is minimised by enclosing the furnace in a metal sheath. A thermo-couple is placed in the axis. The furnace permits the distillation of 20 kilos. of coal in 1–2 hours. Distillation generally commences at about 350° C. and is complete at 500° C. The yield of tar is 3—30% according to the kind of coal used. The first portions of the oils are lighter than water, the last portions are heavier, the mean density being slightly greater than unity. In thin layers, the tar forms a golden-

red oil which is more or less viscous according to the kind of coal used. (See also this J., 1919, 492A.)—H. W.

Petroleum spirit from coal. F. Fischer and W. Gluud. Ber., 1919, **52**, 1053—1068.

THE object of the investigation was to obtain a general insight into the nature of the most volatile fractions of low-temperature tar (see preceding abstract). It was found that considerable quantities (about 1% of the weight of the coal) of light petroleum could be obtained, and that benzene is not present in more than minimal amount. Three different coals were investigated, a gas coal (Zeche Lohberg) and two bituminous coals (Flöz Albert and Minden). The last-named was of interest since the mine from which it was obtained was known to smell of petroleum; this coal evolved paraffins at a temperature well below that at which carbonisation commenced, so that it is established that light paraffins can exist pre-formed in certain coals. The light petroleum was isolated from the gas and also from the tar. In the former case, since it was desired to operate under technical conditions, extreme cooling, as with liquid air, was not adopted; the products were isolated either by liquefaction by compression in steel cylinders, or, preferably, by compression into paraffin oil and subsequent treatment of the latter with steam. In this manner, the considerable fraction boiling below 20° C. was lost; the product had mainly b.pt. 20°—100° C., with only small portions of higher boiling point. The tar was treated with steam, distillation being discontinued when only small quantities of oil came over, since otherwise considerable amounts of phenolic substances distilled. The distillates had b.pt. mainly 60°—100° C. They were purified by treatment with alkali and then with concentrated and 15% fuming sulphuric acid, or, preferably, with aluminium chloride; the use of liquid sulphur dioxide proved less advantageous. Perfectly colourless liquids were thus obtained which were stable to light and air. The fraction of b.pt. 20°—60° C. was composed of saturated paraffin hydrocarbons; that of b.pt. 60°—100° C. contained naphthenes mixed, in the case of the gas coal, with paraffins. The composition of the higher fractions, b.pt. 100°—125° C. and 125°—190° C., was less definite; they appeared to be mixtures of paraffins with naphthenes of higher hydrogen content and, probably, complex aromatic compounds. The fraction, b.pt. 60°—100° C., was examined for benzene; the presence of the latter in small amount was established in a product obtained from the Minden coal and purified by liquid sulphur dioxide, the isolation being directly effected by exposure to low temperature; the quantity in the fraction cannot exceed 3%. The fractions obtained from the second bituminous coal and from gas coal respectively and purified by aluminium chloride appeared to be free from benzene when examined by the triphenylmethane method. The usual identification by successive conversion into nitrobenzene and aniline appeared inadmissible in this instance owing to the danger of the acid forming benzene by the oxidation of more highly hydrogenated products. The behaviour of the several fractions when cooled was also fully investigated.—H. W.

Paraffin from coal. W. Gluud. Ber., 1919, **52**, 1039—1053.

THE occurrence of paraffin in low-temperature tars has been frequently noted but little is known as to the nature of the individual components. The author has investigated the tar obtained from a Mond gas plant fed with gas coal and finds the paraffin to be a mixture of normal saturated paraffins in which hexa- and hepta-cosane preponderate, the highest member present being $C_{29}H_{60}$. The series thus appears to be less comprehensive than in lignite tars. The paraffin exists as such in the crystalline state in the tar, from which it is isolated by treatment with acetone. In the earlier experiments, attempts were made to isolate a pure product by repeated crystallisation of the crude substance first from acetone and subsequently from benzene; in this manner, heptacosane was ultimately obtained. Better results, however, were secured by repeated fractional distillation of the crude product under diminished pressure and crystallisation of the individual fractions when necessary. The complete series from $C_{24}H_{50}$ to $C_{29}H_{60}$ could thus be isolated in the pure condition and the identity of the individual hydrocarbons established by direct comparison with the synthetic compounds. Investigation of the paraffins obtained from other varieties of coal indicated that they are closely similar in composition. The isolation of small amounts of paraffin by the direct extraction of coal with benzene at 260°—270° C. leads the author to the conclusion that, in all probability, it exists to some extent as such in coal and is therefore not exclusively a product of secondary processes occurring during distillation. (See also J. Chem. Soc., 1919, i., 378.)—H. W.

Hydrocarbons contained in light petroleum; Preparation of some volatile, saturated, acyclic or cyclic ——. G. Chavanne and L. J. Simon. Comptes rend., 1919, **168**, 1324—1326.

THE following aliphatic and cyclic hydrocarbons have been prepared and their b.pts., specific gravities, and critical temperatures of solution in aniline determined:

—	Crit. temp. of solution in aniline	B.pt.	Sp. gr. at 4°/15° C.
Pentane	72° C.	36·3° C.	0·6454*
Isopentane	77° C.	28° C.	0·6391*
Isohexane	73·8° C.	61·7-62·4° C.	0·658
Isoheptane	72·8° C.	90·91° C.	0·6842
Heptane	70° C.	98-98·3° C.	0·6879
Octane	71·8° C.	125·8° C.	0·7063
Methylcyclohexane	41° C.	100·4° C.	0·780*
1·2-Dimethylcyclohexane	42·1° C.	128·6-129° C.	0·798
1·3-Dimethylcyclohexane	49·7° C.	121·2-121·8° C.	0·775
1·4-Dimethylcyclohexane	48° C.	122·7-123° C.	0·783
Cyclopentane	18° C.	49·5° C.	0·750
Methylcyclopentane	35° C.	72° C.	0·753

* At 4°/0° C.

The authors find that, for the conversion of butyric, adipic or methyladipic acid into its corresponding ketone, manganous carbonate is a very effective catalyst.—W. G.

Crude petroleum; Action of micro-organisms on ——. J. Tausz. Petroleum, 1919, **14**, 553—555. Chem. Zentr., 1919, **90**, II., 697.

A LAYER of petroleum from 1 to 2 mm. in depth was spread over a mixture of ditch water with a solution containing 0·1% of magnesium ammonium phosphate, 0·08% of dipotassium phosphate, 0·01% of calcium sulphate, and traces of sodium chloride, potassium iodide, and ferric chloride. After several weeks the oil was found to have decomposed, and the liquid had become turbid with apparent formation of asphalt. With thicker layers of oil the action did not take place. Thin slices of paraffin wax placed in the nutrient solution were also attacked, and the liquid became turbid. Experiments were made with refined and crude Russian and American lubricating oil and cylinder oil, and with the aid

of pure cultures of micro-organisms it was found possible to effect separation of the paraffin and naphthene hydrocarbons. Three new species of bacteria were isolated during the research.

—L. A. C.

Acetylene; Decomposition of —— at high temperatures under the influence of different catalysts. S. Hilpert. Ges. Abhandl. zur Kenntnis der Kohle, 1917, I., 271—275. Chem. Zentr., 1919, **90**, I., 709—710.

ACETYLENE prepared from calcium carbide was purified by passing it over a layer of kieselguhr saturated with a solution of copper chloride in hydrochloric acid and was then passed through a length of Jena glass tube, 1½ cm. in width, filled with different catalysts and bound round with 1 mm. nickel wire by means of which it could be heated electrically to 600° C. Whether the acetylene was heated alone or with catalysts, much carbon was deposited and the formation of tar and benzene appeared to be a secondary reaction. Nothing approaching a quantitative yield of benzene could be obtained. Using coke as the catalyst, the impurities in the coke, particularly the sulphur, affected the reaction. If the tube was filled with pieces of broken glass, a tar mist appeared at 400° C., and at 500° C. a layer of carbon appeared gradually on the surface of the glass, while benzene and a tar containing unsaturated compounds distilled over; decomposition of acetylene on glass is thus characterised by formation of carbon at a relatively high temperature with simultaneous formation of tar. With iron powder, and with nickel to a more marked extent, decomposition began at 300° C. and proceeded at 400° C. at such a rate that the tube was soon choked with carbon, while the tar was highly unsaturated and contained little benzene. The use of aluminium, lead, mercury, zinc, and tungsten had little effect, whereas with copper a brown mass which rapidly formed soon choked the tube and a small quantity of an evil-smelling tar distilled over. Brass turnings produce somewhat similar results to those obtained with broken glass. Molten phenanthrene and anthracene, alone or mixed with aluminium chloride, did not react with acetylene.—L. A. C.

Carbon tetrachloride etc. from natural gas. Jones and Allison. *See* XX.

PATENTS.

Solid fuel. H. Boissier, Paris. Eng. Pat. 115,645, 10.5.18. (Appl. 7862/18.) Int. Conv., 10.5.17.

A SOLID fuel is constituted of sawdust intimately mixed with a plastic hydrocarbon such as paraffin wax. If desired, animal charcoal may be added. The mixture is compressed and moulded to shape. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 12,382 of 1909 and 22,719 of 1913.)

—J. S. G. T.

Removing water from peat and similar substances; Method of and means for ——. A. ten Bosch, The Hague, Holland. Eng. Pat. 128,064, 19.8.18. (Appl. 13,463/18.) Int. Conv., 3.7.18.

PEAT is charged into vertical open containers or towers of height about 25 metres, at the base of which is a grid on which the peat rests. The towers are of greater width at the bottom than at the top. The peat is subjected to the pressure of the superincumbent mass, and to a gradually increasing temperature, first by means of warm water expressed from the peat, and afterwards by steam, the maximum temperature being preferably below that necessary for wet carbonising. The tower is closed above by means of a valve, while the peat is subjected to the action of the steam. The liquid expressed during the rise of temperature is supplied to a fresh quantity of peat contained in a second vertical tower, and the process can be carried on with any desired number of towers, the fresh peat being always brought initially into contact with warm liquid obtained from previously treated peat. When the peat has been sufficiently treated in any tower, it is automatically removed therefrom by the pressure existing therein, and the tower recharged with peat which is then pre-treated by the warm liquid expressed from a following tower. The process is operated continuously, and the moisture content of the peat is reduced from 85 to 68%.—J. S. G. T.

Liquid fuel. A. A. Backhaus, Baltimore, Md., Assignor to U.S. Industrial Alcohol Co. U.S. Pat. 1,306,241, 10.6.19. Appl., 28.11.17.

A LIQUID fuel is composed of petroleum distillate, an alcohol, and a fatty acid adapted to blend the other constituents. For example, the fuel may be composed of gasoline, kerosene, alcohol, and linolic acid.—J. S. G. T.

Vertical [gas] retort. J. A. Yeadon, Leeds. Eng. Pat. 127,986, 12.6.18. (Appl. 9623/18.)

A VERTICAL retort for carbonising coal etc. has its body, namely the part exposed to external heat, of a corrugated or fluted section internally and externally, the corrugations being vertical and extending the full length of the retort.—T. H. B.

Gas generators or producers. W. Beswick, Stockton-on-Tees. Eng. Pat. 126,420, 8.4.18. (Appl. 5971/18.)

GAS coming directly from the producer or generator is passed through a chamber containing solid fuel to separate dust, and the fuel is periodically or continuously charged into the producer.—T. H. B.

Gases; Production of — — from water or oil. E. C. R. Marks, London. From Soc. Anon. Ital. Gio. Ansaldo & Co., Genoa, Italy. Eng. Pat. 127,363, 15.4.18. (Appl. 6361/18.)

HEAVY or light oils are injected through nozzles into a gas producer of the kind in which the ash of the solid fuel used is fused. The nozzles are arranged in one or more rows above the dry-air nozzles.

—T. H. B.

Producer gas; Manufacture of — —. G. Helps, Nuneaton, and J. Harger, Liverpool. Eng. Pat. 127,916, 10.7.17. (Appl. 9942/17.)

COAL or coke is burnt in a producer with air containing more oxygen than atmospheric air, and the resulting gas while still very hot (900°—1000° C.) is passed over blocks of alkali carbonate, carbon, and iron, to convert the nitrogen partially or wholly into cyanide, carbon monoxide being produced at the same time. Thus, together with elimination of nitrogen, the calorific value of the gas is considerably increased and cyanide is recovered.—T. H. B.

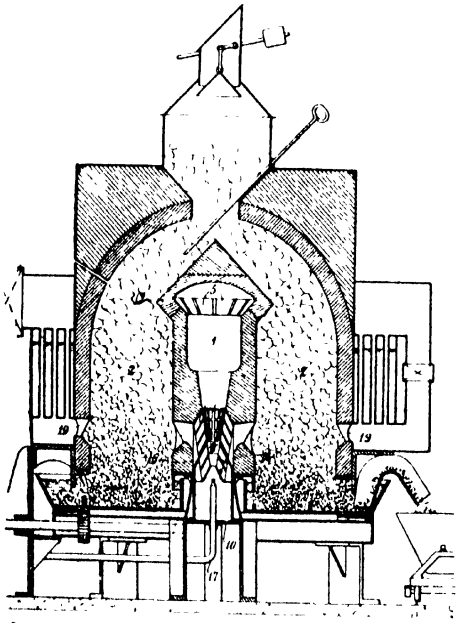
Coal dust or/and the like; Means to generate gas or gases from ——. J. H. Corthesy and S. T. S. Castelli, London. Eng. Pat. 127,933, 8.5.18. (Appl. 7710/18.)

Two generating chambers are provided one above the other. The finely divided fuel is introduced into the upper chamber which is only heated suffi-

ciently to distil gas from the coal; this gas is suitable for illuminating purposes. The fuel then passes into the lower chamber to complete its gasification, giving gas suitable for heating or power purposes; the gases from the two chambers may be mixed if desired. The fuel is held in suspension and subjected to a whirling motion by means of jets of air in the lower chamber and jets of gas in the upper chamber. Steam also may be introduced into the lower chamber. A grid between the two chambers is so arranged as to permit passage of the fuel without mixing of the gases from the two chambers. Baffles round the cylindrical walls of the chamber help to maintain the fuel particles in suspension.—T. H. B.

Gas generators or producers and method of working such gas generators or producers. H. Francart, London. Eng. Pat. 127,974, 8.6.18. (Appl. 9473/18.)

In a producer, air and steam introduced respectively through the openings, 10, and pipe, 17, are diluted with excess of gas in a combustion chamber, 1, within the producer. The resulting gaseous mixture then passes through passages, 5, to the fuel chamber, 2, "to regenerate the products



of combustion," the excess of gas in the mixture being chemically inactive. The difference in density of the gaseous mixtures in the fuel chamber and the combustion chamber respectively is used alone, or with steam or air induction, to effect the circulation of gas through the two chambers. Gas for use leaves the producer through the outlets, 19. In an alternative form the combustion chamber surrounds the fuel chamber.—T. H. B.

Gas-producer. C. W. Lummis, Assignor to Morgan Construction Co., Worcester, Mass. U.S. Pat. 1,305,913, 3.6.19. Appl., 27.1.15.

A gas-producer is provided with a water jacket open at the top and surrounding the zone of highest temperature. The firebrick lining between the jacket and the producer is sufficiently thin to conduct the heat into the water jacket at a rate which prevents fusion of the firebrick.—W. F. F.

Gas dissolved in liquid; Storing mass for —— and method of producing the same. G. Dalen, Stockholm, Assignor to American Gasaccumulator Co., Elizabeth, N.J. U.S. Pat. 1,304,160, 20.5.19. Appl., 28.7.16.

A porous mass is obtained by mixing a fibrous substance with a carbonisable material and heating the mixture to cause decomposition of the carbonisable material, the residue from which serves as a binder for the fibrous substance.—T. H. B.

Coal gas; Purification of ——. W. G. Adam, London. Eng. Pat. 127,431, 21.6.18. (Appl. 10,287/18.)

Coal gas, after passage through the usual purifiers and scrubbers, is passed through granulated animal or wood charcoal to remove naphthalene and sulphur compounds. The quantity of charcoal used is such as not to remove ethylene, for instance 70 lb. of charcoal is used to purify 12,000 cb. ft. of gas containing 35 grains of sulphur and 6 grains of naphthalene per 100 cb. ft.—T. H. B.

Gas-purifying apparatus. T. Kawai, Fukuoka-Ken, Japan. U.S. Pat. 1,304,884, 27.5.19. Appl., 18.1.18.

Two concentric vertical cylinders open at the bottom and dipping into water are provided with a vertical partition dividing the inner cylinder into two parts. Gas passes round the outer annular space and thence to the bottom of another tall vertical cylinder surrounded by a larger cylinder, the annular space being formed as a helical passage. The gas then passes down through the helical passage to one compartment of the inner cylinder first mentioned, and is finally discharged from the other compartment of the cylinder.

—W. F. F.

Coal-gas; Purification of ——. Berlin-Anhaltische Maschinenbau A.-G., Berlin. Ger. Pat. 311,418, 24.5.16.

About 75% of the tar and liquor is first removed from coal gas by means of the tar washer described in Ger. Pat. 284,971, and the remaining tar is removed by injecting a fine spray of water into the gas. The water is readily separated from the mixture of tar and water produced, and can be circulated again through the injector. Gas from producers fired with lignite can readily be freed sufficiently from tar and dust by this means for use in gas engines.—L. A. C.

Mixing and proportioning gases; Method and apparatus for ——. Jet apparatus. W. B. Eddison, Irvington, N.Y., Assignor to The Surface Combustion Co., Inc., New York. U.S. Pats. (A) 1,294,781, (B) 1,295,085, and (C) 1,295,086, 18.2.19. Appl., (A) 14.6.17, (B) 11.11.16, and (C) 2.7.17.

(A, B) A jet of fuel gas is directed across an air space in an enclosing chamber into the entrance cone of a Venturi tube formed to maintain the point of minimum cross-section of the jet stationary under varying rates of flow. The pressure of the air surrounding the jet is substantially equal to the pressure against which the mixture is discharged. The mixture passing from the Venturi tube to the furnace is regulated by a flow-controlling orifice. The quantity of mixed gas supplied is varied, without altering the proportions of gas and air, by varying the amount of fuel gas supplied. The proportions are varied by varying the size of the inlet orifice. (C) A high-velocity jet of gas in [illegible]

into a Venturi tube the cross-section of which is several times as large as that of the nozzle orifice, and the nozzle is set so close to the Venturi tube that the cross-section of the jet is much less than the area of the tube. The expanding part of the tube is sufficiently long to equalise the pressure of the mixture across the stream, and the mixture at an increased pressure discharges into a burner nozzle having a restricted orifice.—W. F. F.

Fuel; Art of burning ——. *Intrageneratire furnace. Fuel-burning apparatus.* J. M. Schutz, Assignor to Schutz Hawley Co., Chicago, Ill. U.S. Pats. (A) 1,306,233, (B) 1,306,234, and (C) 1,306,235, 10.6.19. Appl., (A) 28.3.17, (B) 10.2.17, and (C) 21.11.13. (C) Renewed 30.1.19.

(A) A MIXTURE of gaseous fuel and air for combustion is fed tangentially into an annulus of refractory material whereby a helically moving column of the gaseous mixture is established at the walls of the annulus. The products of combustion return within the central portion of the annulus and pass out longitudinally therefrom. (B) A furnace for effecting gaseous combustion as described under (A) consists of a chamber or pit having refractory walls and refractory bottom, the axis of the chamber being substantially vertical. The combustible gas mixed with air is caused to whirl helically downwards over the inner vertical wall of the chamber. The top of the chamber is open for the free discharge of the products of combustion into a fire chamber, wherein they are mixed with air. The bottom of the chamber contains an opening for the discharge of the slag, communicating with a closed slag chamber. A refractory annular chamber arranged in a pit may be similarly employed, a mixture of gaseous fuel and air being caused to whirl from top to bottom, and air, gas, or similar medium being admitted to the annulus through a slag-discharge opening arranged centrally at the bottom. (C) A refractory cylinder, open at one end and closed at the other, is divided longitudinally into a rear chamber and a forward chamber by means of a partition provided with a central opening connecting the two chambers. Each of the chambers is provided with an inlet arranged tangentially.—J. S. G. T.

Combustible gases; Method and apparatus for the oxidation of ——. E. M. Chance, Wilkes-Barre, Pa. U.S. Pat. 1,298,889, 1.4.19. Appl., 14.8.17.

COMBUSTIBLE gas such as a mixture of hydrogen and air is subjected to a silent electric discharge produced by a high-tension current. The resulting water is removed as it is formed. The method may be applied to the oxidation of poisonous gases.
—W. F. F.

Petroleum and the like oils; Treatment of ——. E. W. Wynne, Liverpool. Eng. Pat. 127,918, 29.5.18. (Appl. 17,640/17.)

PREHEATED petroleum or similar oil is injected upwards as a fine spray by means of steam or heated air near the top of a vertical column where it is subjected to the action of powerful jets of ozonised oxygen; the mixture then passes down the column, in the lower half of which are arranged electrodes, and into a heated still also fitted with electrodes. From the far end of the still the oil passes into an ordinary distillation apparatus. An alternating current of 10^6 periods per sec. and 3000 volts or upwards may be used, and on treating American petroleum by this method the flash point of the products is raised considerably, and the amount of still residue is decreased by 25%.
—L. A. C.

Light mineral oils from heavier oils; Production of ——. H. S. Maxim, London. Eng. Pat. 128,227, 15.6.16. (Appl. 8477/16.)

A MIXTURE of the heavy oil with finely divided zinc and slightly acidulated water is heated at 300° – 420° C. in a closed vessel which is rotated during the operation. The vessel is only partially filled with the liquid. After the desired transformation has been effected the lighter hydrocarbons are separated from the residual oil by distillation.
—A. E. D.

Hydrocarbons; Treatment and production of ——. G. F. Forward and J. G. Taplay, London. Eng. Pat. 128,255, 3.7.17. (Appl. 9598/17.)

HEAVY hydrocarbon oils are vaporised and passed in the presence of steam over carbonaceous spent shale heated to 450° – 600° C. The process may be so arranged that shale, continuously passing down a vertical retort, is submitted to destructive distillation and the oil vapour is brought into contact with nascent hydrogen derived from the action of steam on the heated spent shale towards the lower end of the retort.—A. E. D.

Petroleum; Process of treating [cracking] ——. W. A. Schmidt and E. R. Wolcott, Assignors to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,307,931, 24.6.19. Appl., 27.3.17.

A LIQUID hydrocarbon is heated to convert it into vapour, which is subjected to the action of a "corona discharge" to crack the hydrocarbon, and the resulting vapours are condensed to produce liquid products different from the original hydrocarbon.—B. N.

Gasoline and other hydrocarbons; Recovery of ——. W. E. Walker, Arkansas City, Kans. U.S. Pat. 1,307,280, 17.6.19. Appl., 9.3.18.

A CURRENT of liquid hydrocarbons is passed through a vessel into which the hydrocarbon gases from compressed "wet" gas enter at an elevated temperature and pressure; by this means the volatile portion of the liquid hydrocarbons is distilled off and may be recovered.—A. E. D.

Gasoline; Recovery of — — *from natural gas etc.* E. S. Merriam, Marietta, Ohio. U.S. Pat. 1,304,587, 27.5.19. Appl., 30.10.17.

As a step in the recovery of gasoline from natural gas, condensable vapours are separated from a liquid menstruum by feeding the latter into one end of a long narrow horizontal still at such a rate that a constant level is maintained therein. The liquid is heated gradually and progressively during its passage through the still by means of a series of burners underneath, and passes out at the far end, whilst the vapours are led off at the top of the still.—L. A. C.

Paraffins; Treatment [powdering] of solid ——. W. Elborne, Peterborough. Eng. Pat. 128,239, 16.6.17. (Appl. 8693/17.)

SOLID paraffins derived from petroleum, shale, cannel coal, etc., and also natural wax, such as ozokerite, can be powdered to any desired degree of division by grinding in the presence of ethyl or methyl alcohol (methylated spirit). One fluid oz. of the alcohol to 1 lb. of the wax is a suitable proportion. The alcohol can be recovered by treatment of the powdered wax with a current of dried air.—A. E. D.

Pulverulent fuel; Feeding devices for ——. Motala Verkstads Nya Aktiebolag, Motala Verkstad, Sweden. Eng. Pat. 118,101, 17.7.18. (Appl. 11,761/18.) Int. Conv., 31.12.14.

Pulverised fuel; Apparatus for feeding ——. Fuel Saving Co., Assignees of W. D. Wood, Allentown, Pa., U.S.A. Eng. Pat. 129,199, 27.11.18. (Appl. 19,616/18.) Int. Conv., 27.9.18.

Hydrocarbons; Process and apparatus for cracking ——. A. E. White, London. From Sinclair Refining Co., Chicago, Ill., U.S.A. Eng. Pat. 128,806, 12.9.18. (Appl. 14,865/18.)

See U.S. Pat. 1,285,200 of 1918; this J., 1919, 100 A.

Felt. U.S. Pat. 1,305,404. *See* V.

Hydrogen. Eng. Pat. 127,609. *See* VII.

Hydrogen. Eng. Pat 128,273. *See* VII.

Hydrogen. U.S. Pat. 1,306,831. *See* VII.

Potash [from gases from coal-fired furnaces]. U S Pat. 1,307,127. *See* VII.

Resinous products. U.S. Pat. 1,305,790 *See* XIII.

Gas analysing apparatus. Eng. Pat. 116,715. *See* XXIII.

Hydrogen in gaseous mixtures. Eng Pat. 127,656. *See* XXIII.

Combustible atmospheres. U S. Pat. 1,298,800. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Fir wood lignin. Klason. *See* V.

PATENTS.

Material containing condensable volatile matter; Apparatus for treating ——. C. O. Hoover, Denver, Colo., Assignor to J. D. and L. F. Lumaghi and R. D. Hatton. U.S. Pat. 1,305,109, 27.5.19. Appl., 14.7.17.

THE material to be treated is contained in an upright chamber having an outlet near its upper end. The walls of the chamber are heated by means of a series of flues, and its bottom is inclined and composed of a number of sections in stepped formation with openings between their overlapping ends. These openings serve as fluid inlets and communicate with a passage for fluid extending along and beneath the bottom of the chamber. Beneath the passage is a conduit for fluid which communicates at the end opposite its inlet with the passage. The passage and conduit are exposed to the heat from the flues.—T. H. B.

Cathode rays; Method and apparatus for utilising the thermic effect of ——. A. Sinding-Larsen, Christiania, Norway. Eng. Pat. 121,280, 24.10.18. (Appl. 17,395/18.) Int. Conv., 7.12.17.

THE cathodes producing the rays are constructed as concave mirrors, which form a part of the wall of a vacuum container, the back of each electrode being electrically insulated and provided with a cooling arrangement. The concave mirror electrodes may be so constructed as to act either as cathodes or anodes. The rays are collected so as to produce narrow pencils of rays, which are passed through narrow openings in a thermally insulating body enclosing the object to be heated, and the rays are made to act upon the object.—B. N.

Carbons for electric arc lamps. W. Heape, London, and H. B. Grylls, Weybridge, Surrey. Eng. Pat. 128,057, 2.8.18. (Appl. 12,661/18.)

CARBONS for electric arc lamps are impregnated with a solution of an albuminoid or carbohydrate colloid of low viscosity (*e.g.*, gelatin, starch, gum), containing a suitable proportion of an organic salt of calcium, together with a small quantity of a suitable cerium salt.—B. N.

Iodine etc. from seaweed by distillation. U.S. Pat. 1,305,058. *See* VII.

Quartz lamp. U.S. Pat. 1,307,500. *See* XIXb.

III.—TAR AND TAR PRODUCTS.

Monochlorobenzene; Determination of —— in mixtures containing benzene, monochlorobenzene, and dichlorobenzene. N. G. S. Coppin and F. Holt. Analyst, 1919, **44**, 226—229.

NORTHALL-LAURIE'S method of determining toluene in commercial toluols (this J., 1915, 950) has been adapted to the determination of monochlorobenzene in crude chlorinated benzene and mixtures obtained by distilling the crude product. 200 c.c. of the sample, dried by means of calcium chloride, or, better, sodium peroxide, is distilled at a uniform rate of 7 c.c. per min., and the distillate collected in two fractions of 50 c.c. and 100 c.c. The boiling points of the first 50 c.c. of distillate and of the residual 50 c.c. in the distillation flask are then determined in the special constant boiling-point flasks (*loc. cit.*), and from the results the composition of the sample is obtained by reference to a graph constructed from the results of determinations made with mixtures of known composition. In preparing the graph, mixtures of benzene, monochlorobenzene, and *p*-dichlorobenzene of known composition by weight are used. The small amount of trichlorobenzene produced in the chlorination of benzene is practically negligible, whilst the quantity of *o*-dichlorobenzene produced does not affect the results to any appreciable extent. The b.pts. of the first 50 c.c. of distillate are plotted as ordinates, whilst those of the residual 50 c.c. form the abscissæ. In the case of samples containing more than 25% of dichlorobenzene care must be taken to prevent the solidification of that substance in the condenser tube towards the end of the distillation. The bulk of the samples dealt with in commercial work contain from 0 to 30% of benzene, and the percentage can be read upon the graph with an accuracy of 0·1%. In dealing with samples containing less than 50% of monochlorobenzene, a known weight of pure monochlorobenzene should be added to the mixture so as to bring the results within the limits of the graph, and a correction subsequently applied for this addition. Greater accuracy is obtained by adopting this course in the case of all samples containing more than 30% of benzene. (See also Frankland and others; this J., 1919, 153 T.)—C. A. M.

Decomposition of acetylene. Hilpert. *See* IIA.

PATENTS.

Phthalic anhydride; Process for the purification of crude ——. C. Conover, Philadelphia, Pa., and H. D. Gibbs, San Francisco, Cal. U.S. Pat. 1,301,288, 22.4.19. Appl., 29.6.18.

THE solution obtained by treating crude phthalic anhydride with a non-aqueous solvent above 30° C. is filtered and treated with a substance capable of adsorbing colour; the temperature is then lowered, whereby phthalic anhydride crystallises out. The impurities are separated by again lowering the temperature and the mother liquor is used for the treatment of more crude material.—L. A. C.

Carbazole; Process of purifying ——. J. M. Weiss, New York, Assignor to The Barrett Co. U.S. Pat. 1,301,796, 22.4.19. Appl., 25.10.18.

SUFFICIENT concentrated sulphuric acid is added at the normal temperature to mixtures containing carbazole to dissolve the carbazole and to sulphonate other compounds present; the carbazole is then precipitated by the addition of water.—L. A. C.

Carbolic acid [phenol]; Manufacture of synthetic ——. F. Cobellis, Philadelphia, Pa. U.S. Pat. 1,301,909, 29.4.19. Appl., 9.2.17.

BENZENESULPHONIC acid together with sulphuric acid is neutralised by means of a zinc compound with the production of zinc sulphate and zinc benzenesulphonate; barium sulphide is then added to the solution, precipitating barium sulphate and zinc sulphide. The barium benzenesulphonate remaining in solution is used for conversion into phenol.—L. A. C.

Amines. Eng. Pat. 127,740. *See* XX.

IV.—COLOURING MATTERS AND DYES.

Dyestuffs; Adsorption of —— by inorganic substances. F. Feigl. Oesterr. Chem.-Zeit., 1919, 22, 36—37, 42—44.

EQUAL quantities of the carbonates of calcium, barium, and strontium, sulphates of barium and lead, aluminium hydroxide, mercurous chloride, silica, felspar, kaolin, and blood charcoal were treated with equal volumes of solutions of the same strength of dyestuffs containing varying numbers of atoms in the molecule. The carbonates showed no appreciable difference in the depth of colouring obtained with acid and basic dyes respectively, thus demonstrating their amphoteric character. Barium sulphate, which possesses great absorptive power, was no more coloured than lead sulphate or the carbonates. In most cases absorption of colour occurred only with those dyes forming colloidal solutions, *i.e.*, those containing 44 or more atoms in the molecule. Exceptions were Eosin and Erythrosin, due to the chlorine atoms contained in these dyestuffs, and Neutral Red, Fast Red, and Ponceau, due to the transitional position which they occupy between dyes giving true and colloidal solutions. On the other hand, some dyestuffs containing more than 44 atoms in the molecule showed very slight tinctorial power. These contain sulpho groups, which, according to Blitz, decrease colloidal character. The colours remaining in the substances, after washing with hot water, were fast to light, air, washing with alkali hydroxide, and prolonged agitation with water, and appeared quite homogeneous under the microscope. The mercurous chloride was in many cases greyish after the treatment on account of the separation of mercury. The coloured substances, when dissolved in acid, gave a solution similar to that obtained by dissolving the dyestuff itself in acid. The intensity of coloration is influenced by the size of the particles of the substance under treatment, the duration of contact, and the electrolytes present in solution. Of the amount of dyestuff absorbed (which depends on the concentration of the dye solution), a part was removed by washing with water. The ratio between the quantity of Acid Violet permanently absorbed and that temporarily absorbed by calcium carbonate under various conditions was determined. The ratio was found to be approximately constant (0·3), and may be considered as a measure of the fast-dyeing power. The quantity of dye fixed is influenced by the end-concentration of the dyebath. The distribution coefficient becomes smaller with increase in concentration of the liquor, and the experimental results correspond to those calculated from the known adsorption formula.—S. S. A.

PATENT.

Picric acid. Eng. Pat. 128,303. *See* XXII.

V. FIBRES; TEXTILES; CELLULOSE; PAPER.

Cotton linters; Making cellulose from ——. J. H. Wallace. Paper, Ann. Conv. No., 1919, 23, 31—42.

IN the United States, cellulose for nitration is manufactured from a mixture of 75% of cotton linters and 25% of cotton seed hull fibres. The materials are blended in the "devil duster" machines, into which the cotton is fed from the bale-opening machines. From the dusters it is blown over into storage bins each capable of holding a charge of 6500 lb., sufficient for one digester of 1200 cub. ft. capacity. For this quantity of cotton, 1360 lb. of caustic soda is employed, equivalent to 21% of the weight of the cotton, the caustic soda solution being mixed with some of the "black liquor" from a previous charge. The total amount of digestion liquor is about 825 cub. ft. and this is heated to the boiling point before passing to the digester. The digester has a perforated false bottom and the circulation of the liquor is effected by a centrifugal pump through an external heater. The liquor is circulated through the cotton and the heater until it reaches 160° C. corresponding to a steam pressure of 72 lb. per sq. in.; thus no live steam is admitted to the digester and the concentration of the liquor is not reduced. When the temperature of the charge has reached the desired point, the circulation is stopped and the charge is allowed to stand under pressure for a given time. Afterwards, live steam is admitted to the digester, the pressure is raised to 100—110 lb., and the whole charge is blown over into a diffuser. The time of heating up is about 1½ hours and the time under pressure about 2 hours. In the diffusers the black liquor is drained off and the cotton is washed by downward displacement, first with weak washings from a previous charge and then with hot water. The washed fibre is discharged from the diffusers into a stuff-chest below, where it is stirred and suspended in water. Thence it is pumped to a washing engine where it is further washed and the excess of water is removed. The thickened charge is then transferred to a bleaching engine holding about 7000 lb. of dry fibre, and

bleached with about 2·5% of bleaching powder at a temperature of 36° C. for about one hour. Finally, the pulp is acidified with about 30 lb. of sulphuric acid and washed in drainers with warm water. The washed fibre is stirred with water in a stuff-chest and pumped over on to "wet-end" or *rinsing machines at a concentration of* about 1% of fibre. The water is squeezed out and the fibre, after going through a picking machine, is delivered on an apron, 8 ft. wide and 90 ft. long, on which it is dried by hot air from steam coils. Each dryer has a capacity of 800 lb. of cotton per hour with steam at 75 lb. pressure. The "white water" is used again for diluting the stuff and any excess is discharged through "save-alls." The recovery of soda from the black liquor is performed in the usual way, the use of black liquor in the digester charge facilitating the recovery process by maintaining the strength of the solution.—J. F. B.

Fir wood lignin; Chemical constitution of ——. P. Klason. Ark. Kemi, Min, o. Geol., 1917, **6**, 21 pp. Chem. Zentr., 1919, **90**, I., 92—93

THE constitutional relationship of the lignin of coniferous wood to coniferyl alcohol, $HO.C_6H_3(OCH_3).CH:CH.CH_2OH$, has previously been developed by the author (this J., 1898, 63). The separation of the carbohydrates from the salts of ligninsulphonic acids in the spent sulphite liquors may be effected by precipitation with calcium chloride after first precipitating the sulphuric acid by barium chloride. The calcium ligninsulphonate from fir wood has a composition represented by the formula, $C_{40}H_{44}O_{18}S_2Ca$, which may be expressed as 1 mol. of coniferyl alcohol ($C_{10}H_{12}O_3$)+3 mols. of hydroxyconiferyl alcohol ($C_{30}H_{36}O_{12}$)+1 mol. $Ca(SO_3H)_2$−3 mols. H_2O. By the boiling point method the value of 916 was determined for the molecular weight of the ligninsulphonate, allowance being made for the degree of dissociation; it is readily soluble in water and nearly insoluble in alcohol. Naphthylamine ligninsulphonate is obtained by treating the calcium salt with naphthylamine hydrochloride; it is a yellowish sandy powder almost insoluble in water. After the precipitation of the calcium or barium ligninsulphonate from the sulphite liquor, a further precipitate may be obtained with naphthylamine hydrochloride. This latter salt has the formula, $C_{50}H_{60}O_{14}S_2N_2$, and would correspond to a lignin of the formula, $C_{29}H_{26}O_3$, containing 12·3% CH_3O, whereas the calcium salt corresponds to a lignin of the formula, $C_{40}H_{42}O_{12}$, containing 17% CH_3O. The original lignin might be regarded as being composed of equal molecules of both. The molecule apparently contains a benzene nucleus substituted in the 1.3.4 positions. On destructive distillation the lignin yielded 15% of phenols. The author favours the hypothesis that the lignin of fir wood consists of condensed forms of more or less methylated cinnamic alcohols and allied aldehydes and acids, and the general type of substituents shows a relationship to protocatechuic acid, to which resins and tannins are also allied. It is not improbable that lignin may be present in the wood in the form of a glucoside, and it may be built up from the pentoses.—J. F. B.

[*Calcium bisulphite.*] *Requirements of a good cooking acid.* W. E. B. Baker. Paper, Ann. Conv. No., 1919, **23**, 164—178.

IN the analysis of bisulphite liquors the liquor should not be violently stirred during titration or sulphur dioxide will escape; a gentle rotary motion is advisable. Winkler's method, in which alkalimetric and iodimetric titrations are performed on two separate portions of the bisulphite solution, is preferable to Hohn's method, in which the liquor is first titrated with iodine and then with alkali. One drawback of Winkler's method is the hydrolysis of sodium sulphite in solution, whereby an alkaline reaction to phenolphthalein is shown before the point of exact equivalence is reached. The amount of this error should be determined for the quantities and concentrations of the tests by titrating a solution of pure sulphurous acid and making the necessary correction in the alkalimetric titration of the bisulphite liquor. If this correction be made, Winkler's method is the best, because a small error in the titre of the standard solutions has a smaller influence on the results than in Hohn's method. One of the principal points requiring attention, whichever method be used, is to obtain an accurate relationship between the standard iodine and the standard caustic soda; that is, the two solutions should be standardised against the same standard substance.—J. F. B.

[*Wood pulp;*] *Indirect cooking* [*of* ——] *by forced circulation. The Morterud system.* O. L. Berger. Paper, Ann. Conv. No., 1919, **23**, 104—114.

So far as technical quality is concerned the pulp digested by the Mitscherlich process with indirect steam heating is always superior to that produced by the rapid Ritter-Kellner process with live steam. On the other hand there are certain difficulties and disadvantages in the Mitscherlich process which restrict its use and increase the cost. The Morterud system of forced circulation and external heating has been designed to give a pulp of the Mitscherlich character, while overcoming the principal objections to the process of indirect heating. Power is required to maintain a high-speed circulation of the liquor through the heater, and the latter requires repairs and upkeep. The condensed water from the heater tubes is taken by a pump to the boiler, thereby increasing the efficiency of the heating surface. The vertical heater is designed to bring the liquor up to its full temperature in 4½ hours. It is furnished with bronze or copper pipes, the other parts being constructed of steel, lead-lined. The upper end of the chamber has a steam and condensed water chamber and the lower end is tapered to form a trap for detached scale. The circulating pump is constructed of bronze or lead and requires 8—15 h.p., running at 800—2000 revs. per min. The condensed water pump receives the water from six or more heaters and forces it back into the boilers against the steam pressure; it takes 10—15 h.p. and runs at 1400—3000 revs. per min. Under certain circumstances an internal circulating pump is fitted to the lining of the digester for use when the heater is not required. The quantity of fresh acid charged is only 70% of that required by other systems; the balance is made up by the transfusion of spent liquor from a digester which is nearly ready to blow off. The composition of the fresh "acid" for an easy bleaching pulp is: total SO_2, 4·5%; free SO_2, 3·6%; and combined SO_2, 0·9%. The transfusion stage is an important feature of the Morterud process: besides saving time in heating up the new digester, it provides gas-space in the digester from which the liquor is being taken, and the evolution of gas which occurs opens up the fibre bundles and makes the fibres more accessible. Time is also saved by the avoidance of the "rest" periods during the process of heating up, as the artificial circulation ensures uniformity from start to finish; the relieving of the liquor during this stage is also unnecessary, so that a weaker initial liquor may be used. After the maximum temperature has been reached (*viz.* 140° C. in Europe or 165° C. in

America) the steam is shut off and the liquor is circulated until a test shows that digestion is complete; gassing off is then effected in graduated stages. The precipitation of calcium sulphite in the Morterud process is particularly small, since free SO_2 is not relieved until the digestion is practically finished. Further, in the recovery of alcohol or other by-products, a great advantage of the process lies in the fact that the spent liquor contains 50% more dissolved matter than in the Ritter-Kellner process; indeed the percentage of sugar has been raised from 2·2 up to 4.—J. F. B.

[*Paper-sizing;*] *The best furnishes of rosin and alum* [*in* ——]. P. de C. Bray. Techn. Assoc. Pulp and Paper Ind., New York, Feb. 6 and 7, 1918, 38—41.

Results in the paper mill demonstrated the economy of employing a size with a high proportion of free rosin. Equivalent sizing results were obtained with 2 parts of rosin in the form of a size containing 40% of its rosin in the free state, as compared with 5 parts of rosin with a size containing 26% of free rosin. The economy of alum was correspondingly in favour of the size with a high content of free rosin. Free rosin appears to be the active sizing agent, provided it be maintained in the proper condition of colloidal emulsion; rosin spots are avoided by using the size in a suitably diluted form. An excess of size has a bad effect on the colour of the paper, tends to clog the machine wire and makes the paper harsh with poor folding qualities. Under comparable conditions, the ink-resistance of the paper increases with the quantity of size used, up to a maximum point which, in the experiments cited, corresponded to about 3·5% of rosin. The consumption of alum is determined by the requirements of the pulp and the alkali in the size. In a series of trials under comparative conditions with definite proportions of size, the effect of the addition of increasing quantities of alum was determined. In every case, depending on the proportion of size used, the ink-resistance of the paper increased up to a maximum point when the quantity of alum was increased, but after this point, at which the requirements of the pulp and size were satisfied, further increase in the quantity of alum had no influence on the ink-resistance of the paper. —J. F. B.

Paper; Research work on the sizing of ——. F. C. Clark and A. G. Durgin. Techn. Assoc. Pulp and Paper Ind., New York, Feb. 6 and 7, 1918, 48—54.

In the valuation of rosin, for the determination of its saponification value, it is advisable to take only 0·5 grm. of the rosin and boil for 2 hours with 25 c.c. of *N*/2 alcoholic sodium hydroxide. A sample of "G" rosin showed: saponification value, 180·3; acid value, 156·9; ester value, 23·8; ash, 0·15%. On boiling this rosin with the exact equivalent of soda ash, a neutral size was obtained showing on analysis: total rosin, 4·12%; free rosin, 0·10%; combined rosin, 4·02%; total solids, 4·39%. By using smaller proportions of soda ash, other size solutions were prepared containing respectively 25% and 50% of the total rosin in the free state, these solutions being then suitably diluted without the formation of clots. Sheets were produced from a standard paper stock by stirring up the unsized paper with water by means of a high-speed propeller until separation of the fibres was complete, adding the desired proportions of rosin size and alum, stirring thoroughly after each addition, and pouring the sized pulp on to a circular suction mould. The sheets were made to represent three different weights, with the three different rosin sizes, fixed with three different proportions of alum, and sized with increasing proportions of rosin from 0·5 to 8·0% on the weight of the paper, the alum in each case being adjusted to show the effects of insufficient quantity, correct quantity, and excess. The sheets in each case were divided into two sets, one being dried at a low temperature and the other at the temperature of the paper machine cylinders. Analyses were made to determine the percentage of rosin retained in the sheets and passing through with the waters, the results of which are not yet complete. The scheme for the further examination of the papers comprises the determination of the water-resistance of the sheets by a modification of Okell's electrical method, which consists in measuring the conductivity of an electrolyte. Details of a proposed research by the U.S. Bureau of Standards on the sizing of sheets of standard paper with the three different rosin sizes under varied conditions are given.—J. F. B.

Waste sulphite liquor; Alcohol from ——. V. K. Krieble. Paper, Ann. Conv. No., 1919, **23**, 153—162.

The total reducing sugars in sulphite waste liquors may be estimated with sufficient accuracy by neutralising the liquor and titrating it directly into Fehling's solution, using ferrous thiocyanate as indicator. The ratio of non-sugar reducing substances to sugars appears to be constant, and if the total values be reduced by 10%, the results agree with those obtained by isolating the sugars by means of alcohol. The yield of alcohol by fermentation corresponds to 49% of the quantity of sugar consumed. A number of waste liquors from Canadian pulp mills have been examined, and the general results were in accordance with data recorded for liquors from European mills. Making allowance for those liquors which were obviously dilute, or which had been subject to high temperatures capable of destroying the sugars, it may be concluded that typical Canadian liquors contain 2·0—2·9% of sugars, which compares favourably with European liquors. The proportion of fermentable sugars varied from 61·2 to 75% of the total. The yield of alcohol ranged from 0·82 to 1·23% by vol., and in practice fully 1% should be obtainable. The Canadian liquors are met with in two sharply defined classes, one with about 20% of the total organic matter in the form of reducing sugars and the other with 28%. This difference appears to be due to the destruction of reducing sugars in the course of the digestion. By determining the ratio of sugars to total organic matter at different periods of the digestion, it was established that in the early stages polysaccharides are dissolved and then hydrolysed, since the ratio of sugars to dissolved organic matter increases between the 6th and 8th hours; moreover in this period of the digestion 50% of the total sugar is produced. The production of sugar then goes on at a decreasing rate, but destruction of sugar takes place simultaneously, so that after the tenth hour, if the temperature exceeds 145° C., the rate of destruction may exceed that of the production, and the total yield of sugar will be materially decreased. The fermentable sugars are the first to be destroyed.—J. F. B.

Percarbonate washing powders. Kühl. *See* XII.

Enzymic studies on cellulose degradation products. Pringsheim and Von Markatz. *See* XVIII.

Nitrocellulose. Schwarz. *See* XXII.

Nitrating wood cellulose. Wells and Edwardes. *See* XXII.

Nitrocellulose from wood pulps. Baker. *See* XXII.

PATENTS.

Paper-making machine. C. E. Pope, Springfield, Mass., Assignor to Great Northern Paper Co., Millinocket, Me. U.S. Pat. 1,304,903, 27.5.19. Appl., 6.8.17.

A SCRAPER blade is arranged to move in contact with the surface of the upper press roll of the paper machine at a point beyond the pinch of the rolls and below a horizontal plane passing through the axis of the upper press roll. The blade is provided with a combined journal and operating rod supported by a bearing to permit the scraper blade to be moved into or out of contact with the press roll, whereby the blade may be engaged with the latter to detach a leading strip of the wet paper web from the upper press roll and deflect it so that it will move by gravity and its own momentum on to and with the felt.—J. F. B.

Felt and process of making the same. R. P. Perry, Upper Montclair, N.J., Assignor to The Barrett Co. U.S. Pat. 1,305,404, 3.6.19. Appl., 12.4.17. Renewed 20.11.18

A DETERMINED quantity of a fusible waterproofing material in the form of filaments is added to paper pulp, the mixture is formed into a layer to produce a sheet of paper, and the sheet is saturated with molten bituminous material.—J. F. B.

Waste liquors such as those from wool scouring and the like; Treatment of ——. W. P. Thompson, Liverpool. From F. E. Underwood and B. F. Ilston, Jamestown, N.Y., U.S.A. Eng. Pat. 128,730, 26.6.18. (Appl. 10,513/18.)

SEE U.S. Pat. 1,277,784 of 1918; this J., 1918, 687 A.

Viscose; Processes for the production of articles from ——. B. Borzykowski, Cleveland, Ohio, U.S.A. Eng. Pat. 116,268, 15.4.18. (Appl. 6346/18.) Int. Conv., 29.5.17.

SEE U.S. Pat. 1,260,508 of 1918; this J., 1918, 297 A.

Paper making machines; Fourdrinier ——. S. Milne, Edinburgh. Eng. Pat. 128,425, 4.7.18. (Appl. 10,985/18.)

SEE U.S. Pat. 1,303,493 of 1919; this J., 1919, 531 A.

Paper; Waterproof ——. K. Konagai, Tokyo. U.S. Pat. 1,307,405, 24.6.19. Appl., 8.11.18.

SEE Eng. Pat. 124,689 of 1918; this J., 1919, 357 A.

Separating solids. Eng. Pat. 128,144. *See* I.

Drying and conditioning machine. U.S. Pat. 1,304,645. *See* I.

Adhesives. Ger. Pat. 311,557. *See* XVII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Absorption of dyestuffs. Feigl. *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sulphur-burner gases; Analysis of ——. F. M. Williams Techn. Assoc. Pulp and Paper Ind., New York, Feb. 6 and 7, 1918, 26—27.

FOR the control of the gases from sulphur burners, better results are obtained by the direct analysis of a measured volume of the gas than by aspirating a current of the gas through a series of absorption vessels containing iodine solution. Apparatus of the Orsat type is most convenient for the purpose, and a slightly modified form, in which the fragile U-tube or goose-neck reagent vessels are replaced by straight pipettes inverted in cylindrical containers is described. The author employs an apparatus with three vessels, which can be used either for sulphur-burner gases or for flue gases. In the case of sulphur-burner gases the sulphur dioxide is absorbed by caustic potash solution, and the result may be verified by a determination of the oxygen in the residue. With this method of operation it is easy to confirm the fact that the absorption of the sulphur dioxide is complete, thus avoiding a source of uncertainty which always attends the use of the aspiration method. The burner gases should show 17—18% of sulphur dioxide in practical working: the production of a richer gas is usually accompanied by volatilisation of sulphur.—J. F. B.

Ammonia; Formation of —— by means of an electric arc. Influence of diminishing the pressure. E. Briner and A. Baerfuss. J. Chim. Phys., 1919, **17**, 71—140.

AMMONIA has been synthesised by submitting a mixture of nitrogen and hydrogen to an electric arc under various conditions. At sufficiently low pressures (150 mm. and below) the arc assumes the form of a luminous sheath which surrounds the electrodes and becomes longer the lower the pressure and the greater the current intensity. This sheath plays an important part in the synthesis of ammonia. At pressures of the order 600—700 mm., an increase in the arc current effects an increase in the "energy yield" (grms. NH_3 formed per kilowatt-hour) which is due to the lowering of the tension; at pressures of 100 mm., with the theoretical mixture of gases, there is an increase in the "energy yield," which is mainly attributable to the lowering of the tension. At this pressure and with platinum electrodes an increase in the percentage of nitrogen leads to an increased yield (grms. NH_3 per ampère-hour) of about 200% for the optimum mixture of 5 vols. of nitrogen and 1 vol. of hydrogen. Electrodes of the metals of the platinum group give the best results, platinum itself being the most efficient; these metals are followed by tungsten and copper. Iron and nickel are very much less effective and for these the optimum yield is obtainable from the theoretical mixture at all pressures. The presence of moisture does not appear to affect the synthesis, whilst the presence of small quantities of oxygen under certain circumstances acts favourably. At reduced pressures the influence of the current intensity appears to be connected with the temperature produced at the electrodes; for a given diameter of the electrode there is an optimum yield for a definite current intensity. For currents up to 0·020 amp., cooling of the region containing the arc does not increase the yield. At low pressures the yield of ammonia per ampère-hour is almost independent of the distance between the electrodes, consequently since this space can only play a secondary part in the reaction, it is advisable to reduce it as much as possible. There is no appreciable formation of ammonia when nitrogen and hydrogen, which have been submitted to the arc, are allowed to mix. The authors suggest that ammonia is formed in the relatively cool regions, which are near the luminous sheath, the elements having been previously activated by contact with the electrodes. The activation consists in the thermal dissociation of the molecules into atoms at the high temperature and is favoured by a

diminution of the pressure. The active nitrogen described by Strutt does not appear to take any part in the synthesis.—J. F. S.

Nitrogen and ammonia; Determination of —— as ammonium chloride. A. Villiers. Bull. Soc. Chim., 1919, **26**, 335–337. (See this J., 1918, 504 A.)

Further evidence is given showing that the loss in weight of ammonium chloride when heated in a narrow-necked conical flask for four days at 105° C. is practically negligible.—W. G.

Chlorine-caustic soda plant at Edgewood Arsenal; U.S. Government — —. S. M. Green. Chem. and Met. Eng., 1919, **21**, 17–21.

The installation is the largest chlorine manufacturing plant in the world, having a capacity of 100 tons per 24 hours and consisting of two sets of 1776 Nelson 1000-amp. electrolytic chlorine-caustic soda cell units. The electrical power supply is 20,000 kw. at 60,000 volts, about 14,000 kw. being required to operate the cells. The general arrangement of the plant is shown in a plan. The salt storing and treating building contains 7 tanks for salt of 4000 tons capacity each. Water flowing upwards through the salt is pumped into 24 treating tanks of 72,000 gallons each. An eighth tank is reserved for soda ash, which is dissolved and pumped into the treating tanks. The treated brine is pumped into 4 tanks wherein it is neutralised with hydrochloric acid, and then delivered to a constant-level tank whence it flows by gravity to the cells. There are two cell buildings partitioned into 4 sections, each complete in itself. The piping used is of stoneware and the drying apparatus is a stoneware tower with a large number of plates. The chlorine is delivered to large receiving tanks connected by steel pipe mains to the chemical plant. The Nelson electrolytic cell is fitted with an automatic feeding device to preserve a constant liquor level in the cathode department. The outflow from the cells is carried by gravity to the weak caustic storage tanks. The evaporators are heated by exhaust steam from steam turbines. The evaporator equipment consists of two sets of six 108 in. double effect evaporators, each set being connected to one large condenser. The concentrated caustic liquor is stored in 4 steel tanks of capacity 79,000 gallons each. The 36 caustic fusion pots are arranged in two rows. The fused caustic is charged into drums by centrifugal pumps.—T. H. Bu.

Sodium sulphate–copper sulphate–sulphuric acid–water; Equilibrium in the system —— H. W. Foote. J. Ind. Eng. Chem., 1919, **11**, 629–631.

The changes which take place on adding increasing quantities of sulphuric acid to the system, sodium sulphate—copper sulphate—water, have been studied by determining the solubility of univariant systems at definite temperatures and connecting the points on the curves by straight lines to show the composition of corresponding divariant systems. In the case of the system—Na_2SO_4–H_2SO_4—H_2O—the results agreed with those of D'Ans (this J., 1906, 534), but no indication was obtained of the hydrate, $Na_2H(SO_4)_2.H_2O$, which D'Ans found to be occasionally formed. The solubility relationships are more simple at 12° C. than at 25° C., for at the former temperature anhydrous salt is not stable under any conditions, and the decahydrate exists in equilibrium with the salt $Na_2H(SO_4)_2$ at the univariant point (see also Pascal, this J., 1917, 594). In the system, copper sulphate—sulphuric acid—water—the solid phases were $CuSO_4,5H_2O$, $CuSO_4,5H_2O$ with $CuSO_4,3H_2O$, and $CuSO_4,3H_2O$ with $CuSO_4,H_2O$. In the system, sodium sulphate—copper sulphate—sulphuric acid—water, the points corresponding to the univariant points in the ternary mixture were obtained by adding an excess of the third solid necessary. The double salt, $Na_2SO_4,CuSO_4,2H_2O$, was the only one produced under a wide range of conditions, and formed one of the solid phases in every univariant system containing the four components. The diagrammatic representation of the results shows the great instability of the hydrogen sulphates of sodium in the presence of copper sulphate in solution, which rapidly converts them into the double copper-sodium sulphate. The difficulty experienced in using nitre cake to replace sulphuric acid for pickling copper alloys is probably due to this slight solubility of copper sulphate, and the resulting precipitation of the double salt. This behaviour suggests a practical method of preventing the accumulation of copper sulphate in solution or of removing it from a solution. (See also J. Chem. Soc., Sept., 1919.)

—C. A. M

Sulphates; Determination of — as barium sulphate. I. M. Kolthoff and E. H. Vogelenzang. Z. anal. Chem., 1919, **58**, 49–69.

The author reviews the sources of error in the determination of sulphates as barium sulphate, and concludes that it is not possible to prescribe a general method for the determination of sulphate in any or every solution. W. P. S.

Sulphurous acid; Reduction of — by hydrogen sulphide in aqueous solution. E. Heinze. J. prakt. Chem., 1919, **99**, 109–178.

The reaction between sulphur dioxide and hydrogen sulphide in aqueous solution in absence of air has been studied quantitatively. When the reacting gases are in the proportion $2H_2S : SO_2$, the final condition is represented by the equation, $2H_2S+SO_2 = 3S+2H_2O$, but the reaction only comes to completion after many months. The primary reaction is supposed to be a reversible one, $H_2SO_3+H_2S \rightleftarrows H_2SO_2+H_2SO$. The sulphoxylic acid, H_2SO_2, then interacts with a further molecule of hydrogen sulphide, $H_2SO_2+H_2S \rightleftarrows 2H_2SO$. The compound, H_2SO, is considered to be of the hydrogen peroxide type and to decompose into free sulphur and water. When sulphur dioxide is in excess, less sulphur is formed and a greater proportion of polythionic acids. Only tetra- and penta-thionic acids are formed in appreciable quantities, the former predominating when a large excess of sulphur dioxide is present. As intermediate products hydrosulphurous and thiosulphuric acids are probably formed. The reversible reactions involved are probably:

$$H_2SO_2+SO_2 \rightleftarrows H_2S_2O_4;\ H_2SO+H_2SO_3 \rightleftarrows H_2S_2O_3+H_2O;$$
$$H_2S_2O_4+H_2S_2O_3 \rightleftarrows H_2S_3O_6+H_2O;$$
$$H_2S_4O_6+H_2S_2O_3 \rightleftarrows H_2S_5O_6+H_2SO_3.$$

(See also J. Chem. Soc., 1919, ii., 334.)—E. H. R.

Dissociation of carbonate rocks; Apparatus for studying the — —. G. A. Bole. J. Amer. Ceram. Soc., 1919, **2**, 410–417.

About 0·1–0·5 grm. of the sample is heated in a silica tube fitted with a side delivery tube leading to a pneumatic trough and gas burette. The tube is heated in an electric furnace, the temperature of the sample being measured by a thermocouple inside the silica tube. The volume of gas evolved (after allowing for the expansion of the air in the

apparatus) is observed. The apparatus may be used to determine the temperature of dissociation at atmospheric pressure; the rate of dissociation; the proportion of carbon dioxide associated with lime and magnesia respectively in dolomites; or to control calcination processes. (See also J. Chem. Soc., 1919, II, 320.)—A. B. S.

Iodides; Titration of — by means of conductivity measurements. I. M. Kolthoff. Chem. Weekblad, 1919, **16**, 926—929.

IODIDE is completely oxidised to iodine by means of iodate in acid solution, according to the equation: $5I' + IO_3' + 6H = 3H_2O + 3I_2$. If the iodide-iodate mixture is titrated with hydrochloric acid, and the conductivity determined after each addition of acid, an approximately constant value is obtained until the oxidation is complete, when a rapid increase in the conductivity is observed. The end point is sharply shown graphically by plotting conductivity against volume of acid added. Iodide may be accurately titrated in this way even in presence of large excess of bromide, as the analogous oxidation of bromide requires greater acid concentration and higher temperature.—W. S. M.

Perchlorates; Determination of — alone, or in the presence of chlorates and chlorides. J. G. Williams. Chem. News, 1919, **119**, 8.

IN fairly concentrated hot solution, titanium trichloride reduces perchlorates but not chlorates. A weighed quantity of the chlorate (about 0·1 grm.) is dissolved in 15 c.c. of water, 10 c.c. of 15% titanium trichloride solution and 10 c.c. of 5% sulphuric acid are added, the mixture is boiled, cooled, and the excess of titanium trichloride titrated with ferric sulphate solution. The titanium trichloride solution is standardised against pure ammonium persulphate.—W. P. S.

Sodium thiosulphate; Action of — on hypochlorites. F. Diénert and F. Wandenbulcke. Comptes rend., 1919, **169**, 29—30.

IN dilute aqueous solutions the reaction between sodium thiosulphate and sodium hypochlorite is:

$$5NaOCl + 3Na_2S_2O_3 + 5H_2O = 2Na_2SO_4 + Na_2S_4O_6 + 5NaCl + 5H_2O.$$

In the presence of acids, however, or even in the presence of sodium bicarbonate, much less sodium thiosulphate is required, the reaction being represented by

$$Na_2S_2O_3 + 4Cl_2 + 5H_2O = 2NaHSO_4 + 8HCl.$$

—W. G.

Manganese salts; Sensitive reaction of —. H. Caron and D. Raquet. Ann. Chim. Analyt., 1919, **1**, 174.

TEN c.c. of the manganese solution is treated successively with 2 c.c. of saturated potassium oxalate solution, 1 c.c. of acetic acid, and a few drops of potassium hypochlorite solution. A red coloration develops if as little as 0·05 mgrm. of manganese is present. Iron salts must not be present, but zinc salts do not interfere if sufficient oxalate is added to redissolve the zinc oxalate and the mixture is then rendered distinctly acid with acetic acid.

—W. P. S.

Fluorides; Modified "etching" test for —. W. Partridge. Analyst, 1919, **44**, 234—235.

THE following modification of the "etching" test will detect 0·01 grm. of sodium fluoride. Two or 3 c.c. of 25 (by vol.) % of sulphuric acid is added to the substance in a test tube, and the liquid covered with a layer of butter fat. The tube is immersed upright in water at 80°—95° C. for 3 hours and is then cleaned and examined. "Etching" due to the action of hydrofluoric acid is not affected by successive treatment with ether, boiling alcohol, and boiling hydrochloric acid, and rubbing with a piece of wood.—C. A. M.

Iodine; Recovery of — from residues. F. Arndt. Ber., 1919, **52**, 1131—1134.

THE residues are placed in a large flask provided with a rubber stopper which carries a tube reaching nearly to the bottom of the liquid. The other end of the tube is connected through a reversed wash-bottle to a source of oxygen. The residues (which should not more than half fill the flask) are acidified with sulphuric acid, and oxygen is passed into the flask. A small amount of nitrite solution is added, the flask is securely corked, and passage of the oxygen is continued into the well-shaken liquid. Completion of the action is indicated by cessation of the oxygen absorption, when a small further quantity of the nitrite should be added to ensure that all the iodine has separated. The crude iodine is purified by distillation with steam, the vapours being passed directly into a large Erlenmeyer flask which is cooled by water and which is also provided with a long upright tube to serve as air-condenser. The iodine which is thus obtained retains water with considerable obstinacy and is most easily dried by warming it on the steam-bath in a covered porcelain dish; the cover is frequently removed and the deposit of moisture and iodine is scraped off. As soon as the sublimate appears perfectly dry, the main portion may safely be regarded as dry also. The iodine so obtained is pure. If the original solution is free from organic matter of high molecular weight, such as starch, the distillation with steam may be omitted.—H. W.

Hydrogen peroxide; Estimation and conservation of —. I. M. Kolthoff. Pharm. Weekblad, 1919, **56**, 949—959.

IN the estimation of hydrogen peroxide iodometrically, the solution may be titrated directly, after the addition of acid and potassium iodide, if a few drops of *N*/1 ammonium molybdate solution are added as a catalyst. To conserve peroxide solutions the addition of 75—100 mgrms. of acetanilide, benzoic acid, or salicylic acid per litre is recommended. The solution should react acid to dimethyl yellow and should be kept in brown bottles.

—W. S. M.

Phosgene; Preparation of — by means of carbon tetrachloride and oleum or ordinary sulphuric acid. V. Grignard and E. Urbain. Comptes rend., 1919, **169**, 17—20.

CARBON tetrachloride reacts with sulphuric anhydride, $2SO_3 + CCl_4 = COCl_2 + S_2O_5Cl_2$, and with pyrosulphuric acid, $SO_3 + H_2SO_4 + CCl_4 = COCl_2 + 2SO_3HCl$. Thus one molecule of sulphur trioxide in the anhydrous state gives 49·5 grms. of carbonyl chloride; as 60% oleum it gives 76·4 grms., and as 45% oleum 99·0 grms. With ordinary sulphuric acid in the presence of infusorial earth as a catalyst, the reaction is $2H_2SO_4 + 3CCl_4 = 3COCl_2 + 4HCl + S_2O_5Cl_2$. The reaction commences at 80° C. but towards the end the temperature must be raised to 135°—140° C. Using pure carbon tetrachloride the yield is 93—96%. At the higher temperature a slight secondary reaction occurs, $S_2O_5Cl_2 + CCl_4 = COCl_2 + 2SO_2Cl_2$. By this latter method an impure carbonyl chloride is obtained,

mixed with hydrogen chloride, but if the issuing gases are passed into carbon tetrachloride the carbonyl chloride dissolves whilst the hydrogen chloride is only sparingly soluble. Finally, by boiling, the carbonyl chloride is obtained, containing not more than 10% of hydrogen chloride.
—W. G.

Carbon tetrachloride; Action of concentrated sulphuric acid on ——. C. Mauguin and L. J. Simon. Comptes rend., 1919, **169**, 34—36. (See preceding abstract.)

Carbonyl chloride may be prepared by the interaction of sulphuric acid and carbon tetrachloride at about 150° C.

$$CCl_4+H_2SO_4=SO_3HCl+COCl_2+HCl.$$

If a slightly aqueous acid is used the water present is decomposed by the chlorosulphonic acid first formed, giving sulphuric acid and hydrogen chloride. Finally the chlorosulphonic acid itself reacts with carbon tetrachloride,

$$CCl_4+2SO_3HCl=S_2O_5Cl_2+2HCl+COCl_2.$$

The carbonyl chloride may be purified by solution in carbon tetrachloride and subsequent distillation.
—W. G.

Colloids. Schryver and Speer. *See* I.

Calcium bisulphite solution. Baker. *See* V.

Silver and halogens. Eggert and Zipfel. *See* XXIII.

Patents.

Sulphuric acid or other liquids; Concentration of — . J. S. Morgan, Freshfield. Eng. Pat. 127,652, 14.5.17. (Appl. 6831/17.)

Shallow, lipped basins are fixed, one above the other, alternately on opposite sides of a tower, on cast iron supports. Weak acid, or other liquid, is passed from a tank into the top of the tower, and in flowing downwards from basin to basin is concentrated by the heat of gases (such as the products of combustion from coke ovens) passing up the tower. A slight vacuum is maintained in the tower, the waste gases are exhausted at the top, and the concentrated acid is removed through a sump near the bottom. The sides of the tower are so fitted that one or more may be removed *en bloc* for cleaning or repairs.—S. S. A.

Hydrocyanic acid; Method of and apparatus for producing liquid ——. W. G. Dingle, Los Angeles, Cal. U.S. Pat. 1,304,745, 27.5.19. Appl., 5.5.17.

Hydrocyanic acid is generated by the action of sulphuric acid on a solution of a cyanide, and the gaseous product is led against condensing surfaces within a separating chamber, the temperature of which can be controlled, whereby impurities present in the gas are precipitated. The gas then passes into a cooler and down condensing tubes into a collecting chamber.—L. A. C.

Ammonia; Catalytic oxidation of ——. E. B. Maxted and T. A. Smith, Walsall. Eng. Pat. 127,845, 29.5.17. (Appl. 7655/17.)

In the catalytic oxidation of ammonia to nitric acid or oxides of nitrogen, less active, cheaper catalysts (*e.g.*, iron) may be used, if the process is carried out at a pressure above atmospheric (*e.g.*, 2—30 atms.). The products are separated by refrigeration at a pressure approximating to that used in the oxidation.—S. S. A.

Ammonia; Process of regulating the oxidation of ——. L. Rabinovitz, Montclair, N.J., Assignor to Ellis-Foster Co. U.S. Pat. 1,304,707, 27.5.19. Appl., 10.3.17.

In the catalytic oxidation of ammonia, a quantity of mixed gases containing a greater proportion of nitrogen than the air is added to the mixture of ammonia and air passing to the catalytic chamber.
—L. A. C.

Ammonia and air mixture; Process of forming ——. L. C. Jones, Syracuse, N.Y., Assignor to Semet-Solvay Co., Solvay, N.Y. U.S. Pat. 1,307,739, 24.6.19. Appl., 1.8.18.

A mixture of ammonia and air is obtained by causing preheated air to bubble through a counter current of ammonia solution.—A. B. S.

Electrolysis of chlorides of the alkaline metals; Apparatus and process for the ——. Norsk Alkali A./S., Trondhjem, Norway. Eng. Pat. 121,460, 5.11.18. (Appl. 18,135/18.) Int. Conv., 13.12.17.

An apparatus for the electrolysis of alkali chloride solutions is provided with a horizontal diaphragm, comprising metal wire netting with 100 meshes or more per sq. cm. as cathode, on which is spread a layer of fibrous or pulverulent material, such as powdered asbestos and washed asbestos flour in the form of a paste, each layer being arranged so that the coarse powder is at the bottom and the finest fraction at the top. A layer of calcined alumina, silica, iron oxide, barium sulphate, or the like, is arranged above, and covered with a top layer of a loose substance of a long fibrous character, such as glass wool or asbestos wool.
—B. N.

Chlorine; Electrolytic cells for the production of ——. T. W. S. Hutchins, Middlewich, Cheshire. Eng. Pats. (A) 127,914 and (B) 127,915, 27.6.17. (Appls. 9232 and 9233/17.)

(A) A mastic or cement for fixing in position the diaphragms, cathodes, and walls or covers of electrolytic chlorine cells, is produced by mixing finely-powdered china clay with calcium chloride solution of 30°—40° Tw. (sp. gr. 1·15—1·20), to produce a pasty mass, and incorporating asbestos with the mass during the mixing. (B) Dish-like vessels are provided for the inflowing and outflowing liquids in electrolytic chlorine cells, each vessel having a number of small-bore liquid passages which deliver the liquid from each dish in discontinuous streams of drops. Recesses between the liquid outlets, or nipple-like projections for the outlets, are formed on the underside of the dish to prevent continuity of the liquid between the outlets.—B. N.

Electrolytic [chlorine] cell. C. P. Townsend, Washington, D.C., Assignor to Hooker Electrochemical Co., New York. U.S. Pat. 1,306,237, 10.6.19. Appl., 24.7.17.

An electrolytic cell is provided with a gas space and means for maintaining atmospheric or lower pressure therein. A portion, at least, of the evolved gas (chlorine) is withdrawn under positive pressure before reaching the gas space.—J. S. G. T.

Salts of potassium; Recovering —— *from solutions thereof.* N. T. Bacon, Peace Dale, R.I., Assignor to The Solvay Process Co., Solvay, N.Y. U.S. Pat. 1,304,931, 27.5.19. Appl., 29.10.17.

A solution containing potassium salts is exposed to solar evaporation in a layer of such depth that

the solution is approximately saturated with the potassium salts at the highest temperature attained during an exposure of a single day.—L. A. C.

Potash; Recovering —— [*from gases from coal-fired furnaces*]. W. Hoskins, Chicago, Ill. U.S. Pat. 1,307,127, 17.6.19. Appl., 12.1.17.

POTASH is extracted from solid and condensable matter collected from the gases produced by the combustion of coal in industrial furnaces.
—S. S. A.

Saline liquors; Process of treating ——. J. H. Reeve, Oswego, N.Y., Assignor to The Diamond Match Co., Chicago, Ill. U.S. Pat. 1,305,566, 3.6.19. Appl., 6.12.15.

A SUFFICIENT quantity of magnesium chloride is added to a hot liquor containing potassium chloride and other salts, to retain the potassium chloride in solution whilst the other salts are precipitated. The liquor is separated from the precipitate, and on cooling, the potassium is obtained as carnallite.
—S. S. A.

Potassium salts; Process for dissolving ——. Gewerkschaft Siegfried I, Vogelbeck. Ger. Pat. 311,595, 6.4.17.

CRUDE potassium salts are washed by a current of the liquor for dissolving the same in a trough so arranged that the liquor overflows into a second trough carrying with it the greater part of the fine material, leaving behind the coarser particles. The coarser particles then come in contact with fresh solution, and soluble salts are more readily dissolved from them than if the finer particles also were present to be acted upon. Moreover, the residue from the finer particles, on account of its purity, is more readily worked up for kieserite, sodium chloride, etc. than the coarser residue, which contains much aluminium salts, anhydrite, etc.—L. A. C.

Nitrides; Process and apparatus for the production of metallic ——. F. T. Snyder, Oak Park, Ill. U.S. Pat. 1,305,414, 3.6.19. Appl., 16.1.15.

A LARGE excess of superheated producer gas is passed over a charge of a basic metal oxide (*e.g.*, alumina) and carbon contained in a rotary furnace, the temperature of the gas being above the reduction temperature of the metallic oxide; and after leaving the furnace, the gas is mixed with air and allowed to burn in a regenerator attached to the exit end of the furnace, and the products of combustion pass into another regenerator attached to the entrance to the furnace in which they superheat the incoming gas. The air supply is then shut off and the unburned nitrogen is passed through the gas producer in order to maintain the circulation of gas over the charge without further heating of the regenerators.—L. A. C.

Barium oxide; Process of producing ——. J. B. Pierce, jun., Charleston, W. Va. U.S. Pat. 1,305,618, 3.6.19. Appl., 6.5.18.

BARIUM carbonate, free from reducing agent, is heated in a high vacuum.—S. S. A.

Magnesium chloride and the like; Method of making ——. E. O. Barstow, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pats. (A) 1,305,641 and (B) 1,305,642, 3.6.19. Appl., 6.6.16.

CALCIUM chloride in solution is treated with magnesium hydroxide and (A) a compound containing an available acid sulphate component or (B) the acid sulphate of an alkali metal, whereby calcium sulphate is precipitated and magnesium chloride is left in solution.—S. S. A.

Cyanide; Method of manufacturing alkali metal ——, *and separating the same from alkali metal hydroxide.* F. J. Metzger, Assignor to Air Reduction Co., New York. U.S. Pat. 1,295,049, 18.2.19. Appl., 25.7.17.

A MIXTURE of carbonaceous matter and an alkali carbonate, together with iron as a catalyst, is treated with nitrogen to obtain a product containing alkali cyanide, carbonate, and oxide. This is treated with a composite solvent in which the carbonate in decahydrate form is practically insoluble, and which converts the oxide to hydroxide, and the mixture is subjected to the action of carbon dioxide under slight pressure, whereby the hydroxide is converted into carbonate decahydrate. Alternatively, the treatment with carbon dioxide may precede the addition of the solvent. The insoluble matter is removed by filtration and may be added to the furnace charge for production of a further quantity of cyanide, whilst the solution of cyanide is evaporated. Mixtures of water with organic solvents such as ethyl or methyl alcohol, acetone, etc., form suitable composite solvents.—S. S. A.

Cyanogen and ammonia; Method of producing ——. P. A. Starke, Berkeley, Cal., Assignor to The Balfour-Guthrie Investment Co., San Francisco, Ca. U.S. Pat. 1,306,862, 17.6.19. Appl., 26.7.17.

A GASEOUS mixture of nitrogen and a substance capable of reacting to form ammonia or cyanogen, or both, is caused to react with a catalytic mass containing a metal of the iron group, an alkaline-earth, and an alkali, in the first instance at a temperature of 1500°—1900° F. (about 815°—1040° C.), and then again at a temperature of 600°—1200° F. (315°—650° C.).—S. S. A.

Rare metals; Process of making compounds of ——. R. McKnight, Pittsburgh, Pa. U.S. Pat. 1,306,070, 10.6.19. Appl., 28.4.17.

A COMPOUND of a rare metal, such as tungsten, vanadium, or uranium, and a "common metal," is melted with an alkali chloride, and the mixture is combined with a molten "common metal."
—S. S. A.

Thorium fluoride; Treatment of ——. *Recovery of thorium.* L. W. Ryan, Assignor to Lindsay Light Co., Chicago, Ill. U.S. Pats. (A) 1,307,152 and (B) 1,307,153, 17.6.19. Appl., (A) 29.5 and (B) 8.7.18.

(A) THORIUM fluoride is digested with sulphuric acid at an elevated temperature. (B) From a solution of thorium containing impurities such as those found in monazite sand, the thorium is precipitated as fluoride, and from the precipitate the metal is dissolved as carbonate.—S. S. A.

Mercuric oxide; Process and apparatus for the manufacture of flocculent ——. H. Danneel, und Elektrizitätswerk Lonza A.-G., Basle. Ger. Pat. 311,173, 11.1.18.

MERCURY is fed through a horizontal pipe into a number of troughs above the pipe, and connected with the same by means of short lengths of pipe. The troughs, which are made of an insulating material, are kept filled with mercury which serves as the anode, while a horizontal iron plate above the troughs serves as the cathode. The electrolyte is

an alkaline solution, and the mercury oxide which forms on the surface of the mercury in a flocculent form falls continually off and to the bottom of the enclosing vessel. Any mercury carried over can be readily separated from the oxide, an oxide of 99% purity being obtained.—L. A. C.

Bleaching powder; Chamber for use in the manufacture of ——. J. L. C. Eckelt, Berlin. Ger. Pat. 311,219, 3.3.18.

Lime is fed into a chamber from a number of hoppers at the top each fitted with two sliding plates so that by opening and closing these alternately the lime falls into the interior without escape of gas. All the hoppers are emptied simultaneously in order to distribute the lime uniformly in the chamber. A stream of chlorine gas is led through the chamber, and the lime passes down a series of shelves on to the floor which can be rotated in order to empty the bleaching powder into a closed receptacle below without interrupting the flow of gas.—L. A. C.

Alkali salts [or fertilisers]; Preparation of —— from alkali cyanamides and acids. E. Hene, Stassfurt, and A. van Haaren, Leopoldshall. Ger. Pat. 311,596, 13.2.17.

Carbon dioxide is passed through a solution of an alkali cyanamide, which is then partially evaporated, preferably under vacuum; the dicyandiamide floats on the surface of the sodium carbonate solution and is removed. Nitric acid may also be used for the reaction with very little secondary decomposition provided the temperature is kept below 60° C. and the liquor contains only 4 to 8% of acid. The solution of the alkali nitrate is then separated, evaporated, and allowed to crystallise. In order to prevent formation of urea, the solution of the alkali cyanamide may be neutralised with nitric acid, heated to 60° to 80° C. for several hours to convert the cyanamide into dicyandiamide, then acidified until it contains 4% of free acid, heated for 12 hours at 55° C., and sufficient acid added to replace that consumed in the formation of dicyandiamidine nitrate. Pure sodium nitrate can then be recovered from the solution by crystallisation. By direct evaporation of the solution to dryness, without crystallisation of the alkali nitrate, a valuable manure is obtained in both cases.—L. A. C.

Hydrogen and carbon monoxide; Treatment or purification of mixtures of —— for the separation therefrom of the latter. J. Harger, Liverpool, and H. Terrey, Bishops Waltham. Eng. Pat. 127,609, 28.4.17. (Appl. 6007/17.)

To separate carbon monoxide from hydrogen, the gases, together with an admixture of air slightly in excess of the amount required for the oxidation of the carbon monoxide, are passed over a suitable solid catalyst, or series of catalysts (*e.g.*, copper, copper oxide, or other metallic oxide or mixture of oxides), in a finely divided or porous state, maintained at a temperature between 100° C. and 300° C., depending on the catalyst used and the heat of the gaseous mixture, but not sufficiently high to promote oxidation of the hydrogen. Before being passed over the catalyst, the gases may be heated, *e.g.*, in a heat interchanger by the gases leaving the reaction chamber. In treating gases containing large quantities of carbon dioxide, steam is added to the mixture in sufficient quantity to prevent oxidation of hydrogen. The carbon dioxide is subsequently separated by any of the usual methods.—S. S. A.

Hydrogen; Preparation of —— from carbon or carbon-containing substances by the action of water or water vapour thereon. H. J. Prins, Zaandam, Netherlands. Eng. aPt. 128,273, 9.7.17. (Appl. 9896/17.)

Carbon, or material containing carbon chiefly in the free state or combined with hydrogen, is intimately mixed with two or more catalysts, one or more being selected from each of two groups, *viz.*, (1) oxygen-containing salts of the alkali or alkaline-earth metals, or compounds from which the process produces such salts, *e.g.*, the oxides or hydroxides of sodium, potassium, and barium; and (2) inorganic oxides or hydroxides which behave as a non-volatile weak acid or acid anhydride, or compounds from which such substances result during the process, *e.g.*, boron trioxide, aluminium oxide, aluminium carbide. Oxide of iron, chromium, or manganese may also be incorporated with these substances. Water vapour is passed over the mixture at 300°—600° C., and from the mixture of hydrogen and carbon dioxide formed the latter is removed. For example, water vapour is passed over an intimate mixture of 1 part by weight of calcium phosphate, 2 of sand, and 20 of coke, maintained at 400°—500° C. The mixture of gases obtained is washed with soda lye, whereby a gas free from carbon monoxide and containing 98–99% hydrogen is produced.—S. S. A.

Hydrogen; Apparatus for making ——. F. D. Moses, Trenton, N.J. U.S. Pat. 1,306,831, 17.6.19. Appl., 13.9.17.

A gas generator of the alternate reduction and oxygen-absorbing type, so combined with a producer as to be heated by the combustion of the gas supplied by the producer and to heat in turn the supply of gas and water vapour delivered to the generator, operates in conjunction with a gas holder and purifier, the capacity of which is so proportioned to the gas-making capacity of the generator, that the holder is filled by the operation of the generator, and emptied before the beginning of the next gas-making period.—S. S. A.

Nitrogen; Process of purifying ——. N. T. Bacon, Peace Dale, R.I., Assignor to The Solvay Process Co., Solvay, N.Y. U.S. Pat. 1,304,032, 27.5.19. Appl., 27.11.17.

The nitrogen of the atmosphere is separated from oxygen by burning limestone with an excess of coke and absorbing the carbon dioxide in the gaseous product by means of a solution of ammonia.

—L. A. C.

Iodine and other chemical products [bromine]; Process of extracting —— from seaweed by dry distillation. J. A. W. Bredenberg and E. G. Cron, Assignors to Aktiebolaget Fucus, Stockholm, Sweden. U.S. Pat. 1,305,058, 27.5.19. Appl., 14.11.17.

Seaweed is subjected to dry distillation in a closed retort, and the non-condensable gases evolved are passed through a metal salt capable of absorbing volatile compounds of iodine and bromine.

—L. A. C.

Pure elements; Method of producing ——. E. Weintraub, New York, Assignor to General Electric Co. U.S. Pat. 1,306,568, 10.6.19. Appl., 26.3.18.

A compound of the element is treated with a reducing metal, *e.g.*, sodium, and the by-products of the

reaction are volatilised at a temperature not sufficiently high to volatilise the element.—S. S. A.

Aluminous materials; Process of purifying ——. Norton Co., Worcester, Mass., Assignees of L. E. Saunders, Niagara Falls, N.Y., U.S.A. Eng. Pat. 118,605, 11.7.18. (Appl. 11,378/18.) Int. Conv., 18.8.17

See U.S. Pat. 1,269,223 of 1918; this J., 1918, 545 A.

Cyanides; Extraction of ——. W. J. Mellersh-Jackson, London. From Air Reduction Co., New York. Eng. Pat. 128,507, 6.1.19. (Appl. 381/19.)

See U.S. Pat. 1,295,049; preceding.

Zirconia; Manufacture of a new compound of zirconium and its application in the production of pure ——. *Basic oxychloride of zirconium and process of making same. Basic zirconium sulphate.* W. Rosenhain and E. H. Rodd, Teddington, Assignors to The Imperial Trust for the Encouragement of Scientific and Industrial Research, London, and R. T. Glazebrook, Teddington. U.S. Pats. (A) 1,307,881, (B) 1,307,882, and (C) 1,307,883, 24.6.19. Appl., (A) 13.10.17, (B) (C) 14.11.18.

See Eng. Pat. 112,973 of 1917; this J., 1918, 181 A.

Raising acids. Eng. Pat. 128,061. *See* I.

Cement-kiln dust. U.S. Pat. 1,307,920 *See* IX.

Electrolytic gas generators. Eng. Pat. 127,937. *See* XI.

Hydrogen in gaseous mixtures. Eng. Pat. 127,656. *See* XXIII.

VIII.—GLASS; CERAMICS.

Optical-glass pots; Volatilisation of iron from —— by chlorine at high temperatures. J. C. Hostetter, H. S. Roberts, and J. B. Ferguson. J. Amer. Ceram. Soc., 1919, **2**, 356—372.

Full sized glasshouse pots were fitted with covers and dry chlorine was passed in through a silica tube reaching nearly to the bottom of the pot, the temperature of the latter being 1000°—1200° C. The pots were thoroughly bleached and a deposit of red hæmatite crystals was formed round the edge of the pot where the escaping ferric chloride vapours came into contact with the moist furnace gases. About 7½ lb. of (liquid) chlorine was vaporised and passed through the pot in 5 hours at a cost of 6*s.* 3*d.* for chlorine. It is necessary to replace the chlorine by dry air as soon as the treatment is finished, otherwise the ferric chloride present may be reduced to ferrous oxide and this would, later, be dissolved by the glass melted in the pot. It is easy to reduce the iron in the pots to half its original amount. When the iron in the pots acts as a binder its removal renders the pots more porous and therefore more readily attacked by the molten glass.—A. B. S.

Optical glass manufacture. C. N. Fenner. J. Amer. Ceram. Soc., 1919, **2**, 373.

An inference might be drawn from Morey's paper (this J., 1919, 364 A) that the period required for the fining of glass may be reduced without restriction, whereas a longer period is advantageous or even essential if sulphates or chlorides are present in excess of 0·3% SO_3 and 2·0% Cl.—A. B. S.

Porcelain mixtures; Progress of vitrification and solution in some ——. A. S. Watts. J. Amer. Ceram. Soc., 1919, **2**, 400—409.

Test-pieces of a porcelain body containing 33% of Canadian felspar, 17% of flint, 23% of American china clay, and 25% of American ball clay were fired at cones 9, 11, and 13 respectively. It was found that the development of sillimanite starts at the felspar grains and progresses with the fusion, but the size of the sillimanite grains does not increase with increase of temperature. A matrix of fused felspar saturated with clay and quartz permeates the mass and renders it homogeneous. The introduction of whiting does not facilitate the formation of sillimanite, but increases the solution of the quartz. The presence of alkaline-earths appears to be unfavourable to the development of sillimanite from an alkali aluminosilicate saturated with clay. The substitution of soda-felspar for potash-felspar increases the size of the sillimanite crystals, but does not affect the amount of sillimanite formed.—A. B. S.

Light-weight clay refractories; Study of ——. M. F. Beecher. J. Amer. Ceram. Soc., 1919, **2**, 336—355.

Seven experimental light-weight firebricks composed of No. 1 refractory clay, kaolin, grog from slabs and saggers, kaolin grog, and soft-wood sawdust, and five full-weight commercial firebricks were examined comparatively. It was found that the working properties and behaviour during drying of the light-weight bricks are affected by additions of sawdust in the same manner as by additions of grog. The total shrinkage is not appreciably affected by additions of less than 20% of sawdust. The maximum practical amount of sawdust is about 40%. Raw kaolin increases the shrinkage on drying and burning, but is harmless up to one-third of the plastic clay present. At least 45% of plastic clay should be present to ensure good working properties. Additions of sawdust increase the porosity of the burned bricks by an amount equal to half the bulk volume added. The weight of the bricks is controlled largely by the amount of sawdust added, but the porosity and sp. gr. of the clay also have some influence. About 4 lb. appears to be a minimum weight for bricks of standard size compatible with good working properties in the mixture. There is no relation between the porosity and thermal insulation of the bricks. Bricks with the best insulating properties appear to spall the least. The best single test for light-weight bricks appears to consist in determining the amount of deformation when the bricks are heated under a load of 50 lb. per sq. in. at 1350° C. Most of the light-weight bricks examined were deformed less than any of the commercial full-weight bricks. In the discussion, R. L. Clare stated that ground cork (8—16 mesh) gave better and more uniform results than sawdust and 50% of cork may be used as against a maximum of 40% of sawdust.—A. B. S.

Alabama graphite; Effect of variable pressure and tar content on the briquetting of ——. R. T. Stull and H. G. Schurecht. J. Amer. Ceram. Soc., 1919, **2**, 391—399.

Alabama graphite is sold in the form of thin, flat plates which pass through a 20-mesh sieve. It has been suggested that if these flakes could be converted into larger granules the product would

be improved for use in crucible manufacture and would more closely resemble Ceylon graphite. Samples of Alabama graphite were mixed with tar and briquetted at different pressures ranging from 500 to 5000 lb. per sq. in.; these were coked rapidly at 1000° C., crushed, and screened between 16- and 100-mesh sieves. As anticipated, the most desirable properties (highest crushing strength, lowest porosity, highest density, and lowest bulkiness) were found when high pressures (5000 lb. per sq. in.) were used in briquetting. It was found that 15% of tar gave the best results, except for the lowest pressure, when up to 20% of tar is required. A large sample (200 lb.) was made by mixing 3 parts of Alabama flake of 20-mesh and 1 part of 100-mesh graphite dust, adding 15% of tar, compressing into briquettes under a pressure of 5000 lb. per sq. in., coking at 1000° C., and crushing and screening the product between 16- and 100-mesh sieves. Crucibles containing raw Alabama graphite were moulded with difficulty; the graphite is "slippery," causing the material to adhere to the tool and slide rather than pack against the mould. It did not weld readily and laminated badly. The coked product moulded perfectly and showed no welding seams or laminations. Contrary to expectation, however, four crucibles containing raw Alabama flake graphite gave better service than four others containing coked graphite and than four crucibles containing Ceylon graphite. The results require confirmation on a larger scale.

—A. B. S.

PATENTS.

Glass. E. C. Sullivan and W. C. Taylor, Assignors to Corning Glass Works, Corning, N.Y. U.S. Pat. 1,304,623, 27.5.19. Appl., 18.9.16.

A GLASS containing more than 70% of silica and less than 3% of alumina, together with boric oxide and sodium oxide in the ratio of not less than 2 : 1.

—A. B. S.

Glass. H. P. Gage and W. C. Taylor, Assignors to Corning Glass Works, Corning, N.Y. U.S. Pats. (A) 1,305,793 and (B) 1,305,794, 3.6.19. Appl., (A) 28.5.18 and (B) 14.10.18.

(A) A GLASS containing nickel oxide and substantially free from lead oxide, lime, and magnesia. (B) A glass consisting of an alkali-zinc silicate coloured with nickel oxide.—A. B. S.

Glass-matting process. T. Ueda, Kioto, Japan. U.S. Pat. 1,306,505, 10.6.19. Appl., 5.12.18.

A MATT surface is produced on vitreous material by applying to the latter a substance which reacts therewith, when heated, forming a product which can be decomposed by acids, and removing this product with the aid of an acid. The reagent is applied in conjunction with an inert material.

—A. B. S.

Brick kiln and dryer; Continuous ——. H. Webster, Newport, Ky., and N. B. Kincaid, Cincinnati, Ohio. U.S. Pat. 1,304,831, 27.5.19. Appl., 26.11.17.

A KILN of the continuous chamber type has a series of fuel passages (feed holes) at the tops of the chambers and a separate furnace communicating with the sole of each chamber and with the central main flue.—A. B. S.

Kiln. C. H. Zwermann, Kalamazoo, Mich. U.S. Pat. 1,306,161, 10.6.19. Appl., 11.9.18.

Two tunnel kilns placed side by side, with the inlet end of one close to the outlet end of the other, are heated by means of combustion chambers at the outer sides of the tunnels. The products of combustion pass from the combustion chambers into preheating chambers, below which are transverse flues communicating with the tunnel chambers by means of vertical air flues which extend through the preheating chambers. Baffle-walls are placed between the tunnel chambers and the combustion chambers so as to direct the heat both above and below these walls. The baffle-walls are extended so as to form the inner walls of the preheating chambers. Circulating flues at the inner sides of the discharge ends of the tunnels open at their upper and lower ends through the inner wall of the tunnel into the ends thereof, and passages for preheating air are arranged in the top of the tunnels and lead from the discharge ends of the tunnels to the combustion chambers.—A. B. S.

Bricks and furnace linings from dead-burned magnesite; Manufacture of ——. S. G. McAnally, Hull, Quebec. U.S. Pat. 1,305,475, 3.6.19. Appl., 27.5.18.

BRICKS and furnace linings are made of dead-burned magnesite containing 16—18% of lime and 14—15% of iron oxide, silica, and alumina.

—A. B. S.

Magnesia brick and method of making the same. H. H. Hanson, Boston, Mass., and H. K. Moore, Assignors to Berlin Mills Co., Berlin, N.H. U.S. Pat. 1,307,197, 17.6.19. Appl., 11.5.15.

REFRACTORY bricks are made by mixing 83% of magnesia and 17% of a siliceous material with a temporary cohesive binder, and burning the mixture at about 1600° C. so as to produce a slagging action.

—A. B. S.

Heat-insulating composition and articles made therefrom. F. A. Headson, Milwaukee, Wis. U.S. Pats. (A) 1,307,548 and (B) 1,307,549, 24.6.19. Appl., 2.10.18.

(A) A HEAT-INSULATING composition consisting of finely divided calcined asbestos and a refractory binder. (B) A heat-insulating brick formed of finely divided calcined diatomaceous earth and finely divided asbestos, the particles of which are in adhesive contact.—A. B. S.

Baked carbon article. A. T. Hinckley, Niagara Falls, N.Y., Assignor to National Carbon Co. U.S. Pat. 1,307,738, 24.6.19. Appl. 1.9.17.

COLLOIDAL carbon suspended in water is added to a liquid carbonaceous binder, the mixture is heated to drive off the water, and the residue is mixed with powder or granular carbon and baked so as to decompose the binder and cause it to set.—A. B. S.

Aluminous abrasive. Norton Co., Worcester, Mass., Assignees of L. E. Saunders and R. H. White, Niagara Falls, N.Y., U.S.A. Eng. Pat. 121,721, 11.7.18. (Appl. 11,380/18.) Int. Conv., 26.12.17.

SEE U.S. Pat. 1,263,607 of 1918; this J., 1918, 418A.

Enamelled ware; Process of marking —— and products thereof. E. C. R. Marks, London. From Kohler Co., Kohler, Wis., U.S.A. Eng. Pat. 129,206, 23.12.18. (Appl. 21,557/18.)

SEE U.S. Pat. 1,290,580 of 1919; this J., 1919, 177A.

IX.—BUILDING MATERIALS.

Phosphoric anhydride and titanium; Presence and determination of —— in Italian puzzuolana. A. Cavazzi. Annali Chim. Appl., 1919, **11**, 93—99.

The following method is applicable to puzzuolanas and to rocks containing similar constituents. About 50 grms., ground to pass completely through a 4900-mesh sieve, is dried at 100° C. and a portion then ground in an agate mortar. 10 grms. of this product is gently boiled for 45 minutes with 50 c.c. of water and 50 c.c. of fuming hydrochloric acid in a beaker surmounted by a round-bottomed flask full of cold water, this flask being changed every 15 minutes. After addition of 100 c.c. of water, the cold liquid is filtered with the aid of slight suction; the filter is washed six times with boiling water faintly acidified with hydrochloric acid, and the filtrate evaporated with a little nitric acid and 6 c.c. of concentrated sulphuric acid until it becomes syrupy, then heated gently till white fumes appear, whilst continuously stirred with a glass rod to prevent spurting. The temperature is then gradually raised, the heating being continued until no further fumes are formed. When cold, the substance is finely powdered with a smooth glass pestle, then gently boiled for 30 minutes with 40 c.c. of water and 6 c.c. of concentrated nitric acid, cooled, and filtered through a 7 cm. filter, the filter being washed five times with boiling water. The filtrate is heated to incipient boiling with 10 grms. of crystallised ammonium nitrate, 3 grms. of ammonium molybdate dissolved in 20 c.c. of boiling water being then quickly added and the liquid stirred for some minutes, kept for 30 minutes at 70°—80° C. and then cooled. The precipitated phosphomolybdate is washed by decantation with four quantities of 20 c.c. of a solution containing 50 grms. of ammonium nitrate and 40 c.c. of nitric acid (sp. gr. 1·153) per litre. 10 c.c. of ammonia solution (4 of concentrated ammonia to 6 of water) is dropped on to the edges of the filter-paper, which is afterwards washed five times with water, this filtrate being collected in the beaker containing the phosphomolybdate precipitate and stirred until the latter dissolves. The solution is filtered through a 5 cm. paper, the filter being washed six times with cold water and burnt in a platinum crucible, and the residual ash fused with 0·4—0·5 grm. of sodium-potassium carbonate; when cold, the fused mass is lixiviated with several quantities of 3—4 c.c. of boiling water and filtered into a porcelain dish, the filtrate being rendered strongly acid with nitric acid and evaporated to dryness. The residue is treated with boiling water, filtered, if necessary, through the same small filter, and treated with a slight excess of ammonia, and then added to the ammoniacal solution of phosphomolybdate, which is heated to boiling, mixed with one-fifth of its volume of concentrated ammonia solution and precipitated, with stirring, by addition, drop by drop, of 10 c.c. of magnesia mixture (55 grms. of crystallised magnesium chloride and 105 grms. of ammonium chloride per litre) (see this J., 1917, 1095; 1919, 143 A). Various puzzuolanas were found to contain from 0·066% to 0·593% P_2O_5. The presence of titanium may be detected as follows: 0·5 grm. of the product, finely ground in an agate mortar, is gently boiled for 30 minutes or rather longer in a covered 50 c.c. beaker with 10 c.c. of hydrochloric acid (1 : 1) and 1 c.c. of concentrated sulphuric acid. The cold liquid, which should not amount to more than about 3 c.c., is mixed with 10 c.c. of cold water, filtered, and evaporated with a little nitric acid until white fumes appear. The cold residue is treated with 10 c.c. of cold water and filtered, the almost colourless filtrate being treated with a few drops of hydrogen peroxide solution, which produces an orange-red or a more or less pale yellow coloration according to the amount of titanium present. All the four puzzuolanas examined responded to this test.—T. H. P.

Reinforced concrete structures; Cause of the adhesion of concrete to iron in ——. V. Karpen. Comptes rend., 1919, **169**, 21—22.

In a mathematical discussion of the subject the author shows that the adhesion is largely due to the contraction of the concrete on setting which sets up friction between the iron rods and the concrete. A mathematical formula is given, by means of which this adhesive friction may be calculated.
—W. G.

Patents.

Diatomaceous composition. T. M. Caven, Baltimore, Md., Assignor to Maryland Products Co. U.S. Pat. 1,305,522, 3.6.19. Appl., 11.4.17.

Diatomaceous material is ground in water to form a plastic mass, burned, crushed, and mixed with Portland cement, water being added when the composition is required for use.—A. B. S.

Cement-kiln dust; Utilisation of ——. R. J. Nestell, Assignor to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,307,920, 24.6.19. Appl., 15.1.17.

Cement-kiln dust is mixed with water and hot kiln gases containing carbon dioxide are passed through the mixture to increase the solubility of any potassium compounds, carbonate any lime present, and evaporate the water.—A. B. S.

Porous concrete pipes of great strength; Production of ——. H. Bassmann, Altona-Ottensen. Ger. Pat. 311,786, 31.5.17.

Porous concrete pipes are made of a mixture of angular fragments of flint, cement, and water, which is compressed in moulds, by means of tamping irons fitted with blades or teeth, whereby there is a tendency for the flints to become arranged with their larger surfaces in contact. Pipes so made are porous, very strong, and suitable for use in drainage systems where they are subject to great pressure.—A. B. S.

Concrete resistant to moisture; Methods of making ——. A. E. Horn, Long Island City, N.Y., U.S.A. Eng. Pat. 120,918, 19.11.18. (Appl. 18,960/18.) Int. Conv., 20.10.17.

See U.S. Pat. 1,225,116 of 1918; this J., 1918, 183 A.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Electrolytic iron; Properties and preparation of ——. G. Vié. Ann. Chim. Analyt., 1919, **1**, 175—177.

Electrolytic iron may be prepared from the sulphate or chloride, but the latter gives the better results. A solution containing 285 grms. of ferrous chloride and 102 grms. of sodium chloride per litre is electrolysed for 9 days with a current of 1·6 amp. per sq. dm., the solution being kept at 50°—70° C. The anode is of ordinary sheet iron and the cathode a thin sheet of pure iron. Electrolytic iron has a purity of 99·9%, the only foreign substance present being hydrogen; it absorbs 600 to 700 times its volume of hydrogen and then becomes very brittle

so that it can be powdered in a mortar. The hydrogen is expelled by heat; the magnetic properties of electrolytic iron are also considerably modified when the metal is heated.—W. P. S.

Cast iron; Heat treatment of grey —— at low temperatures. J. E. Hurst. Engineering, 1919, 108, 1—3.

Commercial cast-iron bars, ¾ in. square after removing the surface skin, were heated at 575°—600° C. for 48 hours and allowed to cool slowly. Decomposition of pearlite carbide was produced, and was nearly complete in irons containing more than 2% of silicon. At the same time the final value of combined carbon was the same in the higher silicon irons whatever the original combined carbon content. A general tendency towards increased impact value accompanied by a fall in the tensile strength was exhibited. The heat-treated specimens showed an average expansion of 0·35% in all directions, but no further expansion occurred on longer treatment. This expansion is presumably partly due to the precipitation of free carbon, and it is considered that occluded gases also influence the change in dimensions. In view of the considerable expansion brought about at 550°—600° C. it is improbable that any advantage is secured by the commercial practice of annealing gas-engine pistons at 450° C., as under the conditions of usage the piston head attains a temperature of 500°—600° C. For these conditions it would seem desirable that cast iron should contain 1% or less silicon, or alternatively a high silicon content with a very low content of combined carbon.

—C. A. K.

Magnetic hardness of ferrous metals; Method of measuring the —— and its utility for carrying out research work on thermal treatment. L. A. Wild. Faraday Soc., 14.7.19. [Advance proof.]

The magnetic hardness is defined as the coercive force necessary to overcome the remanent magnetic flux after the metal has been magnetised to saturation. A method has been devised by which this force can be readily determined on a test rod ¼ in. in diameter and 3 ins. long. The specimen is placed inside a magnetising coil disposed symmetrically within a wrought iron yoke shaped in the form of a square frame, which completes the magnetic circuit. After having been magnetised, the specimen is removed, the yoke removing most of the remaining magnetism. A fraction remains in the specimen, however, and this is proportional to the magnetic hardness and can be measured by means of a ballistic coil and galvanometer. The method has been applied to the study of the hardness of different steels and the effect of heat treatment. The effect of different quenching mediums on a number of steels was studied. Carbon steels are sensitive to delayed quenching and are much softer when quenched in oil than in water. Tungsten reduces this sensitiveness, but a so-called oil-hardening steel containing 1% Mn was little more than "half hard" when quenched in oil. The addition of 0·5% Cr gives a good oil-hardening steel. A true oil-hardening steel maintains its hardness when quenched in water at 60° C. The effect of tempering on various steels is well shown by a study of the magnetic hardness. In ordinary plain carbon steels the "water hardness" depends on the carbon content alone, the variations of manganese being of little significance. So far as ordinary carbon steels are concerned the magnetic method classes them in the same order as the scleroscope, but the addition of managnese reduces the scleroscope hardness of quenched steel and leaves the magnetic hardness unaltered. Tungsten increases the magnetic hardness of water-quenched steel, but it reduces the scleroscope hardness. In the works laboratory the magnetic method may be used for such purposes as deciding between the merits of different oils for quenching, and for similar problems.—E. H. R.

Carbon; Rapid methods of determining —— in steel and cast-iron. A. Piva and U. Salvadeo. Annali Chim. Appl., 1919, 11, 113—129.

Fox's method for estimating carbon in steel and cast-iron (Ind. Chim. Miner. e Metall., 1917, 161) gives erroneous results in some cases, but accurate results are obtained by the following modification: 0·5 grm. of the finely powdered cast-iron is heated with 35 c.c. of 30% copper-potassium chloride solution containing 5% of concentrated hydrochloric acid at 40°—50° C. until the copper deposited is completely redissolved, the liquid is filtered by suction through the least possible quantity of calcined asbestos, and the residue in the beaker washed three or four times by decantation with the copper-potassium chloride solution diluted with 10 vols. of water. The residue is brought on to the filter and there washed with hot dilute sulphuric acid until the filtrate ceases to decolorise very dilute permanganate solution. Filter and residue are introduced into a beaker, together with a weighed quantity of 0·5—1 grm. (more is rarely necessary) of pure potassium bichromate, the funnel being washed into the beaker with 10—20 c.c. of water, which also dissolves the bichromate. After addition of 50 c.c. of sulphuric acid (1:1), the beaker is covered with the funnel and the liquid boiled gently for at least 30 mins. The cold solution is mixed with 3—6 grms. of Mohr's salt (more is rarely required) and 20—30 c.c. of water and titrated with *N*/10 potassium bichromate, 0·1% potassium ferricyanide solution being used as external indicator; the change from blue to pale green shows the end of the reaction. If x denotes the percentage of carbon in the sample, n the number of c.c. of *N*/10 bichromate used, a the number of grms. of solid bichromate added, b the grms. of Mohr's salt, and q the grms. of cast-iron taken, then,

$$x = \frac{[0{\cdot}0049a\,n-(b+0{\cdot}125)]0{\cdot}03}{q}.$$

This method is applicable only in cases where the carbon is separable by means of copper-potassium chloride. Other methods of general applicability are discussed, in particular modifications of Wiborg's method, and in order that the quantity of hydrocarbons left unoxidised may be reduced to a minimum, attack of the metal by copper sulphate is abandoned. The sample is heated in not less than 20 minutes to incipient boiling with chromic-sulphuric acid, the liquid being then kept gently boiling for about an hour. The gas evolved is measured, then freed from carbon dioxide in a caustic potash pipette, again measured and afterwards burnt over copper oxide, the carbon dioxide produced in the combustion being measured as before. The apparatus used and the details of the determination are described.—T. H. P.

Steel and iron; Determination of phosphorus in ——. N. D. Ridsdale. Proc. Cleveland Inst. Eng., 1919, 155—174.

The following directions are given for the direct determination of phosphorus in iron and steel by the molybdate method without previous separation of arsenic. Two grms. of the sample is dissolved in 55 c.c. of nitric acid (sp. gr. 1·20), the solution is heated to expel brown fumes and then boiled for 2 mins. with the addition of 5 c.c. of 5% permanganate solution. A slight excess of 4% ammonium oxalate solution is then added (from 10

to 13 c.c. is usually sufficient to destroy the permanganate), the mixture is heated gently for 2 mins., and 15 c.c. of 60% ammonium nitrate solution is added; the total volume should then be 85 c.c. The solution is heated to boiling, the source of heat removed, and 50 c.c. of 5% neutral ammonium molybdate solution is added; the mixture is shaken for 2 mins., and, after a further 15 mins., the precipitate is collected on a pulp filter, washed with 2% nitric acid, and then with 0·1% potassium nitrate solution until the washings are neutral towards methyl orange. The precipitate and filter are transferred to a beaker, treated with an excess of *N*/6·72 sodium hydroxide solution, and the excess of the latter titrated with *N*/6·72 nitric acid, using phenolphthalein as indicator. The number of c.c. of the sodium hydroxide solution required to decompose the precipitate is multiplied by 0·01 to obtain the percentage of phosphorus present. If it is desired to use an acid molybdate solution, the sample (2 grms.) is dissolved in 30 c.c. of nitric acid (sp. gr. 1·20), 25 c.c. of water is added, and the subsequent precipitation made with a mixture of 25 c.c. of 10% ammonium molybdate solution and 25 c.c. of nitric acid (sp. gr. 1·20). To determine phosphorus in hæmatite iron, 2·857 grms. of the sample is dissolved in 90 c.c. of nitric acid (sp. gr. 1·20), the solution cooled, diluted to 100 c.c., filtered, and 70 c.c. of the filtrate treated as described above, except that 60 c.c. of neutral ammonium molybdate solution is used for the precipitation. A control method, in which arsenic is removed before the phosphorus is determined, consists in dissolving 3 grms. of the sample in 25 c.c. of nitric acid (sp. gr. 1·42), adding 15 c.c. of hydrochloric acid (sp. gr. 1·16), evaporating the mixture to dryness, and baking the residue for 10 mins. to complete the oxidation and decompose nitrates. The residue is treated with 40 c.c. of hydrochloric acid (sp. gr. 1·16), filtered to remove graphite and silica, the insoluble portion washed with hot water, and 1 grm. of granulated zinc is added to the filtrate; when the zinc has dissolved, 5 grms. of ammonium bromide is added, and the solution evaporated to a paste. This treatment eliminates all the arsenic, chiefly as tribromide. The paste is dissolved in 20 c.c. of hydrochloric acid, the solution filtered, the filtrate oxidised by the gradual addition of 5 c.c. of nitric acid, and evaporated to a volume of about 70 c.c. After cooling, the solution is treated with ammonia (sp. gr. 0·880) until a permanent precipitate of ferric hydroxide is formed, 8 c.c. of the ammonia is then added, followed by 7 c.c. of nitric acid (sp. gr. 1·42), the mixture boiled, nitric acid is added until the precipitate is just dissolved, the solution evaporated to 100 c.c., cooled, and a mixture of 20 c.c. of ammonium molybdate solution and 5 c.c. of nitric acid (sp. gr. 1·42) is added. The mixture is stirred for 2 mins., placed aside for 15 mins., and the phosphomolybdate precipitate then collected and determined by any of the usual methods.—W. P. S.

Steel; Quenching cracks in carbon ——. K. Honda and T. Matsushita. Sci. Reports Tôhoku Imp. Univ., 1919, **8**, 31—42.

The cracking of high carbon steel in quenching occurs only when the temperature of the metal before quenching exceeds the carbon change point. Cracking occurs at relatively very low temperatures, *viz.*, below 200° C., when the temperature differences between the centre and surface of the specimen is far below the maximum difference. It is concluded that cracking is not due to the stresses set up as a result of purely thermal differences owing to unequal cooling nor to the sudden stresses set up as a result of the expansion which occurs at the moment when parts pass through the Ar1 transformation, but to the persistent stress occurring as a result of the differential expansion of adjacent parts due to different degrees of martensitisation. Only those parts of quenched specimens subject to tensional stresses show cracks. For example, a short cylinder quenched vertically shows no crack in the lower half subject to compression, while in the upper portion radial and concentric cracking occurs due to radial and tangential tensions.

—F. C. Th.

Nickel in ferronickel and steel; Estimation of ——. P. Nicolardot and G. Gourmain. Bull. Soc. Chim., 1919, **25**, 338—344.

From a comparative trial of the three methods of estimating nickel in steels the authors show that Tschugaev's method (precipitation of the nickel by means of dimethylglyoxime) is simpler than Grossmann's method (precipitation with dicyanodiamidine), and quicker than the electrolytic method. Further, the results by the electrolytic method are generally higher than those obtained by use of dimethylglyoxime, since in the former any cobalt present and generally a little iron and manganese are weighed in the nickel deposit.—W. G.

Nickel steels; Moduli of elasticity and rigidity of ——. K. Honda. Sci. Reports Tôhoku Imp. Univ., 1919, **8**, 59—60.

The following are the results obtained:—

Nickel, %	Modulus of elasticity $\times 10^{-12}$	Modulus of rigidity $\times 10^{-11}$	Nickel, %	Modulus of elasticity $\times 10^{-12}$	Modulus of rigidity $\times 10^{-11}$
0	2·052	8·34	30·5	1·498	6·14
4·6	1·930	7·50	36·9	1·405	5·88
9·2	1·875	7·22	46·3	1·529	—
13·8	1·806	6·89	55·4	1·738	6·85
18·5	1·689	6·55	73·8	1·925	7·66
21·2	1·639	6·28	83·0	2·008	7·79
23·6	1·633	6·44	92·3	1·965	7·76
29·1	1·617	6·37			

—F. C. Th.

Iron-cobalt alloys; Physical constants of ——. K. Honda. Sci. Reports Tôhoku Imp. Univ., 1919, **8**, 51—58.

The iron and cobalt from which the alloys were made had the following analyses:—Iron: 0·09% C, 0·11% Si, 0·31% Mn, 0·29% Cu. Cobalt: 0·24% C, 1·4% Fe, 1·1% Ni. The following results were obtained:—

Cobalt %	Thermal conductivity	Electrical conductivity $\times 10^{-4}$	Modulus of elasticity $\times 10^{-12}$	Modulus of rigidity $\times 10^{-11}$	Intensity of magnetisation (H=1200)
0	0·1090	6·02	2·087	8·34	1662
5	0·0960	4·56	2·062	8·24	1710
10	0·0944	4·04	2·030	8·14	1750
15	0·0978	3·96	2·090	8·13	1755
20	0·1047	4·25	2·119	8·30	1828
30	0·1201	6·08	2·132	8·86	1868
40	0·1430	7·42	2·068	8·96	1862
50	0·1700	8·90	—	—	1829
70	0·1721	10·86	1·836	7·25	1655
80	0·1223	7·48	1·703	6·30	1521
90	0·0960	6·21	1·934	7·13 6·82	1359
100	0·1653	11·64	2·038	7·63 4·71	1163

—F. C. Th.

Alloy steels for helmets and armour. J. A. Coyle. Chem. and Met. Eng., 1919, **20**, 618—620.

An investigation to determine the most suitable steel for helmets resulted in the use of a steel of

the following composition: C 0·37—0·47%, Si 0·15—0·25%, S and P 0·02% max., Mn 0·95—1·05%, Ni 2·00%, and V 0·25%. The material worked very readily and the helmets were shaped in one draw, the sheet metal being annealed at 925° C., quenched at 815° C., and drawn at 230° C. Steel for armour, 0·175 in. thick, had the same composition except that only 0·15% V was added as a scavenger. The bulk of this sheet material was melted in a 6-ton Héroult electric furnace. A 110-volt current was used and the charge was melted in 2¾ hours. Dephosphorisation proceeded to completion in about 45 min., and the slag was then removed. A design of furnace is suggested which would make all parts of the bath accessible to the skimmer. A carbide slag was added for desulphurisation, and the current reduced to 80% of the maximum input. After addition of the requisite ferro-alloys, the very hot metal was quickly poured into the ladle. The ingots were cast into metal moulds with short rectangular sinkheads, which were opened as soon as a sufficiently strong skin had chilled on the ingots. The furnace lining was repaired with double calcined dolomite. The details of the time required for one heat are given, four heats being produced every 24 hrs. with a consumption of 750 to 850 kw.-hrs. per ton.

—T. H. Bu.

Vanadium [*and chromium*]; *Determination of* —— *in steels by electrometric titration. Selective oxidation of vanadyl salts by nitric acid in the presence of chromic salts.* G. L. Kelley, J. A. Wiley, R. T. Bohn, and W. C. Wright. J. Ind. Eng. Chem., 1919, **11**, 632—634.

Vanadium in steel:—Two grms. of the sample (or 1 grm. if the amount of vanadium exceed 0·5%) is dissolved in 80 c.c. of sulphuric acid (sp. gr. 1·20), and the solution treated, drop by drop, with 2 c.c. of nitric acid, and boiled until nitrogen oxides are expelled and any tungstic oxide present becomes yellow. The solution is diluted with hot water to 100—125 c.c., treated with 40 c.c. of strong nitric acid, and boiled for an hour or more at such a rate that the volume does not fall below 100 c.c. Under these conditions the vanadium is oxidised (up to 99%), whilst no oxidation of chromium occurs. The liquid is cooled, diluted to 300 c.c., and titrated electrometrically with ferrous sulphate solution (8 grms. of ferrous ammonium sulphate and 50 c.c. of sulphuric acid per litre), which has been standardised with potassium bichromate solution (0·9609 grm. per litre). One c.c. of the bichromate solution is equivalent to 0·1% of vanadium in 1 grm. of steel. The apparatus described previously (this J., 1917, 1011) is used in the electrometric titration, and 1% of the amount of vanadium found is added to the result as a correction for deficient oxidation.

Chromium in chrome-vanadium steels:—One grm. of samples containing less than 5% of chromium (or less for higher percentages) is dissolved in 70 c.c. of sulphuric acid (sp. gr. 1·20), the solution being evaporated until salts separate to decompose carbides, if necessary. The solution is diluted to 75 c.c. and after dissolving separated salts (in the case of tungsten steel evaporation is unnecessary) the liquid is treated with 2 c.c. of nitric acid and boiled for about 5 mins. It is then diluted to 250—300 c.c., heated to boiling, treated with 10 c.c. of silver nitrate solution (2·5 grms. per litre), and 20 c.c. or more of ammonium persulphate solution (100 grms. per litre) added until a permanent coloration due to permanganic acid is obtained after 2 to 3 mins. The solution is boiled for about 8 mins. to decompose the persulphate, then treated while still boiling with 5 c.c. of dilute (1:3) hydrochloric acid, and the boiling continued for at least 5 mins., after which the solution is cooled to 20° C. for the titration. For this purpose a solution of ferrous ammonium sulphate (23 grms. with 100 c.c. of sulphuric acid per litre) standardised with freshly prepared potassium bichromate solution (2·829 grms. per litre) is used. Both chromium and vanadium are titrated together, the vanadium endpoint being that previously described (this J., 1916, 966). A correction is applied for the vanadium as given above (but not including that portion which is in the tungstic oxide). The result is multiplied by 0·339 to obtain the relationship between the bichromate used for titrating vanadium and that used for titrating chromium. The difference between this value and the total bichromate used for the titration of chromium and vanadium gives the amount used by the chromium alone.—C. A. M.

Lime as a settling reagent [*in the cyanide process*]. P. T. Bruhl. Eng. and Min. J., 1919, **107**, 1089—1090.

The proper settling of slime is of importance in cyanide mills where decantation is practised, and a knowledge of the manner in which lime functions as a settling agent is necessary for economical working. Poor settling may be caused when the pulp is of too high a viscosity, and increasing the temperature of the pulp so as to reduce the viscosity will result in more rapid settling. The time of settling also depends on the physical condition (fineness) of the slime. Quartz particles probably acquire charges of negative electricity which by inter-repulsive action retard settling. Lime dissolves with the production of positive ions in excess, thereby exercising a neutralising or discharging effect. A small quantity of lime may not neutralise all the negatively charged quartz particles, but owing to collision of the residual charged particles with other particles, the charge is distributed and rendered less intense, and the force of repulsion is then insufficient to hinder settling appreciably. An excess of lime may be regarded as neutralising all the negative charges, and then to some extent transferring a positive charge to the quartz particles, which again impedes subsidence. Lime is best added in the form of a spray of slaked lime, just below the surface of the solution in the thickener.—C. A. K.

Alpha brass; Influence of certain variables associated with the annealing of cold-worked ——. A. Phillips and G. C. Gerner. Chem. and Met. Eng., 1919, **20**, 622—628.

The greater the cold reduction of α-brass the lower the temperature of visible recrystallisation, whilst the size of the recrystallised units decreases progressively with increase in the degree of plastic deformation. Experimental data are given showing the effect of time of annealing at 650° C. on the tensile strength of α-brass subjected to various amounts of cold rolling. For brass reduced 40%, annealing for 2 hours gave lower tensile strength, and after 5 hours annealing the strength was practically the same as after 2 hours. There is a small temperature range—the "germinative temperature"—for every degree of reduction, at which grain growth is particularly marked, but in mill practice involving annealing at a moderately high temperature following a rather high degree of reduction, considerable latitude may be allowed. Experimental data are given as to the influence of grain size prior to deformation on the microstructure and mechanical properties of rather severely worked α-brass annealed under conditions comparable to mill practice. The reduction was 33% and

the annealing temperatures prior to this 550°, 650°, and 750° C., the duration of annealing being 1 hour in all cases. Longitudinal and transverse tests were made, the transverse tests for the annealed samples agreeing closely with the longitudinal. In the rolled specimens the longitudinal tests gave higher ductility, although the tensile strengths were practically the same. Tensile tests on the annealed samples indicate that the influence of the grain size before reduction is small, especially when the final annealing temperature is 750 C., for which also the Brinell hardness and grain size show little change. Large initial grain size tends to increase the elongation whether the final annealing is effected at 750° C. or at a lower temperature. For lower temperature final anneals smaller initial grain size yields finer grain fragments and the tensile strength is increased. Microphotographs show that the grain size prior to reduction considerably affects the final grain size. The grain size after final annealing increases with increase in the temperature of the annealing prior to reduction. The authors' results on ductility do not agree with those of Price and Davidson (this J., 1916, 1114), who found longitudinal and transverse strips to have the same elongation after reduction up to 35%. Above this value the longitudinal tests gave less elongation. The authors checked their results on further specimens and put forward the following explanation. Due to the compressive action of the rolls plastic deformation takes place along a number of cleavage planes mostly at right angles to the direction of the grain extension. In a transverse test bar there are a large number of lines of deformation by slip parallel to the length of the test bar. Along these planes will be numerous plates of amorphous material of low ductility which will lower that of the mass. In a longitudinal strip there still remains a considerable number of gliding planes along which movement can take place.—T. H. Bu.

[*Zinc smelting:*] *Effect of sodium chloride on blue-powder formation* [*in — —*]. R. S. Dean. Chem. and Met. Eng., 1919, **20**, 628.

SMALL amounts of salt added to the charge in zinc smelting have been found to reduce the amount of blue powder formed. Sodium carbonate has been shown to act similarly to the chloride. The author puts forward the following hypothesis. The formation of blue powder is due to re-oxidation of zinc in the condenser by carbon dioxide, $ZnO+CO \rightleftarrows Zn+CO_2$, the percentage of carbon dioxide in equilibrium with a given mixture having been shown to be greater at high than at low temperatures. The presence of salt modifies the reaction thus: $2NaCl+ZnO+C \rightleftarrows 2Na+ZnCl_2+CO$, though the amount of salt reacting in this way is a small percentage of the whole. The metallic sodium passes off with the zinc and reduces the content of carbon dioxide, being oxidised instead of the zinc as the temperature falls. Sodium carbonate produces a similar result, as the reaction, $Na_2CO_3+2C \rightarrow 2Na+3CO$ proceeds at fairly high temperatures. With the carbonate there is no loss of zinc as chloride, but there is a tendency to form slag.—T. H. Bu.

Solders for aluminium. U.S. Bureau of Standards, Circ. 78, Jan. 28, 1919. 9 pages.

ALUMINIUM may be soldered satisfactorily after cleaning the surface of the metal by abrasion and tinning the surfaces to be soldered. A perfect union between solder and aluminium is difficult to obtain, but the higher the temperature at which tinning is done, the better is the adhesion of the tinned layer. The joint between the tinned surfaces may be made in the usual manner with ordinary soft solder, and no advantage is to be found in the use of fluxes in either the tinning or jointing processes. Tinning solders should consist of a tin base with the addition of zinc, or of zinc and aluminium, to produce an alloy of suitable melting point. Suggested compositions for tin-zinc solders are: tin, 85—50%; zinc, 15—50%, and for tin-zinc-aluminium solders: zinc, 8—15%; aluminium, 5—12%; tin, remainder. Excess of aluminium, or the presence of copper or antimony, should be avoided, as brittleness in the solder is undesirable. All alloys used for soldering aluminium are electro-negative to that metal, and the joint is therefore subject to corrosion when exposed to moisture.—C. A. K.

Aluminium alloys; Technical —. E. H. Schulz. Metall u. Erz., 1919, **16**, 91—101.

THE author has examined the influence of cold rolling, drawing, and pressing of aluminium alloys, and gives tables and diagrams of results for pure aluminium for an alloy with 2·33% Cu (duralumin) and another with 3·64% Cu and 0·53% Mn. The alloys were tested for hardness, tensile strength, resistance to hydrochloric acid and alkalis, and to corrosion by water. The test-pieces were cut from sheet 7 mm. thick, and were rolled down 1 mm. at a time, without intermediate annealing, to 2 mm. thickness. Hardness was determined by the Brinell and by the Shore methods. It increased fairly regularly with increase in the process of cold rolling. The breaking stress and elongation tests showed that the softer the alloy was to begin with, the greater was the relative increase of hardness, on subjecting to cold rolling up to 70% decrease of thickness expressed as percentage of original thickness. Pure aluminium showed a large elongation to begin with, when cold rolled, but only a much smaller elongation after about 30% of rolling. A feature of the breaking stress experiments was that a number of samples showed at the fracture a split in the metal, in the direction of rolling. In the corrosion tests pieces of sheet metal, 25×40 mm., were used. These were submitted to the action of 10% hydrochloric acid during 20 hours and the loss of weight noted. Pure aluminium lost less than the alloys, but the influence of cold rolling was not uniformly the same. More regular results were shown when the sheet samples were left for 4 hours in a 0·5% solution of potassium hydroxide. There was no direct relation between the amount of copper in the alloy and the tendency to corrosion. Aluminium showed a tendency to increased corrosion with increased cold rolling. Photographs of test-pieces showing the effects of corrosion are given. Pure aluminium was uniformly attacked all over the surface; the alloys showed spots of less or greater corrosion. Distilled water destroyed the metallic polish on pure aluminium and the surface became darker as the samples were subjected to more cold rolling. Cold rolling thus appears to spoil the surface of the metal and thereby increase corrosion. Experiments were also made to ascertain whether electrolytic action takes place between metals of different degrees of cold rolling, the loss of weight of samples of different hardness, connected by wire and suspended in tap water, being measured during a period of 6 months. The results indicate that corrosion increases rapidly when an alloy is electrically connected with the same alloy which has been subjected to a different degree of cold rolling, and that in the cases of electrically connected alloys which have been subjected to different degrees of cold rolling, the alloy which has received most rolling is corroded to the greatest extent.

—C. W.

***Aluminium dust; Inflammability of* ——.** A. Leighton. U.S. Bureau of Mines, Techn. Paper 152, 1918. 13 pages.

As several disastrous explosions of aluminium dust clouds have occurred, the author has investigated the properties of the dust with special regard to inflammability and to the problem of extinguishing fires and minimising the force of explosions once started. A review of the available literature on the subject is given. The material used was commercial aluminium dust (aluminium bronze), *i.e.*, finely divided metal with a coating of oil. Aluminium dust is very light, and to prevent the formation of dust clouds, all apparatus should be enclosed and the ventilation should not keep the air in rapid motion. If a fan suction system is employed, a dust precipitator should be introduced a short way from the grinding machines. As the heat of formation of aluminium compounds is high, the reaction is very violent when aluminium burns. Aluminium has a high specific heat so that clouds are with difficulty ignited with small sources of heat. The oil employed has a low flash point so that only enough should be used to ensure protective action. The presence of moisture is dangerous if the dust be heated, even though only to a slight extent. If water is put on a burning mass, hydrogen is liberated and an extremely violent explosion results. As the dust is hygroscopic the air must be kept dry. The electric conductivity is low at low voltages, but the resistance breaks down at a potential of about 300 volts. All apparatus should be earthed, and tools of the softer metals should be used. The machinery should be kept in good condition. As spontaneous heating often takes place in piles of dust exposed to air, especially in presence of excess of oil, the accumulation of dust should be prevented and the amount of oil used regulated. An attempt to determine the ignition temperature of aluminium dust clouds with a Clement-Frazer apparatus (this J., 1918, 566A) was unsuccessful, but some useful results were obtained by heating a small clay incinerating dish in a muffle furnace to progressively higher temperatures and pouring 10 grms. of dust into the hot dish. At 800° C. an aluminium dust cloud ignited, whilst a coal dust cloud did not ignite at 840° C. For extinguishing fires of aluminium dust carbon tetrachloride was found to be as useless as water, but if the aluminium fire is smothered with oil, carbon tetrachloride may be used to extinguish the oil fire. Sand or preferably shale dust is most effective as a fire extinguisher.—T. H. Bu.

Nickel ores; Treatment of low-grade ——. C. W. Davis. J. Ind. Eng. Chem., 1919, **11**, 644—648.

A sample of N. Carolina nickel ore, which may be taken as typical of the lowest grade of nickel ores, had the following composition: Silica and insoluble matter, 56·5; iron oxide, 22·0; alumina, 4·1; nickel oxide, 1·2; magnesium oxide, 7·2; and loss on ignition, 8·9%. It was not possible to obtain satisfactory concentration of this ore and a similar ore from Alaska by any of the usual methods. The nickel could be completely extracted from the finely ground ores by digestion with hot nitric acid or *aqua regia*, but not by other solvents, even in large excess. Treatment with an excess of hot dilute (2%) sulphuric acid extracted the nickel from ores which had previously been reduced with water-gas at 1000° C., but a large excess of the acid was required to react with the iron before much of the nickel was attacked. A large proportion of the nickel could be extracted from the reduced ores by means of an excessive amount of ferric sulphate solution. For the extraction of the nickel as chloride after roasting with a mixture of salt and sulphur, the best results were obtained by the use of 10% of water, or 37% of 1% acid. Fusion of the reduced N. Carolina ore with an equal weight of sodium bisulphate rendered about 90% of the nickel soluble in water. In the case of roasted and reduced Alaska ores the most suitable ratio of the ore to sodium bisulphate varied with the nickel content, *viz.* 1 : 1 for a 2·3% ore, 2 : 3 for a 3 to 4% ore, and 1 : 3 for an 8 to 11% ore. The best temperature for the fusion was 500° C. and about 30 mins. was required for small quantities of the ore. Utilisation of this method, with ultimate electrolytic recovery of the extracted nickel, would be contingent on a favourable price for the sodium bisulphate. By treating Alaska ore with an equal weight of 70% nitric acid, and heating the mixture for 2 hours at 250° C., 95% of the nickel was rendered soluble, whilst all but 1·2% of the acid was removed by heating, and, for the most part, could be recovered by absorption with water.—C. A. M.

Nodulising flotation concentrates in a rotary kiln with powdered coal. R. M. Draper. Chem. and Met. Eng., 1919, **20**, 621.

Experiments with three high-grade concentrates assaying 19·25 to 26·57% Cu and 18 to 19% S are described. The kiln was 125 ft. long and 7 ft. inside diameter. To prevent loss of sulphur from the concentrates the following methods were tried —a spray pipe was run into the feed end of the kiln to keep the concentrates as wet as possible; the discharge end of the kiln was sealed as tightly as possible; a damper was placed in the stack to keep the kiln full of fumes at all times and so prevent entry of air. The last-mentioned method was found to be the most effective. The nodules obtained were in a satisfactory physical condition, and contained about 70–80% of the original sulphur. They retained as much sulphur when cooled in air as when quenched in water. Poor bituminous coal with 20% ash was used, but no trouble was experienced and 5 tons of concentrates was nodulised per hour with a coal ratio of 1 to 15.
—T. H. Bu.

Electrochemical analyses. King. *See* XXIII.

Patents.

Copper alloys; Production of ——. Vereinigte Hüttenwerke Burbach-Eich-Dudelingen A.-G., Düdelingen, Luxemburg. Eng. Pat. 114,852, 12.4.18. (Appl. 6274/18.) Int. Conv., 23.6.16.

Copper alloys free from oxygen are produced by melting scrap material in an electric furnace, preferably of the induction type, in the presence of a reducing slag containing alkali manganosilicate, which is regenerated at intervals or during the operation of the furnace, by additions of charcoal, metallic chippings, potassium cyanide, water-glass, or borax.—T. H. Bu.

Tinned scrap and tinned articles; Electrolytic apparatus for the treatment of ——. H. Rogers and C. M. Walter, Birmingham. Eng. Pat. 127,985, 12.6.18. (Appl. 9622/18.)

The apparatus comprises a vat for the electrolyte, and a polygonal perforated rotary drum for containing the scrap. The drum is divided into compartments by radial cathode plates between screens at the divisions of the drum, the cathode plates being retained by conductor rods engaged in clips secured to the end plates of the drum, so that the cathode plates are readily removable; current leads are connected to the clips. External cathodes may also be employed.—B. N.

Soft metal alloy. P. S. Braucher, Reading, Pa. U.S. Pat. 1,304,849, 27.5.19. Appl., 4.2.19.

The alloy contains 89% of lead and 0·25% of phosphorus.—T. H. Bu.

Aluminium alloy. A. O. Mason, Chicago, Ill. U.S. Pat. 1,305,300, 3.6.19. Appl., 1.7.18.

The alloy consists of 94·5% of aluminium, 6·5% of copper, and 2% of zinc.—T. H. Bu.

Aluminium alloy. H. C. Kirk, Roland Park, Md. U.S. Pat. 1,305,551, 3.6.19. Appl., 27.8.18.

The alloy contains 90%—97% of aluminium, the remainder consisting of two parts of nickel to one part of copper.—T. H. Bu.

Pickling ferrous articles and electrically regenerating the pickling bath. A. F. Hoffman, Pittsburgh, Pa. U.S. Pat. 1,305,213, 27.5.19. Appl., 20.3.17.

The articles are pickled in an acid solution of a ferric salt and the solution is regenerated by electrolytic oxidation with the aid of a manganese compound acting as a catalyst.—T. H. Bu.

Siliceous ores; Method of treating ——. G. H. Wigton, Eureka, Utah. U.S. Pat. 1,305,327, 3.6.19. Appl., 7.2.18.

A mineral containing an alkaline-earth metal is added to a mixture of the ore and a compound containing chlorine, in order to obtain a furnace mixture which will not clinker or become sticky at the volatilisation temperature of the metal to be recovered from the ore.—T. H. Bu.

Rust-preventing coating. G. H. and W. H. Allen, Detroit, Mich. U.S. Pat. 1,305,331, 3.6.19. Appl., 20.2.18.

A coating for protecting iron and steel consists of casein and barium phosphate.—T. H. Bu.

Molybdenum; Extraction of ——. T. R. Förland, Haugesund, Norway. U.S. Pat. 1,305,350, 3.6.19. Appl., 5.4.18.

Molybdenum is obtained by electrolysing a fused salt mixture of chlorides of molybdenum, sodium, and aluminium.—T. H. Bu.

Electrolytic [copper] slimes; Treatment of ——. W. C. Ferguson, Garden City, N.Y., Assignor to Nichols Copper Co., New York. U.S. Pats. (A) 1,305,787 and (B) 1,305,788, 3.6.19. Appl., (A) 29.9.15. Renewed 26.10.18. (B) 19.11.18.

(A) Electrolytic copper refinery slimes, containing silver but very little sulphur, are roasted in the presence of a sulphatising agent until the greater part of the silver is converted into sulphate. The product is afterwards leached. (B) Electrolytic slime is roasted with a sulphatising agent under such conditions that most of the silver but as little of the copper as possible is converted into sulphate. —A. B. S.

Electrolytic deposition of lead; Process for the ——. *Method of recovering metals from their ores [electrolytically].* D. F. Harbaugh, Chicago, Ill. U.S. Pats. (A) 1,306,479 and (B) 1,306,480, 10.6.19 Appl., 5.7.18.

(A) A compound of saccharine material previously moistened with lead oxide is dissolved in sodium hydroxide solution, and the solution, the concentration of which is kept constant, is subjected to the action of the electric current. (B) A quantity of the metal is fused with sodium carbonate, and then with a quantity of the ore to form an anode, which is employed in a suitable electrolyte.—B. N.

Galvanising process for hollow bodies. Akt.-Ges. "Weser," Bremen. Ger. Pat. 311,584, 27.10.16.

In a galvanising process in which a fall of potential takes place in the electrode owing to the low conductivity of the latter, a uniform deposit of metal is obtained by so controlling the flow of electrolyte that the product of the current density and the metal-content of electrolyte is the same at all parts of the electrode. The process is applicable to the deposition of zinc, nickel, or lead upon hollow vessels of all shapes; *e.g.*, tubes may be coated internally, or both internally and externally at the same time.—J. H. L.

Steel; Manufacture of open hearth ——. H. C. Ryding and A. W. Allen, Birmingham, Ala., U.S.A. Eng. Pat. 128,836, 21.11.18. (Appl. 19,168/18.)

See U.S. Pat. 1,289,057 of 1918; this J., 1919, 146 A.

Case-hardening of metal. P. C. Rushen, London. From P. W. Shimer, Easton, and J. W. Richards, South Bethlehem, Pa., U.S.A. Eng. Pat. 129,144, 20.7.18. (Appl. 11,901/18.)

See U.S. Pats. 1,279,457—8 of 1918; this J., 1918, 772 A.

Zinc; Process of alloying —— with iron or steel. B. F. Dimm, Erie, Pa., Assignor to C. A. Dimm. U.S. Pat. 1,307,853, 24.6.19. Appl., 19.2.14.

See Eng. Pat. 2389 of 1915; this J., 1916, 425.

Crucible-furnace for melting metals. P. V. Parsy, Paris. U.S. Pat. 1,308,190, 1.7.19. Appl., 26.12.16.

See Eng. Pat. 102,959 of 1916; this J., 1917, 967.

XI.—ELECTRO-CHEMISTRY.

Formation of ammonia. Briner and Baerfuss. *See* VII.

Chlorine-caustic soda plant. Green. *See* VII.

Electrochemical analyses. King. *See* XXIII.

Electrolytic preparation of chloroform. Feyer. *See* XX.

Patents.

Electrode for an electrolytic cell. C. Zorzi, Milan, Italy. Eng. Pat. 117,450, 20.6.18. (Appl. 10,187/18.) Int. Conv., 9.10.16.

An electrode comprises a series of elements in the form of truncated cones with central apertures, and vertical supports, on which the elements are mounted one above the other with their apertures disposed in co-axial alinement. Insulating caps, substantially similar in form to the elements, encircle the several elements, and are carried by and spaced from them. Spaces are thus provided between adjacent elements, forming guide channels for conducting the liquid or gaseous products of the electrolytic decomposition to and through the central apertures. A collecting pipe is connected to the topmost element into which the products of

electrolysis pass, the pipe being surrounded by a vertical sleeve terminating in and forming an extension of the insulating cap on the upper element. —B. N.

Electrolytic gas generators. I. H. Levin, New York. Eng. Pat. 127,937, 16.5.18. (Appl. 8207/18.) Int. Conv., 22.5.17.

An electrolytic apparatus for the generation of oxygen and hydrogen is composed of two terminal dished or recessed electrodes of opposite polarity, and one intermediate recessed electrode, each electrode being integrally formed with separate gas outlet and liquid supply passages. Each electrode is insulated from the next adjacent electrode, from which it is also separated by a porous diaphragm secured between the open sides, and means are provided to allow the flow of electrolyte to take place from one side of the diaphragm to the other. —B. N.

Heating oils, fats, and other liquids by electricity for distillation etc.; Method and apparatus for ——. H. Alexander and W. T. Vint, Leeds, and A. Imbery, Halifax. Eng. Pat. 127,987, 12.6.18. (Appl. 9641/18.)

A vat or bath, preferably enclosed in a brick chamber lined with insulating material, is provided internally with bearings for a rotary shaft carrying an electrical heating element fitted with vanes. Electrical connection to the rotary heating element can be made by slip rings insulated from the shaft. The vat may also be fitted with inlet pipes for superheated steam, ozone, etc.—A. de W.

Electrical fixation of gases; Apparatus for ——. B. Thomas, Seattle, Wash. U.S. Pat. 1,304,823, 27.5.19. Appl., 18.4.17.

The apparatus comprises a series of horn electrodes, disposed about a common central axis and curved to resemble conical helices having the base of the cone at their free ends.—B. N.

Storage-battery plate and process of treating same. R. N. Chamberlain, Chicago, Ill., Assignor to Gould Storage Battery Co. U.S. Pat. 1,304,852, 27.5.19. Appl., 13.5.16.

Formed storage battery negative plates are treated by immersing them for 4–6 hours in a zinc sulphate solution.—B. N.

Dry cells; Manufacture of ——. C. F. Burgess, Assignor to Burgess Battery Co., Madison, Wis. U.S. Pats. (A) 1,305,250, (B) 1,305,251, and (C) 1,305,252, 3.6.19. Appl., 20.10.17.

(A) A manganese oxide ore is roasted to convert it partially into a lower oxide, and then treated with a mineral acid to dissolve the lower oxide, and leave a porous residue of relatively pure manganese dioxide. The residue is intimately mixed with carbonaceous material to form a depolarising mixture for dry cells. (B) Manganese oxide ore is treated with a solvent, having greater activity towards it than the sal-ammoniac-zinc chloride electrolyte commonly employed in dry cells, and the impurities in the ore are dissolved. The residue is mixed with carbon to form a depolariser. (C) The partially de-oxidised depolarising mixture of a worn-out dry cell is regenerated by washing it to remove the electrolyte, treating with dilute mineral acid to dissolve out the lower oxide and render the dioxide porous, and finally washing and drying the purified mixture.—B. N.

Electrolytic cell. L. W. Chubb, Edgewood Park, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,305,443, 3.6.19. Appl., 5.4.17.

An electrolytic cell comprises a closed hollow electrode of film-forming material, an expansion chamber, a tube leading from the electrode to the expansion chamber, and a second electrode of film-forming material enclosed within the first and completely submerged by an electrolyte contained therein.—B. N.

Electrolytic cell. C. Le G. Fortescue, Pittsburgh, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,305,458, 3.6.19. Appl., 4.4.17.

An electrolytic cell comprises an elongated electrolyte container having two opposed inner walls of electrode material, and an electrode disposed within the container and co-operating electrolytically with both of the walls.—B. N.

Furnace; Electric ——. (A, B) O. A. Colby, Larimer, Pa., (C) F. Thornton, jun., Pittsburgh, and O. A. Colby, Assignors to Westinghouse Electric and Manufacturing Co. U.S. Pats. (A) 1,306,250, (B) 1,306,251, and (C) 1,306,289, 10.6.19. Appl., (A) 13.10.17, (B, C) 24.10.17.

(A) The furnace comprises a heating chamber and an adjacent resister with terminal electrodes. A mass of electrically-conducting material, insulating to heat, is interposed between each of the electrodes and the resister to conduct the current, and to prevent overheating and consumption of the electrodes. (B) The resister comprises refractory electrically-conducting block material. (C) The resister comprises blocks of refractory electrically-conducting material in contact with each other, and forming the top and bottom walls of the heating chamber.—B. N.

Furnace; Electric ——. M. S. Clawson, Weehawken, N.J. U.S. Pat. 1,306,948, 17.6.19. Appl., 21.2.17.

The furnace comprises a main supporting member, on which side portions are pivoted. A resistance member is secured between revoluble heads mounted on the side portions, and is adapted to hold the material to be heated, means being provided for adjusting the side portions.—B. N.

Electrically accelerating chemical reactions; Process and apparatus for ——. W. A. Schmidt and E. R. Wolcott, Assignors to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,307,930, 24.6.19. Appl., 24.5.15.

Chemical changes are accelerated by subjecting the substance under treatment to the action of an electric discharge produced by sudden impulses, each of which is of such high potential that it would, if continued, break down the dielectric resistance of the substance, but is of such short duration as to prevent the break-down.—B. N.

Electric furnaces; Electrode holder for ——. Spear and Jackson, Ltd., and G. Marriott, Sheffield. Eng. Pat. 129,027, 27.9.17. (Appl. 13,918/17.)

Electric induction furnaces. O. C. Böckman, Horten, Norway. Eng. Pat. 120,030, 17.5.18. (Appl. 8273/18.) Int. Conv., 12.10.17.

See U.S. Pat. 1,275,206 of 1918; this J., 1918, 662 A.

Electric furnaces. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 129,014, 20.9.17. (Appl. 13,544/17.)

See U.S. Pat. 1,242,275 of 1917; this J., 1917, 1279.

Electric furnace control apparatus. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 129,039, 2.10.17. (Appl. 14,215/17.)

See U.S. Pat. 1,253,732 of 1918; this J., 1918, 156 A.

Electric furnace. J. Bibby, London. U.S. Pat. 1,308,273, 1.7.19. Appl., 6.3.19.

See Eng. Pat. 125,179 of 1918; this J., 1919, 424 A.

Electrolytic cells. E. C. R. Marks, London. From A. T. Stuart, Toronto, Canada. Eng. Pat. 128,436, 17.7.18. (Appl. 11,739/18.)

See U.S. Pat. 1,303,519 of 1919; this J., 1919, 543 A.

Separating emulsions. U.S. Pat. 1,304,786. *See* I.

Treatment of petroleum. Eng. Pat. 127,918. *See* IIa.

Treating petroleum. U.S. Pat. 1,307,931. *See* IIa.

Oxidation of combustible gases. U.S. Pat. 1,298,889. *See* IIa.

Apparatus for electrolysis. Eng. Pat. 121,460. *See* VII.

Electrolytic cells. Eng. Pats. 127,914—5. *See* VII.

Electrolytic cell. U.S. Pat. 1,306,237. *See* VII.

Pickling. U.S. Pat. 1,305,213. *See* X.

Molybdenum. U.S. Pat. 1,305,350. *See* X.

XII.—FATS; OILS; WAXES.

Linseed oil; Effect of exposure on raw ——. E. J. Sheppard. J. Ind. Eng. Chem., 1919, **11**, 637—639.

Samples of raw American and La Plata linseed oils were exposed to the air in shallow glass dishes. The sp. gr. showed a gradual increase, whilst the iodine values decreased, the changes being apparently independent of the rate of gain in weight.—C. A. M.

Vegetable oils; Modification of the composition of —— *with special reference to increasing unsaturation.* H. L. White. J. Ind. Eng. Chem., 1919, **11**, 648—651.

Soya beans were grown under abnormal conditions, such as in diffused light and at low temperatures in a greenhouse, in darkness, etc., in order to determine whether any conditions of metabolism occurred during the growth of the plant which would promote the formation of unsaturated fatty acids. It was found that during growth of the plants up to a height of 8 to 12 cm. there was no increase in the amount of unsaturated fatty acids in the oil extracted from the beans with ether. On the other hand, there was a decrease in the iodine value, but not to such an extent as in the case of other oil seeds. Experiments to determine the influence of the organisms or enzymes in linseed oil "foots" on the composition of raw linseed oil, showed that whilst bacteria and enzymes have a pronounced hydrolytic effect on oils in the presence of sufficient water, they have only a slight action upon dry oils. They show no tendency to increase the unsaturation of oils. Salts of certain metals, notably zinc lactate and cobalt acetate, in certain concentrations in sunlight or at 37° C. act as catalysts in promoting hydrolysis, but do not increase the unsaturation of oils. In the case of zinc lactate the oil was bleached to a considerable extent, whilst the iodine value was reduced from 184·9 to 176·6. Ultra-violet light acting upon oils and emulsions containing salts effects slight hydrolysis.—C. A. M.

Fenugreek oil. H. E. Wunschendorff. J. Pharm. Chim., 1919, **19**, 397—398.

Fenugreek seeds yield about 5% of oil having a yellow colour and disagreeable taste; when spread in a film on glass, the oil dries rapidly, yielding a yellow varnish which is insoluble in ether. The oil dissolves in most of the usual solvents, but is not completely soluble in acetone; it has the following characters: sp. gr. at 15° C., 0·9471; N_D^{22} = 1·4774; saponif. value, 189·5; iodine value, 137·8; Maumené value, 98·9; free acid, 3·2%; solid fatty acids, 92·9%; volatile fatty acids, 1·50%; unsaponifiable matter, 0·90%; lecithins, 6·25%; phytosterol, 0·55%. The phytosterol melts at 135·5° C., its acetate at 131° C.—W. P. S.

Oil of Ceratotheca sesamoides. E. R. Bolton. Analyst, 1919, **44**, 233—234.

The seeds of *Ceratotheca sesamoides* ("bungu") closely resemble those of white *Sesamum indicum* (gingelly) in appearance except that they are reddish brown in colour, and somewhat larger and flatter. A sample from the Gold Coast yielded 35·47% of a pale yellow oil with a slight nutty flavour. It gave the following results:—Sp. gr. at 15°/15° C., 0·9163; refractometer reading (Zeiss) at 40° C., 59·60; saponific. value, 190·2; iodine value, 110·6; free fatty acids (as oleic acid) 0·63%, and unsaponifiable matter, 1·53%. The oil gave a negative result in Halphen's test, and, although derived from seeds so closely related to sesame seeds, gave no coloration in the Baudouin test. If the seed could be collected in sufficient quantity the oil would be of commercial value for use in margarine etc.
—C. A. M.

Fatty acids; Neutralisation of the higher —— *and estimation of their saponification value.* H. Pomeranz. Seifensieder-Zeit., 1918, **45**, 578. Chem. Zentr., 1919, **90**, II., 647.

Mercuric chloride solution gives a milky white precipitate with neutral soap, but a yellow precipitate if free alkali is present. This behaviour may be utilised to determine the neutral point and saponification value in the preparation of soap. One kilo. of fat is heated with 1 litre of water until it has melted, and after the addition of 400 grms. of sodium hydroxide solution (38° B., sp. gr. 1·36), the mixture is boiled for 20 to 30 mins. A test portion is then dissolved in hot water and a little mercuric chloride solution (20 grms. $HgCl_2$ in 1 litre) is added; if a milky white precipitate is formed, the boiling is continued with further additions of 10 grms. of sodium hydroxide solution until a test portion gives a yellow precipitate of mercuric hydroxide in place of the white precipitate, showing that sodium hydroxide is present in excess, 50 grms. of fat is then added to the solution, which

is again boiled for 20 to 30 mins., another test is made, and this is repeated until the precipitate is again white. Many fatty acids give reddish mercury soaps in the neighbourhood of the neutralisation point, but the end point is sharply indicated by the pure yellow colour of mercuric hydroxide.
—L. A. C.

Wijs' solution for determining the iodine value; Modification of ——. E. Hildt. Rev. Prod. Chim., 1918, **21**, 254—255. Chem. Zentr., 1919, **90**, II., 722.

By using carbon tetrachloride instead of glacial acetic acid as the solvent for the iodine chloride, a solution much richer in iodine than the ordinary Wijs' solution is obtained. A solution of 1·137% of chlorine in carbon tetrachloride will dissolve 4·0367% of iodine as iodine chloride, and the solution is very stable if a fragment of dry calcium chloride is placed in the bottle. From 30 mins. to 2 hours is required for the complete absorption of the halogen by fats, and the results are concordant and agree with those obtained by Hübl's method.
—C. A. M.

Percarbonate washing powders. H. Kühl. Chem.-Zeit., 1919, **43**, 354—355.

Results of experiments are recorded showing that fabrics are not injured by boiling with percarbonate solutions; washing powders, alleged to contain substances yielding oxygen, are on the market and certain of these are undoubtedly injurious to fabrics, but the harm is more probably due to the presence of such substances as sodium silicate, free alkali, sodium sulphate containing much iron, etc., rather than to the presence of per-salts. Persulphates should not, however, be used in washing powders since they may yield free sulphuric acid.
—W. P. S.

Patents.

Castor oil [; Treatment of — — for use as lubricant]. W. H. Huxley, Liverpool. Eng. Pat. 128,007, 14.6.18. (Appl. 9795/18.)

Sulphuric acid (1 part) is added to castor oil (4—7 parts), the temperature being kept below 100° F. (38° C.). The mixture is agitated for 10—24 hours and allowed to stand for a further 10—24 hours. The oil is then mixed with an equal bulk of water at about 212° F. (100° C.) and in this mixture zinc plates, connected to a source of electric current at 230 volts and 5—10 ampères, are immersed until no more hydrogen is evolved. The mixture is then allowed to separate. The treated oil is subsequently washed with boiling water until free from zinc sulphate, and dried, preferably at 220°—230° F. (105°—110° C.). The treated oil is miscible with mineral oil.—A. de W.

Cotton seed; Process of treating ——. H. A. Fee and G. A. Aevaenes, San Antonio, Tex. U.S. Pat. 1,304,670, 27.5.19. Appl., 4.6.17.

Cotton seed is hulled, centrifuged, and sprayed with a saline solution, then centrifuged again and simultaneously sprayed with a solution of common salt in water. Finally the spraying is stopped, and the centrifugal motion accelerated until all the moisture has been expelled.—C. A. M.

Nickel catalyser [for hydrogenation]; Production of ——. W. P. Schuck, Portland, Oreg. U.S. Pat. 1,305,173, 27.5.19. Appl., 9.1.18.

An intimate mixture of a nitrate of a catalytic metal (nickel) and a carbohydrate is heated to redness in a non-oxidising atmosphere, the proportion of the two components being such as to yield an uncaked intimate mixture of a free catalytic metal and free carbon. The resulting product is cooled in a non-oxidising atmosphere.—C. A. M.

Hydrogenation of fatty bodies or other organic products; Regenerating catalysers containing nickel which have been employed for the ——. G. N. Vis, Paris. U.S. Pat. 1,306,871, 17.6.19. Appl., 21.11.17.

The spent catalyst is treated with a solvent to remove fatty bodies, the residue heated in air to destroy organic matter, washed in water to free it from soluble impurities, and then converted into nickel suboxide by heating to 300° C. in oil through which hydrogen is passed.—A. de W.

Hydrogenising oils and fats; Apparatus for ——. H. Lane, Ashford. U.S Pat. 1,307,588, 24.6.19. Appl., 12.2.19.

See Eng. Pat. 123,966 of 1918; this J., 1919, 262 A.

Heating oils etc. Eng. Pat. 127,987. *See* XI.

Glycerin substitute. Ger. Pat. 311,374. *See* XX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Colophony; Action of sulphuric acid on ——. A. Grün and R. Winkler. Chem. Umschau, 1919, **26**, 77—79.

Ten grms. of colophony (acid value 164·4, saponif. value 175·9, iodine value 244·2, and unsaponif. matter 6·7%) was mixed with petroleum spirit, and treated for 6 hours at —5° C., with 30 grms. of strong sulphuric acid. The viscid mass was boiled with water until free from acid, and the product dissolved in benzene, dried, and the solvent evaporated. The residue had the following characters:—Unsaponif. matter, 9·33%; total resin acids, 90·9%; acid value, 103·7; saponif. value, 153·9; iodine value (Wijs) after 1 hour, 105·2; after 2 hours, 113·7; and acetyl value, 54·2. From these results it was calculated that the product consisted of 64·1% of the inner ester of a hydroxy acid,

$$C_{19}H_{30}(OH)COOC_{19}H_{30}COOH,$$

26·5% of unaltered abietic acid, and 9·4% of unsaponifiable matter. The formation of the inner ester of this hydroxy acid is analogous to the formation of diricinolcic acid from the sulphuric acid ester of ricinoleic acid, the sulphuric acid combining with the double linkage and the product then being decomposed by water. Esterification of the colophony with sulphuric acid in presence of methyl alcohol yielded a product which, when boiled with water, and separated as before, had the following characters:—Total resin acids, 93·01; free acid, 15·05%; unsaponifiable matter, 6·59%; hydroxyl value, 4·0; and methoxyl content of ester, 7·85%. These results corresponded with 77·96% of the methyl ester of abietic acid, only traces of a hydroxy acid being present. The iodine value (Wijs, 2 hours) was 164·0, so that the ester under these conditions absorbs only 2 mols. of halogen as against 3 mols. in the case of free abietic acid. (See also J. Chem. Soc., Sept., 1919.)—C. A. M.

Colloids. Schryver and Speer. *See* I.

Absorption of dyestuffs. Feigl. *See* IV.

Inflammability of aluminium dust. Leighton. *See* X.

Linseed oil. Sheppard. *See* XII.

PATENTS.

Lampblack; Method of producing ——. L. Bendit, Chelsea, Okla. U.S. Pat. 1,304,729. 27.5.19. Appl., 15.3.18.

CARBONIFEROUS material is incompletely burnt in an enclosed chamber, and the products of combustion are admitted to a zone of lower pressure, where the carbon is precipitated by electrostatic action. —E. W. L.

Resinous products; Manufacture of ——. C. N. Forrest, Rahway, and J. V. Meigs, Perth Amboy, N.J., Assignors to The Barber Asphalt Paving Co., Philadelphia, Pa. U.S. Pat. 1,305,790, 3.6.19. Appl., 31.12.17.

A BALSAMIC or resinous material, which is insoluble in petroleum ether or carbon bisulphide but soluble in alcohol and acetone, is made by the reaction of nitric acid or nitrogen oxides on the unsaturated and reactive distillates of native bitumen.—A. B. S.

[*Paint and varnish remover.*] *Composite solvent and process of making same.* C. Ellis, Montclair, N.J., Assignor to Chadeloid Chemical Co., New York. U.S. Pat. 1,306,221, 10.6.19. Appl., 16.9.14.

A PAINT and varnish remover consisting of a mixture of benzyl alcohol and a chlorinated solvent containing chlorotoluene is obtained by chlorinating toluene partly in the side-chain and partly in the benzene ring, and subsequently treating the product with an alkaline dechlorinating agent, whereby chlorine is selectively removed from the side-chain and replaced by a hydroxyl group, while the chlorine in the benzene ring is substantially unaffected.—A. de W.

Phenolic condensation product and process of making same. L. H. Baekeland, Yonkers, N.Y., Assignor to General Bakelite Co., New York. U.S. Pat. 1,306,681, 17.6.19. Appl., 9.11.16.

A FUSIBLE body of the salliretin class is formed by condensation of a cresol mixture enriched in *p*-cresol with a substance containing a mobile methylene group. The substance fuses at a temperature materially above 115° C.—A. de W.

Self-luminous material; Preparation of ——. E. Parade, Leipzig. Ger. Pat. 311,500, 2.12.15.

RADIOACTIVE zinc sulphide is used in the preparation of plastic self-luminous material, care being taken that the crystalline structure of the zinc sulphide is not destroyed during the mixing with the other constituents.—L. A. C.

Zinc-lead pigments and the method of manufacturing the same. New Jersey Zinc Co., New York, Assignees of J. A. Singmaster and F. G. Breyer, Palmerton, Pa., U.S.A. Eng. Pat. 120,194, 12.4.18. (Appl. 6270/18.) Int. Conv., 26.10.17.

SEE U.S. Pat. 1,257,136 of 1918; this J., 1918, 251 A. (Reference is directed, in pursuance of Sect. 7, Subsect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 7119 of 1893 and 2789 of 1907.)

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber content of latex; Use of hydrometers to determine the ——. O. de Vries. Indiarubber J., 1919, 58, 81.

THE satisfactory determination of the rubber content of diluted latex by use of instruments of the hydrometer type is not possible. The scale of the "metrolac" and "latexometer" is so constructed as to give correct readings for the rubber content of mixtures of water with latex of original specific gravity approx. 0·977 and containing approx. 37% of rubber, and that these values cannot be considered to apply generally is obvious from the fact that in testing various latices obtained in Java the hydrometer indicated from 0 to 120%, but mostly 70—80% of the rubber actually present.—D. F. T.

Rubber compounds; Effect of light on unvulcanised ——. R. Repony. Rubber Age and Tire News, 5, [5]. Indiarubber J., 1919, 58, 72.

THE harmful effect of sunlight on vulcanised rubber goods is generally recognised but the similar effect on unvulcanised rubber compounds appears to be less definitely realised; although only the surface film of the rubber may be affected the result may seriously influence the quality of the finished vulcanised article, especially if the exposed rubber stock is in the form of calendered sheet which in the course of subsequent manufacture is built up in superimposed layers. A mixing of 40% of fine Para rubber and 60% of mineral filler after being calendered and exposed to sunlight for 2 hours in July, had completely lost its surface tackiness and this could not be restored even by moistening with gasoline; also two layers when vulcanised with the oxidised surfaces pressed together failed to become united. Experiments with rubber placed between plates of glass of various colours, with almost complete exclusion of air, indicated that light is a more important factor than air or heat in producing the alteration in question. Rubber mixings containing a high percentage of mineral fillers, especially oxides, are more affected than those rich in rubber, and pure rubber free from sulphur is least sensitive. Although the presence of paraffin wax, mineral oil, or other non-drying oils retards the oxidising action of light the best precaution is to protect mixed rubber stock from direct exposure to the sun's rays and as completely as possible even from daylight.—D. F. T.

PATENTS.

Crude rubber or other materials containing grit; Washing ——. O. Shaw, Manchester. Eng. Pat. 127,533, 28.1.19. (Appl. 2072/19.)

WATER under pressure is led through a pipe passing through the guide-plate at the end of the roller of a rubber-washing machine, into a groove in the end of the roller, and emerging through the narrow opening between the roller and the guide-plate, forms a baffling stream preventing access of grit to the bearings of the roller.—E. W. L.

Rubber composition and method of making same. J. M. Bierer, Assignor to Boston Woven Hose and Rubber Co., Boston, Mass. U.S. Pat. 1,303,759, 13.5.19. Appl., 1.9.16.

A RUBBER composition comprises a mixture of rubber and chemically treated cotton in powdered form, free, or substantially free from the tensile strength possessed by untreated cotton.—E. W. L.

Rubber-compound material; Resilient ——. T. H. Rieder and W. B. Wiegand, Montreal, Canada, Assignors to Goodyear's Metallic Rubber Shoe Co. U.S. Pat. 1,305,008, 27.5.19. Appl., 25.4.16.

A SHEET of resilient material having a non-slipping hairy surface consists of a vulcanised rubber binder having incorporated therewith wool fibres in such proportion that the material possesses the tensile

strength and wear-resisting property of a zinc oxide-rubber mixing, together with the elasticity of pure rubber.—E. W. L.

Rubber or other substances; Machines for cleaning scrap ——. R. W. James, London. From C. C. Stephen, Colombo, Ceylon. Eng. Pat. 128,717, 21.6.18. (Appl. 10,259/18.)

Vulcanising rubber goods; Apparatus and process for ——. W. J. Mellersh-Jackson, London. From American Rubber Co., Boston, Mass. U.S.A. Eng. Pat. 128,852, 6.1.19. (Appl. 384/19.)

See U.S. Pat. 1,289,043 of 1918; this J., 1919, 188 A.

Leather substitutes. Eng. Pat. 127,932. *See* XV.

XV.—LEATHER; BONE; HORN; GLUE.

Tannins II. Chebulinic acid. K. Freudenberg. Ber., 1919, **52**, 1238—1246.

Chebulinic acid is a moderately strong acid in which the presence of a free carboxyl group has been assumed previously, and this hypothesis is now further confirmed. It cannot be hydrolysed by tannase, probably on account of the inhibiting action of the acid group. When heated in aqueous solution, the acidity increases, particularly at first, far more rapidly than corresponds to the gallic acid liberated. This is due to the liberation of a second acid, since after removal of gallic acid with ether, neutralisation of the solution, and extraction of a crystalline tannin with ethyl acetate, an apparently new phenolcarboxylic acid can be isolated in the form of its thallium salt, which approximates to thallium gallate in composition. The crystalline tannin, mentioned above, has $[\alpha]^{18}_{D} = +85° (\pm 4°)$ in alcoholic solution, and appears to be a digalloylglucose. The results so far obtained with chebulinic acid seem to indicate that the glucose is esterified with two molecules of gallic acid and that the new acid is not attached to the glucose residue through its carboxyl-group, which is free, but probably by a glucosidic linkage. The use of thallium carbonate or hydroxide for the neutralisation of solutions after hydrolysis appears very advantageous since the subsequent removal of thallium is readily effected by addition of halogen acid, and, in this particular instance, it also effects the precipitation of highly-coloured impurities.
—H. W.

Tannin content of redwood. C. C. Scalione and D. R. Merrill. J. Ind. Eng. Chem., 1919, **11**, 643—644.

Samples of the bark, heart-wood, and sap-wood, of the coast redwood (*Sequoia sempervirens*) were shredded and ground and the tannin determined by the hide-powder method of the Amer. Leather Chemists' Assoc. Percentages of tannins and soluble non-tannins found, referred to the dry substance, were: heartwood, 12·2 and 13·5; sap-wood, 1·15 and 3·62; and bark, 0·86 and 1·89. Only the heartwood would therefore be of value as a source of tannin, and sawdust would be the principal waste material available. Strips of hide experimentally tanned with the extract were coloured a dark purplish brown on the outside, but the colour did not penetrate through the hide. The grain developed quickly, and tanning was complete in about 4 days. The material might be satisfactory for heavy sole leather. Another possible source of redwood tannin is the liquor obtained when the wood is steam-kilned. This contains about 7 to 10% of tannin.—C. A. M.

Collagen. Swelling and contraction of connective tissue fibrils in hot water. A. Ewald. Z. physiol. Chem., 1919, **105**, 115—134.

The author has studied the shortening of the collagen fibrils of connective tissue (mouse tendon), which takes place on heating in water, particularly with reference to the effect of previous treatment with various substances. An extraordinary shortening takes place in fibres which have been previously purified by tryptic digestion. The limiting temperatures at which the contraction takes place are appreciably higher when the collagen has been pre-treated with osmic acid, tannin, or chromium compounds in the presence of light.—J. C. D.

Collagen II. Action of formaldehyde on collagen fibrils and a new histological reaction for collagen. A. Ewald. Z. physiol. Chem., 1919, **105**, 135—157.

The behaviour of collagen treated with formaldehyde when subjected to the action of hot water is so peculiar that it may be considered a new reaction of collagen. The fibres shrink to one-third of their original length at 93° C., and extend again immediately on placing in cold water to two-thirds their length. On treatment at 69° C. they again contract to one-third, but on keeping for some time in cold water they completely regain their original length.
—J. C. D.

Patents.

Leather; Manufacture of ——. E. T. Doran, Arendal, Norway. Eng. Pat. 126,938, 4.10.18. (Appl. 16,175/18.) Int. Conv., 11.5.18.

To produce a hard, tough, waterproof leather, possessing considerable resistance to the action of heat, tanned hides, preferably chrome-tanned, are uniformly partially dried, and treated for more than 24 hours at 18° 20° C., without being agitated, in a bath containing lead acetate acidified with acetic acid. Barium acetate may also be added to the liquor. Before treatment with acetate the tanned hides may be swelled with acids.—S. S. A.

Leather; Compositions for use as a substitute for ——. W. S. Smith, London. Eng. Pat. 127,932, 6.5.18. (Appl. 7585/18.)

The compositions described consist essentially of reclaimed rubber, finely-divided leather waste, and fibrous vegetable material. Additions of raw rubber and sulphur, and of the ordinary compounding ingredients of rubber mixings may also be made. The mixtures are vulcanised.—E. W. L.

Hides; Pits used for liming and tanning ——. G. Randall, Worcester. Eng. Pat. 128,835, 21.11.18. (Appl. 19,121/18.)

XVI.—SOILS; FERTILISERS.

Carbon in soils; Simplified wet combustion method for the determination of ——. D. D. Waynick. J. Ind. Eng. Chem., 1919, **11**, 634—637.

A simple modification of apparatus is described by means of which the carbon in soils etc. may be rapidly determined by the wet combustion method of Ames and Gaultier (this J., 1914, 800) the carbon dioxide being absorbed in soda-lime tubes. The combustion is effected in a long-necked Kjeldahl flask closed by a cork through which passes a dropping-funnel and an outlet tube. The dropping funnel, which also serves for the introduction of the sulphuric acid, is closed at the top, and is connected with tubes containing calcium chloride and soda-lime and a flask containing potassium hydroxide solution. The air passes through these before entering the combustion flask, and subsequently

passes through a series of scrubbers, one of which contains glass beads wetted with sulphuric acid, another zinc amalgamated with mercury, and a third calcium chloride and phosphoric anhydride separated by a layer of glass wool. A flask at the base of the first scrubber serves to catch condensed sulphuric acid, and a trap between the first and second scrubbers is charged with strong silver sulphate solution to retain traces of chlorine or sulphur trioxide which have escaped absorption in the scrubbers. The air current, which is drawn by suction through the apparatus, is thus freed from sulphur trioxide and moisture before entering the soda-lime absorption bulb. In making a determination 5 to 15 grms. of the soil and 5 c.c. of the chromic acid solution (33 grms. in 5 c.c.) are introduced into the combustion flask, 50 c.c. of sulphuric acid is run in rapidly, and a current of air drawn through the apparatus. The flask is heated so that its contents boil within 5 mins. after the introduction of the acid, and the heating is continued for about 20 mins., after which the flask is allowed to cool while the aspiration of air is continued for another 5 mins. The soda-lime bulb is then closed and weighed. About 5 litres of air should be drawn through the apparatus during a combustion, but not so rapidly as to carry forward an excessive amount of sulphur trioxide. If desired, phosphoric acid may be used with the sulphuric acid for the combustion as proposed by Schollenberger (this J., 1917, 40).—C. A. M.

Organic manures; Agricultural value of ——. E. J. Russell. J. Bd. Agric., 1919, **26**, 228–246.

Comparative manurial trials at Rothamsted with three crops, barley, wheat and mangolds, each grown continuously on the same land for sixty years, shows that the nitrogen of rape cake is not as effective, weight for weight, as that of sodium nitrate or ammonium sulphate, provided that the latter are mixed with the requisite amount of phosphate and potash. The rape cake had no residual manurial effect on the wheat and barley plots, but there was a fairly well marked effect for at least two years on the mangold plot, due probably to the large weight of leaf formed on the mangolds, which was subsequently ploughed in each year. Similarly, rotation experiments showed that rape cake produced no appreciable effect after the year of application. Trials on light land at Woburn showed that in no case was rape cake superior to a mixture of sodium nitrate and other mineral fertilisers. A comparison of Peruvian guano, rape cake, and shoddy showed that the effects produced by these manures in the year of application were in the order 100, 91, 88, but the shoddy showed a residual effect. The chief advantage of rape cake would appear to be that it is a safe mixed manure which can be applied as a heavy dressing, whereas artificial fertilisers must be applied in several small doses in order to avoid damaging the plant or the soil.—W. G.

Patent.

Fertilisers. Ger. Pat. 311,596. *See* VII.

XVII.—SUGARS; STARCHES; GUMS.

Beetroots; Storage of ——. W. Bartoš. Z. Zuckerind. Böhm., 1919, **43**, 269–279. Chem. Zentr., 1919, **90**, II., 674.

The author lays down rules to be observed in gathering and storing beets in order to minimise loss of sugar. The first roots gathered should never be stored, but worked up as soon as possible. Frozen or damaged beets must not be stored. Some numerical data are given illustrating the serious loss of sugar which may occur in damaged roots. Respiration during storage should be restricted as far as possible; two roots stored in the autumn of 1916 and taken out in November 1917 had lost 15—18% of the total sugar by respiration. In beets stored without topping there occurs an appreciable increase in sugar-content during the first few weeks; in a case cited by the author the increase amounted to 0·71% in five weeks.—J. H. L.

Cane sugars; Deterioration of —— *in storage.* N. and L. Kopeloff. La. Planter, 1919, **62**, 237—238.

Sterilised sugars were inoculated with *Aspergillus niger*, the blue *Aspergillus* observed by Owen (see this J., 1919, 549A), and *Cladosporium*, and it was found that even in the case of sugars having a factor of safety less than 0·333 deterioration will occur if the sugar is sufficiently infected. Bacteriological examination of the products at the several stages of manufacture showed that bacteria and moulds were most numerous in the raw juice, and that after clarification the juice is almost completely sterile. Re-infection takes place when syrup and massecuite are exposed to the air, particularly when centrifuging. It is suggested that the mixers and centrifuges should remain covered, and that this stage of the process might be carried out in a separate room, periodically disinfected.—J. P. O.

[Sugar] juice; Determination of the suspended solids in mixed cane ——. H. L. White. Int. Sugar J., 1919, **21**, 353—354.

According to the procedure prescribed by the Hawaiian Chemists' Association (Int. Sugar J., 1916, 556), the suspended solids of mixed mill juice, some of which are in a colloidal condition, are determined by diluting 20—50 grms. with 200 c.c. of water, and passing the liquid through a tared Gooch crucible. This method, however, is very slow, as a moderate degree only of suction may be applied to avoid rupture of the paper. Satisfactory results are stated to be obtained by the use of an extraction thimble, 33 × 94 mm., placed inside a gauze basket, which in turn is contained in a copper filter-tube, the upper part of the basket being provided with a smooth surface to form a seal. In this way, 100 grms. of the mixed juice diluted with 400 c.c. of water can be filtered in about 5 mins. with a practically complete separation of the solids. Washing, moreover, is easy; a high suction may be employed; and one thimble can be used for 3 or 4 determinations before it becomes sluggish in action.—J. P. O.

Sugar juices; New economical process of purification of [beet] ——. E. Pšenička. Z. Zuckerind. Böhm., 1919, **43**, 224—227. Chem. Zentr., 1919, **90**, II., 674—675.

In order to avoid a darkening of colour in diffusion juice, which frequently occurs when the juice is neutralised with lime in the cold, the author recommends the addition of 4—20% or more of unfiltered carbonated juice, which also effects a considerable purification. Since, under these conditions, no new saccharate compounds are formed, as when lime is used, the washing of the scums is much simplified. The rate of filtration is also doubled, and it is not necessary to heat the juice after carbonatation to render the precipitate granular. This method of working involves no costly modification of plant, and it renders possible a saving of ¼% of the lime required.—J. H. L.

Sugar; Revision of the copper-phosphate method for the titration of ——. O. Folin and E. C. Peck. J. Biol. Chem., 1919, **38**, 287—291.

Considerable care must be taken in the preparation of the salt mixture employed in the process of Folin

and McEllroy (this J., 1918, 275 A), otherwise variable results may be obtained. The preparation of the reagents and the modified technique are fully described.—J. C. D.

Polariscopes equipped with an international scale of 20 grms.; Construction of ——. C. A. Browne. Int. Sugar J., 1919, **21**, 128–131.

AMONG the advantages of a normal saccharimetric weight of 20 grms. in place of the present one of 26 grms., are the facts that the specific rotation of sucrose at a concentration of 20 grms. in 100 c.c. is at its maximum, and that 20 grms. is always available as a one-piece unit in an analytical set of weights. Adoption of another weight would necessitate the revision of tables now in use; but in view of the work of Bates and Jackson (Reports 8th Intern. Cong. Appl. Chem.) showing that the present weight of 26·0 grms. is inaccurate to the extent of at least 0·10° this would seem to be demanded in any case. It is therefore urged that the 100° point on the scale of a saccharimeter should be accepted internationally as that given by a solution containing 20 grms. of sucrose dissolved in 100 metric c.c. when observed in a 200-mm. tube at 20° C.—J. P. O.

Polariscopes with an international scale of 20 grms. F. Bates. La. Planter, 1919, **62**, 217–218. Int. Sugar J., 1919, **21**, 408.

AGAINST the proposal to adopt a normal saccharimetric weight of 20 grms. (see previous abstract), it is pointed out that a reduction in the normal weight would cause a corresponding diminution in the degree of accuracy of the determination; that the re-scaling of instruments would not be practicable; and that unless the adoption of the new standard were universal (which would seem unlikely for some time) confusion would be caused, rendering international tests open to question.—J. P. O.

Ash; Wagenaar's method of estimating —— in substances containing sugar. H. I. Waterman and H. de Wijs. Chem. Weekblad, 1919, **16**, 885–888.

FOR the estimation of ash in raw sugar, syrup, molasses, etc. the rapid method of Wagenaar (Pharm. Weekblad, 1913, **50**, 1213) is preferable to the carbonate-ash and sulphate-ash methods. In Wagenaar's method the syrup or the like is introduced, drop by drop, into a platinum crucible previously heated to bright redness. The real ash present may be calculated from the sulphate-ash by diminishing the amount of the latter by 18·3%–20·8%.—W. S. M.

Sucrose; Solubility of —— in the presence of invert sugar. T. van 'der Linden. Archief Suikerind. Nederl.-Indië, 1919, **27**, 591–598.

BY preparing a series of solutions containing 25 grms. of sucrose in 7·5 of water, and adding to each increasing amounts of invert sugar, Prinsen Geerligs (Archief Suikerind. Nederl.-Indië, 1905, 298) found that after a month practically the same amount of sucrose had crystallised out in each test; and he therefore came to the conclusion that the solubility of sucrose was unaffected by the presence of invert sugar. In order to induce crystallisation, he "seeded" the solutions, but they were allowed to remain at rest. Experiments carried out by the author under similar conditions, excepting that the solutions were constantly rotated, showed that the solubility of the sucrose is diminished in direct proportion to the invert sugar present. It is suggested that in Geerligs' experiments the solutions remained supersaturated.—J. P. O.

Sugar factories; Investigations on the waste waters from [beet-] ——, and on the deposition of earthy impurities in water. F. Schulz. Z. Zuckerind. Böhm., 1919, **43**, 198–224. Chem. Zentr., 1919, **90**, II., 657–658.

THE concentration of earthy impurities in waste waters does not influence their rate of subsidence. The clarifying effect of a settling tank, *i.e.*, the volume of liquid clarified in a given time, therefore depends on the area of the tank and not on the depth of liquid. On practical grounds it is advisable to operate with as small a depth of liquid as possible without risk of disturbing the sludge. Without lime or other precipitant it is impossible in practice to separate more than 80–85%, or in some cases 90%, of the earthy impurities from sugar factory waste waters; but by addition of 0·01% of lime 97–98% can be separated in 20 mins. from a depth of liquid of 0·2 metre. On this basis the treatment of 1000 cubic metres of waste water daily would require a tank area of at least 70 sq. metres. Equally good results may be obtained by addition of magnesium chloride or ferrous sulphate and an equivalent amount of lime. "Humin," together with 0·01% of lime, is no more effective than the lime alone, and with smaller quantities of lime it actually retards clarification (*cp.* this J., Thein, 1911, 639; Roubinek, 1913, 43; Andrlik and Stanek, 1913, 376). Diffusion waters have practically no influence on the deposition of earthy impurities from wash waters.—J. H. L.

Rhamnose; Preparation of ——. E. P. Clark. J. Biol. Chem., 1919, **38**, 255–256.

THE preparation of rhamnose from commercial quercitron extract is described. The yield is 50–55 grms. of the pure sugar from 2½ kilos. of extract. (See further J. Chem. Soc., 1919, I., 387.) —J. C. D.

PATENTS.

Dextrins, gums, and modified starches; Method of manufacturing ——. A. W. H. Lenders, Assignor to Douglas Co., Cedar Rapids, Iowa. U.S. Pat. 1,305,291, 3.6.19. Appl., 5.7.17.

STARCH is mixed with acid and water, a part of the liquid is separated by pressure (in a filter-press), and the moist but relatively solid residue is heated for a time *in vacuo*, the vapours emitted being continuously withdrawn; afterwards the vacuum is broken and heating is continued without withdrawal of vapours.—J. H. L.

Starch; Process and apparatus for the preparation of —— and by-products, especially feeding-stuffs, from potatoes. F. Fritsche, Berlin-Schöneberg. Ger. Pat. 311,453, 20.5.14.

POTATOES are converted into chips or slices, instead of pulp, and subjected to great pressure by being fed, in a thin layer, between closely set rollers revolving at different speeds, whereby nearly all the cells are ruptured and the starch grains set free. A very high yield of starch is thus obtained, and the potato residues are recovered in a condition suitable for the preparation of dry feeding-stuffs.—J. H. L.

Starch; Apparatus for extracting —— from pulped potatoes. B. Sjollema, Utrecht, and O. Meyer, Veendam, Holland. Ger. Pat. 311,454, 28.12.16.

IN apparatus for extracting starch from potato pulp by means of water, a series of screening drums is mounted on a shaft, and between the drums are situated mixing vessels. The apparatus is worked on the counter-current principle, fresh pulp being

introduced into the first of the mixing vessels and fresh water into the last. A bucket feed device transfers the contents of each mixing vessel to the succeeding drum. The liquid escaping from each drum (except the first) is caught in a trough below, which communicates with the next mixing vessel but one in the series in one direction, whilst the pulp from the drum is discharged into the adjacent mixer in the other direction. J. H. L.

Adhesives; Process for producing ——. G. Hildenbrandt, Hamburg. Ger. Pat. 311,557, 13.12.16.

Sodium cellulosexanthate, sulphite-cellulose waste liquors, natural or converted starch, or yeast, or mixtures of these materials, are heated at 100°—120° C. with alkali salts of monohydric or polohydric phenols in presence or absence of free alkalis. Excess of alkali may afterwards be neutralised by means of an acid gas, and any phenolic odour may be eliminated by passing air or other gas through the material. In a modified form of the process the carbohydrate materials mentioned above are treated first with concentrated alkaline solutions and then with phenols. The products may be employed for gumming paper, wood, etc., or mixed with water-glass they may be used in the preparation of plastic masses from paper pulp, peat, or sawdust. —J. H. L.

XVIII.—FERMENTATION INDUSTRIES.

Brewing water; Interaction of the salts of —— with the salts derived from the malt, and the fate of gypsum in brewing water. W. Windisch. Woch. Brau., 1919, **36**, 1—4, 12—13, 19—20, 30—33, 37—40, 46—47, 52—56, 62—64, 66—68.

The author sets out fully his views on the reactions which take place between the salt constituents of wort in the mash tun and in the copper, and adduces in support thereof the results of experiments in which dilute solutions of various salt mixtures were boiled and the resulting precipitates, if any, investigated. Great importance is attached to the influence of the various reactions on the acidity of the wort. In this connection calcium salts (apart from the carbonate) are considered beneficial, since owing to the insolubility of secondary and tertiary calcium phosphates, they remove these types of phosphates from the wort and thus alter the salt equilibrium in favour of the acid-reacting primary phosphates. Calcium sulphate acts in this way, thus

$$4K_2HPO_4+3CaSO_4=Ca_3(PO_4)_2+2KH_2PO_4+3K_2SO_4,$$
or $$K_2HPO_4+CaSO_4=CaHPO_4+K_2SO_4,$$

but the author nevertheless deprecates addition of calcium sulphate to brewing waters, because the above reactions remain far from complete unless a very large excess of calcium sulphate is added and also because the latter, by interaction with other salts, gives rise to the formation of potassium and magnesium sulphates, both of which impair the flavour of beer. A high sulphate-content of brewing waters is considered undesirable even for dark beers, and for pale beers the softest water is the best. Magnesium salts are in all respects more injurious than calcium salts in brewing. Unlike the latter, they do not assist in raising the acidity of wort by precipitation of phosphates, for secondary magnesium phosphate is soluble, and the insoluble tertiary salt, if precipitated at all in the copper, readily interacts with primary phosphates as the wort cools, and thus redissolves again as secondary magnesium phosphate. Since by far the greater part of the magnesia in worts is derived from the malt the author suggests that its amount might with advantage be reduced, by the cultivation and use of brewing barleys of minimum magnesia-content, provided that the yeast is not weakened thereby. —J. H. L.

Yeast cells; Increased catalase action in ——. H. von Euler and R. Blix. Z. physiol. Chem., 1919, **105**, 83—114.

The power which fresh yeast possesses of decomposing hydrogen peroxide is greatly increased by the addition of small quantities of protoplasmic poisons, such as toluene, or by dehydrating, providing the enzymes are not destroyed. (See further J. Chem. Soc., 1919, i., 425.)—J. C. D.

Italian wines; Value of the Halphen ratio for ——. G. Halphen. Ann. Chim. Analyt., 1919, ii., **1**, 185—186.

The minimum ratio of alcohol to acid (Halphen ratio) of Italian wines is practically the same as that of French, Algerian, and Tunisian wines. (Compare Scurti and Rolando, this J., 1917, 1284.)—W. P. S.

Whisky; Results of experiments on the production of German ——. E. Duntze. Deutsche Essigind., 1919, **23**, 67—70. Chem. Zentr., 1919, **90**, II., 679—680.

Potato-spirit of 40—50% alcoholic strength, filtered or not filtered, was stored under various conditions for 3—4 years in casks made of fresh "Slavonic oak" and also in carbonised casks. The results showed that potable spirits equal in quality to well-known foreign (non-German) brands can be produced in this way, filtration and storage in carbonised casks conferring mildness of aroma and flavour. The spirit used in these experiments was practically free from fusel oil.—J. H. L.

Methyl alcohol [in ethyl alcohol etc.]; Detection of ——. W. Zimmermann. Pharm. Zentralh., 1919, **60**, 175—177.

In tests for methyl alcohol (in ethyl alcohol, spirits, etc.) which depend on the oxidation of the methyl alcohol to formaldehyde by means of permanganate and the detection of the aldehyde by magenta-sulphurous acid reagent, the latter should be at least 24 hrs. old; freshly prepared reagent gives a coloration in the absence of methyl alcohol. The presence of acetaldehyde in the sample does not interfere with the test, as it is destroyed during the oxidation. A coloration which develops after 5 mins. should be ignored. Methyl alcohol may also be detected by dissolving 0·5 grm. of sodium salicylate in 1 grm. of the alcohol to be tested and adding 5 drops of concentrated sulphuric acid during 1 min.; a distinct odour of methyl salicylate is noticed if methyl alcohol is present.—W. P. S.

Cellulose degradation products; Enzyme studies on ——. H. Pringsheim and M. von Markatz. Z. physiol. Chem., 1919, **105**, 173—178.

Diastase was without action on a dextrin prepared from cellulose. Extracts prepared from the stomach, intestines, and pancreas of oxen were also unable to decompose the dextrin, from which it is concluded that the hydrolysis of cellulose in the digestive system of these animals is caused by bacteria.—J. C. D.

Action of micro-organisms on petroleum. Tausz. *See* IIA.

Alcohol from sulphite liquor. Krieble. *See* V.

Enzyme action. Falk and others. *See* XIXA.

PATENTS.

Lactic acid; Process of manufacturing —. G. A. Richter, Assignor to Brown Co., Berlin, N.H. U.S. Pat. 1,305,623, 3.6.19. Appl., 2.11.17.

SAWDUST or other carbohydrate material is hydrolysed with lactic acid, the sugar formed is fermented by means of lactic bacteria, and the lactic acid produced is recovered.—J. H. L.

Beer; Preparation of alcohol-reduced —. H. Heuser, Chicago, Ill. U.S. Pat. 1,308,588, 1.7.19. Appl., 15.8.18.

BEER of reduced alcohol-content is rendered light-proof by treatment with 4–12 grms. of potassium pyrosulphite (metabisulphite) per barrel.—J. H. L.

Potatoes [for distilleries]; Process for the preservation of —. Verein der Spiritus-Fabrikanten in Deutschland, Berlin. Ger. Pats. (A) 291,307, 14.2.14, and (B) 291,308, 29.4.14. Additions to Ger. Pat. 286,106 (this J., 1916, 192).

(A) GRATED raw potatoes are heated to a temperature favourable to lactic bacilli by admixture with steamed potatoes. (B) In the acidification of grated raw potatoes by means of pure culture bacteria, the material is heated to such a temperature (60°–70° C. when *B. Delbrückii* is employed) that it becomes homogeneous owing to gelatinisation of starch granules, and consequently does not separate into solid and liquid layers. The heating may be effected after the acidification process is completed, and the acidifying organisms may be weakened or killed to prevent further action as far as possible.
—J. H. L.

Dry yeast. U.S. Pat. 1,306,569. *See* XIXA.

XIXA.—FOODS.

Flour, bread, etc.; Determination of fat in —. E. Vautier. Ann. Chim. Analyt., 1919, **1**, 180–182.

ONE grm. of the sample is boiled for about 2 mins. with dilute hydrochloric acid (1 : 1) in a graduated tube, cooled, a mixture of equal vols. of ether and petroleum spirit is added, the contents of the tube shaken for 5 mins., and then centrifuged. The volume of the ethereal layer is noted, an aliquot portion (25 c.c.) is drawn off, evaporated in a weighed flask, and the residue of fat dried and weighed.—W. P. S.

Buttermilk; Composition of —. T. R. Hodgson. Analyst, 1919, **44**, 229–233.

ANALYSES are given of 312 samples of buttermilk purchased under the Sale of Foods and Drugs Acts. The highest amount of fat found was 1·7% and the lowest 0·1%; 25% of the samples contained less than 0·4% fat, 50% less than 0·5%, and over 80% less than 0·7%. The proportion of fat rarely exceeds 0·6% when the churning has been efficiently carried out. The lowest amount of solids-not-fat found was 3·71%, corresponding to 56·4% of added water; 6 samples contained 8·5% or more of solids-not-fat. Over 50% of the samples contained less than 20% of added water, 23% contained over 25%, and 8% contained over 30%. Legal proceedings were taken when the amount exceeded 30%. From results obtained during each month of the year the conclusion is drawn that it is quite possible to prepare buttermilk at any period of the year without the addition of any water at all.—C. A. M.

Lactalbumin; Stability of — towards heat. A. D. Emmett and G. O. Luros. J. Biol. Chem., 1919, **38**, 257–265.

THE value of lactalbumin as a source of protein for the growing animal is not perceptibly lowered by heating at 90°–100° C. for 16 hours, or by heating in an autoclave at 15 lb. pressure for 2 or 6 hours. (See further, J. Chem. Soc., 1919, I., 420.)—J. C. D.

Enzyme action; Studies of —. *XVII. The oxydase, peroxydase, catalase, and amylase of fresh and dehydrated vegetables.* K. G. Falk, G. McGuire, and E. Blount. J. Biol. Chem., 1919, **38**, 229–244.

THE general effect of dehydration was to bring about a decreased enzyme action. (See further, J. Chem. Soc., 1919, I., 426.)—J. C. D.

Grain extracts and amino acids in presence of alcohol; Acidimetric titration of —. V. Birckner. J. Biol. Chem., 1919, **38**, 245–254.

THE presence of alcohol may raise the amount of alkali necessary to neutralise grain extracts of solutions of amino-acids. This may be due to interaction between the amino-groups and the alcohol.
—J. C. D.

Zinc; Content of — in some food products. V. Birckner. J. Biol. Chem., 1919, **38**, 191–203.

SMALL amounts of zinc were constantly found in egg yolk and in milk. It is possible that this element plays an important rôle in nutrition. (See further, J. Chem. Soc., 1919, I., 420.)—J. C. D.

Oysters; Zinc in —. R. S. Hiltner and H. J. Wichmann. J. Biol. Chem., 1919, **38**, 205–221.

ZINC is universally present in oysters grown in Atlantic waters. The amount found is very variable, and copper is probably also always present. (See further, J. Chem. Soc., 1919, I., 421.)—J. C. D.

Coffee berries; Determination of glaze on —. W. Friese. Pharm. Zentralh., 1919, **60**, 191–194, 203–206.

TEN grms. of the whole berries is shaken for 1 min. with 100 c.c. of a mixture of equal vols. of alcohol (90%), ether, and water; the liquid is then filtered through fine bolting cloth, the berries washed once with the above mixture, the liquid evaporated, and the residue dried and weighed. Unglazed berries yield about 0·5% of residue, glazed berries about 1·3%. The glaze may consist of coffee husk extract, dextrin, dextrose, starch, gum, molasses, gelatin, resin, shellac, glycerol, alkali carbonate, borax, mineral oil, vegetable oil, etc.—W. P. S.

Fruits; Composition of the mesocarp cells and their relation to the mellowing of —. C. Griebel and A. Schäfer. Z. Unters. Nahr. Genussm., 1919, **37**, 97–111.

CERTAIN fruits, particularly those of the *Pyrus* species, possess a mesocarp consisting solely of tannin cells; the term "inclusion cells" is adopted for such cells to distinguish them from the tannin idioblasts occurring in other vegetable tissues. These fruits rapidly pass from the ripe to the over-ripe or mellow stage, the only exception being the fruit of *Prunus spinosa* (sloe). During the mellowing process the tannin becomes insoluble,

and to this is due the disappearance of the bitter taste of the fruits. In the case of *Pyrus domestica* (service tree) the mesocarp cells contain a tannin soluble in water and in alcohol and which is combined, in part, with a sparingly soluble colloidal substance of unknown composition. The cell contents become insoluble when the fruit mellows or is dried, and brown-coloured substances are formed gradually; acetaldehyde is also formed during the mellowing process. Small quantities of pentosan and galactan are present in the mesocarp cells of *P. domestica*, but sugars are absent. The unchanged tannin in the cells appears to be a catechol derivative, since it yields the reactions of orthohydroxy compounds; on fusion with potassium hydroxide it gives a small amount of pyrocatechuic acid but no phloroglucinol. Its properties class it with the oak-bark tannins. "Inclusion cells" are present in the fruits of the following plants: *Pyrus communis* (pear), *P. salicifolia*, *P. betulifolia*, *P. amygdaliformis*, *P. sinensis*, *P. pulcherrima*, *P. baccata*, and *Prunus spinosa*.
—W. P. S.

Lignin-free crude fibre in cocoa [or chocolate]; Estimation of the —— by oxidation. T. von Fellenberg. Mitt. Lebensmitteluntersuch. u. Hyg., 1918, **9**, 277–283. Chem. Zentr., 1919, **90**, II., 685–686.

ONE grm. of cocoa or 2 grms. of chocolate is freed from fat, and added with 30 c.c. of *N*/1 nitric acid to a further 120 c.c. of the boiling acid; the solution is then boiled gently in a covered beaker, with stirring, for exactly 10 minutes, and filtered through a double filter paper of about 10 cm. diameter. After washing the residue thoroughly with hot water, and then successively with hot 1% caustic soda, hot nitric acid, ammonia, hot water, alcohol, and ether, the filter is dried for an hour in a water oven. The increase in weight gives the weight of lignin-free fibre and sand; the papers are then incinerated separately, and the difference in weight gives the weight of the sand. Good asbestos may be advantageously employed in place of filter paper.—L. A. C.

Enzymic studies on cellulose degradation products. Pringsheim and Von Markatz. *See* XVIII.

Fat in blood. Weehuizen. *See* XXIII.

PATENTS.

Cooling viscous liquids [e.g., sweetened condensed milk]; Process and apparatus for ——. R. Rafn, Moss, Norway. Eng. Pat. 121,117, 30.9.18. (Appl. 15,893/18.) Int. Conv., 30.11.17.

THE viscous liquid to be cooled, *e.g.*, sweetened condensed milk, is passed downwards through a wide inclined pipe which revolves inside a water-jacket through which cold water is passed in an upward direction. A hollow tube rests on the bottom of the inclined pipe and is supported in ball bearings at either end. A current of cold water may be passed through the hollow tube. The revolution of the inclined pipe causes the inner hollow tube to roll round, which action presses the milk between the sides of the two pipes and cools it evenly. When the milk reaches the end of the inclined pipe it is scraped off by a knife.—J. H. J.

Vegetable extracts; Manufacture of ——. G. Calvert, Twickenham Park, Middlesex. Eng. Pat. 127,950, 4.6.18. (Appl. 9230/18.)

FRESH vegetables are macerated with cold water, pressed, and extracted at a temperature below 50° C. to preserve the vitamines. A second quantity of vegetables mixed with sodium bicarbonate or sodium benzoate is digested with steam at 25 lb. pressure, and the two extracts are mixed and concentrated below 50° C. The second extract may be prepared from vegetable waste and concentrated by itself and then added to the first extract. Vegetable waste may also be used as the sole source of the extract, and the residue may be dried and used as a cattle food. The fresh extract may also be put up in pellet form by drying with sodium bicarbonate and mixing with the required quantity of tartaric acid to form an effervescent saline.
—J. H. J.

Potatoes; Process of treating —— to obtain potato flakes or potato flour or meal. F. E. Palmer, Norwich. Eng. Pat. 127,975, 10.6.18. (Appl. 9487/18.)

POTATOES are graded and washed, sterilised by steam at a pressure of 10 lb. per sq. in. for 20 mins., and cooled by exposure to a blast of air at 40° F. (5° C.). They are then sliced or shredded into portions ¼ in. thick, which are allowed to fall from the shredding machine through a hot-air chamber, where they are exposed to a forced draught at 300° F. (150° C.), and from which they pass to a drying machine and are dried at a gradually falling temperature for ½ hr. The product is in grain form and is ready to be milled. After milling the skins are extracted, and the grains are ground to flour.—J. H. J.

Potatoes, fruit, and vegetables; Preservation of ——. G. and H. Ney, Pölitz, Pomerania. Ger. Pat. 311,350, 1.11.17.

THE presence of a trace of coal gas or its constituents in the air of a room used for storing potatoes, fruit, or vegetables causes the tubers, etc., to remain "in the sap" and hinders but does not destroy the power of germination. The gas is suitably added by placing a vessel containing water from a gas-meter in the room.—L. A. C.

Semolina; Treatment of ——. A. R. Goodwin, Kidderminster. Eng. Pat. 128,089, 24.9.18. (Appl. 15,507/18.)

WHEATEN semolina is submitted to the action of steam until the outside of the grains becomes very slightly glutinous. A flavouring substance in the form of a thin paste or liquid, such as chocolate, fruit essence, vegetable extract, is then added, and the mixture is shaken until each grain becomes coated with the substance added. The product is steamed for a short time, and dried at 100°–150° F. (38°–65·5° C.) by passing hot air through it.
—J. H. J.

Alimentary substance; Method of producing an —— and product thereof. E. E. Gridley, Assignor to Minute Tapioca Co., Orange, Mass. U.S. Pat. 1,304,679, 27.5.19. Appl., 15.10.17.

TAPIOCA flour is mixed with 40–50% of water to form a crumbly dough, which is mechanically granulated and steam cooked with continuous stirring until it is of a gelatinous consistence. It is then dried, cooled, stored for a time, and crushed.
—J. H. J.

Citrus-fruit juices; Preservation of ——. R. F. Bacon, Pittsburgh, Pa., Assignor to Newmont Co., New York. U.S. Pat. 1,305,244, 3.6.19. Appl., 20.10.16. Renewed 29.10.18.

CITRUS-FRUIT juice is deoxidised, treated with sulphur dioxide, and allowed to stand until the

organisms present are destroyed. The sulphur dioxide is then removed by passing a non-oxidising gas through the juice.—J. H. J.

Drying various substances [vegetables]; Process for —. A. A. Goubert, Englewood, Assignor to H. Bentz, Montclair, N.J. U.S. Pat. 1,305,599, 3.6.19. Appl., 28.2.17.

A CURRENT of air is passed in a counter direction over the moving mass of vegetables to be dried. The temperature of the air at the point of first contact with the vegetables is maintained above that of the atmosphere, and the volume of the current is varied so as to maintain a constant high content of moisture at the point of last contact with the vegetables.—J. H. J.

Vegetables; Apparatus for treating and drying —. D. J. Pennock, Zevenbergen, Netherlands. U.S. Pat. 1,306,835, 17.6.19. Appl., 23.4.18.

THE material to be treated is fed through a hopper into a horizontal cylinder in which a shaft rotates carrying radial blades which pass the material into the top of a closed receptacle adapted to withstand internal pressure. A conveyor is situated inside the receptacle, and steam under pressure is admitted through a series of nozzles. The material is discharged from the bottom of the receptacle through a horizontal cylinder similar to the first one.—J. H. J.

Yeast; Dry — *and process of making same.* G. F. Whitney, South Orange, N.J., Assignor to Whitney Yeast Corporation, New York. U.S. Pat. 1,306,569, 10.6.19. Appl., 24.10.18.

WET yeast is mixed with soluble and insoluble carbohydrates suitable as yeast food, and the mixture is disintegrated and dried by a current of air at 100°—140° F. (38°—60° C.) until the moisture content is reduced to 15%.—J. H. J.

Food material; Apparatus for treating —. J. D. Belton, Crowley, La. U.S. Pat. 1,307,075, 17.6.19. Appl., 20.8.17.

EDIBLE fibrous material is finely comminuted and passed into a drying chamber, provided with a conveyor on which the material is spread in a thin layer. As the material is conveyed through the chamber it is dried and parched, and the moisture and chaff are removed. As it leaves the chamber it passes through a mill which reduces it to meal.—J. H. J.

Coffee substitute; Manufacture of a — *from lupins.* H. Thoms and H. Michaelis, Berlin. Ger. Pat. 305,604, 19.7.17.

LUPIN pods, which contain practically none of the bitter and poisonous constituents of the seeds, are separated from the seeds, and roasted either whole or finely divided, and preferably with addition of sugar, at 200°—250° C.—L. A. C.

Foodstuff; Manufacture of a — *rich in albumins from lupins.* H. Thoms and H. Michaelis, Berlin. Ger. Pat. 307,007, 15.2.17.

FINELY divided lupin seeds are freed from oil by extraction with benzene, ether, or a similar solvent, treated with alcohol to which has been added an acid for the purpose of fixing the alkaloids, and then with alkali carbonate. The product is dried and finely powdered.—L. A. C.

Potatoes. Ger. Pat. 311,453. *See* XVII.

XIXB.—WATER PURIFICATION; SANITATION.

Carbon dioxide in mine air; Estimation of —. H. R. S. Wilkes. J. Chem., Met. Soc. S. Africa, 1919, **19**, 216—218.

A RAPID approximate method for the determination of carbon dioxide in mine air on the spot is described, which is sufficiently accurate to determine whether the carbon dioxide is above the safety limit. The apparatus, which is portable, consists of several 8-oz. sampling bottles, and a set of 1-oz. reagent bottles, containing known amounts of *N*/10 baryta water, a little phenolphthalein, and distilled water to fill the bottle. Corrections for temperature, tension of water vapour, height above sea level, etc., are allowed for when measuring the amounts of baryta water into the reagent bottles. A table is prepared showing the percentage of carbon dioxide corresponding to each reagent bottle. In making a determination a sampling bottle is filled with the air by a bellows, and then connected to one of the reagent bottles. The contents of the two bottles are mixed and shaken for seven minutes. If the colour of the phenolphthalein is discharged, the air contains more carbon dioxide than the percentage given in the table; if the colour is rendered faint, the amount of carbon dioxide is equal to that given in the table; while if the colour is not changed, the carbon dioxide is less than that given in the table.—J. H. J.

Waste and by-products; Recovery and utilisation of —. C. Frabot. Mem. et Compt. Rend. Trav. Soc. Ing. Civils France, 1919, **72**, 7—26

ATTENTION is directed to the importance of the recovery of by-products, waste materials, etc., and to the wide field of research which such a subject entails. Amongst the instances cited to show the economy of recovering waste products are the recovery of alcohol and ether in the manufacture of explosives, of solvents from celluloid and rubber preparations, wool washings, oil from sewage, tin plate residues, and especially the recovery of ammonia and phosphates from sewage. (See also this J., 1919, 195A.) W. P. S.

Deposition of earthy impurities in water. Schulz. *See* XVII.

PATENTS.

Filters [; Water —]. W. E. Evans, London. From M. Lourtie, Belgian Army. Eng. Pat. 128,094, 2.10.18. (Appl. 16,021/18.)

As filtering material for small portable water filters, such as are used in the army, waste aluminium turnings or chippings are used, care being taken to remove powdered metal.—J. H. J.

Water; Process of purifying —. H. Kriegsheim, Assignor to The Permutit Co., New York. U.S. Pat. 1,305,123, 27.5.19. Appl., 20.9.18.

HARD water is treated first with an excess of alkali to precipitate the substances causing the hardness, and then with acid in sufficient amount to remove caustic alkalinity and also the remaining phenolphthalein alkalinity. The water thus treated is passed through exchange silicates to remove residual hardness.—J. H. J.

Quartz lamp [for sterilising by means of ultra-violet rays]. F. G. Keyes, Boston, Mass., Assignor to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,307,500, 24.6.19. Appl., 28.6.13.

A STERILISING apparatus comprises a stationary corrugated surface exposed to the action of ultra-violet radiation.—B. N.

Garbage disposal; Method of ——. E. C. Wallace, West Roxbury, and S. C. Prescott, Brookline, Mass., U.S.A. Eng. Pat. 117,267, 4.7.18. (Appl. 11,010/18.) Int. Conv., 5.7.17.

SEE U.S. Pat. 1,260,103 of 1918; this J., 1918, 321 A.

Refuse-destructor furnaces. H. N. Leask, Wallasey. U.S. Pat. 1,307,909, 24.6.19. Appl., 11.2.16.

SEE Eng. Pat. 3013 of 1915; this J., 1916, 326.

Separating solids. Eng. Pat. 128,114. *See* I.

Oxidation of combustible gases. U.S. Pat. 1,298,889. *See* IIA.

Combustible atmospheres. U.S. Pat. 1,298,890. *See* XXIII.

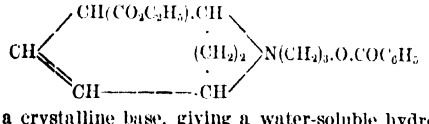
XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Dihydrohydroxycodeinone hydrochloride. M. Freund and E. Speyer. Münch. med. Wochenschr., 1917, **64**, 380—381. Chem. Zentr., 1919, **90**, I., 28—29.

THE hydrochloride of dihydrohydroxycodeinone (this J., 1917, 303), "eucodal," is a very stable substance, and its aqueous solution can be sterilised without decomposition. It has narcotic properties.—G. F. M.

Eckaine and certain homotropines; Pharmacological properties of ——. W. Wichura. Z. ex. Path. und Ther., 1919, **20**, 1—13. Chem. Zentr., 1919, **90**, I., 765.

N-BENZOYLHYDROXYPROPYLNORECGONIDINE ester, or eckaine,



is a crystalline base, giving a water-soluble hydrochloride which in neutral solution can be sterilised at 100° C. without decomposition. It is only slightly toxic, acts on the respiratory centre similarly to cocaine but to a lesser degree, and is a powerful local anæsthetic. Its administration causes at first a lowering, often followed by an increase, of the blood pressure. The anæsthetic action of other norecgonidine derivatives such as hydroeckaine, or the corresponding hydroxyethyl and hydroxyamyl compounds, is much weaker than that of eckaine. The tropic acid ester of homotropine, "mydriasine," acts on the pupil and vagus like atropine, and is an equally powerful mydriatic. In all these respects it is superior to the benzoic and mandelic esters, and to the tropic acid ester of dimethylaminopropanol.—G. F. M.

Caryophyllin and ursone; The isomeric lactones ——. F. D. Dodge. J. Amer. Chem. Soc., 1918, **40**, 1917—1939.

CARYOPHYLLIN was obtained in pure condition by the crystallisation of its potassium salt from aqueous methyl alcohol, and subsequent decomposition with hydrochloric acid. It melts at 310° C., and in alcoholic solution has $[\alpha]_D = +54{\cdot}5°$. It behaves as a weak acid and its acid value indicates the molecular formula, $(C_{16}H_{16}O)_3$. Since both a mono- and a di-acetyl derivative were obtained from caryophyllin, it appears to be the lactone of a dihydroxy acid, a supposition which is borne out by the general behaviour of both the acetates and the original substance. Oxidation with nitric acid converted caryophyllin into a tribasic acid, $C_{27}H_{43}O_3(CO_2H)_3$, caryophyllic acid. Ursone, prepared from bearberry leaves and purified by the above method for caryophyllin, is isomeric with that substance and shows remarkable similarity in chemical behaviour. The most characteristic distinctions are the much greater solubility of the potassium salt of ursone in alcohol, and the m.pt., 285° C. The chemical behaviour points to a lactone structure for this substance also.—G. F. M.

Arsenobenzenes; Chemico-therapeutics of certain ——, *particularly the arsalytes.* Glemsa. Deutsch. med. Wochenschr., 1919, **45**, 94—95. Chem. Zentr., 1919, **90**, I., 673—674.

A BRIEF report on hexa-aminoarsenobenzene, an easily soluble derivative, hexa-aminoarsenobenzene-sulphaminic acid

$(NH_2)_2C_6H_2.As:As.C_6H_2(NH_2)_2NHSO_3H$,

"ethylarsalyte,"

$NHC_2H_5(NH_2)_2C_6H_2.As:As.C_6H_2(NH_2)_2NHC_2H_5$,

and its dichloro substitution product. Certain members of these classes of substances have in addition to notable therapeutic properties the advantage of giving solutions which can be kept without change for a long period, when enclosed in ampoules in an atmosphere of an indifferent gas, or, with the addition of a reducing agent (sulphite), even when exposed to the air.—G. F. M.

Urea; Determination of —— *in urine.* Philibert. J. Pharm. Chim., 1919, **19**, 335—346, 386—397, 434—441.

TEN c.c. of the urine is treated with 2 c.c. of basic lead acetate solution, then diluted to 50 c.c. and filtered; 10 c.c. of the filtrate is transferred to a urometer, 5 c.c. of 10% sodium hydroxide solution is added, and the mixture well shaken so as to mix it with the mercury. The volume of gas liberated is observed. Control experiments with pure urea are made at the same time and under exactly the same conditions. Ammonia is determined separately and an allowance made for its quantity. The method is particularly suitable for the determination of urea in urines containing sugar.

—W. P. S.

[*Organic*] *acid salts; Decomposition of* —— *in aqueous solution into normal salts and free acids.* W. Dieckmann and A. Hardt. Ber., 1919, **52**, 1134—1142. (See also Sabalitschka, this J., 1919, 497 A.)

McCOY'S method of estimating the ratio of the first to the second dissociation constant of dibasic organic acids by extraction of aqueous solutions of their sodium hydrogen salts with ether and measurement of the concentration of acid in the aqueous and ethereal solutions (J. Amer. Chem. Soc., 1908, **30**, 688, 694) has been applied to homo-

phthalic acid, benzylmalonic acid, and α-keto-γ-phenyladipic acid. The influence of constitutive factors on the above ratio is discussed. (See also J. Chem. Soc., 1919, ii., 326.)—H. W.

Amylene, tertiary amyl alcohol. Organic chemical reagents II. R. Adams, O. Kamm, and C. S. Marvel. J. Amer. Chem. Soc., 1918, **40**, 1950–1955.

AMYLENE is prepared by vigorously boiling a mixture of 1500 c.c. of amyl alcohol and 100 c.c. of concentrated sulphuric acid under a reflex condenser maintained at 60°–90° C., the low boiling vapours passing through being led into an efficient condenser and about 900 c.c. of distillate collected, washed, and fractionated, whereby unchanged amyl alcohol is recovered, and 250 c.c. of amylene, b.pt. 32°–42° C., is obtained. For the preparation of larger quantities the catalytic method of Ipatiew (this J., 1903, 657) is preferable, using pumice soaked in a paste of aluminium oxide as catalyst in an electrically heated tube furnace, 5 ft. long and 2 ins. in diameter. The optimum temperature for the dehydration of amyl alcohol is 500°–540° C., and with an apparatus of the above dimensions 1 litre per hour can be catalysed, giving a 70–80% yield of pentene free from iso-amyl ether which is formed in large quantities by the sulphuric acid method. Tertiary amyl alcohol is obtained from amylene by gradually running 500 c.c. into an ice-cold mixture of 500 c.c. of concentrated sulphuric acid with its own volume of water, with vigorous agitation, decomposing the hydrogen sulphate with concentrated sodium hydroxide, distilling off the alcohol from the reaction mixture and salting it out of the distillate with potassium carbonate, 325 grms. of hydrocarbon giving 275–300 grms. of alcohol boiling at 100°–103° C.—G. F. M.

Carbon tetrachloride, chloroform, and carbon hexachloride [*hexachlorethane*] *from natural gas.* G. W. Jones and V. C. Allison. J. Ind. Eng. Chem., 1919, **11**, 639–643.

FOR the successful chlorination of natural gas, without using a large excess of either natural gas or chlorine, a catalyst is required to make the reaction proceed smoothly without explosions or deposition of carbon, and to effect the substitution of the chlorine in the methane or ethane molecule, instead of producing carbon and hydrochloric acid, $CH_4+2Cl_2=C+4HCl$. Catalysts, such as active charcoal, steamed anthracite coal, and "bachite" (a patent form of carbon) are very effective, whilst other forms of charcoal, or coke impregnated with metals or metallic oxide, allow some of the chlorine to pass without reacting. The best catalysts for complete chlorination are those with a high absorptive capacity for chlorine. Methane is less reactive towards chlorine than are saturated hydrocarbons of higher molecular weight. At certain temperatures ethane will react readily with chlorine to form hexachlorethane, while there is little reaction with methane. The natural gas used in the experiments contained methane 89·5, ethane 10·1, and nitrogen 0·4%. Regulated supplies of the gas and of chlorine were conducted through a reaction tube containing 100 grms. of the catalyst protected at each end by glass wool; the tube was heated in an electric furnace, and the hot products of the reaction were passed through a triple-walled condenser, then through a trap into a sodium hydroxide scrubber, and afterwards into two flasks containing water, and cooled in ice-baths. The reaction begins a little below 250° C., and increases in intensity up to about 500° C., at which temperature the catalyst is attacked and carbon begins to deposit. The reaction is promoted by the presence of a little moisture (1% by vol.). One litre of natural gas (90% CH_4 and 10% C_2H_6) when completely chlorinated should yield 4·01 c.c. of liquid chlorination products. The distillate above 80° C. from the scrubber and cooler consisted of a mixture of carbon tetrachloride and hexachlorethane, which could be separated by repeated fractional distillation, whilst only a negligible quantity of chloroform was produced. In practice with larger quantities of gas it was found best to mix the gases in the presence of the catalyst in the cool part of the reaction tube projecting about 6 in. outside the furnace, no explosion then occurring in the heated part of the tube. When the natural gas was introduced into the tube at the rate of 1 litre per hour, together with the maximum amount of chlorine, the methane was completely converted into carbon tetrachloride, and the ethane into hexachlorethane. By increasing the velocity of the gas chloroform was obtained in addition to carbon tetrachloride.—C. A. M.

Chloroform; Electrolytic preparation of . . . J. Feyer. Z. Elektrochem., 1919, **25**, 145–145.

THE electrolytic preparation of chloroform from alcohol and acetone has been investigated under various conditions, particularly in solutions of alkaline-earth chlorides and alkali chlorides. Many of the statements in the literature are inaccurate owing to faulty analytical details. The present methods of isolating chloroform are imperfect; this applies both to the method of absorption in alcohol and to the distillation method. Both methods involve considerable loss of material. Pure chloroform can only be directly obtained by freezing it out of its mixture with hydrogen by means of solid carbon dioxide and ether. The present methods of electrolysis are inefficient because the alkali produced in the process decomposes considerable quantities of chloroform. By using a neutralisation cathode, *i.e.*, a second cathode in a porous cell through which is passed a current of sufficient strength to keep the electrolyte approximately neutral, it is possible to obtain a current yield of 65%. When platinum electrodes are used a yield of 75–80% of the theoretical quantity of chloroform (calculated from the quantity of acetone) is obtained with a current density of 1·1 amp. per sq. cm. at the anode and 0·5 amp. per sq. cm. at the cathode. The primary reaction in the electrolysis is the formation of hypochlorite, which is followed by the reaction, $CH_3COCH_3+3HOCl=CHCl_3+CH_3COOH+2H_2O$. Methyl ethyl ketone and higher ketones react in the same way with electrolytic hypochlorite. The method for the preparation of chloroform from alcohol put forward by Trechzinsky (this J., 1907, 100) is criticised. It is, however, possible in the case of alcohol by the introduction of a neutralisation electrode to obtain considerable yields of chloroform at 25°–35° C., when a current density of 1 amp. per sq. cm. is used at the anode and 1·5 amp. per sq. cm. at the cathode. A current yield of 77% and a material yield of 82% was obtained under these conditions. The maximum yield is obtained at 25°–30° C. The preparation of chloroform from acetone or alcohol in calcium chloride solution only proceeds well when nickel or copper cathodes, which have been immersed in strong nitric acid for a few moments and then washed with water, are used. Under these conditions a current yield of 71% and a material yield of 80% was obtained from acetone, whilst from alcohol a 99% material yield and a 90% current yield was obtained. The formation of chloroform occurs in three stages as indicated by the equations (1) $CH_3CH_2OH+HOCl=CH_3CHO+H_2O+HCl$;

(ii) $OH' + Cl_2 = H' + Cl' + ClO'$; (iii) $CH_3CHO + 3HOCl = CHCl_3 + HCOOH + 2H_2O$; (iv) $H.COOH + HOCl = CO_2 + H_2O + HCl$. The reaction (i) is often partially replaced by the reaction $CH_3.CH_2OH + O = CH_3CHO + H_2O$.—J. F. S.

Hydrocarbons in light petroleum. Chavanne and Simon. *See* IIA.

Chlorobenzenes. Coppin and Holt. *See* III.

Titration of amino-acids. Birckner. *See* XIXA.

Fat in blood. Weehuizen. *See* XXIII.

PATENTS.

Amines; Preparation of ——. W. Rintoul, J. Thomas, and Nobel's Explosives Co., Ltd., Stevenston, N.B. Eng. Pat. 127,740, 15.6.18. (Appl. 9894/18.)

TERTIARY amines are isolated from mixtures containing also primary and/or secondary amines by converting the latter into the corresponding urethanes by treatment in the cold with ethyl chloroformate in presence of aqueous sodium carbonate. The unchanged tertiary base is removed from the urethanes by washing with dilute mineral acid and is recovered by treatment of the acid washings with alkali, whilst the primary and secondary bases are regenerated by hydrolysis of the urethanes. For example, 230 grms. of crude dimethylaniline, containing 22% of monomethylaniline, is agitated with a solution of 30 grms. of sodium carbonate in 150 c.c. of water, and 53 grms. of ethyl chloroformate is gradually added. Agitation is continued for 15 mins. The residual oil, separated from the aqueous layer, is washed with dilute hydrochloric acid to remove unchanged dimethylaniline, and the insoluble methylphenylurethane is hydrolysed by boiling with *N*/10 alcoholic potash.—G. F. M.

Gulonic lactone; Process of manufacturing ——. F. B. La Forge, Washington, D.C. U.S. Pat. 1,285,248, 19.11.18. Appl., 13.4.18. (Dedicated to the public.)

GULONIC lactone is prepared by treating 100 grms. of xylose in aqueous solution with hydrocyanic acid generated from 40 grms. of sodium cyanide and 80 grms. of 50% sulphuric acid. After standing for about 20 hours, a further 84 grms. of 95% sulphuric acid is added to convert the sodium sulphate into the more soluble acid sulphate and the ammonia formed in the reaction into ammonium sulphate, and the solution is concentrated in a vacuum to a thick syrup from which nearly pure gulonic lactone crystallises after standing for several hours. The yield is about 40 grms.—G. F. M.

Trimethylene glycol disalicylate and method of preparing the same. A. M. Clover, Assignor to Parke, Davis and Co., Detroit, Mich. U.S. Pat. 1,286,944, 10.12.18. Appl., 4.5.18.

TRIMETHYLENEGLYCOL disalicylate is prepared by treating trimethyleneglycol (100 grms.) with sulphuric acid (50 grms.) at a temperature not exceeding 100° C., adding salicylic acid (200 grms.), and heating to 100° C. in a covered vessel. The reaction product is poured into water at 50° C., and the unchanged salicylic acid is neutralised with sodium carbonate. On cooling the ester solidifies, and is purified by crystallisation from alcohol. It melts at 77° C., is colourless and odourless, and has valuable medicinal properties, especially in the treatment of rheumatism.—G. F. M.

Tobacco; Denarcotising ——. H. Brinkhaus, Brooklyn, N.Y. U.S. Pat. 1,304,539, 27.5.19. Appl., 30.6.17.

A MIXTURE of steam and air is passed over tobacco in a closed chamber at such a temperature that the nicotine is removed without destroying or removing the aromatic substances.—W. F. F.

Glycerin substitute for technical, pharmaceutical, and cosmetic purposes. Chem. Fabr. Flörsheim Dr. H. Noerdlinger, Flörsheim. Ger. Pat. 311,374, 3.9.16.

A SUBSTITUTE for glycerin is composed of magnesium butyrate, either alone or mixed with a small percentage of glycerin, alcohol, or with other glycerin substitutes, magnesium chloride in particular.—L. A. C.

Nickel catalyser. U.S. Pat. 1,305,173. *See* XII.

Regenerating catalysts. U.S. Pat. 1,306,871. *See* XII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photographic rendering of contrast; The fundamental law for the true ——. A. W. Porter and R. E. Slade. Phil. Mag., 1919, **38**, 187–197.

ASSUMING that for a true rendering of contrast in a print it is necessary to have the same ratio of light emitted from two portions of the final picture as that which fell in the camera from the two corresponding portions of the subject, the authors deduce the relationship between the characteristic curves for the plate used for the negative and the material used for the final picture. If E_1 be the light incident on any point of the plate and I_1 be the light transmitted by the corresponding point of the print (for simplicity taken as a transparency) when illuminated by light of strength V, then $I = KE_1$ where K is a constant reduction factor. If the characteristic curve (logs. exposures plotted against densities) of the negative plate be known, the authors show that to maintain the ratio $I = KE_1$ the characteristic curve of the printing material is obtained by turning the plate curve through 90° and then viewing it from the back. The position of the origin of the new curve is dependent upon the particular values selected for the printing and viewing lights of the positive and upon the reduction factor, K. The nearer K is to unity the more nearly will the light from the positive be not only the same in gradation as that from the subject but also the same in absolute intensity. Taking the simpler (theoretical) case where the whole of the negative image is within the straight line portion of the plate curve, a printing medium must be selected with a sufficiently long straight line portion and developed to such a gamma that the product of gammas of positive and negative is unity; this is fairly easy for a transparency but it may be difficult for a print on paper, since papers have generally a very short straight-line range. It is not necessary however to be restricted to the straight-line portions of the curves since there is a certain amount of correspondence between the lower (under-exposure) portion of a plate curve and the upper portion of its conjugate; by careful selection

of negative and positive materials it is possible therefore to get a fair approximation to a correct rendering in the print, or a major portion of it, using the under-exposure periods in both cases. The work and conclusions of previous workers in this field—Hurter and Driffield, Jones, Nutting, and Mees, Renwick, and Rayleigh—are subjected to considerable criticism.—B. V. S.

Intensity- or intermittency-scales for sensitometric purposes. Some remarks on their applications. A. Odencrants. Z. wiss. Phot., 1919, **18**, 209—220.

A HISTORICAL summary of the various methods used in obtaining graded exposures for photometric purposes is given, and the objections to the intermittency time-scale (sector wheel) method are discussed in some detail. The main argument against the use of an intensity screen, that of the possibility of spectral selectivity of the absorbing medium, is overcome by Goldberg's method of obtaining neutral tint wedges of either the continuous or the step form. The author used a wedge of a range of about 1 : 10,000 in a simple form of dark slide, allowing a number of exposures to be made side by side on one plate and having two plate-holders to accommodate different sizes of plate. Exposures were made with a 10-volt osram-nitrogen lamp which was controlled with the aid of a milli-voltmeter, a constancy of 1% in the light value being easily maintained. For easy interpretation of the results, more especially where only comparisons were required, prints were taken of the wedge pictures on a hard-gradation development paper, positions of equal density on different pictures being easily selected by direct comparison of the prints. Figures are given showing the difference in halation with an ordinary plate and an Isolar (anti-halation) plate, and the different effects of a series of colour filters on an ordinary and a colour-sensitive plate.—B. V. S.

Intensity weakening for development papers. [Schwarzschild's constant.] A. Odencrants. Z. wiss. Phot., 1919, **18**, 220—226.

WITH apparatus described in the preceding abstract determinations were made of Schwarzschild's constant (p in the expression $i_1 t_1^p = i_2 t_2^p$, for equal effects, where t is the time of exposure and i the corresponding intensity). A series of eleven exposures, increasing or decreasing by the ratio 1·5 for consecutive exposures, was given; the positions of corresponding points on adjacent images noted, and p determined from the usual formula $p = (\log I_2 - \log I_1)/(\log t_2 - \log t_1)$. A table is given showing the results obtained for seven papers of different makes and qualities with a normal metol-quinol developer, also for one of the papers with a metol and a quinol developer and a mixture of these, with another paper for different times of development, and with another paper for violet, blue, and blue-green filters. The total range of p was from 0·67 to 0·95. The results indicate that p increases with hardness, and that different developers give different values of p, metol (a rapid developer) giving a higher value than quinol (a slow developer) (p = 0·94 and 0·85 resp.); in the mixture the effect of the metol dominates. Increase of time of development gives a higher value for p (0·83 for 20 secs., to 0·87 for 120 secs.). Within the range of the maximum of sensitiveness p remains constant with variation of the wave-length; outside these limits p decreases with increasing wave-length (p = 0·9 for blue and violet and 0·87 for blue-green). Within the limits of ordinarily used light intensities p is almost constant; it may possibly increase somewhat with increasing intensity.—B. V. S.

Milk-silver [photographic] emulsions. B. Maklakoff. Russ. phot. Anzeiger, Odessa, March, 1916, 90. Z. wiss. Phot., 1919, **18**, 240.

AN emulsion suitable for the preparation of sensitised paper is obtained by adding a solution of 2·3 grms. of silver nitrate and 0·3 grm. of citric acid in 10 c.c. of water, treated with ammonia slightly in excess of the quantity required to re-dissolve the precipitate first formed, to a solution of 2 grms. of potassium bromide and 0·3 grm. of sodium chloride in 40 c.c. of cream, raised nearly to boiling point. The emulsion is kept in hot water for some hours, filtered, and then coated on the paper. After drying, the paper is washed with distilled water and again dried.—B. V. S.

Photographic plates; Influence of temperature on . G. von Dalezki. Russ. phot. Ber. Odessa, 1916, 155. Z. wiss. Phot., 1919, **18**, 233—234.

THE apparatus used consisted of a camera with revolving plate-holder and suitable lens and shutter, before which was placed a matt-white screen illuminated from the side by a Uviol lamp. An image of a small rectangular patch was thrown on to the plate, by revolving which eight such images could be received by one plate. The apparatus was enclosed in a double-walled, water-jacketed chamber, dead black inside, the temperature of which could be controlled to $\pm \frac{1}{2}°$ over the range 7° to 64° C. With white light a temperature coefficient was obtained of 1·06 with plates in their usual condition, and also with plates thoroughly dried. With pinachrome-sensitised plates the values obtained were 1·04 for blue light and 1·08 for green light and yellow light, or if the plates were previously slightly fogged, 1·03 for blue light and 1·04 for green and yellow light. Previous determinations of temperature coefficient have been: Lumière, 190° to 20°, 1·03, Schellen, - 32° to 90°, 1·00, Padoa-Mervini, 85° to 15°, 1·05, and, for previously fogged plates, Abney and Dewar, 190° to 200 C., 1·08.—B. V. S.

PATENTS.

Pigment or "carbon" printing by silver. T. P. Middleton, London. Eng. Pat. 127,953, 5.6.18. (Appl. 9293/18.)

THE sensitive film is a thin coating on a temporary support of a gelatino-bromide of silver emulsion containing a suitable pigment such as lampblack, sepia, etc., not affected by the subsequent processes. The emulsion is preferably of the type in which emulsification is carried out in part only of the gelatin, this allowing of the intimate mixture of the pigment with the remainder of the gelatin in ordinary actinic light. The temporary support for the sensitive film is one which allows the transfer to the final support, or to the intermediate support in case of double transfer, by stripping when dry or by aid of a solvent, such as alcohol or benzene, but not by the assistance of hot or cold water. In order to equalise the exposures with differently coloured pigments and to keep the effect of the exposure as far as possible in the upper layers of the film, a non-actinic dye such as Naphthol Yellow may be added to the emulsion. The developer used should be one, such as amidol or glycin, with only slight tanning action on the gelatin; fixing should be effected in a bath made slightly acid, preferably with boric acid, or may be omitted. After transfer and removal of the original support the silver image is bleached in a bath such as a solution containing chromic acid, copper sulphate, and potassium bromide, the silver bromide thus produced is fixed

or developed, and the film washed and dried. In the double transfer process the intermediate support is preferably prepared by treatment with a solution of caoutchouc, gum elemi, and gum dammar in benzene which allows transfer by mere stripping.
—B. V. S.

Photographic materials; High-temperature development of —. A. J. Agnew, F. F. Renwick, and Ilford, Ltd., Ilford. Eng. Pat. 128,337, 20.4.18. (Appl. 6723/18.)

To allow of the development etc. of plates, papers, and films at high temperatures the gelatin film is first hardened by treatment in a bath containing formalin and a salt which has the property of raising the melting point of a gelatin jelly and of retarding or restricting the absorption of water by dry gelatin; the restraining action of the salt allows the hardening effect of the formalin to take place before melting of the gelatin film, which might otherwise occur in a solution of formalin alone. The most suitable salts are sodium citrate, sodium, ammonium, and magnesium sulphates, and disodium ortho-phosphate, a suitable solution being 2½% of 40% formalin and 20% of sodium sulphate. Paraformaldehyde or other substance easily giving formaldehyde in solution may be used in place of the formalin solution; a solid preparation in convenient form may be made by mixing paraformaldehyde and one of the salts in anhydrous form. After rinsing, to free the film from excess of the hardening solution, the developing process may be at once proceeded with, no restrictions as to the developer being imposed by the hardening bath. The temperature may be as high as 110° C. and no cooling device is necessary.—B. V. S.

[*Photographic*] *coloured image and process of producing the same.* J. I. Crabtree, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pat. 1,305,962, 3.6.19. Appl., 25.1.17.

A SILVER image is copper-toned and then treated in a solution of a dye to which the copper acts selectively as a mordant.—B. V. S.

Colour photography. F. E. Ives, Philadelphia, Pa. U.S. Pat. 1,306,904, 17.6.19. Appl., 9.8.17.

DIFFERENTLY sensitised films, one or more of which may be also coloured, are arranged in one pack so that the upper films act as colour screens for the lower ones, different colour records being thus obtained. For instance, the upper film may be blue-sensitive, the second film green-sensitive and dyed red to form a screen for the third, red-sensitive, film; to bring the sensitive surfaces as near together as possible the outer ones are placed facing one another and the middle film is coated on celluloid.—B. V. S.

XXII.—EXPLOSIVES; MATCHES.

Cotton wool and its substitutes for the manufacture of nitrocellulose. R. Schwarz. Oesterr. Chem.-Zeit., 1919, **22**, 50—52, 57—60.

FOR use in the manufacture of nitrocellulose the waste from textile factories and cotton and linen rags are purified by boiling with dilute alkali under pressure, followed by mechanical treatment to remove knots, impurities, etc., bleaching with calcium hypochlorite, and disintegration in two machines. The loss in these operations varies according to the kind of rags from about 20 to 40%. To prevent loss in the form of dust attempts have been made to cut the rags into fragments before bleaching, but this caused irregular nitration. The following specifications have been issued:—Maximum ash in nitration cotton wool, 0·6% (or 1·2% in the torn partially purified rag material); fat, 0·4% (or 1·0% in the impure material); and water, 6%. A white colour, freedom from chlorine, acidity, and dust, and the absence of vegetable impurities are also specified. Too high ash results in waste of the nitrating acids, and causes difficulty in gelatinising the nitrocellulose powder, whilst fat in excess of the specified amount increases the difficulty of nitration and leads to overheating of the mixture. Short fibre fragments are unsuitable for nitration, since some of the nitrocellulose then remains dissolved in the waste nitrating acid, and causes explosions when this is redistilled. Experiments on the use of wood cellulose showed that conifer woods, containing on the average 0·4 to 0·5% of ash and about 8 to 10% of water, are the most suitable for this purpose, whilst soft woods, such as poplar, lime, and beech, yield inferior products. In preparing the wood the outer bark, dirt, etc., are removed, and the wood cut into sections about 1 m. long and 5 cm. thick, and these are shredded, whilst the harder parts (knots) are ground in a mill. The soda process gives a product which dissolves to some extent in the subsequent acid treatment, and is difficult to bleach, but, apart from the lower yield, the cellulose obtained by this process does not differ materially from that obtained by the sulphite-cellulose process. The Ritter-Kellner method of direct boiling proved cheaper and yielded a cellulose which was softer and absorbed acid more readily than the product obtained by the Mitscherlich sulphite process. It was specified that suitable wood cellulose should weigh from 18 to 22 grms. per sq. m., should be in flocks of 5 to 10 cm. in size, free from small particles, dust, knots, and vegetable impurities. It should absorb acids readily (35 to 40 mins. per charge), and should be white and free from bleaching agent (chlorine). The permissible limit for ash was fixed at 0·6%; fat and rosin, 0·5%; water, 6%; and wood gum (alkali-soluble constituent of cellulose), 2·5%. When nitrated it should not become pasty, and must not become more than pale yellow (not brown). It should be free from lignin. Cellulose and cellulose wool intended for the manufacture of smokeless powder must have been made from well-seasoned wood and be free from knots. After boiling and washing the unbleached cellulose should give, at most, a slight rose coloration in the phloroglucinol test. It should be bleached in the cold with a not too concentrated solution, washed, and dried at a temperature not exceeding 110°—120° C. In 1915—1916 cellulose wool was only used as a partial substitute for cotton wool, but subsequently it was used alone. Nitrated wood cellulose is usually chemically purer than cotton cellulose. It consumes somewhat less acid in nitration, and there is less risk of ignition. The opening of the compressed balls in the powder factory is more readily effected, and with less loss (dust) than in the case of the cotton product. It is also dried more rapidly, and there is less loss in washing the nitrocellulose, whilst the last traces of absorbed acid are removed more easily. On the other hand, wood cellulose is more voluminous than cotton cellulose, so that the nitration charge is reduced by about 10%. The adherent (as distinguished from the absorbed) acid requires longer washing to remove, and the absorptive capacity for acid is less than with cotton cellulose. On the whole, however, the advantages outweigh the disadvantages.—C. A. M.

Wood pulp cellulose; Nitrating ——. S. D. Wells and V. P. Edwardes. Paper, Ann. Conv. No., 1919, **23**, 180—185.

THE woods of the deciduous trees are considerably inferior to those from coniferous trees as raw materials for the manufacture of cellulose suitable for nitration. The inferiority is based mainly on the high percentage of pentosans in the cellulose and on the extreme shortness of the fibres of the former group. In the manufacture of wood cellulose the most difficult point to meet in the specification is that which requires a solubility in 10% potassium hydroxide solution not exceeding 7%. Soda wood pulp manufactured from Jack pine in the unbleached condition, prepared by rapid digestion by severe treatment, came within the limits of the specification, but after bleaching, the amount of matter soluble in caustic alkali was increased to an abnormal extent, so that the specification could not be met when more than 5% of bleaching powder was employed. That amount, however, is quite inadequate for bleaching a soda wood pulp, so that the authors recommend the use of soda pulp only in the unbleached condition, and consider the caramelised brown colouring matters as probably innocuous for explosives manufacture. Sulphite pulp, on the other hand, does not form products soluble in caustic alkali as the result of moderate bleaching, but it contains a large amount of such matters originally. By digesting sulphite pulp with weak caustic soda under mild conditions, matters soluble in alkali are removed, but the pulp suffers a loss of about 25% in weight. Sulphite pulp so treated is sufficiently pure to pass the nitration tests without bleaching, but if a good colour be required it may be bleached satisfactorily with 4% of bleaching powder. Batches both of soda pulp and purified sulphite pulp in the form of crêped sheets have been submitted to nitration with distinctly satisfactory results. The sheets nitrated evenly, yielding products with high solubility in ether-alcohol, and a high nitrogen content. The sulphite pulp gave a little trouble in the wringers on account of the clogging of the holes. The nitrocellulose from the wood pulp occupied more space in the boiling tubs than that from cotton but it was ground in half the time in the hollanders. The wood pulp product was not so easily dehydrated as that from cotton. It was less viscous than nitro-cotton and a saving of 10% in solvent was recorded. Yields of nitrocellulose from wood pulp in the laboratory showed 150%, as compared with 160—165% from cotton.—J. F. B.

Nitrocellulose from wood pulps. W. E. B. Baker. Techn. Assoc. Pulp and Paper Ind., New York, Feb. 6 and 7, 1918, 45—47.

WAXY and resinous impurities present in wood pulp tend to form yellow compounds on nitration which have a bad influence on the stability. The yellow compounds are partly eliminated by prolonged boiling with water, preferably with the addition of a little sodium carbonate. The presence of hydrocellulose or oxycellulose in the wood pulp is also highly deleterious from the point of view of stability, and the products of the chlorine bleach are very detrimental. The mineral constituents of the pulp, especially the silica, should be reduced to a minimum. Vegetable wax and resins present a resistance to the uniform penetration of the nitrating acids which is inimical to successful nitration; for this reason the ether-extract of the cellulose should not exceed 0·4%. The physical condition of the cellulose is of the greatest importance; the texture and length of fibres should be as uniform as possible. The yield of nitrated product is considerably reduced by the presence of modified cellulose which is soluble in the acids. For this reason bleached soda pulp gives results greatly inferior to sulphite pulp. The suitability of a pulp from this point of view may be determined by the loss of weight when boiled with a 10% solution of potassium hydroxide. Samples of wood pulp specially manufactured in Germany for the preparation of explosives have been examined and nitrated on the large scale, and the nitrocellulose obtained was in every respect equal to similar products prepared from cotton.—J. F. B.

Nitrogen peroxide explosives; Experiments with ——. H. Kast and P. Günther. Z. ges. Schiess- u. Sprengstoffwesen, 1919, **14**, 81—84, 103—105. Chem. Zentr., 1919, **90**, II., 794.

PRELIMINARY experiments with mixtures of nitrogen peroxide with benzene, toluene, nitrotoluene, carbon tetrachloride, nitrobenzene, and carbon bisulphide, in the proportions necessary for complete combustion, showed that only the mixtures with nitrobenzene and carbon bisulphide were strongly explosive. The mixtures were fairly stable in the laboratory, but the nitrogen peroxide acted slowly upon nitrobenzene, even at the ordinary temperature. Soft non-plastic masses were obtained by absorbing the mixtures in kieselguhr. The explosive force of the nitrobenzene and carbon bisulphide mixtures in varying proportions with nitrogen peroxide was tested in Trauzl's lead cylinder and in Kast's apparatus, and their sensitiveness to shock and ignition was also determined. In the case of the nitrobenzene mixture a sharp maximum in the explosive force was observed at 70% N_2O_4, whilst with the carbon bisulphide mixture a less sharp maximum was obtained at 65% N_2O_4. Tested in Kast's apparatus the nitrobenzene mixture showed an explosive force approximately equal to that of nitroglycerin, which was remarkable in view of its lower specific gravity (1·3 as compared with 1·6). On the other hand, the carbon bisulphide mixture (panclastite) described by Turpin in 1881 has so little activity that, in view of its disadvantages, it is unsuitable for technical purposes. The sensitiveness to shock of both mixtures is approximately equal to that of nitroglycerin. A mixture of 65 parts by vol. of nitrobenzene with 35 parts of carbon bisulphide gave the best results in admixture with nitrogen peroxide, the liquid freezing at a lower temperature than nitrobenzene. The explosive force of the product thus prepared exceeds, under favourable conditions, that of picric acid in the lead block. C. A. M.

Nitrocellulose products, especially nitroglycerin powders; New stability test for ——. F. M. Mayrhofer. Z. ges. Schiess- u. Sprengstoffw., 1918, **13**, 425—429, 448—451. Chem. Zentr., 1919, **90**, II., 702.

IN the method of Bergmann and Junk (this J., 1904, 953), the author recommends the use of 20 c.c. of a 2% solution of potassium iodide instead of water for the quantitative collection of the decomposition products. For estimating the stability of a nitroglycerin powder, it is tested both dry and moistened with 0·05 grm. of water. A stable powder behaves in a similar manner whether heated dry or moist, whereas an unstable powder is rapidly decomposed in the presence of traces of moisture. By this method, variations of stability can be detected which are not apparent by the usual test at 120° C.

—L. A. C.

Trinitroxylene. D. E. Schweizer. Z. ges. Schiess- u. Sprengstoffw., 1919, **14**, 24—25. Chem. Zentr., 1919, **90**, II., 700.

XYLENE is more readily nitrated than toluene. On account of the difficulty of isolating the xylene from

coal tar, only certain fractions, *e.g.*, solvent naphtha, have hitherto been nitrated, and these give liquid products. If however 50 grms. of technical xylene, containing only the three isomers, is nitrated with 500 grms. of mixed acid consisting of 2 parts of nitric acid (sp. gr. 1·52) and 3 parts of sulphuric acid (sp. gr. 1·84), 52 grms. of a solid trinitroxylene and 17 grms. of a yellow liquid nitroxylene are obtained. The presence of a small amount of dinitroxylene renders the product useless as an explosive, but by a second nitration a trinitroxylene capable of detonation by 0·15 to 0·2 grm. of silver azide is obtained in the form of white crystals melting between 120° and 177° C.—L. A. C.

Cellulose from cotton linters. Wallace. *See* V.

Inflammability of aluminium dust. Leighton. *See* X.

PATENTS.

Powder; Process of making propellant ——. *Process of producing propellant powder. Process of producing propellant explosives.* E. I. du Pont de Nemours and Co., Assignees of (A) A. L. Broadbent and R. G. Woodbridge, jun., (B) O. J. Teeple, jun., and (C) A. S. O'Neil, Wilmington, Del. Eng. Pats. (A) 127,871, (B) 127,872, and (C) 127,873, 9.6.17. Appls. 8260 -2/17. Int. Conv., (A) 14.7, (B) 29.7, and (C) 17.8.16.

(A) THE surface of grains of propellant powder, such as nitrocellulose powder, are coated with a deterrent material, such as dinitrotoluene, by heating the substances together in the presence of a liquid such as water, in which neither of them is soluble. The heating may be effected at a temperature below the melting point of the deterrent material. (B) Gelatinised powder grains (*e.g.* of nitrocellulose powder) are impregnated with a material which is a solvent for the grains, by treating the latter with the deterrent material (dinitrotoluene or substantially pure 1.2.4-dinitrotoluene) and subjecting the treated grains to the action of heated vapour, such as steam. (C) The explosive grains are heated with the deterrent material, in the presence of a small quantity of a solid substance (*e.g.* camphor) to lower the melting point of the deterrent material, with or without the addition of a stabilising agent, such as diphenylamine.—C. A. M.

Azides; Production of ——. W. R. Hodgkinson, Woolwich. Eng. Pat. 128,014, 17.6.18. (Appl. 9952/18.)

AZIDES are produced by diazotising salts of hydrazine by means of a suitable nitrite under such conditions that the reaction mass is at no time so distinctly acid as to redden litmus paper. For example, the calculated amount of sodium nitrite in 500 c.c. of water is added to a solution of 130 grms. of hydrazine sulphate which has been converted to hydrazine ammonium sulphate by the addition of ammonia in 500 c.c. of water; the solution is then added gradually to 1000 c.c. of *N*/1 silver nitrate solution to which has been added 1 c.c. of 70% nitric acid. During each addition, the solution must be well stirred and the temperature kept below about 30° C. In the production of lead azide, a hydrazine salt of an acid which will not precipitate an insoluble lead salt, *e.g.* hydrazine nitrate, is employed.—L. A. C.

Trinitrotoluene; Method of and apparatus for drying —— in a molten condition. The Clayton Aniline Co., Ltd., and A. Schedler, Manchester. Eng. Pat. 128,263, 5.7.17. (Appl. 9722/17.)

CRUDE trinitrotoluene, after being washed and melted with hot water, is run on to a tray heated underneath by means of a steam-jacket. The tray is slightly inclined and is divided into compartments by transverse partitions perforated at the bottom to allow the material to pass from one compartment to the next.—L. A. C.

Picric acid or other products of nitration; Continuous process and plant for the production of ——. Brookes Chemicals, Ltd., and N. Brooke, Lightcliffe, Yorks. Eng. Pat. 128,303, 27.7.17. (Appl. 10,811/17.)

NITRIC acid, phenolsulphonic acid, and waste acid are fed into one end of a long trough provided with a series of baffle-plates throughout its length. The reaction, which begins in the first portion of the trough with the development of a certain amount of heat, is completed in the central portion where the reaction mixture is heated by a number of tubes through which steam is passed; in the last portion of the trough, the product is cooled by means of similar tubes supplied with water. Picric acid crystallises out and is carried down an inclined shoot to a filter. The trough is covered with slabs while the process is working and fumes are removed through suitable openings. The plant may be used for the nitration of other products.
—L. A. C.

Guncotton and the like; Method of and apparatus for treating ——. F. D. Crane, Montclair, N.J. U.S. Pat. 1,295,089, 18.2.19. Appl., 14.1.18.

THE explosion of wet guncotton while being treated in a centrifugal dryer is prevented by suddenly reducing the pressure of the gaseous medium surrounding the mass at a definite stage in the drying process. The rapid evaporation cools and loosens the mass.—W. F. F.

Nitrostarch explosive. C. E. Waller, Allentown, Pa., Assignor to Independent Non-Freezing Powder Co., Newark, N.J. U.S. Pats. (A) 1,305,845 and (B) 1,305,846, 3.6.19. Appl., (A) 22.1.15 and (B) 30.12.15.

(A) A GRANULAR explosive contains nitro-starch as the sole detonating ingredient, the percentage present being such that the explosive is incapable of detonation in non-granular bulk form under ordinary conditions. (B) Nitrostarch in a non-colloidal form is incorporated with substantially a third of its weight of mononitronaphthalene to obtain a blasting explosive.—C. A. M.

Nitroglycols [as explosives]. J. Barab, Dover, N.J., Assignor to Hercules Powder Co., Wilmington, Del. U.S. Pats. (A) 1,307,032, (B) 1,307,033, and (C) 1,307,034, 17.6.19. Appl., 24.7.18.

AN explosive contains (A) trimethyleneglycol dinitrate, (B) nitrated propylene- and ethylene-glycol, and (C) trimethyleneglycol dinitrate and a nitrated glycol derivative from an olefine.—L. A. C.

Explosive compound. R. L. Hill and A. J. Strane, Tamaqua, Pa., Assignors to Atlas Powder Co., Wilmington, Del. U.S Pat. 1,307,495, 24.6.19. Appl., 1.11.18.

AN explosive compound contains copper sulphate and ammonium nitrate as its principal ingredients.
—R. N.

Explosive composition. W. R. Swint, Assignor to E. I. du Pont de Nemours & Co., Wilmington, Del. U.S. Pat. 1,307,766, 24.6.19. Appl., 31.1.18.

A HIGH explosive composition contains nitrocellulose of a high degree of nitration, nitroglycerin, and wood pulp.—L. A. C.

(A) *Explosive black powder; Process of making* ——. (B) *Smokeless powder and process of coating same.* (C, D) *Process of making smokeless powder.* (E) *Process of preparing explosive charges for shells.* (A) E. du Pont, (B, C, E) F. I. du Pont, and (D) F. I. and E. P. du Pont, Assignors to Ball Grain Explosives Co., Wilmington, Del. U.S. Pats. (A) 1,308,342, (B) 1,308,343, (C) 1,308,344, (D) 1,308,346, and (E) 1,308,347, 1.7.19. Appl., (A) 29.12.15, (B, C) 2.5.16, (D) 25.9.17, and (E) 8.3.18.

(A) THE ingredients of an explosive black powder are incorporated with a liquid having no solvent or chemical action on the same and with water, and the mixture is moulded. (B) A smokeless powder grain has a relatively quick burning body coated with a relatively slow burning composition containing an ingredient having a lubricating property. (C) Nitrocellulose is mixed with ether, the excess of ether removed by pressure, and the product mixed with alcohol to form a gelatinous or colloidal mass. (D) In the manufacture of smokeless powder, water is expelled from guncotton by means of ether. (E) In order to pack an explosive powder charge in a tubular container, the powder is mixed with a liquid having no solvent or chemical action upon it; portions of the mixture are then compressed into the container in order to remove a portion of the liquid and to consolidate the powder into a solid mass within the container.—L. A. C.

Explosives. A. J. Marin, Stockholm. Eng. Pat. 129,036, 1.10.17. (Appl. 14,160/17.) Int. Conv., 14.4.17. Addition to 108,853, 14.8.16.

SEE U.S. Pat. 1,297,213 of 1919; this J., 1919, 390 A.

XXIII.—ANALYSIS.

Electrochemical analyses; New and rapid apparatus for ——. J. T. King. Chem. and Met. Eng., 1919, **21**, 25—29.

IN electrochemical analyses, agitation of the electrolyte hastens deposition of the metal. The author has devised a more efficient method of agitation by rotating the containing beaker. The apparatus contains four cells with a compartment for the driving motor and accessories. A belt drives five aluminium pulleys spaced equi-distantly which engage the conical faces of cups carrying the beakers. The cups are supported by steel spindles turning in aluminium bearing tubes, which slide in wooden guide posts having upper and lower face plates so connected in the wiring that the current is not broken when a beaker is lowered and the cell removed from the circuit. Cylindrical cathodes of 28-mesh, 28-gauge copper gauze are used, the anodes being strips of platinum foil. The operation of the apparatus and the method of carrying out an analysis are described. Tests were made on copper solutions of known strength to determine the speed and accuracy of the apparatus, and the results are tabulated. When using electrolytes containing nitric acid it was found that at high current densities copper was dissolved from the cathode more quickly than it was deposited. To overcome this, potassium nitrate was substituted for most of the nitric acid. Speeds of rotation of about 500 revs. per minute were used with no splattering or throwing of the liquid. With currents of 3, 6, and 9 amps. the times taken to deposit 1 grm. of copper were 35, 26, and 16 minutes respectively. Three unknown brasses were analysed for copper and the results obtained by this and other methods of stirring carried out by different operators showed excellent agreement.—T. H. Bu.

Magnesium; Volumetric determination of phosphoric acid applied to the indirect determination of ——. J. W. Springer. Z. angew. Chem., 1919, **32**, 192.

MAGNESIUM salts are first precipitated as ammonium magnesium phosphate by heating the acid solution containing the magnesium salt and ammonium chloride to boiling, adding an excess of ammonium phosphate and then 10% ammonia in quantity equal to one-third of the volume of the total solution. After cooling, the precipitate is collected, washed with 2·5% ammonia, then transferred to a beaker, mixed with 20 c.c. of ammonium acetate solution and 50 c.c. of water, and the boiling mixture titrated with standardised uranyl acetate solution, powdered potassium ferrocyanide being used as an external indicator. W. P. S.

Silver and halogens in ammoniacal solution; Cyanometric method of estimating ——. J. Eggert and L. Zipfel. Ber., 1919, **52**, 1177—1185.

THE procedure depends on the fact that silver iodide is only precipitated from very dilute ammoniacal solutions of silver salts by addition of potassium iodide when electrolytes are present in large amount or when the solution is warmed, continuously shaken, or preserved for a long time; otherwise an opalescence of colloidal silver iodide is formed; if potassium cyanide solution is added, the turbidity increases at first and suddenly disappears when the amount of CN' necessary for the formation of $Ag(CN)'_2$ has been added. Silver is estimated in ammoniacal solution in the following manner. A known volume of approximately *N*/10 potassium cyanide solution is diluted with about four times its volume of water and sufficient ammonia is added to make the solution at least *N*/4; after introduction of a quantity of potassium iodide approximately equivalent to that of the cyanide taken, the silver solution is added to incipient turbidity. Halogens are estimated indirectly by using an excess of silver nitrate solution and titration of the residual silver after filtration of the silver halide. The method can also be applied to the estimation of acids, the silver salts of which are distinguished by sufficient difference in their solubility in ammonia; thus chloride and iodide may be simultaneously estimated in that their sum is determined by the indirect process and the iodide alone estimated in a solution which is sufficiently ammoniacal to retain the silver chloride in the dissolved state. To obtain accurate results, it is necessary that the amount of potassium iodide used as indicator should be approximately equivalent to the amount of substance taken for titration. The use of potassium iodide in Liebig's method of titration is shown to bring no advantage and, in certain cases, even to lead to false results. H. W.

Fat; Micro-estimation of —— *in blood.* E. and F. Weehuizen. Pharm. Weekblad, 1919, **56**, 810—822.

ABOUT 0·3 grm. of blood is absorbed in two or three pieces of filter paper (16×26 mm.) and the weight determined in a torsion balance. The papers are dried *in vacuo* and placed in a test-tube (2·5×16 cm.) with about 7 c.c. of alcohol. The tube is suspended in a water-bath and the alcohol boiled for 5 minutes. The solution is transferred to a pointed centrifuge tube (1·5×10 cm.) and evaporated to 2·5 c.c. The papers are extracted again with 8 c.c. of alcohol, and the solution is poured into the centrifuge tube in which the volume is again reduced to 2·5 c.c. In both cases evaporation is expedited by passing hydrogen through a capillary tube into the liquid. 5 drops of *N*/2 sodium hydroxide solution are now

added, and the evaporation is continued until the volume is reduced to 0·3 c.c. As the saponification must continue for at least 20 mins., it may be necessary to add 10 drops of alcohol and a drop of water when a volume of 1 c.c. is reached. The residue, which must be free from alcohol, is made up to 5 c.c. and is transferred to a micro-burette. This solution is used to titrate 1 c.c. of standard calcium chloride solution made by adding 13 grms. of sodium chloride to 5·9 c.c. of *N*/10 calcium chloride solution and diluting to 1 litre. 1 c.c. of this solution is equivalent to 0·312 mgrm. of triolein. —W. S. M.

Coal analysis. Davis and Fairchild. *See* IIA.

Classification of lignites. Salvadori and Mondini. *See* IIA.

Chlorobenzenes. Coppin and Holt. *See* III.

Calcium bisulphite solution. Baker. *See* V.

Sulphur burner gases. Williams. *See* VII.

Dissociation of carbonates. Bole. *See* VII.

Nitrogen and ammonia. Villiers. *See* VII.

Sulphates. Kolthoff and Vogelenzang. *See* VII.

Iodides. Kolthoff. *See* VII.

Perchlorates. Williams. *See* VII.

Sodium thiosulphate and hypochlorites. Diénert and Wandenbulcke. *See* VII.

Fluorides. Partridge. *See* VII.

Manganese salts. Caron and Raquet. *See* VII.

Hydrogen peroxide. Kolthoff. *See* VII.

Phosphoric anhydride and titanium. Cavazzi. *See* IX.

Magnetic hardness. Wild. *See* X.

Carbon in steel etc. Piva and Salvadeo. *See* X.

Phosphorus in steel and iron. Ridsdale. *See* X.

Nickel. Nicolardot and Gourmain. *See* X.

Vanadium and chromium in steels. Kelley and others. *See* X.

Saponification value. Pomeranz. *See* XII.

Wijs' solution. Hildt. *See* XII.

Carbon in soils. Waynick. *See* XVI.

Suspended solids in sugar juice. White. *See* XVII.

Titration of sugar. Folin and Peck. *See* XVII.

Polariscopes with international scale of 20 grms. (1) Browne; (2) Bates. *See* XVII.

Ash in sugar products. Waterman and De Wijs. *See* XVII.

Methyl alcohol. Zimmermann. *See* XVIII.

Fat in flour, bread, etc. Vautier. *See* XIXA.

Titration of grain extracts etc. Birckner. *See* XIXA.

Coffee berries. Friese. *See* XIXA.

Lignin-free crude fibre. Von Fellenberg. *See* XIXA.

Carbon dioxide in air. Wilkes. *See* XIXB.

Urea in urine. Philibert. *See* XX.

PATENTS.

Gas analysing apparatus. Aktiebolaget Ingeniörsfirma F. Egnell, Stockholm. Eng. Pat. 116,715, 10.6.18. (Appl. 9509/18.) Int. Conv., 9.6.17.

To determine the percentage of carbon monoxide and hydrocarbons present in gaseous mixtures, the gas is passed through a furnace containing, *e.g.*, iron oxide or copper oxide heated to about 250° C., whereby the carbon monoxide is oxidised to carbon dioxide. After absorption of the carbon dioxide in the usual manner, the residual gas is passed through another furnace similar to the first, but heated to about 700° C., in which the hydrocarbons are oxidised. The carbon dioxide is absorbed in a separate apparatus and from the quantity generated during each heating, the percentages of carbon monoxide and hydrocarbons in the gas can be calculated.—L. A. C.

Hydrogen in gaseous mixtures; Method of and apparatus for detecting the presence of ——. P. R. Bassett, Brooklyn Borough, N.Y., U.S.A. Eng. Pat. 127,656, 14.5.17. (Appl. 6892/17.)

A SAMPLE of the gas to be tested is drawn into a chamber containing two receptacles, one of which is sealed and contains pure air, while the other is open to the air within the chamber. Passing through the receptacles are double tungsten conductors connected in such a manner as to form a Wheatstone bridge. An electric current sufficient to raise the temperature of the conductors as high as possible without oxidising the wire, *i.e.*, considerably below red heat, is passed through the circuit, and if hydrogen is present in the air being tested, the two conductors in the open receptacle will have a lower temperature than those in the receptacle containing pure air owing to the greater heat conductivity and specific heat of hydrogen; this will cause a difference in the resistance of the two sets of wires which is recorded by a millivoltmeter or a similar apparatus calibrated to record the percentage of hydrogen present. The apparatus may be employed for estimating the purity of the gas produced by a hydrogen-generating plant, and a continuous recorder may be attached to the instrument.—L. A. C.

Combustible atmospheres; Method and apparatus for the differential detection of ——. T. M. Chance, Wilkes-Barre, and E. M. Chance, Philadelphia, Pa. U.S. Pat. 1,298,890, 1.4.19. Appl., 1.5.17.

A TEMPERATURE-RESPONSIVE element is maintained in contact with an oxidising agent which is heated by a jacket. The reaction of the combustible gas and the oxidising agent raises the temperature of the temperature-responsive element which operates a signalling device when a predetermined limit is reached.—W. F. F.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Adams. Tankage process for sedimentation, and means for operating same. 19,049. Aug. 1.

Armstrong and others. 18,917. *See* II.

Bulgin, Hall, and Searle. Apparatus for treating air or gases with liquids, or *vice versâ*. 18,742. July 29.

Chenard. Apparatus for fractional distillation. 19,318. Aug. 5. (France, 5.8.18.)

Couche. Evaporators. 18,949. July 31.

Gulliver. Continuous still for evaporation and distillation or fractionation of liquids. 19,543. Aug. 8.

Haddock. Tubular coil vacuum drier. 19,531. Aug. 8.

Hall. Grinding machinery. 19,172. Aug. 7.

Hansen. Grinding-machines. 18,934. July 30. (Denmark, 7.11.18.)

Harris. Drying-apparatus. 19,287. Aug. 5.

Janson. Furnaces etc. 19,403. Aug. 6.

Junquera. Manufacture of concentrated solutions. 19,639. Aug. 9. (France, May 30.)

Knight. Coke-burning furnace for steam-generators. 18,786. July 29.

Mellersh-Jackson (Griscom-Russell Co.). Apparatus for heating or cooling fluids. 18,712. July 28.

Mellersh-Jackson (Griscom-Russell Co.). Evaporators. 18,718. July 28.

Whitfield. Subliming chemical elements or compounds. 18,854. July 30.

Complete Specifications Accepted.

1007 (1918). L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. Process of effecting exothermic chemical syntheses taking place under pressure and at a high temperature. (130,086.) Aug. 7.

1072 (1918). L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. Process of effecting exothermic chemical syntheses. (130,087.) Aug. 7.

1278 (1918). L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. Process for the separation of gaseous mixtures, and particularly the extraction of hydrogen from gaseous mixtures. (130,092.) Aug. 7.

6791 (1918). Muller. Manufacture of colloidal solutions. (115,236.) Aug. 13.

11,818 (1918). Sturgeon. Centrifugal separators. (130,128.) Aug. 7.

12,582 (1918). Smeeton-Wright Furnaces, Ltd., Fletcher, and Wright. Recuperators for furnaces. (130,471.) Aug. 13.

12,599 (1918). Smeeton-Wright Furnaces, Ltd., Fletcher, and Wright. Gas-fired furnaces. (130,475.) Aug. 13.

12,846 (1918). Phillips. Mechanical retorts or heating-chambers. (130,175.) Aug. 7.

12,962 (1918). Reavell, and Kestner Evaporator and Engineering Co. Evaporators. (130,181.) Aug. 7.

12,978 (1918). Williams, and South Durham Steel and Iron Co. Chequer bricks for regenerator chambers of furnaces and the like. (130,479.) Aug. 13.

13,359 (1918). Robinson. *See* II.

16,238 (1918). Nutt and Harvey. *See* X.

16,882 (1918). Robinson and Son, Robinson, and Stevenson. Machines for separating dust and other particles from grain and other granular substances. (130,514.) Aug. 13.

17,875 (1918). Leicester. *See* V.

2543 (1919). King, Taudevin, and Gregson, Gregson, and King. Gas-heated furnaces. (130,274.) Aug. 7.

16,967 (1919). Guye. Pulsometers for raising liquids. (129,635.) Aug. 13.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Armstrong, Davidson, and Low Temperature Carbonisation, Ltd. Retorts. 18,917. July 30.

Ayestarán é Irazusta. Agglutinant for conglomeration of coal. 19,477. Aug. 7.

Bussey. Treating carbonaceous material for recovery of volatile hydrocarbon constituents. 18,837. July 29.

De Becker. Incandescent electric lamps. 18,928. July 30

Edwards. Method of extracting oil from shale, coal, etc. 19,650. Aug. 9.

Evans. Fuel. 18,669. July 28.

Knight. 18,786. *See* I.

Kormann. Petroleum reduction. 19,421. Aug. 6.

Mackenzie-O'Brien. Fuel for motors, engines, etc. 18,887. July 30.

Richardson. Purification of petroleum etc. 19,238. Aug. 5.

Rohde, and Svenska Aktiebolaget Mono. 19,518. *See* XXIII.

Rütgerswerke A.-G. Treatment of coal to obtain bituminous constituents. 19,574. Aug. 8. (Germany, 9.8.18.)

Soc. Lyonnaise de Recherches Catalytiques Camell, Cochet, Gritte, et Cie. Catalytic heating-apparatus. 18,936. July 30. (France, Apr. 24.)

Wells. Tar extractors and scrubbers for gas. 19,478. Aug. 7.

Complete Specifications Accepted.

16,713 (1917). Deutsche Gasglühlicht A.-G. (Auerges.). Manufacture of incandescent electric lamps. (111,298.) Aug. 7.

1278 (1918). L'Air Liquide. *See* I.

1553 (1918). L'Air Liquide. *See* VII.

2055 (1918). Wells and Southcombe. Lubricating-oils. (130,377.) Aug. 13.

2239 (1918). South Metropolitan Gas Co., and Somerville. *See* VII.

2746 (1918). British Thomson-Houston Co. (General Electric Co.). Electron discharge devices. (130,400.) Aug. 13.

6812 (1918). Simon-Carves, Ltd., and Preston. Means for regulating the pressure in the gas mains of coke ovens and the like. (130,106.) Aug. 7.

10,885 (1918). Westerberg. Firing with pulverised fuel or the like. (117,265.) Aug. 7.

12,399 (1918). Bone. Treatment of certain fuels to improve their calorific value. (130,455.) Aug. 13.

12,599 (1918). Smeeton-Wright Furnaces, Ltd., and others. *See* I.

12,846 (1918). Phillips. *See* I.

13,359 (1918). Robinson. Employment of pulverised fuel in the furnaces of steam-generators. (130,486.) Aug. 13.

15,684 (1918). British Thomson-Houston Co. (General Electric Co.). Hermetic seals for the leading-in wires of electric lamps and like apparatus. (130,212.) Aug. 7.

2543 (1919). King, Taudevin, and Gregson, and others. *See* I.

III.—TAR AND TAR PRODUCTS.

APPLICATION.

Imperial Trust for the Encouragement of Scientific and Industrial Research, and Morgan. Manufacture of aromatic arylsulphonyl and arylenedisulphonyl derivatives of 1.4-naphthylenediamine and its sulphonic acids. 19,392. Aug. 6.

COMPLETE SPECIFICATION ACCEPTED.

1635 (1918). Lessing. Separation of oils and pitch from tar. (130,362.) Aug. 13.

IV.—COLOURING MATTERS AND DYES.

COMPLETE SPECIFICATION ACCEPTED.

2200 (1918). Holliday and Clayton. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Clayton. Apparatus for manufacture of artificial silk. 19,297. 19,298. Aug. 5.

Lloyd, Ltd., and Martin. Paper and wood pulp manufacture. 18,920. July 30.

Plowman and Cameron-Rose. Wool-scouring etc. preparations. 19,606. Aug. 8.

COMPLETE SPECIFICATIONS ACCEPTED.

19,049 (1917). Stevenson. Acetylcellulose. (130,029.) Aug. 7.

2754 (1918). Cellon, Ltd., Tyrer & Co., Chambers, and Feasey. Production of cellulose acetate solutions. (130,402.) Aug. 13.

2814 and 13,251 (1918). Albrecht. *See* XXII.

12,442 (1918). Spence and Sons, and Craig. Treatment of textile fibres and fabrics and other porous or absorbent substances to render same less inflammable. (130,461.) Aug. 13.

12,456 (1918). Grolea and Weyler. *See* XIII.

17,875 (1918). Leicester. Mixing and atomising devices employed in the production of emulsions for sizing. (130,235.) Aug. 7.

2911 (1919). Golssedet. Process for the production of new derivatives of cellulose. (130,277.) Aug. 7.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATION.

Quas-Cohen, Drucquer, Levy, and Cohen & Wilkes. Process for treatment of textiles. 19,222. Aug. 5.

COMPLETE SPECIFICATION ACCEPTED.

17,875 (1918). Leicester. *See* V.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Henwood. Manufacture of nitric acid 18,847. July 29.

Hobsbawm (Grigioni). Recovery of nitrate of soda from solutions. 19,391. Aug. 6.

McLeod (Browning). Process for production of hydrogen sulphide from sulphurous gases. 19,027. July 31.

Nitrum A.-G. Method for manufacturing solutions of nitrate of calcium of high percentage. 18,681. July 28. (Switzerland, 6.8.18.)

Soc. Ind. de Produits Chimiques. Process for transforming alkaline monochromates into bichromates or chromic acid. 19,388. Aug. 6. (France, 13.8.18.)

Wade (Pennsylvania Salt Manufacturing Co.). Manufacture of basic sulphate of zirconium. 19,601. Aug. 8.

Wynne. Manufacture of ammonium sulphate. 19,282. Aug. 5.

COMPLETE SPECIFICATIONS ACCEPTED.

18,931 (1917). Maxted. Synthesis of ammonia. (130,023.) Aug. 7.

19,353 (1917). Dreyfus. *See* XX.

117 (1918). Cocking, and Kynoch, Ltd. Processes for concentrating nitric acid. (130,038.) Aug. 7.

660 (1918). Maxted. Synthesis of ammonia. (130,063.) Aug. 7.

703 (1918). Parsons, Jenkins, and C. I. (1914) Syndicate. Process for the manufacture of ammonia. (130,069.) Aug. 7.

1278 (1918). L'Air Liquide. *See* I.

1553 (1918). L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. Process for the manufacture of compressed hydrogen. (130,358.) Aug. 13.

1713 (1918). L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. Process for the conversion of synthetic ammonia into a solid product applicable for agricultural purposes in conjunction with the production of carbonate of soda. (130,365.) Aug. 13.

2239 (1918). South Metropolitan Gas Co., and Somerville. Manufacture of a material for removing carbon monoxide from gases. (130,383.) Aug. 13.

6769 (1918). Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Manufacture of nitric acid. (116,495.) Aug. 7.

12,232 (1918). Welford. Treatment of suitable clay or aluminium compounds for the production of aluminium intermediate products and bleaching powder. (130,164.) Aug. 7.

12,646 (1918). Distillates, Ltd., and Jarmain. Process for the separation of carbonates and/or hydrates of potassium and sodium. (130,173.) Aug. 7.

15,113 (1918). Lindblad. Synthetic production of cyanides and nitrides. (119,243.) Aug. 7.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Miller. Machines for forming glass articles. 19,289—92. Aug. 5. (U.S., 11.8.17.)

Reeves and Tucker. Method of getting viscous glass charges. 19,288. Aug. 5. (U.S., 12.8.18.)

COMPLETE SPECIFICATION ACCEPTED.

11,889 (1918). Roberts, Thomas, and Williams. Manufacture of tiles, bricks, pottery, and coarse ware. (130,134.) Aug. 7.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Brock. Manufacture of mortars, cements, etc. 18,911. July 30.

Roy. Rendering wood impermeable and recovering liquids contained therein. 18,772. 18,775. July 29. (France, 3.8.18 and 15.3.19.)

COMPLETE SPECIFICATION ACCEPTED.

11,957 (1918). Gastaldo and Mino. Artificial stone. (130,135.) Aug. 7.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Basset. Manufacture of iron and steel from scrap etc. 18,821. July 29. (France, 29.1.18.)

Browning. Process for extraction of metals from minerals or solutions or for separation or refinement of metals. 19,028. July 31.

Bygloverza, Ltd., and Ormes. Production of iron. 19,139. Aug. 2.

Collins. Recovery of tin. 19,585. Aug. 8.

Cowper-Coles. Drums for sherardising. 19,426. Aug. 6.

Cowper-Coles. Process for building up or growing iron upon steel etc. surface. 19,427. Aug. 6.

Cowper-Coles. Electro-deposition of iron alloy. 19,428. Aug. 6.

Cowper-Coles. Manufacture of iron tubes by electro-deposition. 19,429. Aug. 6.

Cowper-Coles. Apparatus for electro-deposition of iron. 19,430. Aug. 6.

Cowper-Coles. Process for recovery of iron from scrap tinned steel. 19,431. Aug. 6.

De Dudzeele et Cie. Process of coating articles with metal. 19,262. Aug. 5. (Belgium, Feb. 18.)

Heyes. Electric arc welding. 19,366. Aug. 6.

Hibbert and Niiranen. Recovery or separation of metals. 19,015. July 31.

Lloyd and others. 19,083. *See* XI.

Loring. Method of altering electrical conductivity of metals. 19,465. Aug. 7.

McConnell. Processes of manufacturing electric steel. 18,868. July 30.

Madsen. Electro-deposited metals. 19,316. Aug. 5. (U.S., Apr. 26.)

Priestman. Etching on metal surfaces. 19,220. Aug. 5.

COMPLETE SPECIFICATIONS ACCEPTED.

14,640 (1916). Stock. Manufacture of iron. (130,343.) Aug. 13

387 (1918). Soc. Franç. d'Exploit. de Fours Spéciaux à Haute Température. Furnaces for heating blooms, ingots, and the like. (130,051.) Aug. 7.

388 (1918). Soc. Franç. d'Exploit. de Fours Spéciaux à Haute Température. Furnaces for melting steel, iron, or the like. (130,052.) Aug. 7.

2186 (1918). Naish. Aluminium alloys. (130,381.) Aug. 13.

9354 (1918). Hadfield. Remelting of manganese steel scrap. (130,436.) Aug. 13.

10,531 and 10,834 (1918). Sumitomo Chukosho, Ltd. Magnet steel. (118,601. 118,602.) Aug. 7.

12,125 (1918). Marino. Process for electroplating metals, and particularly for coppering iron and steel. (130,446.) Aug. 13.

12,277 (1918). Godfrey. Cutting of metals and the like by the oxy-acetylene process or similar methods. (130,450.) Aug. 13.

13,183 (1918). Aramaki. Zinc-melting apparatus. (130,483.) Aug. 13.

13,698 (1918). Alexander, Vint, and Imbery. Electrical device for automatically indicating the correct temperature of electrically-heated steel before quenching in order to obtain correct hardening thereof. (130,191.) Aug. 7.

13,932 (1918). Henderson. Process for removing coatings from metals. (130,494.) Aug. 13.

14,694 (1918). Frankignoul. Blast furnaces. (130,198.) Aug. 7.

16,238 (1918). Nutt and Harvey. Construction of doors for metallurgical and like furnaces. (130,216.) Aug. 7.

9012 (1919). Soc. Anon. Stabilimenti Blak. Zinc alloy. (125,397.) Aug. 13.

10,314 (1919). Marino and Bowen. Electrolytic process for coating iron or steel with lead, or antimony, or an alloy of lead and antimony. (130,302.) Aug. 7.

10,490 (1919). Electrolytic Zinc Co. of Australia. Treatment of zinc-bearing ores for the recovery of zinc by electro-deposition. (126,296.) Aug. 7.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Atherstone. Manufacture of electric batteries. 18,930. 18,931. July 30.

British Thomson-Houston Co. (General Electric Co.). Induction electric furnaces. 19,571. Aug. 8.

Collins. Electric furnaces. 19,378. Aug. 6. (U.S., 21.9.18.)

Cowper-Coles. 19,428. 19,429. 19,430. *See* X.

Fuller. Accumulators etc. 18,841. July 29.

Greville and Read. Electrodes. 19,567. Aug. 8.

Heyes. 19,366. *See* X.

Lee, and St. Helens Cable and Rubber Co. Electric conductors. 19,225. Aug. 5.

Lloyd, Whitecross Co., and Wilson. Electrodes for welding etc. 19,083. Aug. 1.

Loring. 19,465. *See* X.

McConnell. 18,868. *See* X.

Madsen. 19,316. *See* X.

Marks (Soc. Anon. Ital. G. Ansaldo & Co.). Manufacture of carbon electrodes. 19,005. July 31.

Olsen. Material for manufacture of electrodes. 19,383. Aug. 6.

Sanders. Electrical apparatus for heating liquids. 19,599. Aug. 8.

COMPLETE SPECIFICATIONS ACCEPTED.

18,876 (1917). Coates, and Watford Electric and Manufacturing Co. Electric arc furnaces. (130,020.) Aug. 7.

19,082 (1917). Chem. Fabr. Weissenstein Ges., and Walter. Diaphragms for electrolytic cells. (112,446.) Aug. 7.

12,125 (1918). Marino. *See* X.

13,698 (1918). Alexander and others. *See* X.

14,079 (1918). Keene. Electric furnaces. (119,228.) Aug. 13.

14,400 (1918). Bally and Cope. Electric melting-furnaces. (119,234.) Aug. 7.

15,302 (1918) and 222 (1919). Hoyle and Fawcett. Electric furnaces. (130,205.) Aug. 7.

1071 (1919). Tyler and Naylor. Electric batteries. (130,545.) Aug. 13.

5212 (1919). Marriott. Electric furnaces. (130,288.) Aug. 7.

10,314 (1919). Marino and Bowen. *See* X.

10,490 (1919). Electrolytic Zinc Co. of Australia. *See* X.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Blumn. Installation for recovery of fats from waste liquids. 18,982. July 31.

Danin. Reducing solid fats to liquid. 19,246. Aug. 5.

Jackson. Helical extrusion apparatus for manufacturing or for treating fatty substances. 18,977. July 31.

Scobel. Process of solidifying oleaginous substances. 19,286. Aug. 5.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Airne. Instantaneously drying ink, and manufacturing same. 19,198. Aug. 5.

Chaillaux. Manufacture of gold-coloured sulphurs and vermilions of antimony. 19,085. Aug. 1.

Deleglise. Plastic compositions. 18,799. July 29.

Hutchison. Non-inflammable and waterproof paint. 18,726. July 28.

Ioco Proofing Co., Nuttall, and Vickers, Ltd. Condensation of phenolic bodies with aldehydic compounds. 18,827. July 29.

Resan-Kunstharz-Erzeugungs-Ges. Process for manufacture of artificial resin and intermediary products. 18,789. July 29. (Austria, 22.3.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

2105 (1918). Cleghorn, and Gayner Pneumatic Co. Materials or process of producing materials for coating substances to protect them or render them non-porous. (130,379.) Aug. 13.

11,819 and 15,359 (1918). Machin. Material for use as a distemper or in marking off metal, and for other purposes. (130,129.) Aug. 7.

12,456 (1918). Grolea and Weyler. Process for the production of dopes, varnishes, coatings, or plastic films with an acetone-soluble cellulose acetate basis. (123,712.) Aug. 7.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATIONS.

Benner and Young. Processes of reclaiming rubber. 19,380. Aug. 6.

Burney (Westwood). Method of coagulating latex. 18,906. July 30.

Peachey. Process for vulcanising dissolved caoutchouc. 19,132. Aug. 2.

Pearce, Tooley, and Wood-Milne, Ltd. Rubber-mixing machines. 19,339. Aug. 6.

COMPLETE SPECIFICATION ACCEPTED.

19,128 (1918). MacDonald. Manufacture of india-rubber compositions or substitutes therefor. (130,528.) Aug. 13.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATION.

Marris, and Walker and Sons. Treatment of refuse from tanneries. 19,058. Aug. 1.

COMPLETE SPECIFICATION ACCEPTED.

16,970 (1917). Silberberger. Process for obtaining tanning material from pine-tree bark. (130,010.) Aug. 7.

XVI.—SOILS; FERTILISERS.

COMPLETE SPECIFICATION ACCEPTED.

1713 (1918). L'Air Liquide. *See* VII.

XVII.—SUGARS; STARCHES; GUMS.

COMPLETE SPECIFICATIONS ACCEPTED.

10,532 (1918). McLaurin. Process of making dextrin. (130,119.) Aug. 7.

10,533 (1918). McLaurin. Dextrin. (130,120.) Aug. 7.

13,778 (1918). Jacobson and Wrathall. Method of and apparatus for washing and purifying sugar. (130,492.) Aug. 13.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATIONS.

Chenard. 19,318. *See* I.

Elektrizitäts-Werk Lonza. Manufacture of alcohol. 19,573. Aug. 8. (Switz., 27.10.18.)

Gulliver. 19,543. *See* I.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Adams. 19,049. *See* I.

Blunn. 18,982. *See* XII.

Flatau. Food. 18,667. July 28.

Laffillée. Apparatus for drying and smoking fish and meat under pressure. 19,483. Aug. 7. (France, May 9.)

McDougall. Food product, and method of preparing same. 19,471. Aug. 7.

Müllertz. Sterilisation or pasteurisation of liquids. 19,425. Aug. 6. (Denmark, 31.8.18.)

Paterson and Rideal. Purification of water, sewage, etc. 19,024. July 31.

COMPLETE SPECIFICATIONS ACCEPTED.

12,067 (1918). Buckley. Apparatus for filtering sewage sludge. (130,146.) Aug. 7.

12,401 (1918). Imray (Soc. Chem. Ind. in Basle). Manufacture of organic phosphorus-reserve compound of green plants and salts thereof. (130,456.) Aug. 13.

13,656 (1918). Hegney and Hegney. Sterilising milk. (130,189.) Aug. 7.

16,642 (1918). Brodrick. Manufacture of drinks. (130,221.) Aug. 7.

16,882 (1918). Robinson and Son, and others. *See* I.

19,209 (1918). Newbould. Butter substitutes. (130,246.) Aug. 7.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATION.

Chemical Works, formerly Sandoz. Process for isolation of hyoscyamine. 18,686. July 28. (Switz., 15.8.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

19,353 (1917). Dreyfus. Manufacture of acetic acid from acetaldehyde. (130,035.) Aug. 7.

2733 (1918). Boake, Roberts & Co., and Durrans. Manufacture of organic acid anhydrides and chlorides. (130,399.) Aug. 13.

12,008 (1918). Imray (Soc. Chem. Ind. in Basle). Manufacture of acetaldehyde. (130,138.) Aug. 7.

12,401 (1918). Imray (Soc. Chem. Ind. in Basle). *See* XIX.

13,077 (1918). Du Pont de Nemours & Co. Method and apparatus for purifying camphor. (124,704.) Aug. 7.

217 (1919). Soc. Chim. Usines du Rhône anc. Gilliard, Monnet, et Cartier. Process for the preparation of the primary alcohols. (122,630.) Aug. 13.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

Kelley and Mason. Photographic printing. 18,699. July 28. (U.S., 26.7.17.)

Neame. Photography. 19,523. Aug. 7.

XXII.—EXPLOSIVES; MATCHES.

APPLICATIONS.

Beardmore and Co., and Bremberg. Propellants for ordnance. 18,979. July 31.

Duclaux. Process for purification of nitrocellulose. 19,165. Aug. 2. (France, 25.8.13.)

COMPLETE SPECIFICATIONS ACCEPTED.

1349 (1918). Landrin. Manufacture of explosive materials. (130,093.) Aug. 7.

1517 (1918). James, Jones, and Lewis. Manufacture of explosives. (130,357.) Aug. 13.

2200 (1918). Holliday and Clayton. Process for the production of picric acid. (130,382.) Aug. 13.

2814 and 13,251 (1918). Albrecht. Fabric for use in the manufacture of bags for propellant explosives. (130,410.) Aug. 13.

12,368 (1918). Harrison (Soc. d'Etudes Chim. pour l'Industrie). Process for preventing danger of explosion in the preparation and handling of dangerous explosive substances. (130,166.) Aug. 7.

XXIII.—ANALYSIS.

APPLICATION.

Rohde, and Svenska Aktiebolaget Mono. Gas analysing apparatus. 19,518. Aug. 7.

I.—GENERAL; PLANT; MACHINERY.

Lubricating properties of certain chemical substances; Static friction, and the ——. W. B. and J. K. Hardy. Phil. Mag., 1919, **38**, 32—48. (See also this J., 1919, 7 T.)

In an attempt to throw further light on an observation made by Rayleigh that, in certain cases, the friction is greater with a large amount than with a minute quantity of the same oil, experiments have been made on the static friction between perfectly clean glass surfaces and on the effect of a number of pure liquids when used as lubricants. The clean surfaces were found to "seize," and when a sufficiently strong tangential force was applied to cause movement, the first effect was to tear the two glass surfaces. The liquids examined fall into two classes. The first class, the inactive fluids which have no lubricating effect, includes water, ethyl alcohol, ethyl ether, benzene, strong ammonia, and glycerin, but the last substance can exert the maximum lubricating effect if the surfaces are flooded. Among active fluids were found sulphuric, hydrochloric, acetic, butyric, and oleic acids, a number of organic bases, castor oil, and paraffin. It was noticed in the case of some of the acids that the friction was slightly greater with the surfaces flooded than with an invisible film of liquid, but this may have been caused by the presence of a trace of water which diminishes the effect of an active fluid. The evidence, so far as it goes, is against the conclusion that lubrication is a function of the quantity of lubricant when this is a pure chemical substance and when its viscosity is not very great.—E. H. R.

Automobile "anti-freeze" solutions. Rudnick. *See* VII.

Optical pyrometer. Forsythe. *See* XXIII.

Gas flow meters. Benton. *See* XXIII.

PATENTS.

Completing or promoting combustion of gases in boiler furnace flues; Means for ——. W. Hassall, Woodville. Eng. Pat. 128,325, 12.11.17. (Appl. 16,584/17.)

In boilers of Lancashire or similar type, a block or blocks of refractory material are placed in the flue or flues (one or more in each), preferably some distance away from the fire-bridge. The blocks present a concave surface towards the fire, thus reverberating heat and helping to consume the smoke. Only a narrow annular passage is left round the blocks so that the hot gases must pass close to the plates of the flue. The blocks may be made in several pieces, and assembled inside the flue.—B. M. V.

Furnaces, gas producers, and the like. R. Colombo, J. Cazaban, and M. F. Fernandez, Buenos Aires. Eng. Pat. 128,375, 17.6.18. (Appl. 9048/18.)

A FIREBOX having an air chamber underneath is fitted with a central draught flue, with openings along its length. The combustion chamber is wholly or partially closed by an adjustable cover, and the gas formed may be led away to burners. The draught through the fire is regulated partly by the amount of gas used and partly by adjustment of the opening to the air chamber underneath. —C. A. K.

Kiln [; Continuous calcining ——]. J. D. Hoff, Oakland, Cal. U.S. Pat. 1,307,974, 24.6.19. Appl., 1.12.17.

The kiln has a central shaft, the walls of which are provided with discharge ports at the bottom. Above the discharge ports are firing chambers, and above these are observation ports. Passages are provided in the firing chambers leading direct into the discharge ports to conduct away any calcine which falls into the firing chambers.—B. M. V.

Furnace. L. B. Richards, Shields, Pa., and C. P. Watkins, Louisville, Ky., Assignors to Tate-Jones and Co., Inc., Pittsburgh, Pa. U.S. Pat. 1,308,743, 1.7.19. Appl., 7.10.18.

The combustion chamber of the furnace is above the heating chamber, from which it is separated by a perforated false roof. Independent burners discharge into the bottom of the heating chamber to make the temperature approximately uniform over the whole of the heating chamber.—B. M. V.

Furnace; Continuous ——. H. E. Smythe, Assignor to The S. R. Smythe Co., Pittsburgh, Pa. U.S. Pat. 1,310,846, 22.7.19. Appl., 23.1.19.

The furnace has one or more oscillating hearths arranged between stationary hearths; on the forward stroke the oscillating hearth is raised by means of links and levers slightly above the fixed hearths, and lowered slightly below them on the return stroke.—B. M. V.

Furnace linings; Protecting refractory ——. H. F. Chappell, New York. U.S. Pat. 1,308,481, 1.7.19. Appl., 12.6.18.

Siliceous refractory linings are heated to a fritting temperature, and powdered aluminous material is applied to the exposed surfaces.—B. M. V.

Dissolving chemicals and elevating the solutions; Apparatus for — —. F. W. Thorold and J. M. Sinclair, Toronto. Eng. Pat. 128,351, 4.6.18. (Appl. 9209/18.)

The material to be dissolved is supported on a grid in a closed vessel well away from the bottom. The vessel is fitted with a water-tight charging door at the top, means for draining and cleaning out mud at the bottom, and supply and delivery pipes above and below the grid. Water may be delivered under ordinary pressure above the grid and the resulting solution led off below the grid (or *vice versâ*), and since the vessel is water-tight the solution may be delivered through the discharge pipe to any reasonable height above the vessel. —B. M. V.

Separating the constituents of mixtures of volatile liquids; Method and apparatus for ——. A. G. Green, Manchester, and Levinstein, Ltd., Blackley. Eng. Pat. 128,362, 12.6.18. (Appl. 9689/18.)

For the continuous separation of two constituents from a liquor the latter is fed to a climbing film evaporator operating under such conditions of temperature, rate of flow, vacuum, etc. that the escaping vapour consists of substantially pure lower-boiling constituent. The liquor flowing from the separator at the top of the first evaporator is passed to the bottom of a second evaporator operated so that the remainder of the lower-boiling and some of the higher-boiling constituent are removed as vapour, whilst the residual liquor consists of substantially pure higher-boiling con-

stituent. The vapour from the second evaporator is condensed, and returned to the feed reservoir of the first evaporator. Instead of using two evaporators, a single evaporator may be used intermittently, if desired, and more than two constituents may be separated by an extension of the process.—B. M. V.

Volatile solvents; [Continuous] process for the recovery of ——. J. H. Bregeat, Paris. Eng. Pat. 128,640, 21.8.17. (Appl. 11,994/17.) Int. Conv., 25.5.17.

In order to remove from gaseous mixtures the vapour of methyl alcohol, amyl alcohol, ethyl acetate, amyl acetate, carbon tetrachloride, chloroform, dichloroethylene, trichloroethylene, tetrachloroethylene, tetrachloroethane, pentachloroethane, or petroleum spirit, phenol or one of its homologues is used as a scrubbing medium. For example crude cresol is caused to flow downwards through a column through which the vapour-laden gases pass upwards, being discharged free from volatile solvents. The cresol with volatile solvent passes through a heat interchanger and steam heater (surface type) to a cascade evaporator, where it is distilled by steam jets; the hot liquid cresol now free from volatile solvent passes through the heat-interchanger and a final water cooler to a tank ready for re-use. The volatile solvents together with steam pass from the cascade evaporator to one or more distillation columns (rectifiers) and condensers.—B. M. V.

Ether and alcohol; Recovery of —— from vapour-laden air. R. A. Craig, R. Robertson, J. I. O. Masson, and A. A. Drummond, Woolwich. Eng. Pat. 129,024, 26.9.17. (Appl. 13,874/17.)

The ether vapour is recovered by scrubbing with a large quantity of liquid ethyl alcohol preferably refrigerated and used in several stages. Towers such as that described in Eng. Pat. 25,993 of 1901 (this J., 1903, 85) may be used. The alcohol vapour is then recovered by scrubbing with cold water, acid, a salt solution, or other suitable liquid.—B. M. V.

Heat conveying circuits [using viscous liquids]. E. C. R. Marks, London. From Merrill Process Co., Boston, Mass., U.S.A. Eng. Pat. 128,709, 17.6.18. (Appl. 9956/18.)

A viscous liquid is circulated through a heating device and a device where the heat can be given up (radiating device) by means of a pump and flow and return pipes which are fitted with short-circuiting pipes, to facilitate starting up when cold, valves (both hand operated and automatic relief), a stand pipe and vessel to maintain the necessary static head, a supply pipe for make-up liquid, an air supply pipe, thermometer, and strainer.
—B. M. V.

Dryer. E. C. Horst, San Francisco, Cal. U.S. Pat. 1,291,891, 21.1.19. Appl., 6.2.18.

Air outlets are provided at opposite ends of both end walls of a drying chamber, and a deflecting plate with its concave surface directed towards the interior of the chamber is arranged between each pair of outlets. Air is supplied through inlet pipes, one at each end of the chamber, which extend into the chamber and deliver the air against the concave surfaces of the deflecting plates. When air is being delivered through one pipe the air outlets at that end of the chamber and the other air inlet pipe are closed.

Drying machine. T. Allsop and W. W. Sibson, Assignors to The Philadelphia Drying Machinery Co., Philadelphia, Pa. U.S. Pat. 1,308,024, 1.7.19. Appl., 18.9.16.

The drying compartment contains two pairs of chainways parallel to one another and on the same level, each pair of chainways comprising guides vertically above one another. One pair is fixed and the other pair is adjustable toward and from the first. An endless chain runs in each pair of chainways and is provided with extensions projecting laterally from its links and carrying pins at the ends of the extensions.—W. F. F.

Dryer. W. A. Hutchinson, Charleston, S.C. U.S. Pat. 1,308,241, 1.7.19. Appl., 3.9.18.

A drying floor is arranged over a heater and provided with an agitator carried by an endless chain moving over the floor. The chain carries agitator arms pivoted on transverse carriers at intervals and suspended from them. The arms are formed with angular ends, extending in different directions, so that the material is moved backwards and forwards over the floor while carried from one end to the other.—W. F. F.

Drying machine. E. T. Firth, Richmond, Ind. U.S. Pat. 1,310,824, 22.7.19. Appl., 12.10.17.

The framework of a horizontal drying tunnel carries superposed horizontal tracks over which the two sides of an endless conveyor travel. The conveyor consists of wire netting and carries trucks having wheels which co-operate with the guide tracks. The conveyor passes over drums outside the tunnel at each end. The tunnel is heated by a furnace at each end having supply and exhaust passages for the hot gases.—W. F. F.

Dryer. J. C. Dozier, Baton Rouge, La. U.S. Pat. 1,310,858, 22.7.19. Appl., 5.2.19.

A drying chamber contains a number of separate, superposed, horizontal endless conveyors, each in a compartment formed by horizontal partitions across the chamber. The partitions have openings at each end alternately, so that air passing upwards through the chamber is compelled to take a tortuous course. Inclined guide plates are provided in the openings at the ends of the partitions to direct the material from each conveyor to the one next below, in its downward passage through the chamber.—W. F. F.

Fire-extinguishing composition. H. S. Mork, Brookline, Mass., Assignor to American La France Fire Engine Co., Elmira, N.Y. U.S. Pats. (A) 1,306,707, (B) 1,306,708, and (C) 1,306,709, 17.6.19. Appl., 14.1.18.

Carbonate solutions for fire extinguishers contain as essential ingredients the following:—(A) Normal sodium carbonate and sodium lactate in the proportion of 3·49 parts of the former and 66 parts of the latter to 100 parts of water, (B) ammonium bicarbonate 5·21 parts, and glycerin 150·2 parts, in 100 parts of water, or (C) normal potassium carbonate 4·54 parts, and glycerin 162 parts in 100 parts of water.—G. F. M.

Grinding instrumentality and process of producing same. Grinding machine. R. Forsyth, New York. U.S. Pats. (A) 1,308,007 and (B) 1,308,008, 24.6.19. Appl., 29.9.17 and 23.12.16. Both renewed 23.9.18.

Two metal cones with axes horizontal and parallel are arranged to rotate in opposite directions with

their conical surfaces in contact. The cones are formed of soft tough metal in which the material is embedded and crushed.—W. F. F.

Steam-generating plant. J. F. Spiegel, Toronto, Canada. U.S. Pat. 1,308,122, 1.7.19. Appl., 16.3.17.

A BOILER and feed water tank of ordinary form are combined with a producer-gas generator within the tank, and jacketed by the water. Gas from the generator is used to heat the boiler, and the gas-supply pipe is provided with a valve controlled by the steam pressure in the boiler.—W. F. F.

Separator; Centrifugal ——. E. A. Baylis, El Paso, Tex. U.S. Pat. 1,308,271, 1.7.19. Appl., 23.8.15.

VERTICAL drums having a riffled separating surface are mounted so as to revolve around a vertical shaft and also rotate on their own axes. The angle of the axes of the drums with relation to the central shaft may be varied.—W. F. F.

Centrifugal separator; Continuous ——. L. M. Mulet, San Juan, Porto Rico. U.S. Pat. 1,309,651, 15.7.19. Appl., 9.5.17.

THE casing of the separator is divided into two portions, the upper to receive liquid expelled through the walls of the basket and the lower to receive solid matter expelled at the bottom edge of the basket. The walls of the rotating basket are formed of perforated endless bands arranged vertically and overlapping, supported by upper and lower pulleys (or chains and sprockets) which are rotated by gearing so that the inside surface of the basket travels slowly downwards.—B. M. V.

Filter-press plate. G. F. Miller, New York. U.S. Pat. 1,308,438, 1.7.19. Appl., 22.1.19.

THE filter plate is strengthened by reinforcing pieces, dovetailed into, and connecting the upper and lower portions respectively of the sides of the plate, and secured against lateral movement.
—S. S. A.

Filter and method of making same. G. Moore, Joplin, Mo. U.S. Pat. 1,309,330, 8.7.19. Appl., 15.7.15.

A FILM of barytes on a support is used as a filter.
—W. F. F.

Corrosive liquids; Method of and apparatus for pumping ——. C. F. Wallace, Tompkinsville, and M. F. Tiernan, Jamaica, N.Y. U.S. Pat. 1,308,515, 1.7.19. Appl., 14.3.18.

A PISTON and cylinder pump is provided with a space in the connecting conduit from the supply of corrosive liquid. The space is of such a volume in relation to the piston displacement that the corrosive liquid is drawn into and forced out of it without reaching the cylinder. The non-corrosive liquid actually in contact with the piston is maintained by the continuous addition of small quantities of liquid.—W. F. F.

Evaporating apparatus. B. E. Taylor, Mount Vernon, N.Y., Assignor to Borden's Condensed Milk Co., New York. U.S. Pat. 1,308,819, 8.7.19. Appl., 10.5.18.

A HORIZONTAL cylindrical drum, double walled on its cylindrical surface, is provided with a concentric rotating shaft passing through it. A bar extending parallel to the shaft and just within the inner surface is arranged to be movable in an orbit concentric with the shaft. The bar carries radial fingers free to vibrate independently of one another, and having detachable tips of "organic material" which are normally in contact with the inner surface. The bar is operatively connected with the shaft.—W. F. F.

Evaporating pan. C. M. Crossno, Sallisaw, Okla. U.S. Pat. 1,311,049, 22.7.19. Appl., 8.7.18.

A SHALLOW evaporating pan is mounted immediately over a flat heating chamber of similar size and shape, forming a cover for the latter. The bottoms of the two chambers are connected by bolts passing through sleeves in the heating chamber. Steam inlet, outlet, and drain pipes are provided for the heating chamber, which is surrounded on its bottom and sides by an asbestos jacket.—W. F. F.

Aerating liquescent material; Method of —— and machine for the purpose. M. Hopkins and C. Brunkhurst, Middletown, N.Y., Assignors to Borden's Condensed Milk Co., New York. U.S. Pat. 1,308,904, 8.7.19. Appl., 30.8.18.

Two horizontal cylindrical cages are rotated one above the other, in opposite directions, in a tank, so that horizontal bars of the cages intermesh but do not come in contact with each other.—B. M. V.

Separating solid matter from liquids; Apparatus for ——. A. W. French, Piqua, Ohio. U.S. Pat. 1,308,943, 8.7.19. Appl., 28.11.17.

SEPARATION is effected in a number of parallel vertical containers with porous walls. To permit discharge of solid matter the lower ends of the containers may be opened periodically by a number of laterally movable members which may be reciprocated towards and from one another by a number of small vertical fluid pressure rams acting through toggle levers.—W. F. F.

Corrosion-resisting conduit-pipe [; *Flexible* ——]. C. A. Rose, Perth Amboy, N.J., and G. Monrath, Chuquicamata, Chile, Assignors to Chile Exploration Co., New York. U.S. Pat. 1,310,715, 22.7.19. Appl., 3.12.15.

SPIRALLY wound layers of elastic fibrous material (*e.g.*, roofing felt), which may be impregnated with hydrocarbon residuum and compacted, are alternated with layers of moisture-excluding and adhesive viscous material (*e.g.*, asphalt). Adjacent spirals are wound in opposite directions and the whole may be armoured, but the innermost and outermost layers are always the corrosion-resisting material.—B. M. V.

Separation of materials by gravity. R. L. Lloyd, Assignor to Dwight and Lloyd Metallurgical Co., New York. U.S. Pat. 1,310,998, 22.7.19. Appl., 21.2.16.

A CONTAINING vessel is provided with a small well communicating with it at the bottom only. A layer of the heavier of the materials to be separated is maintained at the bottom of the vessel and well, and a layer of the lighter material above it. A floating layer of one or more reagents is contained in the well only, and material of which one or more constituents is to be chemically treated and separated is delivered into the well above the reagent.—W. F. F.

Evaporating or concentrating liquids; Apparatus for ——. E. Shaw, Toronto, Canada. Eng. Pat. 129,584, 10.2.19. (Appl. 3238/19.)

SEE U.S. Pat. 1,299,703 of 1919; this J., 1919, 398A.

***Filtering process and apparatus; Continuous pressure* ——.** J. A. McCaskell, Salt Lake City, Utah, U.S.A. Eng. Pat. 129,905, 21.11.18. (Appl. 19,133/18.)

SEE U.S. Pat. 1,288,433 of 1918; this J., 1919, 164 A.

Treatment of one liquid with another; Apparatus for the ——. A. E. Holley, Oldbury, and O. E. Mott, Woolwich, Assignors to Chance and Hunt, Ltd., Oldbury. U.S. Pat. 1,297,171, 11.3.19. Appl., 5.12.17.

SEE Eng. Pat. 125,426 of 1916; this J., 1919, 397 A.

Filling material for absorption, reaction, mixing, and cooling towers. H. Nielsen, London. U.S. Pat. 1,307,635, 24.6.19. Appl., 29.12.16.

SEE Eng. Pat. 26,269 of 1913; this J., 1914, 241.

Pumping fluid; Apparatus for ——. H. A. Humphrey, London, and W. J. Rusdell, Wolverhampton, Assignors to Humphrey Gas Pump Co. U.S. Pat. 1,309,943, 15.7.19. Appl., 2.12.15.

SEE Eng. Pat. 8890 of 1915; this J., 1916, 822.

Furnace; Liquid-fuel ——. W. M. and M. M. Burdon, Assignors to Burdon's, Ltd., Bellshill, Scotland. U.S. Pat. 1,310,152, 15.7.19. Appl., 3.8.18.

SEE Eng. Pat. 119,376 of 1918; this J., 1918, 682 A.

Acid-pots or such like vessels; Composition for the manufacture of linings of ——. C. F. Curtis, Pontardawe, Wales. U.S. Pat. 1,311,051, 22.7.19. Appl., 19.4.19.

SEE Eng. Pat. 121,585 of 1918; this J., 1919, 107 A.

Expressing liquid from materials. J. W. Hinchley, London, and C. S. D. Harper, Stockton-upon-Tees. U.S. Pat. 1,311,070, 22.7.19. Appl., 26.12.18.

SEE Eng. Pat. 121,759 of 1917; this J., 1919, 99 A.

Catalyst. U.S. Pat. 1,309,623. *See* VII.

Electrical treatment of gases. U.S. Pat. 1,309,221. *See* XI.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Chemical investigation of banded bituminous* ——. *Studies in the composition of coal. F. V. Tideswell and R. V. Wheeler. Chem. Soc. Trans., 1919, **115**, 619—636. (See Stopes, this J., 1919, 452 A.)

LEAVING out of account fusain, which stands apart in its character, the ingredients of the banded Hamstead coal investigated show differences which grade them in all chemical characteristics in the sequence vitrain, clarain, and durain. This is evidenced in the fall in the moisture, and rise in the ash content; in the increased percentage of carbon, and fall of oxygen, and in the diminishing reactivity towards solvents, reagents, and heat treatment. A most striking evidence of gradation is afforded by an examination of the gaseous products of destructive distillation. The volume-temperature curves for individual gases run nearly parallel, the quantity evolved over equal temperature ranges being the greatest with vitrain, and least with fusain, clarain and durain being intermediate. No essentially distinct types of compounds peculiar to any one of the ingredients of banded coal were found, and it is suggested that the difference lies in the proportion of "reactive" material to "inert" in the various ingredients, so that if, for example, a certain weight of vitrain be assumed to contain x parts of "reactive" material, the same weight of clarain would contain $0{\cdot}9x$ and of durain $0{\cdot}7x$ parts.—G. F. M.

Coal; Utilisation of waste ——. H. Copaux. Chim. et Ind., 1919, **2**, 656—660.

A REPORT has been issued by a French Commission for the utilisation of waste coal, set up in July 1918 to continue experiments started before the war by the Compagnie des Mines de Lens. Experiments have been made on the low-temperature carbonisation of a carefully chosen sample of coal residues from the Blanzy mines, the analysis of which was: Moisture, 2·1%; volatile matter, 23·3—23·6%; ash, 39·25—38·3%; nitrogen, 0·85—0·89%. The yield of ammonia when the coal was carbonised at 650° C. was only 7·4% of that calculated from the total nitrogen present, whilst at 950° C. it was 19%. By carbonising slowly at a low temperature, so that about one-third of the tar came over below 500° C. and the remainder below 680°, most of it below 550° C., a yield of 40 kilos. of tar per ton of material was obtained, comparing very favourably with the 20—25 kilos. obtained under gas-retort or coke-oven conditions. The low-temperature tar contained no naphthalene and a high proportion of phenolic substances, 13·3% against 1% in ordinary tar. It also gave a higher proportion of the more valuable light oils. The heavy oil, containing little aromatic hydrocarbons, was specially suitable for Diesel engines. The coke contained 5—6% of volatile matter. To make the low temperature treatment profitable it would be necessary to recover the rest of the nitrogen, and further experiments are necessary to determine whether this can be done by subsequent high temperature treatment of the coke. The yield of gas, which is low, may also be increased by this means.—E. H. R.

Coal and coke; Determination of ash in ——. W. Erhard. Chem.-Zeit., 1919, **43**, 422.

To avoid waste of time involved in igniting the coal or coke at a low temperature, or loss of volatile salts when the ignition is made at a high temperature, it is recommended that the ignition be made in a current of oxygen at about 600° C. The sample is weighed into a boat and this is then placed in the tube of a combustion furnace. The total carbon may be determined at the same time if the combustion tube is connected with the usual series of drying and absorption vessels including a small tube containing chromic acid to retain sulphur compounds.—W. P. S.

Spontaneous ignition; Determination of the liability of substances to ——. L. Schaper. Chem.-Zeit., 1919, **43**, 401—403.

AN account of the application of the Dennstedt-Blinz apparatus (this J., 1908, 930; 1913, 11) to the determination of the liability of substances to spontaneous ignition. No definite relationship can be established between the reduction or oxidation capacity, the iodine absorption or other chemical properties of substances, and their anti-heating capacity or spontaneous ignition temperature. In general the initial temperature for testing coal in the apparatus may be found approximately by means of the formula 100+% coke (including ash)−% volatile constituents (including water). In tests continued for 60 mins. the initial tempera-

ture for various samples of coal lay between 100° and 160° C., whilst for lignite it was 90° C. In 30-minute tests in which 15 grms. of the substance was oxidised on 30 grms. of cotton wool, the initial temperatures to produce spontaneous ignition lay between 70° and 150° C. in the following order:—Chinese wood oil, seal oil, walnut oil, linseed oil, cottonseed oil, rape oil, arachis oil, oleine, lard, margarine, olive oil, wool fat (lanoline), nut-oil, tallow, stearin, butter, ox tallow, coconut oil, and glycerin. If coal has been oxidised for 60 mins. at 5° to 10° C. below the initial temperature, the test may be continued for 90 or 120 mins. until ignition takes place, but oxidising at a temperature 15° C. below the correct "initial temperature" no ignition can be obtained. The adsorption capacity of a substance in moist air may be determined by means of a "humidator." The substance is dried in a small boat in a current of hydrogen, then weighed, mixed with 1 grm. of charcoal, and left in a desiccator over phosphorus pentoxide. The next day it is placed over wet filter paper in the "humidator" for 6 hours, and the increase in weight determined. For determining the friability of coal, 500 to 200 grms. of the sample passed through a 1-mesh (per sq. cm.) and retained by a 16-mesh sieve, is shaken 40 times a minute, for half an hour, in a drum turned vertically upon its axis by means of a handle. The resulting powder is passed through a wire sieve with 144 meshes per sq. cm. and the weight of powder passing through expressed in parts per 1000. —C. A. M.

Lignite; Combustion experiments with North Dakota ——. H. Kreisinger, C. E. Augustine, and W. C. Harpster. U.S. Bureau of Mines. Tech. Paper 207, 1919. 44 pages.

DETAILS are given of the results of combustion tests of North Dakota lignite and of the carbonised residue thereof from gas retorts. The tests of the natural lignite were carried out in a small laboratory furnace and in a hand-fired furnace. In the former the fuel was burnt at rates of 3, 6, 10, 20, 40, and 60 lb. of fuel per sq. ft. of grate area per hour and with fuel beds 6 in. and 12 in. thick. Tests were also made by heating small cubes of lignite and determining the rates of heating and the accompanying changes in appearance of the lignite. The carbonised residue was consumed in the small laboratory furnace at the same rates of combustion with fuel beds 4 in. and 6 in. thick. Both the lignite and the carbonised residue were also tested in a step-grate type of furnace specially designed for the purpose. Both lignite and the carbonised residue are difficult to ignite. A comparatively strong draught is necessary for combustion and the fire tends to burn unevenly. The surface of the fuel bed with ordinary rates of combustion is nearly black owing to the almost complete reduction of the carbon dioxide produced by combustion of the fuel in the first 3 in. or so of the fuel bed. The combustion of lignite is accompanied by high ash losses. With rates of combustion not exceeding 10 lb. only a very small amount of clinker was obtained. Burnt at a rate exceeding 20 lb., dense and impervious clinker forms on the grate. A rate of combustion of the carbonised residue of 40 lb. was apparently the best for a horizontal grate. With rates of combustion exceeding 10 lb., the ash yielded by the carbonised residue forms a solid and impervious clinker, covering the grate but not adhering thereto. Both types of fuel are suitable for use in gas producers. Carbonised lignite retains about as much moisture as anthracite and is a marketable product. A special step-grate type of furnace designed for the combustion of both types of fuel for house heating purposes is described. Details are given of a suggested design for a boiler furnace consuming lignite. —J. S. G. T.

Coal; Dressing and gasification of ——. F. Herbst. J. Gasbeleucht., 1919, **62**, 317—323.

INQUIRIES by Bunte showed that the ash content of 42% of the coal employed in gas production in Germany averaged 23·6%, corresponding to 31·1% in the coke. A formula is developed for the relation between the ash content and the weight of the dressed coal, and conditions representing a recovery of 100%, 98·57%, and 96·62% of the coal are represented graphically. The author recommends that the different mines should establish a system of co-operative working whereby the various coals are mixed so as to ensure a uniform ash content. Attention is directed to the difficulties of coal washing. In some cases, as for instance with cannel, the combustible and incombustible constituents of the coal are so intimately mixed that separation of coal from ash is a matter of great difficulty. Such coals, owing to the excessive cost of dressing, cannot be carried economically to great distances. The size of the "nuts" is of importance. Course nuts of linear dimensions from 25 to 30 mm. can be washed at little cost. With finer coals composed of pieces of 10—25 mm., much loss is incurred in washing owing to the formation of a sludge which retains much water. Within recent years it has been customary to brush the coal dust off coal which is to be washed, the unwashed dust being subsequently added to the washed coal.—J. S. G. T.

Ascension-pipe stoppages. M. Coudelou. Gas J., 1919, **147**, 243.

ASCENSION-PIPE stoppages are stated to be due chiefly to the deposition of dust, which occurs owing to the diameter of the ascension pipe being so large that the velocity of the gas is insufficient to transport the dust to the hydraulic main. Considerable thickening of the tar in the hydraulic main owing to dust deposition therein occurred when the velocity of the gas stream in the ascension pipe was 8·9—9·4 in. per sec., while the tar was fluid when the gas velocity was 5·5—6·1 in. per sec. Ascension pipes should be kept clean, and sudden changes of direction of flow of the gas therein must be avoided. No naphthalene troubles were experienced in a distribution system employing direct fired settings, but such troubles were present both on the works and in the distributing system in the case of three out of four systems employing regenerative firing of the retorts. Experiments are referred to showing that for efficient removal of naphthalene from gas, the condensers should be so proportioned that they not merely act as coolers but also secure deposition of tar wherewith the gas comes into contact, tar and naphthalene being deposited together.—J. S. G. T.

Benzol recovery [from gas]. C. Berthelot. Soc. Tech. du Gaz en France, July, 1919. Gas J., 1919, **147**, 290—291.

THE requirements of French dye manufacturers amount to 5000 tons of benzene, 3500 tons of naphthalene, and 1000 tons of anthracene annually. The benzol required for internal combustion engines amounts to about 66 million gallons. In coal distillation, the processes concerned in the formation of benzol begin at about 500° C. and an increased yield of benzol is to be anticipated from raising the temperature of the free space in the retort through which the evolved gases pass on their way to the hydraulic main. The efficiency of benzol recovery by means of washers of the grid or perforated plate

type is approximately 85%. No oil washing plant reduced the benzol content of the gas below 220 grains per 100 cub. ft., equivalent to a loss of 23,000 grains of benzol per ton of coal carbonised. A species of grading of the benzol content of the gas into light, medium, and heavy oils of respective boiling points 75° C., 95° C., and 120° C., is secured in the Mallet plant. The steam consumption in such a plant is 12 kilos. per kilo. of commercial benzol. The heat economy due to the installation of heat exchangers amounts to 13·6%. Further innovations have reduced the steam requirements to 3·7 kilos. per kilo. of crude benzol. Essentially, the plant consists of a rectifying still with two steam coils, one for surface heating and the other for the injection of live steam towards the end of the operation, together with a condenser of the perforated plate type, a water-tube dephlegmator, and collecting tanks. Intermittent distillation produces a grading of the distillate. Decanted tars employed in chemical washing contain coumarone or indene. Results of second rectification as practised in the United States are given as pure benzene 85·3%, intermediate products 3·4%, pure toluene 9·8%, residue 1·3%, and loss 0·2%.

—J. S. G. T.

Vertical [gas] retorts; Comparative tests on Glover-West and Dessau (1912 model) ——. K. Bunte. J. Gasbeleucht., 1919, **62**, 349—355, 365—369.

THE tests were made in 1913 on settings newly erected in the Mariendorf Gasworks, Berlin, and each test extended over 4 to 6 days. A South Yorkshire (Denaby nuts) and a Durham (Lambton) coal were carbonised in each setting. The results are tabulated below:—

	Denaby nuts		Lambton coal	
	Glover-West	Dessau	Glover-West	Dessau
Loss on air drying	4·36%	3·45%	2·94%	2·36%
,, at 110° C.	2·92	3·41	1·65	1·57
Ash	2·95	3·05	8·64	8·49
Fixed carbon	60·53	60,78	60·04	60·69
Volatile matter	29·24	29·31	26·73	27·19
Coal carbonised in 24 hours, kilos.	17,070	18,290	15,550	20,100
Gas made in 24 hours, cb. m.	6,650	7,290	5,460	7,280
Fuel used in 24 hours, kilos.	1,910	2,640	2,125	2,945
Gas made per 100 kilos. of coal at 0° C., cb. m.	38·95	39·8	35·1	36·2
,, ,, ,, ,, 15° C., cb. m.	41·8	42·75	37·7	38·85
,, ,, ton of coal at 15° C., cb. ft.	15,000	15,330	13,520	13,930
Fuel per 100 kilos. of coal, kilos.	11·2	14·4	13·65	14·65
,, 100 cb. m. of gas at 0° C., kilos.	28·8	36·2	38·95	40·4
Yield of coke per 100 kilos. of coal, kilos.	66·3	68·0	—	—
Calorific value (gross) 0° C., 760 mm., $\frac{\text{cals.}}{\text{cb. m.}}$	5,245	5,185	5,280	5,280
,, ,, ,, 15° C., 760 mm., $\frac{\text{cals.}}{\text{cb. m.}}$	4,890	4,830	4,920	4,920
,, ,, ,, ,, ,, $\frac{\text{B.T.U.}}{\text{cb. ft.}}$	550	543	553	553
,, multiple $\frac{\text{cb. m.}}{100 \text{ kilos.}} \times \frac{\text{cals.}}{\text{cb. m.}}$	2,045	2,065	1,853	1,913
,, ,, $\frac{\text{ton}}{\text{cb. ft.}} \times \frac{\text{B.T.U.}}{\text{cb. ft.}}$	8,250,000	8,320,000	7,480,000	7,720,000
Specific gravity	0·433	0·423	0·415	0·393
Illuminating power (Hefner candles)	13·2	13·2	12·5	13·6
Sulphur in 100 cb. m. purified gas, grams	35·6	30·3	48·3	37·2
CO_2 in gas, %	2·4	2·6	2·2	2·2
N_2 in gas, %	2·9	2·2	3·4	1·6
Gas yield per 100 kilos. ash- and moisture-free coal, cb. m.	41·1	42·65	39·5	40·25
Calorific multiple in ash- and moisture-free coal	2,155	2,210	2,085	2,125
Heat recovered in gas per 100 heat units in coal	27·5	27·65	25·3	26·1
Ash- and moisture-free coke used per 100 kilos. of ash- and moisture-free coal, kilos.	10·75	14·1	12·95	13·85
Heat units used in coke per 100 heat units in gas	39·6	48·1	52·1	53·1
,, ,, ,, ,, coal	10·7	13·4	12·9	13·85
Gas analyses:—				
Carbon dioxide	2·10	2·75	2·00	2·8
Heavy hydrocarbons	2·00	2·55	2·05	2·2
Oxygen	trace	trace	trace	trace
Carbon monoxide	12·35	13·80	10·00	11·1
Hydrogen	54·65	56·55	55·65	55·6
Methane	24·10	21·35	26·00	25·0
Nitrogen (by difference)	4·80	3·00	4·30	3·3

The coke from the Dessau retorts was dense, hard, fissured lumps, while that from the Glover-West retorts was lumpy but porous, spongy, and fissureless. When forked the latter left the larger proportion of fines but withstood dropping from a height of 4·2 metres better; it also disintegrated more than the other after 3 hours in a revolving drum. All samples ultimately took up 23·5% by weight of water, although at varying rates. The yields of tar and ammonia were substantially the same for both systems. The quantity and quality of gas produced in each case were practically identical. The Glover-West system shows a superior fuel economy in use but the Dessau has the higher rate of carbonisation. The construction and control of the Glover-West setting receive a detailed discussion and in particular the utilisation of the heat abstracted from the coke by the secondary air. This air is not preheated by the waste gases, to which the heat of the coke is ultimately transferred, thereby raising their temperature to about 850° on leaving the setting as against 400° in other systems. In the ordinary systems this heat is lost in quenching the coke, but when carried in flue gases at so high a temperature it becomes available for heating boilers etc. The better fuel economy in the Glover-West system, in spite of the hotter waste gases, is accounted for by the more efficient transmission of heat across the retort wall due to the greater average difference of temperature of the flue and the charge.—H. J. H.

Water-gas process; Shortcomings of the ——. J. Harger. Chem. Age, 1919, **1**, 30—31.

THE efficiency of the water-gas process would be increased 10% if a hot air blast were employed,

and clinkering troubles would be done away with. The waste gases from the "blow" customarily contain 7—10% and frequently 15% of unburnt gas. The brickwork should be designed so as to function as a heat accumulator during the "blow," and as a heater during the "run" and "blow." The author proposes to secure complete combustion of the "blow" gases by adding hot air thereto immediately before or after leaving the fuel bed, the heat being stored in the coke, and in a regenerator of perforated brickwork built in a number of sections. The fuel bed should have a depth of 12 ft. and air inlets passing through the shell and lining and controlled independently should be arranged at different levels. By employing regenerators, the temperature of the entering steam could be considerably increased (*e.g.*, to 1000° C.). As the coke cools, the steam should be passed at a slower rate. The "blow" should be directed downwards as in the Loomis generator. A saving of from 2 to 5% of coke is to be anticipated from operating in this manner. The steam "run" and the air "blow" should be directed in opposite directions. The dead space above and below the fuel should be reduced. Attention to this point results in the nitrogen content of the water-gas being reduced from 4—5% to 1% or less. For heat insulation of the generator the author recommends a firebrick lining, 9 to 12 ins. thick, then 4 ins. of kieselguhr brick, followed by 2 to 5 ins. of kieselguhr powder next to the shell.—J. S. G. T.

Water-gas: Economics of the production of ——. R. Gelpert. J. Gasbeleucht., 1919, **62**, 269—274.

In the author's experience, the average requirements for water-gas production in producers amount to 60 kilos of coke and 60 kilos. of steam per 100 cub.m. of water-gas. The power requirements for this volume of gas amount to from 1 to 3 kilowatts per hour, and the cooling water to about 1 cub.m. Water-gas production in vertical retorts is simpler than in producers. Details are given of water-gas production in eighteen vertical retorts during a trial extending over 6 days, the coal gasified during this period amounting to 112,436 kilos. (wet). The yield of gas was 387 cub.m. per 100 kilos. of wet coal, and its gross calorific value 5324 calories per cub.m. The gasification lasted 11 hours, steaming being carried out during 80 minutes. Assuming that under these conditions, 5 cub.m. of water-gas is produced from 100 kilos. of air-dried coal, it is shown that 77% of the steam employed is converted into water-gas. The total amount of coke required per 100 cub.m. of water-gas amounts to 46—51 kilos. The yield of coke is diminished by about 1·25 kilos. per 100 kilos. of coal by steaming. Trials were also carried out in which the total duration of the gasification process was extended to 16½ hours. In one series the coal was carbonised for 12½ hours and subsequently steamed for 4 hours. In the other series, the carbonising period was 8 hours, the subsequent steaming of the charge lasting 8½ hours. In each series 9410 kilos. of moist coal (8817 kilos. of dry coal) was used. Details are given of the hourly yield of gas, and the nitrogen and carbon dioxide content thereof. In the first series, employing 4 hours' steaming, the yield was 2834 cub.m. of coal gas and 1534 cub.m. of water-gas, or 4368 cub.m. of mixed gas. The second series, employing 8½ hours' steaming, yielded 2834 cub.m. of coal gas and 2057 cub.m. of water-gas, or 4891 cub.m. of mixed gas, all gaseous volumes being measured at 18° C. and 735 mm. The percentage of water-gas is too high for practical purposes in the second series. The total coke employed in the first series was 54·4 kilos. per 100 cub.m. of water-gas. Water-gas is produced principally in the lower and middle part of the retort. The water-gas produced in vertical retorts resembles that derived from producers in composition, and has the same calorific value. The total cost of production of water-gas in vertical retorts is less than in the case of producers, labour and repair charges being considerably less.—J. S. G. T.

Water-gas generators; Exhaust steam used in ——. R. L. Greene. Gas Age (New York). Gas J., 1919, **147**, 240.

For the utilisation of exhaust steam for the manufacture of carburetted water-gas in an installation of twelve generators, 8 lb. pressure in the exhaust main and 6-in. pipe lines was regarded as most suitable. Any irregularity in operation was adjusted by live steam supplied through manually-operated valves. Operated thus, there is little, if any, less expenditure of generator fuel per 1000 cub. ft. of gas produced, but about 21% less expenditure of boiler fuel when superheated live steam is replaced by exhaust steam.—J. S. G. T.

Gas production from sewage sludge. M. Hönig J. Gasbeleucht., 1919, **62**, 278—282, 287—289.

The dry substance of Brünn sewage sludge closely resembles peat in composition, except that it contains considerably more nitrogen. The results obtained at Brünn, Frankfort, and Tegel respectively by the distillation of sewage sludge are detailed, and it is pointed out that the results were obtained without the operation of an exhauster, under which circumstances the yield of gas from coal is about 25% less than when the exhauster is operative. Without exhaustion, 100 kilos. of dried sewage sludge yields, on the average, 23·8 to 24·8 cub.m. of purified lighting gas, with a calorific value between 4100 and 4500 calories per cub.m., and containing about 1% of ammonia. The yield of coke is about 58%, of calorific value 2100 to 2400 cals. per kilo. The purified gas is similar in composition and calorific value to that obtained by the carbonisation of lignite. The crude gas derived from sewage contains about 15% CO_2. The addition of 2% of caustic lime to the sewage sludge increased the yield of ammonia to 1¼%. The sludge when dried till it contains 80—85% of dry substance is a friable mass, which must be briquetted before distillation. This can be effected by subjecting the mass to about 50 atmospheres pressure. The coke obtained is very porous, and burns readily. The necessary period of distillation is from 2 to 2½ hours. The wet sludge is concentrated to a content of 30—40% of dry substance by centrifuging or by means of suction drum filters, and the percentage of dry substance is increased to 80—85% by submitting the thickened sludge to a temperature of 200°—300° C. in rotating drums of 2m. diam. and about 21m. long. The calorific value of the dried substance is about 2250 calories. In Frankfort the drying is effected by waste heat. At Brünn a part of the necessary heat is derived from the coke obtained by the distillation. Details are given of the costs of the various items of the installation at Brünn. The sewage should be worked up as quickly as possible in order that its nitrogen content may not be lost, the profitableness of the process depending largely upon the yield of ammonia obtained.—J. S. G. T.

Gaseous fuel; Utilisation of —— in commercial practice, with consideration of the types of gas-fired furnaces and methods for their control. F. W. Epworth. Gas J., 1919, **146**, 755—759, 804—806.

The chemical and physical characteristics of the gases used industrially for furnace work are

described and data relative to the combustion of such gases, and to heat losses are tabulated. With town's gas and water-gas, temperatures up to 1400° C. can be attained without preheating, but this limit cannot be attained by using producer gas or Mond gas. Reasons are advanced why the theoretically calculated temperatures attainable by the combustion of gaseous mixtures are in excess of those practically realised, and it is pointed out that carbon monoxide when burnt radiates about 8% of its total heat of combustion, hydrogen on the other hand radiating only about 3%. In general, preheating the air supply to 200° C. has the same effect upon the efficiency of gaseous firing as preheating the gas to 500° C., and preheating of the air rather than of the gas is to be preferred. The various types of gas-fired furnaces are described, and their distinctive features illustrated by a number of examples. Thermal efficiency in the gaseous heating of furnaces is dependent upon a correct adjustment of the ratio of the gas to the air mixed therewith and necessary for complete combustion. This gas to air ratio may be controlled automatically, and devices affording some measure of success in such control are described. Optical indication of the correct apportionment of gas to air is afforded by the light emitted by an incandescent burner in which a portion of the mixture is consumed, but is dependent on personal observation and experience with the device. A Pilot tube used with a simple form of micro-manometer serves to measure the actual gas and air consumptions. The defects of these methods are discussed, and it is suggested that a device in which the mixture is burnt in a conical tube, the position of the flame therein altering with variation in the ratio of gas to air, would serve as a reliable indicator. The contraction on sparking a sample of the mixture could also be employed for the same purpose.—J. S. G. T.

Acetylene and air; Propagation of flame in mixtures of ——. W. Mason and R. V. Wheeler. Chem. Soc. Trans., 1919, **115**, 578—587.

THE velocity of the horizontal propagation of flame in mixtures of air and acetylene in tubes of different diameters was determined photographically by moving a sensitive film at a rapid speed in a direction normal to the direction of propagation of the flame. The velocity increased to a maximum of 335 cm. per second for mixtures containing 9—10% of acetylene in a 90 mm. tube. In tubes of narrower bore the velocity was in all cases correspondingly less; thus with a mixture containing 5·4% of acetylene in tubes of 12·5, 25, and 50 mm. internal diameter, velocities of 120, 140, and 160 cm. per second respectively were observed. A common feature in all the flame photographs was the undulating character of the flame fronts, which was shown to be due to resonance induced in the tubes at the moment of ignition, and the observed frequencies of the undulations coincided with the calculated frequencies of sound waves for the fundamental tone of the tube.—G. F. M.

Specific heats of gases for calculations concerned with technical heating. B. Neumann. Z. angew. Chem., 1919, **32**, 141—146.

THE author has examined the results obtained within recent years by a number of authorities—Langen, Pier, Bjerrum, Holborn, Henning, Austin, Von Scheel, Heusse, and others—for the specific heats of various gases over a range of temperature from 0° C. to 3000° C. He concludes that the various results are sufficiently in agreement to permit the proposal of values for the respective specific heats which should be generally employed in technical practice. Tables are given for:—(1) The true specific heats at constant pressure of carbon dioxide, sulphur dioxide, water vapour, oxygen, nitrogen, carbon monoxide, air, and hydrogen (calculated for 1 kilo. of gas) at intervals of 100° C. over the range from 0° C. to 3000° C.; (2) the mean specific heats at constant pressure between 0° and t° C. for the same series of gases (calculated for 1 kilo. of gas) over the same range calculated for values of t differing by 100° C.; (3) the true specific heat at constant pressure of carbon dioxide, sulphur dioxide, water vapour, oxygen, nitrogen, air, and carbon monoxide (calculated for 1 cub. m. of gas) at intervals of 100° C. over the range from 0° C. to 3000° C.; (4) the mean specific heats at constant pressure between 0° C. and t° C. for the same series of gases (calculated for 1 cub. m. of gas) over the same range calculated for values of t differing by 100° C. The subjoined figures for true specific heat at constant pressure of 1 kilo. of gas are taken from Table 1:—

t(° C.)	CO_2, SO_2	H_2O	O_2	N_2, CO	Air	H_2
0	0·202	0·462	0·218	0·249	0·241	3·445
100	0·215	0·465	0·221	0·252	0·244	3·490
200	0·230	0·470	0·224	0·255	0·247	3·534
300	0·244	0·475	0·226	0·259	0·250	3·579
400	0·257	0·481	0·229	0·262	0·253	3·624
500	0·268	0·489	0·232	0·265	0·256	3.668
1000	0·297	0·551	0·246	0·282	0·272	3·891
1500	0·309	0·670	0·260	0·299	0·288	4·115
2000	0·319	0·808	0·274	0·315	0·303	4·338
2500	0·327	0·954	0·288	0·332	0·319	4·561
3000	0·336	1·105	0·302	0·349	0·334	4·784

The results are also represented graphically. In Tables 1 and 2 the values given for carbon dioxide and sulphur dioxide are the same, and likewise similar values are given for nitrogen and carbon monoxide. A similar remark applies to carbon dioxide and sulphur dioxide in Tables 3 and 4, and to the group, nitrogen, oxygen, air, and carbon monoxide in these latter tables. The methods for calculating the respective molecular heats and the specific heats at constant volume are explained. The respective temperature coefficients are given in the case of some gases. A critical examination is made of the various determinations in the case of the several gases, and examples are given of the method of application of the tables to the calculation of the flame temperature theoretically attainable by the use of technical gas and vapour mixtures, such as tar oil and producer gas. The values of the mean specific heats between 0° and 200° C. per kilo. and per cub. m. respectively at constant pressure of methane, ethylene, acetylene, and benzene vapour are also included.—J. S. G. T.

Raw tars as fuels for Diesel engines; Use of ——. H. Moore. Engineering, 1919, **108**, 167—168.

THE use of tar oils and raw tars as fuel in internal combustion engines is accompanied by ignition troubles when employing engines of standard design, obstruction of the atomising devices, and increased wear on the exhaust valve face and seat. The ignition trouble has been overcome by the provision of a pilot lighting device employing petroleum. Specially chosen tars of low free carbon content do not so readily cause obstruction of the atomising devices as do certain tar oils. Tars for use in Diesel engines should be rich in aliphatic compounds and low in free carbon content. Tars from horizontal retorts are rich in aromatic compounds and contain much free carbon. Tars from vertical retorts worked either continuously or intermittently are particularly suitable for use in Diesel engines. Inclined retorts give tars closely akin to those from horizontal retorts, but the free carbon content is usually lower. The tars derived from coke-ovens are irregular in pro-

perties. Tars resulting from low-temperature carbonisation have a large content of aliphatic compounds and a low free carbon content, but removal of water therefrom is a serious difficulty. Tars derived from lignite can be satisfactorily burnt in Diesel engines, behaving similarly to petroleum and shale oils. Oil-gas tar resulting from "cracking" heavy petroleum distillates behaves in a Diesel engine similarly to tar oil, but does not cause pulveriser choking. The physical characteristics of the various tars are tabulated, the specific gravity, ash and coke contents, free carbon, and net calorific value being given. With engines of over 100 B.H.P., the full load consumption for raw tars is about 0·55 lb. per brake horse-power-hour. A specification of a suitable quality of tar for Diesel engine purposes is given:—sp. gr., below 1·12; ash, less than 0·08%; water content, not more than 2%; calorific value (gross), at least 9100 calories per lb. (=16,380 B.Th.U. per lb.); free carbon, not more than 6%; and coke value, not more than 10%.—J. S. G. T.

Petroleum spirit; Use of the critical temperature of solution in aniline in the rapid examination of ——. G. Chavanne and L. J. Simon. Comptes rend., 1919, **169**, 70—72.

The method is designed to give the percentage of aromatic and of saturated cyclic hydrocarbons in the petroleum spirit. The critical temperature of solution in aniline is determined on the original spirit and on the spirit freed from aromatic hydrocarbons by nitration and washing with sulphuric acid. These two temperatures being represented by T_1 and T_2, the content of aromatic hydrocarbons is given by $Ar = k(T_2 - T_1)$. Assuming the values, T_A and T_C, for the critical temperatures of solution in aniline, which would be given by the acyclic and the saturated cyclic hydrocarbons respectively present in the spirit if isolated, then the content of the latter is given by $C = \frac{T_A - T_2}{T_A - T_C}(100 - Ar)$. These formulæ are only applicable where the percentage of aromatic hydrocarbons present is not greater than 15—20 and then k=1·18. The values for T_A and T_C may be taken as 72° and 40° C. respectively. Where it is shown that ethylenic hydrocarbons are present to the extent of E%, expressed as amylene, then for T_1 in the formula $T_1 + 0·4E$ should be written. In order to correct for traces of nitro-compounds left in the spirit after nitration, $T_2 + 0·2$ is used instead of T_2, and to correct for the slight departure from the law of additivity shown by the saturated cyclic hydrocarbons $T_C - 0·5$ is used instead of T_C, *i.e.*, the value becomes 39·5° instead of 40° C.—W. G.

Asphalts; Melting point of ——. L. M. Proctor. Chem. and Met. Eng., 1919, **21**, No. 2, 81—83.

Particulars are given of comparative tests made on four different asphalts (derived from residual oils) by the Richardson ball (or over mercury) method, the General Electric method, the Krämer and Sarnow method, and the ball and ring method. The results obtained, each the average of three determinations, are shown in a diagram. The Richardson ball method was found to be rapid and simple, and gave very concordant results, but was subject to greater personal error than the other processes. The General Electric method gave fairly concordant results, but was slow and also subject to serious personal error. The Krämer and Sarnow process gave the least concordant results and was found to be more complicated and tedious than any of the other methods. The ball and ring method (compare this J., 1914, 1196), being practically free from personal error, gave results which could be readily duplicated by another observer. This process has been adopted as a standard method by the American Society for Testing Materials.—W. E. F. P.

Ammonium salts. Friese and Heineken. *See* VII.

Patents.

Fuel briquettes; Process for the manufacture of ——. D. H. Bibb, London. Eng. Pat. 128,485, 15.10.18. (Appl. 16,809/18.)

The fuel is ground to particles of substantially uniform size and half of it is mixed with the heated binder. The remainder of the fuel is then added and mixed.—W. F. F.

Fuel; Artificial ——. D. Evans, Ystradgynlais, Brecon. Eng. Pat. 128,815, 19.11.18. (Appl. 15,991/18.)

Anthracite duff 75%, colliery shale or clay 14·5%, pitch 8·5%, and "common soda liquid" 2·0% are mixed together and made into briquettes. W. F. F.

Tubulous masses of plastic material [artificial fuel]; Apparatus for producing ——. American Linseed Co., New York, Assignees of J. Schaub, Newark, N.J., U.S.A. Eng. Pat. 117,635, 17.7.18. (Appl. 11,742/18.) Int. Conv., 17.7.17.

An apparatus for carrying out the process described in U.S. Pat. 1,262,267 of 1918; this J., 1918, 330 A.

Combustion of powdered fuel. H. B. Pruden, Chicago, Ill. U.S. Pat. 1,307,375, 24.6.19. Appl., 22.5.16.

Jets of air are caused to impinge upon a mass of powdered fuel contained in a closed chamber, and the fuel-laden air thus produced is continuously agitated to prevent deposition of the fuel and drawn off and fed to the combustion chamber.
—L. L. L.

Burning of explosive gaseous mixtures. C. E. Lucke, Assignor to Gas and Oil Combustion Co., New York. U.S. Pat. 1,302,819, 6.5.19. Appl., 10.7.15.

A supply of an explosive gaseous mixture with a velocity greater than the rate of propagation of inflammation of the mixture is caused to spread out and to advance with decreasing velocity until the velocity is equal to the rate of propagation of inflammation. It is then burned in a surface-combustion apparatus comprising a hearth in the form of a receptacle filled with firebrick and connected to the gaseous mixture supply chamber by means of conduits which pass through the receptacle and firebrick and open immediately below a perforated plate resting on the firebrick.

Explosive gaseous mixtures; Apparatus for burning ——. C. E. Lucke, Assignor to Gas and Oil Combustion Co., New York. U.S. Pat. 1,308,364, 1.7.19. Appl., 21.9.12.

The gaseous mixture is caused to flow, in an upward direction and at an initial velocity greater than the normal rate of propagation of inflammation, through a combustion bed composed of two layers, the lower of which is more finely granular (less permeable) than the upper.—W. E. F. P.

Vertical ovens, more particularly coke and gas ovens; Charging apparatus for continuous —— J. Pieters, Paris. U.S. Pat. 1,308,641, 1.7.19. Appl., 23.1.18.

In a coking oven, an oven chamber open at the top communicates with a charging hopper in which

means are provided for feeding the charge to the chamber and for compacting the upper portion of the charge so as to seal the top of the chamber against the escape of gases during the coking operation.—W. E. F. P.

Coke plants; Flushing system for by-product ——. L. H. Underwood, Youngstown, and R. B. Hitchcock, Struthers, Ohio. U.S. Pat. 1,309,161, 8.7.19. Appl., 30.11.18.

A TANK is divided into two compartments, one for flushing and the other a hot drain compartment; a mixture of tar and liquor is introduced into the top of the flushing compartment, from which a pipe leads at a suitable level above the bottom. A pipe for withdrawal of liquor leads from the same compartment at a suitable distance above the tar-withdrawing pipe, and a siphon with its receiving end in the lowermost strata conveys to the hot drain compartment the contents of the flushing compartment. Means may be provided for indicating the separation zone between tar and liquor.
—T. H. B.

Carbon matter; Apparatus for completely gasifying ——. L. Colson, Paris. Eng. Pat. 121,124, 25.11.18. (Appl. 19,378/18.) Int. Conv., 26.11.17.

A MIXTURE of coal and lime is heated in a vertical retort, into which steam is injected, liberating a mixture of carbon dioxide, hydrogen, and methane. The gas is passed through a cooling coil in a bath of potassium bicarbonate solution which is thereby heated and converted into potassium carbonate. The gas then passes through a hydraulic seal and is forced by a pump through a cooler to an ammonia extraction apparatus where the ammonia is recovered either as aqueous solution or sulphate. The gas then passes through the solution of neutral potassium carbonate obtained from the cooling bath, when the carbon dioxide is absorbed and the bicarbonate is reproduced for use again in the cooling bath. The purified gas may then be stored. The retort may be heated externally either by heavy oil or by the gas purified as above.—W. F. F.

Pitch; Method of and apparatus for the destructive distillation and carbonising of ——. F. M. Perkin, and Nitrogen Products and Carbide Co., Ltd., London. Eng. Pat. 129,091, 29.6.18. (Appl. 10,759/18.)

PITCH is fed into a cast or wrought iron still arranged in a setting above a horizontal gas retort of ordinary construction, so that it is heated by the waste heat to a temperature not above 600° C., and the distillate is collected. The solid residue is transferred to the gas-retort below and distilled at 900°—1000° C. In a modification, the preliminary still is replaced by another gas retort which is provided with iron trays to receive the pitch.—W. F. F.

Water-gas; Adaptation of dust or like arresting means to plant for manufacture of ——. R. and J. Dempster, Ltd., and J. M. Ballinghall, Manchester. Eng. Pat. 127,179, 14.10.18. (Appl. 16,711/18.)

THE gases from a water-gas producer are made to pass through a screen of water falling from the outer surface of a hood into which the gases pass on their way to the chimney during the "blow" period or to the gas outlet during the gas-making period. Means are provided for removing accumulated mud from the receptacle into which the dirty water falls.—T. H. B.

Ammonia and tar recovery process. Ammonia, tar and benzol recovery process. J. Becker, Assignor to The Koppers Co., Pittsburgh, Pa. U.S. Pats. (A) 1,307,533 and (B) 1,307,534, 24.6.19. Appl., 12.8.18.

(A) PRODUCER-GAS from which the dust and tar have been removed is passed, while nearly at its saturation temperature, through an acid wash and is then cooled and dehydrated. The mother liquor from the acid wash is conveyed to a saturation bath through which the gas is then passed to effect deposition of ammonium sulphate. (B) Coke-oven gas is treated while hot for the recovery of tar and is then subjected to the process described under (A).—W. E. F. P.

Ammonia and tar recovery process [for producer-gas and coke-oven gas]. J. van Ackeren, Assignor to The Koppers Co., Pittsburgh, Pa. U.S. Pat. 1,307,571, 24.6.19. Appl., 12.8.18.

THE ammonia is absorbed from producer-gas freed from dust and tar, at nearly its saturation temperature, by an acid wash, the mother liquor from which is conveyed to a saturation bath through which tar-free coke-oven gas, of relatively low temperature, is passed, whereby the ammonia is also absorbed from the coke-oven gas, and ammonium sulphate is deposited. The heat in the saturation bath is mainly derived from the heating of the acid solution in the acid wash by the hot producer-gas.—G. F. M.

Liquor from plants for purifying gases from producers, or the like; Treatment of —— *[for recovery of ammonia].* D. M. Holmes, Stockton-on-Tees. Eng. Pat. 128,401, 20.6.18. (Appl. 10,208/18.)

THE liquor obtained in the purification (washing etc.) of producer-gas is concentrated to about one-quarter of its bulk and distilled with lime until the rapid evolution of ammonia ceases. The residue in the still, containing 20—25% of the total ammonia, together with organic matter, is then run into a producer, when the remainder of the ammonia is recovered.—W. E. F. P.

Purification of gases; Disintegrator apparatus for the ——. Dinglersche Maschinenfabrik A.-G., Zweibrücken. Ger. Pat. 310,501, 13.3.15.

THE purifier is composed of two chambers communicating with one another, each containing a number of fixed and moving blades, these latter rotating about a common axis. In the first chamber the blades, both stationary and movable, are parallel to the common axis of the chambers and the movable blades are contained within the space defined by the fixed blades. The second chamber is an annular one and tapers towards the region of entry of the gas. The blades therein are arranged radially. In its passage from the first chamber to the second, the gas current is deflected through 180°. Water is sprayed into both chambers from a number of jets arranged on a screen rotating co-axially with the blades. In the first chamber the water spray is directed in counter current to the gas stream, whereas in the second chamber water and gas move in the same direction. Channels are provided at either end of the second chamber for running off the water charged with impurities. The apparatus can be rapidly dissembled for cleaning purposes, and is especially applicable to the purification of blast-furnace gases etc.—J. S. G. T.

Fuel oil; Production of —— from crude oil. F. Tinker, Birmingham. Eng. Pat. 128,288, 17.7.17. (Appl. 10,327/17.)

The crude oil is mixed in a "topping tower" with the hot vapour arising from the distillation of a portion of the treated oil, thereby causing the evaporation of the lighter constituents which are separated and condensed. Of the treated oil from the base of the tower a small portion is passed to a still, whilst the major portion is collected for use as fuel oil. The distillation residue may be utilised to heat the still.—A. E. D.

Mineral oil; Production of ——. J. B. Carper, London. Eng. Pat. 128,326, 7.11.18. (Appl. 18,688/17.)

Spent or crude oil, *e.g.*, spent washing oil, middle oil, creosote, paraffin, or cracked oil, is distilled to about 325° C., the distillate is washed with about 1% of sulphuric acid of 60° B. (sp. gr. 1·71), then with 4% of acid of the same strength, followed by 10—12% of saturated caustic soda solution, and finally with water. The washed distillate is fractionated.—A. E. D.

Liquid fuel for internal combustion engines. F. Spicer and H. Jackson, Stoke-on-Trent. Eng. Pat. 129,010, 19.9.17. (Appl. 13,439/17.)

The residue obtained from a crude benzol still of a Simon-Carvès plant, known as naphthalene oil, is cooled and drained off from the naphthalene salts. The oil is distilled till the whole of the lighter oil and heavy naphtha and a small proportion of naphthalene are driven off, and this distillate is washed and treated with acid, soda, and water. The oil is then distilled again up to 190° C. A corresponding method is given for obtaining a light oil from crude benzol when there is no excess of naphthalene. This oil is mixed with about one-twelfth part by weight of crude benzol or petrol for use as a petrol substitute.—W. F. F.

Hydrocarbon; Apparatus for cracking ——. J. W. Coast, jun., Assignor to The Process Co., Tulsa, Okla. U.S. Pat. 1,307,724, 24.6.19. Appl., 6.10.17.

An endless sweeping arrangement is mounted in a cracking still and provision is made for the reception of coke therefrom.—A. E. D.

Hydrocarbon oils; Process of treating ——. R. H. Brownlee, Pittsburgh, Pa. U.S. Pat. 1,308,161, 1.7.19. Appl., 29.3.17.

To increase the yield of low-boiling products, hydrocarbon oils are subjected to a counter current of gas, in a pipe system heated and maintained under pressure, in such a way that the heavier components separated at any point in the system undergo further treatment in the presence of a lesser concentration of the lighter vapours than at the point of separation.—A. E. D.

Lubricating oils; Process of manufacturing —— and products thereof. R. H. Brownlee, Pittsburgh, Pa. U.S. Pat. 1,309,432, 8.7.19. Appl., 13.5.18.

A suitable petroleum distillate is agitated in the presence of a catalyst, undesirable matter is separated, and the product is "reduced."—A. E. D.

Hydrocarbons; Process of separating —— from water. W. A. Brown, Assignor to F. S. White, Los Angeles, Cal. U.S. Pat. 1,309,794, 15.7.19. Appl., 12.7.16.

A mixture of oil and water is heated under a pressure sufficient to prevent foaming, but not sufficient to prevent the lighter hydrocarbons from vaporising. These conditions are maintained until the emulsion breaks down, when the water is separated.—A. E. D.

Petroleum oil; Method and apparatus for using reagents in the refining of ——. E. H. Leslie, Los Angeles, Cal., Assignor to General Petroleum Corporation. U.S. Pat. 1,310,164, 15.7.19. Appl., 25.9.17.

The oil is treated in a closed vessel, down which the reagent passes. The reagent collects at the bottom and is repeatedly forced through the oil, which is continuously withdrawn at the top and injected at the bottom.—A. E. D.

Pulverulent fuel; Feeding devices for ——. Motala Verkstads Nya Aktiebolag, Motala Verkstad, Sweden. Eng. Pat. 118,100, 17.7.18. (Appl. 11,760/18.) Int. Conv., 31.12.14.

Coke oven doors and the like. W. H. Wright, Dunston-on-Tyne, and E. Fenton, Durham. Eng. Pat. 129,605, 7.10.18. (Appl. 7363/19.)

Gas producers; Poking apparatus for —— and analogous purposes. A. Wilson, Doxey. Eng. Pat. 129,823, 25.7.18. (Appl. 12,153/18.)

Gas purifiers; Construction of grids for ——. J. A. Spencer, Southall. Eng. Pat. 129,885, 18.10.18. (Appl. 17,015/18.)

Liquid fuels; Atomising and vaporising —— for burning. J. S. Johnson, Smethwick. Eng. Pat. 129,398, 9.5.18. (Appl. 7764/18.)

Fuel; Artificial —— and methods of making same. American Linseed Co., New York, Assignees of J. Schaub, Newark, N.J., U.S.A. Eng. Pat. 117,634, 17.7.18. (Appl. 11,741/18.) Int. Conv., 17.7.17.

See U.S. Pats. 1,262,267–8 of 1918; this J., 1918, 330 A.

Producer-gas; Recovery of ammonia from ——. A. H. Lynn and N. E. Rambush, London. U.S. Pat. 1,309,143, 8.7.19. Appl., 23.7.18.

See Eng. Pat. 119,049 of 1917; this J., 1918, 682 A.

Steam-generating plant. U.S. Pat. 1,308,122. *See* I.

Carbon-black from natural gas. U.S. Pat. 1,307,430. *See* XIII.

Butane and propane. U.S. Pat. 1,307,353. *See* XX.

Diolefines. U.S. Pat. 1,308,802. *See* XX.

Gas-analyser. U.S. Pat. 1,308,788. *See* XXIII.

Gas analysis. U.S. Pat. 1,309,681. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Photometer. Bloch. *See* XXIII.

Patents.

Carbonaceous materials; Destructive distillation of —— to increase the aromatic by-products thereof. F. M. Perkin, and Nitrogen Products and Carbide Co., Ltd., London. Eng. Pat. 128,660, 28.8.17. (Appl. 12,350/17.)

Coal is heated in a vertical retort to a temperature which decreases from the bottom upwards. An inert gas such as producer gas, or stripped gas

from the same retort, is mixed with 2·5—10% of acetylene and passed upwards through the charge and withdrawn at the top. The conversion of acetylene into benzol is found to be more complete than when pure acetylene is used.—W. F. F.

Retorts for use in the destructive distillation of coal and the like. J. West, Southport, and W. Wild, Blackpool. Eng. Pat. 129,139, 17.7.18. (Appl. 11,738/18.)

COAL is destructively distilled in a horizontal or inclined retort and the charge is fed forward by a plunger or plungers. The forward movement of the charge is facilitated by making the retort so that the sides taper toward the bottom in vertical cross-section. The sides are preferably curved and convex.—W. F. F.

Shale and the like; Apparatus for distilling ——. H. R. Godfrey, Los Angeles, Cal. U.S. Pat. 1,309,890, 15.7.19. Appl., 5.5.19.

Two heaters in the form of vertical flues are connected by an elevator shaft leading from the bottom of one to the top of the other; a retort is mounted in each of the heaters, and a funnel at the top of one heater has a spout discharging into one retort. There are also spouts or shoots leading from the bottom of this retort to the bottom of the elevator shaft, and from the top of the elevator shaft to the top of the second retort, also a discharge shoot leading outwards from the bottom of the second retort, and a pump connecting the bottom of the elevator shaft to the upper part of the first retort.—T. H. B.

Distilling apparatus. I. Hechenblelkner and P. S. Gilchrist, Assignors to Chemical Construction Co., Charlotte, N.C. U.S. Pat. 1,310,078, 15.7.19. Appl., 15.2.19.

A DISTILLING apparatus comprises a lower and an upper fuel chamber communicating with one another, means to feed the material to be treated into the upper fuel chamber and separate vapour outlets leading to separate condensers from the respective chambers.—A. de W.

Mercury vapour [incandescence] lamps. M. J. Cornu, Paris. Eng. Pat. 129,022, 25.9.17. (Appl. 13,807/17.) Int. Conv., 25.9.16.

THE mercury of the cathode cannot be displaced, but the anode mercury, cooled by a condensation chamber, may be slowly displaced by passing through a valve intended to damp its oscillations, the pressure inside the lamp being always, even in a cold state, greater than atmospheric pressure. The cathode section is formed by a tube, which is in connection with the negative pole of the current supply and united to a cooling chamber connected by a thick-walled bent quartz tube to a condensing chamber. A valved tube, forming a part of the anode section, is in connection on the one side with the condensing chamber and on the other side with the positive pole of the current supply, through the medium of a spiral-shaped conductor exerting pressure on the valve. The meniscuses of mercury may be separated for striking the arc by means of a gas heater under the quartz tube, or by a capillary tube connected to a pump for introducing nitrogen, argon, etc., at the highest point of the quartz tube, or by means of an expansion bulb, containing a heated filament and filled with gas, connected by a capillary tube to the quartz tube. —B. N.

X-ray apparatus. W. D. Coolidge, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,310,061, 15.7.19. Appl., 13.4.17.

AN electron-discharge device comprises a bulb, evacuated to a pressure so low that conduction of energy may occur in the evacuated space independently of gas ionisation. A cathode and anode are mounted in the bulb, with means for heating the cathode, and the latter is surrounded by a conductor for focussing the cathode discharge upon the anode, the conductor being located and proportioned to receive an electron discharge from a heated focal spot on the anode.—B. N.

Arc device; Inclosed ——. P. K. Devers, jun., Lynn, Mass., Assignor to General Electric Co. U.S. Pat. 1,310,067, 15.7.19. Appl., 6.3.16.

AN electric arc device comprises a sealed container containing electrodes of refractory material and a quantity of an amalgam of an alkali metal. Means are provided distinct from the electrodes for vaporising and ionising part of the amalgam preliminary to starting an arc between the electrodes.—B. N.

Arc-lamp electrode. W. R. Molt, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,311,133, 22.7.19. Appl., 2.10.18.

AN electrode containing carbon and tantalum. —B. N.

Electric arc-lamps; Manufacture of carbons for ——. W. Heape, London, and H. B. Grylls, Weybridge. U.S. Pat. 1,302,795, 6.5.19. Appl., 26.3.19.

SEE Eng. Pat. 126,673 of 1917; this J., 1919, 455 A.

Filtering medium. U.S. Pat. 1,303,826. *See* XVII.

III.—TAR AND TAR PRODUCTS.

Tars for Diesel engines. Moore. *See* IIA.

Benzol recovery. Berthelot. *See* IIA.

Melting point of asphalts. Proctor. *See* IIA.

PATENTS.

Diphenylamine; Apparatus for the manufacture of ——. A. E. Houlehan, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,308,356, 1.7.19. Appl., 25.5.17.

THE apparatus comprises an autoclave capable of withstanding high pressure, and surmounted by a column of considerable length.—G. F. M.

Mineral oils. Eng. Pat. 128,326. *See* IIA.

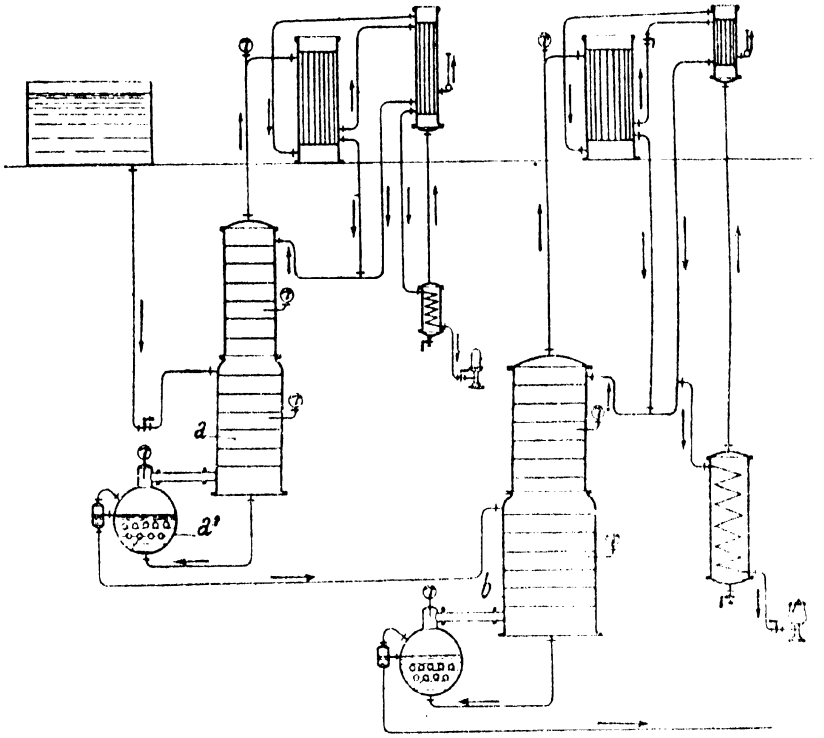
Liquid fuel. Eng. Pat. 129,010. *See* IIA.

Carbonising pitch. Eng. Pat. 129,091. *See* IIA.

Amines. Eng. Pat. 128,372. *See* XX.

***Benzols; Process and apparatus for rectifying* —.** Soc. Anon. des Etablissements Egrot, Paris. Eng. Pat. 127,853, 31.5.17. (Appl. 7842/17.) Int. Conv., 1.3.17.

CRUDE benzol flows continuously into the top of the lower half of a rectifying column, *a*, in which the "head products," *i.e.* products more volatile than benzene, are evaporated and pass up the column, while benzene and products of higher boiling point flow downwards and pass out of the bottom of the column into a vessel, a^2, in which the liquid is boiled. The vapour is led back into the lower end of the column and provides the heat necessary for the rectification, and the excess of liquid flows into a second column, *b*, similar to the first, in which the benzene fraction is removed as vapour, while the liquid residue passes into a third column, not shown, for separating the toluene from the solvent naphtha.—L. A. C.



IV.—COLOURING MATTERS AND DYES.

m-Nitro-p-toluidine Red. H. Shiraishi. Kōgyō-Kwagaku Zasshi (J. Chem. Ind. Tokyo), 1919, **22**, 99—112.

TOLUENE was nitrated with three times its weight of nitric acid (sp. gr. 1·475) at the ordinary temperature for 16 hours, and at 60° C. for 7 hours. The product, containing 30% of the *p*-nitro-compound, was reduced with iron and hydrochloric acid and *p*-toluidine was isolated and acetylated. The *p*-acet-toluide was then converted into *m*-nitro-*p*-acet-toluide by treatment for ¼ hour with a mixture of nitric and sulphuric acids, and the acetyl group removed by hydrolysis with potash. The resulting *m*-nitro-*p*-toluidine was diazotised and the diazo solution to which sodium acetate had been added was poured into a solution of *β*-naphthol in sodium hydroxide mixed with barium sulphate and Turkey-red oil. The lake obtained was washed three or four times by decantation.—G. F. M.

Eosins and erythrosins; Examination of —. T. T. Cocking, J. D. Kettle, and E. J. Chappel. Pharm. J., 1919, **103**, 80—81.

THE percentage of dye acid is determined by precipitating with sulphuric acid and collecting in a Gooch crucible, the filtrate being reserved for the estimation of halogens in inorganic combination as impurities or diluents, whilst the precipitate is washed with dilute hydrochloric acid, dried, and weighed. Halogen in organic combination is then determined by fusing 0·5 grm. of the dye acid with a large excess of sodium carbonate, and estimating the sodium halide or mixed halides in the melt by precipitating with excess of *N*/10 silver nitrate.—G. F. M.

PATENTS.

Sulphur dyes; Manufacture of —. B. F. Halvorsen and C. Hörbye, Christiania, Norway. Eng. Pat. 128,099, 8.10.18. (Appl. 16,381/18.)

CYMENE, which is obtained as a by-product in the manufacture of cellulose by the sulphite process, is converted into *p*-toluic acid by oxidation. The *p*-toluic acid is nitrated with a mixture of nitric and sulphuric acids, to give mono- or di-nitro-*p*-toluic acid. The nitro acids when fused with alkali polysulphides give sulphide dyestuffs which dye brown shades.—L. L. L.

Sulphide dye; Manufacture of — *from filter-cakes of sugar-juice.* J. Nagashima, Tapanee, Formosa, Assignor to Tainan Seito Kabushiki Kaisha, Tokyo, Japan. U.S. Pat. 1,308,552, 1.7.19. Appl., 9.10.17.

THE "filter-cakes of the juice of sugar cane" are neutralised with acid, the lime present is dissolved, and the product converted into a sulphide dye by means of sulphur and alkali.—L. L. L.

Isatine and its substitution derivatives; Production of —— and intermediate products therefor. H. Imrie, London. From J. R. Geigy, Basle, Switzerland. Eng. Pat. 128,122, 6.12.18. (Appl. 20,256/18.)

Isonitrosoacetanilide and its substitution products may be produced by the condensation of aniline or its ring substitution products or N-monosubstituted products, with chloral hydrate and hydroxylamine, in dilute mineral acid solution, at a suitable temperature. Isonitrosoacetanilide, or its derivatives which are susceptible of condensation, when heated with concentrated sulphuric acid, give isatinimides, which on addition of water are hydrolysed into isatines and ammonia.—L. L. L.

Dye-soap. L. C. Cates, Assignor to Sunbeam Chemical Co., Chicago, Ill. U.S. Pat. 1,307,113, 17.6.19. Appl., 29.11.18.

A dye soap is prepared by heating a saponified solution to about 200° F. (93° C.), and adding a solution of a dye and sulphonated oil at approximately the same temperature, agitating the mass, and then moulding the product.—L. L. L.

Sulphur dyes; Process for the production of blue ——. G. B. Ellis, London. From Chemical Works, formerly Sandoz, Basle, Switzerland. Eng. Pat. 129,182, 14.10.18. (Appl. 16,761/18.)

See U.S. Pat. 1,302,671 of 1919; this J., 1919, 530 A.

Sulphur dyes; Manufacture of ——. B. F. Halvorsen and C. Hörbye, Christiania. U.S. Pat. 1,310,751, 22.7.19. Appl., 23.11.18.

See Eng. Pat. 128,099 of 1918; preceding.

Dye compositions adapted for domestic use. E. C. R. Marks, London. From Sunbeam Chemical Co., Chicago, Ill., U.S.A. Eng. Pat. 129,417, 5.7.18. (Appl. 11,078/18.)

See U.S. Pats. 1,274,046—9 of 1918; this J., 1918, 649 A.

Picric acid. U.S. Pat. 1,309,320. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Silk; Distinction of natural from artificial ——. R. Formhals. Chem.-Zeit., 1919, **43**, 386.

A small portion of the sample is treated for a short time with a few c.c. of concentrated sulphuric acid, the mixture is diluted with water, the solution rendered alkaline with sodium hydroxide, and diazotised *p*-nitraniline solution is added. Under these conditions, natural silk gives a red solution and artificial silk a yellow solution. The test may be applied to weighted and dyed silks.—W. P. S.

Woods; Chemical composition of certain species of German ——. C. G. Schwalbe and E. Becker. Z. angew. Chem., 1919, **32**, 229—231.

The methods previously described and applied to the analysis of flax and hemp sprits (this J., 1919, 407 A and 408 A) have been extended to the examination of typical species of German woods. For the determination of fat and resin it was found that extraction with a mixture of alcohol and benzene gave substantially the same results with wood as the more tedious double extraction with ether followed by alcohol. The direct estimation of lignin was made with highly concentrated hydrochloric acid and with gaseous hydrogen chloride (see König and Becker, this J., 1919, 530 A); both treatments gave equivalent results. The pectin was estimated from the methyl alcohol split off by boiling with dilute acid, according to von Fellenberg, but the methyl alcohol produced was determined by Zeisel's method. On calculating the furfural from the weight of phloroglucide it appears that the precipitate obtained by the rapid precipitation method of Tollens and Böddener (J. Landw., 1910, 232) has the composition $C_{11}H_4O_3$, whereas that formed by Tollens' original method is $C_{11}H_8O_4$. The estimation of methylfurfural by extracting the mixed phloroglucides with alcohol is only approximate and the results are of doubtful value. The pectin estimations are somewhat tedious and the values, in the case of woods, so small, that this item might be omitted in technical investigations. The "acetic acid values" determined by Schorger's method (this J., 1917, 867) afford a useful analytical criterion which might be extended by a separate estimation of the formic acid. The cellulose determined by Cross and Bevan's method contains a portion of the pentosans, as well as hexosans of a similar order of resistance; neither the cellulose, the hexosans, nor the pentosans found in this way represent the technical yields, owing to the more severe hydrolytic action of the treatment on the large scale. On the whole, the values now recorded for German woods conform satisfactorily with those found by Schorger for American woods. The limits of variation in the same species due to age and conditions of growth have still to be determined. In each of the two groups the methoxyl values are practically proportional to the lignin, but the coniferous woods show lower methoxyl and higher lignin values than the deciduous species.

	Calculated on dry substance			
	Spruce, *Picea excelsa* %	Pine, *P. silvestris* %	Beech, *Fagus silvatica* %	Birch, *Betula verrucosa* %	Poplar, *Populus tremula* %
Ash	0·77	0·39	1·17	0·39	0·32
Fat, wax, and resin (*a*) Ether extract	0·78	1·92	0·31	0·71	1·08
(*b*) Alcohol extract	1·52	1·53	1·47	1·09	2·08
(*c*) Sum of (*a*) and (*b*)	2·30	3·45	1·78	1·80	3·16
(*d*) Alcohol-benzene extract	2·34	3·32	1·20	1·68	2·87
Methyl value	2·36	2·20	2·96	2·77	2·57
Pectin (according to von Fellenberg)	1·22	1·11	1·75	1·61	1·82
Acetic acid (Schorger's method)	1·44	1·40	2·34	4·65	4·17
Protein, N × 6·25	0·69	0·80	1·05	0·74	0·63
Furfural	7·49	7·04	14·90	16·08	12·64
Pentosan	11·30	11·02	24·86	27·07	23·75
Methylpentosan	3·00	2·23	1·02	0·84	0·72
Cellulose containing pentosan	63·95	60·54	67·09	64·16	62·89
Pentosan in cellulose	9·55	11·27	20·35	29·40	24·94
Cellulose corrected for pentosan	57·84	54·25	53·46	45·30	47·11
Lignin (HCl method)	28·29	26·36	22·46	19·56	18·24

—J. F. B.

Sulphite cellulose waste liquor. K. H. A. Melander. Teknisk Tidskr., 1918, No. 10—12. Chem. Zentr., 1919, **90**, I., 862—863.

THE product obtained from sulphite waste liquor by salting out with sodium chloride differs from the lignin-sulphonic acid obtained by Klason by precipitation with calcium chloride. It yields on purification a mixture of high molecular lignin-sulphonic acids, similar in properties, which contain a proportion of sulphur dioxide loosely combined in the form of an ester. This mixture is called α-lignin-S-acid and is mostly monobasic. Fusion with alkali under various conditions yields vanillic acid or protocatechuic acid and catechol; at the same time acetic acid and small quantities of higher fatty acids are produced. The free lignin-S-acid is formed by the addition of hydrochloric acid to the salted-out product; it is a light-brown powder, easily resinified, soluble in water and alcohol but precipitated by ether. Its salts with naphthylamine and toluidine always contain one atom of nitrogen to one of sulphur, but the sulphur in the acid appears to be combined in different ways, partly in loose and partly in fixed combination. The titration of α-lignin-S-acid with indicators is very difficult on account of its colour, but a result obtained by measuring the conductivity during titration showed an equivalent weight of 782, while 882 was found by measuring the potential of the solution against a mercurous chloride electrode. The results appeared in all cases to indicate one sulphur atom to one ionisable hydrogen atom, so that the acid contains no carboxylic group. The sodium salt is not appreciably hydrolysed. Molecular weight determinations in aqueous solution by the cryoscopic method gave values between 822 and 991 for different preparations.—J. F. B.

Silk fibroin. Johnson and Daschavsky. *See* XIXA.

Alkali-sawdust fusion. Mahood and Cable. *See* XX.

PATENTS.

Washing agent [especially for wool]. C. Bennert, Cöpenick. Ger. Pat. 311,542, 5.1.15.

USE is made of decomposition products of albumin, such as protalbinic and lysalbinic acids, for washing purposes, either alone or in combination with other suitable agents. The application is particularly beneficial for washing wool fibre, the latter becoming soft and lustrous.—L. L. L.

Fabric for aircraft or other uses. H. Dreyfus, London, Assignee of H. D. Dryvers, Charenton, France. Eng. Pat. 128,274, 10.7.17. (Appl. 9963/17.) Int. Conv., 3.8.16.

A SOLUTION of cellulose acetate in tetrachloroethane or acetone is applied to a metallic fabric. The fabric may be of aluminium, steel, or other metal, preferably of large mesh so as not to spoil the transparency. Tetrachloroethane appears to be the most suitable solvent for leaving a transparent sheet after evaporation. The fabrics, thus prepared, withstand weather and the attack of the physical and chemical agents to which aeroplanes etc. may be exposed.—L. L. L.

Paper yarn and paper textiles; Improving the water-resisting properties of ——. O. Ruff, Breslau. Ger. Pat. 311,772, 28.3.18.

WHEN finely divided and bleached cellulose is kept under water for some time, a mucilaginous substance is produced by fermentation or putrefaction, and under certain conditions in such quantities that the material may be made into paper without further additions. The paper produced, if heated for a moderate time at moderately high temperatures, *e.g.*, 120° C., loses its water-absorbing properties and becomes water-resisting, without the addition of glue or other sizing agents.—L. L. L.

Fibrous pulp from wood and other ligno-cellulosic substances; Manufacture of ——. J. C. van Wessem, Bloemendaal, Holland. Eng. Pat. 122,812, 28.6.18. (Appl. 10,681/18.) Int. Conv., 29.1.18. Addition to 117,086, 23.12.15 (this J., 1919, 496 A).

MATERIAL, other than wood-waste or sawdust, containing ligno-cellulose, *e.g.*, straw, chaff, etc., is subjected to a mechanical process for separating it into fibres while in a moist condition, the operation being continued until the greater part of the moisture has been evaporated. The material is moistened with 60—120% of water, calculated on the dry material, and treated for conversion into fibrous pulp at 70°—100° C., the transformation being so conducted that the material retains the necessary moisture for conversion into fibrous pulp; the production of a fluid pulpy condition or separation of visible water in the mass are avoided. The fibrous pulp contains a maximum of about 40% of moisture, and is suitable for paper or paste-board manufacture and ready for the vat of the paper machine.—L. L. L.

Felts; Process of manufacturing ——. R. P. Perry, Upper Montclair, N.J., Assignor to The Barrett Co. U.S. Pat. 1,307,750, 24.6.19. Appl., 9.10.17.

MOIST sheets of paper-making material, containing fusible waterproofing composition in comminuted form, are passed through a heated gaseous drying medium.—L. L. L.

Fireproof [cellulose acetate] composition. E. G. Robinson, Montclair, N.J., Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,310,841, 22.7.19. Appl., 25.2.18.

THE material is composed of cellulose acetate and ammonium magnesium phosphate.—B. M. V.

Cellulose solvent. G. Mersereau, Assignor to Chemical Development Co., New York. U.S. Pat. 1,308,803, 8.7.19. Appl., 10.9.13. Renewed 2.1.18.

A CELLULOSE solvent containing an alcohol, a cellulose ester, and a mixture of chlorohydrocarbons.—G. F. M.

Sulphite cellulose waste liquors; Separation of organic and inorganic substances from ——. R. W. Strehlenert, Gothenburg, Sweden. Ger. Pat. 310,819, 26.1.18. Int. Conv., 3.2.17.

THE waste liquor is decomposed by heating under high pressure, the free and combined sulphurous acid being converted into sulphuric acid. The yield of precipitated lignin-substances is increased if the lye, before being subjected to the decomposition process, is partially evaporated, with separation of calcium sulphate and acid sulphite and liberation of sulphur dioxide. The evaporation is best carried out by utilising the heat evolved during the decomposition of a previous charge.—L. L. L.

Coated fabrics; Methods of producing ——. E. C. R. Marks, London. From E. I. du Pont de Nemours and Co., Wilmington, Del., U.S.A. Eng. Pat. 126,750, 21.1.18. (Appl. 1188/18.)

SEE U.S. Pat. 1,257,665 of 1918; this J., 198, 315 A.

[*Cardboard*] *vessels; Process for treating porous* ——. G. H. Hadfield, Mitcham, and A. E. Bawtree, Sutton. U.S. Pat. 1,306,375, 10.6.19. Appl., 15.10.18.

SEE Eng. Pat. 120,410 of 1917; this J., 1919, 8 A.

Sulphur dyes. Eng. Pat. 128,099. *See* IV.

Recovering alkali used in pulp digestion. U.S. Pat. 1,308,184. *See* VII.

Waterproofing compositions. U.S. Pat. 1,310,158. *See* XIII.

Oxalic acid. U.S. Pat. 1,310,713. *See* XX.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Wool; Application of the biuret-reaction to ——. M. Becke. Färber-Zeit., 1919, **30**, 101—104, 116—119, and 128—130.

THE author gives an account of further experiments upon the strength of woollen materials before and after certain treatments and the examination of the treated wool with the stannous chloride reaction and of the amount of wool substance passing into solution estimated by the biuret reaction (see this J., 1912, 380). Equivalent solutions of caustic soda or potash give practically the same results, both as regards the quantity of wool substance passing into solution and the strength and elongation of the treated material. Tests with sulphuric acid, from 0 to 10% on the weight of the woollen yarn, show that 2% has least action both in the amount of wool passing into solution and the effect on elongation; 4% of acid has practically the same action as water alone. Woollen yarn that has been chromed with 2% potassium bichromate and 3% lactic acid followed by treatment with sulphuric acid is less soluble in water than unchromed wool; its elongation is practically unaltered, but its breaking strain is reduced; warm and boiling sodium carbonate solutions have less effect on the chromed than upon unchromed wool. To test the dyeing property of wool, worsted yarn was treated with 0, 2, 4, 6, 8, and 10% sulphuric acid, and the samples were then dyed in different baths to the same tone with Patent Blue A, the dyed samples neutralised with cold weak sodium bicarbonate solution, and the colour then tested for fastness to boiling water, warm and boiling soap solution, and soda solutions. The colour was fastest on the yarn which had been treated with 6% or 4% acid; that treated with 8% and 10% less fast than that treated with 0% or 2% acid. Towards the soda bath the neutral dyed material was the fastest and bled less into white wool than the acid-treated material. Caustic soda solutions do not show strong hydrolytic action on wool compared with sulphuric acid, but act mainly as sulphur-abstracting agents. The author concludes from the results of his experiments that the brown colour obtained by the stannous chloride reaction (*loc. cit.*) only indicates partial destruction of the wool substance. The biuret reaction indicates quantitatively the amount of wool substance passing into solution after treatment of wool with water, acids, alkalis, soap solutions, etc. With increasing loss of wool substance there is a reduction of breaking strain and elongation. The biuret method can be very easily adapted to control purposes in conjunction with mechanical breaking strain and elongation tests. For purposes of comparison the chemical test is the more reliable, as it is not affected by milling or felting and binding agents as is the case with the mechanical tests. Sulphuric acid acts chiefly hydrolytically upon wool; the decomposition products are of a basic nature and pass into solution, and the remaining product of acid nature is relatively more soluble in alkalis. Higher temperature, increased duration of action, and increased concentration of the acid bath increase the hydrolytic decomposition. Contrary to the general view, that the dyeing of wool in presence of Glauber's salt and sulphuric acid is the most advantageous, the strength and elasticity by this method are endangered, whereas a better handle is obtained by treatment with water, soap, alkali carbonates, or caustic alkalis. After treatment of wool with sulphuric acid the handle is improved by a subsequent treatment with alkalis, but by treatment of wool with alkalis—within certain limits—no felting of the structure takes place and a far better handle is obtained by subsequent acid treatment.—L. L. L.

Cottonwool; Behaviour of —— towards aluminium acetate. G. Durst. Chem.-Zeit., 1919, **43**, 374—375.

BLEACHED cottonwool, when immersed in aluminium acetate solution for 24 hrs., absorbs about 0·9 grm. of alumina per kilo. of cotton; one-half of this amount of alumina is fixed on the cotton. The fixation of the alumina is influenced by many factors, viz., concentration of the solution, proportion of solution to cotton, temperature, time of immersion, previous treatment of the cotton, etc.

—W. P. S.

Starch substitutes [for finishing textiles]. A. Winter. Färber-Zeit., 1919, **30**, 104—105.

GLUE alone or along with other filling agents is employed. Dark glue may be made suitable for many purposes by swelling in cold water and extracting several times with cold water; the dark colour is generally removed, making the glue suitable for finishing without fear of dark lines or patches. The washed glue is dissolved and applied hot. A high-grade glue should give a good jelly in 150 times its weight of water. Irish moss alone or with glue may be used for finishing fine wool, silk, or cambric goods. For the finishing of curtains and embroidery, mucilages from various seeds, such as flaxseed, fleawort, canary seed, etc., may be used alone or in conjunction with glue and Irish moss. The above-mentioned finishing agents are frequently adulterated with calcium sulphate.

—L. L. L.

PATENTS.

Bleaching textile materials; Apparatus for ——. R. Mohr, Elbergen, Holland. Ger. Pat. 311,546, 14.9.16.

TEXTILE materials, either raw material, yarn, or piece goods, may be bleached without boiling, with the aid of oxygen, loss of oxygen being avoided by collecting and again passing the liberated oxygen through the bleaching liquor. The bath liquor is run into a saturation vessel, treated under pressure with the separated oxygen, and then again used for bleaching purposes. Bleaching is effected under pressure, whereby the bleaching effect is considerably enhanced. If necessary the material may be treated in a number of baths, *e.g.*, the goods may be "chemicked," soured, treated with oxygen, and then soaped. The temperature for treatment need not exceed 80° C. Linen, for example, after a boil with 2% soda and then passing through the above treatment, gives a ½ white. The handling

in the process is very mild, and the process is consequently particularly adapted to the treatment of laces, embroidery, etc.—L. L. L.

Mordanting by means of calcium antimony tartrate. S. M. Hermann, New York. U.S. Pat. 1,307,860, 24.6.19. Appl., 30.4.17.

CALCIUM antimony acid tartrate is produced by boiling fused calcium chloride with excess of tartaric acid, most of the hydrochloric acid formed being eliminated by boiling and any remaining hydrochloric acid being neutralised by addition of sodium bicarbonate. The product is purified, and then boiled with antimony oxide until test samples show a 50% content of antimony oxide.—L. L. L.

Fabric-treating machine. H. M. Dudley, Philadelphia, Pa. U.S. Pat. 1,306,529, 10.6.19. Appl., 5.6.18.

THE machine comprises a revolving foraminous reel provided with a device for closing a portion of the openings so that steam introduced into the reel will pass through the fabric wound thereon. A foraminous cover is provided which may be pressed on the fabric roll to maintain it in position. L. L. L.

Coating with metal of lace and other similar goods and woven or other fabrics. E. A. Holland, Southend-on-Sea. U.S. Pat. 1,309,032, 8.7.19. Appl., 18.4.14. Renewed 25.3.19.

SEE Eng. Pat. 9786 of 1913; this J., 1914, 642.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitrous acid; Influence of fluorides on the oxidimetric determination of ——. I. Bellucci. Gazz. Chim. Ital., 1919, **49**, I., 209–216.

IN determining nitrous acid by Lunge's method of oxidation with potassium permanganate in acid solution, the results are inaccurate in the presence of any notable proportion of fluorides. This is due to the same cause as the anomaly discovered by Müller and Koppe (this J., 1910, 1155) in the oxidimetric determination of manganous manganese by Volhard's method, in the presence of fluorides. In the absence of fluorides permanganate yields its oxygen in accordance with the scheme—

$$Mn_2O_7 \rightarrow 2MnO_2 + 3O,$$

whilst when fluorides are present the decomposition follows the course $Mn_2O_7 \rightarrow Mn_2O_3 + 4O$. In the case of nitrous acid this may be obviated by combining an iodometric with the oxidimetric method. An excess of standard permanganate solution is added to the nitrous acid solution in presence of sulphuric acid, then, after 2 mins., alkali iodide is added, and the liberated iodine is titrated with standard thiosulphate solution. A blank determination is made by adding alkali iodide to the same quantity of potassium permanganate solution as was used to oxidise the nitrous acid and titrating the liberated iodine as before.—C. A. M.

Arsenious acid and arsenic acid; Electrolytic reduction of —— to arsenic hydride by means of different metallic cathodes. L. Ramberg. Lund's Universitets Arsskrift., 1918, **14**, [21], 1–47. Chem. Zentr., 1919, **90**, I., 905–906.

IT is shown that the migration of the arsenate ions in the anode chamber causes a greater error in the reduction of arsenic acid than does diffusion through the diaphragm, and that the complete reduction of arsenic acid is possible only by the use of cathodes which effect the reduction rapidly. The efficiency of mercury, copper, silver, lead, iron, tin, cadmium, nickel, and platinum as cathodes is discussed; these fall into different order as regards their reduction of arsenious and arsenic acids, and their reducing powers are not in the same order as their supertensions (overvoltage). A mercury cathode and certain amalgamated cathodes reduce arsenic acid quantitatively, but not arsenious acid; the reduction of the latter appears to proceed, in part, to arsenic itself which combines with the metallic mercury and this compound is very slowly converted into arsenic hydride.—W. P. S.

Electrolytic caustic soda-chlorine cells. K. Horine. Chem. and Met. Eng., 1919, **21**, 69–72.

THE patent situation, as regards the electrolysis of sodium chloride, is briefly reviewed, and the types of cell employed in the diaphragm, mercury, bell, and fused electrolyte processes are described. Notwithstanding the practical difficulties attending the use of diaphragms, cells of the diaphragm type are the most satisfactory on the market at present. The advantages of the mercury cell efficiency and purity of products are largely offset by the high initial cost and large floor space required and by the difficulty of purifying the mercury. The high fixed charges of this process can be compensated only by low energy costs, *e.g.* abundant water power. Cells of the bell type, although reliable in operation, require a large floor space and have a low energy efficiency; but this is counterbalanced by low capital investment, upkeep, and attendance charges; the possibility of increasing the energy efficiency by decreasing the operating voltage offers a promising field for investigation. In the fused electrolyte process the concentration of caustic soda produced is about 94%, whereas that of chlorine is only about 10%; the energy efficiency is also very low. In the electrolysis of sodium chloride generally, the ampère-hour efficiencies obtained in practice vary between 90 and 98% and the energy efficiencies between 30 and 75%. A chart of co-ordinated curves is given to facilitate correlation of the various factors bearing on the cost of production.—W. E. F. P.

Potassium chloride from the mother liquor in the manufacture of sea salt. T. Nishimura. Kōgyō-Kwagaku Zasshi (J. Chem. Ind., Tokyo), 1919, **22**, 255–287. (See also this J., 1917, 1046.)

IN the case of bittern rich in magnesium sulphate the separation of potassium salt as carnallite is very incomplete, a considerable proportion separating as double sulphate both in the boiling and cooling process. This difficulty is avoided by adding to bittern the mother liquor of carnallite, whereby sodium chloride separates first, and on standing for a week or two in cold weather, magnesium sulphate gradually separates until eventually the ratio $MgSO_4 : MgCl_2$ falls below 0·11, at which point the liquor can be treated for recovery of carnallite.—G. F. M.

Ammonium sulphate; Works experience in the manufacture of ——. A. Krämer. J. Gasbeleucht., 1919, **62**, 341–345.

A CRITICISM of a paper by Wolff (this J., 1919, 103 A). Internal lead lining of the blow-over pipe is unsuitable on account of the contraction of the lead gradually closing the pipe. In the author's experience the lead lining of the saturator and the stoneware lining of the pipe leading from the saturator proved very durable. A salt pan of improved type is recommended. This consists of a lead-lined

pan, designed to tilt and rotate on its base, so that it can serve several hydro-extractors. Sluice-valves, which are an important item in repairs, are unnecessary. The liquor overflow, situated on the opposite side of the pan to the salt outlet, can be regulated to any height, and the inclination of the pan arranged to feed salt of almost constant composition into the hydro-extractor in quantities so regulated as to avoid damage to the drum or axle through concussion. The maintenance cost of this type of pan is very low, and no reserve unit is required.—S. S. A.

Ammonium salts; Simple method for the production of —— from gas liquor in small gas works. Friese and M. Heineken. J. Gasbeleucht., 1919, **62**, 328—329.

A CRITICISM of the process devised by Heineken (this J., 1919, 251 A), followed by a reply by Heineken.—J. S. G. T.

Alkali cyanide; Synthesis of —— from nitrogen. R. Hara and R. Hayashi. Kōgyō-Kwagaku Zasshi (J. Chem. Ind. Tokyo), 1919, **22**, 175—201.

IN the synthesis of sodium cyanide from nitrogen, sodium carbonate, and carbon, with iron as catalyst (see Bucher, this J., 1917, 451), 80% of the carbonate was converted into cyanide in 90 mins. in a vertical electric tube furnace at a temperature of 950° C., the proportions of soda, iron, and carbon being 1 : 1 : 0·7. Traces of chlorine, sulphate, and the impurities contained in ordinary iron did not materially influence the result, but silica diminished the yield.—G. F. M.

Sodium bisulphite crystals ($NaHSO_3.3H_2O$). W. Schiller and A. Wilhelm. Z. angew. Chem., 1919, **32**, 198—199.

AT low winter temperatures sodium bisulphite is deposited from aqueous solution in large, transparent, apparently rhombic crystals containing 3 mols. H_2O. They are only stable in the mother liquor, and when exposed to the air rapidly lose water and disintegrate, leaving a residue of anhydrous sodium bisulphite containing traces of sulphate and pyrosulphite.—G. F. M.

Calcium chloride used in automobile "anti-freeze" solutions; Corrosion tests on commercial ——. P. Rudnick. J. Ind. Eng. Chem., 1919, **11**, 668—670.

CALCIUM chloride solution is quite unsuitable for use in anti-freezing solutions in the cooling systems of motor vehicles in which aluminium or copper, or both, are in electrical contact with iron or steel. Rapid corrosion, particularly of the aluminium parts, takes place.—W. P. S.

Aluminium sulphate; Acidimetric analysis of the liquids obtained in the manufacture of ——. I. Bellucci and F. Lucchesi. Gazz. Chim. Ital, 1919, **49**, I., 216—241.

Two equal samples of the filtered liquid, *e.g.*, from the reaction apparatus, evaporators, etc., are diluted, and to each of them are added 2 c.c. of *N*/10 sulphuric acid, 3 drops of 0·02% methyl orange solution, and 5 drops of 1% phenolphthalein solution. One of the samples is then titrated with *N*/1 sodium hydroxide solution until an orange coloration is obtained. The number of c.c. required = *a*. To the same liquid is added 5 c.c. of a saturated solution of barium chloride, the volume made up to 200—500 c.c., and the titration with alkali continued gradually and with constant agitation until the pink coloration of phenolphthalein persists for some minutes. The number of c.c. = *b*. The other sample of liquid is treated with 5 c.c. of the barium chloride solution and diluted as before, and a volume of sodium hydroxide solution 1 to 2 c.c. less than *b*, is rapidly added. The liquid is boiled for about 5 mins., cooled, and the titration completed, with agitation, until a permanent pink coloration is obtained. The free sulphuric acid in the liquid is equivalent to $a-2$ c.c.; the combined aluminium oxide to $c-a$; and the free alumina to $2-a$ c.c. If $a=2$ c.c. the liquid contained normal aluminium sulphate. The principal impurity in such liquids is iron. This may be rapidly determined by titration with *N*/5 permanganate solution before and after reduction of the iron in the usual way. The number of c.c. consumed by the iron in the ferrous condition is multiplied by 0·4, and that required by the ferric iron by 0·6 to obtain the corresponding quantities of *N*/1 sodium hydroxide solution. The sum of these is deducted from the number of c.c. of *N*/1 alkali used in the acidimetric determination of alumina ($c-a$), to obtain the correction to be applied for the iron sulphate.—C. A. M.

White arsenic; Direct production of ——. C. Doremus. Trans. Amer. Electrochem. Soc., 1919, 279—281.

ARSENO-PYRITES of the composition, AsSFe 47·10% and FeS, 9·67%, was roasted in an internally heated rotary kiln 20 ft. long and 4 ft. in diameter. The kiln was heated by a series of gas-air flames playing direct on to the charge, and the exhaust gases, above the vaporising temperature of "white arsenic," passed to a Cottrell precipitator capable of dealing with 4000 cub. ft. per minute. Collected white arsenic, after shaking from the pipes and chains, fell into a trough from which it was conveyed to storage bins by a screw conveyor. A concentrate was found preferable to the hand-picked ore, and a "Buchart table" was installed. The product collected by the precipitator contained 98% or more As_2O_3.—C. A. K.

"Blue John" and other forms of fluorite. B. Blount and J. H. Sequeira. Chem. Soc. Trans., 1919, **115**, 705—709.

ANALYSES of the blue and white portions of "Blue John" failed to show any material difference in composition, and metals such as manganese which have been regarded as the cause of the colour are practically absent. Traces of organic matter were found, but after extraction with chloroform and toluene the residue remained as blue as before. On heating, however, the "Blue John" decrepitates and loses its colour. Exposure to radium produced a blue colour in white fluorspar and a darker blue in "Blue John." X-rays also caused a temporary colour development in fluorspar.
—G. F. M.

Alkali-sawdust fusion. Mahood and Cable. *See* XX.

Cerium etc. Brinton and James. *See* XXIII.

PATENTS.

Sulphuric acid and other acids; Apparatus for the concentration of ——. G. K. Davis, London. Eng. Pat. 128,396, 19.6.18. (Appl. 10,127/18.)

HOT gases from a furnace burning coke or other suitable fuel are passed into a combustion chamber, and thence, in regulated quantity, into a series of concentration chambers where they meet with

sulphuric acid thrown up in a fine dense spray by a suitable fanner. The weak acid, which is preheated in a heat-interchanger and an economiser by the gases and hot concentrated acid leaving the chambers, passes through the chambers in the opposite direction to the hot gases. The plant is so arranged and the operation so conducted that no saturated gases come into contact with weak acid. The shape and dimensions of the concentration chambers are made to conform to the body of spray produced in order to eliminate "dead" spaces.
—S. S. A.

Sulphuric acid; Concentration of ——. F. Perrin, Volvic, France. U.S. Pat. 1,301,598, 22.4.19. Appl., 7.2.19.

THE apparatus, which is made of Volvic stone or like material, comprises a "regenerator" with superposed shallow troughs containing acid to be concentrated, arranged above a "saturator" which receives the acid from the regenerator. The saturator is provided with partitions to form a central flue and two longitudinal side flues, which are provided with baffle-plates dipping into the acid on the floor of the saturator, so as to cause the hot gases to be forced under the partitions from the central flue into the side flues, thence back into the central flue, and then back again into the side flues. From the saturator the hot gases pass to the regenerator, the lower sides of the troughs in which are provided with grooved projections.
—S. S. A.

Condenser [*for nitric acid vapour*]. A. Hough, Dragon, Quebec. U.S. Pat. 1,291,893, 21.1.19. Appl., 15.7.16.

THE apparatus is similar in form to that described in Eng. Pat. 101,307 of 1916 (this J., 1916, 1108), but the condenser units consist of straight tubes, closed at the lower end and with lips at their upper ends; glass tubes connected with inlet and outlet headers by flexible tubing are arranged within the condenser tubes, extending from a short distance above the bottom to above the lip at the upper end.

Ammonia; [Catalytic] process of oxidation of —— to nitric acid. Catalyser. A. Henwood, Cynwyd, Pa. U.S. Pats. (A) 1,309,622 and (B) 1,309,623, 15.7.19. Appl., 11.7.17 and 25.6.18.

(A) A MIXTURE containing ammonia and oxygen is passed over a heated catalyst, and the partial pressure of the oxygen is kept at not less than double that of the ammonia gas. (B) The catalyst is in the form of a porous diaphragm of practically continuous surface, and so thin that practically the whole of the material is active.—B. M. V.

Acetic acid; Manufacture of —— from acetaldehyde. H. Dreyfus, Basle, Switzerland. U.S. Pat. 1,308,173, 1.7.19. Appl., 19.1.18.

ACETIC acid is prepared by passing a gas containing free oxygen, at atmospheric pressure, through liquid acetaldehyde maintained at 0°—10° C. and vigorously agitated to effect intimate contact with the gas.

Nitre cake; Utilisation of ——. J. S. Morgan, Freshfield. Eng. Pat. 128,302, 27.7.17. (Appl. 10,803/17.)

NITRE cake is thrown on to the surface of molten or partially solidified basic slag in a closed chamber. At the temperature of the crust of the slag (500°—700° C.) oxides of nitrogen and most of the free sulphuric acid are driven off and may be recovered. The residual sulphate is then mixed with the molten slag, by which a temperature of about 1300° C. is attained. The remaining sulphuric acid is thus driven off, chiefly as sulphur dioxide, sodium silicate being formed. The gases evolved at this stage are drawn off and utilised in a sulphuric acid chamber or contact plant.—S. S. A.

Ammonia; Construction of pressure furnaces particularly for use in the synthesis of ——. E. B. Maxted and T. A. Smith, Walsall. Eng. Pat. 128,623, 14.8.17. (Appl. 11,643/17.)

A PRESSURE furnace lined with non-conducting material comprises a main reaction chamber and a separate combustion chamber, inside or surrounding the reaction chamber, which is heated by internal combustion to a temperature sufficiently high to ensure complete combustion and is operated at a pressure about equal to that in the reaction chamber, by means of a valve automatically regulated by the pressure of the reaction gases. The products of combustion are exhausted through a coil and the reaction gases are heated by contact with the combustion chamber and the coil. In the synthesis of ammonia by the interaction of nitrogen and hydrogen in the presence of a catalyst, a portion of the high-pressure nitrogen-hydrogen mixture is admitted along with air into the combustion chamber. Catalysts affected by water vapour may be employed.—S. S. A.

Nitrogen; Process of recovering fixed ——. *Process of making ammonia from atmospheric nitrogen.* E. W. Haslup, Bronxville, Assignor to R. Gilchrist, New York. U.S. Pats. (A) 1,310,478 and (B) 1,310,479, 22.7.19. Appl., 8.4. and 20.6.18.

(A) A MIXTURE of an oxide-bearing material and carbon is heated in a fuel-fed furnace in an atmosphere of producer-gas to a temperature sufficiently high to produce carbo-nitride (cyanamide). The carbo-nitride and producer-gas are drawn from the furnace at a temperature too high to permit the carbo-nitride to condense and are subsequently separated. (B) A mixture containing carbon and an oxide capable of forming a salt with an acid is heated in a fuel-fed furnace in an atmosphere of producer-gas to obtain carbo-nitride, which is withdrawn from the furnace along with the producer-gas at a temperature sufficiently high to prevent condensation. The hot gases are treated with water and the ammonia produced from the carbo-nitride is separated.—S. S. A.

Nitrogen from blast-furnaces; Process of recovering combined ——. E. W. Haslup, Bronxville, N.Y., Assignor to R. Gilchrist, New York. U.S. Pat. 1,310,480, 22.7.19. Appl., 25.6.18.

THE solution obtained by treating the furnace fumes from a blast-furnace with water is heated in an autoclave to convert any cyanamide present into ammonia and carbonates. The resulting solution is freed from sulphides and insoluble matter, and the nitrogen compounds are then separated.
—S. S. A.

Ammonium sulphate; Manufacture of ——. F. W. Sperr, jun., Assignor to H. Koppers Co., Pittsburgh, Pa. U.S. Pat. 1,310,306, 15.7.19. Appl., 10.5.18.

AMMONIUM sulphate crystals are neutralised by treatment with ammonia vapours drawn from "the fixed section of an ammonia still."—C. A. K.

Zinc sulphide; Preparation of anhydrous ——. P. Comment, Dijon, France. Eng. Pat. 126,274, 11.3.19. (Appl. 6089/19.) Int. Conv., 30.4.18. Addition to Eng. Pat. 106,489, 16.5.16.

IN the process involving calcination of a mixture of anhydrous zinc persulphide, anhydrous zinc sulphate, and an alkali sulphate (this J., 1918, 273 A, 313 A), the alkali sulphate may be replaced entirely or in part by sulphites, hyposulphites (thiosulphates), thionates, or other salts which form alkali sulphates at the temperature of calcination. In place of zinc persulphide, other polysulphides of zinc, with or without admixture of zinc sulphide, may be used.—S. S. A.

Antimonious oxide; Production of ——. E. F. Morris, Liverpool. Eng. Pat. 128,818, 8.10.18. (Appl. 16,333/18.)

THE quality of antimonious oxide produced by oxidation of molten antimony is improved by adding to the melt, sulphur, sulphides of arsenic, or high-grade "crudum" (*i.e.*, antimony sulphide obtained from stibnite by liquation), to maintain the percentage of sulphur or arsenic, or both, throughout the oxidation.—S. S. A.

Sodium nitrate or potassium nitrate; Concentration of ——. H. S. Coe, Mound City, Kans., Assignor to The Dorr Co. U.S. Pat. 1,292,580, 28.1.19. Appl., 29.9.17.

CRUDE material containing nitre is treated at about 50°—70° C. in a solution which is saturated when cold both with nitre and with the soluble impurities of the crude nitre, chiefly sodium chloride. The solution dissolves more nitrate but very little more sodium chloride. On cooling, impure nitre separates. This is then digested at 100°—120° C. with a solution which when cool or moderately warm is saturated with both nitre and impurities, whereby the nitre is dissolved but not the impurities, and some of the impurities already in solution are precipitated. On cooling the resulting solution, commercially pure nitrate separates.—L. A. C.

Anhydrous metallic chlorides; Preparation of ——. P. L. Hulin, Grenoble, France. U.S. Pat. 1,304,567, 27.5.19. Appl., 5.3.18.

HYDROGEN and chlorine are caused to interact in a chamber containing a hydrated metallic chloride, *e.g.*, magnesium chloride, the heat of reaction being utilised to dehydrate the hydrated chloride. The hydrogen chloride also serves to prevent decomposition of the metallic chloride. Excess chlorine or/and hydrogen chloride are preferably added to the mixture of hydrogen and chlorine to moderate the heat of reaction.—L. A. C.

Mineral salts; Process of producing dehydrated ——. L. Doonar, Bend, Oreg. U.S. Pat. 1,308,403, 1.7.19. Appl., 27.12.17.

DEHYDRATED mineral salts are produced by superheating a saturated solution of the salt under pressure to a temperature just below the boiling point of the solution at that pressure, atomising the superheated solution by means of a hot gas, and maintaining the atomised solution and gas at a temperature sufficient to convert all the moisture into dry steam, from which the dry salt is separated in a separator.—G. F. M.

Aluminium chloride; Manufacture of ——. G. H. King and G. I. Roberts, Port Arthur, Tex., Assignors to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,308,080, 1.7.19. Appl., 10.4.19.

A MIXTURE of hot producer-gas and chlorine is brought into contact with alumina, and from the resulting vapours aluminium chloride is separated by cooling.—S. S. A.

Halides [aluminium chloride]; Process of and apparatus for making ——. L. S. Abbott, Port Arthur, Tex., Assignor to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,308,885, 8.7.19. Appl., 11.5.17.

IN the manufacture of aluminium chloride by the action of chlorine on a heated mixture of alumina and carbon, the chlorine is preheated sufficiently to maintain the mixture at the necessary temperature.—W. E. F. P.

Pulp digestion; Process of recovering the alkali used in ——. D. S. McAfee, New York, Assignor to The Dorr Co. U.S. Pat. 1,308,184, 1.7.19. Appl., 16.8.18.

THE sodium carbonate present in the recovered soda ash is causticised by bringing the soda ash into contact with unslaked lime whilst the latter is being ground with a liquid slaking agent.—L. L. L.

Soda; Process for treating natural ——. J. de las Fuentes, Mexico. U.S. Pat. 1,308,899, 8.7.19. Appl., 9.1.19.

NATURAL soda is lixiviated with the mother liquor from a previous operation, and the solution is treated with carbon dioxide to produce sodium bicarbonate which is precipitated.—W. E. F. P.

Potassium hydrate [hydroxide] from greensand; Process of producing ——. B. A. Peacock, Philadelphia, Pa., Assignor to R. Gilchrist, New York. U.S. Pat. 1,309,744, 15.7.19. Appl., 3.8.18.

GREENSAND etc. is treated to convert the potassium-bearing silicate into a potassium zeolite, the finely divided product is boiled with water and calcium hydroxide, and the solution of potassium hydroxide formed is separated.—W. E. F. P.

Clays and earths; Treatment of ——. F. Langford, Eureka, Cal. U.S. Pat. 1,308,129, 1.7.19. Appl., 23.11.17.

ALUMINOUS earths and the like are mixed with sulphuric acid and roasted to dryness.—S. S. A.

Silicates containing potassium and aluminium; Process of treating ——. L. A. Eberhardt, New York. U.S. Pat. 1,310,413, 22.7.19. Appl., 7.12.18.

THE product obtained by calcining a mixture of potassium aluminium silicate and calcium fluoride is treated with an acid, and the soluble salts of aluminium and potassium are then extracted.—S. S. A.

Silicates; Process of decomposing natural ——. B. A. Peacock, Philadelphia, Pa., Assignor to R. Gilchrist, New York. U.S. Pat. 1,310,770, 22.7.19. Appl., 30.8.17.

A POTASSIUM-BEARING silicate in a finely-divided state, mixed with a hydrous silicate mineral containing magnesium, is treated with sufficient sulphuric acid to combine with all the potassium and magnesium present.—S. S. A.

Alkali metal chloride [electrolyte] solutions; Purification of ——. C. N. Rüber, Assignor to Norsk Alkali A./S., Trondhjem, Norway. U.S. Pat. 1,308,509, 1.7.19. Appl., 12.12.18.

AN alkali metal chloride solution to be electrolysed is filtered at a temperature not less than that of the electrolyser.—B. N.

Methyl borate and boric acid; Production of —— from crude sodium nitrate. Process of obtaining boric acid from mixtures containing borates. R. P. Calvert and O. L. Thomas, Assignors to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pats. (A) 1,308,576 and (B) 1,308,577, 1.7.19. Appl., 5.11.17.

(A) A LOWER monohydric alcohol is added to mixtures containing boric acid and the alkyl borate is separated by volatilisation. (B) Boric acid is liberated from the borate and combined with a lower monohydric alcohol, the compound being separated by volatilisation.—S. S. A.

Rare metals [tungsten, uranium, etc.]; Process of making compounds of ——. R. McKnight, Pittsburgh, Pa. U.S. Pat. 1,308,911, 8.7.19. Appl., 4.10.12. Renewed 7.11.18.

AN alkali chloride is melted together with a salt of a metal such as tungsten, vanadium, uranium, molybdenum, or tellurium. The fusion is conducted without appreciable volatilisation of the rare metal.—C. A. K.

Lead salts; Method of producing ——. R. M. Harrington, Assignor to E. A. Sperry, Brooklyn, N.Y. U.S. Pat. 1,308,948, 8.7.19. Appl., 27.9.17.

AN electric current is passed from a lead anode to a cathode, through an electrolyte capable of yielding a lead solvent. Lead compounds are excluded from the cathode by means of a diaphragm, an acid capable of precipitating lead from solution being added to the catholyte.—W. E. F. P.

Aluminous materials; Process of purifying ——. O. Hutchins, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,310,342, 15.7.19. Appl., 5.12.18.

ALUMINOUS material is melted in the presence of sufficient carbon to reduce part of the iron, silicon, and titanium oxides, and the reduced impurities are separated. The process is then repeated.
—W. E. F. P.

Alkali cyanide; Apparatus for the manufacture of ——. F. J. Metzger, Assignor to Air Reduction Co., New York. U.S. Pat. 1,309,903, 15.7.19. Appl., 25.7.17.

THE apparatus comprises a retort surrounded by a furnace chamber. A gas inlet pipe extends downwards between the wall of the furnace chamber and the retort and enters the retort near the bottom.—S. S. A.

Cyanogen compounds; Apparatus for production of ——. J. D. Morgan, New York. U.S. Pat. 1,309,650, 15.7.19. Appl., 30.6.17.

A FURNACE for producing cyanogen compounds consists of a vertical chamber which is water-cooled at and near the inlet for solid material; other parts of the chamber are heated, and separate inlets for gas, outlets for waste gas, and outlets for solid material are provided.—B. M. V.

Sulphides; Method of making soluble ——. R. F. Bacon, Pittsburgh, Pa., Assignor to Metals Research Co., New York. U.S. Pat. 1,310,151, 15.7.19 Appl., 10.11.15.

INSOLUBLE metal sulphides, such as sulphide ores and concentrates, intimately mixed in a finely divided state with alkaline material, are heated to a temperature sufficiently high to expel moisture and water of hydration. The temperature is then raised to promote interaction of the components of the mixture, whereby water-soluble sulphide is produced.—S. S. A.

Mine-water; Method of treating ——. Process for treating acid mine-water. Method of treating and recovering by-products from acid mine-water. E. C. Auld and J. R. Campbell, Scotdale, Pa. U.S. Pats. (A) 1,310,382, (B) 1,310,383, and (C) 1,310,384, 15.7.19. Appl., 8.5.16. (B) (C) Renewed 21.8.18 and 16.4.19.

(A) FINELY divided calcareous material is mixed with the water to neutralise it, and precipitate calcium sulphate, the mixture being agitated and aerated to promote precipitation. The sludge is separated and dried. (B) Powdered calcareous material is added in varying quantity according to the acidity of the water so as to neutralise it and precipitate iron salts but not calcium sulphate. (C) The water after neutralisation, precipitation and separation of sludge, is softened by the addition of barium carbonate and the resulting precipitate separated and dried.—T. H. B.

Mica; Process of separating —— from felspar. G. J. Bancroft, Denver, Colo. U.S. Pat. 1,310,939, 22.7.19. Appl., 9.8.17.

MICA is ground with an insoluble abrasive material which is lighter than mica and granular when ground. The mica is then separated by washing the ground substances on a table.—S. S. A.

Calcium carbide; Manufacture of ——. F. M. Becket, Niagara Falls, N.Y., Assignor to Union Carbide Co., New York. U.S. Pat. 1,310,465, 22.7.19. Appl., 15.8.17.

A PLASTIC mixture of hydrated lime and "non-coking carbon" is compressed into masses suitable for furnacing, and subjected to a hardening process. S. S. A.

Bichromates; Process for transforming alkali-metal monochromates into ——. G. N. Vis, Paris. U.S. Pat. 1,310,720, 22.7.19. Appl., 22.1.18.

CARBON dioxide is passed into a neutral solution of alkali chromate of such a strength that the alkali bicarbonate formed is precipitated.—B. M. V.

Chlorine; Process of producing ——. R. Datta, Calcutta, India. U.S. Pat. 1,310,943, 22.7.19. Appl., 17.8.16.

CHLORINE and nitrous gases are produced by passing a mixture of nitrosyl chloride and air through a heated tube filled with an inert material. The chlorine is separated by passing the gaseous mixture through sulphuric acid.—S. S. A.

Sulphuric acid; Concentration of ——. F. Perrin, Volvic, France. Eng. Pat. 118,095, 4.7.18. (Appl. 11,021/18.)

SEE U.S. Pat. 1,301,598 of 1919; preceding.

Magnesium chloride; Preparation of anhydrous ——. P. L. Hulin, Grenoble, France. Eng. Pat. 128,327, 8.1.18. (Appl. 467/18.) Int. Conv., 13.1.17.

SEE U.S. Pat. 1,304,567 of 1919; preceding.

Lead acetate; Preparation of ——. **E. Camus, R. Duchemin, and G. Criqueboeuf, Paris. Eng. Pat. 129,300, 8.5.17. (Appl. 6549/17.)**

SEE U.S. Pat. 1,297,792 of 1919; this J., 1919, 368 A.

Ammonia from liquor from purifying producer-gas. Eng. Pat. 128,401. *See* IIA.

Potassium compounds. U.S. Pat. 1,311,043. *See* X.

Electrolytic gas generators. Eng. Pat. 126,640. *See* XI.

VIII.—GLASS; CERAMICS.

Optical glass; Procedures in the manufacture of ——. N. S. Williams and C. C. Rand. J. Amer. Ceram. Soc., 1919, **2**, 422—442.

At the U.S. Bureau of Standards experimental plant the percentage of iron oxide, sulphur trioxide, and chloride in all the raw materials is determined and is not allowed to exceed predetermined limits; magnetic iron is removed from the sands. The batch materials are weighed, mixed, passed through a 12-mesh screen and then mixed for an hour in a ball mill using no pebbles. Covered pots in single pot furnaces fired by natural gas and air are used for melting the glass. During the making of the pots and before they are dry the particles of grog are worked well back and the interior surface of the pot is covered with clay which gives a more resistant facing than the pot-mixture. This treatment must be carried out before the pot is dry or surface cracks will result. The pots are dried with a steady rise in temperature to 100° C. in 10 hours, maintained at 100° C. for another 10 hours, raised to 125° C. in 4 hours, and maintained at that temperature for 14 hours. A dried pot is placed in the furnace on a 3-in. bed of sand, with a brick under the front of the pot. The temperature is raised as steadily as possible to 750° C. in 40 hours and then to 1400° C. in a further 16 hours, but when the furnace has reached 1100° C. the brick is removed and the pot allowed to rest wholly on the sand bed. When the pot is vitrified at 1400° C. the temperature is allowed to fall (if necessary) and 200 lb. of selected cullet is fed into the pot to form a coating which protects the bottom of the pot. After about 1 hour, 150—200 lb. of batch material is added and further batches of the same material are added every 1½ hours until the pot is full after about 12 hours. During the filling, the temperature of the furnace must not be allowed to fall or the glass will be "seedy." Seeds may be eliminated by placing about ¼ lb. of ammonium nitrate, wrapped in paper, in a forked rod and plunging it into the centre of the molten glass. Two hours after the pot has been filled, the glass is stirred mechanically with a clay thimble which has been heated to about 1210° C. and then laid on the surface of the glass for an hour. The temperature of the glass is kept constant during the first nine hours' stirring and is then allowed to fall to about 1100° C. whilst the stirring is continued for a further 9 hours or until a thoroughly homogeneous material is obtained. The stirrer is not allowed to approach within 3 in. of the sides or bottom of the pot, and the radius of the stirring circle and the speed are gradually shortened to prevent the introduction of air into the glass. The thimble is then removed and the glass cooled as quickly as possible to about 700° C. by tipping the pot back, placing a firebrick under and directing a stream of compressed air against the bottom of the pot for about 3 hours. When the pot is cool enough to handle, it is removed from the furnace and the clay pot broken off and separated from the glass. The glass is broken to sizes suitable for moulding and is then sorted. The glass is then placed in a tray in the furnace and heated and paddled by hand until it is of suitable shape to fit the iron mould in a press; or alternatively, the glass is "stuck up" on a pontil, softened at the glory hole, shaped at a bench by "paddling," then placed in a mould and pressed. The pressed or shaped glass is annealed by lowering its temperature to 200° C. in 4 hours, then heating it to 300° C. in 8 hours and to 400° C. in 12 hours from the start. During the following 3½ hours, the final temperature of the glass is attained, this depending on the nature of the glass, *e.g.*, flint 480° C., light crown 520° C., borosilicate 550° C., light barium crown 610° C., dense barium crown 625° C. After reaching the maximum temperature, the glass is cooled at the rate of 5° C. per hour. In order to stir while gathering, the stirring rod is operated from the rear of the furnace and the gathering is effected from the front, the gathering following the path of the stirring rod so as to secure homogeneous glass. The optical constants of the glasses produced in this way did not always agree with those predicted from the composition of the glasses and it was found that the optical properties are affected by the temperature, time of melting, pressure, etc. and that they are not quite constant in different parts of the same melt. Tables showing the composition, time of melting, and the index of refraction and dispersion of about 180 glasses are given.—A. B. S.

Clays; Technical analysis of Auckland [*New Zealand*] ——. A. B. Jameson. New Zealand J. Sci. Tech., 1919, **2**, 209—219.

For the technical analysis of clay the author adopted the method of Zschokke (Baumaterialenkunde, 1902, **7**, 149—152) which consists in separating the material by elutriation into two fractions, "sand" and "clay," then heating each of these fractions separately on a steam bath for 30 mins. with 10% hydrochloric acid. The portion of the "clay" fraction which is insoluble in hydrochloric acid is washed, dried, and weighed, and about 3 grms. of it heated with 10 c.c. of a mixture of 25 c.c. of sulphuric acid and 20 c.c. of water in a dish until thick fumes are evolved. The liquid is allowed to cool, water is added, the residue is filtered, washed, dried, and weighed. It is examined microscopically and usually consists of fine sand etc., *i.e.*, quartz, felspar, mica, etc. The matter soluble in sulphuric acid, estimated by difference, is regarded as actual clay. The portion of the original material which is soluble in the hydrochloric acid is regarded as containing the fluxes, *e.g.*, calcium carbonate, magnesium carbonate and sulphate, and iron oxide, the constituents being identified by microscopic examination. The portion of the "sand" fraction insoluble in hydrochloric acid (coarse sand etc.) is regarded as composed of coarser particles of the portion of the clay fraction insoluble in sulphuric acid. The portion of the "sand" fraction soluble in hydrochloric acid (coarse fluxes) is considered to consist of coarser particles of the substances contained in that portion of the "clay" fraction which is soluble in hydrochloric acid. The author concludes that the amount of "actual clay" (about 2%) dissolved in the hydrochloric acid is not sufficient to invalidate the method. The "actual clay" may be 1—2% too high as some of the "fine sand etc." is soluble in sulphuric acid. Microscopic examination showed that some of the clays used for brick-making near Auckland contain a large proportion of isotropic glass, closely resembling a pumice or rhyolitic sand interstratified with the beds of clay. A series of mixtures of "actual clay" and "sand" fractions was prepared, burned at cone 14 (1410° C.), and their drying and kiln shrinkage and the porosity of the fired

ware determined. With a refractory sand, the kiln shrinkage of the clays was roughly inversely proportional to the percentage of sand added, but if sand rich in fluxes, such as the pumice sand previously mentioned, was added, the kiln shrinkage increased and the porosity was reduced as more sand was added. A calcareous clay containing 8% of fine and 1·2% of coarse fluxes showed a high kiln shrinkage which was not materially reduced by a large proportion of the "sand fraction."—A. B. S.

Air in clay; Simplified apparatus for the determination of ——. H. Spurrier. J. Amer. Ceram. Soc., 1919, **2**, 490—493.

FOR routine tests, the apparatus previously suggested (this J., 1919, 176 A) may be replaced by a eudiometer made by fusing the lower part of a burette to a bell-shaped funnel. The eudiometer, with the stop-cock open and inverted in a beaker containing 800 c.c. of boiling water, remains partly immersed while the water is boiled for some time to expel the air. The eudiometer is then filled with water by suction and is raised sufficiently to enable the test-piece to be inserted. The air evolved by the disintegration of the clay is collected, whilst the eudiometer is rotated with a slight up and down movement. After a few minutes, the volume of air is measured, any froth being neglected. The errors involved are largely compensatory in character.—A. B. S.

Bond clays for graphite crucibles; Some properties of ——. M. C. Booze. J. Amer. Ceram. Soc., 1919, **2**, 461—476.

SOME of the qualities required in bond clays for graphite crucibles are incompatible and only by blending suitable clays can a satisfactory bond be produced. Dorset ball clay proved to be one of the best single clays examined. For crucibles for melting brass, the bond clay should burn fairly dense and should be strong at about 1100° C., retaining the same structure at 1250° C. (the maximum temperature attained by the brass). For crucibles for melting steel, the bond clay should be more refractory and should be dense and strong at 1400—1600° C. A mixture of equal weights of clay and graphite gave a stronger crucible than one made of the same proportions of clay and sand—probably due to the difference in the shape of the grains. Ceylon graphite (with angular grains) and coked Alabama graphite (thick rounded grains) gave bodies with a lower strength than those made with raw Alabama graphite (thin flakes). The changes in porosity and shrinkage at various temperatures show that the refractoriness of the clay is increased by the addition of graphite. The porosity of the mixtures at 1425° C. appears to be higher than at 1150° C. Some of the mixtures after being burned at 1425° C. showed a lower proportional decrease in strength on quenching than when burned at 1150° C. These peculiar changes may be due to the graphite increasing in volume during the burning at 1425° C.—A. B. S.

Graphite; Refining flake —— for crucible use. F. G. Moses. U.S. Bureau of Mines. War-minerals Investigation Series, Bull. 8. Eng. and Min. J., 1919, **108**, 50—54.

THE possibility of separating graphite and gangue by utilising the difference in specific gravity and shape of particles was tested by passing the crude concentrate through a transverse air current, and by treatment on a pneumatic jig. Some separation was effected in certain cases, and the air-jig produced clean tailings, but the adoption of this method is not probable. Electrostatic separation is often unsatisfactory because of the presence of iron oxide as an impurity, but in the absence of iron oxide the method has proved successful. Flotation materially raises the grade of product and would be justified in commercial working after treatment of the concentrate in pebble or buhr mills. One requirement in the employment of buhr mills is that a comparatively high-grade concentrate is necessary if destruction of the large graphite flakes by coarse gritty particles is to be avoided. The general results of the trials are that the characteristics of the crude graphite and the associated impurities must be studied in each case, as hard impurities are much more difficult to handle than when the gangue material is soft and of small grain. In all cases the buhr mill is a necessary appliance in the finishing process.

—C. A. K.

Graphite crucible bodies; Effect of electrolytes on the properties of ——. H. G. Schurecht. J. Amer. Ceram. Soc., 1919, **2**, 443—450.

THE addition of sodium hydroxide caused a crucible body composed chiefly of flake graphite and Dorset ball clay to lose its plasticity, but a similar body containing Mississippi bond clay was improved. Hydrochloric acid improved the working properties of the Dorset clay mixture. The addition of sodium hydroxide to bodies containing Dorset clay at first decreased their transverse strength but with larger proportions the strength was increased, probably on account of the deflocculation of the clay enabling a dense body to be formed. With the Mississippi clay, sodium hydroxide increased the strength. The effect of acid on the transverse strength was the opposite to that of the alkali. When the graphite was ground with sodium hydroxide prior to mixing it with the clay a notable increase in the strength of the body was produced. This may be due to the production of fine grains of graphite or to the production of colloidal graphite. Small additions of sodium hydroxide decreased the density of bodies containing Dorset clay but increased it in those containing Mississippi clay. With larger additions the opposite effect was produced. Hydrochloric acid produced the opposite effect to sodium hydroxide. The porosity of bodies containing Dorset clay was increased by small additions of hydrochloric acid, but reduced by a larger proportion of acid. Sodium hydroxide made these bodies less porous, but bodies containing Mississippi clay were rendered more porous by sodium hydroxide. The shrinkage of bodies containing Dorset clay was first decreased and then increased by the alkali but in those containing Mississippi clay the shrinkage was increased throughout. The acid had the opposite effect to the alkali. Small additions of sodium hydroxide to slips containing Alabama flake graphite and Dorset clay increased their viscosity, but larger additions reduced it; this increase was not noted when Ceylon graphite or coked Alabama graphite was used. In bodies containing Mississippi clay a small percentage of alkali decreased the viscosity. It was noted that bodies containing Ceylon graphite can be cast more readily than those containing Alabama flake graphite. Bodies containing 0·3—0·4% of sodium hydroxide gave the best results in casting. With a larger proportion of alkali the graphite did not remain in suspension.—A. B. S.

Porcelain; An American —— containing no free silica. A. S. Watts. J. Amer. Ceram. Soc., 1919, **2**, 488—489.

THE non-plastic constituents of a standard porcelain body were calcined at cone 3 sufficiently to effect

a reaction between the felspar, whiting, and flint without reaching the glossy stage and producing an excessively hard mass. Microscopic examination showed that 10—12% of flint remained unaltered. The product was quenched in water, ground, and mixed with plastic materials so as to produce a porcelain of normal composition, which was then burned. The calcination of the fluxes and flint, as described, reduced the maturing point of the body by 40° C. and vastly improved the colour and resistance to sudden temperature changes. The cost of calcination is partly counterbalanced by the saving in kiln-maintenance and in the fuel saved by the lower finishing temperature of the porcelain. —A. B. S.

Porcelain; Modulus of elasticity of technical —— made at the State Porcelain Factory, Berlin. W. Steger. Keram. Runds., 1919, **27**, 113—114.

The modulus of elasticity was determined by supporting a round rod, 1·2 mm. in length and 7·5 mm. diam. on two steel knife edges exactly 1 m. apart, applying a load suspended from a glass plate cemented centrally on the rod and measuring the deflection with a micrometer in combination with a microscope. Six unglazed porcelain rods which had been fired at Seger cone 15 were tested, and the modulus of elasticity was found to vary from 8167 to 8390, with an average of 8300 kilos. per sq. mm. This modulus does not depend so much on the chemical composition of the porcelain as on the conditions of manufacture.—A. B. S.

Elasticity of glazes; Determination of ——. R. Rieke and W. Steger. Keram. Runds., 1919, **27**, 193—195, 203—204.

The modulus of elasticity of glazes may be determined by means of threads or thin rods produced by fusing about 300 grms. of the glaze to a clear liquid at as low a temperature as possible, stirring to ensure homogeneity, and drawing it out in threads about 2 m. long and 0·3—2·0 mm. diameter. The temperature of the molten mass should be such that the threads or rods are of circular section, and ten measurements of the diameter of any thread selected for testing should not vary more than 5% from the average. For the sound-test rods 3—5 mm. diameter were used. The modulus of elasticity of these threads was calculated from (*a*) the extensibility under tension, (*b*) deflection under an increasing load, and (*c*) the rate at which sound travels through the material. The extension method is not satisfactory unless the glaze threads are of uniform cross section throughout, and is very tedious on account of the numerous measurements of diameter involved. The deflection is measured by fixing one end of a thread of glaze in a support so that the thread is horizontal, hanging a scale-pan with weights on it near to the free end and measuring the deflection of the free end with and without a load. The effect of small variations in the diameter of the thread is minimised by turning it through a right angle and repeating the test. The deflection method is much better and less tedious than the previous one and threads only 10 cm. long can be used. The rate of transmission of sound through the glazes is measured by cementing a small cork disc on one end of a rod and inserting this into one end of a glass tube 1·2 m. long and 2 cm. diameter, the other end of the tube being closed by a disc which can be moved along the tube as required. The rod is clamped exactly at the middle of its length. A little cork-dust or lycopodium is placed in the tube and the rod is gently stroked with a piece of wet leather or rubbed gently by a rotating disc covered with wet leather to create a clear note. When the distance between the two discs is properly adjusted the powder in the tube will arrange itself into definite series of heaps. The distance between the discs is then half the wave length of the sound produced by the rod. In this case the modulus of elasticity varies with the product of the sp. gr. of the glaze and the rate of transmission of sound in the rod. This method requires the least care in the preparation of the test pieces and gives concordant results without requiring a microscope or micrometer. Using a plumbiferous stoneware glaze maturing at Seger cone 09 (920° C.) made by fritting 80 grms. of red lead, 15 of marble, 19 of kaolin, 25 of boric acid, and 51 of sand and mixing 200 grms. of the frit with 7·7 grms. of kaolin, the mean modulus of elasticity determined by each of the three methods was (*a*) by extension method 6020, (*b*) by deflection 5851, (*c*) by sound-transmission 6175 kilos. per sq. mm.—A. B. S.

Radioactive bricks. H. J. Knollman. J. Amer. Ceram. Soc., 1919, **2**, 451—460.

Radioactive bricks or plates for use in making water radioactive are manufactured with a radioactivity varying from 500 to 5000 Mache units, *i.e.*, $1·65 \times 10^{-10}$ to $16·5 \times 10^{-10}$ amps. per 24 hrs. The proportion of radiation emitted depends on the state of subdivision of the radium salt used. Compact radium sulphate only emits about 2½%, but if finely powdered and distributed through clay a 10% emission can be obtained. In making radioactive bricks, very finely ground radium-barium sulphate is added to a mixture of Albany slip clay, a lean sandy clay or grog, and infusorial earth, the mixture is ground dry for a few hours in a porcelain mill containing flint pebbles, then removed, mixed with 26—27% of water, weighed, and the exact proportion of water present is ascertained. Weighed portions of the mixture, corresponding to 40 grms. of dry material are then formed into corrugated plates 3¾ by 1¼ by ⅜ in. when burned. These plates are dried and then burned in a small muffle to cone 08 (940° C.) in 8—10 hours and cooled in the same length of time. Oxidising conditions in the kiln are essential or the radium sulphate may be reduced to sulphite which is soluble in water. Over-firing must be avoided as the effective radioactivity is thereby reduced. The presence of vitrified material is objectionable as the α emanation cannot penetrate it. The plates are washed in running water for several hours, dried, and tested. The activity of the plates is low at first, but after immersion in water for 3 or 4 days it becomes normal.—A. B. S.

Refractories employed in the construction of furnaces; Thermal conductivity and specific heat of —— as a basis for thermo-technical calculations. E. Czakó. J. Gasbeleucht., 1919, **62**, 274—278.

The values of the thermal conductivities between 0° and 1000° C., the chemical composition, density, and porosity of firebrick, fireclay-silica brick, and silica brick, as determined by various workers are tabulated. The thermal conductivities of firebrick and silica brick increase with increase of temperature. It is pointed out that Wologdine's values (this J., 1909, 709) are too high. Porosity exercises considerable influence upon the value of the thermal conductivity of refractories, but Goerens' conclusion (34 Versamml.-Ber. Ver. Deuts. Fabr. Feuerf. Prod., 1914, 92; Ferrum, 1914, **1**, 17) that the conductivity decreases with increasing porosity does not hold generally. An increase in the temperature at which the refractory is fired is accompanied by an increase in the thermal conductivity, which also depends to some extent upon the ease with which air or other gas can penetrate into the pores of

the material. The average values of the thermal conductivities between 0° and 1000° C. for firebrick, silica-fireclay brick, and silica brick are 0·8, 0·9, and 1·0 respectively expressed in terms of calorie, metre, hour, degree centigrade units. It is customary in technical practice to use the value 0·2 calorie for the specific heat of refractory materials, this being about the value between 0° C. and 100° C. A table is given of recent determinations of the true and mean specific heats of firebrick and silica brick at intervals of about 100° C. over the range from 0° to 1300° C. The specific heats increase with increase of temperature, the increase between 0° and 1300° C. being about 30% of the value at the lower temperature. The values for the specific heats obtained by Heyn, Bauer, and Wetzel (this J., 1915, 426) are intermediate between those found by Osann (this J., 1910, 432), and by Wilson, Holdcroft, and Mellor (this J., 1913, 977), and the agreement between different observers is good. Heyn, Bauer, and Wetzel find that the mean specific heat of firebrick between 0° and 200° C. is 0·204 calorie. The same observers find that the true specific heats of the material at 200° C. and 1200° C. are respectively 0·222 calorie and 0·302 calorie. For silica brick, the value of the mean specific heat between 0° and 200° C. is 0·220 calorie, and between 0° and 1200° C. 0·267 calorie. The true specific heats at temperatures of 200° C. and 1200° C. are respectively 0·237 and 0·291. For technical purposes an extension of our knowledge of the specific heats of the types of refractories commonly employed is desirable, and thermal conductivities should be determined up to 1500° C. Information as to the emissivities of refractory materials is not available.—J. S. G. T.

Magnesia as an opacifier [in enamels]: Use of ——. V. S. Schory. J. Amer. Ceram. Soc. 1919, 2, 477—480.

GLAZE slips containing potash, lime, zinc oxide, magnesia, alumina, and silica in the following proportions:—

No. 1	No. 2	No. 3	
0·30	0·30	0·30 K_2O	0·50 Al_2O_3 4·00 SiO_2
0·20	0·30	0·40 CaO	
0·20	0·10	0·00 ZnO	
0·30	0·30	0·30 MgO	

No. 4	No. 5	No. 6	
0·25	0·25	0·25 K_2O	0·40 Al_2O_3 3·30 SiO_2
0·25	0·35	0·45 CaO	
0·20	0·10	0·00 ZnO	
0·30	0·30	0·30 MgO	

No. 7	
0·30 K_2O	0·50 Al_2O_3 4·00 SiO_2
0·70 CaO	

when evaporated, made into briquettes, and burned at cones 5, 7, 9, and 12, were found to resemble over-fired porcelains with a stony fracture and may be accurately designated as glossy vitreous slips. Each mixture gave a good white at the stage where the porcelain was sufficiently over-fired to develop good gloss. At cone 12 all were yellow and less opaque. Barium and zinc oxides did not increase the transparency of the glazes except in so far as they increased their fusibility. The action of zinc oxide was mainly to promote early fusion; it did not affect the colour.—A. B. S.

Photoceramic pigment process; Cologne glue in the ——. C. Flecke. Keram. Runds., 1919, 27, 205.

FOR reproducing photographs on pottery, a suitable coating material consists of 1000 parts of water, 50—65 of Cologne glue, 30—40 of white sugar, 30—35 of iridium oxide, and 30 parts of potassium bichromate. The mixture is filtered through linen, poured on to a sheet of glass, and dried in the dark. The plate is exposed to light under a negative in the customary manner, coated with a 3—4% solution of collodion, and then immersed in several changes of water until the last water is colourless. A sheet of paper is lightly pressed on to the film, which is then transferred from the glass, with the collodion side uppermost, to the ware to be decorated, the paper removed, and the picture developed by washing with warm water, and fixed by means of an alcoholic solution of potash alum. After drying, the collodion is removed by solution in ether, the picture coated with a mixture of copaiba balsam, oil of cloves, a pigment showing a strong contrast to the one previously used, and a flux, and finally the ware is burned in a muffle. If glazed ware is to be decorated in this manner it should be coated with copal varnish before the sensitised film is applied.—A. B. S.

PATENTS.

Glass-melting furnaces. E. Roirant, St. Ouen, France. Eng. Pat. 117,452, 27.6.18. (Appl. 10,572/18.) Int. Conv., 12.7.17.

THE top of a glass-melting furnace is extended and provided with an additional wall and sides so as to form a small supplementary heated chamber in which a receptacle for definite quantities of molten glass is placed. Means are provided for lifting the receptacle out of and returning it to the heated chamber. A damper forms a partition between the supplementary chamber and the furnace when the receptacle is moved to the gathering point and is removed automatically when a fresh charge of glass flows from the furnace to the receptacle. With this arrangement the time of exposure of the glass to the atmosphere, before it is gathered, is very short so that undue cooling is obviated, and the receptacle may be of small size thus permitting frequent renewal of the glass, and requiring less fuel for heating.—A. B. S.

Glass; Manufacture of ——. J. A. Chambers, Pittsburgh, Pa. U.S. Pat. 1,309,274, 8.7.19. Appl., 8.10.18.

IN the manufacture of glass, a sufficient amount of the molten glass to make several of the required articles is drawn from the furnace, and any surplus is melted by the addition of molten glass at a higher temperature.—A. B. S.

Glass wool; Machine for the manufacture of ——. A. R. Holmes, London. Eng. Pat. 129,324, 17.10.17. (Appl. 15,078/17.)

A MACHINE for manufacturing glass wool consists of an electrically heated melting vessel made of tungsten, iridium, or an alloy having a high electrical resistance. The glass is drawn through apertures in the top of the melting pot on to a rotating drum, the flexible rim of which yields as the wool cools and contracts when wound thereon.—A. B. S.

Reinforcement of articles made of clay or clay compounds. F. Humphries, Boscombe. Eng. Pat. 129,006, 18.9.17. (Appl. 13,368/17.)

ARTICLES made of clay or the like are reinforced by incorporating therein pieces of metal coated with a glaze which fuses at a temperature above 300° C., but below that at which the reinforced ware is burned and also below the melting point of the metal.—A. B. S.

Kiln. C. H. Zwermann, Newark, Ohio. U.S. Pat. 1,308,973, 8.7.19. Appl., 27.3.19.

EACH of a pair of tunnel kilns placed side by side and having a common inner wall, is divided into a water-smoking zone, a preheating zone, a firing zone, and a cooling zone, the inlet of one kiln being placed alongside the outlet of the other. Circulating flues deliver hot air from the cooling zone of one tunnel into the top and bottom of the water-smoking zone of the other tunnel. In the outer wall of each firing zone are several burners delivering into the top of the zone, and into a series of preheating flues one above another and below the burners, with inlets adjacent to the bottom of the tunnels. Air-heating flues in the tops of the tunnels extend over the preheating and firing zones to the burners and to other air flues in the bottom of the tunnels.—A. B. S.

Refractory bricks and blocks; Manufacture of —. F. H. Brooke, Sheffield, and T. Twynam, Redcar. Eng. Pat. 129,485, 7.8.18. (Appl. 12,811/18.)

THE acid or basic material used for the manufacture of refractory bricks and blocks is mixed with a small percentage of fine flue dust containing a high percentage of magnetic oxide of iron, obtained from the downcomers of blast furnaces and burned in the customary manner. For silica bricks ½—3% of the dust is used, but for bricks made of shrunk Greek magnesite 2½—10% is required to bind the material effectively.—A. B. S.

Abrasive wheel. H. R. Power, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pats. (A) 1,310,291 and (B) 1,310,292, 15.7.19. Appl., 27.8.18.

IN an abrasive wheel, composed of abrasive particles united with a silicate binder, the voids are filled with (A) the coal-tar distillate paracoumarone (polymerised benzofuran) or (B) a mixture of mineral wax and paracoumarone.—A. B. S.

Abrasive wheel H. C. Martin, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,310,360, 15.7.19. Appl., 27.8.18.

IN an abrasive wheel composed of abrasive particles united by a silicate binder to form a porous structure, the voids are filled with a synthetic material formed by the action of chlorine on naphthalene.—A. B. S.

[*Insulating and abrasive*] *composition of matter.* H. M. Olson, Burbank, and H. W. Becker, Lompoc, Cal., U.S.A. Eng. Pat. 129,505, 30.8.18. (Appl. 14,120/18.)

THE material is composed of 75—95% of pulverised infusorial earth or non-crystalline silica in a finely divided state and 5—25% of a binder of aluminium sulphate and an alkali sulphate and/or lime. A mixture of infusorial earth 88%, sodium sulphate 1%, aluminium sulphate 1%, and lime 10% is specially mentioned. The material may be mixed with water to form a mortar or it may be formed into bricks etc. The mortar or bricks may be calcined at 800°—2700° F. (425° C.—1480° C.) producing a crystalline substance with the appearance of natural kieselguhr and the abrasive properties of crystalline silica.—A. B. S.

Dryer for clay wares. A. Bührer, Constance. Ger. Pat. 311,258, 10.7.13.

A DRYER consists of two parallel series of chambers which are connected by transverse flues in the floor of each chamber to a flue for partially saturated air and another flue for hot air and a main or exit flue, all of which are placed between the two rows of chambers. Hot air is passed through the hot air flue into the chambers containing nearly dry goods and thence, in a partially saturated state, into the moist air flue, from which it passes into those chambers requiring moist air, and thence into a main flue leading to a fan.—A. B. S.

Glass; Method of and apparatus for operating on tubular articles of —. S. English and W. M. Gibbons, Sheffield. Eng. Pat. 129,508, 7.9.18. (Appl. 14,545/18.)

Glass; Feeding or controlling of the feed of molten —— *from glass furnaces or tanks.* J. Forster, St. Helens. Eng. Pat. 129,822, 25.7.18. (Appl. 12,093/18.)

Glass articles; Process and apparatus for drawing hollow —. H. Wade, London. From Empire Machine Co., Pittsburgh, Pa., U.S.A. Eng. Pat. 129,211, 13.1.19. (Appl. 926/19.)

SEE U.S. Pat. 1,301,771 of 1919; this J., 1919, 465 A.

Furnace linings. U.S. Pat. 1,308,481. *See* I.

IX.—BUILDING MATERIALS.

Concrete; Light-weight —. W. L. Scott. Engineering, 1919, **108**, 33.

CONCRETE suitable for reinforced concrete structures can be prepared by the use of an artificial aggregate having an apparent specific gravity less than unity. The light artificial aggregate used in America is made from clay which is burned to about 2000° F. (1090° C.) in 30 hours. This rapid burning causes the clay to swell and form a solid mass of clinker which is non-porous. After cooling, the product is ground and by careful grading a concrete may be made weighing about 110 lb. per cub. ft., and having a crushing strength at 28 days of 4000 lb. per sq. in. The method of eliminating voids in concrete by means of pneumatic hammers is advocated.—C. A. K.

Portland cement; Electrolytic determination of iron oxide and alumina in —. Wolf. Zement, 1918, 105. Chem.-Zeit., 1919, **43**, Rep., 124.

ONE grm. of the cement is treated in the usual way for the separation of silica, the filtrate is treated with ammonia to precipitate ferric hydroxide, this is dissolved, re-precipitated, washed, dissolved in dilute sulphuric acid, and the solution added to 5 grms. of ammonium oxalate dissolved in water; the total volume should be about 150 c.c. This solution is electrolysed using a gauze cathode and a spiral anode. With 1·5 to 2·5 amps. and 4 to 5 volts, the iron is deposited in about 90 mins. After the current has been interrupted, the cathode is washed with dilute sodium hydroxide solution, then with water, dried, and weighed. The solution and washings may be used for the determination of the aluminium; the conditions are the same as for the deposition of the iron except that platinum foil is used as the cathode. The aluminium separates out as hydroxide which is collected on a filter and washed; the filtrate is boiled with the addition of ammonium chloride until excess of ammonia has been expelled, when a further small quantity of aluminium hydroxide is obtained, which is added to the first quantity.—W. P. S.

PATENTS.

Cement; Non-porous ——. F. D. Mulligan, Belfast. Eng. Pat. 128,452, 31.7.18. (Appl. 12,478/18.)

A NON-POROUS cement is made by adding ½ oz. of a mixture of 20 oz. of slaked lime and 3 oz. of raw linseed oil to 1 lb. of a mixture of cement and sand after the latter has been mixed with water to form a paste. The mixture of lime and oil may also be used to make ordinary cement-mortar waterproof. —A. B. S.

Printing surfaces [of cement]; Production of ——. J. C. Grant, Barnes. Eng. Pat. 128,718, 22.6.18. (Appl. 10,332/18.)

PRINTING surfaces in relief, *e.g.*, type, printing plates, process blocks, etc., are made by pouring pure Portland cement into a flong, papier-mâché or other mould, the latter being surrounded by glass or metal sheets forming a casing sufficiently deep to permit the cement cast to be of the desired thickness. An oiled sheet of glass or other plane surface is placed on the cement whilst it is still liquid so as to make the back of the cast quite even, or a backing of plaster of Paris may be used. —A. B. S.

Portland cement; Manufacture of ——. W. S. Akerman, Burnham. Eng. Pat. 128,750, 2.7.18. (Appl. 10,801/18.)

A MIXTURE of limestone and shale or clay in suitable proportions, with or without the addition of fuel, is heated in an inclined tubular calcining retort placed in a chamber of a continuous kiln having oscillatory shafts. The carbon dioxide and other gases evolved, together with any oil and tar, are conveyed through suitable piping and used in any convenient manner, *e.g.*, for heating the kiln. The calcined material is then introduced into a kiln and heated in the usual manner until it forms cement-clinker. The waste heat from the kiln is used to heat the calcining retort.—A. B. S.

Lime; Process of treating ——. *Cementitious composition and method of preparing same.* C. Catlett, Staunton, Va. U.S. Pats. (A) 1,308,931 and (B) 1,308,932, 8.7.19. Appl., 23.9.18.

(A) LIME and a pulverulent oxy-salt are mixed with water. (B) Hydraulic cement compositions are prepared by intimately mixing a dry oxy-salt with a hydraulic cement.—A. B. S.

Cement; Method of and apparatus for testing ——. W. G. Skinner, Yorktown, Va. U.S. Pat. 1,309,702, 15.7.19. Appl., 17.4.18.

THE fineness of comminuted mineral substances, such as cement, is determined by applying an adherent coating of a liquid of known sp. gr. to the surface area of a definite amount of the material and measuring the amount of liquid retained.—A. B. S.

Priming for concrete. Eng. Pat. 128,402. *See* XIII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Steel turnings; Utilisation of —— in the blast furnace. Tripier. Comptes Rend. Soc. de l'Ind. Min. Engineering, 1919, **108**, 58.

IN 1918 the shortage of Spanish ore and later of Briey ore necessitated the use of steel turnings in the blast furnaces at an ironworks in the North of France. At first a proportion of steel turnings equal to 10% of the weight of pig-iron produced was added to the burden of a hæmatite furnace with irregular results, but later the proportion was raised to 20%, 30%, and 50% of the weight of pig-iron cast, and with the complete failure of ironstone a successful attempt to use turnings exclusively was made. In 1917 three furnaces, two hæmatite and one basic, worked quite regularly for three months on turnings alone, the monthly consumption of turnings exceeding 25,000 tons. The following are some of the charges used per metric ton of pig-iron produced, the weights being given in kilos. Hæmatite foundry pig (Si 2·50%, Mn 1·00%, S 0·04%, P 0·08%): (*a*) coke 1275, Spanish ore 2200, limestone 900; (*b*) coke 575, turnings 1000, tap cinder 100, ferromanganese slag 40, "silex" stones 20. Basic pig-iron (Si 0·3%, Mn 1·25%, S 0·08%, P 2·10%): (*a*) coke 1250, Normandy ore 2200, manganese ore 70, basic slag 80, limestone 1100; (*b*) coke 450, turnings 950, Normandy ore 150, basic slag 260, manganese ore 20. Comparing the basic burdens, the output of a furnace burning 200 tons of coke per day was 160 tons of pig-iron when using ore, and 445 tons when using steel turnings, so that it might be advantageous to utilise turnings even when the cost price of a ton of pig-iron was not decreased.—C. A. K.

Blast-furnace gas; Electrical cleaning of ——. W. H. Gellert. Blast Furnace and Steel Plant, 1919, **7**, 334—339.

THE removal of dust and fume from blast-furnace gas while at the same time conserving the sensible heat of the gas is a difficult problem, and the dry system has not been successful so far owing to the non-removal of fume. By the Cottrell system of electrical precipitation it has been found possible to remove practically all of the dust from the gas, including zinc and potash fume. The latter is of importance apart from its intrinsic value, when the elimination of the fluxing of stove bricks is taken into account. The potash content is greater in ores used in the manufacture of spiegeleisen and ferromanganese, and manganese ores usually contain considerable quantities of zinc. Under various conditions of working the use of electrical precipitation on blast-furnace gas has effected a removal of from 89·7% to 93·4% of the dust and fume. About 50% of the total dust coming from the furnace is collected in the dry dust catcher, and contains less than 1½% of K_2O. The fine dust collected by the precipitator contained from 2·74% to 20·79% of water soluble potash (K_2O) when gases from pig-iron manufacture were treated, and even when the potash recovery is insignificant electrical precipitation secures a dry clean gas for use in the hot stoves or boilers.—C. A. K.

Sulphur in the converter; Reaction of ——. B. Osann. Stahl u. Eisen, 1919, **39**, 677—678.

THE behaviour of sulphur in the basic Bessemer converter is principally considered. The metallurgy of the process as put forward by various investigators is discussed and the following conclusions arrived at. The principal desulphurisation begins shortly after the beginning of the after-blow and extends over a period. The sulphur in the iron reacts with the manganese oxide, forming manganese sulphide, which passes into the slag, $5FeS+5MnO+2P=5Fe+5MnS+P_2O_5$. That desulphurisation takes place with the formation of calcium sulphide is not correct. Calcium sulphide in the presence of the excess of ferrous oxide in the slag reacts as follows: $CaS+FeO=FeS+CaO$. In the acid converter only a small amount of desulphurisation takes place.—J. W. D.

Graphitisation of white cast iron on annealing. P. D. Merica and L. F. Gurevich. U.S. Bureau Standards, Technol. Paper 129. J. Franklin Inst., 1919, 188, 126.

THE temperature of initial precipitation of temper carbon after six hours' annealing is about 830° C., and is not noticeably affected by varying the sulphur content from 0·1 to 0·2% or by varying the total carbon from 3·6 to 3·9%. For a forty-eight hour period of annealing the temperature is about 725° C. Annealing two specimens of the same iron at 1000° and 1100° C. respectively and cooling at equal rates causes decomposition of all the free cementite, but less graphite is found in the latter case than in the former. Graphite would therefore appear to separate directly from the solid solution on cooling when its nuclei are already present.

—J. W. D.

Case-hardening process; Improvements in the ——. D. Hanson and J. E. Hurst. Iron and Steel Inst., May, 1919. 19 pages.

AN investigation into the prevention of flaking and chipping in case-hardened articles during and after grinding. In ordinary methods of case-hardening, heating the steel to 900° C. in contact with a fairly vigorous carburising agent, followed by cooling in the box, favours the production of a network of cementite in the case, which is a frequent source of cracks. In case-hardened nickel steels with up to 3·5% Ni, refining at a temperature lower than the carburising temperature tends to aggravate this trouble. Several methods for overcoming the difficulty are suggested, that being preferred which deals with the modification of the existing practice in such a manner that a case of practically eutectoid composition is obtained. This is accomplished by introducing a prolonged period of cooling from the carburising temperature to a temperature lying between the final refining temperature and the eutectoid temperature before withdrawing the box from the furnace. The modified process has been carried out successfully both experimentally and on the works scale. In the works the temperatures for 2·5% or 3·5% nickel steel were carburising at 900° C. and slow cooling in the furnace to 740° C., before withdrawing the boxes. Satisfactory results have also been obtained for plain carbon steels. For 5% nickel steels a high carburising temperature (950° C.) without any falling temperature treatment appears to be satisfactory.—J. W. D.

Alloy steel; Effect of rate of temperature change on the transformations in an ——. H. Scott. U.S. Bureau Standards, Scient. Paper 335. J. Franklin Inst., 1919, 188, 127.

COOLING curves of a high-speed tool steel showed two critical points on cooling from 920° C. One at about 750° C. was accompanied by the precipitation of carbide, while the other, on fast cooling, was at about 400° C., the carbon remaining in solution as martensite. Both were detected on cooling at intermediate rates, the micro-constituents being martensite and troostite. Heating curves of the steel made on specimens which had been rapidly and slowly cooled showed critical points at temperatures of about 645° C. and 660° C. respectively. Those temperatures indicate the precipitation of the carbide previously held in solution by cooling.

—J. W. D.

Silicon-manganese; Production of —— in the electric furnace. B. G. Klugh. Trans. Amer. Electrochem. Soc., 1919, 269—278. [Advance copy.]

THE operation of making alloys containing over 20% Si and over 25% Mn from cheap raw material was carried out in a carbon-lined electrical furnace of a three-phase type, having three electrodes in line. Alabama bituminous coal was used as the reducing agent. Alloy of the average composition about 65% Mn, 21% Si, 13% Fe, and below 1% C, was produced from a mixture of ores containing from 33·1 to 17·8% Mn. A recovery of 73% of the manganese charged was obtained in the alloy, and 10% in the slag, 17% being lost by volatilisation. A high slag volume was maintained to preserve the alumina balance required for a fluid slag. Accumulations of high-manganese slags from previous production of ferromanganese were treated in the furnace with the addition of iron turnings to supply the necessary iron for the alloy and to increase the conductivity of the charge. The average analysis of the metal produced was 70% Mn, 9% Fe, 20% Si, below 1% C. The weight of slag (1% Mn) produced was 4·7 times that of alloy, and would not be regarded as satisfactory for normal economic conditions. The use in steel-works practice of silicon-manganese alloys of suitable composition is urged.—C. A. K.

Silver volatilisation in smelting. F. P. Dewey. Eng. and Min. J., 1919, 108, 87—89.

IT is invariably stated that little loss of silver occurs in the Parkes process for desilverising base bullion with zinc, but in seven miscellaneous samples of Parkes zinc, silver was found present in quantities of from 28 oz. to 604·5 oz. per ton. The results show wide differences in the distilling conditions and it is possible to distil the zinc out of the crusts so that it carries only slight amounts of silver. The loss of silver has no connection with volatilisation, and is caused by excessive ebullition of the zinc in the retort. The presence of lead does not promote volatilisation of silver; on the contrary analytical results demonstrate that it protects the silver from the "drag" of the volatile zinc. The conditions in distilling zinc from ores are somewhat different, particularly in that there is no bath of lead to hold back the silver, and "dusting" may occur. The quantity of silver lost in dusting is small, a figure of 0·64% of the silver charged being obtained on samples representing a month's record of commercial cupels.—C. A. K.

Zinc ores; Roasting and magnetic separation of Wisconsin ——. E. G. Deutman. Eng. and Min. J., 1919, 107, 1107—1111.

ZINC blende is usually associated with marcasite (FeS_2) in the Wisconsin field and the mine concentrate is not suitable for smelting owing to the high iron content. It is therefore further concentrated by magnetic treatment after roasting. The concentrate is roasted in a multiple-hearth furnace of the Wedge type and is self-roasting. A maximum temperature of 900°—1000° F. (480°—540° C.) is attained, and maintained so as not to oxidise the zinc blende. The marcasite particles are converted on the surface into magnetic iron oxide, the cores of the particles remaining $Fe_n S_{n+1}$ and, to some extent, unaltered FeS_2. Gas containing 4—5% of sulphur dioxide is evolved and is suitable for sulphuric acid manufacture after the removal of dust by a Cottrell precipitator. The roasted ore passes through rotary drums cooled externally by means of a water spray, and is fed on to a vibrating conveyor which passes over a "rougher" magnetic separator of the Dings type MM machine. Magnetic iron sulphide particles are carried on a circular path out of the magnetic field and discharged, while the ore, containing 56—58% of zinc and 3—4% of iron, is fed on to the "finisher" magnetic separator belts which move at the rate of 70 ft. per min. between magnetic coils and a revolving armature.

—C. A. K.

Flotation test work; An outline for ——. H. L. Hazen. Eng. and Min. J., 1919, 107, 1160—1161.

In the preparation of an ore for flotation tests the sample should be crushed, as nearly as possible by the method to be used in prospective practice. Ore which has been ground dry is usually less amenable to flotation separation than that subjected to wet grinding, and the physical characteristics of ore ground by the two methods are quite different. Preliminary tests are directed mainly to the discovery of reagents which give the best extraction. If the ore is not amenable to direct flotation, auxiliary methods which may improve the separation are tested, but must always be considered in relation to the general flow sheet of the process, and subsequent experiments are made under conditions which reproduce mill practice. A "locked" flotation test is carried out by dividing the ore sample into a number of equal parts, and treating the first portion. The middlings are then returned and treated again with the second portion, and so on, as the tailings from a single flotation test never represent the character of that product as obtained in continuous working. The ore, tested in this way, should be previously ground to pass a sieve with 40 meshes per linear inch, and a screen analysis, with assays, made. The tailing product is screened and assays made on the respective sizes, thus determining with a fair degree of accuracy the coarsest permissible grinding of the ore. The method of crushing the original ore to pass screens of various sized mesh, and concentrating each sample separately is not recommended. Tests are further made on the smallest quantity of reagents necessary, the minimum time of treatment and the lowest rate of dilution required. The values obtained should correspond closely with results obtained in practice in a mill of the same class.

—C. A. K.

Flotation [*of ores*]. J. P. Ruth, jun. Eng. and Min. J., 1919, 107, 1149—1159.

The five most important factors in flotation are: agitation, the solubility of the contaminant (usually oil), the surface tension, the size of bubbles, and the size of the sulphide particles. These factors are inter-dependent. As more oil goes into solution, the surface tension of the bubbles is diminished, and as smaller bubbles are formed, the smaller becomes the mass of particles that can be floated. Fine grinding increases the surface contact of the particle with the bubble and the influence of gravity is reduced. The probability that all the floatable particles in the pulp will be brought into contact with bubble surface is dependent on the total bubble surface, and the smaller the bubble, the larger is the bubble surface for any given volume of air, though the slower upward motion of a small bubble is an adverse factor.—C. A. K.

Cobalt-nickel liquors; Treatment of ——. O. Barth. Metall u. Erz, 1919, 16, 267—273.

The dry treatment of complex cobalt-nickel speiss being almost impossible, wet methods of extraction are used. Before bringing the crude speiss into solution, arsenic is removed by roasting, the product concentrated in a furnace and the iron present slagged off. The concentrated speiss is again roasted and calcined with soda, yielding a mixture of oxides which is finely ground and dissolved in hydrochloric or sulphuric acid. When dissolving with hydrochloric acid, the acid is heated in an earthenware or preferably sandstone vessel and the oxides stirred in, the metals dissolving in the following order; Pb, Cu, Ni, Co, As, Sb, Fe. Solution in sulphuric acid is rather more complex. The acid is contained in rotating iron pans, the oxides being stirred in. Much heat is liberated and powdery sulphates result. They are heated to 500°—600° C. and then dissolved in water. In either case the solution is diluted to precipitate lead, silver, antimony, and arsenic as far as possible. Besides copper, cobalt, and nickel the solutions still contain iron—as ferric iron in the hydrochloric acid solution and ferrous iron in the sulphuric acid. The metals may be separated by three methods. (1) Precipitation by metals. Silver is precipitated by copper and copper by iron, but if ferric iron is present more copper may be required to reduce the iron than to precipitate the silver. Both metals may be precipitated at once by iron, especially if ferric iron be present, but this introduces ferrous iron into the solution which must afterwards be precipitated by alkali. The behaviour in hydrochloric and sulphuric acid is the same. (2) Precipitation by sulphides. Copper and silver are precipitated together by hydrogen sulphide, but the operation is expensive and necessitates more work than with metallic precipitants. As hydrogen sulphide is a reducing agent, all iron should be in the ferrous state. The iron can be separated from the cobalt-nickel by using alkali sulphides, sodium sulphide being preferable to calcium sulphide. The precipitate and solution are heated together, the iron sulphide thus being redissolved. The CoS NiS mixture is roasted to sulphates, dissolved, and the cobalt precipitated by hypochlorite. This method is preferably carried out in sulphuric acid solution. (3) Precipitation by alkalis and alkaline earths. The reagents are soda, caustic alkali, and sodium hypochlorite, or lime, milk of lime, and bleaching powder. Solution in hydrochloric acid has the advantage that the cheaper lime reagents may be used. Precipitation takes place in the following order—Fe_2, (As, Sb), Al, Cu, Co, Zn, Ni, Ca, Mg, the separation being the more complete the wider apart the metals are in the series. The iron should be in the ferric state. The precipitant should be added first in the solid state, afterwards as solution. Each metal is considered separately and the best conditions for its isolation are discussed. When using this method, silver should be absent and copper should be low. If these two metals are present in notable quantities, a combination of method 3 and method 2 should be used. Whether hydrochloric or sulphuric acid should be used as solvent depends on the proportions of the metals present, whether it is economical to extract them, and the degree of purity required. For speisses containing no lead, copper, or precious metals hydrochloric acid is preferable. If these metals are present in appreciable proportions, sulphuric acid should be used.

—T. H. Bu.

Electric resistance heat treating furnace. A. M Clark. Blast Furnace and Steel Plant, 1919, 7, 343—345.

Two forms of a new type of electric resistance furnace have been developed by the General Electric Co., *viz.*, a high temperature (1000° C.) furnace used in tempering, hardening, and gun forgings, and a low temperature furnace (up to 510° C.) used for shrinking jackets on a variety of cores. The furnace is built in sectional units which may be fitted above one another to give a greater depth of heating surface. Each unit of the low temperature furnace consists of a cylindrical casing with top and bottom castings and a heating unit of calorite ribbon mounted on, but insulated from, a cast iron supporting plate. A one-section furnace is usually provided with automatic control. The construction of the vertical high temperature furnace involves the use of a heavy calorite ribbon supported on insulators embedded in the furnace wall of refractory

bricks, so as to eliminate the inherent weakness of metal supports at high temperatures. Each section is controlled independently and automatically. The advantages claimed for this type of furnace include minimum temperature variation, uniform and maximum rate of heating, and the elimination of scale due to oxidation.—C. A. K.

Basic slag. Bainbridge. *See* XVI.

Iron in iron ores. Brandt. *See* XXIII.

PATENTS.

Iron silicon alloys; Manufacture of ——. R. A. Hadfield, Westminster. Eng. Pat. 127,981. (Appls. 9577, 11.6.18 and 10,924, 3.7.18.)

AN iron-silicon alloy containing about 10% or more silicon with relatively small quantities of carbon (up to 3%) and manganese (up to 1%) offers considerable resistance to corrosion by acids. It is made by melting iron or steel with suitable proportions of ferrosilicon and ferromanganese. From 1% to 2% of phosphorus may be added to give a stronger metal. The quality of the metal may be improved by air-cooling from 1000° C.—C. A. K.

Pickling iron and steel plates or sheets, and apparatus to be employed therein. H. G. Thomas, Llandaff, and W. R. Davies, Whitchurch. Eng. Pat. 128,398, 20.6.18. (Appl. 10,155/18.)

IRON or steel plates are passed through a compartment, or a series of compartments, made of acid-resisting material, and are subjected to the action of acid liquor delivered on to the metal in the form of spray. The spraying device is so arranged as to give a greater action of the pickling liquor on the portions of the sheets which have the heaviest coating of oxide.—C. A. K.

Iron, steel, or alloys thereof; Electric welding of ——. A. C. Hyde, Perivale. Eng. Pat. 128,463, 27.8.18. (Appl. 13,926/18.)

THE wires, rods, or tapes etc. to be welded are coated with a closely adhering flux material, such as a mixture of asbestos and sodium silicate, which is fused or vitrified on them, and has a coefficient of expansion approximately the same as the metallic core.—T. H. Bu.

Steel and other metals; Method and apparatus for determining the condition of —— *when under heat-treatment.* M. O'Gorman and G. H. Thomas, London. Eng. Pat. 128,756, 4.7.18. (Appl. 11,002/18.)

AN indication of the state of a metal undergoing heat-treatment is obtained by observing any temperature change which occurs in the metal due to recalescence. The article itself is connected to one terminal of a galvanometer, and a platinum wire to the other terminal. The platinum wire may be attached to any particular part of the article subject to the heating effect, or may be used to explore the surface so that the temperature change of any part desired may be indicated.—C. A. K.

Iron, steel, and the like metals or tools or articles made therefrom; Protecting —— from oxidation when heated to a high temperature. A. L. Dendrinos, London. Eng. Pat. 128,876, 26.2.19. (Appl. 4837/19.)

THE articles are coated with a layer of an oxalate, preferably an alkaline-earth oxalate, either alone or mixed with other oxalates, or substances adapted to prevent oxidation or to reduce any oxide formed, such as aluminium powder, graphite powder, and charcoal. The coating may be applied as powder, paste, solution, suspension, or melt and is easily removed after heating.—T. H. Bu.

[*Steel*] *shell; Manufacture of* ——. R. A. Hadfield, Westminster. Eng. Pat. 128,961, 3.4.16. (Appl. 4907/16.)

A SHELL case for high explosives, which is not liable to crack in use, is made by forging or pressing a nickel-chromium steel blank to shape, and slowly heating it to 750°—800° C. After maintaining this temperature for some hours the furnace is allowed to cool slowly and the shell case is turned to finished size. The chemical and mechanical properties are as follows:—0·45—0·6% C, 0·2—0·4% Si, 0·2—0·8% Mn, 2% Ni, and 2% Cr. Elastic limit, 23—30 tons per sq. in.; tensile strength, 42—54 tons per sq. in.; elongation, 15—30%; reduction in area, 34—58%.—C. A. K.

Steel; Production of refined basic ——. W. R. Walker, New York. U.S. Pat. 1,309,162, 8.7.19. Appl., 12.3.18.

THE charge of metal is treated under a phosphorus-extracting slag in a basic furnace or converter, then transferred to a ladle or the like, in which the necessary additions are made, and the metal is heated to allow the additions to take effect and to permit the rise of impurities to the surface and the escape of gases. A modified slag adapted to retard or prevent the return of phosphorus into the steel is used in the ladle.

Acid steel; Process of making ——. W. R. Walker, New York. U.S. Pat. 1,309,496, 8.7.19. Appl., 1.2.18.

A PROCESS for the production of acid steel low in sulphur consists of bessemerising the iron in an acid converter, and treating it successively in a basic open-hearth furnace, a basic electric furnace with a basic slag containing 10% of silica and 90% of lime, and an acid-lined electric furnace with a siliceous slag.—J. W. D.

Iron ores contain silica and silicates; Dressing of ——. F. Wüst, Aachen. Ger. Pat. 311,585, 12.5.17.

THE silica and silicates are dissolved by treatment with alkalis or alkali carbonates under pressure.
—J. W. D.

Copper or its alloys; Process for protecting —— *from attack by atmospheres or liquids.* Imperial Trust for the Encouragement of Scientific and Industrial Research, The Institute of Metals, G. D. Bengough, and O. F. Hudson, London. Eng. Pat. 128,297, 23.7.17. (Appl. 10,576/17.)

ARTICLES of copper or an alloy of copper are given a coating of oxide by exposure (at a temperature not exceeding 450° C.) to air, or to an oxidising liquid, *e.g.*, a solution of a permanganate, or an aerated solution of a carbonate. The adherent oxide coating may be subsequently converted into an oxy-salt by exposure to the atmosphere or to a saline solution. Alternatively, the two operations may be carried out at the same time.—C. A. K.

Electric welding; Process of and apparatus for ——. H. D. Morton, Detroit, Mich., U.S.A. Eng. Pat. 128,394, 19.6.18. (Appl. 10,105/18.)

A METALLIC electrode in the form of a wire of welding material is fed between two serrated rolls to

the work, which forms the other electrode. Interruption of the arc occurs owing to irregularities in the electrode or contours in the work, and this is controlled by passing the welding current through a solenoid coil. If the length of arc alters and causes a variation in the quantity of current passing, the solenoid plunger moves and causes a pivoted switch arm to engage one of two plugs. The contact established actuates a second solenoid, the plunger of which is connected to the contact point of a rheostat in series with the motor driving the rolls. The rate of feed of the welding wire is thereby increased or decreased. An alternative method is to employ a series motor, which is susceptible to load, both to drive the rolls and to supply the welding current. As the electrode approaches the work, the increased current passing through the arc throws an increased load on the motor, which automatically reduces the rate of feed of the welding wire.—C. A. K.

Welding cast-iron; Method of ——. D. H. Wilson, Ridgewood Park, N.J. U.S. Pat. 1,306,295, 10.6.19. Appl., 31.10.17.

Welding material is caused to adhere to cast-iron by converting the brittle surface layer of the cast-iron into a more ductile form by means of an electric arc.—C. A. K.

Electric welding. M. H. Roberts, Jersey City, and C. C. Van Nuys, New York, Assignors to Air Reduction Co. U.S. Pat. 1,309,696, 15.7.19. Appl., 4.2.19.

A method of improving the character of welds produced by the electric arc process which comprises blanketing the heated parts of the work during the welding operation with nitrogen and thereby excluding oxygen.—J. W. D.

Furnaces for melting lead and other soft metals and for other purposes. J. E. Morfett, Sunderland. Eng. Pat. 128,417, 29.6.18. (Appl. 10,763/18.)

In a furnace of the crucible type, heat is applied by a vertical series of burners arranged round the furnace. The burners may be arranged to play direct on to the pots, or tangentially, but in working the heat is applied first to the upper portion of the pot to melt the surface metal. The lower portion of the pot is then heated to melt the remainder of the metal. It is claimed that the risk of bursting the crucible is obviated by this method. —C. A. K.

Furnace; Regenerative oven or —— [*for reheating metals or smelting ores*]. B. W. Brooks, London. Eng. Pat. 128,740, 28.6.18. (Appl. 10,659/18.)

Flue gases from a furnace are conducted into a heating chamber below the furnace and through flues which are provided with pilot lights giving an injector effect. Gas is led in through pipes passing through a heating compartment above the furnace arch, in a downward direction inside the side-wall, and through the heating chamber to the gas inlet of the burner. A branched pipe passing through the heating chamber conveys primary air to the burner inlet and secondary air to the burner mouth. The admission of secondary air is controlled by the regulation of the pilot jets in the exit flues.—C. A. K.

Crucible furnaces; Rocking ——. M. Mathy, Flemalle-Grande, Belgium. Eng. Pat. 128,874, 22.2.19. (Appl. 4482/19.)

The furnace is rocked about an axis adjacent to the extremity of the lip of the crucible, and the cover is so mounted that when in its open position it serves as a balance weight to facilitate the rocking movement.

Annealing furnace. J. J. Beeman, Assignor to Standard Fuel Engineering Co., Detroit, Mich. U.S. Pat. 1,305,991, 10.6.19. Appl., 7.1.18.

A furnace chamber for the heat treatment of metal articles consists of an annular conduit with spaced ends providing an inlet and outlet. A central rotary vertical shaft carries a series of horizontal arms, which project into the furnace through a circumferential slot in the inner wall, and carry the articles to be heated.—C. A. K.

Furnace; Open-hearth ——. G. F. Downs, Buffalo, N.Y. U.S. Pat. 1,308,404, 1.7.19. Appl., 5.3.18.

Within an open-hearth furnace a straight, metallic, tubular flue is supported, connecting the gas uptake with the interior of the furnace. The flue is entirely surrounded by a jacket through which water can be circulated, and a nozzle pipe, movable lengthwise inside the jacket from without the furnace, is provided for agitating the cooling water.—G. F. M.

Open-hearth furnace. A. Miller, Buffalo, N.Y. U.S. Pat. 1,309,149, 8.7.19. Appl., 29.4.18.

The furnace has a pit below its floor-level with a down-flue from the hearth. In the pit is a wheeled receptacle for the removal of the slag from the flue. At the top of the pit is an opening with a lid for the removal of the slag receptacle. Between this lid and the rear portion of the pit there is a vertically sliding door arranged in the pit. —J. W. D.

Blast-furnaces; Method of blowing down and blowing out ——. *Method of preventing gas explosions in blast-furnaces during temporary stops.* J. W. Dougherty, Beaver, Pa. U.S. Pats. (A) 1,309,465 and (B) 1,309,466, 8.7.19. Appl., 14.3 and 20.3.19.

(A) A non-explosive gaseous mixture is formed and maintained within the furnace at about the time the blast is turned off. (B) Steam is introduced into the gas system at a point between the hot blast stoves and the shaft of the furnace. By this means a volume of steam is maintained between the points at which air and gas are admitted to the system, the movement of the steam being in the direction of the gas.—J. W. D.

Gas-fired roasting furnace. Donnersmarckhütte Oberschlesische Eisen- und Kohlenwerke A.-G. Ger. Pat. 310,283, 28.11.16.

The furnace consists of a series of narrow walls between which are sloping plates overlapping one another and down which the ore passes. A number of gas burners are let into the walls for heating, and below the lowest plate are cooling chambers with flues for regulating the air supply during the roasting process. The bottoms of the cooling chambers can be opened and shut to allow withdrawal of the roasted material. In the upper heating chambers mechanical contrivances are placed in the passages to stir up and keep the ore open.—J. W. D.

Zinc, copper or other metals; Electrolytic production of ——. Soc. de Métallurgie Electrolytique, Paris. Eng. Pat. 128,676, 26.10.17. (Appl. 15,629/17.) Int. Conv., 28.10.16.

The anodes are formed of lead plates, or other conducting acid-resisting material, having an active

surface less than that of the cathode formed by the parts of the cathode discs immersed in the electrolyte. The anodes are inclined with respect to the cathode discs which rotate vertically, the discs being fixed on a rotary shaft against a ring and separated from each other by a series of movable sleeves, the whole being clamped on the shaft by a nut. Rubbers, consisting of flexible strips, are arranged to wipe the deposited metal, and are carried on a metal bar inclined relatively to the electrolytic vessel, the strips being pressed on the surface of the discs by a rubber tube or other resilient device. In order to effect uniform wiping of the metal, the inclined bars supporting the rubbers are reciprocated, one end sliding in a fixed guide, whilst the other end is mounted on a cranked shaft, the rubbers supported by each inclined bar being adapted to wipe the faces of two adjacent discs. The periphery of each cathode disc is covered by an insulator composed of a mixture of wax and resin.—B. N.

Metal surfaces; Preservative preparation for protection of ——. W. H. V. Morley, Lytham. Eng. Pat. 128,797, 22.8.18. (Appl. 13,663/18.)

A COATING for protecting metal surfaces from the action of water etc. consists of 50% of china clay, whiting, zinc oxide, or other finely divided earthy substance having no action on the metal, 6% of soda ash, 3% of sodium aluminate, 40% of water, and 1% of an agglutinant which can be rendered insoluble in water, preferably algine paste. The coating prevents badly rusted surfaces from further rusting.—T. H. Bu.

Tin from tinned metals; Recovery of ——. A. W. Gregory, London. Eng. Pat. 128,833, 10.10.18. (Appl. 18,818/18.)

TINNED scrap is treated with a hot solution of a soluble polysulphide to which sufficient ammonium salt is added to form ammonium polysulphide. Alternatively a hot solution of ammonium polysulphide may be used, with or without the addition of caustic alkali. The tin passes into solution as sulphostannate, successive quantities of scrap being added till the solution is saturated.—T. H. Bu.

Tin scrap; Utilisation of ——. D. A. and S. H. Wilcox, Garden City, N.Y. U.S. Pat. 1,310,381, 15.7.19. Appl., 26.10.14. Renewed 2.12.18.

TIN scrap is subjected to the action of chlorine at such a temperature as to convert tin and iron into chlorides, which are removed by volatilisation and recovered by fractional condensation; chlorine is recovered for use on further quantities of scrap.
—T. H. B.

Composite or compound metal plates and large sheets; Process of manufacture of ——. E. Martin, Brussels. Eng. Pat. 128,855, 8.1.19. (Appl. 595/19.)

IN order to roll down thick blocks of composite metal (*e.g.*, steel and copper) so that the softer metal does not project beyond the edges of the steel, the softer metal is applied in the form of a number of thin sheets. The whole is then heated to 800°—1000° C., and pressed or rolled in the usual way. Sheets of composite metal may be interposed between the steel and copper sheets to assist adhesion, and other metal sheets may be placed on the outside of the packs of sheets to obtain different coloured surfaces when rolled.—C. A. K.

Metallic mixtures; Ignitable ——. C. Vautin, and Thermalloy, Ltd., London. Eng. Pat. 129,046. (Appls. 1003, 17.1.18, and 2587, 13.2.18.)

THE mixture is in the form of a solid body containing free sulphur, prepared by heating a mixture of sulphur and a finely divided metal such as aluminium to a temperature not exceeding 200° C., or by stirring the metal into the plastic sulphur. Finely divided metal with free sulphur may also be mixed and heated as described with a finely divided metal and an oxide which together constitute an ignitable mixture. For use in substitution for the whole or part of the sulphur a metallic sulphide may be ground to a fine powder, mixed with 15 to 50% of finely divided sulphur, made into a plastic mass, cooled, and ground.—T. H. Bu.

Electromagnetic separator. W. E. Poole, Leeds. Eng. Pat. 129,166, 4.9.18. (Appl. 14,350/18.)

THE separating action and the operation of a safety valve are performed by one central electromagnet. When the current is passing the valve is held open to allow the discharge of non-magnetic material, but when the current fails or is switched off, the valve closes so that the magnetic material can be collected separately.—B. N.

Magnetic ore-separator. G. Gröndal, Djursholm, Sweden. Ger. Pat. 311,587, 5.11.15.

A DRUM-SHAPED secondary magnet rotates above or in contact with a stream of ore pulp. The magnet consists of laminæ arranged radially. A water spray washes away the magnetised portions, while a number of water jets placed in the interior of the magnet vertically above the stream of ore pulp wash back the unmagnetised particles.—J. W. D.

Reducing metal to a finely divided condition; Method and apparatus for ——. E. J. Hall, Assignor to Metals Disintegrating Co., Inc., New York. U.S. Pat. 1,306,060, 10.6.19. Appl., 28.8.16.

PARTICLES of molten metal are continuously passed through a protecting gas and then through a protecting liquid. Both the gas and liquid in contact with the molten metal are continuously renewed.
—C. A. K.

Copper-cadmium alloy. W. C. Smith, Roselle, N.J., Assignor to United States Smelting, Refining, and Mining Co. U.S. Pat. 1,307,642, 24.6.19. Appl., 15.8.18.

MOLTEN copper is reduced to a temperature below the boiling point of cadmium by the addition of solid cadmium, and more cadmium is added while maintaining the bath above the melting point of cadmium. A small quantity of the solid alloy is afterwards introduced into a bath of molten copper.
—C. A. K.

Metals; Colouring liquor and method of staining ——. F. C. Mathers and J. Papish, Bloomington, Ind. U.S. Pat. 1,308,092, 1.7.19. Appl., 22.9.17.

A METAL surface is treated with a solution of basic tellurium nitrate in hydrochloric acid.—C. A. K.

Electric furnace. I. Hechenbleikner, Assignor to Chemical Construction Co., Charlotte, N.C. U.S. Pat. 1,310,079, 15.7.19. Appl., 22.3.19.

AN electric furnace comprises a casing containing a chamber supporting a bracket and an electrode extending through the casing wall and adjustable in or out of the chamber by means of an outer threaded part and nut bearing against the bracket.
—A. de W.

Electric furnace. O. Hutchins, Assignor to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,310,341, 15.7.19. Appl., 18.11.18.

An electric pot furnace, shaped like an inverted truncated cone, and having means for the distribution of cooling water over the outside.

—W. E. F. P.

Electric furnace for fusing metals. Electric furnace for fusing metals contained in crucibles. J. Thomson, New York. U.S. Pats. (A) 1,308,877 and (B) 1,308,880, 8.7.19. Appl., (A) 7.10.18, (B) 30.11.18.

(A) A carbon resistor is suspended along a central longitudinal axis of the furnace above an open melting tank. The arch of the furnace is so shaped as to refract the heat on to the charge. (B) Crucibles in a furnace chamber rest upon a zig-zag carbon resistor, from which heat is transmitted to the crucibles by direct conduction.—C. A. K.

Electric carbon resistors; Method of preventing —— from oxidising. Method of eliminating carbon dioxide and oxygen in electric smelting furnaces. J. Thomson, New York. U.S. Pats. (A) 1,308,878 and (B) 1,308,879, 8.7.19. Appl., 7.10 and 24.10.18.

(A) A charge of zinc oxide and carbon is placed in the resistor chamber of an electric furnace and heated until reaction occurs. The carbon monoxide and zinc fumes evolved by the reaction protect the carbon heating element from oxidation. (B) In an electric furnace in which heat is radiated from a carbon resistance to an underlying charge, the thermal element is protected by covering the charge with a layer of "filter-carbon" and maintaining it at a temperature of 1100° C. or over.—C. A. K.

Molybdenum-tungsten alloy; Manufacture of ——. F. G. Keyes, Assignor to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,308,907, 8.7.19. Appl., 16.10.15.

An alloy of molybdenum and tungsten containing 20% Mo.—C. A. K.

Borings; Process and mechanism for melting ——. S. J. Huber, Newark, and E. J. Schwanhausser, Jersey City, N.J. U.S. Pat. 1,309,851, 15.7.19. Appl., 7.12.18.

An auxiliary furnace with heater and air blast is connected with a cupola furnace, so that the molten metal (pig iron, scrap iron, or iron borings) from the auxiliary furnace is delivered into the cupola furnace below the melting zone of the latter.

—T. H. B.

Alloy. Method of making alloys. H. G. C. Thofehrn, New York, Assignor to Light Metals Co., Elizabeth, N.J. U.S. Pats. (A) 1,310,309 and (B) 1,310,310, 15.7.19. Appl., 15.12.17.

(A) An alloy of aluminium with magnesium and uranium in relatively small proportions possesses the properties of high tensile strength and toughness. (B) Aluminium is added to uranium oxide at a bright red heat, and the temperature is maintained so as to melt the aluminium. The addition of magnesium promotes the reduction of uranium oxide and a homogeneous alloy is produced.

—C. A. K.

Alloy. F. Milliken, Lawrence, N.Y. U.S. Pat. 1,310,363, 15.7.19. Appl., 29.8.18.

An alloy composed of Cu 56—64%, Ni 13—17%, Zn 10—15%, and Fe 10—16%.—T. H. B.

Electro-deposition of magnesium. G. O. Seward, Assignor to American Magnesium Corporation, Niagara Falls, N.Y. U.S. Pats. 1,310,449 and 1,310,450, 22.7.19. Appl., 23.3.16 and 19.11.17.

The process consists in passing an electric current through a molten bath containing a mixture of magnesium fluoride and excess of magnesium oxide, the mixture being of sufficient density to prevent rapid subsidence of the undissolved portions. The magnesium is withdrawn in the molten state from the upper portion of the bath.—J. W. D.

Ores or concentrates; Roasting of ——. U. C. Tainton, Johannesburg. U.S. Pat. 1,310,455, 22.7.19. Appl., 1.4.18.

Ore or concentrate in a finely divided condition is blown by means of an air blast through a roasting chamber, so that each particle is roasted while suspended in the blast. After cooling, the particles are collected in a settling chamber.—T. H. B.

Reduction process. S. Westberg, Christiania, Norway. U.S. Pat. 1,310,724, 22.7.19. Appl., 22.10.17.

Metallic material is reduced in a current of preheated "hydrogenous gas," the temperature of which is regulated by the admission of more or less cool "hydrogenous gas"; the reduced metal is cooled in absence of oxidising material.

—B. M. V.

Metal and potassium compounds; Treatment of ores for production of ——. C. Catlett, Staunton, Va., Assignor to The British Potash Co., Ltd., London. U.S. Pat. 1,311,043, 22.7.19. Appl., 18.2.18.

Metalliferous mineral matter and potassium-bearing material is smelted with a suitable flux. A salt "favouring volatilisation of combined potassium" is also added to the furnace charge, and the potash values are recovered from the furnace gases.—C. A. K.

Furnace dust; Process for sintering ——. W. Schumacher, Berlin. Ger. Pat. 311,629, 11.3.17.

The dust is conveyed directly from the collecting chamber to the sintering furnace without being in contact with the air. A preheated current of air is passed through the material, and sufficient heat is developed by combustion of the particles of iron present in the dust to effect sintering without the addition of fuel.—J. W. D.

Manganese-steel; Manufacture of ——. R. A. Hadfield, Westminster. U.S. Pat. 1,310,528, 22.7.19. Appl., 10.8.17.

See Eng. Pat. 124,817 of 1916; this J., 1919, 371 A.

Cerium and similar rare earth metals or alloys thereof; Processes for producing ——. Alpha Products Co., Assignees of A. and M. Hirsch, New York. Eng. Pat. 119,229, 2.9.18. (Appl. 14,238/18.) Int. Conv., 1.9.17.

See U.S. Pat. 1,273,223 of 1918; this J., 1918, 591 A.

Melting pots or crucibles. E. C. R. Marks, London. From Driver-Harris Co., Harrison, N.J., U.S.A. Eng. Pat. 129,403, 4.6.18. (Appl. 9210/18.)

See U.S. Pat. 1,241,971 of 1917; this J., 1917, 1182.

Melting and casting metal; Means for ——. I. Hall, Birmingham. U.S. Pat. 1,306,376, 10.6.19. Appl., 8.2.16.

See Eng. Pat. 10,281 of 1915; this J., 1916 640.

Copper alloy. W. D. Berry, New Brighton, Pa., U.S.A. Eng. Pat. 129,056, 25.4.19. (Appl. 10,358/19.) Int. Conv., 13.8.18.

SEE U.S. Pat. 1,286,921 of 1918; this J., 1919, 147 A.

Pneumatic conveyance of materials; Apparatus for —— [to metallurgical furnaces]. J. Westly Lysaker, Norway, Assignor to Sulitelma Aktiebolag, Helsingborg, Sweden. U.S. Pat. 1,308,464, 1.7.19. Appl., 19.3.17.

SEE Eng. Pat. 104,512 of 1917; this J., 1917, 1088.

Brass; Recovery of —— from foundry ash and the like. C. H. White, Coventry. U.S. Pat. 1,309,165, 8.7.19. Appl., 4.12.18.

SEE Eng. Pat. 124,019 of 1918; this J., 1919, 327 A.

Ore-concentrating apparatus. J. D. Wolf, London. U.S. Pat. 1,310,492, 22.7.19. Appl., 10.8.14.

SEE Eng. Pat. 18,351 of 1913; this J., 1914, 926.

Nitrogen compounds from blast-furnaces. U.S. Pat. 1,310,480. *See* VII.

Mine-water. U.S. Pats. 1,310,382—4. *See* VII.

Lead powder. Eng. Pat. 129,392. *See* XIII.

Hardness of metals. Eng. Pat. 128,894. *See* XXIII.

XI.—ELECTRO-CHEMISTRY.

Arsenious and arsenic acids. Ramberg. *See* VII.

Electric furnace. Clark. *See* X.

Separating lead from chromium. Milbauer and Setlik. *See* XIII.

PATENTS.

Electrolytic gas generators. I. H. Levin, New York. Eng. Pat. 126,640, 16.5.18. (Appl. 11,436/19.) Int. Conv., 22.5.17.

AN electrolytic apparatus for the generation of oxygen and hydrogen is provided with dished or recessed electrodes of opposite polarity insulated from each other, which are secured together at their open sides with a porous diaphragm between them. Separable combined liquid supply and safety gas-outlet devices are provided, each having passages formed therein which are adapted for supplying liquid to the apparatus, for separating gas from the liquid within the device, and for releasing gas from the apparatus when the pressure therein becomes excessive.—B. N.

Ozone generators. E. L. Joseph, London. Eng. Pat. 128,867, 13.2.19. (Appl. 3558/19.)

EACH electrode is of a substantially right-angled trapezoidal shape; the rods serving to lead the electric current to or from the electrodes of appropriate polarity pass through the projecting substantially triangular portions of the electrodes, and serve also to clamp together the assembled electrodes and dielectric sheets. In a modification, the assembled electrodes and dielectrics are clamped together by additional means, comprising a nut and a centrally arranged rod disposed in a glass tube passing through apertures in the dielectrics with distance pieces of insulating material surrounding the glass tube and disposed in apertures in the electrodes. The assembled electrodes and dielectrics are placed in a container provided at the top near one end with an inlet for the air to be ozonised, and at the bottom near the other end with an outlet for the ozonised air. Baffles are arranged obliquely, so that the air passage to and from the electrodes is gradually decreased in cross-sectional area as the distance from the inlet or outlet pipe is increased respectively, thus ensuring a uniform distribution of the volume of air passing through the apparatus.—B. N.

Electrolytic cells. H. C. Jenkins, and C. I. (1914) Syndicate, Ltd., London. Eng. Pat. 129,083, 28.6.18. (Appl. 10,658/18.)

THE electrolyte is discharged automatically from the cell by the rise in level of the liquid feed in a separate feed tank, connected to the source of supply and having a restricted outlet. The discharge may be effected automatically by a float which opens or closes a valve in the discharge pipe, the float being operated by the rise and fall in the level of the electrolyte in a chamber connected to the feed tank.—B. N.

Storage-battery electrode and process of making same. E. J. Rueb, Assignor to O. K. Electric Storage Battery Co., Oklahoma, Okla. U.S. Pat. 1,291,167, 14.1.19. Appl., 24.7.17.

SUITABLE supports are covered with a paste composed of active electrode material, *e.g.*, lead oxide, mixed with constituents of the electrolyte to be used in the battery, *e.g.*, aluminium sulphate and sulphuric acid. The electrodes thus formed are baked in a chamber within which is a vessel containing some of the electrolyte (sulphuric acid, aluminium and ferric sulphates, and glycerin), then "cured" by dipping them repeatedly in the electrolyte, washed with water, and "finished" by repeatedly charging and discharging them.

Furnace; Electric —— and process of operating the same. W. E. Moore, Pittsburgh, Pa. U.S. Pat. 1,309,045, 8.7.19. Appl., 9.8.18.

A POLYPHASE electric furnace comprises a number of arcing electrodes connected to a polyphase circuit, with means for unbalancing the voltage supplied to one of the electrodes.—B. N.

Furnace-control apparatus; Electric ——. H. A. Winne, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,310,109, 15.7.19. Appl., 2.1.19.

A REGULATOR for a number of arcing electrodes comprises means for regulating the arcing relation of one of the electrodes, and means for similarly regulating a second electrode in response to a predetermined relation between the voltage drop across the respective arcs of the electrodes.—B. N.

Furnace; Electric resistance ——. E. F. Collins, Schenectady, N.Y., Assignor to General Electric Co. U.S. Pat. 1,310,060, 15.7.19. Appl., 21.9.18. Renewed 30.4.19.

AN electric furnace comprises a casing, with circumferential frames supported at different heights by the inner wall of the casing and refractory insulating members on each of the frames. A looped resistance heater is supported at the bends by the members, and extends between the frames.
—B. N.

Arc furnace, with auxiliary heating by means of induced currents. Maschinenbau Anstalt Humboldt, Cöln-Kalk. Ger. Pat. 309,087, 19.9.16.

A FURNACE is heated in the usual manner by an electric arc between electrodes arranged above the surface of the material to be melted, and the molten material is discharged through channels situated beneath the floor of the furnace and separated therefrom by insulating material. Secondary coils of an induction machine are arranged within these channels and the heat developed by means of them produces a brisk circulation in the molten material passing from the furnace to the discharge channel. A better mixing of the contents of the furnace is thus effected. The various parts of the induction machine are arranged below the floor of the furnace.—J. S. G. T.

Electrode. E. A. C. Smith, New York. U.S. Pat. 1,311,096, 22.7.19. Appl., 7.1.18.

AN electrode is composed of cast silicon iron, with a conductive lead of a metal of lower melting point than the iron, one end of the conductive lead being embedded in the solid silicon iron and in intimate mechanical and electrical contact therewith whilst physically separate and distinct therefrom.—B. N.

Resistance; Variable ——. T. W. Case, Scipio, N.Y. U.S. Pat. 1,309,181, 8.7.19. Appl., 9.10.17.

A RESISTANCE element is formed of a compound of thallium and iodine.—B. N.

Gases; Apparatus for electrical treatment of ——. A. A. Schmidt, Assignor to International Precipitation Co., Los Angeles, Cal. U.S. Pat. 1,309,221, 8.7.19. Appl., 3.10.17.

AN apparatus for precipitating suspended particles from gases by electrical action comprises a porous electrode, and means for supplying water from the outside surface and through the porous electrode to the inner surface.—B. N.

Electric batteries. G. N. Antonoff, London. Eng. Pat. 128,316. (Appls. 11,081, 1.8.17, and 3660, 1.3.18.)

SEE U.S. Pat. 1,303,843 of 1919; this J., 1919, 543 A.

Electric batteries. G. N. Antonoff, London. Eng. Pat. 128,600, 2.8.17. (Appl. 11,154/17.)

SEE U.S. Pat. 1,303,844 of 1919; this J., 1919, 543 A.

Electrolytic cell for production of oxygen and hydrogen. E. Geeraerd, Prestwich, Assignor to G. J. Stanfield, Manchester. U.S. Pat. 1,308,704, 1.7.19. Appl., 17.5.17.

SEE Eng. Pat. 101,598 of 1916; this J., 1916, 1162.

Electrode. C. Zorzi, Milan, Italy. U.S. Pat. 1,310,727, 22.7.19. Appl., 29.6.18.

SEE Eng. Pat. 117,450 of 1918; this J., 1919, 586 A.

Alkali chlorides. U.S. Pat. 1,308,509. *See* VII.

Lead salts. U.S. Pat. 1,308,948. *See* VII.

Glycols. U.S. Pat. 1,308,797. *See* XX.

XII.—FATS; OILS; WAXES.

Oiticica fat. C. Grimme. Chem. Umschau, 1919, **26**, 89—91. (See also this J., 1918, 430 A.)

THE name "oiticica" is applied in Brazil to several species of *Moquilea* and *Couepia*, belonging to the *Rosaceæ*, but the tree from which the oil-containing fruit is mainly obtained is *Pleurogyne umbrasissimia*, and not, as formerly stated, *Moquilea tomentosa*. A sample of fat extracted this year from material collected in 1915 had the following values:—Sp. gr. at 15·5° C., 0·9518; m.pt. (beginning), 15·9° C., (end) 57° C.; solidif. pt., 15·2° C.; refractive index (30° C.), 1·4945; acid value, 10·5; saponif. value, 195·3; iodine value, 83·65; m.pt. of fatty acids (beginning), 63° C., (end), 68° C.; and unsaponif. matter, 6·14%. (See also Bolton and Revis, this J., 1918, 430 A.)—C. A. M.

Spontaneous ignition. Schaper. *See* IIA.

PATENTS.

Fat; Extracting —— *from bones and other material.* W. T. and B. B. Powling, Prittlewell, Essex. Eng. Pat. 128,397, 19.6.18. (Appl. 10,129/18.)

BONES, or other fat-containing materials, are heated in a container whose only outlet during the process is near the bottom. The vapour and gases generated are drawn away downwards through the heated material by means of a suction pump connected to the outlet, and the melted fat runs into a container constituting the lower portion of the heating chamber above the outlet, or through the outlet into an external grease trap; in either case it may be drawn off from time to time by temporarily breaking the vacuum. The vapour and gases may be led through a condensing chamber. It is claimed that the dried residue—freed from grease—is richer in fertilising properties when prepared in this way than when the material is heated in a vessel having an outlet at the top.—E. W. L.

Hydrogenation of fats and oils; Apparatus for ——. G. Martin, Manchester. Eng. Pat. 129,461, 17.6.18. (Appl. 11,762/18.)

THE apparatus consists of a reservoir for the oil or fat and catalyst connected at its lower end with conduits in series or parallel surrounded concentrically by heating jackets. The oil and catalyst are circulated through the reservoir and conduits and meet a counter-current of hydrogen introduced through perforated pipes within the heated conduits. The oil or fat is pumped back to the upper part of the reservior, whilst the hydrogen not absorbed by the oil in the heated conduit escapes through the body of the oil into the upper part of the reservoir, whence it is returned to the perforated pipes within the heated conduit. An additional pump is provided to supply fresh hydrogen to the system.—A. de W.

Catalysers employed in the hydrogenation of fatty bodies; Regeneration of oxide of nickel ——. Soc. Ind. de Prod. Chimiques, Paris. Eng. Pat. 112,768, 5.11.17. (Appl. 16,149/17.) Int. Conv., 16.1.17.

THE spent catalyst is freed from grease by means of ordinary chlorinated solvents, then calcined and oxidised as completely as possible with excess of air; the resulting grey nickel oxide (NiO) is washed with water and reduced dry with hydrogen at about 300° C., but not to such a degree that the product becomes pyrophoric. Thorough washing of the nickel oxide is essential when chlorinated solvents are used for extraction of the grease.—E. W. L.

Wax from sugar-cane; Process of recovering ——. R. U. Bunker, Yonkers, N.Y. U.S. Pat. 1,309,999, 15.7.19. Appl., 27.2.19.

SUGAR-CANE is passed continuously through a tank through which hot water is passed in the opposite direction. The wax liberated from the surface of the cane collects as a film on the surface of the water, and the upper layers of water, together with the film of wax, are delivered to a separator. —W. P. S.

Vegetable oils [maize oil]; Process of treating ——. C. J. Barton, Chicago, Ill. U.S. Pat. 1,310,977, 22.7.19. Appl., 22.9.17.

CORN oil (maize oil) is heated with steam or water to a temperature sufficiently high to produce an emulsion, and such part of the non-emulsified oil as may be separated by a brief interval of standing is removed from the emulsion by decantation. The emulsion is reheated with additional water to a temperature sufficient to permit of the separation of the remainder of the non-emulsified oil with a centrifuge.—A. de W.

Washing agent. Ger. Pat. 311,542. *See* V.

Garbage. U.S. Pats. 1,307,991—2. *See* XIXB.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Lead; Electrolytic separation of —— from chromium and analysis of chrome yellow and similar pigments. J. Milbauer and I. Šetlík. J. prakt. Chem., 1919, **99**, 85—92.

IN a matt surface Classen electrolytic dish, serving as anode, a double circular gauze electrode of the Hildebrandt type was suspended. The solution used consisted of lead and chromium nitrates corresponding to 0·2009 grm. of lead and 0·0506 grm. of chromium, together with 20 c.c. of nitric acid (sp. gr. 1·4) and distilled water to a total volume of 150 c.c. Electrolysis was continued for 2¾ hours at the ordinary temperature, the current being 1·5 amps. and the voltage 2·5—2·7; the cathode was stationary. The layer of lead oxide obtained was washed, dried at different temperatures in different cases, and weighed, the residual liquid being concentrated and neutralised with ammonia and the chromium precipitated as hydroxide and weighed as Cr_2O_3. By drying the peroxide at 230° C. a result corresponding to 0·2006 grm. of lead was obtained, and by igniting at 600° C. and weighing as PbO, 0·2007 grm. of lead; the Cr_2O_3 obtained corresponded to 0·0504 grm. of chromium. Similar results were obtained with different currents, voltages, and proportions of lead and chromium. The estimation is not affected by the presence of perchloric acid and is applicable to pigments with a basis of lead chromate. 0·3 grm. of the pigment is dissolved by boiling for a short time (at most 20 minutes) with 20 c.c. of nitric acid (sp. gr. 1·4) and 15 c.c. of perchloric acid (sp. gr. 1·12), the solution being then diluted and electrolysed as above. If the cathode is rotated at 800 revs. per minute and a current of 3·5 amps. at 2·5 volts is used, the deposition of the lead peroxide and the reduction of CrO_4'' to Cr''' are complete in 30 minutes. The results of analyses of chrome orange, chrome yellow, and canary yellow are given.—T. H. P.

Pinabietic acid. A new resin acid from sulphite-cellulose waste liquors. O. Aschan and K. E. Ekholm. Finska Kemistsamfundets Meddel., 1918. Chem. Zentr., 1919, **90**, I., 285—286.

A NEW resin acid, pinabietic acid, $C_{19}H_{28}O_3$, has been isolated from sulphite-cellulose liquors after the removal of fatty acids, in the form of glittering needles, m.pt. 176°—178° C., which readily resinify. It is readily soluble in benzene, ether, ethyl acetate, chloroform, acetone, acetic and formic acids, but very difficultly soluble in cold ethyl and methyl alcohols. On adding a trace of concentrated sulphuric acid to a mixture of the acid with chloroform and acetic anhydride, a purplish-red colour changing through violet and blue to black is obtained, whilst with ferric chloride and hydrochloric acid a violet-blue colour is obtained. On evaporating with nitric acid and treatment of the residue with ammonia an orange-yellow colour is obtained in distinction to abietic acid, which gives a violet colour. The optical activity depends to a very large extent on the solvent employed, the rotation being dextro in aromatic and lævo in aliphatic hydrocarbons and varying with the particular solvent employed. —T. C.

Resin; Natural —— from Liquidamber Formosana, Hance. R. Tsuchihashi and S. Tasaki. Kōgyō-Kwagaku Zasshi (J. Chem. Ind. Tokyo), 1919, **22**, 288—295.

Two natural resins from *Liquidamber Formosana* were examined. The first was a solid and gave the following analytical values:—Volatile matter 1·42%, ash 0·87%, soluble in ether-alcohol 93·45%, acid value 43·46, saponification value 95·42. An amorphous resin alcohol, m.pt. 155°—162° C., probably identical with styresinol, $C_{16}H_{26}O_2$, was isolated from it. The second resin was semi-liquid and gave 4·64% of volatile matter, 0·06% of ash, 82·87% soluble in ether-alcohol, acid value 34·17, and saponification value 101·48. This resin gave after hydrolysis 16% of cinnamic acid, and the presence of cinnamic alcohol and borneol was also established.—G. F. M.

Coumarone varnishes; Examination of ——. H. Wolff. Farben-Zeit., 1918, **23**, 307. Chem.-Zeit., 1919, **43**, Rep., 144.

THE separation of coumarone resin acids from oxidised fatty acids cannot at the present be satisfactorily effected. Coumarone resins often contain considerable quantities of acids which become easily or completely soluble in petroleum spirit in the presence of fatty acids although almost insoluble in that menstruum when present alone. Partial separation of the coumarone resin acids from fatty acids can be effected by esterification, but the larger part of the former remains with the fatty acids. After saponification of the mixture of resin and fatty acid esters for one hour at 100° C., however, the resin acids are so sparingly soluble in petroleum spirit that a nearly perfect separation is possible. The presence of coumarone resins in varnishes can be shown by the relatively low boiling-point (160°—220° C.) of the compounds formed by dry distillation of the non-volatile portion of the unsaponifiable matter. By further fractionation of the latter small quantities of coumarone and indene formed by depolymerisation can often be separated and then identified by their derivatives. —A. de W.

Furfural; Action of —— on phenols. E. Beckmann and E. Dehn. Sitzungsber. Kgl. Preuss. Akad. Wiss., Berlin, 1918, 1201—1221. Chem. Zentr., 1919, **90**, I., 440.

ATTEMPTS made to find a practical use for furfural as a substitute for formaldehyde in its various technical applications have indicated that it is much inferior as a disinfectant and for all other purposes depending on the protein-hardening properties of formaldehyde. On the other hand fur-

fural gives, in presence of suitable catalysts, condensation products with phenols of a resinous or gum-resinous nature similar to the so-called "bakelite" obtained from formaldehyde. With halogen acids, their ammonium salts, or, particularly, acid reacting salts such as aniline hydrochloride, insoluble resinous substances are produced, whilst alkaline catalysts, as alkali carbonates or ammonia, give soluble products suitable for the preparation of lacquers. The properties of the insoluble products can be modified in various ways by the addition of fatty materials, or of diluents such as asbestos or kieselguhr.—G. F. M.

m-Nitro-p-toluidine Red. Shiraishi. *See* IV.

Pine resin. Aschan. *See* XX.

Finnish turpentine. Aschan. *See* XX.

PATENTS.

Metallic lead powder and lead paints; Manufacture of ——. J. Nelson and W. C. White, Glasgow. Eng. Pat. 129,392, 9.4.18. (Appl. 6065/18.)

AN aqueous solution containing lead, *e.g.*, lead sulphate in a 10% sodium chloride solution, galena in hydrochloric acid, etc., is reduced to the metallic state by means of zinc scrap or zinc and iron (galvanised iron), with or without the aid of heat. The excess of zinc or iron is removed, the lead precipitate separated from the liquor, washed, and dried at a temperature preferably not exceeding 100° C. *in vacuo* or in an inert atmosphere. If agitation be employed it must be such as to avoid excessive grinding or pressing, and care must be taken to avoid access of air during drying or subsequent cooling. The amorphous lead powder may be incorporated with the usual paint vehicles to form a paint, the same care being taken to avoid excessive pressure or friction as during the preparation of the powder.—A. de W.

Priming or paint for concrete or cement surfaces and other surfaces. J. F. Bottomley, Brighouse. Eng. Pat. 128,402, 20.6.18. (Appl. 10,213/18.)

AN aqueous solution consisting of zinc sulphate (11·5—49·0%) and an azo dyestuff, *e.g.*, the sodium salt of *p*-sulphobenzene-azo-β-naphthol (0·5—2·0%) is claimed as a priming coat to permit of oil paints being applied to concrete.—A. de W.

Antimony colours; Manufacture of ——. E. F. Morris, Liverpool. Eng. Pat. 128,482, 8.10.18. (Appl. 16,334/18.)

AN antimony salt or mixture of salts is mixed with a thiosulphate at a low temperature, *e.g.*, 100 parts by weight of crystallised sodium thiosulphate and 50 of ice are mixed with 60 parts by volume of antimony trichloride solution of 116° Tw. (sp. gr. 1·58). The mixture is poured into a strong, boiling solution of sodium sulphate, with agitation, then allowed to settle, and the precipitated pigment washed as usual.—A. de W.

Carbon-black; Process of manufacturing —— [*from natural gas*]. D. F. Zimmers, Altoona, E. N. Jessop, Glassport, W. J. Koenig, Springdale, and J. B. Garner, Assignors to Hope Natural Gas Co., Pittsburgh, Pa. U.S. Pat. 1,307,480, 24.6.19. Appl., 3.4.18.

A CONSTITUENT, lighter than pentane, is separated from natural gas, and is then decomposed by heat at 700°—950° C.—E. W. L.

Phenol-formaldehyde condensation products; Compositions containing ——. G. L. Scott, London. Eng. Pat. 128,477, 23.9.18. (Appl. 15,449/18.)

CALCIUM oxide is added to already-formed phenol-formaldehyde condensation products to the amount of 5%—20% of the weight of the alcoholic solution of the condensation product to facilitate the formation of sound products free from bubbles or blisters. Inorganic and organic filling materials such as clays, asbestos, wood flour, fibrous materials, etc., may also be added, and the solution of the condensation product may be mixed with rubber solution prior to the incorporation of the calcium oxide and the filling materials. The condensation product may alternatively be employed in the form of the powdered gum.—A. de W.

Phenolic condensation products; Process of producing ——. L. V. Redman, Evanston, and A. J. Weith and F. P. Brock, Assignors to Redmanol Chemical Products Co., Chicago, Ill. U.S. Pats. (A) 1,310,087 and (B) 1,310,088, 15.7.19. Appl., 16.9.18.

(A) PHENOLIC condensation products are produced without the use of a condensing agent by boiling together a solution of formaldehyde and an excess of phenolic compound until the former is substantially eliminated from the supernatant aqueous layer and a viscous gummy lower layer is produced. The aqueous layer is discarded and the gummy layer mixed with a solution of formaldehyde in lesser proportion than in the first step, concentrated by heat, poured into moulds, and set below 100° C., then removed from the moulds and finally hardened below 100° C. (B) A condensation product obtained by reaction between a phenolic substance and a substance containing an active methylene group is hardened and rendered practically insoluble and anhydrous by prolonged heat treatment below 100° C., and is then subjected to a temperature above 100° C. for a relatively short period.

—A. de W.

Varnishes containing volatile solvents ["*dopes*"]; *Application of* ——. G. L. Ward, London. Eng. Pat. 128,658, 28.8.17. (Appl. 12,312/17.)

VARNISHES containing volatile solvents, *e.g.*, spirit varnishes and "dopes," are applied by means of a spray the propelling medium of which is compressed air highly charged with the vapour of the volatile solvent used in the varnish in order to prevent or retard evaporation of the solvent during application. The operation of spraying is performed within an enclosed space containing an atmosphere charged with the vapour of the solvent, whilst the drying of the coated article is carried out in another sealed chamber provided with means for exhausting the internal atmosphere and condensing it if desired.—A. de W.

Dopes or varnishes used in aeroplane construction. S. E. Groves, Felling-on-Tyne, and T. W. H. Ward, London. Eng. Pat. 128,659, 28.8.17. (Appl. 12,349/17.)

A NEUTRALISED hygroscopic chloride or mixture of chlorides soluble in the usual organic "dope" solvents, *e.g.*, calcium chloride, zinc chloride, etc., is added to "dope" to an amount equal to about 1% of combined chlorine, to reduce the variability of tautness of the stretched aeroplane fabric to which the dope is applied, to reduce the viscosity of the "dope," and, in the case of celluloid "dopes," to reduce the inflammability of the coated fabric.—A. de W.

Dopes or varnishes for aircraft construction. The British Aeroplane Varnish Co., Ltd., London, and S. E. Groves, Felling-on-Tyne. Eng. Pat. 128,974, 6.9.17. (Appl. 12,807/17.)

AN addition of beeswax and paraffin wax having a total weight about equal to that of the cellulose ester or celluloid in a "dope" is claimed to minimise the variability in the tension of the aircraft fabric to which it is applied, to reduce the rate of evaporation of the solvent, and to improve the resistance to penetration by water.—A. de W.

Resin-recovering process. R. Simpson, Cincinnati, Ohio. U.S. Pat. 1,308,768, 8.7.19. Appl., 25.3.19.

A MASS of resin-bearing chips etc. is supported on a sloping floor in an open fireplace, heat being applied to the under surface of the floor and the exposed surface of the chips etc. ignited at a distance from the lowest portion of the floor. Air is excluded from the bottom of the mass of chips in order to allow of the progressive burning of the chips to melt the resin and cause it to percolate downward through the chips, the melted resin then being removed.—A. de W.

Indurated organic substance [shellac compound] and process of preparing same. W. W. Simonson and L. V. D. Blair, Cincinnati, Ohio, Assignors to The Mantle Lamp Co. of America, Chicago, Ill. U.S. Pat. 1,309,967, 15.7.19. Appl., 1.6.18.

SHELLAC is treated with caustic soda solution to produce a sodium shellac compound, and subjected to the action of a solution of a metal salt to effect substitution of the metal of the salt for the sodium, the precipitate being then heated to complete its induration.—A. de W.

Waterproofing compositions; Process for purifying ——. O. E. Gelertsen, Westfield, N.J., Assignor to Greenfield Paper Bottle Co., New York. U.S. Pat. 1,310,158, 15.7.19. Appl., 5.6.16.

A WATERPROOFING composition comprising resin and hydrocarbon wax or oils is subjected to the action of heated air in the presence of a catalytic agent, *e.g.*, chromium, manganese, or iron, or compounds of the same, until the volatile impurities are removed from the waterproofing compound, the impurities insoluble in the waterproofing compound being then separated.—A. de W.

Flexible waterproof antiseptic and antifouling composition. M. A. Kelly, Hove. Eng. Pat. 129,526, 1.10.19. (Appl. 15,940/18.)

FINELY-GROUND amorphous calcium or magnesium carbonate is hydrated with water or steam to form a stiff paste and then heated with oils, resins, or bitumens until a jelly is formed, the excess of liquid being removed centrifugally. The proportion of hydrated paste used in the composition varies from 15 to 50%, according as the oils used are mineral or vegetable and should be sufficient to neutralise any acidity. For use as an antifouling composition a tar acid insoluble in water which will absorb bromine, *e.g. m*-cresol, is added, whilst for use in damp situations an addition of burnt calcium aluminium silicate is advantageous.
—A. de W.

Lampblack; Manufacture of ——. T. W. S. Hutchins, Middlewich. U.S. Pat. 1,309,070, 8.7.19. Appl., 16.10.18.

SEE Eng. Pat. 124,557 of 1918; this J., 1919, 378 A.

Protecting metal. Eng. Pat. 128,797. *See* X.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Latex and rubber from upper and lower cut. O. de Vries. Comm. Central Rubber Stat. Buitenzorg, 1919, **3**, [13], 124—129.

EXAMINATION of the latex from the upper and lower cut, when tapping with two left cuts on one quarter, shows the latex and rubber derived therefrom to be practically of uniform quality. Even when the tapping surface is nearly finished so that the upper bark forms only a small strip between the already tapped parts no appreciable difference is observed in the latex; factors changing the relative quantities of latex from the upper and lower cut therefore are not likely to cause any variability in the product.
—D. F. T.

Latex and rubber; Influence of a change in tapping surface on ——. O. de Vries. Comm. Central Rubber Stat. Buitenzorg, 1919, **3**, [13], 130—138.

OPENING a tapping cut on trees that have had a rest, or on untapped trees, gives latex with an unusually high rubber content and rubber with a slow rate of cure. Change of tapping surface in ordinary estate routine is, however, not a cause of appreciable variability, but change of tapping surface accompanied by an alteration in the tapping system effects a change in the latex and rubber in the manner described.—D. F. T.

Turgescence [of rubber]. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9845—9852.

THE investigation has been extended to petroleum solvents, carbon tetrachloride, and a mixture of carbon tetrachloride with carbon bisulphide, the same vulcanised rubber being used as in the previous experiments (this J., 1919, 546 A). With petroleum spirit of sp. gr. 0·7447 at 15° C. and initial b.pt. 87° C., the maximum degree of swelling at 10°—11° C. was reached in 72 hours, the value of the "turgescence number" being 273. A "white spirit," of sp. gr. 0·7677, and initial b.pt. 88° C., and of which the major portion distilled at 140° C., gave a "turgescence number" of 296; the maximum swelling was attained in about 100 hours. Examination of the solvent at the end of the experiment showed that approximately 9·7% of the rubber sample had gone into solution. With carbon tetrachloride a greater degree of swelling was observed than with any other single solvent, the "turgescence number" obtained by the gravimetric method of investigation being 508; only 3·3% of the rubber passed into solution. A mixture of carbon bisulphide and carbon tetrachloride in equal volumes, of sp. gr. 1·385, possessed greater swelling power than either of its constituents, its "turgescence number" being 524; approximately 4·6% of the rubber was dissolved by the solvent. In all the experiments quoted the swelling occurred almost entirely in the first 24 hours; the final weight calculated for an initial weight of 100 parts of rubber for the various solvents was "white spirit" 172·5, petroleum spirit 180·0, tetrachloroethane 363·2, carbon tetrachloride 425·1, mixture of carbon tetrachloride and carbon bisulphide 449.—D. F. T.

Vulcanisation accelerators. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9853, 9856—9857, 9858, 9860—9865.

SUGGESTIONS are made as to the probable value of certain substances as accelerators of vulcanisation, the matter being considered particularly from the point of view of the author's theory as to the mode of action of such accelerators (this J., 1917, 296). Amongst the substances mentioned are the salts of

hexamethylenetetramine with nitric acid, dinitrosopentamethylenetetramine, various cobaltammine compounds, guanidine and its derivatives, and certain sulphur dyes.—D. F. T.

PATENT.

Rubber; Process for vulcanising —— with aid of an accelerator. J. F. B. van Hasselt, Rotterdam, Holland. Eng. Pat. 126,606, 14.1.19. (Appl. 1008/19.) Int. Conv., 8.5.18.

DOUBLE compounds of nitrosodimethylaniline with aromatic bases are used as accelerators, and are claimed to be more efficient than either constituent alone. The following are examples of these compounds, which contain 2 mols. of nitrosodimethylaniline combined with, respectively, 1 mol. aniline (m.pt. 93°.C.); 1 mol. dimethylaniline (m.pt. 84° C.); 1 mol. *o*-toluidine (m.pt. 72° C.); 1 mol. diphenylamine (m.pt. 61° C.); 1 mol. *p*-phenylenediamine (m.pt. 121° C.); 1 mol. α-naphthylamine (m.pt. 82° C.). The amount added to the mixing is of the order 0·25—0·5%.—E. W. L.

XV.—LEATHER; BONE; HORN; GLUE.

Tannin of the Canadian hemlock (Tsuga Canadensis, Carr). R. J. Manning and M. Nierenstein. Chem. Soc. Trans., 1919, 115, 662–673.

HEMLOCK tannin was prepared by extraction of hemlock bark with acetone, concentration of the extract in a vacuum, precipitation of the phlobaphens by repeated dilution with water and concentration in a vacuum and finally fractional precipitation of the acetone solution of crude tannin with chloroform. The fractions showed considerable variation in composition and gave bromo-derivatives containing from 40 to 49% Br. Hydrolysis of the purified tannin by alcoholic barium hydroxide gave protocatechuic acid, 2,3-dihydroxybenzoic acid, and an aldehyde, $C_{10}H_8O_3$. With diazomethane an amorphous methylated derivative of indefinite melting point was produced which on hydrolysis with alcoholic potassium hydroxide gave vanillic acid, and an insoluble acid which on oxidation gave hemipinic acid, and on hydrolysis opianic acid, suggesting the presence of a noroplanic acid complex in the original tannin.—G. F. M.

PATENTS.

Tanning, liming and like operations on hides and skins. R. Kay and G. A. Platt, Warrington. Eng. Pat. 128,339. (Appls. 7694, 8.5.18 and 18,305, 8.11.18.)

TANNING, liming and the like liquors are circulated in an upward direction, through a pit or series of pits, in which the hides or skins are suspended, and are strengthened on the completion of each cycle by passage through a leaching vat containing (solid) tanning extract, lime, or other active material, before beginning a fresh cycle. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 1456 of 1882, 5700 of 1893, 27,573 of 1909, and 6796 of 1911; this J., 1894, 701; 1910, 1400; 1912, 82.)
—E. W. L.

Hides or skins; Liming ——. C. M. Owen, Warrington, Lancs. Eng. Pat. 128,451, 31.7.18. (Appl. 12,445/18.)

PADDLES arranged on horizontal shafts fixed at the bottom of a lime-pit, and put into vibratory motion by means of a vertical arm down one side of the pit, through a bell-crank lever, drive the lime liquor against stationary division boards fixed parallel to and above the shaft, and thus effect a vertical displacement of the liquors through the suspended hides.—E. W. L.

XVI.—SOILS; FERTILISERS.

Soil; Influence of the kind of —— and of manuring on the nitrogen and ash constituents of cultivated plants. J. G. Maschhaupt. Verslagen van Landbouwkundige Onderzoekingen der Rijkslandbouwproefstat., 1918, 1—94. Chem. Zentr., 1919, 90, I., 313—314.

DURING the years 1909-16, five soils were manured with sodium nitrate, potassium nitrate, and ammonium sulphate. Determinations of the nitrogenous and ash constituents of the crops were made. It was found that potassium nitrate gave a smaller increase than sodium nitrate. The influence of the kind of soil upon the nitrogen and ash was greater with potato haulms and turnip tops than with the tubers and roots, and greater with corn straw than with the grain itself, and it was greatest upon the silica content, especially in the straw on clay soils. The increase of silica was not accompanied by any increase of bases. The nitrogen, phosphate, potash, and lime showed important increases in potato haulms and turnip tops, especially the potash in potato haulms. The nature of the nitrogenous fertiliser used had no marked influence upon the nitrogen and ash, except in the case of turnips in which the potash content was raised by the use of potassium nitrate, and the soda content by sodium nitrate. In most cases the increase in acid constituents was more marked than in basic constituents.—J. H. J.

Blast-furnace dust; Value of —— as a potash manure: Report on field trials. J. Bd. Agric., 1919, 26, 387–396.

A REPORT on field trials at sixteen centres with different grades of blast-furnace dust. Low-, medium-, and high-grade dusts, water-extracted dust, and medium-grade dust applied at later dates were compared with German sulphate of potash, as potash manures for potatoes and mangolds. The results are not conclusive as several centres failed to show any response with any of the fertilisers. Considering only the centres where positive results were obtained, the extracted and high-grade dusts gave the best results, being followed closely by the medium-grade dust and sulphate of potash. The low-grade dust and the later applications of the medium-grade did not give good results. No explanation is forthcoming as to why the extracted dust from which all the water-soluble potash had been removed should give such high results.—W. G.

Phosphates in basic slag; Effect of fluorspar additions on the ——. Part I. Manurial value of basic slag containing fluorspar. F. Bainbridge. Iron and Steel Inst., Carnegie Scholarship Memoirs, 1919. [Advance copy.] 8 pages.

IN order to determine the manurial value of basic slag containing fluorspar a series of pot experiments was made on the growth of barley in soil treated with a citric-insoluble slag and in soil treated with a soluble slag. The insoluble slag was prepared by adding fluorspar to a soluble slag in a basic open-hearth furnace. The percentage of soluble phosphate in the slag without added fluorspar was 10·5, and in the slag with fluorspar 0·874. Other necessary plant foods were added to the pots. A third series of pots in which no slag was added was also

employed. The barley seeds were planted at the beginning of April and the crop gathered at the end of August. In the untreated soil no barley heads had grown, in the soil treated with insoluble slag the length of straw was greatest, and in the soil with soluble slag the yield of grain was greatest. The total phosphate in the crop with insoluble slag was 0·85 grm. and in the crop with soluble slag 3·446 grms. The conclusions drawn are that when a basic slag containing fluorspar is applied to soil just before the seed is sown, the crop is not so good as when a soluble slag is employed; that nevertheless a basic slag with fluorspar has considerable fertilising value; and that the phosphate content of the grain and straw of a barley crop is much greater on a soil treated with a soluble slag than on one treated with an insoluble slag.—J. H. J.

PATENTS.

Fertilising method and material. W. O. Snelling, Allentown, Pa. U.S. Pat. 1,308,453, 1.7.19. Appl., 23.7.18.

AN explosive is prepared from a substance which also possesses soil fertilising properties and which is present in larger amount than is necessary to bring about explosion merely.—J. H. J.

Phosphate fertiliser; Manufacture of ——. A. Henwood, Cynwood, Pa. U.S. Pat. 1,310,080, 15.7.19. Appl., 11.12.17.

FINELY-GROUND phosphate rock and ground acid sulphate are sifted together in the presence of a proportion of finely-divided water just about sufficient to hydrate the calcium sulphate.—A. de W.

Superphosphate dens; Cutting device for emptying ——. G. Dittmann, Hildesheim. Ger. Pat. 311,637, 7.3.17.

A BAND cutter, approximately U-shaped in cross-section and wound upon a horizontal rotary drum, serves to detach the superphosphate and convey it away and deliver it through openings in the wall of the drum to a discharge shoot. The cutter may be inclined on both sides, so that the detached superphosphate is delivered simultaneously in opposite directions.

Fertiliser composition and process of making same. G. H. Earp-Thomas, Richmond, Va. Reissue 14,686, 15.7.19, of U.S. Pat. 1,212,196, 16.1.17. Appl., 4.4.17.

SEE this J., 1917, 397. The mixture is subjected to the action of selected nitro-bacteria, beneficial to soil.

Fat from bones etc. Eng. Pat. 128,397. *See* XII.

XVII.—SUGARS; STARCHES; GUMS.

Dry substance; Determination of the true —— of sugar products, using solution factors. J. P. Ogilvie and J. H. Lindfield. Intern. Sugar J., 1919, **21**, 398—400.

IT has been pointed out by Muller (Bull. Assoc. [illegible]. Sucr., **35**, 195—198) and others that in cane [illegible] any particular area working under the factories [illegible]ions there exists a reasonably constant same condit[illegible] between the so-called "true" dry substance as [illegible] found by the desiccation method and the "apparent [illegible]r. In order, therefore, to reduce Brix hydromet[illegible] e time required in desiccation, it is the considerabl[illegible] proposed that solution factors appropriate to the several products should be employed. In practice, these would be established by ascertaining at tropical laboratory temperatures, the sp. gr. of solutions of average samples of juice, syrup, massecuite, and molasses, containing exactly 10 grms. in 100 c.c. of actual dry substance according to the desiccation process. In any particular class of product the mutual proportions of sucrose, reducing sugars, organic non-sugars, and mineral matter controlling the factor do not vary throughout the season to any extent sufficient to disturb it, excepting sometimes in the case of molasses, in which the ash should be determined at intervals as a precaution.—J. P. O.

Ammonium carbonate; Presence of —— in evaporator condensed water [of cane sugar factories]. T. van der Linden. Archief Suikerind. Nederl.-Indië, 1919, **27**, 811—846. Intern. Sugar J., 1919, **21**, 351.

IN the water condensed from the vapours of a multiple-effect evaporator in a cane sugar factory in Java the author has found ammonia, the presence of which is due to the decomposition of proteins, principally amino-acids and acid amides, during boiling. Its quantity was considerably less than that generally occurring in the beet sugar factory, in which it is evolved at every stage of the heating process. Carbon dioxide was also present, probably as the result of the reaction taking place between reducing sugars and amino-acids pointed out by Maillard (Intern. Sugar J., 1914, 184, 230), while dark coloured substances are formed at the same time. It was also possible to identify ethyl alcohol and acetaldehyde. (*Cf.* also Jentink, this J., 1918, 317 A.)—J. P. O.

Decolorising carbon; Experiments on the revivification of —— ("*Carboraffin*"). V. Stanek. Zelts. Zuckerind. Böhm., 1919, **42**, 331—339. Intern. Sugar J., 1919, **21**, 342—344.

AFTER washing the exhausted decolorising carbon with water, it is boiled for half an hour with sodium hydroxide solution (5—10%), filtered, again washed with water, heated with sodium hydroxide solution (10—20%) in an autoclave at 130°—150° C. for one hour, filtered, and washed successively with water, dilute hydrochloric acid, and water, any traces of acid remaining being finally neutralised with sodium hydroxide. Using this process (which has been patented by the Verein der Zuckerindustrie in Böhmen), laboratory experiments showed that after revivifying six times the decolorising value had decreased only 6 % of its original value, while the rate of filtration had even somewhat increased. Tests made on a larger scale with an apparatus which could be used either as an autoclave or as a filter (using a layer of asbestos) indicated no decrease in the decolorising power after revivifying four times. An area of 1 sq. metre sufficed to filter about 140 kilos. in 9 hours, but about 38 hectolitres of water was required for washing 100 kilos. of the carbon.

—J. P. O.

Maltose; Constitution of ——. *New example of degradation in the sugar group.* J. C. Irvine and J. S. Dick. Chem. Soc. Trans., 1919, **115**, 593—602.

IN an attempt to establish the constitution of maltose by complete methylation, followed by hydrolysis of the heptamethyl methylglucoside to tetramethyl- and trimethyl-glucose, it was found that degradation of the maltose molecule to derivatives of a sugar containing eleven carbon atoms in the

chain had occurred at some stage of the reactions, so that whilst crystalline tetramethylglucose was isolated from the product and identified, the other part of the maltose molecule appeared as a viscous syrup possessing the composition of a dimethylpentose. The degradation probably occurred in the decomposition of the maltose octa-acetate by hydrogen iodide.—G. F. M.

Starch substitutes. Winter. *See* VI.

Starches. Sherman and others. *See* XVIII.

PATENTS.

Filtering mediums; Method of manufacturing carbonaceous ——. M. Weinrich, Yonkers, N.Y. U.S. Pat. 1,308,826, 8.7.19. Appl., 21.6.18.

SOLUTIONS containing sucrose or glucose or both are mixed with lime in such proportions and at such temperatures that a hard mass is obtained by chemical combination. The mass is comminuted, calcined, and cooled.—W. F. F.

Sugar; Treatment or preparation of ——. E. Shaw and G. S. Baker, London. U.S. Pat. 1,309,425, 8.7.19. Appl., 16.3.15.

SEE Eng. Pat. 2851 of 1915; this J., 1916, 432.

Sulphide dye from filter-cakes of sugar-juice. U.S. Pat. 1,308,552. *See* IV.

Wax from sugar-cane. U.S. Pat. 1,309,999. *See* XII.

XVIII.—FERMENTATION INDUSTRIES.

Starches of different origin; Action of enzymes on ——. H. C. Sherman, F. Walker, and M. Caldwell. J. Amer. Chem. Soc., 1919, **41**, 1123—1129.

WHEN similarly purified by washing with very dilute alkali and/or ether, wheat, maize, and rice starches show the same digestibility in the sense that under the action of the same kind and amount of amylase they are all transformed into reducing sugar at essentially the same rate. The amylase preparations employed included saliva, pancreatin, purified pancreatic amylase, malt extract, purified malt amylase, taka-diastase, and purified amylase of *Aspergillus oryzæ*. As obtained by washing with water only, potato starch is almost pure, but the cereal starches, especially maize starch, appear to contain sufficient amounts of fatty or waxy matter to interfere appreciably with the action of the enzymes even after the starch has been gelatinised by boiling in water for three minutes. Potato starch, even if only water washed, showed in general a rate of enzymic hydrolysis equal to, or slightly greater than that of the alkali-washed cereal starches with the sole exception of the case where both starch and enzyme were employed in a highly purified condition, and even here the tendency to a lower rate of hydrolysis is corrected by suitable additions to the digestion mixture.
—G. F. M.

Refractometer; Use of the —— in analysis of alcohol-water mixtures. O. Faust. Z. anal. Chem., 1919, **58**, 145—148.

THE amount of alcohol in a mixture of alcohol and water may be determined from the refractive index of the mixture; not more than 40% of alcohol should be present, since the maximum refraction is shown by a mixture containing about 80% of alcohol. Between 50 and 100% alcohol there are always two mixtures having the same refraction.—W. P. S.

Garbage. U.S. Pats. 1,307,991—2. *See* XIXB.

XIXA.—FOODS.

Methylguanidine in meat; Supposed occurrence of ——, with observations on the oxidation of creatine by mercuric acetate. I. Greenwald. J. Amer. Chem. Soc., 1919, **41**, 1109—1115.

PRECIPITATION with mercuric salts is not suitable for the isolation of methylguanidine, as they not only do not completely precipitate this substance, but they also oxidise creatine to methylguanidine and incidentally oxalic acid and methylguanido-glyoxylic acid, and hence the isolation of methylguanidine from meat by this method is entirely accounted for by this fact. Using a modification of Brieger's long and elaborate phosphotungstic acid method for the isolation of methylguanidine with specimens of meat 3—4 days old, negative results were obtained, and this substance can therefore scarcely be regarded as playing an important part in the mechanism of "meat poisoning."—G. F. M.

Sterilisation; Temperature-time relations in canned foods during ——. G. E. Thompson. J. Ind. Eng. Chem., 1919, **11**, 657—664.

THE author has determined, by means of thermo-couples embedded in the centre of tins of food, the time-temperature curves when the tins were subjected to various temperatures in hot water, steam, cool air, and cool water. Graphs and formulæ are given by means of which the temperature at the centre of a tin of food can be ascertained approximately at any time after the tin has been immersed in the sterilising bath.—W. P. S.

Food [meat]; Method of preserving ——. K. G. Falk and E. M. Frankel, Assignors to W. G. Lyle, New York. U.S. Pat. 1,309,357, 8.7.19. Appl., 30.1.18.

PIECES of meat, free from bone, excess of fat, etc. are heated at 60° C. under reduced pressure until the moisture has been removed.—W. P. S.

Margarine; Determination of the water content of ——. M. Monhaupt. Chem.-Zeit., 1919, **43**, 385—386.

THE addition of about 0·03 grm. of sodium bicarbonate to the 10 grms. of margarine taken for the determination of the water causes the water to boil off smoothly when the sample is heated and there is no danger of loss by spirting.—W. P. S.

[Silk] fibroin; Destructive distillation of ——. *Researches on proteins. VI.* T. B. Johnson and P. G. Daschavsky. J. Amer. Chem. Soc., 1919, **41**, 1147—1149.

WHEN distilled in a vacuum (25—27 mm.) silk fibroin gave about 43% of its weight of a red oily distillate, 41% of "silk carbon," and 16% of volatile and gaseous products. From the red oil, which is strongly ammoniacal, and contains a large proportion of water, phenol has been isolated and definitely identified. It probably originates from the degradation of tyrosine.—G. F. M.

Food substances; Organic —— with specific action. E. Abderhalden and H. Schaumann. Pflüg. Arch., 1918, **172**, 1—274. Chem. Zentr., 1919, **90**, I., 566—568.

A LONG paper dealing with the so-called anti-beriberi vitamine. Attempts to isolate the curative principle from yeast are described. The authors distinguish two types of substance which play a rôle in the curative process; these they term "eutonines" and "nutramines." A new base was isolated from hydrolysed yeast. It is termed aschamine and has the constitution of a dimethylpropenylamine.—J. C. D.

Vitamines; Note on ——. A suet emulsion for infant feeding. C. H. Hampshire and G. E. G. Hawker. Pharm. J., 1919, **103**, 82.

A BEEF suet emulsion containing a small quantity of olive, or preferably arachis oil is recommended in place of a linseed oil emulsion hitherto used as a substitute for cream, as it contains the essential anti-rachitic vitamine, "fat soluble A," which is not present in linseed oil.—G. F. M.

PATENTS.

Bread making. V. Fano, Ferrara, Italy. Eng. Pat. 123,535, 17.2.19. (Appl. 3937/19.) Int. Conv., 15.2.18.

CORN is scoured and skinned from the periphery to the endosperm, and the resulting flour is sifted in order to remove the cellulose. As this flour contains all the nitrogenous constituents of the grain, it is used for cultivation of the yeast required for the subsequent bread-making process. The stripped grain is hydrated by mixing with water in a vacuum. Warm water is then added and a pressure of 3—4 atmospheres is produced and maintained in the containing chamber. The product is passed to a kneading machine for conversion into dough.

—J. H. J.

Emulsifying agent; Process for obtaining an —— especially intended for use in the manufacture of margarine. P. C. Rushen, London. From Naaml. Vennoots. A. Jurgens Vereen. Fabr., Oss, Netherlands. Eng. Pat. 129,165, 3.9.18. (Appl. 14,329/18.)

CASEIN prepared from skimmed milk is dried, finely ground, and extracted with methyl or ethyl alcohol, or with a mixture of the two. The extract is concentrated by evaporation to the consistence of a syrup. The product obtained forms an especially good emulsifying agent for use in manufacturing margarine.—J. H. J.

Solids; Process for obtaining the —— from liquids [e.g., for preparing milk powder]. O. E. Merrell, Assignor to Merrell-Soule Co., Syracuse, N.Y. Reissue 14,693, 22.7.19, of U.S. Pat. 1,136,356, 20.4.15. Appl., 16.2.16.

SEE this J., 1915, 602. The process is applied to concentrated milk for the production of desiccated milk powder.

Milk; Apparatus for producing dried ——. C. H. Campbell, Assignor to Borden's Condensed Milk Co., New York. U.S. Pat. 1,292,577, 28.1.19. Appl., 11.4.17.

AN apparatus for treating milk consists of a long tank divided into compartments by partitions, each containing a variable opening situated between the top and bottom. Concentrated milk is caused to pass through the compartments in succession, and means are provided for injecting air into the compartments and for stirring their contents. The aerated mass thus obtained is in suitable condition for rapidly and uniformly drying to powder.

—J. H. J.

Food product and its method of manufacture. R. Douglas, Assignor to Douglas Packing Co., Rochester, N.Y. U.S. Pat. 1,304,166, 20.5.19. Appl., 14.8.13.

SEE Fr. Pat. 462,045 of 1913; this J., 1914, 215.

XIXB.—WATER PURIFICATION; SANITATION.

Barium sulphate; Precipitation and filtration of —— in water analysis. V. Froboese. Chem.-Zeit., 1919, **43**, 367.

FROM 200 to 300 c.c. of the water is neutralised with *N*/10 hydrochloric acid, using methyl orange as indicator, 2·5 c.c. of the acid is added in excess, the solution boiled, and treated with a very slight excess of barium chloride solution, added drop by drop. After cooling, the precipitate is washed by decantation, and then collected on a filter.

—W. P. S.

Chlorine in water; Influence of carbonate hardness upon the determination of ——. W. Herbig. Z. angew. Chem., 1919, **32**, 216.

A STANDARD solution of lime was saturated with carbon dioxide and titrated with sulphuric acid in presence of phenolphthalein. By using various dilutions of the standard solution it was found that the amount of calcium carbonate could be accurately determined by this method. Two solutions were then prepared of 6·57° and 26·26° carbonate hardness and to each was added sodium chloride equivalent to 0·1758 grm. Cl per litre. The chlorine in these two solutions was determined by titration with silver nitrate directly and also after first neutralising the carbonate hardness with sulphuric acid. The results of direct titration were from 0·0031 to 0·0038 grm. chlorine per litre higher than after neutralisation. This amount is considered to be too small to affect technical water analysis, and therefore there is no need to remove the carbonate hardness before determining the chlorine.—J. H. J.

Gas masks; Protection afforded by —— against various industrial gases. A. C. Fieldner, M. C. Teague, and J. H. Yoe. J. Ind. Eng. Chem., 1919, **11**, 622—623.

MASKS containing the standard army filling (charcoal, 60, soda-lime, 40) afford protection against chlorine, phosgene, tin tetrachloride, silicon tetrachloride, titanium tetrachloride, arsenic trichloride, xylyl and benzyl bromides, chloroacetone, bromoacetone, chloropicrin, dimethyl sulphate, perchloromethylchloroformate, and nitrogen peroxide. An all-charcoal filling is recommended for gasoline vapour, carbon bisulphide, carbon tetrachloride, cyanogen bromide, and similar vapours, whilst a soda-lime filling may be used for protection against sulphur dioxide, carbon dioxide, hydrocyanic acid, hydrogen sulphide, hydrogen chloride, and other acid gases. Cottonwool filters are also required when the gases contain solid particles. Ammonia, carbon monoxide, coal gas, etc. are not removed by the above-mentioned fillings.

—W. P. S.

Benzoic acid as a disinfectant. H. P. Kaufmann. Z. angew. Chem., 1919, **32**, 199—200.

IN a study of the bactericidal power of benzoic acid due regard must be had to possible neutrali-

sation or precipitation of the acid by alkalis or albumin in the medium under examination, and only that remaining uncombined taken into account. In a sugar-peptone-Liebig's extract bouillon sterility was produced with *Staphylococcus* by a concentration of 0·08% of benzoic acid in 5—6 days, and by 0·23% in 24 hours, whilst with diphtheria bacilli in a sugar-horseflesh bouillon 0·14% caused sterility in 10 hours and 0·04% in 5 days. Still lower concentrations of benzoic acid vapours in steam or even in water vapour at temperatures as low as 37° C. showed powerful bactericidal action comparable with that of phenol under similar conditions. The volatility of benzoic acid with water vapour from boiling aqueous solutions of 1, 2·5, and 5% concentrations was determined in this connection and a percentage of acid in the distillate, increasing as distillation proceeded, from 0·25 to about 1·0% was found.—G. F. M.

Gas from sewage sludge. Hönig. *See* IIA.

Radioactive bricks. Knollman. *See* VIII.

PATENTS.

Measuring and mixing liquids; Apparatus for —— [in water softening]. A. E. Smith, Matlock. Eng. Pat. 128,370, 15.6.18. (Appl. 9876/18.)

A TANK is divided into a large and a small compartment with a connecting pipe from the upper part of the large to the lower part of the small compartment. The reagents for softening are supplied in a concentrated solution to the small compartment, the supply being regulated by a float operated by the rise of the water to be treated in the large compartment. When the large compartment is full, water flows from it to the small compartment, thus diluting the reagents to the required strength. When both compartments are full, a siphon in the large compartment, connected by a suction pipe with the small compartment, comes into action and the contents of both tanks are emptied into a precipitation tank below. The siphon delivers into a series of pipes with perforations along the bottom of the tank. The issue of liquid from the perforations causes a stirring up of the precipitate from a previous treatment which mixes with the new precipitate and causes it to settle rapidly.—J. H. J.

Water; Impregnation of —— with radium emanation. D. H. Kabakjian, Lansdowne, Pa. U.S. Pat. 1,309,139, 8.7.19. Appl., 16.5.18.

RADIUM is placed in a carrier, made of material impervious to liquids and gases, which is immersed, in a vertical position, in a vessel containing the water to be treated. Inverted cup-shaped vessels surrounding the carrier act as air seals, enabling the emanation to diffuse into the water.

—J. H. J.

Garbage and the like; Method of extracting values from ——. R. Wells, Homer, N.Y., Assignor to Cobwell Corporation, Cleveland, Ohio. U.S. Pats. (A) 1,307,991 and (B) 1,307,992, 24.6.19. Appl., (A) 13.11.16, (B) 2.1.18.

(A) GARBAGE containing starch, sugar, and gum as well as oil, grease, and fat is boiled for several hours, cooled to 140° F. (60° C.), mixed with malt infusion, and further cooled to 90° F. (32° C.). Yeast is added, which ferments the carbohydrates into alcohol. A solvent for fat, non-miscible with water, is added, and the temperature raised to the boiling point of the mixture, whereby water, alcohol, and the solvent are evaporated, the loss of solvent being replaced from time to time. Afterwards the solvent is separated from the residue. (B) After fermentation with yeast, the mixture is heated to drive off alcohol and hot water is added to float the oil, grease, and fat, which are then run off. The residue is heated and stirred until the water is driven off.—J. H. J.

Sewage or contaminated liquid; Process for the complete treatment of ——. L. Linden, Assignor to W. J. Stewart, London. U.S. Pat. 1,307,086, 24.6.19. Appl., 5.9.18.

SEE Eng. Pat. 127,353 of 1917; this J., 1919, 552 A.

Mine-water. U.S. Pats. 1,310,382—4. *See* VII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Strophanthus Kombé seeds; Experimental study of ——. K. Samaan. Pharm. J., 1919, **103**, 66—67.

THE oil of strophanthus seeds isolated by dry petroleum spirit is physiologically inactive, as is also the ethereal extract of the residual de-fatted seeds. The activity of the seeds is due entirely to a water-soluble glucoside or glucosides, and no other active principle was removed by any of the other solvents employed—absolute alcohol, amyl alcohol, methyl alcohol, and chloroform. Of these solvents only water and methyl alcohol completely removed the active principle from the seeds, whilst chloroform proved a very poor solvent. For the preparation of tincture of strophanthus 65% alcohol is to be preferred, as with higher strengths the removal of the strophanthin is slow and incomplete, and with lower strengths the keeping properties of the tincture are impaired. The resulting tincture should be standardised both chemically and physiologically. Of the chemical methods of assay Fromme's 1910 method and Lampart and Mueller's method (this J., 1914, 216) agree most closely with the physiological standardisation, but with the seeds themselves percolation with 65% alcohol instead of absolute alcohol is necessary for complete exhaustion. A new qualitative test for strophanthin and other active principles of a reducing character is an intense blue colour given with sulphuric acid (2 drops) and ammonium molybdate (0·1 grm.).—G. F. M.

Cryptopine. Part II. W. H. Perkin, jun. Chem. Soc. Trans., 1919, **115**, 713—790. (See this J., 1916, 1177.)

A DETAILED study of the reduction products of anhydrocryptopine methosulphate, cryptopine methochloride, isocryptopine chloride, ψ-cryptopine chloride, and isoanhydrocryptopine. In most cases different products were obtained by reduction in acid and in alkaline solution with sodium amalgam and frequently reduction was accompanied by disruption of one or other of the isoquinoline rings or of the ten-membered ring characteristic of cryptopine. In the case of ψ-cryptopine chloride and dihydromethylisoanhydrocryptopine methosulphate a remarkable decomposition resulting in the elimination of a nitrogen atom in the reduction with sodium amalgam at ordinary temperatures was observed.—G. F. M.

Cytisoline; Synthesis of ——. E. Späth. Monatsh., 1919, **40**, 93—128.

THE synthesis of 2-hydroxy-6.8-dimethylquinoline from 6.8-dimethylquinoline through the additive

compound with methyl sulphate, 2-keto-1.6.8-trimethyl-1.2-dihydroquinoline, 2-chloro-6.8-dimethylquinoline, and 2-methoxy-6.8-dimethylquinoline is described; the substance is proved to be identical with Freund's cytisoline. In the same way 2-hydroxy-6-methylquinoline, m.pt. 232°—233° C., and 2-hydroxy-8-methylquinoline, m.pt. 219°—220° C., have been prepared from 6-methyl- and 8-methyl-quinoline respectively, whilst 4-hydroxy-6.8-dimethylquinoline, m.pt. 221° C., has been synthesised from *m*-4-xylidine. (See also J. Chem. Soc., Sept., 1919.)—C. S.

Tropic acids; The isomeric ——. A. McKenzie and J. K. Wood. Chem. Soc. Trans., 1919, **115**, 828—840.

A CONVENIENT and more practical method than those hitherto published for the synthesis of tropic acid starts from atrolactinic acid which may be obtained in 73% yield from acetophenone through its cyanohydrin by the usual methods.

$$C_6H_5.CO.CH_3 \rightarrow C_6H_5(CH_3)C(OH)CN \rightarrow C_6H_5(CH_2)C(OH)CO_2H.$$

On distillation under diminished pressure atrolactinic acid gives a 72% yield of atropic acid which on treatment with dry hydrogen chloride in ethereal solution is converted into *β*-chlorohydratropic acid. The substance on boiling with aqueous sodium carbonate gives tropic acid in 70% yield.

$$C_6H_5(CH_3)C(OH)CO_2H \rightarrow CH_2 : C(C_6H_5).CO_2H \rightarrow CH_2Cl.CH(C_6H_5).CO_2H \rightarrow CH_2OH.CH(C_6H_5).CO_2H.$$

r-Tropic acid thus obtained melts at 116°—117° C. By means of the quinine salt the *d*-acid was obtained in lustrous needles, m.pt. 128°—129° C., and $[\alpha]_D^{16} = +72{\cdot}2°$ in ethyl alcoholic solution (c=2·695). The *l*-acid obtained by means of morphine had m.pt. 128°—129° C., $[\alpha]_D^{13} = -72{\cdot}5°$ for c=2·578 in alcohol, and $[\alpha]_D^{15} = -79°$ for c=1·538 in aqueous solution.—G. F. M.

Digitalis preparations; Standardisation of ——. E. Berry. Pharm. J., 1919, **103**, 69—71.

A SATISFACTORY standardisation of digitalis preparations combines the colorimetric estimation of water-soluble and total glucosides, with a perfusion experiment on a male frog. In the first colorimetric estimation digitoxin and saponin are eliminated by removing alcohol from the tincture, precipitating extraneous matter with lead acetate, filtering through kieselguhr plates in Buchner funnels, removing excess of lead by addition of sodium phosphate, evaporating the filtered solution with addition of chalk, and purifying the residue by solution in methyl alcohol and chloroform. The final residue, equivalent to 7·5 c.c. of the original tincture, is dissolved in 3 c.c. of glacial acetic acid, 0·2 c.c. mixed with 2 c.c. of Frohde's reagent, and the colour produced in 15 mins. compared with a colour chart which gives the equivalent M.L.D. (minimum lethal dose) value, and the relative strength "A" compared with a standard tincture (M.L.D. by injection=0·75) as unity. In the second colorimetric estimation an alcoholic strength of 70% is maintained throughout in order to keep all the glucosides in solution, and filtration through kieselguhr is omitted, otherwise the procedure is the same as above, and a second value "B" is obtained from the colour chart. The difference B−A is the toxic value, and A is the therapeutic value of the tincture; toxicity of different preparations is compared by the ratio (B−A)/A. In the perfusion experiment the number of drops of Ringer's solution containing 1% of tincture required per 100 grms. of frog to stop the heart is determined and the M.L.D. obtained from the graph.—G. F. M.

Digitalis leaf extracts; Stability of ——. J. M. Schmidt and F. W. Heyl. Amer. J. Pharm., 1919, **91**, 425—436.

ALCOHOLIC extracts of digitalis leaves gradually lose activity until after 12—18 months an equilibrium of somewhat marked stability is reached at a point representing about 40% of the initial activity, and this seems to indicate that the leaf contains a stable, and a second active, but unstable constituent, which may be digitoxin and the so-called digitalein respectively. A similar but slower loss of activity occurs in the leaves themselves, and extracts made from older drug reach an equilibrium of greater activity compared with the initial activity (about 70%) than extracts from the fresh leaves.—G. F. M.

Cytisine; Constitution of ——. E. Späth. Monatsh. Chem., 1919, **40**, 15—33.

PREVIOUS work on the constitution of cytisine is reviewed and the possible formulæ discussed. (See J. Chem. Soc., Sept., 1919.)—T. H. P.

Aromatic ketones related to zingerone; Comparative study of the pungency of synthetic ——. L. K. Pearson. Pharm. J., 1919, **103**, 78—80.

COMPARATIVE data as to the pungency of a number of substituted styryl methyl ketones and their reduction products were obtained by dissolving 0·1 grm. in 10 c.c. of alcohol and continuing the dilution with aqueous alcohol until the pungency became imperceptible. The most pungent substance investigated was *o*-hydroxystyryl methyl ketone, which at a dilution of 1 : 100,000 was still appreciably pungent. The corresponding saturated compound in this as in all other cases was much less pungent. An increase in the weight of the side chain increased to a decided degree the pungency of the compound; thus 4-hydroxy-3-methoxystyryl phenyl ketone is more pungent than the corresponding ethyl ketone, and the latter more than the methyl ketone. Further the replacement of the 3-hydroxyl-4-methoxyl groups in the above compounds by the dioxymethylene group increases the pungency to a notable extent. The presence of a free phenolic hydroxyl group is therefore not essential to pungency.—G. F. M.

Capsaicin, the pungent principle of capsicum; Constitution of ——. E. K. Nelson. J. Amer. Chem. Soc., 1919, **41**, 1115—1121.

METHYLCAPSAICIN was prepared by the action of dimethyl sulphate on capsaicin, and from the products of its oxidation with alkaline permanganate veratric acid was isolated. Hydrolysis with hydrochloric acid in 50% methyl alcoholic solution at 125° C. gave veratrylamine hydrochloride and the ester of a volatile acid, whilst the similar hydrolysis of capsaicin itself yielded vanillylamine (3-hydroxy-4-methoxybenzylamine), m.pt. 132°—133° C., identical with the base obtained by the reduction of vanillin-oxime. Alkaline hydrolysis of capsaicin at 180° C. gave the decomposition products of vanillylamine together with the salt of an unsaturated acid, $C_{10}H_{18}O_2$, which was almost insoluble in water, boiled at 258°—261° C., gave an amide, m.pt. 96°—97° C., and with hydrogen a decylic acid, m.pt. 24°—25° C., which was not identical with capric acid. Capsaicin is therefore a condensation product of vanillylamine and a decylenic acid and is represented by the formula, $CH_3O(HO).C_6H_3.CH_2.NH.COC_9H_{17}$.—G. F. M.

Diacetonamine; Preparation of ——. A. E. Everest. Chem. Soc. Trans., 1919, 115, 588—592.

Dry ammonia is passed into a mixture of 1160 grms. of acetone and 200 grms. of anhydrous calcium chloride under a reflux condenser until 200 grms. has been absorbed, and the solution is allowed to stand for 8—9 days. The lower layer of aqueous calcium chloride is then removed, and the upper layer, after volatilisation of as much ammonia as possible by a current of air, is treated with sufficient alcoholic oxalic acid to form the hydrogen oxalate. The mixture is then distilled to 75° C. to remove unchanged acetone, and filtered hot. From the filtrate diacetonamine hydrogen oxalate separates in crystals, and a further quantity can be obtained by evaporation of the mother liquors and further extraction of the precipitated ammonium hydrogen oxalate, giving a total yield of about 800 grms. Pure diacetonamine hydrogen oxalate melts at 126°—127° C. to a clear liquid. The presence of the ammonium salt slightly lowers the melting point, and produces an opalescence in the resulting liquid. Vinyldiacetonamine oxalate melts sharply at 184°—185° C.—G. F. M.

Valerianates; Examination of ——. H. D. Richmond and W. T. T. Ainsworth. Pharm. J., 1919, 103, 83.

Valeric acid in valerianates is estimated by distilling over 90% of an aqueous solution containing sodium bisulphate, and titrating the acid in the distillate. One five-hundredth of a grm.-molecule is taken with 25 c.c. of *N*/10 sulphuric acid in the case of the sodium, potassium, or lithium salts, or 35 c.c. of *N*/10 acid and 10 c.c. of *N*/10 sodium hydroxide in the case of the zinc, quinine, etc. salts; the solution is made up to 100 c.c., and 90 c.c. is distilled, when essentially the whole of the volatile acid present will have passed over. Menthyl valerianate requires preliminary hydrolysis with alcoholic potassium hydroxide and after extracting the menthol by means of chloroform, the aqueous solution is acidified to such an extent as to convert the potassium into the bisulphate and distilled as described above.—G. F. M.

Ether; Purified —— and the variations in commercial samples. A. J. Jones. Pharm. J., 1919, 103, 71—73.

All commercial samples of purified ether, including those made from pure ethyl alcohol, give positive results, varying from 0·02—0·08%, for methyl compounds, or compounds which under the conditions of the B.P. test are oxidised to formaldehyde, and it is suggested that comparison against a given standard with a limit of 0·05% would be preferable to the Pharmacopœia requirement of a negative reaction. In performing the test freshly prepared Schiff reagent must be used, and after adding it to the distillates from the ether extract and the standard methyl alcohol comparison tests, the mixtures are warmed to about 45° C. in order to destroy a confusing bluish-violet coloration always produced with a sensitive reagent. In ether which had been kept for 12 months a distinct reaction for formaldehyde was given by the gallic acid ring test, and ketones varying from 0·18 to 5·0 parts per 10,000 were found in all the samples examined, the method employed being the Scott-Wilson precipitation process with an alkaline silver mercuric cyanide reagent (J. Physiol., 1911, 42, 444).
—G. F. M.

Tetrachloroethylene; Preparation of ——. H. B. Weiser and G. E. Wightman. J. Phys. Chem., 1919, 23, 415—439.

Carbon tetrachloride may be decomposed into chlorine and tetrachloroethylene at temperatures as low as 600° C., but the best yields of the latter substance are obtained at 1300°—1400° C. The decomposition products must be cooled as rapidly as possible in order to minimise the formation of hexachloroethane, and they may with advantage be diluted with cold air or nitrogen at the point of their emergence from the furnace. The reaction is conveniently carried out in an electrically heated quartz tube connected with a large iron condenser in which are also preferably a number of cooling coils. Provided the iron condensing surfaces are dry and are kept below 150° C. the action of the chlorine on the metal is negligible. The solid hexachloro-compound, which is formed as a by-product, can be readily reduced with zinc and sulphuric acid to tetrachloroethylene.—G. F. M.

Acetylene and mercuric chloride; Interaction of ——. D. L. Chapman and W. J. Jenkins. Chem. Soc. Trans., 1919, 115, 847—849.

By passing acetylene into a saturated solution of mercuric chloride in absolute alcohol containing a small quantity of hydrogen chloride, a substance of the molecular formula, $HgCl_2.C_2H_2$, was deposited in long needles after 16 hours, and on pouring the liquors into water a further quantity was obtained, making a total yield of about 60% of the mercury salt taken. The substance is soluble in organic solvents, melts at about 113° C., and probably has the constitution, $ClHg.CH:CHCl$. It is only formed in the presence of ionising solvents, and appears to be the first product of the interaction of acetylene and mercuric chloride in acetaldehyde formation.—G. F. M.

Alkali-sawdust fusion; Reaction products of ——. *Acetic, formic and oxalic acids, and methyl alcohol.* S. A. Mahood and D. E. Cable. J. Ind. Eng. Chem., 1919, 11, 651—655.

From 17 to 20% of acetic acid, calculated on the dry wood, can be obtained by fusing hardwood sawdust with sodium hydroxide; about 50% of oxalic acid is formed at the same time. If the reaction is carried out in a closed vessel, about 2·4% of methyl alcohol is formed, but when the temperature rises above 200° C. the yield of oxalic acid decreases considerably; at lower temperatures, both formic and acetic acids are produced (about 15% of each). The yield of acetic acid is somewhat lower than that obtained by Cross, Bevan, and Isaac, using potassium hydroxide (this J., 1892, 966); it appears that the yield of acetic acid obtained with sodium hydroxide would more nearly approach that obtained with potassium hydroxide if the temperature is kept at about 200° C., the heating prolonged, and the ratio of alkali to sawdust maintained at 3 : 1. About 91% of the alkali used may be recovered.—W. P. S.

Cyanic acid; Formation of —— by oxidation of organic substances. Its identification based on quantitative analysis. R. Fosse. Comptes rend., 1919, 169, 91—93.

The author has proved that cyanic acid is an intermediate product in the formation of urea by oxidation of proteins alone or in the presence of glucose, or by the oxidation of ammoniacal solutions of amino-acids, glycerol, carbohydrates, or formaldehyde, by isolating the cyanic acid as silver cyanate and analysing this compound. The liquor resulting from the oxidation is nearly neutralised with nitric acid and silver nitrate is added. The precipitate is extracted with boiling water, and from the extract, after filtering, silver cyanate crystallises out. The salt is warmed on a water bath in ammoniacal

solution with ammonium chloride and after acidifying with acetic acid the silver chloride is collected and weighed. The urea in the filtrate is precipitated as its xanthydrol derivative and also weighed. —W. G.

Bismuth; Determination of —— by the formaldehyde process. S. B. Tallantyre. Pharm. J., 1919, **103**, 81.

THE estimation of bismuth in pharmaceutical bismuth preparations and salts is most conveniently carried out by the formaldehyde reduction method. The preparation should be warmed with 10% of hydrochloric acid until all the bismuth is in solution, and is then treated with 10% sodium hydroxide followed by 15 c.c. of 4% formaldehyde solution. Metallic bismuth separates and on boiling and stirring the liquid it collects into a spongy mass which is removed from the liquor, washed, and dried. The method is applicable to a large number of bismuth preparations, including xeroform, but with the subgallate and tannate preliminary destruction of the organic matter is advisable as direct reduction gives a colloidal bismuth solution which does not coagulate well.—G. F. M.

Organic compounds; Action of sulphuric acid on homologous and isomeric ——. J. Milbauer and A. Němec. J. prakt. Chem., 1919, **99**, 93—105.

WITH the object of elucidating the mechanism of the oxidation of organic compounds by sulphuric acid, as in the Kjeldahl method of estimating nitrogen, the authors have studied the velocity of attack of a number of compounds of various types by sulphuric acid at 200° or in some cases at 290° C. (See also J. Chem. Soc., 1919, ii., 362.)—T. H. P.

Geranium oils; Japanese ——. S. Furukawa. Kōgyō-Kwagaku Zasshi (J. Chem. Ind. Tokyo), 1919, **22**, 83—90.

OF three Japanese geranium oils examined, that from *Pelargonium denticulatum* resembled foreign commercial oils in composition, the others being of inferior value as perfumes. The following figures were obtained:—

	P. graveolens	*P. radula*	*P. denticulatum*
Sp. gr.	0·9178	0·9234	0·8860
Acid value	183·68	5·6	7·17
Ester value	4·8	31·7	12·8
Total geraniol % ..	23·1	26·3	63·5
Free alcohol % (as geraniol)	22·0	17·26	60·0
Yield from fresh plant	1·75—2%	1·5%	5·0%

The chief constituents of the oil of *P. graveolens* were isolated, *viz.*, *d*-citronellic acid (56%), *l*-menthone, and *l*-citronellol.—G. F. M.

Finnish turpentine; A new terpene from ——. O. Aschan. Reprint. Chem. Zentr., 1919, **90**, I., 284.

A NEW bicyclic, saturated terpene hydrocarbon, b.pt. 163°—165° C., sp. gr. at 20°/4° C. 0·8628, $[\alpha]_D = +7·7°$, closely related to pinene, can be obtained from Finnish turpentine by distilling with steam. It gives pinene nitrosochloride on treatment with amyl nitrite and hydrochloric acid.—T. C.

Finnish turpentine. Formation of terpene hydrate and terpineol. The high-boiling constituents. O. Aschan. Bidrag till kännedom af Finlands natur och folk, 1918, **77**, [1], [2]. Chem. Zentr., 1919, **90**, I., 284—285.

STUDY of the action of sulphuric acid on turpentine oil without cooling indicates that the formation of terpin, probably always formed as an intermediate product when pinene is converted by acids into dipentene, takes place at ordinary temperatures, whilst at higher concentrations and temperatures this reaction is almost immediately checked by the liberation of water consequent on the formation of dipentene. By stirring turpentine rapidly for 10 hours at 1° C. with 45% sulphuric acid 53·2% of the theoretical yield of terpin was obtained, the *trans*-terpin of Bayer being obtained as a by-product. Nopinene from American turpentine also yielded terpin when acted on by 45% sulphuric acid at a low temperature. Terpin can be obtained by the action of 55% sulphuric acid at −6° C. on dipentene, *trans*-terpine being also obtained as a by-product. The conversion of terpin hydrate into terpineol by the abstraction of water is best brought about by the action of 0·5% oxalic acid solution, whilst formic acid is the most suitable for the conversion of pinene into terpineol. Five parts of 40% sulphuric acid stirred for 5 hours with 1 part of terpineol with ice-cooling gives an almost quantitative yield of terpin hydrate. The fraction from Finnish turpentine distilling at 155°—167° C. containing the pinene-like terpin (see preceding abstract) also gives a good yield of terpin hydrate. Terpene alcohol and cadinene were recognised in a sample of Finnish turpentine and in a product obtained by distilling resin from *Pinus sylvestris* in the fraction boiling at 125°—130° C. at 9 mm., although it is possible that cadinene might have been formed from another sesquiterpene during the process of separation. —T. C.

Finnish turpentine; The high-boiling constituents of ——. O. Aschan. Finska Kemistsamfundets Meddel., 1918. Chem. Zentr., 1919, **90**, I., 285.

AN unsaturated, unfreezable terpene alcohol, $C_{10}H_{17}OH$, was isolated together with a sesquiterpene from the fractions from Finnish turpentine from various sources boiling at 210°—220° C. and 260° C. The terpene alcohol was not identical with ordinary terpineol and is perhaps a mixture of terpineol with other terpene alcohols. The sesquiterpene, $C_{15}H_{24}$, has b.pt. 260°—263° C. at 760 mm., sp. gr. at 20°/4° C. 0·9187, and is unsaturated towards permanganate, bromine, and hydrochloric acid. On treatment with dry hydrogen chloride it is converted into cadinene dihydrochloride, m.pt. 117°—118° C., from which cadinene, b.pt. 271° C., can be isolated. (See preceding abstract.)—T. C.

Pine resin; The sesquiterpene fraction from ——. O. Aschan. Finska Kemistsamfundets Meddel., 1918. Chem. Zentr., 1919, **90**, I., 285.

A DISTILLATE obtained in the large scale distillation of pine resin contained a new sesquiterpene, probably a bicyclic sesquiterpene allied to cadinene, giving a dihydrochloride, $C_{15}H_{26}Cl_2$, m.pt. 85°—86° C., in the form of glittering rhombic leaflets readily soluble in organic solvents.—T. C.

Terebene and its pharmacopœia standards. B. F. Howard. Pharm. J., 1919, **103**, 76—78.

THE pharmacopœia standard for terebene, requiring optical inactivity, is no criterion of purity, and with the alteration in recent years of the optical properties of commercial turpentine, the test now stands condemned. The specific gravity limit should also be lowered to 0·854. The average rotation and sp. gr. of a number of batches of terebene made from recently imported turpentine were −10° 30′ and 0·8570 respectively, and although quite satisfactory in all other respects this terebene would be rejected if tested by the existing artificial physical

standards. It is suggested that the present optical test be deleted and a distillation standard be substituted, *viz.* that not more than 5% should distil below 160° C., and the main fraction between 165° and 185° C., leaving only a slight viscous residue.
—G. F. M.

PATENTS.

Camphor; Process and apparatus for purifying ——. E. I. du Pont de Nemours and Co., Wilmington, Del., Assignees of E. G. Loomis, Newark, N.J., U.S.A. Eng. Pat. 124,413, 12.8.18. (Appl. 13,076/18.) Int. Conv., 16.3.18.

THE process for purifying crude camphor comprising melting, heating or "baking" to render the camphor oil non-volatile, followed by volatilisation of the camphor (Eng. Pat. 118,489, this J., 1918, 636 A) is rendered continuous by operating in an apparatus consisting essentially of a melting vessel, fed with solid camphor by means of a worm conveyor, and heated by a coil through which hot oil is circulated, and from the base of which the molten camphor flows through an inclined tube into an oil-heated vaporiser. The tube is also heated and the camphor, as it slowly flows through, is "baked." The camphor vapours from the vaporiser pass through a scrubber into a large condensing chamber from which the solid purified product is removed from time to time by a second worm conveyor. Water contained in the crude camphor escapes as steam from the upper part of the melting vessel and is condensed by a water spray in a water-sealed condensing vessel.—G. F. M.

Camphor; Process of purifying ——. J. E. Crane, Newark, N.J., Assignor to The Arlington Co., Arlington, N.J. U.S. Pat. 1,308,398, 1.7.19. Appl., 26.5.16.

CAMPHOR containing camphor oil is heated for a sufficient length of time to change the camphor oil into a product more readily separated from the camphor.—G. F. M.

Organic acid chlorides; Preparation of ——. T. H. Durrans, Oxford, and A. Boake, Roberts and Co., Ltd., Stratford. Eng. Pat. 128,270, 6.7.17. (Appl. 9815/17.)

IF the proportion of sulphur used in the Goldschmidt method of preparing acid anhydrides (Eng. Pat. 25,433 of 1908; this J., 1910, 112) be reduced, acid chlorides are obtained:

$2CH_3CO_2Na+S+2Cl_2=2CH_3COCl+2NaCl+SO_2$

and/or

$3CH_3CO_2Na+S+3Cl_2=3CH_3COCl+3NaCl+SO_2$.

Sodium may be replaced by other alkali metals or alkaline-earth metals, and the acetic acid radical by that of any other organic acid, *e.g.*, butyric or benzoic acid. The process is carried out by passing chlorine into the mixture of the organic salt and sulphur in the proportions required by the above equations or intermediate between them, and the temperature is preferably kept below 50° C.
—G. F. M.

Chlorinated products [chlorhydrins]; Method of making ——. J. M. Moness, Long Island City, N.Y., Assignor to Chemical Development Co. U.S. Pat. 1,308,763, 8.7.19. Appl., 8.2.17.

IN the manufacture of chlorhydrins a mixture of chlorine and steam is brought into reaction with oil-gas in a chamber containing material of an oxidising nature.—G. F. M.

Acetic anhydride and acetyl chloride; Preparation of ——. T. H. Durrans, Oxford, and A. Boake, Roberts and Co., Ltd., Stratford. Eng. Pat. 128,282, 13.7.17. (Appl. 10,196/17.)

ACETIC anhydride is produced by the action of chlorine on a mixture of phosphorus and an anhydrous acetate at temperatures preferably below 50° C. For example, by passing 106·5—177·5 parts of chlorine into an intimate mixture of 31 parts of red phosphorus and 492—656 parts of anhydrous sodium acetate, reactions occur represented by the equations $6CH_3CO_2Na + P + 3Cl = 3(CH_3CO)_2O + Na_3PO_3 + 3NaCl$, or $8CH_3CO_2Na + P + 5Cl = 4(CH_3CO)_2O + Na_2PO_4 + 5NaCl$. Using a lesser proportion of anhydrous acetate acetyl chloride is formed as the chief product.—G. F. M.

Amines; Preparation of ——. W. Rintoul, J. Thomas, and Nobel's Explosives Co., Ltd., Stevenston, N.B. Eng. Pat. 128,372, 15.6.18. (Appl. 9895/18.)

SECONDARY and tertiary amines are separated from mixtures of the two containing an excess of the latter by treatment with phosgene at temperatures below 25° C., whereby the secondary amine is converted into an urea chloride with the elimination of hydrogen chloride, which combines with the excess of tertiary amine. The reaction mixture is then treated with sufficient hydrochloric acid to remove the whole of the tertiary amine as hydrochloride, whilst the insoluble urea chloride is collected and boiled with either water or dilute hydrochloric acid to regenerate the secondary amine. In cases where the mixture contains an excess of secondary amine, either the operation is repeated until the amines isolated from the hydrochloride contain an excess of tertiary amine, or tertiary amine is added to the original mixture in quantity sufficient to produce an excess. Examples: (1) 20 parts of diethylaniline containing 9% of monoethylaniline is treated with 2 parts of phosgene. The whole is washed with dilute hydrochloric acid, the ethylurea chloride filtered off, and diethylaniline containing only 0·3% of secondary amine is precipitated from the filtrate; (2) 500 parts of impure ethyl-*o*-toluidine containing only 22% of tertiary amine is treated in 400 parts of benzene with 198 parts of phosgene. The mixture is washed with dilute hydrochloric acid and the base recovered from the washings then contains only 44·6% of secondary amine. On repeating the operation diethyl-*o*-toluidine is recovered containing less than 1% of secondary amine.—G. F. M.

Chlorhydrins; Manufacture of ——. T. and E. H. Kerfoot, Bardsley, Lancs, J. C. Irvine, and W. N. Haworth, St. Andrews, Fife. Eng. Pat. 128,635, 18.8.17. (Appl. 11,876/17.)

CHLORHYDRINS, and particularly glycol chlorhydrin, are prepared by subjecting an aqueous medium containing a copper salt, preferably the chloride or oxychloride, to the alternate action of chlorine and ethylene or its homologues, whereby a weak aqueous solution of hypochlorous acid is first formed, and in the second stage of the operation combines with the unsaturated substance to give the chlorhydrin. Means are provided, either by vigorously agitating the liquid with the gases, or else by means of packed towers, or trickling towers divided into a number of horizontal zones alternately filled with chlorine and ethylene, to expose as great a surface as possible of the liquid to the action of the gases. By repeating these operations a relatively strong solution of chlorhydrin is obtained, particularly if the liquid is kept neutral by the addition of basic copper carbonate. The product may be isolated by

extraction with ether and subsequent fractional distillation, or in the case of glycol chlorhydrin a constant boiling mixture containing 43% of this substance and 57% of water, boiling at 97° C., may be obtained by fractionating the reaction product. —G. F. M.

Furfural; Manufacture of ——. E. Ricard, Melle, France. Eng. Pat. 129,025, 26.9.17. (Appl. 13,880/17.) Int. Conv., 26.6.17.

The yield and purity of furfural obtained by acting on cellulosic materials with acid or other reagents are improved by using the reagent as dilute as possible and, by rapid distillation, separating the furfural as quickly as possible so as to prevent secondary reactions. The material is packed into two boilers operated alternately, and is covered with, say, 13—14% hydrochloric acid. The vapours pass through a fractionating column where they are washed by the returned aqueous portion of the distillate in order to free them from impurities and acid. The lower layer of the distillate is hydrated furfural which from a charge of 500 kilos. should collect at the rate of 25–35 kilos. per hour. It is finally purified by vacuum distillation, whilst the acid liquors which have been returned to the still are run off from the spent residue, filtered through a layer of slag, and used again for another charge. —G. F. M.

Catalysis; Process of regulating —— in formation of unsaturated organic compounds. B. E. Eldred and G. Mersereau, New York, Assignors to Chemical Development Co. U.S. Pat. 1,308,777, 8.7.19. Appl., 8.8.12. Renewed 13.12.18.

Unsaturated carbon compounds are formed by passing over a catalyst a gaseous mixture of an unsaturated compound with the vapour or gaseous form of a substance with which it will react to form an additive product. The mixture is diluted with an inert gas, the diluent being present in such quantity in relation to the time of exposure to the catalyst as to inhibit the formation of a saturated carbon compound.—G. F. M.

Hydrocarbons; Process of oxidising ——. [*Preparation of chlorhydrins and glycols.*] K. P. McElroy, Washington, D.C., Assignor to Chemical Development Co., Augusta, Me. U.S. Pats. (A) 1,308,796 and (B) 1,308,797, 8.7.19. Appls., (A) 10.1.18, Renewed 2.11.18, (B) 26.6.17.

(A) Chlorhydrins are obtained by the action of hypochlorous acid on gaseous olefines, a supply of the acid being maintained in the zone of the reaction. (B) Glycols are obtained by electrolysing a chloride solution in a cell not fitted with a diaphragm, in such a way as to oxidise the chloride, whilst the electrolyte is saturated with a gaseous olefine in the presence of an oxygen-carrying catalyst.—G. F. M.

Diolefines; Apparatus for producing ——. G. Mersereau, New York, Assignor to Chemical Development Co. U.S. Pat. 1,308,802, 8.7.19. Appl., 14.9.12. Renewed 13.12.18.

The apparatus comprises a retort heated at a low uniform temperature to vaporise petroleum, means for recovering unchanged oil vapours and diolefines from the treated gas, means for reheating the gas to produce a further quantity of diolefines, and means for recovering this further quantity. —G. F. M.

Oxalic acid; Manufacture of ——. H. C. Reed, Stamford, Conn. U.S. Pat. 1,310,713, 22.7.19. Appl., 23.9.15.

Waste liquor from the "chemical manufacture of paper" is evaporated to dryness and fused with a large excess of caustic alkali, the temperature eventually being maintained at 250° C. for a sufficient time to effect formation of alkali oxalate. The melt is then cooled and the excess of alkali dissolved out, leaving a residue of oxalate which is separated from the alkaline solution.—G. F. M.

Monochloracetic acid; Manufacture of —— and of its esters. L. J. Simon and G. Chavanne, Paris. Eng. Pat. 129,301, 21.5.17. (Appl. 7325/17.)

See U.S. Pat. 1,304,108 of 1919; this J., 1919, 553 A. The process may be carried out by bringing vaporised trichloroethylene into contact with sulphuric acid by bubbling, by spraying, or by circulation past baffles or through porous bodies. Esters are obtained by addition of the corresponding alcohol to the sulphuric acid solution of the monochloroacetic acid.

Tropic acid; Process of synthetically producing ——. E. Müller, Basle, Switzerland, Assignor to The Hoffmann-La Roche Chemical Works, New York. U.S. Pat. 1,305,301, 3.6.19. Appl., 16.12.16.

An alkyl ester of oxymethylenephenylacetic acid is treated with a reducing agent, whereby a tropic acid ester is produced, which on saponification under suitable conditions yields tropic acid. —G. F. M.

Halogen derivatives of hydrocarbons; Method of making ——. H. H. Dow, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pat. 1,306,472, 10.6.19. Appl., 24.5.17.

Double halogen derivatives of hydrocarbons are prepared by treating a hydrocarbon with the vapours of two halogens mixed in the proportions required by the reaction.—G. F. M.

Thymol; Synthetic manufacture of ——. C. E. Andrews, Pittsburgh, Pa. U.S. Pat. 1,306,512, 10.6.19. Appl., 15.9.17.

Thymol is prepared by nitrating aminocymene after protecting the amino group, then converting the product into nitrocymene by eliminating the amino group, and afterwards replacing the nitro-group by hydroxyl.—G. F. M.

Ginger root; Extraction of a pungent principle from ——. H. Nomura, Sendai, Japan. U.S. Pat. 1,306,710, 17.6.19. Appl., 6.6.17. (See also this J., 1917, 1062.)

A new pungent principle, methyl 3-methoxy-4-hydroxyphenyl ethyl ketone, $C_{11}H_{14}O_3$, or "zingiberone," is isolated from ginger root (*Zingiber officinale*). It forms colourless needles, soluble in ether and 50% alcohol, and melting at 40°—41° C. —G. F. M.

Butane and propane; Recovery of ——. J. B. Garner and H. C. Cooper, Assignors to Hope Natural Gas Co., Pittsburgh, Pa. U.S. Pat. 1,307,353, 24.6.19. Appl., 5.8.16.

A substantially pure mixture of butane and propane is forced into a suitable chamber until the condensation pressure of butane is reached, and the liquid is drawn off at the bottom of the chamber. The propane remaining in the chamber is then further compressed to the point of condensation, and the liquefied propane is drawn off.—G. F. M.

Dialkyl-diaryl-ureas; Production of ——. H. Winkel, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,307,570, 24.6.19. Appl., 25.9.18.

DIALKYLDIARYLUREAS are produced by treating a mixture of an alkylarylamine and a dialkylarylamine with carbonyl chloride at a temperature sufficient to maintain the mixture in a liquid condition.
—G. F. M.

Ethanol-trialkyl-arsonium hydroxides, and process for making the same. M. Guggenheim and E. Hug, Riehen, Switzerland, Assignors to The Hoffmann-La Roche Chemical Works, New York. U.S. Pats. (A) 1,308,413 and (B) 1,308,414, 1.7.19. Appl., 6.12.16.

A HALOGEN salt of halogen-ethyl-trialkyl-arsonium is heated with water until the substituting halogen is completely replaced by hydroxyl.—G. F. M.

Acetic aldehyde; Manufacture of ——. H. Dreyfus, Basle, Switzerland. U.S. Pats. 1,310,743 and 1,310,984, 22.7.19. Appl., 1.6.17 and 17.4.18.

SEE Eng. Pat. 105,064 of 1917; this J., 1918, 222 A.

Volatile solvents. Eng. Pat. 128,640. *See* I.

Ether and alcohol. Eng. Pat. 129,024. *See* I.

Methyl borate. U.S. Pats. 1,308,576–7. *See* VII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photoceramic pigment process. Flecke. *See* VIII.

PATENTS.

Colour photography. Process of treating cinematograph-films. Developing, colouring, and washing tank for two-sided photographic films. A. Hamburger, London. U.S. Pats. 1,308,708–10, 1.7.19. Appl., 20.1, 4.2, and 20.5.19.

SEE Eng. Pats. 123,786–7 of 1917; this J., 1919, 304 A.

XXII.—EXPLOSIVES; MATCHES.

Nitric esters of glycerol; Absorption spectra of ——. H. Hepworth. Chem. Soc. Trans. 1919, **115**, 840–847.

FROM an examination of the absorption spectra it is evident that the labile and stable forms of nitroglycerin are physical isomerides and are identical in aqueous solution. The order of increasing absorption in aqueous solution is glycerol, β-mononitrate, α-mononitrate, αγ-dinitrate, αβ-dinitrate, trinitrate, commercial nitroglycerin, but the displacement of the first hydrogen atom by the nitro-group makes a much more profound change in the absorption spectrum than the displacement of one or both of the remaining hydroxyl hydrogen atoms.
—G. F. M.

Gas analysis by refractometric method. **Ponchon. *See* XXIII.**

PATENTS.

Priming charge. Charge for primers. W. H. Buell, New Haven, Conn. Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pats. (A) 1,308,393 and (B) 1,308,394, 1.7.19. Appl., 31.8.17.

(A) A PRIMING charge consisting of a mixture, one of the constituents of which is a trinitroresorcinate of an alkali-forming metal. (B) A priming charge, free from mercury fulminate, and containing tetranitromethylaniline as the essential detonator.
—G. F. M.

[Picric acid.] Nitration method. C. Ellis, Montclair, and A. A. Wells, Caldwell, N.J., Assignors to Ellis-Foster Co. U.S. Pat. 1,309,320, 8.7.19. Appl., 19.3.17.

PICRIC acid is made by sulphonating phenol and nitrating it with a mixture of sodium nitrate, sulphuric acid, water, and the products of their reaction.—W. F. F.

Explosive. F. M. Becket, Assignor to Electro Metallurgical Co., Niagara Falls, N.Y. U.S. Pat. 1,310,466, 22.7.19. Appl., 7.6.18.

A MIXTURE containing an oxidising agent and a magnesium-silicon alloy.—S. S. A.

Explosive; Plastic chlorate ——. J. M. Brown, Unaka Springs, Tenn., Assignor to National Explosive Corporation. U.S. Pat. 1,309,014, 8.7.19. Appl., 6.9.17.

AN alkali metal chlorate is incorporated with a drying oil, vegetable flour, magnesium carbonate, vaseline, and nitroglycerin.—C. A. M.

Explosive compounds; Process of producing —— *and product thereof. Blasting-cap charge.* C. M. Stine, Woodbury, N.J., Assignor to E. I. du Pont de Nemours and Co. U.S. Pats. (A) 1,309,551 and (B) 1,309,552, 8.7.19. Appl., (A) 20.7.16 and (B) 12.8.16.

(A) AN explosive containing nitro and nitrate groups and having more than one of one of these groups present is obtained by nitrating and halogenating an organic compound, hydrolysing the product to substitute a hydroxyl for the halogen group, and then nitrating it to replace the hydroxyl group by a nitrate group. (B) A blasting-cap charge is made by mixing an organic compound containing a nitro group and a nitrate group with a priming material.—C. A. M.

Explosive. W. R. Swint, Wilmington, Del., Assignor to E. I. du Pont de Nemours and Co. U.S. Pat. 1,309,553, 8.7.19. Appl., 31.1.18.

HIGH-GRADE guncotton is incorporated with a liquid organic nitrated compound.—C. A. M.

Bursting charge for containers intended to be exploded and process of forming said charges. C. A. Woodbury, Middletown, Pa., Assignor to E. I. du Pont de Nemours and Co. U.S. Pat. 1,309,558, 8.7.19. Appl., 4.8.17.

THE bursting charge is composed of trinitrotoluene and ammonium picrate.—C. A. M.

Trinitrotoluol; Process of refining crude —— *and other crude aromatic nitro compounds.* C. A. Woodbury, Middletown, Pa., Assignor to E. I. du Pont de Nemours and Co. U.S. Pat. 1,309,559, 8.7.19. Appl., 5.11.17.

THE crude aromatic nitro compound is mixed with sulphuric acid at the ordinary temperature, and the

liquid containing the impurities separated from the undissolved nitro compounds.—C. A. M.

Bursting charge for containers intended to be exploded and process of forming said charge. C. L. Reese, Wilmington, Del., Assignor to E. I. du Pont de Nemours and Co. U.S. Pat. 1,309,558, 8.7.19. Appl., 4.8.17.

TRINITROXYLENE is incorporated with another organic nitro compound of lower melting point to form a bursting charge.—C. A. M.

Coating process [ammonium nitrate etc.] and apparatus. W. O. Snelling, Long Island City, N.Y. U.S. Pat. 1,310,037, 15.7.19. Appl., 31.5.16.

A HYGROSCOPIC crystalline substance such as ammonium nitrate is made to fall through, or is otherwise brought into contact with, a vaporised condensable coating material, such as nitronaphthalene, which has previously been heated at a pressure sufficiently low to prevent substantial decomposition. Apparatus for this process comprises a treating chamber connected, by a conveyor, with a hopper above, and with a vaporising device below. The supply of material to be coated is controlled by means of two superposed radially slotted discs, which can be moved so as to bring the slots progressively into alinement.—C. A. M.

Explosive compound. W. O. Snelling, Allentown, Pa., Assignor to Trojan Powder Co., New York. U.S. Pat. 1,310,969, 22.7.19. Appl., 14.8.17.

SMOKELESS powder is composed of nitro-starch the granules of which are non-colloidal in their interior, but have been brought superficially into colloidal form to make them adhere.—C. A. M.

Nitrated bodies; Process of treating ——. J. V. Skoglund, Assignor to Trojan Powder Co., New York. U.S. Pat. 1,311,017, 22.7.19. Appl., 4.3.18.

THE mixed acids are separated from nitrated substances by displacing the free acid by means of acids of gradually decreasing strength.—C. A. M.

Explosive. W. Rintoul and D. Cross, Assignors to Nobel's Explosives Co., Ltd., Stevenston, N.B. U.S. Pat. 1,310,489, 22.7.19. Appl., 4.12.17.

SEE Eng. Pat. 126,056 of 1916; this J., 1919, 513 A.

Propellent powder; Process of producing ——. O. J. Teeple, jun., Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,310,848, 22.7.19. Appl., 29.7.16.

SEE Eng. Pat. 127,872 of 1917; this J., 1919, 604 A.

Incendiary composition. G. W. C. Webb, Dartford, Assignor to Vickers, Ltd., London. U.S. Pat. 1,308,463, 1.7.19. Appl., 25.9.18.

SEE Eng. Pat. 126,394 of 1917; this J., 1919, 480 A.

Matches; Process for moisture-proofing ——. F. Johnston and A. Orr, Calgary, Alberta. Eng. Pat. 129,228, 25.2.19. (Appl. 4645/19.)

SEE U.S. Pat. 1,301,448 of 1919; this J., 1919, 514 A.

Volatile solvents. Eng. Pat. 128,640. *See* I.

Ether and alcohol. Eng. Pat. 129,024. *See* I.

Fertilising. U.S. Pat. 1,308,453. *See* XVI.

XXIII.—ANALYSIS.

Gas flow meters for small rates of flow. A. F. Benton. J. Ind. Eng. Chem., 1919, 11, 623—629.

THE meters described consist of a horizontal piece of capillary tubing inserted in the tube conveying the gas; side tubes on the latter, one on each side of the capillary tubing, are connected with the ends of the usual U-form manometer. The capillary tube is connected with the gas tube by means of rubber tubing and is replaceable. By using capillary tubes of varying diameter, the meter may be used for rates of flow of gas varying from less than 500 c.c. to more than 200 litres per min.—W. P. S.

Gas burette. P. Nicolardot and G. Prevot. Ann. Falsif., 1919, 12, 140—145.

THE burette consists of two parts, the upper or wider part having a diameter of about 6 cm. whilst the lower has a diameter of about 2 cm. Both parts are graduated, and the capacity of the narrower part is from one-fourth to one-half that of the wider part. Taps are provided at the top and bottom and the whole burette holds from 200 to 400 c.c.—W. P. S.

Photometer; A universal ——. L. Bloch. J. Gasbeleucht., 1919, 62, 355—357.

THE light from a small Ulbricht sphere containing two small standardised "Nitra" lamps can pass out by two square windows, the right hand one of fixed and the left of variable area capable of accurate measurement. The light from these two windows illuminates separately two horizontal diffusely reflecting plates side by side at the bottom of a wooden box. The two beams reflected vertically can be examined by a photometer head which contains a system of reflecting prisms arranged so that the two halves of the field are illuminated separately by the two beams. The eye-piece is fitted with four glasses, colourless, and standard Jena red, green, and blue, so that light of any of these colours or combinations of them may be examined and brought to equality by adjustment of the variable aperture. The apparatus can be used for a great variety of measurements. The absorptive power of solids and liquids can be determined if the specimen be placed in the path of the left hand beam and above the corresponding reflecting plate. Other measurements are enumerated which can be made with the apparatus: —the properties of luminescent surfaces, X-rays, photochemical measurements. The apparatus can be used for the measurement of illumination and intensity of light sources. The left hand window in the sphere is then closed and the beam to be measured is admitted at the left hand side of the box and reflected through 90° up into the photometer head. It can then be compared with the standard source by adjustment of the aperture.

—H. J. H.

Optical pyrometer; Disappearing filament type of ——. W. E. Forsythe. Faraday Soc., 14.7.19. [Advance proof.]

THE disappearing filament type of optical pyrometer, known in America as the Morse or Holborn-Kurlbaum pyrometer, is constructed in the form of a telescope having at the focus of the objective lens a lamp filament. In series with the filament are a small battery, a resistance, and an ammeter. To measure the temperature of a hot body with this instrument it is sighted on the body and the current adjusted until the filament just equals the object in brightness. The instrument is calibrated so that

the temperature of the body can be ascertained from the magnitude of the current, and is generally useful for temperatures betwen 1100° and 1800° Abs. It has been studied and developed in the laboratory of the General Electric Co., and the results of the work are summarised in the present paper. A discussion of the principles of optical pyrometry is included. The tests on the disappearing filament pyrometer show that it gives accurate results even in the hands of inexperienced observers. One great advantage claimed for it is that the object the temperature of which is being measured can be seen and the temperature of any particular small area of the object can be taken. The instrument is also free from errors due to polarisation of light.

—E. H. R.

Membranes for disymmetric filtration; New porous ——. L. Benoist. Comptes rend., 1919, **168**, 1320—1321.

USING a porous vessel constructed of three successive layers, the porosity of which was represented by $P_1=0{\cdot}30$, $P_2=0{\cdot}23$, and $P_3=0{\cdot}18$, the flow of a given volume of water, at the same initial pressure, through the layers from $P_1 \rightarrow P_3$ and *vice versâ*, was measured. The velocity was found to be greater in the direction $P_3 \rightarrow P_1$ than in the direction $P_1 \rightarrow P_3$, the ratio being 1·27 : 1, this being an illustration of the Venturi effect.—W. G.

X-Ray chemical analysis. A. W. Hull. J. Franklin Inst., 1919, **188**, 131—133.

A METHOD used in the Research Laboratory of the General Electric Company consists in reducing the substance to be examined to powder form, placing it in a small glass tube, sending a beam of monochromatic X-rays through it, and photographing the diffraction pattern produced. Only 1 cub. mm. of the material is necessary for one determination and the method is applicable to all elements and chemical compounds which are crystalline in form. When the photograph is developed there is, in addition to the overexposed line in the centre where the direct beam strikes, a series of other lines on each side of the centre. These lines are caused by the reflections of the X-rays from the tiny crystals in the powder. Substances with different crystalline structures give entirely different patterns of lines, and substances of similar crystalline structure give similar patterns, except that the spread of the pattern is different for each one, being inversely proportional to the molecular volume. In a mixture of substances each produces its patterns independent of the others, and it has been found very easy to recognise each component in a three-component mixture, whilst in the case of the simpler salts many more than this could certainly be identified.—J. W. D.

Solutions; Freezing point of ——, *with special reference to solutions containing several solutes.* C. E. Fawsitt. Chem. Soc. Trans., 1919, **115**, 790—801.

IN freezing point determinations the weight of the solvent, w, may be substituted by the expression $w + b\,w$, in which w is the weight of the solute and b is a constant depending on both solvent and solute, and is only determinable experimentally. When several solutes are dissolved at one time in the same solvent, then if b is positive for the individual solutes the sum of the individual depressions of the freezing point by the various solutes is greater than the observed depression of the freezing point; if b is negative for each individual solute, the sum of the individual depressions is less than the observed depression of the freezing point. If several solutes are dissolved together in a solvent and the quantity of solvent be taken as $W + w_1b_1 + w_2b_2 + w_3b_3 +$ etc., where w is the actual weight of the solvent, w_1, w_2, w_3 the weights of the solutes, and b_1, b_2, b_3 the constants of the solutes, then the sum of the calculated values of the depressions of the individual solutes differs from the observed total depressions by only a small amount in all cases considered by the author.

—J. F. S.

Freezing point determinations; Use of —— *in quantitative analysis.* C. E. Fawsitt. Chem. Soc. Trans., 1919, **115**, 801—808.

THE method of estimating an ingredient, A_1, in a substance, A, by finding the freezing-point depression of A in A_1 (as solvent) and also in some other solvent, S, may be applied in special cases where it is possible to experiment previously with samples of substance somewhat similar to A. The percentage of A_1 can then be determined in certain cases to an accuracy of about 2 units % with the ordinary freezing-point apparatus. When it is not possible to experiment with the same class of substance beforehand, the method of determination is liable to much larger errors. The method can be recommended for use in the cases: (1) When there has been a previous experience with the same class of substance; (2) when other possible methods of determination are not capable of a greater degree of accuracy; (3) when other methods require for their successful application a larger quantity of substance than is available. The freezing-point method requires about 1 grm. of substance for a successful determination, but it is more satisfactory to use 4—6 grms.—J. F. S.

Gas evolved in a chemical reaction; Apparatus for measuring the volume of ——. P. Nicolardot and M. H. Robert. Chim. et Ind., 1919, **2**, 641—646.

THE method employed consists in bringing the gas evolved to a constant volume and determining its pressure. The reaction tube, which is made as small as possible, is connected to a cooling coil and thence to a vertical gas burette by a capillary tube entering the burette at the top by a stop-cock. The burette has sharply conical ends and is connected at the lower extremity to a reservoir which communicates with a water manometer. On the constricted tube between the burette and the reservoir is a mark to which the water is brought in order to bring the gas in the burette to a constant volume, determined by this mark at the lower and the stop-cock at the upper extremity of the burette. The whole apparatus is immersed in a water-bath at constant temperature. It is specially suitable for such purposes as the measurement of the volume of hydrogen evolved by the action of caustic soda on aluminium, and the error does not exceed one part in a thousand.—E. H. R.

Gases; Industrial analysis of mixtures of —— *by the refractometric method.* M. Ponchon. Chim. et Ind., 1919, **2**, 647—655.

THE author has studied the method devised by Rayleigh (Proc. Roy. Soc., 1896, A, **59**; 1898, **64**) for determining the composition of a binary mixture of gases by an interferential refractometric method, with a view to its application to industrial purposes. The principle of the method consists in causing two rays of light from a common source to interfere, the one having passed through a tube of the gas to be examined, the other through another tube containing a standard gas. The position of the interference fringes is noted and the displacement of the fringes when both tubes contain the standard gas. The displacement is proportional to the difference between the refractive

indices of the gas under examination and the standard. A portable form of apparatus is described. The author has carried out experiments to determine the degree of accuracy of the method. The error in the determination of the difference of the refractive indices amounts to only 10^{-7}, but, of course, the accuracy of the estimation of the composition of a mixture of gases depends on the magnitude of the difference between the refractive indices of the gas under test and the standard. For instance, the difference between the indices of air and nitrogen is only 52×10^{-7} and the error would be considerable, but for air and carbon dioxide the difference is 1576×10^{-7} and a high degree of accuracy can be obtained. The method has been used with success for following the changes in composition in the gases pumped to the ether recovery plant in a nitrocellulose works. It could also be adopted for controlling the ventilation of mines and for estimating the degree of purity of certain industrial gases.—E. H. R.

Phenolsulphophthalein indicators; Spectrophotometric study of the "end points" and "fading" of ——. The quinone-phenolate theory of indicators. C. L. Brightman, J. J. Hopfield, M. R. Meuchem, and S. F. Acree. J. Amer. Chem. Soc., 1918, **40**, 1940—1944.

The phenolsulphophthaleins are twice as deeply coloured as phenolphthalein in alkaline solution, and show sharper colour changes. No appreciable fading is caused by the amount of alkali necessary to produce the "end point" of the neutralisation, and standardised stock solutions can be kept with ordinary care, without appreciable change occurring in the absorption index when treated with alkali. Tetranitrophenolsulphophthalein is not so satisfactory as an indicator, as, although giving an intense colour, it quickly fades with excess of alkali.—G. F. M.

Indicators; Quinone-phenolate theory of ——. A spectrophotometric method for measuring the concentrations of the quinoidal and lactoidal salts and the equilibrium and affinity constants of the phenolphthaleins and phenolsulphophthaleins. R. T. Birge and S. F. Acree. J. Amer. Chem. Soc., 1919, **41**, 1031—1050. (See also preceding abstract.)

By spectrophotometric methods the percentages of phenolphthalein indicators transformed into the coloured quinone-phenolate salts in alkaline solution were determined. With phenolphthalein itself only about 44% was so changed, the remainder forming colourless lactoidal salts. Of the tetrahalogen derivatives 1—2% only is quinoidal and these indicators are therefore very poor. The phenolsulphophthaleins and the phenoltetrachlorophthaleins however give 100% and 90% respectively of coloured quinone-phenolate salts, and are accordingly very good, intensely coloured indicators.—G. F. M.

Acids of group 1; Systematic procedure for the detection of ——. L. J. Curtman and D. Hart. Chem. News, 1919, **119**, 25—29, 37—40.

The chief points of the procedure recommended are as follows:—Preliminary precipitation of all the acids of group 1 by a mixture of barium chloride and calcium chloride. Treatment of the precipitate with hydrochloric acid to dissolve all but barium sulphate. Oxidation of sulphite to sulphate by hydrogen peroxide and precipitation of the sulphate by barium chloride. Removal of barium by ammonium sulphate. Separation of fluoride, arsenate, and phosphate from borate and tartrate in alkaline solution in the presence of a sufficient quantity of ammonium salts. Separation of oxalate and fluoride from arsenate and phosphate in an acetic acid solution containing excess of calcium salt. Reduction of arsenate to arsenite by sulphurous acid and separation of arsenite from phosphate by precipitation with hydrogen sulphide in hydrochloric acid solution. Separate tests for carbonates and chromates, and to determine the state of oxidation of arsenic.—W. P. S.

Free alkali or alkali carbonate; Determination of —— alone or in the presence of alkali hypochlorite. W. Mestrezat. J. Pharm. Chim., 1919, **20**, 9—14. (See Philibert, this J., 1919, 72 A.)

Free alkali or alkali carbonate may be titrated directly in hypochlorite solution after the hypochlorite has been decomposed with sodium thiosulphate. In the cold, and in concentration of less than N/80, carbonates can be titrated exactly to the bicarbonate stage when phenolphthalein is used as the indicator.—W. P. S.

Alkali hypochlorite solution; Determination of free alkali and alkali carbonate in ——. Philibert. J. Pharm. Chim., 1919, **20**, 52—55.

In view of a recent paper by Mestrezat (see preceding abstract), the author maintains the reliability of the iodoacidimetric method described previously by himself (this J., 1919, 72 A).—W. P. S.

Oxalates; Specific colour reaction of ——. H. Caron and D. Raquet. Ann. Chim. Analyt., 1919, II., **1**, 205.

A red coloration is obtained when an alkali oxalate solution is treated with 2 drops of 10% manganese sulphate solution, 1 c.c. of acetic acid and a few drops of potassium bichromate solution or alkali hypochlorite solution. The reaction is given by as little as 0·01 grm. of oxalic acid. In dealing with oxalic acid itself, or an acid solution of an oxalate, the acetic acid used in the test should be replaced by sodium acetate; insoluble oxalates may be boiled with sodium carbonate, the solution filtered, and the filtrate employed for the test. The inverse reaction may be used for the detection of manganese. (See this J., 1919, 574 A.) W. P. S.

Iron in iron ores; Determination of —— by permanganate. L. Brandt. Chem.-Zeit., 1919, **43**, 373—374, 394—397.

The addition of colloidal silica, as recommended by Schwarz and Rolfes (this J., 1919, 179 A), does not appear to serve any useful purpose in the titration of ferrous salts with permanganate in the presence of hydrochloric acid. There is a slight decrease in the quantity of permanganate required when colloidal silica is added, less permanganate being used the greater the amount of silica introduced. This takes place in both sulphuric and hydrochloric acid solutions, showing that the silica does not enter into the reaction between hydrochloric acid and permanganate. The action of colloidal silica in other reactions is also discussed. Decrease in the quantity of permanganate required for the titration is due to the oxygen in the water and reagents, this oxygen, in the presence of permanganate, ferrous salts, sodium silicate, etc., combining with the ferrous salt. Silicate does not appear to influence the combination of oxygen with ferrous salts except in the presence of permanganate. When air or oxygen is excluded, the effect of the silicate is almost inappreciable.—W. P. S.

Chromium; New method of determining ——. A. Terni and P. Malaguti. Gazz. Chim. Ital., 1919, **49**, I., 251—256.

A solution of a chromic salt is boiled with 20 c.c. of nitric acid (sp. gr. 1·4) and about 1 grm. of

lead dioxide until reduced to a few c.c. It is then diluted with 40 to 50 c.c. of water, and treated with sufficient sodium hydroxide solution (25 to 30%) to redissolve the precipitate of lead chromate. The solution is heated nearly to boiling and filtered, and the residue washed with boiling water rendered slightly alkaline with sodium hydroxide. The filtrate is diluted to 150—200 c.c., and treated with nitric acid (sp. gr. 1·2), free from nitrous acid, until the lead chromate has dissolved, when a further 25 c.c. of the same acid is added. The solution is treated with 5—10 c.c. of 10% potassium iodide solution, and the liberated iodine is titrated with a solution of sodium thiosulphate (about 25 grms. per litre), which has been standardised against *N*/10 potassium bichromate solution in the presence of 25 c.c. of nitric acid (sp. gr. 1·2). The method is applicable in the presence of iron, manganese, and aluminium.
—C. A. M.

Zinc and calcium; Determination of —— in the presence of lead. E. Nyman. Canadian Chem. J., 1919, **3**, 217—218.

The solution containing salts of the three metals is rendered strongly ammoniacal, then acidified with acetic acid, a few grms. of ammonium acetate is added, the mixture boiled, rendered slightly ammoniacal, and titrated at 80° C. with standardised ferrocyanide solution, using uranyl acetate acidified with hydrochloric acid as an external indicator. The latter gives a reddish-brown coloration with a drop of the mixture when all the zinc has been precipitated. To determine calcium, the procedure is the same up to the point where the slightly ammoniacal mixture is obtained; this is then treated with an excess of ammonium oxalate. The calcium is precipitated as oxalate; lead oxalate is soluble in ammonium acetate solution and zinc does not interfere.—W. P. S.

Tin, antimony, and arsenic; Separation of —— by Plato's [distillation] method. W. Hartmann. Z. anal. Chem., 1919, **58**, 148—156.

A modification of the method described originally by Plato (this J., 1910, 1179) is recommended. After the antimony and arsenic have been distilled in a current of carbon dioxide from a solution containing sulphuric, hydrochloric, and phosphoric acids, the residual solution is treated with a mixture of hydrobromic acid (sp. gr. 1·40), 1, and hydrochloric acid (sp. gr. 1·17), 3 parts, and the distillation continued at 130°—140° C. in a current of carbon dioxide until all tin has been carried over. The arsenic and antimony are separated by treating the strongly acid distillate with hydrogen sulphide in the cold; arsenic trisulphide is precipitated and is filtered off, the filtrate being then neutralised with ammonia and the antimony precipitated as sulphide.—W. P. S.

Arsenic; B.P. quantitative limit test for —— E. G. Jones. Analyst, 1919, **44**, 235—236.

In applying the B.P. arsenic test a convenient holder for the mercuric chloride paper is made from a transverse section of a grey rubber stopper, ¾ in. thick, through which is bored a hole just large enough to take the tube from the flask. A slit for about two-thirds of its width is made in the rubber, in a plane parallel to the ends, and the glass tube inserted into the hole so that its widened mouth projects into the slit. The mercuric chloride paper is placed over the mouth of the tube, and the two parts of the rubber pressed together by means of two screw clips, so that the paper is held firmly in position and no gas from the flask can escape through the slit.—C. A. M.

Arsenic; Modified method of determining —— as ammonium magnesium arsenate. O. Bailly. J. Pharm. Chim., 1919, **20**, 55—58.

Titration of precipitated ammonium magnesium arsenate is recommended; the precipitate, obtained as usual, is washed with dilute ammonia, next with 95% alcohol until all free ammonia has been removed, and is then titrated with *N*/2 hydrochloric acid, using methyl orange as indicator. Each c.c. of *N*/2 acid corresponds with 0·01875 grm. of arsenic.—W. P. S.

Bismuth compounds; Microchemical reaction of ——. G. Denigès. Bull. Soc. Pharm. Bordeaux, 1919, [1]. Ann. Chim. Analyt., 1919, II., **1**, 213—214.

To a mixture of 1 drop of dilute hydrochloric acid (1 : 1) and 1 drop of 5% hexamethylenetetramine solution on a microscope slide is added a small particle of an insoluble bismuth compound or a drop of a solution of a soluble bismuth salt. The mixture is then examined under the microscope directly, a cover-glass not being used. Colourless crystals will be observed surrounding the particles or at the junction of the two liquids (in the case of a solution); the crystals are hexahedral, rhombic dodecahedral or octahedral, or hexagonal plates. The reaction is given by practically all bismuth compounds.—W. P. S.

Cerium; Determination of —— in the presence of other rare earths by precipitation as ceric iodate. P. H. M.-P. Brinton and C. James. J. Amer. Chem. Soc., 1919, **41**, 1080—1085.

From a solution of the salts of the rare earths containing ¼ of its volume of nitric acid cerium is precipitated as ceric iodate by 10—15 times the theoretical quantity of potassium iodate in presence of potassium bromate. As this precipitate may include traces of neodymium it is re-dissolved in hot nitric acid and re-precipitated with iodate as before. The precipitate is collected, washed, and converted into cerous oxalate by boiling with oxalic acid until iodine vapours are no longer given off. The oxalate is then ignited in a platinum crucible and the cerium weighed as ceric oxide.
—G. F. M.

Halogens in organic compounds; The liquid ammonia-sodium method for [the estimation of] ——, the formation of cyanide, and method of removing it from the solution. C. W. Clifford. J. Amer. Chem. Soc., 1919, **41**, 1051—1060.

Treatment with sodium in liquid ammonia completely converts halogens present in organic compounds into sodium halide, and the method is applicable for their estimation provided that the cyanide which is always formed in varying proportion is efficiently removed. Boiling with nitric acid is only approximately quantitative except in the case of chlorine, but boiling of the solution for 1 hour with a slight excess (about 1 c.c.) of acetic acid in all cases effects a complete removal of hydrogen cyanide without loss of halogen acid. The halogen can then in most cases be estimated volumetrically by precipitation with silver nitrate and titration with thiocyanate. With aromatic compounds interfering colours may be produced, and it is then advisable to estimate gravimetrically.
—G. F. M.

Pyramidone; Various applications of —— in analysis. Eschalch. J. Pharm. Chim., 1919, **20**, 49—52.

Nitrites, ferric chloride, and oxidising substances in general yield a blue coloration when treated with

pyramidone solution and acetic acid. If pyridine is added, pyramidone may be used as a specific reagent for the detection of anaëroxydases. The presence of blood in urine is indicated by the formation of a blue coloration when 1 c.c. of the sample is added to a mixture of 1 c.c. of 10% pyramidone solution, 1 c.c. of pyridine, and 2 drops of hydrogen peroxide; it is not necessary to add acetic acid, but the addition renders the coloration more permanent. Raw milk also gives a blue coloration when treated similarly, but not boiled milk. Hydrocyanic acid may be detected by means of pyramidone; a blue coloration and a turbidity are obtained when a mixture of 1 c.c. of the reagent, 1 c.c. of 0·25% copper sulphate solution, and 10 drops of acetic acid is treated with a few drops of a cyanide solution. The inverse reaction may be used for the detection of traces of copper salts. A blue colour, rapidly changing to purple, is obtained when hydrogen peroxide is substituted for hydrocyanic acid in this test for copper; pyridine prevents the formation of the violet colour, thus distinguishing between traces of copper and blood.—W. P. S.

Kjeldahl's method; Simplification of —— in clinical chemistry. E. Pittarelli. Riv. crit. clin. med., 1919, No. 12. J. Pharm. Chim., 1919, **20**, 32—34.

Attention is directed to modifications which render this method applicable to the determination of nitrogen in various substances, *e.g.*, use of phenol in the case of nitrates and nitrites, removal of bromides and iodides by evaporation with hydrochloric acid, etc., and to the fact that there is a loss of nitrogen when permanganate is added to complete the oxidation. The author prefers to use a small quantity of persulphate when the substance has been almost completely oxidised by digestion with sulphuric acid alone. To determine nitrogen in urine, 1 c.c. of a 10% solution of the urine is digested with 2 c.c. of sulphuric acid containing 1 drop of phenol; in the case of blood, milk, serum, etc., 0·5 c.c. of a 10% solution is used. A crystal of potassium persulphate is added towards the end of the digestion; the mixture is then diluted, neutralised with sodium carbonate solution, using phenolphthalein as indicator, and 10 c.c. of a mixture of saturated sodium bicarbonate solution, 3 vols., and saturated mercuric chloride solution, 1 vol., is added. The turbidity obtained is compared with that produced by a known amount of ammonia.—W. P. S.

Nitrogen; Determination of —— by Kjeldahl's method. A. Villiers and A. Moreau-Talon. Ann. Chim. Analyt., 1919, **1**, 183—185.

To be certain that the nitrogen has been converted into ammonia and not partly into amines during the digestion stage of Kjeldahl's method, it is recommended that, in the subsequent distillation, the distillate should be collected in an excess of hydrochloric acid, evaporated, the residue dried, weighed, and its chlorine content determined. The quantity of ammonia calculated from the weight of the residue should agree with that calculated from the chlorine titration; if a part of the nitrogen has been converted into amines, the two results will not agree.—W. P. S.

Oxygen content of organic substances; Determination of the ——. R. Strebinger. Z. anal. Chem., 1919, **58**, 97—114.

When the percentage quantities of the other constituents are known, the oxygen content of an organic substance may be determined by oxidation with potassium iodate and sulphuric acid. The substance is heated at 200° C. with a known quantity (an excess) of potassium iodate and sulphuric acid until iodine vapours are no longer given off, the mixture is cooled, diluted, remaining traces of free iodine are expelled by boiling, an excess of potassium iodide is added, and the mixture titrated with *N*/10 thiosulphate solution. The oxygen content is calculated from the formula: $\%O = 2{\cdot}6666 \times \%C + (1 - 0{\cdot}21568 \times \%N/\%H) \times 7{\cdot}9369 \times \%H + 1{\cdot}497 \times \%S - 100\ O'/E$; where E is the quantity of substance taken and O' the oxygen obtained from the iodate. Six mols. of iodate yield 15 atoms of oxygen. The method may be applied to substances containing sulphur, halogens, and nitrogen, but the latter must not be present as amide.—W. P. S.

Proteins; Precipitation of —— by ammonium sulphate, in biochemical analysis. A. C. Hollande. Compt. rend. Soc. Biol., 1919, 567. J. Pharm. Chim., 1919, **20**, 92—94.

In the identification and examination of proteins by precipitin reactions, it is advantageous first to precipitate the proteins by means of ammonium sulphate; this effects a purification and concentration of the protein in question. In the case of urine containing albumin, a portion of the sample is saturated with ammonium sulphate, the precipitate is collected after 10 mins., washed with saturated ammonium sulphate solution, then dissolved in 0·9% sodium chloride solution, the solution filtered, and precipitin tests are applied to the filtrate.
—W. P. S.

Micro-elementary analysis. E. Diepolder. Chem.-Zeit., 1919, **43**, 353—354.

Detailed directions are given for the determination of nitrogen, carbon, hydrogen, and halogens, the quantity of substance used being only a few mgrms. Nitrogen is determined by combustion with copper oxide; the carbon dioxide employed is best obtained by heating sodium bicarbonate. Carbon and hydrogen are determined by combustion in oxygen in the usual way; the combustion tube contains lead peroxide, copper oxide, and platinised asbestos, or, in special cases, lead peroxide, a silver spiral, and a mixture of copper oxide and lead chromate. Carius' method, on a micro-scale, is employed for the determination of halogens.
—W. P. S.

Ash in coal and coke. Erhard. *See* IIA.

Spontaneous ignition. Schaper. *See* IIA.

Petroleum spirit. Chavanne and Simon. *See* IIA.

Melting-point of asphalts. Proctor. *See* IIA.

Eosins and erythrosins. Cocking and others. *See* IV.

Natural and artificial silks. Formhals. *See* V.

German woods. Schwalbe and Becker. *See* V.

Nitrous acid. Bellucci. *See* VII.

Aluminium sulphate. Bellucci and Lucchesi. *See* VII.

Arsenious and arsenic acids. Ramberg. *See* VII.

Air in clay. Spurrier. *See* VIII.

Clays. Jameson. *See* VIII.

Portland cement. Wolf. *See* IX.

Chrome yellow etc. Milbauer and Šetlík. *See* XIII.

Coumarone varnishes. Wolff. *See* XIII.

Dry substance of sugar products. Ogilvie and Lindfield. *See* XVII.

Refractometer in analysis. Faust. *See* XVIII.

Water in margarine. Monhaupt. *See* XIXA.

Barium sulphate precipitation. Froboese. *See* XIXB.

Chlorine in water. Herbig. *See* XIXB.

Digitalis preparations. Berry. *See* XX.

Valerianates. Richmond. *See* XX.

Identifying cyanic acid. Fosse. *See* XX.

Action of sulphuric acid on organic compounds. Milbauer and Němec. *See* XX.

Bismuth. Tallantyre. *See* XX.

Terebene. Howard. *See* XX.

PATENTS.

Gas-analyser. W. Kemp, St. Louis, Mo. U.S. Pat. 1,308,788, 8.7.19. Appl., 13.12.18.

A CHAMBER containing a liquid communicates with the source of the gas to be analysed; the liquid from this chamber is pumped into a second chamber, the rise and fall of liquid in the latter controlling the starting and stopping of the action of the pump.—W. P. S.

Gas-analysis apparatus; Automatic ——. J. A. Fries, State College, Pa. U.S. Pat. 1,309,681, 15.7.19. Appl., 17.11.17.

THE apparatus comprises two gas-measuring bulbs of the same capacity, each provided with a mercury valve, a pump for leading a gas through the apparatus at definite intervals, a gas-absorbing chamber, and an indicator of the amount of gas absorbed.—W. P. S.

Hardness of metals and other materials; Means for ascertaining the ——. R. A. Craig, H. Moore, and R. Mather, Woolwich. Eng. Pat. 128,894, 31.1.16. (Appl. 1473/16.)

A HARDENED ball, of 1 mm. diameter, is pressed into the metal by suspending freely a known weight on the ball. The ball is held in the upper part of a stirrup which carries a suitable load, and the stirrup as a whole may be lowered on to, or raised from, the specimen by means of a screw fitting through a cross-head above. Oscillation of the stirrup is prevented by carrying the suspension head on three triangularly spaced steel balls. The load varies from 2 to 100 kilos., according to the hardness of the material tested.—C. A. K.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Bailey and Hartley. Tunnel or muffle kilns. 20,726. Aug. 23.

Bedford, Fuller, and Roberts. Furnaces. 19,924. Aug. 13.

Bennett. Separation of solids of different specific gravity or inertia. 20,347. Aug. 19.

Case. 20,167. *See* XVI.

Davis. Pulverisers. 20,148. Aug. 16.

Humphries. Driers. 20,509. Aug. 21.

Marshall and Nielsen. Heat-exchange apparatus. 20,591. Aug. 21.

Marshall and Nielsen. Air-saturation towers. 20,593. Aug. 21.

Mauss. Centrifugal apparatus with planetary movement. 20,118. Aug. 15.

Morton. Apparatus for mixing or heating liquids etc. 20,642. Aug. 22.

Paterson. Filtering apparatus. 20,771. Aug. 23.

Sutcliffe. Agglomeration of finely-divided materials. 20,503. Aug. 20.

COMPLETE SPECIFICATIONS ACCEPTED.

4453 (1918). Slocum. Apparatus for treating material with gas or vapour. (130,680.) Aug. 20.

9429 (1918). Morton. Apparatus for drying vegetables and other materials. (130,714.) Aug. 20.

12,457 (1918). Carter, Wright, and Ratcliffe. Impregnation of porous or permeable substances or materials with liquid or plastic materials. (130,731.) Aug. 20.

12,760 (1918). Ionides. Drying powdered material. (130,755.) Aug. 20.

14,057 (1918). Erith's Engineering Co., and Erith. Two-stage apparatus for drying, carbonising, roasting, etc. (131,179.) Aug. 27.

16,023 (1918). Candy. Filters for the purification of liquids. (131,198.) Aug. 27.

17,811 (1918). Titan Co. Freeing liquids from particles suspended therein. (121,457.) Aug. 20.

1415 (1919). Johnson (Philadelphia Textile Machinery Co.). Drying or steaming or like apparatus. (130,889.) Aug. 20.

4589 (1919). Zulver and Smith. Furnaces. (130,912.) Aug. 20.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Armstrong, Davidson, and Low Temperature Carbonization, Ltd. Distillation of coal etc. 20,598. Aug. 21.

Armstrong, Davidson, and Low Temperature Carbonization, Ltd. Retort settings. 20,599. Aug. 21.

Broadbridge and others. 19,797. *See* XII.

Brown and White. Separating hydrocarbons and water. 20,689. Aug. 22.

Bury, and Skinningrove Iron Co. Recovery of valuable products from gases evolved in destructive distillation of coal, shale, etc. 20,157. Aug. 16.

Davidson. Manufacture of fuel. 20,710. Aug. 22.

Davidson. Manufacture of fuel for producer-gas. 20,711. Aug. 22.

Densified Peat Fuel and Products, Ltd., and Macdonald. Composition fuel. 20,277. Aug. 18.

Dibdin. Revivifying spent oxide. 20,322. Aug. 18.

Finlayson and Morgan. Separating and utilising sulphur from coal gas etc. 20,533. Aug. 21.

Harger. Manufacture of tarless fuel etc. 20,259. Aug. 18.

Hood, Spence, and Spence and Sons. Lubricants, anti-scouring agents, etc. 20,152. Aug. 16.

Jackson (Soc. Anon. la Combustion Rationelle). Apparatus for pulverising solid fuels. 20,420. Aug. 19.

Lamplough, and Synthol, Ltd. Conversion of heavy hydrocarbons into lighter hydrocarbons. 20,132. Aug. 15.

Leadbeater. Manufacture of artificial fuel. 20,735. Aug. 23.

Marshall and Nielsen. Gas-producers. 20,590. Aug. 21.

Marshall and Nielsen. Gas-washing apparatus. 20,592. Aug. 21.

Pardubitzer Fabr. der A.-G. für Mineralöl-Ind. vorm. D. Fanto und Co. Conversion of paraffin into fatty acids. 19,822, 19,823, 19,824, 19,921, 20,023. Aug. 12—14. (Austria, 2.9.16, 17.11.17, 29.1.18, 25.9.18, 23.12.18.)

Rambush. Removal of sulphur from gases. 19,702. Aug. 11.

Scott. Conversion of waste products of coal etc. into inflammable gas for consuming in furnaces. 20,651. Aug. 22.

Steinschneider. Boiler for distilling heavy hydrocarbons etc. 20,022. Aug. 14.

Stenning. Generation of producer-gas. 20,028. Aug. 14.

Szekely. Producing cakes of solid crude paraffin residue. 19,727. Aug. 11. (Austria, 30.11.18.)

Testrup. Fuel combustion. 20,666. Aug. 22.

Thompson. Paper fuel. 20,082. Aug. 15.

Wells. Gas-cleaning apparatus. 20,504. Aug. 20.

Wells. Gas-producers. 20,697. Aug. 22.

Yeo. Gas-producers. 20,568. Aug. 21.

COMPLETE SPECIFICATIONS ACCEPTED.

13,321 (1917) and 4963 (1918). Poore. Destructive distillation of wood, woody fibre, peat, etc. (131,006.) Aug. 27.

3702 (1918). Rideal and Taylor. Removal of sulphur and sulphur-containing bodies from gases. (130,654.) Aug. 20.

4757 (1918). Tinker. Fuel oils. (130,699.) Aug. 20.

4802 (1918). Dempster and Ballingall. Hydrogen-gas plants. (130,701.) Aug. 20.

10,895 (1918). Davies. Distillation, gasification, and the like of carbonaceous materials, and separation of the volatile matter. (131,105.) Aug. 27.

12,483 and 12,588 (1918). Ingeniörsfirma F. Egnell. *See* XXIII.

12,759 (1918). Barrow, Scott, and Cadbury Bros. Suction-gas producers. (130,754.) Aug. 20.

13,017 (1918). Helse. Removal of tar from gas. (131,125.) Aug. 27.

13,404 (1918). Simpson and Hislop. Gas manufacture. (130,796.) Aug. 20.

13,673 and 13,674 (1918). Senior and Bates. Gas-producers. (131,169 and 131,170.) Aug. 27.

14,057 (1918). Erith and others. *See* I.

19,645 (1918). Dalton. Artificial fuel composition and process. (122,402.) Aug. 20.

13,496 (1919). American Linseed Co. Artificial fuel. (127,585.) Aug. 27.

III.—TAR AND TAR PRODUCTS.

APPLICATIONS.

Barrett Co. Process of oxidising anthracene. 20,707. Aug. 22. (U.S., 1.11.18.)

Craig, Hood, and Spence and Sons. Treatment of pitch materials etc. 20,153. Aug. 16.

Evans, Hollings, and South Metropolitan Gas Co. Purification of benzole etc. 20,217. Aug. 16.

Howse. Nitration of oils. 20,192. Aug. 16.

Steinschneider. 20,022. *See* II.

COMPLETE SPECIFICATIONS ACCEPTED.

7032 (1918). Klein. Dehydration of tar. (131,087.) Aug. 27.

13,017 (1918). Helse. *See* II.

IV.—COLOURING MATTERS AND DYES.

APPLICATION.

Crompton, Ecroyd, and Entwistle. Packing, storage, and use of dyes etc. 20,517. Aug. 21.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Burby. Process of re-working old paper. 20,675. Aug. 22.

Clayton. Apparatus for manufacture of artificial silk. 19,802. Aug. 12.

Hansel. Manufacture of waterproof bookbinding calico etc. 20,048. Aug. 14. (Austria, 9.4.18.)

Howard and Kershaw. Manufacture or treatment of vulcanised fibre. 19,857. Aug. 13.

Johnson. Process for retting flax. 20,456. Aug. 20.

Thompson. 20,082. *See* II.

COMPLETE SPECIFICATIONS ACCEPTED.

3898 and 5052 (1918). Ward and Henshilwood. Treatment of fibrous substances. (130,662.) Aug. 20.

4181 (1918). Cochrane. Treatment of fabrics to render them invisible. (130,672.) Aug. 20.

6909 (1918). Sutherland and others. *See* XIII.

12,683 (1918). Spence and Sons, and Craig. Treatment of textile fibres and fabrics etc. to render them less inflammable. (130,743.) Aug. 20.

19,144 (1918). Fine Cotton Spinners' and Doublers' Assocn., Cunningham, and Cross. Treatment of cellulose textiles. (131,212.) Aug. 27.

3084 (1919). Witham. Apparatus for testing the resistance of paper to tearing. (130,905.) Aug. 20.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATION.

Lecloux. Apparatus for dyeing wool etc. 19,711. Aug. 11.

COMPLETE SPECIFICATION ACCEPTED.

7829 (1918). Barnes, and Spence and Sons. Mordanting vegetable fibres. (131,098.) Aug. 27.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

British Cellulose and Chemical Manufacturing Co., Hotz, and Soller. Manufacture of acetic acid. 20,574. Aug. 21.

Fairrie. Kilns for pyrites. 19,978. Aug. 14.

Finlayson and Morgan. 20,533. *See* II.

Glertsen. 20,021. *See* XX.

Hanna and Major. Production of a mixture of hydrogen and nitrogen. 20,124. Aug. 15.

Lundén and Thorssell. Apparatus for producing nitrogen products. 20,042. Aug. 14.

Morel. 19,901. *See* XII.

Nair. Production of caustic soda from brine by electrolysis. 20,784. Aug. 23.

Welford. 20,647. *See* X.

COMPLETE SPECIFICATIONS ACCEPTED.

1677 (1918). Heap and Newbery. Manufacture of metal chlorides. (130,626.) Aug. 20.
3590 (1918). Comp. des Prod. Chim. d'Alais. *See* XX.
4623 and 11,192 (1918). Pearson and Parkes. Fixation of nitrogen of the atmosphere. (130,693.) Aug. 20.
4802 (1918). Dempster and Ballingall. *See* II.
4877 (1918). Bailey, Denny, and Jefferis. Production of ammonium nitrate. (131,017.) Aug. 27.
5199 (1918). Clayton Aniline Co., Shedler, and Marchant. Manufacture of chlorsulphonic acid. (131,024.) Aug. 27.
5397 (1918). Quinan. Production of nitric acid. (131,029.) Aug. 27.
5596 (1918). Heap and Newbery. Manufacture of anhydrous chlorides. (131,039.) Aug. 27.
5741 (1918). Maxted. Synthetic production of ammonia. (131,049.) Aug. 27.
7082 (1918). L'Air Liquide Soc. Anon. Liberation of hydrogen from mixtures containing it. (131,091.) Aug. 27.
7576 (1918). Mond and Heberlein. Production of preparations containing colloidal copper compound for fungicidal and like purposes. (130,709.) Aug. 20.
7623 (1918). Hodson. Kilns for incinerating earth matters and limes, dolomites, and cements. (131,095.) Aug. 27.
15,691 (1918). Pierce. Manufacture of strontium peroxide. (130,840.) Aug. 20.
16,446 (1918). Tyrer. Manufacture of sodium permanganate. (130,844.) Aug. 20

VIII.—GLASS; CERAMICS.

APPLICATIONS.

British Thomson-Houston Co. (General Electric Co.). Refractory material. 20,386. Aug. 19.
Grace. Drying china clay etc. 20,763. Aug. 23.
Marlow. Ovens or kilns for manufacture of tiles, pottery, etc. 19,688. Aug. 11.
Morris. Pottery ware. 20,133. Aug. 15.
Norman. Ceramic kilns. 20,746. Aug. 23.

COMPLETE SPECIFICATIONS ACCEPTED.

7487 (1918). Marlow. Ovens or kilns for use in the manufacture of tiles, pottery, etc. (130,708.) Aug. 20.
7623 (1918). Hodson. *See* VII.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Crawford. Burnt concrete bricks. 20,130. Aug. 15.
De Bas. Composition consisting of cement, lime, or plaster, to which micaceous iron ore is added. 20,686. Aug. 22. (Holland, June 4.)
Entwisle. Supply of heat to tunnel brick dryers. 20,142. Aug. 16.
Holzapfel and Walther. 20,174. *See* X.

COMPLETE SPECIFICATIONS ACCEPTED.

7623 (1918). Hodson. *See* VII.
13,022 (1918). Pedersen. Process for making wood lastingly soft and pliable. (131,128.) Aug. 27.
13,567 (1918). Moncrieff and Hines. Cement. (131,164.) Aug. 27.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Ballantyne. Production of chrome iron or chrome steel alloys. 20,261. Aug. 16.
Broadbridge and others. 19,797. *See* XII.
Coles. Electrolyte for deposition of iron. 20,096. Aug. 15.
Collins. Means for recovering tin. 20,481. Aug. 20.
Conder. Apparatus for flotation and collection of minerals etc. 20,231. Aug. 18.
Harbeck. Electrolytic tinning process. 20,216. Aug. 16.
Holzapfel and Walther. Composition for coating iron, steel, and wood. 20,174. Aug. 16.
Jones. Production of malleable iron castings. 20,521. Aug. 21.
Laird. Aluminium tinning and soldering. 19,984. Aug. 14.
Newman. Protecting ferrous metals from rust. 20,656. Aug. 22.
Partington, Taylor, and Vivian. Treatment of ores by flotation. 19,715. Aug. 11.
Soc. Anon. des Laminoirs et Cablerie. Aluminium solders. 19,750. Aug. 11. (Switzerland, 9.8.18.)
Welford. Production of aluminium, sodium silicates, etc. 20,647. Aug. 22.

COMPLETE SPECIFICATIONS ACCEPTED.

5710 (1918). Coles. Rendering aluminium and its alloys more durable. (131,047.) Aug. 27.
13,026 (1918). Alloy Welding Processes, Ltd., and Jones. Manufacture of electrodes for soldering and depositing metals by the electric arc. (130,782.) Aug. 20.
13,210 (1918). Scott. Concentration of ores. (119,224.) Aug. 27.
13,231 (1918). Guess. Electrolytically separating nickel from copper. (118,629.) Aug. 20.
15,598 (1918). Ferguson. Apparatus for use in concentrating ores etc. (130,838.) Aug. 27.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Bolte and Slaughter. Dry batteries. 19,713. Aug. 11.
Branfield. Electrodes for electric furnaces. 19,666. Aug. 11.
Campbell. Electric furnaces. 20,034. Aug. 14.
Coles. 20,096. *See* X.
Coulson, and Opalyte, Ltd. Electric batteries. 20,197. Aug. 16.
Elmer. Electrical furnaces. 20,687. Aug. 22.
Fuller, Fuller, and Fuller. Galvanic batteries. 19,895. Aug. 13.
Harbeck. 20,216. *See* X.
Nair. 20,784. *See* VII.

COMPLETE SPECIFICATIONS ACCEPTED.

4527 (1918). Gow. Mounting electrodes of electric furnaces. (130,687.) Aug. 20.
4841 (1918). British Thomson-Houston Co., and Ash. Electric arc furnaces. (130,703.) Aug. 20.
6039 (1918). Fleming. Electric furnaces. (131,061.) Aug. 27.
12,749 (1918). Hutchison. Electric accumulators. (130,752.) Aug. 20.
13,231 (1918). Guess. *See* X.
13,984 (1918). Ridoni, and Soc. Talco e Grafiti Val Chisone. Manufacture of natural graphite electrodes. (123,972.) Aug. 27.
14,235 (1918). Bibby. Electric arc furnaces. (130,816.) Aug. 20.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Broadbridge, Edser, and Minerals Separation, Ltd. Treatment of emulsions etc. 19,797. Aug. 12.
Morel. Utilisation of a waste sulphite of soda and its derivatives in manufacture of soaps. 19,991. Aug. 13. (Fr., 28.8.18.)

Rogers. Manufacture of soap. 20,570. Aug. 21.
Stephens (Sharples Speciality Co.). Extraction of oily and fatty matters from wet sludges. 19,739. Aug. 11.
Vakil. Removing free fatty acids, deodorising, and refining oils and fats. 19,701. Aug. 11.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Arié. Antifouling paint for ships' bottoms. 20,577. Aug. 21. (Austria, 23.5.14.)
Holzapfel and Walther. 20,174. *See* X.

Complete Specifications Accepted.

6909 (1918). Sutherland, and Wall Paper Manufacturers, Ltd. Varnishes or dopes especially for applying to the fabrics of aeroplanes etc. (131,082.) Aug. 27.
11,601 (1918). Potter, and Damard Lacquer Co. Phenol formaldehyde condensation products. (131,112.) Aug. 27.
468 (1919). Muller and MacFarlane. Manufacture of luminous paint. (130,885.) Aug. 20.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Complete Specification Accepted.

17,908 (1918). North British Rubber Co. (Goodyear Tire and Rubber Co.). Manufacture of caoutchouc substances. (130,857.) Aug. 20.

XV.—LEATHER; BONE; HORN; GLUE.

Applications.

Serle. Production of casein cements. 20,665. Aug. 22.
Symington and Symington. Leather substitute. 20,154. Aug. 16.

XVI.—SOILS; FERTILISERS.

Application.

Case. Fertiliser grinding and drying apparatus. 20,167. Aug. 16.

Complete Specification Accepted.

7576 (1918). Mond and Heberlein. *See* VII.

XVIII.—FERMENTATION INDUSTRIES.

Applications.

Aktiebolaget Dansk Gærings-Industri, and Sak. Manufacture of yeast. 19,732, 19,733. Aug. 11.
Groll. Manufacture of fermentative preparations. 19,830. Aug. 12. (Austria, 13.12.17.)

Complete Specifications Accepted.

4047 (1918). Ricard. Manufacture of acetone and butyl alcohol by fermentation. (130,666.) Aug. 20.
5160 (1918). Henley. Treatment of fermenting wort or wash. (131,021.) Aug. 27.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Beckmann, and Veredelungsges. f. Nahrung- u. Futtermittel. Manufacture of fodder from straw. 20,134. Aug. 15.
Bennett. Device for determining the amount of water in grain. 20,663. Aug. 22.
Imperial Trust, and Piqué. Freezing fish etc. 20,667. Aug. 22.
Lendrich. Manufacture of coffee substitutes from cereals etc. 19,825. Aug. 12. (Ger., 28.4.17.)
Lendrich. Production of coffee substitutes containing caffein. 20,298. Aug. 18.
Marks (Robinson Co.). Treatment of coffee. 19,819. Aug. 12.
Rose. Food preparation and storage. 19,678. Aug. 11.
Serle. 20,665. *See* XV.
Stephens. 19,739. *See* XII.

Complete Specifications Accepted.

15,328 (1918). Linden. Treatment of sludge. (130,830.) Aug. 20.
16,023 (1918). Candy. *See* I.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Chem. Fabr. vorm. Sandoz. Manufacture of alkaloids. 20,223. Aug. 16. (Switzerland, 25.10.18.)
Giertsen. Production of urea or ammonia from cyanamide. 20,021. Aug. 14.
Soc. des Aciéries et Forges de Firminy. Manufacture of ethyl acetate from paraldehyde. 20,572. Aug. 21. (Fr., 13.3.18.)

Complete Specifications Accepted.

3589 (1918). Comp. des Prod. Chim. d'Alais et de la Camargue. Preparation of acetaldehyde from acetylene. (130,650.) Aug. 20.
3590 (1918). Comp. des Prod. Chim. d'Alais et de la Camargue. Preparation of acetic acid by oxidation of acetaldehyde. (130,651.) Aug. 20.
3797 (1918). Dreyfus. Manufacture of acetic anhydride. (130,660.) Aug. 20.
4047 (1918). Ricard. *See* XVIII.
6980 (1918). Crosfield and Sons, and Hilditch. Manufacture of acetaldehyde. (131,084.) Aug. 27.
7040 (1918). Boake, Roberts and Co., Durrans, and Ellis. Manufacture of esters. (131,088.) Aug. 27.
13,504 (1918). Confectionery Ingredients, Ltd., Matthews, King, and Kane. Manufacture of vanillin. (131,161.) Aug. 27.

XXII.—EXPLOSIVES; MATCHES.

Applications.

Adams. Utilising explosives. 20,431. Aug. 20.
Arnot and Beakbane. Removing amatol from shells etc. for recovering the ammonium nitrate. 19,969. Aug. 14.
Howse. 20,192. *See* III.
Marks (Davey, Bickford, Smith and Co.). Explosive charge for blasting. 20,576. Aug. 21.
Marks (Hamburger). Recovery of nitrating acid in the manufacture of nitrocellulose etc. 20,670. Aug. 22.

Complete Specification Accepted.

4029 (1918). Thomson, Severn, and Twycross. Manufacture of nitrated cellulose products. (130,665.) Aug. 20.

XXIII.—ANALYSIS.

Application.

Bennett. 20,663. *See* XIX.

Complete Specifications Accepted.

12,483 and 12,588 (1918). Ingeniörsfirma F. Egnell. Gas-analysing apparatus. (118,112 and 118,114.) Aug. 20.
13,323 (1918). Davis and Davis. Apparatus for the quantitative estimation of vapour pressures in gases. (131,154.) Aug. 27.

I.—GENERAL; PLANT; MACHINERY.

Evaporating pans; Determination of the efficiency of the heating surface of ——. H. Claassen. Z. angew. Chem., 1919, 32, 241—246.

In determining the heat-transmission value of an evaporating pan such factors as the air and oil content of the steam, the accumulation of condensed water in the heating jacket, the pressure of the liquid in the pan, etc., have to be taken into account. The "practical heat transmission value," K, signifies the average amount of heat transmitted by 1 sq. metre of the heating surface of an evaporator in the given unit of time for 1° C. difference in temperature, under the special conditions of the test. It is calculated by means of the formula, $K = W \div z\ F\ (t_1 - t_2)$, where W represents the amount of heat, z the time, F the heating surface, and $t_1 - t_2$ the difference in temperature. An evaporating test should continue for at least 10—15 mins., and the results are preferably calculated in hour-units. The amount of heat, W, transmitted during the test may be measured by determining the amount of steam used or the water formed by condensation (*i.e.*, in the case of dry steam), but the most accurate results are obtained by weighing the condensed water from the evaporated liquid, and calculating the amount of heat transmitted for 1 kilo of steam by means of the formula, $606{\cdot}5 - 0{\cdot}695\ td$. td being the temperature of the steam. The usually accepted definition of the difference of temperature as that between the temperature of the heating steam and of the boiling liquid on the heating surface is not applicable in the case of evaporating pans, apart from the fact that it is not possible to determine the temperature near the heating surface. The most trustworthy results are obtained from the determination of the pressure and temperature of the steam used for the heating and of that escaping from the evaporating liquid.—C. A. M.

Patents.

High temperature reactions; Method of and apparatus for conducting ——. N. Testrup, and Techno-Chemical Laboratories, Ltd., London. Eng. Pats. (A) 129,758, 12.6.18, and (B) 129,771, 3.7.18. (Appls. 9655 and 10,930/18.)

(A) A flat horizontal chamber is strongly heated by internal gas burners and is provided with a floor consisting of a thin magnesia slab or other refractory substance. The furnace walls extend slightly below the refractory slab, and the material is carried by a conveyor in a thin layer just below the floor of the chamber. The narrow space between the material and the floor is provided with an outlet pipe for the gaseous products of the reaction. The conveyor is protected in the heated zone by a layer of inert material which is deposited on it by a hopper in advance of the hopper containing the material to be treated. The apparatus may be used for the distillation of coal, and means may be provided to separate the treated material from the layer of inert material. (B) In apparatus of the type described in (A), the air or gas used for heating the furnace is preheated by passing it through a flat horizontal chamber over which the conveyor passes while subjected to the heat of the furnace. The combustion chamber is surmounted by a heat interchanging device through which the combustion products pass in a series of horizontal passages. The air from the preheating chamber passes through intermediate passages so that it is further heated before passing into the combustion chamber. (See also Eng. Pat. 115,087; this J., 1918, 357A.)

—W. F. F.

Furnaces and other heating appliances; Construction of ——. G. H. Roberts and W. N. Booth, Woolwich. Eng. Pat. 129,830, 27.1.19. (Appl. 12,337/18.)

A gas-heated furnace is arranged above a recuperator provided in a horizontal flue immediately below, and the whole is surrounded by a casing so that a space is left between the outer wall of the furnace and the inner wall of the casing. The waste gas from the furnace passes from a central opening at the top into the surrounding space and then downward into the recuperator, through which it passes in the opposite direction to that of the air and gas. The casing may be surrounded by an insulating layer and finally by an outer shell. The applications to an oven furnace, muffle furnace, crucible tilting furnace, and billet-heating furnace are described.—W. F. F.

Furnaces applicable for heating articles or pieces. G. E. Allin, Derby, and J. R. C. August, Halifax. Eng. Pat. 129,478, 29.7.18. (Appl. 12,304/18.)

The furnace chamber is divided into two longitudinal horizontal flues communicating at their ends and containing an endless conveyor passing over sprocket wheels in the end portions of the furnace. The articles to be heated are charged on to the upper part of the conveyor at one end and discharged at the other end, while hot gases from a gas burner pass over the conveyor in the opposite direction. The conveyor is composed of links, each having a flattened portion carrying a slab of cement, the sides of which project beyond the links and are close to the walls of the flue. The top of the upper flue may be inclined to the conveyor, being closer at the charging end, or may be serrated, to deflect the flame or hot gas downwards on the conveyor.

—W. F. F.

Gas-heated furnaces. King, Taudevin and Gregson, Ltd., W. Gregson, and J. King, Sheffield. Eng. Pat. 130,274, 1.2.19. (Appl. 2543/19.)

In a gas-fired furnace of the regenerative type, the waste gases pass from the combustion chamber along zig-zagging superimposed longitudinal flues composed of hollow bricks, and heat the supply of secondary air which passes through flues formed transversely over the top and up the sides of the said flues. The secondary air is delivered therefrom to a series of nozzles immediately above the gas ports, and the mixture of gas and preheated air is ignited and delivered to vertical side flues constituted of refractory blocks constructed in accordance with Eng. Pat. 125,258 (this J., 1919, 347A). The hot gases thereafter enter the heating chamber and pass therefrom to the preheating flues by outlets, situate one at each side of the front of the furnace, and on a level with the floor of the heating chamber.—J. S. G. T.

Gas-fired furnaces. Smeeton-Wright Furnaces, Ltd., J. E. Fletcher, and T. Wright, London. Eng. Pat. 130,475, 1.8.18. (Appl. 12,599/18.)

In furnaces employed for heating iron, steel, or other materials, an intermediate and a lower arch are arranged below one another and just below the top arch of the furnace crown. The two separate spaces included between these arches constitute preheating chambers for the gas and air respectively. A number of loose burner nozzles are placed in the intermediate arch and project towards or into mixing nozzles in the bottom arch, these latter being either fixed or self-adjustable, and provided with guiding tongues projecting upwards and extending a little above the lower ends of the burner nozzles. If desired, the

upper air or gas space may be dispensed with, the gas or air being led direct to the top set of nozzles through a suitable duct.—J. S. G. T.

Furnaces; Methods of, and apparatus for determining and indicating heat losses in ——, *and the constituent elements of these losses.* M. Chopin, Neuilly, France. Eng. Pat. 129,801, 17.7.18. (Appl. 11,724/18.)

A MEASURED volume of the chimney gas is caused to pass through and to be absorbed by a measured volume of sodium hydroxide solution, and the resultant change in specific gravity or in the electrical conductivity of the solution is indicated electrically by the needle of a galvanometer on a scale graduated in percentages of CO_2 in the chimney gas. Another galvanometer needle connected to a thermo-couple placed in the flue indicates on a scale graduated in temperature degrees the difference in temperature between the gas entering and leaving the furnace. The two scales are on the same instrument, and so arranged that the pointers cross one another. A third scale is provided between the other two, so that by noting where the intersection of the pointers falls on this scale a direct reading of the heat loss may be made. (See also this J., 1918, 568 A.)—W. H. C.

Air, vapour or gas; Superheaters for ——. F. O. Bynoe, Twickenham, Middlesex. Eng. Pat. 129,391, 9.4.18. (Appl. 6021/18.)

THE gas is heated by passing it downward through a series of horizontal heating flues arranged in a flue through which the hot gases from a furnace pass upward. The heating flues are arranged in such a way as to form a tortuous passage for the furnace gases. Each gas heating flue is provided with a longitudinal partition extending from its open end nearly to its closed end and slightly inclined to the horizontal so that the two passages thus formed increase gradually in cross section from their inlet to their outlet ends. The gas is thus allowed to expand as it is heated, while still maintaining a constant velocity. Each of the partitions is carried by a head piece which is inserted in the vertical wall of the casing so as to make a tight joint, and provide means for withdrawal.—W. F. F.

Drying cylinders. A., W., and T. Rigby, Bury. Eng. Pat. 129,577, 28.1.19. (Appl. 2011/19.)

THE drying cylinder is provided with dished ends, to the centres of which hollow nozzles are fixed. These serve as bearings and to attach the driving gear, but their chief function is to provide an outlet for condensed liquid. Each nozzle projects somewhat into the cylinder and is provided on the inside with four or more slots, through which the condensed liquid passes. Radial arms, which extend to the periphery of the cylinder and are provided with curved plates at their outer edges, are fixed between the slots, and serve to guide the liquid into the slots as the cylinder rotates.—W. H. C.

Drying apparatus. Maschinenfabrik Imperial G. m. b. H., Meissen. Ger. Pat. 312,017, 17.2.17.

A PERFORATED drum rotating in an outer casing is divided into a number of chambers by means of transverse partition walls, and hot air is supplied by means of an axial distributing pipe. Openings regulated by slides are provided at one or both ends of the drum, and pipes extend therefrom to supply external air as desired to the several chambers. The distributing pipe is constituted of a number of branches.—J. S. G. T.

Pressure or vacuum and temperature indicating gauges. The British Refrigerating Co., Ltd., and E. W. Jodrey, London. Eng. Pat. 129,808, 17.7.18. (Appl. 11,756/18.)

A PRESSURE and vacuum gauge is combined with a temperature indicator in the same instrument. The pressure within the vessel to which the gauge is attached acts on a Bourdon tube which is geared to a spindle by a toothed wheel. A pointer attached to the wheel behind the dial of the gauge is bent over the edge so that its end indicates on the front of the dial. The pressure thermometer is geared to a toothed wheel which fits as a sleeve on the spindle and has a pointer attached to it on the front of the dial. In order to indicate when the solution in the vessel has acquired any desired specific gravity, it is necessary to find by experiment at what temperature and pressure this is the case for any particular liquid. The gearing of the pointers and the graduation of the dial are then adjusted so that when this particular combination of temperature and pressure is reached the two pointers are in alinement. The gauge may be arranged to cut off automatically the supply of heating medium when the desired condition is reached, by causing the heating medium to pass through a valve chamber attached to the back of the gauge and having therein a valve actuated by the spindle.—W. H. C.

Gas washer. A. J. Liversedge, London, and W. B. Davidson, Huddersfield. Eng. Pat. 129,829, 29.7.18. (Appl. 12,334/18.)

IN a gas washer, comprising a connected series of superposed chambers, the washing liquid is circulated within each chamber by means of a pump. The liquid is delivered to each gas space in spray or jet form, or is caused to form a shower of drops by means of small points or projections on the under side of a tray or diaphragm, and is allowed to accumulate to a predetermined depth at the bottom of each chamber. The gas is broken up into streams by means of spaced openings in the tops or bottoms of the washing chambers, or by means of deflector plates covering the gas orifices.—W. E. F. P.

Smoke and fume [e.g., zinc oxide] or other dust-laden gas; Treatment of ——. W. E. Gibbs and R. J. Gilderson, Southampton, and H. E. F. Goold-Adams, London. Eng. Pat. 129,721, 7.12.17. (Appl. 18,179/17.)

STEAM or other suitable fluid is injected into the stream of dust-laden gas to cause the dust particles to coalesce into larger aggregates, which are carried forward and caught by screens placed transversely to the flow. The screens are constructed of fabric which consists partly or wholly of warp threads, supported on suitable frames and kept taut by means that are spaced apart and strengthened by cross battens.—W. H. C.

Tanks, conduits and the like; Construction of acid-resisting ——. Brookes Chemicals, Ltd., and N. Brooke, Lightcliffe. Eng. Pat. 129,709, 3.12.17. (Appl. 17,836/17.)

THE vessel is constructed of bricks. The outer layer is set in cement, then comes a layer of asphalt or bituminous material, and finally an inner layer of bricks set in, and grouted with, molten sulphur.
—W. H. C.

Refrigeration; Process of ——. F. E. Norton, Assignor to Jefferies-Norton Corporation, Worcester, Mass. U.S. Pat. 1,292,958, 28.1.19. Appl., 29.1.16.

THE latent heat of liquefaction of a gas is extracted by a circulating gas, the pressure of which is then raised and the resulting superheat removed. The circulating gas is then condensed by transferring the heat extracted by it to the liquefied gas, and the pressure of the circulating gas is reduced before it is again used for the extraction of latent heat as above.—W. F. F.

Pulverulent material; Machines for disintegrating and screening ——. L. M. Fraser, Romford, Essex, and F. Peel, London. Eng. Pat. 129,458, 17.7.18. (Appl. 11,730/18.)

An inverted conical screen is arranged coaxially within an inverted conical casing, each being provided with an outlet at the bottom. Two sets of horizontal beaters are arranged to rotate in opposite directions above the screen, and are carried by concentric solid and hollow shafts. The upper set of beaters, on to which the material is fed, is provided with a rim in the form of a truncated cone.—W. F. F.

Furnaces; Recuperators for ——. Smeeton-Wright Furnaces, Ltd., J. E. Fletcher, and T. Wright, Eng. Pat. 130,471, 1.8.18. (Appl. 12,582/18.)

Chequer bricks for regenerator chambers of furnaces and the like. T. Williams, Seaton Carew, and South Durham Steel and Iron Co., Ltd., Stockton. Eng. Pat. 130,479, 9.8.18. (Appl. 12,978/18.)

Separating dust and other particles from grain and other granular substances; Machines for ——. T. Robinson and Son, Ltd., C. J. Robinson, and T. J. Stevenson, Rochdale. Eng. Pat. 130,514, 16.10.18. (Appl. 16,882/18.)

Fires; Process of and apparatus for extinguishing ——. W. W. Walker, Camden, N.J., U.S.A. Eng. Pat. 130,550, 30.1.19. (Appl. 2304/19.)

Evaporating liquids; Method of and apparatus for ——. O. Carr, New York, Assignor to E. W. Deming, New Orleans. U.S. Pat. 1,312,019, 5.8.18. Appl., 24.9.17.

See Eng. Pat. 117,469 of 1917; this J., 1918, 496A.

Separating solids from suspension in liquids; Method of —— and apparatus therefor. W. J. Gee, London. U.S. Pat. 1,312,316, 5.8.19. Appl., 15.6.16.

See Eng. Pat. 9365 of 1915; this J., 1916, 1206.

Briquettes; Press applicable for the production of —— and for other purposes. E. R. Sutcliffe, Leigh, Assignor to Pure Coal Briquettes, Ltd., Cardiff. U.S. Pat. 1,312,367, 5.8.19. Appl., 30.10.15.

See Eng. Pat. 13,796 of 1915; this J., 1917, 205.

Generating combustion products. Eng. Pat. 129,725. *See* IIA.

Generating steam and combustion products. Eng. Pat. 129,806. *See* IIA.

Retorts etc. Eng. Pat. 130,175. *See* IIA.

Emulsion. Eng. Pat. 129,757. *See* XII.

Filter. Eng. Pat. 129,599. *See* XVIII.

Drying liquids. Eng. Pat. 129,388. See XIXA.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Oxidation of ——. F. V. Tideswell and R. V. Wheeler. Chem. Soc. Trans., 1919, **115**, 895—902.

Mixtures of carbon monoxide and air, and air and hydrogen respectively have been circulated over powdered coal from the "durain" portion of the thick coal seam, Hamstead Colliery, at 100° and 200° C. No trace of hydrogen could be detected in oxygen which had been circulated over coal at 100° for several days. Moist mixtures of carbon monoxide and air circulated over coal at 100° suffered no change other than that due to the action of oxygen on the coal. No hydrogen was formed. Mixtures of hydrogen and air circulated over coal at 100° suffered no loss of hydrogen. In each set of experiments the usual formation of carbon dioxide and carbon monoxide, in the ratio 2·4 : 2, took place.—J. F. S.

Steaming of horizontal retorts. P. B. Ellacott. Gas. J., 1919, **147**, 451—452.

In a series of trials extending over five months, steam was admitted to the retorts at a pressure of 2 lb., the steam entering the retorts at the bottom of their back ends. The heavy charges were carbonised for 12 hours and subsequently steamed for 36 hours. Little depreciation of the retorts occurs if the period of steaming does not exceed 36 hours. In the trials with steaming, the gas made per ton of coal averaged 14,200 cub. ft., having a calorific value of approximately 450 B. Th. U., and the proportion of water-gas to coal gas was 10 : 15. Without steaming, the yield of gas was 12,000 cub. ft. Further trials over a period of six weeks gave results, with steaming, indicating the production of 15,030 cub. ft. of gas per ton of coal, compared with 11,218 cub. ft. without steaming. The yields of tar and ammonia are increased by steaming, and the process possesses labour-saving advantages. —J. S. G. T.

Explosions; Factors limiting the maximum pressures developed in gaseous ——. W. T. David. Engineering, 1919, **108**, 251—252.

The maximum pressure developed during the explosion of an inflammable mixture is only about half that expected from theoretical calculations based on the assumption that the whole of the inflammable gas is burnt completely and that the volumetric heat (*i.e.*, the amount of heat required to raise the temperature of unit volume of gas 1° C. when the volume is constant) of the product of combustion is independent of the temperature. It is known that the volumetric heat of carbon dioxide and of steam increase very rapidly with the temperature, and this may account for half the "missing pressure"; the remainder of this "missing pressure" is due to: (1) Translational energy of the molecules. (2) Internal energy of the molecules including their rotational and vibratory energy respectively, which will vary with the temperature. In a gaseous explosion the chemical energy of combination appears first to be transformed into internal energy of the combining molecules, the excess of internal energy then being transformed into translational energy at an unknown but apparently rapid rate. The author's experiments indicate that the vibratory energy of the molecules at the moment of maximum pressure is somewhat in excess of the equilibrium amount corresponding to the temperature, and W. M. Thornton has concluded that the rotational energy of the molecule at the amount of maximum pressure is above its equilibrium value. Hence part of the energy of combustion is hidden away as an excess of molecular energy, some of this excess being gradually transformed into pressure energy. (3) Heat lost by conduction and radiation to the walls of the containing vessel, which may, at the moment of maximum pressure, exceed 12% of the total heat of combustion. (4) Incomplete combustion (the presence of unburnt gas having been shown by Clerk). (5) Dissociation of the carbon dioxide and water vapour at the high temperature attained. (6) Ionisation and luminescence (probably of little importance). If, as a result of certain experiments suggested, the known internal energy of the mixed gases were found to differ considerably from that calculated

from the volume heat at the temperature of the mixed gases, it would show that the excess molecular internal energy is considerable, and its conversion into other forms of energy slow, and would probably account for much of the "missing pressure."

—A. B. S.

Benzol in coal gas. St. Claire Deville. Metz Congress, Soc. Technique du Gaz. Gas. J., 1919, **147**, 392—394.

IN the present review of experimental work extending over 30 years, data are given relating to the development of the author's method of determining benzol in coal gas by freezing, and to the amounts and composition of the benzol obtained by this means from normal and debenzolised coal gas and from gas produced from different coals at various temperatures and periods of carbonisation. The effects of benzol on the illuminating power and calorific value of coal gas, and the influence of seasonal atmospheric temperature on the benzol content of the gas are also considered, together with the solubility of benzol in water under the conditions of gas storage.—W. E. F. P.

Petroleum oils; Absence of terpenes from crude ——. J. Tausz. Z. angew. Chem., 1919, **32**, 233—235.

THE terpenes generally appear to be capable of reacting at the ordinary temperature with mercury salts such as mercuric acetate in alcoholic solution, either giving rise to mercury derivatives or undergoing oxidation. Examination of six crude petroleum oils by this reagent gave no indication of any appreciable quantity of terpenes.—D. F. T.

Critical temperatures of solution (T C D) in aniline of mixtures of hydrocarbons. Application to the analysis of petroleum spirits. C. Chavanne and L. J. Simon. Comptes rend., 1919, **169**, 185—188.

A MIXTURE of two acyclic hydrocarbons, or of one acyclic and one saturated cyclic hydrocarbon, obeys the law of additivity in so far as its critical temperature of solution in aniline is concerned, but a mixture of two saturated cyclic hydrocarbons does not obey this law. If to a mixture of hydrocarbons, free from aromatic hydrocarbons, benzene is added to an extent not exceeding 10—15%, then the depression of the T C D in aniline is proportional to the percentage of benzene added, the ratio being 1:1·14. For toluene the coefficient is 1·19, and for xylene 1·24. The above results furnish the basis for the method of analysis of a petroleum spirit previously described (see this J., 1919, 619A). It is necessary, however, first to fractionate the petroleum so that there is only one saturated cyclic hydrocarbon in any fraction.—W. G.

Petroleum spirit; Production of —— from lignite tar by cracking under atmospheric pressure. F. Fischer and W. Schneider. Ges. Abhandl. zur Kenntnis der Kohle, 1917, II., 36—56. Chem. Zentr., 1919, **90**, II., 866—867. (Cp. this J., 1917, 587.)

EXPERIMENTS were carried out in an iron retort fitted with a superheating tube; the apparatus was so designed that only products boiling below a certain temperature distilled, whilst those of higher boiling point returned to the retort. Catalysts of various kinds, introduced into the superheating tube, exerted little influence; they affected the yields appreciably, but did not enable the cracking temperature (530°—560° C.) to be lowered. Much higher yields of gases and lower yields of liquid products were obtained than in the previous experiments at high pressures (*loc. cit.*). The yields of spirit boiling between 35° and 150° C. from paraffin and lignite tar were 34% and 15% respectively, compared with 47% and 25% under pressure (*ibid.*). The quantity of petroleum spirit carried away by the gases amounted to 3—4% on the average. The fractions resembled those obtained under pressure in odour and colour, their specific gravity was somewhat higher, and they were much richer in unsaturated compounds. Treatment with sodium hydroxide alone effected considerable improvement in odour and colour, but better results were obtained with warm alkali and zinc chloride.

—J. H. L.

PATENTS.

Pulverised fuel; Employment of —— in the furnaces of steam generators [locomotives]. J. G. Robinson, Manchester. Eng. Pat. 130,486, 16.8.18. (Appl. 13,359/18.)

THE invention refers to improvements in the general arrangement of the apparatus described in Eng. Pat. 109,063 (this J., 1917, 1123), whereby greater convenience and efficiency in use are secured. A small steam engine is provided for driving the fuel screw conveyors through a two-speed gear, and also for driving the fan or blower supplying the forced draught if necessary.

—J. S. G. T.

Coke; Method of regulating the quality of ——. W. L. Graul, Detroit, Mich., Assignor to Semet-Solvay Co., Solvay, N.Y. U.S. Pat. 1,308,754, 8.7.19. (Appl. 7.1.19.)

PITCH or breeze is added to the coal before coking in such proportion as to correct the excess or deficiency of coking substance and to produce the desired degree of toughness and hardness in the coke.—L. L. L.

Coal tar pitch and the like; Treatment of —— for the production of fuel. S. Pearson and Son, Ltd., J. S. Smith, and J. E. Hackford, London. Eng. Pat. 129,393. (Appls. 6280, 13.4.18, and 8470, 21.5.18.)

COAL-TAR pitch, coal, coal products, or the like are heated in a retort or still to about 750°—850° C., preferably the lower temperature for about eight hours, and then for a further two hours after rapidly increasing the temperature to about 850° C. The distillation is effected in a horizontal retort arranged in a combustion chamber, so that its ends, which are provided with doors, project through the walls of the chamber; the retort is supported from above by a steel frame or the like, whilst below the centre line of the retort is a chequered brick wall packed on the top with asbestos, which is compressed when the retort expands, forming a supporting cushion. The spaces between the projecting ends of the retort and the surrounding brickwork are packed with asbestos, so that the retort is free to expand and the chamber does not support any of its weight.

—T. H. B.

Liquid fuel. S. Pearson and Son, J. S. Smith, and J. E. Hackford, Westminster. Eng. Pat. 129,495, 15.8.18. (Appl. 13,285/18.)

DISTILLATE from coal tar pitch (see preceding abstract) is dissolved in creosote or other suitable solvent and mixed with petroleum fuel oil. A suitable mixture consists of 1 vol. of coal-tar pitch distillate, 1 vol. of creosote, and 2 vols. of fuel oil.

—T. H. B.

Slag or the like; Apparatus for the separation of coke or carbon from ——. Soc. "Le Coke Industriel," St. Etienne, France. Eng. Pat. 120,932, 23.11.18. (Appl. 19,322/18.) Int. Conv., 23.11.17.

SLAG or the like material containing coke or carbon

is fed by a horizontal stream of water over openings through which ascending currents of water flow; the material is conveyed over horizontal plates arranged at gradually descending levels, between which the spaces for the rising currents of water are arranged. In front of the horizontal plates and below the spaces, inclined plates, solid or perforated, are arranged to form the tops of compartments into which the water for the rising currents is fed. The heavier material falls through the spaces and is collected in a trough at the bottom, whilst the lighter particles are carried to the outlet. —T. H. B.

Coke ovens or the like. T. Marr, W. Colquhoun, and The Coke Oven Construction Co., Ltd., Sheffield. Eng. Pats. (A) 129,432 and (B) 129,433, 9.7.18. (Appls. 11,256 and 11,257/18.)

(A) A COKE oven of the horizontal flue type has two sets of vertical air-supply flues at both ends of the horizontal heating flues, fed from one or more main air-flues at the bottom and at the top of the oven respectively, the first set of flues extending approximately half way up the oven, and the second set halfway down. The ends of the heating flues are tapered on the sides which are towards each other, and the vertical air flues between the tapered ends are correspondingly tapered on both sides. (B) The oven is of the regenerative type, in which only two parallel series of horizontal heating flues are provided in each dividing wall, and a combined air-supplying and heating flue extends up the same wall at one end of the series and communicates only with the top flues. The vertical flue is divided into two separate smaller flues in the same vertical planes as the horizontal heating flues and communicating with the top horizontal heating flues, thus reducing the thickness of the wall. An additional branch vertical air-supply flue may be provided at the opposite end of the horizontal flues to that at which the double vertical flue is situated.—T. H. B.

Mechanical retorts or heating chambers. T. Phillips, Bideford, Devon. Eng. Pat. 130,175, 8.8.18. (Appl. 12,846/18.)

THE material to be carbonised or otherwise treated is passed through the retort by means of an endless travelling scraper, which moves along the top of a flue arranged centrally in and extending the greater part of the length of the retort. The flue is divided into two longitudinal compartments, and communicates at one end with the furnace flue for the supply of hot gases, and at the opposite end with the chimney flue which is situated over the top of the retort. A feed inlet for supply of material to be treated has a pivoted plate at its lower end, and this plate is alternately raised and lowered by means of plates projecting from the scraper, the material being thereby agitated and distributed. The material is discharged through an outlet in the bottom of the retort, wherein a rotating roller provided with peripheral pockets is arranged so that the discharge occurs at regular intervals.—J. S. G. T.

Gas-producer. H. L. Millner, Morganton, N.C. U.S. Pat. 1,312,411, 5.8.19. Appl., 9.9.18.

A GAS-PRODUCER comprises a furnace, a stationary grate, and a rotary grate having the form of a basket. The rotary grate is provided with an opening directly above the stationary grate, and its sides are of unequal length and slope so that the rotation of the grate causes an upward heaving motion of the fuel above, the ash being drawn across the bars of the stationary grate.—J. S. G. T.

Illuminating gas; Process of recovering by-products of ——. W. H. Fulweiler, Wallingford, Pa., Assignor to United Gas Improvement Co., Philadelphia, Pa. U.S. Pat. 1,310,748, 22.7.19. Appl., 18.9.16.

To recover toluol from illuminating gas, the gas is scrubbed with oil saturated with benzol, xylol, and unsaturated hydrocarbons in the same proportions as they are contained in the gas. The temperature of the gas is raised during the scrubbing operation so as to balance the vapour tension of the scrubbing oil before and after the operation. —W. F. F.

Gas; Process and apparatus for the production of illuminating ——, power gas, and coke. F. Muhlert, Göttingen, Germany. Ger. Pats. (A) 311,078, 8.8.16, and (B) 311,495, 8.5.17.

(A) IN a vertical retort the lower part of which is designed to serve as a (water-) gas generator, gasification of the coal is effected by the heat of the gases from the generator portion of the retort, the heating of the coal being carried only so far as to effect complete coking, whilst after the coking period is ended gasification is completed by a strong blast of air or steam through the generator. The retort has special outlet pipes for the gas produced, and discharge openings for the coke above the level of the generator portion. It is claimed that as there are no intensely heated retort walls the gas produced is rich in hydrocarbons, and high yields of tar and ammonia are obtained. The yield of ammonia can be further increased by injection of a strong blast of steam in the later stages of gasification. (B) In a retort of the kind claimed above, the generator space is partially separated from the retort space proper by perforate or imperforate vertical walls extending about two-thirds the height of the retort, so that the generator space may be charged with a different fuel from that in the rest of the retort.—J. H. L.

Carbon monoxide; Material for removing —— from gases. South Metropolitan Gas. Co., and J. M. Somerville, London. Eng. Pat. 130,383, 7.2.18. (Appl. 2239/18.)

FUSED alkali (2·2 parts) is incorporated with asbestos (0·8 part) and heated at 700° F. (370° C.) to produce an apparently homogeneous pasty mass, which only deliquesces slightly and at 680°—700° F. readily removes carbon monoxide from gases. —A. E. D.

Combustion products under pressure; Apparatus for generating ——. C. M. Pattison, Pengam, Mon. Eng. Pat. 129,725, 10.12.17. (Appl. 18,262/17.)

THE apparatus consists of two or more explosion chambers, each having means for igniting the fuel charges, a valve-controlled chamber into which the products of combustion are received, and a compressed-air chamber, the arrangement being such that the timing of the ignition is controlled automatically by the pressures in the explosion and compressed-air chambers. Means are provided for mixing air from the compressed-air chamber with the fuel to form the vaporised charge; for utilising the gases remaining in any one combustion chamber (after the main products have passed to the receiving chamber) in operating the air compressor; and for utilising the pressures in the air and receiving chambers for starting the air compressor. The air in the compression chamber is heated by contact with the valves or adjacent parts through which the gases are admitted to the receiving chamber, and any excess of predetermined maximum pressure in

the latter is adapted to stop the supply of fuel and the ignition.—W. E. F. P.

Steam and products of combustion; Generator for producing and utilising mixed ——. M. F. Torazzi, Sandgate, Queensland, and G. W. C. Webb, Dartford. Eng. Pat. 129,806, 17.7.18. (Appl. 11,729/18.)

THE products of combustion from a high-pressure and high-temperature burner are caused to pass through a series of expanding nozzles of progressively increasing diameter, the arrangement forming an ejector to which water is fed. The water is vaporised, by the high temperature of the gases and flame, as it enters the nozzles, and the product, consisting of mixed steam and gases, is conveyed at high velocity to a motor, turbine, or other power generator in which the kinetic energy of the mixture is utilised.—W. E. F. P.

Retort waste; Process and machine for reclaiming ——. O. Gerlach and C. B. Libme, Assignors to the Industrial Research Laboratories, Chicago, Ill. U.S. Pat. 1,312,173, 5.8.19. Appl., 17.12.17.

WATER is sprayed into the retort, slag is screened from the coke, and the latter is coated with hot tar.—A. E. D.

Lubricating oils. H. M. Wells, St. Annes-on-Sea, and J. E. Southcombe, Birkenhead. Eng. Pat. 130,377, 5.2.18. (Appl. 2055/18.)

THE superiority of a "compounded lubricating oil" over a pure mineral oil is due to the presence of a small amount of free fatty acid, pre-existing in the added saponifiable oil or formed therefrom by hydrolysis. It is therefore proposed to prepare lubricating oils by adding to mineral oil such a quantity as 1 or 2% of a free fatty acid, which may or may not be incorporated with another oil as vehicle. The use of acids of low molecular weight, *e.g.*, butyric, cinnamic, and naphthenic acids, results in the formation of a non-emulsifiable oil, whereas acids of high molecular weight such as those obtained from rape oil, wool grease, or whale oil, form emulsifying oils suitable for marine lubrication.—A. E. D.

Oils; Process and apparatus for refining [mineral] ——. J. R. Miller, Okmulgee, Okla. U.S. Pat. 1,312,265, 5.8.19. Appl., 13.3.18.

THE oil is cracked and a portion of the volatile products is separated into fixed gases, heavy oils, and vapour of specific gravity intermediate between those of the light and heavy components. The vapour is fractionated and the lighter portions are condensed.—A. E. D.

Petroleum-bearing sands or shale; Separating the petroleum content from ——. F. Navin, Salt Lake City, Utah. U.S. Pat. 1,312,266, 5.8.19. Appl., 15.4.18.

WATER and a solvent for petroleum are added to the sand or shale; after thorough mixing the constituents separate out according to their densities.
—A. E. D.

Petroleum-oil; Filtration of ——. J. C. Whitman, Sugar Creek, Assignor to H. G. Whitman, Franklin, Pa. U.S. Pat. 1,312,375, 5.8.19. Appl., 12.2.19.

THE oil is filtered through bog iron-ore.—A. E. D.

Oil; Process of purifying ——. A. E. Miller, Port Arthur, Tex., Assignor to Gulf Refining Co., Pittsburgh, Pa. U.S. Pat. 1,311,987, 5.8.19. Appl., 26.6.17.

OILS which have been subjected to the action of aluminium chloride are treated with a current of air, whereby the suspended or dissolved reagent is converted into a condition in which it readily settles out.—A. E. D.

Oils; Removal of sulphur from ——. G. F. Forwood and J. G. Taplay, London. Eng. Pat. 129,349, 27.10.17. (Appl. 15,672/17.)

THE oil is agitated with a solution of alkali or alkaline-earth sulphides, either at atmospheric temperature or at about 40° C.—W. E. F. P.

Alcohol; Denaturant for the purpose of rendering —— unfit for human consumption. A. F. Joseph, London. From W. N. Rae and C. T. Symons, Colombo, Ceylon. Eng. Pat. 120,904, 21.11.18. (Appl. 19,095/18.)

THE denaturant consists of one or more essential oils, with or without a mineral oil or product thereof; *e.g.*, 197 parts of alcohol is treated with 2 parts of citronella oil and 1 part of kerosene, paraffin oil, or mineral naphtha.—J. H. L.

Gas mains of coke-ovens and the like; Means for regulating the pressure in the ——. Simon-Carves, Ltd., and J. T. E. Preston, Manchester. Eng. Pat. 130,106, 23.4.18. (Appl. 6812/18.)

Burners for liquid fuel. J. A. Curle and W. Sellar, London. Eng. Pat. 130,132, 19.7.18. (Appl. 11,869/18.)

Distillation of coal; Apparatus for the ——. A. Pinet and A. Debout, Paris. U.S. Pat. 1,312,352, 5.8.19. Appl., 17.7.15.

SEE Fr. Pat. 475,716 of 1914; this J., 1916, 33.

Gas-heated furnaces. Eng. Pat. 130,274. *See* I.

Gas-fired furnaces. Eng. Pat. 130,475. *See* I.

Gas washer. Eng. Pat. 129,829. *See* I.

Hydrogen. Eng. Pat. 129,743. *See* VII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Luminescence due to radioactivity. E. Karrer and D. H. Kabakjian. J. Franklin Inst., 1918, **186**, 317—340.

THE self-luminous paints on the market, consisting generally of mixtures of zinc sulphide with a radioactive substance, gradually diminish in brightness. It has now been found that the brightness of these mixtures can be restored almost to its initial value by heating. The radium salts themselves show this property, and a careful study has been made of the behaviour of radium bromide. The brightness of a freshly prepared specimen of the salt greatly diminishes in the course of a few days; but when the specimen is gradually heated it suddenly returns to its original brightness, which, however, diminishes as the temperature increases until at a dull red heat the luminosity sinks to zero. On cooling, the brightness increases until room temperature is reached, and then in the course of a few days falls to a low value; the cycle of changes can apparently be repeated indefinitely. These phenomena have been studied quantitatively with the object of determining whether self-luminous materials could be utilised as standard light sources in pyrometry and photometry. With radium bromide the brightness obtained depends on the temperature to which the specimen is heated, increasing to a maximum at about 450° C., and then decreasing with higher temperatures. The degree of bright-

ness obtained by heating to a particular temperature is approximately proportional to the percentage of radium element in the specimen. Curves are given showing the falling off in brightness with time, very rapid at first, then gradually approaching a constant value. The authors describe two instruments for determining brightness, in which a tube containing self-luminous radioactive material is used as a standard light source. The light to be examined is brought into photometric balance with the standard by rotating a Nicol prism through which it is observed, the reduction in intensity being read off on a scale attached to the rotating prism. The standard can at any time be restored to its initial brightness by removing it from the instrument and reheating. —E. H. R.

Electric glow lamps; Removal of residual gases from ——. L. Hamburger. Proc. K. Akad. Wetensch., Amsterdam, 1919, **21**, 1062—1077.

PHOSPHORUS vapour, in the presence of electric discharges, reacts rapidly with the residual gases in electric incandescence lamps. The same action is observed when the filament is coated with a silicate. At high temperatures silicates containing combined alkali react with tungsten, an alkali metal being liberated, and this metal removes the residual gases in the same way as phosphorus. On account of the reaction between tungsten and glass, the use of this metal for "leading in" wires becomes a possibility. When rapidly cooled, the vaporised silicate has different properties from those of the normal glass, since it is in a supercooled condition, and this condensate decreases the blackening of the wall of the lamp produced by the vaporised tungsten. (See also J. Chem. Soc., Oct., 1919.) —J. F. S.

Tungsten layers; Absorption of light by thin ——. L. Hamburger, G. Holst, D. Lely, and E. Oosterhuis. Proc. K. Akad. Wetensch., Amsterdam, 1919, **21**, 1078—1088.

THE loss of light occasioned in tungsten lamps may be reduced by spraying the filament with sodium chloride, sodium phosphate, potassium cyanide, sodium oxide, sodium chloride, or calcium fluoride. When the current is passed these substances sublime and condense on the walls of the lamp in a non-crystalline condition and have the effect of reducing the blackening and thus increasing the life of the lamp. If the deposit is rendered crystalline by the introduction of moist air it loses its efficacy. By using sodium chloride the life of the lamp is increased 2·6 times and by using calcium chloride 3·6 times. (See also J. Chem. Soc., Oct., 1919.) —J. F. S.

PATENTS.

Electrodes for arc lamp projectors. The Sperry Gyroscope Co., Assignees of P. R. Bassett, New York. Eng. Pat. 129,735, 13.12.17. (Appl. 18,536/17.) Int. Conv., 18.12.16.

THE horizontal positive electrode, for projectors working at low amperages, is provided with a carbonaceous core of light emitting mixture, and an easily-oxidised pure carbon shell adapted to form a shallow crater, and to promote rapid spindling of the electrode by oxidation, so that substantially only the core is exposed at the arcing end. The negative electrode is provided with a core of arc-sustaining materials (alkali salts) and is arranged at a steep angle, so that the tip of the negative is slightly below or in line with the core of the positive electrode. The negative flame thus sweeps past the positive electrode tip, almost vertically adjacent to it, without enveloping it.—B. N.

Leading-in wires of electric [incandescence] lamps and like apparatus; Hermetic seals for the ——. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, U.S.A. Eng. Pat. 130,212, 26.9.18. (Appl. 15,684/18.)

A CONDUCTOR having an oxidisable surface is sealed into glass by applying to the portion of the conductor to be sealed a vitreous enamel consisting essentially of unreduced lead borate, and proportioned to be slightly less viscous than the glass at the sealing temperature. Substantially no change is produced in the coefficient of expansion of the glass, which is heated with the enamel to form a hermetic seal with the conductor. The vitreous composition is composed of 70—75% by weight of litharge and 25—30% of boric acid, fused into a clear yellow glass. —B. N.

Mercury vapour [incandescence] lamps. M. J. Cornu, Paris. Eng. Pat. 129,702, 29.11.17. (Appl. 17,689/17.) Int. Conv., 5.6.17. Addition to Eng. Pat. 129,022 (this J., 1919, 622 A).

THE lamp is provided with an arc-striking device comprising a bulb communicating with the highest point of the illuminating tube through the medium of a tube provided with small condensing chambers, a heating spiral traversing the arc-striking bulb being connected in series with the lamp. The damper comprises a tube inserted in the path of the mercury between the illuminating tube and the compression bulb connected to the anode, and traversed by a metallic conductor which effects the electrical connection between the two parts. The mercury cathode may be replaced by a cathode of another metal (iron, platinum, tungsten) and the illuminating tube may be placed vertically.—B. N.

Gas from batteries. U.S. Pat. 1,312,311. *See* XI.

III.—TAR AND TAR PRODUCTS.

Phenol; Melting point of pure ——. H. Leroux. J. Pharm. Chim., 1919, **20**, 88—91.

THE recorded m. pt. of phenol varies from 39° to 42° C., but determinations made by the author on the carefully prepared and dried substance show the m. pt. to be 40·85° C. The presence of 0·2% of water lowers the m. pt. to 40° C. Pure phenol boils at 182° C. at 760 mm. W. P. S.

2.4-Dinitrophenol; Preparation of —— *by direct nitration of phenol.* M. Marqueyrol and P. Loriette. Bull. Soc. Chim., 1919, **25**, 375.

PHENOL (94 grms.) is added to water (30 grms.), and this mixture is slowly added to a mixture of 400 c.c. of sulphuric acid (53° B., sp. gr. 1·58) and 270 c.c. of nitric acid (36° B., sp. gr. 1·33), kept well stirred, the temperature not being allowed to rise above 30° C. When the whole of the phenol is added the temperature is allowed to rise to 100° C., the stirring being continued. 2.4-Dinitrophenol separates out and a 71% yield is obtained. —W. G.

Petroleum spirit from lignite tar. Fischer and Schneider. *See* IIA.

Picric acid. Marqueyrol and Loriette. *See* XXII.

Polynitro compounds. Marqueyrol and Loriette. *See* XXII.

PATENTS.

Tar still. W. J. Reid, Coatbridge. Eng. Pat. 127,133, 21.6.18. (Appl. 10,260/18.)

THE legs of flue plates of a tar still are set in inverted V fashion and are riveted along their lower

edges to splayed channels extending the entire length of the still structure, and at their front and back edges to angle frames, so that when it is necessary to re-rivet the plates the operation can be conveniently effected from within the interior of the still.—G. F. M.

Oils and pitch; Separation of —— from tar. R. Lessing, London. Eng. Pat. 130,362, 28.1.18. (Appl. 1635/18.)

Hot tar which has previously been freed from ammoniacal liquor, benzol, and naphtha, enters a closed vessel through an inlet near the top of one side, and a solvent suitable for extracting the oil from the tar, *e.g.*, non-aromatic petroleum distillates, is led in through a perforated pipe at the bottom of the vessel. The mixture of tar and solvent is well stirred, and maintained by means of a steam coil at such a temperature—*i.e.*, about 100° C.—that the pitch remaining after extraction of the oil is in a fluid state. The solvent containing oil in solution overflows into a column still heated by steam pipes, whence the solvent vapour is condensed and returned to the extraction vessel, while the residual oil flows out at the bottom. A vessel may be interposed between the extraction vessel and the still in which the solution is washed either with an alkaline liquid to remove phenols etc., or with an acid liquor to remove pyridine and the like. —L. A. C.

Phenol; Manufacture of ——. A. C. Houghton, Fayetteville, Assignor to Semet-Solvay Co., Solvay, N.Y. U.S. Pat., 1,308,757, 8.7.19. Appl., 9.7.18.

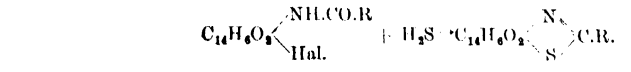
The benzene sulphonation mixture is added directly to molten caustic soda without previous neutralisation.—L. L. L.

Phenol; Recovering benzenemonosulphonic acid and producing ——. M. L. Hamlin, Bloomfield, N.J., Assignor to American Synthetic Dyes Inc. U.S. Pat. 1,309,683, 15.7.19. Appl., 25.8.16.

The mother liquor from the crystallisation of sodium benzenesulphonate is treated with magnesium carbonate, and the magnesium salt, which separates, is fused with the sodium salt and caustic soda. —L. L. L.

Anthraquinone series; Preparation of condensation products of the —— containing nitrogen. Farbwerke vorm. Meister, Lucius, und Brüning, Höchst. Ger. Pat. 311,906, 23.11.13. Addition to Ger Pat. 298,706.

o-Halogen-substituted acidylaminoanthraquinones on treatment with alkali sulphides are converted into thiazoles.



Thus 1-benzoylamino-2-bromoanthraquinone gives, on boiling in alcoholic solution with sodium sulphide, C-phenyl-1.2-anthraquinonethiazole, forming brown needles which give yellow to red-brown solutions in organic solvents. C-methylanthraquinone-2.1-thiazole from 1-chloro-2-acetaminoanthraquinone gives yellowish green needles and yellowish brown solutions in organic solvents. —G. F. M.

Sulphonic acids; Alkali fusion of aromatic ——. South Metropolitan Gas Co., and E. V. Evans, London. Eng. Pat. 129,002, 17.9.17. (Appl. 13,314/17.)

In the manufacture of hydroxy-compounds by fusing aromatic sulphonic acids with caustic alkali, the alkali sulphite produced as a by-product is obtained as a sludge by extracting the melt with a minimum quantity of water, and is electrolysed in a divided cell with a current of 1—2 amps. per sq. dcm., the caustic alkali produced being returned to the fusion operation, whilst the sulphur dioxide is either converted into sulphuric acid or used for liberating the phenol from the alkali hydroxy-compound, whereby a further quantity of alkali sulphite is produced, and subsequently electrolysed. If preferred, the whole melt may be dissolved in water, and the solution electrolysed as above, whereby the phenol is liberated in the anode compartment and caustic alkali in the cathode.—G. F. M.

Chlorination; Process of photochemical ——. B. S. Lacy, Sewaren, N.J., Assignor to The Roessler and Hasslacher Chem. Co., New York. U.S. Pat. 1,308,760, 8.7.19. Appl., 19.4.17.

Chlorinated hydrocarbons are obtained by dissolving chlorine in an organic liquid containing replaceable hydrogen, which is in contact with water, and at the same time submitting the solution to chemically active light; the hydrogen chloride generated is absorbed in the water layer.—L. L. L.

Nitro compounds; Process of obtaining ——. F. B. Holmes, Woodbury, N.J., Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,309,577, 8.7.19. Appl., 11.5.15.

The hydrocarbon to be nitrated is largely diluted with a non-nitrifiable constituent, and this mixture passed upward through nitrating acid.—L. L. L.

Dinitrodiphenylamine; Process of preparing ——. J. Marshall, Swathmore, Pa., Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,309,580, 8.7.19. Appl., 18.10.18.

Aniline and dinitrochlorobenzene are emulsified in a liquid and the emulsion then raised to the temperature at which condensation begins.—L. L. L.

Nitration of organic liquids; Apparatus for ——. A. Hough, New York. U.S. Pat. 1,312,119, 5.8.19. Appl., 18.5.18.

An apparatus for the nitration of organic liquids consists of a tank fitted with cooling coils and a circulator connected with the lower and upper portions of the tank. The liquid from the tank is drawn upwards through the circulator by means of a propeller and is returned to the tank through a tangential inlet. A stirrer, below which is the inlet for the liquid to be nitrated, is also provided in the circulator.—L. A. C.

Naphthalenetrisulphonic acid; Manufacture of ——. L. A. Pratt, Winchester, and F. N. Brink, Woburn, Mass., Assignors to Merrimac Chemical Co., North Woburn, Mass. U.S. Pat. 1,311,090, 22.7.19. Appl., 31.8.18.

Naphthalene is sulphonated with sulphuric acid monohydrate to give the monosulphonic acid; oleum is then added and the sulphonation continued to produce the trisulphonic acid.—L. L. L.

Fuel from pitch. Eng. Pat. 129,393. *See* IIA.

By-products of gas. U.S. Pat. 1,310,748. *See* IIA.

Decolorising and purifying organic compounds. Eng. Pat. 129,074. *See* XXII.

Picric acid etc. Eng. Pat. 129,375. *See* XXII.

IV.—COLOURING MATTERS AND DYES.

Indirubins. J. Martinet. Comptes rend., 1919, 169, 183—185.

Substituted indirubins may be prepared by each of

the three following processes:—(1) Condensation of isatins with indoxylic acid in slightly alkaline medium in an atmosphere of hydrogen. (2) Condensation of isatins with isatin-α-anilide in ammoniacal solution in a current of hydrogen sulphide. By this method a large part of the product often remains in the mother liquor as a leuco-base, in which case, after filtration, these liquors should be warmed in a current of air, when more of the colouring matter separates out. (3) Very easily by adding to an acetic acid solution of the isatin warmed on the water-bath, the technical melt of phenylglycine. A number of indirubins have been prepared, and are described. They are all obtained as very slender, brownish-violet needles, with a reddish-brown, metallic reflex. The reddish-violet alcoholic solutions are very rapidly decolorised on warming with a few drops of aqueous potassium hydroxide in the case of those indirubins which have a substituent attached to nitrogen. With hydrosulphites, in alkaline medium, they give pale yellow vats, which easily dye wool and silk, but have very little affinity for cotton. The monobromo-indirubin dyes have only a feeble affinity for vegetable fibres. These indirubins dissolve in the cold in sulphuric acid (66° B.) with a green colour, if brominated, and violet if not. When warmed on the water-bath these solutions quickly turn reddish violet, sulphines being formed, which directly dye animal fibres a colour very near to that of the original indirubin. (See also J. Chem. Soc., 1919, *i.*, 457.)—W. G.

Congorubin. Ostwald. *See* XXIII.

PATENTS.

Dyestuff; Brown [azo] ——. W. B. Jones, Newark, N.J., Assignor to Butterworth-Judson Corporation, New York. U.S. Pat. 1,310,532, 22.7.19. Appl., 26.2.18.

DIAZOTISED picramic acid is coupled with α-naphthylamine, and the product diazotised and coupled with salicylic acid. The dyestuff is slightly soluble in cold, and very soluble in hot water.—L. L. L.

Disazo-dyestuffs; Manufacture of —— and process of dyeing therewith. O. Imray, London. From Society of Chemical Industry in Basle, Switzerland. Eng. Pat. 128,726, 25.6.18. (Appl. 10,461/18.)

o-HYDROXY-DIAZONAPHTHALENESULPHONIC acids are coupled in concentrated alkaline solution with *m*-aminophenol or a derivative thereof in which the *para* position to the amino group is free, the azo group entering the *para* position to the amino group; these compounds are diazotised and coupled with arylpyrazolone derivatives, aceto-acetic acid arylides, or like compounds, yielding acid dyes which by after-chroming give green shades fast to light, fulling, and potting.—L. L. L.

Sulphurised dye; Manufacture of a blue ——. L'Air Liquide, Soc. Anon. pour L'Etude et L'Exploit. des Proc. G. Claude, Paris. Eng. Pat. 118,103, 31.7.18. (Appl. 11,948/18.) Int. Conv., 31.7.17.

1.2.4.5-TRICHLORONITROBENZENE is heated with aniline in the presence of sodium acetate, producing dichloronitrodiphenylamine, which is condensed, in sulphuric acid solution, with *p*-nitrosophenol. The product on reduction gives 4′-*p*-hydroxyphenylamino-2-amino-4.5-dichlorodiphenylamine, which on subjecting to a sulphur melt is converted into a blue sulphur dyestuff.—L. L. L.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Textile materials; Atmospheric humidity in its relation to electrical phenomena in ——. S. A. Shorter. J. Text. Inst., 1919, **10**, 218—219. (See also this J., 1918, 263A.)

WOOL exposed to an atmosphere of 73% humidity at 65° F. (18° C.), will contain about 16% of moisture ("regain") and will normally exhibit very little electrification; at the same temperature, with an atmosphere of 25% humidity, the wool would contain 8.5% of moisture and will be readily electrified. The most suitable degree of humidity varies for different purposes. For cotton, preparatory to spinning, a humidity of 62% at 70°—80° F. (21°—27° C.) is most suitable. For spinning, rather less humidity —52% at 80°—90° F. (22°—32° C.)—is required. For worsted drawing, a humidity of 70% is sufficient to diminish very largely electrical effects in normal cases. Such a degree of humidity in spinning leads to other troubles, consequently 50% humidity is more suitable. The humidity must also be such that sizing agents remain in a soft condition. In worsted drawing and spinning trouble may occur, even in humid atmospheres, if the wool fibre, owing to its previous treatment, has been brought into a readily electrifiable state. Conversely, the wool may be brought into such a state that it does not appreciably electrify, even in comparatively dry atmospheres.—L. L. L.

Wood and pulp; Destruction of —— by fungi and bacteria. S. F. Acree. Pulp and Paper Mag., 1919, **17**, 569—571.

VERY serious losses may be caused by the rotting of wood in stacks. Calculated on the basis of equal volumes of sound and rotten woods, a loss of 75% of wood substance has been recorded after 12 months. A block of sound spruce wood contains 58% of its weight of cellulose; in a similar block of rotten wood only 13—14% of cellulose was found, equivalent to a loss of 76% of the original cellulose. The methoxyl group, from which wood alcohol is formed, had been destroyed to the extent of 75%; the acetic acid group, 80%; the pentosan, 77%, and the methylpentosan, 65%. These constituents had been converted into gases and soluble substances; the matter soluble in hot water had increased by 146%. The fungi and bacteria infect the stacks in certain parts. Some of them get through into the [mechanical] pulp and growths of red or black patches appear on the pulp laps during storage. Paper made from infected pulp is inferior in colour and strength to that made from sound pulp. Estimates made at pulp mills indicate losses of wood amounting to 5—10% through rotting, and in addition losses of strength in the pulp of 10—20%, or in some cases even 50%. The fungus of "red rust" has been isolated and studied in the form of cultures.—J. F. B.

Papers for baling; Water-resistant ——. F. P. Veitch and E. O. Reed. Paper, 1919, **24**, 21—23.

PAPERS reinforced with textile fabrics do not give good results for bale-papers, the extensibility of the two materials being so divergent, so that the entire strain is borne by the paper. Papers crêped or corrugated in one direction are also unsatisfactory, but papers made expansive in both directions are more serviceable; nevertheless, the loss of strength due to crêping may amount to 50%, and when "duplexed" with asphalt the crêping favours the penetration of water into the asphalt layer. For laboratory tests paper is clamped between two rings, the upper ring carrying a cup; the paper is then exposed to the action of water 3 in. deep for three

hours, and immediately tested for loss in bursting strength. Paper impregnated with paraffin is very little more resistant to water than untreated paper when tested in this way. When kraft paper is "duplexed" with asphalt, water will penetrate as far as the asphalt layer and the duplex paper loses half its strength. When the duplex paper is coated with asphalt on the exposed surface, it is quite resistant, and when it is impregnated with asphalt on one surface it is nearly as good.—J. F. B.

PATENTS.

Retting fibrous substances; Process of ——. E. L. Rinman, Djursholm, Sweden. Eng. Pat. 128,464, 30.8.18. (Appl. 14,104/18.)

RAPE and pineapple leaves, as well as flax, jute, etc., are treated with a waste liquor from a previous operation to which free caustic alkali has been added, at a temperature of at least 90° C., the liquor having a sp. gr. of 1·07 to 1·1. The presence of oxy compounds (acids) in the liquor modifies the effect of the alkali on the fibres to such an extent that they are not coloured or tendered, and are easily bleached. When starting the operation a suitable waste liquor may be obtained by boiling wood, straw, or other vegetable substance with a 2½% solution of caustic soda or potash at a temperature of 100°–120° C. for three hours.—L. L. L.

Drying and shrinking device. A. L. Jacobs, Assignor to A. J. Franke and L. N. Franke, St. Louis, Mo. U.S. Pat. 1,308,951, 8.7.19. Appl., 8.4.18.

THE machine comprises a housing or chamber provided with a set of horizontal power rollers, arranged vertically one above another near to each end of the chamber, the uppermost rollers being of a smaller diameter than the lowermost ones. The rollers carry the fabric in a zig-zag direction through the chamber.—L. L. L.

Fabrics for aircraft. Sheet fabrics. F. Sage and Co., Ltd., London, and N. A. T. N. Feary, Peterborough. Eng. Pats. (A) 128,690 and (B) 128,691, 9.5.18. (Appls. 7812 and 7817/18.)

(A) FABRICS for aeroplanes are made of comminuted or granulated cork and a binding medium of casein along with borax, waterglass, castor oil, and tannin, and reinforced with steel wire or steel wire fabric, and may be backed with a textile fabric and coated with varnish. The finished sheets may be waterproofed by exposure to fumes of formaldehyde. (B) A sheet fabric for covering walls, floors, roofs, etc., consists of fragments of cork bound together with casein and water-glass, and having a wire reinforcement, with or without a covering of paper, muslin, etc.—L. L. L.

Cellulose digesters; Circulating apparatus for ——. A. G. Westad and E. L. Haag, Hunsfos, Norway. U.S. Pat. 1,309,267, 8.7.19. Appl., 8.3.19.

THE body of the digester has a cylindrical lower portion provided with steam inlets. A cylinder is situated in the lower portion of the body, providing a steam compartment, having openings at its lower end, a strainer at the upper end, and means for directing the course of the steam and liquor supplied to the body, so as to ensure a continuous circulation of the liquor and steam upwards along the walls of the body and downwards through the centre thereof.—J. F. B.

Cellulose acetate; Solutions of ——. J. Huebner, Manchester. Eng. Pat. 127,027, 20.3.17. (Appl. 4045/17.)

CELLULOSE acetate may be dissolved in mixtures of ethyl alcohol, acetic acid, and water. The ethyl alcohol may be replaced by methyl alcohol or other volatile solvents miscible with water, and the acetic acid by formic acid. Such solutions make it possible to use water-soluble substances to impart fireproof qualities. Waterproofing and softening agents, such as fats, waxes, etc., and particularly castor oil or sulphonated castor oil, may be dissolved in the volatile solvents in order to produce stable emulsions. *Example.*—27 parts of cellulose acetate is dissolved in 133 of ethyl alcohol (92% vol.), 133 of water, and 133 of 95% acetic acid.—L. L. L.

Cellulose esters; Solutions of ——. The British Aeroplane Varnish Co., Ltd., London, and J. G. Ward, Felling-on-Tyne. Eng. Pat. 129,033, 29.9.17. (Appl. 14,080/17.)

VARNISHES consisting of solutions of celluloid, nitrocellulose, or other cellulose esters in organic solvents, such as ketones or esters, alone or mixed with benzene, benzene homologues, and alcohols, with or without the addition of oils, gums, etc., are apt to become less viscous on ageing. If the solution, immediately or shortly after it is made, be rendered neutral or slightly acid with a polybasic organic acid, it retains its viscosity unimpaired for a long time. The addition of 0·01% of free tartaric or citric acid is found to be sufficient for this purpose.—L. L. L.

Cellulose ester composition. Cellulose nitrate composition. H. T. Clarke, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pats. (A) 1,309,980 and (B) 1,309,981, 15.7.19. Appl., 26.4.19.

(A) A CELLULOSE ester is combined with a dialkyl ester of oxalic acid in which each of the alkyl groups contains 4 or 5 carbon atoms. (B) Cellulose nitrate is specified as the cellulose ester mentioned in (A).—J. F. B.

Oil-proof-paper container and process of making same. C. Ellis, Montclair, N.J. U.S. Pat. 1,311,595, 29.7.19. Appl., 23.1.18.

A CONTAINER for oils, fats, and the like, is constructed of a fibrous material oil-proofed with sulphite waste liquor solids and a hygroscopic agent.—L. A. C.

Fireproofing; Process of —— and products thereof. H. W. Matheson, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,309,581, 8.7.19. Appl., 13.12.15.

IN order to render a surface having a nitrocellulose coating, fire-resistant, a coating of a condensation product of phenol and formaldehyde is applied.—L. L. L.

Drying hanks or warps of yarn, woven or felted fabrics, leather, and fibrous materials; Machine for ——. T. Ogle, Bramley. U.S. Pat. 1,312,348, 5.8.19. Appl., 5.10.18.

SEE Eng. Pat. 116,214 of 1917; this J., 1918, 461A.

Paper or other pulp; Rollers for straining ——. R. W. Clark, Belvedere, C. W. Brown, and G. H. Buxton, Erith. Eng. Pat. 130,257, 11.12.18. (Appl. 20,629/18.)

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

PATENTS.

Bleach kiers; Open —— and the like. Jackson and Brother, Ltd., and J. R. Fish, Bolton. Eng. Pat. 129,171, 18.9.18. (Appl. 15,146/18.)

KIERS for bleaching or treating fabrics in the open

width, in which the fabric to be treated is alternately batched upon one or other of two batch rollers, the direction of rotation of which is reversed automatically as required, are fitted with electrical means, such as a speed regulating and reversing controller, or equivalent, placed outside the kier, for controlling the current driving a reversible motor, and a magnetic clutch or solenoid to reverse the batch rollers and control the speed of the fabric as it is wound off one batch roller and on to the other.—L. L. L.

Washing, disinfecting, and dyeing machine. W. A. E. Henrici, Boston, Assignor to Henrici Washing Machine Co. U.S. Pat. 1,309,411, 8.7.19. Appl., 26.6.16.

A MACHINE for treating fabrics with liquid comprises a cylinder of a length considerably greater than its width, mounted to swing on an axis transverse to its length, and fitted with valved outlet pipes communicating with the end portions of the cylinder.—L. L. L.

Disazo dyes. Eng. Pat. 128,726. *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Hydrobromic acid; Preparation of ——, *using potassium bromide, sulphuric acid, and stannous chloride.* A. Pickles. Chem. News, 1919, 119, 89.

BY adding stannous chloride (0·2 grm.) to a solution of potassium bromide (15 grms. in 25 c.c.) and distilling the mixture with concentrated sulphuric acid (33·4 c.c.) at 120°–127° C., an approximately theoretical yield (95%) of hydrobromic acid was obtained, the product containing no tin and being almost free from hydrochloric acid. In the absence of stannous chloride a smaller yield was obtained, and the product contained free bromine. Further experiments proved conclusively that stannous chloride prevents the decomposition of hydrobromic acid in presence of excess sulphuric acid; but when the above quantity of stannous chloride was exceeded the distillate contained hydrochloric acid and deposited a white, basic tin compound on standing.—W. E. F. P.

Fluorosulphonic acid, fluorosulphonates, and sulphuryl fluoride. W. Traube, J. Hoerenz, and F. Wunderlich. Ber., 1919, 52, 1272–1284.

AMMONIUM fluorosulphonate is most conveniently prepared by the gradual addition of dry ammonium fluoride to sulphuric acid containing about 70% of sulphur trioxide and treatment of the product with a slight excess of ammonia dissolved in methyl alcohol. The alkali fluorosulphonates are prepared by the action of the requisite alkali hydroxide on an aqueous solution of the ammonium salt; the potassium, rubidium, and lithium salts are described. The fluorosulphonates are unexpectedly stable towards water, from which they can be crystallised. In the presence of mineral acids they are readily hydrolysed to hydrofluoric and sulphuric acids, but are more stable in alkaline solution. With aqueous ammonia they yield chiefly aminosulphonates. The alkali fluorosulphonates are very stable towards heat, the potassium salt only decomposing slightly at bright redness. Crude barium fluorosulphonate, on the other hand, decomposes into barium sulphate and sulphuryl fluoride. Fluorosulphonates are also obtained by heating pyrosulphates or persulphates with fluorides, or by the compression of fluoride and pyrosulphate, particularly in the presence of a little moisture. (See also J. Chem Soc., 1919, ii., 365.)
—H. W.

The ternary system CaO–MgO–SiO_2. J. B. Ferguson and H. E. Merwin. Amer. J. Sci., 1919, 48, 81–123.

COOLING curves have been prepared for the tenary system, lime, magnesia, and silica; the following substances occur as crystalline primary phases: lime; magnesia; silica (tridymite and cristobalite); pseudowollastonite, α-CaO,SiO_2; α-$3CaO,2SiO_2$; and β-$2CaO,SiO_2$; clino-enstatite, MgO,SiO_2; forsterite, $2MgO,SiO_2$; diopside, $CaO,MgO,2SiO_2$; $5CaO,2MgO,6SiO_2$; and $2CaO,MgO,2SiO_2$. The melting point of $2CaO,MgO,2SiO_2$ is 1458° ± 5° C., and the decomposition temperature of $5CaO,2MgO,6H_2O$ is 1365° ± 5°. In addition crystals representing five solid solutions appear as primary phases. These are a complete series with clino-enstatite and diopside as end members, generally known as pyroxenes; the pseudowollastonite solid solutions; the wollastonite solid solutions; the $5CaO,2MgO,6SiO_2$ solid solutions; and certain members of the monticellite solid solutions. The temperature-concentration relations of the liquids which may be in equilibrium with each of these phases have been investigated by the quenching method and the results are correlated with the existing data on the remainder of the ternary system. The compounds $5CaO,2MgO,6SiO_2$ and $2CaO,MgO,2SiO_2$ have not been previously prepared. The inversion of tridymite-cristobalite has been studied and the inversion temperature is found to be just below 1500° C. (See also J. Chem. Soc., Oct., 1919.) —J. F. S.

Selenium; Electrolytic preparation of colloidal ——. A. Gutbier and G. L. Weise. Ber., 1919, 52, 1374–1378.

WHEN a dilute aqueous solution of selenium dioxide is electrolysed between platinum poles with an E.M.F. of 220 volts, a moderate evolution of gas which does not contain hydrogen selenide is first observed; the solution rapidly becomes hot, and when it attains its boiling point the formation of colloidal selenium commences, and the solution becomes consecutively yellow, yellowish-red, red, bluish-red, and finally blue. Selenium is not deposited in an irreversible form until the blue stage is reached, provided that the original solution is not too concentrated. The yellow systems become yellowish-red when cooled, and can be preserved even if not dialysed; they can be purified readily by dialysis, are not decomposed by filtration through paper, and can be concentrated considerably by evaporation over a free flame. The yellowish-red when cooled, and can be preserved colour, and at other times become red when cooled; in the former case they can be purified by dialysis, and then behave in the same manner as the yellow solutions. The red solutions invariably exhibit a tendency to become bluish-red when cooled, a sign of incipient coagulation; they can only be obtained in a moderately stable condition if dialysed whilst hot and then immediately diluted with pure water or with a solution of a protective colloid such as gum arabic. The bluish-red and the blue solutions decompose generally when cooled, invariably during dialysis, or when preserved at the ordinary temperature. All the dialysed solutions are extremely sensitive towards electrolytes.—H. W.

Hydrogen; Behaviour of —— *towards iridium.* A. Gutbier, B. Ottenstein, and G. L. Weise. Ber., 1919, 52, 1366–1368.

CHEMICALLY pure iridium is capable of occluding considerable volumes of hydrogen, the maximum occlusion observed having been 140 vols. per vol. of iridium at 20° C. The occluded hydrogen is readily expelled by a slight increase in temperature, but removal of the last traces can only be effected by strong ignition. The quantity of occluded gas is much smaller than with palladium. (See this J., 1913, 661.)—H. W.

Hydrogen; Behaviour of —— towards platinum. A. Gutbier and O. Maisch. Ber., 1919, 52, 1368—1374. (Compare preceding abstract.)

PLATINUM black is far more active towards hydrogen than is spongy platinum; with the latter, the absorption of more than one volume of hydrogen was not observed, whilst with the former, as much as 160 volumes was absorbed. Platinum black absorbs less hydrogen at high than at low temperatures; with spongy platinum the reverse is the case. Below 0° C. the absorptive capacity of both modifications of platinum diminishes. Platinum black absorbs the maximum quantity of hydrogen at 0° C. (See also J. Chem. Soc., 1919, ii., 368.)—H. W.

Errata. Determination of perchlorates (this J., 1919, 574 A). Col. 1, line 32, for "10 c.c. of 5% sulphuric acid" read "10 c.c. of sulphuric acid." Line 37, for "persulphate" read "perchlorate."

PATENTS.

Sulphuric acid; Manufacture of ——. J. Thede, Nordenham, Oldenburg. Ger. Pat. 312,024, 25.6.18.

THE oxides of nitrogen necessary for the manufacture of sulphuric acid by the lead chamber process are obtained by the dry distillation of calcium nitrate or other similar compound, which is conveniently carried out in close connection with the pyrites burners rather than as a separate operation, as the heat relationships are such that the evolution of nitrous fumes is closely proportional to the amount of sulphur dioxide generated, and is accordingly regulated automatically. Owing to the small amount of calcium nitrate used in proportion to the sulphur burnt, the lime remaining in the residues from the burners is not detrimental to their subsequent working up for iron, zinc, etc., as the case may be.—G. F. M.

Nitric acid and ammonium sulphate; Manufacture of ——. A. T. Cocking, and Kynoch, Ltd., Birmingham. Eng. Pat. 129,305, 1.8.16. (Appl. 14,431/17.)

AMMONIUM nitrate is treated with excess of sulphuric acid under reduced pressure and under carefully controlled temperature conditions, decomposition of the ammonium nitrate into water and nitrous oxide being thus avoided. If the neutral sulphate is required, one part of nitrate is treated with 1·1 parts of acid at a pressure of 25 inches of mercury and a temperature not exceeding 100° C. for the first three-quarters of the time of operation, and then rising to a maximum of 195° C.; the excess of sulphuric acid is neutralised with ammonia. For the production of acid sulphate a larger excess of sulphuric acid is required, and a continuous process may be used.—B. V. S.

Nitric acid; Process for concentrating ——. A. T. Cocking, and Kynoch, Ltd., Birmingham. Eng. Pat. 130,038, 2.1.18. (Appl. 117/18.)

DILUTE nitric acid is neutralised with ammonia, the resulting solution evaporated to crystallisation of ammonium nitrate, and the dried salt decomposed at reduced pressure with strong sulphuric acid (preferably waste acid from nitrating plant).
—B. V. S.

Ammonia; Manufacture of ——. R. C. Parsons, H. C. Jenkins, and C. I. (1914) Syndicate, Ltd., London. Eng. Pat. 130,069, 11.1.18. (Appl. 703/18.)

IN the process of forming ammonia by the catalytic union of nitrogen with the hydrogen produced by the electrolysis of a solution of an alkali chloride, the hydrogen is freed from traces of catholyte by filtering through an inert material such as coke or unglazed porcelain. The capacity of the filters should be at least one cubic foot per 1000 ampères of current, and where they are used in series the first one should be kept wet with water previously boiled to remove all dissolved air or oxygen. The electrolyte should have an alkalinity of more than 5% of caustic alkali, preferably about 8%; it should be boiled before use to remove all air or oxygen, and the cathodes should be of pure iron, containing no carbon or nickel, to avoid the formation of hydrocarbon impurities in the hydrogen.—B. V. S.

Ammonia; Synthesis of ——. E. B. Maxted, Walsall. Eng. Pats. (A) 130,023, 21.12.17, and (B) 130,063, 11.1.18. (Appls. 18,931/17 and 660/18.)

THE direct union of nitrogen and hydrogen is effected by raising the mixed gases to a high temperature under increased pressure, preferably 50—100 atmospheres, and then rapidly cooling the gases to remove the ammonia. The residual gases, after removal of the ammonia, are passed into the heating chamber, without loss of pressure, for further treatment. In process (A) the high temperature is obtained by passing the mixed gases, preferably in the proportion of 3 vols. of hydrogen to one of nitrogen, through an electric arc, a temperature of at least 2000° C. being maintained. In process (B) the temperature is obtained by the combustion of a mixture of nitrogen and hydrogen in oxygen or air, the oxygen being insufficient for the complete combustion of the hydrogen, a temperature of at least 1500° C. being maintained; the combustion chamber is in water, and the gases containing the ammonia may be cooled by passing through a water-cooled coil, or by passing directly from the chamber into cold water.—B. V. S.

Ammonia; Preparation of dry —— from nitrolim by means of superheated steam. E. Wiedemann, Bergisch-Gladbach. Ger. Pat. 311,959, 24.12.13.

HEATED nitrolim is treated with a counter-current of superheated steam by a continuous process in a closed vessel provided with a worm propelling gear with corrugated blades, connected by a shaft with a second water-cooled vessel likewise provided with a worm conveyor.—G. F. M.

Sulphate of ammonia; Manufacture of ——. The Oakbank Oil Co., Ltd., and J. Wishart, Glasgow. Eng. Pat. 129,850, 26.8.18. (Appl. 13,842/18.)

IN the separation of ammonium sulphate from its mother liquor by centrifugal or other means, a proportion of the ammonia and ammonium carbonate distillate from the crude ammonia still is added to the material to neutralise the free acid present.
—W. E. F. P.

Ammoniacal liquors and the like; Distillation or treatment of ——. W. Wyld, Menston, near Leeds. Eng. Pat. 129,765, 18.12.18. (Appl. 10,162/18.)

IN an apparatus consisting of a series of receptacles arranged on the "cascade" principle, each receptacle has an adjustable lip or depending flange which dips into the liquid in the next lower vessel, and the degree of immersion of each lip—and hence the area of the stream of liquid exposed to the heating medium—may be varied without tilting or otherwise altering the effective capacity of the receptacle.—W. E. F. P.

Spent liquors containing chlorides, produced in the pickling of metals with sodium bisulphate; Process for working up ——. R. Kreis, Dortmund. Ger. Pat. 312,492, 17.3.18.

SODIUM sulphate is separated from the waste liquor

which is then evaporated to leave a residue of iron oxide, the hydrochloric acid derived from chlorides contained in the sodium bisulphate being evolved during the process and collected. To obtain Turnbull's blue, the appropriate amount of potassium cyanide is added to the mother liquor either before or after separation of the sodium sulphate.
—J. S. G. T.

Nitrates; Production of ——. H. E. F. Goold-Adams, London, J. R. Partington, Lostock Gralam, and E. K. Rideal, London. Eng. Pat. 129,699, 29.11.17. (Appl. 17,670/17.)

Oxides of nitrogen, such as are produced, for instance, in the electric arc process or the ammonia oxidation process, are allowed to react with any suitable oxide or carbonate in solution or suspension, and the nitrite which is first produced along with nitrate is oxidised to nitrate by further treatment with the nitrogen oxides; the lower oxides of nitrogen resulting from the second reaction are mixed with a fresh supply of air or oxygen and used for the treatment of more liquor. The process may be carried out in an alternating series of absorption and oxidation chambers on the counter-current principle, or each absorption chamber may be capable of isolation for purposes of emptying and recharging.—B. V. S.

Oxides of nitrogen; Process of and apparatus for obtaining —— from atmospheric air. F. I. du Pont, Assignor to Delaware Chemical Engineering Co., Wilmington, Del. U.S. Pat. 1,311,594, 29.7.19. Appl., 26.3.15.

Two streams of a mixture of oxygen and nitrogen are passed towards each other along an electric arc in a reaction chamber with non-conducting walls. The gases are cooled as they pass outwards at the junction of the two streams.—L. A. C.

Chromium sulphate; Manufacture of ——. F. M. Mooney, Montreal, Canada. Eng. Pat. 129,958, 5.5.19. (Appl. 11,216/19.)

Potassium or sodium chromate or bichromate is reduced by treatment with sulphuric acid and sodium thiosulphate. After boiling to expel the sulphur dioxide formed, the chromium oxide is filtered off, washed, and dissolved in the necessary quantity of sulphuric acid.—B. V. S.

Aluminium, intermediate products, and bleaching powder; Treatment of suitable clay or aluminium compounds for the production of ——. R. Welford, London. Eng. Pat. 130,164, 27.7.18. (Appl. 12,232/18.)

In the process for the production of aluminium described in Eng. Pat. 118,312 (this J., 1918, 590 A), the gases evolved when the mixture of hydrochloric acid and aluminous material is heated and/or the gases evolved during evaporation of the filtered solution are passed together with air or oxygen over a catalyst to produce chlorine, which may be utilised for obtaining bleaching powder.—L. A. C.

Cyanides and nitrides; Synthetic production of ——. A. R. Lindblad, Stockholm. Eng. Pat. 119,243, 17.9.18. (Appl. 15,113/18.) Int. Conv., 8.6.17.

A charge suitable for the production of cyanides or nitrides is fed into a shaft furnace, open or incompletely closed at the top, and heated by electric current which is supplied by an electrode suspended in the charge and led off by an electrode passing through the bottom of the furnace. An outlet pipe for gases passes through the wall of the furnace near the bottom, and nitrogenous gases are drawn downwards through the charge by means of suction applied to this pipe. In the production of cyanides, the product passes out as gas or dust through the outlet pipe together with waste gases, and slag is withdrawn from the bottom of the furnace through a discharge opening; in the production of nitrides, the product is raked out in an unfused condition through an opening in the bottom.—L. A. C.

Nitrogen compounds [alkali cyanides]; Process of making ——. Process for the separation of cyanide compounds from other substances. C. B. Jacobs, Bloomfield, N.J., Assignor to Air Reduction Co. U.S. Pats. (A) 1,311,231 and (B) 1,311,232, 29.7.19. Appl., (A) 26.12.14 and (B) 7.11.16.

(A) A nitrogenous gas and carbon in a number of relatively fine streams are brought in contact, at a temperature sufficient to effect chemical combination, with the nascent alkali metal produced by electrolysing an alkali metal compound. (B) A mixture of an alkali cyanide and an alkali hydroxide is treated with water in the presence of an alkali bicarbonate in order to convert the hydroxide to carbonate and to form a solution of the alkali cyanide in the presence of the carbonate. The solution is then separated from the residue.
—L. A. C.

Cyanide; Method of hydrolysing —— to ammonia. C. P. Hidden, Assignor to Nitrogen Products Co., Providence, R.I. U.S. Pat. 1,312,116, 5.8.19. Appl., 3.10.18.

Porous briquettes containing a cyanide are treated with dry steam under a pressure substantially below that of the atmosphere to hydrolyse the cyanogen compound to ammonia.—L. A. C.

Potassium chloride; Method of obtaining —— [from a solution containing boric compounds]. N. Wrinkle and W. A. Kuhnert, San Francisco, Cal. U.S. Pat. 1,311,481, 29.7.19. Appl., 26.12.18.

Sufficient magnesium oxide is added to a solution containing potassium chloride and a boric compound to form a boric magnesium compound insoluble in the solution.—L. A. C.

Carbonates and/or hydrates of potassium and sodium; Process for the separation of ——. Distillates, Ltd., and G. G. Jarmain, Kirkheaton, Yorks. Eng. Pat. 130,173, 2.8.18. (Appl. 12,646/18.)

A mixture of potassium and sodium carbonates (or hydroxides) is dissolved in water and sufficient fatty acid or saponifiable matter is added to absorb the soda. The mass is then boiled, evaporated, and cooled; the soap, which contains all the soda, is removed and may be hydrolysed by means of an acid, while the potassium salts are recovered from the solution.—L. A. C.

Colloidal solutions; Manufacture of ——. J. Müller, Hanover, Germany. Eng. Pat. 115,236, 22.4.18. (Appl. 6791/18.) Int. Conv., 3.3.17.

Colloidal solutions of a high degree of stability are prepared by treating finely divided solid substances with an aqueous solution of cherry gum. The process is applicable to sulphur, selenium, carbon, metals, etc. Examples are given showing its use in preparing colloidal iron oxide solutions and stable platinum hydrosols.—L. A. C.

Nitrogen from the air; Process for obtaining ——. Sprengluft-Ges. m. b. H., Charlottenburg. Ger. Pat. 312,286, 19.5.15.

The hydrocarbon gases mechanically occluded in freshly mined coal are removed therefrom by subjecting the coal to a low pressure without heating. The coal is then saturated with air, and the nitrogen withdrawn by suction, oxygen remaining in the coal.—J. S. G. T.

Hydrogen; Purification of —— [*from carbon monoxide*]. E. K. Rideal, London, and H. S. Taylor, St. Helens. Eng. Pat. 129,743, 14.3.18. (Appl. 4532/18.)

THE gas is mixed with a limited quantity of steam and passed over a heated catalyst to convert the greater part of the carbon monoxide into carbon dioxide. The product is then cooled, mixed with a suitable quantity of air or oxygen, and passed over a second catalyst maintained at a lower temperature than the first. The gas is finally treated to remove carbon dioxide and any free oxygen.—W. E. F. P.

Argon mixtures free from oxygen; Preparation of ——. Ges. für Lindes Eismaschinen A.-G., Munich. Ger. Pat. 311,958, 2.2.15. Addition to Ger. Pat. 301,940.

THE gaseous mixture, rich in argon, obtained as described in the principal patent, is led over molten potassium or sodium or alloys of these two metals. It is advantageous under certain circumstances to remove the greater part of the oxygen by a preliminary treatment with copper, hydrogen, or other reducing agents, reserving the treatment with the alkali metals for the removal of the last traces of oxygen.—G. F. M.

Nitric acid; Manufacture of ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania. Eng. Pat. 116,195, 22.1.18. (Appl. 6760/18.) Int. Conv., 8.5.17.

SEE U.S. Pat. 1,273,991 of 1918; this J., 1918, 622 A.

Nitrogen compounds, especially nitrides; Process and apparatus for producing ——. A. R. Lindblad, Stockholm. U.S. Pat. 1,311,568, 29.7.19. Appl., 14.5.18.

SEE Eng. Pat. 122,523 of 1918; this J., 1919, 175 A.

Ammonia. Eng. Pat. 130,365. *See* XVI.

Fertilisers. Eng. Pat. 129,306. *See* XVI.

Potash from tobacco. Eng. Pat. 129,791. *See* XX.

VIII.—GLASS; CERAMICS.

Optical-glass furnaces; Use of optical pyrometers for control of ——. C. N. Fenner. Amer. Inst. Min. and Met Eng., Sept. Engineering, 1919, **108**, 256—257. (See also this J., 1918, 582 A.)

THE temperature of a pot of optical glass must be kept closely within prescribed limits during the whole of the heating period, so that a quick and reliable method for measuring it is important. Ordinary thermo-couples were found to be very unreliable for this work, especially after a time, but careful comparisons in connection with an optical-glass furnace showed that an optical pyrometer of the Holborn-Kurlbaum (disappearing filament) type gave readings which were quite as accurate as a thermo-couple used under the strictest supervision and much more so than ordinary thermo-couples, provided the optical pyrometer was well made (a number of mechanically defective ones were found). Occasional re-calibrations of the optical pyrometer are essential. A convenient "black body" for observing the furnace temperature consists of a porcelain tube 1m. long and 18mm. inside diameter, with one end closed. This tube is passed through the furnace wall so that its closed end rests on the rim of the glass pot and the pyrometer is sighted on that end. During a large part of the time a pot of glass is in the furnace the temperature should be maintained at about 1400° C., this being checked by frequent pyrometer readings. In the later (stirring) stage the temperature is allowed to fall, and at a pre-determined point the stirring is stopped and the pot is removed. This point may be ascertained accurately by sighting the pyrometer on the area of glass immediately behind the stirring rod, plotting a temperature-time curve, and extrapolating to ascertain the point a short time in advance. The distribution of temperature from front to back of an open pot furnace is shown in an illustration. When an optical pyrometer was in constant use it was observed that less milky glass was produced and the loss from leaking pots was almost eliminated.—A. B. S.

Stove-tiles; Crystalline glazes for ——. F. Zirner. Keram. Runds., 1919, 27, 211—212.

THE customary method of preparing crystalline glazes for use at low temperatures (cone 08a—07a; 940° C.—960° C.) by fusing a mixture of quartz and zinc oxide in proportions corresponding to $ZnO:2SiO_2$, and either grinding the product with lead oxide and calcite or applying it to ware previously coated with a stoneware glaze, is not reliable. The following glazes have been prepared:—

Glaze no.	1.	2.	3.	4.	5.
Red lead	91	118	141	182	185
Zinc oxide	40	52	24	—	6½
Calcite	10	—	—	7	5
Quartz	60	48	55	60	75
Boric acid	25	—	—	—	—
Felspar	-	44	44	55	22
Kaolin	-	15	—	-	15
Rutile	-	32	16	21	12½
Molybdic acid ..	-	-	—	5?	4

No. 1 was fritted and used direct as a glaze. It was satisfactorily coloured by the addition of iron, nickel, and copper oxides, which did not interfere with the crystallisation. All the crystals were very small and usually ill-formed. No. 2 produced a rough matt glaze with a strong development of crystals and flowed readily at cone 07a (966° C.); the roughness was due to the amount of crystals formed, the glaze being super-saturated with zinc oxide and rutile. No. 3 produced a matt glaze of light yellow tint with a dark yellow precipitate, but not true crystals. On the addition of 1% of cobalt oxide, the glassy portion was a grey green, and the precipitated matter had a brownish colour. With copper oxide the glaze was dark green and the precipitate almost black. On reducing the rutile or increasing the rutile and increasing the zinc oxide and omitting all aluminous compounds, beautiful matt, half matt, or glossy glazes were produced, all devoid of crystals. Excellent glazes were produced by the addition of colouring oxides. On replacing the rutile and zinc oxide with molybdic, tungstic, or vanadic acid it was found that glazes containing molybdic acid produced beautiful lustre glazes with large, well-formed, star-shaped groups of crystals lying on the surface but sometimes immersed, or needle crystals which were scattered separately over the glazed surface. Glazes with tungstic acid, zinc oxide, and rutile were more opaque and showed many small, iridescent, star-shaped deposits which were particularly beautiful when the glaze was coloured with copper oxide. With vanadic acid the crystals were so small and numerous that they merely produced a matt glaze of no particular beauty. Even in the presence of the definitely crystal-forming substances (rutile, zinc oxide, and molybdic, tungstic, and vanadic acids) the composition of the glaze has considerable influence. Glazes with more than 0·15 equivalent of alumina produced matt glazes with more or less crystalline precipitates. Glazes free from alumina gave the best crystals, but they were too fluid for practical purposes. A small proportion of alumina (up to 0·1 equivalent) is, therefore, desirable and does not hinder the development of the crystals. A small proportion of alkalis is advisable

but not essential. Calcium compounds are necessary, as in lime-free glazes the development of the crystals is meagre and the glazes craze readily. The most suitable colours are produced by copper oxide and cobalt oxide; good crystals are produced in the presence of uranium oxide, but they are inferior to those with copper or cobalt oxides. With iron, manganese, and nickel oxides the crystal development is poor and usually confined to small needles. Glazes Nos. 4 and 5 behave very uniformly; they were used in the raw (unfritted) state and were fired on a body composed of stoneware clay 20%, kaolin 20%, quartz sand 35%, felspar 8%, and chalk 7% in 20—24 hours in a muffle-kiln, the body-materials being ground, pressed, and used as an engobe or dip-body.—A. B. S.

Quartz glass in ceramic laboratories. H. Tafner. Sprechsaal, 1919, **52**, 257—258.

Quartz crucibles cannot replace platinum or clay crucibles where substances containing alkalis have to be heated, as the crucibles are attacked. The assumption that quartz glass has the same hardness as natural quartz (*viz.*, 7 on Mohs' scale) is incorrect; quartz glass is not harder than the harder glasses, and not nearly so hard as agate or porcelain. Hence mortars of quartz glass cannot replace those of agnate. The semi-opaque quartz glass (vitreosil) contains innumerable bubbles, and when the surface is abraded these bubbles form small cavities which retain dirt and prevent the vessels being properly cleaned. The similar bubbles in porcelain are much smaller and do not interfere to the same extent. This may be shown by observing the residue left when vessels of these materials are rubbed with calcined iron oxide and then washed and wiped in the customary manner. Ware made of transparent quartz glass is free from this defect, except when the ware spalls or is scratched in use. The defects mentioned are chiefly important in ceramic laboratories; they do not seriously affect the use of quartz glass in other branches of chemical industry.—A. B. S.

CaO-MgO-SiO_2. Ferguson and Merwin. *See* VII.

Patent.

Tiles, bricks, pottery, and coarse ware; Manufacture of ——. J. Roberts, J. Thomas, and J. Williams, Bethesda, near Bangor. Eng. Pat. 130,134, 20.7.18. (Appl. 11,889/18.)

Tiles, pottery, sanitary ware, bricks, and the like are made of a mixture of 70—85% of slate or shale dust or chippings with 15—30% of a lightening material such as magnesia, talc, or steatite, made into a paste and then moulded and baked in the customary manner. Similar articles may be made by adding 10% or more of a flux such as sodium carbonate or fluorspar to the above-mentioned mixture, fusing it and casting the molten material in moulds.—A. B. S.

IX.—BUILDING MATERIALS.

Destruction of wood. Acree. *See* V.

Patent.

Artificial stone. V. Gastaldo and M. Mino, Philadelphia, U.S.A. Eng. Pat. 130,135, 22.7.18. (Appl. 11,957/18.)

Tiles, bricks, and slabs impervious to moisture and having a mother-of-pearl lustre are made by crushing oyster, mussel, or ablone shells, separating the mother-of-pearl, mixing it with a plastic mass of ordinary cement, and moulding into the desired shape. The surface of the article is afterwards ground and polished and then coated with white dammar.—A. B. S.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

[*Steel*] *Flaky fractures and their possible elimination.* H. Styri. Chem. and Met. Eng., 1919, **20**, 478—483. (See also this J., 1919, 368 A.)

A critical review is given of the literature bearing upon oxides and other inclusions in steel, segregation, effect of blow-holes, etc. The causes of failure in many of the steels examined by the different investigators are similar to those which have resulted in the flaky fractures investigated by the author, and which he ascribes chiefly to non-metallic inclusions and in a less degree to cracks, blow-holes, and segregation. In discussing the factors influencing the elimination of flakes the equilibrium of oxides in iron is considered. To form an idea of the formation of inclusions the author makes use of Le Chatelier's principle for the reduction of oxides by applying the dissociation law, and calculates the partial pressure of oxygen corresponding to saturation at 1600° C., as it varies with the temperature for a hypothetical slag cover of FeO. By using the law of mass action, the partial pressure of the oxygen at less than saturation can be found, and an equation is obtained for the partial pressure of different concentrations of oxygen in steel. The influence of the addition of manganese to the bath at 1600° C. is considered and it is found that the dissociation pressure of manganese oxide in the steel or the partial pressure of oxygen dissolved varies inversely as the square of the concentration of manganese. A chart is given showing the oxygen pressure for different concentrations of oxygen in steel, and the partial pressure of the oxygen which can be in equilibrium with different concentrations of manganese in steel. The oxygen pressure and the concentration of oxygen decrease with the square of the concentration of manganese oxide in the slag and a curve is drawn for 50 molecules % MnO in the slag. A further curve is calculated for the partial pressure of oxygen in the bath which is in equilibrium with varying amounts of silicon, and from consideration of the equation $FeO + C \rightarrow Fe + CO - 36$ cals. at 1600° C., the concentration of oxygen and the corresponding oxygen pressure of the carbon monoxide in steel for different amounts of carbon are calculated. It is deduced from the chart that manganese alone is a comparatively weak deoxidiser, but is much stronger if some other deoxidiser like silicon is present. Carbon is a stronger deoxidiser than manganese, but weaker than silicon for low concentrations. A chart like the one prepared for oxygen would show that desulphurisation depends on the heat of reaction of the sulphides. In regard to casting practice, the author prefers freezing the ingot after the "onion" type to the "landlocking" type. The ingot should be stripped and put in a soaking pit before the outer layer has passed the critical range. It is better to forge between V-dies than flat dies. The precautions to be adopted to minimise inclusions in making steel and in its subsequent treatment are discussed.

—T. H. Bu.

Iron in iron ores; Determination of —— by Reinhardt's method. R. Fresenius. Z. anal. Chem., 1919, **58**, 198—206.

Certain modifications are proposed; the 5 grms. of sample is digested with 50 c.c. of hydrochloric acid (sp. gr. 1·19) instead of 100 c.c. as in the original method; after the acid-soluble portion has been collected the insoluble portion is fused with sodium carbonate, dissolved in hydrochloric acid, the iron

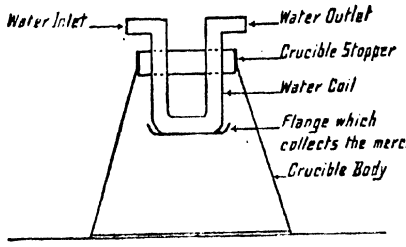
precipitated as hydroxide, and this again dissolved in hydrochloric acid and the solution added to the main quantity. After diluting to 1 litre, 100 c.c. is treated with 10 c.c. of hydrochloric acid (to make the acidity equal to that obtained in the original method), the mixture evaporated to 50 c.c., the ferric salts reduced with stannous chloride, the excess of the latter removed by the addition of mercuric chloride, the whole diluted to 2 litres, treated with 60 c.c. of manganese sulphate-phosphoric acid solution, and then titrated with permanganate solution.—W. P. S.

Nickel and cobalt; Rapid method for determining —— in ores and alloys. W. R. Schoeller and A. R. Powell. Analyst, 1919, 44, 275—280. (See this J., 1917, 720; 1918, 269 A.)

FURTHER work on the method described previously (*loc. cit.*) has confirmed its reliability for the separation of nickel and cobalt from iron, zinc, chromium, etc., but modification is necessary when the ore contains manganese. In the case of ores or alloys containing little or no nickel it has been found that the addition of solid potassium iodide in place of saturated sodium chloride solution promotes complete precipitation of the hexaminecobaltous iodide. The following directions summarise all the chief points of the method and its modifications. (1) *The ore is free from copper, manganese, calcium, and magnesium; presence of arsenic immaterial.* The ore is dissolved in nitric acid or hydrochloric acid, or both, the solution evaporated nearly to dryness, and tartaric acid (10 times the weight of trivalent metals present) dissolved in the minimum quantity of water is added. Fifty c.c. of concentrated ammonia and 5 grms. of potassium iodide are then added, the mixture stirred for 15 mins., the precipitate collected, washed with ammoniacal iodide solution (4% potassium iodide dissolved in 4 vols. of concentrated ammonia: 1 vol. of water), then dissolved in dilute hydrochloric acid, the solution filtered, and the cobalt precipitated from the filtrate as phosphate; the nickel is titrated in the filtrate from the cobalt phosphate. (2) *The ore contains copper, otherwise the same as* (1). The iodide precipitate, obtained as in (1), is dissolved in hydrochloric acid, the solution decolorised by the addition of sulphurous acid, heated just to boiling, cooled, filtered to separate cuprous iodide etc., and the cobalt and nickel then separated by phosphate precipitation. (3) *General procedure for complex ores free from manganese.* The ore is dissolved in a suitable acid, the heavy metals are precipitated with hydrogen sulphide, the mixture is filtered, the filtrate treated with ammonium chloride and a slight excess of ammonia, and the cobalt and nickel precipitated by saturating the solution with hydrogen sulphide. The precipitated sulphides are dissolved in *aqua regia*, the solution is evaporated almost to dryness, and the process continued as described under (1). (4) *The ore contains manganese.* When only a small quantity of manganese is present, the cobalt ammonium phosphate, obtained by any of the above-mentioned methods, may be titrated with $N/5$ acid (not hydrochloric acid), or the weighed cobalt pyrophosphate may be dissolved in sulphuric acid; the manganese is then determined colorimetrically in the solution by means of the persulphate-silver nitrate method, and the amount of cobalt is found by difference. In the case of moderate or large amounts of manganese, the mixed iodide precipitate is dissolved in dilute acid, and the cobalt and nickel precipitated as sulphides from an acetic acid solution, or the acid solution may be neutralised and the nickel and cobalt precipitated as xanthates. Either precipitate is dissolved in *aqua regia* and the two metals separated as described above. When nickel ores are free from cobalt, manganese does not interfere in the cyanide titration in the presence of citrate.—W. P. S.

Mercury ore; Technical analysis of ——. R. F. Heath. Chem. News, 1919, 119, 89—90.

A MODIFIED gold-cup method is described, in which 1—5 grms. of the ore is heated with twice its weight of dehydrated potassium or sodium hydroxide, con-



taining 2% of sodium chloride, in a crucible made of "candia alloy" or platinum-plated nickel and provided with a cover, water-coil, and flange constructed of rolled gold, as shown in the figure. The method is rapid and gives accurate results.

—W. E. F. P.

[Ores] Mechanical dressing; Investigations on ——. E. Dreves. Metall u. Erz, 1919, 13, 297—307.

THE rate of fall of ore grains and admixed particles in water is discussed mathematically. Four cases are considered in which the ore falls at greater, equal, or less velocity than the admixed grains, also when the grain size of the different materials is the same. From a comparison of the equations obtained, the most preferable method of separation can be deduced, also for individual processes the degree of grading that should be made. The behaviour of flake-shaped grains in water currents is considered and the conception of specific cross section is introduced. The importance of grading and the methods of sifting and grading by water currents are discussed and a convenient form of apparatus for obtaining grains between prescribed limits is described. Two new forms of separator are also described, in one of which the motion of the water is accelerated, whilst in the other, in addition to the main horizontal current, the water flows downwards with decreasing velocity due to the introduction of an upward stream.

—T. H. Bu.

Metals; Mechanical tests of ——. C. Frémont. Comptes rend., 1919, 169, 228—231.

Two simple, portable, and inexpensive pieces of apparatus are described for testing the tensile strength and ductility of metals, and their resistance to impact. The apparatus is, in each case, so designed that only small specimens of the metal are necessary. In the former apparatus the test-piece is held between two bars of metal pivoted at their centres, the other ends of the bars being submitted to varying pressures by a vice; a device for indicating the tension on the test-piece is provided. In the impact tester the test-piece is broken by a blow of a hammer actuated by a spring, and the "residual work" is taken up by a spring immediately below the test-piece, the compression of which is indicated on a dial.—W. G.

PATENTS.

Iron ores; Process of reducing ——. G. Jakova-Merturi, Paris. Eng. Pat. 129,354, 29.10.17. (Appl. 15,768/17.) Int. Conv., 2.11.16.

REDUCTION of iron ores mixed with suitable fluxing

material, but without solid carbonaceous fuel, is effected by the combustion in the furnace of "a mixture of poor gas (90% carbon monoxide and 10% hydrogen) and of rich gas (50% carbon monoxide and 50% hydrogen) in such proportions that the volume of carbon monoxide never exceeds 50% of the whole volume, to which mixture hydrogen in any proportion may be added." The proportions of carbon monoxide and of hydrogen depend on the degree of carburisation desired in the metal produced.—C. A. K.

Steel [for cutting tools, etc.]. P. Macgregor and A. Balfour, Sheffield. Eng. Pat. 129,330, 19.10.17. (Appl. 15,224/17.)

Steel for cutting tools and suitable for high-speed work contains 1—6% Ni, 1—3·5% C, 6—20% Cr, and a small percentage of manganese. A steel of the following approximate composition is specifically claimed:—C 1·45%; Si 0·4%; Mn 0·25%; S 0·03%; P 0·03%; Cr 12·5%; Ni 3·5%; Fe 81·84%. —C. A. K.

Ferro-manganese; Manufacture of low-carbon ——. R. A. Hadfield, London. Eng. Pat. 129,426, 8.7.18. (Appl. 11,198/18.)

Low-carbon ferro-manganese is produced by decarburising high-carbon ferro-manganese in an electric furnace by means of a manganese ore and carbonaceous material. The latter prevents excessive oxidation of the bath by reducing the manganese to the manganous state. Small additions of lime, ferro-silicon, or calcium silicide may be made to regulate the condition of the slag produced.—C. A. K.

Iron or steel; Electrolytic method of cleaning ——. Q. Marino, Hendon. Eng. Pat. 129,489, 9.8.18. (Appl. 12,960/18.)

The metals are cleaned by the electrolytic method, using an electrolyte consisting of a solution of a soluble sulphate, such as aluminium, magnesium, potassium, or sodium sulphate, and a soluble fluoride, such as magnesium, potassium, or sodium fluoride, to which 5—20% of hydrofluoric acid may be added. About 1 part of fluoride to 3 of sulphate is recommended.—B. N.

Alloy. W. J. Reardon, Pittsburgh, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,305,166, 27.5.19. Appl., 18.3.14.

An alloy, suitable for casting without the formation of blow-holes and black specks in the castings, contains aluminium, magnesium, and less than 1% of vanadium.—B. N.

Lead; Extraction of —— from its ores. F. E. Elmore, Boxmoor. Eng. Pat. 129,773, 6.7.18. (Appl. 11,126/18.)

In the process of extracting lead from its sulphur ores by means of strong brine solution, in which the lead is recovered partly as sulphate and partly as chloride (Eng. Pat. 127,641; this J., 1919, 541 A), a certain quantity of sodium sulphate accumulates in the brine as a result of the reaction. The mixture of lead sulphate and chloride may be wholly converted into sulphate by cooling the used brine solution to 0° C., dissolving the crystallised sodium sulphate so obtained, and treating the precipitated lead salts with the hot solution. Technically pure lead sulphate may be separated from the sodium chloride solution, which may be returned for the extraction of a fresh quantity of ore.—C. A. K.

Nickel; Recovery of —— from its sulphide or oxide. H. W. C. Annable, Egham, and Nickel Concentration, Ltd., London. Eng. Pat. 129,667, 19.11.17. (Appl. 17,031/17.)

Nickel sulphide ore or matte is heated at 800°—1000° C. in a non-oxidising atmosphere, with a metallic chloride, preferably sodium chloride, together with a material, *e.g.* iron pyrites, to supply sufficient sulphur to convert all the nickel into the sulphide form. After a period of 30—60 mins. the mass is oxidised in contact with air at a temperature sufficiently high (500°—600° C.) to decompose iron and copper sulphates, but below the decomposition temperature of nickel sulphate. The latter is leached out with water, and the nickel values are recovered by known methods.—C. A. K.

Combustion [smelting] process, and apparatus for practising the same. C. A. Garred, Assignor to Garred-Cavers Corp., New York. U.S. Pat. 1,311,807, 29.7.19. Appl., 25.5.17.

The smelting process is carried out in a vertical shaft, wherein the ore to be smelted is arranged upon a suitable bottom support. The interstitial space between the various portions of ore is supplemented by and connected with a chamber adjoining the lower portion of the mass of ore. Air carrying pulverised fuel is forced under pressure into this chamber, and the ignited stream is directed into the lower portion of the ore.—J. S. G. T.

Crucibles, melting-pots, and the like; Electrically-heated ——. The Morgan Crucible Co., Ltd., and C. W. Speirs, London. Eng. Pat. 129,407, 8.6.18. (Appl. 9169/18.)

The crucible is heated by the passage of an electric current through it, and the spout, lip, or pourer is also heated by the current preparatory to the pouring of the metal, the spout being provided with an extension to which an electric terminal may be applied in addition to the terminals used for the body of the crucible.—B. N.

Electrodes for electric arc welding. E. Languepin, Paris. Eng. Pat. 129,360, 31.10.17. (Appl. 15,888/17.)

An electrode for electric arc welding is composed of a rod of metal and a covering sheath, the latter being perfectly homogeneous and compact and not easily fusible, with a boiling point sufficiently close to its melting point to prevent the formation of slag. A thin sheath of pure kaolin may be used, which, in the operation, is entirely volatilised, only giving out vapours which condense on the cool surface of the object to be welded, without being able to mix with the molten metal.—B. N.

Metal reflectors. C. J. V. Fery, Paris. Eng. Pat. 129,323, 17.10.17. (Appl. 15064/17.) Int. Conv., 23.10.16.

Metal reflectors used for concentrating radiations, particularly of infra-red rays, are preserved from corrosion by the application of a film of asphaltum. A solution of asphaltum, in benzine, may be applied to the metal surface as a varnish and exposed to the action of sunlight or to the light from an arc or mercury vapour lamp. The varnish becomes insoluble and is said to absorb luminous rays while at the same time it is transparent to infra-red rays. —C. A. K.

Metallurgical and like furnaces; Construction of doors for ——. A. T. Nutt and F. A. Harvey, Sheffield. Eng. Pat. 130,216, 7.10.18. (Appl. 16,238/18.)

Furnaces for heating blooms, ingots, and the like. Soc. Franc. d'Exploit. de Fours Spéciaux à Haute Temperature, Paris. Eng. Pat. 130,051, 7.1.18. (Appl. 387/18.) Int. Conv., 28.8.17.

Smelting furnace or cupola. A. Poulson, Hough Green, and W. C. A. Mate, Garstang, Assignors to C. J. Rourke, Cheadle Hulme. U.S. Pat. 1,311,711, 29.7.19. Appl., 15.10.17.

See Eng. Pat. 110,283 of 1917; this J., 1917, 1239.

Gas-fired furnaces. Eng. Pat. 130,475. *See* I.

Smoke and fume. Eng. Pat. 129,721. *See* I.

Pickling liquors. Ger. Pat. 312,492. *See* VII.

Aluminium etc. Eng. Pat. 730,164. *See* VII.

XI.—ELECTRO-CHEMISTRY.

PATENTS.

Electrolysis of solutions. V. Grüner, New York, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,311,506, 29.7.19. Appl., 13.2.18.

ANODES used in the electrolysis of aqueous solutions are protected from oxidation by adding water-glass to the electrolyte.—B. N.

Diaphragms for electrolytic cells. Chemische Fabrik Weissenstein G.m.b.H., Vienna, and R. Walter, Villach, Austria. Eng. Pat. 112,446, 24.12.17. (Appl. 19,082/17.) Int. Conv., 19.12.16.

A DIAPHRAGM for electrolytic cells is provided on its faces with a series of staggered notches or grooves for the purpose of reducing its thickness. The stability of the plate is increased, and strains in the material compensated for, by arranging that the notches or grooves, running in straight, broken or curved, or retraced lines, change their direction whilst retaining a symmetrical arrangement.
—B. N.

Electric batteries; Dry —— and method of making the same. W. J. Mellersh-Jackson, London. From Burgess Battery Co., Madison, Wis., U.S.A. Eng. Pat. 128,332, 19.3.18. (Appl. 4866/18.)

A PORTION or all of the materials of a gelatinisable electrolyte is cooled to below 12° C., the materials mixed, and whilst still cold poured between the electrodes of the cell and allowed to gelatinise as the temperature rises from 12° to 24° C. The electrolyte may be prepared by adding two parts of cotton starch and one part of corn (maize) meal to a mixture of 450 grms. of ammonium chloride and 1000 c.c. of zinc chloride solution of about 35° B. (sp. gr. 1·32) cooled to 0°—12° C. It may contain 7—34% by weight of cereal, mixed with 20—70% of mixed chlorides, the zinc chloride constituting 13—47% of the gelatinisable electrolyte. An electrolyte containing about 36·7% of its weight of zinc and ammonium chlorides will set in a few minutes at 12°—24° C.—B. N.

Batteries; Electric ——. L. Rabinovitch, Kings Langley, and A. Mond, London. Eng. Pat. 129,423, 8.7.18. (Appl. 11,181/18.)

THE electrode, or container to be used as the electrode, is prepared by electro-depositing or spraying on to a neutral base a coherent layer of metal or metal alloy capable of producing an electric current with another suitable electrode. A block of wood, ebonite, celluloid, or other suitable material of the shape and size of a battery is made with one or more holes adapted to serve as containers for the battery proper, the interior of the holes being sprayed with metal. Or the outer shell may be prepared from sheets of celluloid, ebonite, non-inflammable celluloid, papier-mâché, cardboard, or the like, stamped in pairs, so as to form one or more semi-circular recesses of equal size, which, when placed in juxtaposition, form cylindrical chambers of the shape of the outer contour of the battery, the recesses being coated with metal. As further alternatives, the shell may be stamped from sheet metal, and the interior of the shell coated with the required metal; or a sheet of paper, celluloid, or other neutral material, made waterproof if necessary, may be cut to the required size and shape, sprayed with the metal, and then bent or folded to shape.—B. N.

Storage batteries; Utilising gas from electric ——. E. I. Dodds, Assignor to Flannery Bolt Co., Pittsburgh, Pa. U.S. Pat. 1,312,311, 5.8.19. Appl., 25.7.17.

THE gas escaping from an electric battery is burned in a burner enclosed in a body of "light-penetrating material" having a coating of phosphorescent material.—B. N.

Furnaces; Electric ——. The Morgan Crucible Co., Ltd., and C. W. Speirs, London. Eng. Pat. 129,760, 14.6.18. (Appl. 9822/18.)

AN electric furnace comprises a container in the form of a dish or hearth composed of a material constituting the conductor through which the current is passed, the hearth being approximately circular in plan and having three integral lateral extensions to which are applied terminals for the supply of three-phase current. The hearth is enclosed in a lined metal casing arranged to tilt, and the arch or roof is also heated electrically by three-phase current.—B. N.

Furnace; Electric ——. J. Rennerfelt, Djursholm, Sweden. U.S. Pat. 1,305,167, 27.5.19. Appl., 3.10.18.

AN electric furnace is provided with a number of electrodes projecting downwards into a heating room towards projections from the side wall which correspond to each electrode and support carbonaceous contact material for arcs from the electrodes.
—B. N.

Furnaces; Electric arc ——. H. Coates, and Watford Electric and Manufacturing Co., Ltd., Watford. Eng. Pat. 130,020, 19.12.17. (Appl. 18,876/17.)

AN automatic regulator for arc-furnaces, controlled by the current-strength of the arc, is combined with an automatic switch having two or more positions controlled by the voltage across the arc; the switch is connected by suitable means with the current-controlled regulator, so that in one position of the switch it permits the regulator to operate in its normal manner, but in another either modifies the action of the regulator or substitutes therefor the control of the connecting means in such a manner that the arc is lengthened, and at a more rapid rate than by the normal operation of the regulator. The switch is constructed to move a live contactor between two yieldingly-supported contact pieces, one affording an idle current, whilst the other forms part of the operating circuit for the switch, and the parts are so constructed that the contactor does not, when moving in either direction, break circuit with one contact piece until it has made circuit with the other. The switch may control a second switch which is closed electro-magnetically in each of the two operative positions, and may be combined with suitable arms, operated by the second switch, to put a brake for the arc-adjusting motor on and off automatically as the switch passes from one position to the other, as, for example, to connect and disconnect a braking resistance to and from the motor armature.
—B. N.

Furnaces; Electric ——. J. R. Hoyle and P. W. Fawcett, Sheffield. Eng. Pat. 130,205. (Appls. 15,302, 20.9.18, and 222, 3.1.19.)

A SHIELD or guard for the electrode is made in two or more parts, which together form a conical

chamber, the lower portion of the shield resting on a water-cooled ring forming a base surrounding the opening in the furnace roof through which the electrode passes. The upper portion of the shield rests against the circumference of the electrode, which can slide through it, and forms a substantially air-tight joint therewith, the segmental members being kept in place against the electrode by means of a divided ring. The segmental members are constructed preferably with overlapping joints, and each member is hinged or pivoted to the flange of the water-cooled ring, so that it may be turned back clear of the electrode.—B. N.

Furnaces; Electric ——. G. Marriott, Sheffield. Eng. Pat. 130,288, 3.3.19. (Appl. 5212/19.)

THE furnace hearth is formed of a layer of fine dolomite, on which is superposed an asbestos millboard covering, which extends partly up the outer walls and around the doors and tapping spout. A copper or bronze plate, placed centrally on the asbestos covering, is surrounded by a layer of thin magnesite bricks, which stand slightly above the level of the plate, and the latter is covered with a layer of graphite powder up to the level of the surrounding bricks. A relatively thick layer of ramming, consisting of dolomite 60%, magnesite 30%, fine metal nail clippings or metal turnings 8%, graphite 2%, and a binding of tar, is built above, and a thinner ramming and banks of the usual construction are superposed on this. A layer of fine chrome ore may be applied to the top of the banks and surrounding brickwork shell, and beneath the furnace walls.—B. N.

(A) *Electrode [for electric furnaces] and process of making the same.* (B, C, D, E, F, G, and H) *Electrode.* J. C. King, Montreal, Canada. U.S. Pats. (A) 1,312,255, (B) 1,312,256, (C) 1,312,257, (D) 1,312,258, (E) 1,312,259, (F) 1,312,260, (G) 1,312,261, (H) 1,312,262, 5.8.19. Appl., (A) 22.5.16; (B to H) 9.10.17.

(A) AN electrode is provided with a roughened surface and a protective coating overlying and baked on the surface. (B) An electrode comprises a core, a non-oxidising protective coating bonded or baked on to the core, and an outer coating of cementitious material applied to the coating. (C) The carbon core is provided with a roughened surface and a coating of non-oxidising material and metal particles bonded or baked on to the roughened surface. (D) Magnesite, (E) dolomite, (F) bauxite, (G) chrome iron ore, (H) "zirconium," mixed with a carbonaceous binding material is bonded or baked on to the roughened surface.—B. N.

Induction [electric] furnace having unidirectional circulation. J. R. Wyatt, Assignor to The Ajax Metal Co., Philadelphia, Pa. U.S. Pat. 1,312,069, 5.8.19. Appl., 29.8.18.

AN induction furnace is provided with walls forming a furnace chamber, and a resister channel for molten metal beneath and communicating with the furnace chamber, one part of the channel being of restricted cross-section. An alternating current transformer is arranged with one leg threaded through the channel, the leg being nearer the metal at the more constricted part of the channel than at other parts.—B. N.

Wehnelt [current] interrupter. Polyphos Elektrizitäts-Ges.m.b.H., Munich. Ger. Pat. 312,568, 25.11.17.

THE durability of the active electrode of the interrupter is increased by making it of osmium or iridium in place of platinum. The current strength, dependent upon the area of the electrode surface, is moreover, thereby maintained more constant.—J. S. G. T.

Furnaces; Electric ——. A. D. Keene, Schenectady, N.Y., U.S.A. Eng. Pat. 119,228, 30.8.18. (Appl. 14,079/18.) Int. Conv., 5.9.17.

SEE U.S. Pat. 1,255,613 of 1918; this J., 1918, 213A.

Melting furnaces; Electric ——. T. F. Baily and F. T. Cope, Alliance, Ohio, U.S.A. Eng. Pat. 119,234, 4.9.18. (Appl. 14,400/18.) Int. Conv., 4.9.17.

SEE U.S. Pat. 1,272,186 of 1918; this J., 1918, 592A.

Dry cells; Process of resuscitating spent ——. K. Horii, Hokkaido, Japan. U.S. Pat. 1,311,559. 29.7.19. Appl., 29.5.18.

SEE Eng. Pat. 124,137; this J., 1919, 376A.

Electrodes. Eng. Pat. 129,735. *See* IIB.

Sulphonic acids. Eng. Pat. 129,002. *See* III.

Electrodes for welding. Eng. Pat. 129,360. *See* X.

Cleaning iron or steel. Eng. Pat. 129,489. *See* X.

XII.—FATS; OILS; WAXES.

Castor oil; Abnormal sample of ——. W. R. G. Atkins. Analyst, 1919, 44, 287—288.

A SAMPLE of castor oil, prepared in Egypt from seeds produced there, had an abnormally low viscosity, the time of flow (Redwood) at 15·5° C. being 262 secs. The spr. gr. was slightly low (0·9575 at 15·5° C.), but all the other values were normal. —W. P. S.

Candlenut oil. Lespinasse. Ann. Falsif., 1919, 12, 152—153.

DRY candlenut kernels (*Aleurites triloba*) yield 63—65% of a yellow oil which has slight purgative properties; the kernels themselves are poisonous, two to four producing grave symptoms when eaten, but the poisonous principle does not appear to pass into the oil. The oil has the following characters:—sp. gr. at 15° C., 0·927; acidity (as oleic acid), 0·70%; saponif. value, 175; iodine value, 137. The oil is suitable for soap-making or as a substitute for linseed oil in paints.—W. P. S.

Acetyl value [of oils]; Determination of the ——. L. Carcano. Boll. Chim. Farm., 1919, 58, 121—122.

ATTENTION is directed to the fact that repeated washing of acetylated oils with boiling water causes a slight hydrolysis of the acetylated product. Free acidity should be titrated in the cold before determining the saponification value of the acetylated oil.—C. A. M.

Glycerol. Connstein and Lüdecke. *See* XVIII.

PATENTS.

Emulsion; Method of and means for producing ——. C. O. J. Christensen, London. Eng. Pat. 129,757, 11.6.18. (Appl. 9604/18.)

A CONE is rotated adjustably within a conical casing supported on a frame. The inner surface of the casing and the outer surface of the cone or rotor are divided into a series of working surfaces by annular grooves cut on the opposed surfaces. The angle which the middle surface makes with the vertical is less than that made by the upper and lower surfaces. A regular feed of melted fat to the different surfaces is ensured by means of a distributing cylinder fixed below the frame of the machine. The cylinder has a number of openings in the bottom, each connected by a separate pipe

with a different surface, and a flat disc with one perforation is rotated close to the bottom by a shaft geared to the machine. The cylinder is kept full of melted fat, and as the disc rotates and the hole comes successively over the openings in the bottom of the cylinder some of the fat passes to the delivery pipe.—W. H. C.

Removing sulphur from oils. Eng. Pat. 129,349. *See* IIA.

Oil-proof paper. U.S. Pat. 1,311,595. *See* V.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Varnishes, etc.; Gravimetric method of comparing viscosities of ——. H. C. S. de Whalley. Analyst, 1919, 44, 288—289.

A MICROSCOPE slide, 3 in. long, 1 in. wide, and about 0·02 in. thick, is placed vertically in a small covered beaker, and the whole is weighed. A fine mark is scratched across the slide 2 in. from the lower end, and the slide is then immersed up to the mark in the varnish, which has been brought previously to a definite temperature; the slide is held in the varnish for 5 secs., slowly withdrawn (vertically), kept suspended just above the surface for 60 secs., and after drawing its lower end across the edge of the vessel containing the varnish, it is replaced in the covered beaker, and weighed. The increase in weight multiplied by 100 gives a viscosity value which serves for comparison purposes.—W. P. S.

Balsams; Alcoholysis of ——. E. Fourneau and M. Crespo. Bull. Soc. Chim., 1919, 25, 386—389.

THE balsam is boiled for six hours with an equal weight of alcohol containing 3% of hydrogen chloride. The product is then neutralised with sodium carbonate, and the esters and alcohols are distilled off in steam and subsequently separated by fractional distillation. In this process the resins are not attacked. Tolu and Peru balsams, benzoin, and storax were examined, and the results show that the balsams consist of mixtures of cinnamyl and benzyl cinnamates and benzoates in varying proportions and resins. From Peru balsam a small quantity of a terpenic alcohol, probably identical with Thoms' peruviol, was found. Storax only yielded cinnamyl cinnamate, there being no indication of the presence of either benzyl alcohol or benzoic acid. The application of alcoholysis in the analysis of balsams is suggested.—W. G.

Coumarone resins etc. E. Stern. Z. angew. Chem., 1919, 32, 246—248. (See this J., 1919, 295A, 329A.)

THE polymerisation of coumarone is reversible. If coumarone resins are distilled under ordinary or, better, under reduced pressure, yellow or golden oils are obtained between 150° and 240° C. consisting, in the main, of coumarone or partially depolymerised paracoumarone, together with indene, hydrindene, and small quantities of phenol. On treating these coumarone oils with condensing agents and catalysts, solid resins or oils are obtained, varying in character with the nature of the catalyst. Zinc chloride and silicon tetrachloride have no polymerising effect, but tin tetrachloride has a pronounced influence even when only 1% is used. The polymerising action of certain chlorides such as aluminium chloride is specific, and is not due to liberation of hydrogen chloride. Coumarone oils are not autoxidisable like drying oils, but when mixed with 4—6% of driers, such as lead resinate or manganese resinate, they yield dry films. A mixture of boiled linseed oil with up to 30% of coumarone oil dries as readily as ordinary boiled linseed oil. On the other hand, the drying power of coumarone oils is retarded by the addition of relatively small amounts of linseed oil. The distinctive oxidation process of coumarone oils is primarily attributable to indene. The addition of pure indene to a coumarone oil, which dries (with driers) in 18—24 hours, distinctly retards the drying process.—C. A. M.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Recent methods for the estimation of ——. Utz. Z. angew. Chem., 1919, 32, 235—236.

PONTIO'S method for the estimation of rubber by precipitation of the filtered solution by alcohol is not to be recommended, the chief difficulty being the removal of enclosed liquid from the rubber clot. In Marquis and Heim's process (this J., 1914, 951), in which the solution of deresinised rubber (1 grm.) in chloroform (100 c.c.) is shaken for 3 minutes with sulphuric acid (8 grms.) before being poured into the alcohol, a flocculent, easily filterable precipitate, of the same composition as the original rubber, is obtained which can be collected in a Gooch crucible, washed with alcohol, and dried; the results obtained in this way are very satisfactory. Vaubel's method (this J., 1912, 887), involving the treatment of 20 c.c. of a solution of the rubber (2 grms.) in chloroform (100 c.c.), with potassium bromide (5 grms.), dilute hydrochloric acid (1:10; 200 c.c.), and potassium bromate of 2% concentration (40 c.c.) in a stoppered flask, followed by the addition of a small fragment of iodine and titration of the excess bromine with sulphite solution, also gives good results; it is advisable, however, to allow 30 minutes to elapse between the commencement of the bromination and the titration. Carbon tetrachloride can be used instead of chloroform, but the precipitate of caoutchouc tetrabromide is then rather less finely divided, and the subsequent titration takes a longer time.—D. F. T.

PATENTS.

Vulcanisation of rubber and other like substances. North British Rubber Co., and B. D. Porritt, Edinburgh. Eng. Pat. 129,798, 17.7.18. (Appl. 11,686/18.)

SODIUM phenoxide and other compounds of the strong alkalis with aromatic hydroxy-compounds, *e.g.*, the cresols or β-naphthol, are used as catalysts for accelerating the combination of rubber and sulphur in vulcanisation; the addition of 2% of sodium phenoxide to a mixing of rubber 90%, sulphur 10%, will reduce the time of vulcanisation at 40 lb. steam pressure by more than 75%.—D. F. T.

Vulcanisation of caoutchouc; Process for the ——. S. J. Peachey, Davenport. Eng. Pat. 129,826, 26.7.18. (Appl. 12,179/18.)

NASCENT sulphur produced by the interaction of sulphur dioxide and hydrogen sulphide appears to be capable of combining with rubber at the ordinary atmospheric temperature and bringing about effective vulcanisation. Rubber sheet, either dry or wetted with benzene, may be submitted successively, and, if necessary, repeatedly to atmospheres containing sulphur dioxide and hydrogen sulphide respectively, or the gases may be applied successively to an ordinary rubber solution; in the latter case the solution rapidly becomes more viscous and ultimately forms a jelly, which is no longer soluble in the solvent.—D. F. T.

Indiarubber compositions or substitutes therefor; Manufacture of ——. W. F. Macdonald, London. Eng. Pat. 130,528, 21.11.18. (Appl. 19,128/18.)

A COMPOSITION of general utility, *e.g.*, for jointing, tyres, and floor mats, is made by mixing 50% of powdered slate with 15% of sulphur and 35% of indiarubber and vulcanising. On increasing the proportion of slate the product becomes suitable for pencil or ink erasers.—D. F. T.

Vulcanising rubber; Process for —— and product obtained thereby. S. P. Thacker. Weehawken, N.Y., Assignor to Revere Rubber Co. U.S. Pat. 1,312,141, 5.8.19. Appl., 5.1.18.

RUBBER or similar material is mixed with an organic vulcanising agent and red lead, and then vulcanised.—D. F. T.

Rubber solvent; Method of recovering ——. J. D. Morron, Lakewood, Ohio, Assignor to Mechanical Rubber Co. U.S. Pat. 1,312,452, 5.8.19. Appl., 11.4.16.

IN the manufacture of vulcanised rubber articles by the dipping method, the dipping form, coated with rubber solution, is first passed through a bath, the liquid of which is mutually soluble with the rubber solvent but not with the rubber; the rubber solvent is then extracted from the bath by agitating with oil and allowing the oil to separate.—D. F. T.

XV.—LEATHER; BONE; HORN; GLUE.

Tannin; Waste pulp mill bark as a source of ——. V. P. Edwards. J. Amer. Leather Chem. Assoc., 1919, 14, 381—90.

WASTE pulp mill hemlock bark contains 50% of moisture, which must be reduced by drying to prevent formation of moulds and to reduce freight charges. The bark, freed as much as possible from wood, is piled to a depth of 10 in. on a sheet iron screen 10 ft. sq. held 30 in. from the ground. Hot air from a large blower fan is admitted in the middle of one side underneath the screen. There is practically no loss of tannin. The analyses of the dried bark have been found to vary between the following limits:—Moisture 7·9—15·9%, non-tans 5·8—7·4%, tannins 8·9—11·35%. The hemlock bark from paper mill operations would be sufficient to supply 55% of the tannin requirements.—D. W.

Tannin analysis; Kaolin for ——. R. W. Frey. J. Amer. Leather Chem. Assoc., 1919, 14, 393—401.

THE following specifications are suggested for a satisfactory kaolin for analytical use:—It should be pure white, free from gritty matter, and should wet up readily, showing no tendency to lump. It should give clear filtrates with tannin solutions, and, on standing overnight with distilled water, should give a clear supernatant liquor which, when boiled down, should not be alkaline to phenolphthalein. The dried sample on ignition should show a loss of 12—15%. It should not give a discoloration with 0·5% tannic acid solution. 15 grms. should be shaken with 250 c.c. of *N*/50 acetic acid, allowed to stand for one hour, and 50 c.c. of supernatant liquor titrated with *N*/10 sodium hydroxide and hæmatine. The titration from this test should give the characteristic end point and not differ from a blank test by more than 0·25 c.c. The remainder of the liquid after pipetting the 50 c.c. should be filtered until clear and 100 c.c of the filtrate evaporated, dried, and weighed. The residue, after subtracting that obtained from a blank test and dividing by six, should not exceed 1·0 mgrm.
—D. W.

PATENTS.

Tanning material from pine-tree bark; Process for obtaining ——. R. Silberberger, Klattau, Bohemia. Eng. Pat. 130,010, 17.11.17. (Appl. 16,970/17.)

THE resin in dried pine-tree bark is removed by means of a solvent, preferably benzine, having a b. pt. of 100° C. or slightly above. The extracted bark is lixiviated with warm water yielding a liquor of 10°—14° B. (sp. gr. 1·07—1·10); an increased yield of 1·5% tanning material is obtained by this process.—D. W.

Adhesive. Vegetable glue and process of making the same. W. M. Grosvenor, New York, Assignor to Perkins Glue Co. U.S. Pats. (A) 1,311,964, (B) 1,311,965, 5.8.19. Appl., 25.2.16 and 8.12.17, (B) renewed 17.2.19.

(A) STARCH (10 parts) and finely ground mixed wax (4 parts), comprising about 80% paraffin and 20% carnauba wax, are mixed with water and heated to melt the wax and burst the starch. The mixture is agitated to emulsify the wax and a filler is added to give body to the adhesive. (B) A salt of an alkali metal and a resinous substance are mixed with a starchy carbohydrate in solution in 3 parts or less by weight of water, thus giving a product having substantially the properties of animal glue.—D. W.

XVI. SOILS; FERTILISERS.

Vegetation; Action of fluorides on ——. *Field trials.* A. Gautier and P. Clausmann. Comptes rend., 1919, 169, 115—122.

IN field trials carried out on a poor sandy soil, amorphous calcium fluoride being applied at the rate of 5·58 grms. per sq. metre as a source of fluorine, increased crop yields varying from 5·2 to 58·7% were obtained with certain species of plants. Positive results were obtained with wheat, oats, carrots, potatoes, peas, beans, and poppies, whilst beetroot, kidney beans, and cabbage gave either no increase or a decrease. Potatoes showed very little increase in the year of application of the calcium fluoride, but a very marked increase (58·7%) in the next year, whilst most of the other crops showed little if any residual effect in the second year.
—W. G.

Sulphates; Relation of —— to plant growth and composition. H. G. Miller. J. Agric. Res., 1919, 17, 87—102.

POT experiments were made with clover, rape, and oats grown in three different soils, to which were added separately calcium sulphate and sodium sulphate in solutions applied daily, and free sulphur mixed with calcium carbonate applied at the commencement of the experiment. A similar set of pot cultures with extracts of the soils added to sand was also carried out. Each pot was watered daily with sodium nitrate solution to eliminate the nitrogen supply as a limiting factor. It was found that enhanced growth was obtained in both the soil and the sand pots in all cases, showing that sulphates and free sulphur acted directly as fertilisers. The sulphates increased the formation of nodules on the clover roots, which was accompanied by a larger amount of nitrogen in the clover crop.—J. H. J.

Alkali salts in soils; The inhibition by stable manure of the injurious effects of ——. C. B. Lipman and W. F. Gericke. Soil Sci., 1919, 7, 105—120.

POT cultures were made with barley grown in a clay soil, to which was added separately 0·3% of sodium chloride, 0·3% of sodium carbonate, and 0·6% of

sodium sulphate before sowing the first crop, and again before sowing the second crop. Four crops were raised. Farmyard manure was added at the rate of 20—160 tons per acre. The results obtained by weighing the crops showed that the addition of the manure had a protective effect against the injury inflicted by the salt present. The effect varies with the amount of the manure and the chemical nature of the salt, and is considered to depend on the amount of internal surface possessed by the soil and the amount added by the manure. —J. H. J.

Soil amendments; Action of some common ——. J. E. Greaves and E. G. Carter. Soil Sci., 1919, 7, 121—160.

A FULL review is given of previous work on the action of salts on soil. Fresh small-scale experiments were instituted to test the action of salts on the nitrates, soluble phosphates, and organic phosphorus in soil. The results showed that the increased nitrate and soluble phosphate in the soil, brought about by the addition of various salts, were sufficient to account for the increase in the crops obtained. The increase in nitrate was very marked, reaching 97% in the case of calcium sulphate. The increase in available phosphate took place in all but two cases; the largest increase in soluble phosphate was 14% with calcium chloride and nitrate, and in organic phosphorus 62% with manganous carbonate.—J. H. J.

Pasture; Botanical composition of a permanent —— as influenced by fertilisers of different compositions. J. J. Skinner and C. F. Noll. Soil Sci., 1919, 7, 161—179.

A PASTURE field on loam soil was treated annually for seven years with acid phosphate, sodium nitrate, and potassium chloride in combinations of two and three together, in regular proportions. The total amount of fertiliser applied to each plot annually was at the rate of 50 lb. per acre. The grasses growing on the pasture were Canada bluegrass, Kentucky bluegrass, timothy grass, and clover. At the end of the experiment Kentucky bluegrass had become the predominant variety, especially on the plots high in nitrogen, whilst timothy grass was most abundant on plots high in potash. Clover grew most easily on plots with a small amount of nitrogen. It was found that the plots receiving a well-balanced fertilising mixture, or one in which the nitrogen was high, were neutral, whereas the absence or only a small proportion of nitrogen caused the soil to become acid.—J. H. J.

Inositol hexaphosphate. Posternak. *See* XX.

PATENTS.

Ammonia; Process for the conversion of synthetic —— into a solid product applicable for agricultural purposes in conjunction with the production of carbonate of soda. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude, Paris. Eng. Pat. 130,365, 29.1.18. (Appl. 1713/18.) Int. Conv., 25.8.17.

A CURRENT of carbon dioxide is passed into a cold solution of sea salt and synthetic ammonia, whereby sodium bicarbonate is precipitated and ammonium chloride remains in solution. The solution, after concentration and removal of as much sodium bicarbonate as possible, is neutralised with hydrochloric or sulphuric acid, and ammonium chloride is crystallised out, giving a product suitable for use in agriculture. The necessary carbon dioxide is obtained partly from the water-gas required for the production of the ammonia and partly by heating the sodium bicarbonate precipitated from the solution.—L. A. C.

Fertilisers; Manufacture of nitro-phosphate ——. A. T. Cocking, and Kynoch, Ltd., Birmingham. Eng. Pat. 129,306, 1.8.16. (Appl. 14,432/17.)

AMMONIUM nitrate is treated with a large excess of waste sulphuric acid, and the mixture obtained, after removal of nitric acid, is used to transform phosphate materials into superphosphate. By its use in this way a nitro-phosphate fertiliser is produced. The ammonium nitrate used may be produced by using ammonia from a gas producer recovery plant, and nitric acid produced electrically from the atmosphere.—J. H. J.

Tobacco. Eng. Pat. 129,791. *See* XX.

XVII.—SUGARS; STARCHES; GUMS.

Sugar factory products; Determination of carbonic acid [carbonates] in ——. V. Staněk and V. Skola. Z. Zuckerind. Böhm., 1919, 43, 191—198. Chem. Zentr., 1919, 90, II., 857—859.

THE authors determined the proportion of carbonates in beet sugar juices, molasses, etc., by decomposition with hydrochloric acid in a flask connected with a carbon dioxode absorption train. The reaction flask was maintained at 35°—38° C. because at higher temperatures carbon dioxide was liable to be produced by interaction of amino-acids and sugars (cp. Maillard, this J., 1912, 144). The percentages of carbonates (calculated as CO_2) found in various factory products were as follows:—juice after the first carbonatation, 0·006—0·008%, and after the second 0·006%; thin juice before boiling, 0·0204—0·0217%; syrup, 0·0043—0·0078%; syrup before boiling, 0·0236%; first massecuite, 0·0103%; second massecuite, 0·0129%; molasses, 0·058%; first green syrup, 0·0251%; second green syrup, 0·0511%; refinery molasses, 0·035—0·044%. There was no general correspondence between these values and the alkalinity of the various products with respect to phenolphthalein.—J. H. L.

[Sugar-] juice; Darkening of —— during evaporation "under pressure," and during its further working. O. Molenda. Z. Zuckerind. Böhm., 1919, 43, 304—321. Chem. Zentr., 1919, 90, II., 856—857.

THE author describes the working of a high-pressure evaporating plant (Brandt system) in the 1918/19 beet campaign. To minimise darkening of the juice, which depends on the duration and temperature of evaporation, it is advisable to operate with the smallest possible charges in the evaporating units. Experiments showed that the state of concentration of juice has no appreciable influence on the formation of dark products, provided the circulation is satisfactory. The plant gives the best results, qualitatively and quantitatively, when working to its full extent; any check on working tends to bring about conditions which cause darkening of the juice. High working efficiency depends mainly on an adequate and uniform separation of condensed water. Given the right amount of juice in the units, and satisfactory circulation, no darkening due to overheating occurs, but if circulation is defective, *e.g.*, while the units are being heated up, the juice in contact with the heating surface may darken rapidly. It was observed that whilst practically no darkening occurred in a concentrated syrup when maintained at rest for 2½ hours at about 97° C., the same syrup darkened relatively strongly during 5 hours' boiling to massecuite at a temperature of only 80°—85° C. Besides duration of heating and temperature, ebullition itself appears to be an important factor in producing dark-coloured substances.—J. H. L.

Sugars; Titration of ——. E. Rupp and F. Lehmann. Z. Unters. Nahr. Genussm., 1919, **37**, 162—164.

FURTHER work has shown a method described previously by the authors to be quite trustworthy (see also Frerichs and Mannheim, this J., 1917, 1022). It is, however, more convenient to mix the 10 c.c. of dextrose solution with 30 c.c. of Fehling's solution and 10 c.c. of water and then heat the mixture to boiling; this mixing in the cold does not impair the accuracy of the results. The mixture is boiled for 2 mins., then cooled rapidly, 2·5 grms. of potassium iodide and 25 c.c. of dilute sulphuric acid are added, and the liberated iodine titrated with thiosulphate solution.—W. P. S.

Maltose. Constitution of the disaccharides. III. W. N. Haworth and G. C. Leitch. Chem. Soc. Trans., 1919, **115**, 809—817.

IT has previously been shown that in lactose the galactose residue is linked not with the terminal carbon atom of the glucose chain but with the carbon atom next to the CH_2OH group. It is now demonstrated that in maltose the two hexose groups are linked by their terminal carbon atoms. Maltose was converted into heptamethyl methylmaltoside by treatment with dimethyl sulphate and alkali (see this J., 1915, 241) and afterwards with methyl iodide and silver oxide. The mode of linkage of the two glucose residues is inferred from the fact that on hydrolysis this methylated maltose yielded a mixture of a known tetramethylglucose and a new trimethylglucose containing a free CH_2OH group. Since there is a close relationship in properties between maltose and melibiose on the one hand and between lactose and cellobiose on the other, it is probable that melibiose has the same mode of linkage as maltose and cellobiose the same as lactose.
—J. H. L.

Aconitic acid; Presence of —— in sugar cane juice, and a new reaction for the detection of the acid. C. S. Taylor. Chem. Soc. Trans., 1919, **115**, 886—889.

IN 1877 Behr discovered relatively large amounts of aconitic acid in muscovado sugar and cane molasses. The author has isolated it also from juice from sound sugar canes by precipitating with basic lead acetate, decomposing the washed precipitate with hydrogen sulphide, evaporating the filtered liquid *in vacuo*, and extracting with ether. The crude substance was purified by similar operations. Calcium aconitate is readily soluble in cold but almost completely insoluble in hot water, and is therefore likely to be deposited on the tubes of evaporating plant unless the juice has been kept hot during filtration. On adding acetic anhydride to a small quantity of aconitic acid a pink coloration is produced, which rapidly becomes red and then magenta. Further heating causes the liquid to become bluish green and finally brown and almost opaque. At the magenta stage the liquid contains a red colouring matter soluble in water and a blue one soluble in ether; these can be easily separated by shaking the acetic anhydride solution with ether. The reaction is extremely delicate. None of the other acids present in sugar cane gives it. Citric acid itself does not, but after gentle fusion with acetic anhydride in a test-tube it forms a trace of aconitic acid, which then shows the reaction.
—J. H. L.

Plant colloids. VII. Action of diastase. M. Samec. Koll. Chem. Beihefte, 1919, **10**, 289—304.

UNDER the influence of diastase at 50° C. the potato starch molecule breaks up into at least two parts, of which one is very similar to starch in its properties, and the other (dialysable) has a somewhat similar structure since it colours iodine blue. The constitution of the starches and the dextrins appears to be very similar since the optical rotation of both is analogous. The dialysable product possesses marked reducing properties. As the reaction proceeds the colloidal starch residue separates high molecular products which are more easily dialysable and give a blue iodine reaction. When the molecular weight of the colloidal residue has sunk to below 20,000, the dextrin molecules produced give a red iodine reaction, and as the reaction continues they give no iodine reaction. The initial dextrin products are further decomposed, forming erythrodextrins and sugar, and the erythrodextrins pass over to achroodextrins. (See also J. Chem. Soc., Oct., 1919.)
—J. F. S.

Evaporating pans. Claassen. *See* I.

PATENTS.

Sugar; Method of and apparatus for washing ——. P. Jacobson, Wallasey, and T. Wrathall, Liverpool. Eng. Pat. 130,492, 24.8.18. (Appl. 13,778/18.)

RAW sugar and either water or syrup are fed into a vessel provided with a vertically adjustable rotary mixer, which is raised gradually during the charging of the vessel so as to mix and level the material as it is introduced without continuing to operate on the lower layers. After the charge has remained at rest for some time the supernatant syrup is drawn off through an internal discharge pipe of adjustable height with a screened opening at the top. A screened outlet at the bottom of the vessel, and others at different heights in the walls, all connected with valved discharge pipes, enable the wet sugar to be drained, if necessary a layer at a time, since the syrup from different layers varies in quality. Draining may be assisted by suction. The drained sugar may be further washed by percolation of fresh syrup through the charge. It is claimed that less sugar is dissolved by this process than by washing in a centrifuge.—J. H. L.

[*Sugar-*] *cane juice or other liquids; Apparatus for separating impurities from* ——. I. H. Morse, New Orleans, La. U.S. Pat. 1,311,831, 29.7.19. Appl., 24.1.19.

A TANK has a well sunk in the centre of the floor, a trough around the top of the tank separated from the interior of the latter by a screen, an inlet pipe to admit liquid to be filtered into the body of the tank, a discharge pipe to draw off the filtered liquid from the trough, a stirring mechanism to rotate the liquid in the tank, and a valved outlet at the bottom of the well to withdraw deposited solid matters.
—J. H. L.

Dextrine; Process of making ——. W. W. McLaurin, Brookfield, Mass., U.S.A. Eng. Pat. 130,119, 26.6.18. (Appl. 10,532/18.)

SEE U.S. Pat. 1,283,839 of 1918; this J., 1919, 86A.

Dextrine. W. W. McLaurin, Brookfield, Mass., U.S.A. Eng. Pat. 130,120, 26.6.18. (Appl. 10,533/18.)

SEE U.S. Pat. 1,284,120 of 1918; this J., 1919, 86A.

XVIII.—FERMENTATION INDUSTRIES.

Glycerol; Preparation of —— by fermentation. W. Connstein and K. Lüdecke. Ber., 1919, **52**, 1385—1391.

THE experiments were undertaken with the object of providing the Central Powers with a means of obtaining glycerol after the importation of fats had been prevented by the blockade.

Glycerol is formed to the extent of about 3% in

the ordinary fermentation of sugar, and the yield is considerably increased when fermentation is effected in the presence of slightly alkaline salts which do not poison the yeast. Under these circumcumstances, however, the solutions are very liable to infection, thereby decreasing the yield of glycerol; in this connection, sodium sulphite is very useful since, particularly at high concentrations, it has an antiseptic action and especially hinders the development of lactic acid bacilli, whilst also it gives the highest yields of glycerol. The latter vary from 23·1% when the weight of sulphite used is 40% of that of the sugar, to 36·7% with twice the weight of the sugar; too large an addition of sodium sulphite causes fermentation to be too slow or damages the yeast. The process does not appear to depend on the particular variety of fermentable sugar (refined sugar, crude sugar, or molasses can be used) or on the species of yeast. The latter, which does not increase by more than a slight amount during the sulphite fermentation, can be utilised for further experiments after subjection to a "purification fermentation" in slightly acid solution. The glycerol, after suitable purification, is adapted not only to nitration but also to pharmaceutical purposes; occasionally, it contains small amounts of trimethyleneglycol, probably due to secondary decomposition of glycerol by bacteria. The volatile products of the fermentation consist chiefly of ethyl alcohol and acetaldehyde. Increase in the quantity of sulphite diminishes the production of alcohol and carbon dioxide and increases that of glycerol and acetaldehyde; for example, when 25% of sulphite is present the yields are aldehyde 2·4%, alcohol 40%, carbon dioxide 37·6%, and with 100% of sulphite 10, 29·4, and 29·4% respectively. With regard to the mechanism of the reaction, two factors appear to be involved, a general action of salts and a specific sulphite action. Increased production of glycerol occurs in the presence of considerable quantities not only of slightly alkaline salts but also of certain neutral or acid salts (calcium chloride, ammonium chloride, sodium chloride, sulphate, or nitrate, ferrous sulphate, aluminium sulphate). The specific action of the sulphite is possibly connected with its relationship to aldehydes. The production of glycerol by this process in Germany reached 1000 tons per month. The yield of glycerol on a manufacturing scale is 20—25% of the weight of sugar. The authors consider that when sugar and alcohol are normal in price, glycerol can be produced by their method sufficiently cheaply to regulate the price of glycerol from fats.—H. W.

Wine; Determination of the total solids in —— and the official methods for the analysis of wine. P. Malvezin. Ann. Falsif., 1919, **12**, 147—152.

FIFTY c.c. of the wine is placed in a flask which is heated by a bath of water at 75° C., and connected with a water pump; the evaporation is continued until the contents of the flask are reduced to a pasty consistence, a current of steam is then passed through the flask for 1 hour, and the drying continued at 100° C. under reduced pressure for about 10 minutes. In this way all glycerol is removed from the total solids, which is not the case in many other methods, including the official (French) method. The author also discusses the reliability of the official and other methods for the general analysis of wine. The methods for the determination of alcohol, potassium sulphate, and reducing sugars (gravimetric) are trustwôrthy, but the separation of fixed and volatile acids leaves much to be desired; the volatile acidity is best determined by Duclaux's method, in which 22 c.c. of the wine is distilled until 20 c.c. of distillate has been collected; this distillate contains 80% of the volatile acids.—W. P. S.

Yeast: The vitamine requirement of ——. R. J. Williams. J. Biol. Chem., 1919, **38**, 465—486.

EVIDENCE is presented that the water-soluble B accessory growth factor, relatively so abundant in yeast, is necessary for the nutrition of yeast cells themselves. (See further J. Chem. Soc., 1919, i., 463.)—J. C. D.

Proteases; Contributions to the study of vegetable ——. E. A. Fisher. Biochem. J., 1919, **13**, 124—134.

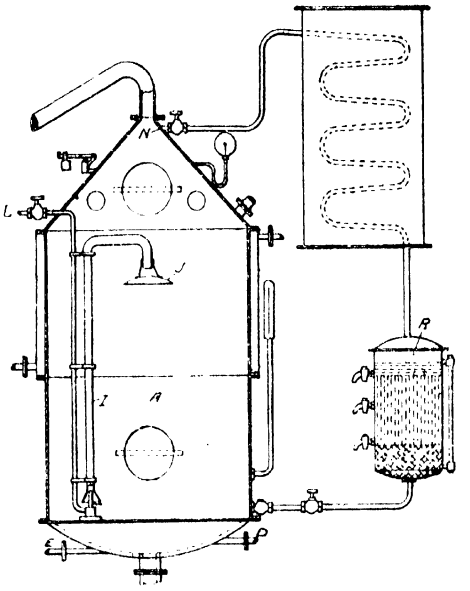
ENZYMES which hydrolyse proteins and peptones are present in the tissues of a number of green plants (cereals, leguminous plants, buckwheat and white mustard). (See further J. Chem. Soc., 1919, i., 464.)—J. C. D.

Phosphorus in yeast. Tarugi. *See* XIX A.

PATENTS.

Brewing. H. B. Wooldridge, Tottenham. Eng. Pat. 129,549. (Appls. 19,764, 29.11.18, and 20,429, 9.12.18.)

WORT from the mash tun is run on to the hops in a closed vessel (A, see fig.) in which its temperature is raised to 110° C. by means of a steam jacket or coils. A vent, N, is opened to encourage ebullition, and the issuing vapours are condensed and collected in R, where a layer of hop oil accumulates on the top of the condensed liquid and a deposit containing hop resins collects at the bottom. The oily layer and the deposit are returned to the vessel,



A, after the aqueous layer has been run off. After the necessary period at 110° C. the temperature of the wort is allowed to fall to 100° C. and the vessel, A, is connected with a vacuum pump. Circulation and aeration of the wort are effected by means of the open-ended bent pipe, I, which projects above the level of the wort. Sterilised air admitted through the tube, L, passes up the pipe, I, and carries with it wort which on issuing from the upper end of the pipe is distributed by a suitable device at J. The distributor, J, may be provided with a brine jacket to accelerate the cooling of the wort.—J. H. L.

Filter for use in breweries and elsewhere. A. Timmermans, Brussels. Eng. Pat. 129,599, 12.3.19. (Appl. 6162/19.)

IN a filtering vessel divided into an upper chamber

to receive the unfiltered liquid, and a lower chamber to collect the filtrate, the two being separated by a horizontal false bottom plate fitted with thimble-shaped filtering tubes or the like, the bottom of the vessel is removable by sliding or turning on a hinge, and the false bottom plate is mounted on a hinge or horizontal axis so that it can be tipped up or turned over to facilitate the removal of the sludge. Claim is further made to a filtering tube for use in this apparatus, comprising an expansible frame which can be covered with a bag of suitable fabric, and means for expanding the frame to fix it in a hole in the false bottom plate.—J. H. L.

Beverages; Manufacture of ——. *Manufacture of ethyl alcohol and residue from beverage.* J. Schneible, Chicago. U.S. Pats. (A) 1,311,251 and (B) 1,311,421, 29.7.19. Appl., (A) 27.6.17 and (B) 21.11.18.

(A) FERMENTED liquor is heated without impairing the proteins present in solution, and then passed through plate columns in which a reduced pressure is maintained, substantially lower than the vapour tension of the heated liquid. The liquor is eventually freed from ethyl alcohol, and the alcoholic vapours are fractionated in a further series of columns. (B) Fermented liquor is distilled and the alcoholic vapours are fractionated; the higher boiling fractions, after separation from ethyl alcohol, are returned to the distillation residue, which is used as a beverage.—J. H. L.

Lactic acid and its salts; Manufacture of —— *and the recovery of the volatile fatty acid by-products.* A. P. H. Desborough, Holton Heath, J. Reilly and A. C. Thaysen, Parkstone, Dorset. Eng. Pat. 128,687, 20.4.18. (Appl. 6729/18.)

SUGARS are fermented by a new type of lactic bacillus, *Bacterium volutans*, which may be isolated from sour mashes, maize or other cereal meals, soil, carrots, and parsnips. This organism forms rods 3—4μ by 0·8—1·2μ, but under certain conditions their length may attain 10μ. The optimal temperature of growth is 37°—43° C., and the maximal temperature 47°—48° C. The cells produce volutin, which may be detected microscopically by staining with polychrome methylene blue solutions. In conjunction with the use of this organism certain methods of operating are claimed specifically. These relate to the preparation of cereal mashes and the isolation of the fermentation products, and include, for example, the addition of calcium carbonate or other neutralising agent to the mash, the recovery of calcium lactate crystals from the fermented liquid by concentration, the subsequent separation of volatile fatty acids from the acidified mother liquors by distillation, and so on.—J. H. L.

Acetone and other products of fermentation; Manufacture of ——. *Manufacture of fermentation products.* A. P. H. Desborough, Holton Heath, J. Reilly and A. C. Thaysen, Parkstone, and F. R. Henley, Wareham, Dorset. Eng. Pats. (A) 128,403 and (B) 128,714, 20.6.18. (Appls. 10,219 and 10,220/18.)

(A) In the manufacture of acetone and other products, by bacterial fermentation, acetic acid or an acetate is aded to the mash before or during the fermentation to increase the yield of acetone (cp. Reilly, this J., 1919, 282 T). (B) In the manufacture of volatile products by bacterial fermentation of mashes or liquors, claim is made to the addition of one or more fatty acids or salts thereof, for the purpose of modifying the course of fermentation and increasing the yield of one or more of the products. In the production of acetone and butyl alcohol, for example, the yield of the latter can be increased relatively to that of the former by adding propionic acid before or during fermentation.—J. H. L.

Alcohol denaturant. Eng. Pat. 129,904. *See* II A.

XIXA.—FOODS.

Flour; Determination of the grade of ——. J. Gerum. Z. Unters. Nahr. Genussm., 1919, **37**, 145—157.

THE grade of a flour may be ascertained from its starch content; if the quantity of ash is also taken into consideration it is possible to determine the amount of wheat flour in a mixture of the same with rye flour. The following are the average results obtained during the years 1915—1918, inclusive:—

	Grade.	Starch.	Ash.
		%	%
Rye flour (German)	82 ..	58·7 ..	1·40
" "	85 ..	57·4 ..	1·44
" "	94 ..	50·8 ..	1·76
Wheat flour, "	50—60 ..	70·0 ..	0·65
" "	60 ..	65·9 ..	0·76
" "	70 ..	64·7 ..	1·08
" "	80 ..	60·7 ..	1·12
" "	94 ..	52·7 ..	1·30

—W. P. S.

Peroxydases in milk. H. Violle. Comptes rend., 1919, **169**, 248—250.

FRESH milk from a healthy mammal may be free from peroxydases, since the latter are contained in the glandular cells. Any affection of the gland may readily result in peroxydases appearing in the milk. Similarly they may be re-introduced into milks which have been heated to 78°—80° C. by the addition of small amounts of fresh organic tissue or liquid of animal or vegetable origin. The peroxydase test is therefore not suitable for distinguishing between fresh and heated milk.—W. G.

Milk; Non-protein nitrogenous constituents of cow's ——. W. Denis and A. S. Minot. J. Biol. Chem., 1919, **38**, 453—458.

FROM a number of analyses it is concluded that the amount of non-protein nitrogen, urea, and amino-nitrogen is influenced by the diet, being high when the protein intake is high. High values are also given for colostrum.—J. C. D.

Putrefaction; Gaseous products of ——. I. Guareschi. Boll. Chim. Farm., 1919, **58**, 181—186.

THE gases from putrefying proteins do not contain hydrocarbons. The chief constituents identified in the gases from putrefying eggs were carbon dioxide, hydrogen, nitrogen, and a small amount of hydrogen sulphide. The odour of fresh truffles which occurs in putrefied material is due to the presence of one or more unidentified gaseous products derived from the proteins.—C. A. M.

Vitamines; Action of ultra-violet rays on ——. S. S. Zilva. Biochem. J., 1919, **13**, 164—171.

FAT-SOLUBLE A present in butter is destroyed by exposure for eight hours to ultra-violet rays. At the same time the butter is bleached and becomes unfit for use. The author raises the important query whether the sterilisation of milk by ultra-violet rays may not reduce its nutritive value. The antineuritic and antiscorbutic vitamines are not destroyed by the rays.—J. C. D.

Trypsin; Effect of alcohol on digestion of fibrin and caseinogen by ——. E. S. Edie. Biochem. J., 1919, **13**, 219—225.

THE digestion of fibrin is inhibited by 3% of alcohol and that of caseinogen by 10%. It is suggested that "trypsin" may not be a single enzyme, or that digestion of these two proteins is carried out by different side chains of the enzyme molecule.
—J. C. D.

Phosphorus; Toxicological detection of —— in yeast and bread baked therewith. N. Tarugi. Boll. Chim. Farm., 1919, **58**, 141—147.

THE detection of phosphorus in admixture with yeast by the silver nitrate paper test is not possible until after the fermentation process has stopped. After about three months at 10°—15° C. subsequent to fermentation phosphorus can again be detected in the yeast by this test, being quantitatively unaltered. After baking, bread made with yeast containing phosphorus is innocuous, the phosphorus being partly volatilised and partly converted into oxidised compounds.—C. A. M.

Lime juice; Analysis of ——. R. Huerre. J. Pharm. Chim., 1919, **20**, 5—9.

ANALYSES of specimens of lime juice expressed from limes bought in Paris yielded the following results: Sp. gr., 1·052—1·064; citric acid, 7·0—7·5; malic acid, 0·50—0·60; tartaric acid, none; sucrose, 0·40—0·50; invert sugar, 1·8—2·0; pectins, etc., 0·40; ash, 1·60—1·80 grms. per 100 c.c.—W. P. S.

Proteins. Lango. *See* XXIII.

PATENTS.

Milk; Drying of liquids, such as ——, *into powders.* F. E. Beeton, and Trufood, Ltd., Wrenbury, Chester. Eng. Pat. 129,388, 26.8.18. (Appl. 1873/18.)

THE liquid is sprayed into heated air maintained at such a low pressure that the corresponding temperature of steam saturation is not high enough to be harmful to the liquid exposed to it for a very short time. The air is used over and over again, being circulated in a closed system which, in the drying of milk, is maintained under a partial vacuum of about 0·5 atm. The milk is injected as a spray into the system at a point where the air, previously heated to 270° F. (132° C.), enters a large desiccating chamber. The hot air rapidly evaporates the liquid and is cooled thereby, and the solid milk particles are deposited in the chamber. The moisture-laden air, filtered from entrained solid particles, is withdrawn from the chamber, pumped through a condenser where it deposits water, and after passing through a heater to raise its temperature to 270° F., it again enters the desiccating chamber to commence the cycle afresh. Means may be provided for continuously removing any surplus air which leaks into the system, and for compressing a small portion of the heated dry air in the system and using it for spraying the milk.—J. H. L.

Milk or other liquids; Apparatus for atomising and drying or evaporating ——. Chemische Verwertungsges. m.b.H., Leipzig. Ger. Pat. 311,471, 19.6.17.

THE liquid is contained in a receptacle from the bottom of which an outflow pipe extends vertically downwards. Below the latter and in a line with it is a narrower vertical pipe, the top of which just projects into the mouth of the liquid outflow pipe, and which discharges compressed air or gas through perforations below its upper end, so that the liquid emerging from the upper pipe is atomised and scattered horizontally in all directions. The lower part of the air or gas pipe is enclosed in a wider pipe from which a further supply of gaseous drying agent is emitted. The apparatus is contained in a large chamber, on the floor of which the desiccated particles are deposited.—J. H. L.

XIXB.—WATER PURIFICATION; SANITATION.

Water; Method for the determination of nitrates in —— by means of the phenolsulphonic acid reaction. R. C. Frederick. Analyst, 1919, **44**, 281—284.

THE interference of chlorides in this method may be eliminated by using a more dilute phenolsulphonic acid reagent than is usually employed and by adding the reagent to the water before the latter is evaporated. The reagent is prepared by heating phenol 4 grms., water 4 c.c., and sulphuric acid 100 c.c. at 85° C. for 6 hrs.; after cooling, the solution is diluted to 500 c.c., and a mixture of sulphuric acid 300 c.c., and water 500 c.c., is added. Twenty-five c.c. of the sample of water is treated with 2 c.c. of the reagent, evaporated as far as possible on a steam-bath, 5—10 c.c. of water is added, again evaporated, and the dilution and evaporation repeated. The residue is then dissolved in water, diluted to about 95 c.c., 3 c.c. of ammonia (sp. gr. 0·880) is added, the whole diluted to 100 c.c., and the coloration compared with that produced by a known amount of nitrate under similar conditions.
—W. P. S.

PATENTS.

Softening water; Producing materials for ——. H. Reisert Ges.m.b.H., Cologne-Braunsfeld, Germany. Eng. Pat. 110,363, 9.10.17. (Appl. 14,620/17.) Int. Conv., 11.10.16.

IN the process of precipitating iron salts with water-glass to produce a material for softening water, an improvement is effected by boiling the precipitate with a solution of caustic soda or other alkali at normal or increased pressure. The product has increased base-exchanging properties.
—J. H. J.

Sewage-sludge; Apparatus for filtering ——. W. Buckley, Chicago. Eng. Pat. 130,146, 24.7.18. (Appl. 12,067/18.)

See U.S. Pat. 1,271,425 of 1918; this J., 1918, 604A.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Steam distillation; Studies in ——. *The possibilities and limitations of Duclaux's method for the determination of homologous acids.* H. D. Richmond. Analyst, 1919, **44**, 255—274. (See this J., 1917, 519.)

TABLES are given of results obtained by the author with various fatty acids, showing the quantity of each acid distilled, for each 10% by vol. of the solution distilled, the table being divided according to the initial strength of the acid; a column is also included which shows the percentage to be added or subtracted for each 1% of volume distilled above or below the quantity stated. Comparison of the results with those of distillations given in previous papers shows that there are no great differences, but butyric acid exhibits more variation with concentration than had previously been assumed. Duclaux's method may be used to determine the amount of volatile acid in a substance from which it cannot be conveniently separated (*e.g.*, formic acid in a mixture containing sodium and potassium formates); further, it enables the purity of an acid

to be determined and also the quantity of impurity present. When two acids only are present their amounts can be determined with an error of about 1%, and if three acids are present the error should be less than 5% by a single determination, or about 1% if a fractionation is made.—W. P. S.

Methyl hydrogen sulphate; Action of chlorosulphonic acid on ——. R. Levaillant and L. J. Simon. Comptes rend., 1919, **169**, 140—143.

When methyl hydrogen sulphate reacts with chlorosulphonic acid the main change, which is reversible, is given by the equation
$SO_2(OH)Cl + SO_2(OH).OCH_3 \rightleftarrows SO_2(OCH_3)Cl + H_2SO_4$.
A secondary reaction, also reversible, then proceeds
$$SO_2(OCH_3)Cl + SO_2(OH).OCH_3 \rightleftarrows SO_2(OH)Cl + SO_2(OCH_3)_2.$$
The result is that the yield of methyl chlorosulphonate is only about half the theoretical yield. (See J. Chem. Soc., 1919, i., 430).—W. G.

Methyl sulphate; Action of chlorosulphonic acid on ——. *Preparation of methyl chlorosulphonate.* R. Levaillant and L. J. Simon. Comptes rend., 1919, **169**, 234—236.

Methyl sulphate reacts with chlorosulphonic acid according to the equation
$$SO_2(OH)Cl + (CH_3)_2SO_4 = SO_2(OCH_3)Cl + SO_2(OH).OCH_3.$$
The methyl hydrogen sulphate formed will in its turn react with the chlorosulphonic acid (see preceding abstract). The products of the reaction are distilled, giving two fractions, the first consisting of methyl chlorosulphonate with a little chlorosulphonic acid, and the second consisting of chlorosulphonic acid, methyl chlorosulphonate, and methyl sulphate. If the second fraction is added to the next lot of reaction-mixture the yield of methyl chlorosulphonate may be increased to 80—90%.—W. G.

Alkyl chlorides; Catalytic formation of —— from primary alcohols. P. Sabatier and A. Mailhe. Comptes rend., 1919, **169**, 122—125.

When the vapours of primary aliphatic alcohols are passed along with hydrogen chloride over aluminium oxide heated to 420° C., a mixture of the corresponding primary, secondary, and tertiary alkyl chlorides is obtained together with some ethylenic hydrocarbon. The secondary or tertiary chlorides usually predominate. (See further J. Chem. Soc., 1919, i., 430.)—W. G.

Aminosulphonic acids; Preparation of —— by the aid of salts of fluorosulphonic acid. W. Traube and E. Brehmer. Ber., 1919, **52**, 1284—1293.

The fluorosulphonates (see p. 679 A) react in aqueous solution with ammonia and amines, forming aminosulphonic acids:
$$F.SO_3M + RNH_2 = RNH.SO_3M + HF.$$
The hydrofluoric and sulphuric acids formed by hydrolysis, which are the sole by-products of the reaction, can readily be removed by chalk or barium hydroxide. The reaction has been studied with ammonia, ethylenenediamine, hydrazine, methylamine, ethylamine, propylamine, *iso*butylamine, *iso*amylamine, aniline, and methylhydrazine. (See also J. Chem. Soc., 1919, i., 434.)—H. W.

αγ-Aminoalcohols with secondary alcohol function. E. Fourneau and P. Ramart-Lucas. Bull. Soc. Chim., 1919, **25**, 364—370.

Chloropropionaldehyde readily reacts with magnesium alkyl bromides or iodides to give the corresponding secondary αγ-chloroalcohols of the type α-chloropentan-γ-ol, $CH_2Cl.CH_2.CH(C_2H_5).OH$, and these alcohols condense with amines to give the corresponding αγ-aminoalcohols. A number of these chloroalcohols have been prepared and condensed with dimethylamine and diethylamine and from the resulting aminoalcohols the hydrochlorides of their benzoyl derivatives have been prepared, with a view to testing their use as anæsthetics. These latter appear to be almost equivalent in intensity to the corresponding derivatives of the stovaine group, but their effect does not last so long. (See further J. Chem. Soc., 1919, i., 435.)—W. G.

Inositol hexaphosphate; Synthesis of —— and its identity with the phospho-organic reserve principle of green plants. S. Posternak. Comptes rend., 1919, **169**, 138—140. (See this J., 1919, 551 A.)

By heating inositol with phosphoric acid in the presence of phosphoric anhydride at 120°—130° C. for three hours, inositol hexaphosphate has been synthesised and subsequently isolated as its double calcium sodium salt. The crystals of this salt and of the salt obtained from phytin have now been found to be identical. This is regarded as conclusive proof that the phospho-organic reserve principle of green plants is inositol hexaphosphate.—W. G.

Poplar species; Application of the biochemical method to the wood and bark of various members of the ——. M. Bridel. J. Pharm Chim., 1919, **20**, 14—23.

The action of emulsin and invertin on the young twigs and bark of *Populus pyramidalis*, *P. canadensis*, *P. albo*, *P. tremula*, and *P. nigra* showed that populin was not present, but the presence of a number of new sugars was indicated. A glucoside, having a high reduction index, was found in the bark of *P. pyramidalis*, and one having a low index in *P. nigra*. Salicin was detected in the bark of *P. canadensis*, *P. alba*, and *P. tremula*, whilst the wood of the two latter contained a glucoside probably identical with that occurring in the bark of *P. nigra*.—W. P. S.

Fenugreek seeds; The proteins of ——. H. E. Wunschendorff. J. Pharm. Chim., 1919, **20**, 86—88.

The proteins (total, 27%) present in fenugreek seeds consist of a globulin, 25%, two albumins, α and β, 20%, and a nucleoprotein, 55%. The α-albumin coagulates at 60°—61° C., the β-albumin at 72°—73° C.; they contain 0·65% of sulphur. The nucleoprotein has $[\alpha]_D = -97·7°$ (in alkali solution); it is particularly rich in phosphorus (1·58%) and iron (3·39). When hydrolysed for 2 hours with 10% hydrochloric acid it yields glycine 0, alanine 1·60, leucine 7·30, phenylalanine 2·50, glutamic acid 35·71, aspartic acid 1·32, tyrosine 4·65, arginine 3·15, lysine 0, histidine 0·75, tryptophane traces, proline 3·80%.—W. P. S.

Aconitic acid. Taylor. *See* XVII.

Detection of mercury. Abelmann. *See* XXIII.

Patents.

Acetaldehyde; Manufacture of ——. O. Imray, London. From Soc. Chem. Ind. in Basle, Basle, Switzerland. Eng. Pat. 130,138, 23.7.18. (Appl. 12,008/18.)

In the process of manufacturing acetaldehyde by passing acetylene through a dilute sulphuric acid solution containing a mercury salt as catalyst, the continuous regeneration of the mercury catalyst is effected by passing also an electric current through the liquid; the presence of an oxygen carrier such as ferrous sulphate is an advantage. It is preferable to construct the apparatus of such a form that the reguline mercury which is formed by the reaction comes into contact with the anode; the

reaction may be started with metallic mercury at the anode instead of adding the oxide or other salt. —B. V. S.

Acetic anhydride; Process of concentrating ——. L. S. Finch, Dover, N.J., Assignor to Hercules Powder Co., Wilmington, Del. U.S. Pat. 1,311,158, 29.7.19. Appl., 7.3.19.

Acetic anhydride is concentrated by mixing with sodium acetate and distilling the anhydride from the mixture.—B. V. S.

6-Hydroxy-2-phenylpyridine-5-carboxylic acid; Preparation of ——. Chem. Fab. auf Actien vorm. E. Schering, Berlin. Ger. Pat. 312,098, 6.6.16.

2-Phenylquinoline bases substituted in the benzene nucleus are oxidised by potassium permanganate in acid solution to 6-hydroxy-2-phenylpyridine-5-carboxylic acid. Examples are given of the oxidation of 8-methoxy-2-phenylquinoline, 8-hydroxy-2-phenylquinoline, 6-ethoxy-2-phenylquinoline, and 6-amino-2-phenylquinoline. The two latter substances are prepared by heating the corresponding 4-carboxylic acids. 6-Hydroxy-2-phenylpyridine-5-carboxylic acid forms colourless crystals, m.pt. 287° —288° C., soluble in acetic acid, but almost insoluble in water and ether, and giving with ferric chloride a reddish brown coloration. On heating to 300° C. the carboxyl group is eliminated. The substance has diuretic properties.—G. F. M.

Ureides of substituted amino-naphthol substances. B. Heymann, O. Dressel, R. Kothe, and A. Ossenbeck, Assignors to Synthetic Patents Co., New York. U.S. Pat. 1,308,071, 1.7.19. Appl., 19.3.14.

Ureides having valuable therapeutic properties are produced by treating with phosgene an aminonaphthol derivative containing the grouping

$$C_{10}H_{n}X_{6-n}(OH).NH.R.C_{6}H_{m}(X'_{4-m}).NH,$$

Where X and X′ are substituting groups, n a number less than 7, m a number less than 5, and R a divalent acidyl group.—G. F. M.

Tobacco, tobacco stalks, and offal tobacco; Process for obtaining nicotine, potash, and other substances from ——. H. Jephcott, Hampstead. Eng. Pat. 129,971. (Appls. 11,637, 16.7.18, and 13,384, 17.8.18.)

The tobacco, mixed with about 20% of alkali, preferably lime, and an equal weight of water, is subjected to destructive distillation under reduced pressure, the temperature being gradually increased from 100° C. to 250°—300° C. at the finish. The volatile product is freed from nicotine and ammonia by passing through scrubbers containing hot 50% sulphuric acid, and the residual vapours, consisting mainly of acetone and methyl alcohol, are condensed. The charred mass remaining in the still is first used as a fuel, and the resultant ash either used as a fertiliser or extracted for potash, as desired.—G. F. M.

Ethyl alcohol from acetaldehyde; Process for the manufacture of ——. T. Lichtenhahn, Basle, Assignor to Elektrizitätswerk Lonza, Gampel, Switzerland. U.S. Pat. 1,311,824, 29.7.19. Appl., 25.4.18.

See Eng. Pat. 120,163 of 1918; this J., 1919, 28A.

Camphor; Method and apparatus for purifying ——. E. I. du Pont de Nemours and Co., Wilmington, Assignees of J. E. Crane and E. G. Loomis, Newark, N.J., U.S.A. Eng. Pat. 124,704, 12.8.18. (Appl. 13,077/18.) Int. Conv., 28.3.18.

See U.S. Pat. 1,308,398 of 1919, this J., 1919, 657A.

Acetals; Manufacture of ——. A. T. King, Wimbledon, and F. A. Mason, London. U.S. Pat. 1,312,186, 5.8.19. Appl., 2.1.17.

See Eng. Pat. 101,428 of 1916; this J., 1916, 1131.

Acetone, etc. Eng. Pats. 128,403 and 128,714. *See* XVIII.

Lactic acid. Eng. Pat. 128,687. *See* XVIII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Radioscopy; New fluorescent screens for ——. P. Roubertie and A. Nemirovsky. Comptes rend., 1919, 169, 233—234.

The authors have prepared screens with cadmium tungstate as the basis in place of barium platinocyanide. Such screens are free from permanent phosphorescence, and are not affected by physical or atmospheric agents or by the prolonged action of X-rays. Their luminescence, under the influence of X-rays, is white, the body being examined giving a black image on the screen. They are thus less tiring to the eyes of the operator, and the images formed may be photographed.—W. G.

Development pictures and colour-sensitiveness of different silver salts. F. Kropf. Phot. Korr., 56, 33—42. Chem. Zentr., 1919, 90, IV., 168.

Emulsions of the various salts examined were prepared by adding to a solution of 100 grms. gelatin in 500 c.c. water a solution of a slight excess of the corresponding salt in 200 c.c. water and 50 grms. silver nitrate in 300 c.c. water. The colour sensitiveness was examined either directly with the aid of a spectroscope or, where the sensitiveness was only slight, by the aid of a Chapman-Jones exposure scale, the colour patches of which were examined spectroscopically. Silver chloride is sensitive to all parts of the spectrum and more sensitive to the less refrangible rays than silver bromide. Other salts examined were sulphite, cyanate, thiocyanate, ferrocyanide, bromate, iodate, periodate, phosphate, pyrophosphate, arsenite, arsenate, chromate, bichromate, citrate, and tartrate. All show sensitiveness chiefly to the shorter wave-lengths, with definite maxima in that region, *e.g.*, sulphite 440$\mu\mu$—470$\mu\mu$, thiocyanate 390$\mu\mu$—410$\mu\mu$, with a second maximum at 440—480$\mu\mu$. Although there is considerable variety in the spectral sensitiveness, no relation between this and the colour of the salt was observed. Sensitising with dyes gave no noteworthy results.—B. V. S.

Patents.

Colour photography. J. T. Smith, London. Eng. Pat. 129,717, 7.12.17. (Appl. 18,141/17.)

A multi-colour screen for photographic purposes, having very sharp lines of demarcation between adjacent colours, or with very little spreading of one colour into another, is prepared by lining or stippling with an aqueous dye-solution containing a suitable colloid, preferably Le Page's fish-glue, on a very thin film of non-water-absorbent substance, such as pyroxylin, on a glass support, and then staining the unprotected parts of the base with a solution of dye, approximately complementary to the first colour, in a non-aqueous solvent. Before applying the second dye solution the colloid lines are preferably hardened by treatment with formaldehyde vapour or with bichromate and then thoroughly dried. The solvent used in the second staining solution depends on the dye used and on the solubility of the pyroxylin film, which should be only slightly softened on the surface. Aniline or similar

weak organic base generally answers well, but its action may require modification by the addition of methyl alcohol, amyl acetate, acetone, or nitrobenzene, and in cases where the pyroxylin film is very tough it may be preferable to use nitrobenzene alone. A very short treatment (from 3 to 30 secs.) is given in this dye bath, followed immediately by blotting off the excess solution, a better result being obtained by repeating the treatment if necessary to get the desired depth of colour than by prolonged treatment. The film is then treated with a clearing bath, for example, a dilute acid solution following an aniline dye bath, to remove all traces of the second dye from the colloid lines. A protective coating of varnish or collodion is finally given before coating with a sensitive emulsion, or the screen film is transferred face down to another support, in which case the film base forms the protective coating. If a 3- or 4-colour screen is desired, a third colour is applied by lining or spraying, the dye and solvent being selected to combine with either or both of the first two colours according to the desired colour scheme. The dyes recommended for use are *p*-rosaniline colour-base or similar magenta colour or acid-green for the first solution, and acid-green or methyl-red for the second solution.—B. V. S.

Gelatinous compositions for use in the reproduction of line documents; Manufacture of ——. F. Dorel, Paris. Eng. Pat. 121,274, 2.9.18. (Appl. 4262/18.) Int. Conv., 7.12.17.

In the method of obtaining a printing block in which an undeveloped blue print is brought into contact with a film of gelatin containing a salt such as ferrous sulphate and mounted on a suitable base such as a sheet of zinc, copper, etc., a considerable increase in the visibility of the result, leading to easier control of the process, is obtained by incorporating with the gelatin film a white substance such as barium sulphate or lead carbonate. The white substance may be added as such or may be formed in the gelatin solution by double decomposition.—B. V. S.

Photography; Methods and devices for discovering the time of exposure in ——. U. Stefani, Tessin, Switzerland. Eng. Pat. 121,583, 29.7.18. (Appl. 12,316/18.)

XXII.—EXPLOSIVES; MATCHES.

Nitro-explosives; Modern high ——. C. F. van Duin and K. Brackmann. Chem. Weekblad, 1919, **16**, 501—509.

Various aromatic nitro-compounds have been examined with a view to finding an efficient initial exploder for trinitrotoluene. 1·5 grms. of explosive was compressed in a copper cylinder under a pressure of 770 kilos. per sq. cm. and detonated on an iron plate 3 mm. thick. The bursting effect was compared by the relative sizes of the holes produced and the intensity of "starring" in the plate. The greatest detonation velocity observed was with tetranitrophenylmethylnitramine. The introduction of a more negative group containing oxygen increases the effect, the maximum effect being obtained by the introduction of a fourth nitro-group into a trinitro-compound. Tetranitro-derivatives are, however, more unstable and sensitive to shock.—W. S. M.

Picric acid; Manufacture of ——. *I.* M. Marqueyrol and P. Loriette. Bull. Soc. Chim., 1919, **25**, 376—384.

In the usual processes for the manufacture of picric acid the yields do not exceed 175 grms. of picric acid from 100 grms. of phenol, although the theoretical yield is 243 grms. The authors consider that this loss is due partly to the presence of dinitrophenol-sulphonic acids in the mother liquors. This hypothesis they have verified by an examination of the mother liquors obtained from a factory. As a result of this and further trial nitrations, it is suggested that a higher yield of picric acid is obtained by sulphonating the phenol in the usual way (*i.e.*, at steam heat) and subsequently heating the products of nitration to 110° C. for six hours. If this supplementary heating is not carried out, the best yield (195 grms.) is obtained by sulphonating at 125° C.—W. G.

Polynitro aromatic compounds; Preparation of some ——. M. Marqueyrol and P. Loriette. Bull. Soc. Chim., 1919, **25**, 370—375.

For the preparation of di- and trinitrophenols and analogous compounds, the authors recommend that the phenol should first be converted into its sulphonic acid, and that the nitration should then be carried out in successive stages. By this method they claim that there is practically no evolution of nitrous fumes and but little more than the theoretical quantities of sulphuric and nitric acids are required. Phenol is first converted into *p*-phenol-sulphonic acid, which is diluted with water and added to a cold aqueous solution of sodium nitrate. The resulting sodium nitrophenolsulphonate is not isolated, but to the solution nitric acid (30°—40° B., sp. gr. 1·26—1·38) is added, the products being a mixture of 2:4-dinitrophenol and sodium dinitrophenolsulphonate. On cooling, the dinitrophenol separates out and is filtered off and may be further nitrated. To the filtrate more nitric acid (40° B.) is added and the liquid brought to the boil, picric acid in a pure state and in very satisfactory yield being obtained. Starting with commercial cresol, at the end of the second stage in the nitration dinitro-*o*-cresol and dinitro-*p*-cresol are formed and, being insoluble, separate out and are removed, so that at the end of the third stage trinitro-*m*-cresol alone is obtained in a pure state. By using potassium nitrate instead of sodium nitrate for the first nitration of the cresolsulphonic acids the three potassium nitrocresolsulphonates may be separated, since the salt from *p*-cresol is formed in the cold and is only sparingly soluble, that from *o*-cresol is only formed at 50° C. and is sparingly soluble, whilst that from *m*-cresol is only formed at 60° C. and is soluble in water.—W. G.

Tetranitromethylaniline; Decomposition of ——. E. von Herz. Z. ges. Schiess und Sprengstoffw. 14, 155—157. Chem. Zentr., 1919, **90**, IV., 163.

Tetranitromethylaniline can be decomposed electrolytically, diazo-compounds of the type of dinitroquinone-diazide being formed and not azo compounds. The main reaction concerns the benzene nucleus, the formation of ammonia, methylamine, etc., being due to secondary reactions which are without effect on the characteristic change of the nucleus. Trinitrobenzene and its derivatives give similar decompositions. Decomposition of mercury fulminate contained in zinc capsules with copper or brass linings is probably due to local electric currents.—B. V. S.

2:4-*Dinitrophenol.* Marqueyrol and Loriette. *See* III.

Gaseous explosions. David. *See* IIA.

PATENTS.

Trinitrotoluol and other crystallisable organic compounds; Decolorisation and purification of —— and apparatus therefor. H. N. Morris and Co., Ltd., H. N. Morris, and W. J. Sable, Manchester. Eng. Pat. 129,074, 5.6.18. (Appl. 9258/18.)

Di- and tri-nitro or ketonic derivatives of benzene, toluene, or naphthalene are agitated in the melted

condition or in solution, with a silicious earth such as fuller's earth or kieselguhr, in a steam-heated vessel, the hot liquid or solution filtered, and the filtrate allowed to crystallise. The process may be carried out in a steam-jacketed pan with a bottom in the shape of an inverted dome and provided with an internal agitator and an outlet connected with a steam-jacketed filter.—C. A. M.

Picric acid; Method of and means for the continuous production of —— and other products of nitration. J. N. Brooke, Halifax. Eng. Pat. 129,375, 9.11.17. (Appl. 16,431/17.)

Picric acid etc. is produced by carrying out the nitration as a continuous process in a closed vessel of the type described in Eng. Pat. 128,303/17 (this J., 1919, 604 A), in which the acid liquid is heated and agitated and subsequently cooled by air-pipes on its passage through the trough. After leaving the primary nitration vessel the acid is cooled to about 60° C. and filtered, and the filtrate is conveyed to secondary combined nitration and concentration vessels.—C. A. M.

Guncotton; Manufacture of ——. The National Explosives Co., Ltd., London, and W. Bate, Hayle. Eng. Pat. 128,978, 7.9.17. (Appl. 12,845/17.)

Nitrated cotton is washed by the continuous introduction of hot or cold distilled water into the washing vessel so as to displace the acid liquid upwards or downwards, the water being supplied at such a rate and in such volume that displacement takes place practically without mixing.—C. A. M.

Azides; Production of ——. W. R. Hodgkinson, London. Eng. Pat. 129,152, 8.8.18. (Appl. 12,881/18.)

An azide of a metal (silver azide) is treated with a salt (sodium chloride) the acidic constituent of which will combine with the basic constituent of the azide to form an insoluble salt. The azide initially used may be formed by diazotising a salt of hydrazine by means of a nitrite in presence of a salt (silver nitrate) adapted to form an insoluble azide, and under such conditions that the reaction of the mass is on the border line of acidity and alkalinity.—C. A. M.

Explosives. A. J. Marin, Paris. Eng. Pat. 121,294, 5.12.18. (Appl. 20,180/18.) Int. Conv., 12.11.17.

A plastic explosive, not readily combustible, is obtained by incorporating ammonium perchlorate (*e.g.*, 34—32·2%) and sodium nitrate (25—24·6%) with a nitrohydrocarbon combustible such as di- or tri-nitrotoluene or a mixture of the two (11—13·6%), and adding guanidine nitrate or dicyanodiamidine nitrate (26—24%) and trinitronaphthalene (4—5·6%) to prevent hardening and shrinkage of the composition when stored. If desired the guanidine nitrate may be replaced wholly or in part by guanidine perchlorate.
—C. A. M.

Pyrotechnic and like compositions. G. H. Wicks and G. Gray, London, and J. Turner, Huddersfield. Eng. Pat. 128,986, 10.9.17. (Appl. 12,960/17.)

Coloured smoke or gas is produced by igniting mixtures of soluble or insoluble artificial dyestuffs, such as auramine O, gallocyanine, or methylene blue, with a substance promoting combustion such as potassium chlorate or other highly oxygenated salt, with or without the addition of a combustible substance, such as lactose or shellac, to retard the combustion of the mixture.—C. A. M.

Propellent explosives; Process of producing ——. Propellent explosive. A. S. O'Neil, Assignor to E. I. du Pont de Nemours and Co., Wilmington. U.S. Pats. 1,311,909 and 1,311,910, 5.8.19. Appl., 17.8.16.

See Eng. Pat. 125,482 of 1917; this J., 1919, 443 A.

Nitro compounds. U.S. Pat. 1,309,577. *See* III.

Nitrating. U.S. Pat. 1,312,119. *See* III.

XXIII.—ANALYSIS.

Mercury; Colour reaction for the detection of —— in mercury compounds. A. Abelmann. Pharm. Zentr., 1919, **60**, 247—248.

The solution or suspension of the mercury compound is treated in a test-tube with one drop of nitric acid and an excess of ferrous sulphate solution, and concentrated sulphuric acid is added so as to form a layer under the mixture. A red-violet ring appears at once at the junction of the two liquids; the usual brown ring, due to the nitric acid reaction, develops later and above the red-violet ring. The reaction is given even by organic mercury compounds which do not yield a coloration with hydrogen sulphide.—W. P. S.

Congorubin; Colloid chemistry of ——. Theory of indicators and the theory of the colour change of organic substances. Wo. Ostwald. Koll. Chem. Beihefte, 1919, **10**, 179—288.

The colour changes observed in the case of congorubin during the neutralisation of an acid solution by alkali are due to changes in the degree of dispersion. On the basis of the experiments which lead to this result it is concluded that the colour change of organic substances such as indicators is in many cases mainly due to colloid or dispersoid-chemical processes. (See J. Chem. Soc., Oct., 1919.)—J. F. S.

Indicator-papers; Coloured ——. I. M. Kolthoff. Pharm. Weekblad, 1919, **56**, 175—187.

The sensitiveness of a number of indicator-papers has been examined with reference to the quality of the paper used and its pre-treatment, the nature of the colouring matter used and its concentration on the paper. Sized papers are less sensitive than unsized, although the reaction on the former is sharper. The most sensitive congo paper was obtained from filter paper by impregnation with a 0·1% solution of the dyestuff; this indicated an acidity of 0·0001*N* hydrochloric acid. The most sensitive paper for strong acids and bases is prepared from a 0·1% solution of azolitmin.—W. S. M.

Lead; Determination of —— in urine, fæces, and tissues. W. Denis and A. S. Minot. J. Biol. Chem., 1919, **38**, 449—452.

The organic matter is destroyed by oxidation with sodium nitrate, and after dissolving the residue in dilute acid the lead is precipitated together with a small amount of added copper as sulphide. The sulphides, after careful washing, are dissolved in nitric acid and the solution electrolysed. The lead is deposited on the anode as lead peroxide, which is treated with potassium iodide and acetic acid, the liberated iodine being estimated by titration with sodium thiosulphate. (See further J. Chem. Soc., 1919, ii., 372.)—J. C. D.

Iodine-starch reaction, and its application to the colomimetric estimation of protein in immunity reactions. C. Lange. Biochem. Zeits., 1919, **95**, 46—84.

The reaction between starch and iodine may be

interfered with by the presence of protein. Upon this basis a method has been devised for comparing the protein content of fluids in immunological studies. (See further J. Chem. Soc., Oct., 1919.) —J. C. D.

Iron in ores. Fresenius. *See* X.

Nickel and cobalt. Schoeller and Powell. *See* X.

Acetyl value of oils. Carcano. *See* XII.

Viscosities of varnishes etc. De Whalley. *See* XIII.

Balsams. Fourneau and Crispo. *See* XIII.

Rubber. Utz. *See* XIV.

Tannin analysis. Frey. *See* XV.

Carbonates in sugar factory products. Stanek and Skola. *See* XVII.

Sugars. Rupp and Lehmann. *See* XVII.

Aconitic acid. Taylor. *See* XVII.

Wine. Malvezin. *See* XVIII.

Flour. Gerum. *See* XIX A.

Peroxydases in milk. Violle. *See* XIX A.

Phosphorus in yeast and bread. Tarugi. *See* XIX A.

Nitrates in water. Frederick. *See* XIX B.

Steam distillation. Richmond. *See* XX.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Adam and Legg. Catalysts. 21,667. Sep. 3.

Aktieselskapet de Norske Saltverker. Manufacture of coarsely-crystalline substances from solutions thereof. 21,684. Sep. 3. (Norway, 16.9.18.)

Allsop and Sibson. Drying-machines. 21,694 and 21,695. Sep. 3.

Baggaley, Wadkin, and Wadkin, Mills, and Co. Grinding-machines. 21,167. Aug. 28.

Claude. Protection of walls of enclosures in which reactions take place under high temperatures and pressures. 21,317. Aug. 29.

Gaskill. Furnace. 21,697. Sep. 3. (U.S., 3.9.18.)

Grey. Mixing apparatus. 21,830. Sep. 5.

Jones, Lapworth, and Myers. Still head or fractionating column. 20,813. Aug. 25.

Krause. Process of evaporating liquids. 21,553. Sep. 2. (Germany, 11.7.17.)

Marks (Aktiebolaget Indunstare). Evaporation, distillation, etc. 21,674. Sep. 3.

Rammage. Acid-resisting pipes etc. 21,048. Aug. 27.

Trottier. Crushers. 20,867. Aug. 25. (France, 12.9.18.)

Weyel and Zimmermann. Drying-plants. 21,881. Sep. 5.

Complete Specifications Accepted.

5016 (1918). Rialland. *See* XIX.

5232 (1918). Barbet et Fils et Cie. Tubular evaporating, condensing, and cooling apparatus. (114,838.) Sep. 10.

7515 (1918). Cooper and Griffiths. Electrically heated apparatus for evolving gases from liquids. (131,344.) Sep. 3.

7530 (1918). Cunningham. Separation of liquid mixtures. (131,346.) Sep. 3.

8400 (1918). Whittaker. *See* III.

13,760 (1918). Thunholm. Evaporating apparatus. (118,635.) Sep. 10.

17,065 (1918). Kestner. *See* VII.

18,304 (1918). Wigley. *See* X.

6640 (1919). Matter. Process for concentrating or evaporating liquids. (124,732.) Sep. 3.

13,104 (1919). Henning. Agents for refrigeration plants, and process of making same. (131,573.) Sep. 3.

14,460 (1919). Hansen. Apparatus for mixing liquids in closed vessels. (127,833.) Sep. 10.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Alexandre. 20,878. *See* XXIII.

Broadbridge, Edser, Stenning, and Minerals Separation, Ltd. Production of coal briquettes. 20,891. Aug. 26.

Crittall and Musgrave. Treatment of explosives for use as fuel. 21,647. Sep. 3.

Day, Johnston, and Summerfield. Composite fuel. 21,960. Sep. 6.

Everson. Production of a combustible material. 20,990. Aug. 27.

France. Coal etc. washing apparatus. 21,074. Aug. 27.

Jackson (Metals Recovery Co.). Concentration of bituminous coal by flotation. 21,573. Sep. 2.

McLaughlin. Fuel, and manufacture of same. 21,188. Aug. 28.

Munder, and Zeller and Gmelin. Obtaining shale oils. 20,876. Aug. 25.

Sandiford and Seccombe. Artificial fuel. 20,800. Aug. 25.

Scrivner. Suction-gas generators. 21,969. Sep. 6. (Australia, 6.9.18.)

Wells. Gas-producers. 21,478. Sep. 1.

West, Wild, and West's Gas Improvement Co. Vertical retorts. 21,383. Aug. 30.

Complete Specifications Accepted.

7232 (1918). Rideal and Taylor. *See* VII.

7557 (1918). Dempster and Ballingall. *See* VII.

8245 (1918). Vickers, Ltd., and Webb. Incendiary compositions. (131,360.) Sep. 3.

8400 (1918). Whittaker. *See* III.

11,610 (1918). Toogood, and Dempster and Sons. Distillation of coal. (131,409.) Sep. 3.

12,567 and 18,767 (1918). Harger, and Lever Bros. *See* VII.

13,531 (1918). Edwards. *See* IX.

17,874 (1918). Burnett. Extracting water or other liquids from washed coal etc., particularly applicable for fine coal for coking. (131,788.) Sep. 10.

III.—TAR AND TAR PRODUCTS.

Applications.

Chem. Fabr. Flora. 20,863. *See* XX.

Gulliver. Apparatus for splitting up or getting pitch etc. 21,505. Sep. 2.

Morris, and Morris and Co. Sulphonation and chlorination of organic compounds. 20,996. Aug. 27.

Sinfield, Sinfield, and Sinfield Bros. Still for distilling tar, pitch, benzol, naphtha, ammonia, and carbolic acid. 21,483. Sep. 2.

Complete Specifications Accepted.

8400 (1918). Whittaker. Apparatus for distilling the lower boiling constituents from oils and other like liquids. (131,365.) Sep. 3.

10,518 (1918). Brewster. Processes of producing dinitrophenol. (131,403.) Sep. 3.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Bonwitt and Goldschmidt. Process of degumming fibres. 21,172. Aug. 28. (Germany, 8.10.17.)

Bouffe. Production of artificial silk threads. 21,643. Sep. 3.

Drews and Van Noorden. Treatment of leaves etc. for extraction of fibre therefrom. 21,378. Aug. 30.

Drews and Van Noorden. Reclaiming textile fibres. 21,387. Aug. 30.

Dreyfus. Manufacture of cellulose acetate compositions etc. 20,975. Aug. 26.

Dreyfus. Manufacture of cellulose derivatives. 21,474, 21,661, 21,662, and 21,773. Sep. 1, 3, and 4.

Marks (Du Pont de Nemours and Co.). 20,852 and 20,853. *See* XXII.

Complete Specifications Accepted.

8216 (1918). Radcliffe. Manufacture of cellulose acetate. (131,357.) Sep. 3.

9488 (1918). Cumbers, and British Cellulose and Chemical Manufacturing Co. Covering and producing tautness of fabrics. (131,384.) Sep. 3.

10,862 (1918). Barr and Lazell. *See* XIII.

10,949 (1918). Gilmour, and Dunville and Co. Production of solutions of cellulose acetate and methods of joining articles made of cellulose acetate. (131,647.) Sep. 10.

12,085 (1918). Dreyfus. *See* XIII.

13,531 (1918). Edwards. *See* IX.

19,220 (1918). Bleachers' Assoc., and Higgins. Process of scouring cotton and other vegetable yarns and fabrics. (131,798.) Sep. 10.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Bawtree. 20,832. *See* XXIII.

Brierley. Bleaching process. 21,720. Sep. 4.

Calico Printers' Assoc., and Turner. Ageing machines. 21,134. Aug. 28.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Aktieselskapet de Norske Saltverker. 21,684. *See* I.

Beilby. Fixation of atmospheric nitrogen. 21,373. Aug. 30.

Deuts. Molybdän-Werke. Extraction of molybdenum compounds from yellow lead ores. 21,039 and 21,040. Aug. 27. (Germany, 23.5 and 2.10.16.)

Dreyfus. Manufacture of acetic acid. 21,140. Aug. 28.

Goldsmith and others. 21,051. *See* X.

Hanna and Major. Manufacture of hydrogen or mixture of hydrogen and nitrogen. 20,974. Aug. 26.

Island. Fixation of atmospheric nitrogen 21,690. Sep. 3.

Matheson. Utilisation of alunite ore. 21,220. Aug. 28.

Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Production of liquid ammonia. 21,447. Sep. 1. (Norway, 13.9.18.)

Sinfield. 21,483. *See* III.

Wilton. Manufacture of sulphate of ammonia. 20,931. Aug. 26.

Complete Specifications Accepted.

9210 (1916). Montgomery and Royston. Obtaining nitrogen compound from the nitrogen of the atmosphere. (131,609.) Sep. 10.

1698 (1918). Barbet et Fils et Cie. Production of chemically pure oxygen and nitrogen from atmospheric air. (131,321.) Sep. 3.

7232 (1918). Rideal and Taylor. Manufacture of hydrogen. (131,328.) Sep. 3.

7392 (1918). Gros et Bouchardy. Manufacture of nitric anhydride. (131,334.) Sep. 3.

7393 (1918). Gros et Bouchardy. Manufacture of concentrated nitric acid. (131,335.) Sep. 3.

7394 (1918). Gros et Bouchardy. Manufacture of nitric acid. (131,336.) Sep. 3.

7557 (1918). Dempster and Ballingall. Heat-controlling means for hydrogen gas plants. (131,347.) Sep. 3.

8228 (1918). Rivett. Production of ammonium nitrate. (131,358.) Sep. 3.

10,869 (1918). Bousfield, and Nobels' Explosives Co. Manufacture of liquid nitrogen peroxide and nitric acid. (131,642.) Sep. 10.

12,565 and 18,767 (1918). Harger, and Lever Bros. Manufacture of hydrogen, nitrogen, and carbon dioxide. (131,684.) Sep. 10.

13,369 (1918). Electrolytic Zinc Co. *See* X.

13,524 (1918). Hyatt and Fellowes. Process of obtaining products from seaweed. (131,443.) Sep. 3.

13,792 (1918). Dreyfus and Bloch. Manufacture of alkali manganates. (131,460.) Sep. 3.

14,661 (1918). Arthur and Killby. Manufacture of a compound of lime and bromine. (131,750.) Sep. 10.

15,670 (1918). Thorssell and Lunden. Production of calcium nitrate. (131,493.) Sep. 3.

15,786 (1918). Blockey, and Walker and Sons. Manufacture of chrome liquors and salts. (131,772.) Sep. 10.

VIII.—GLASS; CERAMICS.

Applications.

McCoy. Apparatus for production of sheet glass. 21,788. Sep. 4.

McGee. Glass-working apparatus. 21,223. Aug. 28.

Complete Specifications Accepted.

13,771 (1918). Goldreich. Ovens for use in the manufacture of splinterless glass. (131,714.) Sep. 10.

14,802 (1918). British Thomson-Houston Co., and Gray. Devices for discharging predetermined quantities of glass from glass furnaces. (131,756.) Sep. 10.

IX. BUILDING MATERIALS.

Applications.

Arosio. Impermeable and non-hygroscopic material. 21,187. Aug. 28. (Italy, 26.6.18.)

Arosio. Coating hygroscopic materials. 21,202. Aug. 28. (Italy, 26.6.18.)

Arosio. Increasing strength and eliminating hygroscopicity of wooden materials etc. 21,215. Aug. 28. (Italy, 26.6.18.)

Baines. Wood substitute. 21,020. Aug. 27.

Baines. Materials for building etc. 21,490. Sep. 2.

Bayer. Manufacture of concrete for shipbuilding etc. 21,183. Aug. 28. (Denmark, 6.9.18.)

Damerau. Impregnation of timber. 21,388. Aug. 30. (Germany, 17.11.13.)

Roberts, Thomas, Thomas, and Williams. Manufacture of bricks, paints, sealing-wax, soap, etc. 21,362. Aug. 30.

Complete Specifications Accepted.

13,531 (1918). Edwards. Manufacture of a heat-insulating material and a fuel from paper. (131,446.) Sep. 3.

9911 (1919). Andouard. Treatment of cement and like surfaces for applying paints thereto. (125,979.) Sep. 10.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Basset. Revolving furnace for direct production of iron or steel etc. 21,677. Sep. 3. (France, 3.9.18.)

Deuts. Molybdän-Werke. Production of alloys of iron and metals of the chromium group. 21,038. Aug. 27. (Germany 25.11.16.)

Deuts. Molybdän-Werke. 21,039 and 21,040. *See* VII.

Goldsmith, Rose, and Imperial Trust. Recovery of tin by conversion into volatile compounds. 21,051. Aug. 27.

James. Manufacture of tin, terne, etc. plates or sheets. 21,286. Aug. 29.

Kirk. Heat-treating furnace. 20,854. Aug. 25.

Lloyd. Roasting and sintering ores etc. 21,812. Sep. 4.

Mackay. Treatment of sulphide ores containing lead and zinc. 21,819. Sep. 4.

Nevett, Palmer, and Seale. Flotation separation of mineral substances. 21,608. Sep. 3. (Australia, 2.9.18.)

Wickett. Treating castings of ferrous metals. 21,691. Sep. 3.

Complete Specifications Accepted.

7732 (1918). Elmore. Extraction of lead and zinc from ores. (131,353.) Sep. 3.

8761 (1918). Sarron and Simon. Electro converter furnaces, and manufacture of steels thereby. (131,372.) Sep. 3.

12,364 (1918). Blackwell. Manufacture of ferro-titanium. (131,675.) Sep. 10.

13,369 (1918). Electrolytic Zinc Co. of Australasia Proprietary, Ltd. Treatment of zinc solution preparatory to the recovery of zinc by electro-deposition. (131,702.) Sep. 10.

13,642 (1918). Jascowitz and Rosenbaum. Cleaning metals by electrolysis. (131,455.) Sep. 3.

13,665 (1918). Marino. Removing paint, varnish, and grease from iron, steel, and copper, rust from iron or steel, and sulphide or oxide from copper. (131,709.) Sep. 10.

14,177 (1918). Stein et Cie. Regenerative furnaces of the soaking pit type. (120,039.) Sep. 10.

14,233 (1918). Bolitho. Roasting and refining impure tin. (131,743.) Sep. 10.

15,664 (1918). Ibe. Iron alloys. (131,492.) Sep. 3.

18,304 (1918). Wigley. Crucible furnaces. (131,516.) Sep. 3.

17,117 (1919). Mordey. Heat treatment of articles of iron and steel and alloys thereof. (131,575.) Sep. 3.

XI. ELECTRO-CHEMISTRY.

Applications.

Fuller, and Fuller's United Electric Works. Wood separators for electric accumulators. 21,842. Sep. 5.

Gardiner. Storage batteries. 20,920. Aug. 26.

Heyen. Electric arc furnaces. 21,342. Aug. 30.

Lawton. Electric furnaces. 20,994. Aug. 27.

Luca. Electric furnaces. 21,582. Sep. 2.

Royston (Federal Storage Battery Co.). Storage batteries. 21,334. Aug. 30.

Rumbaken. Electric accumulators. 21,168. Aug. 28.

Schneider. Electrodes for electric accumulators. 21,585. Sep. 2. (Germany, 3.11.17.)

Complete Specifications Accepted.

7515 (1918). Cooper and Griffiths. *See* I.

8761 (1918). Sarron and Simon. *See* X.

13,369 (1918). Electrolytic Zinc Co. *See* X.

13,642 (1918). Jascowitz and Rosenbaum. *See* X.

15,277 (1918). Clark, and Hart Accumulator Co. Electric accumulators or secondary batteries. (131,765.) Sep. 10.

15,320 (1918). British Thomson-Houston Co. (General Electric Co.). Electric furnaces. (131,767.) Sep. 10.

17,338 (1918). Cave. Alkaline electric accumulators. (121,118.) Sep. 10.

2916 (1919). Fuller Accumulator Co., and Jones. Electric storage batteries. (131,826.) Sep. 10.

XII.—FATS; OILS; WAXES.

Applications.

Brown. Manufacture of soap. 21,786. Sep. 4.

Mansbridge. Treatment or purification of oils or fats, etc. 21,116. Aug. 28.

Poumier. Apparatus for separating oils, fats, etc., from waste waters, etc. 21,451. Sep. 1.
Roberts and others. 21,362. *See* IX.

XIII. PAINTS; PIGMENTS; VARNISHES; RESINS.

Application.

Roberts and others. 21,362. *See* IX.

Complete Specifications Accepted.

10,862 (1918). Barr and Lazell. Production of dopes. (131,641.) Sep. 10.
12,085 (1918). Dreyfus. Manufacture of dopes, solutions, or preparations having a basis of cellulose acetate. (131,669.) Sep. 10.
13,665 (1918). Marino. *See* X.
15,533 (1918). Duke. Pigments. (131,769.) Sep. 10.
9910 (1919). Andouard. *See* IX.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Application.

Sheppard. Rubber solutions. 21,023. Aug. 27.

XV.—LEATHER; BONE; HORN; GLUE.

Applications.

Marks (Nitritfabrik). 21,280 and 21,281. *See* XX.

Complete Specifications Accepted.

10,396 (1918). Roy and Grandeville. Glue. (131,400.) Sep. 3.
15,786 (1918). Blockey, and Walker and Sons. *See* VII.

XVII.—SUGARS; STARCHES; GUMS.

Complete Specification Accepted.

12,241 (1919). Lemoine. Apparatus for complete separation of liquor and remelted syrup in remelting centrifugal machines. (131,860.) Sep. 10.

XVIII.—FERMENTATION INDUSTRIES.

Application.

Anderschou. Treating waste brewers' yeast to render it suitable for baking. 21,915. Sep. 5.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Anderschou. 21,915. *See* XVIII.
Borum and Krüger. Removal of fungi from grain in bags. 21,923. Sep. 5. (Denmark, 31.8.16.)
Imperial Trust, Jorgensen, and Stiles. Preservation of fruits etc. 21,988. Sep. 6.
Poumier. 21,451. *See* XII.

Complete Specification Accepted.

5016 (1918). Rialland. Process of purifying liquids. (121,452.) Sep. 10.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Chem. Fabr. Flora. Substituting halogens for amino groups in amines and salts of amino acids. 20,863. Aug. 25. (Switz., 31.8.18.)
Dreyfus. Manufacture of aromatic derivatives. 21,554. Sep. 2.
Marks (Nitritfabrik A.-G.). Preparation of gallic acid. 21,280. Aug. 29.
Marks (Nitritfabrik A.-G.). Preparation of pyrogallic acid. 21,281. Aug. 29.
Morris, and Morris and Co. 21,360. *See* III.

Complete Specifications Accepted.

9119 (1918). Durrans, and Boake, Roberts and Co. Preparation of organic acid anhydrides and organic acid chlorides. (131,379.) Sep. 3.
9131 (1918). Weizmann and Bainbridge. Production of glycols. (131,628.) Sep. 10.
10,395 (1918). Soc. Chim. des Usines du Rhône. Production of acetic anhydride and acetaldehyde. (131,399.) Sep. 3.
12,455 (1918). Grolea and Weyler. Production of esters. (131,678.) Sep. 10.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Application.

Wieland. Manufacture of colour grate plates for colour photography. 21,263. Aug. 29.

Complete Specification Accepted.

11,134 (1916). Lawshe. Production of multicolour photographs. (131,319.) Sep. 3.

XXII.—EXPLOSIVES; MATCHES.

Applications.

Atlas Powder Co. Explosives. 21,438 and 21,439. Sep. 1. (U.S., 1.11.18.)
Blyth. Manufacture of explosives or smokeless powders. 21,217. Aug. 28.
Crittall and Musgrave. 21,647. *See* II.
Hedberg. Manufacture of explosives. 21,170. Aug. 28.
Marks (Du Pont de Nemours and Co.). Production of pyroxylin bodies. 20,852. Aug. 25.
Marks (Du Pont de Nemours and Co.). Pyroxylin solvents and solutions of pyroxylin. 20,853. Aug. 25.

Complete Specifications Accepted.

9134 (1918). Hargreaves, Gardner, and Roburite and Ammonal, Ltd. Explosives. (131,380.) Sep. 3.
9753 (1918). Marin. Preparation of combustible salt suitable for the manufacture of explosives and process for making these explosives. (131,388.) Sep. 3.
9849 (1918). Rintoul, Nolan and Nobel's Explosives Co., Ltd. Gelatinisation of cellulose nitric esters in the manufacture of explosives. (131,389.) Sep. 3.

XXIII.—ANALYSIS.

Applications.

Alexandre. Gas-analysing apparatus. 20,878. Aug. 25.
Bawtree. Instrument for quantitative analysis of colour. 20,832. Aug. 25.
Stewart. Gas calorimeters. 21,832. Sep. 5.

I.—GENERAL; PLANT; MACHINERY.

Mechanical handling of chemical materials. G. F. Zimmer. Chem. Age, 1919, 1, 294—296, 322—323.

The contrivances used for handling chemical substances are, as a rule, of relatively small capacity and have to satisfy the following conditions in addition to those common to all such apparatus:—Dust must be prevented to avoid injury to the workers, loss, and danger of explosion. Materials may have to be handled at high temperatures. It may be desirable to submit the material while being conveyed to various operations such as heating, cooling, etc. The same handling device may have to be employed for different materials. For coarse and dry mineral and vegetable substances which do not readily deteriorate during handling, band, push-plate, tray, gravity-bucket, and reciprocating conveyors are suitable, and if the material is not too coarse the worm conveyor may also be used. Elevators for the heavier class of material should be vertical, and have double endless chains, with deep buckets, and they may be run at full speed; while for lighter materials, inclined elevators having shallower buckets attached to cotton bands should be used. For vegetable substances the band or reciprocating trough conveyor is the best. Where the material has to be discharged at different points, push-plate, worm, or reciprocating conveyors are preferable. For coarse, dry, amorphous or crystalline substances which are friable, slow running flexible steel band, slat, or tray conveyors are best, as the material remains undisturbed during transit, but with the exception of the steel band type the conveyors are not suitable for delivery at intermediate points. The discharge from the steel band conveyor is effected by a plough which can be lowered or turned into position at the point where the discharge is desired. It is important that friable material should be subjected to as little drop as possible when being delivered to or discharged from handling apparatus, consequently vertical dump elevators and tip tray conveyors, both discharging on to inclined shoots, down which the material can slide, are most suitable. For coarse, moist, amorphous and crystalline substances, if the moisture is only external and the substance is not sticky, spiral conveyors and bucket elevators are quite suitable. For clayey or sticky substances, however, spiral conveyors are quite useless, and flexible steel band or reciprocating conveyors should be used, whilst for elevating, a skip-hoist, though not continuous, is by far the best. In the case of fine dry powders, the necessity for preventing the formation of dust, especially with powders that are of a "lively" nature and run through the fingers easily, limits the choice of appliances to those which can be completely covered in, such as screw conveyors, which may also be used as elevators, whilst for material such as cement, which lies "dead," a belt conveyor may be used. Common salt is often elevated by a band conveyor having cross slats at intervals which enables it to carry up an incline of 40°. Tubular conveyors, that is to say tubes mounted and rotated on rollers about their axes and having a set of blades fixed in a spiral, or a continuous helix fixed inside, are useful for conveying fine powders for comparatively short distances. For elevating, entirely enclosed bucket elevators are most suitable. Very fine, dry powders may be dealt with very satisfactorily by pneumatic means similar to the well-known vacuum carpet cleaner. **Steel or rubber band or tray, pan or continuous trough conveyors are best for fine moist material, and bucket elevators with shallow buckets if the band conveyor cannot be used both for elevating and conveying.—W. H. C.**

Filtration; Progress in industrial ——. L. Fabre. Chim. et. Ind., 1919, 2, 759—769.

The filter press possesses many defects, the chief of which are: the cakes have different degrees of porosity in different parts; the layer of cake nearest the filtering medium is hard and compact whilst that farther away is soft and wet; filtration is thus rendered difficult, but more important still, the complete washing of the cake is almost impossible; the opening, closing, and cleaning of the filtering surfaces involve considerable labour and power; and the necessity of having a good joint between the plates to prevent leaks causes the filter cloths to wear out rapidly. Modern filtering systems may be divided into four classes:—Continuous rotary drum filters; rotary drums with drying sieves; rotary clarifiers; and open tank filters. All these systems operate by suction and the cakes formed are of uniform consistency and are readily washed free from soluble matter. The first three types are similar in design and consist of a drum which is rotated on a horizontal axis. The periphery of the drum is divided into a number of sections, boxes, or trays, separated by partitions parallel to the axis. In the first type the outer surface of the trays is covered with the filtering medium and each tray communicates by a pipe with a rotary valve on the axis. By this means each tray, as the drum rotates, is successively put into communication with a vacuum pump and with a supply of compressed air. The rotary drum filter is rotated, half submerged, in a tank which contains the mud to be filtered kept in a state of agitation. The suction causes a cake to form on the portion of the surface immersed, the liquid passing through the cloth and along the pipe to the central valve. The surface of each section as it rises out of the tank is sprayed with washing liquid which is conveyed by the valve to a separate reservoir; as the rotation continues pressure is applied to the outer surface of the cake to consolidate it, and when the section begins to descend again compressed air is introduced behind the cloth and forces the cake off the surface, this removal being assisted by a scraper. In some cases the use of compressed air is undesirable and is avoided. In the second type, the filter surfaces have edges or sides forming shallow trays; these are filled with the material from a shoot, drained by suction as before, and the cakes are discharged by gravity as they reach the lowest point. These filters are suitable for products such as crystals which drain easily. The rotary clarifier is similar to the first type, but is rotated entirely immersed in the liquid. The fourth type consists of a number of filter leaves (frames covered with filter cloth) suspended from an overhead travelling crane; the interior of each leaf can be put into communication with a vacuum pump or with a supply of compressed air. The leaves are first dipped into a tank containing the liquid or mud to be filtered, and at the same time they are connected with the vacuum. When the cake is of sufficient thickness the leaves are lifted out and dipped into a tank which contains the washing liquid; this is drawn through, and the leaves are once more lifted out and suspended over the sludge tank and the washed cakes are blown off by compressed air introduced into the interior of the leaves. This also serves to keep the pores of the filter cloth free from obstruction. These various types can be made of iron or wood, or partly of iron and partly of wood, or of hard lead for acids. Canvas filter cloths are used for neutral and alkaline liquids, cloths of Monel metal for very caustic liquids, and of woollen felt for acids. **A rotary filter 1·82 m. (6 ft.) diam. and 0·91 m. (3 ft.) wide is capable of treating about 30 tons of dry calcium carbonate from a caustic soda plant per 24 hours. The cake contains about 30% of water and less than**

1% of NaOH. With sodium bicarbonate as much as 50 tons is treated in the same time. The weight of the apparatus is about 5¼ tons; 5 h.-p. is required for rotating the drum, about 200 cub. ft. of air per minute and a vacuum of 635 mm. (25 in.) are required to be maintained at the filter. A rotary dryer 1·62 m. (5 ft. 4 in.) diam. and 0·91 m. (3 ft.) wide treated about 30 tons of ammonium sulphate per 24 hours and required 3 h.-p. and the same volume of air and degree of vacuum. The open tank filter is especially suitable for very finely divided materials such as gold and silver ore slimes and colloidal precipitates. An apparatus consisting of 10 leaves 1·62×0·82 metres (5 ft. 4 in.×2 ft. 8in.) treated two tons of ferric hydroxide per 24 hours. A number of diagrams are given showing the efficiency of the various types described.—W. H. C.

Autoclaves; Failure of two ——. Ann. Rep. Swiss Soc. Steam Boiler Owners, 1918. Engineering, 1919, **108**, 289—290.

A DIGESTER of cast steel with a wall thickness of 90 mm., which had been in use since 1915 in a chemical works at a maximum registered pressure of 60 atmos. was distorted and exploded through serious overheating, the explosion occurring at 48 atmos. and 265° C. The digester was replaced by a similar one in which the mixing device was placed close to the bottom. The distance between the digester and the grate was increased. The bottom of a second digester of grey cast-iron, 1000 mm. long, 800 mm. diameter, with a wall thickness of 120 mm. and a bottom thickness of 130 mm. worn to 87 mm., gave way, the explosion producing a crack which, in the cold state, was 500 mm. long and 5—10 mm. wide. The digester was 550 mm. above the grate. It was made in 1900, for a maximum authorised pressure of 40 atmos., and had been tested to 120 atmos. The pressure at the time of the explosion is not known, but the temperature was at least 240° C. The bottom of the digester was covered with a 20 mm. layer of a chalky deposit, which was a bad heat conductor. The growth of grey cast-iron may also have played an important part. It is suggested that the metal elongated like a firebar is known to do, until fracture occurred. The resistance to bending of test pieces taken from the top flange and the bottom of the digester varied from 2·56 tons per sq. cm. in the flange to 3·14 tons per sq. cm. in the bottom. The Swiss Federal Government stipulates 2·80 tons per sq. cm. for steel bridges. The chemical analysis of the bottom and the flange was normal, though the phosphorus (1% in each) was rather high. Micro-sections showed that the material had been long exposed to high temperatures. The flange had probably been heated to 200°—300° C. and the bottom to 500° C. The report advises casting autoclaves standing, the gate being over the flange and not over the bottom.—A. B. S.

Lifting sulphuric acid. Tungay. *See* VII.

Turpentine resin as a foam breaker. Kendall. *See* XXIII.

PATENTS.

Freeing of liquids from particles suspended therein. Titan Co. A./S., Christiania. Eng. Pat. 121,457, 31.10.18. (Appl. 17,811/18.) Int. Conv., 12.12.17.

SULPHUR is precipitated in the liquid by reaction between hydrogen sulphide and ferric sulphate or other oxidising compound. The precipitated sulphur encloses the finely divided suspended particles or neutralises their charge of electricity and renders filtration or settling easy.—W. H. C.

Condenser tubes and the like; Composition for cleaning ——. J. Urruty, Toulon. Eng. Pat. 121,590, 8.11.18. (Appl. 18,348/18.) Int. Conv., 20.12.17.

A LIQUID composed, approximately, of 50% HCl, 2·5% $CuSO_4$, 0·5% $NaHCO_3$, 0·5% KCN, and 46·5 water is circulated through the tubes.—W. H. C.

Condensers; Tubular ——. T. Phillips, Bideford. Eng. Pat. 130,766, 8.8.18. (Appl. 12,845/18.)

THE upper tube-plate of a tubular condenser forms the bottom of a chamber, which is surrounded by water, and through which the vapours enter the tubes. The top of the chamber has a number of openings corresponding to the upper ends of the tubes, in which are inserted short tubes provided with plugs and projecting a little distance into the chamber, through which a brush may be passed to clean the condenser tubes.—W. H. G.

Pulsometers for raising liquids [of high vapour tension]. P. A. Guye, Geneva. Eng. Pat. 129,635, 7.7.19. (Appl. 16,967/19.) Int. Conv., 9.7.18.

THE motive power used in the pulsometer, which is only suitable for liquids of high vapour tension or mixtures of liquids one at least of which is of high vapour tension, is obtained by vaporising a small portion of the liquid. When the vapour so generated has done its work it is passed through a condenser and returned to the pulsometer for re-use.—W. H. C.

Centrifugal machines [; Turbine-driven ——]. J. Schmidt, London. Eng. Pat. 131,094, 10.8.18. (Appl. 2393/18.)

IN a centrifugal separator driven by a steam turbine, the dividing plate between the turbine wheel and the rotating basket is provided with a stuffing box or other packing device to prevent steam reaching the material under treatment. If it is desired to heat the material under treatment the dividing plate may be provided with radiating gills and, further, the exhaust steam may be passed through a jacket surrounding the basket chamber.—B. M. V.

Evaporators. J. A. Reavell, Beckenham, and Kestner Evaporator and Engineering Co., Ltd., London. Eng. Pat. 130,181, 9.8.18. (Appl. 12,962/18.)

IN climbing or falling film apparatus for concentrating, evaporating, or distilling, the liquid to be treated is passed through one or more heater tubes and through a controlling valve before entering the evaporator tubes; both sets of tubes are contained within the same casing.—W. H. C.

Evaporator. J. Helm, St. Louis, Mo. U.S. Pat. 1,311,890, 5.8.19. Appl., 6.10.17.

A NUMBER of movable trays are supported, spaced apart, one above the other, in an oven in such a manner that the removal of a tray from one end of the column and the addition of a tray at the other end controls the movement.—W. H. C.

Treating material with gas or vapour; Apparatus for ——. F. Slocum, Pittsburgh, Pa., U.S.A. Eng. Pat. 130,680, 13.3.18. (Appl. 4453/18.)

A CAGE consisting of a skeleton frame with uprights and cross-pieces is fitted with longitudinal angle irons on which can be placed shallow trays with perforated bottoms and sides for holding the material. By means of a rack and pinion mounted on a carriage the cage can be moved in or out of a series of heating chambers, which are heated by a furnace. Suitable pipes are provided for introducing gases into the chambers and discharging the exhaust products. The use of the apparatus is described in connection with the treatment of calcium carbide with nitrogen, and the production of ammonia by the action of steam on the product.—W. J. W.

Liquid [liquefied] gases; Vaporisation of —— for maintaining a supply of gas. R. A. Dibdin, Barnes. Eng. Pat. 130,686, 14.3.18. (Appl. 4526/18.)

THE liquefied gas is contained in a vacuum vessel, surrounded by an outer jacket and closed by a cap having a screw plug for filling, which also acts as a safety valve, an outlet for gas provided with a cock and pressure gauge, and with a wheel and rod for actuating a valve which closes a passage, formed between the interior of the inner vessel and the outer jacket. When a supply of gas is required this valve is opened, and some of the liquefied gas allowed to flow into the outer jacket, where it evaporates, passes back into the inner vessel through the liquefied gas and accumulates above it. By suitably adjusting the outlet cock a steady stream of gas can be obtained.—W. H. C.

Filter. E. J. Sweetland, Montclair, N.J., Assignor to United Filters Corporation. U.S. Pat. 1,292,534, 28.1.19. Appl., 18.5.16.

THE filter casing is a horizontal cylinder made in two parts which are separable along a diametral horizontal plane. The lower part is supported on horizontal trunnions so that when it is desired to remove solid material from the filter leaves, this part of the casing may be inverted and material detached by compressed air or steam admitted to the interior of the filter leaves. The liquid may be charged into the filter through the hollow trunnions. The construction, charging, discharging, and the mounting of the filter elements are described in detail.—W. F. F.

Filter presses; Indicating the thickness of cake formation in —— D. T. Nicholson, Visalia, Cal. U.S. Pat. 1,299,996, 8.4.19. Appl., 2.3.18.

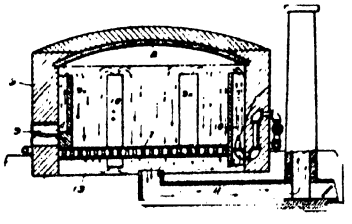
AN indiarubber cup mounted on a rod is adjusted so as to be fixed at a predetermined distance from one face of a filter element. When the accumulation of material closes the mouth of the cup, the excess of pressure on the other side of the filter element forces the cup and rod outwards and releases a striker which sounds a bell when the predetermined thickness of cake is reached.—W. F. F.

Filter element. K. Kiefer, Cincinnati, Ohio. U.S. Pat. 1,311,280, 29.7.19. Appl., 27.3.16.

HORIZONTAL layers of compressed moist pulp are separated by thin, flat plates having intersecting liquid channels on both faces. The channels are of rectangular cross-section and are separated so as to allow a sufficient flat surface to support the filtering material. Liquid is supplied to and exhausted from the channels only at the periphery of the plates.—W. F. F.

Kiln. F. Munhollon, Assignor to C. F. Lockhart, Cleveland, Ohio. U.S. Pat. 1,311,286, 29.7.19. Appl., 20.1.19.

THE kiln is provided with a perforated floor, 7, and with a number of fireplaces, 9, arranged around the wall, 6. The hot gas is discharged through the



passages, 9*a*, into the top of the kiln, passes downwards through the floor, 7, into the space, 13, and is directed back again into the kiln by injector jets in passages, 10, which are arranged around the kiln in alternation with the fireplaces. An outlet flue, 11, is provided.—W. F. F.

Filter. E. J. Sweetland, Montclair, N.J., Assignor to United Filters Corporation. U.S. Pat. 1,313,929, 26.8.19. Appl., 2.2.17.

A FILTER of the type in which the cakes form on rotating elements inside a casing is provided with an indicating device which is oscillated by the rotating filter when the cake reaches a predetermined thickness.—B. M. V.

Kiln; Rotary ——. P. A. Boeck, New York. U.S. Pat. 1,314,461, 26.8.19. Appl., 28.4.17.

KIESELGUHR bricks are placed between the inner refractory lining and the outer shell of a rotary kiln. —B. M. V.

Cooling and oxidation apparatus [for gases]. I. Hechenbleikner, Assignor to Chemical Construction Co., Charlotte, N.C. U.S. Pat. 1,311,395, 29.7.19. Appl., 7.4.19.

THE gas is passed through a series of horizontal cooling and oxidation chambers side by side and communicating with one another, and the condensate is collected in the chambers. Water-cooled tubes project downwards through the roofs of the cooling chambers, and the overflow from them is received by troughs extending along the roofs. —W. F. F.

Dryer. J. B. Adt, Assignor to J. B. Adt Co., Baltimore, Md. U.S. Pat. 1,311,431, 29.7.19. Appl., 5.11.18.

THE material is deposited on the surface of a heated, rotary drying cylinder, pressed into a thin film by rollers, removed from and re-deposited on the surface, and finally when the treatment is complete the finished product is removed from the cylinder. —W. H. C.

Drying machine; Centrifugal ——. T. A. Bryson, Troy, N.Y., Assignor to Tolhurst Machine Works. U.S. Pat. 1,311,871, 5.8.19. Appl., 13.11.16.

A VERTICAL casing, which contains a rotary basket, is provided with flanges on its outer wall about midway of its height. The casing is supported by means of bolts passing through the flanges to a support above, the bearing surfaces at both ends of the bolts being spherical to allow horizontal movement of the casing.—W. F. F.

Drying apparatus. H. Baetz, St. Louis, Mo. U.S. Pat. 1,312,607, 12.8.19. Appl., 30.10.18.

THE articles to be dried are arranged in a long horizontal chamber which is provided with a succession of air-circulating and air-heating devices alternately just below the roof. The air passes vertically across the articles from an air-circulator and then back to an air-heater while gradually moving longitudinally through the chamber. —W. F. F.

Drying material; Method of ——. A. E. Stacey, jun., Chicago, Ill., Assignor to Carrier Engineering Corporation, New York. U.S. Pat. 1,312,759, 12.8.19. Appl., 6.9.17.

THE material is arranged in a room to which air having a lower dew-point is supplied until the air in the room reaches a similar condition. The dew-point of the air admitted is then lowered, and the supply continued until the air in the room again reaches a similar condition.—W. F. F.

Pulveriser. H. J. Shelton, St. Louis, Mo. U.S. Pat. 1,311,535, 29.7.19. Appl., 31.10.17.

CURVED recesses are formed in the curved sides of the pulveriser casing and a breaker plate is secured

to a projection, having an upwardly inclined face, which extends from the end of the casing. A screen, guided by the curved recess, abuts against the breaker plate.—W. H. C.

Absorption apparatus. H. Torrance, New York. U.S. Pat. 1,311,627, 29.7.19. Appl., 19.7.16.

GAS and absorbing liquid are passed at high velocity through a tubular absorber and the strong liquor then passes downwards through a trap which prevents back flow, to a second absorber at a lower level. The difference in level is such as to compensate for the loss of pressure between the inlet and outlet of the first absorber.—W. F. F.

Flue-dust; Briquetting ——. F. A. Vogel, Assignor to General Briquetting Co., New York. U.S. Pat. 1,312,218, 5.8.19. Appl., 26.10.18.

WET flue-dust is reduced to a pulp by extracting mechanically the readily removable surplus water. The pulp is then mixed with an excess of material in relatively dry particles and the mixture is ground, mixed, and masticated until a uniform, coherent mass is obtained which is then briquetted. —W. H. C.

Solidifying normally solid substances; Method for ——. W. D. Richardson, Assignor to Swift and Co., Chicago, Ill. U.S. Pat. 1,312,424, 5.8.19. Appl., 8.1.16.

THE material is heated until it is in a plastic state and then agitated by a screw conveyor working in the bottom of the tank containing the material and forced through a cooler into a conduit also containing a screw conveyor, and terminating in a conical discharge piece through which the now nearly solid mass is forced as a continuous bar or rod by the pressure of the agitated mass behind it.—W. H. C.

Pyrometer. E. L. Clark, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,312,951, 12.8.19. Appl., 23.7.13.

A RESISTANCE is interposed between a thermocouple and a galvanometer and a second resistance having a positive temperature coefficient is connected in parallel. The resistances are adjusted to compensate approximately for temperature variations in the cold junction of the thermocouple for a given temperature in the hot junction.—W. F. F.

Distillation of liquids; Process and apparatus for fractional ——. C. Goudet, Assignor to Soc. d'Etudes Chimiques pour l'Industrie, Geneva, Switzerland. U.S. Pat. 1,312,974, 12.8.19. Appl., 27.2.19.

VOLATILE liquids to be separated are passed through a dephlegmator contained within a vessel which is maintained at a given temperature for a predetermined period. The temperature is then varied by varying the pressure of the medium by which the dephlegmator is heated.—W. F. F.

Rotary kilns; Devices [adjustable cutters] for removing crust formation in ——. M. Vogel-Jörgensen, Frederiksberg, Denmark. Eng. Pat. 118,284, 10.8.18. (Appl. 12,986/18.) Int. Conv., 28.2.17.

Furnaces. C. Zulver, London, and L. E. Smith, South Shields. Eng. Pat. 130,912, 24.2.19. (Appl. 4589/19.)

Furnaces of steam generators for the employment of pulverised fuel. J. G. Robinson, Manchester. Eng. Pat. 130,954, 16.8.18. (Appl. 14,183/19.)

Drying, or steaming, apparatus, or like apparatus, wherein materials are to be subjected to the action of gases, or vapours. J. Y. Johnson, London. From Philadelphia Textile Machinery Co., Philadelphia, U.S.A. Eng. Pat. 130,889, 20.1.19. (Appl. 1415/19.)

SEE U.S. Pat. 1,298,285 of 1919; this J., 1919, 398 A.

Furnace for heating and treating articles. Furnace for treating articles. A. Smallwood, Highgate. U.S. Pats. 1,312,927 and 1,312,928, 12.8.19. Appl., 19.9.16.

SEE Eng. Pats. 16,309, 102,242, and 102,243 of 1915; this J., 1917, 36.

Furnace, kiln, oven and the like. H. Francart, London. U.S. Pat. 1,314,486, 26.8.19. Appl., 26.3.19.

SEE Eng. Pat. 122,742 of 1918; this J., 1919, 164 A.

Impregnating liquids with carbonic acid or other gases; Apparatus for ——. A. A. Pindstofte, Frederiksberg, Denmark. U.S. Pat. 1,314,148, 26.8.19. Appl., 29.3.17.

SEE Eng. Pat. 109,958 of 1917; this J., 1917, 1171.

Drying, carbonising, etc. Eng. Pat. 131,179. *See* IIB.

Drying. Eng. Pat. 130,755. *See* VII.

Acid-concentrating apparatus. U.S. Pats. 1,286,080 and 1,286,188. *See* VII.

Tunnel-kiln. U.S. Pat. 1,311,487. *See* VIII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coking of Illinois coal in Koppers type oven. R. S. McBride and W. A. Selvig. U.S. Bureau of Standards, Tech. Paper No. 137. Chem. and Met. Eng., 1919, 21, 122—128.

SCREENED coal from the Orient Mine, Illinois, was used in a test of 7½ days' duration in a Koppers plant of 1100 (short) tons normal daily capacity. The coking period was increased from the ordinary working of 16-17 hours with Eastern coals to an average of 19½ hours. A slightly lower temperature also produced a better-class coke, but in all other respects Illinois coal proved satisfactory in use in chamber type ovens. The coal, as charged, contained 8·07% moisture, 34·66% volatile matter, 48·38% fixed carbon, and 8% of ash, and the percentages of hydrogen and oxygen were respectively 5·32 and 15·75. Below the level of the horizontal flue the coal was usually thoroughly coked, but the top of the coke mass was always colder than the rest of the charge. After quenching and loading the pieces of coke were smaller than when using Eastern coals, and showed longitudinal fractures and brittle characteristics. The material was decidedly lighter than the average by-product coke; it had apparent specific gravity 0·88, porosity 52·4%. 8·23 (U.S.?) galls. of dry tar (sp. gr. 1·19) and 30·33 lb. of ammonium sulphate were produced per ton of dry coal, and the analytical results show 2·29 galls. of benzene, 0·54 gall. of toluene, and 0·14 gall. of solvent naphtha per ton of coal (dry).

C. A. K.

Calorific value of commercial coke and coke breeze. K. Norton. Gas World, 1919, 71, 165.

A COMPARISON of various cokes in respect of their relative calorific values is readily effected by determining their content of volatile matter and of ash on a dry basis. The fixed carbon content is calculated by difference. The calorific value of the sample is then equal to 146·7 C + 220 V B.Th.U. per lb. on dry basis, where C represents the percentage of fixed carbon and V the percentage of volatile matter (both on a dry basis) in the sample. A graph is given, by the use of which the calorific value of all cokes within the range, ash content up to 20%, volatile matter up to 15%, and fixed carbon from 80% to 100%, can be ascertained.

—J. S. G. T.

Chamber ovens in gasworks; Use of ——. H. Koppers. J. Gasbeleucht., 1919, **62**, 399—405, 420—421.

THE high cost of labour makes it necessary to reduce the number of operations to as few as possible. This purpose may be served by increasing the size of the retort units. In the coking industry ovens of large capacity are used, and the fewer charges and discharges result in a large saving of labour. The regenerative coke-oven has a higher heat efficiency than the gas retort, and the system is sufficiently flexible to allow of diminution of output during slack periods. The size of the chamber ovens required in gas works will depend upon the gas production desired, the yield of a single oven varying from 1200 to 3500 cub. m. (42,000 to 124,000 cub. ft.) of gas, the charge taking place once each 24 hours. The machines required are a filling waggon, a levelling machine, a discharging machine, and a coke quencher. The table gives an indication of the yields obtainable and the quality of the gas. The values are those of an actual series of tests at Budapest over a period of 12 months, with Koppers chamber ovens:—

Charge of raw coal	9·07 metric tons
Yield of gas (per ton of coal)	14,000 cub. ft.
Calorific value of gas (per cub. ft.)	568 B.Th.U.
,, ,, ,, (per lb. of coal)	3620 B.Th.U.
Nitrogen in gas	5·25%
Fuel required (coke calc. as raw coal) ..	10·25%
,, (coke per 1,000 cub. ft. gas) ..	184 lb.

The yield of tar per ton of coal is 0·04 ton and of ammonia 0·003 ton. The labour required is small, the following being the number of workers required for all the necessary processes:—

For 100,000 cub. m. in 24 hours,	17 workers.
200,000 ,, ,, ,,	22 ,,
300,000 ,, ,, ,,	32 ,,

The extra power required is small, being taken up in discharging the ovens. The power required for discharging and levelling is not more than 30 kilowatt-hours per day. The quality of the coke is not a prime consideration in ordinary gasworks practice, and a much better quality is obtainable from chamber ovens. Owing to the variation in composition of coal from layer to layer, the quality of the coke may be improved and rendered more uniform by a preliminary grinding of the coal. The extra power and labour required for grinding is paid for by the increased value of the coke.
—W. P.

Gas retorts; Heat economy of ——. O. Peischer. J. Gasbeleucht., 1919, **62**, 381—385.

A COMPARISON between regenerative and recuperative systems. The former is found to be much more economical. The amount of fuel required for gasification calculated on the raw coal was found in a series of tests to be 11·4% and 16·3% respectively, the temperature of the waste gases in the two cases being 240° C. and 550°—600° C. Central producers were found to be more efficient than separate generators, 81% of the total heat being utilised as against 75%.—W. P.

Horizontals [gas retorts]; Steaming ——. R. J. Rew. Gas J., 1919, **147**, 557—558.

RESULTS of eighteen months' experience in steaming horizontal gas retorts (this J., 1918, 329 A.). An eight-hour alternating period of steaming has been found advantageous, four retorts out of six in a setting being steamed, and the other two being used for carbonising coal continuously. The normal make of "straight" coal gas was 11,300 cub. ft. per ton, which was increased to 15,400 cub. ft. per ton by this method of steaming. The steamed retorts were worked under slightly reduced pressure. The first channel retorts have been in continuous use for thirteen months. Trouble was experienced with the superheaters, this being overcome by fixing them inside the setting and completely enclosing them with fireclay tiles, 1½ in. thick.—W. P.

Gas cooling. J. Becker. J. Gasbeleucht., 1919, **62**, 405—406.

TROUBLE is often experienced on extending plant to increase gas production. The purifiers become choked and inefficient, dry gas meters do not record correctly, etc. This is usually due to the cooling plant being of insufficient capacity to deal with the larger quantity of gas, and as a result the gas is not cooled below its dew point early enough in the cooling system to ensure the tar fog being deposited before the gas reaches the exit.—W. P.

Gas; Low grade ——. W. Cranfield. N. Brit. Assoc. Gas Managers, 4.9.19. Gas J., 1919, **147**, 565—571.

LOW-GRADE gas is a comparative term, applied by the author to that having a calorific value between 375 and 425 B.Th.U. gross. The amount of air required for complete combustion is generally less in the case of a low-grade gas than with a rich gas, and it is found that all mixtures containing combining proportions of gas and air have roughly the same heat of combustion. The lower air requirement of the low-grade gas results in better aeration of the flame, ensuring rapid and complete combustion. Burners require adjusting to suit the particular gas being used, but a given fluctuation in gas quality produces less change in efficiency with a lean gas than with a rich one. Low grade gas has been found efficient for lighting, heating, and power purposes when the necessary adjustments have been made.—W. P.

Coal gas; Determination of total sulphur in —— by means of N/10 iodine solution. M. Hirsch. Chem.-Zeit., 1919, **43**, 482.

FROM 30 to 40 litres of the gas (measured with a suitable meter) is burnt in a Drehschmidt's apparatus, and the products of combustion are aspirated through two absorption flasks, the first of which contains 15 c.c. of *N*/10 iodine solution, and the second 15 c.c. of *N*/10 thiosulphate solution. At the end of the operation the contents of the absorption flasks are mixed and titrated with *N*/10 iodine solution. Each c.c. of *N*/10 iodine solution reduced by the gas (SO_2 formed during the combustion) is equivalent to 0·0016034 grm. of sulphur.
—W. P. S.

Carbon dioxide; Effect of —— when present in inflammable gaseous mixtures on explosion phenomena. W. T. David. Engineering, 1919, **108**, 300—302.

MIXTURES of Cambridge coal gas, carbon dioxide, and oxygen were exploded in a cast-iron cylinder 30 cm. long, 30 cm. diameter, the interior of which was coated with dull black paint. The mixtures were exploded by an electric spark in the centre of the vessel, and the pressures were recorded by a Hopkinson optical indicator, which reflected a spot of light on a revolving photographic film. The radiated heat was measured by means of a platinum bolometer protected from the gaseous mixture by a fluorite plate. In a mixture containing 15% of coal gas and 58—65% of carbon dioxide, the latter greatly reduces the pressure developed during the explosion (roughly by 50%), slows down the speed of combustion, and reduces the rate of cooling. The lower pressure is largely due to the greater specific heat of carbon dioxide. A considerable amount of chemical activity proceeds for some time during the cooling, and a notable fraction of the chemical energy of the inflammable gas remains latent so far as pressure energy is concerned. The heat radiated by the mixture containing carbon dioxide is

much less than when nitrogen is used. After 0·25 sec. it is half, but the difference rapidly diminishes so that after 1 sec. the difference is only 5—10%. The radiation is emitted almost entirely by carbon dioxide and steam. With a mixture richer in coal gas the radiation is greater and, except in the earlier stages, its rate is also greater. Chemical activity appears to continue until the mean gas temperature has fallen to 1900° C. (abs), *i.e.*, one-fifth of a second after ignition with a mixture containing 20·7% of coal gas. The maximum rate of emission occurs a considerable time before the attainment of maximum pressure, and is greater in the earlier stages of the period of maximum pressure. During the period of constant maximum pressure the loss of heat is considerable—20% or more of the heat of combustion of the coal gas—so that there must be a conversion of energy into pressure or translational energy—probably mainly a conversion from chemical energy. The author's experiments indicate the importance of reducing the proportion of products of combustion in the charge of an internal combustion engine to a minimum, especially when using gas mixtures of moderate strength.—A. B. S.

[*Ammonium*] *sulphate making; "Direct process" of —— in gasworks.* Fifty-fifth annual report (1918) on alkali, etc., works, by the Chief Inspector, 26—47.

IN the operation of the "direct process" (this J., 1916, 1001; 1917, 997; 1918, 498A) working losses are reduced by better circulation in the "bubbler," and attention to due adjustment of the lime and liquor feeds to the virgin liquor still. The "rotation" system of operating oxide purifies with downward flow of gas described in the annual reports for 1915 and 1916 (this J., 1916, 1001; 1917, 997) possesses advantages over the direct system with upward flow. The conditions ruling in the "rotation" system with downward flow favour a better distribution of ammonia, the boxes are fouled and discharged far less frequently, and any residual ammonia retained in a box is subsequently utilised on rotation. Back pressure is reduced, and tar fog and naphthalene are filtered out in the top layer of oxide, which is easily accessible. Moreover, a cyclic movement of the boxes tends to better equalisation of hydration conditions, and to the maintenance of conditions favourable to the utilisation of residual oxygen in the third and fourth purifiers. The report details the results of experience at a works wherein the direct process was installed in 1915 and progressively improved. The backward system of rotation with downward flow was practised in 1918. The ammonium sulphate recovered per ton of coal amounted to 18·5 lb. in 1915, 21·2 lb. in 1916, 20·7 lb. in 1917, and 24·0 lb. in 1918. The plant consisted of four purifiers, 21 ft. square, with three layers of oxide, 9 in. deep, containing about 40 tons per box. The average results obtained by the operation of the boxes in cycles of 5, 10, 13, 20, 25, 41, 43, and 58 days are represented graphically, the temperature of the oxide and the increase of temperature of the middle and bottom layers respectively being shown. Graphs are also exhibited of the increase of temperature of the middle and bottom layers of oxide in purifiers Nos. 2 and 3, when occupying various positions in the series of rotation. The make of sulphur decreases from layer to layer in a downward direction, and the rise of temperature of the oxide on the middle layer in all positions of a box is greater than that on the bottom layer. The results obtained indicate that the rise of temperature in a layer affords valuable information as to the activity of the oxide and guidance as to the possibility of disorganisation. A cyclic period of 15—20 days is calculated to secure a better distribution of ammonia and moisture than one of 40—50 days.—J. S. G. T.

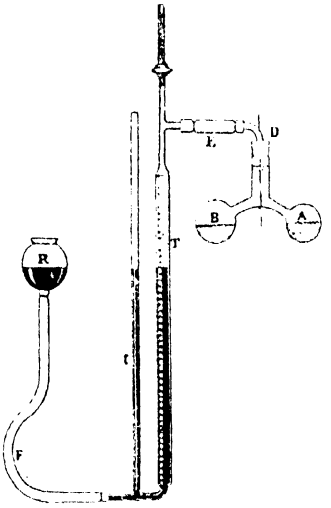
Oil shales; Testing ——. P. Nicolardot and H. Baurier. Chim. et Ind., 1919, 2, 770—777.

THE apparatus consists of a flask to generate steam, a retort made of a German 77 mm. shell case fitted with a screw cap pierced with three screwed holes containing respectively an inlet for steam or other gas, a closed tube containing a thermo-couple, and an exit tube for the products of distillation; these pass to a condenser formed of a jacketed U-tube having a pocket at the lower end and a tap by which the products can be run into a graduated cylinder; an absorption tower, in which any uncondensed products are trapped by paraffin, and finally to a gas holder provided with a pressure gauge. The sample is pounded in a mortar until there are no particles larger than 10—15 mm., separated by sifting through a 2 mm. sieve into two portions, which are each weighed, and a mixture of fine and coarse made in the proportions of the weights. 500 grms. of the mixture is introduced into the retort, the latter is closed with a plug, and slowly heated in a Méker furnace, either alone, or with the introduction of a current of steam, hydrogen, or of previously obtained gas. The heating must be done slowly, so that all vapours are condensed in the U-tube and only a very small increase in the weight of the paraffin tube occurs; generally from 2½ to 3 hours will be required to attain a temperature of 700°—750° C., when all the oils will have been driven off. When the distillation is finished the cold water is run out of the jacket of the U-tube and warm water passed through it to liquefy any viscous oils clinging to the sides. The condensed oil and water are run out into the graduated cylinder, which is kept at 60°—80° C. for two hours to ensure separation, then cooled to 15°, and the volumes read off. The oil is separated, its specific gravity is taken, and the weight of the oily distillate calculated after adding the increase in weight of the paraffin absorber. 25 c.c. is then distilled from a small flask provided with a thermometer graduated to 500° C., and nine fractions of 2½ c.c. each are collected. Several tables and charts are given showing the influence of a current of steam, hydrogen, or gas on the results. Steam appears to increase the yield of oil and to raise its specific gravity, but hydrogen and gas seem to have very little effect.—W. H. C.

Shales, lignites, and coals; Estimation of ammonia in the aqueous products of the distillation of ——. P. Nicolardot and H. Baurier. Chim. et Ind., 1919, 2, 777—779.

THE estimation of ammonia in the aqueous products obtained by the distillation of shale, lignite, and coal is rendered difficult by the presence of considerable amounts of pyridine, amines, and other bases. To overcome the difficulty the authors make use of the hypochlorite or hypobromite method with the apparatus shown in the figure, which avoids long rubber tubes and contact between the reagents and mercury. It consists of a decomposing vessel, A, B, connected by a glass bend and a very short rubber tube, E, to the measuring vessel, T. The latter is provided with a stopcock, and is graduated in $\frac{1}{10}$ cc. and connected at the lower end with a pressure tube, t, a levelling tube, F, and mercury reservoir, R. 10 to 15 c.c. of the liquid to be tested is run from a pipette into one of the bulbs, A or B, and 20—25 c.c. of sodium hypochlorite solution and 5 c.c. of a 30% solution of sodium hydroxide into the other. The bulbs are connected with the rest of the apparatus, the measuring tube adjusted to zero, and the contents of the two bulbs mixed by raising and lowering them alternately. The decomposition should be complete in 3 hours, after which the levels are adjusted and the volume of nitrogen is read off, the temperature and atmospheric pressure are noted, and the nitrogen is calculated into ammonia. Pyridine is estimated in the residue

left in the bulbs; the contents are washed into a flask, sodium hydroxide is added, and the pyridine is distilled into a measured quantity of standard



sulphuric acid and the excess titrated back in the usual way. 1 c.c. of $N/1$ H_2SO_4 corresponds to 0·0079 grm. of pyridine. The presence of amines and other bases vitiates the pyridine estimation. Figures are given showing the accuracy of the process.—W. H. C.

Ammonia recovery. Thau. See VII.

Ammoniacal liquor. See VII.

PATENTS.

Pulverised fuel or the like; Firing with ——. C. A. A. Westerberg, Stockholm. Eng. Pat. 117,265, 2.7.18. (Appl. 10,885/18.)

COAL or coke breeze or powder, sawdust, peat powder, etc., is contained in a hopper which is provided at the bottom with a feeding wheel and an air-blast nozzle. The fuel dust is blown into a mixing nozzle arranged within a gas supply pipe opening into the furnace, so that gas is drawn in by the injector action of the jet issuing from the mixing nozzle. A compressed air or steam pipe projecting into the hopper enables the powdered fuel to be loosened when necessary.—W. F. F.

Explosive fuel mixtures; Method of preparing —— and operating internal combustion engines therewith. W. P. Deppé, Brightwaters, N.Y., U.S.A. Eng. Pat. 130,209, 25.9.18. (Appl. 15,576/18.)

THE fuel is sprayed into highly-heated air so that it is vaporised, and the mixture is churned and then compressed in the engine cylinder to a temperature just below the ignition point, after which it is fired. An additional predetermined amount of highly-heated air or moisture may be added before the churning operation, and after the churning the mixture may be passed through a tube provided with a succession of flattened portions at which the rate of flow is increased, while at the same time the temperature is raised step by step.—W. F. F.

Fuels; Treatment of certain —— to improve their calorific value. W. A. Bone, London. Eng. Pat. 130,455, 30.7.18. (Appl. 12,399/18.)

BROWN coal or lignite, *e.g.*, Morwell brown coal, is dried and then heated to a temperature between 250° and 400° C. (*e.g.*, about 375° C.), until elimination of water and gas has ceased. The heating may be effected by the direct action of boiler-flue gases containing about 10—12·5% of carbon dioxide, which does not permit ignition of the coal. The temperature is that at which water is eliminated by chemical change, and just below that at which oils are given off by destructive distillation.
—W. F. F.

Peat; Process of treating ——. N. de Long, Chicago. U.S. Pat. 1,312,521, 12.8.19. Appl., 23.9.18.

THE peat is mixed with a small amount of alkali, "which attacks the water-holding cells without combining with the water thereof," and the mixture is exposed to air.—A. E. D.

Artificial fuel and method of making same. H. M. Brigham, Brooklyn, N.Y., Assignor to American Linseed Co. U.S. Pat. 1,313,876, 26.8.19. Appl., 23.2.18.

DEHYDRATED ethyl alcohol is mixed with acetone, and cellulose nitrated to have a nitrogen content which renders it soluble in the mixture is added thereto, and the whole agitated until the cellulose is dissolved. Sufficient commercial alcohol is then added to produce the desired degree of viscosity.
—J. S. G. T.

Combustion; Process of promoting ——. E. C. Lillie, Denver, Colo. U.S. Pat. 1,312,916, 12.8.19. Appl., 16.5.16.

THE lower portion only of a deep and narrow bed of fuel is kept in a state of ignition, and the gaseous products are withdrawn laterally into a rising column of flame which results from the combustion of the fixed carbon of the fuel.—A. E. D.

Coke ovens; Fuel piping for ——. A. Roberts, Evanston, Ill. U.S. Pat. 1,292,066, 21.1.19. Appl., 5.8.15. Renewed 6.6.18.

AN arrangement of piping is described by which provision is made for inequalities in the expansion of the piping and the oven walls. The ovens are separated by walls containing heating flues provided with burners which are supplied with air and gas from a pair of headers along one side of the bench of ovens at the top. The headers are supported by hangers. Each header is connected to horizontal transverse pipes, which are vertically above one another in pairs. These pipes extend the full width of each oven, and are supported on rollers; a row of burners at each side is supplied with air and gas from them. The arrangement is such that a minimum amount of piping is used.
—W. F. F.

Coke oven. P. Plantinga, Cleveland, Ohio. U.S. Pat. 1,292,369, 21.1.19. Appl., 20.2.17.

A NUMBER of flat, vertical coke ovens are separated by walls containing heating flues, and each oven is arranged over a pair of chequer work reversible regenerators for the air and gas. Air after passing through one regenerator enters a horizontal chamber between the regenerator and the oven, and then travels upwards through flues in the oven wall, which divide at the top into two flues extending downwards on either side, in which the air is mixed with gas and burnt. The hot gases then pass through horizontal heating flues below the floors of the ovens. Only one half of the combustion flues in the walls are used as such at any one time, the hot gases from the horizontal heating flues passing through the remaining half and thence to the other regenerator. The air and gas supplies may be regulated.—W. F. F.

Coking retort oven. J. Becker, Assignor to The Koppers Co., Pittsburgh, Pa. U.S. Pat. 1,312,301, 5.8.19. Appl., 7.2.17.

A SERIES of vertical coking chambers is provided

with intermediate heating walls having internal combustion flues. Air and gas regenerators arranged below the coking chambers communicate with the heating flues. The gas regenerators may be used as auxiliary air regenerators by connecting the heating flues to an alternative gas supply. The openings of the air regenerators into the heating flues are provided with removable plugs so that their cross section may be reduced when the alternative gas supply is being used, without altering the direction of flow of the air.—W. F. F.

Coking retort oven. J. van Ackeren, Assignor to The Koppers Co., Pittsburgh, Pa. U.S. Pat. 1,312,372, 5.8.19. Appl., 7.2.17.

A SET of coking chambers is provided with intermediate heating walls, each wall having a set of triangular combustion flues on each side, adjacent to the coking chambers on either side of the wall. Each of the triangular flues is connected to an air regenerator and a gas regenerator simultaneously. —W. F. F.

Coke-oven; Regenerative ——. A. Roberts, Evanston, Ill. U.S. Pats. (A) 1,313,207, and (B) 1,313,208, 12.8.19. Appl., 3.1.16, and 22.6.16. Both renewed 8.11.18.

(A) A BENCH of coke-ovens is provided with a number of heating walls, each having regenerators under each end. Connections are made from each regenerator to a common connexion, which delivers hot air to all portions of the corresponding heating wall. (B) A coke-oven heating wall is provided with a number of heating passages, each having a burner at one end and a waste gas outlet at the other end. Air may be supplied simultaneously to all the burners from either end of the heating wall, and the spent gas may be removed simultaneously from all the passages to an outlet at either end of the wall. A regenerator is provided at each end of the wall, and may be connected with the air supply means at one end and the gas outlet at the other end or *vice versâ*.—W. F. F.

Suction gas producers. L. Barrow, S. McA. Scott, and Cadbury Bros., Ltd., Birmingham. Eng. Pat. 130,754, 6.8.18. (Appl. 12.759/18.)

THE supply of steam or water to a producer employed in conjunction with a mechanically propelled vehicle is controlled by a device similar to a petrol carburettor of the jet type. A float chamber is in communication with a nozzle preferably consisting of a vertical tube slotted near its upper end, over which is fitted a slotted sleeve rotatable by an external hand lever, whereby the exposed area of the slots in the nozzle may be varied. The nozzle is surrounded by an air passage, which at its outer end is controlled by one or more slides or shutters. The air flowing past the nozzle carries with it the requisite amount of water vapour, and the relative proportion of air and vapour is kept the same at all loads.—J. S. G. T.

Gas manufacture. R. McD. Simpson, Buckie, Banff, and G. R. Hislop, jun., Paisley. Eng. Pat. 130,796, 17.8.18. (Appl. 13,404/18.)

A CHAMBER is arranged underneath and external to a horizontal gas retort. A steam conduit pipe is arranged with the chamber, and is furnished with a number of holes, slots, or nozzles throughout its length for the escape of steam. The steam enters the retort through a number of bevelled slots in the floor of the retort and percolates through the coke in the retort. The steam conduit pipe is removable for inspection or repair.—J. S. G. T.

Preheater for gas generators. O. A. L. Heise, Copenhagen, Denmark. Eng. Pat. 131,127, 10.8.18. (Appl. 13,019/18.)

A LINING for the combustion chamber is formed of an iron cylinder, and a coiled tube through which the fluid to be heated flows is wound round the cylinder, a small space intervening between the cylinder and the coil.—J. S. G. T.

Gas producers; Wood refuse or waste fuel ——. H. V. Senior and A. D. Bates, Lincoln. Eng. Pats. (A) 131,169 and (B) 131,170, 22.8.18. (Appls. 13,673 and 13,674/18.)

(A) IN order to enable the depth of the fuel bed in the producer to be regulated to suit the nature of the fuel employed, the fuel bell or container is made of a number of telescoping sections, each having the form of a conical frustum. The various sections can be raised or lowered by any form of lifting device. Pokers or stirrers are inserted into the fuel bed through the top of each truncation. (B) In a gas producer using fuel with a high moisture content (50%), the passage of steam to fresh fuel during the process of gas production is prevented by providing an outlet on the side of the hopper leading to a chimney, which is furnished with an exhausting device such as an ejector or blower worked by compressed air or steam. A flap valve or water seal at the outlet of the hopper to the chimney prevents the passage of air to the producer. A shield open at both ends and perforated throughout its length extends from the top into the lower part of the hopper and permits the passage of gas from different levels in the fuel bed to the chimney. A guard is fitted over the upper end of the shield to prevent choking of the passage-way to the hopper outlet by fuel.—J. S. G. T.

Producer-gas; Process of making ——. H. A. Grine, Collinsville, Okla., Assignor to Gas Power Machinery Co., Los Angeles, Cal. U.S. Pat. 1,313,180, 12.8.19. Appl., 13.2.15.

LIQUID fuel is mixed with an oxygen-carrying medium and a retarder medium in such proportions that when the mixture is ignited in the gasifying chamber two different zones are formed. In one zone, wherein the temperature is maintained below the burning point of the fuel, volatilisation of the mixture occurs, whilst in the other zone, in which the temperature rises above the burning point of the fuel, partial combustion takes place with formation of producer gas.—J. S. G. T.

Removal of sulphur and sulphur-containing bodies from gases. E. K. Rideal and H. S. Taylor, London. Eng. Pat. 130,654, 2.3.18. (Appl. 3702/18.)

THE gas in admixture with a sufficient quantity of water vapour, to prevent reduction of the oxide employed, is passed over iron oxide mixed with one or more of the oxides of chromium, nickel, cobalt, cerium, thorium, zirconium, manganese, molybdenum, and maintained at a temperature between 300° C. and 650° C. Sulphur-containing bodies are thereby converted into hydrogen sulphide, which passes on with the remainder of the gas and is not fixed by the oxide. The gas suffers no material alteration in composition or ultimate quality. Operating with a catalyst comprising iron oxide admixed with 15% of chromium oxide, at 350° C., over 90% of the sulphur content of coal-gas was removed by addition of 7% by volume of steam. —J. S. G. T.

Gas; Process for removing tar from ——. O. A. L. Heise, Copenhagen. Eng. Pat. 131,125, 10.8.18. (Appl. 13,017/18.)

THE gas passes upwards through a tower, in which are arranged a number of superposed trays provided with grate bottoms and supporting heath or other filtering material. Hot water is introduced into the top of the tower from a sprinkler to keep the tar fluid.—J. S. G. T.

Fuel oils. **F. Tinker, Birmingham. Eng. Pat. 130,699, 18.3.18. (Appl. 4757/18.)**

In order to utilise tars containing pitch in conjunction with mineral oils, *e.g.*, liquid fuel, a third substance is incorporated, miscible with each of the above materials, and intermediate between them as regards chemical composition and surface tension. This material may be a residue from an asphaltic oil or from an oil rich in aromatic hydrocarbons, or from an oil which is naturally suitable for this purpose by reason of its composition. Blown shale oil is also of use. The intermediary oil is mixed with an equal weight of gas tar at about 60° C., and a suitable mineral fuel oil is added, so that approximately equal weights of the three components are present.—A. E. D.

Petroleum; Process of treating ——. C. S. Palmer, Pittsburgh. U.S. Pat. 1,313,009, 12.8.19. Appl., 29.8.17.

Crude paraffin base petroleum and residues are digested under a pressure of more than four atmospheres, and at a temperature above 200° C., until most of the oil has been converted into more volatile products. The temperature attained is below that at which notable carbonisation occurs, and the pressure is varied alternately from high to low by intermittently releasing the volatile compounds produced.—A. E. D.

Fuel; Liquid ——. A. A. Backhaus, Baltimore, Assignor to U.S. Industrial Alcohol Co. U.S. Pat. 1,313,158, 12.8.19. Appl., 22.11.17.

The fuel contains a petroleum distillate, an alcohol, and an organic chlorine derivative.—A. E. D.

Petroleum products; Art of refining ——. C. K. Francis and D. G. Morgan, Assignors to Cosden and Co., Tulsa, Okla. U.S. Pat. 1,313,629, 19.8.19. Appl., 16.12.18.

Water-white products are prepared from petroleum hydrocarbons by mixing the hydrocarbons with a saponaceous mixture containing an excess of alkali and distilling the product.—L. A. C.

Feeding pulverised or finely divided fuel or other material; Apparatus for ——. W. O. Renkin, Oradell, N.J., U.S.A. Eng. Pat. 121,135, 29.11.18. (Appl. 19,758/18.) Int. Conv., 30.11.17.

Gas and air mixing apparatus for producer or suction gas generators and like purposes. Sharp and Preston, Ltd., and A. Docking, Dublin. Eng. Pat. 131,459, 24.8.18. (Appl. 13,777/18.)

Artificial fuel composition and process. R. F. Dalton, New York. Eng. Pat. 122,402, 28.11.18. (Appl. 19,645/18.) Int. Conv., 12.1.18.

See U.S. Pat. 1,260,286 of 1918; this J., 1918, 292 A.

Fuel; Artificial ——. American Linseed Co., New York, Assignees of J. Schaub, Newark, N.J., U.S.A. Eng. Pat. 127,585, 17.7.18. (Appl. 13,496/19.) Int. Conv., 17.7.17.

See U.S. Pat. 1,262,267 of 1918; this J., 1918, 330 A.

Gas; Manufacture of ——. R. P. Brousson, London. U.S. Pat. 1,313,514, 19.8.19. Appl., 28.9.15.

See Eng. Pat. 6873 of 1915; this J., 1916, 958.

Liquefied gases. Eng. Pat. 130,686. *See* I.

Hydrogen. Eng. Pats. 130,092 and 130,358. *See* VII.

Gas-analysing apparatus. **Eng. Pats. 118,112 and 118,114. *See* XXIII.**

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Lignin. Pringsheim and Magnus. *See* V.

Patents.

Destructive distillation of wood, woody fibre, peat, and similar carbonaceous substances. P. Poore, London. Eng. Pat. 131,006. (Appls. 13,321, 17.9.17, and 4963, 20.3.18.)

The wood or other material, in small pieces, is subjected to a preliminary drying process whereby its moisture content is reduced to 5–8%, and then distilled in a retort. When the temperature throughout the charge is just above 100° C., superheated steam is introduced into the retort. Waste gases from the retort furnace are employed to superheat the steam. Air is later intermixed with the waste gases in such proportion that the temperature of the mixture is well below 130° C., and this mixture is employed for effecting the preliminary drying of the material. Suitable apparatus for carrying out the various operations is described. The process is stated to give increased yields of acetic acid, wood spirit, etc.—J. S. G. T.

Distillation, gasification and the like of carbonaceous materials and the separation of the volatile matter therefrom. W. E. Davies, Tonypandy, S. Wales. Eng. Pat. 131,105, 3.7.18. (Appl. 10,895/18.)

Electrical means are employed to control the chemical and physical properties of the products resulting from the distillation process. Gases substantially free from uncombined oxygen, such as products of combustion, producer gas, hydrogen, steam, carbon dioxide, etc., are mixed with the volatile products of distillation either within the retort or close to it. Electrodes are arranged so that these gases at the place of introduction are in contact with one electrode (anode or cathode), and after passage through the charge come into contact with the other electrode (cathode or anode) arranged at the outlet. If desired, dust not exceeding 5% by weight of the fuel carbonised may be introduced with the gases. The potential difference employed may vary from 100 volts to 100,000 volts or more. The process may be carried out at a pressure either below or above atmospheric pressure (up to 250 atm.). The process is best practised using fuel prepared in accordance with Eng. Pat. 127,940 (this J., 1919, 526 A).
—J. S. G. T.

Drying, carbonising, roasting, or like treatment of materials; Two-stage apparatus for the ——. Erith's Engineering Co., Ltd., and C. Erith, London. Eng. Pat. 131,179, 29.8.18. (Appl. 14,057/18.)

A two-stage apparatus devised more particularly for drying and carbonising moist fuels comprises a low temperature chamber and a high temperature chamber placed end to end substantially in alinement. The heat necessary for the preliminary and final treatment is derived from a mechanically fired furnace provided with means for controlling the combustion of fuel therein and distributing the products of combustion to the respective treatment chambers. The furnace is also provided with burners for the combustion of by-product gas evolved during the treatment of the material. Supplementary fuel is supplied to the furnace by means of an automatic stoker. The distribution of heat from the furnace to the chambers is controlled by forced draught and induced draught fans, atmospheric air being admitted at appropriate points and mixed with the products of combustion so as to reduce their temperature to suit the pre-

liminary drying and final carbonising steps. The ash is discharged automatically from the furnace. —J. S. G. T.

III.—TAR AND TAR PRODUCTS.

Nitro-derivatives of phenyl-2-naphthylamine. Ryan and Drumm. *See* XXII.

Diphenylamine. Ryan and Ryan. *See* XXII.

PATENTS.

Tar; Process for the dehydration of ——. C. A. Klein, Brimsdown, Middlesex. Eng. Pat. 131,087, 26.4.18. (Appl. 7032/18.)

WATERY tar is brought into intimate contact with a convenient excess of added water at a temperature above 40° C.; the tar is then allowed to settle and is separated from the layer of water. By this means a tar containing less than 4% of water is obtained. To produce intimate contact between the tar and added water, the tar, heated to above 40° C., may be forced through a perforated plate into a vessel containing water at about the same temperature, or a jet of steam or water may be made to impinge on a jet of tar above a vessel for receiving the moisture, or a mixture of tar and water may be heated by jets of live steam, or the tar may be agitated by mechanical means with an excess of hot water. The process is particularly applicable to the dehydration of tar from gas producer plants.—L. A. C.

m-Xylene; Separation of —— from xylene substances. P. Lepers, Lyon, France. U.S. Pat. 1,311,848, 29.7.19. Appl., 23.4.19.

THE *m*-xylene in a mixture of isomeric xylenes is sulphonated by means of 75% sulphuric acid in presence of *m*-xylenesulphonic acid. The *m*-xylenesulphonic acid thus produced is separated from the unchanged hydrocarbons, and is desulphonated to *m*-xylene.—G. F. M.

Phenol; Process of making ——. R. H. McKee, Ridgefield Park, N.J. U.S. Pat. 1,312,127, 5.8.19. Appl., 17.11.17.

THE melt obtained by fusing sodium benzenesulphonate with sodium hydroxide is dissolved in water containing phenol; the distillate contains the greater portion of the phenol present in the sludge.—G. F. M.

Resorcinol; Process of making ——. N. Goodman and B. Grubman, New York. U.S. Pat. 1,314,138, 26.8.19. Appl., 18.7.18.

RESORCINOL is extracted in the process of manufacture by means of a mixture of ether and benzol. —L. A. C.

Fuel oils. Eng. Pat. 130,699. *See* IIA.

Chlorosulphonic acid. Eng. Pat. 131,021. *See* VII.

IV.—COLOURING MATTERS AND DYES.

Juglone; Halogenation of ——. *New type of naphthalene dyes.* A. S. Wheeler and J. W. Scott. J. Amer. Chem. Soc., 1919, **41**, 833—841.

THE following derivatives of juglone (5-hydroxy-1.4-naphthoquinone) are described. Juglone 2.3-dichloride and dibromide, 2-chloro- and 2-bromojuglones, 2.3-dichloro-, 2.3.8-tribromo-, 8-chloro-2.3-dibromo- and 8-hydroxy-2.3-dibromo-juglones. 2.3.8-Tribromojuglone (5-hydroxy-2.3.8-tribromo-1.4-naphthoquinone), obtained by the action of bromine on juglone in hot acetic acid solution, is a brilliant red compound and constitutes a naphthalene dyestuff of a new type. Its sodium salt, readily prepared by shaking its ethereal solution with aqueous sodium carbonate, is an indigo blue compound and dyes silk a fine champagne colour and wool a tan colour, which may be modified by the use of mordants; in both cases the colour is fast against washing and ironing and fades only after long exposure to a southern light. Cotton requires a mordant and, when tannin is used in this capacity, assumes an ecru colour. According to its constitution, juglone itself should act as a dye, but attempts to prepare its sodium salt resulted in its oxidation, whilst careful halogenation of juglone in the cold yields an unstable additive compound. (See also J. Chem. Soc., 1919, i., 490.)—T. H. P.

p-Aminoazobenzene; Titration of ——. F. Neitzel. Chem.-Zeit., 1919, **43**, 472.

ONE grm. of the substance is dissolved in 100 c.c. of alcohol and 5 c.c. of hydrochloric acid (sp. gr. 1·19) and the solution is titrated with *N*/1 nitrite solution, using iodide-starch paper as an external indicator.—W. P. S.

Lakes from the glucosides of natural colouring matters used in printing and dyeing; Manufacture of ——. J. Zubelen. Bull. Soc. Ind. Mulhouse, 1919, **84**, 511—512.

THE colouring matter of Persian berries is xanthorhamnin, a glucoside which is hydrolysed by boiling dilute acids, giving an insoluble colouring matter, rhamnetin, together with rhamnose. Lakes are produced by decomposing the glucoside by heating with salts of acid reaction at a regulated temperature. The following procedure is described: The berries are extracted to form an infusion having a density of 2°—3° B. (sp. gr. 1·013—1·020), solutions of salts of tin and aluminium are then added, and the liquor is neutralised with 300 litres of caustic soda solution. The ingredients required are: 300 kilos. of Persian berries, 90 kilos. of tin salt, 15 kilos. of potash alum, and 31 kilos. of caustic soda. If the neutralisation be performed at 50° C., immediately after the addition of the mordants, no rhamnetin is produced and the canary yellow lake corresponds to xanthorhamnin. By operating at 100° C., some rhamnetin is formed and the lake has an orange shade. By working between 50° and 100° C., and allowing the acid salts to react for a quarter of an hour before neutralising, shades ranging from canary yellow at 50° to deep orange at 100° C. may be obtained, according to the proportion of rhamnetin produced. Similar results have been obtained with quercitrin.—J. F. B.

PATENT.

Picric acid. Eng. Pat. 130,382. *See* XXII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Fibre board; Impact tester for ——. E. O. Reed and F. P. Veitch. Paper, 1919, **24**, 923—926.

THE serviceability of fibre board for containers and wall boards is largely dependent on resistance to impact, and the indications of the usual bursting test machine are not quite relevant to the purpose in view. Moreover, corrugated board is crushed when clamped in a bursting strength machine and the results are still less a measure of the serviceability of such composite board. The authors have devised an impact tester somewhat on the lines of that used for testing samples of cement

and rock. The clamping plate is 5×7 in., and owing to this large area the board may be firmly clamped with light pressure without crushing. The hole in the clamping plate and base of the machine is 8 cm. in diameter and the plunger, which is dropped from an adjustable height, weighs 1 kilo. and has a spherical end 2 cm. in diameter. The height of the drop necessary to break through the board to the shoulder on the plunger is determined by a series of trials and is taken as the impact test. There is no relationship between the results of the impact test and those of the bursting test as indicated by the Mullen tester, and it is suggested that the impact test might be instituted as the standard test for framing specifications. The divergence between impact and bursting tests is greater in the case of corrugated boards than with solid boards, the corrugated boards showing relatively better results against impact.

—J. F. B.

Cellulose; Reactions of ——. Development of oxycellulose in papermaking. F. B. Seibert and J. E. Minor. Paper, 1919, 24, 1007—1012.

In the course of the prolonged beating of unbleached sulphite pulp chemical changes occur which are shown by a progressive increase in the "copper value" of the pulp. This increase is attributed to hydrolysis and oxidation of the cellulose owing to the hydration of the fibre and its prolonged exposure to the air, and does not take place to the same extent when the fibre is rapidly cut up, for instance, in a Jordan refiner. A break in the regularity of the increase in the copper value is noted immediately after the addition of a basic dyestuff, at which point a sharp fall in the copper value takes place, but the loss is again made up by further changes occurring during the subsequent beating. The influence of basic dyestuffs is accounted for by their chemical reaction with the lignin. During the process of washing after bleaching there is a progressive decrease of the copper value, showing that the removal of soluble oxidisable products by washing takes place more rapidly than the formation of such products due to the beating; when washing is stopped the copper value begins to increase. The copper value increases considerably during the process of bleaching, but the increase does not correspond with the quantity of bleach liquor until a large excess of bleach liquor has been used. The loss of weight of the pulp apparently varies directly with the amount of bleach liquor used, but it is not excessive even when the proportion of bleach liquor is high. A distinct advantage in the quality and feel of the paper is derived from the use of a substantial amount of bleach liquor and the loss of strength of the paper is barely appreciable. On the other hand with a large excess of bleach liquor, sufficient to increase the copper value of the pulp to an abnormal extent, especially if kept warm, the destruction of the fibres is very pronounced.

—J. F. B.

Cellulose acetate. G. Barr and L. S. Bircumshaw. Advisory Committee for Aeronautics, Reports and Memoranda, No. 303. 12 pages. (Price 2d.)

I. Determination of the copper number of cellulose acetates.—The cupric-reducing value of cellulose acetate is supposed to indicate the extent of the depolymerisation suffered by the cellulose molecule in the process of conversion into acetate, and hence should afford a measure of the chemical quality and mechanical and physical resistance of the acetylated product. The authors show that the results are extremely variable according to the conditions adopted for the test. The methods generally adopted allow half an hour for digestion with water in order to wet the material thoroughly, one hour with diluted Fehling's solution on the top of the water-bath to saponify the ester and to start the reduction, and finally, 10 minutes' boiling to complete the reduction. By omitting the boiling and by digesting for one hour in the boiling water-bath, results are considerably lower but far more consistent between duplicate tests. The fineness of division of the cellulose acetate taken for the test influences the result, higher copper values being obtained with the finer material. It is concluded that the results of the Fehling test must be interpreted with caution and comparisons may only be made between values determined under rigorously identical conditions. Later experience has confirmed the view that this test is of little quantitative value in the valuation of cellulose acetates. While it is true that degraded acetates have high cupric-reducing values, the method is too gross and the indications are too erratic for useful work. *II. Report on examination of two samples of cellulose acetate.*—An abnormal sample of cellulose acetate of Swiss manufacture was compared with a normal sample of French make. The Swiss sample contained a high proportion of sulphuric acid combined in the form of an acetosulphate, which rendered the product unstable. The occurrence of these unstable acetates was, however, exceptional, even at the time (June, 1916) when this investigation was made, and such inferior products are not to be found at the present day. *III. Decomposition of a dope on storage.*—A cellulose acetate dope, prepared in 1915 and containing both tetrachloroethane and carbon tetrachloride, was found to have deposited a large cake of white insoluble material after storage for two years. This material on analysis showed the composition of a degraded cellulose acetate, having an acetyl value of only 17·84 %, as compared with 40·63 % for the normal acetate; the copper value showed 17·01%, as compared with 6·55%. Hence it is probable that the decomposition of the cellulose acetate in the dope was due to hydrolysis by acidity. Since a similar dope containing tetrachloroethane but no carbon tetrachloride was apparently unchanged during storage, it would appear that the use of carbon tetrachloride in dopes is to be regarded with considerable suspicion.—J. F. B.

American pulp woods. O. Kress, S. D. Wells, and V. P. Edwardes. Paper, 1919, 24, 914 - 922.

An account is given of all the species of American woods which have been tested in the Forest Products Laboratory, showing weights per solid cub. ft., lengths of ultimate fibres, yields of pulp by sulphite and sulphate process, bleaching qualities, character and uses of pulps. The more important species of coniferous woods are: Black spruce (*Picea mariana*), excellent for sulphite and sulphate pulps; blue spruce (*P. parryana*), ditto; Engelmann spruce (*P. engelmanni*), ditto, also for mechanical pulp; red spruce (*P. rubens*), ditto; length of fibre 3·7 mm.; Sitka spruce (*P. sitchensis*), excellent for sulphite and sulphate, length of fibre 3·5 mm., mechanical pulp slightly greyish; white spruce (*P. canadensis*), the standard sulphite pulp wood of America, sulphate pulp of highest quality, mechanical pulp excellent, fibre length 2·8 mm.; Alpine fir (*Abies lasiocarpa*), excellent sulphite, sulphate, and mechanical pulps, equivalent to spruce; Amabalis fir (*A. amabalis*), sulphite pulp fair strength, sulphate excellent, mechanical excellent strength, slightly greyish; balsam fir (*A. balsamea*), all pulps excellent, almost as good as spruce; grand fir (*A. grandis*), sulphite pulp fair strength, other pulps equivalent to spruce; noble fir (*A. nobilis*), sulphite pulp poor strength, sulphate good, mechanical excellent; red fir (*A. magnifica*), sulphite pulp good but hard to bleach, sulphate pulp good, mechanical fair; white fir (*A. con-*

color), all pulps good; Douglas fir (*Pseudotsuga taxifolia*), sulphite pulp poor colour, few uses, sulphate pulp fairly strong; hemlock (*Tsuga canadensis*), sulphite pulp fair, sulphate good, mechanical fair; Western hemlock (*Tsuga heterophylla*), sulphite and sulphate pulps good, mechanical greyish; tamarack (*Larix laricina*), sulphite pulp strong but difficult to bleach, coarse, sulphate pulp good, mechanical fair; Western larch (*Larix occidentalis*), ditto; Jack pine (*Pinus divaricata*), sulphite pulp useless, sulphate excellent, mechanical rather poor; loblolly pine (*P. taeda*), sulphite pulp fair, sulphate strong but coarse, mechanical poor; lodgepole pine (*P. murrayana*), sulphite good, sulphate excellent, mechanical good but pitchy; longleaf pine (*P. palustris*), sulphite unsuitable, sulphate good. The other varieties of pine are practically useless for sulphite pulps, but give excellent or good sulphate pulps; white pine (*P. strobus*) and yellow pine (*P. ponderosa*) give mechanical pulps of medium quality.—J. F. B.

Lignin; Acetyl content of ——. H. Pringsheim and H. Magnus. Z. physiol. Chem., 1919, **105**, 179—186.

THE acetic acid formed from wood products on treatment with caustic alkalis arises chiefly from the lignin, but a small fraction may be formed from the cellulose. The lignin of hornbeam wood contains nearly twice as much acetyl as that of pinewood. (See further J. Chem. Soc., 1919, i., 473.)—J. C. D.

PATENTS.

Bags for propellant explosives; Fabric for use in the manufacture of ——. W. H. Albrecht, Leeds. Eng. Pat. 130,410. (Appls. 2814, 18.2.18, and 13,251, 15.8.18).

BAGS for propellant explosives are made of cotton yarn or thread, which prior to weaving has been passed through a bath of animal size or starch and then impregnated with magnesium sulphate or other slightly fireproofing material, and dried. Or the woven fabric may be passed through a weak solution of starch, dried, and subsequently passed through a solution of rubber and chlorine in petroleum spirit, with the object of preventing its smouldering while in use. Or the woven fabric may be converted by any of the usual methods into an explosive of low power, so that when used in the gun it will completely disappear.—C. A. M.

Dopes, varnishes, coatings or plastic films with an acetone-soluble cellulose acetate basis; Production of ——. J. Grolea, Suresnes, and J. L. Weyler, Paris. Eng. Pat. 123,712, 31.7.18. (Appl. 12,456/18.) Int. Conv., 25.2.18.

NEUTRAL tartaric and citric esters of *n*-butyl, isobutyl, and iso-amyl alcohols are added to solutions of cellulose acetate in volatile solvents, such as acetone or methyl acetate. The addition of these plastifying agents gives a transparent film which does not change under atmospheric influence.
—L. L. L.

Cellulose acetate solutions; Production of ——. Cellon, Ltd., T. Tyrer and Co., Ltd., and T. Tyrer, London. Eng. Pat. 130,402, 15.2.18. (Appl. 2754/18.)

To solutions of cellulose acetate in the usual mixtures of volatile solvents and diluents, a small proportion of cyclohexanone or other cyclic ketone is added in quantities less than the amount of cellulose acetate present. For instance, the addition of 0·25 gall. of cyclohexanone to 300 galls. of dope containing 200 lb. of cellulose acetate is sufficient to prevent the dope from drying white.—J. F. B.

Acetylcellulose. W. J. Stevenson, London. Eng. Pat. 130,029, 30.11.17. (Appl. 19,049/17.)

BLEACHED sulphite wood pulp is used as the cellulose basis in the manufacture of acetylcellulose. A mixture of sulphite cellulose, 1 part; glacial acetic acid, 2·8; acetic anhydride, 4·0, and zinc chloride, 0·2 parts is digested at 60°—70° C. for 7—8 hours.
—J. F. B.

Cellulose; Process for the production of new derivatives of ——. P. E. C. Goissedet, Paris. Eng. Pat. 130,277, 6.2.19. (Appl. 2911/19.)

CELLULOSE, such as cotton, preferably in the dry condition, or cellulose derivatives containing hydroxyl groups, is made to react with an aliphatic or aromatic isocyanic ester, with or without the addition of a tertiary base or bases, to produce carbamic esters, which can be used for the same purpose as other cellulose esters. Thus, dried cellulose may be heated with about three times its weight of phenyl isocyanate or other isocyanic ester, in presence of anhydrous pyridine (which promotes the reaction and acts as a diluent), and the resulting phenylcarbamic ester is isolated by pouring the mass into water.—C. A. M.

Cellulose; Process of making ——. B. Loomis, Assignor to G. L. Loomis, Hartford, Conn. U.S. Pat. 1,311,980, 5.8.19. Appl., 1.11.16.

SHREDDED green plant material is macerated below the boiling point in a closed chamber, the liquid is circulated through the material, the extract run off, fresh water and an alkaline reagent are added, and the temperature raised to about 212° F. (100° C.) to dissolve resinous matter, whereby cellulose of strong fibre is produced.—L. L. L.

Paper-stock; Method of removing printers' ink from —— . T. Jespersen, Neenah, Wis. U.S. Pat. 1,311,563, 5.8.19. Appl., 11.12.16.

THE waste paper stock is treated with calcium hydroxide.—L. L. L.

Moistening of paper and the surfaces of other materials with saturated magnesium chloride, or other similar solution. L. Elkan Erben, G.m.b.H., Berlin. Ger. Pat. 312,355, 23.12.17.

THE addition of small quantities of ethereal oils such as turpentine, menthol, etc., to magnesium chloride or similar concentrated solutions of hygroscopic salts, increases their moistening properties and facilitates the penetration of the surface wetted by them.—G. F. M.

Emulsions for sizing; Mixing and atomising devices employed in the production of ——. A. E. Leicester, Chester. Eng. Pat. 130,235, 1.11.18. (Appl., 17,875/18.)

THE atomising device comprises a steam injector having a flared delivery cone provided throughout its length with internal spiral grooves and at its discharge end with a ring of spiral vanes which may be arranged in line with and/or between the spiral grooves. The vanes, which may be radial, curved, or tangential, are conveniently formed on a ring which fits into the discharge end of the cone.—J. F. B.

Washing and cleaning; Process of ——. M. Buchner, Hannover-Kleefeld. Ger. Pat. 312,220, 23.2.15.

MATERIALS of any sort to be washed are treated with aqueous inorganic gel-forming colloids, such as aluminium hydroxide, magnesium hydroxide, ferric hydroxide, manganese hydroxide, or silicic acid. Gelatinous aluminium hydroxide, for example, produced by precipitation with ammonia from dilute solutions of aluminium salts, forms emulsions with fats, oils, or hydrocarbons; it is miscible in almost

all proportions with petroleum and its distillates, vaseline, fats, and carbon tetrachloride, and the emulsions are not destroyed even by large quantities of water. The gelatinous colloid rapidly removes dirt from the skin, from fabrics, and from wood or metal utensils.—G. F. M.

Sizing of paper. H. Wandrowsky, Berlin. Ger. Pat. 312,594, 6.8.18.

By double decomposition an insoluble metallic aluminate is deposited on the fibre of the paper, *e.g.*, during the treatment in the hollander; thus, for example, a deposit of magnesium aluminate is obtained by the successive addition of potassium aluminate and magnesium sulphate to the paper pulp.—G. F. M.

Sulphite liquor products and process of producing same. Binding and adhesive substance, tanning agent and the like. Briquet and process of manufacturing the same. C. Ellis, Montclair, N.J., Assignor to Ellis-Foster Co. U.S. Pats. (A) 1,311,215, (B) 1,311,216, (C) 1,311,217, (D) 1,311,218, (E) 1,311,219, (F) 1,311,220, (G) 1,311,221, (H) 1,311,222, 29.7.19. Appl., (A) 13.7.13. Renewed 13.6.18, (B) 22.6.17, (C) 8.5.17, (D) 27.8.17, (E) 12.5.17, (F) 13.11.17, (G) 22.6.17, (H) 16.8.17.

(A) A BINDER is composed of strongly acid sulphite cellulose liquor solids in a non-fluent form, soluble in water, stable on exposure to air while the solids are in the dried condition, and becoming gradually insoluble when subjected to a protracted exposure to air in the presence of moisture. (B) A binder is composed of solid, oxidised constituents of waste sulphite cellulose liquor which has its normal acidity reduced about one-half. (C) Sulphite cellulose liquor is partially neutralised, then evaporated to a solid mass and comminuted. (D) Normally acid sulphite cellulose liquor is treated with a quantity of alkaline substance insufficient to neutralise the liquor, and the product is evaporated by atomising in the presence of oxygen to form a solid binder. (E) An acid binding agent is prepared by dissolving the desiccated solids of sulphite cellulose liquor in water, the composition being characterised by having a viscosity at least 10% lower than that of ordinary concentrated sulphite cellulose liquor of the same density. (F) A dry mixture of acid solids of sulphite waste liquor and lime. (G) Briquettes or other moulded articles are made by incorporating a bulking material and a binding agent comprising atomised, dried, slightly oxidised, water-soluble solids of sulphite cellulose liquor, moulding, and converting the solids of the binder into an insoluble form. (H) Dried, powdered sulphite cellulose liquor solids are incorporated with an agent capable of rendering them insoluble, a waterproofing agent, water, and a material to serve as a filler, and then shaped.—J. F. B.

Waste sulphite liquors; Treatment of ——. O. W. Willcox, Dover, N.J. U.S. Pat. 1,312,293, 5.8.19. Appl., 8.9.15.

THE fermented waste liquor is preheated by means of the hot raw liquor from the digester and also by the hot spent liquor from the still, the liquor entering the still approximately at the distillation temperature.—L. L. L.

Artificial fuel. U.S. Pat. 1,313,876. *See* IIA.

Impregnation of porous materials. **Eng. Pat. 130,731. *See* XV.**

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Cotton; Use of strontia instead of lime in the bleaching of ——. R. Weiss. Bull. Soc. Ind. Mulhouse, 1914, 84, 499—506. (Sealed communications deposited 28.5.02 and 23.6.02.)

A COMPARISON of the three alkaline earths was made by boiling cotton fabrics contaminated with oil stains. The saponifying power of baryta was found to be inferior to that of lime, but strontia, in equimolecular proportions, was found to saponify the oils three times more rapidly than lime, and the bleaching effects were superior. The maximum concentration of the boiling liquor is fixed at 20 grms. of the hydrate $Sr(OH)_2+8H_2O$ per litre, since stronger solutions have an oxidising action; strontia absorbs carbon dioxide from the air more rapidly than lime. The proposed bleaching process may be performed in cages. The goods are run through the solution of strontia, packed in the cages, boiled (8—9 hours), rinsed in the kier, soured by transferring the cage to the souring vat, re-boiled in old liquor, again soured, lightly boiled in a caustic-sodium carbonate liquor with soap, soured, and washed. A good colour is obtainable without the use of bleaching powder. A superior result is obtained by boiling with a mixed liquor containing 7 grms. of sodium hydroxide and 10—12 grms. of hydrated strontium hydroxide per litre. The goods are boiled for two hours at a temperature below 150° C., soured, rinsed, and re-boiled in a liquor containing soda ash and soap or rosin, at a moderate temperature to avoid yellowing. A report by E. E. Gillieron on the above communications states that the practical application of the process presents two serious drawbacks: the cost of strontia and the danger of tendering the goods, and the process is only useful under certain exceptional circumstances. J. F. B.

Lakes from glucosides of natural colouring matters. Zubelen. *See* IV.

PATENTS.

Dyeing, bleaching, washing and the like, yarn and the like in hank; Machine for ——. L. G. Macintyre, Broughty Ferry, N.B. Eng. Pat. 129,532, 4.10.18. (Appl. 16,149/18.)

THE hanks are loosely hung on rotating rollers or reels which are led by endless conveyer chains over tanks in which the hanks are treated, means being provided by which the direction of rotation of the hanks is reversed when passing through the liquid. The immersion of the hanks, their movement through the liquid for thorough treatment, their withdrawal, and the expression of liquid from them are performed automatically; successive operations are performed in separate tanks, the passage of the hanks from one tank to another being carried out automatically.—L. L. L.

Impregnating fabrics; Apparatus for ——. J. E. and P. D. Thropp, Assignors to The De Laski and Thropp Circular Woven Tyre Co., Trenton, N.J. U.S. Pat. 1,312,878, 12.8.19. Appl., 23.5.17.

THE fabric passes from an airtight chamber downwards through an inclined conduit which dips into a tank containing the impregnating material. The fabric then passes under a roller in the tank and vertically upwards to a series of drying rollers.

—W. F. F.

Dyeings on vegetable fibres; Production of fast ——. F. V. Kallab, Offenbach. Ger. Pat. 312,583, 5.4.17.

VEGETABLE fibres, *e.g.*, in the form of yarn or tex-

tiles, are treated in a dry state at a temperature of 40°—80° C., in a bath containing gelatin or glue, a "softening" material, such as glycerin, glycerin substitute (glycol, alkali lactates, etc.), sugar, molasses, or starch syrup, etc., and the dyestuff, which is generally a fast wool dye, and preferably one which is used direct in an acid bath. After this treatment the gelatin is hardened in the usual way with formaldehyde, and the goods are systematically dried and softened by calendering. The process is particularly useful for bookbinder's linen and calico, and also for unsized paper.—G. F. M.

Textile fibres and fabrics and other porous or absorbent substances; Treatment of —— to render same less inflammable. P. Spence and Sons, Ltd., and T. J. I. Craig, Manchester. Eng. Pat. 130,461, 31.7.18. (Appl. 12,442/18.)

The material is impregnated with sodium aluminate and is then treated with carbon dioxide in a prepared atmosphere, preferably in presence of moisture, at a temperature that will not injure the material, and at a pressure substantially higher than that necessary merely to cause the gas to permeate the material. For example, the temperature may be 105° C. and the pressure 10—20 lb. per sq. in., applied for 30 mins. The material is then washed and dried. The sodium aluminate may be applied as a single solution of sp. gr. 1·13, or first a solution of sp. gr. 1·1 is used, and following the carbon dioxide treatment the material is impregnated with a solution of sp. gr. 1·08 and again submitted to the treatment.—L. L. L.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Lifting sulphuric acid; Methods of ——. S. J. Tungay. Chem. Age, 1919, 1, 326—328.

By far the largest item in the cost for power in the manufacture of sulphuric acid is that for lifting acid to the top of the towers. Until recently, compressed air has been chiefly used for this purpose, and has been found inefficient. Many types of plunger pump have been tried without much success, and it was only the introduction of acid-resisting iron that enabled the problem to be solved by use of this material for the construction of centrifugal pumps for acids. One great advantage of this type of pump is the absence of valves. The difficulty of leakage through the glands was overcome by connecting them with the suction of the pump so that they were never under pressure when the pump was working. These pumps were effective for pumping up to 35—40 feet, but the modern trend of acid plant design requires that acid may be pumped up to as much as 150 feet. Multiple-stage centrifugal or turbine pumps have been found to solve the problem. There is only one gland, and that is under suction as soon as the pump starts, and the pressure of the rising column of liquid is taken by an enclosed ball-thrust bearing at the opposite end of the shaft. The author gives tables showing the output and power consumption of various types.—W. H. C.

Ammonia recovery; Formation of Prussian blue in ——. A. Thau. Glückauf. Gas World (Coking Sect.), 1919, 71, 93.

The blue coloration of ammonium sulphate is due to the presence of Prussian blue, which is most frequently formed in distillation ammonia recovery processes. It is generally accepted that its formation is due to the existence of neutral zones in the saturator, leading to precipitation of ferrous sulphide, which then reacts with gaseous cyanogen compounds. Violent agitation or high acid content in the saturator is often sufficient to prevent local alkalinity, but even under these conditions blue salt may be obtained, especially just after starting up. Prussian blue may be formed before entering the saturator, the hydrogen sulphide in the vapours acting on the exposed iron parts of still and connections. Decrease in the concentration of hydrogen sulphide, or increased steaming, retards the formation of ferrous sulphide. Coating the interior with lead prevents the formation in the delivery pipe. When shutting down the still the flow of liquor should first be stopped, and after a little while steam should be passed in order to drive over any hydrogen sulphide left in the column. The still should be well steamed before starting the feed of liquor. Preheating the ammonia liquor is also advised to raise the temperature of the still head, thus reducing the condensation of water vapour here to a minimum.—W. P.

Ammoniacal liquor; Analysis of ——. Fifty-fifth annual report (1918) on alkali, etc., works by the Chief Inspector, 53-74.

The quantitative determination of the respective constituents of ammoniacal liquors has been reinvestigated, more particularly with a view to testing the accuracy of the procedure recommended by Colman and Yeoman (this J., 1918, 319—324 T). Feld's method for the estimation of cyanide by distillation with lead nitrate gives low results if free ammonia co-exists in the solution with thiosulphate. Moreover, the interaction of ammonium polysulphide and cyanide in the analysis of concentrated liquor is slow, and conversion of cyanide into thiocyanate apt to be incomplete unless a decided excess of polysulphide (or conversely of cyanide) be present. Investigations of the stability of solutions of ammonium ferrocyanide, cyanide, sulphide, and thiosulphate show that loss of ammonia and cyanogen accompanies the boiling of a ferrocyanide solution. A solution of sodium ferrocyanide suffers no decomposition on boiling. Sodium cyanide in solution suffers little change on boiling, in absence of free ammonia. No loss of cyanogen occurs on boiling a solution of ammonium thiocyanate *in vacuo* at 40°—45° F. (4°—7° C.). Ammonium thiocarbonate is unstable and is readily converted into thiocyanate. Details are given of experiments to determine the amount of such conversion under various conditions. Thiocarbonate is not completely removed by treatment with lead carbonate in presence of strong ammonia. The conversion of ammonium thiocarbonate into ammonium thiocyanate at 80°—90° C. is retarded by the presence of ammonium polysulphide, and is about 50% of that effected in the absence of polysulphide. An approximate measure of the amount of thiocarbonate present can be obtained by digesting the sample in absence of air and with addition of free ammonia, if necessary, at 80°—90° C., with subsequent removal of sulphide by shaking with lead carbonate. Estimation of thiocyanate in concentrated ammonia liquor is subject to interference owing to the solubility of thiocarbonate on shaking with lead carbonate in the presence of free ammonia. With concentrated liquor it might be found possible to apply a colorimetric method for the estimation of thiocyanate, where thiocarbonate is present, based on the procedure of Spielmann and Wood (this J., 1919, 43 T). The method of Colman and Yeoman for the estimation of cyanide in concentrated liquor (this J., 1918, 322 T) yielded results which were invariably low when thiosulphate was present. This was due to the decomposition of lead thiosulphate on distillation, free sulphur being produced and reacting with cyanide and lead oxide to form non-volatile thiocyanate. The procedure has been modified to avoid such fixation of cyanide, and the modified method involves the use of aluminium chloride. When ferrocyanides are present, addition of sodium car-

bonate is necessary to remove excess of aluminium chloride prior to addition of lead nitrate and distillation with caustic soda. In the case of concentrated liquor it is desirable to expel the bulk of ammonia by boiling with caustic soda prior to addition of the aluminium salt. Details are given of the application of the modified procedure to the estimation of cyanogen compounds in ammoniacal liquors of ordinary and concentrated strengths respectively, in the presence of free ammonia, and when sulphide or thiocarbonate is present in addition.—J. S. G. T.

Ammonia-oxidation process; Determination of yield in the ——. J. Baumann. Chem.-Zeit., 1919, **43**, 466.

THE method described consists in determining the amounts of free and combined nitrogen before and after the gases have passed through the contact chamber, the yield or efficiency being calculated from the results obtained.—W. P. S.

Sodium carbonate; Conditions for obtaining pure —— for standardising acid, and application of crystallised oxalic acid as a standard for titration. H. Kunz-Krause and R. Richter. Arch. Pharm., 1917, **255**, 540-549.

WHEN heated in a crucible and stirred with a platinum wire, so that all portions of the contents of the crucible are brought into contact with the air, sodium hydrogen carbonate is converted quantitatively into the normal carbonate at a temperature of 250° C. Microcrystalline oxalic acid ($+2H_2O$) as sold "for analysis," may be weighed out directly for preparing standard acid. Concentrated oxalic acid solution, and even the $N/1$ solution, remain long unchanged, but it is advisable to protect the $N/10$ and also the $N/1$ acid from the action of light; bottles of common green glass serve well for this purpose, whilst those of blue, brown, or yellowish-brown glass often afford no greater protection than those of colourless glass.—T. H. P.

Carbide conversion calculations. I. E. Knapp. Chem. and Met. Eng., 1919, **21**, 139—140.

NEGLECTING the small quantities of free carbon and sulphur in crude carbide from the furnace, the reaction between lime and carbon in carbide manufacture may be represented by the equation

$$CaO+3C=CaC_2+CO.$$

On this basis the furnace product will only contain calcium carbide, coke ash, lime impurities, and unchanged lime. Representing the decimal fraction of fixed carbon in the coke by A, of ash in the coke by B, of CaO in the lime by C, and of the loss on ignition of the lime by D, then $1-A-B$ = moisture + volatile + sulphur in the coke and $1-C-D$ = the impurities in the lime. If E represents the efficiency of conversion, the total weight of CaC_2 in the furnace product will be $64E$, with similar expressions for other constituents of the charge, and the total furnace product

$$F=64E+36B/A+56\,(1-C-D)/C+(1-E)\,56. \quad (1).$$

The purity of the carbide (P) $=64E/F$, and substituting this expression for F in the above equation,

$$E=P\{36B/A+56\,(1-C-D)/C+56\}\div(64-8P). \quad (2).$$

In practice the proportion of carbon used may exceed the theoretical, and the necessary factor in place of 36 is applied. The maximum purity which can be obtained from given raw materials may be calculated by making $E=1$ in equation (2) and solving for P.—C. A. K.

Iodine; Reaction of thiosulphate with ——. I. M. Kolthoff. Pharm. Weekblad, 1919, **56**, 572—585.

IN neutral or acid solution the reaction between iodine and thiosulphate is:—

$$2Na_2S_2O_3+I_2=Na_2S_4O_6+2NaI.$$

In weakly alkaline solution part of the thiosulphate is oxidised directly to sulphate without the intermediate formation of tetrathionate. In strongly alkaline solution all the thiosulphate may be oxidised to sulphate.—W. S. M.

Mineral-forming agents; Theory of magmatic ——. J. Jakob. Z. anorg. Chem., 1919, **106**, 229—267.

THE theory is advanced that the chemical processes in magma are determined by the presence of certain agents which have been termed "mineralisators" (mineral-forming agents). The chief of these agents is water, which acts in virtue of its ready ionisability, its great solvent power, and its capacity for entering into the composition of many complex co-ordinated compounds. Such co-ordinated compounds are considered to play an important part in mineral formation, and the structure of many minerals can be explained by formulæ of the co-ordinated type. Other important mineral-forming agents are hydrogen sulphide, hydrogen fluoride, carbon dioxide, sulphur dioxide, besides the oxides of a number of the less common elements such as titanium, vanadium, tungsten, etc. These agents probably play as important a part in rock metamorphosis as in actual rock formation.—E. H. R.

Hydrogen; Iron ores for the preparation of ——. A. von Skopnik. Chem.-Zeit., 1919, **43**, 481—482.

EXPERIMENTS with roasted pyrites as a contact material for the preparation of hydrogen showed that Spanish and Swedish ores are suitable for the purpose; they withstand changes of temperature without disintegrating and retain their efficiency for a considerable period. Hungarian ores are quite unsuitable, since they disintegrate rapidly both in the open air and in the furnace. A defect, which interferes with the use of roasted pyrites, lies in the fact that the porous surface is liable to fusion; a fused silicious glaze may also form on the surface of the lumps.—W. P. S.

Filtration. Fabre. *See* I.

Ammonium sulphate by "direct process." See IIA.

Ammonia in shale etc. distillates. Nicolardot and Baurier. See IIA.

Ammonia-fixing by calcium sulphate. Bear and Workman. *See* XVI.

Mercury salts. Utz. *See* XX.

Estimation of phosphoric acid. Balareff. *See* XXIII.

PATENTS.

Sulphuric acid; Production of ——. K. B. Quinan, Somerset West, S. Africa. Eng. Pat. 130,712, 17.5.18. (Appl. 8322/18.)

IN producing sulphuric acid by the use of nitric oxide, without lead chambers, the gaseous reactions and the interactions of gases with liquids are carried out in separate units. This localisation ensures better control of temperature and composition and provides the best conditions for contact. For the interaction of the gases with liquids, the latter are distributed over a permeable diaphragm, forming a layer through which the gases pass, percolation of the liquid being at the same time largely prevented. (See also Eng. Pats. 29,568 of 1912 and 28,743 of 1913; this J., 1913, 1109; 1915, 226.)—W. J. W.

Sulphuric acid; Contact process for making ——. H. H. Meyers, Pittsburgh, Pa., Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pat. 1,314,280, 26.8.19. Appl., 26.6.18.

SULPHUR trioxide and a soluble double sulphate of potassium and aluminium are produced simul-

taneously by bringing a mixture of sulphur dioxide and oxygen into contact with alunite at a temperature suitable for catalytic oxidation.—W. J. W.

Nitre-cake; Process of making salt-cake and sulphuric acid from ——. W. J. Kee, Assignor to Kalbfleisch Corporation, New York. U.S. Pat. 1,313,192, 12.8.19. Appl., 19.9.18.

NITRE-CAKE is heated so that it evolves sulphur trioxide and forms salt-cake. Solid sodium sulphate is then added to cause solidification of the mass.
—W. J. W.

Acid concentrating apparatus. J. Patten, Baltimore, Md. U.S. Pats. (A) 1,286,080, and (B) 1,286,188, 26.11.18. Appl., 19.4.17, and 28.11.17. (A) Renewed 26.8.18.

(A) THE apparatus is intended specially for concentrating sulphuric acid which has been diluted by the absorption of water vapour in a vacuum ice-making apparatus. The acid is circulated through several chambers in series in which it is heated by steam coils while maintained under vacuum. The acid containers are provided with lead linings having special supporting means at the top to avoid buckling, and means are also described for connecting the liners with the corresponding liners of the vapour space at the top of the containers to permit relative movement due to expansion. (B) In the apparatus described in (A) the bottoms of the lead liners of the acid containers are supported by a central circular plate surrounded by a series of sector plates mounted on rollers to permit slight radial movement. The method of connecting the conduits to the successive lead containers is described.—W. F. F.

Nitric acid; Production of ——. K. B. Quinan, Somerset West, S. Africa. Eng. Pat. 131,029, 27.3.18. (Appl. 5397/18.)

IN the manufacture of nitric acid by oxidation of nitrogen or ammonia, oxides of nitrogen are absorbed by water, which is distributed over permeable diaphragms, through which the gases pass without appreciable percolation of the liquid. The gaseous reactions take place in chambers of such a volume as to give sufficient time for the reaction. Improved control of temperatures and lower cost of plant as compared with towers are claimed. A description of the plant is given.—W. J. W.

Nitric acid; Concentrating —— and apparatus therefor. J. D. Davis, Washington, D.C. U.S. Pat. 1,314,485, 26.8.19. Appl., 8.8.18.

DILUTE nitric acid is preheated and allowed to flow down a suitably packed tower, at the base of which are introduced nitrous gases at a temperature above 300° C.—W. J. W.

Chlorosulphonic acid; Manufacture of ——. Clayton Aniline Co., Ltd., A. Schedler, and E. N. Marchant, Manchester. Eng. Pat. 131,024, 25.3.18. (Appl. 5199/18.)

SULPHUR trioxide is caused to react with dry hydrogen chloride. The latter is obtained cheaply as a by-product of the chlorination of organic compounds. If these are volatile, traces carried away by the hydrogen chloride are recovered by passing this through the chlorinated product and then passing the purified gas into oleum.—W. J. W.

Phosphoric acid; Process of making ——. I. Hechenbleikner, Assignor to Chemical Construction Co., Charlotte, N.C. U.S. Pat. 1,313,379, 19.8.19. Appl., 9.6.19.

PHOSPHORIC acid is prepared by treating phosphate rock with a mixture of dilute hydrofluosilicic and hydrofluoric acids.—L. A. C.

Chemical syntheses [production of ammonia] taking place under pressure and at a high temperature; Process of effecting exothermic ——. *Process of effecting exothermic chemical syntheses.* L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit des Proc. G. Claude, Paris. Eng. Pats. (A) 130,086, 17.1.18. (Appl. 1007/18.) Int. Conv., 31.3.17, and (B) 130,087, 18.1.18. (Appl. 1072/18.) Int. Conv., 7.8.17.

(A) IN a process for effecting the synthesis of ammonia, and similar reactions occurring under pressure in the presence of a heated catalyst, the pressure employed is greater than 500, and may exceed 2000 atmospheres. The catalyst is contained in an enclosure of low thermal conductivity, the heat of reaction (in excess of that required) being withdrawn as produced through the external surface of this enclosure. (B) As a means of increasing the fall of temperature in the wall of the reaction chamber, the inner surface of the wall is lined with successive rings of asbestos cord supported by a thin metal tube, leaving an annular space around the central thin tube of the enclosure; or the internal surface of the outer thick wall of the enclosure is coated with an enamel which is a bad conductor of heat, does not crack or melt at 600°—700° C., and is not affected by the reacting gases or product.—W. E. F. P.

Ammonia; Synthetic production of ——. E. B. Maxted, Walsall. Eng. Pat. 131,049, 4.4.18. (Appl. 5741/18.)

LOW yields of ammonia, produced synthetically by passing a mixture of nitrogen and hydrogen over a catalyst, may be due to presence of carbon monoxide in these gases. The yields may be increased by first passing the gases over a catalyst which is active for the hydrogenation of carbon monoxide and not appreciably active for formation of ammonia. Nickel is a suitable catalyst, as it may be employed below 450° C. (the temperature at which hydrogen removes carbon from steel) and consequently admits of steel vessels being employed without risk.—W. J. W.

Nitrogen of the atmosphere; Fixation of ——. R. Pearson and H. C. Parkes, London. Eng. Pat. 130,693. (Appls. 4623, 15.3.18, and 11,192, 8.7.18.)

ATMOSPHERIC air is subjected to the action of electric sparks which are caused to pass through or around a suitable catalyst heated to a high temperature (300° C. or more). An increased yield of nitrous acid is thus obtained.—W. J. W.

Metal chlorides; Manufacture of ——. W. Heap, Heaton Chapel, and E. Newbery, Manchester. Eng. Pat. 130,626, 29.1.18. (Appl. 1677/18.)

ANHYDROUS chlorides of aluminium, magnesium, cerium, and the rare earth metals are obtained by the action of carbonyl chloride on the corresponding oxides, carbonates, or oxalates, heated to a suitable temperature, *e.g.*, 350°—400° C. for aluminium, 500°—600° C. for magnesium, and 650° C. for cerium. The carbonyl chloride may be replaced by a mixture of carbon monoxide and chlorine which has been passed over a catalyst (animal charcoal) before reaching the metallic oxide. In the case of aluminium, the chloride which distils over contains double compounds with carbonyl chloride, and is yellow. It is purified by redistillation with calcined alumina. The above process of treatment with carbonyl chloride or its constituents can also be used for dehydrating hydrated chlorides of the above-mentioned metals.—G. F. M.

Chlorides; Manufacture of anhydrous ——. W. Heap, Stockport, and E. Newbery, Manchester. Eng. Pat. 131,039, 2.4.18. (Appl. 5596/18.)

ANHYDROUS metallic chlorides, especially of the

cerium group, are produced by treating the oxide, hydroxide, carbonate, oxalate, etc., with chlorine and producer gas. The advantages of producer gas as a source of carbon monoxide are its cheapness and freedom from hydrogen. Dilution of the gas with atmospheric nitrogen is not detrimental. A catalyst may be employed with advantage. The process is applicable to the dehydration of hydrated chlorides.—W. J. W.

Copper compound for fungicidal purposes; Production of preparations containing colloidal ——. R. Mond, Sevenoaks, and C. Heberlein, London. Eng. Pat. 130,709, 6.5.18. (Appl. 7576/18.)

In spraying mixtures consisting of copper sulphate and an alkali carbonate or bicarbonate, the latter is usually present in at least theoretical proportions for complete precipitation of the copper. Varying results in mixtures containing the same amount of colloidal copper are ascribed to differences in the proportion of hydrosol in the copper compound. To obtain the desirable maximum hydrosol content, the amount of alkali in the mixture should be about 93% of its chemical equivalent, *i.e.*, sufficient to leave neither free copper sulphate nor free alkali carbonate in the mixture. Too little alkali will render the mixture acid and will reduce the hydrosol content. Lime may be added, and a colloid, such as glue, for stabilising the colloidal copper hydrosol.—W. J. W.

Drying powdered material [aluminium hydroxide]. A. C. Jonides, jun., London. Eng. Pat. 130,755, 6.8.18. (Appl. 12,760/18.)

Aluminium hydroxide and like substances are successively dried, freed from combined water, and calcined in a shaft kiln, in which, as the material descends through an annular space of increasing cross-section, it is subjected to zones of varying temperature. The heating is effected by the combustion of a previously made mixture of gas and air under pressure in the requisite proportions, so that no secondary air is required. The kiln is provided with a charging hood having an outlet for the vapour.—W. H. C.

Strontium peroxide; Process for manufacturing ——. J. B. Pierce, jun., Charleston, W. Va., U.S.A. Eng. Pat. 130,840, 26.9.18. (Appl. 15,691/18.)

Strontium peroxide is prepared by the direct combination of strontium oxide with oxygen in a steel autoclave under a pressure of 1500—1800 lb. per sq. in., and at a temperature of 400°—500° C. The product is similar to barium peroxide as regards density, etc., and contains over 85% SrO_2.
—G. F. M.

Sodium permanganate; Manufacture of ——. D. Tyrer, Stockton-on-Tees. Eng. Pat. 130,844, 9.10.18. (Appl. 16,446/18.)

In the manufacture of sodium permanganate from barium manganate, sulphuric is added in such a manner as to ensure the presence of free permanganic acid; a small quantity of barium permanganate may be added to the manganate prior to the treatment with sulphuric acid. Any residual acidity is neutralised by addition of barium hydroxide, the barium permanganate is converted into the sodium salt by means of sodium sulphate, and the solution is evaporated until it solidifies on cooling.—W. J. W.

Ammonium nitrate; Production of ——. C. W. Bailey, H. S. Denny, and A. T. Jefferis, Langwith. Eng. Pat. 131,017, 20.3.18. (Appl. 4877/18.)

Ammonium nitrate is produced by double decomposition of ammonium sulphate and sodium nitrate in presence of water and a bisulphate, in such proportions as to form a solution from which sodium sulphate separates at a high temperature, and ammonium nitrate on cooling without dilation. The process is made continuous by adding further quantities of salts to the mother liquor. Nitre cake may be employed as a source of the bisulphate.
—W. J. W.

Potassium [aluminium] silicates; Process of decomposing ——. S. R. Scholes, Beaver, Assignor to H. C. Fry Glass Co., Rochester, Pa. U.S. Pat. 1,312,053, 5.8.19. Appl., 18.11.18.

A mixture of the finely divided mineral with an alkali carbonate is heated to produce a glass-like mass, and the latter is powdered and digested with water under pressure and at a temperature above 100° C. to dissolve out the combined alkali metal and convert the alumina into the form of a colloid.
W. E. F. P.

Potash and cement; Manufacture of ——. A. C. Spencer, Washington, Assignor to A. Cox, New York. U.S. Pat. 1,312,592, 12.8.19. Appl., 21.8.17.

A calcareous, potassium-bearing silicate mixture is heated to produce nodules of clinker and a fume containing a potassium compound. The clinker is then disintegrated and re-heated to produce a further quantity of fume. W. E. F. P.

[Corrosive] sublimate; Method for preparing ——. E. G. Mooys, Nymegen, Netherlands. U.S. Pat. 1,312,743, 12.8.19. Appl., 18.9.17.

A mixture of mercury with hydrochloric acid and a silicate is heated, and the vapour produced is condensed.—W. E. F. P.

Carbon bisulphide; Method for making ——. H. K. Moore and G. A. Richter, Assignors to Brown Co., Berlin, N.H. U.S. Pat. 1,312,800, 12.8.19. Appl., 24.11.17.

A continuous stream of molten sulphur is fed into a closed chamber in which the liquid is vaporised in contact with heated charcoal. The gaseous product is condensed by direct contact with water, from which the carbon bisulphide is separated continuously. W. E. F. P.

Cyanogen compounds; Process of making ——. L. S. Finch, Dover, N.J., Assignor to Hercules Powder Co., Wilmington, Del. U.S. Pat. 1,312,842, 12.8.19. Appl., 7.10.18.

In a process of forming a cyanogen compound by the reaction of nitrogen with a soluble alkali-metal compound and carbon in the presence of a catalyst, a mixture of carbon which is relatively active and carbon which is relatively inactive but capable of being activated by the active carbon is employed.
W. E. F. P.

Hydrogen from gaseous mixtures; Process for the separation of gaseous mixtures and particularly the extraction of ——. *Process for the manufacture of compressed hydrogen.* L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude, Paris. Eng. Pats. (A) 130,092, 22.1.18. (Appl. 1278/18.) Int. Conv., 16.4.17, and (B) 130,358, 26.1.18. (Appl. 1553/18.) Int. Conv., 9.8.17.

(A) In a process applicable more particularly to the separation of hydrogen from water-gas, coke-oven gas, coal gas and the like, the gaseous mixture under a pressure of from 500 to 2000 atmospheres, and a sufficient quantity of a suitable solvent (*e.g.*, methyl or ethyl alcohol, acetone, benzene, etc.), are caused to circulate through a system in opposite directions and in contact with each other, so that the gas richest in the constituents to be dissolved comes first into contact with the solvent most

highly charged with these constituents, and so on. When saturated, the solvent (in which hydrogen is much less soluble than the other gases) is subjected to diminished—although still much greater than atmospheric—pressure, whereby the dissolved gases are released, and is then returned to the cycle, its re-entrance into the apparatus being effected by the combined pressure of the saturated liquid passing out and a column of mercury. (b) The solvent employed is ethyl ether or other liquid having approximately the same power of dissolving carbon monoxide, the same ratio of solubilities CO/H, and the same temperature coefficient of this solubility ratio. The liquid is used at medium pressures of 50—300 atmospheres and at temperatures between −40° and −60° C., at which latter the ratio of solubilities is considerably increased. Desaturation of the solvent is effected by lowering the pressure to that of the atmosphere in two stages, thus minimising the losses due to vapour tension. —W. E. F. P.

Chlorine; Manufacture of ——. H. H. Meyers, Pittsburgh, Pa., Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pat. 1,311,175, 29.7.19. Appl., 3.7.18.

A GASEOUS mixture containing hydrogen chloride and oxygen is passed through a catalyst of mineral alunite.—C. A. M.

Sulphuric acid; Chamber used in the manufacture of ——. W. G. Mills and C. T. Packard, Assignors to E. Packard and Co., Ltd., Ipswich. U.S. Pats. 1,312,741 and 1,312,742, 12.8.19. Appl., 31.7.18 and 4.3.19.

SEE Eng. Pat. 124,852 of 1918; this J., 1919, 321 A.

Calcium nitrate; Processes for the production of ——. C. T. Thorssell and H. L. R. Lundén, Gothenburg, Sweden. Eng. Pat. 131,493, 26.9.18. (Appl. 15,670/18.)

SEE U.S. Pat. 1,286,839 of 1918; this J., 1919, 131 A.

Sulphate of ammonia; Manufacture of ——. J. T. Sheard, Birley Carr. U.S. Pat. 1,313,023, 12.8.19. Appl., 19.5.19.

SEE Eng. Pat. 121,946 of 1918; this J., 1919, 322 A.

Compressing chlorine and other gases; Process for ——. L. L. Bianchini, Assignor to Soc. Ital. di Elettrochimica, Rome. U.S. Pat. 1,313,160, 12.8.19. Appl., 12.9.16. Renewed 17.5.19.

SEE Eng. Pat. 106,722 of 1916; this J., 1917, 872.

Treating material with gas or vapour. Eng. Pat. 130,680. *See* I.

Sulphur from gases. Eng. Pat. 130,654. *See* II. A.

Nitre cake etc. U.S. Pats. 1,312,782—4. *See* VIII.

Acetic acid. Eng. Pat. 130,035. *See* XX.

Acetic acid. Eng. Pat. 130,651. *See* XX.

VIII.—GLASS; CERAMICS.

Gas-fired pot [glass] furnace; Experiments with a ——. M. W. Travers. J. Soc. Glass Tech., 1919, 3, 70—72.

A GAS-FIRED furnace was used in which covered pots, 36 in. by 38 in., were set in separate arches, arranged in pairs on either side of the gas producer. The gas entered each arch through two ports, 6 in. by 9 in., in front of the pot. The secondary air was brought through flues in the floor of the furnace and met the gas 8 in. below the bottom of the pot. Combustion took place in the arch in front of one pot, the waste products passing around the pot and out through a flue in the top of the arch. A very high quality of glass was obtained and the cracking of the front of the pots—which usually occurs in furnaces of this type in which the front of the pot is not heated—was avoided.—A. B. S.

Glass-house pots; Preparation of raw materials for and the manufacture of ——. B. J. Allen. J. Soc. Glass Tech., 1919, 3, 78—93.

INFERIOR fireclays of grade 3 quality may be raised to grade 1 quality by deflocculating the clay and precipitating the coarse particles containing the bulk of the impurities. For experimental purposes the author uses a copper can, 6½ in. high and 3½ in. diameter, connected to the negative pole of an electric circuit. In this is suspended a rod of type-metal, 9 in. long and ¾ in. diameter, connected to the positive pole. The clay is stirred with twice its weight of water, to which has been added a small quantity of a solution of sodium silicate, hydroxide, or carbonate. The stirring should be continued for 1½ hours, after which the liquid should rest for 1—1½ hrs., during which the coarse particles will be deposited. The liquid is then siphoned into another vessel, allowed to stand a further 2 hours, and the supernatant fluid, with the clay in suspension, transferred to the copper can and an electric current passed through it under an E. M. F. of 55 to 85 volts. After about 3 mins. the current is switched off and the adherent purified clay removed from the rod. The grog used for glass-house pots should be prepared from the same clay as that used as the base material, and it should be calcined at a sufficiently high temperature to prevent any marked "after-contraction." The grog should be ground in an edge-runner mill with a perforated pan and the runners set ¼in. above this. The mill should be adjusted to produce angular grains. The clay and grog should not be mixed in either a pan mill or a pug mill, but should be made into a slip with warm water to which a little alkali has been added. If the blunger used for this purpose is 4 ft. diameter, the arms should revolve at 80 r.p.m., the stirring being continued for two hours. A blunger with a semi-circular base and horizontal shaft is preferable to the customary type with vertical shaft. Some clays may require the addition of a barium salt; with others the addition of sulphite-cellulose liquor as a substitute for sodium silicate is an advantage. The slip is then cast in plaster moulds provided with an air-tight outer case, a vacuum being created in the space between the plaster and the case. If desired, the slip in the mould may be subjected to pressure so as to facilitate the production of pots with thick bottoms and tapering sides. As a cast pot dries more rapidly than the ordinary built-up pots, there is no advantage in drying vacuum-moulded pots for more than a week, and it might even be better to bake them two days after they have been taken from the mould. There is a saving of 30—60% when the vacuum casting process is used as compared with the cost of pressed pots.—A. B. S.

[Glass] pot attack; Some phenomena of ——. W. Rosenhain. J. Soc. Glass Tech., 1919, 3, 93—116.

SMALL, experimental pots, 35 mm. wide and 40 mm. high, were made of 60% of china clay and 40% of grog made by calcining the same clay at above cone 18 (1500° C.) and subsequently grinding it and passing it through a 60-mesh sieve. The pots were cast with the usual addition of deflocculators. Two series of glasses were used containing respectively sodium oxide 3·8, barium oxide 56·7, boric oxide 17·3, and silica 22·2%, and sodium oxide 3·6, barium oxide 39·5, boric oxide 12·0, silica 36·1, and alumina 8·8%. These glasses were prepared in china clay crucibles, the molten material being poured into water and the resulting

cullet used for the experiments. The experimental pots were packed with finely granulated cullet, a rod made of the same material as the pot and 30 mm. by 6·4 mm. diameter being suspended vertically from the lid so as to reach within 5 mm. from the bottom of the pot. The pot was placed inside a larger one partly filled with pure sand, and the whole was placed in a specially designed electric furnace and heated in one hour to 700° C., and in the following ten minutes to 1230° C., at which it was maintained for two hours. The thickness of the bottom of the pots and the diameter of the rods before and after use were accurately measured, and the difference regarded as a measure of the extent to which they were attacked by the glass. The main attack was on the bottom and lower part of the sides of the pots, a series of minute pits being often formed; the rods after removal from the glass were usually tapered towards the lower end, the intensity of the attack on them being proportional to the depth of the glass. The porosity of the rod does not appear to play so large a part as is commonly supposed. Rods of fused salts soluble in water or dilute acid produce, when exposed to such a liquid, a taper which is inverted as compared with that in the clay rods attacked by glass. It was found that with soluble salts and water the introduction of the rod started a violent circulation of the liquid, the denser solution of the salt rapidly sinking and being replaced by the water, so that the maximum attack is near the water-line, whilst with a rod immersed in molten glass the solution is lighter than the glass, so that the maximum attack is at the lower end of the rod. A reversed taper (similar to that with a rod of fused salt in water) was produced by using a china clay rod in a very light borate glass, in which the clay dissolved to form a denser solution. In an ordinary glass-pot there is an upward flow of glass along the sides of the pot and a downward flow nearer the centre of the glass. This accounts for the bottom and lower part of the sides of the pot being most strongly attacked. The formation of pit-holes in the bottom of the pot may be similarly explained, each hole reproducing the entire phenomena of a small pot. A thin disc of zirconia placed at the bottom of a pot entirely protected the bottom, but transferred the drilling action to the sides. By means of a deflector of this material of suitable shape, the greater part of the pitting may be prevented. Alternatively, there may be added to the material used for the pot some substance, as alumina or zirconia, which, when dissolved in the glass, would produce a solution of greater density than the glass. A graph connecting the rate of pot-attack with temperature for any given glass and pot-material would serve as a useful guide to the manufacturers in working the furnaces. The presence of defects and variations in the texture of pots may be examined by means of X-ray photographs, iron compounds in an unfired pot showing as dark spots against a light background of clay, but in a fired pot they have a light central region and a darker rim. Fragments of plaster of Paris in a fired china clay pot and air bubbles or cavities are equally easy to recognise. An extensive use of X-rays for examining glass pots prior to use is recommended.—A. B. S.

Optical glass melts; Cooling of——. H. S. Roberts. J. Amer. Ceram. Soc., 1919, **2**, 543—563.

When molten optical glass is cooled in the pot, neither striæ nor bubbles should be introduced nor carried to the centre of the melt, the glass should not lose its homogeneity by the formation of crystal, the greater part of the glass should be cracked into roughly rectangular blocks with smooth flat surfaces, and these pieces should be sufficiently free from strain to cleave readily with a smooth fracture. To secure the foregoing, the cooling should be rapid at first, commencing at the bottom of the pot; this may be effected by blowing air beneath the pot whilst it is in the furnace or by taking it out of the furnace and placing it on bricks, the surface of the glass being immediately covered with kieselguhr or other insulator so as to prevent premature cooling of the top of the glass. As soon as convection currents have ceased, owing to the glass becoming solid, it should be heated to the annealing temperature and carefully annealed. The subsequent cooling should be sufficiently slow to prevent the formation of spherical cracks, but so soon as plane cracks have begun (at about 250° below the annealing temperature) the rate of cooling should be increased. If necessary, the whole of the pot may be surrounded by a heat-insulating material, or it may be prevented from cooling too fast by replacing it in a heated furnace. C. N. Fenner has found that a good glass is produced by drawing the pot containing the fined glass out of the furnace for 15 mins., then placing it in a hot arch, the burners in which are adjusted so that the temperature of the glass falls to 500°—600° C. in about 16 hours and to 400° C. in another 24 hours. A cooling schedule based on careful observation is a useful guide. The formation of spherical pieces of glass is objectionable, as they are difficult to break and often include too much of the top of the glass and the walls of the pot, which can only be separated with difficulty. The temperature at which plane cracks form is almost independent of the rate of cooling, so that by controlling the latter it is possible to prevent the formation of spherical cracks until the plane cracks have relieved the internal strain in the glass. A. B. S.

Optical glass; Examination of —— in relation to weathering properties. A. V. Elsden, O. Roberts, and H. S. Jones. J. Soc. Glass Tech., 1919, **3**, 52—69.

On exposure, some optical glasses became covered with a film composed of minute globules or a "bloom" of much smaller particles, which largely disappeared on heating, but left a residue. Glasses which are likely to behave in this manner may be recognised by means of the following "dimming test": The glass to be tested (in the form of small polished plates, 1½ × ¾ × ¼ in.) is cleaned with a mixture of equal volumes of water and alcohol to which 2% of acetic acid has been added, then rinsed in distilled water, dried with specially prepared linen cloths, and passed once rapidly over a Bunsen flame to de-electrify it. One or more polished quartz plates are similarly treated to act as controls. The glass and quartz plates are placed in a wide tube enclosed in a thermostat maintained at 80° C. and a current of washed air, saturated with moisture at 80° C., is passed over it at a rate not exceeding one-third litre per hour. After a desired time, the thermostat is allowed to cool to 50° C. and is then cooled more rapidly by passing cold water through it so that the temperature falls from 50° C. to 2° C. below the temperature of the laboratory in 3 hours. The rate of cooling and of the passage of air through the apparatus must be such that no condensation of moisture occurs on the quartz plates. The tube containing the test piece is then removed from the thermostat and the contents examined *in situ*. A "dew" will usually be observed on the glass, but not on the quartz plates. The glass plates are rapidly transferred to clean dry test-tubes, which are immediately closed by rubber stoppers. The dew usually disappears in the dry tube, a poor glass retaining it longer than a better one. The glass plates are then examined, first with the naked eye and then under a microscope with a ⅓-in. objective. The composition of the products of corrosion has not been fully established, but soluble lead compounds

were produced from some lead glasses and alkali carbonates have been detected in other tests.
—A. B. S.

Lime-soda glasses; Annealing temperature of ——. S. English and W. E. S. Turner. J. Soc. Glass Tech., 1919, 3, 125—128.

To ascertain the effect on the annealing temperature of varying the composition, 11 lime-soda glasses with a constant percentage of silica but variable lime and soda were investigated. Rods, 3 cm. long and 8 mm. diameter, with plane polished ends, were made of each of these glasses and heated until optically free from strain, the temperature being then noted. The results, plotted on a lime-temperature graph, produce a smooth curve which rises fairly steeply with an increase in the proportion of lime. Hence, glasses with a high proportion of alkali can be annealed at a fairly low temperature, though higher than that required for lead glasses. As the proportion of lime increases, the annealing temperature also rises. Ordinary white flint (lime-soda) glass with 15—17% of soda, 7—9% of lime, and about 74% of silica, require to be heated to 538°—562° C., but a glass with 11·6% of lime must be heated to 601° C.—A. B. S.

Glasses; Reactivity of powdered ——. P. Nicolardot. Comptes rend., 1919, **169**, 335—337.

THE method of testing the resistance of glass to solvent action by boiling the powdered material with water and with dilute hydrochloric acid and determining the loss in weight requires that account should be taken of the degree of fineness of the powder. Tables are given showing the loss in weight per 1000 when various kinds of glass in three different degrees of subdivision were boiled for three hours in platinum vessels with water, and with $N/10$ hydrochloric acid. The powders were passed through sieves, and the surface areas were substantially in the ratio 1 : 2·84 : 12·8. As examples Jena glass lost 0·25, 0·75, and 2·75 parts per 1000 to water, and 2·00, 5·25, and 40·25 to dilute hydrochloric acid, whilst the corresponding figures for Kavalier glass were 1·75, 2·75, 18·50, and 0·75, 2·50, and 17·00. Contrary to observations made on entire glass vessels, the powdered glass in nearly all cases is attacked more by dilute hydrochloric acid than by water. (See further J. Chem. Soc., 1919, ii., 393.)—G. F. M.

Tridymite and cristobalite; Relations between ——. C. N. Fenner. J. Soc. Glass Tech., 1919, 3, 116—125.

CRISTOBALITE and tridymite may be distinguished by immersing them in a liquid having an index of refraction $n = 1·480$, since for cristobalite $n = 1·485$ and for tridymite $n = 1·475$. Potassium-mercury iodide solution is unsuitable, but a mixture of "albolene," "Russian oil," or "American oil," the index of which ranges from 1·477 to 1·485, with kerosene ($n = 1·450$) or with α-monobromonaphthalene ($n = 1·658$) is quite satisfactory. Tridymite frequently assumes a lath-like development, and extinction is then parallel to the elongation which is α. With cristobalite, the grains are frequently elongated, but extinction may occur at various angles; polysynthetic twinning, as in plagioclase, is characteristic. The temperature of the $\alpha—\beta$ inversions also serves to distinguish tridymite and cristobalite, but requires special apparatus. A mixture of 44·5 grms. of specially purified quartz and 14·8 grms. of crystallised sodium tungstate was heated for 118 hours at 1000° C. The resulting product, after treatment with hydrochloric acid, ammonia, and water, was shown to be tridymite. It was ground in an agate mortar and heated alone in a platinum crucible at 1423°—1580° C. for 42 mins. and then at 1585° C. for 113 mins. The tridymite was wholly converted into cristobalite. A fresh portion of tridymite powder was heated in a thimble crucible in an electric furnace; the temperature was raised from 1523° to 1560° C. in two hours, but fell to 1542° C. during the next two hours and rose to 1552° C. in the following 25 mins. About half the product was cristobalite. On reheating, in a similar manner, the next day, about three-quarters of the product was cristobalite. These results are incompatible with statements by Le Chatelier, Rees, and Scott on the stability of tridymite up to 1550° C. The author finds that no flux is necessary for the conversion of tridymite into cristobalite. He states that Le Chatelier's view that cristobalite is only formed by crystallisation of silica from solution in a melt is incorrect. Moreover, the amount of cristobalite formed increases with the length of heating above 1470° C. Tridymite heated with sodium tungstate for several days at 1000°—1100° C. remained wholly as tridymite, but on reheating it to 1531° C. in a cracked crucible, which allowed the material which was molten to drain away, the residue was wholly cristobalite. Artificial tridymite was heated with a little sodium tungstate for three periods of five hours at 1480° C. About one-third was converted into cristobalite. When cristobalite was similarly heated it remained unchanged. When cristobalite mixed with a little sodium tungstate was heated to 1460° C. for 4½ hours, the product was mostly cristobalite, but numerous grains of tridymite were present. At temperatures much below the inversion point, the transformation from cristobalite to tridymite proceeds with reasonable rapidity. Thus, ground quartz was first completely converted into cristobalite by heating it without a flux to near the fusion point. The cristobalite was mixed with five times its weight of sodium tungstate, ground in an agate mortar, and heated at 1380°—1400° C. for five hours, when most of it was found to be converted into tridymite. In numerous experiments at temperatures above 1470° ± 10° C., quartz, tridymite, and amorphous silica have been repeatedly and unequivocally converted into cristobalite; between 1470° and 870° C. quartz, cristobalite and amorphous silica have been similarly converted into tridymite, and below 870° ± 10° C. tridymite, cristobalite, and amorphous silica have been converted into quartz. Moreover, as the melting point of tridymite is lower than that of crystobalite, the latter must be the high temperature form. Le Chatelier's figure (1780° C.) for the melting point of cristobalite is certainly too high, as it may be melted in platinum crucibles. The true melting point is probably 1710° C.—A. B. S.

Porcelains; Special spark-plug ——. A. V. Bleininger and F. H. Riddle. J. Amer. Ceram. Soc., 1919, 2, 565—575.

ORDINARY porcelain is not suitable for sparking-plugs, since it breaks down at a rate which rapidly increases with the temperature, due to electrolytic effects. It is not constant in volume, the changes being greater than those due to thermal expansion. The inversion changes of quartz at high temperatures are also objectionable, and for this reason free quartz should not be used in making sparking plug porcelain. It may be replaced by calcined china clay, sillimanite, zirconia, or fused alumina, but the last-named is difficult to obtain sufficiently free from iron compounds. Various porcelains in the form of cups, 60 mm. outside diameter, 65 mm. high, and 2·5 mm. thick, were prepared, and were heated to the temperature at which 1 c.c. of the material shows a resistance of one megohm. This temperature is independent of the composition of the porcelain, but is related to the firing temperature of the ware and to the felspar content. In the place of felspar artificially prepared magnesium

(or beryllium)-aluminium di, tetra-, and hexasilicates were prepared, calcined, and ground. They greatly increased the temperature to which the ware could be heated without breakdown in the electrical test, and are correspondingly superior to felspar. A porcelain composed of 30% of kaolin, 10% of ball clay, 40% of sillimanite, and 20% of fluxing calcine ($MgO,Al_2O_3,4SiO_2$), fired at cone 16, had excellent electrical properties (690° C.), but required rapid cooling in the kiln. The highest temperature attained in the resistivity test (800° C.) was obtained with a porcelain composed of 5% of kaolin, 10% of ball clay, 85% of a calcine composed of 34·3% of magnesite and 65·7% of flint heated at cone 16. The sparking plugs ordinarily sold have a temperature-resistivity figure of about 400° C. Other similar mixtures were prepared, and their composition, thermal expansion, and electrical resistivity are given.—A. B. S.

Graphite; Structure of —— in relation to crucible making. R. Thiessen. J. Amer. Ceram. Soc., 1919, 2, 508—542.

CRUCIBLES made of American graphite are less satisfactory than those made of Ceylon graphite, and in an investigation to discover the cause of this difference 31 crucibles of different origin and the graphites and clays used in their manufacture were submitted to miscroscopical examination. Of the American graphites, Alabama flakes are usually the smallest and thinnest, being of all widths below 2 mm. Pennsylvania flakes are slightly larger and thicker, and the Canadian flakes are larger still and more irregular. The Madagascar flakes are nearly twice as large as the American ones, and instead of being oval are polygonal. The particles of Ceylon graphite are irregularly formed grains with rounded corners and edges, but with few flakes. The Canadian and Madagascar graphites are highly laminated, the Alabama much less so. Ceylon graphite consists of extremely thin laminæ which are not continuous, but blocked off into more or less regular areas by means of breaks not at right angles to the outer face, as in American graphites, but diagonally. Some grains of Ceylon graphite are roughly rectangular, others are triangular. A very important characteristic of Ceylon graphite is that no matter to what extent the grains are broken the fracture usually produces an irregular grain and rarely a flake. In an English crucible of great durability the thin flakes of Madagascar graphite were parallel to each other and to a tangent to the wall of the crucible, the flakes overlapping each other like tiles on a roof; this arrangement is regarded as highly desirable as it subjects the graphite to the least exposure to oxidation. In crucibles made with Ceylon graphite the latter is arranged irregularly. More care is required in making crucibles containing flake graphite as the material does not flow uniformly in all directions. Uniformly small particles of graphite are preferable to uniformly large ones, but if particles of various sizes are used it is advisable to have an even gradation of the particles. The graphite grains should be packed uniformly and closely together. In a mixture of clay and small grains of graphite the plasticity of the clay is reduced to a minimum, but if flaky graphite is used the loss of plasticity is much greater as the flow of the material under pressure is interfered with to a larger degree in the direction perpendicular to the plane of the flakes than in any other, and any movement in this direction tends to rupture the bond. The natural direction of flow is parallel to the flakes, and if excessive may cause too great a slipping when the pot is being moulded. Hence a mixture of clay and granular (Ceylon) graphite will be more uniformly plastic and more easily worked with less risk of rupture than one containing flake graphite. By reducing the clay to its ultra-particles some of the drawbacks of flake graphite may be avoided. The clay should be one which forms a plastic mass even after the addition of graphite. The ratio of total surface to the volume of all the constituents of the mixture is important and requires further investigation.
—A. B. S.

PATENTS.

Nitre cake and similar substances; Process and product for utilising ——. Manufacture of glass. H. A. Galt, Barberton, Ohio. U.S. Pats. (A) 1,312,782, (B) 1,312,783, and (C) 1,312,784, 12.8.19. Appl., 15.12.17.

(A) A NEW material in finely divided form consists of a mechanical mixture of sodium bisulphate and a neutralising base. (B) The base may be sodium carbonate. (C) The products claimed in (A) and (B) may be added to a lime-silica batch, fused, and made into glass.—A. B. S.

Ovens or kilns for use in the manufacture of tiles, pottery and other ware. J. H. Marlow, Stoke-on-Trent. Eng. Pat. 130,708, 4.5.18. (Appl. 7487/18.)

A LINING for kilns or ovens is constructed of a series of tubes, the sides of which are connected so as to form a rectangular slab or wall. Each tube forms a continuous flue extending from one side of the kiln through the arch to the other. The faces of the slabs may be corrugated or irregular, and transverse holes may be made so as to allow hot gases to escape from the tubular slabs to the inside of the kiln, and *vice versâ*.—A. B. S.

Tunnel-kiln. G. H. Benjamin, New York. U.S. Pat. 1,311,487, 29.7.19. Appl., 27.6.17.

THE material is passed in succession through a preliminary heating chamber, a closed coating chamber, and a second heating chamber.—W. F. F.

Clay-binder and process for making same. H. L. Kohler, St. Louis, Mo. U.S. Pat. 1,312,853, 12.8.19. Appl., 24.3.19.

A BINDER for a clay body is made by generating basic aluminium sulphate in the mass of the clay.
—A. B. S.

Magnesite refractories; Method of manufacturing ——. R. D. Pike, San Francisco. U.S. Pat. 1,312,871, 12.8.19. Appl., 23.10.17.

MAGNESITE is mixed with a ferro alloy and the mixture is heated to a temperature sufficiently high to cause the materials to react with each other and form a refractory product containing ferric oxide.
—A. B. S.

Glass tubing; Apparatus for manufacture of articles from ——. W. A. Whatmough, London. Eng. Pat. 131,532, 20.12.18. (Appl. 21,386/18.)

IX.—BUILDING MATERIALS.

Burnt earth concrete, with iron and wood reinforcement. L. P. Hodge. Engineering, 1919, **108**, 302—304.

TESTS on two piles, two beams, and four concrete planks were quite satisfactory, and 72 concrete piles containing burned earth were driven through clay without any failure. Hence, well burned earth (alluvium), passed through a 1 in. mesh and retained on a ¼ in. mesh, may be used safely and advantageously as a substitute for stone in concrete when the cost of stone is prohibitive. Hard wood may be advantageously substituted for iron and steel in fairly large sections when the cost of iron is prohibitive. In small sections the cost of pre-

paring and placing the wood is prohibitive. Greenheart (*Nectandra rodioci*) wood is the most suitable; it should be immersed in water for 24 hours before being placed in the concrete.—A. B. S.

Jarrah wood; Rapid seasoning of ——. A. Tomlinson. Western Australian Inst. Eng., 14.5.19. Engineering, 1919, **108**, 287—289, 323—325.

To dry or season wood so that it will shrink uniformly without splitting or cracking, it is necessary to keep the wood-substance in a plastic state during the greater part of the drying process. Water exists in wood as free water in the cell cavities and as moisture absorbed by the cell walls or fibre. The removal of the cell-water does not affect the properties of the wood beyond reducing its weight, but when the fibre saturation point is passed and the fibre-water is removed structural changes occur, and the wood begins to shrink. In Jarrah and other eucalypts and some oaks, shrinkage begins before all the cell-water has been removed, *i.e.* with a moisture content of 70%, as compared with 25—30% of the dry weight in other woods. The fibre-saturation point of Jarrah is about 30% of the dry weight, thus corresponding to that of other woods. During seasoning the maximum rate of drying occurs when the water is evaporated from the surface at the same rate as it is transmitted from the interior. After the fibre-saturation point is passed the fibre-water is transmitted through the cell-walls and not through the cavities, and drying proceeds more slowly. The air in the seasoning kiln should be sufficiently moist to prevent the surface drying below the fibre-saturation point until all the cell-water has evaporated, after which there is little risk of injury to the wood, and the humidity of the air may be greatly reduced. About 1000 cub. ft. of air is required for each 1 lb. of water removed. The air must be circulated so as to come in contact with every portion of the timber, as stagnant air soon becomes saturated with moisture, and causes the timber to rot. The natural movement of air through moist timber is downwards, owing to the air being cooled, and the timber should be stacked so as to allow for this. Forced draught, unless combined with a natural system, is liable to cause irregular drying. Many commercial kilns fail through faulty circulation. The kilns used for seasoning timber are of two chief types: progressive and compartment. In the progressive kilns the timber is moved through the whole kiln, the air circulation is longitudinal, and its condition varies from one end to the other. In compartment kilns, the timber is stationary, but the condition of the atmosphere is changed in accordance with the drying. The air circulation is transverse, so that the conditions at any time during the drying are uniform throughout the whole kiln. Three methods of operation are used. In the non-condensing system, the humidity is controlled by escaping steam or evaporated moisture, the moist air escaping from the kiln, which is usually of the progressive type. The control is imperfect, and, whilst suitable for a soft wood, this method is not sufficiently positive for hard woods. The superheating method, in which superheated steam is passed over the timber contained in compartments, is only suitable for pine, ash, and other woods requiring to be dried very quickly at a high temperature. It is injurious to hard woods such as oak and walnut. In the condensing system, the humidity is controlled by passing the air, which has taken up moisture from the timber, across water pipes or through water sprays so as to cause partial condensation of the moisture and regulate its humidity when it is reheated before being again passed over the timber. Compartment kilns worked in this manner are suitable for all kinds of woods. In a full-sized kiln of the compartment-condensing type, with natural and partly forced circulation, erected at the University, Crawley, Western Australia, the humidity is controlled by water sprays. The temperature of the air is controlled by means of steam-heated radiators and by live steam admitted into the lower part of the drying chamber. The air at the baffles at the bottom of the kiln is fully saturated with moisture, so that, knowing its temperature at the baffles and also its maximum temperature, the minimum humidity can be ascertained. Condensed water is used to heat the sprays. In using the kiln for Jarrah, the timber should be evenly stacked on trucks having a transverse slope of 1 in 7, so as to facilitate the downward movement of the air during the drying. The boards should be separated by strips 1—2 ins. thick. Weighed trial pieces, the ends of which are coated with lampblack and asphaltum varnish to prevent drying, should be inserted in the stack. When the compartment is full, it is heated to about 120° F. (50° C.) for several hours without allowing any drying to take place, and to remove any initial case-hardening. For this purpose sufficient steam is admitted to saturate the air and to raise the temperature to 120° F. (50° C.) for 6 hours for each 1 in. thickness of green timber. The humidity of the circulating air should then be governed by the moisture-content of the timber. During the first stage of drying (*i.e.* from green timber to the fibre-saturation point) the humidity should be 75—85%, the maximum temperature of the kiln being 115° F. (46° C.). After the fibre-saturation point has been reached the humidity may be gradually reduced to 40%, the maximum temperature of the kiln being gradually raised to 140° F. (60° C.) by the further admission of steam for about 3 hours. The percentage of moisture in the timber is ascertained daily, and the humidity and temperature regulated accordingly. Thus, if excessive case-hardening is taking place, it may be removed by increasing the humidity of the atmosphere, *e.g.* by injecting steam for a few hours. On removal from the kiln the wood should contain 5—10% of moisture. A. B. S.

PATENTS.

Wood; Method of rendering —— insect-repellent. J. Kruse, New Orleans, La. U.S. Pat. 1,312,634, 12.8.19. Appl., 11.8.17.

Wood is protected against attack by ants etc. by impregnating it with a solution of mercuric chloride containing sufficient hydrochloric acid to open the pores of the wood in order to facilitate the entrance of the mercuric chloride, and afterwards drying the wood.—A. B. S.

Concrete; Process of making porous ——. E. Walter, Montclair, N.J. U.S. Pat. 1,313,931, 26.8.19. Appl., 31.10.18.

CONCRETE is mixed with particles of a material which is insoluble in water, but which melts at a temperature insufficient to injure the concrete and which is extracted after the concrete has set.

—B. M. V.

Potash and cement. U.S. Pat. 1,312,592. *See* VII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Steel; Analysis of ——. A. Travers. Ann. Chim., 1919, **11**, 17—128.

A COMPREHENSIVE investigation of methods recommended for the determination of the various constituents of steel, particular attention being paid to the rapid methods of analysis. Carbon is determined by combustion, using the volumetric method

for the determination of the resulting carbon dioxide. Sulphur is also determined by combustion and the resulting sulphur compounds titrated iodometrically. The persulphate-silver nitrate method is recommended for the determination of manganese; the quantity of silver nitrate used is increased with the manganese content of the steel and, when the manganese exceeds 3%, hydrofluoric acid is also added; chromium may be determined by the persulphate method, after the manganese. Phosphorus is determined by the molybdate method. Reduction with titanium trichloride is used for the determination of molybdenum and vanadium. (See also this J., 1919, 256 A.)—W. P. S.

Sulphur in iron and steel; Determination of ——. M. Molyneaux. Chem. Trade J., 1919, **65**, 146.

A SERIES of experiments have been made with the "neutroscope" (a series of absorption bulbs surmounting the decomposition flask) using various absorbents. The evolved hydrogen sulphide was absorbed directly in standard iodine solution without any appreciable escape of iodine, the iodine solution being then titrated with standard thiosulphate, or in cadmium acetate or bromine solution, and the sulphur precipitated as barium sulphate. All the methods tested gave concordant results sufficiently accurate for steel works routine. —J. W. D.

Sheeting material [iron]; Exposure tests of ——. S. L. Hoyt. Chem. and Met. Eng., 1919, **21**, 142–144.

COMMERCIAL metal sheets were exposed to the atmosphere for periods up to three years. The rate of corrosion was determined by the difference in weight before exposure and after removing the rust film by treating the metal with hot ammonium citrate solution. Corroborative evidence was obtained from the complete failure of some of the specimens and the general appearance of the series. The copper-bearing steels (0·2–0·25 Cu) offered the greatest resistance to corrosion, and pure iron was less attacked than either Bessemer or open-hearth steels.—C. A. K.

Zinc retorts; Influence of pressure on the permeability of ——. O. Mühlhäuser. Metall u. Erz, 1919, **16**, 323–326.

EXPERIMENTS on the permeability of zinc retorts showed that with increasing pressure in the retort less gas flows out of the condenser, and not only the amount but the nitrogen content of the retort gases decreases. Using a new retort and diminishing the pressure in the furnace, the permeability decreases towards a minimum value with increasing density of the walls of the retort, due to shrinkage and to formation of a skin of silicate. Penetration of certain components of the gases of combustion leads to the formation of larger quantities of zinc dust, which tends to stop up the muffle and condenser, and the increase in pressure in the distillation apparatus inducing diffusion of the gases of reduction into the combustion chamber causes greater metal loss. It is found that the greater part of the gas passes through the cracks in the retort walls. A zinc furnace should not be kept for a long time under chimney draught. The permeability of the retort is greater at the back where the pressure is greater. The furnace should be built to work at the highest possible pressure. —T. H. Bu.

Manganin. M. A. Hunter and J. W. Bacon. Amer. Electrochem. Soc., Chicago, 29.9.19. [Advance copy.] 13 pp.

FROM a study of the effects of small variations in composition on the electrical resistivity and the temperature coefficient of resistivity of manganin wire, it is concluded that small variations in the manganese content affect the resistivity but not the temperature coefficient; that the temperature coefficient is affected considerably by the presence of iron, being improved by amounts up to 1%; that oxidation of the wire must be avoided during annealing, for which heating at 700° C. for a few minutes in a stream of carbon dioxide is recommended; and that the annealed wire may be stabilised by maintaining it at 150° C. in an oil bath for five hours. The thermo-electromotive force of manganin against copper was low, varying from 3 to 8 microvolts per ° C. in the case of all the samples tested.—W. E. F. P.

Magnetising roasting [of pyrites]; Experiments in ——. G. J. Young. Eng. and Min. J., 1919, **108**, 176–177.

PYRITES can be separated from blende by a magnetising roast and the use of a magnetic separator. The minerals should be present in individual grains, the object of the process being to coat each particle with a magnetic film. The temperature should not be above 600° C. so as to avoid the formation of zinc ferrate. The wide latitude possible in the degree of roasting is illustrated by experiments with pyritic concentrate. A spongy shell of ferric oxide is objectionable, as it is easily abraded. The particles should not be too coarse. The temperature must be at least that at which pyrites ignites. The time required is only a few moments if the temperature is right. The results of three experiments with 1000 lb. of pyritic concentrates are summarised. The maximum temperatures in the three experiments were 375°, 410°, and 500° C., the percentage of magnetic products being 25, 66·5, and 93 respectively. The five products obtained from the Wetherill separator are described; if the roasting is satisfactory the characteristic pyrites particles are absent in the roasted product and the colour is flat or dead. A black colour is characteristic of a deficiency of air. A high degree of magnetic susceptibility is accompanied by a furry appearance. Any type of roasting furnace can be used if the charge is passed through quickly enough. T. H. Bu.

Magnetite in matte and slag; Determination of ——. F. G. Hawley. Eng. and Min. J., 1919, **108**, 308–310.

THE method is based on the absence, in fresh copper mattes and slags, of ferric iron in any form but magnetite, and depends on the determination of ferric iron and the calculation of the latter to the magnetic oxide. Details are given of the means employed to verify the accuracy of the method. *Slag.* To 0·5–1·0 grm. of the 100-mesh sample, about 20 c.c. of a hot mixture of concentrated nitric acid and a 15% aqueous solution of sodium chlorate in equal parts is added, and the mixture is heated just to boiling and quickly diluted with 100 c.c. of cold water. The mixture is allowed to settle for a few minutes and decanted through a small filter, the residue being washed several times by decantation and the paper washed free from acid. To the residue (containing practically all the magnetite) 7 c.c. of water is added, the flask is covered and the water is heated to expel most of the air; 10 c.c. of a hot mixture of hydrofluoric and hydrochloric acids (1:3 or more) is then added and the mixture is heated to boiling, together with the portion of the filter to which the black residue has adhered, until complete solution of the residue and disintegration of the paper are effected; 5 c.c. of a saturated solution of boric acid in warm 50% hydrochloric acid is then added, and the boiling solution is titrated for ferric iron with a solution of stannous chloride (crystallised stannous chloride 21 grms., water 100 c.c., hydrochloric

acid 55 c.c., tartaric acid 5 grms., diluted to 2 litres) previously standardised against a known solution of ferric iron (prepared from ferrous ammonium sulphate) under conditions approximating to those of the assay. Natural magnetite generally contains titanium and cannot be employed for standardising without previous examination. *Matte.* 0·5—1·0 grm. is shaken with a solution of 3 c.c. of bromine in 3 c.c. of acetic acid, and the mixture is allowed to stand in a warm place for 10 mins.; 20 c.c. of the nitric acid and chlorate mixture is then added and the process is continued as for slag. The method is rapid, a single determination occupying about 20 mins., and has been found satisfactory at two large copper smelteries. Duplicate results usually agree within 0·1—0·2%, but the absolute accuracy probably does not exceed 0·5—0·6%. From 15 to 25 determinations may usually be made in one flask.

—W. E. F. P.

Furnace slags; Losses in ——. E. H. Robie. Eng. and Min. J., 1919, **108**, 265—267.

A summary is given of a series of experiments to determine the effect of changes in furnace practice on slag loss, the slags containing about one part of copper to two parts of nickel. Of seven blast furnaces in operation, three were charged with broken up converter slag along with the regular charge. In the other four cases, molten converter slag was poured into the settlers. The forms in which the copper-nickel probably occurred in the furnace slag are enumerated, and the conditions on which their respective amounts depend are discussed. Some conditions on which slag loss was thought to depend were varied, temperature readings were taken twice daily on the slag-matte stream, and the grade of matte, the percentage of silica in the slag, and the tonnage put through the furnaces were determined. Curves are given showing the results obtained in the case of furnaces in which cold converter slag was added to the charge. It was found that the tonnage charged has no pronounced effect on the slag loss. The slag loss is a minimum when the copper-nickel content in the matte is between 16 and 18%, and increases above and below these percentages. The slag loss decreases as the silica in the slag decreases from 37 to 31%, remains approximately constant from 34 to 32%, and increases again down to 30% silica. The slag loss also increases as the temperature rises from 1190° C. to 1275° C. There is no relation between the temperature of the slag-matte stream and the copper-nickel content of the matte or the silica in the slag. By pouring the slag into the settlers instead of charging it solid the slag loss is 0·045% higher for normal mattes of about 23—24% copper-nickel content. For settlers taking liquid converter slag the greater the tonnage the greater is the slag loss.—T. H. Bu.

Tin dressing floors in Cornwall; Effluent water from ——. J. C. Philip. Bull. Inst. Min. and Met., Aug. 1919.

Three samples of effluent water were examined. The amounts of sediment deposited in five days from 2·5 litres were 16—17 grms., 40—50 grms., and 80—90 grms. respectively. The supernatant water in the first two cases was clear, and in the third case reddish in colour and very turbid. No colloidal tin was detected in any of the samples.—J. W. D.

[*Tin in*] *Reed River water.* H. R. Beringer. Bull. Inst. Min. and Met., Aug., 1919.

A sample of Reed River water contained 434 parts of tin (as cassiterite) in suspension and less than 0·25 part in solution per two million parts.

—J. W. D.

Erratum.—*Rapid method of determining nickel and cobalt.* W. R. Schoeller and A. R. Powell (this J., Sept. 30, 1919, 684 A). In the eighth line of the abstract, for "sodium chloride" read "potassium iodide."

Filtration. Fabre. *See* I.

Autoclaves. *See* I.

Mineral-forming agents. Jakob. *See* VII.

Tin as pyrometric substance. Northrup. *See* XXIII.

Patents.

Steel; Magnet ——. S. Chukosho, Ltd., Osaka, Japan. Eng. Pats. (A) 118,601 and (B) 118,602, 26.6 and 2.7.18. (Appls. 10,531 and 10,834/18.) Int. Conv., 15.6 and 10.7.17.

(A) Permanent magnets of high coercive force (up to 700 C.G.S. units) may be made from an alloy steel containing 20—60% Co, with or without a proportion of tungsten, molybdenum, or other metal of the chromium group. (B) A carbon steel containing 20—60% Co and 0·3—10% Cr.—C. A. K.

Basic pig iron; Manufacture of ——. Comp. des Forges de Chatillon Commentry et Neuves Maisons, Paris. Eng. Pat. 129,957, 30.4.19. (Appl. 10,744/19.) Int. Conv., 20.2.19.

The whole or part of the manganese ore in the furnace charge is replaced by waste iron, steel scrap, or steel turnings, or by iron ores difficult to reduce, or by ferruginous slags, these materials becoming fused or reduced like manganese ore, and thus preventing the reduction of silica while the bath of metal retains a temperature ensuring perfect fluidity. The desulphurised hot iron obtained contains less than 1% and generally not more than 0·5% Mn and less than 0·75% Si, and is suitable for treatment in the basic converter.—J. W. D.

Steel; Manufacture and treatment of ——. J. C. Sellers, London. Eng. Pat. 129,676, 22.11.17. (Appl. 17,243/17.)

A steel alloy is produced by the basic or open hearth process containing C 0·35—0·4%, Ni 3·5—4·5, Si 0·1—0·18, Mn 0·73—1·0, S 0·02—0·04, P 0·02—0·04, V 0·17—0·20%, the vanadium being added either prior or subsequent to the running of the metal into the ladle. After being rolled into plates and cut and machined to the required size, the steel is heated to 750°—800° C. for one hour, cooled to 625° C. and quenched in hot water, reheated to 800° C., and quenched in oil at 90° C. The alloy is particularly suitable for use in the manufacture of bullet-proof steel plates.—J. W. D.

Furnaces for melting steel, iron, or the like. Soc. Franç. d'Exploit. de Fours Spéciaux à Haute Temperature, Paris. Eng. Pat. 130,052, 7.1.18. (Appl. 388/18.) Int. Conv., 28.8.17.

The gases from a producer are mixed in a combustion chamber with air heated by recuperation and directed to the fusion chamber through a flue, the top wall of which is composed of arches arranged in steps to reduce the speed of the gases and project them against the upper surface of the mass to be melted. The air is first heated by circulation in a recuperator traversed by the gases from the fusion chamber and then in a partitioned column above the gas producer.—J. W. D.

Steel; Electrical device for automatically indicating by visual or audible means the correct temperature of electrically heated —— before quenching. H. Alexander and W. T. Vint, Leeds, and A. Imbery, Halifax. Eng. Pat. 130,191, 22.8.18. (Appl. 13,698/19.)

The steel is heated electrically by an alternating

current, a circular coil of small gauge copper wire being arranged co-axially with it, in such a manner as to form the secondary of a transformer of which the steel forms the core, in series with which is a telephone receiver wound with high-resistance coils. As the temperature of the steel rises a buzz is heard in the telephone, which increases in intensity to a maximum just before the point of decalescence is reached. For visual indication an alternating current millivolt meter is placed in series or parallel with the receiver.—J. W. D.

Iron: Manufacture of —— [from steel turnings and scrap]. G. J. Stock, Bradford. Eng. Pat. 130,343, 14.10.16. (Appl. 14,640/16.)

GREY or white iron suitable for casting purposes is made from steel turnings or scrap steel, by melting the charge, together with powdered carbon, in an electric furnace. Silicon or ferro-silicon is added to the molten charge according to the amount of uncombined carbon desired in the finished metal.—C. A. K.

Manganese steel scrap; Remelting of ——. R. A. Hadfield, London. Eng. Pat. 130,436, 6.6.18. (Appl. 9354/18.)

MANGANESE steel scrap is remelted in an electric furnace for re-use as manganese steel, any variation in the percentages of iron, carbon, and manganese from the required percentages being corrected by suitable additions to the steel of metal and/or metallic oxide. The percentage of carbon is adjusted by diluting the bath with iron or steel free from or low in carbon or by the addition of manganese oxide as a reducing agent. Silicon-spiegel, or silico-manganese, or ferro-manganese, each low in carbon, or a mixture of silico-manganese alloy and ferro-manganese low in carbon, iron or steel free from or low in carbon is, if necessary, added to the bath to restore the relative percentages of iron, carbon, and manganese. Lime or other slag-forming agent may be added, the manganese oxide of the slag being reduced by the silicon of the added ferro-silicon.—J. W. D.

Metal: Method of treating —— [in steel making]. G. L. Fisk, Harrisburg, Pa. U.S. Pat. 1,312,471, 5.8.19. Appl., 9.5.16.

AN air blast is delivered on to molten unrefined metal contained in a conveying vessel during its passage from a melting to a finishing furnace. The metal is thereby heated and partially refined.
—C. A. K.

Rust-proofing of iron and steel articles. J. A. Thomson, and Ferrotherm, Ltd., Birmingham. Eng. Pat. 129,831, 30.7.18. (Appl. 12,384/18.)

THE articles are heated to produce on them a coating of oxide, which is subsequently reduced to black or grey oxide by converting the furnace atmosphere to a reducing atmosphere containing hydrogen, produced by the decomposition of steam passed over hot iron or other material, and carbon monoxide produced by the imperfect combustion of furnace gases. The hot articles are immersed in an oil bath.—J. W. D.

Iron and steel; Process for rust-proofing ——. R. D. Colquhoun, Assignor to Parker Rust-Proof Co. of America, Detroit, Mich. U.S. Pat. 1,311,319, 29.7.19. Appl., 31.3.19.

IRON and steel articles for rust-proofing are submerged in a solution of a "compound of phosphorus." The solution is maintained in a state of maximum activity by the constant addition of a more concentrated solution of the same reagent.
—C. A. K.

Iron or steel; Electrolytic process for coating —— with lead or antimony, or an alloy of lead and antimony. Q. Marino, Hendon, and C. Bowen, London. Eng. Pat. 130,302, 29.4.18. (Appl. 10,314/19.)

IRON or steel articles may be electrolytically coated with lead by employing the cleaned article as cathode, with a lead anode. The electrolyte consists of a mixture of solutions of ammonium tartrate and of a soluble lead salt (*e.g.*, lead acetate), to which is added sufficient sodium or potassium hydroxide to form a clear solution, and salicylic acid to the extent of about 5% of the weight of lead salt. Lead salts may be partly or entirely replaced by antimony salts, preferably the chloride, and a carbon or platinum anode is then used.—C. A. K.

Electro-plating metals; Process for ——, particularly for coppering iron and steel. Q. Marino, Hendon. Eng. Pat. 130,116, 25.7.18. (Appl. 12,125/18.)

THE electrolyte consists of a solution in caustic alkali of the phosphate or pyrophosphate of the metal or metals to be deposited, with the addition to the solution of ammonium tartrate, salicylate, or citrate, or a mixture of two or more of these ammonium salts. While the process is particularly suited for deposition of copper on iron or steel, zinc, tin, lead, or brass may also be deposited on various metals employed as the cathode.—J. W. D.

Zinc alloy. Soc. Anon. Stabilimenti Biak, Assignees of P. Peynetti, Turin, Italy. Eng. Pat. 125,397, 9.4.19. (Appl. 9012/19.) Int. Conv., 12.4.18.

A ZINC alloy having a fine-grained structure and capable of being worked metallurgically and mechanically, contains more than 85% Zn, less than 8% Cu, 0·5—1·9% Fe, 0·3—0·9% Mn, and a small proportion of at least one of the metals, cadmium, nickel, aluminium, or zirconium.
—C. A. K.

Zinc-bearing ores; Treatment of —— for the recovery of zinc by electro-deposition. Electrolytic Zinc Co. of Australasia Proprietary, Ltd., Melbourne. Eng. Pat. 126,296, 28.4.19. (Appl. 10,490/19.) Int. Conv., 27.4.18.

ZINC-BEARING solutions are purified by ordinary means, *e.g.*, with limestone and zinc dust or blue powder, and then electrolysed to deposit the zinc in presence of such quantity of glue as is required to maintain efficient working. When the cobalt and other impurities have accumulated to such an extent as to interfere with the successful deposition of zinc, these impurities are removed by other methods, *e.g.*, by means of arsenic treatment, or by means of lead peroxide or calcium plumbate treatment in the presence of a manganese salt, after which the first-mentioned processes are again applied.
—J. W. D.

Zinc melting apparatus. T. Aramaki, Tokyo, Japan. Eng. Pat. 130,483, 14.8.18. (Appl. 13,183/18.)

AN iron tank, with rounded corners and open at the bottom, is supported inside a larger tank having more acutely rounded corners, by means of flanges resting on the upper edge of the outer tank. The lower part of the tank is filled with molten lead so as to seal the free space between the side walls of the two tanks, and zinc to be melted is filled into the inner tank on to the molten lead. The heat required for melting the zinc is transmitted by the molten lead, and no mixing occurs owing to the difference in density between the two metals.—C. A. K.

Annealing processes and apparatus. A. F. Topley and G. Ractcliffe, Southampton, and H. E. F. Goold-Adams, London. Eng. Pat. 129,720, 7.12.17. (Appl. 18,178/17.)

Metal strip is fed mechanically by means of rolls at a given rate through the interior of a heated vertical retort the lower end of which is sealed with liquid (*e.g.*, water) and the upper end closed. The lower end of the heated strip dips into the sealing liquid and produces therefrom within the retort a gas to prevent oxidation of the surface of the metal strip which passes out of the apparatus. —J. W. D.

Furnaces; Open-hearth smelting ——. W. Topham, Manchester. Eng. Pat. 129,816, 20.7.18. (Appl. 11,911/18.)

An arrangement of flues of open-hearth regenerator-furnaces is described having for its object to provide more efficient mixing of the air and gas at the point where they are burned, and to ensure that any burning down of the air and gas ports shall be uniform, and that ports which are burned down can be easily repaired. Means are provided for collecting slag and any light residues that are carried along with the combustion products through the flues, so that they cannot enter the regenerator chambers or obstruct them.—J. W. D.

Open-hearth furnaces; Furnace ends of ——. W. J. Mellersh-Jackson, London. From Soc. Anon. C. M. Stein & Co., Rome. Eng. Pat. 129,869, 19.9.18. (Appl. 15,254/18.)

The air ports of a regenerative open-hearth furnace of the Siemens or Martin Neinkoff type are disposed at each side of the gas ports, and the air and the gas are prevented from mixing before they reach the furnace hearth from their respective ports by independent short separating and common extensions or partitions between the respective ports. The roof of the furnace joins the roof of the gas flue behind the mouth of the ports.—J. W. D.

Blast furnace. A. Frankignoul, The Hague, Holland. Eng. Pat. 130,198, 10.9.18. (Appl. 14,694/18.)

A modification of Eng. Pat. 125,194 (this J., 1919, 372 A) is made in that the gas tuyères and the electrodes are fitted at the same level in the blast furnace. The electrodes are in the form of nozzles arranged axially to the tuyères proper and project into the furnace through the tuyère openings in the furnace wall.—C. A. K.

Case-hardening furnace. Method of case hardening using salt, potassium carbonate, potassium nitrate, and carbonaceous material. H. Nettgens, Basle. Ger. Pats. (A) 312,151, 5.6.14, (B) 312,540, 30.8.14.

(A) The furnace consists of two chambers surrounded by a coil of heating pipes. The lower chamber is charged with lead, salt, potassium carbonate, etc., and the upper chamber contains the carburising material and the articles to be hardened. (B) A case of 1—1¼ mm. thickness is obtained by maintaining the furnace for 3 hours at a temperature of 800°—900° C.—J. W. D.

Aluminium alloys. W. A. Naish, Putney. Eng. Pat. 130,381, 6.8.18. (Appl. 2186/18.)

An aluminium alloy containing 0·75—1·5% Cu, 6—12% Zn, 0·25—0·75% Mg, 0·5—2% Fe, and 0·5—1·5% Si, does not require heat treatment. —C. A. K.

Metals; Process for removing coatings from ——. A. J. Henderson, Surbiton. Eng. Pat. 130,494, 27.8.18. (Appl. 13,932/18.)

Metal coatings or enamels are removed from a metal of higher melting point by heating the coated metal above the fusion temperature of the coating and directing a blast of air, steam, or other gas at high velocity on to the metal so that it has a scouring action. The coating material is carried away by the blast and is deposited in a collecting chamber.—C. A. K.

Concentrating ores and the like; Apparatus for use in ——. A. Ferguson, Scorrier, Cornwall. Eng. Pat. 130,838, 25.9.18. (Appl. 15,598/18.)

In an ore-concentrating apparatus, annular series of trays, disposed radially, are arranged one above the other to form one or more pairs, and in such relative positions that, by the rotation of the apparatus, the material under treatment is caused to pass over each series in succession and over adjacent series in opposite directions.—W. E. F. P.

Ores; Sulphidation and flotation of ——. R. F. Bacon, Pittsburgh, Pa., Assignor to Metals Recovery Co., New York. U.S. Pat. 1,312,668, 12.8.19. Appl., 6.3.17.

Oxidised metalliferous ore is subjected to flotation treatment in the presence of a product obtained by heating sulphide minerals with alkaline material to form a water-soluble sulphide. —W. E. F. P.

Alkali-earth metals [magnesium]; Process of producing ——. *Apparatus for producing alkali-earth metals. Alkali-earth-metal material.* W. F. Bleecker and W. L. Morrison, Canonsburg, Pa., Assignors to Electric Reduction Co. U.S. Pats. (A) 1,311,378, (B) 1,311,379, and (C) 1,311,380, 29.7.19. Appl., 19.10.15.

(A) Magnesium oxide is heated with a reducing agent to produce magnesium vapour which is condensed in an inert atmosphere. (B) An "electromagnetic furnace" for the production of magnesium has both electrodes in contact with a bath of the molten metal, and at least one in the furnace chamber. The furnace communicates with a condenser and is provided with means for introducing an inert (non-oxidising) gas. (C) Claim is made for a magnesium product, analogous to "zinc dust," consisting of a fine powder composed largely of metallic magnesium in amorphous and nodular form, which, owing to superficial impurities, is incapable of being liquefied by fusion. —W. E. F. P.

Ore-reducing process. B. Q. P. Foss, Assignor to The Foss International Ore Reduction Co., Chicago, Ill. U.S. Pat. 1,311,645, 29.7.19. Appl., 25.6.11.

Large lumps of ore are reduced to small pieces and exposed to a flame of fuel gas which is generated close to the burner. Moisture and volatile matter are expelled without any fusion of the ore taking place, and the material is rendered friable by sudden immersion in a continuously flowing cooling medium.—C. A. K.

Welding; Method of electric ——. H. Gravell, Brooklyn, N.Y., Assignor to Thomson Spot Welder Co., Boston, Mass. U.S. Pat. 1,312,844, 12.8.19. Appl., 16.1.18.

In a method of electric welding, the contacting surfaces to be joined are treated with an acid, the electric current subsequently employed causing the acid to remove the adhering oxide before producing the weld.—W. E. F. P.

Soldering and welding with hydrogen. Deuts. Oxyhydric A.-G., Cologne. Ger. Pat. 305,101, 23.1.17.

A visible area is produced in the inner zone of the

current, a circular coil of small gauge copper wire being arranged co-axially with it, in such a manner as to form the secondary of a transformer of which the steel forms the core, in series with which is a telephone receiver wound with high-resistance coils. As the temperature of the steel rises a buzz is heard in the telephone, which increases in intensity to a maximum just before the point of decalescence is reached. For visual indication an alternating current millivolt meter is placed in series or parallel with the receiver.—J. W. D.

Iron: Manufacture of —— [from steel turnings and scrap]. G. J. Stock, Bradford. Eng. Pat. 130,343, 14.10.16. (Appl. 14,640/16.)

GREY or white iron suitable for casting purposes is made from steel turnings or scrap steel, by melting the charge, together with powdered carbon, in an electric furnace. Silicon or ferro-silicon is added to the molten charge according to the amount of uncombined carbon desired in the finished metal.—C. A. K.

Manganese steel scrap; Remelting of ——. R. A. Hadfield, London. Eng. Pat. 130,436, 6.6.18. (Appl. 9354/18.)

MANGANESE steel scrap is remelted in an electric furnace for re-use as manganese steel, any variation in the percentages of iron, carbon, and manganese from the required percentages being corrected by suitable additions to the steel of metal and/or metallic oxide. The percentage of carbon is adjusted by diluting the bath with iron or steel free from or low in carbon or by the addition of manganese oxide as a reducing agent. Silicon-spiegel, or silico-manganese, or ferro-manganese, each low in carbon, or a mixture of silico-manganese alloy and ferro-manganese low in carbon, iron or steel free from or low in carbon is, if necessary, added to the bath to restore the relative percentages of iron, carbon, and manganese. Lime or other slag-forming agent may be added, the manganese oxide of the slag being reduced by the silicon of the added ferro-silicon.—J. W. D.

Metal: Method of treating —— [in steel making]. G. L. Fisk, Harrisburg, Pa. U.S. Pat. 1,312,471, 5.8.19. Appl., 9.5.16.

AN air blast is delivered on to molten unrefined metal contained in a conveying vessel during its passage from a melting to a finishing furnace. The metal is thereby heated and partially refined.
—C. A. K.

Rust-proofing of iron and steel articles. J. A. Thomson, and Ferrotherm, Ltd., Birmingham. Eng. Pat. 129,831, 30.7.18. (Appl. 12,384/18.)

THE articles are heated to produce on them a coating of oxide, which is subsequently reduced to black or grey oxide by converting the furnace atmosphere to a reducing atmosphere containing hydrogen, produced by the decomposition of steam passed over hot iron or other material, and carbon monoxide produced by the imperfect combustion of furnace gases. The hot articles are immersed in an oil bath.—J. W. D.

Iron and steel; Process for rust-proofing ——. R. D. Colquhoun, Assignor to Parker Rust-Proof Co. of America, Detroit, Mich. U.S. Pat. 1,311,319, 29.7.19. Appl., 31.3.19.

IRON and steel articles for rust-proofing are submerged in a solution of a "compound of phosphorus." The solution is maintained in a state of maximum activity by the constant addition of a more concentrated solution of the same reagent.
—C. A. K.

Iron or steel; Electrolytic process for coating —— with lead or antimony, or an alloy of lead and antimony. Q. Marino, Hendon, and C. Bowen, London. Eng. Pat. 130,302, 29.4.18. (Appl. 10,314/19.)

IRON or steel articles may be electrolytically coated with lead by employing the cleaned article as cathode, with a lead anode. The electrolyte consists of a mixture of solutions of ammonium tartrate and of a soluble lead salt (*e.g.*, lead acetate), to which is added sufficient sodium or potassium hydroxide to form a clear solution, and salicylic acid to the extent of about 5% of the weight of lead salt. Lead salts may be partly or entirely replaced by antimony salts, preferably the chloride, and a carbon or platinum anode is then used.—C. A. K.

Electro-plating metals; Process for ——, particularly for coppering iron and steel. Q. Marino, Hendon. Eng. Pat. 130,116, 25.7.18. (Appl. 12,125/18.)

THE electrolyte consists of a solution in caustic alkali of the phosphate or pyrophosphate of the metal or metals to be deposited, with the addition to the solution of ammonium tartrate, salicylate, or citrate, or a mixture of two or more of these ammonium salts. While the process is particularly suited for deposition of copper on iron or steel, zinc, tin, lead, or brass may also be deposited on various metals employed as the cathode.—J. W. D.

Zinc alloy. Soc. Anon. Stabilimenti Biak, Assignees of P. Peynetti, Turin, Italy. Eng. Pat. 125,397, 9.4.19. (Appl. 9012/19.) Int. Conv., 12.4.18.

A ZINC alloy having a fine-grained structure and capable of being worked metallurgically and mechanically, contains more than 85% Zn, less than 8% Cu, 0·5—1·9% Fe, 0·3—0·9% Mn, and a small proportion of at least one of the metals, cadmium, nickel, aluminium, or zirconium.
—C. A. K.

Zinc-bearing ores; Treatment of —— for the recovery of zinc by electro-deposition. Electrolytic Zinc Co. of Australasia Proprietary, Ltd., Melbourne. Eng. Pat. 126,296, 28.4.19. (Appl. 10,490/19.) Int. Conv., 27.4.18.

ZINC-BEARING solutions are purified by ordinary means, *e.g.*, with limestone and zinc dust or blue powder, and then electrolysed to deposit the zinc in presence of such quantity of glue as is required to maintain efficient working. When the cobalt and other impurities have accumulated to such an extent as to interfere with the successful deposition of zinc, these impurities are removed by other methods, *e.g.*, by means of arsenic treatment, or by means of lead peroxide or calcium plumbate treatment in the presence of a manganese salt, after which the first-mentioned processes are again applied.
—J. W. D.

Zinc melting apparatus. T. Aramaki, Tokyo, Japan. Eng. Pat. 130,483, 14.8.18. (Appl. 13,183/18.)

AN iron tank, with rounded corners and open at the bottom, is supported inside a larger tank having more acutely rounded corners, by means of flanges resting on the upper edge of the outer tank. The lower part of the tank is filled with molten lead so as to seal the free space between the side walls of the two tanks, and zinc to be melted is filled into the inner tank on to the molten lead. The heat required for melting the zinc is transmitted by the molten lead, and no mixing occurs owing to the difference in density between the two metals.—C. A. K.

guished from hydrogenated rape oil by the fact that they contain palmitic acid, which is not present in hydrogenated rape oil. About 100 grms. of the fat is heated with several times its weight of methyl alcohol and 1 to 2% of strong sulphuric acid. The resulting methyl esters are washed, dried, and distilled under reduced pressure (3 to 4 mm.). The first third of the distillate is redistilled and the first quarter of the new distillate collected. The saponification value of this fraction is determined to obtain the molecular equivalent of the fatty acids present, or the neutralisation value of the liberated fatty acids may be determined. In the case of hydrogenated herring oil the molecular equivalent of the fatty acids was 237·1, corresponding to a mixture of palmitic and myristic acids, and similar results were obtained with hydrogenated seal and whale oils. The corresponding fraction from hydrogenated rape oil contained fatty acids with a neutralisation value not exceeding 201. In the presence of coconut or palm-kernel oil the first fraction would consist essentially of the ester of lauric acid instead of myristic and palmitic acids.—C. A. M.

Wax of a South Brazilian wild bee. J. Gadamer. Arch. Pharm., 1917, **255**, 425—441.

THIS wax, probably of a bee of the *Melipona* or *Trigona* species, has the following characters: m.pt. 66° C., sp. gr. 0·9898, acid value 26·5, ester value 57·3—59·2, or, in boiling xylol, 59·3—62·1, Buchner value 5·5 c.c. Its composition is: 28% of melissyl alcohol, $C_{30}H_{62}O$ or $C_{31}H_{64}O$; 13% of a doubly unsaturated alcohol of the formula, $C_nH_{2n-2}O_2$, where $n=26-30$; 10% of a glycol of the probable formula, $C_{30}H_{60}O_2$; 7% of ceryl alcohol, $C_{26}H_{54}O$; 3% of a saturated hydrocarbon, C_nH_{2n+2}; an unsaturated alcohol-acid of the probable formula, $C_{29}H_{38}O_3$, $[\alpha]_D=-37·5°$; higher fatty acids; a resin acid; various volatile acids of the $C_nH_{2n}O_2$ series, among which are probably acetic and isobutyric or methylethylacetic acids.—T. H. P.

Ricinine. Winterstein and others. *See* XX.

PATENTS.

Tung-oil; Treating —— and coating or impregnating objects therewith. L. H. Backeland, Yonkers, N.Y., Assignor to General Bakelite Co., New York. U.S. Pat. 1,312,093, 5.8.19. Appl., 16.1.17.

TUNG-OIL is heated to about 200° C. while avoiding solidification, and is then reheated at a lower temperature in presence of an article to be impregnated, which causes solidification of the oil. The article is afterwards coated externally with an infusible and insoluble phenolic condensation product. A modified tung oil is prepared which is stable up to 100° C., and solidifies about 160° C.
—J. H. J.

Soapsuds; Process for re-using previously used ——. H. M. Gray, Los Angeles, Cal. U.S. Pat. 1,312,477, 5.8.19. Appl., 15.8.17.

USED soapsuds are treated with an alkali and allowed to stratify. The suds fit for re-use form an intermediate stratum between the lighter and heavier impurities.—C. A. K.

Hydrogenation of oils, fats, and like materials; Process of and apparatus for the ——. E. B. Maxted, Wallsall. U.S. Pat. 1,313,407, 19.8.19. Appl., 22.6.18.

SEE Eng. Pat. 109,993 of 1916; this J., 1917, 1185.

Solidifying substances. U.S. Pat. 1,312,424. *See* I.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Iron etc. in resins. Gonnermann. *See* XII.

PATENTS.

Paint; Manufacture of luminous ——. G. A. H. Muller and J. Macfarlane, Montreal, Canada. Eng. Pat. 130,885, 7.1.19. (Appl. 468/19.)

A COMPOSITION for luminous paints is made by heating together sublimed sulphur (about 26 parts) with strontium sulphate (preferably about 19 parts), calcium sulphate (6 parts), and magnesium carbonate (1 part), and grinding the mass to a fine powder.
—C. A. M.

Lacquering sheet metal; Process of ——. T. L. Taliaferro, Assignor to Phœnix Hermetic Co., Chicago, Ill. U.S. Pat. 1,312,815, 12.8.19. Appl., 30.12.18.

SHEET metal is coated with lacquer and exposed to a drying atmosphere only for a sufficient time to cause a protecting film to form on the coating, after which it is again lacquered and then baked for a sufficient time to cause thorough fusion or coalescence of the particles of lacquer.—C. A. M.

Turpentine-distilling apparatus. J. A. Boyer and H. E. Bryant, Jacksonville, Fla. U.S. Pat. 1,312,826, 12.8.19. Appl., 9.2.18.

MIXED vaporous and liquid distillate from a turpentine-distilling apparatus are received in a chamber, from which extends a passage containing a vapour trap, whilst means are provided for condensing the vapour.—C. A. M.

Resins; Direct separation and purification of the solid and oily products contained in natural ——. J. Merz, Brünn. Ger. Pat. 302,442, 31.8.16.

THE resin is deprived of oil by distillation in superheated steam at 180° C., or in a vacuum, and the residue is subjected to extraction by the usual solvents, whereby colophony, free from turpentine oil, is obtained, and no separation of turpentine from the volatile solvent is necessary.—G. F. M.

Coating substances to protect them or render them non-porous; Materials or the process of producing materials for ——. C. A. Cleghorn, Newcastle-on-Tyne, and The Gayner Pneumatic Co., Ltd., London. Eng. Pat. 130,379, 5.2.18. (Appl. 2105/18.)

"TURKISH bird-lime," or a similar substance prepared from fruits of trees of the *Cordiaceæ*, is heated to about 180° F. (about 80° C.) and gradually mixed with alcohol, with or without previous addition of a solution of borax or of water. Suitable proportions claimed are 2 parts of "Turkish bird-lime," 3 parts by measure of 2½% borax solution, and about 3 parts of alcohol. Diatomaceous earth, shellac, or both, or dextrin, may be added to vary the consistency of the product.
—C. A. M.

Dopes, varnishes, etc. Eng. Pat. 123,712. *See* V.

Coating with tung oil. U.S. Pat. 1,312,093. *See* XII.

XIV. INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Eight years' work on synthetic ——. German war-time uses described. K. Gottlob. Gummi-Zeit. Indiarubber J., 1919, **58**, 305—308, 348—350, 391—395, 433—436.

THE synthetic rubber obtained from methylisoprene has been of greater promise than that from erythrene or isoprene, but whether polymerisation is

effected in the cold or with the aid of heat or of sodium the material is undesirably prone to oxidation, and also refuses to combine appreciably with sulphur in the absence of a catalyst. Another marked difference between synthetic rubber and the natural product is the lack of tendency in the former to become plastic when worked between rolls, the material obtained by the "hot" and "sodium" processes retaining their elasticity and toughness, whilst the "cold" product is hard and white and of a persistent granular structure. By shaking isoprene with an aqueous emulsion of albumin or similar substances, with simultaneous application of heat, it was found possible to produce a rubber of decidedly more attractive properties. It was also found that various organic bases have the power of retarding the oxidation of methyl-rubber, and this led to the further discovery that certain bases, *e.g.*, piperidine, also greatly expedite the reaction with sulphur. Substances such as aldehyde-ammonia, piperidine, piperidyldithiocarbonate, and dipiperidyl, which are marked accelerators of vulcanisation, are also very effective in preventing deterioration by oxidation. By the addition of certain cellulose derivatives to methyl-rubber at the stage of the polymerisation process it is possible to render methyl-rubber extremely resistant to oxidation. The first satisfactory vulcanised material from synthetic rubber was obtained in 1913, when, with the aid of an organic catalyst, methyl-rubber was vulcanised to such a degree that the unsaturation of the molecule was almost entirely removed and the tendency to oxidation thereby checked. The vulcanite or hard rubber product contained 23%—26% of combined sulphur ($C_5H_8S_2$ contains 28·1%), and in mechanical characteristics, such as electrical strength and resistance to heat, was only slightly inferior to similar products from the best Para rubber. The chief distinction was that in thin plates the synthetic product was transparent with a red colour. At the end of 1914 there had been no commercial production of synthetic rubber in Germany. In 1915, by adding oil to the methyl-rubber, it was found possible to extrude smooth cylindrical rods for the production of vulcanite "antennæ," which satisfied all the specified requirements, and marked the first successful application of the material on a considerable commercial scale. The next application was to accumulator cells, for which purpose it was found necessary to exclude mineral ingredients from the mixings. Another application was to replace some of the natural rubber in mixings for automobile tyre covers and in certain reclaimed rubbers in which raw rubber had been used as a binding agent. Late in 1915 some hundreds of tons of "cold" methyl-rubber were ordered for use in submarines, the greater part going into accumulator boxes, but some into Bosch igniters. With increased experience it became possible to reduce the percentage of methyl-rubber to 40%, and for thicker sheets for accumulators also to add some reclaimed rubber. Methyl-rubber was also converted into soft rubber goods such as high-pressure packing sheet, spread fabrics, wire insulation, and tyres, the hot polymerisation product being used because this only is soluble, and even then needs thorough mastication. The employment of methyl-rubber for gas-masks had to be abandoned on account of the shortage of fabric, and leather impregnated with a synthetic oil was used instead. Balloon fabrics, however, were made successfully, as also was the covering material for field and submarine cables. For the manufacture of rubber tyres the extraordinarily low elasticity of the vulcanised methyl-rubber proved a difficulty, and the addition of certain oily materials or "elasticators" was necessary. The action of these is purely physical, and oils generally, mineral and vegetable, can be used, but dimethylaniline and toluidine, which also possess preservative action, were commonly applied. These elasticators also considerably decrease the tendency of the methyl-rubber to become quite hard a few degrees below 0° C. For solid tyres the mixing contained 60% of methyl-rubber (cold process), the necessary sulphur, 6% of the elasticator, and mineral fillers such as zinc oxide or lithopone. The vulcanised tyres were inelastic and hard at the ordinary temperature, but became elastic when gently warmed. They wore away by disintegration rather than by abrasion. Attempts to produce inner tubes for motor tyre covers were not very successful.—D. F. T.

Rubber: Variability in plantation —. O. de Vries and W. Spoon. Comm. Central Rubber Stat., Buitenzorg, Java, 1919, No. 15, 32 pages.

THE results of hundreds of tests over the last few years indicate clearly the advantage to be gained by the adoption of a standardised process in the production of raw rubber. During 1918 the normal values for the optimum tensile strength of crêpe rubber vulcanised under the usual conditions (rubber 92·5%, sulphur 7·5%, temperature 148° C.) ranged from 1·31 to 1·40 (average 1·372), and of smoked sheet from 1·34 to 1·41 (average 1·377). The figures for "slope" or "type" (see Schidlowitz and Goldsbrough, this J., 1919, 347 T) were 35·5 and 36·5 for crêpe and smoked sheet respectively, whilst the normal time of vulcanisation required to bring the stress-strain curve to an elongation of 990% (at 1·30 kilo.) for the two grades ranged from 110 to 125 minutes and from 85 to 105 minutes. The time of vulcanisation for smoked sheet therefore is approximately 20 minutes shorter than for first quality crêpe rubber, but the latter shows less variability in this matter.—D. F. T.

Para rubber seed oil. Eaton. *See* XII.

PATENTS.

Caoutchouc substances; Manufacture of —. North British Rubber Co., Ltd., Edinburgh. From The Goodyear Tire and Rubber Co., Akron, Ohio, U.S.A. Eng. Pat. 130,857, 2.11.18. (Appl. 17,968/18.)

THE nitrogenous substances used as accelerators in vulcanisation probably first react with the sulphur, so that the sulphur reaction-product forms the actual catalyst. The production of vulcanisation catalysts by heating *p*-nitrosodimethylaniline with sulphur has already been described (Peachey, this J., 1918, 216 A). Other nitrogenous accelerators may be treated in the same way, so that vulcanisation with the aid of such catalysts is resolved into two distinct processes, namely, the interaction of the nitrogenous substance and sulphur and the subsequent vulcanisation process expedited by the product of the first operation. Anhydroformaldehyde-aniline, methylenediphenyldiamine, thiocarbanilide, and triphenylguanidine, used either alone or mixed, are quoted as typical instances.—D. F. T.

Rubber article; Decorated — *and method of making same.* A. A. Somerville, Flushing, N.Y., Assignor to New York Belting and Packing Co. U.S. Pat. 1,309,703, 15.7.19. Appl., 7.2.18.

UNVULCANISED rubber is compounded with light-sensitive material, formed into the desired article, subjected to the action of light-rays conforming with the desired design, and then vulcanised by heat.—E. W. L.

Rubber; Process for reclaiming —. H. R. Haertel, Franklin, Mass. U.S. Pat. 1,310,013, 15.7.19. Appl., 23.12.18.

THE process consists in causing vulcanised rubber to swell while under pressure and then suddenly releasing the pressure.

XV.—LEATHER; BONE; HORN; GLUE.

Chrome [tanning] liquor: Effect of the concentration of a —— upon adsorption by hide substance. M. E. Baldwin. J. Amer. Leather Chem. Assoc., 1919, **14**, 433—443.

A SERIES of solutions containing varying amounts of a stock chrome liquor were each shaken with a definite amount of hide substance. Analyses were made of the chromed hide substance and of the liquor before and after adsorption. The percentage of chromium removed from the solution was found to decrease very rapidly as the concentration of the chromium increased, being only 3% with 5 grms. Cr_2O_3 per 100 c.c. At the point of maximum adsorption 20% of the chromium was removed from the liquor. The percentage of sulphate removed was less than that of the chromium, but in every case the difference was small. Curves representing the change in chromium content of the liquors and the amount of chromium remaining in the thoroughly washed hide powder revealed a maximum at the same concentration of 1·5—2 grms. Cr_2O_3 per 100 c.c.; further increase in the concentration caused a slight decrease in the chromium adsorbed. The analysis of the liquors before and after adsorption was not found to give a measure of the chromium adsorbed by the hide powder. The results are explicable by the assumption of a three-phase system consisting of an outer solution, the chromed hide substance, which is a solid network structure enclosing the third phase, the inner solution. The concentration of Cr_2O_3 in the initial solution is lowered by the formation of chromium collagenate and by the removal of a liquid of lesser concentration to form the liquid in the interstices of the collagen network. This latter factor has greater influence the more concentrated the chrome liquors and accounts for the difference in the curves. The maximum of Cr_2O_3 adsorbed was 134 mgrms. per grm. of hide substance. From Wilson's calculation of 3·38 grms. as the proportion of Cr_2O_3 equivalent to 100 grms. of collagen (J. Amer. Leather Chem. Assoc., 1917, **12**, 108) it follows that four equivalents of chromium combine with one of collagen at this maximum.—D. W.

Tannage of skins with salts of iron. Part II. V. Casaburi. J. Soc. Leather Trades Chem., 1919, **3**, 74. (See this J., 1919, 547 A.)

LABORATORY tanning trials were carried out with four different iron tanning liquors, the best results being obtained with a basic ferric sulphate liquor prepared by acidifying a solution of ferrous sulphate, 168·8 grms., in water, 500 c.c., with sulphuric acid (60° B.; sp. gr. 1·71), 37·7 grms., and then oxidising with nitric acid (42° B.; sp. gr. 1·41), 18·5 grms., the solution being boiled until it gave no coloration with ferricyanide. Sodium carbonate was added to the cooled solution in quantity sufficient to form the basic salt, $Fe_2(SO_4)_2(OH)_2$, and the whole was then diluted to 1000 c.c. Tannage was complete in 10 days, the concentration of the liquors being progressively increased from 0·23 to 0·94 grm. Fe_2O_3 per 100 c.c. The amount of Fe_2O_3 absorbed by the pelt was 3·84% on the pelt weight, the dry leather containing 7·88%. The final basicity of the liquor was the same as the initial basicity. Skins tanned in a basic ferric sulphate liquor, and afterwards treated with a solution of sodium sulphate at 40° C., washed, and oiled on the grain, gave a leather which with 23·34% of moisture contained 68·3% of hide substance, and had a permeability at 23° C. (French military method) of 4·18, 17·9, and 63·31% respectively after 15 mins., 30 mins., and 24 hours.—E. W. L.

Leather; Determination of the total, soluble, and insoluble ash in ——. J. M. Seltzer. Addition to the report of a Committee of the American Leather Chemists' Association. J. Amer. Leather Chem. Assoc., 1919, **14**, 443—450.

AN account of a discussion and replies received to inquiries *re* the report (see this J., 1919, 472 A). Six members of the committee carried out the direct incineration of leather samples in platinum dishes and over Bunsen or Méker burners. Only one used a muffle furnace. It was suggested in discussion that the same method of burning should be recommended and that the insoluble ash should be determined on the extracted leather only. The difference in the results reported for the insoluble ash from the water-soluble solution are attributed to the variation in the reduction of the magnesium sulphate.—D. W.

Glues; Water-resistant ——. F. L. Browne. Chem. and Met. Eng., 1919, **21**, 136—138.

GELATIN glues can only be made resistant to humid conditions by using waterproof coatings, and in certain cases (*e.g.*, the plywood parts of aeroplanes) where such a coating is not practicable a water-resistant glue becomes a necessity. Blood-albumin and casein glues are more resistant in the sense that the amount of water absorbed is limited and the saturated glue still has sufficient strength to hold the joined surfaces together. In the former class the material used is the black albumin remaining after the removal of the fibrin and part of the hæmoglobin from blood, and a satisfactory blood glue is made by soaking 6 parts of black blood albumin in 11 parts of water, and straining out any undissolved particles; a little ammonia solution and hydrated lime are then added to the mixture. The hardening of blood glues is dependent on heating to a temperature at which albumin coagulates (above 74° C.). Casein glues do not require the application of heat, but the shortness of the "life" of wet mixed glues is a disadvantage. Dry mixtures of the constituents are sometimes used to obviate this difficulty, and a thorough mixing after soaking is necessary. A suitable mixture for a "wet" glue is made by soaking 100 parts of casein in 130—280 of water for 15 mins., adding a mixture of 15—22 of hydrated lime and 90 of water, and finally mixing with 70 parts of sodium silicate (water-glass).—C. A. K.

Gelatin and agar-agar; Liquefaction of —— by calcium salts. R. E. Liesegang. Farben-Zeit., 1919, **24**, 971—972. Chem. Zentr., 1919, **90**, IV., 150—151.

THE addition to 150 grms. of gelatin and 115 grms. of water of 245 grms. of hydrated calcium chloride, or a lesser quantity of the nitrate, caused liquefaction. The solution again gelatinised on pouring water over the surface, on account of the outward diffusion of the calcium salt, and on the other hand a gelatin jelly containing calcium nitrate is liquefied by concentration. 20 grms. of agar-agar is liquefied in the cold by 150 grms. of hydrated calcium nitrate in 130 grms. of water, the solution in contrast to the gelatin solution not being ropy.—G. F. M.

PATENTS.

Impregnation or charging of porous or permeable substances or materials [e.g., leather] with liquid or plastic materials. J. E. Carter, S. A. Wright, and W. Ratcliffe, Halifax. Eng. Pat. 130,731, 31.7.18. (Appl. 12,457/18.)

LEATHER, cloth, or like material to be impregnated is placed in an upright position in a vessel provided with an air-tight lid, which is then closed. A pipe from the vessel is connected to a pump, whereby

most of the air is withdrawn. The pump is stopped, heated oil, fat, tanning material, waterproofing or other composition in a liquid or plastic condition is admitted through an inlet pipe, and air is re-admitted under several atmospheres pressure to force the oil, fat, etc., into the material being impregnated.—D. W.

Tanning process. S. Saxe, New York. Reissue 14,719, 26.8.19, of U.S. Pat. 1,297,255, 11.3.19. Appl., 19.6.19.

See this J., 1919, 431 A.

Sulphite liquor products. U.S. Pats. 1,311,215—1,311,222. *See* V.

XVI.—SOILS; FERTILISERS.

Carbon dioxide, ammonia, and nitrate in soil; Parallel formation of ——. P. L. Gainey. Soil Sci., 1919, 7, 293—311.

Purified air was drawn in a downward direction through a column of loam soil in a cylinder, and then through glass beads moistened with caustic soda and afterwards through glass beads moistened with dilute acid. The absorption vessels caught the carbon dioxide and ammonia given off, and sufficient of the top layer of soil was removed to determine ammonia and nitrates. The carbon dioxide in the soil was not taken into consideration. As a substance readily decomposed by bacteria, cottonseed meal was added to the soil to the extent of 1%. Each experiment extended over some weeks and observations were made at intervals. Varying the amount of moisture in the soil had little effect on the evolution of carbon dioxide provided the moisture was above a minimum of 12 c.c. per 100 grms. of soil. The production of ammonia ran parallel with that of carbon dioxide, except that the optimum minimum of moisture was higher. Nitrates were not found till the fifth day and increased regularly, accompanied by a corresponding diminution of ammonia. Variations in air supply had a marked effect on the bacterial process. Unless the current of air was continuous, there was a marked delay and diminution in the changes produced. In the case of ammonia there was a permanent diminution in amount, but the carbon dioxide finally reached the amount produced with continuous aeration. Nitrate nitrogen accumulated very slowly in all cases, and near the end of the experiment nitrification appeared to be inversely proportional to the aeration. Increasing the volume of air above that necessary for a continuous current had no effect. Experiments were made also with 1% of dried blood added to the soil. With this substance the production of carbon dioxide was much diminished and that of ammonia relatively increased, probably due to the higher nitrogen content of the blood over the cottonseed meal and to the content of readily oxidisable carbon being insufficient to supply energy for complete decomposition.—J. H. J.

Soils in field-placed cylinder experiments; Abnormality of ——. C. A. Mooers. Soil Sci., 1919, 7, 247—251.

In raising crops in soils contained in cylinders sunk in the ground, it was observed that the soils became quite unproductive after 3—8 years unless limed, although the same soil in its normal state continued productive. The cylinders projected a few inches above the general ground surface, and it is concluded that the prevention of all run-off in times of heavy rainfall led to an increased supply of water and excessive leaching of calcium carbonate, so that this constituent became the limiting factor in fertility. It was observed that the soil nitrogen appeared to be rendered more available under the above conditions.—J. H. J.

Soils; Comparative rate of formation of soluble material in cropped and virgin —— as measured by the freezing-point method. C. E. Millar. Soil Sci., 1919, 7, 253—257.

Samples of six loam and sand soils, both in a virgin and cultivated condition, were washed till soluble matter was removed as tested by depression of freezing-point. Portions were then placed in freezing-point tubes, incubated at 25° C., and the freezing-point determined at intervals during 40 days. In three cases there was a greater production of soluble matter by the virgin than by the cultivated samples, the total concentration of the solution also being higher in the virgin samples. In the remaining cases there was little difference in the rates of formation of soluble matter in the virgin and cultivated samples. It is suggested that a marked decrease in the rate of formation of soluble matter is one of the changes a soil may undergo as the result of cultivation with little return of fertilising matter. J. H. J.

Soil; Changes in composition of the —— and of the water extract of the soil, following addition of [stable] manure. P. L. Hibbard. Soil Sci., 1919, 7, 259—272.

Stable manure was mixed with soil in the proportions of 1, 2, and 5 and the mixtures were kept at the optimum moisture content. Analyses were made from time to time for a year. It was found that the carbon dioxide in the soil air increased in proportion to the manure added. The total carbon in the mixtures decreased while the total nitrogen was constant during the period. The soluble matter decreased at first to below the amount in the soil alone, but increased later above that in the soil; it never became equal to that in the soil and the added manure. Nitrates disappeared at once, but afterwards reappeared, and increased in proportion to the amount of manure present. It is concluded that the addition of fresh manure to soil should not be made just previous to nor during the time a crop is growing.—J. H. J.

Lime requirements [of soils] as determined by the plant and by the chemist. B. L. Hartwell, F. R. Pember, and L. P. Howard. Soil Sci., 1919, 7, 279—282.

Pot experiments were conducted with plants whose growth is favoured by liming, namely, beet and lettuce. Varying quantities of slaked lime, together with other fertilisers, were added before sowing. Increased crops were obtained in the limed pots. When as large crops as possible had been obtained so that the addition of more lime gave no further growth, the lime requirements of the pots, as tested by chemical methods, were found still to be very large. The addition of acid phosphate (superphosphate) to unlimed pots also led to an increased growth of lettuce, although the superphosphate very largely increased the lime requirements of the soil as tested by chemical methods.—J. H. J.

Limestone; Comparative [agricultural] value of various forms of ——. R. Stewart and F. A. Wyatt. Soil Sci., 1919, 7, 273—278.

From field experiments on acid soils in Illinois it was found that, after the initial acidity had been neutralised, an application of 1 ton of limestone per acre was sufficient to keep the soil alkaline for four years, and that dolomite was as effective for this purpose as a limestone rich in calcium. A coarsely ground limestone was as efficient as a finely ground one and also was retained better by the

soil. Limestone applied to the surface slowly penetrates for 6—20 ins., but the process takes many years; none was found in the subsoil. The annual loss of limestone from the top 20 ins. varied from 500 to 700 lb. per acre.—J. H. J.

Ammonia-fixing capacity of calcium sulphate. F. E. Bear and A. C. Workman. Soil Sci., 1919, **7**, 283—291.

OBSERVATIONS have been made in practice that the addition of calcium sulphate to manure prevents volatilisation of ammonia. To test the nature of this reaction under simple conditions, laboratory experiments were carried out in which the manure was replaced by paper pulp which was mixed with calcium sulphate and placed in a bottle. A solution of ammonium carbonate was poured over the pulp, giving a water content of 75%. The amounts of the substances present were equivalent to 300 lb. of calcium sulphate and 19·29 lb. of nitrogen to the ton of soil. The bottle was kept at different temperatures between 20° and 80° C. A current of moist air free from carbon dioxide and ammonia was drawn through the mixture and then through absorption vessels containing standard acid. Observations were continued over 95 days, air being drawn through daily for about ten minutes at a time. The amount of nitrogen carried over from the pulp at the end of the experiment was 1·1419 grm., or 11%, and in a control experiment without calcium sulphate 5·6225 grms., or about 58%. Much more nitrogen was carried over at the higher temperatures (above 30° C.), and at those temperatures the proportion held back by the calcium sulphate was considerably less. It would thus appear that the addition of 300 lb. of calcium sulphate to a ton of manure would effect a pronounced fixation of ammonia, provided there was sufficient moisture present to dissolve the calcium sulphate. It is concluded that under the conditions of the experiment the reaction is a simple double decomposition.—J. H. J.

PATENTS.

Fertiliser. R. G. Brindle and A. H. Flint, Chicago, Assignors to Corn Products Refining Co. U.S. Pat. 1,313,162, 12.8.19. Appl., 3.7.18.

THE fertiliser contains the soluble matter extracted from Indian corn.—A. E. D.

Colloidal copper compound. Eng. Pat. 130,712. *See* VII.

XVII. SUGARS; STARCHES; GUMS.

Beet juice; Dextro-rotatory non-sugar substances in ——. V. Stanek. Z. Zuckerind. Böhm., 1917, **42**, 218—228.

THE experiments were undertaken with the hope of finding an explanation of the discrepancies observed between the amounts of sugar found in beet juice by polarimetric analysis and the quantities isolated on the manufacturing scale. The results, however, are not entirely satisfactory. The quantity of optically active, so-called "non-sugar" as determined by Clerget's method in digestion, diffusion, and expressed juice, and the decrease in activity caused by treating the juice with alkali are not sufficient to account for the losses in sugar factories. The "non-sugar" which is assumed to be present is soluble in alcohol; sucrose can be precipitated in a nearly pure condition by the addition of alcohol to the sufficiently concentrated juice, whilst the non-sugar remains dissolved. This observation and the fact that the "non-sugar" substance loses its activity when treated with warm alkali leads the author to the conclusion that it is probably a monosaccharide (possibly dextrose or a pentose) rather than a polysaccharide or pectin substance, since the latter are for the most part precipitable with alcohol and neither so rapidly nor radically altered by alkali. In a diffusion juice, in which unusual quantities of invert sugar were present, a larger amount of optically active "non-sugar" was found than in juices prepared by digestion or expression of the same material.—H. W.

Epifucose. E. Votocek and J. Cerveny. Z. Zuckerind. Böhm., 1917, **42**, 215—217.

FUCONIC acid is converted into epifuconic acid by treatment with pyridine and water and the lactone of the latter acid is reduced by sodium amalgam to epifucose, which was isolated as a sweet, viscous, pale-yellow syrup which did not crystallise after preservation during six months; it has $[\alpha]_D$ = about −9°. The phenylosazone and the *p*-bromophenylosazone are identical with the products obtained from fucose. H. W.

Iron, etc., in gums. Gonnermann. *See* XII.

Breaking down of sugars by enzymes. Euler and Svanberg. *See* XVIII.

Photosynthesis of sugar. Kögel. *See* XX.

XVIII.—FERMENTATION INDUSTRIES.

Sugars; Breaking down of —— by enzymes. H. Euler and O. Svanberg. Z. physiol. Chem., 1919, **105**, 187—239.

THE fermentation of sugars in an alkaline medium (p_H = 8) has been studied. Dextrose, lævulose, sucrose, and invert sugar are rapidly fermented under these conditions, but mannose and galactose are less readily attacked. Maltose is unattacked, so that the enzyme maltase appears to be inactive at p_H 8. The influence of a number of cell poisons on the fermentation of sugar in an alkaline medium has been examined; chloroform, toluene, acetaldehyde, aniline, pyridine, resorcinol, sodium picrate, and phenol inhibited fermentation, whilst sodium salicylate caused a slight increase in the rate of fermentation, and sodium lactate, chloroacetic acid, adrenaline, thyroid extract, and sodium thiosulphate had no appreciable effect. The growth of the yeasts themselves under these conditions has been investigated. (See further J., Chem. Soc., 1919, i., 471.)—J. C. D.

Acetone; Formation of —— by Bacillus acetoethylicum. J. H. Northrup, L. H. Ashe, and J. K. Senior. J. Biol. Chem., 1919, **39**, 1—21.

AN organism which produces acetone and ethyl alcohol from starch or sugar was isolated from old potatoes. The characteristic properties of this organism are not entirely identical with those described for *Bacillus macerans* by Schardinger (Centr. Bakteriol., 2te. Abt., 1905, **14**, 772). Accordingly the new organism is regarded as distinct, and is termed *Bacillus acetoethylicum*. The chief non-gaseous products of fermentation are acetone, ethyl alcohol, and formic acid. The optimum temperature for acetone formation is 43° C., whilst most vigorous fermentation takes place when the reaction of the media is first adjusted to p_H = 8 or 9. The yield of acetone is lower in each succeeding generation, showing that the fermentative power of the organism is injured by sub-culture. Under the conditions employed by the authors the maximum yield of alcohol and acetone is reached in from seven to nine days. This time appears to be little influenced by the quantity of ferment added. The organism ferments pentoses as well as hexoses; from glycerol

no acetone, but only alcohol is formed. The commercial aspect of the process was considered, and it was ascertained that maize meal was the most favourable raw material. The influence of the addition of nitrogenous material, variations in the air supply, and concentration were studied. The addition of nitrogenous material, such as peptone or yeast, increased the acetone yield when little air was admitted to the culture. Aerobic conditions caused a similar increase in the yield of acetone, with, however, a decrease in the yield of alcohol. Addition of nitrogenous substances under these conditions caused no further increase in the amount of acetone produced. The maximum concentration which fermented completely was 8 parts of maize to 100 parts of water. The fermentation of cane molasses was also investigated. A semi-continuous method for carrying on the fermentation is described.—J. C. D.

Ethyl alcohol, aldehyde, and acetone; Determination of ——— in mixtures of the same. K. Hoepner. Z. Unters. Nahr. Genussm., 1917, **34**, 453—466.

To determine alcohol, aldehyde, and acetone in an aqueous solution of the same (*e.g.*, a distillate), a portion of the solution, containing not more than 0·8 grm. of alcohol, is oxidised in the cold with chromic acid mixture. The excess of chromic acid is then reduced by the addition of ferrous sulphate solution, the mixture distilled into dilute sodium hydroxide solution, and this distillate again distilled into hydroxylamine hydrochloride solution. The acetone, which is not oxidised by the chromic acid, forms a ketoxime with the hydroxylamine, and an equivalent quantity of hydrochloric acid is liberated. Titration of this acid gives the quantity of acetone present. $(CH_3)_2CO + NH_2OH,HCl = (CH_3)_2C:N.OH + H_2O + HCl$. Another portion of the original solution is then treated with hydroxylamine hydrochloride solution; the aldehyde and acetone yield the aldoxime and ketoxime respectively, with liberation of hydrochloric acid, and the difference between this quantity of hydrochloric acid and that found previously is a measure of the amount of aldehyde. Alcohol and aldehyde are determined together by oxidising another portion of the solution in the cold with chromic acid mixture. After deducting the amount of chromic acid required by the aldehyde, the remainder of the quantity reduced is a measure of the alcohol present.—W. P. S.

XIXA.—FOODS.

Gluten; Determination of ———. Marchadier and Goujon. Ann. Chim. Analyt., 1919, **1**, 243—246.

One grm. of the flour is mixed with 10 c.c. of glacial acetic acid and centrifuged for 5 mins. at 1500 revs. per min.; the clear liquid is decanted and the sediment is again treated with acetic acid and centrifuged. The united acid liquids are evaporated, the residue dried at 100° C. for 1 hr., and then weighed. The quantity of gluten found in this way agrees with that obtained by the usual washing process and is about 1% lower than the figure obtained by multiplying the total nitrogen by 6·25, as is to be expected, since flour contains nitrogenous compounds other than gluten.
—W. P. S.

Milk; Non-protein nitrogenous constituents of human ———. W. Denis, F. B. Talbot, and A. S. Minot. J. Biol. Chem., 1919, **39**, 47—51.

The results of determinations of total non-protein nitrogen, urea, uric acid, creatine, and creatinine in the milk of normal women are recorded. The values for non-protein nitrogen, urea, preformed creatinine, and uric acid are of the same order as those found for normal blood.—J. C. D.

Protein free from the water-soluble vitamine; Preparation of ———. T. B. Osborne, L. B. Mendel, and E. L. Ferry. J. Biol. Chem., 1919, **39**, 35—46.

Caseinogen, gliadin, lactalbumin, and ovovitellin when prepared by the usual methods are apparently free from the vitamine. Edestin tends to retain the growth factor somewhat tenaciously.
—J. C. D.

Proteins; Colour reaction of ———. S. Edlbacher. Z. physiol. Chem., 1919, **105**, 240—241.

The protein solution is shaken with sodium hydroxide solution and dimethyl sulphate, and concentrated sulphuric acid is added. A purple coloration develops at the junction of the two liquids. The reaction is dependent on the presence of tryptophane in the protein.—J. C. D.

Cocoa and chocolate; Rapid method for the determination of fat in ———. E. B. Hughes. Chem. News, 1919, **119**, 101.

Two grms. of the powdered sample is mixed with 30 c.c. of 50% alcohol, centrifuged, and the clear liquid decanted; this treatment is repeated. The sediment is then mixed with 25 c.c. of a mixture of equal vols. of ether and petroleum spirit, centrifuged for 15 mins., and the ethereal solution decanted; after a similar second extraction, the mixed ethereal extracts are evaporated, and the residue of fat weighed.—W. P. S.

Fish meal as a food for live stock. C. Crowther. J. Bd. Agric., 1919, **26**, 480—484.

Fish meal for use as a feeding stuff is made from fresh offal removed from fish at the ports, together with whole fish rejected as unfit for human consumption or rendered unsaleable owing to an excessive supply. It is usual to omit herrings on the ground that they contain too much oil, and if cured, too much salt. The material is steamed and a portion of the oil removed; the residue is completely dried and ground to a meal. Analytical results usually lie within the following limits:—Moisture 7—18%, protein 51—63%, oil 1—6%, carbohydrate 0·3—4%, ash 20—28%, calcium phosphate 16—20%, salt 0·6—5%. In order to secure that the use of the meal shall not impart a taint to the flesh of animals fed with it, the Association of Fish Meal, Fish Guano and Fish Oil Manufacturers has agreed to produce a meal to be known as "White Fish Meal," which will have the following limits of composition:—Albuminoids not less than 55%, calcium phosphate not less than 16%, oil not more than 5%, salt not more than 4%.—J. H. J.

Stone-fruit kernels. Alpers. *See* XII.

Patents.

Sterilising milk. V. J. and C. Hegney, Glasgow. Eng. Pat. 130,189, 22.8.18. (Appl. 13,656/18.)

A tank is provided with non-conducting walls and a perforated false bottom. Cans holding the milk to be sterilised stand on the false bottom and are surrounded with water. Electric resistances are placed in the tank below the false bottom and serve for heating the water. When the milk has been raised to the desired temperature, the electric current is cut off, the hot water run out of the tank and replaced by cold water, and the cans removed.—J. H. J.

Butter substitutes. C. E. Newbould, St. Saviour's, Jersey. Eng. Pat. 130,246, 22.11.18. (Appl. 19,209/18.)

A MIXTURE of cooked vegetables, such as butter beans, lentils, carrots, and potatoes, is passed through a wire sieve, then through a hair sieve, and is then rolled up in a cloth and again passed through a hair sieve. The paste is spread out and turned over during three days at 60°—70° F. (15·5°—21° C.). Beef suet to double the weight of the vegetable mixture is boiled, cooled, and mixed with the latter.—J. H. J.

Bottles or flasks used for emulsifying purposes. J. Moderate, Belfast. Eng. Pat. 130,548, 23.1.19. (Appl. 1697/19.)

A BOTTLE or metal flask for emulsifying edible oils with milk or the like is provided with an inwardly projecting bottom in stepped formation and preferably somewhat in the form of a stepped cone. Alternatively, or in combination with this bottom projection, a tapering top of stepped formation may be provided, the object being to produce a maximum of friction when the contents of the bottle are shaken.—C. A. M.

Chilling and freezing animal substances; Process of —— and apparatus therefor. J. C. Shaw, Pretoria, S. Africa. Eng. Pat. 130,346, 31.10.17. (Appl. 15,896/17.)

MEAT is placed in a chamber in which it is subjected to an initial cooling in a partial vacuum for 12—15 hrs., the air exhausted not being returned to the chamber. A superficial drying of the meat takes place under these conditions, which prevents escape of the nutritive contents. Cold air is then circulated through the chamber for 12—15 hrs. to give a secondary chilling at 28° F. (−2° C.). The meat is finally frozen by direct expansion or by brine circulation.—J. H. J.

Syrup and feed; Process of producing —— [from sweet potatoes]. H. C. Gore, Takoma Park, Md. U.S. Pat. 1,310,012, 15.7.19. Appl., 18.2.19.

A MIXTURE of sweet potatoes and water is boiled, ground malt is added, the mixture boiled again, and the liquid portion then separated from the solid for use as a syrup—E. W. L.

Mould; Means for preventing formation of —— [on foods]. G. P. Plaisance, Assignor to Ralston Purina Co., St. Louis, Mo. U.S. Pat. 1,311,709, 29.7.19. Appl., 18.3.18.

THE formation of mould is prevented by adding acetic acid in the proportion of less than 1% to a dry, finely divided food material in granular or powder form.—J. H. J.

Bread-making. G. R. Baker, London, and J. W. Owen, Plymouth. U.S. Pat. 1,312,094, 5.8.19. Appl., 28.3.17.

DOUGH is mixed with a fermenting agent and an acidifying medium and, without proving, sheeted and folded at right angles a large number of times, the folding operations being effected by the gravity of the dough. A large number of fermentation centres are evenly distributed throughout the dough, which is then proved and baked, or first moulded into loaves and then proved and baked.
—J. H. J.

Steep water [from Indian corn]; Product from ——. R. G. Brindle, Chicago, Assignor to Corn Products Refining Co. U.S. Pat. 1,313,163, 12.8.19. Appl., 11.10.18.

THE product consists of the soluble matter from Indian corn, with the sugar content caramelised.
—A. E. D.

Margarine; Churning or kneading apparatus for ——. A. Rasmussen, Liverpool. Eng. Pat. 131,482, 13.9.18. (Appl. 14,898/18.)

XIXB.—WATER PURIFICATION; SANITATION.

PATENTS.

Water-purifying material and process of making same. H. Kriegsheim, Assignor to The Permutit Co., New York. U.S. Pat. 1,312,552, 12.8.19. Appl., 14.10.16.

THE material consists of zeolite particles bound into a hard and rigid but porous body by a water-resisting binding material.—J. H. J.

[Sewage] sludge; Method and apparatus for treating ——. L. Linden, London. Eng. Pat. 130,830, 20.9.18. (Appl. 15,328/18.)

SLUDGE is transferred directly from the bottom of a settling tank into a hopper with controlled outlet in which the denser solids settle to the bottom and are run off into a spherical vessel with an outlet at the bottom and provided with revolving arms for mixing the sludge. A deodorant may be added to the sludge at this stage through a special pipe at the top of the vessel. The latter is surrounded by a jacket, so that the sludge may be heated during the mixing process, in which case an outlet pipe for vapour is provided. From the bottom of this vessel the sludge passes into a hopper and is distributed as an even layer upon an endless perforated band travelling across the top of a chamber supplied with hot air or gases. From the end of this band the sludge is discharged on to another band travelling over a table under a weighted roller. The pressed sludge passes on to another perforated band travelling over a heated chamber similar to the first, and then into a series of troughs superposed above one another in a drying chamber. Archimedean screws revolve in the troughs and serve to break up the sludge, as well as to pass it along to an outlet. There is a fire-grate at the bottom of the chamber, and the dried sludge may be passed on to the grate and burned. Instead of the fire, the chamber may be heated by gases from a refuse destructor.—J. H. J.

Formaldehyde solutions; Preparation of stable ——. L. Elkan Erben, G.m.b.H., Berlin. Ger. Pat. 312,649, 25.11.17.

THE stability and also the disinfecting properties of formaldehyde solutions are increased by the addition of salts of lignic or sulpholignic acid or of cellulose extracts.—G. F. M.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Cinchona series; Syntheses in the ——. I. The simpler cinchona alkaloids and their dihydro-derivatives. M. Heidelberger and W. A. Jacobs. J. Amer. Chem. Soc., 1919, 41, 817—833.

DESCRIPTIONS are given of the products of the reduction of various cinchona alkaloids by means of palladous chloride in dilute sulphuric acid. Hydrocupreine, obtainable in large quantity by de-etherifying hydroquinine by treatment with boiling aqueous hydrobromic acid, and its ethyl ether, which are both lævo-rotatory, are compared with

their dextro-rotatory stereoisomerides, hydrocupreidine and ethylhydrocupreidine. These have not been previously described; the former is readily prepared from hydroquinidine by the method used for preparing hydrocupreine, and is easily converted into its ethyl ether by means of ethyl sulphate and alcoholic alkali hydroxide. Iso-octylhydrocupreine dihydrochloride, recommended in Germany during the war, under the name "Vuzin," for the treatment of infected wounds, has also been prepared. (See also J. Chem. Soc., 1919, i., 493.)—T. H. P.

Morphine; Quantitative estimation of —— and solubility of morphine in ammonia. A. Heiduschka and M. Faul. Arch. Pharm., 1917, 255, 441—466.

A MODIFICATION of the Kjeldahl method is described by means of which the nitrogen content of morphine may be determined accurately. The method for the estimation of morphine in opium described in the Deutsches Arzneibuch (5th Edition, 1910) is based on the precipitation of the morphine by means of ammonia and subsequent titration of the morphine with standard acid in presence of iodeosin as indicator. Since morphine is soluble in ammonia solutions, and discordant values have been given by different authors for its solubility, the authors have measured the solubility in distilled water and in ammonia solutions of various concentrations at 18° and 25° C. The results show that the solubility of morphine in ammonia solutions is proportional to the concentration, not of the ammonia, but of the hydroxyl ions. Experiment shows that the complete precipitation of the morphine from 10 c.c. of $N/10$ morphine solution requires the addition of 17·5 c.c. of $N/10$ ammonia solution; that is, 1·75 times the theoretical quantity; in the application of this method to the estimation of morphine the authors suggest that double the theoretical amount of ammonia be taken. According to the method of the Deutsches Arzneibuch, almost exactly three times the theoretical quantity of ammonia is used, and this, with opium containing 12% of morphine, results in an error of 0·105%. With adulterated opium poor in morphine such error increases, and if the method indicates m grms. of morphine, the true weight, M, is given by the expression,

$$M = m + (0{\cdot}085 - 34{\cdot}068m/303{\cdot}18)k \text{ grms.};$$

for k, which is the amount of morphine dissolved by 1 grm. of ammonia, the mean value 0·3149 may be employed. Correction in this way of the values obtained in the determination of morphine in presence of lactose leads to results approximating closely to the truth.—T. H. P.

Meconic acid and its behaviour in the quantitative estimation of morphine in opium. A. Heiduschka and M. Faul. Arch. Pharm., 1917, 255, 482—496.

EXPERIMENT shows that the estimation of morphine in opium by the method given in the Deutsches Arzneibuch (compare preceding abstract) is not affected by the presence of meconic acid, which also occurs in opium, since, under the conditions employed, this acid is not precipitated with the morphine, but remains in solution. It is, however, important that the mother liquor shall be removed as completely as possible from the crystallised morphine, since otherwise the subsequent drying would be accompanied by separation of crystalline calcium ammonium meconate, which reacts alkaline towards iodeosin, the indicator used in the titration of the morphine. Such removal is actually effected by the procedure prescribed by the method. The meconic acid in the ammoniacal opium extract may be determined by precipitating it as calcium meconate, igniting the latter, and weighing the residual calcium oxide; allowance must be made for the solubility of calcium meconate in the ammonia solution.—T. H. P.

Berberine; Determination of —— and content of hydrastine and berberine in Hydrastis canadensis cultivated in Austria. R. Wasicky and M. Joachimowitz. Arch. Pharm., 1919, 255, 497—506.

No method yet given serves for the accurate estimation of berberine, although Schwickerath and Linde's method, based on precipitation of the berberine as sulphate, suffices for practical purposes. More accurate results may be obtained by estimating the total alkaloids and subtracting therefrom the amount of hydrastine determined by means of picrolonic acid (compare Matthes and Rammstedt, this J., 1907, 483); the relatively unimportant proportions of canadine and meconine may be neglected. The authors' experiments show that berberine may be determined accurately as follows: 6 grms. of the powdered drug is left in contact with 60 grms. of 95% alcohol for 48 hours, with occasional shaking, 50 grms. of the extract being then filtered off and treated with excess (50 grms. is more than sufficient) of acidified Mayer's reagent (13·55 grms. of mercuric chloride and 50 grms. of potassium iodide to 1 litre of water). The precipitate formed is filtered off and washed three times with 50% alcohol containing a little Mayer's reagent and then with water containing mercuric-potassium iodide. The filter and its contents are transferred to an extraction funnel and shaken for five minutes alone and for thirty minutes with 5 grms. of sodium chloride and 150 c.c. of ether; after being left at rest for five hours the funnel is again shaken for five minutes, 100 c.c. of the clear berberinal solution is pipetted off and treated with excess of an ethereal solution of picrolonic acid, the berberine picrolonate formed being collected in a Gooch crucible, washed with ether, dried at 110° and weighed. Berberine : berberine picrolonate = 353·26 : 600·25. For the separation of berberine and hydrastine the mercuric potassium iodide may be replaced by aqueous potassium iodide solution. 6 grms. of the drug is heated with 60 grms. of water on a water-bath for 15 minutes and, after replacement of the water evaporated, left for 48 hours. 50 grms. of the pressed and filtered extract is then treated with excess of potassium iodide solution, the precipitated berberine hydriodide being filtered off, washed with water containing potassium iodide so long as the filtrate shows alkaloid reactions, and treated in the way described above for the mercuric potassium iodide precipitate, except that a 10:1 ether-alcohol mixture is used for the shaking. The percentages of hydrastine (h) and berberine (b) found in different parts of *Hydrastis canadensis* grown at Kornenburg, near Vienna, are as follows: Subsidiary roots, h = 1·9, b = 2; root-stock, h = 3·77, b = 3·0; leaves, h = 0·77, b = 0·55; axial shoots and leaf stems, h = 1·12, b = 1·18.—T. H. P.

Alkaloids; Applicability of cuprammonium sulphate to the acidimetric estimation of —— by Falières' process. H. Kunz-Krause and R. Richter. Arch. Pharm., 1917, 255, 507—513.

THE cuprammonium sulphate solution prepared by Falières (this J., 1899, 869) for the estimation of alkaloids becomes turbid after a few days, so that repeated filtration and re-standardisation are necessary. This may be avoided if the amount of ammonia solution added to the copper sulphate solution is just sufficient, instead of just insufficient, to dissolve the cupric hydroxide first precipitated.

The cuprammonium solution is standardised by adding it slowly to 20 c.c. of $N/10$ sulphuric acid until a single drop produces turbidity in the clear liquid, 0·05 c.c. being then subtracted from the volume thus run in. In carrying out the estimation of an alkaloid, the liquid being titrated should be compared with a quantity of the same liquid in a similar beaker of pure white glass, the two beakers being placed on the same surface, which is either white or black, according to the colour of the liquid. Towards the end of the titration it is necessary, after addition of each drop of the cuprammonium solution, to shake the liquid vigorously and allow it to stand for some time, since the turbidity develops only gradually. With these precautions the method gives satisfactory results with solutions of pure alkaloids, but it is inapplicable to tinctures, extracts, etc., preliminary separation of the alkaloids being necessary. In any case it lacks the sensitiveness of the iodeosin method, which admits of the use of $N/100$ solutions.
—T. H. P.

Alkaloids; Effect of plant injury upon ——. O. Tunmann. Biochem. Zeits., 1919, **95**, 164—169.

No increase in the amount of alkaloid present in the leaves of *Atropa belladonna* or *Pilocarpus pennatifolius* was detected after injury.—J. C. D.

Uzarin from Gomphocarpus root. L. Koller. Arch. Pharm., 1917, **255**, 550—552.

The extraction of uzarin (compare Hennig, this J., 1918, 39 A) is described and various reactions for it are given. (See J. Chem. Soc., 1919, i., 492.)
—T. H. P.

Ricinine. E. Winterstein, J. Keller, and A. B. Weinhagen. Arch. Pharm., 1917, **255**, 513—539.

Ricinine may be prepared as follows: 50 kilos. of pressed *Ricinus* residue is digested with 200 kilos. of water for 24 hours, then boiled for 3 hours and the liquid separated by means of filter bags. The residue is washed and again boiled with water, the whole extract being evaporated first over a naked flame and afterwards on a water-bath to a syrup (7·5 kilos.), which is exhausted by boiling twice with two quantities of 20 litres of 90% alcohol. The alcoholic solution yields a brown mass (750 grms.), which is boiled for an hour with five separate quantities of chloroform, the latter being filtered off after each boiling. Distillation of the chloroform leaves a crystalline mass contaminated with fatty and resinous matter. After being purified to some extent by treatment with ether, the crystals are dissolved in boiling water and the solution treated with lead acetate and filtered, the filtrate being freed from excess of lead by cautious addition of sulphuric acid. Evaporation of the solution yields crystalline ricinine (80 grms.), a further amount (10 grms.) being obtainable from the mother-liquors by addition of excess of lead acetate and treatment with sulphuric acid as before. Extraction of the final mother-liquor with chloroform gives more ricinine (2 grms.), the total yield being 0·18%. Ricinine occurs in all the organs of the *Ricinus* plant: about 0·15% in the ripe seeds, 1·37% in the leaves of young plants, and almost 2·5% in etiolated seedlings. The properties of ricinine, its formula, and its decomposition products have been investigated (see J. Chem. Soc., 1919, i., 500).—T. H. P.

Thyroid; Isolation of iodine compound of ——. E. C. Kendall. J. Biol. Chem., 1919, **39**, 125—147.

The method for isolating the physiologically active component of the thyroid gland is described. The product, thyroxin, has been prepared in a crystalline form. (See further J. Chem. Soc., 1919, i., 496.)—J. C. D.

Vitamine studies. IV. Antineuritic properties of certain physiological products. R. A. Dutcher. J. Biol. Chem., 1919, **39**, 63—68.

The paralytic symptoms in avian polyneuritis were relieved in pigeons by administration of thyroxin, desiccated thyroid gland, pilocarpine hydrochloride, and tethelin.—J. C. D.

Catechol and adrenaline; New reaction of ——. Denigès. Bull. Soc. Pharm. Bordeaux, 1919 Ann. Chim. Analyt., 1919, **1**, 255.

The reaction of apomorphine described by Grimbert and Leclerc (this J., 1915, 150) is also given by morphine, codeine, and other direct derivatives of morphine. The substance is heated with 2 drops of sulphuric acid until charring commences, the mixture cooled, treated with 5 c.c. of saturated sodium acetate solution and 2 drops of saturated mercuric chloride solution, and boiled; a green coloration develops. In the case of catechol, the above test yields a red-violet coloration; the colour is soluble in ether, chloroform, and amyl alcohol. Adrenaline (catechol-methylaminopropanol), under the same conditions, gives an intense red coloration; the coloration begins to appear in the cold, and the temperature should not exceed 50° C., otherwise the coloration disappears.
—W. P. S.

Hexamethylenetetramine; Quantitative study of the breaking down of ——. P. Trendelenburg. Biochem. Zeits., 1919, **95**, 146—163.

The breaking down of hexamethylenetetramine into formaldehyde occurs in acid solutions. Slight decomposition may occur in neutral solution, but when the reaction is alkaline this is prevented. The bearing of these observations on the value of hexamethylenetetramine for therapeutic purposes is discussed. (See further J. Chem. Soc., 1919, ii., 103.)—J. C. D.

Formaldehyde and sugar; Photosynthesis of ——. P. R. Kögel. Biochem. Zeits., 1919, **95**, 313—316.

Keto-enol changes probably play an important rôle in the photosynthesis of formaldehyde and sugar.—J. C. D.

Bay oil and thymol in Montserrat. F. Watts. Annual report on the Agricultural Department, Montserrat. Perf. Essent. Oil Rec., 1919, **10**, 213—216.

In 1917 the experimental bay-tree plantation yielded 71 lb. of oil per acre, an average yield of 17·8 oz. per 100 lb. of green leaves, compared with 17·3 oz. in the previous year. There was a further improvement in the quality of the oil, the average sp. gr. and phenol content being 0·9441 and 55% respectively, as against 0·9351 and 50·9% in 1914–16. Further trials were carried out with ajowan (*Carum copticum*), but owing to unfavourable rainfall the results were not so good as in previous years. Yields of 471 lb. and 360 lb. of cleaned seeds per acre were obtained on two separate plots, and these gave on distillation 2·7—3·0% of oil having the following characteristics:—Sp. gr. 0·9112, refractive index 1·502, phenols 47·3%, thymol recovered 43·5%. The oil was therefore similar to commercial ajowan oil. The oil obtained by the distillation of the stems and seeds of the plant was very inferior in quality, and contained but little thymol.—G. F. M.

Eucalyptol; Determination of —— in eucalyptus oil. C. T. Bennett and M. S. Salamon. Perf. Essent. Oil Rec., 1919, **10**, 211—212.

For the determination of eucalyptol in oils containing less than 85%, 5 c.c. of phosphoric acid, as specified in the B.P. test, is quite sufficient for complete precipitation. When the eucalyptol content is greater than 85% the use of 6 c.c. of phosphoric acid gives slightly higher results, but 7 c.c. is always too much and invariably gives low results. Arsenic acid gives practically the same results as phosphoric acid, but both processes undoubtedly give low values, chiefly owing to decomposition during the pressing of the phosphate or arsenate cake, which can be minimised to some extent by operating at as low a temperature as possible. The addition of petroleum spirit to the oil before precipitation does not tend to give concordant results. —G. F. M.

Camphor; Solubility of —— in water. H. Leo and E. Rimbach. Biochem. Zeits., 1919, **95**, 306—312.

The solubility of camphor in pure water is 1 part in 598. In Ringer's solution it is 1 in 577. The solubility in water falls with rise of temperature. —J. C. D.

Sodium salicylate; The quantitative B.P. test for ——. J. B. P. Harrison and F. E. Carter. Pharm. J., 1919, **103**, 230—231.

In the estimation of sodium salicylate by ignition and titration of the resulting sodium carbonate, low results are obtained owing to occlusion of alkali in the carbonaceous residue. This cannot be removed by boiling with water or even dilute acid, but the difficulty may be overcome by re-igniting the carbonaceous residue and filter paper, after filtering off the aqueous extract, until all the carbon has burned away, dissolving the residue in water and adding to the main filtrate. A known excess of acid is then added, the precipitated colloidal carbon filtered off, and the excess acid titrated back in the clear colourless filtrate.—G. F. M.

Mercury salts; Volumetric determination of ——. Evaluation of mercury chloride compresses. Utz. Pharm. Zentr., 1919, **60**, 301—302.

A method described by Adanti (this J., 1916, 1258) was prosposed originally by Rupp (this J., 1905, 752; 1906, 1175).—W. P. S.

Alcohol, aldehyde, and acetone. Hoepner. *See* XVIII.

Patents.

Alcohols; Process for preparation of primary ——. Soc. Chim. des Usines du Rhône, Paris. Eng. Pat. 122,630, 3.1.19. (Appl. 217/19.) Int. Conv., 22.1.18.

Primary alcohols are obtained in almost theoretical yield by the action of dry gaseous ethylene oxide on organic magnesium compounds of the type R.Mg. Halogen (where R is an aryl radical), and hydrolysing the addition compounds produced. For example, a current of gaseous ethylene oxide is passed into an ethereal solution of magnesium phenyl bromide, the temperature being maintained between 0° and 10° C. When 1 mol. has been absorbed for each mol. of phenyl bromide 200 c.c. of dry benzene is added for each grm.-mol., the ether is evaporated off, dilute sulphuric acid is added, and the phenylethyl alcohol formed is decanted from the benzene solution and purified by distillation. Examples are also given of the preparation of *p*-tolylethyl alcohol, *p*-methoxyphenylethyl alcohol and 2-methoxytolyl-5-ethyl alcohol.—G. F. M.

Acetic acid; Manufacture of —— from acetaldehyde. H. Dreyfus, Basle, Switzerland. Eng. Pat. 130,035, 31.12.17. (Appl. 19,353/17.) Int. Conv., 22.2.17.

Acetaldehyde is oxidised almost quantitatively to acetic acid by introducing oxygen, air, or other gas containing free oxygen, at substantially atmospheric pressure, into the liquid substance, maintained by suitable cooling at a temperature between 0° and 10° C., and thoroughly agitated by a rotary stirrer revolving at 500—1000 revs. per minute in order to atomise the entering gas in contact with the liquid. The speed of the reaction may be increased by the addition of ferric oxide or acetate or both as contact material. The temperature must not be allowed to fall below 0° C. owing to danger of explosion from the formation of per-acid. —G. F. M.

Acetic acid; Preparation of —— by means of the oxidation of acetaldehyde. Comp. des Prod. Chim. d'Alais et de la Camargue, Paris. Eng. Pat. 130,651, 28.2.18. (Appl. 3590/18.) Int. Conv., 6.3.17.

Acetaldehyde is oxidised in a tower or series of towers, containing quartz, broken glass, or other inert material, by means of oxygen or air without a catalyst, and the reaction product flows into a supplementary heating apparatus, maintained at 100° C., where any per-acetic acid not decomposed in the oxidation towers is immediately converted into acetic acid, thereby averting the danger of explosion resulting from its accumulation in the oxidation apparatus.—G. F. M.

Acid anhydrides and chlorides; Manufacture of organic ——. A. Boake, Roberts, and Co., Ltd., Stratford, and T. H. Durrans, Oxford. Eng. Pat. 130,399, 15.2.18. (Appl. 2733/18.)

In the manufacture of organic acid anhydrides or chlorides by the simultaneous action of sulphur dioxide and chlorine on an alkali or alkaline-earth salt of an organic acid, the absorption of the gases proceeds much more readily when a small proportion (1%) of organic or inorganic esters, phenols, ethers, aldehydes, hydrocarbons, or acetals is mixed with the metallic salt. Amongst the substances cited in the patent are ethyl acetate, triphenyl phosphate, dibenzyl ether, pinene, benzaldehyde, the cresols, and methylal.—G. F. M.

Acetic anhydride; Manufacture of ——. H. Dreyfus, London. Eng. Pat. 130,660, 4.3.18. (Appl. 3797/18.)

In the manufacture of acetic anhydride by the action of sulphur trioxide on an alkali or alkaline-earth acetate (Eng. Pat. 17,920/15; this J., 1917, 162) better results are obtained if the trioxide is introduced in the gaseous form diluted with an indifferent gas such as, for example, the gaseous mixture obtained in the manufacture of sulphuric anhydride by the contact process. Such a gaseous mixture can be cooled to 0° to −20° C. without the solidification of the trioxide, and can accordingly be brought into reaction with the acetate, mixed or not with acetic anhydride, and maintained at this temperature during the introduction of the reagent.—G. F. M.

Phosphorus-reserve-compound of green plants; Manufacture of the organic —— and salts thereof. O. Imray, London. From Society of Chemical Industry in Basle, Switzerland. Eng. Pat. 130,456, 30.7.18. (Appl. 12,401/18.)

A pure sodium salt of the organic phosphorus reserve compound is obtained by dissolving a mixture

of salts of the compound or the impure free acid of the compound in dilute mineral acid, precipitating the phosphorus compound by means of a solution of a ferric salt, decomposing the washed precipitate with an excess of sodium hydroxide, adding alcohol to the filtered solution, allowing the weak alcoholic solution to crystallise, and recrystallising the crystalline mass from water. Well developed efflorescent prisms of the composition, $C_6H_6P_2O_{24}Na_{12},47H_2O$, are thus obtained, melting at 49° C. The anhydrous salt is a snow-white, non-hygroscopic powder, alkaline in reaction, and insoluble in organic solvents. By double decomposition insoluble calcium, magnesium, strontium, barium, lead, or copper salts may be obtained, from which by the action of oxalic acid or hydrogen sulphide, as the case may be, a solution of the pure acid of the phosphorus compound can be prepared. The acid may be partially or wholly saturated with organic or inorganic bases to prepare definite acid, neutral, or alkaline salts.—G. F. M.

Acetic aldehyde; Preparation of —— from acetylene. Comp. des Prod. Chim. d'Alais et de la Camargue, Paris. Eng. Pat. 130,650, 28.2.18. (Appl. 3589/18.) Int. Conv., 12.1.17.

In the continuous preparation of acetaldehyde from acetylene in the presence of mercury catalysts the difficulties arising from subsidiary reactions between the aldehyde and the catalyst are eliminated by the continuous removal of the aldehyde from the reaction mixture by the use of a vacuum. In order that the acetylene should not be drawn through the liquid without being fixed, the vacuum is applied to a receiver separate from the reaction vessel, but connected with it in such a way that there is a continuous circulation of the reaction liquid between the two vessels. This may, for example, be attained by placing the vacuum vessel at a certain height above the reaction vessel, connecting it to a point below the level of the liquid in the latter by a pipe, through which, by the action of the vacuum, the liquid is drawn, and providing a reflux pipe from the bottom of the vacuum vessel to the reaction vessel.—G. F. M.

Acetaldehyde; Manufacture of ——. J. Crosfield and Sons, Ltd., Warrington, Lancs., and T. P. Hilditch, Grappenhall, Cheshire. Eng. Pat. 131,084, 25.4.18. (Appl. 6980/18.)

In the manufacture of acetaldehyde from acetylene in the presence of mercuric salts, the insoluble sludge of mercury and mercurous sulphate which is formed during the reaction by reduction of the mercuric salt by a portion of the acetaldehyde formed, is re-oxidised at the conclusion of the production of acetaldehyde by the addition of a small quantity of lead dioxide, red lead, cerium dioxide, or manganese dioxide to the liquor containing the sludge and agitation of the mixture by continuation of the passage of the acetylene. The oxidation may be repeated several times until the accumulation of resins prevents satisfactory absorption of the acetylene, and then the sludge can be washed free of organic matter and again re-oxidised in the presence of fresh sulphuric acid.—L. A. C.

Esters; Manufacture of ——. A. Boake, Roberts, and Co., Ltd., Stratford, T. H. Durrans and W. E. Ellis, Oxford. Eng. Pat. 131,088, 26.4.18. (Appl. 7040/18.)

In the manufacture of esters by passing a mixture of the vapours of alcohols and fatty acids over a catalyst, such as phosphoric or sulphuric acid, acid alkali phosphate or sulphate, zinc, calcium, or magnesium chloride, or the like, the catalyst is applied to an inert solid material capable of holding or retaining it. Suitable materials are pumice stone, unglazed earthenware, coke, firebrick, and asbestos. Example:—Pumice stone in irregular pieces of about 1 inch diameter and free from dust is immersed in orthophosphoric acid, allowed to drain in an atmosphere free from water, and heated to about 300° C. to expel excess acid. A mixture of methyl alcohol and acetic acid vapour is passed over the catalyst heated to between 100° and 300° C. (*e.g.*, from 120° to 130° C.) under normal or reduced pressure. The issuing vapours are condensed and the constituents separated, *e.g.*, by fractional distillation. If the material is treated with a solution of the catalyst in water, the water must be subsequently removed by heating, preferably under reduced pressure.—L. A. C.

Vanillin; Manufacture of ——. Confectionery Ingredients Ltd., London, F. E. Matthews, London, A. T. King, Wimbledon, and T. Kane, Gaywood. Eng. Pat. 131,161, 20.8.18. (Appl. 13,504/18.)

Acyl derivatives of 4-hydroxy-3-methoxybenzoyl chloride (vanilloyl chloride), such as the acetate, benzoate, or carbonic ester, or the *p*-toluenesulphonic ester, or aralkyl derivatives, such as the benzyl ether, in solution in boiling toluene, xylene, or other suitable inert solvent, are reduced by a current of dry hydrogen in the presence of a hydrogenating catalyst, *e.g.*, palladium deposited on barium sulphate or asbestos, to the corresponding vanillin derivatives. The reduction product is then hydrolysed to vanillin. Example:—Dry hydrogen is passed through a boiling solution of 154 parts of vanilloyl chloride in 1000 parts of dry xylene containing 30 parts of 5% palladised barium sulphate until evolution of hydrogen chloride ceases. The aldehyde formed yields 185 parts of the sodium bisulphite compound, which on conversion again to the aldehyde, gives a product melting at 122° C.—L. A. C.

Chloroform; Manufacture of ——. H. H. Dow, Midland, Mich., and W. O. Quayle, Wilmington, Del., Assignors to The Dow Chemical Co., Midland, Mich. U.S. Pat. 1,311,329, 29.7.19. Appl., 8.6.14.

A mixture of carbon tetrachloride and water is treated with a reducing agent in quantity sufficient to effect reduction to chloroform. Distillation under reduced pressure proceeds concurrently with the reaction, the vapours being led through a fractionating column to effect the separation of the chloroform from other volatile substances distilling over.—G. F. M.

Ether; Anæsthesia —— and process of making the same. E. M. Flaherty, Parlin, N.J., Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,312,475, 5.8.19. Appl., 18.2.18.

Ether is treated with a cold aqueous solution of an alkali, and the ether vapour is passed subsequently over solid sodium hydroxide.—C. A. K.

Tannin-protein compound; Preparation of a ——. Knoll und Co., Ludwigshafen. Ger. Pat. 312,602, 15.9.17.

A tannin-protein compound containing about 40% of tannin is obtained by treatment of either moist or dry casein with a solution of tannin, either with or without a preliminary treatment with sodium hydroxide.—G. F. M.

Sodium iodide-dextrose; Preparation of anhydrous ——. J. A. Wülfing, Berlin. Ger. Pat. 312,643, 4.5.18.

Anhydrous dextrose and dry sodium iodide, in the

proportion of 2 mols. of the former to 1 mol. of the latter, are intimately mixed, and the mixture is either melted, or moistened with strong alcohol and dried at 100°—115° C., whereby the double compound $2C_6H_{12}O_6,NaI$ is formed in quantitative yield. This compound has the advantage over both sodium iodide and the hydrated compound $2C_6H_{12}O_6,NaI, H_2O$ of being non-hygroscopic. If desired the amount of dextrose may be increased beyond that specified, whereby a more friable and more readily fusible substance is produced.—G. F. M.

Organic phosphorus compound from plants. S. Posternak, Chêne-Bougeries, Assignor to Soc. Chem. Ind. in Basle, Switzerland. U.S. Pat. 1,313,014, 12.8.19. Appl., 12.7.18.

See Eng. Pat. 130,456 of 1918; preceding.

Hormones and phosphatides and process of obtaining same. S. Fraenkel and E. Hermann, Vienna, Assignors to Soc. of Chem. Ind. in Basle, Switzerland. U.S. Pat. 1,314,321, 26.8.19. Appl., 30.7.14.

See Ger. Pat. 309,482 of 1914; this J., 1919, 554 A.

Formaldehyde solutions. Ger. Pat. 312,649. *See* XIX B.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Sulphur-toning in solutions of polysulphides. L. P. Clerc. Bull. Soc. Franç. Phot., 1919, **6**, 200—201.

Desalme's method of toning with polysulphides (this J., 1913, 253) does not work equally well with all papers, some being apparently quite unaffected by the treatment. In most of these cases there is, however, a certain amount of toning, the colour of the sulphide formed being masked by the blackness of the remaining silver image, since a print which was submitted to the sulphiding bath with no apparent effect was found, on treatment with a bleaching solution of ferricyanide and thiosulphate, to leave a sepia-brown image. The action of the toning bath may be hastened by an increase of temperature up to 50° C., a preliminary hardening of the film being given by formaldehyde treatment, but the tone obtained is a brown-purple, more like that given by a hypo-alum bath than the usual sepia tone of the polysulphide bath. Continued treatment up to 6 hours' duration will also effect toning of some prints apparently unaffected by normal treatment. Transparencies behave similarly to papers, but some prints will withstand even prolonged hot treatment.—B. V. S.

Patent.

Photographs; Method of producing multicolour ——. A. R. Lawshe, Trenton, N. J., U.S.A. Eng. Pat. 131,319, 7.8.16. (Appl. 11,134/16.)

See U.S. Pat. 1,248,139 of 1917; this J., 1918, 75 A.

XXII.—EXPLOSIVES; MATCHES.

Nitrocellulose; Study of ——. E. C. Caron. Ann. Chim. Analyt., 1919, **1**, 235—243.

The method employed for drying washed, but non-stabilised, nitrocellulose consisted in heating the substance for 4 hours in a current of dry air. All the samples examined yielded sulphuric acid when extracted with alcohol, and it is suggested that the relative stability obtained after washing with alcohol may be due to the removal of sulphuric esters. To determine combined sulphuric acid, the nitrocellulose was treated with hydrogen peroxide and sodium hydroxide solution, heated for 5 mins., cooled, the treatment repeated, the mixture then acidified slightly with hydrochloric acid, filtered, and the sulphuric acid in the filtrate precipitated by barium chloride. The author has also investigated the question of the presence of nitrous esters in nitrocellulose without coming to any very definite conclusions. Further experiments showed that acetaldehyde gelatinises nitrocellulose, yielding a mass which is insoluble in alcohol-ether and in chloroform, but which is readily soluble in acetone. The jelly yielded crystals on standing. On reprecipitating the nitrocellulose from the acetone solution it was found to yield 22% of HNO_3, whilst the highest amount of HNO_3 given by a specimen not treated with acetaldehyde did not exceed 6·7%.
—W. P. S.

α-, β- and γ-Trinitrotoluenes. H. Ryan and W. M. O'Riordan. Proc. Roy. Irish Acad., 1918, **34**, B, 175—193.

The authors have investigated the behaviour of α-, β- and γ-trinitrotoluenes towards alkalis, amines, hydrocarbons, and aldehydes under comparable conditions. (See also J. Chem. Soc. 1919, i., 477.)
—T. H. P.

Azides and fulminates; Initial action of ——. L. Wöhler and F. Martin. Z. ges. Schiess- u. Sprengstoffw., 1917, **12**, 1—3, 18—21, 39—42, 54—57, 74—76. Chem. Zentr., 1919, **90**, I., 423—425.

Kast's detonation formula was applied to various azides and fulminates, and the cals. per grm. and heat of decomposition per mol. were calculated. The number of cals. per grm. ranged from 233 (thallium azide) and 266 (mercury azide), to 558 (cadmium azide), 582 (copper azide), 625 (calcium azide), and 676 (manganese azide). The initiating capacity was graphically represented as a function of the sensitiveness of the secondary explosive. In this respect cadmium azide and silver and copper fulminates were the best. A table is given of the minimum charges required to effect the explosion of 0·5 grm. of tetryl, picric acid, trotyl, trinitroanisol, and trinitroxylene. From the results obtained with Martin's apparatus, in which the detonation is used as the indicator, it appears that a definite initiating capacity requires the production of a definite pressure, for the development of which different quantities of detonating substances are required. Equivalent initiating quantities produce in their immediate vicinity equal compression, so that the initiating action consists in the formation of a definite pressure, and the initial explosion in the distribution of a high velocity of reaction in the external layers of the explosive to be detonated.
—C. A. M.

Phenyl-2-naphthylamine; Nitro-derivatives of ——. H. Ryan and J. J. Drumm. Proc. Roy. Irish Acad., 1918, **34**, B, 165—174.

Phenylaceto-2-naphthalide has been suggested as a stabiliser for use with nitrocellulose powders. The authors have investigated the behaviour of this substance with nitrous and nitric acids. Nitrogen peroxide, from lead nitrate, has apparently no action on this stabiliser in dry ethereal solution. In moist ether hydrolysis and nitration occur, phenyl-2-naphthylamine and one of its mononitro-derivatives, m.pt. 119°—120° C., separating from xylene in colourless crystals, being formed. When treated with nitrogen peroxide in alcoholic solution the stabiliser forms 2′.4′-dinitrophenyl-1-nitro-2-naphthylamine, yellow crystals, m.pt. 242° C., and also an isomeric trinitro-derivative, orange crystals,

m.pt. 179° C. Other methods of formation of these substances are described. (See also J. Chem. Soc., 1919, i., 324.)—F. C.

Diphenylamine; Action of nitric and nitrous acids on ——. *I. and II.* H. and P. Ryan. Proc. Roy. Irish Acad., 1918, 34, B, 194—204, 212—217.

IN order to throw light on the changes undergone by diphenylamine added to nitrocellulose powders as a stabiliser, the authors have investigated the action of nitric and nitrous acids at low concentrations and at the ordinary temperature on diphenylamine in glacial acetic acid and in carbon tetrachloride. The products obtained are described and a scheme given showing the various stages in the reaction. (See also J. Chem. Soc., 1919, i., 481, 482.)—T. H. P.

Diphenylamine; Action of bromine on some derivatives of ——. H. Ryan and W. O'Riordan. Proc. Roy. Irish Acad., 1919, 34, B, 218—225.

THE method given by Berger (compare Buisson, *Le Problème des Poudres*) for the estimation of the total amount of diphenylamine, either free or as nitroso-derivative, present as stabiliser in a powder depends on the conversion of the base into its tetrabromo-compound. By boiling the powder with dilute sodium hydroxide solution, the diphenylnitrosamine is converted into diphenylamine; the distillate is then treated with excess of bromine and the amount of the latter not used in the formation of tetrabromodiphenylamine estimated volumetrically. The results of the authors' investigations show that this method, and also that of Dreger (this J., 1909, 489), will give inaccurate results if any of the volatile nitro-compounds which are formed from diphenylamine in a nitrocellulose powder escape interaction with the alkali, or if a mixture of tetra- and hexabromodiphenylamines is formed in consequence either of rise of temperature caused by rapid addition of the bromine or of prolonged contact of the bromine with the product. (See also J. Chem. Soc., 1919, i., 480.)—T. H. P.

PATENTS.

Explosive materials; Manufacture of ——. P. Landrin, Lyons, France. Eng. Pat. 130,093. 23.1.18. (Appl. 1319/18.) Int. Conv., 13.11.17.

SOLID granules of an explosive are obtained by pouring the substance in a melted condition on to a bed of granulated explosive material, which is simultaneously agitated (*e.g.*, in a rotating vessel) and cooled by a current of air.—C. A. M.

Explosive substances; Process for preventing danger of explosion in the preparation and handling of ——. G. Harrison, London. From Soc. d'Etudes Chimiques pour l'Industrie, Geneva. Eng. Pat. 130,166, 30.7.18. (Appl. 12,368/18.)

A POROUS inert material is treated with solutions of non-explosive substances which react together within the porous medium to form an explosive. For example, paper is impregnated with a solution of lead acetate and then treated with a solution of sodium nitride (azide) so as to produce lead nitride (azide), which may be handled without danger while thus distributed through the paper.
—C. A. M.

Explosives; Manufacture of ——. T. C. James, Aberystwyth, J. I. M. Jones and R. I. Lewis, Faversham. Eng. Pat. 130,357, 26.1.18. (Appl. 1517/18.)

TRINITROPHENYLMETHYLNITRAMINE (tetryl) combines with aromatic amines to form stable condensation products which can be readily nitrated by treatment with warm nitric acid, yielding products suitable for use as high explosives. For example, a solution of tetryl and aniline oil in benzene, acetone, etc., yields a crystalline deposit of picrylaniline $C_6H_2(NO_2)_3NH.C_6H_5$, which when treated with warm nitric acid yields hexanitrodiphenylamine without any by-products.—C. A. M.

Picric acid; Process for the production of ——. L. B. Holliday, Huddersfield, and A. Clayton, London. Eng. Pat. 130,382, 7.2.18. (Appl. 2200/18.)

A SOLUTION of sulphonated phenol is treated with a portion (say one-fourth) of a mixture of nitric and sulphuric acids (*e.g.*, 460 lb. of 90% sulphuric acid, 460 lb. of 20% oleum, and 660 lb. of 90% nitric acid), at a temperature not exceeding 45° C., and the mixture stirred for about an hour. The remaining portion of mixed acid, which has previously been heated to 70° C. or over, is then added, and the mass heated to any higher temperature for a suitable time, cooled, and filtered. Under these conditions the reaction takes place without violence.
—C. A. M.

Explosive. C. F. McKenna, New York. U.S. Pat. 1,311,171, 29.7.19. Appl., 22.8.14. Renewed 28.9.18.

THE explosive consists of 75 parts of ammonium perchlorate, 5 parts of nitrated oils separated by fractional distillation of the nitrated oils of wood tar, 5 parts of nitrobenzene, and 5 parts of carbon bisulphide.—C. A. M.

Explosive shells; Cooling ——. A. J. Moxham, New York. U.S. Pat. 1,311,176, 29.7.19. Appl., 9.1.18.

To prevent pitting during cooling, the entire body of explosive material is cooled first to a point approximating to but above its crystallisation temperature, and then to a point below that temperature.—C. A. M.

Explosive and process for making same. C. T. P. Hansen, Glen Olden, Pa., Assignor to F. Berman, Chester, Pa. U.S. Pat. 1,311,274, 29.7.19. Appl., 7.2.18.

THE explosive consists of a mixture of ammonium nitrate, potassium nitrate, resin, sulphur, manganese dioxide, starch, naphthalene, paraffin, tallow, potassium permanganate, and sodium chloride.
—W. F. F.

Primers; Charge for ——. W. H. Buell, New Haven, Conn., Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,311,872, 5.8.19. Appl., 31.8.17.

A PRIMING charge contains trinitronitranilide.
—W. F. F.

Priming charge. W. H. Buell, New Haven, Conn. U.S. Pat. 1,312,156, 5.8.19. Appl., 21.7.16.

A DETONATING salt of trinitroresorcinol is mixed with a nitrated organic substance to form a priming charge.—C. A. M.

Detonators; Composition for ——. C. M. Stine, Chester, Pa., Assignor to E. I. du Pont de Nemours and Co. U.S. Pat. 1,313,650, 19.8.19. Appl., 13.12.13.

THE detonator charge consists of nitrated hemicellulose with a primer containing an initial detonating composition.—W. J. W.

Nitrated cellulose products; Manufacture of ——. W. B. Thomson, W. D. Severn, and G. Twycross, Cape Town. Eng. Pat. 130,665, 7.3.18. (Appl. 4029/18.)

SEE U.S. Pat. 1,302,455 of 1919; this J., 1919, 480 A.

Propellent powder; Process of making ——. A. L. Broadbent and R. G. Woodbridge, jun., Assignors to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,313,459, 19.8.19. Appl., 14.7.16.

See Eng. Pat. 127,871 of 1917; this J., 1919, 604 A.

Bags for explosives. Eng. Pat. 130,410. *See* V.

XXIII.—ANALYSIS.

Normal temperature for chemical standards. W. Block. Chem.-Zeit., 1919, **43**, 477—479.

A TEMPERATURE of 15° C. is now generally used in standardising chemical volumetric apparatus, but the author considers that 20° C. would be more suitable and convenient. Standardising at 15° C. often involves artificial cooling, which is less convenient than the application of heat.—W. P. S.

Tin: an ideal pyrometric substance. E. F. Northrup. Amer. Inst. Min. and Met. Eng. Engineering, 1919, **108**, 309—310.

TIN in a state of high purity may be obtained at a relatively low cost, and so is suitable for pyrometry. It melts at 232° C. and does not begin to boil below 2270° C. It remains chemically uncontaminated after prolonged heating at 1680° C. in Acheson graphite. Wires of pure tungsten do not melt in tin at 1680° C., and so may be used as electrodes for measuring the resistance of the molten metal. When tin is heated in a covered graphite vessel, the carbon monoxide present prevents its oxidation and enables it to retain its surface of mirror brightness. Its increase in resistivity and decrease in density with increase in temperature are of a strictly linear character, and tin is therefore an excellent material for determining temperatures. The relation between temperature and resistivity is best determined by Northrup and Sherwood's method (this J., 1916, 1162). A suitable method for determining the expansion or decrease in density with increase in temperature has been described previously (this J., 1917, 1161). The author suggests that a re-determination of the melting points of the more refractory metals should be made in terms of the resistivity of tin.—A. B. S.

Calcium, magnesium, and phosphorus; Quantitative estimation of very small amounts of —— in animal substances. L. Dienes. Biochem. Zeits., 1919, **95**, 131—145.

THE author has modified certain standard methods so that they may be employed for the analysis of very small amounts of material. (See further J. Chem. Soc., 1919, ii., 427.)—J. C. D.

Phosphoric acid; Determination of —— as magnesium pyrophosphate. D. Balareff. Z. anorg. Chem., 1919, **106**, 268—280.

ALTHOUGH Schmitz's method gives consistent results with wide variations of conditions (see this J., 1918, 638 A), a pure precipitate of magnesium ammonium phosphate can only be obtained under very special conditions. When too little ammonium chloride is used and the solution is not stirred during precipitation, the results are too high. The use of alcohol gives high results. Neubauer's method (this J., 1918, 109 A) for the determination of magnesium, in which a solution of phosphoric acid is added to the magnesium solution, gives high results when the ammonia is added quickly for the second precipitation, but when the ammonia is added slowly the results approximate to those obtained by Schmitz's method. The use of an alkali phosphate in place of phosphoric acid causes high results on account of the precipitation of alkali magnesium phosphate.—E. H. R.

Turpentine resin in turpentine as a foam breaker. E. C. Kendall. J. Biol. Chem., 1919, **38**, 529.

A 20% solution of resin in turpentine, neutral to alizarin, is a very effective foam breaker.—J. C. D.

Sulphur in coal gas. Hirsch. *See* IIA.

Oil shales. Nicolardot and Baurier. *See* IIA.

Ammonia in shale etc. distillates. Nicolardot and Baurier. *See* IIA.

p-Aminoazobenzene. Neitzel. *See* IV.

Ammoniacal liquor. *See* VII.

Sodium carbonate and oxalic acid. Kunz-Krause and Richter. *See* VII.

Optical glass. Elsden and others. *See* VIII.

Steel. Travers. *See* X.

Sulphur in iron and steel. Molyneaux. *See* X.

Manganin. Hunter and Bacon. *See* X.

Magnetite in matte and slag. Hawley. *See* X.

Hardened oils. Grün. *See* XII.

Alcohol, aldehyde, and acetone. Hoepner. *See* XVIII.

Gluten. Marchadier and Goujon. *See* XIXA.

Proteins. Edlbacher. *See* XIXA.

Fat in cocoa etc. Hughes. *See* XIXA.

Morphine. Heiduschka and Faul. *See* XX.

Meconic acid. Heiduschka and Faul. *See* XX.

Berberine. Wasicky and Joachimowitz. *See* XX.

Alkaloids. Kunz-Krause and Richter. *See* XX.

Catechol and adrenaline. Denigès. *See* XX.

Eucalyptol. Bennett and Salamon. *See* XX.

Sodium salicylate. Harrison and Carter. *See* XX.

Mercury salts. Utz. *See* XX.

Nitrocellulose. Carron. *See* XXII.

Diphenylamine. Ryan and O'Riordan. *See* XXII.

PATENTS.

Gas analysing apparatus. Aktiebolaget Ingeniörsfirma F. Egnell, Stockholm. Eng. Pats. (A) 118,112, 31.7.18. (Appl. 12,483/18.) Int. Conv., 31.7.17, and (B) 118,114, 1.8.18. (Appl. 12,588/18.) Int. Conv., 1.8.17.

(A) In a gas analysing apparatus, in which the flow of gas is caused by a rising and falling liquid and in which the gas is subjected to mechanical or chemical change before or after the absorption, a ball controlled by an adjustable spring is inserted in one of the pipes so that the gas or liquid is retarded when flowing in one direction, but not in the opposite direction. (B) In a gas analysing apparatus of the type described in (A), in which several different analyses are effected by diverting the gas through a valve into different analysers, the valve is operated by a piston actuated by the pressure changes in the pump. The valve is moved in one direction by the piston rod acting on a ratchet wheel, but is prevented from moving in the opposite direction by a catch, which is released by an electro-magnet when the rise of mercury in the pump completes an electric circuit. The electrical release may be replaced by a mechanical release.—W. F. F.

Flue gases; Analysing ——. H. M. Sharp, Buffalo, N.Y. U.S. Pat. 1,299,865, 8.4.19. Appl., 6.5.18.

APPARATUS for analysing flue gases to determine the proportions of carbon dioxide, oxygen, carbon monoxide, and nitrogen, consists of absorption vessels alternating with vessels containing an electrolyte. The gas is bubbled through all the vessels in series. The inlet tubes in the electrolytic vessels contain an electric conductor, the other conductor being immersed in the liquid in the vessel. The flow of gas through the inlet tubes varies the electrical resistance by displacing the electrolyte from the conductor each time a bubble passes, and electrical recording mechanism is provided to register the number of bubbles thus passing. The difference in the number of bubbles before and after any particular absorbing vessel gives a measure of the amount of gas absorbed in that vessel.—W. F. F.

Vapour pressures in gases; Quantitative estimation of ——. H. S. and M. D. Davis, Clifton, Nova Scotia. Eng. Pat. 131,154, 16.8.18. (Appl. 13,323/18.)

SEE U.S. Pat. 1,272,922 of 1918; this J., 1918, 609A.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Adams. Separating and lifting semi-solids. 22,349. Sep. 11.

Adams. Air-lift apparatus. 22,350. Sep. 11.

Béadle. Apparatus for conducting a liquid and a gas soluble in said liquid through closed cycle of thermal operations. 23,491. Sep. 24.

Beth. Filter-bag cleaning devices. 22,128. Sep. 9. (Ger., 9.9.18.)

British Thomson-Houston Co. (General Electric Co.). Catalysing material. 22,076. Sep. 8.

Bruman. Intermixing fluids, gases, etc. 22,286. Sep. 10.

Chambers. Grinding machinery. 22,235. Sep. 10.

Coates, and Edina Engineering Co. Grinding mill and machine. 22,868. Sep. 17.

Cotton. 22,444. *See* II.

Empson. Apparatus for detecting and for controlling mixture of liquids and solutions. 23,478. Sep. 24.

Fryer, and Rowntree and Co. Machines for thrashing liquids or materials in a state of fine subdivision. 22,062. Sep. 8.

Mauss. Centrifugal separation. 23,206. Sep. 20.

Peck, Frean, and Co., and Whymper. 23,022. *See* XX.

Philip. Stills. 22,661. Sep. 15.

Spiby and Stringer. Mixing-machines having rotary drums. 22,874. Sep. 17.

Woltersdorf. Grinding and disintegrating machines. 22,724. Sep. 16. (Austria, 29.8.17.)

COMPLETE SPECIFICATIONS ACCEPTED.

11,284 (1915). Hope. Furnaces. Oct. 1.

5240 (1918). Bregeat. Recovery of volatile solvents used in manufacture. (131,938.) Sep. 17.

9555 (1918). Brownlow. Centrifugal separators. (132,291.) Sep. 24.

10,062 (1918). Muller. *See* XIX.

13,494 and 14,893 (1918). Hind. Mixing or kneading apparatus. (132,000.) Sep. 17.

14,468 (1918). Candlot. Kilns or shaft furnaces. (119,235.) Sep. 17.

14,791 (1918). Roberts. Kilns or furnaces. (132,350.) Sep. 24.

14,996 (1918). Cortesi. Refrigerating-apparatus. (132,360.) Sep. 24.

15,255 (1918). Bigot. *See* VIII.

15,408 (1918). Kestner. Apparatus for enabling extracts, infusions, or decoctions to be obtained in a continuous manner. (132,075.) Sep. 17.

18,632 (1918). Calvert. Apparatus for catalytic reactions. (132,120.) Sep. 17.

20,161 (1918). Kelvin, Bottomley, and Baird, and Wright. Thermocouples for pyrometers. (132,132.) Sep. 17.

21,701 (1918). Brayshaw Furnaces and Tools, Ltd., and Brayshaw. Oil-fired furnaces. (132,421.) Sep. 24.

158 (1919). Burris. Filters. (132,696.) Oct. 1.

2437 (1919). Wetter (Weinrich). Manufacture of carbonaceous materials suitable for use as filtering media. (132,164.) Sep. 17.

3728 (1919). Soc. d'Etudes Chimiques. Fractional distillation of liquids. (123,735.) Oct. 1.

4043 (1919). Savy. *See* XIX.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Blakeley and Shaw. Continuously-acting apparatus for breaking, screening, washing, and assorting coke, furnace waste, etc. 22,803. Sep. 17.

Burgoyne and Holt. Purification of gas. 23,167. Sep. 20.

Cotton. Furnaces for burning low grade fuel. 22,444. Sep. 12.

Deguide and Marbais. Complete extraction of naphthalene from coal gas. 22,544. Sep. 13.

Densified Peat, Fuel, and Products, Ltd., and Macdonald. Treatment of peat. 23,178. Sep. 20.

France. Coal etc. washing apparatus. 22,662. Sep. 15.

Goskar and Thomas. Treating peat, brown coal, etc. 22,054. Sep. 8.

Hall Motor Fuel, Ltd., and McCrea. Desulphurising sulphur-bearing hydrocarbons. 22,094. Sep. 8.

Hamilton. Apparatus for drying peat. 22,018. Sep. 8.

Knibbs. Treatment of mineral oils etc. 23,515. Sep. 24.

Rincker. Gasification of solid fuel. 22,785. Sep. 16. (Holland, 24.2.19.)

Scharff. Manufacture of peat fuel. 22,885. Sep. 17.

Stevens. Mantles for gas lighting by incandescence. 23,154. Sep. 20.

Wells. Grates for gas producers and carbonising plants. 23,086. Sep. 19.

COMPLETE SPECIFICATIONS ACCEPTED.

13,072 (1918). Chapman Engineering Co. Gas producers. (125,932.) Sep. 24.

13,111 (1918). Leadbeater. Treating peat to obtain carbonaceous material for decolorising purposes. (132,572.) Oct. 1.

13,321 (1918). Anderson, Deacon, and Brady. Furnaces for distilling coal, shale, etc. (132,576.) Oct. 1.

13,938 (1918) and 1267 (1919). Liversedge and Davidson. Gas-cleaning apparatus. (132,586.) Oct. 1.

14,349 (1918). Hart. Suction-gas scrubbers and cleaners. (118,848.) Sep. 17.

14,628 (1918). Hart. Suction-gas plant. (120,717.) Oct. 24.

14,645 (1918). Chance. Washing coal and concentrating ores and minerals. (119,038.) Sep. 17.

14,658 (1918). Clark. Distilling hydrocarbons or converting them into products of lower boiling point. (132,337.) Sep. 24.

14,725 (1918). Piette. Coke ovens. (120,201.) Sep. 24.

17,003 (1918). May. Coal-cakes and process of making same. (132,383.) Sep. 24.

18,983 (1918). South Metropolitan Gas Co., and Chandler. *See* X.

21,378 (1918). Gonville. Fuel. (132,418.) Sep. 24.

21,701 (1918). Brayshaw and others. *See* I.

2437 (1919). Wetter (Weinrich). *See* I.

5296 (1919). Cash. Fuel of the briquette type. (132,183.) Sep. 17.

10,624 (1919). Anderson, Deacon, and Brady. Furnaces for distilling coal etc. (132,744.) Oct. 1.

III.—TAR AND TAR PRODUCTS.

APPLICATIONS.

Deguide and Marbais. 22,544. *See* II.

Hall Motor Fuel, Ltd., and McCrea. 22,094. *See* II.

Morris, and Morris and Co. 22,940. *See* XX.

COMPLETE SPECIFICATIONS ACCEPTED.

9257 (1918). Morris and Co., and Morris. Manufacture of salts of amido organic substances. (131,957.) Sep. 17.

9710 (1918). Lapworth, and Levinstein, Ltd. *See* XX.

10,117 (1918). Barbet et Fils et Cie. Continuous sulphonation of aromatic hydrocarbons other than benzene. (132,298.) Sep. 24.

11,196 (1918). Gibbs, Ambler, and Selden Co. Production of sulphonic acids. (131,970.) Sep. 17.

12,454 (1918). Gros et Bouchardy, and Perruche. Production of aromatic nitro-compounds. (131,982.) Sep. 17.

14,658 (1918). Clark. *See* II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

Peck, Frean, and Co., and Whymper. 23,022. *See* XX.

Pope, and Scottish Dyes, Ltd. Production of colouring matters. 23,799. Sep. 27.

COMPLETE SPECIFICATION ACCEPTED.

18,016 (1918). A'Brassard and Crawford, and Singer. Manufacture of colouring matters. (132,390.) Sep. 24.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Carlsson and Thall. Reducing viscosity of cellulose solutions. 22,187. Sep. 9. (Sweden, 6.12.18.)

Chanaz and Jennison. Paper manufacture. 22,146. Sep. 9.

Cross and Gerland. 22,704. *See* VI.

Foden. Medicated cellulose or cotton wool. 23,525. Sep. 24.

Pickup and Wilson. Treating fibres. 22,680. Sep. 15.

Wurzner. Devices for colouring or impregnating paper etc. 23,134. Sep. 19.

COMPLETE SPECIFICATIONS ACCEPTED.

7192 (1918). Dreyfus. Manufacture of compositions or articles having a basis of cellulose acetate. (132,283.) Sep. 24.

19,298 (1918). Calico Printers' Assoc., and Roberts. *See* VI.

21,906 (1918). Stockton. Purifying cottonseed hull fibre. (132,422.) Sep. 24.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Brown, and Calico Printers' Assoc. Block for printing textile materials. 22,025. Sep. 8.

Cross and Gerland. Chemical preparation of felted compositions for printing fabrics, wall papers, etc., also substitute for leather. 22,704. Sep. 16.

Tomlinson and Walsh. Printing and sizing yarns etc. 23,232. Sep. 22.

Whitaker and Whitaker. Machines for dyeing, scouring, and washing wool etc. 22,202. Sep. 10.

Wurzner. 23,134. *See* V.

COMPLETE SPECIFICATIONS ACCEPTED.

14,740 (1918). Barnes, Wrigley, and Spence and Sons. Dyeing, staining, and mordanting by means of salts of titanium and iron. (132,345.) Sep. 24.

15,965 (1918). Tutsche. Bleaching boiler plant. (119,663.) Sept. 17.

19,298 (1918). Calico Printers' Assoc., and Roberts. Machines for washing, saturating, and similarly treating textile fabrics and yarns in rope form. (132,672.) Oct. 1.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Arrowsmith. 22,825 and 22,826. *See* XIII.

Ashcroft. Manufacture of anhydrous magnesium chloride and anhydrous calcium chloride. 23,000. Sep. 18.

Ashcroft. Manufacture of oxides or salts of tungsten or of metallic tungsten. 23,001. Sep. 18.

Ashcroft. Manufacture of compounds of metals, or of metals, or of non-metals from ores, residues, wastes, etc. 23,002. Sep. 18.

Ashcroft. Manufacture of aluminium or its oxides or salts. 23,003. Sep. 18.

Calvert. Manufacture of cyanide and cyanogen compounds. 23,211. Sep. 20.

Datta. Manufacture of alkali chromates and iodine. 23,375. Sep. 23.

Dupare and Urfer. Direct oxidation of ammonia. 23,505. Sep. 24. (Switzerland, 24.9.18.)

Evans and Evans. 23,318. *See* X.

Gans. Recovery of ammonium-aluminium sulphate from aluminium sulphate solutions containing ferric oxide. 22,079. Sep. 8. (Germany, 21.9.17.)

Hood. Purification of sulphur. 22,082. Sep. 8.

Matheson. Apparatus for manufacture of acetic acid. 22,166. Sep. 9.

Soc. des Aciéries et Forges de Firminy. Catalytic preparation of acetic acid from acetylene. 22,482. Sep. 12. (France, 13.3.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

3509 (1917). Chem. Fabr. Milch. *See* XVI.

11,954 (1917). Wade (Deuts. Gold- u. Silber-Scheide-Anstalt). Manufacture of percarbonates. (131,930.) Sep. 17.

5101 (1918). Baur and Nagel. *See* X.

6112 (1918). Partington and Rideal. Oxidation of ammonia. (131,942.) Sep. 17.

7221 (1918). Jones and Parsons. Oxidising ammonia to form oxides of nitrogen and nitric acid. (132,551.) Oct. 1.

8986 (1918). Freeth and Cocksedge. Removal of sodium sulphate from solution. (131,956.) Sep. 17.

10,071 (1918). Matheson. *See* XX.

10,072 (1918). Matheson. Recovering mercury from mercury sludge. (132,559.) Oct. 1.

10,073 (1918). Matheson. Process of oxidising mercury. (132,560.) Oct. 1.

10,282 (1918). Deuts. Gold- u. Silber-Scheide-Anstalt. Manufacture of alkali percarbonates. (116,903.) Oct. 1.

10,931 (1918). Testrup, and Techno-Chemical Laboratories. Production of cyanides. (131,964.) Sep. 17.

13,037 (1918.) Maxted and Smith. Burner for the oxidation of ammonia. (132,571.) Sep. 24.

13,368 (1918). Electrolytic Zinc Co. *See* X.

14,325 (1918). Frabetti. Manufacture of platinised asbestos. (120,551.) Sep. 17.

15,241 (1918). Norsk Hydro-Elektrisk Kvaelstof-Aktieselskab. Manufacture of concentrated nitric acid. (120,378.) Oct. 1.

15,540 (1918). Gros et Bouchardy. *See* XVI.

15,667 and 15,669 (1918). Thorssell and Lunden. Production of nitrates by means of bacteria. (132,625 and 132,626.) Oct. 1.

15,862 (1918). Busvold. Manufacture of bismuth compounds and metallic bismuth free from arsenic. (119,659.) Sep. 24.

17,813 (1918). Grayson. Manufacture of sulphur dioxide. (132,387.) Sep. 24.

17,869 (1918). British Dyes, Ltd., Turner, and Davidson. Recovery of unoxidised sulphur dioxide in the catalytic manufacture of sulphuric acid. (132,661.) Oct. 1.

19,427 (1918). Norske Aktieselskab for Elektrokemisk Industri. Production of alumina from clay and similar materials. (122,623.) Sep. 17.

21,808 (1918). Grauel. Recovery of potassium from silicates. (132,693.) Oct. 1.

1637 (1919). Howorth (Norsk Hydro-Elektrisk Kvaelstofaktieselskab). Concentration of sulphuric acid. (132,704.) Oct. 1.

VIII.—GLASS; CERAMICS.

APPLICATION.

White (Fours et Procédés Mathy Soc. Anon.). Crucible furnaces for treating glass etc. 22,261. Sep. 10.

COMPLETE SPECIFICATIONS ACCEPTED.

15,255 (1918). Bigot. Tunnel furnaces. (132,069.) Sep. 17.

16,591 (1918). McCoy. Apparatus for the production of sheet glass. (132,649.) Oct. 1.

IX.- BUILDING MATERIALS.

APPLICATIONS.

Brown, Hughes, and Hill-Jones, Ltd. Manufacture of bricks, blocks, etc., for paving or building etc. 22,588. Sep. 13.

Pattison. Curing colouring, etc. asbestos-cement sheets etc. 22,311. Sep. 11.

Ward. Manufacture of artificial stone. 23,606. Sep. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

14,869 (1918). Waine. Manufacture of bricks and artificial stones. (132,356.) Sep. 24.

14,938 (1918). Olsen. Concrete, and method of manufacture thereof. (132,593.) Oct. 1.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Ansell. Combined flux solder for aluminium. 22,057. Sep. 8.

Ashcroft. 23,001, 23,002, and 23,003. *See* VII.

Boever and Dutoit. Manufacture of brass and alloys of copper. 22,296. Sep. 10. (Switzerland, 11.9.18.)

Capron and Petersson. Treatment of sulphide minerals. 23,128. Sep. 19.

Coles. Production of spring or tempered copper. 22,376. Sep. 11.

Coles. 22,377. *See* XI.

Coles. Conversion of blue billy into high-grade iron. 22,598. Sep. 13.

Darling and Stopford. Apparatus for detecting temperature of demagnetisation of steel etc. 23,319. Sep. 23.

Evans and Evans. Recovery of tin from tin-pot skimmings and zinc chloride as by-product. 23,318. Sept. 23.

Fletcher. Manufacture of puddled iron. 22,959. Sep. 18.

Harris, Williams, and Metals Extraction Corporation. Electrolytic cells for deposition of metal from solution. 22,541. Sep. 13.

Houldsworth. Extracting particles of iron or steel from ores, mixtures, etc. 22,072. Sep. 8.

Marks (Union Carbide Co.). Alloys. 22,388. Sep. 11.

Nicholson and Sons, and Wyld. Apparatus for precipitation of copper. 22,134. Sep. 9.

Paterson. Furnace for melting brass, copper, etc. 23,662. Sep. 25.

Soc. des Alliages et Bronges Forgeables. Tilting crucible or melting-pot furnaces. 23,746 and 23,747. Sep. 26. (Fr., 21 and 22.7.19.)

Vautin. Recovery of metals from slags. 22,651. Sep. 15.

Winder. Annealing, hardening, and tempering furnaces. 23,183. Sep. 20.

COMPLETE SPECIFICATIONS ACCEPTED.

5104 (1918). Baur and Nagel. Recovery of gold,

silver, and radium from extremely dilute solutions, particularly sea-water. (114,316.) Sep. 24.

11,588 (1917). Rigg. Desulphurisation of zinc sulphide ores. (119,223.) Oct. 1.

12,332 and 18,684 (1918). Hadfield. Manufacture of alloy steel. (131,980.) Sep. 17.

13,368 (1918). Electrolytic Zinc Co. of Australasia Proprietary. Treatment of zinc solutions preparatory to the recovery of zinc by electro-deposition. (131,998.) Sep. 17.

14,246 (1918). Dehn (National Lead Co.). Smelting furnace. 132,023. Sep. 17.

14,645 (1918). Chance. *See* II.

15,345 (1918). Bibby and Boving. Electric blast furnaces. (132,616.) Oct. 1.

15,554 (1918). Arnold. High-speed steel. (132,082.) Sep. 17.

15,830 (1918). Aarts and Aarts. Process for sulphatising ores etc. (119,867.) Oct. 1.

15,862 (1918). Busvold. *See* VII.

16,772 (1918). Williams. Crucible furnace. (132,381.) Sep. 24.

18,983 (1918). South Metropolitan Gas Co., and Chandler. Gas-heated crucible and like furnaces. (132,398.) Sep. 24.

20,292 (1918). Wigan and Grover. Aluminium alloys. (132,411.) Sep. 24.

1409 (1919). Hoyle and Leach. Conversion of scrap steel, shell, etc., into usable bars. (132,702.) Oct. 1.

6985 (1919). Leopard. Solder for aluminium and its alloys. (132,724.) Oct. 1.

XI.—ELECTRO-CHEMISTRY.

Applications.

Albe and Hanman. Selenium cells. 23,052. Sep. 19.

Coles. Manufacture of zinc cylinders for primary batteries. 22,377. Sep. 11.

Dukes and Kremenesky. Galvanic cells. 22,913. Sep. 17. (Austria, 18.7.18.)

Harris and others. 22,541. *See* X.

Hepburn, and Mather and Platt. Bipolar electrode electrolysers. 23,750. Sep. 26.

Norske Aktieselskab for Elektrokemisk Industri. Electrodes for electric furnaces etc. 22,068. Sep. 8. (Norway, 17.1.19.)

Oldham, Oldham, and Oldham. Galavanic batteries. 22,686 and 22,787. Sep. 15 and 16.

Complete Specifications Accepted.

10,205 (1918). Jenkins, and East Stratford Works. Electrolytic cells. (132,561.) Oct. 1.

13,368 (1918). Electrolytic Zinc Co. *See* X.

15,345 (1918). Bibby and Boving. *See* X.

15,542 (1918). Simon and Sarron. Electric resistance furnaces for heating gases. (132,080.) Sep. 17.

15,548 (1918). Watson and Co., Greaves, and Etchells. Electric furnaces. (132,081.) Sep. 17.

15,812 (1918). Lawton and Hampton. Electric furnaces. (132,635.) Oct. 1.

17,962 and 17,972 (1918). Kaplan. Galvanic cells. (132,113 and 132,114.) Sep. 17.

16,843 (1919). Rabinovitch and Mond. Electric batteries. (132,480.) Sep. 24.

XII.—FATS; OILS; WAXES.

Applications.

Cocking and Lilly. 23,644. *See* XVIII.

Erslev. Method of cooling or allowing to crystalise fatty emulsions. 23,585. Sep. 25. (Holland, 7.11.18.)

Gans. Manufacture of soap. 22,080. Sep. 8. (Ger., 24.6.18.)

Vakil. Removal of free fatty acids, deodorising and refining oils and fats. 22,159. Sep. 9.

Willis. Extracting and purifying beeswax. 22,455. Sep. 12.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Arent. Protective treatment of materials. 23,199. Sep. 20. (U.S., 20.9.18.)

Arrowsmith. Manufacture of acid pots for production of white lead. 22,825. Sep. 17.

Arrowsmith. Acid pots for manufacture of white lead. 22,826. Sep. 17.

Jaloustre, Kheifetz, and Warchevsky. Pectisation of condensation products of phenols and aldehydes. 23,379 and 23,380. Sep. 23. (Fr., 23.1 and 15.2.19.)

Robertson Co. Coating material. 22,312. Sep. 11. (U.S., 11.9.18.)

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Application.

Naaml. Vennoots. Verschure en Co.'s Scheepswerf en Maschinefabriek. Mills for grinding, crushing, or pulverising rubber. 22,580. Sep. 13. (Holland, 17.9.18.)

XV.—LEATHER; BONE; HORN; GLUE.

Applications.

Barber and Barber. Tanning chrome leather. 22,717. Sep. 16.

Collinson. Testing physical qualities of leather. 23,351. Sept. 23.

Cross and Gerland. 22,704. *See* VI.

Fairrie. Pits for tanning. 22,328. Sep. 11.

Fairrie. Treating leather after tanning and before or during drying. 23,346. Sep. 23.

Fairrie. Drying leather by gases. 23,347. Sep. 23.

Röhm. Process for neutralising chrome leather. 22,970. Sep. 18. (Ger., 17.11.16.)

Complete Specifications Accepted.

3053 (1918). Heyl. Drying japanned or "patent" leather or the like. (113,620.) Sep. 24.

12,972 (1918). Mauerhofer. Treatment of hides and leather. (118,120.) Sep. 24.

XVI.—SOILS; FERTILISERS.

Application.

Fellowes and Hyatt. Fertilisers, and method of manufacture. 23,730. Sep. 26.

Complete Specifications Accepted.

3509 (1917). Chem. Fabr. Milch, and Rabenau. Apparatus for the preparation of superphosphates. (104,693.) Sep. 24.

15,540 (1918). Gros et Bouchardy. Production of cyanamide. (132,622.) Oct. 1.

XVII.—SUGARS; STARCHES; GUMS.

Application.

Kowalski. Manufacture of precipitate rich in albumen and poor in ash from raw juices and waste liquors of sugar factories. 22,774. Sep. 16. (Ger., 11.7.16.)

COMPLETE SPECIFICATIONS ACCEPTED.

13,111 (1918). Leadbeater. *See* I.
2437 (1919). Wetter (Weinrich). *See* I.
9826 (1919). Peek, Frean, and Co., Carr, Bradley, Baker and Sons, and Rowntree and Co. Treatment or preparation of sugar for use in the manufacture of chocolate. (132,200.) Sep. 17.
12,344 (1919). Lemoine. Complete separation of extracted liquor and remelted syrup in direct remelting centrifugal machines. (132,212.) Sep. 17.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATIONS.

Bailey. Treatment of beer. 23,036. Sep. 19.
Cocking and Lilly. Production of glycerin by fermentation. 23,644. Sep. 25.
Fazi. Malting process. 22,905. Sep. 17. (Italy, 22.5.19.)

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Alberts. Manufacture of cocoa powder. 22,429. Sep. 12.
Bréchot. Refuse-destructor furnaces. 22,274. Sep. 10. (Fr., 30.9.18.)
Ersley. 23,585. *See* XII.
Hepburn. Water softening. 22,520. Sep. 13.
Hieber. Treatment of fruit juices etc. 22,844. Sep. 17.
Kowalski. 22,774. *See* XVII.
Lewis and Quain. Manufacture of foods. 22,282. Sep. 10.
Sluyter. Process of making article of food. 23,549. Sep. 25.
Viemeier. Food-preserving methods. 23,610. Sep. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

10,062 (1918). Muller. Apparatus for simultaneously atomising and drying or evaporating milk or other liquids. (116,902.) Sep. 24.
11,839 (1918). Townsend. Food products. (132,566.) Oct. 1.
13,379 (1918). Jones, and Jones and Attwood. Purification of sewage and other liquids. (132,581.) Oct. 1.
14,260 (1918). Campbell and Glover. Manufacture of vegetable food products. (132,024.) Sep. 17.
15,021 (1918). Goldreich. Manufacture of fodder. (132,597.) Oct. 1.
16,658 (1918). Surie, and Nieuwhof, Surie and Co. Manufacture of milk powder. (132,096.) Sep. 17.
2437 (1919). Wetter (Weinrich). *See* I.
4043 (1919). Savy. Drying vegetables, fruits, etc. (123,981.) Sep. 24.
9826 (1919). Peek, Frean, and Co., and others. *See* XVII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Carpmael (Bayer and Co.). Manufacture of cyanide derivatives of α-halogenated acids. 22,467. Sep. 12.
Carpmael (Bayer and Co.). Production of dialkylbromoacetylureas. 22,468. Sep. 12.
Damiens, Loisy, and Piette. Manufacture of alcohol or ether. 22,739. Sep. 16.
Farbenfabr. vorm. F. Bayer und Co. Manufacture of derivatives of bromoacylised urea compounds. 22,766. Sep. 16. (Ger., 9.8.17.)
Farbenfabr. vorm. F. Bayer und Co. Manufacture of trimethylacetylsalicylic acid and its homologues. 22,767. Sep. 16. (Ger., 4.2.18.)
Hall (Dunham). Production of polymerised compounds from unsaturated hydrocarbons. 22,095. Sep. 8.
Morris, and Morris and Co. Apparatus for treating or saturating amido organic substances to form salts. 22,940. Sep. 18.
Napp (Hoffmann-La Roche & Co.). Manufacture of complex silver salts of α-amido-acids. 23,372. Sep. 23.
Peak, Frean, and Co., and Whymper. Extracting and concentrating aromatic, flavouring, or colouring matters etc. 23,022. Sep. 18.
Soc des Aciéries et Forges de Firminy. 22,482. *See* VII.

COMPLETE SPECIFICATIONS ACCEPTED.

8486 (1917). Deuts. Gold- u. Silber-Scheide-Anstalt. Manufacture of acetaldehyde. (107,584.) Sep. 24.
8565 (1917). Deuts. Gold- u. Silber-Scheide-Anstalt. Manufacture of acetaldehyde. (107,585.) Sep. 24.
9257 (1918). Morris. *See* III.
9684 (1918). Pickard, Rankin, and Pickard, Ive, and Rankin. Aspirin tablets. (132,294.) Sep. 24.
9710 (1918). Lapworth, and Levinstein, Ltd. Manufacture of N-monoalkyl derivatives of certain aromatic compounds. (132,555.) Oct. 1.
10,117 (1918). Barbet et Fils et Cie. *See* III.
10,070 (1918). Matheson. Manufacture of acetaldehyde. (132,557.) Oct. 1.
10,071 (1918). Matheson. Manufacture of acetic acid. (132,558.) Oct. 1.
11,196 (1918). Gibbs and others. *See* III.
14,513 (1918). Comp. des Prod. Chim. d'Alais et de la Camargue. Continuous preparation of monochloracetic acid. (132,042.) Sep. 17.
2943 (1919). Leach, and United Alkali Co. Manufacture of benzoic acid. (132,433.) Sep. 24.
12,120 (1919). Comp. des Prod. Chim. d'Alais et de la Camargue. Preparation of trichlorethylene from tetrachlorethane. (132,755.) Oct. 1.
12,787 (1919). Comp. des Prod. Chim. d'Alais et de la Camargue. Preparation of symmetrical tetrachlorethane. (132,757.) Oct. 1.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

Christensen. Manufacture of coloured photographic pictures. 23,256. Sep. 22. (Denmark, 20.9.18.)
Sanders and Wellesley. Production of photographic films in natural colours. 22,884. Sep. 17.
Wellesley. Natural-colour photography. 23,531. Sep. 24.

COMPLETE SPECIFICATION ACCEPTED.

13,271 (1918). Comstock, and Technicolor Motion Picture Corporation. Colour photography. (132,580.) Oct. 1.

XXII.—EXPLOSIVES; MATCHES.

APPLICATION.

Bernardini and Mascarelli. Explosives. 22,775. Sep. 16.

I.—GENERAL; PLANT; MACHINERY.

Mechanical handling of chemical materials. G. F. Zimmer. Chem. Age, 1919, 1, 378—380, 406—407. (See also this J., 1919, 703 A).

Viscous materials are best handled in receptacles on gravity runways, slat conveyors, or swing-tray elevators and conveyors. Deliquescent materials may be handled on a band conveyor of flexible steel, or of cotton with a thick rubber covering, whichever is least acted on by the material. For such substances as superphosphates, tray or continuous trough conveyors should be used, but special methods of supporting the trays on their return journey are necessary on account of the sticky nature of the material. Flexible steel band conveyors are particularly useful for yeast, evaporated milk, beet pulp, raw sugar, etc. For mud, sludges, and semi-liquids generally, bucket elevators are used, and the material, having been raised to the highest point, continues its journey by gravity, flowing along inclined shoots or troughs. Examples are given of the application of mechanical apparatus for handling nitre cake, ammonium sulphate, salt, TNT., etc. Band or tray conveyors are suitable for finely divided dry materials if run at a sufficiently slow speed, and if precautions are taken to prevent the formation of dust at the loading and discharging ends they need not be enclosed, but push-plate, worm, and reciprocating conveyors must be covered in when used for fine dry powders. A reciprocating conveyor with a small stroke produces practically no dust, as through its peculiar motion the finer material is always covered by the coarser. For handling materials at high temperatures push-bar and push-plate conveyors as well as steel band conveyors may be used. Treatment of various kinds can be applied to material being transported; for example, it may be sifted by using a reciprocating conveyor in which several perforated plates have been inserted, and the conveyor may be made to pass during part of its journey through a chamber or tunnel which is suitably heated or cooled. If it is desired to use the same apparatus for different materials, appliances which empty themselves completely must be selected; worm conveyors should be avoided, and band, trough, or reciprocating conveyors which can be brushed or wiped clean should be chosen.

W. H. C.

Heat exchangers. G. Bastien. Mem. Soc. Ing. Civils de France, 1919, 72, 183—237.

The author deals first with the composition and classification of coals and with the combustion of solid and gaseous fuels, and then proceeds to an examination of the efficiency of heat exchange in exchangers as influenced by various factors. The efficiency is dependent upon, amongst other factors, the conductivity of the material of the exchanger, the cleanliness of its surfaces, the conductivity of the fluid to be heated, the supply of heated fluid available, the number of impacts of the molecules of the fluid to be heated upon the wall of the exchanger; the relative direction of flow of the two currents, and the circulation of the fluids in the exchanger. Formulæ are developed for calculating the efficiency of heat transference in any exchanger. The principal result obtained is that the efficiency and mean difference of temperature between the two fluids exchanging heat are related to one another in general by a parabolic formula. The efficiency of an exchanger is not to be determined by the result of experiments carried out under a single set of external conditions, and attention is directed to the influence on the efficiency of the initial temperature of the heating fluid, the heat losses due to infiltration of air and to radiation, and the temperature of the external atmosphere. The "pivotal" characteristic determining the performance of an exchanger is the difference in temperature of the two fluids. The concluding section contains a number of tables to facilitate calculations by means of the formulæ developed.—J. S. G. T.

Heat-meter; Compensated ——. C. P. Frey. Chem. and Met. Eng., 1919, 21, 259—261.

The effect of the variable external resistance introduced by the thermo-couple and lead wires is too great to allow of reliable indications by a pyrometer of low internal resistance. High internal resistance pyrometers have therefore been adopted in order to reduce the influence of the external resistance, but the instrument is rendered more delicate in construction. In the Brown precision pyrometer a divided circuit, operated by means of a contact point, may be introduced into the instrument, the current then passing partly through the swamping coil and partly through a shunt resistance. When the shunt operates, a suitable resistance in the galvanometer circuit is cut out, so that the same current flows through the ammeter whether the circuit is divided or not, and the deflection of the instrument will remain unaltered by opening or closing the shunt contact. If a line resistance be introduced, the current through the undivided circuit will be less than through the ammeter branch of the divided circuit, and to remedy this a resistance in the form of a rheostat is added and can be adjusted to be equivalent to the external resistance. When so adjusted the deflection of the indicator will again be the same whether the current passes through the single or divided circuit, and the correct temperature of a distant thermo-couple will be indicated.—C. A. K.

Colloid chemistry and its general and industrial applications. Second report. F. G. Donnan, W. C. McC. Lewis, E. F. Armstrong, A. J. Brown, C. H. Desch, E. Hatschek, H. R. Procter, W. Ramsden, A. S. Shorter, H. P. Stevens, and H. B. Stocks. Rep. Brit. Assoc., 1918, 1—72.

The report consists of articles on the following subjects: Peptisation and precipitation (pp. 15), Wilder D. Bancroft; Emulsions (pp. 5), E. Hatschek; The Liesegang phenomenon (pp. 5), E. Hatschek; Electrical endosmose (pp. 28), T. R. Briggs (this article deals with de-watering of peat and clay, electrical tanning, preservation of timber, manufacture of bricks, and electro-therapeutics); Colloid chemistry in the textile industries (pp. 18), W. Harrison; Colloids in agricultural phenomena (pp. 12), E. J. Russell; Sewage purification (pp. 15), E. Ardern; Colloid problems in dairy chemistry (pp. 22), W. Clayton; Colloid chemistry in physiology (pp. 38), W. M. Bayliss; Administration of colloids in disease (pp. 18), A. B. Searle.—J. F. S.

Patents.

Regulating the volume of liquid disincrustant or analogous reagent supplied to boilers; Method and means for automatically ——. G. Jolivet, Bois-Colombes, France. Eng. Pat. 11,423, 8.5.14. Int. Conv., 10.5.13.

The reagent is pumped by the small end of a double piston, the large end of which is lifted by the pulsation of pressure in the water delivered by the boiler feed pump and returned by a spring. The stroke is adjusted by a nut which alters the compression of the spring.—B. M. V.

Evaporating, condensing and cooling apparatus; [Increasing the capacity of] tubular ——. E. Barbet et Fils et Cie., Paris. Eng. Pat. 114,838, 25.3.18. (Appl. 5232/18.) Int. Conv., 31.3.17.

THE apparatus is suitable for the interchange of heat between any two fluids so long as the fluid losing its heat is a condensable gas, the object of the invention being to give very rapid circulation of the steam, thus increasing the rate of transmission of heat through the tube walls. For example, in an evaporator the steam is confined to a narrow layer round the liquor tubes by means of a second set of larger tubes forming annular spaces. The steam enters through the nozzle of an injector to the top header of the nest of annular steam spaces, is then partially condensed to water, and passes from the bottom header to a steam-water separator, and the water is removed as usual by a steam trap or air pump; the uncondensed steam is taken up again by a return pipe to the side inlet of the injector. A fan or other kind of pump may be inserted in the return pipe, but this is not usually necessary with proper design of the injector.
—B. M. V.

Concentrating or evaporating liquids; Process for ——. P. E. Matter, Aarau, Switzerland. Eng. Pat. 121,732, 17.3.19. (Appl. 6610/19.) Int. Conv., 23.3.18.

Two or more evaporators are used, the liquid to be evaporated passing through them in series; all the vapours given off are passed to an air compressor, where they are compressed and then used to heat the evaporator containing the strongest liquor and afterwards to heat the other evaporators, either in series or in parallel, as may be desired.—B. M. V.

Kilns or shaft furnaces [*; Device for continuously discharging* ——.] C. Candlot, Paris. Eng. Pat. 119,235, 5.9.18. (Appl. 14,468/18.) Int. Conv., 23.3.17.

THE bottom of a shaft kiln is formed of cones with their axes substantially horizontal and their apices toward the centre of the kiln. The cones are rocked or rotated so that the material resting on them is broken up and continuously discharged through spaces left between their sides and pushed outwards, being guided by a stationary vertical cone which also supports the inner bearings for the moving cones. Air for combustion may be admitted through the hollow interiors of the cones and through holes in the conical surfaces which are too small to permit the passage of lumps of material. The cones may be provided with teeth or serrations to assist the discharge, and each has a clutch for independently stopping one or more at a time. To avoid excessive base diameter the outer ends of the cones may have cylindrical extensions.
—B. M. V.

Furnaces, or their flues; Device for use with —— *for enabling the progress or condition of combustion to be ascertained.* J. G. W. Hintze, Helsingborg. Eng. Pat. 131,864, 29.5.19. (Appl. 13,636/19.)

Two small passages are made in the walls of the flue, one with an adjustable shutter to admit air, and the other closed by a transparent shutter for observation. The air passage is connected inside to a curved nozzle which impinges into the wide end of a conical hole cut in a fireclay block projecting from the wall of the flue, thus effecting thorough mixing of the flue gases with the additional air admitted. If any considerable amount of unburnt carbon monoxide or soot is present a flame appears.—B. M. V.

Furnace for heating granular or powdered material. O. Bavmann, Amberg. Ger. Pat. 312,244, 8.11.16.

THE furnace chamber is cylindrical in form and is provided with a conical cover, through the apex of which the granular or powdered material is introduced along with a downwardly directed flame. The flame is reflected from the floor of the furnace whereon the greater portion of the powdered material collects. The gases produced are reflected on to the walls of the chamber, and thence a part is caught up by the incoming flame and the remainder discharged to a dust chamber. Alternatively the powdered material may be introduced upwards into the hot flame through the side of the furnace, being caught up in the ascending current of gas. The process may be used for consolidating loose material or for melting materials ordinarily fusible with difficulty.—J. S. G. T.

Discharge apparatus for tanks for [*inflammable*] *fluids.* D. H. van Os, Utrecht, Holland. Eng. Pat. 125,961, 11.4.19. (Appl. 9309/19.) Int. Conv., 15.2.18.

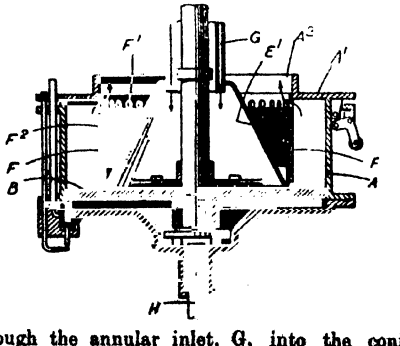
IN a tank containing inflammable liquid discharged by the pressure of a neutral gas above the liquid, the outlet siphon pipe for liquid is provided, above the highest level of the liquid, with an opening into the gas space; this normally prevents the siphon action and is adapted to be closed by a flexible membrane only when the pressure in the supply pipe for inert gas is rather greater than the gas pressure inside the tank. A convenient means of doing this is to have one side of the membrane freely open to the tank, while the other side is open to the gas supply pipe and, by means of a small hole only, to the gas space in the tank. With this apparatus it is necessary for both the liquid and gas valves to be open before liquid can be drawn off, thus preventing accidental drawing off. B. M. V.

Mixing liquids in closed vessels; Apparatus for ——. E. D. Hansen, Copenhagen. Eng. Pat. 127,833, 6.6.19. (Appl. 14,460/19.) Int. Conv., 21.3.17.

THE apparatus is more particularly of use when it is desired to heat rather viscous liquids uniformly in large vessels—*e.g.*, sterilisation of milk and cream. The closed containing vessel is provided with a loose or loosely suspended member or members of such shape that when the vessel is inverted or rocked the liquid is thoroughly agitated. Types described are a ball in a narrow cylinder, a disc guided by an axial rod in a comparatively wide cylinder, and a hinged flap inside a cylindrical vessel.—B. M. V.

Centrifugal separators. R. A. Sturgeon, Southsea. Eng. Pat. 130,128, 19.7.18. (Appl. 11,818/18.)

LIQUID containing suspended solid matter is fed



through the annular inlet, G, into the conical chamber, E^1, and passes under the lower rim of

this chamber into the annular space within the casing, A. The solid matter is deposited on the wall, A, and the liquid escapes through the upper openings in the perforated wall, F. When it is desired to remove the solid material, pressure liquid is admitted through the pipe, H, to the space below the piston, B. The outlet below the rim of the conical chamber is first closed, and this chamber is lifted through the opening, A^2. The solid material is compressed and liquid is forced inward through the filtering material, F^2. The cover, A^1, is eventually lifted, and the solids ejected. The process is then repeated. The invention is also applicable to machines in which the piston is fixed and the cylinder movable axially, and the position of the filter or strainer may be varied.—W. F. F.

Evolving gases from liquids; Electrically heated apparatus for ——. B. G. Cooper, Sutton, Surrey, and E. A. Griffiths, Teddington. Eng. Pat. 131,344, 4.5.18. (Appl. 7515/18.)

The apparatus is more particularly intended for evolving oxygen from liquid oxygen or liquid air, and consists of a vacuum-jacketed flask filled with fibrous material such as asbestos, but with a perforated tube down the centre and closed by a stopper through which pass a delivery tube and two leads connected to the electric heating coil, which is well distributed among the mass of the fibrous filling.
—B. M. V.

Liquid mixtures; Separation of ——. E. A. Cunningham, London. Eng. Pat. 131,346, 4.5.18. (Appl. 7530/18.)

The liquid mixture (more particularly a mixture of the three isomeric mononitrotoluenes) is supplied alternately from either of two storage vessels to a point rather below the middle of a distilling column, which is preferably heated by an internal steam coil and packed with metallic gauze or beads, and which is maintained under such conditions of temperature, vacuum, etc., that only the most volatile constituent is distilled and rectified on its passage up the column. The liquid residue passes out from the bottom of the column to two crystallisers (used alternately) where it is maintained by means of a jacket at such a temperature that only the constituent of highest melting point crystallises out. These crystallisers may have a perforated tray and conical bottom to permit easy separation of the crystals and liquid.—B. M. V.

Rate of flow of fluid; Method of and apparatus for measuring the ——, more especially when under high pressure. H. C. Greenwood and T. W. G. Acland, London. Eng. Pat. 131,375, 29.5.18. (Appl. 8882/18.)

The stream of fluid in part of its course is made to pass through a conduit which passes through or surrounds co-axially a second conduit through which water or other fluid of known specific heat is caused to flow at a known constant rate. The two streams are preferably arranged in counter current. The difference in temperature between the incoming and outgoing stream of water is measured, likewise the difference between the temperatures of the incoming and outgoing fluid stream, preferably by means of thermo-couples. The rate of flow of the fluid is then calculated by the aid of a chart.—J. S. G. T.

Steam-flow; Calorimetric method of and apparatus for measuring ——. W. J. Crowell, jun., Wyncote, Pa. U.S. Pat. 1,314,249, 26.8.19. Appl., 24.9.18.

A pair of throttling-calorimeters are connected to two separated points in a steam main, and each is heated to a temperature corresponding to the quality of the steam at the point from which it is taken. A heat exchanging device is inserted in the main between the two calorimeters so as to change the quality of the steam by a known amount. The temperature of each calorimeter is utilised to create a vapour pressure, and the difference between the two vapour pressures gives a measure of the steam flow.—W. F. F.

Refrigerating agents and process for making same. A. Henning, Leytonstone. Eng. Pat. 131,573, 24.5.19. (Appl. 13,104/19.)

When methyl chloride is used in refrigerating machines a high pressure is necessary, and when ethyl chloride is used a vacuum is necessary, but these disadvantages largely neutralise each other if a mixture of the two chlorides is used. This mixture may be conveniently made direct from a (not necessarily pure) mixture of methyl and ethyl alcohols by means of hydrogen chloride, with or without zinc chloride or other catalytic reagent. If the resulting mixture is not in the desired proportion this may be corrected by redistillation. For example, a mixture containing 96% of ethyl chloride and 4% of methyl chloride is obtained by saturating with hydrogen chloride a mixture of 95 parts of ethyl alcohol, 5 parts of methyl alcohol, and 5 parts of zinc chloride (dissolved in the minimum amount of water), and distilling the product.
—B. M. V.

Volatile solvents; [Continuous] process for the recovery of ——. J. H. Brégeat, Paris. Eng. Pat. 131,938, 25.3.18. (Appl. 5240/18.) Int. Conv., 29.11.17. Addition to 128,640 (this J., 1919, 621 A.)

The process previously described (*loc. cit.*) is extended to include the recovery of propyl and butyl alcohols and methyl, propyl, and butyl acetates.
—B. M. V.

Mixing or kneading apparatus. R. F. Hind, Preston. Eng. Pat. 132,000, 20.8.18. (Appls. 13,494, 20.8.18 and 14,893, 13.9.18.)

The rotating part of the apparatus consists of helical blades grouped in pairs of opposite inclination arranged so that each blade of a pair sweeps through substantially the same space. In order that the material may progress slowly parallel with the shaft as well as be mixed, the blades that tend to push the material forward are brought as close as possible to the outer container, while the other blades are of slightly smaller diameter, though they may be made wider, to give a backward impulse very nearly equal to the forward one.
—B. M. V.

Extracts, infusions, or decoctions; Apparatus for enabling —— to be obtained in a continuous manner. P. Kestner, Paris. Eng. Pat. 132,075, 21.9.18. (Appl. 15,408/18.)

Buckets with perforated bottoms are carried by trunnions on a vertical conveyor. The solid material to be extracted is charged into the buckets at any point between just after the commencement of descent and just after the commencement of ascent, the particular bucket which is passing the filling shoot being slightly tilted by means of a pinion on its trunnion engaging with a short rack. Water or other solvent is continuously supplied to the uppermost bucket and drips through from bucket to bucket, the solution thus becoming enriched on its downward passage while the solid matter is more and more impoverished on its upward passage. As each bucket passes over the head sprockets it is completely inverted, and discharges its contents into a shoot, and it then returned to its normal position by means of the before-mentioned pinion engaging with a longer rack.—B. M. V.

Extraction of solutions; Continuous —— by means of liquids immiscible therewith. Farbenfabr. vorm. F. Bayer und Co., Leverkusen. Ger. Pat. 312,539, 26.8.16.

THE extraction column is filled with rings, of which the height is approximately equal to the diameter. The distribution of liquid thus effected results in highly efficient extraction. A portion of the extracting medium is preferably introduced in the form of vapour.—J. S. G. T.

Generating pressure; Method of ——. A. T. Kasley, Swissville, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,313,698, 19.8.19. Appl., 31.3.17.

A CARBONACEOUS heat-storing material is initially heated in a closed chamber, and a fuel and supporter of combustion are then delivered into the chamber. The products of combustion are stored under pressure in the chamber.—W. F. F.

Steam boiler economiser and method of operating the same. D. S. Jacobus, Jersey City, N.J., Assignor to The Babcock and Wilcox Co., Bayonne, N.J. U.S. Pat. 1,314,110, 26.8.19. Appl., 8.12.14.

THE water in the boiler is treated so as to render it non-corrosive, part of it is withdrawn and mixed with the feed water, which is then treated to free it from air and gas and fed through an economiser back to the boiler.—W. F. F.

Filling material; Tubular —— for packing reaction chambers. H. Petersen, Berlin-Steglitz. Ger. Pat. 312,023, 9.11.17.

THE packing material is composed of a number of tubular units, the transverse section of each being oval or of an angular approximately oval form. The height of such units may be greater or less than the diameter.—J. S. G. T.

Precipitation of dust or other impurities from gases or vapours by means of high tension, direct or alternating current; Apparatus for ——. F. Schultz, Münster. Ger. Pat. 312,049, 26.3.18.

THE apparatus is provided with tubular electrodes composed of non-conducting material, the appropriate surfaces of which are made conducting by means of a layer of metal; the tubes should be made of materials possessing different dielectric constants, that of the inner being the greater. The outer electrode tube, through which the gas is passed, is vertical, and the inner tube is suspended in this with its axis horizontal. It may be desirable to use two or more of these short inner electrodes.—J. S. G. T.

Gas regulating valves for furnaces. Eng. Pat. 131,728. *See* IIA.

Distilling oils etc. Eng. Pat. 131,365. *See* III.

Filling material for Glover towers etc Eng. Pat. 131,502. *See* VII.

Tunnel furnaces. Eng. Pat. 132,069. *See* VIII.

Drying vegetables etc. Eng. Pat. 130,744. *See* XIXA.

Heating or cooling plastic materials. Eng. Pat. 131,495. *See* XIXA.

Cleansing filters. Eng. Pat. 131,198. *See* XIXB.

Anemometer. Eng Pat. 132,090. *See* XXIII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Researches on the chemistry of ——. I. The action of pyridine on the coal substance. W. A. Bone and R. J. Sarjant. Proc. Roy Soc., 1919, A, **96**, 119—136.

EXPERIMENTS on the solvent action of pyridine on coal have shown that the presence of oxygen has an important retarding action, varying with the nature of the coal, on the extraction process. This is due to oxidation of the coal substance which may occur before or during the extraction. Previous oxygenation of the coal renders it much less susceptible to the solvent action of pyridine. The presence of water in the pyridine also has a retarding influence. To obtain concordant results it is therefore necessary to exclude air, to use carefully dried and purified pyridine, and in addition to grind the coal to a standard mesh and to employ a standard form of extraction apparatus. Such an apparatus is described in the present paper. Experiments under these conditions with a Durham coking coal showed that about 32% was extracted in the course of about 180 hours, this being the practical limit. This exceeds considerably the amount of volatile matter expelled from the coal at 950° C. The picolines extract about the same amount, but, owing to their greater instability, they are less suitable as solvents than pyridine. In the presence of oxygen only 17—18% was extracted in the same time. A specimen of Barnsley hard steam coal, having practically the same composition as the Durham coal, behaved quite differently. Here the maximum extraction in absence of oxygen was 11·61%, whilst in presence of oxygen it was 13·07%, although in the early stages the oxygen had a retarding influence. The extract obtained from the first coal by means of pyridine was extracted for two days with chloroform, 52% dissolving. According to Clark and Wheeler (this J., 1913, **32**, 969), chloroform effects a complete separation of the resinic from the cellulosic constituents of the coal, but the analysis of the pyridine-chloroform extract does not warrant the view that it represents even a nearly pure coal resin.—E. H. R.

Spontaneous heating in coal heaps; A system of filling small coal, with remarks upon the prevention of ——. J. Morison. Tr. N. Eng. Inst. Min. and Mech. Eng., 1918, **68**, 154—164.

RECOMMENDATIONS suggested by experience of storing large quantities of small coal during the war are given. Heaps of coal should not be formed on marshy ground, and should not be allowed to exceed about 12 ft. in height unless coned, when the maximum height should be 15 ft. Iron rods ½ to ¾ in. in diameter, of a length equal to the height of the heap, should be inserted at intervals of about 8 yards, and tested daily for heating by being drawn through the hand. The whole surface of the heap should be raked periodically. Whenever any heating is noticed the top of the heap should be trenched irregularly to a depth of 4 ft. or more. The use of a long stiff bar or poker, worked into the heap so as to form funnel-shaped orifices at intervals, has also been found beneficial.—W. P.

Colloidal fuels. L. W. Bates, 141, Broadway, New York. Aug., 1919. 28 pages.

NUMEROUS tests carried out during recent years have shown that oil possesses many advantages over coal for naval, locomotive, and power plant requirements. By the use of "colloidal fuel" (this J., 1919, 165 R, 349 A) the advantages of both oil fuel and powdered coal may be obtained without many

of their usual disadvantages when used alone. Colloidal fuels containing up to 40% by weight of coal and 59% of oil are liquid, and can be handled in the same manner as oil fuel, though a given volume has a greater heat of combustion than that of a corresponding fuel oil. They contain very little moisture, and are low in ash and sulphur content. One of the chief advantages of colloidal fuels is the possibility of their safe storage, as they are very easily protected against fire risks. Their flash point is high, above 200° F. (93° C.), and as they are heavier than water (weighing from 8¾ to 11¼ lb. per U.S. gall.) they may be fireproofed by a water seal of an inch or more of water, which remains on top. They are the most compact fuels known, a typical colloidal fuel having a heat value of 1,196,880 B. Th. U. per cub. ft., as compared with 902,777 B Th. U. per cub. ft. for an average lump anthracite.—W. P.

Fuel economy. Second report of the Brit. Assoc. Committee. Iron and Coal Trades Rev., Sep. 12, 1919, 327.

The present report is of an interim nature, and records the reduction in output and the increase in price of coal in Great Britain since 1913 as compared with American average figures. Research work upon the chemistry of coal has been continued, and recent experiments support the view that extraction of coal with pyridine is not merely a process of solution, but that it affects the coal substance as a whole. The action is retarded by the presence of water or of oxygen (see Bone and Sarjant, preceding). Bone and his co-workers have devised a method (to be published shortly) for extracting the pure resinic constituents of coal. In connection with fuel research, warning is given against the sterilising effect of over-centralisation. Reports have been published dealing with fuel consumption and economy in blast furnaces and steelworks and in cupola practice (see pp. 770-771 A). With reference to gas standards, the Committee generally agrees that it would be more equitable to supply gas on a basis of "heat units" rather than on "cubic feet" supplied, providing that certain conditions are assured. National policy should not exclude the possibility of distributing surplus coke-oven gas or securing the advantages of reduced costs of production which accrue from steaming coals during the process of carbonisation. The view is expressed that the report of the Fuel Research Board (this J., 1919, 191 R) does not recognise sufficiently the importance of methane as a "steadying" constituent, and a specification having a minimum value of 20% of methane, with maximum values of 20% of carbon monoxide and 12% of "inerts," is recommended for a domestic gas supply. Though recognising the national shortage of motor spirit, the Committee feels that gas undertakings should be under no obligation to remove benzenoid hydrocarbons from gas unless financial advantages accrue.
—C. A. K.

Hydrogen; Production of —— by the interaction of carbon monoxide and calcium hydroxide, and acceleration of the water-gas reaction by means of iron. W. H. Engels. J. Gasbeleucht., 1919, 62, 477—483, 493—500.

The author has investigated the conditions under which the reaction between carbon monoxide and calcium hydroxide will best serve for the technical production of hydrogen. The work of Merz and Weith (Ber., 1880, 13, 720) is discussed. These workers concluded that there was no evidence of the formation of intermediate compounds—formate and oxalate—during the reaction between slaked lime and carbon monoxide, but that the reaction proceeded direct to its conclusion, the formation of calcium carbonate and hydrogen at temperatures between 200° C. and 300° C. The reaction is discussed in the light of the law of mass action. An investigation with the purpose of determining whether the course of the reaction for the production of hydrogen is represented by the equation $CO + H_2O \rightleftarrows H_2 + CO_2$, or by the equation $Ca(OH)_2 + CO \rightleftarrows CaCO_3 + H_2$ is detailed. The results obtained indicate that the course of the reaction is determined principally by the latter equation, a little of the hydrogen, however, resulting from the reaction represented by the first equation. The reaction is best carried out at about 500° C. The use of more steam in the water-gas mixture than that corresponding to the vapour pressure of calcium hydroxide at the temperature employed is to be avoided. The reaction between carbon monoxide and calcium oxide is accelerated at least elevenfold by the catalytic action of iron in consequence of the acceleration of the water-gas reaction by this catalyst. The effect of temperature upon the equilibrium of the water-gas reaction is well represented by the thermodynamic relation deduced by Haber (this J., 1910, 205) from Hahn's experimental results (this J., 1903, 1038),

$$\log K = -\frac{2170}{T} + 0{\cdot}979 \log T - \frac{1082}{10^3} T + \frac{1{\cdot}734}{10^7} T^2$$

—J. S. G. T.

Ammonia in producer gas. F. K. Ovitz. Chem. and Met. Eng., 1919, 21, 253—255.

The quantity of ammonia in gas from a producer plant of the Smith type was determined. The coal used contained about 1·5% N on a moisture- and ash-free basis, but was not uniform in size and gave irregular working on the plant. Air saturated at 150°—160° F. (65°—71° C.) was used to gasify the fuel, in the proportion of 4 lb. of air and 1 lb. of steam per lb. of coal. The hot gas was conveyed to the bottom of a primary scrubber, in which it was cooled by water sprays, then through tar filters and secondary scrubbers, in which it was again washed, and cooled to about 100° F. (38° C.). An assumed figure of 130,000 cubic ft. of gas per ton of coal was employed in the calculations and an average figure equivalent to 22·11 lb. of ammonium sulphate per ton of coal was found in the crude gas from the hot main, 20—25% of the ammonia being present as "fixed" salts. Volatile ammonia absorbed in the scrubbing water was almost entirely dissipated into the atmosphere during the cooling of the water in a spray pond.—C. A. K.

Gasoline-kerosene mixtures; The flash and burning points of ——. J. T. Robson and J. R. Withrow. Chem. and Met. Eng., 1919, 21, 243—251.

Contamination of kerosene by more volatile petroleum fractions may be detected by a flash point test. Tests made on the inflammability of mixtures of high grade gasoline and kerosene showed that when 1% of gasoline was present the open cup flash point was depressed from 120° F. (49° C.) for pure kerosene to 105·3° F. (40·7° C.) and the burning point from 134·6° F. (57° C.) to 118·8° F. (48° C.). Increased proportions of gasoline further reduced the flash point, which was 31·5° F. (−0·3° C.) for a 10% gasoline mixture. Closed cup determinations gave higher flash point figures than open cup determinations; the flash point curves obtained for mixtures containing more than 2% of gasoline do not show a constant relation between the two methods. Addition of light petroleum spirit has a remarkable effect on the flash point of kerosene, 2·9% of petroleum spirit decreasing the flash point of kerosene 88·5° F. (31·4° C.), or as much as for 10% of high-grade gasoline. It is evident that slight contamination of kerosene by the more volatile petroleum fractions is attended with grave danger in after use.—C. A. K.

Asphalt; Rapid method of determining hard ——. J. Tausz and A. Lüttgen. Petroleum, 1919, **14**, 653—654. Chem. Zentr., 1919, **90**, IV., 25—26.

A SMALL quantity of the asphalt is placed in a centrifuge tube on a micro-balance, the tube then filled with petroleum spirit, and centrifuged for 10 mins. The liquid is then poured off, and the adherent deposit is purified by repeated solution in benzene and re precipitation with petroleum spirit. From 0·2 to 0·5 grm. of oil is used for a determination, and the results agree within 0·1 to 0·2% with those obtained by Holde's method.—C. A. M.

Lubricating oil; Regeneration of used ——. Rialland. Ann. Falsif., 1919, **12**, 217—218.

To remove extremely fine particles of metal, carbonised matter, metallic soaps, etc., from used lubricating oil, the latter is agitated with 5% of its weight of dilute sulphuric acid (52° B., sp. gr. 1·56), and then, without removing the acid, with an equal quantity of a solution prepared by the action of sodium hydroxide on tannin-gelatin compound; the quantity of alkali in this solution should be somewhat less than is required to neutralise the whole of the sulphuric acid used. (See also Eng. Pat. 121,452; following.)—W. P. S.

Sulphite fuel process. Müller. *See* V.

Replacement of lead in ammonia-recovery plants. Thau. *See* VII.

Hydrogen sulphide. Czakó. *See* VII.

Fuel economy in manufacture of iron and steel. Bone and others. *See* X.

Fuel economy in German iron and steel industry. Johns and Ennis. *See* X.

Fuel economy in cupola practice. Yates. *See* X.

Fuel control in metallurgical furnaces. Hadfield and Sarjant. *See* X.

Powdered fuel for puddling furnaces. Simons. *See* X.

Waste liquor from ammonia recovery from coke oven gas. Marsson and Weldert. *See* XIXB.

Cubic foot standard for gas. Stillman. *See* XXIII.

Bomb calorimeter. Holland and others. *See* XXIII.

PATENTS.

Washing coal and concentrating ores and minerals; Method and apparatus for ——. T. M. Chance, Philadelphia, U.S.A. Eng. Pat. 119,038, 9.9.18. (Appl. 14,645/18.) Int. Conv., 27.8.17.

THE material to be treated is fed into a fluid mixture of liquid with insoluble solid particles maintained in suspension therein by agitation produced either mechanically as by rotation, or by injection of liquid under pressure through orifices, or by any other device. Superposed upon this agitated mixture is a layer of liquid of specific gravity not greater than that of the liquid constituent of the fluid mixture. Light material of specific gravity not greater than that of the superposed layer of liquids floats in this latter layer and is removed therefrom. Grading of the remaining material to be treated, into layers according to specific gravity, occurs in the agitated mixture, and the several layers are separately withdrawn by elevating buckets or similar device operating at suitable levels in the mixture. The superposed layer of liquid serves to wash the material after separation.—J. S. G. T.

Washed coal and the like; Means for extracting water or other liquids from —— particularly applicable to fine coal for coking. C. Burnett, Trowbridge, Wilts. Eng. Pat. 131,788, 1.11.18. (Appl. 17,874/18.)

WASHED coal is fed on to the lower end of an inclined endless conveyor belt from a hopper having an opening which can be regulated. Another belt is arranged just above, and is caused to curve downward into contact with the lower belt by means of guide rollers. The coal is compressed between the two belts and the water expressed. The aperture in the hopper is of less width than the belt, so as to allow for the spreading of the layer of coal. The conveyor belts may be formed of plain, perforated, corrugated, or serrated plates. Alternatively the washed coal may be fed on to the belt conveyor by a screw conveyor.—W. F. F.

Coal refuse; Process for obtaining a valuable fuel from ——. Bergmann-Elektrizitäts-Werke A.-G., Berlin. Ger. Pat. 301,273, 24.12.15.

THE refuse from coal mines (siftings, washings, etc.) is brought into the finest possible state of division (colloidal solution) and then subjected to an electro-osmotic process, whereby clay and other impurities are separated.—C. A. M.

Fuel of the briquette type. W. C. Cash, Manchester. Eng. Pat. 132,183, 4.3.19. (Appl. 5296/19.)

PALM kernel shell (about 53%), coal refuse (25%), and pitch (22%) are mixed together in a cold state and then moulded in a briquette-pressing machine. —J. S. G. T.

Fuel for explosion motors. B. Teufer, Chemnitz. Ger. Pat. 312,201, 17.5.18.

FURFURAL, to which benzol or other combustible substance may be added, is used as fuel for explosion motors. No deposits or crusts are formed, the walls of the cylinder are not attacked, and lubricants are not affected.—C. A. M.

Furnace for converting energy of fuel into force. W. C. and F. E. Wells, Columbus, Ohio. U.S. Pat. 1,314,175, 26.8.19. Appl., 15.11.15.

FUEL is burned in a furnace by means of compressed air, and a further supply of compressed air is admitted and expanded by heat to bring the combustion gases to the desired temperature. Both supplies of compressed air are controlled automatically by the temperature.—W. F. F.

Gas producers, furnaces, and the like; Gas regulating valves for ——. W. Simons, Newcastle-under-Lyme, and I. B. Evans, Stoke-on-Trent. Eng. Pat. 131,728, 28.8.18. (Appl. 13,957/18.)

THE gas-producer flue and the furnace flue are semi-circular in cross-section and are separated by a vertical diametral partition. The cylindrical structure thus formed is provided with an annular vessel containing water around its upper edge, and with a shallow communicating trough along the top of the partition. The valve controlling the two flues is constructed as a shallow pan containing water, and is provided with downward projections, which form water seals. The valve is completely closed when in its lowest position, but when raised the diametral projection is lifted out of the trough and the two flues are put into communication. The annular water seal is not broken in the highest position. The valve is balanced by a weight, and its central operating spindle is not subject to the action of the hot gases.—W. F. F.

Illuminating and power gas; Process of obtaining —— in addition to coke. F. Muhlert, Göttingen. Ger. Pat. 312,101, 12.8.17. Addition to Ger. Pats. 311,073 and 311,195 (this J., 1919, 673 A).

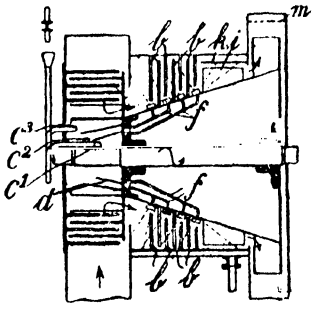
Low-grade gas is burnt below or within the column of incandescent coke to assist in gasifying the coal. A certain amount of coke is consumed by the hot blast in the process described in the original patent, and carbon monoxide is produced $2C+O_2=2CO$. By the present process, however, a part of this carbon monoxide is burned, and the carbon dioxide again reduced to carbon monoxide by the column of glowing coke, with the result that less coke is consumed. The process is suitable for coke-works, where the production of coke is the main object. —C. A. M.

Scrubbers and coolers; Suction gas ——. W. Hart, Sydney, N.S.W. Eng. Pat. 118,848, 4.9.18. (Appl. 14,319/18.) Int. Conv., 28.8.17.

A casing contains a chamber provided internally with a series of inclined perforated plates secured alternately on opposite sides of the chamber. A water tank is arranged within the casing below the chamber and water is pumped therefrom to the uppermost inclined plates, whence it trickles in a zigzag course over the inclined plates, returning to the water tank. Gas enters the chamber from below and passes upwards through the perforations in the inclined plates, any solid particles washed out of the gas being collected in gutters provided at the lower end of each plate, and passing thence to the water tank. Leaving the chamber the gas passes through a number of cooling tubes connected with headers, and is cooled by a current of air from a fan placed within a channel contained by the casing.—J. S. G. T.

Gas washer. Dinglersche Maschinenfabrik A.-G., Zweibrücken. Ger. Pat. 311,594, 22.1.18.

The washing liquid is introduced through one or more inlets, c^1, c^2, c^3, conical or cylindrical, into distributors arranged co-axially and rotating with the washing drum. The liquid is directed thence



by centrifugal force through tubes, f, and discharged against radial rods, b, in the washing drum. The mixed gas and washing liquid on its way to the exit is directed by vanes, i, against fixed perforated plates, k, to separate the liquid, and any remaining liquid is separated from the gas by the screen, m. —C. A. M.

Liquids [waste mineral oils]; Process for purifying ——. A. Rialland, Rennes, France. Eng. Pat. 121,452, 21.3.18. (Appl. 5016/18.) Int. Conv., 10.12.17.

Ten litres of 2*N* solution of sodium hydroxide is added to one kilo. of tanned leather waste, and the mixture is allowed to stand for five days. One litre of the solution is added to 10 litres of waste mineral oil heated on a water bath, and, while the mixture is well stirred, sufficient acid, *e.g.*, 1 litre of 2*N* sulphuric acid, is added to acidify the solution. Tannate of gelatin is precipitated, bringing down with it the impurities present in the oil, which pass into the aqueous layer. The liquid is allowed to settle, and the hot oil is filtered. In order to avoid oxidation of the tannin, a small quantity of a reducing agent, *e.g.*, a sulphite, may be added to the alkaline solution.—L. A. C.

Oil fuel burners. R. E. Ellis and F. R. Macdonald, London. From E. C. Bowden-Smith, Cairo. Eng. Pat. 131,955, 30.5.18. (Appl. 8958/18.)

Discharge of inflammable liquids. Eng. Pat. 125,961. *See* I.

Combustion in furnaces. Eng. Pat. 131,864. *See* I.

Generating pressure. U.S. Pat. 1,313,698. *See* I.

Distilling oils etc. Eng. Pat. 131,365. *See* III.

Fuel from paper. Eng. Pat. 131,446. *See* V.

Hydrogen. Eng. Pat. 131,091. *See* VII.

Hydrogen. Eng. Pat. 131,328. *See* VII.

Hydrogen. Eng. Pat. 131,347. *See* VII.

Hydrogen etc. Eng. Pat. 131,684. *See* VII.

Nitrogen compound from nitrogen of atmosphere. Eng. Pat. 131,609. *See* VII.

Cement. Eng. Pat. 131,164. *See* IX.

Gas detector. U.S. Pat. 1,313,323. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Photometric scale; The ——. H. E. Ives. J. Franklin Inst., 1919, 188, 217—235.

This paper is a revision to date of the author's system of colour difference photometry described in a previous communication (Trans. Illuminating Engineering Soc., 1915). The following factors are discussed: Conditions of observation; method of choosing observers; relative luminous values of radiant energy of various wave-lengths; the value of the lumen in terms of the watt of luminous flux; standards of luminous intensity; standards of colour difference. As the scale now stands, it is claimed, it provides complete and practical means for the precision measurement of the luminous values of all kinds of light sources.—E. H. R.

Patents.

Distillation of coal. H. J. Toogood, and R. Dempster and Sons, Ltd., Elland, Yorks. Eng. Pat. 131,409, 16.7.18. (Appl. 11,610/18.)

The process of carbonisation of coal in intermittent vertical retorts described in Eng. Pat. 28,201 of 1908 (this J., 1909, 1240), in which retorts in widely different stages of carbonisation are coupled in such manner that the lean gas coming off from the nearly spent coke in one retort traverses the newly-charged coal in another retort, is modified in that the incandescent coke in one retort is steamed in a downward direction, and the gas evolved passed through the adjacent retort or retorts in an upward direction or *vice versâ*. The process can be applied to carbonisation in inclined or horizontal retorts. In the case of horizontal retorts, the steam is superheated and introduced into the retort at the

highest available pressure through a minute orifice. (See also this J., 1919, 349 A.)—J. S. G. T.

Gas mantles; Process for the preparation of —— from cellulose. F. Breslauer, Berlin. Ger. Pat. 312,177, 27.2.18.

Cellulose is treated at any stage of its conversion into gas mantles with ether, alcohol, glacial acetic acid, methyl alcohol, or similar substances, including solvents for resins, or with mixtures of such substances.—C. A. M.

Gas mantles; Process for the manufacture of —— from cellulose fibres. M. Mayer, Berlin-Schöneberg. Ger. Pat. 312,178, 27.2.18.

Cellulose or cellulose yarns or fabrics are bleached, and the residual inorganic constituents then removed, *e.g.*, by treatment with acid.—C. A. M.

Decolorising carbon. U.S. Pat. 1,314,201. *See* XVII.

III.—TAR AND TAR PRODUCTS.

Aniline; Determination of —— in dilute aqueous solution. W. G. O. Christiansen. J. Ind. Eng. Chem., 1919, 11, 763–764.

A simple colorimetric routine method for determining small quantities of aniline in water, *e.g.*, in the aqueous liquors from rectification, is based on the formation of Runge's Violet. Five c.c. of the aqueous liquid is treated with 1 drop of dilute sodium hydroxide solution, 3 drops of a saturated aqueous solution of phenol, and 4 c.c. of a fresh saturated filtered solution of bleaching powder. After standing for ½ hour the liquid is diluted with 50 c.c. of water and its colour compared with those produced under similar conditions by water containing respectively 0·1, 0·15, 0·2, 0·25, 0·3, 0·35, 0·4, and 0·5% of aniline. As the coloration is not permanent, a set of standards is prepared by mixing solutions of red and blue inks in suitable proportions, and adding sufficient finely powdered chalk to produce, after shaking, the degree of opacity shown by actual test liquids.—J. H. L.

Patents.

Distilling the lower boiling constituents from oils [e.g., benzol] and other like liquids; Apparatus for ——. E. Whittaker, Sheffield. Eng. Pat. 131,365, 21.5.18. (Appl. 8400/18.)

A still consisting of a number of tubes arranged within an annular chamber is situated directly above a tubular heat-exchanger of similar construction. An annular chamber surrounding the still communicates at its lower end with the interior of the heat-exchanger, and at its upper end with a chamber extending across the upper surface of the apparatus and which is in communication with the interiors of the tubes of the still, and with a second annular chamber surrounding the first. This second annular chamber may be extended downwards so as to surround the heat-exchanger to any desired level, and contains a series of U-shaped rings or receptacles, arranged at suitable distances apart, and each connected by a suitable pipe, for the collection of the distillate in fractions. The still is heated by steam. The oil to be fractionated enters the heat-exchanger, and after passing upwards through the heat-exchanger and still traverses the same again in a downward direction. The whole, save the distillates retained by the U-shaped receptacles, finally condenses at the base of the heat-exchanger and is run off through a duct.—J. S. G. T.

Salts of amido organic substances; Manufacture of ——. H. N. Morris and Co., Ltd., and H. N. Morris, Manchester. Eng. Pat. 131,957, 5.6.18. (Appl. 9257/18.)

An organic amine, *e.g.*, aniline, toluidine, or xylidine, in the free state, in solution, or as an emulsion, and excess of an acid, either in the gaseous or liquid form, are sprayed through atomisers into a chamber cooled by water coils or a current of air. The excess acid passes into a condenser, and the organic salt is removed through a manhole at the bottom of the chamber.—L. A. C.

Sulphonic acids; Production of ——. H. D. Gibbs, Cherrydale, Va., J. A. Ambler, Norwich, Conn., and The Selden Co., Pittsburgh, Pa., U.S.A. Eng. Pat. 131,970, 8.7.18. (Appl. 11,196/18.)

See U.S. Pats. 1,292,950 and 1,300,227-8 of 1919; this J., 1919, 280 A, 405 A. A partial vacuum may be maintained in the reaction chamber in order to cause the hydrocarbon to boil at a lower temperature than the boiling point at atmospheric pressure. Toluene yields chiefly the *para*-monosulphonic acid when sulphonated at 150° C., whilst disulphonic acids are produced by sulphonating at 240°–250° C. From naphthalene the 2.7-disulphonic acid is obtained by sulphonating at 220°–230° C., and the β-monosulphonic acid by sulphonating at a temperature below the normal boiling point of naphthalene, a partial vacuum being maintained in the reaction chamber.

Separating liquid mixtures. Eng. Pat. 131,346. *See* I.

Cleaning metals. Eng. Pat. 131,455. *See* X.

IV.—COLOURING MATTERS AND DYES.

Asymmetric dyes. C. W. Porter and C. T. Hirst. J. Amer. Chem. Soc., 1919, 41, 1261–1267.

The methyl and ethyl carbinols made by the Grignard reaction from β-aminobenzophenone, and the benzhydrol obtained by reduction, have been diazotised and coupled with β-napnthol, dimethylaniline, naphtholsulphonic acids, and naphthylaminesulphonic acids. The dyes are mostly yellow to red in colour and contain an asymmetric carbon atom. One of them (it is not stated which) is found to be partially resolved by dyeing on wool, this absorbing more of the lævo-modification. (See also J. Chem. Soc., Nov., 1919.)—J. C. W.

Pinaverdol; Crystallography and optical properties of the photographic sensitising dye ——. E. T. Wherry and E. Q. Adams. J. Wash. Acad. Sci., 1919, 9, 396–405.

Pinaverdol (1.1'.6'-trimethyl-*iso*-cyanine iodide) is used to sensitise the silver halide of photographic plates to green and yellow light. The various habits in which it crystallises are described. It exhibits a brilliant reflection pleochroism and an extremely strong double refraction. (See also J. Chem. Soc., 1919, i., 496.)—J. F. S.

Ragweed pollen; The yellow colouring substances of ——. F. W. Heyl. J. Amer. Chem. Soc., 1919, 41, 1285–1289.

Ragweed pollen contains about 0·6% of pigments which give precipitates with basic lead acetate. The chief one seems to be a glucoside of *iso*-rhamnetin, but the least soluble one is a quercitin glucoside, which melts at 228°–229° C. to a cherry-red oil, and is therefore different from its known isomerides, quercimeritrin, *iso*-quercitrin, and incarnatin.—J. C. W.

Pyrazole dyes. Meyer. *See* XX.

PATENTS.

Indigo; Process for obtaining bromine derivatives of —— and of its homologues. Soc. Chim. des Usines du Rhône, Paris. Eng. Pat. 119,860, 21.8.18. (Appl. 13,618/18.) Int. Conv., 10.10.17.

BROMINATION is carried out in sulphuric chlorhydrin (chlorosulphonic acid) solution in presence of phosphoric anhydride. The water formed by the oxidation of the hydrogen bromide produced during bromination, combines with the phosphoric anhydride. There is consequently no nascent sulphuric acid produced, and variable yields due to sulphonation of indigo are prevented.—L. L. L.

Indigo-yellow series. Preparation of leuco-compounds of the ——. Farbwerke vorm. Meister, Lucius, and Brüning, Höchst. Ger. Pat. 312,601, 30.12.15.

THE yellow vat colours obtained according to Ger. Pats. 259,145 and 266,875 (see U.S. Pat. 994,988; this J., 1911, 886) are treated with hydrosulphites in presence of an alkali carbonate. The insoluble free leuco-compound (phenol) is formed which is much more stable in the air than the red solutions obtained with hydrosulphites and caustic alkali. Examples are given of the use of the dyes prepared from indigo and 5:5'-dimethylindigo by the action of benzoyl chloride and benzotrichloride.
—G. F. M.

o-[Hydr]oxy-azo-dyestuffs and chromium compounds thereof; Manufacture of —— and process of dyeing therewith. O. Imray, London. From Society of Chemical Industry in Basle, Switzerland. Eng. Pat. 129,782, 12.7.18. (Appl. 11,458/18.)

p-MONONITRO-*o*-hydroxy-diazo-aryl compounds free from sulpho groups are coupled with 2-amino-naphthalenesulphonic acid compounds free from hydroxy groups, producing dyestuffs which when after-chromed give green shades of a purity and fastness to light not previously attained with dyestuffs of this class. The dyestuffs may be dyed as acid colours and then after-chromed, or the chromium lakes may be produced according to Eng. Pats. 26,460/12, 15,456/15, 104,045, and 116,535 (this J., 1913, 905; 1916, 1255; 1917, 512; 1918, 460 A), and then applied to animal fibres from an acid bath; the chromium lakes are insensitive to copper.—L. L. L.

Colouring product. Eng. Pat. 129,761. *See* VI.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Textile fabrics; Mechanical and physical tests for ——. R. H. Pickard and W. M. Wallace. J. Text. Inst., 1919, **10**, 240—244.

A MACHINE for testing the resistance of textile fabrics to the impact of a heavy pendulum has been constructed and its operation investigated. It is concluded, however, that the impact tester, originally introduced for testing metals, does not give very satisfactory results with fabrics, wide differences being obtained for samples from the same piece of cloth. It was found also that the rupture did not always take place across one section of the cloth, and the distribution of the stress depended on the position of the weakest section or sections and on the nature of the rupture at these sections. More consistent results were obtained with another machine designed to indicate the area of the stress-strain diagram under direct tensile stresses, the load being applied in increments, and the extension of the cloth measured for each load. The energy necessary to break the cloth is indicated by the area enclosed by the curve of co-ordinates. For static tests loads are applied by sliding weights on two levers operating on the bottom clip, the two sides being adjusted to uniformity with light loads before applying the heavier loads by hanging weights on the ends of the levers. The machine is also adapted for applying a limited cycle of successive stresses by means of a bar pressed against the middle of the strip by means of a bell-crank lever operated by a cam-wheel, whereby the extension for a given load is magnified. The deflection brought about by the pressure of the bar is measured by an electrical contact at the top of the bell crank lever. Curves are given illustrating the application to the cloth of stresses up to 60 lb. applied gradually. These curves show in the initial portions a relatively greater resistance to stretch than in the later portions. This is characteristic of all fabrics, and probably represents the initial resistance of the threads to longitudinal displacement. After the maximum load of 60 lb. had been attained the load was gradually released, and the immediate return of the extensions noted. These figures show much greater extensions for the same loads, indicating that the recovery of the strained fabric is not immediate; it is also observed that when the total load is released there is a residual stretch remaining in the cloth. As the elastic restoring forces exert their action, this residual stretch is gradually diminished, and after a few hours' rest the "permanent stretch" of the cloth may be recorded. On again applying the tension a curve very similar to the first one is obtained, but showing greater extensions owing to the permanent stretch in the cloth. This principle of repeated stretches may be developed to indicate the decrease in the resistance of the cloth as the result of wear. If the cam wheel be mechanically driven, the application and release of the stresses follow continuously for any desired number of cycles, and the decrease in the tensile strength of the cloth due to the internal wear may be determined by a static test.—J. F. B.

[Paper] pulp discoloration. C. L. Bachelder. Paper, 1919, **24**, 1096—1097.

IN the bleaching of pulp prepared from cotton linters and hull fibres a considerable discoloration of the bleached pulp was observed after drying in the oven at 110° C., and the discoloration was greater the higher the proportion of bleaching powder consumed, whereas the same samples, dried in the air at 30° C., retained their standard whiteness irrespective of the excess of bleaching powder used. Quantitative colour determinations were made on standard samples of wood pulps after drying at 30°, 70°, 75°, 87°, and 102° C. for 16 hours. It was found that, whereas unbleached sulphite and sulphate pulps showed only a slight discoloration, increasing with the temperature of drying, unbleached soda (aspen) and bleached sulphite pulps were affected about twice as much, whilst bleached aspen pulp showed four times the discoloration of the first two. A bleached pulp is thus far more sensitive to discoloration by heat than the same pulp in the unbleached condition, and the danger is greater the larger the excess of bleach liquor employed. It is suggested that this discoloration is due to the formation of a chlorinated product.—J. F. B.

Starch in paper; Quantitative estimation of ——. V. Voorhees and O. Kamm. Paper, 1919, **24**, 1091—1095.

FOR the determination of starch in paper by hydrolysis it is essential that the starch be first extracted from the paper before hydrolysing with

mineral acid, otherwise a substantial quantity of cupric-reducing sugar is formed at the expense of the fibre itself. For this purpose, digestion with dilute acetic acid is recommended. Five grms. of the paper, torn into shreds, is placed in a 500 c.c. round bottom flask, and covered with 200 c.c. of water containing 5 c.c. of glacial acetic acid, and the liquid is boiled under a reflux condenser for 1½ hours. The extract is decanted through a Buchner filter with suction, and the pulp is washed with 50 c.c. of hot water. To the filtrate is added 15 c.c. of strong hydrochloric acid, and the solution is boiled for 30 minutes, the volume being allowed to decrease by evaporation to about 200 c.c. The acid is treated while hot with solid sodium carbonate until effervescence ceases and the solution is made up to a known volume. This is titrated into 2—10 c.c. of boiling Fehling's solution, boiling for one minute after each addition of sugar solution, and the end point is determined by spotting with ferrocyanide and acetic acid. The Fehling's solution is standardised against ordinary paper-makers' starch hydrolysed in the same manner. Control tests have shown that starch added to paper may be extracted and estimated in this manner with sufficient accuracy, that the acetic acid treatment liberates the starch from its combination with the other sizing agents, that the latter have no influence on the cupric reducing value, and that in papers composed of cotton rag and sulphite-pulp fibres the amount of sugar contributed by the pulp itself does not exceed 0·2% calculated as starch. On the other hand, soda wood pulp and particularly mechanical wood pulp yield appreciable quantities of cupric reducing substances which raise the starch value unduly.—J. F. B.

Sulphite fuel process; Strehlenert's ——. M. Müller. Papierfab., 1919, **17**, 917—919. (See this J., 1919, 318 A).

A SATISFACTORY material for the construction of the plant has been found in Krupp's silicon-iron. The yields on the large scale at the Greaker factory show from 7 to 9·5% of dry fuel from liquors containing 11·5% of dry substance. The reaction takes place more regularly in the large autoclaves than in the small ones, and it is possible to work at lower temperatures and pressures. The use of compressed air for oxidation has been discontinued. No sulphuric acid should be formed in the early stages of the boiling while the temperature still remains moderate; for this reason the air is completely exhausted from the autoclave at the start, and oxidation is avoided. No change takes place in the liquor during the heating up until a temperature is reached at which sulphuric acid is formed. Then the decomposition sets in instantaneously and a dense precipitate, which can be readily filtered, is produced. The decomposition continues during the blowing off, while the precipitate becomes more granular. This is assisted by the rapid evaporation of the liquor which takes place during blowing off, and effects the removal of 25% of the water. An excess of heat amounting to about 30% is developed during the chemical reaction. The blow-off valves are constructed of hard lead, and the faces are reground after every operation. The precipitate is collected and drained on a filter-bed to a content of 40—45% of dry substance, and is then further dried by waste heat to about 60% of dry substance, in which state it is ready for combustion. The fuel is burnt in rotary furnaces, 4 m. long, placed in front of the steam boilers; it is fed on the counter-current principle and becomes further dried until it reaches the middle of the furnace, where it is ignited. It may also be burnt as a powder by injecting it into the hearth of the steam boiler by compressed air. The fuel is best transported from the factory to the boiler house through pipes under blast pressure with exhaust furnace gases, whereby a further drying is effected. The time of boiling the waste liquor in the autoclaves depends on the composition of the liquor; decomposition cannot be completed in less than four hours. The presence of sodium chloride due to the use of salt water in the factory has a very deleterious influence on the reaction.
—J. F. B.

Impermeable fabrics. Dubosc. *See* XIV.

PATENTS.

Fabrics; Process for rendering —— gas and waterproof. Process for doping and fireproofing fabrics. A. Flatters, Bramhall. Eng. Pats. (A) 129,455 and (B) 129,456, 16.7.18. (Appls. 11,607 and 11,608/18.)

(A) TEXTILE fibres are coated with a homogeneous colloid consisting of a mixture of casein, borax, soap, glycerin, and water; the dried coating is then rendered waterproof by coating with a solution of commercial gum animi. (B) The dope consists of a mixture of the ingredients given in (A), along with glue, gelatin, "oil mulch," and soluble creosote. The "oil mulch" consists of an emulsion of gum arabic, cod liver oil, and water. For the fireproof dope the casein and "oil mulch" are replaced by a further addition of borax and magnesium sulphate. A fireproofing and waterproofing coating of ammonium sulphate, powdered abestos, white lead, and gum animi or "fabric copal" is finally applied.
—L. L. L.

Fibrous substances; Treatment [fireproofing] of ——. A. Ward, Halifax, and A. B. Henshilwood, Bradford. Eng. Pat. 130,662. (Appls. 3898, 6.3.17, and 5052, 22.3.19.)

FIBROUS substances and fabrics employed for enclosing explosive charges are treated with a view to preventing smouldering after discharge by impregnation with a solution of a readily fusible substance which forms a glassy coating. Suitable substances are boric acid, ammonium borate, and ammonium phosphate, which are used on vegetable fibres in the form of 1—2% solutions, and microcosmic salt which is used at 6% concentration.
—J. F. B.

Textile fibres and fabrics and other porous and absorbent substances; Treatment of —— to render same less inflammable. P. Spence and Sons, Ltd., and T. J. I. Craig, Manchester. Eng. Pat. 130,743, 3.8.18. (Appl. 12,683/18.)

FABRICS or other materials are impregnated with sulphur either before or after (preferably after) being subjected to a fireproofing treatment, *e.g.* according to Eng. Pat. 16,153/14 (this J., 1915, 868) with alumina and an alkali carbonate. A strong solution of colloidal sulphur is prepared by treating a solution of sulphurous acid with hydrogen sulphide and neutralising the free acid; alternatively a solution of sulphur in a volatile solvent may be employed. The fibres or fabrics are impregnated with this solution by a "padding" machine. The presence of the sulphur is stated to prevent the fireproofed materials from smouldering at the edges.
—J. F. B.

Fabric; Composite ——. W. Beardmore and Co., Ltd., and N. Meadowcroft, Dalmuir, Dumbarton. Eng. Pat. 130,827, 18.9.18. (Appl. 15,170/18.)

A BASE of fine cotton fabric is coated on one side with an adhesive comprising gelatin, glycerin, and dilute acetic acid dissolved in hot water, and wet gold-beaters' skins are laid upon the adhesive coating; a solution of alum or aluminium acetate or other damp-proofing agent may be either mixed with the adhesive or spread over the reverse side of the

fabric after the skins have been laid, and the skin-covered surface may be finished with a coat of varnish.—J. F. B.

Cellulose textiles; Process of treating —— [with alkali]. The Fine Cotton Spinners' and Doublers' Assoc., Ltd., and M. Cunningham, Manchester, and C. F. Cross, London. Eng. Pat. 131,212, 21.11.18. (Appl. 19,144/18.)

COTTON textiles or spinners' raw cotton materials are treated with caustic alkali of strength below that which produces the effects of mercerisation, whereby the material is improved in elasticity and extensibility. A suitable caustic lye may contain 9% caustic soda, but the strength may be varied somewhat and the treatment carried out between 15° C. and 50° C.—L. L. L.

Silk and silk wastes; Process of producing foam or froth baths for ungumming ——. P. Schmid, Basle, Switzerland. U.S. Pat. 1,313,235, 12.8.19. Appl., 5.6.17.

A DILUTE aqueous solution of sodium carbonate containing only sericin as the froth-producing substance is heated to boiling to produce a froth bath for the degumming of silk and silk wastes.
—J. F. B.

Visibility of objects; Process for diminishing the —— and preventing their being picked up by an artificial beam of light. Soc. Nauton Frères et de Marsac, and T. F. Tesse, St.-Ouen, France. Eng. Pat. 131,369, 24.5.18. (Appl. 8655/18.) Int. Conv., 23.1.18.

THE object, *e.g.*, aeroplane fabric, is first coated with a ground coat of a matt, very dark-coloured opaque varnish, which may be composed of opaque pigments, such as smoke black or Paris blue, incorporated in a medium of a fatty varnish, cellulose ester, insoluble gelatin, etc., and one or more coats of a coloured transparent or translucent varnish are then applied, the colour being selected according to the nature of the source of the projected light. The translucent coat is composed of a red lake, more particularly Alizarin Red precipitated on pure aluminium hydroxide, and a transparent varnish. This combination has the effect of absorbing the rays of light of which the beam is composed so that practically no light is reflected.
—L. L. L.

Covering and producing tautness of fabrics, especially applicable for aeroplane wings or other air-craft components. F. Cumbers, and British Cellulose and Chemical Manufacturing Co., Ltd., London. Eng. Pat. 131,384, 10.6.18. (Appl. 9488/18.)

A DOPE or solution of cellulose ester, with or without addition of a softening agent or other liquids or solvents, is applied to a fabric stretched on a framework, and while the dope is wet a layer or film of cellulose ester is fixed thereon, either in sections or complete lengths or pieces, in such a manner that the film adheres firmly to the fabric and produces tautness after drying or evaporation of the solvents or liquids. Further layers or films may be applied upon the first. Woven net or paper or other suitable material in mesh, network, or sheet form may be used as a reinforcing or supporting material embedded in or in combination with the sheets or films of cellulose ester.—L. L. L.

Wall-covering; Process of producing —— and product thereof. R. H. Wiggin, East Orange, N.J., Assignor to H. B. Wiggin's Sons Co., Bloomfield, N.J. U.S. Pat. 1,313,658, 19.8.19. Appl., 9.9.15.

A WATER-RESISTING surface is produced on a fabric by impregnating it with an aqueous solution of an albuminoid and a soluble soap, and then treating with formaldehyde to render the albuminoid insoluble, and with an aqueous solution of a water-soluble metallic salt to render the soap insoluble.
—L. L. L.

Doping aeroplane and the like fabrics or materials; Means for ——. A. Mond, London. Eng. Pat. 131,940, 30.9.18. (Appl. 5619/18.)

A CONTRIVANCE for doping aeroplane fabrics and the like consists of a felt-covered roller and a number of brushes rotated by means of the roller and so arranged that successive brushes rotate in opposite directions. A liquid such as acetone is fed on to the roller from a container above, and another container feeds the dope on to the surface of the cloth in front of the first brush.—L. A. C.

Viscose; Manufacture of filamentous material from ——. A. Pellerin, Trouville, France. Eng. Pat. 121,731, 17.12.18. (Appl. 21,084/18.) Int. Conv., 20.11.13.

A FILAMENTOUS mass, especially suitable for carding and spinning purposes, prepared from a viscose solution by the process described in Fr. Pats. 410,776 and 442,022 (this J., 1910, 811; 1912, 916), is drawn through a precipitating bath by means of a cylinder; the speed of the cylinder may be regulated by a change-speed gear with expansible pulleys or other means, and thereby the fineness and brilliance of the filaments varied as desired without interrupting the process of manufacture.
—L. L. L.

Cellulose acetate; Manufacture of ——. J. Radcliffe, East Barnet. Eng. Pat. 131,357, 16.5.18. (Appl. 8216/18.)

CELLULOSE is acetylated with an excess of acetic anhydride until the desired degree of acetylation is attained. The acetylation is then stopped by mixing with the mass finely powdered salts containing a large proportion of water of crystallisation. In this manner water is distributed throughout the mass rapidly so that acetylation is checked at the correct time, and excessive dilution at any part avoided.—L. L. L.

Paper pulp; Apparatus for opening up —— and removing undesirable matter therefrom. J. White, Edinburgh, and F. W. Gray, Leith. Eng. Pat. 131,418. (Appls. 13,034, 12.8.18, and 17,130, 21.10.18.)

THE apparatus comprises a vat divided into compartments by one or more sluices so arranged that the path of flow through the vat is alternately upward and downward. The lighter undesirable matters may be retained at the upper level of the vat by the upstanding sluices, and the heavier undesirable matters settle by gravitation, and may pass into a chamber below the vat. The compartments are provided with perforated diaphragms, which may be given a reciprocating or rotary motion, to cause local acceleration and retardation of the rate of flow through the vat. The separator is an efficient fibre washer, since the fibres are subjected to a strong scouring action while passing through the perforations in the diaphragms.
—L. L. L.

Rice straw; Treatment of —— for recovery of its values. M. W. Marsden, Philadelphia. U.S. Pat. 1,315,403, 19.8.19. Appl., 28.10.16.

THE straw is subjected to a preliminary steaming until it is fully saturated with hot moisture and is rendered soft and pliant, whereupon it is shredded and then leached with steam and water to remove colouring matter, silica, and other soluble matter, this treatment being continued until the liquor has a density of 12°—20° B. (sp. gr. 1·09—1·16). The separated leaching liquor is treated with calcium

carbonate preliminary to the recovery of the products of the treatment, and the separated fibre is washed and refined.—L. L. L.

Paper; Apparatus for testing the resistance to tearing of ——. G. S. Witham, sen., Hudson Falls, N.Y., U.S.A. Eng. Pat. 130,905, 7.2.19. (Appl. 3084/19.)

A SHEET of paper, in which a slit terminating in a hole has been made, is stretched tightly between two spring clamps against a vertical board. The lower edge of the paper on one side of the slit, which has not been clipped to the board, is attached to a swivel clamp at the end of a balance scale-beam adjusted to a horizontal position by means of sliding weights. From the other end of the beam is suspended a cup into which liquid may be delivered from a burette. The weight of the liquid, plus any additional load which may be applied by the sliding weight, is observed when the paper starts to tear from the punched hole, and the length of the tear is recorded by a pointer carried by the beam.
—J. F. B.

Paper; Manufacture of a heat-insulating material and a fuel from ——, *also applicable to other purposes.* L. A. Edwards, London. Eng. Pat. 131,446, 20.8.18. (Appl. 13,531/18.)

WASTE paper is reduced to pulp by soaking in cold water for two or three days, then broken into small pieces, subjected to a light rubbing or rolling pressure, and dried in the air or by other means. The product is a light, coarsely granular substance suitable as a heat-insulating medium. For producing fuel the coarse granulated material is impregnated with paraffin or other, preferably heavy, hydrocarbon.—L. L. L.

Paper mass [*papier-maché*]; *Process of preparing* ——. M. Rosenthal, G.m.b.H., Berlin. Ger. Pat. 311,828, 2.10.17.

PAPER-MAKING material, such as wood, straw, grass, etc., is intimately mixed with 10—60 % of lake mud (sapropel), and the mass made into the desired form and dried in the air or at a moderate heat. This stiffens and hardens the material, which, owing to its content of wax-like substances, has a smooth surface, and does not require hardening.
—C. A. M.

Formic acid; Process of preparing paper, cotton wool, etc., developing ——. L. Elkan Erben Ges. m. b. H., Berlin. Ger. Pat. 312,063, 11.6.18.

PAPER, cotton wool, etc., is saturated with a solution of neutral (normal) formate of calcium, strontium, or magnesium. When the material is subsequently moistened with water the formate is dissociated with the liberation of formic acid. The impregnated material is suitable for wrapping foods etc.—C. A. M.

Wood particles; Separation of —— *from the liquid in which they are contained or suspended.* N. Pedersen, Borregaard, Norway. Eng. Pat. 119,028, 1.8.18. (Appl. 12,581/18.) Int. Conv., 13.9.17.

THE outlet waters of wood pulp plants are treated with air or gas bubbles introduced into the liquid under pressure and then liberated at atmospheric pressure. The fine air bubbles carry the suspended wood particles with them to the surface.—L. L. L.

Waste lyes from the digestion of vegetable substances with alkalis; Process of utilising ——. F. Bergius and E. Hägglund, Essen. Ger. Pat. 311,933, 10.10.17.

THE waste lyes are heated under pressure at a high temperature. If soda-cellulose lye is heated under pressure to 250°—300° C. the bulk of the organic constituents is precipitated after about two hours as a carbonaceous deposit.—C. A. M.

Gas mantles. Ger. Pats. 312,177 and 312,178. *See* II B.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Dyeing and finishing of "staple-fibre" goods. A. Winter. Färber-Zeit., 1919, **30**, 161—164.

"STAPLE-FIBRE" pulp (Kramer, this J., 1919, 281 A) is deficient in water-resisting power, and material woven from it will not withstand pulling. The strength of the goods produced from it is greatly enhanced by admixture of wool or cotton yarn, and the mixed material may be washed, bleached, or dyed like any other textile fibre. For material that has to be dyed pale shades, bleaching with hypochlorite is recommended for mixtures consisting wholly of vegetable fibres, and with sodium perborate for mixtures containing animal fibres. Dyeing is effected with direct cotton colours with addition of Glauber's salt to the dye-bath, and in cases where greater fastness is required dyestuffs are used that may be "after-treated" with chrome, copper, formaldehyde, etc. The material may be dyed with sulphide or vat colours or with Aniline Black. Material containing animal fibres is dyed in a single bath with direct cotton colours and neutral wool colours. For finishing, soluble starch, Irish moss, and glycerin are used, and for water-insoluble finishes, glue, followed by treatment with formaldehyde.—L. L. L.

PATENTS.

Mordant; New colouring product and tinctorial ——. R. H. and M. H. Vegas, Buenos Aires. Eng. Pat. 129,761, 14.6.18. (Appl. 9823/18.)

THE bark, wood, roots and leaves of the retama tree are extracted with water at 60°—70° C., and the extract concentrated by evaporation. The tree is indigenous to the provinces of San Juan and Mendoza in the Argentine. The product is entirely innocuous, and may be used for dyeing and mordanting textiles and as a substitute for saffron for colouring food products.—L. L. L.

Mordanting of vegetable fibres [*with titanium*]. J. Barnes, and P. Spence and Sons, Ltd., Manchester. Eng. Pat. 131,098, 10.5.18. (Appl. 7829/18.)

A SATISFACTORY degree of mordanting, without the use of tannin, may be obtained by treating the fabric or yarn with a solution of a titanous salt, removing the excess, and subjecting the wetted material to air, these operations being repeated if necessary. Iron, if present in the solution, is not fixed, as is the case with the tannin method. When commercial titanous sulphate or chloride, which usually contain free acid, is used, a fuller mordanting effect may be obtained by partially neutralising the free acid in the solution.—L. L. L.

Fabrics having the property of invisibility; Production of ——. F. Cochrane, Cheadle Hulme. Eng. Pat. 129,712, 4.12.17. (Appl. 17,944/17.)

COTTON, woollen, linen, or other fabric is padded with an aluminium salt solution, such as aluminium sulphacetate, or with tannin. Pigment or insoluble colouring materials mixed with albumin or similar reagent, which coagulates on heating and forms with the alumina an insoluble fixing medium for the colours, are then applied to produce promiscuous colour patches. The wet condition of the fabric causes a softening of the colour effects by preventing strong lines of demarcation between

adjacent colours. The colours are fixed by ageing or heating so as to coagulate the albumin. The fabric is then waterproofed by passing it through a hot emulsion of paraffin, carnauba wax, Japan wax, and stearine.—L. L. L.

Fabrics; Treatment of —— to render them invisible. F. Cochrane, Cheadle Hulme. Eng. Pat. 130,672, 9.3.18. (Appl. 4181/18.)

THE surface of the fabric is treated with a cold solution of an aluminium salt, or of tannin, or of substances which convert blood or other albuminous matter into an insoluble fixing medium for colouring matters; the material is then partly dried and a solution of blood or other albuminous matter mixed with pigment is applied in promiscuous patches to the fabric. A wax emulsion, consisting mainly of paraffin wax and stearic acid, together with a little Japan and carnauba waxes, and emulsified with ammonia solution, may be incorporated with the colour mixtures to impart a certain degree of water-resistance. The aluminium salt employed may be aluminium sulphacetate, to which may be added copper acetate to impart rot-resisting properties to the fabric.—J. F. B.

Seaweed; Process for obtaining products [dressings for fabrics] from ——. W. H. Hyatt, Long Ditton, Surrey, and E. N. Fellowes, London. Eng. Pat. 131,413, 20.8.18. (Appl. 13,521/18.)

PRODUCTS extracted from seaweed by hot water are rendered insoluble—and thus suitable for use as dressings for fabrics etc.—by the addition of formaldehyde.—W. E. F. P.

Bleaching boiler plant. C. Tütsch, Winterthur, Switzerland. Eng. Pat. 119,663, 1.10.18. (Appl. 15,965/18.) Int. Conv., 2.10.17.

SEE Ger. Pat. 309,974 of 1917; this J., 1919, 197 A.

Dyeing with o-hydroxyazo dyestuffs. Eng. Pat. 129,782. *See* IV.

Chrome liquors. Eng. Pat. 131,772. *See* XV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Copper sulphate in the presence of sulphuric acid; Electrical conductivity and other properties of saturated solutions of ——. H. M. Goodwin and W. G. Horsch. Chem. and Met. Eng., 1919, **21**, 181—182.

THE specific electrical conductivity at 25° C. of saturated solutions of copper sulphate containing from 0·15 to 3·6 equivalents of sulphuric acid per litre has been determined using the customary Wheatstone bridge arrangement with alternating current. The solutions were rotated in presence of excess of copper sulphate in a constant temperature bath and the measurements continued until constant readings were obtained which indicated saturation. The results show that the conductivity increases according to a straight line law with increasing concentration of sulphuric acid. The solubility of copper sulphate in the presence of sulphuric acid was determined, the copper sulphate content being measured by electro-analysis. The curve shows that the saturation concentration of copper sulphate falls continuously with increase in concentration of sulphuric acid up to four equivalents per litre. The acid content of the original solutions was determined by titrating with standard sodium hydroxide solution in the presence of copper sulphate, using methyl orange as an indicator. The density of the solutions was measured by means of a Mohr-Westphal balance. The specific gravity first falls with increasing sulphuric acid content and then increases rectilinearly with a minimum at about 0·5 equivalent per litre.—T. H. Bv.

Ammonia-recovery plants; Replacement of lead in ——. A. Thau. Glückauf, 1919, **55**, 241—243. Chem. Zentr., 1919, **90**, IV., 7—8.

A CONSIDERABLE saving of lead may be effected by lining the saturators with acid-proof cement. Only a thin coating of lead need then be applied to the iron surface as a safeguard against flaws in the cement lining. The receiver for the lye draining from the ammonium sulphate may be made of concrete or cement, coated with asphalt, and lined with lead. The shallow pans to receive the drippings are conveniently of copper or lead, cast in one piece, whilst seamless wrought iron or steel tubes, the flanges of which are made tight with packing of pure rubber, are suitable for the acid conduits. The cocks etc. should be made of stoneware, hard lead, or phosphor bronze. C. A. M.

Hydrogen sulphide; Determination of —— in gas mixtures by titration. E. Czakó. J. Gasbeleucht., 1919, **62**, 483—486.

THE titration method for the determination of hydrogen sulphide is in constant use at the Lehr- und Versuchsgasanstalt, Karlsruhe. The gas burette employed has a volume of 110—115 c.c., the lower and narrower portion having a volume of about 50 c.c. Two separate scales are provided, each reading to 0·1 c.c.; one serves to measure the volume of gas employed, and the other to measure the volume of liquid in the burette. At its upper end the burette is closed by a three-way tap, the plug of which is bored along two radii at an angle of 120° with one another, so that any two of the three branches of the tap can be put into communication. The determination of hydrogen sulphide is made by interaction of the gas with iodine solution (1·056 grm. per litre; 1 c.c. = 0·1 c.c. H_2S, saturated with moisture at 15° C. and 760 mm.), the excess of which is then titrated with sodium thiosulphate or, better, arsenite solution. The corresponding $\frac{1}{10}$ "gas normal" arsenite solution contains 0·4117 grm. As_2O_3 per litre. The determination of hydrogen sulphide is carried out by first filling the burette with iodine solution, thereafter introducing about 100 c.c. of gas into the burette. The reaction is quickly completed by shaking. The volumes of iodine solution in the burette and of gas free from hydrogen sulphide are read with the usual precautions, and the liquid content of the burette transferred to a beaker and titrated with arsenite solution. In the case of gas containing from 0·1 to 3% of hydrogen sulphide, $\frac{1}{10}$ "gas-normal" solutions are employed, $\frac{1}{4}$ gas-normal or $\frac{1}{2}$ "gas-normal" solutions being employed for higher concentrations and $\frac{1}{100}$ "gas-normal" solutions for lower concentrations. The heavier hydrocarbons present in coal gas cause the results to be 0·02% too high, which is well within the experimental error of the method.—J. S. G. T.

Alkali hypochlorites; Constitution of ——. E. Justin-Mueller. J. Pharm. Chim., 1919, **20**, 113—115.

ANALOGY of the reactions of calcium hypochlorite and alkali hypochlorites, and the general reactions of the latter, lead the author to the opinion that alkali hypochlorites have the formula X_2OCl_2 (XOCl+XCl) and not XOCl. (See also J. Chem. Soc., Nov., 1919.)—W. P. S.

Alumina from clay; Manufacture of ——. V. Gerber. Z. Elektrochem., 1919, **25**, 193—208.

AN account of the extraction and purification of alumina from bauxite is followed by a description

of a large number of experiments made with the object of devising a technical process for the production from clay of alumina suitable for aluminium manufacture. A German clay was used, having the composition: SiO_2, 46·08%; Al_2O_3, 33·88; Fe_2O_3, 2·48; CaO, 0·70; MgO, 0·31; $(Na, K)_2O$, 2·61; loss on ignition, 13·44%. Experiments showed that much of the alumina could be rendered soluble in hydrochloric acid by previous ignition of the clay. Heating for three hours at 800° C. rendered 84% of the alumina soluble, but much silica dissolved at the same time. It is supposed that the effect of ignition is to form a soluble aluminosilicate and not, as was supposed by Le Chatelier, the complete decomposition of the kaolinite into two molecules of silica and one of alumina. When the ignition was carried out at 900° C., very little of the alumina became soluble in acid, presumably owing to the formation of an insoluble modification of the aluminosilicate. Admixture of lime with the clay before ignition did not improve the yield of alumina obtained on subsequent extraction, but the use of calcium chloride increased the yield to over 90%, whilst at the same time the temperature of ignition could be raised to 900° C. without risk of an insoluble product being obtained. The disadvantage of the process of acid extraction is that the alumina is contaminated with iron and silica from which it has to be separated by further treatment. In processes involving alkali fusion the cost is considerably increased through loss of alkali due to formation of alkali silicate. Experiments have been carried out with the idea of avoiding this loss by using lime to combine with the silica. Clay was fused with mixtures of sodium carbonate and calcium carbonate at 800°—1200° C. and the mass extracted with water to disssolve the sodium aluminate. The best proportions were found to be 1 mol. Na_2CO_3 : 1 mol. Al_2O_3 and 2 mols. $CaCO_3$: 1 mol. SiO_2, a yield of 70% of the alumina present in the clay being obtained and an equivalent amount of the soda used recovered. An improvement on this process, and one which might be applied technically, is the use of barium carbonate in place of sodium carbonate. The clay is ignited at about 1150° C. with barium and calcium carbonates in the proportions 1 mol. $BaCO_3$: 1 mol. Al_2O_3 and 2 mols. $CaCO_3$: 1 mol. SiO_2, with about 8 mols. sodium chloride as flux. The soluble barium aluminate formed is extracted with water (yield about 75%) and the barium recovered by precipitation with sodium carbonate. The sodium aluminate solution obtained is then worked up by the Baeyer process as used for bauxite purification. In the fusion, excess of barium carbonate must be avoided, since it leads to the formation of an insoluble barium aluminosilicate. The calcium carbonate may all be replaced by barium carbonate, the insoluble ternary compound not being formed under these conditions. Another process which appears to have technical possibilities consists in heating the clay with calcium carbonate alone and extracting the mass with sodium carbonate solution. An alumina free from iron, but containing silica, is thus obtained which would be suitable material for the preparation of aluminium salts.—E. H. R.

Arsenious oxide and iodine; Reaction between ——. I. M. Kolthoff. Pharm. Weekblad, 1919, **56**, 621—634.

The reaction, $As_2O_3+2I_2+2H_2O \rightleftarrows As_2O_5+4HI$, has been studied with reference to the limits of acidity of the solution within which a definite end-point can be obtained. These limits were determined by the colorimetric estimation of the hydrogen ion concentration by means of various indicators. The purity of the arsenious oxide used is best tested by measurement of the conductivity of a saturated solution. The common impurity is arsenic oxide. Neutral or weakly acid solutions of arsenious oxide are stable and may be kept indefinitely without change of titre. In alkaline solution oxidation of arsenious to arsenic oxide takes place.—W. S. M.

Arsenic acid; Iodometric estimation of ——. I. M. Kolthoff. Pharm. Weekblad, 1919, **56**, 1322—1326.

The reaction, $As_2O_3+4HI \rightleftarrows As_2O_5+2I_2+2H_2O$, proceeds from left to right only in acid solution. In order to obtain satisfactory results by titration of the liberated iodine with thiosulphate, hydrochloric acid must be present as $4N$ acid in the mixture if the solution of arsenate is $N/5$ to $N/10$. If the arsenate is more dilute ($N/50$) a minimum concentration of $4·5N$ hydrochloric acid is necessary. The reaction mixture must stand for five minutes before titration with thiosulphate.—W. S. M.

Cyanogen chloride; Preparation of ——. W. L. Jennings and W. B. Scott. J. Amer. Chem. Soc., 1919, **41**, 1241—1248.

Finely powdered sodium cyanide is mixed with about 2% of its weight of water and sufficient carbon tetrachloride to prevent the mass from becoming pasty. Well-washed chlorine is introduced into the mixture at −5° to −3° C., and when absorption is complete the liquid is allowed to warm up to 28° C., and the cyanogen chloride is distilled through a calcium chloride tube into a chilled receiver. The process is not accompanied by any risk of explosion and the yield is almost quantitative. The product is stable except when it contains traces of hydrogen chloride, which causes polymerisation. It may be freed from chlorine by standing over mercury, and from hydrochloric acid by shaking with lime. (See also J. Chem. Soc., Nov., 1919.)—J. C. W.

Cyanogen chloride C. Mauguin and L. J. Simon. Comptes rend., 1919, **169**, 474—476.

There are only two cyanogen chlorides, one boiling at 12·5° C. under atmospheric pressure, and the other a solid polymeride of this melting at 145° C. The volatile chloride may be prepared by the action of chlorine on an aqueous solution of hydrogen cyanide, or sodium cyanide and hydrochloric acid. It is also conveniently obtained by the electrolysis of solutions containing equimolecular proportions of hydrogen cyanide and chloride, using a graphite anode in a closed porous pot provided with a delivery tube leading to a freezing bath for the collection of the cyanogen chloride. The cathode compartment contains dilute hydrochloric acid. (See further J. Chem. Soc., 1919, i., 177.)—G. F. M.

Silica jelly; Preparation of —— for use as a bacteriological medium. A. T. Legg. Biochem. J., 1919, **13**, 107—110.

The membranes used for dialysis were made from collodion solution prepared by dissolving 6 grms. of guncotton in 100 c.c. of ether-alcohol (1:1); 500 c.c. of this solution is allowed to stand for 24 hours, decanted through a glass-wool filter, and the membrane formed by pouring small quantities into test-tubes. Detailed instructions for this procedure are given to enable thick membranes to be produced. For the preparation of silica jelly, 100 grms. of pure, re-fused sodium silicate dissolved in a litre of distilled water is added slowly to an equal volume of re-distilled hydrochloric acid of sp. gr. 1·10. After shaking and allowing to stand for 3—4 hours, the liquid is dialysed into distilled water, which is changed hourly, until the silicic acid is neutral to litmus (this usually requires two days). The neutral jelly is then mixed with

nutrient substances, boiled for 5 mins. to expel air, tubed while hot, and immediately heated in an autoclave for 20 mins. at 135°—140° C.

Molybdenite; Some optical and photoelectrical properties of ——. W. W. Coblentz and H. Kahler. U.S. Bureau of Standards, Scientific Paper 338. J. Franklin Inst., 1919, **188**, 263.

Measurements have been made of the change in electrical conductivity of molybdenite when exposed to radiations of wave-lengths extending from the ultra-violet into the extreme infra-red. Samples of molybdenite obtained from various localities were found to differ greatly in photo-electrical sensitivity. The sensitivity varies with the wave-length of the incident radiation, and maxima were found in the regions of 0·73μ, 0·85μ, 1·02μ, and 1·8μ. The sensitivity increases with decrease in temperature. At 70° C. the bands at 1·02μ and 1·8μ have practically disappeared. On the other hand, at liquid air temperatures, the greatest change in electrical conductivity is produced by radiations of wave-lengths between 0·8μ and 0·9μ. Molybdenite appears to be unique in being photo-electrically sensitive to infra-red rays, extending to about 3μ.—E. H. R.

Isotopes; Possibility of separating ——. S. Chapman. Phil. Mag., 1919, **38**, 182—186.

The method suggested depends on thermal diffusion; if free communication is made between like mixtures of gases in vessels maintained at different temperatures, diffusion will take place until an equilibrium is reached in which there is a slight excess of the heavier gas in the cold vessel and of the lighter gas in the hot vessel. If the molecular masses are equal, but the diameters unequal, the larger molecules will be in excess in the cold vessel. The author discusses the subject from a mathematical point of view, and reasons that thermal diffusion, many times repeated, should prove a practical method of separating isotopes of the neon and metaneon type. It appears that the time required is to be reckoned in hours at most. (See also J. Chem. Soc., 1919, ii., 390.)
—W. P. S.

Ammonia in producer gas. Ovitz. *See* IIa.

Hydrogen. Engels. *See* IIa.

Wollastonite etc. Ferguson and Merwin. *See* VIII.

Agricultural lime. Robertson. *See* XVI.

Burgundy mixtures. Mond and Heberlein. *See* XIXb.

War gases. Morris. *See* XX.

Acetic acid. Matheson. *See* XX.

Catalytic reduction of hydrogen cyanide. Barratt and Tilley. *See* XX.

Iodine in nitric acid and sodium nitrate. White. *See* XXII.

Determination of magnesia in presence of alkalis. Nicolardot and Dandurand. *See* XXIII.

Determination of chlorine. Yoder. *See* XXIII.

Patents.

Nitric anhydride; Manufacture of ——. F. Gros et Bouchardy, Paris, Assignees of P. A. Guye, Geneva, Switzerland. Eng. Pat. 131,334, 2.5.18. (Appl. 7392/18.) Int. Conv., 16.5.17.

Two currents of gas, one containing ozone, the other an oxide of nitrogen of a lower degree of oxidation than N_2O_5, and higher than N_2O, are caused to react in such proportions as to avoid excess of either. The nitric anhydride produced is either condensed by cooling the gaseous mixture to −80° C., a heat interchanger being used in addition with advantage, or is dissolved at a temperature below −20° C. in a suitable solvent such as nitric acid, sulphuric acid, oleum, or carbon tetrachloride.—W. J. W.

Nitric acid; Manufacture of concentrated ——. F. Gros et Bouchardy, Paris, Assignees of P. A. Guye, Geneva, Switzerland. Eng. Pat. 131,335, 2.5.18. (Appl. 7393/18.) Int. Conv., 2.6.17.

Aqueous nitric acid is concentrated by passing into it a current of ozonised oxygen or air and nitrogen peroxide which interact to form nitric anhydride, the latter combining with the water present in the nitric acid.—W. J. W.

Nitric acid; Manufacture of ——. F. Gros et Bouchardy, Paris, Assignees of P. A. Guye, Geneva, Switzerland. Eng. Pat. 131,336, 2.5.18. (Appl. 7391/18.) Int. Conv., 16.6.17.

Liquid nitrogen peroxide is caused to react for a prolonged time with water or dilute nitric acid in an atmosphere of oxygen. To keep the water saturated the proportion of nitrogen peroxide to water must be at least 15:1. Two immiscible layers are formed of which one, representing about four-fifths of the volume, contains nitric acid (98% — 100% HNO_3) and its own weight of N_2O_4. The other consists of nitrogen peroxide containing 2% to 5% of nitric acid. The nitric acid layer is easily separated by decantation and then distilled, or it may be recovered by distillation of the mixture under reduced pressure. The time of reaction may be reduced by agitation, by increasing the temperature to 30° C., or by compressing the oxygen up to 20 atmospheres. An increase of from 1 to 10 atmospheres reduces the time from thirty one to four hours. The process may be intermittent or continuous.—W. J. W.

Nitrogen peroxide and nitric acid; Process for manufacture of liquid ——. W. R. Bousfield, Hendon, and Nobel's Explosives Co., Ltd., Glasgow. Eng. Pat. 131,642, 2.7.18. (Appl. 10,869/18.)

In the synthetic manufacture of nitric acid by the electric arc or ammonia oxidation processes, the oxidation of the nitrogen peroxide is very expensive, and if the peroxide is condensed a temperature of −90° C. is necessary to avoid loss, which renders this procedure impracticable. According to this invention nitric acid is used as a solvent for the nitrogen peroxide. The gases from the ammonia oxidation process, for example, are refrigerated to −10° C. in a cooler, and then brought into contact with nitric acid in a scrubbing tower. The nitrogen peroxide may be separated from the solution and condensed or oxidised. The invention is specially applicable to the Haber process, in which oxygen sufficient for the oxidation of a large proportion of the nitrogen peroxide produced is obtained as a by-product. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 1143 of 1911.)
—W. J. W.

Ammonia; Process for the oxidation of ——. J. R. Partington, Lostock Gralam, Cheshire, and E. K. Rideal, London. Eng. Pat. 131,942, 19.4.18. (Appl. 6112/18.)

In the oxidation of ammonia, more air or oxygen than that required theoretically to produce nitric oxide alone is employed, and the gases leaving the oxidiser are cooled rapidly (in 30 seconds) to a temperature below the condensation point of steam (30° C.), whereby a large proportion of the water vapour present is removed before any appreciable oxidation of the nitric oxide occurs.—W. E. F. P.

Filling material for use in Glover towers and similar apparatus and [continuous] means for producing same. P. Kestner, Paris. Eng. Pat. 131,502, 18.10.18. (Appl. 17,065/18.)

THE material is intended to be thrown promiscuously into the tower and consists of rings of earthenware or other suitable material which are thin in proportion to their diameter, the size recommended being about 1 to 1½ cm. diam. and 1 mm. thick. Various shapes of rings and of cross sections are described, but a ring of triangular cross section is preferred as being easiest to manufacture. An automatic moulding and drying machine for making such rings consists of an endless thin metal band indented with shapes for the rings and, except at the feed end, enclosed in a chamber heated by hot air. As the band passes upwards over a roller at the feed end, it passes under a close fitting hopper provided with a piston which presses clay into the shapes, any excess being removed by a scraper; the moulded rings are then carried through the dryer, and as the band passes over the roller at the other end the rings drop off on to another conveyor which removes them, preferably direct to the baking oven. The oven consists of a vertical shaft furnace with hopper above, and combined outlet for finished rings and inlet for cool air at the bottom; gas is admitted by side burners some distance up the shaft, where it burns among the rings with the air already heated by the cooling of the rings in the lower portion of the shaft.—B. M. V.

Platinised asbestos; Manufacture of ——. G. Frabetti, Milan, Italy. Eng. Pat. 120,551, 3.9.18. (Appl. 14,325/18.) Int. Conv., 5.11.17.

A SOLUTION of platinum in *aqua regia* is evaporated to eliminate nitric acid, and the residue is treated with hydrochloric acid. The solution is neutralised with sodium carbonate, mixed with asbestos previously made into a paste with distilled water, and the mixture heated to 60° C. and agitated with formic acid until the liquid becomes clear (denoting complete deposition of the platinum). The chlorides are then removed by washing, and the product is dried and converted into a flaked condition suitable for use as a catalyst, *e.g.*, in the manufacture of sulphuric acid by the contact process.—W. E. F. P.

Alumina from clay and similar materials; Production of ——. Det Norske Aktieselskab for Elektrokemisk Industri Norsk Industri-Hypotekbank, Christiania, Norway. Eng. Pat. 122,623, 26.11.18. (Appl. 19,427/18.) Int. Conv., 24.1.18.

CLAY etc. is heated to redness (500° C.) in a reducing atmosphere (carbon monoxide), and then boiled with dilute nitric acid (30%) to produce a solution of aluminium nitrate which is filtered and evaporated to dryness. The aluminium nitrate is then calcined to produce alumina and nitrous gases from which nitric acid is regenerated.
—W. E. F. P.

Ammonium nitrate; Production of ——. A. C. D. Rivett, Melbourne, Australia. Eng. Pat. 131,358, 16.5.18. (Appl. 8228/18.)

AMMONIUM sulphate and sodium nitrate are brought together in the presence of water. After some sodium sulphate has separated out at an elevated temperature, ammonia gas is introduced, which first precipitates sodium sulphate and then, as the temperature falls, ammonium sodium sulphate. The ammonia is then removed under reduced pressure, and the solution on cooling deposits ammonium nitrate of a satisfactory degree of purity. The mother liquor may be further treated with the salts precipitated by the ammonia and used again in the process. Dilution and evaporation of the liquor, before and after separation of the ammonium nitrate, are obviated by this process.
—W. J. W.

Alkaline manganates; Process of manufacturing ——. C. Dreyfus and J. J. Bloch, Manchester. Eng. Pat. 131,460, 24.8.18. (Appl. 13,792/18.)

ALKALI manganates are produced by heating an intimate mixture of manganese oxide and caustic alkali at a temperature below the melting point of the alkali, the mixture being agitated or stirred.
—W. E. F. P.

Sulphur dioxide; Process for the manufacture of pure ——. British Dyes Ltd., J. Turner, and W. B. Davidson, Huddersfield. Eng. Pat. 131,512, 1.11.18. (Appl. 17,870/18.)

PURE sulphur dioxide is produced by heating sulphuric acid (or waste sulphuric acid) with a small proportion (10%) of pitch to 150°—200° C. A suitable pitch is that obtained by dehydrating the tar produced in the manufacture of Mond gas.
—W. E. F. P.

Nitrogen compound from nitrogen of the atmosphere; Obtaining of —— [*by means of internal combustion engines*]. C. J. Montgomery, Saltcoats, and E. R. Royston, Liverpool. Eng. Pat. 131,609, 30.6.16. (Appl. 9210/16.)

ATMOSPHERIC nitrogen which enters the cylinders of internal combustion engines employing liquid hydrocarbon fuel is caused to unite with hydrogen which is introduced as soon as possible after ignition of the combustible mixture, a catalyst, *e.g.*, asbestos impregnated with osmium, being placed in the head of the combustion chamber. The high temperature of combustion makes possible the combination of the nitrogen and hydrogen. The nitrogen compound (ammonia) which passes off with the gaseous products is caused to combine with, or be absorbed by, sulphuric acid, a preliminary separation from the products of combustion being effected by condensation, if necessary.—W. J. W.

Alkali percarbonates; Manufacture of ——. H. Wade, London. From Deutsche Gold und Silber Scheideanstalt vorm. Roessler, Frankfort, Germany. Eng. Pat. 131,930, 20.8.17. (Appl. 11,954/17.)

A PROCESS for rendering solid alkali percarbonates stable consists in the addition of magnesium chloride or silicate, alkali silicate, or gum-arabic to the finished salts or/and to the reacting substances from which the percarbonates are produced. For example, magnesium chloride is incorporated with the reaction mixture and gum-arabic with the finished product.—W. E. F. P.

Sodium sulphate; Removal of —— *from solution.* F. A. Freeth, Sandiway, Cheshire, and H. E. Cocksedge, London. Eng. Pat. 131,956, 31.5.18. (Appl. 8986/18.)

TO remove, at any given temperature, sodium sulphate from a saturated solution of this salt (which may also contain other salts except sodium bisulphate), the solution is digested with sufficient calcium sulphate, or soluble calcium salt, at or slightly above the required temperature, whereby the double salt, $CaSO_4,Na_2SO_4$, is precipitated. The precipitate is separated and treated with water for the recovery of its component salts.—W. E. F. P.

Cyanides; Production of ——. N. Testrup, and Techno-Chemical Laboratories, Ltd., London. Eng. Pat. 131,964, 3.7.18. (Appl. 10,931/18.)

IN a method of producing cyanides by spraying a finely divided metal compound (barium carbonate)

and carbon into a heated reaction chamber, the heat required is generated by spraying into the enclosure powdered carbon with sufficient air to produce only carbon monoxide, the air being preheated by the waste gases. The product of the reaction is withdrawn upon a bed of finely divided material, *e.g.*, the reaction substance or inert material, which forms a moving bottom for the chamber.—W. E. F. P.

Cyanides; Production and extraction of ——. F. J. Metzger, New York. U.S. Pat. 1,313,313, 19.8.19. Appl., 6.9.18.

Cyanides are recovered from furnace products containing them in admixture with a relatively large amount of iron, by leaching the material with a solvent by which the production and extraction of ferrocyanide is retarded.—W. E. F. P.

Nitrogen; Process and means for fixing atmospheric ——. R. Williams, Assignor to Nitrogen Products Co., Providence, R.I. U.S. Pat. 1,314,231, 26.8.19. Appl., 26.10.17.

In the fixation of nitrogen as metallic cyanogen compound by means of briquettes containing finely divided catalytic material, carbon, and a binding agent which also provides the metallic base of the cyanogen compound, it is best to use pure flocculent carbon as produced in and deposited from gaseous material, for incorporation with the binding agent in the making of the briquettes. A briquette is claimed consisting of petroleum coke, finely divided iron, and sodium carbonate, the pores of the coke being substantially open and free from the carbonate.—J. H. L.

Cyanides and the like; System and process for recovering —— from cyanide-bearing material. E. E. Arnold, Greene, R.I., Assignor to Nitrogen Products Co., Providence, R.I. U.S. Pats. (A) 1,314,236 and (B) 1,314,237, 26.8.19. Appl., (A) 16.2.18, (B) 2.12.18.

(A) Apparatus for carrying out the process described below comprises a closed lixiviator, a closed steam-jacketed evaporator, and various auxiliary vessels and pumps, forming with pipe connections a unified plant. (B) Porous material containing alkali cyanide and other substances is leached with a solvent which extracts only the cyanide. The extract is separated from the residue and evaporated, and a portion at least of the vapour is passed through the leached residue at such a temperature that it volatilises the solvent retained therein.—J. H. L.

Formates; Production of ——. F. J. Metzger, New York. U.S. Pat. 1,313,312, 19.8.19. Appl., 6.9.18.

Formates are extracted from products containing them in admixture with carbonates, by leaching with a solvent in which the carbonate is relatively insoluble.—W. E. F. P.

Ammonia [from cyanamides]; Apparatus and process for the production of ——. *Process for the production of ammonia. Process of purifying ammonia.* J. J. Elbert, Elizabeth, N.J., Assignor to American Cyanamid Co., New York. U.S. Pats. (A) 1,313,884, (B) 1,313,885, and (C) 1,313,886, 26.8.19. Appl., 5.11.18.

(A) A crude cyanamide is made into a slurry with a predetermined quantity of hot liquor from a previous operation, and the slurry is heated in an autoclave. The apparatus consists of a container for the cyanamide, a measuring tank for the liquor, and a mixing tank connected with an autoclave by means of a pipe. After the autoclave is charged, fresh liquor is forced through the connecting pipe to remove any slurry remaining. (B) Heating of the slurry is effected in two stages, the temperature and pressure being greater during the second than during the initial period, and the ammonia produced at each stage is collected separately. (C) The ammonia is purified by rectification and removal of water, followed by treatment of the gas with cuprous chloride and oil.—W. E. F. P.

Phosphoric acid and compounds of the same; Method of and apparatus for producing ——. F. S. Washburn, Rye, N.Y., Assignor to American Cyanamid Co., New York. U.S. Pat. 1,314,229, 26.8.19. Appl., 21.4.19.

One portion of a mixture of mineral phosphate and silicious matter is charged into an electric furnace together with charcoal, and a second portion without charcoal is introduced above the first. The first portion is heated to a temperature sufficient to liberate carbon monoxide and a substantial proportion of the phosphorus present. By admitting air into the furnace at a suitable height, the carbon monoxide is burnt as the mixed gases pass upwards through the descending charge, whereby the latter is preheated. J. H. L.

Basic magnesium carbonate; Process for the manufacture of ——. Chem. Fabrik Buckau, Magdeburg. Ger. Pat. 311,960, 16.8.12.

A solution of a magnesium salt is treated between 40° and 70° C. with a mixture of ammonia and ammonium carbonate, in which at least 20% and at most 85% of the ammonia is in the combined state. The amount of ammonia in the mixture must always exceed the magnesium, whilst the amount of carbon dioxide present must only be in slight excess of that required to convert the whole of the magnesium into basic carbonate, but not exceeding 63 parts by weight to 24 parts of magnesium. The resulting basic magnesium carbonate contains more water of crystallisation than the ordinary commercial product, but loses the greater part of the water at low temperatures, and on heating at 400° C. (as compared with 800° for the ordinary product) yields a *magnesia usta* which is much finer and more reactive than the ordinary product.
—C. A. M.

Hydrogen; Liberation of —— from mixtures containing it. L'Air Liquide, Soc. Anon. pour L'Etude et l'Exploit. des Proc. G. Claude, Paris. Eng. Pat. 131,091, 26.4.18. (Appl. 7082/18.) Int. Conv., 17.11.17.

In the separation of hydrogen from gaseous mixtures by dissolving the admixed gases under pressure and at a low temperature (Eng. Pat. 130,358; this J., 1919, 719 A), the low temperature necessary is obtained by the expansion, in a motor, of the gases liberated from the solvent. The expansion is effected by causing the saturated solvent to impinge on to the larger face of a differential piston, the smaller face of which is used to force an equal quantity of desaturated solvent into the dissolving apparatus.—W. E. F. P.

Hydrogen; Manufacture of ——. E. K. Rideal, London, and H. S. Taylor, St. Helens. Eng. Pat. 131,328, 30.4.18. (Appl. 7232/18.)

In the manufacture of hydrogen by the action of steam upon heated iron, carbon monoxide (instead of water-gas etc.) is used to reduce the iron oxide formed and is regenerated by passing the effluent gases through a bed of incandescent coke. In practice, an initial amount of steam is admitted to a gas-producer and the gases formed are passed over the heated iron oxide and through the producer alternately.—W. E. F. P.

Hydrogen gas plants; Heat controlling means for ——. R. and J. Dempster Ltd., and J. M. Ballingall, Manchester. Eng. Pat. 131,347, 6.5.18. (Appl. 7557/18.)

In apparatus for the manufacture of hydrogen by the alternate oxidation and reduction of iron, special means, in addition to the usual dampers, are provided whereby the volume of the outgoing waste gases is restricted during the oxidising period and the maximum heating effect of the gases is obtained during the reducing period. The controlling device is operated in conjunction with the hydrogen gas valve.—W. E. F. P.

Hydrogen, nitrogen, and carbon dioxide; Manufacture of ——. J. Harger, Gateacre, Lancs, and Lever Bros., Ltd., Port Sunlight, Cheshire. Eng. Pat. 131,684. (Appls. 12,565, 1.8.18, and 18.767, 15.11.18.)

The spent gas obtained after the reduction of the iron oxide in the steam-iron process for manufacturing hydrogen is passed over hot copper oxide arranged adjacent to the iron, and the heat of the reaction is applied to heat the iron material. The water-gas used for the reduction of iron oxide contains a residue of carbon monoxide and hydrogen, and these gases reduce the copper oxide to the metal. Air or a mixture of air and steam is then passed over the copper to re-oxidise it and heat is evolved by the reaction. The residual nitrogen thus obtained, and the carbon dioxide obtained from the spent gas may be separately collected. —W. F. F.

Oxygen and nitrogen from atmospheric air; Process and apparatus for producing chemically pure ——. E. Barbet et Fils et Cie., Paris. Eng. Pat. 131,321, 29.1.18. (Appl. 1698/18.) Int. Conv., 31.1.17.

Air partly in the liquid state and partly in the gaseous state near the point of liquefaction, and obtained by utilising the latent and sensible cold units of gaseous nitrogen and oxygen previously produced, is subjected to continuous rectification in a plate rectifying column. The nitrogen issuing from the top of the column is successively compressed, cooled, liquefied, expanded to eliminate neon, hydrogen, and helium, and returned in the liquid state to the top of the column. About half of the liquid nitrogen so returned is drawn off in the pure state from the second or third plates of the rectifier, the purity of this fraction being regulated by the intensity of the circulation imparted to the nitrogen by varying the speed of the compressor employed in liquefying this gas. Argon is drawn off in the liquid state from the plate where this impurity has its maximum concentration; the liquid rich in oxygen, at the bottom of the rectifier, is freed from xenon and krypton by withdrawing a small quantity of this fraction. Pure gaseous oxygen is extracted at a point a few plates above the bottom of the column. The additional cold units required to balance radiation losses are supplied by a supplementary condensation of the gases withdrawn at a point a few plates below the point of supply to the rectifier and above the part where the argon is extracted.—W. E. F. P.

Sulphur [from hydrogen sulphide]; Process of recovery of ——. R. L. Datta, Calcutta. U.S. Pat. 1,313,370, 19.8.19. Appl., 25.9.18.

Hydrogen sulphide, alone or mixed with other gases, is oxidised by means of nitrous gases for the production of sulphur.—W. E. F. P.

Diamonds; Separation of —— from other minerals. Labouchere & Co., Amsterdam. Ger. Pat. 312,093, 22.8.18.

The mixture of minerals is subjected to a gradually increasing pressure sufficiently great to crush the other minerals but not to damage any of the diamonds. The diamonds are afterwards separated by sifting. Diamonds can withstand a much greater pressure than other minerals, provided it is applied without blows or shocks.—A. B. S.

Evolving gases from liquids. Eng. Pat. 131,344. *See* I.

Electric resistance furnaces. Eng. Pat. 132,080. *See* X.

Furnace for roasting etc. Ger. Pat. 312,077. *See* X.

Chrome liquors and salts. Eng. Pat. 131,772. *See* XV.

VIII.—GLASS; CERAMICS.

Glass pots; Equipment of a casting plant for the manufacture of ——. F. H. Riddle. J. Amer. Ceram. Soc., 1919, 2, 647—658.

A description of a method of manufacture and of a plant used for casting ten pots each of 600 lb. capacity per day. The grinding plant consists of a jaw crusher, grinding pan with screens, magnetic separator, elevator, cars, and cleaning bench. The plant for producing the slip consists of scales, car, dry-mixer, elevator, blunger, agitator, and screen, with the requisite troughs and pipes. The viscosity of the slip is determined by a flow viscometer of 1 gall. capacity and a discharge nozzle at least ¾ in. diameter. It is not necessary to have duplicate sets of moulds, as they can be filled once daily and dried at the week-end. Details of the use of the various appliances are given.—A. B. S.

Glass pots; Casting porcelain ——. J. W. Wright and D. H. Fuller. J. Amer. Ceram. Soc., 1919, 2, 659—663.

The characteristics of a casting slip and of the fired body depend on the composition, including the proportions of grog, kaolin, ball clay, and felspar, the grading of the grog, the properties of the various clays used, and the amount of sodium silicate and carbonate added. Too large a proportion of grog passing an 80-mesh sieve should be avoided as a glassy structure is undesirable. The following grog grading is suggested: between 10- and 20-mesh, 30%; 20- to 40-mesh, 40%; 40- to 80 mesh, 17%; and through 80 mesh, 13%. The primary kaolins are more responsive to the action of electrolytes than secondary clays. Slips containing 17—22% of ball clay gave the best results in casting. If a slip stiffens as soon as agitation ceases, 0·01% of barium carbonate should be added to precipitate sulphates. By the addition of 0·20—0·33% of sodium silicate and carbonate, the water content is reduced, and a dense slip is obtained with low shrinkage and a good capillary structure which facilitates drying. The substances should be mixed in the following order: water and silicate, clay etc., and sodium carbonate last. A ratio of 3:4 for the carbonate and silicate is best. The sp. gr. of the slip should be 1·90—1·95. The viscosity should be such that a pot is cast solid in 17 hrs.—A. B. S.

Iron; Rapid electrometric determination of —— in some optical glasses. J. B. Ferguson and J. C. Hostetter. J. Amer. Ceram. Soc., 1919, 2, 608—621.

The following method enables an accurate determination of the iron in a glass to be made in about ten minutes, the only substances commonly present which are likely to cause inaccuracy being

arsenious compounds; compounds of quinquevalent arsenic do not interfere. The glass is crushed in a brass mortar and then ground in an agate mortar until it passes completely through a 100-mesh sieve. The general procedure and three modifications are described:—(1) 10 grms. of the sample is placed in a Pyrex Erlenmeyer flask, covered with 25 c.c. of hydrochloric acid (1:1), and rather less hydrofluoric acid added than is necessary to decompose the sample. When the reaction has ceased, sufficient concentrated hydrochloric acid is added to bring the volume to 150 c.c., and the liquid is heated to boiling, reduced with stannous chloride, and titrated electrometrically with $N/100$ potassium bichromate, the electromotive force developed during the titration being plotted against the volume of bichromate used. Any undissolved sample is washed, dried over a flame, and its weight deducted from that of the original sample. (2) If pure hydrofluoric acid is not obtainable, the foregoing procedure should be modified as follows: 5 grms. of the sample is placed in a pure platinum dish, moistened with 5 c.c. of sulphuric acid (1:1) and 10—15 c.c. of 48% hydrofluoric acid added cautiously. When the reaction has ceased the dish is heated until copious fumes of sulphur trioxide are evolved for a few minutes; it is then allowed to cool, 150 c.c. of hydrochloric acid (1:1) is added, and the liquid titrated as described in (1). (3) If any organic matter is present which is not decomposed by method (2), the contents of the dish may be dissolved in sufficient hydrochloric acid to prevent the precipitation of sulphates, cooled, filtered, the residue washed with cold water, and a few c.c. of $N/10$ alum solution added to the filtrate. The alumina and iron are then precipitated with ammonia, the precipitate is collected, washed, and dissolved in hydrochloric acid and the solution is titrated as described in (1). (4) Methods (2) and (3) are unsuitable for glasses containing barium; these should be decomposed as in (2), then treated with hydrochloric acid as in (3), but using sufficient acid to prevent the precipitation of any sulphates other than barium sulphate. The latter will contain a considerable proportion of the iron, so that it should be filtered off, fused with sodium carbonate, extracted with water, filtered, and washed to separate sulphates. The residue is dissolved in hydrochloric acid and titrated as in (1). The filtrate from the barium sulphate contains some of the iron in solution; it should be titrated separately as in (1). Ferrous iron in other than barium crown glasses is determined by boiling 10 grms. of the sample with 50 c.c. of hydrochloric acid (1:1) in a flask through which a current of inert gas is passed to expel the air. 20 c.c. of concentrated hydrofluoric acid is then added, and when the reaction has ceased, freshly boiled hydrochloric acid is added to bring the volume up to 150 c.c. and the acid concentration to 1:1. The solution is cooled in the inert atmosphere and titrated as in (1). With barium glasses, the sample is moistened with water and boiled to expel the air, as such glasses are decomposed by boiling hydrochloric acid. The addition of the latter is therefore deferred until all the air has been expelled from the flask.—A. B. S.

Glasses for protecting the eye from injurious radiations; Recent progress in the manufacture of ——. W. W. Coblentz. J. Franklin Inst., 1919, **188**, 255—261.

For a number of coloured glasses, employed for protecting the eye from injurious radiations in the ultra-violet or the infra-red, curves are given showing the optical transmission up to the wave-length $5{\cdot}0\mu$. Red glass absorbs the ultra-violet rays but affords no protection from the infra-red rays. Blue and green glasses absorb the infra-red, but transmit the ultra-violet rays; nevertheless cobalt blue glasses are used in some classes of high temperature work. Blue glass combined with an amber, red, or green glass affords complete protection from injurious rays, and such combinations are used in arc welding. A thin film of gold on glass eliminates the infra red and the ultra-violet, and, if of proper density, provides protection from ordinary visual rays. Attempts have been made to use dyed celluloid films instead of coloured glass for protection against harmful radiations, but unless a dye is found which shows marked absorption for the infra red the outlook for substituting these films for coloured glasses is not very encouraging.

—E. H. R.

Clay; Effect of extraction on the plasticity of ——. W. A. Hamor and H. E. Gill. J. Amer. Ceram. Soc., 1919, **2**, 594—601.

A WHITE, fairly plastic fireclay from Missouri, a highly plastic ball clay from Kentucky, and a similar clay from Mississippi were dried, ground to pass through an 80 mesh sieve, and shaken for 14 hrs. with rather more than an equal weight of one of the following solvents: 95% alcohol, alcohol containing 1% HCl, commercial benzol, acetone, and carbon tetrachloride. The liquid was filtered off and the residue was dried, again passed through the sieve, and its plasticity determined by Bleininger and Loomis' and by Atterberg's methods respectively. All the clays lost plasticity when treated with the solvents mentioned, the greatest loss being due to alcohol, acid alcohol, and acetone.—A. B. S.

Porcelains; Study of high-fire ——. C. C. Lin. J. Amer. Ceram. Soc., 1919, **2**, 622—637.

THE author has endeavoured to produce a porcelain body with good working properties in the plastic state, and which matures with a minimum of warping at a temperature sufficiently high to ensure translucency, and to cover this with a true porcelain glaze. He prepared 29 porcelains with the following limits of composition: Canadian felspar 10—20%, Ohio flint 30—45%, a mixture of equal parts of Georgia and Florida kaolin 30—45%, and ball clay 10%. Bars, cups, wedges, and moulds were made of these mixtures and fired to cone 10 in 28 hrs. or to cone 13—14 in a downdraught laboratory kiln. The shrinkage, modulus of rupture, translucency, and resistance to abrasion (rattler test) were determined. It was found that the shrinkage of the different mixtures was roughly proportional to the clay content, but was very irregular. With bodies containing 15—20% of felspar, the shrinkage at cone 13—14 was less than at cone 10, on account of the development of a vesicular structure. The best bodies were those which had been fired at cone 13—14 and had been made from the following mixtures:—

Felspar	...	17·5	15·0	12·5%
Clay	...	45·0	52·5	47·5%
Flint	...	37·5	32·5	40·0%

—A. B. S.

Japanese porcelains from the chemical point of view and how to improve them. Y. Kitamura. Chem. and Met. Eng., 1919, **21**, 183—185.

Two tables are given of the analytical results of bodies of 59 varieties of Japanese porcelain, the limits of composition in their molecular formulas being classified according to localities. Similar analytical results are given for crude glazes before burning. Japanese porcelains have wider ranges of chemical composition than hitherto believed. The limits given are: for bodies, 0·26—0·57RO, $1Al_2O_3$, 4·68—8·21 SiO_2; for glazes, 1RO, 0·32—0·99 Al_2O_3, 2·27—8·26 SiO_2. Body materials are divided into two classes containing strongly plastic clays

with felspar and quartz or quartz porphyry. The majority belong to the first class. The first-class Japanese porcelain bodies contain more basic impurities and silica than the best European porcelain bodies, and the second class contain about the same proportion of basic components but considerably more silica, which has an embrittling effect. To improve the mechanical properties of Japanese porcelain it is suggested that the composition be corrected by changing the proportions of the raw materials, but it is practically impossible to increase the content of alumina by using the old materials alone. A mixture of strong plastic Gainome clay with weak plastic Korean clay should be used.—T. H. Bu.

Porcelain; Porosity of —— with special reference to insulators for electric transmission lines. C. C. Farr. N.Z. J. Sci. and Tech., 1919, 2, 302—307.

Pieces weighing 25—100 grms. each were cut from porcelain insulators, dried, weighed, immersed in a solution of fuchsin, and the latter subjected to an air pressure of 2000 lb. per sq. in. for 50 hrs. The pieces were removed, washed, dried, and re-weighed to ascertain the amount of solution absorbed. They were then cut to see how far the fuchsin solution had penetrated into the porcelain. Ten specimens weighing 37—61 grms. each cut from the second shell of an insulator—five from the glazed part and five from the unglazed crown—showed a mean increase in weight of 0·007 grm., and none of the fractured pieces showed any sign of absorbed colour. Of ten other similar specimens, two showed signs of the penetration of the dye in defective parts but no general coloration. In nine other specimens a greater increase in weight but no coloration was noted. Pieces of insulators suspected of being porous were similarly treated for 69 hours, and a distinct coloration as well as an increase in weight of 0·202—0·719 grm. was observed. The colour change is abrupt and not gradual, and appears to indicate a corresponding change in structure of the porcelain from the natural surface inwards. The density and permeability of the specimens appear to have little or no connection with each other. A. B. S.

Refractory properties of aluminous products. H. Le Chatelier and B. Bogitch. Comptes rend., 1919, **169**, 495—499.

In spite of their high fusing points, bricks prepared from bauxite and other materials rich in alumina are unsatisfactory for such structures as the arched roofs of steel furnaces, being far inferior to silica, which has a lower fusing point. To investigate this anomaly, experiments have been made to determine the crushing strengths at high temperatures of a number of aluminous mixtures, using the method previously described, as applied in the case of silica, clay, and magnesia refractories (this J., 1917, 595, 963, and 1236.) The materials used for the experiments were commercial pure bauxite brick, containing Al_2O_3, 58·6%; Fe_2O_3, 5·2%; SiO_2, 29·5%; TiO_2, 3·8%: corundite, a fusion product of bauxite, containing Al_2O_3, 61·4%; Fe_2O_3, 5·7%; SiO_2, 21·0%; free C, 3·7%; TiO_2, 4·8%; and carborundum containing SiC, 79·2%; SiO_2, 12·9%; Fe_2O_3, 6·8%. The following samples were examined: (1) Pure bauxite brick, moulded under pressure, fired at 1300° C. (2) Corundite with 10% crude bauxite. (3) Corundite with 10% kaolin. (4) Corundite with a 2% solution of syrupy sodium silicate. (5) Corundite with 6·5% silicate. (6) Carborundum with 10% kaolin. The samples were moulded by hand, and fired for 3 hours at 1200° C., the carborundum at 1400° C. In the following table the crushing strengths are given in kilos. per sq. cm., the figures in parentheses indicating the load under which the material had become quite plastic.

Sample.	20°C.	1000°C.	1200°C.	1300°C.	1400°C.	1500°C.	1600°C.
1	200	180	73	34	18	(12)	(10)
2	43	—	5	—	(2)	—	—
3	55	—	15	9	—	(2)	—
4	25	—	(4)	—	—	—	—
5	41	—	(6)	—	—	—	—
6	143	110	19	(8)	(7)	(6)	(5)

All the samples become plastic between 1200° and 1500° C., hence their unsuitability for a steel furnace where the temperature reaches 1600° C. Although the alumina is infusible at these temperatures, it is floating in a molten magma, and the material lacks the cohesion which is present in silica owing to the lattice structure of the crystalline tridymite. Silicate is inferior as a binder to kaolin, but small furnaces for laboratory use can very well be made using silicate. Material moulded with 6·5% of silicate has the advantage that when cold, before firing, it has a crushing strength of 15 kilos. per sq. cm., and can be safely handled without fear of fracture. Such small furnaces can be used without a previous firing, and can be used up to 1600° C. For temperatures of 1700° C. and over, the best material to use is carborundum with kaolin as a binder. Extremely refractory products can be obtained using mixtures of 80% of pure alumina (as used for the manufacture of aluminium) with 20% of white bauxite, or 90% of pure alumina with 10% of kaolin. After an initial firing at 1700° C. the material is crushed, mixed with 25% of unfired material, moulded under pressure, and again fired at 1700° C. Its crushing strength at 1600° C. is 20 to 40 kilos. per sq. cm. E. H. R.

Wollastonite ($CaO.SiO_2$) and related solid solutions in the ternary system lime-magnesia-silica. J. B. Ferguson and H. E. Merwin. Amer. J. Sci., 1919, **48**, 165—189. (See this J., 1919, 679 A.)

An examination of the solid phases of the ternary system shows that solid solutions of wollastonite-diopside exist, containing a maximum of 17% of diopside, and solid solutions of pseudo-wollastonite-diopside containing a maximum of 16% of diopside are also formed. A new compound, $5CaO.2MgO.6SiO_2$, is described. Solid solutions of Akermanite (or perhaps of an unstable compound $3CaO.MgO.3SiO_2$) in both wollastonite and pseudo-wollastonite are capable of existence. The wollastonite solutions extend to a composition containing 60%—70% of Akermanite, and the pseudo-wollastonite solutions extend to a composition containing 23% of Akermanite. (See also J. Chem. Soc., Nov., 1919.)—J. F. S.

Firebricks; Machine for testing the hot crushing strength of ——. H. G. Schurecht. J. Amer. Ceram. Soc., 1919, 2, 602—607.

The bricks are heated at a slow rate to 1300° C. if fireclay, to 1350° C. if magnesite or chrome, or to 1500° C. if silica bricks, under a load of 25 lb. per sq. in., and the pressure is then increased until they break, the crushing strength at the maximum temperature being determined simultaneously with the expansion. The silica and magnesite bricks expanded more than the fireclay and chrome bricks, a large increase in the expansion of the silica bricks being observed at 300° C., possibly due to inversion of cristobalite. The silica and magnesite bricks showed the least deformation. Graphs showing the relations between the time of heating, temperature, expansion, and crushing strength are given.—A. B. S.

Abrasive wheels; Manufacture of ——. S. C. Linbarger. J. Amer. Ceram. Soc., 1919, 2, 638—646.

A general outline—with few details—of the manufacture of abrasive wheels made of particles of

carborundum, or of artificial aluminous abrasives, of various sizes united with a suitable bond. Three different types of bond are used, *viz.*, vitrified bonds of fusible clays; silicate bonds composed of water-glass with some substance which will form an insoluble silicate, and elastic bonds of shellac or rubber.—A. B. S.

PATENTS.

Quartz glass; Apparatus for building up an object of ——. W. S. Quimby and F. W. Robinson, Newark, N.J., U.S.A. Eng. Pat. 131,233, 5.2.19. (Appl. 2866/19.)

AN apparatus for forming objects of quartz glass consists of a means of supporting a nucleus of quartz glass in such a manner that it can be heated by an inclined gas burner mounted on a reciprocating carriage, which also carries a tray containing powdered quartz. When the quartz glass nucleus has become plastic, the carriage is moved and the plastic nucleus coated uniformly by rotating it in the powdered quartz. During this process the nucleus is elongated by mechanical tension, and on further heating the quartz is fused and becomes part of the article to be formed. Compressed air may be supplied to the interior or exterior of the article, either to assist in shaping it or to prevent deformation. By varying the different stages, such as the time of heating, the duration of the rotation, and the tension or pressure applied, articles of different shapes may be produced.—A. B. S.

Splinterless glass; Ovens for use in the manufacture of ——. S. Goldreich, London. Eng. Pat. 131,714, 23.8.18. (Appl. 13,771/18.)

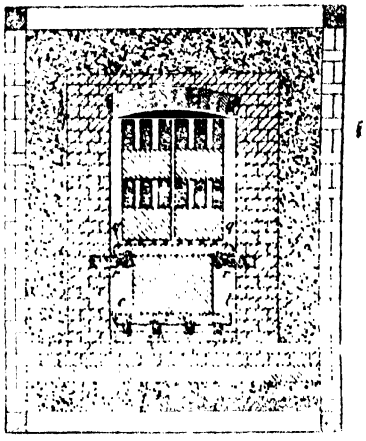
AN oven for use in the manufacture of splinterless glass is provided with an outer door, and a number of separate inner doors, each giving access to a different part of the oven, so as to prevent the heat escaping from the whole of the interior each time sheets are placed in or taken from the oven. —A. B. S.

Glass; Devices for discharging predetermined quantities of —— from glass furnaces. The British Thomson-Houston Co., Ltd., London, and J. Gray, Bromley. Eng. Pat. 131,756, 12.9.18. (Appl. 14,862/18.)

MOLTEN glass is discharged from a furnace in predetermined quantities by means of a cone of known volume, mounted on a vertical shaft, the cone being alternately lowered into, and withdrawn from, the molten glass.—A. B. S.

Tunnel furnaces. A. Bigot, Paris. Eng. Pat. 132,069, 19.9.18. (Appl. 15,255/18.) Int. Conv., 8.11.17.

A GAS-FIRED tunnel kiln in which the goods are placed on slabs of refractory materials (such as fused bauxite, alumina, corundum, and the like, bonded with 2—3% of lime or 5—10% of clay) resting on a series of balls—also of refractory material—running in grooves or races to facilitate the passage of the goods through the tunnel. The kiln is composed of an internal refractory lining with either solid or hollow walls, portions being composed of material of high thermal conductivity. These walls rest on a refractory base, and an external jacket is connected with the lining by cross-walls, the intervening space being filled with very light refractory powder or agglomerate which acts as an insulator. In a modification (see fig.) the vehicle carrying the goods is provided with a projecting piece, *q*, at each end which extends over similar projections, *r*, from the interior of the kiln and forms a baffle, which shields the balls, *b*, and grooves, *c*, from the heat. It is claimed that a kiln of this construction utilises 70% of the heat evolved from the fuel, as compared with 10% for



single ovens, and 50% for other tunnel kilns, and that goods may be fired at higher temperatures than in any other form of tunnel kiln. (See also this J., 1919, 106 A.)—A. B. S.

Abrasive material and method of making same. N. C. Harrison, Newtonville, Mass. U.S. Pat. 1,314,061, 26.8.19. Appl., 5.4.19.

AN abrasive material is made by grinding coke and particles of iron together, mixing the product with diaspore, and then fusing the mixture in an electric furnace.—A. B. S.

Glass or like material; Method and apparatus for separating quantities of molten —— from mass. O. M. Tucker and W. A. Reeves, Columbus, Ohio, U.S.A. Eng. Pat. 109,782, 24.4.17. (Appl. 5747/17.) Int. Conv., 16.9.16.

Quartz glass; Apparatus for building up objects of ——. W. S. Quimby and F. W. Robinson, Assignors to Hanovia Chemical and Manufacturing Co., Newark, N.J. U.S. Pat. 1,314,212, 26.8.19. Appl., 23.11.18.

SEE Eng. Pat. 131,233 of 1919; preceding.

Kiln. Ger. Pat. 312,015. *See* IX.

IX.—BUILDING MATERIALS.

Cements; Behaviour of different —— in solutions of sodium and magnesium sulphates of varying concentration. H. Nitzsche. Technik u. Ind., 1919, 81—90. Chem. Zentr., 1919, **90**, IV., 43.

Two Portland cements and one blast-furnace slag cement were kept immersed in solutions containing 0·1, 0·5, 1·0, 2·0, 5·0, 10·0, 15·0, and 20·0% of sodium sulphate and magnesium sulphate respectively. It was found that calcium sulphoaluminate may decompose cement mortar. In the more concentrated solutions the destruction is due chiefly to the formation of gypsum. In both weak and strong solutions the slag cements, especially those low in lime, are more resistant to the sulphate solutions than Portland cement.—A. B. S.

PATENTS.

Cement and like surfaces; Treatment of —— for applying paints thereto. P. J. A. Andouard, legal representative of A. P. Andouard, Nantes, France. Eng. Pat. 125,979, 17.4.19. (Appl. 9911/19.) Int. Conv., 27.11.13.

CEMENT or like surfaces are prepared for a sub-

sequent application of paint by applying two coatings composed of the whites of 20 eggs, 300 c.c. of phosphoric acid of sp. gr. 1·349, 1 grm. of sodium fluoride, and water to make up the volume to 1 litre. This solution neutralises the basic elements of the cement, and the coating is allowed to dry for six hours. The surface is then coated twice with a resinous varnish composed of a 25% solution of colophony in benzine, and as soon as it is dry the surface may be painted.—A. B. S.

Cement. G. K. Scott-Moncrieff and J. Hines, London. Eng. Pat. 131,164, 21.8.18 (Appl. 13,567/18.)

A WATERPROOF cement is made by grinding together equal parts of Norfolk chalk and the residue left after the distillation of oil shale, heating the mixture so as to form a clinker, and then adding raw oil shale to the latter and grinding to a fine powder so as to produce a cement containing approximately 40% of "residue," 40% of chalk, and 20% of raw shale. The cement is specially useful for the production of a surface to receive an asphaltic or bituminous carpet.—A. B. S.

Kilns for the incineration of earth matters, and dolomites, limes, and cements. T. Hodson, Matlock. Eng. Pat. 131,095, 7.5.18. (Appl. 7623/18.)

A KILN for calcining earthy material, dolomite, lime, cement, etc., consists of a series of vertical shafts in which the cross-section is reduced immediately above the points where the flues from the fires or furnaces enter the shafts. The furnaces are arranged around each shaft and the flues connecting them to the latter are formed with two or more sharp turns so as to prevent any particles of solid fuel from entering the shaft. The supply of air to the furnaces may be by natural draught or blast. Hinged doors at the top of each shaft, arranged one on each side of the flue through which the waste gases escape, may be provided to facilitate the charging of the kiln.—A. B. S.

Kiln with inclined shaft for burning lime, bricks, etc. M. A. Skipper, Skanderborg, Denmark. Ger. Pat. 312,015, 2.2.17. Int. Conv., 9.6.16.

THE shaft of the kiln increases progressively in diameter from the top to the bottom, and is composed of two portions meeting at an obtuse angle. The lower, less steeply inclined portion has a grate at the bottom. The fuel is charged in at the middle of the shaft, and the material enters at the top, the burned product being discharged at the bottom. The heating and cooling are gradual, and the breakage of the material by sudden changes of temperature is therefore avoided.—A. B. S.

Rotary [cement] kiln. J. S. Fasting, Frederiksberg, Denmark, Assignor to F. L. Smidth and Co., New York. U.S. Pat. 1,313,281, 19.8.19. Appl., 18.7.18.

NEAR the feeding end of a rotary kiln for burning cement slurry, chains are arranged helically so that during the rotation of the kiln the chains dip into the wet slurry and in lifting it expose it to the hot products of combustion in the kiln.—A. B. S.

Wood; Process for making —— lastingly soft and pliable. H. Pedersen, Copenhagen. Eng. Pat. 131,128, 10.8.18. (Appl. 13,022/18.)

WOOD may be made permanently soft and pliable by cooking and steaming it in the usual way, and afterwards pressing it in the direction of the fibres or grain of the wood, keeping it under pressure until it is dry and cool.—A. B. S.

Fibrous material [wood]; Treatment of ——. W. Weimar, Appleton, Wis. U.S. Pat. 1,313,437, 19.8.19. Appl., 22.10.17.

WOOD or like fibrous material is impregnated with a solution of sodium chloride, then boiled in a solution of sulphur and resin, and afterwards cooled.—A. B. S.

Discharging shaft kilns. Eng. Pat. 119,235. *See* I.

Heat-insulating material from paper. Eng. Pat. 131,446. *See* V.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Fuel economy and consumptions in the manufacture of iron and steel; Report on ——. W. A. Bone, R. A. Hadfield, and A. Hutchinson, on behalf of the Brit. Assoc. Fuel Economy Committee. Iron and Steel Inst., Sept., 1919. [Advance copy.] 42 pages.

THE conclusions arrived at were based upon data on fuel consumption and arrangements submitted by selected iron and steel works. The achievement of the utmost fuel economy in an iron and steel works is essentially a question of the scientific organisation of the plant as a whole, as the energy contained in the surplus blast-furnace and coke-oven gases is sufficient for the steel making and rolling processes. A consumption of 1·75 tons of good coking coal per ton of finished steel sections is accepted as a "practical ideal" for a modern British plant, and some of the more essential conditions for the achievement of this ideal are outlined. Regenerative by-product coke ovens, blast furnaces, steel works, and rolling mills should be concentrated on one site. Blast furnaces should be provided with double bells, and the gases should be dry cleaned, preferably by electrostatic means, so as to reduce the dust content to 0·1 grm. per cubic metre. For use in gas engines the content of dust in the gases should be not more than 0·015 grm. per cubic metre. The supplies of blast-furnace gas and coke oven gas should be kept separate and mixed only at the various points of combustion; a mixture in such proportions as will yield a heating gas of 160—170 B.Th.U. per cub. ft. is advised for steel furnaces. Rolling mills should be driven electrically rather than by steam. In discussing further economies it has been calculated that the heat lost in the slag from a Cleveland blast furnace is equivalent to 11·6% of the coke charged. The loss of heat in gas-engine exhausts and in chimney gases is also considerable, and a large proportion might be recovered in waste heat boilers. The conservation of gases at week-ends when other parts of the works are idle is an important question; the provision of gas holders implies large capital outlay. Linking up of electrical generating plants where possible would result in equalising the loads on individual power stations. In an analysis of returns from 21 works, only five used blast-furnace gas in internal-combustion engines for generating the blast. Generally the efficiency of steam raising in gas-fired boilers was low, but better combustion was maintained in the stoves. Considerable losses of heat were evident from the returns for steel furnaces, due to too great an excess of air being used, and non-recovery of heat from the waste gases. (See also following abstract.)—C. A. K.

Fuel economy in German iron and steel industry of the occupied territory on the left bank of the Rhine; Report on the present status of ——. C. Johns and L. Ennis. Iron and Steel Inst., Sept., 1919. [Advance copy,] 19 pages.

THE average iron content of the Lorraine ore smelted during the period of the war was less than 30% and at least 3½ tons of iron ore is required for each ton of pig-iron made. On this account most

of the important works are adjacent to the iron field. Westphalian coke is used and is imported by rail to reduce the waste by breakage caused by the extra handling entailed by water transit. Ore-storage bins with capacities of from 15,000 to 25,000 tons are used to facilitate regular working of the blast furnace. German practice has concentrated its efforts on the full utilisation of blast-furnace gas and every works inspected was equipped with a gas-cleaning plant on either a wet (*e.g.*, Zschocke) or dry (*e.g.*, Halberg-Beth) system. In some cases a final cooling of the gas was effected in a Theisen washer and in all cases a maximum dust content of 0·10 grm. per cubic metre was attained. Batteries of gas-engines of from 1500 to 5000 h.-p. were employed as prime movers, and at the Volklingen works a waste heat boiler was successfully utilising the sensible heat of the exhaust gas from a 3000 h.-p. gas-engine. Blast furnaces were practically always associated with a complete steel plant in which the pig-iron (containing well below 1% Si and 0·06—0·07% S) was converted into steel by the basic Bessemer process. Basic open-hearth furnaces dealt with scrap produced in the mills together with about 25% of pig-metal, and were thus able to work on a low fuel consumption of about 250 kilos. of coal per ton of ingots. A few electric furnaces used liquid metal from the converters. Economy in reheating was effected by the extensive soaking pits, some of which were heated by regenerated blast-furnace gas, and by the use of a mixture of blast-furnace and coke-oven gases in continuous and other heating furnaces. Generally, preparations were being made for the replacement of solid fuel on furnace and producer grates by regenerated blast-furnace gas. Current practice was distinctly against the electrical driving of large rolling mills on account of the rapid and considerable variation in the power consumption of such mills, but the linking up of neighbouring power stations as at Luxemburg is an obvious remedy. The conclusion is drawn that the most expedient attempts to promote fuel economy are:—Blast-furnace gas should be cleaned without loss of sensible heat until the dust content is below 0·1 grm. per cub. metre. All power should be generated in gas-driven prime movers, with only such steam turbines as are necessary to deal with fluctuating loads. Waste heat boilers of the fire-tube type should be attached to large gas-engines. If linking up of neighbouring power stations is possible, the whole of the steel works should be electrically driven. Enriched blast-furnace gas should be the principal fuel in melting and reheating furnaces. In order to realise these conditions it is necessary that the pig-iron made should be within the required limits of Si and S and should be regular in composition. This necessitates ample supplies of ore available for the regular working of the furnace. (See also preceding abstract.)—C. A. K.

Fuel economy in cupola practice. H. J. Yates, on behalf of Brit. Assoc. Fuel Economy Committee. Iron and Steel Inst., Sept., 1919. [Advance copy.] 7 pages.

The variation in radiation loss owing to different diameters of the cupola is of small importance compared with the loss of sensible heat in the waste gases, and the cupola should be sufficiently high to allow the charge to reduce the temperature of the ascending gases as far as possible. If from four to six tuyères are used and the ratio tuyère area: cupola area is maintained about a certain figure, no advantage is secured by more than one row, or by special design, of tuyères. A furnace with a smaller diameter from the base plate to above the tuyères is better than a corresponding furnace of cylindrical section when large-sized cupolas are in question, as the coke bed is smaller and the blast can reach the centre more easily. A kindling tuyère, placed near the sand bottom, prevents the chilling of the first iron melted as the coke bed may be heated up prior to blowing the ordinary tuyères. The blast pressure and coke charge should be reduced towards the end of the blow. Cupolas engaged on light castings and producing hot metal showed the following ratios:—

Area at tuyères / Area of tuyères	4·3	5·4	5·8
Height from tuyères to charging door / Diam. at tuyères	3·8	2·8	5·3
Iron (tons) / Hours of blast	10·8	14·3	3·1
Total coke, lb. per ton of iron	191	212	227

—C. A. K.

Fuel control in metallurgical furnaces. R. A. Hadfield and R. J. Sarjant. Iron and Steel Inst., Sept., 1919. [Advance copy.] 13 pages.

In all questions of efficiency in metallurgical furnaces there is need of much further data with regard to thermal measurements, particularly with respect to the specific heats and heat conductivities of refractory materials. Consideration of the "theoretical calorific intensity," or the ratio of net available heat to the thermal capacity of the combustion products, must be made with certain reservations pending further investigation of thermal equilibria involved in the process of combustion. In all high-temperature processes in which turbulence can be brought about, the inherent heat conductivity of the flame is aided by developing the heat units in close proximity to the mass to be heated. The difficulty of obtaining a true sample of the gas and air mixture immediately before ignition is a serious obstacle to the determination of a correct admixture for combustion, and the only reliable method of determining the efficiency of combustion is to combine determinations of the composition and temperature of the waste gases with a knowledge of the original composition of the gas used. The distribution of heat is difficult to determine, as it is impossible to attain the absolute value of the heat conductivity of the materials of the walls under average working conditions. The radiation losses may be measured by the application of Stefan's law, and by the consideration of the value obtained in this way and the value obtained by conductivity measurement a fairly effective approximation to the heat lost is possible.—C. A. K.

Powdered fuel for puddling furnaces; Report on the experimental use of ——. W. Simons. Iron and Steel Inst., Sep., 1919. [Advance copy.] 2 pp.

No difficulty was experienced in attaining the requisite temperature when using powdered fuel. The time taken for heating the furnace from cold was 1—1½ hours as compared with a normal period of 3—4 hours. Rapid wear of the brickwork in the combustion chamber occurred at first, but with suitable alteration in the position of the burners the wear was considerably reduced. An economy of 30% in fuel was obtained and further economy is to be expected in a complete plant. Greater output of metal was obtained with powdered fuel, the heats being worked in 1½ hours. On the basis of a 30% fuel economy using powdered fuel, a saving of 23% on the capital outlay is estimated for a plant of about 10 puddling furnaces together with the necessary boilers.—C. A. K.

Cast iron; Synthetic ——. C. A. Keller. Iron and Steel Inst., Sep., 1919. [Advance copy.] 19 pp.

Synthetic cast iron is manufactured in the electric furnace by the simultaneous melting and

carburisation of steel scrap (turnings). (Eng. Pat. 22,692 of 1913; this J., 1914, 868.) Cementation takes place from a temperature of 650° C. upwards and becomes more rapid as the temperature rises. Carburisation of the iron subsequently takes place by contact between the solid carbon and the partially carburised metal in the course of melting, and becomes complete on full melting. To make a useful form of white cast iron economically, steel turnings and carbon (small coke or wood charcoal) are mixed with a definite amount of basic slag to lower the conductivity of the mixture and to effect desulphurisation of the resulting metal. A two-stage process is necessary for removing excess phosphorus. Steel turnings are first melted in the presence of carbon and a basic oxidising slag until a carburisation of 1% is obtained and all the metal dephosphorised. It is then cast into ingots, which are subsequently melted in an open-hearth furnace or electric furnace together with the necessary additions of carbon and a desulphurising slag composed of materials containing very little phosphorus. The composition of the synthetic iron produced is C 2·9%, Si 1·75%, Mn 0·50%, S traces, P 0·05%; the tensile strength is 50 kilos. per square mm., and impact resistance 60 blows.—J. W. D.

Iron oxides; Action of —— on acid [open-hearth] furnace structure. J. H. Whiteley and A. F. Hallimond. Iron and Steel Inst., Sep., 1919. [Advance copy.] 21 pp.

THE greater part of the corrosive dust which is carried over in suspension by the outgoing gases in acid open-hearth steel furnaces and becomes absorbed in the chequerwork of the regenerators is due to spitting of metal during the "boil." This corrosive dust consists principally of iron oxide, and its action on all parts of the furnace structure is very detrimental. The life of the furnace can only be prolonged by removing or counteracting the action of the oxide. To prevent the formation of the oxide is difficult, as its evolution appears to be an unavoidable effect in working the process. The coarser particles may be stopped by separate slag chambers and filter-chequers, but a large quantity of fine material remains. In the gas chequer-work a considerable proportion of the dust is absorbed, so that the porosity of the bricks when new is an important factor. Very little absorption takes place in the air-chequers; consequently some advantage might be gained by hollowing the surfaces of the bricks so as to increase the space in which the oxide can settle, or by increasing the interspaces between the bricks to the limit compatible with efficient regeneration. The possibility of removing the accumulated material during working by means of a flux is very doubtful, but the volume might be reduced considerably at intervals by fusing or fritting if a sufficiently high temperature could be attained.—J. W. D.

[Steel] converter; Temperature calculations of the ——. B. Osann. Stahl u. Eisen, 1919, **39**, 961—966.

THE temperature increases produced in the converter by the combustion of different elements added to the iron have been calculated. The combustion of 1% manganese raises the temperature 76° C., 1% silicon 334° C., 1% phosphorus 216° C., and 1% carbon 51° C. These figures cannot be directly applied to estimate the temperature increase for a pig iron of given composition without attention to such factors as heat of combustion and latent heat, the influence of lime additions, the heat lost to surroundings, etc. An example is given showing how all these factors affect the calculation. The influence of different measures adopted in practice is then investigated. It is found that small amounts of solid additions raise rather than lower the temperature of the iron, but when increased to 10%, even with good preheating, freezing may take place. When the phosphorus content is increased to 2·8% the heat generated enables 9% of scrap to be melted in the converter. Attention is drawn to the importance of drying the blast.—T. H. Bu.

Steel; Determination of the critical points of —— by the differential method. A Portevin and V. Bernard. Rev. Mét., 1919, **16**, 175—192.

THE heat changes which occur in steel when heated may be represented graphically on a photographic plate. The deflection of a mirror galvanometer which is connected to a thermo-couple indicating the temperature of the specimen is recorded on the plate by a spot of light, and as the temperature of the steel increases a line is produced which forms the abscissa of the graph. The ordinate is recorded by a similar galvanometer which indicates the difference in temperature between the steel specimen and another piece of metal similar in size, but which possesses no transformation points (*e.g.*, platinum, nickel). The beam of light from the second galvanometer passes through a prism in order to transform the horizontal displacement imparted by the rotation of the mirror into a vertical displacement. If the two metal cylinders are heated uniformly in a tube furnace no difference in temperature exists between them until a transformation point is reached, at which point heat will be absorbed by the steel and a lag occurs. During cooling, evolution of heat at the transformation point will cause the steel to be hotter than the comparison cylinder, and a curve in the opposite sense to that produced during heating will be recorded on the photographic plate. Several sources of error resulting in unequal heating of the two cylinders may occur, *e.g.*, zones of different temperature in the furnace; difference in mass or emissivity of the two cylinders, or cooling effects from the proximity of thermo-couple sheaths or supports. It was found advisable to use a rod of refractory material extending the full length of the furnace tube. The metal cylinders rested in a cut-out portion near the centre, and the thermo-couple wires were threaded through holes bored longitudinally in the rod. A neutral atmosphere is essential, as decarburisation or oxidation of the iron causes anomalies quite independent of the transition phenomena.—C. A. K.

Steel; Decarburisation of —— with hydrogen. E. D. Campbell. Iron and Steel Inst., Sep., 1919. [Advance copy.] 8 pp.

SMALL bars of steels of varying compositions (plain carbon steels and alloy steels) were decarburised at a temperature between 950° and 1000° C. for periods varying from four to twelve days by means of electrolytic hydrogen saturated with water vapour at the ordinary temperature, the saturated hydrogen being replaced by pure dry hydrogen during the time the furnace was cooling. Evidence was obtained regarding the influence of elements, other than carbon, on the stability of the carbides occurring in steels. Pure carbides of iron are less stable and more completely dissociated, when in solid solution, than are the carbides formed when other elements are present. Silicon replaces part of the carbon in the carbide molecule and modifies the products of dissociation; while the double carbides of iron and manganese are much more stable than those of pure iron. Chromium-, tungsten-, and molybdenum-steels show an increase in electrical resistivity on decarburisation, the complex or mixed carbides being decomposed and the liberated chromium, tungsten, or molybdenum combining with or dissolving in the iron. Nickel-steels, on the other hand, where the nickel is almost wholly in

solution in the iron, show a decrease in electrical resistivity on decarburisation similar to the decrease found in the case of plain carbon steels. Generally one-third of the sulphur was removed from the steels, excepting the manganese steel, where there was no desulphurisation.—J. W. D.

Steel; Heat treatment of ——— with special reference to steels used for aeroplane motors. A. Sauveur. J. Franklin Inst., 1919, 188, 189–197.

Heat treatment of steels may be regarded as either a softening, strengthening, or hardening process, according to whether the metal is cooled slowly from a temperature exceeding its critical range, or whether it is cooled rapidly through the critical range. In the softening treatment low and medium carbon steels are cooled slowly from 900° C., but steels containing 0·8 % C or more and some alloy steels are heated only to 600°–675° C. with subsequent slow cooling. This process usually precedes machining operations. Tensile strength, elasticity, hardness, and resistance to shock are increased at the sacrifice of some ductility by cooling in air, oil, or water, steels which have been heated to 50° C. above the critical range. A second heating to below the critical point and cooling is advantageous for alloy steels or steels containing more than 0·25 % C. A hardening treatment decreases ductility to the point of brittleness, and is applied to finished parts as a last treatment or to be followed by grinding only. When heated above the critical range the metal is cooled rapidly in water or oil, and afterwards tempered at 200°—400° C. to remove internal strains. Specific treatments for different types of carbon and alloy steels used in the construction of aeroplane motors are given in detail.—C. A. K.

Steel; Heat treatment of ———. T. D. Lynch. Proc. Eng. Soc. W. Pa., 1919, 35, 215–242.

The heat treatment of steel with reference to the standardisation of treatments and the results obtained by standard treatments are dealt with in a series of tables. The tables were prepared from the results of many tests in the laboratories of the Westinghouse Electric and Manufacturing Company, and cover the heat treatment of plain carbon and alloy steels and also case-hardening steels. The case of special grades of steel treated by special processes is also considered, and reference is made to a carbon steel containing 0·15–0·25% carbon, where the elastic limit was increased from 18,000 lb. to 52,000 lb. by heat treatment, without decrease in the ductility. The heat treatment of 6 in. and 8 in. shells is fully considered. The first shells treated were subjected to a water treatment, but latterly an oil treatment was introduced. In the case of the water treatment the shells were heated at 800° C. in a continuous furnace, drawn, and quenched nose down with water playing into the interior of the shell against the base. The shells were then removed from the bath and tempered at 610° C., the water in the quenching tank being left warm for the next shell. This method of treatment gave a good grain structure with practically no loss from breakage. On account of an official decision the water quenching was superseded by oil quenching. The shells were heated in a continuous furnace at 800° C., conveyed from the furnace to the quenching tank on rollers, lowered into the oil and rolled through the oil by means of an endless chain, automatically drained, and conveyed to the drawing furnace, where they remained for approximately one hour, the temperature being varied from 610° to 640° C., according to the carbon content of the steel. A minimum Brinell hardness of 207 was required in order to give the necessary elastic limit (45,000 lb. per sq. in.), while a maximum hardness of 255 for machining purposes was established.—J. W. D.

Steel; Fibrous structure in high carbon ———. A. W. Lorens. Chem. and Met. Eng., 1919, 21, 203—204.

In the acceptance test of forgings, 9 ft. long by 7 in. diameter, made from one ingot, three tensile test-pieces were taken from slabs cut from the ends of the forging representing the top and bottom of the ingot. It was found that there was greater uniformity of tests from the bottom as compared with the middle and top of the ingot. This indicated trouble due to impurities which slowly rose to the upper end of the ingot during cooling. An accidental omission to wash the ingot moulds with tar gave 100% of good forgings. It was thought that the tar in distilling filled the metal with gas, which worked its way into the upper portion of the ingot and on forging gave rise to hair cracks. When samples which had failed were etched with sulphuric acid, cracks ¼ in. long were revealed. The tensile test-piece taken from the region of greatest working under the press was invariably good. The test-piece from the middle of the forging which was responsible for most failures did not receive sufficient work to weld up the holes. Heats cast using graphite as a mould wash were superior to those obtained when tar-washed moulds were used. While the use of tar is not held altogether responsible for the trouble, the author concludes that fibrous structure is often due to the presence of gas cavities, which during working become squeezed out into thin streaks without being welded.—T. H. Bu.

Steels; Woody structures of fractures of transverse test-pieces taken from certain special ———. J. J. Cohade. Iron and Steel Inst., Sept., 1919. [Advance copy.] 15 pages.

The author has investigated the effect of chemical composition in relation to defective transverse tests with woody fractures in forged steels. With the carbon below 0·3% or, better still, 0·25%, good results are obtained, provided the metal is properly made, even if a high percentage of special elements is added to secure high tensile strength after quenching and tempering. This applies to steels which have received a working ratio up to 1:8. In steels containing less than 2·5% Ni it is not necessary to reduce the carbon content, as good results have been obtained with as high as 0·5% carbon. Transverse tests are improved by forging ingots wholly at high temperature, and also by quenching after keeping at a high temperature, but not sufficiently if maximum results for transverse strength are required, as, for example, in the case of steel for guns. Molybdenum, even in small quantity, accentuates bad results in transverse tests. The differences between tests from the edge and those from the centre of an ingot are not accounted for by differences in the rate of cooling. Quenching a large basic open-hearth ingot prior to forging effected no improvement. Basic open-hearth casts gave occasional flaky fractures with defective tests, but acid open-hearth casts, with proper precautions, gave excellent results. Indecisive results were obtained in tests to determine the influence of the co-efficient of working. The results from the bottom portions of the ingots were distinctly the best. Fractures are more "woody" after quenching than in the annealed bars.

—T. H. Bu.

Carbon in steel; Electrolytic resistance method for determining ———. J. R. Cain and L. C. Maxwell. J. Ind. Eng. Chem., 1919, 11, 852—860.

Carbon in steel may be determined in 4 to 5 mins. with an accuracy of 0·01% by a direct combustion method in which the carbon dioxide is determined by absorbing it in barium hydroxide solution and measuring the change in the electrolytic resistance

of the solution in relation to its concentration. A simple absorption apparatus has been devised in which there is an elongated arm with a series of bulbs and a cell in which the platinised electrodes can be adjusted so as to give a definite cell constant. This constant should be checked from time to time by the combustion of standard samples, or by determining the resistance of a $N/10$ solution of pure potassium chloride, and calculating the cell constant by means of the formula $R = NS$, where R represents the observed resistance, N the cell constant, and S the specific resistance of $N/10$ potassium chloride solution at the definite temperature (Landolt-Börnstein's Physikalisch-Chemische Tabellen, 4th Ed., p. 1117). From the results of measurements at 20°—30° C. of the resistance of barium hydroxide solutions varying in concentration up to 42·25 grms. per litre, it was found that solutions containing from 5·82 to 7·30 grms. of barium hydroxide per litre were the most suitable for this method. Weibel's galvanometer (Bureau of Standards, Scientific Paper No. 297, 1917) was found a simple and accurate instrument for measuring the electrical resistance of the solutions, and this was incorporated in a Leeds and Northrup bridge containing the resistance coils in a hermetically-sealed box. In making a determination the two absorption vessels are connected with the electric combustion furnace, and each is charged with 200 c.c. of the barium hydroxide solution (preferably "equivalent" to about 5 % of carbon). Oxygen or air free from carbon dioxide is passed through the solutions and their temperatures and resistances are then determined. In the meantime the combustion boat, filled with alundum sand, is heated at 1050°—1100° C., and when the sand is at a low red heat the sample of steel is distributed over the alundum, and the boat again heated without any oxygen passing through the furnace. After a short time oxygen is introduced at the rate of 300—400 c.c. per min., and after 2 mins. air free from carbon dioxide is also admitted to the absorption tube at the same rate as the oxygen from the furnace, the object being to remove the last traces of carbon dioxide from the large bulb of the absorption apparatus. While the air is passing through the latter the combustion of a second sample of steel may be carried out, using the second absorption tube. The second reading of the electrical resistance and temperature of the barium hydroxide solution is then made, and the percentage of carbon is calculated from the increase in the resistance due to the precipitation of barium ions. A table is given containing the data for plotting the resistance-concentration curve for barium hydroxide solutions of about 4—5 % carbon equivalent strength (*i.e.*, the percentage of carbon required to precipitate the whole of the barium when 2-grm. samples are used), as well as a nomographic chart by means of which the carbon percentage can be read directly from the observed values before and after the combustion, with an error of less than 0·005 % carbon.—C. A. M.

Steel: Estimation of manganese in special —— by the persulphate method. P. Nicolardot and A. Levi. Rev. Mét., 1919, **16**, 201—216.

Experiments on the mechanism of the action of ammonium persulphate on manganese salts in solution show that, in the absence of silver nitrate, manganese is oxidised and precipitated as manganese dioxide. If a small quantity of silver nitrate or sulphate is present, the manganese is oxidised to permanganate and the characteristic colour is developed. Excess of silver nitrate tends to cause precipitation of silver peroxide or persulphate, which introduces an error in the subsequent titration with sodium arsenite. Destruction of the permanganate formed occurs if the acidity of the solution exceeds 10% H_2SO_4 or 5% HNO_3, especially if the temperature is above 60° C. Too great a quantity of persulphate causes a slow re-oxidation of the manganese during titration of the cooled solution. For the determination of manganese in ordinary steels, 0·2 grm. of steel is dissolved in 10 c.c. of sulphuric acid (1 : 3) and 0·5 c.c. of nitric acid. After cooling and adding 50 c.c. of a saturated solution of silver sulphate and 5 grms. of ammonium persulphate, the solution is heated in a water bath for 3—5 mins., cooled, and titrated with a solution containing 1 grm. As_2O_3 and 5 grms. $NaHCO_3$ in 2 litres. Alloy steels present difficulties, *e.g.*, the interference of chromium and the precipitation of tungstic acid, but the following method is applicable in the presence of Cr, W, Ni, Co, or V. 0·2 grm. of steel is dissolved in sulphuric acid (1 : 4) in presence of 0·5 c.c. of nitric acid, and the solution is boiled until tungstic acid is precipitated. After cooling, sodium hydroxide is added until tungstic acid is redissolved and precipitation of ferric oxide occurs. 3 c.c. of phosphoric acid solution (38 % P_2O_5) is added, the solution cooled, re acidified with a slight excess of sulphuric acid, treated with 10 c.c. of a saturated silver sulphate solution and 1 grm. of persulphate, and heated in a water bath until the colour develops. The solution is then cooled in air, treated with a known quantity (0·002 grm. Mn) of permanganate solution, and titrated with a solution of sodium arsenite, the result being corrected for the manganese added. High chromium steels require the addition of 1—3 grms. of persulphate to ensure oxidation.—C. A. K.

Nickel steel; Experiments on [action of carbon monoxide on] ——. N. Hudson. Iron and Steel Inst., Sept., 1919. [Advance copy.] 3 pages.

Carbon monoxide will combine with the nickel in a nickel steel even in the case of steel of a fairly low nickel content. The most favourable conditions for the formation of nickel carbonyl appear to be the exposure of a large surface area of freshly-machined metal at a low temperature. Nickel steel is sometimes used in positions where it is liable to exposure to carbon monoxide under varying conditions of temperature and pressure, and the possible removal of nickel from its surface in the form of nickel carbonyl may have some practical bearing on such questions as the investigation of erosion, etc.—J. W. D.

Nickel-chrome and other steels; Brittleness in ——. F. Rogers. Iron and Steel Inst., Sept., 1919. [Advance copy.] 4 pages.

Nickel-chrome steels, carbon steels (0·20 to 0·40% C), nickel steels, and chrome-vanadium steels are subject more or less to development of brittleness as a result of slow cooling from the tempering temperature. The Brinell hardness is consistently higher where hardened samples of such steels are quenched from the usual tempering temperature than when the tempering is followed by slow cooling. Study of heating and cooling curves of the alloys showed that the temperature at which heat begins to be absorbed lies between 400° and 500° C., hence the usual tempering temperature (600°—650° C.) lies in a region where a very material absorption of heat and therefore re-solution of carbides takes place. Steels quenched from 600°—650° C. have therefore a different constitution from those slowly cooled. The difference in behaviour depends fundamentally on the condition of the steel previous to the tempering process, and results indicate that the more a steel is worked the greater is its susceptibility to "temper brittleness." This is due to the degree of aggregation of the constituents (carbides and solvent) produced by proper

mechanical treatment. When the constituents are homogeneously blended by suitable hardening the distribution of the low-concentration solution formed in the usual tempering zones is more intimate. The retention, so far as is possible by quenching, of this low-concentration solution, which, despite admixture with free carbides and possibly solvent also, gives the maximum combination of toughness with a certain hardness, is desirable.—J. W. D.

Nickel-chrome [steel] forgings. J. H. Andrew, J. N. Greenwood, and G. W. Green. Iron and Steel Inst., Sept., 1919. [Advance copy.] 93 pages.

From a detailed examination of a large number of hollow forgings from 45-ton, 22-ton, and 11-ton ingots of the average composition C 0·3, Mn 0·45, Ni 3·5, Cr 0·7%, the authors conclude that the casting operation is the most important of all, any faults arising in the ingot generally persisting to the final heat treatment. The cast metal and the mould walls should be as clean as possible and loose sand kept from getting into the mould. Ingots should be cast wide end up, and should be as small as is consistent with practice. The metal should be run into the mould as cold as possible, as high casting temperature promotes segregation, ghost lines, etc., and causes increased crystalline growth throughout. The macrostructure, determined only by the temperature and method of casting, persists throughout, no matter what the mechanical and heat treatment may be. Large ingots which are to be subjected to solid forging will be sounder and less liable to crack if transferred as soon as possible after casting to a soaking pit and allowed to become evenly heated throughout before being transferred to the forging press. This procedure induces diffusion of the carbon and general homogeneity of the mass, and the forging breaks down the original crystalline structure and refines the grain. At any stage when reheating is necessary the whole thickness of the metal as nearly as possible should pass the critical point at the same time. The more the steel is mechanically worked the greater is the tendency towards laminated fracture, *i.e.*, mechanical work can be overdone. The smaller the dendrites in the macrostructure the better the fracture both for mechanically worked and unworked steel. The macrostructure gives some information as to casting conditions, and for mechanically worked steel the manner and to some extent the amount of deformation can be deduced. The final tests on heat-treated material show little difference between the various sized ingots. Annealing previous to oil quenching and tempering does not improve the mechanical tests or facilitate machining. The effect of mechanical work on untreated material is clearly marked, but oil quenching and tempering remove discrepancies, in fact the mechanical tests seem to depend only on the casting and final treatment. The temperature of oil hardening seems to have little or no effect on mechanical properties, but the heating should be as short as possible. The configuration shown on benders gives some indication of the casting treatment. Photomicrographs are in accordance with the views suggested.—T. H. Bu.

Ferrosilicons. A. Sanfourche. Rev. Mét., 1919, **16**, 217—224.

The fusion points of mixtures of pure iron and pure silicon were determined in a porcelain or silica tube heated in a carbon resistance furnace. A layer of sodium chloride prevented the oxidation of the alloy during the heating period. The melting point of the pure iron (1515° C.) is reduced to 1445° C., when the silicon content is 1·5%. As the silicon content is increased the melting point is raised to 1516° C. (3% Si), and then falls again to 1410° C. (6% Si). A 7% Si alloy melts at 1427° C., and the fusion point falls regularly to 1256° C. (14·3% Si). The system is not univariant, but is probably comparable with that of other alloys (*e.g.*, ferro-chromium) named "pseudo-binary" (Portevin, Rev. Mét., 1911, 6), in which the solution may be partly dissociated during fusion. A silicon content of 14—19% gives a new series of alloys, and a further series containing 19—21·5% Si includes the compound Fe_2Si. The differential attack of acids on the alloys is noticeable in this series. Between 21·5% and 25% Si (theoretically 33% Si for FeSi) a transformation occurs in the solid alloys at about 1055° C., and above this concentration of silicon the primary crystals always have the composition FeSi. The melting point curve of alloys containing 50—60% Si is not very definite, and it is thought that a region of instability has been reached. A maximum point (1217° C.) on the curve for 55·55% Si points to a new compound, Fe_3Si_5, and long treatment with a boiling solution of sodium hydroxide confirms the existence of this compound. An alloy containing 60% Si ($FeSi_3$) has a fusion point of 1202° C., which is reduced to 1199° C. for an alloy containing 61·38% Si. Above 61·5% Si two points are distinctly noticeable, the higher one marking the melting point of silicon, the lower one (1199° C.) being the melting point of the eutectic mixture Si + $FeSi_3$. The silicon crystallises first and rises to the surface, and the alloy ceases to be homogeneous. The critical points of iron are influenced to a small extent by the presence of silicon.—C. A. K.

Titanium; Determination of —— in titaniferous iron ores. J. Waddell. Analyst, 1919, **44**, 307—309.

The ore is fused with eight times its weight of sodium peroxide in an iron crucible, the mass is then disintegrated with water and dissolved by the addition of a slight excess of sulphuric acid. Tartaric acid (four times the weight of the ore taken) is added to the solution, the iron is reduced with hydrogen sulphide and precipitated by the addition of ammonia and further treatment with hydrogen sulphide; the precipitate is removed by filtration, the filtrate treated with an excess of sulphuric acid, boiled to expel hydrogen sulphide and coagulate sulphur, the solution filtered, and the titanium precipitated by the addition of a solution of "cupferron" (ammonium salt of nitrosophenylhydroxylamine). The precipitate is collected, washed with water or dilute hydrochloric acid, and ignited to TiO_2. An alternative method consists in diluting the solution to a definite volume and determining the titanium colorimetrically by means of hydrogen peroxide; in this case the comparison solution, containing a known amount of titanium, should also receive the addition of tartaric acid.—W. P. S.

Gold; Solubility of —— in cyanide solutions. H. A. White. J. Chem. Met. Soc. S. Africa, 1919, **20**, 1—8.

Gold leaf and thin plates of fine gold and of battery bullion were subjected to the action of synthetic and working solutions of alkali cyanide under various conditions as regards temperature, concentration, aeration, and contact of the metal with carbon and iron. From the results obtained it is concluded that the speed of reaction is entirely dependent on the rate of diffusion of the cyanide and the necessary oxygen, the latter being the more important; that a maximum action upon gold free from electrolytic contact is exerted by cyanide solutions containing between 0·02 and 0·03% KCN; and that adequate oxygen concentration is always

advantageous, especially in the case of working solutions subject to deoxidising influences.
—W. E. F. P.

Zinc dust; Estimation of metallic zinc content of ——. W. F. Edwards. Chem. and Met. Eng., 1919, 21, 192.

THE author finds that the hydrogen gas method is not on the whole suited to the analysis of zinc dust, used or unused, in sherardising, nor is estimation by reduction of potassium iodate a good working method in commercial plants. The amalgam method gives uncertain results, and is not satisfactory for practical purposes. The method of reduction of ferric sulphate gave inconsistent results, but with crystallised ferric ammonium sulphate satisfactory results were obtained, the time required being approximately 15 minutes against 6 to 36 hours for the gas method. The method adopted is as follows:—1 grm. of zinc dust is treated with 50 grms. of ferric alum crystals and 100 c.c. of water and constantly stirred. As soon as the zinc dust is dissolved, 100 c.c. of sulphuric acid (1:10) is added, and the solution is titrated with potassium permanganate. Comparison of results obtained on new and used zinc dust by the hydrogen gas method and the ferric alum method are given and show good agreement.—T. H. Bu.

Aluminium ingot; Metallography of ——. R. J. Anderson. Chem. and Met. Eng., 1919, 21, 229—234.

FOR commercial purposes, aluminium ingot is usually divided into two grades, containing 99% and 98—99% Al respectively, though the chemical composition is not regarded now as a complete criterion of quality owing to the widely different physical properties (*e.g.*, toughness) shown by different ingots of similar chemical composition. Not only is the structure different in separate ingots, but it may vary considerably in a specimen cut for micrographic purposes. Macrographic examination yields instructive results, and grains of apparently large size are revealed on etching. Microscopic investigation of these grains shows that each of the presumed large grains possesses a secondary internal structure and is made up of a number of small grains or dendrites. This result of etching is termed "differential group etching," and it seems as if each group of grains is orientated differently. A tentative explanation is that when aluminium freezes normally the large grains represent the true gram size of pure aluminium, and any one so-called group has the same orientation throughout. Part of the eutectic-forming impurities are not rejected to the boundaries of the grain, but freeze in position and give rise to a structure within each large grain. Small grains are formed when the impurities form a continuous network.—C. A. K.

Aluminium alloys [duralumin]; Tempering of certain ——. L. Guillet, J. Durand, and J. Galibourg. Comptes rend., 1919, 169, 508—511.

THE influence of time and temperature on the rate of change of the hardness of duralumin after tempering has been studied. Samples having a hardness number (Brinell) 65 were heated to 300° or 400° C. and quenched in water, the hardness falling to 61 and remaining unchanged after 48 hours. When heated to 450° or 500° C., however, and similarly quenched, the hardness rose during 48 hours from 61 to 93. Samples quenched in liquid air and kept at the same temperature for several days showed no change in hardness, but when the specimens were brought to room temperature the hardness rapidly rose to the maximum value. Whereas at 15° C. the hardness only reaches the maximum after about 48 hours, at higher temperatures the rise is more rapid and at 200° C. the maximum is attained in six hours. At 300° C., however, the hardness decreases with time. To explain these phenomena it is supposed that at 450° C. the metal passes into a form stable at that temperature and, when quenched, gradually changes into a form stable at low temperatures—the harder form. At very low temperatures this change is prevented; it assumes its maximum rate at about 200° C.
—E. H. R.

Aluminium-bronzes; Relation of microstructure to phase changes in heat-treated ——. L. R. Seidell and G. J. Horvitz. Chem. and Met. Eng., 1919, 21, 179—181.

THE authors have investigated the variation in microstructure and physical properties of 10% aluminium-bronze when subjected to heat treatment. Differential heating and cooling curves are given in conjunction with a constitutional diagram representing the nature of the physical constituents present in the different temperature ranges. The phase changes of the thermal curves agree closely with the equilibrium diagram which is also given for comparison. A curve of Brinell hardness tests made on ½ in. specimens cut from a 1¼ in. bar and quenched in water from temperatures ranging from 427° to 982° C. shows that the alloy is at its maximum hardness in the β condition. Another series of specimens after quenching at 870° C. were drawn at temperatures from 370° to 816° C. The maximum drop in hardness occurs in the tempering range 370° to 482° C. Suitable heat treatment greatly improves the strength of aluminium-bronze. Photomicrographs show that the α crystals become progressively smaller as the quenching temperature is raised. The close-grained structure of the quenched and tempered alloy consisting of needle-shaped α crystals in a matrix of β explains its increased strength compared with the cast alloy, the structure of which shows massive primary crystallisation of α and γ. The results suggest the use of the alloy as a bearing metal and as a substitute for steel where resistance to corrosion is desired.—T. H. Bu.

Aluminium and its light alloys with copper and with magnesium; Constitution of ——. P. D. Merica, R. G. Waltenberg, and J. R. Freeman, jun. U.S. Bureau of Standards, Scientific Paper 337. J. Franklin Inst., 1919, 188, 267. (See also this J., 1919, 43 A.)

THE temperature-solubility curves of $CuAl_2$ and of Mg_4Al_3 in aluminium were determined by the method of annealing and microscopic examination. Aluminium dissolves about 4·2% of copper as $CuAl_2$ at 525° C. and about 12·5% of magnesium as Mg_4Al_3 at 450° C. The solubility of both compounds decreases with decreasing temperature. At 300° C. aluminium dissolves only 1% of copper as $CuAl_2$ and slightly less than 5·9% of magnesium as Mg_4Al_3. The structural identification of the various constituents, $FeAl_3$, $CuAl_2$, Mg_4Al_3, found in alloys with magnesium and with copper is described, and a constituent is noted in all light aluminium alloys containing magnesium which is believed to be Mg_2Si. The solubility of iron as $FeAl_3$ in aluminium is at all temperatures less than 0·15%. Small amounts of silicon, up to 0·12—0·20%, are dissolved by aluminium at the eutectic temperature, but are reprecipitated upon cooling, corresponding to the diminished solubility for silicon of aluminium at lower temperatures. Silicon in the usual commercial amounts is probably present as a compound of iron and silicon together with some aluminium; the composition of this compound is

not known, but it separates out with aluminium and FeAl, at an invariant point at 610° C.
—E. H. R.

Aluminium; Ternary alloys of —— with magnesium and copper. R. Vogel. Z. anorg. Chem., 1919, **107**, 265—307.

TERNARY aluminium-magnesium-copper alloys containing up to 55% Mg and 54% Cu have been studied thermally and microscopically, and from the results the triangular equilibrium diagram limited by the phases Al, Al_2Cu, and Al_3Mg_4 has been constructed. The following constituents have been detected in the ternary alloys: ternary mixed crystals of the three elements, ternary mixed crystals containing Al_2Cu, a ternary compound Al_4Mg_4Cu, and binary Al-Mg mixed crystals. When a prepared section of a ternary alloy is etched with concentrated nitric acid, the mixed crystals containing Al_2Cu are rapidly blackened, the crystals of the ternary compound become brown to black much more slowly, and the mixed crystals of the series containing more than 6% of magnesium become yellow, whilst the ternary mixed crystals rich in aluminium remain bright. On adding a drop of water to the nitric acid the black Al_2Cu mixed crystals become rapidly bright red owing to the deposition of copper whilst the ternary compound rapidly blackens. Several photomicrographs of ternary alloys are reproduced. Magnesium up to 6% steadily increases the tensile strength of aluminium owing to the formation of mixed crystals. With more magnesium, a second mixed crystal constituent appears containing the compound Al_3Mg_4. These mixed crystals, and also those of the ternary compound Al_4Mg_4Cu, are hard and brittle and their presence is consequently undesirable. Magnesium and copper alloys of aluminium show a secondary arrest point in the neighbourhood of 569° C., probably due to an allotropic change in the aluminium which is never detected in aluminium itself. The possibility of allotropic change of the aluminium does not explain, however, the increase in tensile strength which aluminium alloys containing magnesium and copper undergo after heating to about 500° C. and cooling to room temperature. This phenomenon cannot yet be explained. (See also J. Chem. Soc., 1919, ii., 414.)—E. H. R.

Antimony in hard lead; Volumetric determination of ——. A. Wogrinz and R. Gohring. Metall, 1919, 117—118. Chem. Zentr., 1919, **90**, IV., 172—173.

TIN was the chief additional element in the alloys analysed. The method of Nissenson and Siedler (this J., 1903, 967) was used, modified as described. 2 grms. of finely filed alloy is melted with a mixture of 3 grms. of sulphur and 6 grms. of calcined soda in a covered porcelain crucible. The melt is treated with water until disintegrated, the solution filtered through a Gooch crucible, in which a thick filter paper is substituted for the asbestos, and the residue of insoluble sulphides washed three times with small quantities of a dilute solution of sodium sulphide. The tin is separated from the antimony in the liquid by oxidation with sodium peroxide by Hampe's method (this J., 1895, 302). The precipitated sodium pyroantimonate is dissolved in hydrochloric acid saturated with tartaric acid. The liquid is placed in a 300 c.c. Erlenmeyer flask, several pieces of sodium sulphite added, and then the flask is plugged with glass wool. The solution is boiled for 6 mins., treated with 10 c.c. of hydrochloric acid, and then titrated hot with potassium bromate solution (1 c.c. = 0·006 grm. Sb), using 5—10 drops of indigo carmine solution as an indicator. If the solution is greenish-yellow in colour some more drops of indigo solution are added and more bromate solution till a yellow colour appears.—T. H. Bu.

Alloys; Electric production of carbon-free ——. E. F. Northrup. Chem. and Met. Eng., 1919, **21**, 258.

METALS or alloys having a fusion point below that of a refractory material such as zirconia may be melted free from chemical contamination in a special type of induction furnace taking a high frequency current of 10,000 cycles or over. The furnace casing is preferably composed of a quartz tube, wrapped with a thin-walled flattened copper tubing which forms the inductor coil, and through which a small flow of water may be maintained for cooling purposes. Small pieces of metal to be melted are contained in a crucible or cylinder of refractory material (*e.g.*, fireclay, magnesia, zirconia) placed centrally in the vertical quartz tube, the space between the crucible and tube being packed with fine sand or alumina. Heating takes place rapidly when the high frequency current is started, and an inductor coil of 40 turns, 6 in. long and 3½ in. diam., supplied with 10—20 kilowatts, will melt 4 lb. of nickel or iron in 20—30 mins. Heating is due solely to the enormously large eddy currents which flow in the small conducting masses of the material being heated, and the electromagnetic forces also cause good circulation and agitation of the molten metal or alloy.—C. A. K.

Thallium-tin alloys. P. Fuchs. Z. anorg. Chem., 1919, **107**, 308—312.

A THERMAL investigation of the alloys of thallium and tin has shown the existence of a eutectic point at 166° C. with 30 at. % of thallium. The eutectic horizontal extends from 0 to 73 at. % thallium; with a greater proportion of thallium the alloy forms homogeneous mixed crystals. Alloys with less than 73% thallium show on cooling, in addition to the arrest point at the eutectic temperature, a second arrest at 114·5° C. This arrest point represents the transition point of saturated mixed crystals containing 73% thallium, the transition point of pure thallium at about 231° C. being lowered to this extent through the influence of the tin.—E. H. R.

Metals; Apparatus for determining the thermal conductivity of ——. G. B. Wilkes. Chem. and Met. Eng., 1919, **21**, 241—242.

AN apparatus designed especially for the determination of the thermal conductivity of aluminium alloys within the range 20°—600° C. consists essentially of a heater, a guard ring, and two continuous flow calorimeters. The lower end of the specimen rod (approx. 14 in. long and ¾ in. in diam.) is screwed into an electrically heated brass cylinder. The upper end of the rod is turned down to ¼ in. diam. and cut with a fine thread. A calorimeter drilled from a brass cylinder is screwed on to this end of the specimen and an internally square cut thread forms the water passage around the metal rod. A brass tube approx. 2 in. diam., screwed on to the heating block, serves as a guard ring, and a small guard ring calorimeter is fitted at the upper end, the annular space around the specimen being packed with a thermal insulating material. The temperature of the rod is measured at three points by means of small thermo-couples inserted through holes drilled in the insulating casing, the guard ring, and the specimen rod. When the heating current is started the specimen and guard ring are heated to the same extent, and the rate of flow of heat along the specimen to the calorimeter may be measured when the brass cylinder has attained a uniform temperature, without correction for loss of heat from any lower portion of the specimen.
—C. A. K.

Uranium; Rapid method of determining —— *in carnotite.* C. E. Scholl. *J. Ind. Eng. Chem.*, 1919, *11*, 842.

A WEIGHED quantity of the mineral containing about 0·2 grm. of uranium oxide is heated with 25—50 c.c. of dilute (1 : 1) nitric acid until all the uranium has dissolved, and the solution is then diluted to about 250 c.c. with warm water and filtered. An amount of ferric chloride equivalent to about three times the quantity of vanadium present is added to the nearly cold filtrate, which is then gradually treated with solid sodium carbonate until about 1 grm. has been added in excess of that required for neutralisation. The liquid is heated for at least 15 mins. at about 90° C., and filtered from the precipitate, which contains the iron, vanadium, and the bulk of the aluminium. The filtrate is gradually neutralised with nitric acid until uranium begins to precipitate, boiled to remove most of the carbon dioxide, treated with excess of sodium hydroxide, boiled for 15 mins., and filtered. The filtrate will contain the remainder of the aluminium and any vanadium not previously precipitated. The precipitate is dissolved in dilute nitric acid, and the solution heated to about 90° C., treated with excess of ammonia, boiled, and filtered. The precipitate is ignited and weighed as uranium oxide (U_3O_8), and should there be any doubt as to its purity it is treated with warm dilute nitric acid, and the residue again ignited. This method obviates the use of hydrogen peroxide, which interferes with the precipitation of uranium.
—C. A. M.

Silica in uranium ores; Determination of ——. C. W. Davis. Eng. and Min. J., 1919, **108**, 411.

A SILICA precipitate from a uranium ore may contain iron and uranium which are partly precipitated in a slightly acid solution on addition of barium chloride and sulphuric acid. During the after-volatilisation of the silica by treatment with hydrofluoric and sulphuric acids, the iron and uranium cause an increase in weight which reduces the loss in weight due to silica. The difficulty may be overcome by first igniting the sulphate precipitate with sulphuric acid, and then with sulphuric and hydrofluoric acids. The difference in weight of the ignited residues gives the weight of silica in the sample.—C. A. K.

Fuel economy. *See* IIA.

Copper sulphate-sulphuric acid solutions. Goodwin and Horsch. *See* VII.

Electric furnaces. Gosrow. *See* XI.

Effect of disinfectants on metals. Will and Landtblom. *See* XIXB.

PATENTS.

Chilled iron rolls and other castings in chilled iron and the like; Method of manufacture of ——. W. Muirhead, Shettleston, Lanark. Eng. Pat. 131,110, 11.7.18. (Appl. 11,366/18.)

A METHOD of manufacturing chilled iron rolls and other castings in chilled iron consists in utilising the cupola furnace to melt a mixture of pig iron and cast iron scrap which has not been previously specially refined or prepared, and then transferring or running the fluid metal into a Siemens or equivalent open-hearth melting furnace, wherein it is allowed to remain sufficiently long to remove by oxidation the excess carbon and a proportion of the silicon.—J. W. D.

Electro-converter furnaces and process of treatment for the manufacture of steels thereby. R. F. Sarron and J. Simon, Lyons, France. Eng. Pat. 131,372, 27.5.18. (Appl. 8761/18.)

A CONVERTER furnace may be adapted for use as an electric furnace when in the horizontal position by fitting one or more electrodes through the wall. The electrodes slide in metal sleeves, which are lined with refractory material to insulate the electrodes from the furnace lining. When the electrodes are withdrawn, the furnace is sealed as tightly as possible by means of refractory plugs and a closing door, and connected to a suction device to produce a partial vacuum. For the manufacture of steel, fusion of the materials is effected in an acid-lined furnace, and the blast is operated until most of the silicon is oxidised. The highly heated metal is then transferred to a basic-lined furnace previously charged with the necessary lime and the conversion is finished. The metal is subjected to partial vacuum in order to eliminate dissolved gases; the electrodes are put in place and the electric refining process is performed.—C. A. K.

Iron and steel and alloys thereof; Heat treatment of articles of ——. W. M. Mordey, London. Eng. Pat. 131,575, 8.5.18. (Appl. 17,117/19.)

HEAT treatment of iron or steel articles up to the critical non-magnetic temperature of the particular metal used is effected by introducing the article into the magnetic circuit of an alternating current electro-magnet. Induced eddy currents are set up and with the aid of magnetic hysteresis, the article is heated until the generation of heat ceases, owing to the reduced permeability of the heated steel. An automatic arrangement may be made in which the metal article falls into a quenching bath when the non-magnetic condition is reached. Supplementary heating may be employed to attain higher temperatures, and the metal articles may be protected from oxidation by a coating, or by a neutral atmosphere. The application of the process to steel rails is claimed in Eng. Pat. 131,096.—C. A. K.

Ferro-titanium; Manufacture of ——. H. A. Blackwell, Blackpool. Eng. Pat. 131,675, 30.7.18. (Appl. 12,361/18.)

IN the manufacture of carbon-free ferro-titanium by the alumino-thermic process, difficulty is found in attaining the temperature necessary for a complete separation of the metal produced, unless an unduly large quantity of iron oxide and aluminium is used. Satisfactory results are obtained by preheating the constituents of the mixture (*e.g.*, ilmenite and aluminium) separately to a dull red heat, and causing the reaction to occur in the heated mixture.—C. A. K.

[Iron] ore; Process of smelting and refining ——. L. Mambourg, Assignor to The Mambourg Continuous Iron and Steel Furnace Co., Lancaster, Ohio. U.S. Pat. 1,313,309, 19.8.19. Appl., 10.6.18.

A MIXTURE of ore, fuel, and flux is fed continuously into a furnace containing a bath of molten metal and maintained at the necessary temperature; the slag is separated from the molten metal produced, and the latter is withdrawn continuously.
—W. E. F. P.

Steel alloy. W. C. Honhorst, Newport, Ky. U.S. Pat. 1,313,891, 26.8.19. Appl., 8.12.17.

A STEEL alloy, having high tensile strength and great torsional resistance, is claimed, "the specialised characteristics of which as distinguished from ordinary steel are determined by the alloy containing dominating components of chromium and copper, not to exceed 5%, and carbon in proportion appropriate for tempering."—J. W. D.

Steel; Carbon-chrome-nickel ——. J. R. Speer, Trappe, Md. U.S. Pat. 1,314,022, 26.8.19. Appl., 15.6.18. Renewed 26.4.19.

A HARDENED worked alloy of steel characterised by

great hardness and toughness, variable by heat treatment, is composed of 97·5—99·5 parts of steel containing 0·50—1·25% carbon and 0·25—1·25 parts each of chromium and nickel, the chromium being not less than the nickel.—J. W. D.

Steel; Art of manufacturing —— [*in electric furnaces*]. G. H. Benjamin, New York. U.S. Pat. 1,314,384, 26.8.19. Appl., 5.12.14.

An electric furnace for the manufacture of steel comprises a body portion with means for generating electric heat of constant thermic value, and a rotating hearth. Means are provided for producing relative movement between the body and the hearth and for holding them in certain defined relations at different intervals during the operation of the furnace, without exposing any portion of the furnace, except the lining, to the temperature effects of the electric heat.—J. W. D.

Furnaces of the soaking pit type; Regenerative ——. C. M. Stein et Cie., Paris. Eng. Pat. 120,039, 31.8.18. (Appl. 14,177/18.) Int. Conv., 8.9.17.

Soaking pits arranged in a battery are provided with a separate regenerator for each pit and a cleaning pit common to all. The gas and air mixture in combustion passes over the upper part of the ingots and returns along the lower portion of the ingots before entering the regenerator.
—C. A. K.

Crucible furnaces. F. S. Wigley, Birmingham. Eng. Pat. 131,516, 8.11.18. (Appl. 18,301/18.)

A battery of crucible furnaces with bottom castings made with lateral air inlets is built in a row at the base of a chimney stack. The fire-bar frames are supported on the flanges of two steel joists instead of on brick piers as in Eng. Pat. 105,146 (this J., 1917, 555). The setting is claimed to be stronger and to have a longer life as the air passing through the fire-bars and the lateral openings is not so strongly heated as when it has to pass between heated brick piers.—C. A. K.

Furnaces; Electric resistance —— *for heating gases* [*for blast-furnaces*]. J. Simon and P. F. Sarron, Lyons, France. Eng. Pat. 132,080, 24.9.18. (Appl. 15,542/18.)

The gases are heated by passing through channels in a body constructed of carborundum and graphite, which is highly heated by the passage of an electric current. This heating element is surrounded by a refractory coating of carborundum enclosed within firebricks contained within the sheet iron outer wall of the heating furnace. If desired, the mixture of graphite and carborundum may be employed in pulverulent form, tubes of cast quartz being embedded therein through which the gases to be heated circulate. The refractory furnace lining of carborundum is in this case omitted. The heated gases are delivered to the blast furnace through tuyères provided with a highly refractory lining of carborundum or cast quartz. A form of furnace for calcining carbonates, including heat recuperators, air-tight furnace chamber, and electric resistance furnace as described, is detailed.—J. S. G. T.

Smelting furnace; Liquid fuel ——. E. E. Rushton, Assignor to E. Hand, Los Angeles, Cal. U.S. Pat. 1,314,150, 26.8.19. Appl., 15.7.18.

A smelting furnace is provided with a sloping elongated chamber the section of which is gradually reduced towards the lower end. A transverse baffle wall extends from the roof across the central portion of the furnace. Ore is fed into the upper end of the chamber and liquid fuel is burned at the lower portion.—C. A. K.

Converter and smelter. T. Miller, Waco, Tex. U.S. Pat. 1,314,348, 26.8.19. Appl., 22.3.18.

A converter having a revolving cylinder contains a series of hollow refractory agitators arranged axially and provided with interior burner vents, means being provided for supplying fuel continuously to the vents.—J. W. D.

Furnace; Superposed hearth——for the continuous roasting of sulphide ores and the like. E. Dohet, Saint-Servais, Belgium. Ger. Pat. 312,077, 20.2.17. Int. Conv., 8.7.16.

The hearths each consist of a series of troughs arranged side by side, and in each trough there is a mixing and transporting roll. The rolls move the material in a direction at right angles to their axis and transverse to the furnace hearth. The material is fed in along the whole length of the troughs and passes continuously through the furnace. On one side, throughout their whole length, the rolls are longitudinally toothed or grooved and on the other side they form shovels or scoops. During each rotation each roll feeds the next throughout its entire length and the output of the furnace is thereby considerably increased. The furnace is suitable for chloridising ores, calcining and drying different products, the production of sodium sulphate, etc.—T. H. Bu.

Aluminium and its alloys; Process for rendering —— *more durable.* S. O. Cowper-Coles, Sunbury-on-Thames. Eng. Pat. 131,017, 3.4.18. (Appl. 5710/18.)

Aluminium is rendered more resistant to atmospheric influences and to salt water by coating it with zinc. The zinc coating is preferably applied by the "vapour-galvanising" process, and a flux consisting of one part of sodium chloride, three parts of sodium fluoride, and five parts of potassium chloride is employed.—C. A. K.

Metals; Cleaning of —— *by electrolysis.* I. Jascowitz and J. Rosenbaum, London. Eng. Pat. 131,455, 22.8.18. (Appl. 13,642/18.)

In an electrolytic method of cleaning metals, the electrolyte consists of a solution of spent caustic melt which remains after the alkali fusion process in the manufacture of a variety of chemicals, *e.g.*, β naphthol, phenol, etc. A prepared solution of similar composition may be used. A typical caustic melt would have the composition, *e.g.*, caustic soda 50%, sodium sulphite 28, sodium sulphate 8, sodium carbonate 8, and phenol 1—2%.—C. A. K.

Tin; Process of roasting and refining impure ——, *and apparatus therefor.* H. Bolitho, Falmouth. Eng. Pat. 131,743, 2.9.18. (Appl. 14,233/18.)

Impure tin is melted in a slightly inclined metal tube enclosed in a furnace. Molten tin flows down the tube into a receiver at the lower end, and during the process of melting air is prevented from circulating through the tube. As soon as the flow of metal ceases, air is allowed to pass through the tube and the oxidised residue is withdrawn for further treatment for the recovery of the contained tin.—C. A. K.

Reducing ores; Means for ——. D. Dias de Barros, Sao Paulo, Brazil. U.S. Pat. 1,313,274, 19.8.19. Appl., 27.12.17.

Metal obtained from an ore is melted in two communicating furnace chambers; carbon is dissolved in the metal in one chamber and ore in that in the other, and the metal containing the dissolved carbon is conveyed to the second furnace chamber.
—C. A. K.

Metallic reductions; Process for economising ——. O. Gerlach, Danville, Ill. U.S. Pat. 1,313,287, 19.8.19. Appl., 20.9.17.

Carbonaceous refuse from metallic reducing retorts is treated so as to remove the coating of metal or oxide, and the residual carbon particles are coated with a hydrocarbon for use in the reduction of a further quantity of ore.—C. A. K.

Ores and minerals; Process for treatment of ——. G. M. Willis, Chicago, Ill. U.S. Pat. 1,313,970, 26.8.19. Appl., 21.1.15.

A process of treating ores and minerals consists in subjecting them to the action of alternating current flow and alternately passing through the ore or mineral the gases of dissociated steam and air.—J. W. D.

Electrode for electric-arc welding. E. Languepin, Paris. U.S. Pat. 1,314,273, 26.8.19. Appl., 29.6.18.

A steel rod is covered with a mixture of aluminium powder, "a powdered oxide of an auxiliary metal," and rosin varnish. The electrode is then given an outer coating of fireproof paint.—C. A. K.

Alloy. F. Milliken, Lawrence, N.Y. U.S. Pat. 1,314,117, 26.8.19. Appl., 29.8.18.

An alloy of substantially the composition: 40–48% Cu, 8–12% Ni, 38–48% Zn, 1–6% Fe, 1–3% Mn.—C. A. K.

White bearing alloys containing silicon; Process for the preparation of ——. C. Hassler, Aalen. Ger. Pat. 312,335, 29.11.17. Addition to Ger. Pat. 297,290 (this J., 1917, 889).

Type metal is used in place of lead for the preparation of alloys of the kind described in the original patent. The primary alloy, A, is prepared by fusing 50 to 98 parts of type metal (containing 55 to 90 parts of lead, 10 to 30 parts of antimony, and 0 to 20 parts of tin), with 1 to 50 parts of an alloy (containing 80 to 84 parts of tin, 11 to 12 parts of antimony, and 5 to 8 parts of copper), 1 to 4 parts of copper, and 0·2 to 20 parts of silicon-copper. An alloy, B, may also be made from 91 to 98 parts of type metal, 1 to 4 parts of copper, and 0·2 to 20 parts of silicon-copper. The final alloy is made by fusing together 20 to 55 parts of A with 20 to 80 parts of type metal, and 25 to 55 parts of lead; or 30 to 75 parts of alloy B, 30 to 40 parts of type metal, 10 to 40 parts of tin, 75 to 25 parts of lead, and 15 to 55 parts of soft lead.—C. A. M.

Electrodes for electric arc welding. E. Languepin, Paris. Eng. Pat. 131,395, 31.10.17. (Appl. 10,059/18.)

See U.S. Pat. 1,314,273 of 1919; preceding.

Concentrating ores. Eng. Pat. 119,038. *See* IIA.

XI.—ELECTRO-CHEMISTRY.

Electric furnaces; Design of ——. R. C. Gosrow. Chem. and Met. Eng., 1919, 21, 235–241.

Large electric furnaces may be made equally as efficient as smaller units if the component parts are properly proportioned in relation to the nature of the charge and the magnitude of the heating paths. The electrodes should be spaced apart only so far as to allow the effective heating areas in a horizontal plane to interpose on one another or, at least, to be tangential to one another. Also, assuming the "area of thermal influence" of a round electrode to be a circle, the side walls of the furnace should be tangential to that area in order to avoid a cold tapping hole, and to prevent the unmelted charge accumulating along the furnace walls. The depth of ore column must bear a definite relation to the material charged, deeper beds being allowed when smelting iron ores than for manganese or chrome ores. Metallurgical conditions in this respect are to some extent subservient to the strength of the electrode joints. The size of coke or other reducing material has an important influence on the furnace output, and hand manipulation of the charge is generally preferable where practicable. The furnace crucible should be so proportioned that after tapping large volumes of cold charge do not come down and cut off the power load for long periods by cooling the crucible and its contents. The greater the rate of power input to the furnace, the more easily can operations be controlled.—C. A. K.

Copper sulphate-sulphuric acid solutions. Goodwin and Horsch. *See* VII.

Cyanogen chloride. Mauguin and Simon. *See* VII.

Porosity of porcelain insulators. Farr. *See* VIII.

Carbon-free alloys. Northrup. *See* X.

Sewage. Creighton and Franklin. *See* XIX B.

Patents.

Electric furnaces. The British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 131,767, 20.9.18. (Appl. 15,320/18.)

See U.S. Pat. 1,287,236 of 1918; this J., 1919, 149 A.

Electric furnaces. T. H. Watson and Co. (of Sheffield), Ltd., H. A. Greaves and H. Etchells, Sheffield. Eng. Pat. 132,081, 25.9.18. (Appl. 15,518/18.)

See U.S. Pat. 1,301,932 of 1919; this J., 1919, 469 A.

Galvanic cells. M. L. Kaplan, Brooklyn, N.Y., U.S.A. Eng. Pats. 132,113 and 132,114, 2.11.18. (Appls. 17,962 and 17,972/18.)

See U.S. Pats. 1,293,161–3 of 1919; this J., 1919, 376 A.

Apparatus for precipitating dust etc. from gases. Ger. Pat. 312,049. *See* I.

Phosphoric acid etc. U.S. Pat. 1,314,229. *See* VII.

Cleaning metals. Eng. Pat. 131,455. *See* X.

Electric resistance furnaces. Eng. Pat. 132,080. *See* X.

Electrode for arc welding. U.S. Pat. 1,314,273. *See* X.

XII.—FATS; OILS; WAXES.

Catalytic actions at solid surfaces; Study of ——. *I. Hydrogenation of saturated fats in the liquid state in presence of nickel.* E. F. Armstrong and T. P. Hilditch. Proc. Roy. Soc., 1919, A, **96**, 137–146.

The rate of hydrogenation of olive, cotton-seed, whale, and linseed oils at about 180° C. has been studied in presence of finely divided nickel by measuring the volume of hydrogen entering and leaving the system by means of water meters. The time-absorption curves obtained do not approach the logarithmic type required for a unimolecular reaction, but consist, except in the case of olive oil, of two well-defined linear portions with a sharp point of inflection. From the position of the point of inflection it is concluded that the first linear section of each curve represents the hydrogenation of glycerides less saturated than olein and the second portion the hydrogenation of olein itself. In the case of olive oil which contains about 90%

olein, the first portion of the curve is almost entirely suppressed. The curves show a strong analogy with the curves representing the hydrolysis of glucosides by enzymes and probably the mechanisms of the two classes of reaction are similar. An unstable complex is formed between the nickel and the unsaturated compound, or between the glucoside and the enzyme. In the case of the reduction of carbon monoxide by hydrogen in presence of nickel, a small quantity of nickel carbonyl is very probably formed. (See also J. Chem. Soc., 1919, ii., 103.)

—E. H. R.

Tomato seed oil: American ——. G. S. Jamieson and H. S. Bailey. J. Ind. Eng. Chem., 1919, 11, 850—852.

AIR-DRIED American tomato seed yielded about 25% of oil when extracted with ether and about 18% when expressed. Nine samples of the oil of undoubted purity had the following characters: Sp. gr. at 25° C., 0·9181 to 0·9196; ref. index at 25° C., 1·4715 to 1·4725; iodine value (Hanus), 117·5 to 125·0; saponif. value 187·0 to 192·0; Reichert-Meissl value (5 samples), 0·1 to 0·3; Polenske value (4 samples), 0·1 to 0·6; acetyl value, 11·4 to 20·5; insoluble fatty acids, 95·0 to 96·6%; soluble fatty acids (3 samples), 0·5 to 0·7%; unsaturated acids, 76·1 to 80·6%; and saturated fatty acids, 15·0 to 18·0%. Refining the oil with sodium hydroxide or bleaching it with fuller's earth had no material effect upon the constants with the exception of the acetyl value, which was lowered from 11·4 to 10·0. Renard's test indicated that tomato seed oil contained a considerable amount of arachidic acid, but further investigation showed that only a small amount of that acid was present. The solid fatty acids separated by the lead-ether method were converted into methyl esters, which were fractionally distilled under reduced pressure. The final fractions distilling between 190° and 197° C. under 6 mm. pressure were united and repeatedly recrystallised from 95% alcohol until pure methyl arachidate (m. pt. 54° C.) was obtained. From the amount of arachidic acid separated it was calculated that the original oil contained at least 0·4% of that acid.—C. A. M.

Chaulmoogra oil: Acidity of ——. V. Cofman. Pharm J., 1919, **103**, 269.

THE acidity of chaulmoogra oil increases with time, but the change is not regular. It also varies with the method of preparation, and is therefore useless for identification purposes. The limits allowed by the present Pharmacopœia are too narrow, especially seeing that no method of preparation is specified, and the author suggests that they should be omitted altogether.—G. F. M.

Glycerin by fermentation. Eoff and others. *See* XVIII.

Hydrogenated oils as foods. Bordas. *See* XIXA.

PATENT.

Oils, fats, and the like; Process for the complete removal of acidity from ——. H. Fremerey, Heidelberg. Ger. Pat. 312,336, 12.3.14.

OIL etc. is saturated at as low a temperature as possible with dry ammonia gas, and then treated with 1 to 1½ parts of water for each part of free fatty acid, to separate the colloidal anhydrous ammonium soap, which is removed and may be subsequently decomposed *in vacuo* below 90° C. into ammonia and fatty acids. The limits given for the addition of water may be extended by introducing hygroscopic substance into the mass. The most suitable salts for the purpose are ammonium carbamate and carbonate, which may be produced within the oil by introducing carbon dioxide prior to the saturation with ammonia. The neutralisation may be carried out as a continuous process on a large scale.—C. A. M.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

White lead; Some microscopical features of ——. J. Scott. Chem. Trade J., 1919, **65**, 327—328.

VARIOUS stages in the formation of lead carbonate, by the addition of sodium carbonate to solutions of lead nitrate and lead acetate, are illustrated by micrographs, in which it is seen that the irregular networks or star like aggregations of minute crystals which first appear are gradually enlarged and consolidated by the continuous deposition of new particles until visible nodules resembling small white seeds are produced. The author is of opinion that the interstices between the granules, of which the "stars" form the nuclei, are occupied by lead hydroxide, which holds the granules together by virtue of its affinity for surrounding oxygen.—W. E. F. P.

Varnish: Action of water containing oxygen on ——. H. Wolff. Farben-Zeit., 1919, **24**, 961—962. Chem. Zentr., 1919, **90**, IV., 111.

VARNISHED tin plate was subjected to the action of water free from air, water saturated with air, water saturated with oxygen, and ordinary tap water. The water saturated with oxygen had a considerable action on the plate, especially at 55° C., whilst water saturated with air had less action. It appears, from the results of these experiments, that varnish is not gas-tight, but permits the passage of oxygen saturated with moisture; rusting then commences, the layer of varnish is raised and cracked, and the oxidation of the metal is accelerated. Experiments with varnished wood showed that any action was due solely to the water and not to the oxygen.—W. P. S.

PATENT.

Preparing cement for painting. Eng. Pat. 125,979. *See* IX.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Turgescence [of rubber]. A. Dubosc. Caoutchouc et Gutta Percha, 1919, **16**, 9961—9965. (See also this J., 1919, 516A, 618A.)

A PIECE of vulcanised rubber immersed at 10° C., in ligroin (petroleum spirit) of sp. gr. 0·7677 and initial boiling-point 188° C., finally increased to almost three times its original bulk, whereas in tetrachloroethane the final bulk was almost 400% of the original.—D. F. T.

Rubber; Effect of certain accelerators upon the properties of vulcanised ——. G. D. Kratz and A. H. Flower. Indiarubber J., 1919, **57**, 827—828, 873—877.

THE physical condition of vulcanised rubber may be, to a considerable extent, independent of the coefficient of vulcanisation, especially if an accelerator has been used, although the coefficient is important as giving an indication of the ultimate stability of the product. Lead oleate is a more effective catalyst than an equimolecular proportion of litharge. An organic accelerator, described as a condensation product of an amine and formaldehyde, was more active than heavy calcined magnesia in accelerating the combination of rubber (90) and sulphur (10) at 281° F. (138° C.), but the products obtained after 60 minutes' vulcanisation with from 0·5 to 1·25% of the organic accelerator required a smaller load to produce a

900% elongation than did the mixtures containing the corresponding proportion of magnesia; indeed, with the organic accelerator, unlike the magnesia, the percentage elongation at break increased concurrently with the tensile strength. In a comparison of the effectiveness of heavy magnesia, light magnesia, and lime, a mixing containing an excess of zinc oxide was taken as standard, and the other mixings were theoretically derived from this by substituting part of the zinc oxide by an equal volume of the accelerator; the "filling" effect of the accelerator was thus minimised; the mixing also contained only 5% of sulphur calculated on the rubber. With vulcanisation at 298° F. (148° C.), it was found that, for each accelerator, the best physical properties were obtained with approximately 10%; the effectiveness fell in the order light magnesia, heavy magnesia, lime. With both varieties of magnesia the mixings, when vulcanised to optimum physical properties, showed lower coefficients of vulcanisation than the catalyst-free optimum product; the difference with 10% of magnesia was greater than that for the 5% mixing. With 5% of lime the vulcanised product showed a lower coefficient of vulcanisation than the physically comparable control sample, but with the mixing containing 10% of lime the coefficient and that of the control sample were almost equal.

—D. F. T.

Rubber; Comparative effect of organic accelerators and magnesia in vulcanising ——. H.P. Stevens. Indiarubber J., 1919, **58**, 527–531.

THE author's results as to the relative activity of magnesium oxide and certain organic accelerators (this J., 1918, 156 T) were obtained with the use of a very light calcined magnesia, whereas Kratz and Flower in a somewhat similar investigation (see preceding abstract) used a heavy calcined magnesia. It is now shown that various grades of calcined magnesia may differ very considerably in activity, and that the feebler accelerating effect of magnesia as observed by Kratz and Flower thus receives an explanation. Lime is a weaker accelerator than magnesia. The conditions of testing affect the results very considerably; light calcined magnesia is more powerful than the organic accelerators in question only until vulcanistion has attained a certain coefficient. The stress strain curve is not entirely trustworthy as an indication of the degree of vulcanisation, and other matters should also be taken into consideration; when working with a mixture of fixed composition, however, the position of the stress strain curve, as measured by the load necessary to produce a definite elongation, bears a close relationship with the coefficient of vulcanisation.—D. F. T.

Devulcanisation of rubber with accelerators. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9923—9926. (See also J., 1919, 261 A.)

ON heating vulcanised rubber, from which the free sulphur had been previously removed by extraction with acetone, for 24 hours with a boiling alcoholic solution of hexamethylenetetramine, it was possible to remove 55% of the combined sulphur; an alcoholic aniline solution under similar conditions caused no appreciable removal of combined sulphur. On the assumption that rubber would be more easily penetrated by gases than by liquids such as alcoholic solutions, a sample of vulcanised rubber was treated alternately and repeatedly with formaldehyde and ammonia; considerable absorption and swelling occurred, and after a final heating with water in an autoclave for 6 hours at 7 atm. pressure, the combined sulphur was found to be reduced to less than 10% of its previous amount. A result almost as marked was obtained on heating vulcanised rubber crumb with a saturated solution of hexamethylenetetramine for 24 hours at the same temperature.—D. F. T.

Rubber analysis; Use of furfural in ——. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9957—9959.

A MIXTURE of furfural (100 c.c.) and tetrachloroethane (10 c.c.) is recommended in place of nitrobenzene, kerosene, etc., as a solvent for the liberation of the mineral fillers from vulcanised rubber.

—D. F. T.

Rubber; Analysis of vulcanised ——. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9901—9907.

A SCHEME of analysis is given based on the usual lines, but intended to enable the individual estimation of all the likely ingredients. The caoutchouc is estimated "by difference," but it is recommended that the result be checked by a determination of the carbon and hydrogen in the final residue after the various extraction processes; the two results should be in fairly good accordance.

—D. F. T.

Rubber and textiles in impermeable fabrics; Estimation of ——. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9907—9911.

A SCHEME of analysis is suggested covering the identification of the fibre employed, the estimation of the loading of the fabric, the estimation of each kind of fibre, and the estimation and analysis of the rubber mixing with which the fabric is spread. The procedure involves recognised methods.

—D. F. T.

XV.—LEATHER; BONE; HORN; GLUE.

Tanning materials from the French African colonies. E. Jalade. Ann. Falsif., 1919, **12**, 151—168, 204—210.

THE following quantities of tannin were found in various woods, barks, etc., obtained from trees growing in the French African colonies:—

	Tannin.	Non-tannins.
	%	%
MOROCCO—		
Rhus pentaphylla (wood)	25·9	2·2
Gonakie (*Acacia arabica*) pods (without seeds)	29·5	13·9
Taksout (*Tamarix articulata*) galls	55·8	10·9
MADAGASCAR—		
Acacia mollissima (bark)	31·3—13·5	11·8
Acacia decalbata (bark)	24·1	9·4
Various mangroves (bark)	23·5 - 12·4	7·3 - 12·2

—W. P. S.

Oil [chamois leather] tannage. W. Möller. Collegium, 1919, 61—72. Chem. Zentr., 1919, **90**, IV., 52—53.

TANNING experiments with mixtures of fish-oils or dégras and phenols indicate that in the case of oil tannage also the author's "peptisation theory" holds good, the phenols acting as peptising agents (this J., 1917, 225). The oxidised fish-oil itself has tanning properties, and therefore Fahrion's view (Neuere Gerbetheorien u. Gerbmethode, p. 48) that tannage is effected only by nascent fatty acids derived from the oxidised oil, is incorrect. In tanning with mixtures of dégras (but not fish-oil) and phenols water is liberated in proportion to the amount of these substances taken up by the skin, and the author concludes that oxidation of the fish-oil is conditioned by the water present in the skin. Oleic and stearic acids also tan in presence of phenols, but the character of

the product resembles that of ordinary leathers rather than chamois leather.—E. W. L.

Hydrocarbon tannage. W. Möller. Collegium, 1919, 72—82. Chem. Zentr., 1919, **90**, IV., 53.

MIXTURES of phenols with mineral oil or with the acid resin—consisting mainly of hydrocarbons—obtained in accordance with Ger. Pat. 262,333, have a tanning action on pelt, producing a leather similar to that obtained in the author's experiments on the chamois leather tannage (see preceding abstract). The presence of active groups (*e.g.*, OH,COOH) in the molecule of the tanning agent is therefore not essential.—E. W. L.

PATENTS.

Chrome liquors and salts [for tanning, dyeing, etc.]; Process of manufacturing ——. J. R. Blockey, and W. Walker and Sons, Ltd., Bolton, Lancs. Eng. Pat. 131,772, 28.9.18. (Appl. 15,786/18.)

SALTS containing hexavalent chromium, *e.g.*, sodium or potassium bichromate, are reduced to salts of trivalent chromium by means of waste tanning products, such as spent tanning materials, waste chrome or vegetable leather, sludge from the bottom of tan pits, and dust from tanning material extraction plants, in the presence of sulphuric or hydrochloric acid. For example: 500 lb. of sodium bichromate is stirred with 100 to 200 galls. of water and 450 lb. of 96% sulphuric acid, and 500 lb. of wet spent tan as received from leaches is gradually added to the hot solution. To lower the temperature and avoid excessive frothing during the reduction, cold water is run in slowly. When the reaction is complete, the liquor is freed from excess spent tan by filtration. (Reference is directed in pursuance of Sect. 8, Subsect. 2, of the Patents and Designs Act, 1907, to Eng. Pat. 120,049; this J., 1919, 83 A.)—L. A. C.

Glue [; Casein ——]. C. Roy and H. J. L. M. de la C. de la Grandville, Paris. Eng. Pat. 131,100, 24.6.18. (Appl. 10,396/18.) Int. Conv., 10.12.17.

A MIXTURE of non-drying (castor) oil, 300 c.c., with a solution of camphor, 15 grms., in light naphtha or petroleum spirit, 1200 c.c., is added to a mixture of commercial casein powder, 16·5 kilos., with barium sulphate, 2·5 kilos. The mass is "malaxated" both before and after the addition of finely powdered quicklime, 7 kilos., and is finally mixed with finely powdered soda ash, 1·15 kilos., to form a fine dry powder.—E. W. L.

Adhesive substances or the like; Process of converting solutions, emulsions, and suspensions of —— *into a solid condition.* O. Ruff, Munich. Ger. Pat. 312,100, 4.6.18.

SOLUTIONS, emulsions, or suspensions of adhesive substances etc. are converted by mechanical treatment, such as beating or stirring, into a finely divided homogeneous mass interspersed with small air bubbles, and then dried. The drying may be carried out in a drum heated by steam, hot air, or gas, and the resulting powder compressed in moulds; or, the aerated mass may be solidified by cooling, cut into tablets, and dried for a few hours in a current of air.—C. A. M.

XVI.—SOILS; FERTILISERS.

Nitrification of different green manures and parts of green manures; Rate of —— and the influence of crop residues on nitrification. **N. V. Joshi. Agric. J. India, 1919, 14, 395—409.**

LABORATORY experiments were made with green plants of six leguminous varieties which were cut in pieces and mixed with air-dried Indian soil, the mixture being kept at 30° C. and at a moisture content of 16%. Samples were analysed for ammonia, nitrites, and nitrates every week for 4 weeks and again after 6 or 8 weeks. In one case nitrification failed to occur at all; in the other cases it was inversely proportional to the succulence of the plant. The amount of nitrate gradually increased for about 4 weeks, after which it became constant. In all the plants used nearly 70% of the plant nitrogen was found in the leaves. On repeating the experiments with the leaves, stem, and root of the plant added separately to the soil, it was found that the leaves yielded results comparable with those of the whole plant, whereas the stem and root yielded hardly any nitrate. It is considered that the presence of the non-nitrogenous constituents of the stems and roots prevented the accumulation of nitrate.—J. H. J.

Manures; Biological determination of the relative availability of different nitrogenous organic —— *in black cotton soil.* F. J. Plymen and D. V. Bal. Agric. J. India, 1919, **14**, 414—421.

SAMPLES of organic fertiliser cakes commonly in use in India were mixed with soil from the Deccan in the proportion of 1%, the moisture brought to the optimum, and the mixtures kept at 30° C. for 8 weeks. Determinations of ammonia, nitrites, and nitrates were made fortnightly. Karanja (*Pongamia glabra*) cake, castor cake, tili (sesame) cake, and undecorticated cottonseed cake had two thirds of their total nitrogen converted into nitrites and nitrates at the end of the period, and sarson (*Brassica napus*) cake about half, whilst mahua (*Bassia latifolia*) cake underwent no nitrogenous change. Tili cake freed from oil underwent an increased decomposition, nearly 80% of the total nitrogen being nitrified.—J. H. J.

Lime; Necessity for a supply of pure agricultural ——. G. S. Robertson. Analyst, 1919, **44**, 309—314.

ANALYSES of 18 samples of ground agricultural lime, obtained directly from the manufacturers, showed that only four of the samples were of satisfactory quality—that is, contained 80% or more of calcium oxide; eight of the samples contained less than 70% of calcium oxide. One sample contained only 57·5% of calcium oxide, with 15·7% of sand and carbon dioxide equivalent to 29·2% of calcium carbonate. The quality of lump lime and of ground calcium carbonate was found to be satisfactory. The author considers that ground lime, lump lime, and chalk should be brought within the provisions of the Fertilisers and Feeding Stuffs Act.—W. P. S.

Sugar-cane. Row. *See* XVII.

Burgundy mixtures. Mond and Heberlein. *See* XIX B.

PATENTS.

Calcium cyanamide fertiliser; Preparation of a dustless germicidal ——. H. S. Gerdes, Bremen. Ger. Pat. 312,493, 12.6.17.

CRUDE calcium cyanamide is mixed with 2—6% of its weight of "carbolineum."—W. P. S.

Insecticides. Eng. Pat. 132,214. *See* XIX B.

Fungicide. Ger. Pat. 311,883. *See* XIX B.

XVII.—SUGARS; STARCHES; GUMS.

Sugar-cane; Studies in the chemistry of the ——. B. Viswanath. Agric. J. India, 1919, **14**, 440—475.

USING a hypodermic needle for the withdrawal of a few drops of juice from the internodes, and assuming the total solids indicated by the refractometer to consist entirely of sugars, it was found that the maximum content of total sugars in the young cane is in its basal joints. As growth proceeds the maximum sugar content is found at progressively higher portions of the stalk, until at maturity the highest dead leaf joint shows the maximum sugar content. After the joint has cast its leaf a large increase in the amount of total sugars in the internode occurs.—J. P. O.

Sugar-cane; Effect of salinity upon the growth and composition of the ——. K. K. Row. Agric. J. India, 1919, **14**, 476—493.

CANE that had been grown on land in India irrigated with water having a high content of sodium chloride was found to yield a juice of lower sucrose and glucose content and of lower purity than that cultivated under normal conditions. Thin and hard canes (as Cheni, Naanal, and M.1826) grew better on the saline soils than soft and thick varieties (as Karun, Chittan, and Purple Mauritius).—J. P. O.

Sugar; Factors affecting the hardness of gur or crude ——. T. S. Swadi. Agric. J., India, 1919, **14**, 431—439.

AN important condition of the safe storage of gur or native sugar during the monsoon in India is its hardness. According to the author's experiments, this quality depends upon the glucose (invert sugar) ratio of the product and also upon its content of hygroscopic salts. Samples of water used in the irrigation of cane from which soft and sticky sugars had been produced were found to be high in magnesium salts, especially chlorides.—J. P. O.

Cane sugar; Nucleus formation in supersaturated solutions of ——. P. J. H. van Ginneken. Chem. Weekblad, 1919, **16**, 1210—1229.

SUPERSATURATED solutions of cane-sugar of known composition were prepared in sealed tubes by agitation in a thermostat at 110° C., 130° C., and 135° C. The tubes were then rapidly transferred to a water-thermostat at 80° C., in which they were rotated at a constant speed. The time required for the appearance of the first crystal (primary nucleus formation) was noted; thereafter the time elapsing from the appearance of the first crystal until the solution was full of crystals (secondary nucleus formation). The former was much greater than the latter. The time required for the formation of the first crystal decreased very rapidly, with increase in sugar concentration up to about 84%, beyond which point the decrease was small. Secondary nucleus formation appears to be an autocatalytic process. The results observed in all cases were to some extent affected by the previous history of the solution, and also by that of the sugar used.—W. S. M.

Sugar; Colour of the crystals of raw —— *as affected by the system of boiling.* W. R. McAllep. Intern. Sugar J., 1919, **21**, 522—523.

CONTINUING the efforts made to improve the refining quality of the raw sugars made in Hawaii (this J., 1918, 316 A), an investigation was conducted at a factory, the product of which gave a particularly dark crystal after being washed in the centrifugal. This defect was found to be due, not to the variety of cane being crushed (which was Rose Bamboo) nor to the use of an excessive amount of lime in clarification, but rather to the system of boiling in vogue, according to which the low-grade sugars were used as "seed" and syrup and molasses added successively. On the other hand, it was shown that when syrup was grained directly in the pan and syrup alone subsequently added, the colour of the crystal of the raw sugar was very light, but less so when after the addition of syrup either molasses or liquor obtained by remelting the low-grade sugar was also drawn into the pan. It is recommended that low-grade sugar should not be used as "seed," but that syrup should be grained directly; that the quantity of molasses returned should not exceed the amount necessary to produce raw sugar of the desired test (96° polarisation); and that the heating of the molasses previous to drawing it into the pan should be done by passing it through a multiple tube apparatus using low pressure vapour, and not by the injection of live steam, as is frequently the practice.—J. P. O.

Plantation white sugar; Cost of production of —— *by the Battelle process and the cost of refining raw sugar in America.* E. E. Battelle. Facts about Sugar, 1919, **9**, 92, 132, and 152.

THE author claims that granulated white sugar suitable for direct consumption can be made on the tropical plantation by the Battelle process (this J., 1915, 916) and sold in the United States market at a profit of 71·70 cents per 100 lb. if admitted duty free, or of 38·69 cents if the full duty is paid, cost, insurance, and freight being estimated at pre-war rates. Under present-day conditions the profits would be $1.52 and $1.20 respectively. These calculations are based on the statement that a Cuban factory working under good conditions produces for every 100 lb. of 96° test raw sugar 2·75 galls. of molasses containing 14 lb. of sucrose; that on the average the American beet factory obtains 107 lb. of granulated sugar and 14 lb. of Steffen waste from a juice of the same sucrose content; and that the additional pre-war costs involved in the Battelle procedure are 23·10 cents per 100 lb. of granulated sugar produced. In considering the pre-war cost of refining raw sugar in American houses, it is stated that wages, coal, cartage, cooperage, animal charcoal, repairs, and selling expenses amount to 44·875 cents per 100 lb. melted. On the average the yields per 100 lb. of 96° test raw sugar melted are 92·5 lb. of sucrose as granulated and other sugars, and 2·5 lb. of sucrose in "barrel syrup," while 1·0 lb. is lost in the process. Taking the cost of granulated sugar as 4·683 cents, of 96° test raw sugar as 3·814 cents, and of barrel syrup as 2·0 cents, the nett refining profit is 18·78 cents per 100 lb. At the present day, however, this figure is increased to $1.00—1.20 per 100 lb. of 96° test raw sugar melted in the refinery.—J. P. O.

Polariscopes [saccharimeters]; Proposed specification for —— *made in the United States.* C. E. Coates. La. Planter, 1919, **62**, No. 4, 58—59.

IT is recommended by a committee representing American sugar chemists that saccharimeters constructed in the United States should conform to the following specification: The instrument should be mounted on a rigid trestle with the eye-piece at a height of 13¾ in. from the table; the trough should be 420 mm. long with its cover slotted to receive both side-filled and continuous observation tubes; and the field should be of the double type. The polarising system should be either the Lippich half-prism end-point device or some modification of the Jellet-Cornu prism; the latter is less fragile, and is to be preferred in the case of instruments for use in tropical countries. A light filter consisting of a cell containing bichromate solution should be permanently attached to the front of the trestle in such a way that it can be thrown into or out of the field. The compensation system should consist of a single quartz wedge having a

range from +110° to −35°, and if quartz of sufficient optical purity be not available a dextrorotatory quartz plate capable of being inserted when required for invert polarisation should be provided. The scale should be etched on ground glass, and should be capable of being easily read to 0·05°. Both scale and wedges should be enclosed in an air-tight case, which can easily be opened. The source of illumination should preferably be a nitrogen filled Mazda lamp of stereo opticon type, and means should be provided for securing that the distance of this light from the instrument, as well as the alinement between it and the optical axis of the instrument, shall be constant. The scale should be such that a reading of 100° is given by a solution containing 20 grms. of pure sucrose in 100 metric c.c. at 20° C. in a 200 mm. tube (cf. this J., 1919, 593 A).—J. P. O.

Reducing sugars; Cuprous chloride-iodine method for [determination of] . . F. M. Scales. J. Ind. Eng. Chem., 1919, 11, 747–750.

THE author proposes a modification of Clark's procedure (this J., 1919, 85 A) which reduces the danger of atmospheric oxidation of the cuprous chloride. The cooled reaction liquid is acidified with dilute acetic acid, which leaves the cuprous oxide undissolved. After addition of an excess of $N/25$ iodine solution, the liquid is shaken round whilst dilute hydrochloric acid is added in such quantity that one minute's continued shaking suffices to dissolve all the cuprous oxide. The excess of iodine is then titrated with $N/25$ thiosulphate solution. Adhering strictly to a specified procedure, and operating with quantities of pure dextrose up to 24 mgrms., the author found a constant ratio of dextrose to iodine absorbed. The method is applicable to other reducing sugars, but no data concerning them are given.—J. H. L.

Horse-chestnuts; Preparation of starch from . F. Wischo. Z. Allg. Oesterr. Apoth-Ver., 1919, 57, 49–50. Chem. Zentr., 1919, **90**, IV., 16–17.

STARCH almost completely free from saponins and fulfilling pharmaceutical requirements may be prepared from horse chestnuts as follows: The fresh chestnuts are carefully peeled, cut through the middle, freed from their embryos, and ground in a bone mill. The product is covered with water, left for twelve hours with frequent stirring, and then strained and pressed with addition of water. The liquid, left to stand for several hours, deposits starch as a white sticky mass. The supernatant liquid contains saponins and may be used for cleansing purposes. The starch deposit is washed with water in the usual manner until the supernatant liquor remains quite clear and the starch is free from bitter flavour. The yield is 6·5%. The chestnut residues can be used as fodder for cows. According to Prausnitz and Mokorcic horse-chestnut starch constitutes a suitable adjunct in bread making. (Cp. this J., Goris, 1917, 1107; Baker and Hulton, 1917, 1285.)—J. H. L.

Nitrogen content of molasses. Ellrodt. *See* XVIII.

Alcohol from cane molasses. Magne. *See* XVIII.

PATENTS.

Centrifugal machines; Apparatus for the complete separation of extracted liquor and remelted [sugar] syrup in direct remelting —. J. L. Lemoine, Paris. Eng. Pats. (A) 131,860, 15.5.19, and (B) 132,212, 16.5.19. (Appls. 12,241 and 12,344/19.) Int. Conv., 4.12.18.

(A) IN a centrifuge used for the separation of molasses from massecuites and the immediate redissolving of the resultant sugar by introduction of water or syrup into the basket, the molasses separated during the first operation is thrown against the casing of the centrifuge and received in a circular channel at the base of the casing, and the syrup produced in the second operation is caught by a non-perforated cylinder which is interposed between the basket and the casing after the first operation, and which discharges the syrup thrown against it into a syrup channel distinct from but concentric with the molasses channel. The non-perforated cylinder is of the same depth as the basket and is movable vertically on guide rods; it is raised above the level of the basket during the first operation. (B) The movable cylinder may be lowered into the syrup channel during the first operation instead of being raised above the level of the basket, and, if necessary, it may be constructed telescopically, so as to occupy a small vertical space when not in action.—J. H. L.

Sugar; Process of making — . R. W. Mumford, New York, Assignor to Refining Products Corp., Wilmington, Del. U.S. Pat. 1,314,203, 26.8.19. Appl., 29.6.17.

SUGAR solutions are purified by vigorous agitation with a relatively coarse-grained vegetable carbon having open pores corresponding with the original texture of the material from which the charcoal was made, the pores being unobstructed by "secondary carbon" and capable of taking up and retaining fine insoluble suspended matter. (See following abstract.)—J. H. L.

[*Decolorising carbon.*] *Process of making purifying preparations.* R. W. Mumford, New York, Assignor to Refining Products Corp., Wilmington, Del. U.S. Pat. 1,314,204, 26.8.19. Appl., 27.3.18.

KIESELGUHR and powdered carbonaceous material are worked into a dough with a tarry matter, and slowly carbonised through a range of temperature ending above 600° C., the conditions during charring being such as to facilitate the escape of volatile products.—J. H. L.

Carbonaceous materials suitable for use as filtering media or for the preparation of filtering media; Method of manufacturing — [*from molasses*]. J. Wetter, London. From M. Weinrich, New York. Eng. Pat. 132,164, 31.1.19. (Appl. 2137/19.)

SEE U.S. Pat. 1,308,826 of 1919; this J., 1919, 651 A.

Adhesive substances. Ger. Pat. 312,100. *See* XV.

Sugar for chocolate manufacture. Eng. Pat. 132,200. *See* XIX A.

XVIII.—FERMENTATION INDUSTRIES.

Yeast nutriment; Superphosphate as — . G. Ellrodt. Brennereiztg., 1919, 36, 8239. Chem. Zentr., 1919, **90**, IV., 48.

IN using (beet) molasses and sugar for yeast manufacture it is necessary to supplement the phosphoric acid present, which amounts only to about 0·06% in molasses. Superphosphate has been used for this purpose. It is added to the boiling acidified molasses before clarification of the latter, or a filtered extract of the superphosphate is added to the molasses or to the actual wort. Whilst as much soluble phosphate as possible should be extracted from the superphosphate, no insoluble matter from the latter should be introduced into the wort. The author has compiled a table showing the amounts of superphosphate required per 100 kilos. of molasses, to obtain given yields of yeast, assuming

that no other important sources of phosphoric acid are employed.—J. H. L.

Molasses; Nitrogen-content of [beet] — — and yield of yeast. G. Ellrodt. Brennereizeit., 1918, **35**, 8183. Chem. Zentr., 1919, **90**, IV., 46.

ABOUT 40—50% of the nitrogen present in (beet) molasses is assimilable by yeast, as compared with 25% in the case of grain or malt-combs. Assuming that 40% of the molasses nitrogen is assimilable and that 45% of the dry substance of pressed yeast consists of protein, it is easy to calculate how much extra nitrogenous matter (*e.g.* ammonium salts, which are entirely assimilable) must be added to molasses worts to produce a given yeast crop.

—J. H. L.

Alcohol; Yield of — — obtainable in the fermentation of cane molasses under different conditions of working. J. Magne. Louisiana Planter, 1917, **59**, 13—14. Intern. Sugar J., 1919, **21**, 466—467.

ASSUMING that the maximum yield of absolute alcohol under laboratory conditions is 7·31 galls. per 100 lb. of sugar (as dextrose), the amounts that may be expected in the fermentation of cane molasses under the different conditions practised in tropical distilleries are: (1) when fermentation is effected by the yeasts occurring naturally in the product, 2·9—4·0 galls. (or about 40—55% of the maximum); (2) when compressed yeast is used, 3·6—5·5 galls. (50—75%); (3) when antiseptics are added, 5·4—6·2 galls. (75—85%); and (4) when a system of fermentation employing a pure culture of yeast is followed, 6·2—6·9 galls. (85—95%).

J. P. O.

Wines; Quantity of higher alcohols in — —. J. Trambics. Z. Unters. Nahr. Genussm., 1917, **34**, 467—468.

SIXTEEN samples of Hungarian red and white wines contained from 21 to 38 mgrms. of higher alcohols per 100 c.c. of wine, or from 302 to 456 mgrms. of the alcohols per 100 grms. of absolute alcohol. The method used was a modification of the Allen-Marquardt process, 400 c.c. of the sample being taken. Six extractions, each with 20 c.c. of carbon tetrachloride, are made, and for the final titration *N*/10 sodium hydroxide solution free from carbonate is used. Other details of the process are also slightly modified. When this method was applied to pure ethyl alcohol only 0·01% of amyl alcohol was indicated, as against 0·12% by the original Allen-Marquardt method. W. P. S.

Glycerin; Production of — — from sugar by fermentation. J. R. Eoff, W. V. Linder, and G. F. Boyer. J. Ind. Eng. Chem., 1919, **11**, 842—845.

THE yeast which gave the best yield of glycerol in the fermentation of sugar was *S. ellipsoideus* (var. Steinberg). It was found that the production of glycerin was increased by adding alkali, preferably sodium or potassium carbonate, to the fermenting solution. The best results were obtained by adding about 5% of sodium carbonate, a larger amount stopping the fermentation permanently, whilst with a smaller amount the alkalinity was insufficient for the maximum production of glycerol. After the addition of a sufficient quantity to the fermenting solution, a large precipitate is formed, the evolution of gas stops, and the yeast apparently becomes dormant. After a time the precipitate disappears and fermentation starts again. Better results are obtained by adding the sodium carbonate in solid form. The best method of preparing the yeast is to make successive cultivations, starting each stage when the yeast is most active, until a yeast mash representing about 10% of the volume of the final mash is obtained. At each stage the yeast should be acclimatised by the addition of 0·5—1% of sodium carbonate to the solution. Vigorous fermentation is essential, and the addition of a small amount of ammonium chloride to the fermenting solution promotes the production of glycerol. The optimum temperature is between 30° and 32° C., lower temperatures causing less vigorous fermentation, whilst higher temperatures lead to a loss of alcohol and glycerol. The most favourable concentrations of the sugar solution are between 1·75 and 2·0 grms. per 100 c.c. When fermented under these conditions from 20—25% of the sugar present is converted into glycerol, whilst the bulk of the remainder is fermented into alcohol and carbon dioxide. Fermentation of Porto Rican "black strap" molasses by this method was completed in about five days. Solutions of 21·2° Balling at 25° C. (containing 16·85% of sugar) were prepared, and pitched with a yeast mash prepared as described above. In one typical fermentation the fermented liquid contained: Glycerol, 3·1; alcohol, 6·75% (by vol.); sugar (apparent), 0·86%, after inversion; and alkalinity, 3·6 grm. Na_2CO_3 per 100 c.c. This molasses mash (3200 lb.) was purified prior to distillation by neutralising it with sulphuric acid, adding 12 galls. of a saturated solution of copperas, heating the liquid nearly to boiling, and adding milk of lime until after boiling for thirty minutes the solution showed an excess of lime. It was then passed through a filter press, the filter cake steamed, and the wash treated with soda ash until it showed an alkalinity of 0·2% after boiling, when it was again filtered, and the filtrate concentrated to a thick syrup in an evaporating pan. The crude glycerin, which contained from 30 to 35% of glycerol, was distilled in a still on the principle of the Jobbins still, and about 50% of the glycerol originally present was recovered. The distilled dynamite glycerin had sp. gr. at 15·6° C., 1·2616; carbonaceous residue, 0·058%; and ash, 0·009%. It was of good colour and showed normal nitration. It is pointed out that the value of the alcohol produced in the fermentation balances the cost of all material and expenses in the production of glycerin from molasses. There is no advantage in using cane sugar or maize glucose solutions since these require the addition of various yeast nutrients, which interfere with the subsequent purification of the glycerin. (See also this J., 1919, 175 R.) C. A. M.

Acetone and ethyl alcohol; Fermentation process for the production of — —. J. H. Northrop, L. H. Ashe, and R. R. Morgan. J. Ind. Eng. Chem., 1919, **11**, 723—727. (Cp. this J., 1919, 271 R *et seq.*, 731 A.)

AN account is given of experimental work carried out in the United States during the war on the production of acetone by a new organism, *Bacillus acetoethylicus*, isolated from old potatoes. The organism forms motile rods, with rounded ends, 4—6$\mu\mu$ by 0·2—0·3$\mu\mu$, which occasionally appear in short chains. The spores, which are elliptical and measure 0·5—1$\mu\mu$, are produced at the ends of the cells and are capable of withstanding boiling water for twenty minutes. The organism is a facultative anaërobe. The optimal reaction for growth is p_H = 8—9, and that for fermentation p_H = 6·8. Under suitable conditions the organism produces up to 10% of acetone and 25% of ethyl alcohol, with small quantities of propyl and butyl alcohols, from sugar and starch. In 10% sucrose solutions much slimy matter is produced. The mash employed in the experiments described was beet or cane molasses diluted to a sugar-content of 7% or less, and brought to a hydrion concentration of p_H = 8—9 by addition of lime. In the final large-scale experiments the mash was steri-

lised and limed in a 600 gall. cooker, whence it passed through cooling coils into a closed fermenting vessel, 42 in. in diam. and 12 feet high, packed with inert solid material, such as brush or maize cobs to prevent the deposition of the ferment as a slimy mass on the bottom of the vessel. Before use the fermenting vessel, packed as described, was sterilised 10 hours a day for 8 days, under 20 lb. steam pressure. Owing to lack of apparatus for preparing enough pure inoculating culture for a full charge, about 40—50 galls. of sterile mash was introduced with 2 galls. of pure culture, into the fermenting vessel, and as the culture grew further quantities of mash were introduced until the vessel was full. Whilst the culture was thus growing in the lower part of the vessel, it was found possible to maintain a low pressure of steam in the upper part to guard against infection. Fermentation occupied 50—60 hours at 40° C. The fermented mash was drawn off near the top of the vessel, being displaced by introduction of fresh sterile mash at the bottom. The process could thus be worked continuously, the rising column of mash being acted upon by the ferment adhering to the material with which the vessel was packed. The mash entering the fermenting vessel consisted of diluted "black strap" molasses, and contained only about 1% of sugar, but if the plant available had enabled the liming of the mash to be effected after cooling, instead of in the cooker, a much more concentrated mash could have been used. The acetone and alcohol formed amounted respectively to 9% and 22% of the sugar. The process described is protected by U.S. Pat. 1,203,172 (this J., 1919, 33A) which is dedicated to public use.—J. H. L.

PATENTS.

Fermenting wort or wash; Treatment of —— [with air] and apparatus used therein. A. T. Henley, Cork. Eng. Pat. 131,021, 23.3.18. (Appl. 5160/18.)

IN aerating fermenting liquids, entrainment of alcohol vapour is minimised by using air previously supersaturated with water vapour, the fermenting vat being fitted with a vessel containing water at a suitable temperature through which the air is passed before entering the wort; or if dry or partially saturated air is used the air outlet from the fermenting vessel is fitted with a cooling device to condense alcohol vapour.—J. H. L.

Acetone and butyl alcohol; Manufacture of —— by fermentation, and apparatus therefor. E. Ricard, Melle, France. Eng. Pat. 130,666, 7.3.18. (Appl. 4047/18.) Int. Conv., 8.8.17.

AN organism isolated from slaughterhouse runnings is used, designated *Bacillus butylicus* B.F. (*Boinot Firmin*). In very young cultures grown from spores it forms long filaments, which break up into cylindrical rods, 3—5μ by 0·4μ. At a later stage the rods swell in the middle and become fusiform owing to the formation of one or two spores which are ultimately evacuated at the ends. The spores are cylindrical 0·5μ in diameter, and withstand heating at 95° C. for 5 mins. The bacillus is a facultative anaërobe, and in mashes from amylaceous materials it produces acetone, butyl alcohol, carbon dioxide, and hydrogen. In the process claimed ground amylaceous material, *e.g.*, maize, is steeped in hot water and cooked under pressure for a short time, with or without acid. The cooked mash is diluted to 8—9% concentration with hot water in a closed vessel, and raised by steam pressure to a closed reservoir in which it is maintained at 100° C. until it is passed, through cooling coils, into a closed fermenting vat. The mash pipes and vats are first sterilised by steam, which is displaced by sterile air before the mash enters. Inoculation of the charge is effected with mash from a charge already in full fermentation. Fermentation is complete in 24—26 hours at 37° C., and the combined yield of acetone and butyl alcohol is 38—40% of the starch or sugars originally present. The proportion of acetone to butyl alcohol is 1 : 2. The disposition of the plant, including a distillation column etc., is described.—J. H. L.

Alcohol from baking bread. U.S. Pat. 1,314,082. *See* XIXA.

XIXA. FOODS.

Milk serum; Specific gravity of ——. R. Leclerc. Ann. Falsif., 1919, 12, 197—201.

DETERMINATION of the specific gravity of milk serum affords a means of detecting the presence or absence of added water in the milk. The serum is obtained by adding 1·5 c.c. of 20% acetic acid to 75 c.c. of the milk, heating the mixture at 70° C. for 5 mins., and filtering it, the first portion of the filtrate being returned to the filter. The specific gravity at 15° C. of serum from genuine milk varies from 1·027 to 1·029; if the specific gravity is lower than 1·025 added water is present.—W. P. S.

Milk; New constant for detecting the removal of fat from ——. R. Leclerc. Ann. Falsif., 1919, 12, 219—225.

IF the Cornalba value of a sample of milk (this J., 1909, 738) is divided by the Vandam value (ratio of casein to fat) the resulting figure is always more than 6 in the case of genuine milks even though the milk may be naturally poor in fat. A figure below 6 indicates that fat has been abstracted from the sample.—W. P. S.

Milk; Simplified molecular constant in the analysis of curdled ——. Fonzes-Diacon. Ann. Falsif., 1919, 12, 202—203.

COAGULATION and decomposition of a sample of milk does not interfere with the use of the simplified molecular constant for detecting the presence of added water (see this J., 1919, 475A); the acidity of the milk gives a measure of the quantity of lactose which has been decomposed, and this quantity added to the amount of lactose still present gives the total lactose. The chlorine is determined in the serum, and the data thus obtained are sufficient for calculating the value of the simplified molecular constant of the milk in question.—W. P. S.

Milk calculations. Formula for calculation of added water in milk. L. J. Harris. Analyst, 1919, 44, 314—318.

A REPLY to criticisms by Richmond (this J., 1919, 510A). The author also gives formulæ for calculating the quantity of added water when fat and solids-not-fat are present in normal ratio, when the rising of cream has caused a depression of the solids-not-fat, and when the sample prior to "watering" contained an excess or deficiency of fat caused by the separation of cream, and the change in composition is not known.—W. P. S.

Oils; Use of hydrogenated —— as foods. Bordas. Ann. Falsif., 1919, 12, 225—235.

AT the request of the French Minister of the Interior, the author has investigated the question of the suitability of hydrogenated oils for edible purposes, and reports that there is no reason why fats produced by hydrogenating oils should not be used as foods. As regards the presence of nickel in such fats, it is shown that the quantity of nickel present is extremely small, much less than is found in foods

cooked in nickel vessels, and that even relatively large doses of nickel salts (up to 0·5 grm. of nickel during 52 days) are without injurious effect. (See also Fahrion, this J., 1919, 510 A.)—W. P. S.

Amino-acid nitrogen; Determination of —— in soup tablets etc. L. Grünhut. Z. Unters. Nahr. Genussm., 1919, 37, 301–323.

From 2·5 to 5 grms. of the sample is dissolved in 10 c.c. of hot water, the solution filtered, the filtrate treated with 1 grm. of solid barium chloride, and then made neutral to litmus paper by addition of saturated barium hydroxide solution; 10 c.c. of the latter solution is then added, the whole diluted to 60 c.c., 15 c.c. of methyl alcohol added, and the ammonia removed by aspirating a current of air through the solution at 25° C. and absorbed in standard acid. After removal of the ammonia the soution is diluted to 100 c.c., filtered, and 20 c.c. of the filtrate is neutralised with $N/10$ hydrochloric acid, using "neutral-red" as indicator. The neutralisation is made in a special colorimeter, in which the vessels containing the test solution, the comparison solution, etc., are placed. In the case of coloured solutions, a portion of the solution is used in one of the vessels to compensate for the colour. The neutralised solution is then treated with 10 c.c. of formaldehyde solution containing phenolphthalein, and the mixture is titrated with $N/10$ sodium hydroxide solution. A mixture of 10 c.c. of the formaldehyde solution, 10 c.c. of water, and 2 c.c. of phenolphthalein solution is titrated similarly, and the small quantity of alkali used is deducted from the amount used for the main titration; the difference is equivalent to the amino-acid nitrogen present.—W. P. S.

Soft corn [maize], its chemical composition and nitrogen distribution. G. Spitzer, R. H. Carr, and W. F. Epple. J. Amer. Chem. Soc., 1919, 41, 1212–1221.

Mature and immature maize when dried have practically the same calorific value, which is therefore of little use in determining their relative food values. On analysis it appears that the solid material of soft maize is poorer in fat, much richer in amidic nitrogen, and poorer in zein, although the total nitrogen and proportion of glutelin (the chief protein of maize) are about the same. Maize could be graded according to its maturity on the determination of its amidic nitrogen and acidity. (See also J. Chem. Soc., Nov., 1919.)—J. C. W.

Nutritive factors in plant tissues. VI. The distribution of the water-soluble vitamine. T. B. Osborne and L. B. Mendel. J. Biol. Chem., 1919, 39, 29–34.

Experiments on rats have indicated that the vitamine is present in onions, turnips, tomatoes, and in the leaves, stem, and roots of beets. Clover, alfalfa (lucerne), and timothy plants contain more of the vitamine when the plants are immature. —J. C. D.

Starch from horse-chestnuts. Wischo. *See* XVII.

Determination of chlorine. Yoder. *See* XXIII.

Patents.

Apple jam; Manufacture of ——. C. H. Simpson, Front Royal, Va., U.S.A. Eng. Pat. 123,536, 17.2.18. (Appl. 3940/19.) Int. Conv., 15.2.18.

Apples are freed from the cores and cut into pieces, about $\frac{1}{8}$ in. in size, with the peel adhering thereto. After addition of water they are half cooked; then sugar is added, and cooking is completed but not carried so far that the cells of the apple tissue are broken down. The presence of the peel helps to hold the particles together and prevents the material forming a pulp.—J. H. L.

Refrigeration of fish and other foods. N. Dahl, Trondhjem, Norway. Eng. Pat. 125,076, 2.4.19. (Appl. 8281/19.) Int. Conv., 3.4.18. (Cp. this J., 1917, 1145.)

In the freezing of fish in barrels, cases, or bags, the refrigerating liquid, *e.g.*, at about −11° C., is introduced into the interior of the mass of goods in the package through a pipe having perforations at the end, so that the liquid flows in different directions through the goods towards suitably disposed outlets. The arrangement and size of the outlets may vary according to circumstances. Bags may be encased in frames or moulds during the process, and thus frozen into a form convenient for packing.—J. H. L.

Drying vegetables and other substances and materials; Apparatus for ——. J. H. Morton, London. Eng. Pat. 130,714, 7.6.18. (Appl. 9429/18.)

The apparatus consists of a drying chamber arranged between a heating chamber and a suction chamber. By the operation of a fan air is drawn into the heating chamber, across the drying trays, through the suction chamber, and into exit ducts. Any desired proportion of the air can be used over again by opening a flap valve in the passage leading from the fan to the heating chamber. A uniform vertical distribution of the air current across the drying chamber is secured by means of adjustable slats in the wall of the heating chamber, which are accessible through a corridor. The heating coils are mounted on carriages for removal in case of repair or inspection. The carriages bearing the drying trays enter and leave the drying chamber at the ends through air-locks. The apparatus may be divided transversely into a number of sections, in each of which the conditions may be controlled independently.—J. H. L.

Chocolate and other plastic materials; Apparatus for heating or cooling ——. J. Baker and Sons, Ltd., and W. E. Prescott, London. Eng. Pat. 131,495, 27.9.18. (Appl. 15,766/18.)

A rotating horizontal drum, through which a heating or cooling medium may be circulated, has its outer surface composed of deep parallel, wavy or zig-zag grooves. The chocolate paste is delivered on to the drum and fills these grooves, but does not form a layer or film across the surface of the drum. The upper part of the drum is provided with an external heating or cooling jacket having its inner surface in contact with the outer surface of the drum. The material is removed from the grooves by means of a series of scrapers which enter the grooves; these scrapers have a lateral movement corresponding with the contour of the grooves. —W. P. S.

Sugar for use in the manufacture of chocolate; Treatment or preparation of ——. Peek, Frean, and Co., Ltd., London, J. Carr, Esher, Surrey, A. B. Bradley, London, J. Baker and Sons, Ltd., London, and Rowntree and Co., Ltd., York. Eng. Pat. 132,200, 17.4.19. (Appl. 9826/19.)

Clarified syrup of refined or raw sugar, of 55°—65° Brix, is passed through a steam-heated coil or equivalent form of cooker at 254°—262° F. (123°—128° C.). The hot concentrated syrup is then passed through a transformer (compare Shaw, this Journal, 1905, 144, 245) in which it is subjected

to continuous stirring and beating, and thus converted into a product consisting of rounded, soft, and easily crushed grains, 0·05–0·1 mm. in size, containing 1—3% of moisture and sometimes as much as 5—6% of invert sugar. The product gives a better quality of chocolate than other prepared sugars, with a smaller consumption of cacao butter and less refining.—J. H. L.

Vegetable food products and process of manufacture thereof. J. Campbell and E. Glover, London. Eng. Pat. 132,024, 2.9.18. (Appl. 14,260/18.)

VEGETABLE materials are finely pulped, mixed with water, treated with sodium hydroxide (usually with sufficient to produce a 0·1% solution), digested for 12—24 hours at temperatures up to 150° F. (66° C.), and stirred gently meanwhile. The mixture is then slightly acidified with lactic, citric, or hydrochloric acid and filtered, and the filtrate is evaporated *in vacuo* to a suitable consistency or to complete dryness. The process is applicable to any vegetable material, whether edible in the solid state or not, which contains no injurious substances soluble in water.—J. H. L.

Milk powder; Manufacture of ——. L. G. Surie, and Nieuwhof, Surie and Co., Ltd., London. Eng. Pat. 132,096, 12.10.18. (Appl. 16,658/18.)

A CHAMBER containing a heat radiator, for heating air or other drying agent, communicates with an adjacent drying chamber by a neck or passage having about equal length and width. A milk supply pipe passes axially through the neck and terminates, just within the drying chamber, in a nozzle which projects a spray towards the centre of the drying chamber. The hot air passes from the heating to the drying chamber through the annular space between the milk supply pipe and the walls of the neck, and thus surrounds the milk spray, preventing any particles being carried back into the heating chamber or against the hot walls by back currents. The milk, without previous concentration, is supplied under a pressure of 750—1500 lb. per sq. in., whereby it is possible to obtain a very fine spray.—J. H. L.

Bananas; Method of drying ——. B. Pilorz and R. O. F. Stange, Honolulu. U.S. Pat. 1,313,557, 19.8.19. Appl., 28.3.18.

THE peeled fruit is steamed under pressure, dried in a current of warm, filtered air until the moisture content is reduced to 25%, then cooled, pressed, and packed in air-tight receptacles.—W. P. S.

Casein-drying apparatus. J. F. Dietrich, Kennewick, Wash. U.S. Pat. 1,313,939, 26.8.19. Appl., 6.8.18.

THE apparatus comprises a rotating horizontal drum having a stationary pipe passing through its axis; sterilised air is blown through a coil in a hot-water tank situated below the drum, and is led into the central pipe, whence it escapes into the drum through suitable openings. A scraper is fitted to the central pipe, so that its edge is in close proximity to the inner surface of the drum; the central pipe also carries a roller arranged to engage the inner surface of the drum.—W. P. S.

Alcohol; Apparatus for securing —— from baking bread. J. Krizek, Gallup, Assignor to P. Kitchen and J. I. Piscek, McKinley County, N. Mex. U.S. Pat. 1,314,082, 26.8.19. Appl., 6.4.18.

THE vapours from the baking oven are led into a vertical drum, the upper part of which is provided with a water-jacket; a vertical cylinder, open at the top, is fitted in the drum and extends through the bottom of the latter. The lower end of the cylinder is connected with a condensing coil, which discharges into a container fitted with a tap and a vent pipe. Liquid condensing in the drum is drawn off through a tap at the bottom.—W. P. S.

Fodder from straw; Preparation of a —— by digestion with alkali solution. E. Beckmann, Berlin-Dahlem. Ger. Pat. 305,641, 26.4.17.

CHOPPED straw is treated at the ordinary temperature with 8 to 9 times its weight of 1 to 2% alkali solution for 24 hours, or more, and is then washed; if desired, the alkali solution may be displaced, after a time, by a similar solution which has been used previously. The lignin is first of all dissolved, whilst the xylan remains in the fodder, only a small part passing into solution. The fodder soon becomes mouldy, but may be stored if it is dried or pressed to form ensilage.—W. P. S.

Mixing apparatus. Eng. Pat. 127,833. *See* I.

Paper etc., developing formic acid. Ger. Pat. 312,063. *See* V.

Colouring product. Eng. Pat. 129,761. *See* VI.

XIXB.—WATER PURIFICATION; SANITATION.

Sewage; Electrical treatment of ——. *The Landreth direct oxidation process.* H. J. M. Creighton and B. Franklin. J. Franklin Inst., 1919, 188, 157—187.

ELECTRICAL precipitation of sewage has previously been tried on an experimental scale, but it has been shown that precipitants and disinfectants produced electrolytically have no greater efficiency than when manufactured outside the plant. In the Landreth process both electricity and lime are used, and the efficacy of the process depends on the combination of the destruction of pathogenic bacteria by nascent oxygen and hydrogen produced by electrolysis and the sedimentation and alkalinity induced by the addition of lime. The electrolytic tank consists of a horizontal cypress wood tank 27¼ ft. long, 3 ft. wide, and 2⅝ ft. deep, provided with a tightly fitting removable top, and openings in the bottom for the removal of sediment. Internally the tank is divided into 11 spaces, each of which contains two sets of electrodes, mounted one above the other. The electrode plates are of mild steel set vertically ¾ in. apart, and parallel to the sides of the tank, alternate plates having the same polarity. Agitators are fitted in the spaces between the plates. Sewage, previously passed through suitable screens to remove extraneous matter, is caused to flow along the tank and between the plates, and close contact with the nascent gases is secured. The addition of milk of lime to the sewage lowers the electrical resistance in the tank and retards the solution of the electrodes by rendering them passive. As crystals of calcium carbonate gradually build up on the plates and interfere with the rotating paddles, the lime supply is checked until resolution is effected by the acid condition of the sewage. The normal operation of the process requires that the effluent from the electrolytic tank shall contain 30 parts per million excess of lime to ensure satisfactory sedimentation. The occlusion of hydrogen and oxygen by the electrodes causes considerable increase in resistance, and it is necessary to reverse the polarity of the electrodes at four-hourly intervals. Collected in tabu-

lar form, the results of the working of a Landreth apparatus with (1) electrolytic-lime treatment, (2) lime alone, and (3) electricity alone are:—

	Electrolytic-lime.	Lime alone.	Electricity alone.
Nitrites and nitrates.	Increased.	Not increased.	Not increased.
Free ammonia.	Decreased.	Increased. Slightly	Increased. Slightly
Albuminoid ammonia.	Decreased.	decreased.	decreased.
Reduction in total bacteria.	92%	82% (37° C.) 90% (20° C.)	38% (37° C.) 70% (20° C.)
Reduction in *B. coli*.	99·85%	92·3%	84·8%

The electrolytic-lime treatment is more effective than either lime or electricity alone and a satisfactory effluent is produced. The economy resulting from the use of the Landreth process is effected largely through a saving in the cost of construction.—C. A. K.

Ammonia recovery from coke-oven gas; Waste liquor from ——. M. Marsson and R. Weldert. Mitt. Landesanst. Wasserhyg., 1919, 237—281. Chem.-Zeit., 1919, 43, Rep., 187.

THE volume of liquor from the stills in the recovery of ammonia resulting from the coking of coal amounts to about 40—60 litres with the direct process, and 200—150 litres with the indirect process, per ton of coal coked. It is discharged at a temperature of about 100° C., and contains lime and other calcium compounds, sodium compounds, and tar. Even after removal of the suspended matter the water is poisonous to organic life in the water into which it is discharged. The liquor may be treated for the recovery of tar products, cyanogen and sulphur compounds etc., or it may be purified by cooling, separating undissolved lime, and precipitating the dissolved and colloidal constituents. For the last-named purpose Radcliffe's process involves passing air containing carbon dioxide into the liquor, which is then allowed to settle in vats and subsequently filtered. A biological process has also been applied, *e.g.*, in Manchester. A process has been developed recently by the Imperial-Continental Gas Ges. whereby by purely mechanical treatment in settling vats, 97—99% of the undissolved matter settles out in 24 hours, the greater part separating in 1 hour. About 50—60 litres of sludge results from 1 cub. m. of waste liquor. Subsequently flue gas is passed through the liquor, followed by air. The liquor is made innocuous to organic life by filtration through a filter bed composed of brown coal in pieces of dimensions less than 1 cm. The usual precipitants, as well as most filtering media, appear to be impracticable for removing the phenols and cyanogen compounds.—J. S. G. T.

Metals; Effect of different disinfecting agents on ——. H. Will and F. O. Landtblom. Z. ges. Brauw., 1919, 42, 81—82. Chem. Zentr., 1919, 90, IV., 203.

THE action of 1, 2, and 5% solutions of hydrofluoric acid, "flammon," "montanin," and formalin on copper, tin, zinc, aluminium, and brass has been studies, the time of exposure being 2—3 days, except for formalin when it amounted to 10 days. A 1% "flammon" solution had no effect on aluminium. Tin and brass were not attacked by any of the solutions, and copper only by the 5% "flammon" solution. Iron, steel, zinc, and aluminium were attacked by all the solutions except formalin. Formic acid formed as a decomposition product of formalin attacks metals and promotes rust formation on iron and steel.
—T. H. Bu.

Burgundy mixtures [fungicides]; Chemistry of ——. R. L. Mond and C. Heberlein. Chem. Soc. Trans., 1919, 115, 908—922.

ON mixing solutions of copper sulphate and sodium carbonate, insoluble hydrated basic copper carbonate forms the bulk of the precipitate which contains also hydrated basic copper sulphate, and a proportion of basic copper sulphate remains in solution. Complete conversion into these salts is obtained when for 1 mol. of copper sulphate 0·93 mol. of sodium carbonate is added. The composition of the copper salts is ill-defined, and alters according to the conditions of precipitation. A 1% mixture in the above proportions at 15° C. gives a basic carbonate having $CuO:CO_2$ in the ratio 2·2:1, an insoluble basic sulphate having $CuO:SO_3$ in the ratio 15:1, soluble basic sulphate equal to 3·6% of the total Cu present, and 52·4% of the total CO_2 present is evolved. This free carbon dioxide acts as a solvent on the basic sulphate only, and with larger amounts of sodium carbonate it is neutralised, and the soluble basic sulphate is accordingly reduced in amount. At 15° C. the copper precipitate contains absorbed sodium carbonate in the ratio $CuO:Na_2CO_3$ 7·1:1, and its colloidal state is apparently conditional on this. Free copper sulphate, sodium bicarbonate, and carbonic acid in the mixture accelerate the change to the crystalline state. Addition of 0·02% of glue prolongs the life of the gel. The dissolved basic copper sulphate is in the form of hydrosol. The crystalline precipitate contains a lesser proportion of carbon dioxide than the colloid. In an old precipitate the ratio $CuO:CO_2$ was found to be 2·94:1.
—G. F. M.

Chrysanthemum cinerariifolium (insect powder); Insecticidal principle of ——. R. Yamamoto. Ber. Ohara Inst. Landw. Forsch., 1918, 1, 389—398.

THE powdered flowers of *Chrysanthemum cinerariifolium* yielded 0·8% of a yellow syrup which had saponif. value 216 and iodine value 116; two alcohols, $C_{31}H_{51}O$, m. pt. 199° C., and $C_{32}H_{46}O$, m. pt. 175°—179° C., and two fatty acids, $C_{16}H_{16}O_2$ and $C_{16}H_{32}O_2$ (palmitic), were isolated from the syrup after saponification. The syrup possesses strong insecticidal and bactericidal properties, but these diminish when it is heated at 100° C. or exposed to air for a long time.—W. P. S.

Insecticide; Derris as an ——. N. E. McIndoo, A. F. Sievers, and W. S. Abbott. J. Agric. Res., 1919, 17, 177—200.

DERRIS or Deguelia is a genus of plants poisonous to fish, and two species, *D. elliptica* and *D. uliginosa*, were found to be contact insecticides as well as stomach poisons. Experiments on the extraction of the toxic principle with various solvents showed that alcohol was the best solvent. The alcoholic solution used as a spray proved to be toxic to certain aphides, larvæ, and small worms. The dried plant used in powdered form was found to be efficient in killing fleas, lice, flies, aphides, etc. The powder mixed with a large volume of water proved to be toxic to aphides, worms, caterpillars, and larvæ when ingested.—J. H. J.

PATENTS.

***Air or gas in a more or less finely divided state; Means for supplying* —— [*to sewage etc.*].** W. Jones, Stourbridge, and Jones and Attwood, Ltd., Amblecote. Eng. Pat. 131,158, 17.8.18. (Appl. 13,391/18.)

A LAYER of cement, concrete, or the like is sup-

ported on a perforated metal or other plate extending along the upper part of a trough, channel, or box. The top of the channel is narrower than the lower part so as to retain the porous layer. Air under pressure admitted to the channel, passes through the porous cement, and escapes from the surface of the latter in a finely divided state. The apparatus is suitable for the aeration of sewage etc.—W. P. S.

Filters for the purification of liquids [; Method of cleansing ——]. F. P. Candy, Cheam, Surrey. Eng. Pat. 131,198, 2.10.18. (Appl. 16,023/18.)

Air, expelled from an elevated receptacle by admitting water to the latter, is forced upwards through the filter bed; the water is then allowed to flow by gravity from the receptacle and upwards through the filter bed in order to wash away the particles of dirt loosened by the air. In the case of two or more closed filters, compressed air from one may be forced through the filter bed contained in another filter. W. P. S.

Insecticides for tea-plants. E. R. Speyer, Sheale, Herts. Eng. Pat. 132,214. 19.5.19. (Appl. 12,556/19.)

Yellow soap (*e.g.*, 10 lb.) is heated to expel water, resin (*e.g.*, 5 lb. of ordinary fir resin) is added, and the heating is continued with agitation to ensure thorough emulsification, after which crude fish oil (*e.g.*, 1 gall. of sardine oil) is added, and the whole violently agitated to emulsify the oil, and then cooled. In use, 3 lb. of the product is made into a jelly with 1 gall. of water and applied by hand to the wood of the trees. The fish oil is an effective insecticide against the shot-hole borer beetle (*Xyleborus fornicatus*).—J. H. L.

Plants; Protective agents for —— [Fungicide.] Chem. Fabr. Flörsheim Dr. H. Noerdlinger, Flörsheim. Ger. Pat. 311,883, 7.6.17.

A preparation for protecting plants consists essentially of finely powdered aluminium, magnesium, or zinc, or a mixture of these powders, which may be incorporated with an inert powder such as kieselguhr, kaolin, talc, etc. Colloidal substances such as glue, gelatin, or casein may also be added.
C. A. M.

Antiseptic and germicidal tablet. C. T. Davis, Assignee of A. Rogers, Brooklyn, N.Y., U.S.A. Eng. Pat. 125,054, 18.2.19. (Appl. 3984/19.) Int. Conv., 2.4.18.

See U.S. Pat. 1,276,119 of 1918; this J., 1918, 670A.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Caffeine; Estimation of —— in vegetable material. F. B. Power and V. K. Chesnut. J. Amer. Chem. Soc., 1919, 41, 1298—1306.

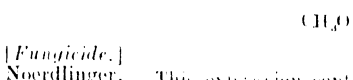
The process described in Allen's *Commercial Organic Analysis* for the estimation of caffeine in tea has been considerably modified so as to apply it to vegetable material generally. The following is the procedure finally adopted:—10 grms. of the material, moistened with alcohol, is extracted for 8 hours in a Soxhlet apparatus with hot alcohol; the extract is added to a suspension of 10 grms. of heavy magnesium oxide in 100 c.c. of water, and the mixture evaporated slowly until nearly dry. The residue is mixed with hot water and filtered, and the contents of the filter are washed with hot water until about 250 c.c. of filtrate is obtained; 10—20 c.c. of 10% sulphuric acid is added to the filtrate, which is then boiled for half an hour to hydrolyse saponin, and, when cool, filtered and shaken with six successive portions of 25 c.c. of chloroform. The united extracts are shaken with 5 c.c. of 1% potassium hydroxide solution, filtered, and distilled, and the residual caffeine dried for an hour in the water oven and weighed.—J. C. W.

Caffeine; Ilex vomitoria as a native source of ——. F. B. Power and V. K. Chesnut. J. Amer. Chem. Soc., 1919, 41, 1307—1312.

The leaves of *Ilex vomitoria*, Aiton, a shrub growing in the south-eastern States, contain sufficient caffeine (0·3 to 1·67% on the air dried material, in different samples) to recommend the plant as a possible source of the drug. Other native species, like European holly, contain no caffeine, whereas "Paraguay tea," which is rich in the base, is derived from South-American species of *Ilex*.
—J. C. W.

Harmine and harmaline. Parts III. and IV. W. H. Perkin, jun., and R. Robinson. Chem. Soc. Trans., 1919, 115, 933—972.

The authors discuss reasons for discarding both the formulæ originally proposed by them (this J., 1912, 659) and also that suggested by O. Fischer (this J., 1914, 210) for harmine. From a study of the oxidation products of harmine and harmaline (dihydroharmine) and consideration of the behaviour of their derivatives, the annexed formula is regarded as the most satisfactory representation of the harmine molecule.



This expression contains a ring system closely related to tryptophan, and further evidence in its favour is found in the fact that the base, $C_{12}H_{10}N_2$, obtained by Hopkins and Cole (J. Physiol., 1902, 29, 451) by the oxidation of tryptophan with ferric chloride is now shown to be identical with harman, the substance produced by the elimination of the methoxyl group from harmine. Harmine itself is therefore probably produced by vital synthesis from the at present unknown amino acid, hydroxytryptophan, by the formation of the pyridine ring from the side chain of the amino acid in presence of acetaldehyde, produced either from tryptophan itself, or some other substance which on oxidation yields acetaldehyde.—G. F. M.

Philippine medicinal plants; Physiologically active constituents of ——. A. H. Wells. Philippine J. Sci., 1919, 14, 1—7.

The dry wood of *Arrangelisia flava* contains 4·8% of berberine, probably a higher percentage than any other Philippine plant. The wood contains only small amounts of extractive matter, and the isolation of the alkaloid is therefore simple and inexpensive, and the plant forms an excellent source of the drug. The rhizome of *Geodorum nutans* contains about 14% of a water-soluble gum. *Cotnaria intermedia*, known in New Zealand as "foot plant," contains a poisonous glucoside in its leaves and fruit. (See further J. Chem. Soc., 1919, i., 493.)—G. F. M.

Croton gubouga bark; Examination of ——. Isolation of 4-hydroxyhygric acid. J. A. Goodson and H. W. B. Clower. Chem. Soc. Trans., 1919, 115, 923—933.

From the alcoholic extract of *Croton gubouga* bark

an acid, $C_6H_{11}O_3N$, was isolated in the form of colourless prisms, m. pt. 242° C., and $[\alpha]_D = -85{\cdot}4°$ (in water). It gave a strong pyrrole reaction and on methylation a mixture of the betaines, betonicine and turicine, was produced, whence it is concluded that the acid is a new optically active 4-hydroxyhygric acid (4-hydroxy-1-methylpyrrolidine-2-carboxylic acid).—G. F. M.

Pyrazole group and its applications for dyes and pharmaceutical products. A. Meyer. Chim. et Ind., 1919, 2, 780—788.

A RÉSUMÉ of the constitution and methods of manufacture of the principal pyrazole derivatives employed as dyes or medicaments. The chief medicaments in the group are antipyrine and pyramidone. The former is prepared by heating under a reflux 120 kilos. of ethyl acetoacetate (b. pt. 180°—181° C.) and 100 kilos. of phenylhydrazine. The pyrazolone thus obtained is methylated by means of methyl chloride, or better dimethyl sulphate in methyl alcohol solution. The alcohol is evaporated on completion of the reaction and the antipyrine extracted with benzene. Antipyrine is converted into pyramidone through its nitroso-compound, which is reduced with zinc and acetic or hydrochloric acid to amino-antipyrine, and this is then methylated with dimethyl sulphate. The dyes of the pyrazole group are all azo- or disazo-derivatives of pyrazolone, and are prepared by coupling a pyrazolone with a diazotised amine or diamine. The mono azo colours are mostly yellow or orange. Such are *e.g.*, Flavazine L, prepared by coupling diazobenzene with *p*-sulphophenylmethylpyrazolone; Normal Yellow 3 GL, obtained from diazotised *m*-xylidine-*o*-sulphonic acid and sulphophenylcarboxy-pyrazolone, and the Tartrazines which are best prepared from sulphophenylcarboxypyrazolone rather than direct from dihydroxytartaric acid and sulphophenylhydrazine. The disazo colours give red, blue, and violet shades, and are derived from diamines of the benzidine type coupled with either two molecules of a pyrazolone or one molecule of a pyrazolone and one molecule of a phenol, salicylic acid, etc.—G. F. M.

Silver sodium salvarsan [; Analysis of ——]. A. Binz. Arbb. Inst. exp. Therapie Georg Speyer Hause, 1919 [7], 43—47. Chem. Zentr., 1919, **90**, IV., 37.

OXIDATION of silver sodium salvarsan with hydrogen peroxide in alkaline solution precipitates the silver as oxide and converts the arsenic into a form in which it is readily oxidised to arsenic acid, *e.g.*, with sodium hypochlorite. The author determined the silver and arsenic by boiling the substance with a solution of Merck's perhydrol for 1 hour, adding concentrated nitric acid, evaporating to dryness, boiling the residue for an hour with sodium hypochlorite under a reflux condenser, destroying excess of hypochlorite by boiling with hydrochloric acid, filtering off the silver chloride, and precipitating the arsenic in the filtrate with magnesia mixture. This method of determining arsenic is not applicable to all organic arsenic compounds.

—J. H. L.

War gases; Manufacture of —— in Germany. J. F. Norris. J. Ind. Eng. Chem., 1919, **11**, 817—829.

THE most important gases used by the Germans for war purposes were $\beta\beta$-dichloroethyl sulphide (mustard gas) and phosgene. For the preparation of the former Victor Meyer's original method was used. Ethylene was made by passing alcohol vapour over aluminium oxide at 380°—400° C. The tubes containing the catalyst were of copper and were heated in a bath of melted potassium nitrate. About 90% of the theoretical yield was obtained. The ethylene was converted into ethylene dichlorhydrin by means of hypochlorous acid formed by the interaction of water, chloride of lime, and carbon dioxide, the reactions being carried out simultaneously between 5° and 10° C. in a cylindrical tank insulated with cork and provided with an agitator. The time required for the introduction of the ethylene was from two to three hours, and the yield of chlorhydrin was from 60 to 80% of the calculated quantity. After separation of the calcium carbonate, the solution was distilled and yielded a distillate containing 18—20% of chlorhydrin. This solution was treated with the theoretical quantity of sodium sulphide to form dihydroxyethyl sulphide, the mixture heated to about 90°—100° C., evaporated, filtered from the separated sodium chloride, and distilled *in vacuo*. The yield was about 90% of the theoretical amount. The thiodiglycol was drawn by a vacuum pump from storage tanks into a reaction vessel made of cast iron lined with lead and provided with a steam or water heating jacket, so that the reaction with the hydrochloric acid could be carried out at 50° C. The vapours from the reaction were passed through a scrubber containing charcoal and water before entering the chimney, and, after the reaction, the dichloroethyl sulphide was drawn by a vacuum pump into a cast iron, lead-lined washing vessel, and subsequently into a still containing a lead heating coil and connected through a spiral lead condenser and receiver with a vacuum pump, where the water was distilled. Finally, the dry oil was transferred to a similar vessel, where it was mixed with a solvent, such as chlorobenzene or carbon tetrachloride. Perchloromethyl chloroformate (diphosgene or superpalite) was prepared from methyl formate made by heating together 95% formic acid and methyl alcohol in a lead-lined iron still connected with a fractionating column. The pure ester was treated with chlorine in cast iron vessels coated with lead and lined with porcelain tiles, the gas being introduced through a number of glass tubes, whilst the reaction was accelerated by the action of light. For this purpose osram filaments were the most effective, whilst mercury vapour and carbon filament lamps were less so. From 1500 to 2000 l. of methyl formate was used for a charge, and the reaction was complete in eight to fourteen days. The fraction of low boiling-point was separated by distillation, and the residual diphosgene transferred to containers. Another favourite gas was diphenylchlorarsine, which produced sneezing and temporary sickness. Diphenylcyanarsine was prepared by treating diphenylchlorarsine with a saturated aqueous solution of potassium or sodium cyanide, whilst ethyldichlorarsine was made by treating ethylarsenious oxide with hydrochloric acid in a lead lined vessel cooled externally by water, and surrounded by an octagonal box, the sides of which had glass windows. Other compounds prepared were phenyliminophosgene, dichloromethyl ether, dibromomethyl ether, bromoacetone, bromomethyl ethyl ketone, xylyl bromide, chloropicrin, and phosgene. The charcoal for gas masks was prepared by soaking small pieces of wood in hydrochloric acid (20°—40° B.; sp. gr. 1·16—1·38) to which zinc chloride had been added, and then carbonising them for at least 6—8 hours in a muffle furnace. Subsequently the charcoal was washed with hydrochloric acid until the zinc content was reduced to about 0·01%, when it was finally washed free from acid, drained, and dried *in vacuo* at 70°—80° C.—C. A. M.

Dimethyl sulphate and alkali methyl sulphate; Action of —— on dry alkali chlorides and bromides. J. Guyot and L. J. Simon. Comptes rend., 1919, **169**, 435—437.

DIMETHYL sulphate and sodium chloride, when

heated together, react according to the equation:

$$(CH_3)_2SO_4 + NaCl = NaCH_3SO_4 + CH_3Cl;$$

subsequently, and on further heating, the following reaction takes place:

$$2NaCH_3SO_4 = Na_2S_2O_7 + (CH_3)_2O.$$

The reactions are not quantitative, however; the residue always contains sodium sulphate, and the ratio of methyl chloride to methyl ether is always more than 2:1. The reaction between dimethyl sulphate and potassium chloride is similar to the second of the above reactions as regards two thirds of the dimethyl sulphate when equimolecular quantities of the two substances are used; with excess of potassium chloride, the reaction is according to the equation:

$$2(CH_3)_2SO_4 + 2KCl = 2CH_3Cl + (CH_3)_2O + K_2S_2O_7.$$

Bromides act on dimethyl sulphate in the same way as do chlorides.—W. P. S.

Acetic acid and acetone; Work of the Canadian Electro Products Co. in the synthetic production of —— from calcium carbide. H. W. Matheson. Canadian Chem. J., 1919, 3, 258–261.

At the plant of the Canadian Electro Products Co., Shawinigan Falls, Quebec, 500,000–600,000 cub. ft. of acetylene is generated per day, and converted into acetaldehyde by passing into dilute sulphuric acid containing mercuric oxide held in suspension by vigorous stirring. The oxide is fed in continuously and the aldehyde removed by using a large excess of acetylene. The vessels employed are constructed of a silicon-iron alloy, and the mercuric oxide is prepared by the electrolysis of caustic soda solution in shallow iron vessels, a layer of mercury resting on the bottom serving as the anode. The oxide is removed as formed by a stirrer sweeping the surface of the mercury. The aldehyde is oxidised to acetic acid in aluminium vessels by means of air, and 98% acid, containing a very small amount of impurities, is formed. One distillation gives a product running 99% pure. The maximum output is approximately 1600 tons per month. Acetone was prepared catalytically from glacial acetic acid in steel tubes, 13 ft. long and 1 ft. wide, containing the catalyst of hydrated lime mixed with a small quantity of magnesia, coated on to rough cast-iron balls. At 483° C. 95% of the acid was converted into acetone, and the vapours from the tubes were scrubbed in a soda tower, and the aqueous acetone rectified in a continuous still. This process is not now worked.

G. F. M.

Ethyl alcohol; Oxidation of —— by means of potassium permanganate. W. L. Evans and J. E. Day. J. Amer. Chem. Soc., 1919, 41, 1267–1285.

The oxidation of alcohol by permanganate at 25°, 50°, 75°, and 100° C., in the presence of varying amounts of potassium hydroxide, has been studied systematically. The following conclusions are recorded:—(1) Beyond a concentration of about 10%, the proportion of alkali has no influence on the oxidation, but up to this point both increase of temperature and increased alkalinity accelerate the reaction. (2) In neutral solutions the sole product is acetic acid, but in the presence of more than a certain amount of alkali, the yield of acetic acid falls and that of oxalic acid and carbon dioxide rises with rise of temperature and with increase of alkalinity up to the above maximum. (3) The lowest limit of alkalinity, below which the sole product is acetic acid, is 0·460 grm. KOH per litre at 100°, up to 2·55 grms. at 25° C. (4) The temperature below which the alkalinity has no influence on the theoretical yield of acetic acid is about −25° C. (See further, J. Chem. Soc., Nov., 1919.)

—J. C. W.

Water, alcohol, and ether; Reciprocal solubility of mixtures of ——. A. Boutin and A. Sanfourche. Bull. Soc. Chim., 1919, 25, 458–463.

The solubility relations between water, alcohol, and ether were determined by measuring the quantity of one constituent which it was necessary to add to different mixtures of the other two of known composition until two layers were just formed or just disappeared. If the results are plotted on a triangular diagram, a curve is obtained dividing the triangular area into two zones, the one representing homogeneous and the other heterogeneous mixtures. From the curve it is easy to calculate the quantity of any constituent which it is necessary to add to any mixture to pass from a homogeneous to a heterogeneous mixture or *vice versâ*. No homogeneous mixture can be made heterogeneous by addition of alcohol alone. The composition of various mixtures at the critical point or limit of heterogeneity at 15° C. is given in the following table:

Water.	Alcohol.	Ether.
%	%	%
93·0	0·0	7·0
85·6	9·0	7·4
84·5	9·7	7·7
77·1	14·9	8·0
69·7	20·3	10·0
61·3	25·9	13·8
55·7	26·1	18·3
19·1	27·4	23·5
39·9	28·2	35·9
29·5	27·8	42·9
23·0	27·0	50·0
18·0	24·9	57·0
10·7	19·4	69·9
6·8	14·7	78·5
4·1	9·9	85·7
2·5	5·0	92·4
1·1	0·0	98·9

E. H. R.

Hydrogen cyanide; Catalytic reduction of ——. S. Barratt and A. F. Titley. Chem. Soc. Trans., 1919, 115, 902–907.

Platinum catalyses the reduction of hydrogen cyanide by gaseous hydrogen at temperatures between 120° and 250° C., with an optimum depends on the concentration of hydrogen cyanide in the gaseous mixture employed, an increase in the proportion of hydrogen giving rise to an increased yield of monomethylamine. When the concentration of hydrogen cyanide was reduced to about 1 in 16, a yield of 80% of total methylamines and over 70% of monomethylamine was obtained, whereas with a concentration of 1 in 5 the total yield of methylamines decreased to 33% and the ammonia increased to 66%. On continued use of a given catalyst also the yield of methylamine diminishes, ammonia being formed instead. The original behaviour of the platinum is restored by treatment with chlorine at 200° C. The dehydrogenation and auto-reduction of methylamine only proceed with noticeable velocity above 300° C. in the presence of platinum.—G. F. M.

Camphor monobromide; Determination of —— in migraine tablets. W. O. Emery. J. Ind. Eng. Chem., 1919, 11, 756–757. (Cp. André and Leulier, this J., 1910, 975.)

A weighed quantity of the finely-powdered material, containing 0·1–0·2 grm. of camphor monobromide, is transferred with 20 c.c. of 96% alcohol and 10 c.c. of water to a round-bottom flask

containing 15 grms. of 1% sodium amalgam. The liquid is maintained in gentle ebullition under a reflux condenser for at least 30 mins. The condenser tube is then rinsed down into the flask with 5 c.c. of alcohol, followed by 5 c.c. of water, and the flask is heated over a steam bath, without the condenser, for 1 hour or until the evolution of hydrogen has almost or quite ceased. Towards the end of this operation the liquid may be neutralised with acetic acid to further the reduction. The aqueous liquid is separated from the mercury, the latter is well washed with water in a separating funnel, and the combined aqueous liquids are filtered, acidified with nitric acid, and precipitated with silver nitrate. One mgrm. AgBr corresponds to 1·23 mgrms. of camphor monobromide. A control should be carried out with the sodium amalgam. The method gave accurate results with camphor monobromide alone and admixed with acetanilide, caffeine, and starch.—J. H. L.

Acidity of chaulmoogra oil. Cofman. *See* XII.

Organic nitro compounds. Elvove. *See* XXIII.

PATENTS.

Esters; Process for the production of ——. J. Grolea, Suresnes, and J. L. Wexler, Paris. Eng. Pat. 131,678, 31.7.18. (Appl. 12,155/18.) Int. Conv., 23.2.18.

CERTAIN neutral aliphatic esters are prepared by heating a mixture of an aliphatic acid and an alcohol at ordinary pressure and without the addition of a catalyst or dehydrating agent in a vessel fitted with a rectifying column, whereby the water formed during esterification is separated from the other reagents. The process is only applicable if either the acid or the alcohol is easily volatile without decomposition and boils at a temperature sufficiently above 100° C. to admit of the separation of water by fractional distillation, and if the ester is completely volatile without decomposition under ordinary or reduced pressure at a temperature not below 100° C. Example:—A mixture of 92 parts of glycerin and 270 parts of glacial acetic acid is heated in a distillation apparatus provided with a rectifying column, and is slowly distilled so that only very weak acetic acid issues from the column. When esterification is complete, *i.e.*, when only strong acetic acid distils over, the triacetin is separated from excess acetic acid by fractional distillation. Other esters which may be prepared by this method are normal or iso-butyl tartrate or citrate and normal or iso-amyl tartrate or citrate.—L. A. C.

Catalytic reactions [e.g., production of aldehydes from alcohols]; Apparatus for ——. G. Calvert, Twickenham. Eng. Pat. 132, 120. (Appls. 18,632, 13.5.18, and 12,325, 29.7.18.)

ONE of the reacting substances (*e.g.*, ethyl alcohol) is vaporised in a boiler and the vapour led to a jet at the end of a burner tube or tubes containing the catalyst (*e.g.*, copper gauze), where the injector action of the vapour jet draws in the other reacting substance (*e.g.*, air) through ports fitted with adjustable covers; the mixture then passes through the catalyst where the reaction product (*e.g.*, aldehyde) is formed. The vapour pipe is coiled outside of the burner round that portion where heat due to the reaction is developed. In the case of the substances named the method of operation is as follows. The alcohol is boiled and the vapour ignited at the jet with air ports full open; the resulting flame heats the catalyst, and when the requisite temperature is reached the air supply is reduced till it is only sufficient to form aldehyde; the flame then disappears and flameless combustion takes place among the copper gauze.—B. M. V.

Arsenical preparation and process of making same; Antisyphilitic ——. J. M. White, Meridian, Miss. U.S. Pat. 1,313,657, 19.8.19. Appl., 12.12.18.

AN alkali dimethylarsenide is treated with benzyl alcohol in aqueous solution.—L. L. L.

Camphor; Method of producing synthetic ——. R. L. Andreau, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,313,661, 19.8.19. Appl., 31.5.17.

ISOBORNEOL is treated with nitric acid in the initial absence of lower oxides of nitrogen and in the presence of a halogen.—L. L. L.

Alkali-soluble compounds of calcium and iron pyrophosphate with proteins; Process of manufacturing ——. Lecinwerk E. Laves, Hanover. Ger. Pat. 312,221, 29.3.17. Addition to Ger. Pat. 253,839.

ALKALI-SOLUBLE compounds of calcium and iron pyrophosphate with proteins are prepared by the interaction of proteins or their halogen compounds or derivatives, pyrophosphoric acid or its salts, and calcium or ferric salts, with the addition of a sufficient quantity of alkali for neutralisation. The resulting compounds may be separated from dilute solutions by gently heating, or from alkaline solutions by neutralisation with acid. They are soluble in solutions of alkalis or their carbonates, or ammonia, forming the corresponding neutral salts, and may be precipitated from these solutions by the addition of salts of the alkaline-earth metals. Casein, caseose, and mixtures of lactalbumin and globulin from cow's milk may be used in the preparation of such products suitable for therapeutic purposes.—C. A. M.

Blood pressure; Manufacture of agents for reducing ——. G. Zuelzer, Berlin. Ger. Pat. 312,592, 18.6.14. Addition to Ger. Pat. 280,107 (see Eng. Pat. 14,365 of 1914; this J., 1916, 557).

NON-PATHOGENIC micro-organisms which form endotoxins are charged with normal amboceptors from rabbits, as described in the chief patent, and then killed, *e.g.*, by means of formaldehyde. The dead bacteria are then mixed with gelatin, or the reactive constituent is extracted and this mixed with gelatin.—L. A. C.

Recovery of solvents. Eng. Pat. 131,938. *See* I.

Acetone and butyl alcohol. Eng. Pat. 130,666. *See* XVIII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photographic phenomenon; New ——. D. N. McArthur and A. W. Stewart. Chem. Soc. Trans., 1919, **115**, 973—974.

A PHOTOGRAPHIC negative was placed on the bottom of a light-tight box, and over it was placed, film upwards, a sensitive plate separated from the negative by microscope slips. After keeping the box for some hours in the neighbourhood of a source of heat—Bunsen burner, batswing flame, or

electric kettle—the sensitive plate on development gave a positive image of the negative. A similar effect was produced whether the negative or the sensitive plate was nearer to the source of heat. Different heat-sources vary in rapidity of action; a Méker burner is very slow, a calcium flame is slow, a sodium or lithium flame is faster; an electric heater operated on its lower resistance gives very good results. The box containing the plates may be of either wood or cardboard. The rays producing the effect on the sensitive plate appear to be similar to light rays, being capable of both diffraction and refraction; glass is transparent to them; inkstains, seccotine, and metals show different degrees of opacity.—B. V. S.

Photographic plate; Effect of a "flash" exposure ("Vorbelichtung") on the rendering of weak light-impressions on the ——. J. M. Eder. Z. wiss. Phot., 1917, **16**, 219—224.

A CRITICISM of a paper under the same title by J. Rheden (Z. wiss Phot., 1916, **16**, Nos. 2 and 3). Reference is made to the previous work in the same field of Eder (1882 and 1884), Burton (1882), Debenham (1882), and especially of Schwarzschild (1900), in which all Rheden's results had been already obtained. Although it appears possible to obtain an apparent increase of sensitiveness by a flash exposure (before, during, or after the main exposure) in, for example, the taking of star negatives, the method is not recommended because of the difficulty of determining the exact exposure and the danger of spoiling the quality of the negative. The similarity between the effect of a flash exposure and the forcing of development up to the beginning of "chemical fog" is also discussed.—B. V. S.

p-Nitrosocarvacrol, a new [photographic] developer. H. V. Lubs. Communication from the U.S. Bureau of Chemistry. Brit. J. Phot., 1919, **56**, 534—535.

CARVACROL may be prepared according to McKee's process (U.S. Pat. 1,265,800; this J., 1918, 531 A) by sulphonation of cymene and alkaline fusion of the sulphonic acid. On the laboratory scale a better yield is obtained by diazotising aminocymene, dropping the cold diazo solution into dilute sulphuric acid, and simultaneously steam distilling. *p*-Nitrosocarvacrol is obtained by a slight modification of Klages' method, sodium nitrite in 50% alcohol being added to an alcoholic solution of carvacrol saturated with hydrochloric acid. The crude nitrosocarvacrol is dissolved in about ten times its weight of 10% ammonia, and a rapid stream of hydrogen sulphide passed into the filtered solution; *p*-aminocarvacrol separates as almost colourless leaves. *p*-Aminocarvacrol resembles metol and *p*-aminophenol in developing properties, and gives a solution which keeps better than the latter. *p*-Aminothymol did not appear to be so satisfactory a developing agent as the carvacrol compound. Thymoquinol was also prepared, by sulphonating carvacrol and oxidising the sulphonic acid by means of potassium bichromate, but the yields were poor and the substance had no advantage over quinol as a developer.—B. V. S.

Pinacerdol. Wherry and Adams. *See* IV.

XXII.—EXPLOSIVES; MATCHES.

Iodine in nitric acid and sodium nitrate [used for nitroglycerin manufacture]. E. A. White. J. S. Afr. Assoc. Anal, Chem., 1919, **2**, 7—12.

Low results obtained with the Abel heat test of nitroglycerin were believed to be due to the presence in the acids of iodine derived from the sodium nitrate. Examination of a cargo of nitrate showed it to consist of three varieties: white, pink, and discoloured. Estimations of iodine in the nitric acid and sodium nitrate were made by a colorimetric method using a 0·1% solution of iodine in chloroform as a standard, suitable reducing and oxidising agents being employed for the determination of free and combined iodine. The pink nitrate contained most iodine — 0·0168 — some crystals showing even as much as 0·041 I. Sodium nitrate with less than 0·01% iodine produces nitric acid which is practically free from iodine. The heat test of nitroglycerin is affected if the iodine in the nitric acid exceeds 0·005%. When nitric acid was manufactured from sodium nitrate by the Valentiner process, most of the iodine was driven off from the still charge in the last stages, and was found in the weak nitric acid fraction collected in the "back jars." It was possible to remove some iodine from this fraction by blowing air through, and on re-distillation of the "back jar" acid, the strong nitric acid obtained was practically free from iodine, which again condensed in the "back jars."—W. J. W.

Powder B: Pure ——. J. Delpech. Comptes rend., 1919, **169**, 137—139.

PURE powder B, prepared by filtering an acetone solution of nitrocellulose through a pad of cotton-wool under a pressure of 10 atm., was found to have the same ballistic properties as the ordinary powder B supplied to the French artillery. The pure powder, however, forms translucent rods, and the detection of impurities is facilitated.—W. P. S.

Organic nitro compounds. Flurscheim. *See* XXIII.

PATENTS.

Explosives [for grenades, bombs, etc.]. J. Hargreaves, Widnes, C. R. Gardner, Gathurst, and Roburite and Ammonal, Ltd., London. Eng. Pat. 131,380, 3.6.18. (Appl. 9134/18.)

AN explosive, safe to handle and capable of being poured in a dry state, consists of ulmic anhydride (ulmin) mixed with trinitrotoluene or other nitro-compound and an oxidising agent such as ammonium nitrate. Ulmic anhydride may also be added as an absorbent to nitroglycerin or hydrocarbons in explosives.—W. J. W.

Explosives; Preparation of combustible salt suitable for the manufacture of —— and process for making these explosives. A. J. Marin, Brussels. Eng. Pat. 131,388, 13.6.18. (Appl. 9753/18.) Int. Conv., 13.6.17.

INSTEAD of adding ammonium perchlorate and sodium nitrate separately to the other ingredients in the manufacture of perchlorate explosives, a mixture of these salts and of a double salt is produced by adding ammonium nitrate to a solution of sodium perchlorate, or to dry sodium perchlorate with the addition of a small quantity of water. The resulting mixture is desiccated and incorporated with the combustible, usually a nitro-compound such as trinitrotoluene etc. Alternatively, the nitro-compound may first be incorporated with ammonium nitrate and a solution of sodium perchlorate added; the mixture is then partly dried, disintegrated, pressed, and finally dried.—W. J. W.

Cellulose nitric esters; Gelatinisation of —— in manufacture of explosives. W. Rintoul, T. J. Nolan, and Nobel's Explosives Co., Ltd., Stevenston, N.B. Eng. Pat. 131,389, 14.6.18. (Appl. 9849/18.)

FOR explosives containing nitrocellulose, whether

for propellant or blasting purposes, urethanes possess stabilising properties (Eng. Pat. 12,743 of 1912; this J., 1913, 991) and also act as gelatinising agents (Eng. Pat. 4941 of 1913; this J., 1914, 712). It is found that members of a sub-class of urethanes, in which two aromatic groups, one being a benzyl or substituted benzyl group, are attached to the nitrogen atom, possess important advantages both as stabilising and as gelatinising agents. Examples of such urethanes are phenylbenzylurethane and benzyl-*o*-tolylurethane. Suitable compositions for propellant powders in cord or strip form, and in flake form, are given. (See also Eng. Pats. 1940 of 1913, 14,655 and 14,656 of 1915, 16,616 of 1916, and 6181 of 1917; this J., 1914, 712; 1919, 310 A, 513 A.) —W. J. W.

Incendiary compositions. Vickers, Ltd., Westminster, and G. W. C. Webb, Dartford. Eng. Pat. 131,360, 16.5.18. (Appl. 8245/18.) Addition to 126,394 (this J., 1919, 480 A).

THE composition described previously is mixed with not more than 3 % of paraffin oil to prevent separation and oxidation of the ingredients.—W. J. W.

Incendiary material. A. Chanard, Rueil, France. Eng. Pat. 131,644, 2.7.18. (Appl. 10,881/18.) Int. Conv., 22.3.17.

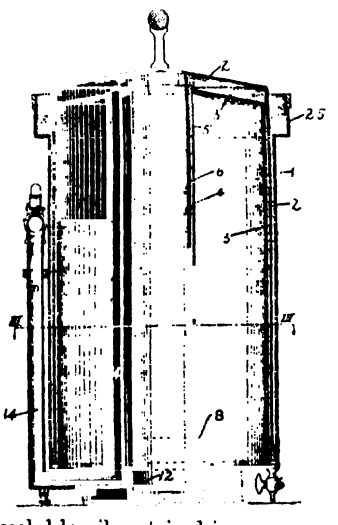
A COMBUSTIBLE mixture, readily inflammable at high temperatures only, consists of resin or similar substance mixed with finely-divided nitrocellulose or celluloid. A solvent for both of the components of the mixture may be added to make the mass homogeneous. A primer of inflammable material, such as celluloid or cotton wool, soaked in petrol, and provided with a fuse, may be inserted in the mixture to facilitate ignition.—W. J. W.

Fireproofing fibrous substances Eng. Pat. 130,662. *See* V.

XXIII.—ANALYSIS.

Gas; A portable cubic-foot standard for ——. M. H. Stillman. U.S. Bureau of Standards, Tech. Paper No. 114, 1919, 13 pages.

THE standard (see fig.) is about 25 in. high overall and consists essentially of a cylindrical metallic



bell, 2, sealed by oil contained in a narrow annular tank in which the bell may be moved up and down. The inner cylinder, 3, of this annular tank is closed at the top, and the clearance space between it and the side of the bell is as small as is consistent with freedom of motion of the latter. Errors due to small pressure changes are thereby rendered negligible. The diameter of the top, 25, of the outer cylinder, 1, is enlarged to form a reservoir of such capacity that the raising and lowering of the bell does not affect materially the height of the sealing liquid. The bell is guided by two telescoping tubes, 4, 6, arranged co-axially with it. The outer of these two tubes is secured gastight to the inner cylinder of the tank and to a base plate. The inner tube is securely fastened at its upper end to the inside of the bell. Lateral motion of the guiding mechanism is reduced to a minimum by two collars, one, 5, fixed to the inside of the upper end of the outer tube, and the other, 8, to the outside of the lower end of the inner tube. The height to which the bell can be raised is regulated by adjusting the position of this lower collar, which is screwed for this purpose. Gas is admitted to the bell through a tube, 14, provided preferably with a three-way cock. The apparatus is constructed of aluminium, and the weight is reduced by providing a large number of holes in the base-plate. "P. I. meter oil" is employed as sealing liquid. By raising the bell, a volume of gas determined by the position of the stops on the guiding mechanism is drawn in, and is delivered on lowering the bell to its initial position. The standard may be adjusted to deliver 1 cub. ft. of air or other gas by the use of an accurately calibrated standard bottle. The apparatus possesses the advantages of portability, accuracy, convenience and rapidity.
—J. S. G. T.

Bomb calorimeter; An adiabatic ——. E. B. Holland, J. C. Reed, and J. P. Buckley. Chem. and Met. Eng., 1919, 21, 190—191.

THE authors describe some improvements made in a Berthelot-Mahler-Kroecker calorimeter used in nutrition work and the examination of fuels. A new double-walled jacket was constructed provided with a helical electric resistance heater and rotary stirrer of skeleton section, the whole being easily assembled or dismantled in a few minutes. Normal type thermometers of special construction were used. A tapper applied to them prevented any perceptible mercury "lag." The lens for reading the thermometers was unsatisfactory, and a prism tube of a Pfeiffer dissecting microscope with ocular 201 and a chromatic objective 1a with special arrangement for varying the focal distance was found on the whole the most satisfactory instrument, though lacking the required magnification.—T. H. Bu.

Indicators; The quinone-phenolate theory of ——. *Reactions of phenolsulphonphthalein and its bromo- and nitro-derivatives, and their monobasic and dibasic acids.* E. C. White and S. F. Acree. J. Amer. Chem. Soc., 1919, 41, 1190—1212.

THE preparation of phenolsulphonphthalein from saccharin and its bromination and nitration are described. The compounds are highly sensitive indicators of different hydrogen-ion concentrations. Thus, the pure parent substance requires the addition of nearly 0·95 of an equivalent of alkali before the typical purple colour is developed, that is, before the intensely coloured quinone-phenolate ion appears, whereas the tetrabromo-compound is already deep blue in dilute aqueous solutions, and the tertanitro-compound gives purple-red solutions which are not optically altered by the addition of small amounts of alkalis. (See also this J., 1919, 662 A, and J. Chem. Soc., Nov., 1919.)—J. C. W.

Magnesium; Alkalimetric determination of small amounts of ——. P. L. Hibbard. J. Ind. Eng. Chem., 1919, 11, 753—754.

THE author has modified Bruckmiller's procedure (this J., 1917, 563) to render the method more convenient and exact for quantities of magnesium from 5 to 0·1 mgrm. For the precipitation of the magnesium in the cold the solution should contain 0·1—0·2% of ammonium chloride and enough free ammonia to give a distinct but not strong odour. A 1·5 solution of microcosmic salt (1 c.c. for 1 mgrm. Mg) is added, drop by drop, with constant shaking, and after 10 mins. the liquid is treated with ¼ of its volume of strong ammonia and left covered for 2 hours or longer. If the original solution contains much ammonium salts which it is inconvenient to remove, it is acidified slightly with hydrochloric acid, heated to boiling, treated with the necessary quantity of microcosmic salt and with ¼ of its volume of strong ammonia and left covered for 2 hours or longer. In either case the precipitate is collected on a fairly thick layer of paper pulp in a Gooch crucible, with moderate suction, and washed 2 or 3 times with 95% alcohol neutral to methyl red, and then 4 times with 5 c.c. of a saturated solution of ammonium magnesium phosphate (prepared by shaking some of the salt with water free from carbon dioxide for several hours and filtering). To ascertain the amount of alkali or acid to be added to the alcohol to render it neutral a sample is titrated after five-fold dilution with water and addition of methyl red. The washed precipitate, together with the pulp, is washed back into the precipitation flask with water, a few drops of a 1% alcoholic solution of methyl red are added, and then an excess (about 5 c.c.) of standard acid, with shaking. After the precipitate is dissolved, which may require a considerable time if the crystals are large, the liquid is titrated back with alkali until the colour changes through pink almost to yellow. One c.c. of *N*/50 acid corresponds to 0·24 mgrm. Mg. Methyl red gives much sharper colour changes than methyl orange.—J. H. L.

Magnesia; Separation and determination of —— *in presence of fixed alkalis.* P. Nicolardot and F. Dandurand. Rev. Mét., 1919, 16, 193—199.

PRECIPITATION of magnesia with ammonium phosphate solution with subsequent removal of the excess of phosphoric acid by the addition of a 10% solution of ferric chloride is regarded as the best method for the separation of magnesia from sodium and potassium salts. Ammonium phosphate solution, of known strength, should be added carefully to avoid large excess. Average analytical figures showed 100·2% of the magnesia and 97·75% of the alkalis present. Schaffgotsch's method, in which magnesia is precipitated by an ammoniacal-alcohol-water solution of ammonium carbonate, is more tedious and less exact. Separation by barium or calcium hydroxide solution is only applicable to a neutral chloride solution free from ammonium salts, and the magnesia value obtained is always too low. The method of estimation of magnesia by evaporating the mixed solution with oxalic acid or ammonium oxalate in sufficient quantity to form quadroxalate, with subsequent ignition and extraction of the alkalis, is not recommended, as a certain quantity of magnesia passes into solution during the extraction. Berzelius' method, in which mercuric oxide is added to the mixed chloride solution in sufficient quantity to convert the magnesium chloride present into the hydrated oxide, is not satisfactory from an analytical point of view.

—C. A. K.

Calcium and magnesium; Estimation of —— *in different saline solutions.* E. Canals. Bull. Soc. Chim., 1919, 25, 90—94. (See this J., 1919, 159 A.)

MAGNESIUM must generally be estimated by precipitation as magnesium ammonium phosphate followed by ignition of the precipitate to magnesium pyrophosphate. Only under special circumstances can it be estimated as oxide or as sulphate, and great care must then be taken on account of the hygroscopic nature of both these substances. Care must also be taken not to decompose the sulphate by overheating. Experiments on the precipitation of magnesium ammonium phosphate, by adding a solution of magnesium sulphate to one of sodium phosphate containing ammonia and ammonium chloride, showed that concordant results could be obtained, with wide variations in the quantity and dilution of each constituent, so long as the minimum amount required was present.—E. H. R.

Chlorine; Adaptation of the Mohr volumetric method to general determinations of ——. L. Yoder. J. Ind. Eng. Chem., 1919, 11, 755.

THE following method gave accurate results with mixtures of potassium chloride, hydrochloric acid, and sodium phosphate, and with organic materials including faeces, grains, and hay. The weighed sample is treated with 5 c.c. of 30% calcium acetate solution and sufficient water to moisten it thoroughly, and then evaporated to dryness at 120° C. and ignited below 450° C. The cooled residue is thoroughly moistened with a few c.c. of 10% ferric acetate solution and again evaporated to dryness and ignited below 450° C. The residue is triturated with hot water, filtered off, and washed free from chlorides. The filtrate is evaporated almost or quite to dryness, treated with just sufficient hot water to dissolve the chlorides when cooled, and after addition of 3 drops of potassium chromate it is titrated with *N*/20 silver nitrate solution. By the procedure described loss of chlorine during ignition is prevented, and the liquid finally obtained is neutral and free from carbonates and phosphates, which interfere with the titration.

—J. H. L.

Organic nitro compounds; Detection and determination of small amounts of certain —— *with special reference to the examination of the urine of TNT workers.* E. Elvove. J. Ind. Eng. Chem., 1919, 11, 863—864.

IN experiments with Webster's test for trinitrotoluene in urine (Brit. Med. J., 1916, 2, 845) it was found that the concentration of the alkali had a great influence on the stability of the coloration. In applying the reaction to the detection and estimation of trinitrotoluene in air, alcohol proved a more satisfactory solvent than ether. A definite volume of the air is drawn by suction through a series of three small test tubes, each of which contains 5 c.c. of absolute alcohol. A portion of the contents of each tube is then transferred to a Nessler tube and diluted with water to 5 c.c., whilst 5 c.c. of standard alcoholic solutions containing from 0·01 to 0·1 mgrm. of pure TNT are placed in similar tubes. An addition of 5 c.c. of *N*/10 sodium hydroxide solution is made to each tube, the alkali being allowed to run down the side of the tube. All the tubes are now shaken, so as to mix the contents as far as possible simultaneously, and, after standing for 10 mins., the resulting colorations are compared in the usual way. A drawback of Webster's test as applied to urine is that the coloration is not specific for TNT since various purgatives such as rhubarb, cascara, etc., give a similar coloration. On the other hand, the Griess nitrite test may be used for the detection and determination of 2.6-dinitro-4-hydroxylaminotoluene, which is formed from trinitrotoluene in the body: 20 c.c. of the urine is acidified with 10 c.c. of 2*N*-sulphuric acid, and shaken thoroughly for 3 mins. with 10 c.c. of ether.

The ethereal extract is washed twice with 2 c.c. of water, and then shaken for 3 mins. with 5 c.c. of *N*/1 sodium hydroxide solution. The alkaline extract is drawn off, the ethereal layer washed twice with 1 c.c. of *N*/1 sodium hydroxide solution, and the united alkaline liquids allowed to stand for a definite period (1 or 2 hours), then diluted with 50 c.c. of water, acidified with 2 c.c. of 5*N*-acetic acid, and made up to 100 c.c. Simultaneously a series of standards is prepared containing known amounts of an ethereal solution of pure 2.6-dinitro-1-hydroxylaminotoluene in 20 c.c. of normal human urine; these are treated as described, and the colorations compared with those given by the sample under examination.—C. A. M.

Tissue analysis; A method of —— applied to the posterior and anterior lobes of cattle pituitaries. C. G. MacArthur. J. Amer. Chem. Soc., 1919, **41**, 1225—1240.

The method embodies most of the modern biochemical analytical methods, so that 10 grms. of material is sufficient for a very exhaustive study. The material is extracted with various solvents, hot and cold, so as to leave a protein fraction, and the extracted matter is treated with very dilute hydrochloric acid and thus separated into a precipitate of lipins, soluble in alcohol and chloroform, and a solution of "extractives." Aliquot parts of the three fractions, extractives, lipins, and proteins, are then examined in detail. (See also J. Chem. Soc., Nov., 1919.)—J. C. W.

Hard asphalt. Tausz and Lüttgen. *See* IIA.

Aniline. Christiansen. *See* III.

Mechanical tests for textile fabrics. Pickard and Wallace. *See* V.

Starch in paper. Voorhees and Kamm. *See* V.

Arsenic acid. Kolthoff. *See* VII.

Reaction between arsenious oxide and iodine. Kolthoff. *See* VII.

Hydrogen sulphide. Czakó. *See* VII.

Iron in glasses. Ferguson and Hostetter. *See* VIII.

Carbon in steel. Cain and Maxwell. *See* X.

Manganese in special steels. Nicolardot and Levi. *See* X

Titanium in iron ores. Waddell. *See* X.

Zinc dust. Edwards. *See* X.

Antimony in hard lead. Wogrinz and Göhring. *See* X.

Uranium in carnotite. Scholl. *See* X.

Silica in uranium ores. Davis. *See* X.

Use of furfural in rubber analysis. Dubosc. *See* XIV.

Vulcanised rubber. Dubosc. *See* XIV.

Impermeable fabrics. Dubosc. *See* XIV.

Polariscopes [saccharimeters]. Coates. *See* XVII.

Reducing sugars. Scales. *See* XVII.

Higher alcohols in wines. Trambics. *See* XVIII.

Sp. gr. of milk serum. Ledent. *See* XIXA.

New constant for milk. Ledent. *See* XIXA.

Curdled milk. Fonzes-Diacon. *See* XIXA.

Milk calculations. Harris. *See* XIXA.

Amino-acid nitrogen. Grünhut. *See* XIXA.

Caffeine. Power and Chesnut. *See* XX.

Silver sodium salvarsan. Binz. *See* XX.

Camphor monobromide. Emery. *See* XX

PATENTS.

Anemometer. S. G. Starling, Forest Gate, Essex, and A. J. Hughes, London. Eng. Pat. 132,090, 2.10.18. (Appl. 16,025/18.)

A flexible wire or cord, drawn taut between suitable supports, is exposed transversely to the air current. One end of the wire is connected to an elastic wall of a closed box, the other end of the wire being fixed to the rigid casing of the box. The box is divided centrally into two chambers by a rigid partition, and each chamber is provided with an elastic wall. The separate limbs of a manometer are respectively connected to one or other of these chambers. An increase of tension in the wire, due to the exposure of the wire to a current of air, produces a diminution of pressure in that chamber whose flexible wall is connected with the wire, and such diminution is indicated by the liquid in the manometer. The indications of the instrument are independent of variations of atmospheric pressure. A modification employing two entirely separate chambers and enabling increased sensitiveness to be secured is described.—J. S. G. T.

Thermocouples for pyrometers. Kelvin, Bottomley, and Baird, Ltd., and C. H. Wright, Glasgow. Eng. Pat. 132,132, 5.12.16. (Appl. 20,161/18.)

In thermocouples for pyrometers of the concentric type comprising elements disposed one within the other, there is attached to the outer element, at the cooler end, a head or box forming one terminal of the couple, inside which is a flexible extension of the inner element composed of the same material as, or of a material thermo-electrically equivalent to, the inner element. This flexible extension is connected to the second terminal of the couple, and affords freedom for relative movement of the cooler ends of the couple.—J. S. G. T.

Gas detector. M. A. Nobles, Philadelphia, Pa., Assignor to W. S. Russell, Carlisle, Pa. U.S. Pat. 1,313,523, 19.8.19. Appl., 27.12.16.

A CATALYTIC element is normally heated by an electric current, the circuit of which includes a thermostatic switch adjacent to the catalytic element. When the temperature of the element is increased by the presence of gas, the switch is opened and an electic alarm is operated.—W. F. F.

Fusing temperature of materials; Apparatus for ascertaining the —. Z. Olsson, Brooklyn, N.Y. U.S. Pat. 1,314,422, 26.8.19. Appl., 19.10.18.

A SPECIMEN of the material is mounted on a movable carriage and is fused by a blowpipe flame fed with a mixture of combustible gas and oxygen. The gas and oxygen supply pipes are provided with valves, and with means for registering their respective pressures. Means are also provided for indicating the distance of the specimen from the burner nozzle.—W. F. F.

Measuring flow of fluids. Eng. Pat. 131,375. *See* I.

Measuring steam flow. U.S. Pat. 1,314,249. *See* I.

Testing paper. Eng. Pat. 130,995. *See* V.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Akkerman. Process for drying liquids. 24,704. Oct. 9.

Arundel and Higginson. Apparatus for raising liquids 24,111. Oct. 2.

Chadwick. Waste-gas furnaces. 23,870. Sep. 29.

Conder and Vivian. Crushing mills of the roller and ring type. 24,766. Oct. 10.

Conder and Vivian. Apparatus for screening materials. 24,767. Oct. 10.

Constantinesco. Pulverising or atomising liquids. 23,880. Sep. 29.

Dorr Co. Sedimentation apparatus. 24,936. Oct. 11. (U.S., 5.10.18.)

Gerlach. Drums for drying materials. 24,228. Oct. 3. (Ger., 10.1.18.)

Higginbottom. Drying apparatus. 24,250. Oct. 4.

Hooke. Separators for granular and pulverulent material, matter in suspension, etc. 24,708. Oct. 9.

Hope. Furnaces. 24,441. Oct 7.

Imray (Secord, Peters, and Paterson). Drying apparatus. 24,048. Oct. 1.

Lambert. Absorbents for gases. 24,709. Oct. 9.

Lang. Means for disintegrating, spraying, or vaporising liquids. 24,209. Oct. 3.

Llewellyn, and Spence and Sons. Purification etc. of liquids. 24,688. Oct. 9.

Ruff. Evaporators or pasteurisers. 24,371. Oct. 6.

Singleton. Hydro-extractors. 23,819. Sep. 29.

Steinmuller. Travelling-grate furnaces. 24,516. Oct. 7. (Ger., 11.12.18.)

Walsh (Stephens and Higginson). 24,319. *See* XV.

Zwermann. Kilns. 23,859. Sep. 29. (U.S., 3.3.19.)

COMPLETE SPECIFICATIONS ACCEPTED.

1156 (1918). Stutz. Apparatus for treating materials with gas or vapour. (133,106.) Oct. 15.

15,683 (1918). Garbutt. Rotary furnaces. (132,885.) Oct. 8.

15,959 and 15,961 (1918). Morterud. Process for evaporating liquids. (132,893 and 120,205.) Oct. 8.

15,971 (1918). Zwermann. Kilns. (128,180.) Oct. 15.

19,888 (1918). Barber. Recovery or separation of colloidal matters from liquids. (132,947.) Oct. 8.

20,270 (1918). Marrath. Apparatus for treating liquids with gases. (133,217.) Oct. 15.

7418 (1919). Watkins. Grinding bodies for use in tube mills. (132,985.) Oct. 8.

II. FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Akker. Process for solidifying kerosene. 24,665. Oct. 9.

Archdale, Payne, and Goodall, Clayton and Co. Vertical gas retorts etc. 24,316 and 24,317. Oct. 6.

Archdale, and Goodall, Clayton and Co. Gas-retorts etc. 24,318. Oct. 6.

Constantaras. Generation of combustible gas for lighting, heating, power, etc. 23,963. Sep. 30.

Holmes and Manley. Cracking hydrocarbon oils. 24,605. Oct. 8.

Long. Process of treating peat. 24,906. Oct. 11.

Marks (Prest-o-lite Co.). Solvents for acetylene etc. 24,848. Oct. 10.

Rook and Rook. Saturated-gas plant. 24,419. Oct. 7.

Rütgerswerke A.-G. Process for making petroleum jelly. 24,047. Oct. 1. (Ger., 26.10.18.)

U.S. Industrial Alcohol Co. Liquid fuel. 24,852. Oct. 10. (U.S., 28.11.17.)

COMPLETE SPECIFICATIONS ACCEPTED.

17,869 and 18,383 (1916). Forwood and Taplay. *See* III.

16,121 (1918). Bury, Ollander, and Bury. Recovery of gaseous products from plants for the destructive distillation of organic materials. (133,159.) Oct. 15.

20,098 (1918). Clere. Gas-generators. (121,290.) Oct. 8.

21,588 (1918). Tinker. Fuel oils. (132,960.) Oct. 8.

3123 (1919). Stein et Cie. Coke ovens. (123,527.) Oct. 15.

7469 (1919). Clements and Allen. Gas-producers. (133,255.) Oct. 15.

III.—TAR AND TAR PRODUCTS.

APPLICATIONS.

British and Foreign Chemical Producers, Ltd. 24,331, 24,388. *See* XX.

COMPLETE SPECIFICATIONS ACCEPTED.

17,869 and 18,383 (1916). Forwood and Taplay. Treatment of hydrocarbons. (133,059.) Oct. 15.

IV.—COLOURING MATTERS AND DYES.

APPLICATION.

Brotherton and Co., Mersey Chemical Works, and Merriman. Manufacture of disazo colouring-matters. 24,870. Oct. 11.

COMPLETE SPECIFICATION ACCEPTED.

10,503 (1918). Robinson, Kay, and British Dyes, Ltd. Manufacture of N-arylthiomorpholines. (133,108.) Oct. 15.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Davis and Poole. Washing or scouring wool. 24,788. Oct. 10.

Kron. Manufacture of fibres for rough pasteboard for saturating with tar etc. 24,123. Oct. 2. (Switz., 19.11.18.)

Laan. 24,119. *See* XXII.

Müller. Production of viscose from cellulose. 24,737. Oct. 9.

Scott and Tulloch. Cellulose acetate. 24,122. Oct. 2.

White and White. Washing wool. 24,519. Oct. 8.

COMPLETE SPECIFICATIONS ACCEPTED.

14,806 (1917). Bloxam (Zellstofffabrik Waldhof). Manufacture of solutions of cellulose or material containing cellulose. (132,815.) Oct. 8.

16,724 (1918). Cavanaugh. Soil-proof fabric. (133,180.) Oct. 15.

11,077 (1919). Gilmour, and Dunville and Co. *See* XIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Drey. Producing discharge and resist effects on pile fabrics. 24,269. Oct. 4.

Graves. Dyeing etc. yarn, thread, etc. 24,236. Oct. 3.

Loxam and Marshall. Manufacture and covering of rollers used in textile process. 24,271. Oct. 4.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Barbé. 24,039. *See* XVI.

Burgess Laboratories. Manufacture of zinc chloride. 24,129. Oct. 2. (U.S., 26.9.18.)

Clayton. Apparatus for manufacture of oxygen compounds of sulphur. 24,040. Oct. 1. (Fr., 11.4.19.)

Lleyellyn, Spence, and Spence and Sons. Manufacture of aluminous compounds. 24,875. Oct. 11.

Parrish, and South Metropolitan Gas Co. Manufacture of sulphuric acid. 24,386. Oct. 6.

Wade (Lindsay Light Co.). Manufacture of thorium compounds. 24,925. Oct. 11.

Walkey. Manufacture of zinc oxide. 21,426. Oct. 7.

COMPLETE SPECIFICATIONS ACCEPTED.

3415 (1918). Nitrogen Corporation. Producing substantially pure cyanogen compounds. (133,095.) Oct. 15.

4445 and 4447 (1918). Reid. Process of making carbide. (133,098 and 133,100.) Oct. 15.

4448, 4449, and 4450 (1918). Slocum. Preparation of crude materials for the manufacture of carbides. (133,101, 133,102, and 133,103.) Oct. 15.

4451 (1918). Slocum. Fixation of nitrogen. (133,104.) Oct. 15.

4452 (1918). Slocum. Production of cyanogen compounds and ammonia. (133,105.) Oct. 15.

13,793 (1918). Dreyfus and Bloch. Manufacture of potassium permanganate. (132,842.) Oct. 8.

15,431 (1918). Auden. Extraction of potash from minerals and manufacture of the residual products into cement. (132,855.) Oct. 8.

15,668 and 15,671 (1918). Thorssell and Lundeu. Production of nitrates from ammonia, ammonium compounds, or organic nitrogen compounds by means of bacteria. (132,882 and 132,883.) Oct. 8.

17,872 (1918). British Dyes, Ltd., Turner, and Davidson. Continuous production of high strengths of fuming sulphuric acid. (132,923.) Oct. 8.

6456 (1919). Lindsay Light Co. Extraction and purification of thorium compounds. (127,555.) Oct. 8.

8585 (1919). Lindsay Light Co. Separation of thorium compounds. (129,624.) Oct. 15.

11,187 (1919). Desachy. *See* XIII.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Atkinson, and Stein and Atkinson. Glass furnaces. 24,884. Oct. 11.

Chandler, and South Metropolitan Gas Co. Glass drawing. 24,196. Oct. 3.

Laird. Tinning and soldering porcelain enamelware. 24,786. Oct. 10.

Wilkinson. Glass furnaces. 24,137. Oct. 7.

COMPLETE SPECIFICATIONS ACCEPTED.

8559 (1917). Imray (Treuhand Vereinigung A.-G.). Manufacture of glass objects. (133,071.) Oct. 15.

15,361 (1918) and 9969 (1919). Hughes. Apparatus for annealing glass. (132,852.) Oct. 8.

15,590 (1918). Webster. Kilns for burning clay products, glazed ware, and pottery. (133,128.) Oct. 15.

IX.—BUILDING MATERIALS.

APPLICATION.

Iwerson. Artificial marble. 24,793. Oct. 10. (Denmark, 29.5.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

5938 (1916). Sanders and Sanders. Treatment of articles or plastering containing cement or lime trass mortar. (102,042.). Oct. 8.

15,431 (1918). Auden. *See* VII.

17,717 (1918). Baarnhielm. Manufacture of cement. (121,728.) Oct. 15.

10,605 (1919). Otto. Treatment of wood for seasoning it. (133,263.) Oct. 15.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Ashcroft. Treatment of metal-bearing ores etc. 23,960. Sep. 30.

Balfour, Bray, and British Oxygen Co. Furnaces or retorts for subjecting ores etc. to the action of gases etc. 24,721. Oct. 9.

Carter and McLain. Open-hearth furnaces. 24,851. Oct. 10.

Electrolytic Zinc Co. Roasting zinc oxides preparatory to leaching. 24,711. Oct 9. (Australia, 7.11.18.)

Gasche. Ore-concentrating machine. 24,166. Oct. 3.

Hedley and Wrightson. Production of steel from iron ore. 23,918. Sep. 30.

Iverson. Solder for aluminium etc. 24,119. Oct. 6.

Morgan Crucible Co., and Speirs. Electrically heated melting etc. furnaces. 24,480. Oct. 7.

Priest. Continuous regenerative gas-fired kilns for burning ore-briquettes. 24,383. Oct. 6.

Complete Specifications Accepted.

7687 (1917). Marks (Soc. Anon. Ital. Ansaldo & Co.). Treatment of alloy steels. (133,069.) Oct. 15.

15,122 (1918). Alpha Products Co. Making castings of rare-earth metals. (119,241.) Oct. 8.

15,285 (1918). Mackenzie and Barclay. Casting, working, and other treatment of copper, steel, etc. (132,847.) Oct. 8.

15,555 (1918). Williams. Alloy. (132,872.) Oct. 8. metal with lead or its alloys. (133,179.) Oct. 15.

16,112 (1918). Ness. Electro-plating and electro-cleaning apparatus. (133,162.) Oct. 15.

16,695 (1918) Thompson and Morrison. Coating metal with lead or its alloys. (133,179). Oct. 15.

1461 (1919). Goldthorpe. Ore-roasting furnaces. (133,236.) Oct. 15.

7128 (1919). Clarke and Gregg. Aluminium alloys. (132,981.) Oct. 8.

14,332 (1919). Marks (Luckenbach Processes Inc.). Mineral selective agent. (133,277.) Oct. 15.

XI.—ELECTRO-CHEMISTRY.

Applications.

Boorne. Electrode, and process of making same. 23,949. Sep. 30.

Fuller, and Fuller's United Electric Works. Galvanic electric batteries. 24,680. Oct. 9.

Marks (Koehler Manufacturing Co.). Electric storage batteries. 24,027. Oct. 1.

Morgan Crucible Co., and Speirs. 24,480. *See* X.

Oldham, Oldham, and Oldham. Galvanic batteries. 24,718. Oct. 9.

Perrett and Wilson. Means for purifying liquids by electricity. 24,502. Oct. 7.

Complete Specifications Accepted.

2368 (1918). British Thomson-Houston Co. (General Electric Co.). Electric furnaces. (133,092.) Oct. 15.

4446 (1918). Reid. Electrical furnaces. (133,099.) Oct. 15.

15,600 (1918). Crosby. Electric furnaces. (132,879.) Oct. 8.

16,112 (1918). Ness. *See* X.

XII. FATS; OILS; WAXES.

Applications.

Bolton and Lush. Conversion of fatty acids or oils or fats containing free fatty acids into glycerides. 23,957. Sep. 30.

Newth. Detergent composition. 23,594. Oct. 8.

Complete Specification Accepted.

11,252 (1917). Dehn (Colwell Corporation). Extracting oils, fats, and other greases from garbage, house offal, and other refuse. (133,075.) Oct. 15.

XIII. PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Emulsion Aktieselskabet. Manufacture of painting, priming, etc. compositions. 23,961. Sep. 30.

Isaacs. Coating-compositions or paints. 24,606. Oct. 8.

Melamid. Production of resin-like bodies. 24,916 and 24,917. Oct. 11. (Ger., 4.2.18.)

Soc. Coralex. Production of phenolic resins or esters. 23,958. Sep. 30. (Fr., 19.7.19.)

Walkey. 24,426. *See* VII.

Complete Specifications Accepted.

11,077 (1919). Gilmour, and Dunville and Co. Production of solutions of cellulose nitrates and celluloid suitable for use as lacquers or varnishes. (132,996.) Oct. 8.

11,187 (1919). Desachy. Conjoint manufacture of zinc sulphide and barium sulphate. (126,628.) Oct. 8.

XIV. INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Fitzgerald. Manufacturing substitutes for vulcanite, horn, ivory, etc. 24,181. Oct. 3.

Stevens. Vulcanisation of rubber, and treatment of vulcanised rubber. 24,333. Oct. 6.

XV. LEATHER; BONE; HORN; GLUE.

Applications.

Fitzgerald. 24,181. *See* XIV.

Long. Treatment of vegetable ivory. 23,935. Sep. 30.

Walsh (Stephens and Higginson). Continuous agitator for lime etc. liquors used in tanneries etc. 24,319. Oct. 6.

Complete Specifications Accepted.

15,496 (1918). Lamb. Detanning chrome leather for the manufacture of glue etc. and recovery of chrome compounds. (132,864.) Oct. 8.

15,969 (1918). Trenaman. Composition for waterproofing leather articles (121,587.) Oct. 8.

20,284 (1918). Dorr Co. Recovery of proteids from waste liquors of the hide-treating art. (123,974.) Oct. 15.

443 (1919). Walker, Exley, and Walker. Apparatus for waterproofing leather. (132,964.) Oct. 8.

XVI.—SOILS; FERTILISERS.

Applications.

Barbé. Process of granulating cyanamide. 24,039. Oct. 1. (Fr., 21.3.19.)

Kestner Evaporator and Engineering Co., and Reavell. Conversion of wash from distillery into fertiliser. 24,176. Oct. 3.

Poupart. Apparatus for enriching poor phosphates. 24,187. Oct. 3. (Fr., 20.6.17.)

XVIII.—FERMENTATION INDUSTRIES.

Application.

Kestner Evaporator and Engineering Co., and Reavell. 24,176. *See* XVI.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Bernard and Schmitt. Preservation of meat etc. 24,149. Oct. 3.

Flood and Griffiths. Means for churning, blending, or lumping margarine etc. 23,990. Oct. 1.

Howles and McDougall. Sheep and cattle dips and washes, and insecticides. 24,915. Oct. 11.

Höyberg. 24,823. *See* XXIII.

Jagger. Fish products. 24,393. Oct. 6.

Newth. Dodoriser. 24,572. Oct. 8.

Perrett and Wilson. 24,502. *See* XI.

Ruff. 24,371. *See* I.

Complete Specifications Accepted.

7104 (1918). Jones, and Jones and Attwood. Purification of sewage and other liquids. (132,826.) Oct. 8.

11,252 (1918). Dehn (Cobwell Corporation). *See* XII.

111 (1919). Powrie. Food product. (133,235.) Oct. 15.

8064 (1919). Hvorth. Preservation of food. (125,373.) Oct. 8.

13,350 (1919). Naaml. Vennoots. Machinefabriek Brons. Drying vegetables etc. (128,199.) Oct. 8.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

British and Foreign Chemical Producers, Ltd. (Rhein. Kampherfabrik). Manufacture of paracymene. 24,331 and 24,388. Oct. 6.

Wilde. Manufacture of aliphatic nitrates. 23,881. Sep. 29. (Fr., 28.9.18.)

Complete Specification Accepted.

16,830 (1918). Imray (Soc. Chem. Industry in Basle). Manufacture of vitamine preparations. (133,183.) Oct. 15.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Application.

Donisthorpe. Photographic printing. 23,910. Sept. 30.

Complete Specification Accepted.

15,194 (1918) Christensen. Manufacture of photographic plates and pictures. (132,846.) Oct. 8.

XXII.—EXPLOSIVES; MATCHES.

Applications.

Laan. Apparatus for stabilising nitrocellulose. 24,119. Oct. 2.

Muller. Manufacture of ammonium nitrate explosives. 24,120. Oct. 2.

Nobel's Explosives Co., Nolan, Rintoul, and Stickland. Explosives. 24,811. Oct. 10.

XXIII.—ANALYSIS.

Applications.

Höyberg. Estimating proportion of fat in milk or cream. 24,823. Oct. 10.

Williams and Williams. Determining composition of gases. 24,005. Oct. 1.

Complete Specification Accepted.

11,387 (1914). Railing and Green. Photometer. Oct. 15.

I.—GENERAL; PLANT; MACHINERY.

Stoneware; Practical notes on the use of —— in industry. M. Kaltenbach. Chim. et Ind., 1919, 2, 899—913.

The author discusses at length the advantages and limitations of stoneware apparatus, conduits, etc., for chemical purposes, and the precautions that must be observed in erection. The selection of a suitable cement for making joints is very important and depends largely on the material for which the plant is to be used. For acid substances asbestos water-glass cement is very generally useful. A tar cement is composed of 3 parts of powdered clay, 1 part of ground stoneware, and tar to make a stiff mortar. It is applied warm. To resist nitric or hydrochloric acid vapours a mixture of 1 part of resin, 1 part of sulphur, and 2 parts of volvic lava powder can be employed. For stoneware-metal joints, molten sulphur, or a cement composed of 20 parts of fine sand, 2 parts of litharge, 1 part of quicklime, and linseed oil is available. A useful acid-resisting rubber cement is made by treating scrap rubber, old rubber stoppers, etc., in boiled linseed oil until a homogeneous mass is obtained.
—G. F. M.

Mercury pump; Self-acting ——. A. Stock. Z. Elektrochem., 1917, 23, 35—40.

A self-acting mercury pump, on the Toepler principle, is described, which permits the collection of the gases pumped off. The movable mercury reservoir is replaced by a strong three-necked bottle into which the foot of the pump passes. The mercury is raised by means of air or carbon dioxide under pressure until the pump is full, then by valves actuated by the mercury the pressure is cut off and the mercury falls again. The pump has the advantage, in addition to the ease of operation, that the mercury does not become contaminated with impurities from rubber connections.—J. F. S.

Valve; Grease-tree —— for gases. A. Stock. Z. Elektrochem., 1917, 23, 33—35.

A modification of the floating valve previously described (Ber., 1914, 47, 3112) is given. This consists of a pair of narrow tubes ground to fit a constriction in each of two connected parallel tubes. On raising a mercury reservoir connected with the tubes the valves are raised and close the apparatus. The action is similar to that of the valve in a Toepler pump. Three forms of valve are described which are designed for use in working with gases which have a chemical action on the lubricant used with glass taps. These valves are made of a porous material which will allow the passage of gases but not of mercury, so that when the valve is in contact with mercury no gas can pass. The valves are fitted into the glass parts of apparatus by ground joints. They may be used in the production of high vacua and exhibit no tendency to absorb gases, but are rather slow in action.
—J. F. S.

Vallez filter. Naudet. *See* XVII.

Patents.

Furnaces [for low-grade fuel]. J. A. Hope, London. Eng. Pat. 11,284, 4.8.15.

There are no firebars fitted to the furnace, and the (firebrick) floor is set very low and is provided with water-cooled conduits which supply air under pressure through small holes at the bottom of the bed of fuel. Air is also supplied under pressure above the fire-door and beyond the fire-bridge. Baffles are placed in the flue so as thoroughly to mix the half-burnt gases and air, and the air for combustion is preheated in tubes heated by the waste gases.—B. M. V.

Atomisers and burners; Combined —— for liquid fuels. A. E. Windle, Birmingham. Eng. Pat. 132,286. (Appls. 9166, 4.6.18, and 18,726, 15.11.18.)

Liquid fuel after filtration enters an atomiser through slits in its periphery and flows on to and around the inner periphery of a transverse passage through which air under pressure is supplied. The oil is carried forward in small particles by the stream of compressed air and passes on through a nozzle pipe leading into the furnace and surrounded by an induction pipe with a trumpet-shaped inlet, through which the necessary additional amount of air for complete combustion is drawn in. The burner is suitable for heavy oils, such as mixtures of pitch and creosote.—T. H. B.

Oil-fired furnaces, and injector burner therefor. Brayshaw Furnaces and Tools, Ltd., and S. N. Brayshaw, Manchester. Eng. Pat. 132,421, 30.12.18. (Appl. 21,701/18.)

An oil burner or injector specially suitable for thick oils, such as mixtures of tar and creosote, comprises a vertical inlet pipe for air under pressure entering the top of the vertical member of an L-shaped combustion chamber and an inclined oil inlet pipe provided with a funnel to receive the oil; an oil supply valve is mounted above the funnel to provide a sight feed for the oil. The horizontal member of the combustion chamber enters the side of the furnace.—T. H. B.

Kilns or furnaces. W. L. H. Roberts, Rochester. Eng. Pat. 132,350, 11.9.18. (Appl. 14,791/18.)

The furnace is designed to supersede rotary furnaces and those in which a stirrer is used. It is suspended from its top or is mounted in a suspended cradle, and is oscillated to and fro.
—J. H. P.

Furnace; Continuous —— and process of regulating atmospheric conditions in furnaces. C. P. Wood, New York. U.S. Pat. 1,297,629, 18.3.19. Appl., 19.9.17.

Combustible gas is passed through a cooling zone of a horizontal furnace to a combustion zone, at the forward end of which air is admitted to maintain combustion. The combustion products then pass through a preheating zone. Air-locks are provided at both ends of the furnace to prevent access of air while material is introduced or removed. The air-lock at the exit of the furnace may be regulated so as to maintain any desired conditions within the furnace.—W. F. F.

Furnace. I. Risdon, Seattle, Wash. U.S. Pat. 1,315,158, 2.9.19. Appl., 31.3.17.

The furnace is provided with an opening in its front wall, through which a horizontal double-walled member projects into the combustion chamber. Fuel is fed by a helical conveyor through the double-walled member on to the floor of the combustion chamber, which is provided with apertures. An air chamber is provided below the floor of the combustion chamber and has wings extending upwards and enclosing the side walls. Air is delivered through the annular space of the double-walled member and the aforesaid wings to the air chamber below the floor of the combustion chamber.
—W. F. F.

Furnace. A. L. Stevens, Chicago, Ill. U.S. Pat. 1,315,252, 9.9.19. Appl., 26.6.16.

Air and gas are introduced through a number of

inlet ports spaced apart on one side of a long, narrow combustion chamber, and the gaseous products of combustion are discharged through a corresponding number of ports on the opposite side of the chamber, spaced apart in staggered relation to the inlet ports, so that the furnace chamber is heated by a number of separately induced currents of burning gas.—W. H. C.

Furnace. L. L. Knox, Bellevue, Assignor to Blaw-Knox Co., Pittsburgh, Pa. U.S. Pat. 1,315,971. 16.9.19. Appl., 3.4.18.

THE combustion chamber of the furnace is formed with opposite inwardly projecting "monkey walls," in which are seated hollow cooling members. These members have portions projecting upwards through and above the roof of the chamber. Means are provided for causing an upward flow of cooling medium through the members, the projecting portions of which are exposed for air cooling.—J. H. P.

Retort; Continuous-action ——. H. P. Bassett, Cynthiana, Ky., Assignor to C. C. Meigs, Philadelphia, Pa., and C. L. Parker, Washington, D.C. U.S. Pat. 1,314,849, 2.9.19. Appl., 17.9.18.

A HEATED rotating drum is provided with a screw conveyor or other feeder at the inlet trunnion, and to help the discharge of material through the hollow outlet trunnion approximately radial vanes are fixed inside the drum at the outlet end.—B. M. V.

Centrifugal separators. R. S. Brownlow, Manchester. Eng. Pat. 132,291, 11.6.18. (Appl. 9555/18.)

A CENTRIFUGAL separator is provided with a plain or annular disc or piston which can be raised by mechanical means, disposed outside the drum, in order to discharge solids over the upper edge of the drum, while the separator is in motion.—J. H. P.

Refrigerating apparatus. C. Cortesi, Menton, France. Eng. Pat. 132,360, 14.9.18. (Appl. 14,996/18.)

AN easily vaporisable liquid is conveyed under low pressure to the top of a refrigerator, passes through a perforated diaphragm, and falls as a fine rain upon brine pipes in the lower portion of the refrigerator. Nearly all the liquid is thus vaporised and passes up by a side compartment in the refrigerator to a pump or ejector, which forces it under high pressure to the condenser. The condenser is connected with the base of the refrigerator by way of a small tank provided with a ball cock which operates to keep the unvaporised liquid in the refrigerator at a suitable level. The pipes from the ball-cock tank and the base of the refrigerator both lead to a lifting ejector, which is worked by air (a small quantity is left in the circuit on purpose) taken from the condenser and returns the liquid to the top of the refrigerator without raising its pressure or temperature to any noticeable extent. Instead of the ejector a pulsometer device may be used.—B. M. V.

Refrigeration apparatus. H. H. Carpenter, Altadena, Cal. U.S. Pat. 1,315,282, 9.9.19. Appl., 1.12.16.

A ROTARY condenser comprising a closed shell contains a compressor cylinder within and rotating with it. The lubricant and the refrigerating medium are separated centrifugally by the rotation of the shell and collected in grooved troughs. A collecting device is provided for each trough whereby the lubricant and refrigerant are transferred to a reservoir within the shell.—W. F. F.

Cooling plant with means for recovering heat. E. Roser, Mühlheim, Germany. Ger. Pat. 311,638, 27.5.16.

THE process is carried out in two units. In the first cooling takes place in presence of very little air, and much of the heat is recovered. The cooled liquid is then further cooled in a second unit with excess of air. The process is applicable to the crystallisation of salts from their solutions, the heat regained being available for heating the solutions.—W. J. W.

Towers for cooling water and other liquids. W. Hobhouse, Bradford. Eng. Pat. 132,445, 7.3.19. (Appl. 5637/19.)

IN a water cooling tower the laths or drip bars and their bearers are arranged at such an angle that the descending water strikes the drip bars or bearers at an angle of about 45°, and the air also passes through the structure at an angle of about 45° to the surfaces.—J. H. P.

Transporting grain and granular materials; Pneumatic apparatus for ——. Henry Simon, Ltd., and C. Bentham, Manchester. Eng. Pat. 132,623, 25.9.18. (Appl. 15,556/18.)

IN a pneumatic suction apparatus for transporting grain or other materials, instead of exhausting the dust-laden used air to the atmosphere or to a cyclone or other separator, it is returned (under pressure produced by the same fan as the vacuum) to the bulk of the material being transported by means of a pipe, which may be pervious to air but not to dust so as to allow a portion of the used air to escape. The pipe ends in a nozzle which preferably takes the form of a sleeve round the suction nozzle, so that some of the dust passes out with the grain, whilst the remainder is kept in circulation.—B. M. V.

Mixing of aggregates for concrete and similar materials; Apparatus for ——. T. Lea, Wolverhampton. Eng. Pat. 132,652, 16.10.18. (Appl. 16,856/18.)

A CIRCULAR pan with flat bottom is provided with a stirrer consisting of arms supported by rollers running on the edge of the pan and carrying vanes which are inclined at an angle so that the material is given a radial movement (in either direction as desired) as well as a circumferential one; the bottom edges of the vanes are bent so as to turn the material over well.—B. M. V.

Liquids [e.g., varnish, oil, fruit juice]; Process for refining ——. E. E. Ayres, jun., Chester, Pa., Assignor to Sharples Specialty Co., West Chester, Pa. U.S. Pat. 1,297,635, 18.3.19. Appl., 3.10.17.

A LIQUID containing solid matter, *e.g.*, varnish, oil, or fruit juice, is heated and an inert substance added which is adapted to combine with the solid matter. The mixture is then separated into layers by centrifugal action. Varnish may be clarified by heating it with 0·5% of kieselguhr to about 70° C., stirring, allowing to settle, and centrifuging.—W. F. F.

Polymerising liquids by means of heat and pressure; Apparatus for ——. F. W. Sperr, jun., Pittsburgh, and M. Darrin, Wilkinsburg, Assignors to The Koppers Co., Pittsburgh, Pa. U.S. Pat. 1,314,613, 2.9.19. Appl., 22.8.18.

THE apparatus comprises an autoclave and a chequerwork furnace with a number of pipes set therein. A pump circulates liquid through and maintains pressure in the autoclave and is connected to the autoclave pipes through a heat exchanger through which also the outlet from the pipes passes. The outcoming liquid, after passing

through the heat-exchanger, may either be discharged or passed back to a reservoir for re-circulation.—J. H. P.

Gas and steam generator; Combined ——. A. J. Bassett and J. E. Sharp, Assignors to Milwaukee Reliance Boiler Works, Milwaukee, Wis. U.S. Pat. 1,314,630, 2.9.19. Appl., 13.7.17.

A FURNACE is disposed beneath a gas generator chamber, the side and top of which are surrounded by a steam-generating jacket. A steam dome is provided on the jacket, and a preheating chamber furnished with water and gas spaces is disposed within the jacket below the water level. A pipe connects the water spaces of the preheating chamber with the lower portion of the steam-generating jacket. The flow of water through the water spaces is controlled by means of a valve. A flue extends from the gas-generating chamber to the gas spaces of the preheating chamber, and a delivery flue extends from the latter. Means are provided for controlling the level of water in the jacket, and an operative connection is arranged between such level-control device and the valve of the inlet pipe of the preheating chamber.—J. S. G. T.

Absorption or concentrating plant. I. Hechenbleikner, Assignor to Chemical Construction Co., Charlotte, N.C. U.S. Pat. 1,314,802, 2.9.19. Appl., 31.10.18.

SEVERAL absorption towers are used in series, and the liquid flows slowly from tower to tower at their bases, but each tower has its own circulating pump which lifts the liquid rapidly from the base to the top of the same tower. The gases for reacting with or concentrating the liquid flow in the same general direction as the liquid, but up one tower and down the next alternately.—B. M. V.

Solutions; Process of concentrating ——. P. Westin, Stockholm. U.S. Pat. 1,315,889, 9.9.19. Appl., 28.2.19.

THE solution to be concentrated is mixed with an absorbent material and the mixture dried at a temperature sufficiently low to prevent charring. This is repeated until the absorbent material contains a sufficient proportion of the dried residue.
—W. F. F.

Dryer. A. Wertenbruch, Detroit, Mich., Assignor to the Larrowe Milling Co., Cohocton, N.Y. U.S. Pat. 1,314,994, 2.9.19. Appl., 16.7.17.

A DRYER of the rotating cylinder type is subdivided by a series of sections independently removable from the drum, and is divided into inner and outer compartments which communicate at the end only of the cylinder by means mounted on the sections.—B. M. V.

Drying apparatus [for liquids]. F. A. Secord, Assignor to A. P. Paterson and C. H. Peters, St. John, New Brunswick, Canada. U.S. Pat. 1,315,530, 9.9.19. Appl., 15.3.17.

THE liquid to be dried flows from a conduit over a number of hollow perforated supports arranged on either side of the conduit.—W. H. C.

Acid-tank. W. J. Russell, Detroit, Mich. U.S. Pat. 1,315,241, 9.9.19. Appl., 12.12.18.

THE tank has an inner wall, spaced apart from, but supported by the outer wall, and the space between the two walls is filled with an acid-resisting material of low melting point.—W. H. C.

***Heat treatment of finely divided material; Method and apparatus for* ——.** **E. O. Blackwell, Englewood, N.J., and N. H. Emmons, New York. U.S. Pat. 1,315,460, 9.9.19. Appl., 12.4.18.**

THE finely divided material is injected into an atmosphere of highly heated gases in a chamber which increases in cross-section away from the inlet. The velocity of the material is thus lowered, and it falls to the hearth upon a layer of previously heated material and remains exposed in the solid state to the heat of the gases until covered by a further layer of material.—B. M. V.

Ball or tube mill. N. L. Hall, Anaconda, Mont. U.S. Pat. 1,315,770, 9.9.19. Appl., 26.11.17.

A BALL or tube mill is provided with a longitudinal non-perforated diaphragm extending from near the inlet to near the outlet apertures of the mill.
—B. M. V.

Ball-mill; Centralised ——. M. J. Barnett, San Francisco, Cal. U.S. Pat. 1,316,670, 23.9.19. Appl., 5.7.18.

MATERIAL is crushed in an annular channel by a series of crushing balls rolling therein. An annular driving device rests on the balls and is driven by a central rotating vertical shaft carrying arms which are connected to the driving device by links arranged symmetrically.—W. F. F.

Grinding-mill. Grinding machine. W. G. Stevenson, Chicago, Ill. U.S. Pats. (A) 1,316,859 and (B) 1,316,860, 23.9.19. Appl., 27.3.19 and 5.10.18.

(A) A GRINDING pan is supported from a vertical rotating shaft by a yielding connection, and the shaft is carried by a frame in which the grinding rolls are journalled on horizontal axes so as to be in rolling engagement with the bottom of the grinding pan. (B) A rotary grinding table is provided with an outer retaining wall, and with a stationary concentric inner wall surrounding the central part of the table. The grinding rollers are situated between the two walls. The inner wall has an opening controlled by a gate, and deflector plates are provided to direct material through the opening into the central space when the gate is open, and to direct it outwards on to the table when the gate is closed. A discharge passage is provided in the central part of the table.—W. F. F.

Sizing and separating comminuted material; Process of and apparatus for ——. *Process of and apparatus for separating and grading material.* H. M. Sutton, W. L. and E. G. Steele, Dallas, Tex. U.S. Pats. 1,315,880 and 1,315,881, 9.9.19. Appl., 26.10.14 and 19.5.15.

THE material is fed on to one end of a table which slopes downwards towards the other end and also towards one side, and which decreases in width from the feed end towards the opposite end. The material is subjected to the action of a gaseous cushioning medium, which causes it to stratify. The heavier particles are subjected to a propelling force transversely to the line of flow and against the action of gravity, and the travel of these particles is impeded by an obstruction. The lighter particles are permitted to move in the opposite direction under the action of gravity. The separated and graded material is collected. The apparatus is suitable for the separation of gangue and concentrates.—W. F. F.

Separator. G. H. Fraser, Brooklyn, N.Y. U.S. Pats. 1,317,014 and 1,317,015, 23.9.19. Appl., 27.8.14 and 28.8.14. Both renewed 18.12.18.

MATERIAL is caused to descend in an annular path in a casing where it meets a fluid current flowing in a direction at right angles to such path. A set of inclined baffles are provided surrounding the annular path and providing a sinuous passage for the fluid in succession to the annular path. Coarse particles are extracted in the sinuous passage and the fluid then passes into an annular settling chamber which is also in communication with the space within the annular path. A central outlet is

Benzol and benzol mixtures; Use of —— as motor fuel. J. C. Mackie. Canadian Chem. J., 1919, 3, 295—297.

COMPARATIVE analyses of the exhaust gas obtained with petrol and a benzol mixture as motor fuel are given, the tests being made at the same engine speed (about 17 miles per hour) and with various settings of the carburettor needle valve. The benzol mixture, termed "disco fuel," consisted of 72% benzol, 21% toluol, and 7% solvent naphtha. For all ordinary settings of the needle valve the exhaust gases from the benzol tests contained more carbon dioxide, more free oxygen, and less carbon monoxide than those from the petrol tests. When, however, the valve was open 540° the carbon monoxide was higher in the benzol exhaust gas, owing to the higher ratio of carbon to hydrogen in the benzol mixture than in petrol. Other tests were made to determine the effect of various adjustments of the cold air inlet to the carburettor, leaving the needle valve unaltered, and the results indicated that no alteration of carburettor was necessary in changing from petrol to benzol mixtures. A test under extreme conditions, with the engine speed as before, in a garage heated to 110° F. (43° C.) and with the cold air inlet to the carburettor closed, showed that even under such conditions the combustion was more complete with the benzol, and the same conclusion was drawn from tests in which the speed of the engine was varied, and under actual driving conditions on the level and climbing a hill. Benzol is superior to petrol as regards the power developed by the engine and the mileage obtained per gallon. It has the further advantage that the spark lever can be left in the advanced position, even when the engine is at low speed, without any of the trouble due to premature explosion. The one disadvantage of benzol fuels, as normally obtained from gas, is their relatively high freezing point. This could be obviated by blending them with sufficient petrol (*e.g.*, 50%) to give a suitable winter fuel, or by the addition of a larger proportion of toluol or xylol to the benzol.—C. A. M.

Petroleum distilling plants; Corrosion in ——. M. Freund. Chem.-Zeit., 1919, 43, 587—588.

IT is well known that the condenser coils in petroleum stills undergo corrosion very quickly. Samples of condensed water withdrawn at intervals during the distillation of Boryslaw crude oil contained iron varying between 0·616 and 0·168 grm. per litre, and during a steam distillation which used 14 cub. m. of water there was dissolved 4 kilos. of iron. The iron in the condensed water occurs as chloride, and hence the corrosion is due to hydrogen chloride derived from sodium chloride in the water emulsified in the oil. From Moreni crude oil the maximum chlorine content per litre of condensed water was 0·625 grm. in the earlier stages of the distillation. Free carbon dioxide is evolved during the distillation of Moreni crude oil, and the percentage present in the total gases increases with the temperature. Crude oil also contains water-soluble aliphatic acids (formic, acetic, valeric, and oxalic acids) which on distillation cause corrosion. The condensed water always contains traces of sulphuric acid and sulphates derived from the original thio-derivatives of the oil, although the water which accompanies the oil in nature is free from sulphate.—A. E. D.

Vaseline; Analysis of ——. G. Armanni and A. G. Rodano. Annali Chim. Appl., 1919, 12, 50—51.

ONE grm. of the sample is heated with 20 c.c. of a mixture of equal parts of benzene and absolute alcohol, and the tube containing the clear solution is left for 24 hours in a cold place. In the case of "natural vaseline" a few oily drops will separate at the bottom of the solution, whereas "artificial vaseline" yields a flocculent or crystalline deposit similar to paraffin wax. An approximate estimate of the amount of "artificial vaseline" present may be formed from the quantity of the deposit, and the method will detect less than 20% of the artificial product.—C. A. M.

Petroleum; Waste lyes and washings from the refining of ——. F. Schulz. Petroleum, 1919, 14, 654—658, 711—718. Chem. Zentr., 1919, 90, IV., 97.

THE waste liquids from the refining of petroleum oil consist of clear lyes, viscid emulsions, and washings. The waste lyes contain, in addition to inorganic salts, salts of naphthenic acids, sulpho acids, and ethylsulphuric acid, together with hydrocarbons in colloidal solution. The organic substances consisted of 25 to 80% of hydrocarbons, and varied in amount from 4 to 80 grms. per litre in the lyes examined. On acidification of certain lyes the organic substances are quantitatively separated; in other cases there is only partial separation, or none at all. Sodium chloride is the only salt suitable for "salting out" the lyes. In the case of petroleum spirit lyes "salting out" only effects incomplete separation of organic substances, but over 99% of the organic matter in the lyes from the treatment of higher fractions can thus be separated. The waste emulsions consist of salts of petroleum acids with iron, aluminium, calcium, and magnesium. These salts are insoluble in water, but form viscid colloidal mixtures with the oil. On adding water to the mixtures milky washings are produced, which can only be clarified by treatment with acid.—C. A. M.

Bituminous road material. Lord. *See* IX.

PATENTS.

Fuel. C. Gonville, Stratford. Eng. Pat. 132,418, 20.12.18. (Appl. 21,378/18.)

HEATED pitch (30%) is incorporated in a heated mixer with substantially 20% of coke breeze, 40% of peat, 5% of sawdust, and 5% of coal dust, and the mixture is pressed into blocks.—T. H. B.

Fuel; Apparatus for burning pulverised ——. C. J. Gadd, Lebanon, Pa., A. E. Gadd, executrix. U.S. Pat. 1,314,740, 2.9.19. Appl., 3.12.15. Renewed 25.4.19.

Two co-axial air-supply pipes terminate in two co-axial discharge nozzles, and spaced ball-and-socket jointed connections between the nozzles and the respective pipes are provided, so that the contents of the two pipes may be separately controlled as far as the end of one of the nozzles.—T. H. B.

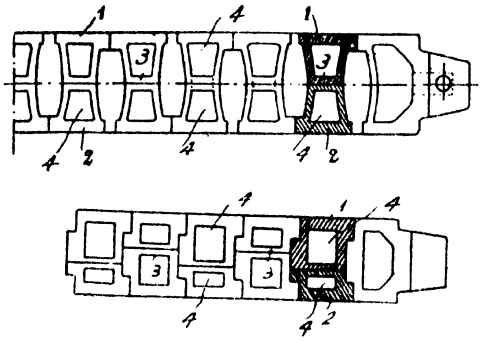
Coal; Apparatus for burning powdered ——. A. J. Grindle, Assignor to Combustion Economy Corp., Chicago, Ill. U.S. Pat. 1,315,719, 9.9.19. Appl., 7.7.16.

THE apparatus comprises a burner, a tubular mixing chamber delivering to the burner, and air supply pipes delivering to the mixing chamber. The mixing chamber is provided with two sets of oppositely inclined blades, those of one set being arranged in an annular series adjacent to the wall of the chamber, and those of the other set located within the space enclosed by the annular series of blades, so that the two sets of blades act simultaneously but independently upon different parts of the air and fuel current passing through the mixing chamber.—T. H. B.

Coke ovens. O. Piette, Brussels. Eng. Pat. 120,201, 10.9.18. (Appl. 14,725/18.)

THE heating walls of the oven consist of hollow firebricks of high mechanical resistance, juxtaposed

in pairs, 1, 2, and interengaging to form transverse series of pairs of parallel heating channels, 4, the walls of the bricks being relatively thin to



ensure good heat transmission. The inner partition, 3, of each juxtaposed pair is so disposed that it can be cut through if desirable to form a single heating channel through each pair.
—T. H. B.

Coke-oven gas; Semi-direct process of treating ——. O. Piette, Assignor to Soc. Franco-Belge de Fours à Coke, Brussels. U.S. Pat. 1,315,639, 9.9.19. Appl., 4.12.18.

IN the semi-direct process of recovering ammonia from coke-oven gas, gas containing ammonia is withdrawn from the ammonia still at about 90° C., heated, mixed with cool coke-oven gas, and the mixture passed into sulphuric acid.—J. S. G. T.

Oil-gas producer for use in internal-combustion engines. E. A. West and E. E. Parsons, Cleveland, Ohio, U.S.A. Eng. Pat. 118,622, 12.8.18. (Appl. 13,068/18.) Int. Conv., 16.8.17.

THE liquid fuel supply conduit leads into a generating chamber, and is provided with a through port having one branch directed towards the air inlet to the chamber and the other towards the outlet. The chamber contains a preheating device between the fuel conduit and the air inlet, and ignition is effected between the conduit and the air outlet. The gases pass into a mixing chamber. An extinguisher for preventing the flame passing through into the mixing chamber consists of a number of separated discs provided with openings arranged out of alinement with each other. Means are provided for operating the fuel supply valve in unison with the valve controlling the admission of air to the mixing chamber.—W. P.

Suction gas plant. W. Hart, Haberfield, N.S.W. Eng. Pat. 120,717, 9.9.18. (Appl. 14,628/18.) Int. Conv., 8.3.18.

THE combustion zone below the hopper of a suction gas producer is surrounded by a circumferential gas chamber, which contains a vaporiser heating-coil, through which water passes; the steam is discharged below the fire-bars of the generator, whence the air supply carries it upwards into the combustion zone. The invention is specially applicable to producers of the type adapted to generate gas for use in engines of self-propelled vehicles.
—W. P.

Gas producers. Chapman Engineering Co., Mt. Vernon, Ohio, Assignees of W. B. Chapman, New York. Eng. Pat. 125,932, 12.8.18. (Appl. 13,072/18.) Int. Conv., 20.4.18.

IN a method of agitating the fuel bed in a gas producer, relative rotative movement is produced between the means for supporting the fuel bed and a vertically movable agitator extending into the fuel, so that the charge can be agitated to a greater or less depth dependent upon the nature of the upper layer of the bed. Means are provided for mechanically feeding coal to the fuel bed so as to effect a uniform rate of supply and distribution.
—W. P.

Gas production from carbonaceous substances; Apparatus for ——. H. Fehn, Helmstedt. Ger. Pat. 310,835, 13.4.15.

IN vertical retorts for the gasification of lignite, wood, peat, and similar carbonaceous substances, the moisture and gases are withdrawn under reduced pressure through a central perforated tube leading down into the fuel bed, an adjustable plug in this tube enabling the products to be withdrawn from different zones or through separate channels at different stages of heating.—W. P.

Gas cleaning apparatus. A. J. Liversedge, London, and W. B. Davidson, Huddersfield. Eng. Pat. 132,586. (Appls. 13,938, 27.8.18, and 1267, 17.1.19.)

A CENTRIFUGAL gas-cleaning appliance is furnished with vanes bent over or so formed at the tips as to provide channel-shaped gutters at their outer ends. The tarry matters in the gas are forced outwards by centrifugal action, and are caught in these gutters, which are shaped so as to collect the tar at one end, whence it is discharged into a main collecting gutter. The channel-shaped gutters prevent the tar being thrown against the wall of the container, whence it might be carried on again by the gas. A jet of steam or water may be directed into the stream of gas as it flows through the cleaner.—W. P.

Gas-cleaning apparatus. H. J. Freyn, Assignor to Freyn and Co., Chicago, Ill. U.S. Pat. 1,316,091, 16.9.19. Appl., 19.2.17.

THE apparatus comprises a vessel containing a number of rows of baffles, the baffles in each row being set at an angle to those in the adjacent row. Means are provided for scraping the baffles.—W. P.

Gas purifier. F. E. Modlin, Fort Worth, Tex., Assignor to P. E. Miller, Tarrant County, Tex. U.S. Pat. 1,316,330, 16.9.19. Appl., 28.12.17.

A CASING having a gas inlet at the top of one end and an outlet at the bottom of the opposite end contains oppositely inclined shelves, one above the other, which carry vertical baffle plates above and below, upward and downward baffles alternating. Baffles are also provided on the top and bottom walls of the casing. Tar or the like separated from the gas drains down the inclined shelves through perforations in the baffles, and on to the bottom of the casing, which slopes downwards to a drain pipe.
—W. P.

Hydrocarbons; Method of distilling —— or converting into products of lower boiling point. L. Clark, Pasadena, Cal., U.S.A. Eng. Pat. 132,377, 9.9.18. (Appl, 14,658/18.)

THE products of combustion of oil or gas are passed under pressure into and through a small pipe in alinement with the combustion chamber. The oil to be treated is fed into the pipe at right angles to the path of the hot gases, and is simultaneously carried forward and acted upon therein.—A. E. D.

Filters [for gasoline]. M. G. Burris, Dartmouth, Nova Scotia. Eng. Pat. 132,696, 2.1.19. (Appl. 158/19.)

A SEDIMENT container fitted with an inlet pipe, a return flow pipe, and a drainage valve is attached to the lower end of a metal cylinder, and an outlet pipe extending the length of the cylinder passes through a cap at the upper end. The portion of the outlet pipe within the cylinder is perforated,

and is surrounded by a corrugated and perforated sleeve over which is stretched a tubular strainer of chamois. Both ends of the strainer are bound closely to the pipe, and the lower end of the pipe is closed by a cap. Gasoline is pumped into the filter through the inlet pipe, passes up the cylinder, through the strainer, and leaves the apparatus through the outlet pipe. When pumping ceases, any sediment which has collected on the strainer falls to the bottom of the container and may be removed.—L. A. C.

Petroleum oils; Process for the treatment of ——. E. B. Cobb, Jersey City, N.J., Assignor to Standard Oil Co. U.S. Pat. 1,315,623, 9.9.19. Appl., 2.8.17.

Oils are treated with sulphuric acid and alkali, and the resulting impurities are removed from the oil by the action of glycerin.—A. E. D.

Crude-oil separator. W. P. Lawrence, Quinlan, Assignor to S. E. Dunnam, L. T. Barnett, and G. N. Cooke, Hunt County, Tex. U.S. Pat. 1,315,632, 9.9.19. Appl., 19.5.19.

A heating coil for crude oil is contained in the lower part of the separator, which is provided with baffles, on to which hot oil is discharged. Provision is made for the removal of vapour and for the overflow of the heated oil which accumulates in the separator at a level above that of the coil.—A. E. D.

Gasoline; Apparatus for making —— from crude oil. P. Danckwardt, Denver, Colo. U.S. Pat. 1,317,077, 23.9.19. Appl., 27.8.17.

A still for the production of gasoline from crude oil is provided with electrodes and with an elevator placed outside the still for transferring material from the lower to the upper portion of the still; a container is also attached to the still, and means are provided for transferring material from the container to the lower end of the still and from the lower end of the still to the lower end of the container.—L. A. C.

Pulverulent fuel; Feeding devices for ——. Motala Verkstads Nya Aktiebolag, Motala Verkstad, Sweden. Eng. Pat. 121,275, 11.9.18. (Appl. 14,802/18.) Int. Conv., 6.12.17.

Artificial-fuel machine. J. Schaub, Newark, N.J., Assignor to American Linseed Co. U.S. Pat. 1,314,984, 2.9.19. Appl., 17.7.17.

See Eng. Pat. 117,635 of 1918; this J., 1919, 619A.

Mixing and proportioning gases for combustion; Methods of and apparatus for ——. A. E. Alexander, London. From Surface Combustion Co., Inc., Long Island City, N.Y., U.S.A. Eng. Pat. 132,545, 3.12.17. (Appl. 17,855/17.)

See U.S. Pats. 1,294,781 and 1,295,085 of 1919; this J., 1919, 566A.

Gas-producer. T. R. Wollaston, Manchester. U.S. Pat. 1,315,269, 9.9.19. Appl., 19.1.18.

See Eng. Pat. 111,964 of 1917; this J., 1918, 49A.

Gas-producers and the like; By-product recovery from ——. N. Testrup, London, and T. Rigby, Dumfries. U.S. Pat. 1,316,339, 16.9.9. Appl., 7.3.16.

See Eng. Pat. 3677 of 1915; this J., 1916, 462.

Gases; Treatment of —— obtained from coal and other carbonaceous substances [to recover cyanogen compounds]. E. V. Espenhahn, Brighton, Victoria. U.S. Pat. 1,315,219, 9.9.19. Appl., 6.7.17.

See Eng. Pat. 109,254 of 1917; this J., 1918, 570A.

Distillation of liquid hydrocarbons and apparatus therefor. J. H. Corthesy, Assignor to S. T. S. Castelli, London. U.S. Pat. 1,316,770, 23.9.19. Appl., 29.4.19.

See Eng. Pat. 127,690 of 1918; this J., 1919, 526A.

Burners for liquid fuels. Eng. Pat. 132,286. *See* I.

Oil-fired furnaces. Eng. Pat. 132,421. *See* I.

Gas and steam generator. U.S. Pat. 1,314,630. *See* I.

Sulphur dioxide. Eng. Pat. 132,387. *See* VII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Hemp waste; Distillation of ——. G. Scagliarini and T. Minganti. Annali Chim. Appl., 1919, 12, 52—53.

It is estimated that about 500 million kilos. of hemp waste per annum is produced in Italy. Samples distilled in an iron laboratory retort between 350° and 400° C. yielded gas containing CO_2 26·3, CO 25·5, CH_4 8·0, and H_2 14·0%. The liquid products consisted of 50·8% of pyroligneous acid, with traces of ammonia, a small amount of methyl alcohol, and from 5 to 6% of tar. The tar was composed of 57·55% of water, 2·35% of oil distilling at 100° C., 1·09% at 100° to 170° C., 14·50% at 170° to 230° C., and 24·47% of residue. The solid products consisted of 57·02% of charcoal containing 5·10% of ash. The charcoal is porous, and has pronounced decolorising properties.—C. A. M.

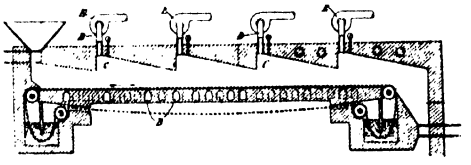
Metal-vapour arcs. Podszus. *See* XI.

Mixtures of acetone and methyl ethyl ketone. Price. *See* XX.

Patents.

Distillation of coal, shale and other like substances; Furnaces for ——. F. A. Anderson, London, M. Deacon, Matlock, and N. P. W. Brady, London. Eng. Pats. (A) 132,576, and (B) 132,744, 14.8.18. (Appls. 13,221/18 and 10,624/19.)

(A) Coal, shale, or like substance is caused to traverse a closed furnace chamber wherein it is subjected to successively increasing temperatures up to



a maximum and subsequently cooled gradually to a lower temperature in its continued progress through the chamber. The chamber is heated by a sinuous flue or duct, B, below, the flow of heat being in the opposite direction to the travel of the charge. A belt conveyor is arranged upon the floor of the chamber, the return path of the conveyor being external to the furnace. The conveyor enters and leaves the chamber by way of liquid seals. (B) In furnaces constructed so that coal, shale, and the like may be subjected to heat treatment as in (A), the roof of the furnace is provided with inverted pockets, C, for the collection of the various distillates. One or more of the pockets are provided with a sloping roof whose gradient from the higher end downwards is in the direction of the forward travel of the fuel beneath. The pockets may or may

not meet so as to form a sharp dividing edge. Suction pipes, D, are connected to the highest points of the several roof pockets and to two or more exhaust-fans, E, which can be regulated independently.
J. S. G. T.

Peat; Means and method of treating —— for obtaining carbonaceous material for decolorising purposes. J. W. Leadbeater, Doncaster. Eng. Pat. 132,572, 13.8.18. (Appl. 13,111/18.)

DECOLORISING carbon prepared from peat as described in Eng. Pat. 122,698 (this J., 1919, 168 A), after being washed with water and acid is mixed with 25—50% of fullers' earth, hydrated aluminium silicate, kieselguhr, diatomite, or other infusorial earth containing nearly pure silica, and the whole heated in a retort.—J. S. G. T.

Incandescence gas mantles; Manufacture of ——. M. Mayer, Berlin-Schöneberg. Ger. Pat. 312,666, 27.2.18.

THE durability of incandescence gas mantles is improved by using a mixed fabric containing wood cellulose as the textile material in place of wood cellulose alone.—L. A. C.

Incandescence gas mantles; Manufacture of ——. J. Goosmann, Charlottenburg-Westend. Ger. Pat. 312,736, 27.2.18.

NITRATED cellulose yarn or fabric is employed as the textile material in the manufacture of incandescence gas mantles.—L. A. C.

Electric lamps; [Sealing stems in bulbs in] manufacture of incandescent ——. British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 132,638, 1.10.18. (Appl. 15,945/18.)

Lamp; [Electric] gaseous-conduction ——. D. McF. Moore, East Orange, N.J., Assignor to General Electric Co. U.S. Pat. 1,316,967, 23.9.19. Appl., 30.11.17.

SEE Eng. Pat. 125,201 of 1918; this J., 1919, 405 A.

III.—TAR AND TAR PRODUCTS.

Tar distillation plant; Hird's continuous ——. S. Stonier. Coke Oven Managers' Association, Sep. 2, 1919. Gas World, 1919, 71, Coking Sect., 109—112.

EXPERIENCE extending over a number of years in connection with a Hird's plant comprising four mild steel stills is described. The temperature in the first still is 190° C., and in the second 240° C., and the distillates from the two stills are mixed, the sp. gr. of the mixture averaging 1·030. Creosote oil is distilled from the third still at 320°—330° C.; its sp. gr. averages 1·060. The temperature in the fourth still is about 275° C. Pitch enters the beds at about 140° C. The depth of tar in the still is 15 in., about 3 or 4 in. over the top of the heating tubes. The stills are best heated by gas; the consumption averages 1500—1875 cub. ft. (400—450 B. Th. U. per cub. ft.) per ton of tar distilled. The cost of attendance is 1s. per ton, and for cleaning 2d. per ton. Very few repairs have been necessary during a period of seven years, in which time 30,000 tons of tar has been distilled. The life of the tubes in the first still is 18 months, in the second 15 months, and in the third 12 months. Excessive chloride in the tar reduces considerably the life of the plant. Particulars are given of a plant capable of distilling 20 tons of tar per day. Compared with pot stills of the intermittent or semi-intermittent types, a continuous system possesses the following advantages:—fuel consumption is reduced to one-half; the plant is easily controlled; cost of upkeep is reduced; cleaning out is only necessary after the distillation of about 600 tons of tar compared with 240 tons in the case of pot stills; the continuous system is flexible, dehydrated tar or hard or soft pitch being readily produced as desired.—J. S. G. T.

Toluene; Critical solution temperature of a ternary mixture as a criterion of purity of ——. K. J. P. Orton and D. C. Jones. Chem. Soc. Trans., 1919, 115, 1055—1070.

THE critical solution temperatures of aqueous acetic acid with commercial benzene, toluene, or xylene which have been fully purified, afford an accurate means of determining the content of paraffin hydrocarbons. Two aqueous acetic acid preparations were used, containing approximately 10·1 and 11·7% of water, and melting at about 2·77° and 0·9° C. respectively. It is preferable to standardise these with pure toluene, since this is readily obtained in quantity. The critical solution temperatures (c.s.t.) were obtained by measuring the aqueous acetic acid and toluene from specially prepared pipettes delivering 0·6232 c.c. and 0·4958 c.c. respectively, mixing the liquids in a narrow tube, to which a thermometer reading to 0·1° C. was attached by rubber bands, and using the whole as a stirrer in a 2 litre water bath, the temperature of which was gradually raised until the two liquid layers coalesced, the disappearance of striations and an increased fluorescence being taken as an indication of the c.s.t. With pure toluene the 10·1% acid gave a c.s.t. at 23·5° C., and the 11·7% acid at 41·9° C. The corresponding figures for benzene are −3·3° and 14·3° C. respectively. Xylene, on the other hand, and, much more pronouncedly so, paraffin hydrocarbons raise the c.s.t above the values for pure toluene. The following figures give the elevation of c.s.t. for 1% of substance as impurity in toluene: Xylene 0·29°, cymene 0·9°, pentane 0·9°, paraffin fraction b. pt. 109°—110° 1·4°, paraffin fraction b. pt. 124°—132° (octane) 1·6° C. Proportions of fatty hydrocarbons less than 0·1% can therefore be estimated in purified commercial toluene by a determination of the c.s.t in aqueous acetic acid.
—G. F. M.

Sulphonation of benzene hydrocarbons; New process for the ——. Preparation of benzenemonosulphonic acid. A. Guyot. Chim. et Ind., 1919, 2, 879—891.

IN the manufacture of benzenesulphonic acid 80% of the calculated quantity of sulphuric acid is utilised by passing benzene vapour through the acid at 170°—200° C. The unconverted benzene vapours escaping from the sulphonator take with them 6% of their weight of the water formed in the reaction, thereby maintaining the sulphonating acid at a strength greater than 64% SO_3, the limiting dilution for sulphonation. The reaction therefore proceeds until nothing but the sulphonic acid containing a few per cent. of sulphuric acid remains in the sulphonator, and the expense of separating the two acids in eliminated. Moreover, weak acid, such as Glover acid, can be utilised for the sulphonation, since it becomes concentrated to the requisite strength by the action of the benzene vapours. The only secondary product formed in any considerable quantity is diphenylsulphone, which represents a loss of about 3% of benzene. The author gives a description of the plant used for continuous sulphonation on the above principles (see Eng. Pats. 101,973 and 126,039; this J., 1917, 705; 1919, 405 A). The condensed benzene vapours are separated from the water and returned to the vaporiser, the benzenesulphonic acid flows continuously from the sulphonator, which is fed to a corresponding extent with fresh sulphuric acid, whilst a regulated amount of

benzene vapour is bubbled in through a distributor. The sulphonators of 2600 litres capacity are capable of sulphonating 86 metric tons of benzene per 24 hours.—G. F. M.

Sulphochlorides of aromatic substances; Analysis of ——. F. Neitzel. Chem.-Zeit., 1919, **43**, 500.

THREE grms. of the powdered substance is mixed with 10 c.c. of water, and free mineral and sulphonic acids are neutralised by the addition of sodium hydroxide solution, using phenolphthalein as indicator; an excess of *N*/1 sodium hydroxide solution (40 to 45 c.c.) and 20 c.c. of neutral alcohol are then added, the mixture heated under a reflux apparatus for 15 mins. (this time is sufficient for the saponification of most sulphochlorides), and the excess of alkali is titrated with *N*/1 hydrochloric acid.—W. P. S.

Phenols; Oxidation of —— by gaseous oxygen, and the catalytic effect of metals [copper]. F. W. Skirrow. Canadian Chem. J., 1919, **3**, 292—294.

IT was found by Williams and Seligman (this J., 1917, 409, 515) that various organic substances, including phenol, have a corrosive action on aluminium, in the absence of moisture, but the factor of the simultaneous action of atmospheric oxygen was not studied. In the author's experiments pieces of pure copper foil were placed, together with pure *o*-cresol, or a solution of cresol, in a glass tube, one end of which was sealed, whilst the other was connected with a mercury manometer to indicate the rate of absorption of atmospheric oxygen. In four cases the total fall in the pressure in fourteen days varied from 131 to 128 mm., whilst in a blank test, in which the oxygen in the tube was replaced by nitrogen, there was no fall in the pressure, and the cresol in the tube did not darken, even after three years' exposure to the light. In experiments on a larger scale a solution of 4·5 grms. of *o*-cresol in benzene was placed in a distillation flask together with pieces of pure copper foil (area = 130 sq. cm), and the side tube of the flask was connected with a gas burette containing oxygen over mercury. The gas was saturated with benzene, and the usual corrections for temperature, pressure, and vapour pressure of the benzene were applied to the observed readings of the volume. Throughout the experiment the apparatus was maintained at a constant temperature. At first there was very little absorption of oxygen, but after 100 hours there was an increase in the rate of absorption, which, after about 120 hours, continued fairly constantly at the rate of about 7 c.c. a day for 3 or 4 weeks. The rate then fell steadily to about the fiftieth day, owing to the accumulation of inert gas, but when this gas was replaced by fresh oxygen the rate of absorption again rose to its former value. The dark liquid in the flask showed a small deposit of green crystals containing 40·4% of copper (44·9% on the material dried at 100° C.). This percentage is too high for copper cresylate or salicylate, and it is possible that it indicates a rupture of the benzene ring during the absorption. The initial slowness of absorption seems to indicate either the formation of a catalyst, or the destruction of some substance which inhibits the absorption. Experiments with pure electrolytic oxygen, purified from traces of ozone, suggested that more consistent results can be obtained with such oxygen than with unpurified oxygen from potassium chlorate. In comparative experiments with phenol it was found that the rate of absorption was much slower than in the case of *o*-cresol, and here, too, there was an initial stage during which the absorption was very slow.—C. A. M.

Iodination of phenols; The active substance in the ——. V. Cofman. Chem. Soc. Trans., 1919, **115**, 1040—1049.

THE iodination of the phenol molecule is conditioned by the presence of hypoiodous acid, the formation of which as an intermediate compound satisfactorily explains the formation of iodophenols by all the various known methods. Iodination with iodine monochloride only occurs in presence of water, and, on the other hand, in an aqueous solution the "active iodine" rapidly disappears. These facts are expressed by the equations $ICl+H_2O \rightleftarrows IOH+HCl$ and $5IOH=2I_2+HIO_3+2H_2O$. In the case of alkaline iodine solutions the decomposition of the "active" iodine compound is a reaction of the second order, and has the same velocity constant as the decomposition of hypoiodous acid, or, in other words, the mass of "active iodine" is at any instant equal to the amount of hypoiodous acid present. In other processes for the preparation of iodophenols, such as the use of iodine and mercuric oxide, hypochlorous acid and potassium iodide, iodine and iodic acid, etc., hypoiodous acid is a constant intermediate product, whilst even in the "dry" reactions of Birnbaum (Ber., 1882, **15**, 459) and Schall (Ber., 1883, **16**, 1897) a mere trace of water would be sufficient to convert eventually all the iodine into hypoiodous acid, since it is regenerated at the final stage, thus:— $C_6H_5ONa+I_2+H_2O = C_6H_5OH+NaI+IOH$ and $C_6H_5OH+IOH=IC_6H_4OH+H_2O$.—G. F. M.

Benzol as motor fuel. Mackie. *See* IIA.

Pitch. Fischer. *See* IIB.

Rosin-pitch mixtures. Wogrinz and Vàri. *See* XIII.

PATENTS.

Dinitrophenol; Process of producing ——. T. J. Brewster, Perth Amboy, N.J., U.S.A. Eng. Pat. 131,103, 26.6.18. (Appl. 10,518/18.) Int. Conv., 20.11.17.

DINITROPHENOL is produced by the action of nitric acid, containing 45—55% HNO_3, on benzene at 50°—60° C. in presence of mercuric nitrate. In order to prevent the formation of by-products the dinitrophenol is removed as it is formed by circulating the reaction mixture through the nitrator, a cooling coil, and a filter, the filtrate being returned either direct to the nitrator or in part through a concentrator in order to maintain the nitric acid at the desired strength. The circulating mixture is supplied with fresh benzene and nitric acid as required, and the nitrous fumes evolved in the oxidation are collected and reoxidised by air in a separate chamber and likewise returned to the nitrator. The reaction mixture contains normally 2% of benzene and about 5% of mercury.—G. F. M.

Aromatic nitro-compounds; Production of ——. Gros et Bouchardy, and L. J. J. Perruche, Paris. Eng. Pat. 131,982, 31.7.18. (Appl. 12,454/18.) Int. Conv., 24.9.17.

AROMATIC nitro-compounds are produced by passing oxygen, air, or ozonised air into a mixture of the substance to be nitrated with liquid nitrogen peroxide and traces of water, the temperature being maintained at 0°—20° C. The gases may be introduced under pressure, or, in the case of oxygen or ozonised air, at atmospheric pressure. Nitric acid is first produced according to the equation $N_2O_4+H_2O+O=2HNO_3$, and this, reacting with the aromatic compound, regenerates a further quantity of water, and the cycle of operations is repeated. When necessary to moderate the violence of the reaction, an inert solvent, such as carbon tetrachloride, may be used. The excess of nitrogen peroxide is removed at the end of the reaction by distillation or by a current of hot air and the nitro-compound isolated from the residue.

after neutralising free nitric acid, or it may be converted into a polynitro-compound by heating the reaction mixture with sulphuric acid. The preparation of nitrobenzene, *m*-dinitrobenzene, and *o*- and *p*-nitroanisol by the process is described. —G. F. M.

Aromatic hydrocarbons other than benzene; Continuous sulphonation of ——. E. Barbet et Fils et Cie., Paris. Eng. Pat. 132,298, 19.6.18. (Appl. 10,117/18.) Int. Conv., 26.6.17. Addition to Eng. Pat. 127,614 (this J., 1919, 529 A).

THE process and apparatus described in the case of benzene may be used for the sulphonation of other aromatic hydrocarbons, with suitable modifications of the heating and cooling arrangements. For instance, for the sulphonation of naphthalene, which requires a temperature of 218° C. for its vaporisation, heating must be effected by direct fire, and, in order to prevent the solidification of naphthalene in the pipes, warm water must be employed in the condenser for the naphthalene vapours which escape sulphonation.—J. F. B.

Diphenylamine; Method for production of ——. H. Rogers, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,314,538, 2.9.19. Appl., 16.7.17.

ANILINE is heated in the presence of water and a catalyst comprising a substance containing bromine.—J. F. B.

Cymenesulphonic acids; Process for the manufacture of ——. J. A. Ambler, Norwich, Conn., H. A. Lubs, Savannah, Ga., and H. D. Gibbs, San Francisco, Cal. U.S. Pat. 1,316,823, 23.9.19. Appl., 21.3.19.

A CONTINUOUS process for the manufacture of cymenesulphonic acids consists in mixing the vapours of cymene with the vapours of sulphuric acid.—J. F. B.

Cymene; Process of treating [nitrating] ——. C. E. Andrews, Assignor to The Selden Co., Pittsburgh, Pa. U.S. Pat. 1,314,920, 2.9.19. Appl., 13.9.17.

SPRUCE turpentine containing cymene and terpenes is dissolved in an anhydrous solvent, and a quantity of mixed nitric and sulphuric acids sufficient to nitrate all the cymene present is added, with continual stirring, whilst the temperature of the mixture is maintained at about 0° C. —G. F. M.

Powder containing tar and sulphur; Manufacture of a fine ——. F. Cremer, Cöln-Müngersdorf. Ger. Pat. 312,787, 11.7.18.

WOOD tar and a powdered mineral insoluble in dilute acid, such as bolus or talc, are added to melted sodium thiosulphate; the product is then treated with hot dilute acid, and, after removal of the clear supernatant liquid, is washed, dried, and powdered.—L. A. C.

Burners for liquid fuels. Eng. Pat. 132,286. *See* I.

Oil-fired furnaces. Eng. Pat. 132,421. *See* I.

Sulphur dioxide. Eng. Pat. 132,387. *See* VII.

Paint or varnish. U.S. Pat. 1,315,658. *See* XIII.

IV.—COLOURING MATTERS AND DYES.

Carbazine dyes, a new class of quinone-imide derivatives. F. Kehrmann, H. Goldstein, and P. Tschudi. Helv. Chim. Acta, 1919, 2, 379—397.

THE amines obtained by reduction of the nitro-derivatives prepared from C-diphenyldihydroacridine (Helv. Chim. Acta, 1919, 2, 315) behave as the leuco-compounds of dyes into which they are transformed by oxidation, and owing to their evident analogy to azoxine and thiazine dyes, the name carbazine dyes is given to them. These dyes exhibit little similarity to the acridine dyes, owing to the difference between the chromophores in the two cases, but their derivation from quinone-diimide is fully borne out by their properties. (See also J. Chem. Soc., 1919, i., 552.)—T. H. P.

Dyes derived from quinolinic acid. P. C. Ghosh. Chem. Soc. Trans., 1919, 115, 1102—1105.

QUINOLINEIN dyes analogous to the phthaleins were prepared by condensing quinolinic acid with phenols and aromatic amines. The condensations were effected by heating the two constituents together without the use of any condensing agent. The presence of nitrogen in the ring had the effect of lightening the colour of the dyes and reducing the fluorescence as compared with the corresponding phthalein. Resorcinolquinolinein, m.pt. 266°—267° C., is fluorescent in alcohol, acetone, toluene, and aqueous potassium hydroxide. Phloroglucinol-quinolinein is a red compound melting at 275°—277° C. The strongest fluorescence was exhibited by *m*-dimethylaminophenolquinolinein, giving a reddish-violet in alcohol. Condensation products from *m*-phenylenediamine and 2.4-diaminophenol were also prepared. G. F. M.

3.5-Dinitrophenoxazine; Derivatives of ——. E. Misslin and A. Bau. Helv. Chim. Acta, 1919, 2, 285—315.

THE action of 2.4.6-trinitroanisole or of picryl chloride on *o*-aminophenol and its nitro-, chloro-, bromo-, or acetamino-substituted derivatives of the type of picramic acid leads, in presence of alkali, to derivatives of 1.3-dinitrophenoxazine, diphenylamine compounds being formed as intermediate products. Except where the substitution occurs in the ortho-position to the amino-group, other derivatives of *o*-aminophenol containing the above substituent groups probably react similarly with 2.4.6-trinitroanisole or picryl chloride. 1.3-Dinitrophenoxazines substituted in the 7-position by NO_2, Cl, Br, or $NH{\cdot}COCH_3$, are coloured Bordeaux-red to violet when treated in alcoholic suspension with alkali hydroxide, whilst those with an NO_2 group in the 6-position give a pure blue coloration. When both the 6- and the 7-positions are substituted, the more strongly negative substituent determines the colour, or, if both substituents are of similar character, that in the 6-position. The action of alkali on the condensation product obtained in the cold from picryl chloride and the potassium derivative of *o*-acetaminophenol yields Turpin's 1.3-dinitrophenoxazine (J. Chem. Soc., 1891, 59, 714). (See also J. Chem. Soc., 1919, i., 555.)—T. H. P.

1.2.3-*Trihydroxyflavone. Constitution of scutellarein.* G. Bargellini. Gazzetta, 1919, 49, ii., 47—63.

THE results obtained indicate that scutellarein is most probably 1.2.3.4'-tetrahydroxyflavone. (See also J. Chem. Soc., 1919, i., 543.)—T. H. P.

1.3.2'-*Trihydroxyflavanol. Synthesis of datiscetin.* G. Bargellini and E. Peratoner. Gazzetta, 1919, 49, ii., 64—69.

THE authors' results lead to the conclusion that datiscetin is 1.3.2'-trihydroxyflavanol. (See also J. Chem. Soc., 1919, i., 547.)—T. H. P.

PATENT.

Azo dyestuffs dyeing mordanted goods. H. Fritzsche, Assignor to Society of Chemical Industry in Basle, Switzerland. U.S. Pat. 1,316,781, 23.9.19. Appl., 7.6.18.

SEE Eng. Pat. 126,460 of 1918; this J., 1919, 457 A.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Wood; Treatment of —— with alkaline waste liquors and the acids produced in the steaming of wood. C. Franck. Svensk Papers Tidung. Papierfab., 1919, 17, 1019—1020.

The black liquors discharged from the digestion of wood by the alkaline process always contain an excess of free alkali, which may be utilised by steeping a fresh charge of wood chips in the hot waste liquor. For instance, on treating 300 grms. (dry weight) of spruce chips with 1·5 litres of hot black liquor containing 1% of free alkali, 90% of this alkali was consumed by the fresh wood. In another case the vessel containing the fresh chips was exhausted before admitting the hot black liquor. On the large scale it should be possible, by a preliminary steeping in black liquor, to effect the saving of one quarter or even one-third of the fresh alkaline liquor. In the steaming of 27 solid metres of wood about 8 cub. m. of acid condensed water was obtained, which on analysis was found to contain 200 grms. of amines, principally methylamines, 140 grms. of acetone, 5·12 kilos. of methyl alcohol, 8·8 kilos. of furfural, 120 grms. of methylfurfural, 147 kilos. (dry weight) of humus substance, 80 kilos. of sugars, and 40 kilos. of volatile acids, principally acetic acid.—J. F. B.

Hemp waste. Scagliarini and Minganti. *See* IIb.

Varnishes for papier-mâché. Andés. *See* XIII.

Balloon fabrics. Frenzel. *See* XIV.

Sulphite-cellulose. Kernahan. *See* XV.

Patents.

Cottonseed hull fibre; Method of purifying ——. F. W. Stockton, Pittsburgh, Pa., U.S.A. Eng. Pat. 132,422, 31.12.18. (Appl. 21,906/18.)

See U.S. Pat. 1,295,078 of 1919; this J., 1919, 319 A.

Scouring yarns or threads of fibrous substances; Means for ——. G. Bailey, Bradford. U.S. Pat. 1,315,698, 9.9.19. Appl., 7.7.15.

See Eng. Pat. 16,629 of 1914; this J., 1915, 712.

Woven articles; Raw material for —— and process of manufacturing it [from palm leaves]. K. Miyake, Tokyo.. U.S. Pat. 1,316,848, 23.9.19. Appl., 26.4.18.

See Eng. Pat. 119,428 of 1918; this J., 1918, 686 A.

Celluloid; Manufacture of non-inflammable ——. H. Dreyfus, London. U.S. Pat. 1,315,480, 9.9.19. Appl., 31.7.18.

See Eng. Pat. 118,891 of 1917; this J., 1918, 651 A.

Gas purifier and cooler. Ger. Pat. 311,664. *See* I.

Lacquer for airplane fabrics. U.S. Pat. 1,315,216. *See* XIII.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitric oxide; Effect of diminution of the pressure on the fixation of nitrogen as —— by the electric arc. E. Briner and P. Naville. Helv. Chim. Acta, 1919, 2, 348-352.

The results obtained with nitrogen-oxygen mixtures are similar to those yielded in the synthesis of ammonia (this J., 1919, 219 A, 284 A, 572 A). Determination of the amount of nitric oxide formed presents difficulties and was effected only by condensing the oxide at temperatures below −200° C. and subsequently transforming it into sodium nitrate by absorption in sodium peroxide solution at the ordinary pressure. To obtain the optimum yield of nitric oxide it is necessary to employ excess of nitrogen, a low pressure, and electrodes of certain metals; with iron and nickel the optimum is given by the normal 50% mixture, displacement of the optimum towards the nitrogen-rich mixtures being most marked with platinum and less so with iridium or copper electrodes. The actual increases in yield resulting from lowering of the pressure and from the use of excess of nitrogen are less pronounced than in the case of ammonia. (See also J. Chem. Soc., 1919, ii., 464.)—T. H. P.

Nitrogen; Technical utilisation of atmospheric —— by means of the electric flame arc. H. Andriessens. Z. Elektrochem., 1919, 25, 255—264.

A résumé of the Birkeland, Pauling, and Hessberger and Schönherr processes for the production of oxides of nitrogen from the air. A new form of arc is described consisting of two electrodes placed parallel and very close together, having between them the air nozzle. When the arc is struck the air blows it outward so that a divided flame is produced. This lies between the poles of a strong electro-magnet which further distends the arc. The advantages claimed for this form of arc are greater stability of flame and a relatively larger flame area for the same current than the best of the earlier forms.—J. F. S.

Sodium sulphate; Manufacture of —— without sulphuric acid. G. Pollitz. Chem.-Zeit., 1919, 43, 517—518.

The author describes the Hargreaves-Robinson process and points out that the advantages it possesses as compared with the methods in which sulphuric acid is used comprise a reduction in coal consumption, in manual labour, and in repairs. Also lead chambers and nitric acid plant are not required, and on account of the completeness and uniformity of the reaction, more hydrochloric acid is obtained, and the product contains less iron, only 0·2—0·6% of salt, and free acid equivalent to about 0·3% of SO_3.—S. S. A.

Deacon process; Calculation of the equilibrium constant in the ——. W. D. Treadwell. Z. Elektrochem., 1917, 23, 177—179.

The equilibrium constant of the Deacon process may be calculated by the expression $\log Kp = 6034/T - 6{\cdot}972$ over the range 300° C.—1800° C. Log Kp decreases from 2·68 at 352° C. to −0·06 at 600° and −4·30 at 1984° C. The formula is approximately correct down to room temperature.
—J. F. S.

Potassium salts; Mother-liquors of marine salt works and the problem of ——. E. Manzella. Annali Chim. Appl., 1919, 11, 145—156.

The author deals with the potash problem as it affects Italy (compare this J., 1917, 453, 641).
—T. H. P.

Sodium hypochlorite. M. P. Applebey. Chem. Soc. Trans., 1919, 115, 1106—1109.

Hydrated sodium hypochlorite in crystalline form was first described by Muspratt and Shrapnell Smith (this J., 1898, 1096; 1899, 210; 1903, 591). The author has prepared the crystals by the following method. Chlorine was passed into an ice-cold 35% solution of sodium hydroxide, the precipitated sodium chloride being removed and an equivalent quantity of sodium hydroxide added at intervals until the hypochlorite strength was about 5*N*. The solution, freed from sodium chloride, was then cooled to −10° C. and induced to crystallise

by shaking or seeding. The hypochlorite separated as a mass of very fine, hair-like crystals. The crystals melted at 18°—19° C., forming a liquid, which appeared cloudy, apparently owing to the formation of some crystals of a lower hydrate. It was found difficult to dry the crystals for the purpose of analysis, but the analytical results obtained indicate that the compound is a heptahydrate and not a hexahydrate, as supposed by Muspratt. When the crystals are heated to 20° C. and then allowed to cool, large, well-formed crystals of another hydrate are deposited. These melt at 27° C., and analysis indicated the composition, $NaOCl,5H_2O$.—E. H. R.

Iodides; Determination of ——. P. Godfrin. Bull. Soc. Pharm. Bordeaux, 1919, 16. Ann. Chim. Analyt., 1919, 1, 295—296.

Ten c.c. of a 1% iodide solution is treated with 1 c.c. of 10% potassium bichromate solution, 15 drops of hydrochloric acid and 20 c.c. of 10% sodium acetate solution; 50 c.c. of water and 2 c.c. of starch solution are then added and the liberated iodine is titrated with thiosulphate solution. To determine iodides in urine a portion of the sample is first titrated with iodine solution (to eliminate the action of substances which absorb iodine), and the process is then carried out as described, but in this case 3 mins. should be allowed to elapse after the bichromate has been added and before the sodium acetate is introduced in order that the liberation of iodine shall reach a maximum.—W. P. S.

The system $SO_2Cl_2 \rightleftarrows SO_2+Cl_2$; Photochemical change in —— under the influence of light rays of definite wave length. M. Le Blanc, K. Andrich, and W. Kangro. Z. Elektrochem., 1919, 25, 229—251.

The absorption spectra of sulphur dioxide, chlorine, and sulphuryl chloride have been determined at a series of pressures. Chlorine absorbs all light from the visible region to the middle ultraviolet, and has a maximum absorption at 340$\mu\mu$; sulphur dioxide has an absorption maximum at 290$\mu\mu$ and a minimum at 240$\mu\mu$; sulphuryl chloride vapour absorbs all light from 300$\mu\mu$ upwards. The illumination of sulphuryl chloride by light which is only absorbed by this substance brings about quantitative decomposition at both 55° C. and 100° C.; concentration has apparently no influence on the course of the reaction. Illumination of the system SO_2+Cl_2 by light which is absorbed by sulphur dioxide only brings about no formation of sulphuryl chloride. The same system illuminated by light which is absorbed by chlorine only is converted into sulphuryl chloride until a stationary condition is set up. The velocity of the reaction and also the position of the stationary state depend, at constant temperature, on the presence of a small quantity of water. The stationary state never coincides with the equilibrium condition of the reaction carried out in the dark, and the two positions diverge from one another more as the temperature is diminished. The temperature coefficient is negligible. (See J. Chem. Soc., 1919, ii., 442.)
—J. F. S.

Sodium peroxide: its properties and microscopical characters. J. Scott. Chem. Trade J., 1919, 65, 383—384.

A short account of the properties of sodium peroxide and its use as a bleaching agent is given. Although generally regarded as amorphous, its minute particles show a semi-crystalline structure under the microscope. The particles gradually change into minute globules through deliquescence. When a little water is added to the specimen on the microscope slide, flat transparent crystals of the hydrate are quickly formed, accompanied or preceded by rosetted clusters. With absolute alcohol the peroxide is converted into a flaky, crystalline substance. Illustrations of these crystals as seen under the microscope are given.—E. H. R.

Sulphurous acid and sulphites; Iodometric determination of ——. I. M. Kolthoff. Pharm. Weekblad, 1919, 56, 1366—1373.

The accuracy of the iodine method for estimating sulphurous acid depends on adding the sulphurous acid to the iodine solution and not *vice versâ*. Errors are caused by oxidation by the air; sodium carbonate and hydrochloric acid increase these errors. Potassium iodide acts similarly, owing to its being a catalyst in the oxidation process. Mannitol, sucrose, and alcohol do not increase the accuracy of the determination. The author does not consider that sulphur is formed and gives erroneous results, except in very concentrated solutions.—W. J. W.

Cyanides, cyanates, and bromides; Determination of —— present together. G. Velardi. Boll. Chim. Farm., 1919, 58, 241.

The components of a mixture of alkali bromides, cyanides, and cyanates may be determined as follows. A known quantity of the mixture is dissolved in water, and in an aliquot part of the alkaline liquid the cyanides are determined by Liebig's method. Another portion is neutralised exactly with acetic acid, and the volume of standard silver nitrate solution required by the bromide, cyanide, and cyanate determined by Mohr's method. In a third portion, rendered acid with nitric acid, the volume of silver solution necessary to precipitate the cyanide and bromide is determined by Volhard's method. Simple calculation then yields the quantities of the separate components. This procedure gives accurate results with an artificial mixture.—T. H. P.

Nickel; Compounds of univalent ——. *II.* I. Bellucci. Gazzetta, 1919, 49, ii., 70—81.

Confirmation has been obtained of the formula of the red potassium nickelocyanide, K_2NiCy_2. This compound is oxidised to the normal yellow nickelocyanide, K_2NiCy_4, (1) by atmospheric oxygen, (2) by water, with liberation of free hydrogen and of metallic nickel, or (3) by an oxidising agent such as hydrogen peroxide, nickelous hydroxide being then separated. (See J. Chem. Soc., 1919, i., 526.)—T. H. P.

Chromium; Oxidation of —— with hydrogen peroxide in alkaline solution. K. Schorlemmer. Collegium, 1919, 5—10. Chem. Zentr., 1919, 90, II., 953—954.

A small addition of ferric chloride facilitates the oxidation and prevents the inhibiting effect of small quantities of organic matter in the solution (see this J., 1918, 343 A, 445 A). Solutions containing large amounts of organic matter cannot be oxidised completely with hydrogen peroxide, but all organic matter is destroyed during oxidation of chromium with permanganate. It is also possible to destroy organic matter in a chrome liquor by evaporating to dryness and igniting. The peroxide method is to be preferred where possible on account of its simplicity.—D. W.

Chromium azide. E. Oliveri-Mandalà. Gazzetta, 1919, 49, ii., 43—46.

The double compound of pyridine and chromium azide $Cr(N_3)_3,3C_5H_5N$, a highly explosive substance, and the basic chromium azide, $HO.Cr(N_3)_2,2H_2O$, less explosive, are described. (See J. Chem. Soc., 1919, ii., 468.)—T. H. P.

Manganous oxide; Reducing action of ——. V. Macri. Boll. Chim. Farm., 1919, **58**, 201—202.

In presence of ammonia, manganous salts reduce the salts of various other metals in solution. (See also J. Chem. Soc., 1919, ii., 467.)—T. H. P.

Beryllia [glucinum oxide]; Manufacture of ——. H. Copaux. Chim. et Ind., 1919, **2**, 914—916.

The process described by the author for the manufacture of glucinum salts from beryl (this J., 1919, 285 A) has been used on the industrial scale at Kremlin-Bicêtre since 1915. The industrial application of glucinum oxide is limited at present to its employment with ceria and thoria for stiffening gas mantles. Its refractory nature suggests a possible use in the ceramic industry, but any application of metallic glucinum is impossible until a more practical method for its isolation is available.—G. F. M.

Uranium and radium; Relation between ——. F. Soddy. Phil. Mag., 1919, **38**, 483—488.

Fresh measurements on the quantity of radium now present in uranium preparations purified in the years 1905 to 1909 confirm the results of the measurements made in 1915 by Soddy and Hitchins (this J., 1915, 869). The growth of radium has proceeded according to theory, the period of average life of ionium, the intermediate member of the series, being 100,000 years, that of radium being taken as 2375 years. The determination of the period of ionium appears to be at least as accurate as, if not more accurate than, the value for radium. The quantity of radium now present in the largest uranium preparation is already such that no increase in accuracy of measurement is to be anticipated on account of its further growth. The growth, $2\cdot10^{-10}$ grm. of radium from 3 kilos. of uranium in 10 years, is equal to the quantity in 1 mgrm. of pitchblende containing 60% of uranium.—E. H. R.

Rubidium [and potassium]; Radioactivity of ——. O. Hahn and M. Rothenbach. Physikal. Zeits., 1919, **20**, 194—202. Chem. Zentr., 1919, **90**, III., 250—252.

Employing an unusually large electroscope, the radioactivity of a large number of rubidium salts was investigated. It was concluded that the radioactivity is a true atomic property of rubidium, and not due to admixture with any other element. Comparative experiments on the penetration of the rays showed that the rubidium β-rays are slightly more penetrating than those of UX_2, the total activity of these rays compared with that of UX_1 rays being as 1:15. Rubidium is at most only ten times weaker than an equal weight of thorium. Potassium was found to be very much weaker than rubidium, and no activity could be detected with cæsium salts. It is to be expected that the degradation product of potassium would be calcium, and of rubidium, strontium, having lower atomic weights than the ordinary forms of calcium and strontium. This being so, a felspar 10^9 years old containing 14% of potassium should contain 0·25 mgrm. of calcium derived from potassium per gram. Unfortunately all felspars contain much other calcium, and the effect of this small proportion of derived calcium on the atomic weight could not be detected. Rubidium minerals contain so small a proportion of the metal that it is improbable that evidence of the presence of derived strontium could be detected. It may, however, be possible to detect derived barium in some cæsium minerals.

—E. H. R.

Photochemical reactions of compounds of less common elements. A. Benrath. Z. wiss. Phot., 1917, **16**, 253—261.

An aqueous solution of commercial ammonium molybdate when diluted with an equal volume of either ethyl alcohol or methyl alcohol and exposed to sunlight changes to blue after a short exposure, and a reddish-brown substance, $(NH_4)_2MoO_4.2MoO_3.2MoO_2.6H_2O$, is deposited on the side of the flask on which the light falls. In this reaction only the complex added group MoO_3 and not the normal ammonium molybdate is reduced. Colloidal molybdic acid is rapidly reduced by alcohol to the blue oxide Mo_2O_5. Normal sodium tungstate is only slowly reduced by alcohol in sunlight, so that after five months' exposure to light only a faint blue colour is produced. On the other hand suspensions of tungstic acid and acidified solutions of tungstates become deep blue in colour when mixed with alcohol and exposed to sunlight for a few hours. The greenish-yellow powder deposited when uranyl chloride dissolved in ether is exposed to sunlight has the formula $UOCl_2$, and the similar precipitate obtained by exposing an aqueous solution of uranyl nitrate containing a little alcohol to sunlight is $UO_2(NO_3)_2$.—J. F. S.

Permutit; Base exchange in ——. G. Kornfeld. Z. Elektrochem., 1917, **23**, 173—177. (See also this J., 1918, 559 A.)

By shaking finely powdered sodium permutit with $N/10$ silver nitrate for 5 minutes, 95% of the available sodium is replaced by silver. Silver permutit shaken respectively with solutions of potassium nitrate, ammonium nitrate, and barium nitrate has a portion of its silver replaced by the cations of the various salts. In all cases except the last named the concentration of the solution has no influence on the change. (See also J. Chem. Soc., 1919, ii., 459.)—J. F. S.

Cyanogen chloride; Preparation of —— by Held's method. C. Mauguin and L. J. Simon. Comptes rend., 1919, **169**, 383—386.

Held's method (1897) for preparing cyanogen chloride by the action of chlorine on an aqueous solution of sodium cyanide, with addition of zinc sulphate to prevent the formation of paracyanogen, gives good results only if the zinc salt is added in the proportion indicated by the equation, $4KCN + ZnSO_4 = Zn(CN)_2.2KCN + K_2SO_4$; a yield of 80% of cyanogen chloride is then obtained. The purity of the product may be controlled as follows: The cyanogen chloride is transformed into sodium cyanate and chloride by excess of sodium hydroxide, $CNCl + 2NaOH = NaOCN + NaCl + H_2O$, the excess of alkali being then determined by titration with standard sulphuric acid in presence of phenolphthalein, to which the cyanate is neutral. The sodium cyanate is then decomposed with excess of standard sulphuric acid, $NaOCN + H_2O + H_2SO_4 = NaNH_3SO_4 + CO_2$, the excess of acid being determined by titration with sodium hydroxide in presence of methyl orange. In the neutralised solution the chlorine is estimated by titration of an aliquot part with standard silver nitrate solution, and the ammonia by Schloesing's method.

—T. H. P.

Hydrogen; Influence of hydrogen sulphide on the occlusion of —— by palladium. E. B. Maxted. Chem. Soc. Trans., 1919, **115**, 1050—1055.

One of the factors which determine the catalytic activity of various preparations of a given metal for hydrogenation reactions is the occlusive power of the preparation for hydrogen. The effect of a typical catalyst poison, hydrogen sulphide, on the occlusive power of palladium has been examined. The hydrogen-occluding power of oxygen-free palladium black was measured before and after treatment with hydrogen sulphide. An absorption of 14 c.c. of hydrogen sulphide per grm. of palladium was found sufficient totally to inhibit the hydrogen-occluding properties of pal-

ladium. On exhausting palladium containing this amount of hydrogen sulphide an almost equivalent amount of gas was evolved, but this consisted almost entirely of hydrogen. The sulphur retained by the palladium was not sufficient to inhibit completely the occlusive power of the palladium for hydrogen. An investigation of the inhibiting effect of different amounts of residual sulphur showed that each atom of sulphur renders almost exactly four atoms of palladium incapable of occluding hydrogen, the remainder retaining its normal occlusive power. There is insufficient evidence to assume the formation of a compound Pd_4S, which would explain this result. Palladium foil remains untarnished by pure dry hydrogen sulphide both at the ordinary temperature and at 100° C.—W. P.

Antozone; The so-called ——. V. Rothmund. Z. Elektrochem., 1917, **23**, 170—173.

The fogs produced when ozone acts on reducing agents such as sodium bisulphite or hydriodic acid have previously been ascribed to the presence of "antozone," a third modification of oxygen. They are now shown to be due to the volatile character of the reducing agent and to be directly caused by the presence of these substances in the vapour phase.—J. F. S.

MgO–Al_2O_3–SiO_2 and CaO–Al_2O_3–MgO. Meissner. *See* VIII.

Phosphoric acid. Neubauer and Wolferts. *See* XVI.

Phosphates. Pfeiffer and others. *See* XVI.

Calcium carbonate. Hager and Kern. *See* XVI.

Calcium cyanamide. Hövermann and Koch. *See* XVI.

Estimation of sulphates. Krieble and Mangum. *See* XIXA.

PATENTS.

Nitric acid; Manufacture of concentrated ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania. Eng. Pat. 120,378, 19.9.18. (Appl. 15,241/18.) Int. Conv., 30.10.17.

In the production of nitric acid from nitrogen peroxide, oxygen, and water or dilute nitric acid under pressure, the oxygen is caused to move in the same direction as the liquid in the separate parts of the apparatus, but in a counter current when the plant is considered as a whole. It thus establishes a circulation of the liquid, and also remains as long as possible in contact with the liquid, and good yields are consequently obtained.—W. J. W.

Nitrous gases [and nitric acid]; Process of producing concentrated ——. B. F. Halvorsen, Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania. U.S. Pat. 1,316,950, 23.9.19. Appl., 4.9.18.

Dilute nitrous gases are brought in contact with a dry mixture of a base and an oxide of a metal capable of forming easily decomposable compounds with alkali and alkaline-earth metal bases. The resulting product is subsequently decomposed.
—W. J. W.

Ammonia; Process and apparatus for oxidising —— to form nitrogen oxides and nitric acid. L. C. Jones, Syracuse, N.Y., and C. L. Parsons, Washington, D.C., U.S.A. Eng. Pat. 132,551, 30.4.18. (Appl. 7221/18.)

In producing nitric acid and nitrogen oxides by the oxidation of ammonia, the efficiency of the oxidation depends on the temperature of the catalyst being maintained above 700° C. Heat liberated by the combustion of the mixture may be utilised for this purpose, loss by radiation and otherwise being prevented by using a special contact element. This consists of a laminated, hollow body of fine gauze sheet carrying the catalyst, the laminations being contiguous and having opposing heat-emitting surfaces. Means are provided for tightening the gauze cylinder. The contact element is further surrounded by a casing lined with refractory material to act as a heat reflector. The gases are caused to pass through the walls of the hollow body.—W. J. W.

Ammonia; Burner for oxidation of ——. E. B. Maxted and T. A. Smith, Walsall. Eng. Pat. 132,571, 12.8.18. (Appl. 13,037/18.)

A burner applicable to the oxidation of ammonia by oxygen, giving high yields and without danger of explosion, consists of an annular oxidation chamber formed of two metallic tubes which may be provided with a baffle. Heating is effected by any suitable means with careful regulation of temperature to avoid explosion. Iron may be used for the construction of the burner; but platinum must not be employed on account of its too energetic action in presence of oxygen.—W. J. W.

Sulphur dioxide; Recovery of unoxidised —— in the contact manufacture of sulphuric acid. British Dyes, Ltd., J. Turner, and W. B. Davidson, Huddersfield. Eng. Pat. 132,661, 1.11.18. (Appl. 17,869/18.)

Loss of sulphur dioxide and pollution of the atmosphere are avoided by conducting the waste gases from sulphuric acid manufacture to scrubbers containing waste sodium sulphite (which may be obtained from the manufacture of synthetic phenol) or sodium carbonate or milk of lime. The solution is then treated with hydrochloric acid, sulphuric acid, or waste products such as nitre-cake, heated by steam under agitation, and the liberated sulphur dioxide is dried by passing through a cooler and returned to the contact chambers. 70%—80% of the waste sulphur dioxide is recovered, and the oxidation efficiency is correspondingly increased from 93% to 98%.—W. J. W.

Catalyser for oxidising reactions [e.g., oxidation of sulphur dioxide]. C. Ellis, Montclair, N.J., Assignor to Ellis-Foster Co. U.S. Pat. 1,314,952, 2.9.19. Appl., 26.6.16.

For the oxidation of sulphur dioxide, a catalyst is employed consisting of a metal of the platinum group and a number of metallic oxides, one at least of these being capable of absorbing relatively large amounts of sulphur dioxide at 750°—1000° F. (about 400°—540° C.).—W. J. W.

Sulphuric acid; Concentration of ——. F. W. Howorth, London. From Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania. Eng. Pat. 132,704, 22.1.19. (Appl. 1637/19.)

Nitrous gases at a temperature of about 1000° C. may be employed for the concentration of sulphuric acid if they are first mixed with a proportion of exhaust gases from the concentration chamber, by which means the temperature is lowered to 500°—600° C. and decomposition of the sulphuric acid is avoided. The remaining exhaust gases are saturated with moisture which is readily removed by condensation.—W. J. W.

Sulphur dioxide; Manufacture of ——. J. Grayson, Huddersfield. Eng. Pat. 132,387, 31.10.18. (Appl. 17,813/18.)

Sulphur dioxide is produced, without formation of oxides of carbon, by heating sulphuric acid (above 70% strength) with 5 to 10% of pitch from coal tar or producer-gas tar at 170°—240° C. The

process is suitable for utilisation of waste acid from the refining of hydrocarbon oils.—W. J. W.

Sulphur dioxide; Treatment of gases containing ——. E. V. Espenhahn, Port Pirie, S. Aus. U.S. Pat. 1,315,183, 2.9.19. Appl., 19.10.18.

The gases are washed with an alkali thiosulphate, the polythionate is heated to form sulphate, which is then reduced to sulphide; the latter is used to treat further quantities of polythionate, obtained in the process, to form thiosulphate.

Boric acid and sodium borate; Process of making ——. H. Blumenberg, jun., Assignor to Chemical Construction Co., Los Angeles, Cal. U.S. Pat. 1,295,958, 4.3.19. Appl., 4.12.17.

Waste gases obtained during the calcining of borate ores containing suspended borates are treated with an acid (dilute sulphuric or nitric acid) to form boric acid, which is then separated. Sodium carbonate solution may be used in place of the acid, in which case sodium borate is produced.—W. F. F.

Hydrofluosilicic-acid gas; Apparatus for absorbing —— and separating silicic acid therefrom. K. F. Stahl, Pittsburgh, Pa. U.S. Pat. 1,315,250, 9.9.19. Appl., 18.8.17.

Gases from the treatment of phosphate rock by acid, containing hydrofluosilicic acid, and silicic acid in suspension, are passed tangentially into the lower part of a closed cylinder, and after being sprayed with water are discharged through an aperture in the centre of the top.—W. H. C.

Hydrofluoric acid; Process for producing ——. E. S. Fickes, Pittsburgh, Pa. U.S. Pat. 1,316,569, 23.9.19. Appl., 8.10.18.

The raw material is fed into a stationary elongated retort at one end, continuously moved and agitated along the length of the retort, and discharged at the other end, whilst the hydrofluoric acid vapour is removed as produced.—S. S. A.

Alkali percarbonates; Manufacture of ——. Deutsche Gold- und Silber-Scheide-Anstalt vorm. Rössler, Frankfort, Germany. Eng. Pat. 116,903, 21.6.18. (Appl. 10,282/18.) Int. Conv., 18.5.17.

A peroxide or peroxide hydrate of an alkaline earth is treated below 0° C. with a solution of an alkali carbonate in the presence of magnesium silicate or sodium silicate, with the exclusion as far as possible of substances having a decomposing effect, such as most salts and oxides of heavy metals. The mixture is filtered, and from the filtrate the percarbonate is salted out by means of common salt.—S. S. A.

Fluoride precipitates [of the rare-earth metals]; Process of obtaining ——. W. S. Chase, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,314,571, 2.9.19. Appl., 31.1.16.

Fluorides of the rare-earth metals are precipitated by adding a soluble complex boro-fluorine compound capable of only slight dissociation into fluorine ions to compounds of the rare-earth metals in the presence of water.—L. A. C.

Aluminium [hydr]oxide; Apparatus for producing ——. *Process for producing aluminium oxide. Production of aluminium oxide.* R. S. Sherwin, East St. Louis, Ill., Assignor to Aluminium Co. of America, Pittsburgh, Pa. U.S. Pats. (A) 1,314,709, (B) 1,314,710, and (C) 1,315,045, 2.9.19. Appl., (A and B) 20.10.17 and (C) 20.6.19. (A) Renewed 23.11.18, (B) 7.12.18.

Aluminium hydroxide is precipitated by suspending aluminium hydroxide in a solution of an alkali aluminate. The finer particles of the precipitate are separated from the coarser particles, and are added to fresh portions of the aluminate solution to start precipitation therein. The coarser particles are washed free of dissolved matter and fine particles, and the wash water is returned to the precipitated liquor.—L. A. C.

Zinc chloride; Manufacture of ——. O. W. Storey, Madison, Wis., Assignor to C. F. Burgess Laboratories. U.S. Pat. 1,314,715, 2.9.19. Appl., 26.9.18.

Zinc chloride is produced by the direct combination of zinc and chlorine in the presence of water. —L. A. C.

Titanium oxide; Process of making ——. E. R. Darling, Montclair, N.J., Assignor to Essex Laboratories, Inc. U.S. Pat. 1,315,011, 2.9.19. Appl., 18.1.19.

Titanium chloride vapour, produced by heating finely-powdered titaniferous ore to a high temperature in the presence of chlorine, is passed into a solution of glucose to form titanium oxide, which is filtered off, washed, and dried to form a fine powder.—L. A. C.

Nitrous oxide; Method of purifying ——. A. R. Warner, Assignor to Lakeside Hospital, Cleveland, Ohio. U.S. Pat. 1,315,354, 9.9.19. Appl., 6.11.14.

Commercial nitrous oxide is treated at atmospheric temperature with solutions of potassium permanganate and sodium hydroxide, and then with dilute sulphuric acid.—W. J. W.

Treating material with gas or vapour; Process of ——. F. L. Slocum, Pittsburgh, Pa. U.S. Pat. 1,315,532, 9.9.19. Appl., 21.9.17.

In the production of ammonia and its compounds from a carbide and nitrogen, all the necessary reactions are carried out in a continuous series of operations and in one apparatus.—J. F. B.

Ammonia and ammonium compounds; Process of producing ——. G. G. Taylor, Crafton, and I. E. Knapp, jun., Coraopolis, Pa. U.S. Pat. 1,315,534, 9.9.19. Appl., 13.9.17.

Material containing nitrogen capable of being converted by heat into ammonia is saturated with water and then heated in the presence of steam to or above 450° C.—W. H. C.

Ammonium nitrate; Process of producing ——. W. S. Landis, Assignor to American Cyanamid Co., New York. U.S. Pat. 1,315,674, 9.9.19. Appl., 15.3.19.

A solution of nitric acid is neutralised with ammonia, the vapours evolved being recovered and returned to the solution.—W. J. W.

Cyanamide; Process of manufacturing ——. W. H. Middleton, Niagara Falls, Ont., Assignor to American Cyanamid Co., New York. U.S. Pat. 1,315,678, 9.9.19. Appl., 14.5.19.

Nitrogen is caused to combine with carbide in a suitable furnace by passing an electric current through a resistance placed in the carbide. The interior of the furnace is lined with a material with a roughened surface which provides free spaces for the better distribution of the nitrogen. —W. J. W.

Cyanamide; Process for the production of ——. F. Gros et Bouchardy, Paris. Eng. Pat. 132,622, 24.9.18. (Appl. 15,540/18.) Int. Conv., 3.11.17.

Powdered calcium carbide in thin layers is conveyed through a high-temperature zone in a tunnel furnace in counter-current to a stream of nitrogen. The calcium cyanamide produced is immediately

cooled in a second zone of the furnace and automatically removed.—S. S. A.

Carbides; Method of grinding and conveying ——. G. Polysius, Dessau. Ger. Pat. 312,685, 19.11.16.

GASES containing little or no oxygen, *e.g.*, the waste gases from lime-kilns, are led into the grinders and mechanical conveyors used in the manufacture of carbides in order to minimise the risk of fire or explosion.—L. A. C.

Nitre-cake; Method of treating ——. J. Beveridge, Chatham, New Brunswick, Canada. U.S. Pat. 1,315,811, 9.9.19. Appl., 7.10.18.

NITRE-CAKE is heated with carbonaceous material in a non-oxidising atmosphere at a temperature which converts the acid sulphate into normal sulphate. The sulphur trioxide and dioxide evolved are recovered as sulphuric acid and sulphite respectively.—S. S. A.

Nitre-decomposing apparatus. N. L. Heinz, La Salle, Ill. U.S. Pat. 1,315,834, 9.9.19. Appl., 15.9.15.

THE apparatus comprises a fire-box provided with a flue containing a receptacle for sodium nitrate, and connected with a further flue, communication with which can be closed by means of a damper during the removal of the nitre receptacle.
—S. S. A.

Mine-water [containing ferric sulphate and sulphuric acid]; Process of treating —— and product thereof. A. F. Hoffman, Pittsburgh, Pa. U.S. Pat. 1,315,836, 9.9.19. Appl., 10.12.17.

THE mine-water is treated with a quantity of an alkaline substance sufficient to convert the major portion of the ferric sulphate into ferric hydroxide and the remainder of the soluble iron compounds into basic sulphate. The precipitate of hydroxide and basic sulphate is separated, and dried at a temperature too low to remove the water of constitution of the ferric hydroxide.

Lime; Method of producing ——. A. S. Dwight and R. L. Lloyd, Assignors to Dwight and Lloyd Metallurgical Co., New York. U.S. Pat. 1,315,952, 16.9.19. Appl., 30.12.12. Renewed 8.2.19.

A THIN layer of an intimate and finely-divided mixture of fuel material and calcium carbonate is deposited on a layer of lime. The mixture is covered by a layer of fuel. The covering layer is fired, and air is passed through the whole mass to effect combustion of the fuel.—S. S. A.

Zirconium; Basic sulphate of —— and method of making the same. E. J. Pugh, Glenside, Pa., Assignor to Pennsylvania Salt Manufacturing Co., Philadelphia, Pa. U.S. Pat. 1,316,107, 16.9.19. Appl., 15.7.18.

SULPHURIC acid is added to an acid solution of zirconium oxychloride, and the mixture is heated.
—S. S. A.

Barium hydroxide; Process for preparing —— from barium sulphide. E. A. Barnes, South San Francisco, Cal. U.S. Pat. 1,316,133, 16.9.19. Appl., 7.2.18.

A SOLUTION of barium sulphide is rapidly cooled to a temperature at which crystals of barium hydroxide are formed.—S. S. A.

Fixation of atmospheric nitrogen; Apparatus for ——. J. S. Island, Assignor to E. P. Coleman, Hamilton, Ont. U.S. Pat. 1,316,445, 16.9.19. Appl., 15.11.17.

AN annular electric flame is created in an annular space between a pair of electrodes, the opposing walls of the electrodes being so formed as to direct a current of air outwards and at right angles to the faces of the electrodes, whereby the flame is distended in a double-walled, tubular fashion.
—W. J. W.

Potassium chloride and borax; Method of separately obtaining —— from certain dry salts. N. Wrinkle and W. A. Kuhnert, San Francisco, Cal. U.S. Pat. 1,316,755, 23.9.19. Appl., 22.5.19.

A MIXTURE of dry salts containing potassium chloride and borax is treated with a solution of sodium hydroxide to produce sodium metaborate soluble in the liquor. The insoluble crystals are removed, and by treating the liquor with carbon dioxide, the sodium metaborate is converted into insoluble sodium biborate from which the mother liquor is removed.—S. S. A.

Mercury; Process of recovering —— from mercury sludge. H. W. Matheson, Shawinigan Falls, Canada. Eng. Pat. 132,559, 18.6.18. (Appl., 10,072/18.)

THE process relates to the recovery of mercury from mercury sludge, such as that obtained in the manufacture of acetaldehyde (see Eng. Pat. 132,557, p. 815 A). The solid portion, which is separated from the liquid by sedimentation, is neutralised and heated to 100° - 125° C. to effect partial decomposition of mercury compounds and cause the particles of metallic mercury to coalesce. The collected mercury is removed, and a further separation of metallic mercury is effected by dry-grinding the remaining mass, which is then heated to 100°—500° C. to decompose mercury compounds, and finally freed from non-mercuric matter by wet-grinding.
—S. S. A.

Mercury; Process of oxidising ——. H. W. Matheson, Shawinigan Falls, Canada. Eng. Pat. 132,560, 18.6.18. (Appl., 10,073/18.)

THE oxidation is effected electrolytically. A layer of mercury placed in a suitable pan or cell serves as the anode. The pan is charged with an acid or alkaline electrolyte (*e.g.*, a 3—10% solution of caustic soda), which is continuously agitated during the process, and in this solution a cathode of iron, nickel, or other suitable metal is suspended. The electrolyte is periodically agitated with increased violence. A current of about 55 amps. per square foot of mercury exposed to the electrolyte and at a potential difference of 8—10 volts is employed. The oxide is separated by sedimentation, neutralised, and washed free from salt.—S. S. A.

Nitrates; Processes for production of —— by means of bacteria. C. T. Thorssell and H. L. R. Lundén, Gothenburg, Sweden. Eng. Pats. 132,625 and 132,626, 26.9.18. (Appls. 15,667 and 15,669/18.)

SEE U.S. Pats. 1,288,754-5 of 1918; this J., 1919, 134 A.

Potassium [compounds]; Process for recovering —— from potassium-bearing silicates. A. Graucl, Toronto, Canada. Eng. Pat. 132,693, 30.12.18. (Appl. 21,808/18.)

SEE U.S. Pat. 1,289,736 of 1918; this J., 1919, 536 A.

Recovering acetic acid. U.S. Pat. 1,314,765. *See* XIX A.

Acetic acid. Eng. Pat. 132,558. *See* XX.

Compound of lime and bromine. Eng. Pat. 131,750. *See* XIX B.

VIII.—GLASS; CERAMICS.

Glass coloured yellow by carbon. L. Springer. *Sprechsaal, 1919, 88. Chem.-Zeit, 1919, 43, Rep., 191.*

The author has shown that sulphur is not essential in the production of yellow colour in glass by carbonaceous substances such as charcoal, coke, soot, sugar, cream of tartar, etc. When such yellow glasses are decomposed by hydrofluoric acid about 1% of a light black residue is left. About two-thirds of the carbon used is volatilised during the fusion of the glass. The intensity of the yellow colour produced by either carbon or sulphur increases with the alkalinity and fusibility of the glass.—A. B. S.

MgO-Al_2O_3-SiO_2 and CaO-Al_2O_3-MgO; The ternary systems ——. A. Meissner. Zement, 1919, **8**, 296–298, 308–310. Chem. Zentr., 1919, **90**, III., 511.

The temperature-concentration relationships, in the system MgO-Al_2O_3-SiO_2, of the different crystallising phases in equilibrium with the liquid phase, are represented by a diagram and a model. A ternary compound $2MgO.Al_2O_3.8SiO_2$ was specially investigated. It is unstable at its melting point, and has a notable tendency to form mixed crystals. Two forms of the compound were observed, the unstable μ-form crystallising from glasses at temperatures in the neighbourhood of 950° C. and changing at higher temperatures into the stable α-form. The properties of both forms, and particularly of the α-form, closely resemble those of the mineral cordierite. The system CaO-Al_2O_3-MgO is fairly simple, as no ternary compounds are stable in equilibrium with the liquid phase. The relationship between the simple components and the binary compounds $3CaO.Al_2O_3$, $5CaO.3Al_2O_3$, $CaO.Al_2O_3$, $3CaO.5Al_2O_3$, and $MgO.Al_2O_3$ were worked out, and are represented on a series of diagrams. A new form of alumina is described and is designated β-Al_2O_3.
—E. H. R.

Stoneware in industry. Kaltenbach. *See* I.

Refractory materials for coke-ovens. Hancock. *See* IIa.

Patents.

Enamelling compounds and product; Process of making opaquing and ——. F. Preusser, Cologne-Kalk, Germany, Assignor to The Chemical Foundation, Inc. U.S. Pat. 1,314,831, 2.9.19. Appl. 28.11.13.

Compounds suitable for producing opacity in enamels etc. are obtained by the reaction of compounds of the opacifying elements, "which exhibit both metallic and metalloid properties," with salts or salt-like compounds of non-opacifying earths and alkaline-earth metals which are insoluble in the cold in fluxes, glazes, enamels and glasses, and eliminating soluble and volatile constituents from the product.—A. B. S.

Enamels; Clouding composition for —— and process of making. P. Eyer, Halberstadt, Germany, Assignor to The Chemical Foundation, Inc. U.S. Pat. 1,314,861, 2.9.19. Appl., 6.11.16.

A compound of zirconia and boric oxide having a ratio of zirconium to boron substantially greater than is represented by $ZrO_2.2B_2O_3$ is added to the enamel as an opacifying agent.—A. B. S.

Enamelled ware; Manufacture of ——. R. D. Cooke, Assignor to Columbian Enameling and Stamping Co., Terre Haute, Ind. U.S. Pat. 1,316,018, 16.9.19. Appl., 4.4.19.

Sheet steel, previously coated with oil, is made into ware of the desired shape, and heated to remove the oil and produce a thin coating of oxide. The enamel is then applied and the ware fired. By this procedure the customary treatment of the oiled surface and the subsequent pickling prior to enamelling are avoided.—A. B. S.

Refractory materials; Apparatus for the fusion of ——. R. A. Hoyle, Worcester, Mass. U.S. Pat. 1,314,871, 2.9.19. Appl., 1.7.18.

Refractory materials are fused electrically in a series of pits, placed in a row, the electrodes being carried by an overhead runway to each pit in turn.
—A. B. S.

Glass; Apparatus for production of sheet ——. T. J. McCoy, Shinglehouse, Pa., U.S.A. Eng. Pat. 132,649, 11.10.18. (Appl. 16,591/18.)

Abrasives; Manufacture of artificial ——. A. T. Snodgrass, Manchester. U.S. Pat. 1,314,835, 2.9.19. Appl., 22.6.18.

See Eng. Pat. 113,731 of 1917; this J., 1918, 213 A.

IX. BUILDING MATERIALS.

Bituminous road materials; Ultramicroscopic examination of disperse colloids in ——. E. C. E. Lord. J. Agric. Res., 1919, **17**, 167–176.

In certain hard native asphalts highly dispersed mineral matter occurs in large amount, and Richardson has concluded that the great adhesive properties of such asphalts are connected with the absorption exerted by this colloidal matter on the bitumen (this J., 1915, 412; 1918, 59 A). The author has therefore developed a method of ultramicroscopical analysis for the determination of the number of disperse particles in any type of bitumen. The utilisation of a paraboloid substage condenser with suitable microscopic apparatus in conjunction with a specially designed cell (0·1 mm. deep and 2·5 mm. diameter) ground out of an ordinary microscope slide, enabled satisfactory counts to be made at a magnification of 320 diameters. The colloidal solutions were made up in an optically empty solvent, which was sufficiently viscous to damp the Brownian movement. This solvent was made by fluxing 2·5 grms. of Mexican oil asphalt with 0·5 grm. of paraffin wax, diluting to 100 c.c. with benzene containing 10% of alcohol, evaporating to constant weight, re-dissolving in benzene, and filtering through an alundum tube clogged with macerated filter paper. The asphalt under examination was made up in benzene to a 2% concentration, allowed to stand 17 hours, and then centrifuged for 1 hour to remove coarser particles. From this solution 1 cub. mm. was diluted with paraffin oil to 10 c.c. so as to obtain an ultimate concentration of 1:5000 of the colloids present in the original sample.

Ultra-microscopic Counts of Colloidal Particles in Bituminous Solutions.

Bitumen.	No. of particles counted per c.c. at 1:5000 dilution.
Trinidad asphalt	406,256
Refined Trinidad asphalt and clay ...	30,529
Trinidad petroleum residuum and clay ...	169,262
Mexican oil asphalt and clay	108,113

The clay sample contained 33% of sandy clay incorporated by heating an aqueous emulsion of clay and bitumen until all moisture and gas was expelled.—A. E. D.

PATENTS.

Concrete; Burned shale and method of preparing the same and [light-weight] —— made thereof. O. Olsen, Oakland, Cal. U.S. Pat. 1,314,752, 2.9.19. Appl., 22.5.18.

A MIXTURE of coarse and fine particles of shale which has been burned, but not sintered, is used as an aggregate in the preparation of concrete. —A. B. S.

Cement-kiln gases; Process and apparatus for cooling —— and the recovery of dust therefrom. L. Stevens, Alpena, Mich. U.S. Pt. 1,315,254, 9.9.19. Appl., 29.12.15.

GASES from a cement-kiln are mixed with a regulated amount of air saturated with water, then with a current of cool air, and are afterwards passed through a dust separator in which the dust is precipitated in a dry state.—A. B. S.

Concrete, and method of manufacture thereof. O. Olsen, Oakland, Cal., U.S.A. Eng. Pat. 132,593, 13.9.18. (Appl. 14,938/18.)

SEE U.S. Pat. 1,314,752 of 1919; preceding.

Mixing concrete. Eng. Pat. 132,652. *See* I.

Lime. U.S. Pat. 1,315,952. *See* VII.

Buildings for storing explosives. Ger. Pat. 303,983. *See* XXII.

X. METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron in iron ores; Determination of —— by means of permanganate. R. Schwarz. Chem.-Zeit., 1919, 43, 499—500.

THE author replies to a recent paper by Brandt (this J., 1919, 662 A) and maintains that the addition of sodium silicate to the titration mixture is of advantage provided that the titration is carried out under the conditions given originally by himself and Rolfes (this J., 1919, 179 A). The use of a large quantity of sodium silicate is to be avoided. —W. P. S.

[*Steel;*] *Nature of the A_1 transformation [in ——] and a theory of quenching.* K. Honda. Iron and Steel Inst., Sept., 1919. [Advance copy.] 22 pages.

THE author gives a series of expansion and contraction curves, obtained with a modification of Chevenard's dilatometer (this J., 1917, 881), of a number of steels of varying carbon content, and it is deduced that the so-called A_1 point consists of the compound transformation:—Pearlite ⇄ sorbite (⇄) troostite) ⇄ martensite ⇄ austenite. Quenching consists in retarding the change from austenite to martensite to room temperature in order to arrest further changes to troostite, sorbite, and pearlite. The troostitic structure usually obtained by quenching and then tempering carbon steels can be obtained by a simple or a stepped quenching. The heat of transformation from austenite to martensite was found to be 4·3 calories. Martensite has two forms. When austenite is cooled β-martensite is first formed, then changes into α-martensite. In heating pearlitic steels the reverse change takes place. α-Martensite is more easily etched by picric acid, and more easily tempered by heating than β-martensite.—T. H. Bu.

Electric steel furnaces; Current economy in ——. F. Hartig. Stahl u. Eisen, 1919, **40**, 1170—1173.

A SERIES of experiments were carried out with a two-phase induction furnace melting ferro-manganese to ascertain the amount of current required for satisfactory melting. The current consumed during the working day was plotted against the tons melted, and the points connected fairly accurately by means of a straight line. With this line as a basis for satisfactory working, it is easy to calculate the current required for any charge. The method is fairly reliable, and can be used to compare furnaces of different melting capacities, and might also be used for other processes. —J. W. D.

Invar; Theory of ——. K. Honda and H. Takagi. Faraday Soc., July 14, 1919. [Advance proof.]

INVAR is a steel containing 35·4% Ni, having an extremely low coefficient of thermal expansion. It is concluded that such a steel is reversible, i.e., that the changes on heating and cooling occur at or about the same temperature down to the temperature of liquid air. Other elements such as manganese or chromium may be added to the nickel steel to produce other "invars" in which, as desired, a small positive or negative coefficient of expansion may be obtained. The nickel steels containing from 28 to 70% Ni are usually considered to be reversible; the authors consider that if cooled sufficiently these also become irreversible. The transformations occurring in nickel iron alloys are explained without the necessity of assuming a compound of iron and nickel by the application of the following generalisation: The critical point of a ferromagnetic substance is lowered by the addition of a non-magnetic or of a ferromagnetic material whose critical point is lower. On the other hand its critical point is raised by adding to it a ferromagnetic substance whose critical point is higher and which forms a solid solution.—F. C. Th.

Iron-chromium alloys; Constitution of ——. E. Jänecke. Z. Elektrochem., 1917, **23**, 49—55.

THE system iron-chromium consists of a single eutectic which can form mixed crystals with either component. The eutectic contains 75% Cr, and melts at 1320° C.; the limits over which mixed crystals are formed are 55%—85% Cr. The crystalline structure of the alloys is finer the greater the percentage of chromium. The alloys are all tough, and only in the case of alloys rich in chromium (above 80%) is it possible to break them on an anvil. The alloys are easily scratched by steel and are easily polished. Nitric acid, even when boiling, is without action, but hot 1:1 sulphuric acid attacks them readily. (See also J. Chem. Soc., Nov., 1919, ii., 468.)—J. F. S.

Nickel-chrome steel; Temper brittleness of ——. (1) R. H. Greaves. (2) R. H. Greaves, M. Fell, and R. A. Hadfield. Iron and Steel Inst., Sept., 1919. [Advance copy.] 20 pages.

THE effect of slow and rapid cooling after tempering on the mechanical properties of steel of the following approximate composition, C 0·25%, Mn 0·5%, Cr 0·6%, and Ni 3·5%, was studied. Material slowly cooled from the tempering temperature was almost identical in tensile strength and microstructure with the quenched material, but gave very different impact figures. Tempering treatment of the hardened steel involving rapid cooling from 600° C. or above produced good impact results, but slow cooling from the same temperature produced considerably lower impact figures. The impact figure after slow cooling from the tempering temperature was lower, the higher the original hardening temperature. Reheating to about 520° C. resulted in brittleness whatever the subsequent rate of cooling. Reheating to a higher temperature followed by slow cooling also produced brittleness. Brittleness can be removed by reheating to 600°—670° C. and cooling rapidly. The

results are in accord with the hypothesis of a critical range of temperature near 550° C. Above this temperature the tough condition is stable, and below it the brittle condition. Experiments were carried out on a large scale on an extruded steel tube of approximately the same composition, and the results entirely confirmed the conclusions from the laboratory experiments.—T. H. Bu.

Iron alloys; Influence of chemical composition and heat treatment of —— upon their magnetic properties, specific resistance, and density. E. Gumlich. Stahl u. Eisen, 1919, **39**, 765—771, 800—805, 841—847, 901—907, 966—972.

A DETAILED account, with numerous tables and photomicrographs, of an investigation carried out at the Physikalisch-Technischen Reichsanstalt, the chief results of which have already been noted (see this J., 1918, 374 A; 1919, 179 A).

Corrosion of metals. Rusting of iron. F. Goudriaan. Chem. Weekblad, 1919, **16**, 1270—1285.

THE author has investigated the conditions which influence the corrosion of metals, especially of iron. In pure, air-free water the action is purely electrolytic and soon ceases. When oxygen is dissolved in the water, active corrosion takes place, proportional to the difference between the rate of formation of ions and their oxidation. Carbon dioxide plays only a secondary part and is not essential for corrosion. The greatest corrosive effect is observed where the iron is in contact with both air and water. Convection currents in the liquid, and renewal of the liquid, increase corrosion. In boilers, the high proportion of oxygen in the air expelled from the water is responsible for severe action on the iron. In very dilute electrolytes, such as salt solutions, iron is not attacked, but as the concentration is increased, a maximum corrosive effect is reached at a "critical concentration." With many electrolytes further concentration diminishes the effect, and a "limit concentration" is obtained at which no corrosion takes place. The supposed negative action of solutions of sodium salts must therefore be considered in connection with the concentration of the solution. Solutions of ammonium salts are generally very active. Tables showing values for various electrolytes are given. The influence of temperature has not been definitely established. Motion in the electrolyte will tend to accelerate corrosion. The condition of the metal itself is an important factor. The impurities in iron set up different potentials in the metal, and thereby induce subsidiary corrosive effects. The metal may be protected by covering it with a metal of lower potential; on the other hand, contact with a metal such as copper or nickel increased the corrosion by 25%—47% and 14%—19% respectively. The author gives many references to the work of other investigators. (See also J. Chem. Soc., 1919, ii., 467.)

—W. J. W.

Platinum ores; New method of analysing ——. Composition of native platinums from the Urals. L. Duparc. Helv. Chim. Acta, 1919, **2**, 324—337.

THE modes of occurrence and processes of extraction of platinum in the Urals are described, and the following method is given for the analysis of platinum ores. The ore (10 grms. at least) is treated with *aqua regia* at 80° C., the undissolved iridium osmide and sand being washed, weighed together, and then fused, in a small refractory crucible previously glazed with borax, with 5—6 grms. of granulated silver and excess of boric anhydride. When cold the crucible is broken, and the metallic bead washed with sulphuric acid and treated with nitric acid, which dissolves the silver but not the osmide. The latter is filtered off and washed with boiling water, the moist filter being carefully incinerated and the weight of the osmide determined; the sand, removed by the borax, is determined by difference. The filtrate from the osmide and sand is freed from nitrous products by repeated evaporation with hydrochloric acid, the residue being dissolved in hot water, and the solution treated for 30 minutes with a stream of chlorine, and afterwards evaporated to a pasty consistence in an air-bath at 38°—42° C.; by this treatment the iridium is maintained as tetrachloride, and reduction of the gold and formation of basic salts are prevented. From 25 to 30 grms. of ammonium chloride is then added in small quantities, all the platinum and iridium being thus precipitated as double salts, which are filtered off after two days and washed with cold saturated ammonium chloride solution (500—600 c.c. required) until the wash liquor fails to give the iron reaction with thiocyanate. A little alcohol is added to the filter, the filtrate being evaporated to dryness, and the residue dissolved in water and added to the first filtrate. The filter and its contents are then incinerated in a muffle furnace, and the spongy mass triturated with hydrochloric acid in a porcelain dish to remove the last traces of iron, then calcined in a current of hydrogen and cooled in carbon dioxide; the iridium and platinum thus obtained are weighed together. To separate the iridium from the platinum, the spongy mass is treated in a porcelain dish with *aqua regia* diluted with five times its volume of water, the temperature being kept below 50° C. and the dish covered to prevent evaporation; this operation is repeated with occasional renewal of the liquid until digestion for 12 hours with fresh liquid produces no further action. The residue is washed with 10% hydrochloric acid, filtered, washed, calcined in hydrogen, and cooled in carbon dioxide; this represents the iridium. The filtrate from the iridium is precipitated with ammonium chloride, and the platinum estimated in the usual way; it is well to treat this platinum a second time with the dilute *aqua regia* in order to ensure complete separation of the iridium. The filtrate from the first ammonium chloride precipitation is treated on the water-bath with 0·75—1 grm. of dimethylglyoxime dissolved in boiling water and heated till a yellowish-brown (yellow in absence of gold) precipitate is formed, which is filtered off, washed with faintly acidified water, dried, and calcined in a tared porcelain crucible. The sponge obtained is redissolved in *aqua regia*, and the nitric acid expelled by repeated evaporation with hydrochloric acid, the residue being treated with water and ammonium chloride added to precipitate any platinum still present; the weight of the platinum thus obtained is added to that previously found. The filtrate from the platinum is evaporated to dryness, and the residue treated several times with nitric and then with hydrochloric acid; after again evaporating to dryness the residue is dissolved in water and the solution heated to 60° C. after addition of 2 grms. of ammonium oxalate. Precipitation of the metallic gold is complete after 4—6 hours; this is filtered off, washed with acidified water, dried, calcined, and weighed. The filtrate from the gold is treated with ammonia until only feebly acid, and then with 1 grm. of dimethylglyoxime dissolved in boiling water, the yellow precipitate formed being filtered off, washed with acidified water, dried, calcined in hydrogen, cooled in carbon dioxide, and weighed as metallic palladium. The filtrate from the gold and palladium is reduced by treatment with 50 grms. of pure zinc and 50 grms. of concentrated hydrochloric acid for 5—6 hours, the black mass being rapidly filtered off, washed until the washings fail to react for chlorine, and filter and precipitate incinerated in a tared porcelain crucible. After trituration in a glass mortar with 50% nitric acid, the calcined mass is treated for about 2 hours with

this acid, the clear liquid being then decanted off and the treatment repeated. The residue contains the rhodium (often with a little platinum); the filtrate, which contains all the copper (and sometimes traces of rhodium) is evaporated several times to dryness with concentrated hydrochloric acid, the residue being treated with water and the copper precipitated as thiocyanate in the ordinary way. The filtrate from the copper is evaporated to dryness, the residue being treated with nitric acid to decompose the thiocyanates, dissolved in water, and reduced with zinc and hydrochloric acid. Any traces of rhodium are thus precipitated, and, after filtration and calcination, are added to the rhodium residue, which is fused for about 30 hours with potassium bisulphate, which dissolves the whole of the rhodium, but leaves any traces of platinum and iridium undissolved. The rhodium is extracted by treatment of the cold mass with 15 c.c. of concentrated hydrochloric acid, and afterwards with water in a water bath, the residue being filtered off, washed, calcined in hydrogen and then in carbon dioxide, weighed, and added to the spongy platinum and iridium before the separation of the latter with *aqua regia*. The solution containing the rhodium is reduced with zinc, the black precipitate being filtered off, washed by trituration with dilute hydrochloric acid, calcined in a current of hydrogen, cooled in carbon dioxide, and weighed as rhodium. The filtrate from the metal obtained by the first reduction with zinc is made up to a definite volume and the iron in an aliquot part precipitated twice as acetate. The mean compositions of samples of platinum from the principal Ural centres are given.—T. H. P.

Silver; Properties of standard or sterling —— *with notes on its manufacture.* E. A. Smith and H. Turner. Inst. of Metals, Sept., 1919. [Advance copy.] 43 pages.

Silver and copper form an interrupted series of mixed crystals, and segregation of the constituents always occurs during solidification. The eutectic mixture containing 72% Ag and 28% Cu is the most uniform in composition of all the alloy series. Standard silver containing 7·5% Cu is invariably richer in silver towards the middle of the cast bar, and a small quantity of pure silver is added in excess to ensure the attainment of the legal standard. Softening of the metal is perceptible at 230° C., but in works practice an annealing temperature of 670° C. is considered to be most satisfactory. Absence of oxidising conditions during annealing is necessary, otherwise copper oxide penetrates the metal and produces a "firemark," which is difficult to remove. In this process a salt bath could be used with advantage. Cold forging, die stamping, or other mechanical treatment greatly increases the hardness of standard silver, and its resistance to wear is materially increased. As an example, the forging of a ¾-in. square bar to 0·14 in. thickness, for knife blades, increases the Brinell hardness number from 71 to 146. The maximum Brinell hardness of cold-worked standard silver is about 183.—C. A. K.

Silver electro-plating; Early history of ——. R. E. Leader. Inst. Metals, Sept., 1919. [Advance copy.] 18 pages.

Notes are given on the history of the industry from 1839 to 1851.

[*Electric*] *radiant resister furnace* [*for zinc distillation*]. F. A. J. Fitzgerald. Trans. Amer. Electro-Chem. Soc., 1919, 1—7. [Advance copy.]

The furnace is used for the distillation of low-grade or scrap zinc, and is constructed of firebrick and heat-insulating material, with a hearth of carbonaceous refractory material, on to which the molten zinc is supplied by an inclined tube. It is heated by resisters of graphite connected in series above the hearth, and above the resisters are two diaphragms, the lower one being porous. The zinc vapour passes through the lower diaphragm, and round the ends of the upper one before passing to the condenser, consisting of a flat box with transverse baffle plates which can be preheated at the start. The cover of the furnace is formed of carbon, firebrick, and heat insulating slabs. The best results are obtained with a current of 845 ampères at 65 volts or 55 kilowatts, and the output is about 50 kilos. of refined zinc per hour.—B. N.

Zinc; Analysis of refined and commercial ——. S. Rothschild. Chem.-Zeit., 1919, **43**, 529—530.

Refined zinc. The chief impurities present are cadmium, lead, and iron. Twenty grms. of the sample is warmed with 200 c.c. of water and 14 c.c. of concentrated sulphuric acid, the insoluble portion is collected on a filter, dissolved in nitric acid, the solution is treated with sulphuric acid in the usual way, and the lead sulphate collected and weighed. The filtrate from the lead sulphate is added to the first filtrate, and the iron is separated by means of "cupferron"; cadmium is determined in the filtrate from the iron precipitate. *Commercial zinc.* Twenty grms. of the sample is treated with 200 c.c. of water and 14 c.c. of concentrated sulphuric acid, and the insoluble portion is separated and treated with nitric acid. Metastannic acid remains insoluble and is collected and weighed. Lead is precipitated as sulphate in the filtrate from the metastannic acid. The filtrate from the lead sulphate is added to the main bulk of the solution (the first filtrate), and iron and copper are precipitated together by means of "cupferron," and separated subsequently. Cadmium is precipitated as sulphide in the filtrate from the "cupferron" precipitate, and aluminium is precipitated as hydroxide in the filtrate from the cadmium sulphide. In the electrolytic method of determining lead in refined zinc, the addition of a small amount of copper promotes the deposition of the lead dioxide.—W. P. S.

[*Brass;*] *Season cracking* [*of* ——]. W. H. Hatfield and G. L. Thirkell. Inst. of Metals, Sept., 1919. [Advance copy.] 25 pages.

A superficial examination of a brass flower bowl which had developed numerous cracks showed that cracking was usually accompanied by corrosion, and that it occurred only in the parts which had been stressed in the manufacture of the bowl. The cracks appear to extend through seats of corrosion, usually around, but sometimes directly through, the crystals. Sections of the bowl lost their brittleness and became quite ductile again when annealed for one hour at 550° C. During experiments made on spinning brass cups, it was found that when the material was overworked without annealing, cracks were readily produced by immersion in an acidified solution of mercurous nitrate. Stresses existing in the cold-worked metal were estimated from the change in diameter of a ring parted from the cup and cut. In some cases the value obtained approached the maximum stress which the metal would stand without rupture, and it is suggested that a certain amount of corrosion might cause sufficient weakening of the metal locally to start a fracture. Annealing of the spun metal was found to reduce the internal stresses, and rendered the cups free from cracking when subjected to the mercurous nitrate test.—C. A. K.

Duralumin; Micro-mechanism of the ageing of ——. Z. Jeffries. Inst. of Metals, Sept., 1919, [Advance copy.] 5 pages.

An aluminium alloy with 3% Cu and 0·5% Mg when rolled and quenched at 500° C. is soft. At the ordinary temperature it subsequently hardens

for four or five days. Copper is soluble in aluminium to the extent of 3% at 500° C. On cooling to 300° C. the solubility is reduced to 1%, with precipitation of excess $CuAl_2$. Slow cooling produces softer, weaker material with relatively large particles of $CuAl_2$, and no further change occurs. After quenching, ageing goes on for about 100 hours, with increase of elastic limit and tensile strength. Ageing of the quenched alloy is inhibited at liquid air temperature. At 200° C. ageing proceeds more completely, and results in a hardness being attained much greater than that produced at the ordinary temperature. Duralumin quenched from 500° C. and at once reheated shows evolution of heat at 260° C. not observed after slow cooling. The hardening is supposed to be due to the precipitation of $CuAl_2$ in an ultra-microscopic condition.—F. C. Th.

Nickel-silver; Graphite and oxide inclusions in ——. F. C. Thompson. Inst. of Metals, Sept., 1919. [Advance copy.] 3 pages.

In the high-nickel alloys which have become carburised a precipitation of graphite occurs as a result of annealing above 700° C. This commences at the surface and proceeds inwards, as in the case of 80:20 cupro-nickel (this J., 1919, 130 A). The graphite forms cell walls around the crystals, rendering the metal very brittle. Oxidation during melting results in the formation of little globules of zinc oxide, whereas slag, when present, occurs as long continuous threads drawn out in the direction of rolling.—F. C. Th.

Britannia metal; Constitution and metallurgy of ——. F. C. Thompson and F. Orme. Inst. of Metals, Sept., 1919. [Advance copy.] 8 pages.

The range of composition found in these alloys is Sn 90—94%, Sb 5—7%, and Cu 1—3%. With the higher antimony and copper contents the metal is harder and less ductile. The melting point is 240° C., the best casting temperature being about 320° C., corresponding to a light blue oxidation tint. Quenching from temperatures about 200° C. results in a distinct hardening, especially as measured by the scleroscope. Chill cast discs are much harder than the corresponding ingots. The structure of the metal dealt with consists of a light constituent, probably the antimony-tin δ solution, embedded in a ground mass which possesses a composite structure, and which is possibly the copper-tin eutectic containing about 1% Cu. The cubes of the antimony-tin γ solution found in white bearing metals are absent. The cored structure is visible in cast Britannia metal. Quenching hardens the alloy, and results in a decrease in the amount of the white constituent present. This constituent is present in the chill cast discs in the form of globules.—F. C. Th.

Bearing-metal; Observations on a typical ——. H. E. Fry and W. Rosenhain. Inst. of Metals. Sept., 1919. [Advance copy.] 7 pages.

It is recognised that Brinell hardness is not necessarily even an approximate measure of the value of a bearing metal. The structure is one of tin-antimony cuboids and needle-like crystals of a copper-tin constituent, in a dark-etching ground mass. Small differences in the temperature of the moulds into which the metal is cast are not accompanied by any striking difference in structure. The temperature of casting is of great importance. With high temperatures a very coarse structure is obtained. Chill castings yield the most uniform structure. With very slow cooling the tin-antimony cuboids rise to the upper part of the ingot. The best conditions appear to be a casting temperature of 350° C., with moulds at 200° C. The depth of chill on the surface was as follows:—

Temperature of casting, °C.	Temperature of mould, °C.	Depth of chill in ins.
300	Cold.	0·08
400	Cold.	0·10
300	350	0·02
300	100	0·06
400	100	0·096
350	200	None.

On the whole the chill cast specimens are harder than those cast in sand. Hammering the metal lowers the Brinell hardness to a small extent, especially when the alloy is subsequently annealed at 100° C. The finer-grained ingots withstand the hammering fairly well.—F. C. Th.

Bearing metal and similar alloys; Simple method of analysis of ——. G. Oesterheld and P. Honegger. Helv. Chim. Acta, 1919, 2, 398—416.

Bearing metal consists of crystals of at least three different types, and great care is necessary in sampling. With large bars, either the entire cross-section should be planed or uniformly distributed borings made. The turning should not be too thick and, especially when the content of antimony is high, the formation of excessive dust during boring is to be avoided, as the dust is always richer in antimony and mostly richer in copper than the borings. The analytical procedure is as follows: 1 grm. of the alloy is dissolved in a covered 300 c.c. Jena glass beaker in 20 c.c. of concentrated sulphuric acid, the sulphur dioxide formed being expelled by boiling. The cold solution, diluted with water to about 100 c.c., is treated with 5 c.c. of concentrated hydrochloric acid and a little methyl orange, and the antimony determined by titration with $N/10$ potassium bromate solution; towards the end of the titration it is advisable to add more methyl orange and to run the bromate in slowly, since change of colour of the indicator in the cold occupies a certain time. After this titration the solution is left at rest for an hour, the separated lead sulphate being then collected in a Gooch crucible (previously dried at 500° C. and weighed) and washed rapidly with dilute sulphuric acid, and finally with a little distilled water. The crucible is heated for 15 minutes at 500°—600° C. in an electric muffle furnace, any traces of sulphur formed by reduction of the sulphuric acid by the tin being thus completely vaporised; higher temperatures should be avoided, owing to the volatility of the lead sulphate. After cooling and weighing, the crucible is ready for the next lead determination. If the content of tin is high, the filtrate from the lead sulphate is rinsed into a 500 c.c. measuring flask with hydrochloric acid and made up to volume, 100 c.c. being pipetted off for reduction; with less than 30% of tin in the alloy, the whole filtrate may be taken. The solution is reduced in a long-necked, 500 c.c. Erlenmeyer flask fitted with a Contat-Göckel valve charged with a concentrated solution of sodium bicarbonate in boiled water, 80 c.c. of concentrated hydrochloric acid and three successive quantities of 3 grms. of zinc turnings being added. The liquid is boiled to re-dissolve the tin, cooled, and, after removal of the valve, immediately treated with 5 c.c. of potassium iodide solution and 5 c.c. of fresh starch solution, and titrated with $N/10$ bromate solution. For estimating the copper, a separate quantity of 1 grm. of the alloy is dissolved as before in 20 c.c. of concentrated sulphuric acid, the solution being diluted approximately to 100 c.c. and, when quite cold, treated with 30 c.c. of, roughly, $N/2$ potassium iodide solution. A special simplified form of silver-platinum double electrode

charged with $N/1$ potassium chloride solution is introduced, this being connected to a millivoltmeter, the scale of which is reduced to suitable dimensions by insertion of a shunt resistance of 50,000 ohms. The liquid is then titrated with $N/10$ thiosulphate solution until the millivoltmeter indicates the end-point. If the alloy contains zinc, a separate quantity of 1 grm. is dissolved in concentrated sulphuric acid, and the solution, after dilution and filtration, precipitated hot with hydrogen sulphide. In this way the metals already determined are precipitated and after their removal the filtrate may be used for the estimation of the zinc and, if necessary, of such impurities as iron, aluminium, etc.—T. H. P.

Tin-antimony-arsenic alloys. J. E. Stead. Inst. of Metals, Sept., 1919. [Advance copy.] 16 pp.

The structure of the alloys investigated consists of incomplete spherical shells of a white constituent embedded in a dark-etching matrix. The more rapid the solidification the more the crystals are curved. The structure was best developed in alloys with 70—85% Sn, 25—18% Sb, and 4—5% As. The alloys are exceedingly brittle, fracture passing midway between the shell walls. With 70% Sn, 25% Sb, and 5% As, the cooling curve showed the following arrests: Commencement of solidification 410° C., a retardation between 325° and 320° C., and the eutectic solidification at 245° C. The first crystals formed contain the maximum arsenic content, the eutectic consisting apparently of antimony and tin only.—F. C. Th.

Metals; Solidification of —— from the liquid state. C. H. Desch. Inst. of Metals, Sept., 1919. [Advance copy.] 23 pp.

According to Kelvin, the most general solution for the homogeneous division of space is the tetrakaidecahedronal cell with fourteen walls, eight hexagonal and four quadrilateral. In foam cells, however, the most common face is pentagonal. A slight curvature of the edges converts the pentagonal dodecahedron into a space-filling form. In a coarse β-brass the five-sided face was found to be the most common type, the relationship between the faces of the grains of this brass and those of a foam cell being very marked. It would appear, therefore, that surface tension plays an important share in determining the form of the crystals in a solidifying metal. It is shown that in convection cells (J. Inst. Metals, 1914, 11, 57) local differences of temperature exist, the boundaries being as much as 6° hotter than the centres. It is considered, however, that this phenomenon is without importance in the solidification of ordinary masses of metal, although it may play a part in solidification of thin sheets.—F. C. Th.

Alloys; Isomeric ——. G. Tammann. Nachr. K. Ges. Wiss. Göttingen, 1918, 332—350. Chem. Zentr., 1919, 90, III., 89—90.

When a galvanic element, in which two metals are immersed in a solution of the less noble metal, is short-circuited, the less noble metal is deposited on the more noble. If the diffusion velocity of the atoms of the less into the more noble metal is very small, when the circuit is broken its potential rapidly rises to the original value. If, however, the diffusion velocity is appreciable, the rise is much slower. This provides a very sensitive method of demonstrating the diffusion of one metal into another. Experiments in which solutions containing cadmium sulphate and copper sulphate were electrolysed showed that, by varying the proportion of copper sulphate in the solution or by varying the current strength, deposits of the mixed metals could be obtained such that, when the circuit was broken, the resulting potential varied between zero and the copper-cadmium potential difference. The alloys prepared by melting together copper and cadmium behaved quite differently, and it is therefore concluded that the alloys prepared by the two methods, although having the same composition, are not identical. When alloys are formed by precipitating one metal from solution by another, the composition of the alloy depends on the affinity of the metals for one another and upon their capacity to form mixed crystals. The alloys thus prepared are identical with those prepared by electrolysis.—E. H. R.

Metals and their mixed crystals; Changes in the chemical properties of —— by mechanical working. G. Tammann. Nachr. K. Ges. Wiss. Göttingen, 1918, 351—361. Chem. Zentr., 1919, 90, III., 90—91.

The energy content of a piece of metal is increased by cold working. The increase of energy depends on the degree of deformation of the metal and on its nature and temperature, and is occasioned firstly through the formation of glide planes and the translation or simple shearing of parts of the metal, and secondly possibly through actual increase in the potential energy of the atoms themselves. The cold-worked metal is "less noble" in the hard state than in the soft state; nevertheless an imperfectly worked specimen, still soft in the centre, can be "less noble" than a "thoroughly hardened" specimen of the same metal. This was confirmed in differently worked specimens of silver wire, and in the case of bismuth, which was supposed to be an exception. The increase in solution velocity of iron through cold-working is probably due to the formation of twin lamellæ in the iron crystals. Alloys of gold with copper and silver become more reactive chemically through cold rolling and hammering. Gold-silver alloys too rich in gold to be attacked in the soft state are readily attacked after cold working. The change in properties of the gold atoms is probably caused by shearing along glide planes, through which they become more loosely bound, and therefore more easily detached from the crystal lattice after removal of the more reactive atoms.—E. H. R.

Thorium-lead. O. Hönigschmid. Z. Elektrochem., 1917, 23, 161—165.

Thorium lead from Ceylon thorite has an atomic weight 207·77 ± 0·14, a value which agrees with Soddy's value determined indirectly. Calculations show that this material contains Ra (G) and Th (E) in the ratio 20:7, and that it is made up of 8·9% uranium-lead and 91·1% thorium-lead. (See also J. Chem. Soc., 1919, ii., 465.)—J. F. S.

Moulding sands for non-ferrous foundry work. P. G. H. Boswell. Inst. of Metals, Sept., 1919. [Advance copy.] 22 pages.

Success in obtaining sound castings of brass, bronze, aluminium, and other metals cast at relatively low temperature is more dependent upon skilful moulding technique than upon chemical characteristics of the sand. At the same time a knowledge of the texture and physical properties of the moulding sand leads to useful practical results. Sands used for non-ferrous casting are closer and finer grained than those used in steel founding, partly in order that a smooth, clean skin may be obtained, and partly to prevent the penetration of the mobile metal. If the metal is properly de-gasified the mould does not require to be so thoroughly vented. Mineral analysis is of less importance than either chemical or mechanical analyses. In metal founding the natural bond of moulding sands is often supplemented by artificial bonds such as treacle, flour, dextrin, etc., which increase the colloid matter present, and to ensure a smooth facing a china clay or graphite "paint" is usually applied to the mould. The sands used

in British non-ferrous foundry practice may be conveniently divided into the red sands from the deposits of Bunter (Triassic) age, occurring along a well-marked belt in England, and various other grey, yellow, and brown sands, of different geological ages, scattered throughout the country, and in many cases insufficiently well known in the immediate locality.—C. A. K.

Phenols and metals. Skirrow. See III.

PATENTS.

Steel; Manufacture of sound ingots and billets of special —— suitable for use in aeroplane and motor construction. R. A. Hadfield, Westminster. Eng. Pat. 131,373, 28.5.18. (Appl. 8815/18.)

THE steel base (*e.g.*, scrap or turnings) is melted and refined in an electric furnace of 3 to 6 tons capacity on a basic hearth, then poured into a bottom run ladle with nozzle of small diameter, and cast as cool as possible into comparatively small taper ingots large end up. The upper end of the ingot is kept in the molten condition while the lower is solidifying. The ingots are annealed, reheated to a suitable rolling temperature, cogged into a bar, then further rolled into a bar of the desired section. The steel has the approximate analysis C 0·30%, Si 0·15%—0·25%, Mn 0·60%, Cr 0·70%, Ni 3·5%.—T. H. Bu.

Steel; Process of making ——. E. T. Pelton, Chicago, Ill., Assignor to American Super-Steel Corporation. U.S. Pat. 1,315,031, 2.9.19. Appl., 4.11.18.

THE charge consists of 2000 lb. of iron materials, with the additions of 100 lb. of dehydrated lime and 100 lb. of carbon. When the charge is reduced, the phosphoric slag formed is removed and 10 lb. each of powdered fluorspar and dehydrated lime added to produce a carbide slag and to remove the sulphur. This slag is removed, and the charge worked to a finish in the usual manner with the addition of 40 lb. of ore.—J. W. D.

Iron alloys. K. Ibe, Nogi Gun, Japan. Eng. Pat. 131,492, 26.9.18. (Appl. 15,664/18.)

AN iron alloy specially suitable for use in deoxidising iron or steel is prepared by fusing from 1 to 5% each of titanium and vanadium with iron or steel in the presence of 5 to 75% of silicon. The alloy may be produced in one continuous operation by reducing an ore or mixture of ores containing iron, titanium, vanadium, and silicon in the prescribed proportions.—T. H. Bu.

Steel; Manufacture of alloy ——. R. A. Hadfield, Westminster. Eng. Pat. 131,980. (Appls. 12,332, 29.7.18 and 18,684, 14.11.18.)

AN alloy steel of considerable tensile strength and resistance to shock stresses contains 0·2 to 0·6% carbon and 1·4 to 3·5% manganese; the higher the percentage of manganese the lower the carbon, the silicon being kept low. The steel is heat-treated by quenching from 800°—900° C., reheating to 450°—700° C., and cooling quickly or slowly according to the physical properties desired. The alloy may contain a small percentage of chromium or nickel or both.—T. H. Bu.

Steel; High-speed ——. J. O. Arnold, Sheffield. Eng. Pat. 132,082, 25.9.18. (Appl. 15,551/18.)

A HIGH-SPEED steel of greater cutting efficiency than those containing tungsten at present manufactured is made by adding to the usual constituent elements minus the tungsten, vanadium and molybdenum with or without a small percentage of aluminium. The preferred composition is C 0·65%, Si 0·35%, S 0·10%, P 0·02%, Mn 0·20%, Cr 3·25%, V 1·25%, Mo 7·50%, Al a trace, Fe 86·68%. The tools are preferably hardened from 1300° C. by blackening at an angle the cutting edge of the tool in hot water and finishing off in a blast of compressed air. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 103,810.)
—T. H. Bu.

Steel for casting high-speed tools; Alloy for ——. M. S. Clawson, Belleville, N.J. U.S. Pat. 1,315,468, 9.9.19. Appl., 19.11.18.

THE alloy consists of Fe 82·40 to 62·25%, W 13 to 25, Cr 2·5 to 5, V 0·5 to 3, C 0·85 to 3·5, and Si 0·30 to 1·50%.—B. M. V.

Removing paint, varnish, and grease from iron, steel, and copper, rust from iron or steel, and oxide or sulphide from copper; [Electrolytic] process for ——. Q. Marino, London. Eng. Pat. 131,709, 22.8.18. (Appl. 13,665/18.)

THE metal to be cleaned is used as cathode in an electrolyte composed of a solution of caustic soda or potash, to which has been added oxalic acid and sodium or magnesium sulphate.—B. N.

Steel; Method of preventing —— from rusting. J. H. Gravell, New York. U.S. Pat. 1,315,017, 2.9.19. Appl., 15.7.18.

IRON and steel articles are prepared for painting by subjecting them to the corrosive action of a solution of oxalic acid and phosphoric acid in alcohol and water at a temperature insufficient to decompose the oxalic acid.—J. W. D.

Galvanized iron; Process for removing the coating from ——. E. H. Kramer, Cleveland, Ohio. U.S. Pat. 1,315,779, 9.9.19. Appl., 20.12.16.

THE iron is dipped into an aqueous solution of a neutral substance containing sulphur and a "nitric salt."—B. M. V.

Briquetting finely pulverised iron ore. J. R. H. A. Lämmerkirt, Hoerde, Germany. U.S. Pat. 1,315,315, 9.9.19. Appl., 6.7.17.

FERROSO-FERRIC materials, in particular iron scale and pulverulent concentrates obtained from magnetic iron ore by the magnetic dressing process, are briquetted by the addition of metallic iron in fine pieces and moist ore containing ferric oxide or oxyhydrates.—J. W. D.

Metal disintegrating apparatus. Metals Disintegrating Co., Inc., New York, Assignees of E. J. Hall, Passiac, N.J., U.S.A. Eng. Pat. 121,600, 4.12.18. (Appl. 20,081/18.) Int. Conv., 20.12.17.

A CONDUIT supplying steam or gas opens tangentially into the lower part of an annular chamber surrounding a vertical nozzle, through which molten metal to be disintegrated is discharged. In the upper part of the annular chamber is a ring having inclined or helical vanes forming passages inclined to the axis of the nozzle, and the chamber terminates at the upper end in an annular discharge orifice surrounding the tip of the nozzle. The tip of the nozzle is bevelled towards the discharge end, and assists in converging the whirling jet of steam or gas on to the stream of metal.
—T. H. Bu.

[Lead] smelting furnace. F. B. Dehn, London. From National Lead Co., New York. Eng. Pat. 132,023, 2.9.18. (Appl. 14,246/18.)

A CARRIAGE is suspended in front of the hearth of a smelting furnace of the Scotch hearth type, with a stationary hearth, and supports a rabbling device which operates on the material on the hearth, but is withdrawn inoperative when the carriage is being moved along the hearth. The carriage makes

a step-by-step movement along the hearth when the rabbling device is in action, is automatically stopped at the end of its movement, and then returned with an uninterrupted and quick movement while the rabbling device remains inoperative.
—T. H. Bu.

Lead and zinc; Processes for the extraction of —— from their ores. F. E. Elmore, Boxmoor, Herts. Eng. Pat. 131,353, 8.5.18. (Appl. 7732/18.)

Lead-zinc sulphide ores, concentrates, etc., are pulverised and heated with strong hydrochloric acid until the lead has been converted into lead chloride, the zinc sulphide remaining substantially unattacked. The mixture is cooled and washed with a limited quantity of cold water; the lead chloride is then dissolved by means of a hot solution of lead chloride in water or brine (mother liquor from a previous operation), the liquor being removed to a crystallising vat, in which the lead chloride crystallises out. After separating the crystals the solution is reheated and used again in the process. The lead chloride is heated with sulphuric acid and the hydrochloric acid evolved is dissolved in water, the solution being used for treating a further quantity of ore.—T. H. Bu.

Zinc-retort residues; Treatment of . O. Spitzer, New York, and C. C. Conover, Springfield, Ill. U.S. Pat. 1,315,349, 9.9.19. Appl., 28.9.15.

The residues are cooled in a substantially non-oxidising atmosphere and then, before the metallic particles become sufficiently oxidised to lose their magnetic permeability, they are subjected to magnetic separation, whereby the metallic particles are separated from the unconsumed carbon.
—J. W. D.

Zinc solutions; Treatment of preparatory to the recovery of zinc by electro-deposition. Electrolytic Zinc Co. of Australasia Proprietary, Ltd., Melbourne. Eng. Pat. 131,702, 16.8.19. (Appl. 13,369/18.) Int. Conv., 17.8.17.

Cobalt is removed from zinc solutions, preparatory to recovery of zinc by electro-deposition, by adding a soluble arsenic compound, and subsequently adding zinc dust; or the arsenic compound may be added to the ore or zinc-bearing material to be treated by leaching for the preparation of the zinc sulphate electrolyte. The precipitation of the cobalt is effected at about 60° C. A compound of copper may be added with the arsenic compound, the solution made slightly acid, heated to about 60° C., and agitated without access of air; zinc dust or "blue powder" is added in separate stages, with agitation between successive additions, and the solution finally separated from the precipitate.
B. N.

Zinc solutions; Treatment of —— preparatory to the recovery of zinc by electrodeposition. Electrolytic Zinc Co. of Australasia Proprietary, Ltd., Melbourne, Australia. Eng. Pat. 131,998, 16.8.18. (Appl. 13,368/18.) Int. Conv., 17.8.17.

Cobalt is removed from zinc solutions preparatory to the recovery of zinc by electrodeposition by adding a soluble manganese compound and precipitating the cobalt and the manganese with lead peroxide or calcium plumbate and sulphuric acid. The manganese compound may be added to the ore before leaching with sulphuric acid to extract the zinc. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 115,846; this J., 1919, 421 A.)
—T. H. Bu.

Furnaces for annealing metal bars, tubes, and the like. A. Hilbig, and Hackethal-Draht und Kabelwerke, Hanover, Germany. Eng. Pat. 131,932, 30.10.17. (Appl. 15,806/17.)

A furnace for annealing bars, tubes, and the like has two openings in opposite sides with closing flaps. A conveying chain carrying blocks arranged in pairs corresponding to the width of the furnace passes through these openings. The material to be treated is held together between successive pairs of blocks which also raise the side closing flaps of the furnace.—T. H. Bu.

Crucible furnace. W. H. Williams, Birmingham. Eng. Pat. 132,381, 15.10.18. (Appl. 16,772/18.)

The furnace consists of two hinged halves, divided vertically, carrying a grate between them in conjunction with which is a fixed crucible pedestal. In the pedestal is an air inlet which communicates with flues in the walls of the furnace. Above is a swinging canopy working in conjunction with a crucible gripping device. J. W. D.

Crucible and like furnaces; Gas heated ——. South Metropolitan Gas Co., and D. Chandler, London. Eng. Pat. 132,398, 19.11.18. (Appl. 18,983/18.)

An opening for the escape of molten metal is provided through the furnace wall, and may be conveniently placed at the back of the burner tube. The orifice is closed by a fusible metal plate which is melted by the molten metal if the crucible breaks during heating.—C. A. K.

Electric melting furnace. J. D. Shipton, Vancouver, B.C. U.S. Pat. 1,313,746, 19.8.19. Appl., 8.2.19.

In an electric furnace comprising an internal chamber with a charging opening, and in which the heat of the arc is radiated on to the metal to be melted, means are provided in the upper part of the chamber for preheating the metal intended later to form a part of the charge in the lower part of the furnace.—B. N.

Blast furnaces; Heat-recuperating process and apparatus for ——. J. P. Dovel, Birmingham, Ala. U.S. Pat. 1,316,086, 16.9.19. Appl., 27.12.18.

By means of a heat recuperator in the stack flue for the waste gases leaving the blast furnace stoves, heat is transferred from the latter to the cold air blast for the furnace. A closed circuit for the heat units is thus set up and from this circuit sufficient heat is withdrawn, for example by passing a portion of the cold air supply for the stoves through the recuperator, to maintain a uniform temperature in the gases at their point of discharge.
—J. W. D.

Electrodes for electric arc welding and metal cutting purposes. W. H. Boorne, London. Eng. Pat. 132,354, 12.9.18. (Appl. 14,857/18.)

A coating for metal rod electrodes consists of a mixture of 10 parts of calcined magnesite, 1—2 parts of powdered aluminium, 5 parts of water, and 20 parts of a 10% solution of sodium silicate. With this electrode covering the slag formed on the weld is easily removable.—C. A. K.

Metals; Melting ——. W. H. Bristol, Assignor to The Bristol Co., Waterbury, Conn. U.S. Pat. 1,315,206, 9.9.19. Appl., 24.12.18.

To prevent the oxidation of metals during melting, an atmosphere of steam is maintained over the surface of the metal.—C. A. K.

Smelting process and apparatus. F. H. F. Hampton, Sewell, Chile, Assignor to W. W. Stenning, London. U.S. Pat. 1,315,551, 9.9.19. Appl., 30.3.16.

A FINELY divided, self fluxing material is projected upwards into a zone sufficiently heated to cause the formation of melted slag; the melted globules are permitted to coalesce to form a bath of slag, and valuable products and all the gases are caused to escape at the base only of such zone.—J. F. B.

Platinum metals; Process of recovering ——. W. C. Ferguson, Garden City, N.Y., Assignor to Nichols Copper Co., New York. U.S. Pat. 1,315,660, 9.9.19. Appl., 6.1.17.

ELECTROLYTIC slimes containing platinum are subjected to a sulphatising roast, and treated subsequently to recover a concentrate of the platinum metals.—C. A. K.

Quicksilver [mercury]; Process of recovering —— from its ores. H. W. Gould, San Francisco, Cal. U.S. Pat. 1,315,663, 9.9.19. Appl., 23.12.17.

ORE containing mercury is roasted to produce mercury vapour. The furnace gases containing the mercury vapour are passed through a cooling chamber and then led into an inclined conduit, through which a current of air is passed in the same direction as the furnace gases, whereby mercury vapour is condensed and collected.—C. A. K.

Ores and concentrates; Process of treating ——. M. F. Coolbaugh, Golden, Colo., Assignor to J. B. Read, Vermilion, S.D. U.S. Pat. 1,315,761, 9.9.19. Appl., 23.2.18.

SULPHIDE ores and concentrates are roasted to convert the sulphides into oxides, and then treated between 450° and 850° C. with sulphurous gases to convert the oxides into sulphates.—J. W. D.

Copper ores; Process of treating —— by lixiviation with a solution of sulphur dioxide. Process of treating copper ores by sulphatisation and flotation. N. C. Christensen, Assignor to Metallurgic Improvement Corporation, Salt Lake City, Utah. U.S. Pats. (A) 1,316,351 and (B) 1,316,352, 16.9.19. Appl., 3.4.18. (B) Renewed, 22.5.19.

(A) COPPER ore is lixiviated with a solution of sulphur dioxide. Metallic copper is added to the solution, which is boiled to expel excess of sulphur dioxide. A precipitate of cupro-cupric sulphite separates during the boiling process. (B) The ore is treated to convert the copper into cupro-cupric sulphite, which is separated from the remainder of the ore by a flotation process.—C. A. K.

Galvanised articles; Manufacture of ——. H. Wade, London. From Ward Nail Co., Struthers, Ohio, U.S.A. Eng. Pat. 132,709, 1.2.19. (Appl. 2590/19.)

SEE U.S. Pat. 1,294,001 of 1919; this J., 1919, 327 A.

Steel; Manufacture of ——. C. A. Keller, Paris. U.S. Pat. 1,316,724, 23.9.19. Appl., 10.8.17.

SEE Eng. Pat. 113,635 of 1917; this J., 1918, 247 A.

Alloying; Admixture of metals or substances for ——. E. G. Burr, Montreal, Canada. U.S. Pat. 1,315,208, 9.9.19. Appl., 3.10.17.

SEE Eng. Pat. 125,785 of 1918; this J., 1919, 422 A.

Wire; Hardening and tempering of ——. H. Hepworth, Cleckheaton. U.S. Pat. 1,315,835, 9.9.19. Appl., 10.4.19.

SEE Eng. Pat. 122,743 of 1918; this J., 1919, 184 A.

Mercury. Eng. Pats. 132,559 and 132,560. *See* VII.

Electrodes for soldering. Eng. Pat. 130,782. *See* XI.

Electric furnaces. Eng. Pat. 131,061. *See* XI.

Cleaning electrodes coated with cobalt. U.S. Pat. 1,314,588. *See* XI.

Electrolytic process. U.S. Pat. 1,314,742. *See* XI.

XI.—ELECTRO-CHEMISTRY.

Electric furnace for experimental work. F. A. J. Fitzgerald and G. C. Moyer. Trans. Amer. Electrochem Soc., 1919, 27—31. [Advance copy.]

THE furnace is constructed to heat the charge in a crucible by radiation from an arc, or it may be used for heating a crucible or horizontal tube embedded in a granular carbon resister, the current used being 500—1000 ampères at 50 volts. The furnace is mounted on a truck built of channel irons, a pipe framework, and boiler plate. The electrode holders are aluminium bronze castings mounted on the base of the truck, and are moved by right- and left-handed screws; they may be adjusted either separately or together by hand. The electrodes are suitably water-cooled by rings pushed close up to the furnace walls.—B. N.

Arcs; Continuous metal vapour ——. E. Podszus. Z. Elektrochem., 1917, 23, 179—181.

A METALLIC vapour arc is described which will burn steadily and continuously in any atmosphere. The lamp consists of a large globe of glass or quartz open at the bottom and fitted with a narrow exit tube at the top. The globe stands in an iron dish containing mercury and provided with three openings admitting respectively a narrow glass tube for gas, the cathode vessel, and the anode vessel. The cathode vessel is made of iron and down the centre of it a tube of boron nitride passes; covering the top of the cathode is a plate of tungsten having a small hole in the centre. The object of the boron nitride tube and the tungsten plate is to stabilise the arc and to prevent fluctuations of the mercury or amalgam which constitutes the cathode. The anode is a tungsten rod. The arc is struck by lowering the anode until it touches the cathode and then drawing it away. The flame produced is thin, and its colour is affected by the gas in the globe and by the amalgam used as cathode. In hydrogen the light is greenish white, in nitrogen bluish-white. All compounds introduced into the arc are reduced; thus the solid element was obtained from boron trichloride and titanium tetrachloride.—J. F. S.

Pocket lamp batteries; Electrochemistry of ——. K. Arndt. Z. Elektrochem., 1917, 23, 165—170. (See also this J., 1917, 89.)

BATTERIES of pocket lamps usually consist of three dry cells connected in series. The cells are made up of a graphite rod packed in a mixture of powdered graphite and pyrolusite, which is placed in a zinc container, the space between being filled with a paste of flour and a solution of zinc and ammonium chlorides. Such batteries, when perfect, delivered current at 2 volts for 167 mins., which corresponds to 2·02 watt-hours. It was found that an exhausted battery had lost 1·4 times the quantity of zinc required by Faraday's law, and 1·26 times as much manganese dioxide has been used up. Apparently the manganese dioxide becomes inactive when its amount has fallen to 35%. Storage of batteries brings about a loss of manganese dioxide and also of zinc, and in some cases the resistance rises from 1·4—0·6 ohm to 450 ohm on keeping.—J. F. S.

Iron; Colorimetric determination of —— in [storage] battery acid by the thiocyanate test. E. Nyman. Canadian Chem J., 1919, 3, 298—300.

One c.c. of new electrolyte acid (strong H_2SO_4) or 0·5 c.c. of the acid from the batteries (sp. gr. about 1·2) is heated until it fumes and is stirred with about 0·01 grm. of potassium chlorate (to destroy organic matter), cooled, mixed with a few c.c. of water, boiled briskly for 1 min., cooled, and diluted to 10—12 c.c. It is then mixed with 4 c.c. (or 2 c.c. in the case of the weak acid) of a 30% solution of pure ammonium thiocyanate, and the colour produced is compared under the same conditions with a standard solution of iron. This is prepared by dissolving 0·2004 grm. of standard iron wire (99·80% Fe), previously washed with ether, in a mixture of 40 c.c. of strong sulphuric acid and 80 c.c. of water, boiling the liquid for 2 mins., adding about 0·3 grm. of potassium chlorate, and continuing the boiling until white fumes appear. The mixture is then diluted with water, about 10 c.c. of strong sulphuric acid added, the liquid again boiled, cooled, and made up to a litre (1 c.c.=0·0002 grm. Fe). It is essential that the strength of the sulphuric acid used for the colour reaction should not exceed sp. gr. 1·2 (27·32% H_2SO_4), since stronger acid decomposes the ferric thiocyanate. The permissible limit for iron in an electrolyte acid for the first filling is 0·005%, and in acid from the batteries 0·01%. Iron compounds are reduced to a lower state of oxidation by the negative plate and reoxidised by the positive plate and in both cases lead sulphate is formed from the plate. Old cells will resist a greater amount of impurities, and in practice an iron content up to 0·015% is often allowed.

C. A. M.

Nitrogen. Andriessens. *See* VII.

Electric steel furnaces. Hartig. *See* X.

Electrometric titrations. (1) Roberts. (2) Hostetter and Roberts. *See* XXIII.

PATENTS.

Electric accumulators; Alkaline ——. A. M. Cave, St. Etienne, France, Eng. Pat. 121,118, 23.10.18. (Appl. 17,338/18.) Int. Conv., 28.11.17.

The active compounds of electrodes for alkaline accumulators are retained in contact with a perforated strip by wire gauze or cloth, preferably of nickel, the whole presenting a flat form and being covered by a non-conducting envelope permeable to gases. Cords or bands of vegetable fibre, or mineral fibres such as asbestos, impregnated with substances unattacked by alkalis, and reinforced by metallic threads during the process of manufacture, are wrapped round the non-conducting envelope.—B. N.

Electric cell plates. T. Majima, Hyogo-Ken, Japan. Eng. Pat. 131,782, 22.10.18. (Appl. 17,217/18.)

A composite cell plate is formed of a body or core of acid-proof material lighter than ordinary cell-plate metal, *e.g.*, porcelain or earthenware, entirely covered with a thin sheathing of lead, with the exception of the distance pieces which are integral with the body or core and are left exposed. The lead sheathing is applied electrolytically or by spraying.—B. N.

Storage battery electrode. A. L. Muren, Burlington, Iowa. U.S. Pat. 1,315,032, 2.9.19. Appl., 28.5.18.

A skeleton framework, formed of a number of wires, coated with active material, and the coating is covered with metallic gauze, the interstices of which are then filled with more active material, the whole being enclosed within metallic gauze making contact with the active material.—J. S. G. T.

Electric battery. R. C. Benner and H. F. French, Fremont, Ohio, Assignors to National Carbon Co., Inc. U.S. Pats. (A) 1,316,760 and (B) 1,316,761, 23.9.19. Appl., 26.1.17 and 30.3.18.

(A) The negative element of a battery contains a mixture of copper oxide and a sulphide adapted to increase the voltage of the cell. (B) A depolariser is prepared by heating a mixture of copper oxide and sulphur to 140°—180° C.—J. S. G. T.

Electrolytic process. [Cleaning electrodes coated Stratford Works, Ltd., London. Eng. Pat. 132,561, 20.6.18. (Appl. 10,205/18.)

An electrolytic cell for carrying out oxidation or reduction processes is constituted of a number of compartments separated by dwarf partitions. In each compartment, one of the electrodes is contained within a porous bag, the bottom of which rests in a recess formed in the upper surface of the partition, so that flow of the electrolyte over the latter is hindered. The secondary electrolyte from the bags collects in the recesses and can be withdrawn without removal of the electrodes. Draw off passages are provided at the bottom of the compartments, so that anolyte and catholyte may be simultaneously withdrawn. The end protected electrodes are placed in recesses formed in the end walls of the cell.—J. S. G. T.

Electrolytic process. [Cleaning electrodes coated with cobalt.] K. S. Guiterman, New York. U.S. Pat. 1,314,588, 2.9.19. Appl., 2.2.16.

Electrodes coated with cobalt are cleaned by employing them as anodes in an electrolytic cell containing an electrolyte having an acidity not less than that corresponding to 20 grms. of free sulphuric acid per litre.—J. S. G. T.

Electrolytic process. [Deposition of copper.] W. E. Greenawalt, Denver, Colo. U.S. Pat. 1,314,742, 2.9.19. Appl., 19.1.14. Renewed 26.12.18.

In the electrolysis of copper solutions containing ferrous salts, deposition of copper at the cathode is accompanied by oxidation of the ferrous salts to ferric salts at the anode. To reduce the ferric salts so produced, the electrolyte is agitated, a portion of the electrolyte is removed from the vicinity of the electrodes, and treated with a fine stream of a reducing gas. Means are provided for atomising the ascending current of gas and for returning the reduced electrolyte to the region of the electrodes.

—J. S. G. T.

Electrodes; Manufacture of natural graphite ——. E. Ridoni, and Soc. Talco e Grafiti Val Chisone, Pinerolo, Italy. Eng. Pat. 123,972, 28.8.18. (Appl. 13,981/18.) Int. Conv., 6.3.18.

Natural graphite, containing quartz or silicates, is treated in such a manner *e.g.*, with an aqueous solution of hydrofluoric acid (25° B., sp. gr. 1·21), that amorphous silica is liberated, which may serve as an agglomerant for the graphitic mass. The purified graphite is agglomerated by means of tar or analogous substances, or by means of pitch "revived" by the addition thereto, while heated, of mineral oils or tar. In use, the amorphous silica combines with the graphitic carbon to form carborundum which acts as a bond, greatly increasing the life of the electrodes.—B. N.

Electrodes of electric furnaces; Mounting of ——. C. C. Gow, London. Eng. Pat. 130,687, 14.3.18. (Appl. 4527/18.)

To reduce the volume and temperature of the gases

escaping past the electrode of an electric furnace, a sleeve is provided closely surrounding the electrode, the lower end of the sleeve engaging with an annular seating adapted to slide in any direction in the plane of contact between the seating and the furnace casing. The lower end of the sleeve is rounded where it engages with the annular seating. Several superposed layers of segments of magnetic material are mounted on the upper part of the sleeve, and are adapted to form a self-adjusting gland around the electrode by the attraction produced by the current traversing the electrode. The inner diameters of the segments are progressively larger, so that a practically gas-tight joint can be maintained, although the diameter of the electrode may vary irregularly at the part to which the segments are applied.
—B. N.

Electrode-coating [; *Electric furnace* —]. W. R. Mott, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,314,603, 2.9.19. Appl., 14.1.19.

AN electrode for use in electric furnaces is constituted of a carbon body with a coating consisting of a metal which is substantially a non-solvent for carbon at high temperatures. A second coating consisting of a metal of high melting point adapted to form a protective oxide film of high melting and high boiling point is superposed upon the first metallic coating.—J. S. G. T.

Electrodes; Manufacture of —— for soldering and depositing metals by the electric arc. Alloy Welding Processes, Ltd., and E. H. Jones, London. Eng. Pat. 130,782, 10.8.18. (Appl. 13,026/18.)

THE ends of the asbestos yarn wound upon the electrode wire are secured mechanically, *e.g.*, by bands, clips, or other means, to the ends of the wire.—B. N.

Furnaces; Electric arc ——. The British Thomson-Houston Co., Ltd., London, and J. J. Ash, Rugby. Eng. Pat. 130,703, 19.3.18. (Appl. 4841/18.)

IN controlling mechanism for electric furnaces, especially of the three phase, three electrode type, contact-making ammeters are connected in each phase, and are adapted to operate upon changes in current and to cause adjustment of the electrode when the current in the circuit varies. Contact-making voltmeters are connected between neutral points where a neutral is provided, or across an artificial neutral where there is no neutral, and are adapted to prevent the adjustment of the electrodes upon changes in current unless accompanied by changes in potential in the inverse sense.
—B. N.

Furnaces; Electric arc ——. J. Bibby, London. Eng. Pat. 130,816, 2.9.18. (Appl. 14,235/18.)

AN electric arc furnace is provided with series and shunt transformers, having the secondary windings arranged in differential relation in the arc regulating circuit, so that they act differentially to control the mechanism regulating the furnace arc. The transformers are so arranged that when the resistance of the arc is reduced appreciably the effect of the current tending to feed the electrode into the furnace is neutralised; hence the electrode cannot be fed into the furnace to an extent which will result in interruption of the action of the furnace.—B. N.

Electric furnaces. J. A. Fleming, London. Eng. Pat. 131,061, 9.4.18. (Appl. 6039/18.)

THE shell of an electric resistance furnace is made of material of very great heat-insulating power, and a heating wire or resister is bent into loops which are suspended from projections on the interior walls of the furnace; the lower ends of the loops hang freely and the wires are kept straight and apart by their own weight. For example, the furnace chamber may be constructed of a fireclay cylinder or a tube of silica or diatomaceous earth in the form of bricks, surrounded by a very thick layer of silicate-cotton or slag-wool enclosed in a brick or iron cylinder. The resistance wire may be of nichrome. A temperature of 1000°—1200° C. can easily be obtained, and furnaces capable of taking 200—300 kilowatts or more, and suitable for annealing large masses of steel, can be built.—B. N.

Electric furnace. T. A. D. Lawton, Wolverhampton, and J. Hampton, Tettenhall, Staffs. Eng. Pat. 132,635, 28.9.18. (Appl. 15,812/18.)

IN electric furnaces of the type in which carbon or graphite resistances are arranged around a muffle or heating chamber, and are themselves surrounded by a non-conducting enclosure, the resistance bars are shaped so that they present a maximum surface to the heating chamber and a minimum of surface to the surrounding enclosure. For example, each resistance bar is rectangular in section towards its inner aspect, and is chamfered towards its outer aspect, terminating in a longitudinal ridge. The inner flat edge of the bar lies in contact with the muffle wall, and adjacent bars are in contact along their rectangular sides, or are slightly separated and electrically connected at opposite ends. The outer ridge makes contact with the refractory wall of the enclosure. Deterioration of the resistance elements is prevented by rendering the enclosure as air-tight as possible.
—J. S. G. T.

Electrical furnace. A. M. Teixeira, Ipanema, Brazil. U.S. Pat. 1,313,761, 19.8.19. Appl., 7.11.18.

A GROUP of electric furnaces surround the base of a central shaft furnace, and are connected to one another through the hearth of the shaft furnace and also by means of lateral channels exterior of the hearth.—B. N.

Electric furnace. I. Rennerfelt, Djursholm, Sweden. U.S. Pat. 1,313,834, 19.8.19. Appl., 12.5.19.

SEVERAL electrodes are suspended from above into a furnace chamber in a substantially vertical plane. A projection from the bottom of the furnace, underneath the electrodes, carries a conducting layer of carbon which forms contacts for arcs from the electrodes, and crucibles are arranged on the bottom of the furnace along the heating zones of the arcs.—B. N.

Electric furnace. J. H. Gray, New York. U.S. Pat. 1,313,890, 26.8.19. Appl., 18.5.18.

AN electrode passing through the roof of the furnace is provided with a surrounding cooling ring on the top of the roof, and the furnace is adapted to tilt about a centre substantially on a line with the top of the roof without moving the electrode and cooling ring from their working positions.
—B. N.

Electric furnace. J. Fitzpatrick and L. T. Stephens, Assignors to The Carborundum Co., Niagara Falls, N.Y. U.S. Pat. 1,313,985, 26.8.19. Appl., 21.3.19.

AN electric resistance furnace comprises a silicon carbide muffle surrounded by current-conducting resistance material.—B. N.

Furnace; Arc melting ——. Westdeuts. Thomasphosphat-Werke, G.m.b.H., Berlin. Ger. Pat. 312,569, 22.9.17.

THE arc and charge are independently movable, the former by moving the electrodes, which are separate from the furnace, in the direction of the axis of rotation of the furnace, the latter by rotating the body of the furnace about its axis. The position of the arc may be changed by an excentric motion of the electrodes.—E. H. R.

Electrical etching; Composition for electrolytes for ——. J. H. Weeks, Rutledge, Pa., Assignor to J. S. Weeks, Delaware County, and R. M. Weeks, Philadelphia, Pa. U.S. Pats. (A) 1,314,839, (B) 1,314,840, (C) 1,314,841, and (D) 1,314,842, 2.9.19. Appl., 30.4.17.

IN electrolytic etching, the anode carrying a resistant image to be etched is used in combination with an electrolyte composed of one or more of (A) borates of ammonium, barium, magnesium, manganese, potassium, sodium, or zinc, (B) acetates of ammonium, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, uranium or zinc, (C) tartrates of antimony, ammonium, barium, boron, calcium, cadmium, iron, lithium, magnesium, potassium, or sodium, (D) nitrates of aluminium, ammonium, barium, cadmium, calcium, cobalt, copper, iron, lead, lithium, magnesium, manganese, nickel, potassium, sodium, strontium, tin, uranium, or zinc.—A. B. S.

Ozone generator. A. E. Walden, Baltimore, Md. U.S. Pat. 1,316,342, 16.9.19. Appl., 29.1.16.

A CYLINDRICAL casing is provided with a chamber at each end with inlet and outlet pipes. An outer electrode and inner dielectric are arranged concentrically and parallel with the axis of the casing, the inner dielectric passing through stuffing-boxes into the end chambers. The outer electrode is shorter, and the ends are mounted in insulating partitions, an inlet and outlet for gases through the electrode being provided.—C. A. K.

Light-reactive [electrical] resistance and method of forming the same. T. W. Case, Scipio, N.Y. U.S. Pat. 1,316,350, 16.9.19. Appl., 5.4.18.

THE resistance is a material comprising thallium oxysulphide.—C. A. K.

[Electric] furnace charging apparatus. W. E. Moore, Pittsburgh, Pa., U.S.A. Eng. Pat. 132,436, 13.2.19. (Appl. 3556/19.)

Mercury. Eng. Pat. 132,560. *See* VII.

Nitrogen fixation. U.S. Pat. 1,316,445. *See* VII.

Fusing refractory materials. U.S. Pat. 1,314,871. *See* VIII.

Removing paint etc. from iron etc. Eng. Pat. 131,709. *See* X.

XII.—FATS; OILS; WAXES.

Sulphonated oils [; Interpretation of analyses of ——]. C. G. Bumcke. J. Amer. Leather Chem. Assoc., 1919, 14, 515—530.

AN unsatisfactory sulphonated oil, which emulsified badly and stripped the colour of dyed leather, was found to contain 36·48% of free fatty acids and 6·32% of ash compared to 56·43% and 4·07% respectively in a satisfactory oil. The stripping action of the former is attributed to its higher content of soap and its inferior emulsifying power to its lower content of free fatty acid. The better of the two oils could serve as an acid fat liquor directly, but the other should be mixed with some saponifiable or mineral oil. The so called "sulphonated oil" and "sulphonation value" are misleading determinations and only the "combined SO_3" is any guide to the degree of sulphonation of an oil. A sulphonated neatsfoot oil, containing 31% of mineral oil, 19·49% of neutral fatty oil, 2·004 of combined SO_3, and 2·51% of ash would not emulsify moellon because it was not sufficiently highly sulphonated to carry 51% of neutral plus mineral oil and an additional amount of moellon. A larger content of soap would have facilitated the emulsification. Complete analyses of 12 sulphonated oils show differences between the free fatty acids as found by titration and by calculation. During sulphonation, oxidised, polymerised, or condensation products, which cannot be titrated or extracted with ether, are formed probably as a result of the further action of the sulphuric acid on the sulphonated fatty acids. D. W.

Manihot seeds; Technical utilisation of different species of ——. C. Grimme. Chem.-Zeit., 1919, 43, 505—506.

THE seeds and kernels of various species of Manihot plants from E. Africa contained the following amounts of oil respectively:—*M. Glaziovii*, 11·06 and 41·34%; *M. dichotoma*, 14·65 and 46·14%; and *M. piauhyensis* 12·61 and 48·95%. The oils extracted from these seeds with ether, and an industrial oil, which had been extracted from a mixture of 67% of *M. dichotoma*, 30% of *M. piauhyensis*, and 3% of *M. Glaziovii*, had the following characters:—

Oils.

Oils.	Sp. gr. at 15° C.	Ref. index 40° C.	Acid value.	Saponif. value.	Iodine value.	Reichert-Meissl value.	Hehner value.	Unsap. matter, %	Glycerol, %
M. Glaziovii	0·9235	1·4674	1·68	187·5	142·0	0·35	95·81	0·76	10·16
M. dichotoma	0·9265	1·4661	1·56	188·6	133·1	0·51	95·78	0·81	10·22
M. piauhyensis	0·9225	1·4681	1·59	187·7	144·0	0·42	95·80	0·78	10·17
Technical oil	0·9245	1·4667	5·74	188·1	136·0	0·47	90·01	1·09	9·58

Fatty acids.

	Refr. index 40° C.	M. pt.	Solidif. pt.	Neutralisation value.	Iodine value.	Mean molec. equiv.
		°C.	°C.			
M. Glaziovii ..	1·4575	23	21·5	188·7	144·1	297·5
M. dichotoma ..	1·4549	23·5	22	189·9	133·8	295·6
M. piauhyensis	1·4576	21	20	188·3	145·3	298·3
Technical oil ..	1·4563	22·5	20·6	189·3	138·1	296·6

It is advisable to decorticate the seeds before expressing the oil, the increased value of the product repaying the cost of treatment. The technical oil is mainly used in the manufacture of varnish and soap. The commercial seed cake had the following composition: Organic substances, 91·49; crude proteins, 12·70; fat, 1·14; N-free extractives, 17·25; crude fibre, 60·72; and ash, 8·11%.—C. A. M.

Fats; Hydrolysis of —— by Twitchell's process. P. Bertolo. Annali Chim. Appl., 1919, 12, 27—50.

THE sulphuric acid (60° B., sp. gr. 1·71) used for

escaping past the electrode of an electric furnace, a sleeve is provided closely surrounding the electrode, the lower end of the sleeve engaging with an annular seating adapted to slide in any direction in the plane of contact between the seating and the furnace casing. The lower end of the sleeve is rounded where it engages with the annular seating. Several superposed layers of segments of magnetic material are mounted on the upper part of the sleeve, and are adapted to form a self-adjusting gland around the electrode by the attraction produced by the current traversing the electrode. The inner diameters of the segments are progressively larger, so that a practically gas-tight joint can be maintained, although the diameter of the electrode may vary irregularly at the part to which the segments are applied.
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Electrode-coating [; *Electric furnace* —]. W. R. Mott, Lakewood, Ohio, Assignor to National Carbon Co., Inc. U.S. Pat. 1,314,603, 2.9.19. Appl., 14.1.19.

AN electrode for use in electric furnaces is constituted of a carbon body with a coating consisting of a metal which is substantially a non-solvent for carbon at high temperatures. A second coating consisting of a metal of high melting point adapted to form a protective oxide film of high melting and high boiling point is superposed upon the first metallic coating.—J. S. G. T.

Electrodes, Manufacture of —— for soldering and depositing metals by the electric arc. Alloy Welding Processes, Ltd., and E. H. Jones, London. Eng. Pat. 130,782, 10.8.18. (Appl. 13,026/18.)

THE ends of the asbestos yarn wound upon the electrode wire are secured mechanically, *e.g.*, by bands, clips, or other means, to the ends of the wire.—B. N.

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Ozone generator. A. E. Walden, Baltimore, Md. U.S. Pat. 1,316,312, 16.9.19. Appl., 29.1.16.

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XII.—FATS; OILS; WAXES.

Sulphonated oils [;Interpretation of analyses of ——]. C. G. Bumcke. J. Amer. Leather Chem. Assoc., 1919, 14, 515—530.

AN unsatisfactory sulphonated oil, which emulsified badly and stripped the colour of dyed leather, was found to contain 36·48% of free fatty acids and 6·32% of ash compared to 56·43% and 4·07% respectively in a satisfactory oil. The stripping action of the former is attributed to its higher content of soap and its inferior emulsifying power to its lower content of free fatty acid. The better of the two oils could serve as an acid fat liquor directly, but the other should be mixed with some saponifiable or mineral oil. The so-called "sulphonated oil" and "sulphonation value" are misleading determinations and only the "combined SO_3" is any guide to the degree of sulphonation of an oil. A sulphonated neatsfoot oil, containing 31% of mineral oil, 19·49% of neutral fatty oil, 2·004% of combined SO_3, and 2·51% of ash would not emulsify moellon because it was not sufficiently highly sulphonated to carry 51% of neutral plus mineral oil and an additional amount of moellon. A larger content of soap would have facilitated the emulsification. Complete analyses of 12 sulphonated oils show differences between the free fatty acids as found by titration and by calculation. During sulphonation, oxidised, polymerised, or condensation products, which cannot be titrated or extracted with ether, are formed probably as a result of the further action of the sulphuric acid on the sulphonated fatty acids.—D. W.

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Oils.

Oils.	Sp. gr. at 15° C.	Ref. index 40° C.	Acid value.	Saponif. value.	Iodine value.	Reichert-Meissl value.	Hehner value.	Unsap. matter, %	Glycerol, %
M. Glaziovii	0·9235	1·4674	1·68	187·5	142·0	0·35	95·81	0·76	10·16
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M. piauhyensis	0·9225	1·4681	1·59	187·7	141·0	0·42	95·80	0·78	10·17
Technical oil	0·9245	1·4667	5·74	188·1	136·0	0·47	90·04	1·09	9·58

Fatty acids.

	Refr. index 40° C.	M. pt.	Solidif. pt.	Neutralisation value.	Iodine value.	Mean molec. equiv.
		°C.	°C.			
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M. dichotoma ..	1·4549	23·5	22	189·9	133·8	295·6
M. piauhyensis	1·4576	21	20	188·3	145·3	298·3
Technical oil ..	1·4563	22·5	20·6	189·3	138·1	296·6

It is advisable to decorticate the seeds before expressing the oil, the increased value of the product repaying the cost of treatment. The technical oil is mainly used in the manufacture of varnish and soap. The commercial seed cake had the following composition: Organic substances, 91·49; crude proteins, 12·70; fat, 1·14; N-free extractives, 17·25; crude fibre, 60·72; and ash, 8·11%.—C. A. M.

Fats; Hydrolysis of —— by Twitchell's process. P. Bertolo. Annali Chim. Appl., 1919, 12, 27—50.

THE sulphuric acid (60° B., sp. gr. 1·71) used for

purifying the fat prior to hydrolysis should be added in the proportion of 1 to 2%. The density of the separated acid liquid should not be less than 9° B. (sp. gr. 1·066). The amount of emulsifying agent should not exceed about 1%, except in the case of very impure fats, when 2% may be used. An excess of the reagent does not increase the velocity or degree of hydrolysis, but, on the contrary, tends to form emulsions which are difficult to separate and yields more impure glycerin and fatty acids. For rapid and complete hydrolysis the amount of water should be kept below 60%, whilst the acidity of the aqueous portion should be from 1 to 2%. It is sufficient to continue the boiling for 30 to 32 hours to obtain a satisfactory hydrolysis in one operation, and there is little advantage in a second treatment.—C. A. M.

Glycerins; Purification of commercial ——. P. Bertolo. Annali Chim. Appl., 1919, 12, 24—27.

THE use of barium carbonate as a purifying agent for glycerin has the drawback that it is difficult to remove the excess of barium. Better results are obtained by the successive use of lime and barium hydroxide. A slight excess of lime is added to the hot sweet waters from the Twitchell or autoclave process, and the liquid allowed to cool completely. The free sulphuric acid is neutralised, and the fatty acids are converted into calcium soaps which carry down with them proteins, colouring matters, and organic impurities. The filtrate from this precipitate is concentrated to 15° B. (sp. gr. 1·116), care being taken that the liquid remains alkaline until the end. During this concentration the calcium sulphate and calcium carbonate are slowly precipitated, together with more organic matter. After concentration, the liquid is filtered into an iron vessel provided with a steam coil, where it is heated to boiling and then treated with a slight excess of barium hydroxide (about 6 to 8 grms. per litre), added in small portions. The mixture is boiled for a few minutes, cooled, filtered, heated to boiling in an iron vessel lined with tin, and the excess of barium removed by adding oxalic acid, with precautions to avoid an excess. If necessary, the last traces of barium are removed by adding a little dilute sulphuric acid. Finally, the liquid is cooled, filtered, and concentrated to 28° B. (sp. gr. 1·24).—C. A. M.

Marine animal oils. Gardner. *See* XIII.

Drying oils. Gardner. *See* XIII.

Driers for soya oil. Gardner. *See* XIII.

PATENTS.

Press plates for oil expressing presses and analogous apparatus. A. W. French, Piqua, Ohio, U.S.A. Eng. Pat. 131,796, 15.11.18. (Appl. 18,789/18.) Addition to Eng. Pat. 111,855, 2.12.16.

A PRESS plate comprises two thin metal plates arranged face to face and preferably riveted at the corners. One of the plates has spaced corrugations forming hollow projecting ribs on the outer side and drainage channels on the inner side; the projections and channels may be formed by bending the plate. The other plate is flat and has holes through which liquid can escape to the drainage channels. Rigidity of the component plates is obtained and obstruction of the channels prevented by wires or rods arranged longitudinally along the channels, the ends being secured in one of the plates. The surface of the plates not in contact with a press-cloth is coated with a metal (*e.g.*, zinc) to which meal will not adhere.—A. DE W.

Catalysing agents of particular efficiency; Process for the manufacture of ——. E. Granichstädten, Vienna. U.S. Pat. 1,314,642, 2.9.19. Appl., 13.5.18.

A METALLIC catalyst is prepared by subjecting to the action of a gaseous reducing agent a heated mixture of oil and an inorganic non-catalytic metal compound, irreducible by simple heating, and the acid radicle of which does not mix or combine with the oil.—E. W. L.

Fats and oils; Process for removing metallic impurities from ——. Elektro-Osmose Akt.-Ges. (Graf Schwerin-Ges.), Berlin. Ger. Pats. (A) 309,157, 30.6, (B) 309,276, and (C) 309,275, 16.12.17.

(A) Fats and oils are treated with aqueous solutions of lower aliphatic acids, or their neutral or acid salts, particularly those containing more than one carboxyl group, or a hydroxyl or amino group in addition to the carboxyl group, *e.g.*, oxalic, lactic, tartaric, and glycollic acid, and glycocoll, which are capable of forming soluble complex salts with metallic impurities such as iron and nickel. The solution is added either to the melted fat or to a solution of the fat, and removal of the impurities is assisted by warming and stirring the mixture. In some cases it is advantageous to pass a stream of an oxidising or a reducing gas through the fat either before or during addition of the solution; the formation of an emulsion is thereby prevented, and the impurities are brought to the stage of oxidation at which the metallic complexes are most readily formed. (B) The warm fat or oil is treated with an undiluted organic acid or salt instead of with an aqueous solution. (C) The above methods are also applicable for the removal of metallic impurities from the higher free fatty acids such as stearic, palmitic, and oleic acids.—L. A. C.

Ageing solidified plastic articles [e.g., soap]; Apparatus for rapidly ——. De N. W. B. Young, Narberth, Pa., Assignor to Soap Works Equipment Co. U.S. Pat. 1,316,262, 16.9.19. Appl., 27.3.17. Renewed, 12.7.19.

Refining liquids. U.S. Pat. 1,297,635. *See* I.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Drying oils and varnishes; Effect of moisture on ——. H. A. Gardner. Circular No. 70, Paint Manufacturers' Association of the U.S. Aug., 1919. 15 pp.

THE cause of the more rapid "setting" of paint or varnish during moist weather was investigated by determining the variation in weight during oxidation of a number of samples of varnish and of raw linseed oil containing various metallic soap driers, the metal content being in a proportion of 0·2% on the oil taken. The films of oil or varnish were exposed on glass plates placed in a specially constructed incubator, the atmosphere of which could be saturated with moisture. In all cases large increases in weight were observed during the first 24 or 48 hours, the gains in 24 hours in the case of trials in moist air almost equalling those in dry air in 48 hours. A decrease approaching that of the original gain followed under both conditions of relative humidity, the moist air trials, however, showing a second increase and loss subsequent to the first increase and loss. The final degree of hardness was greater with those films dried under "dry" conditions. This behaviour is explained by the assumption that the first increase represents

a partial saturation of the double bonds of the oil by oxygen, the subsequent decrease being accounted for by evolution of decomposition products of the oxygenated compounds. Decomposition of the glyceride into glyceryl radicle and fatty acid, with absorption of water to form glycerol under favourable conditions, would then account for a second increase, whilst decomposition of the newly formed glycerol to formic acid, etc., would account for the second decrease in weight. No considerable differences were shown on the change in weight curves for a number of different driers, *viz.*, linoleates, resinates, tungates, etc., of lead, manganese, aluminium, etc. Aluminium compounds, though slow in initial action, appear to be more effective as driers.—A. DE W.

Marine animal oils in paints and varnishes. H. A. Gardner. Circular No. 68, Paint Manufacturers' Association of the U.S. Aug., 1919, 7 pp.

MENHADEN oil has for many years been used as a constituent of the medium of certain paints, notably those intended for barns, roofs, and structural steel. Its dark colour and the softness of the film yielded have precluded its use in white paints. "Active" pigments, such as red lead, which reduce its softening tendency, and a blowing and heating treatment are also indicated as giving better results. Many processes have been patented claiming to reduce the objectionable odour of menhaden oil; the author suggests admixture of 5—10% of pine oil to mask the odour. The keeping qualities of unsterilised menhaden oil are rather poor, due to formation of free fatty acids. The wearing qualities and permanency of colour of white paints containing raw menhaden oil are much improved by replacing a proportion of the latter by linseed oil. A large factory for the manufacture of fur seal oil has been established on the Pribilof Islands, where 25,000—40,000 galls. of oil may be produced annually. Other factories are now established which yield large quantities of dog-fish and shark-liver oils, and it is hoped that other types of fish oil, *i.e.*, skate-liver, tuna, and salmon oil, will in the future be obtainable from the same factories. The possibility of utilising the above oils and that from aquatic skins (a possible substitute for leather in face of the present shortage) as drying oils is being investigated. There appears to be evidence that the dark colour and objectionable odour of liver oils will be overcome by expressing the oil from the livers when in the fresh condition.—A. DE W.

Driers for soya oil. H. A. Gardner. Circular No. 69, Paint Manufacturers' Association of the U.S. Aug., 1919. 12 pp.

AN investigation of the drying properties of soya bean oil as judged by the "finger test" and carried out on both glass plates and painted boards, employing driers of both differing metal bases and acid radicles, showed that soya oil may be made to dry almost as rapidly as boiled linseed oil. Heat treatment followed by blowing of raw soya oil is advantageous to the retention of drier and speed of drying. The proportion of base as metal content yielding the optimum result as drier has been determined, and as a result a drier formula comprising manganese, lead, and cobalt linoleates having metal contents of 0·03%, 0·20%, and 0·01% respectively is given. An alternative formula giving slightly inferior results to the foregoing consisted of cobalt and lead linoleates of metal contents of 0·02% and 0·20% respectively. Linoleates showed on the whole to slightly better advantage than the resinates, borates, and acetates, but there is little to choose between the effects obtained over a range of soaps of the same base or mixture of bases.—A. DE W.

Rosin; Determination of —— in rosin-pitch mixtures. A. Wogrinz and P. Vàri. Chem.-Zeit., 1919, **43**, 506—507.

MIXTURES of petroleum pitch or coal tar pitch with rosin or "lime-rosin" prepared by heating dry lime with colophony have recently been used for various technical purposes. The following method has been devised for the approximate determination of the rosin: 250 grms. of the mixture is dissolved in 75—80 c.c. of benzene, and boiled for 1 to 1½ hours with 125 c.c. of *N*/1 alcoholic potassium hydroxide solution. The alcohol and benzene are then evaporated and the residue extracted for about an hour with three successive portions of 500 c.c. of boiling water, the liquid being cooled each time before decanting. The united extracts are concentrated to about 200 c.c., neutralised with hydrochloric acid (methyl orange as indicator), and evaporated to dryness. The dry residue is freed from calcium chloride by treatment with cold water, the extracts being passed through a filter upon which are also collected separated particles of pitch. Finally, the basin is rubbed with moist gypsum and the whole contents transferred to the filter, which is then dried and extracted with alcohol in a Soxhlet apparatus for 1½ to 2 days. The alcoholic extract is cooled, and the separated particles of pitch washed with cold alcohol. The alcoholic extract and washings, which will contain the whole of the rosin present either as colophony or "lime rosin," are used for the determination of the saponification and iodine values of the dissolved substances. In the latter determination an aliquot portion of the solution may be evaporated, and the residue dissolved in 15 c.c. of chloroform, and treated with Hübl solution. The following values obtained with typical samples of the material gave the data for the calculations:—

Material.	Saponification value.		Iodine value.	
	Min.	Max.	Min.	Max.
Colophony	156·0	189·0	132·0	151·0
1% "lime-rosin" (ash 1·17% CaO)	180·9	182·2	146·7	149·5
5% "lime-rosin" (ash 4·96% CaO)	177·5	179·6	146·9	150·5
Petroleum pitch (softening pt., 39·5° C.)	1·8	1·8	—	—
Coal-tar pitch (softening pt., 43° C.)	6·09	6·58	2·28	2·42

In the case of mixtures of coal-tar pitch it is better to base the calculations upon the iodine value. The results obtained with test mixtures agreed within about 5% of the theoretical quantities.—C. A. M.

Varnishes for papier-maché ware. Andés. Farben-Zeit., 1919, **20**, 999—1001. Chem. Zentr., 1919, **90**, IV., 194.

Two classes of papier-maché ware are to be distinguished, *viz.*, those in which a paper stock is sized with glue, casein, or starch to produce a basis and which are usually decorated with water colours and finished with celluloid, "cellon," or spirit varnish, which, however, does not penetrate the base or influence its condition; and those in which a hardness surpassing wood is obtained by impregnating the moulded and well-dried paper base with warm "amber" varnish and stoving at 100°—125° C. In the latter type it may be desirable to repeat the treatment with varnish and stoving until a sufficiently hard and crust-like surface is obtained. After flatting with pumice or shave-grass, the articles are thinly painted with oil colour ground in varnish ("ready-bound colour"), dried at 70°—80° C., and the operation repeated

until the surface is completely glossy and even. In cases where monochromatic decoration is aimed at, colourless varnish is used as a finish, or a finish is obtained by hand-painting, transfer, or the use of bronze powder or leaf metal. Copal and amber are the raw materials used in the varnish, hardened rosin or artificial gums being seldom employed. Black lacquering is performed with asphaltum varnish or the "black varnish" of the patent leather finisher. Various recipes for varnishes are given.—A. DE W.

PATENTS.

Pigments and the production of the same. J. F. Duke, Shortlands. Eng. Pat. 131,769, 24.9.18. (Appl. 15,533/18.)

CORNFLOUR, starch, dextrin, or other suitable carbohydrate is treated with tannic acid and ferric chloride or other soluble iron salt. Acidity in the resulting black pigment may be neutralised by chalk or quicklime, whilst an antiseptic may be added to prevent decomposition.—A DE W.

Paint composition. A. H. Applegreen, Seattle, Wash. U.S. Pat. 1,314,301, 26.8.19. Appl., 12.11.18.

A MIXTURE of wood pulp and lime is soaked in water, ground, mixed with a vehicle of oil, and again ground. Rosin is added to produce a gloss, and finally a solvent for the rosin.—A. DE W.

Phenol-formaldehyde condensation products and the manufacture thereof. H. V. Potter, and Damard Lacquer Co., London. Eng. Pat. 131,112, 15.7.18. (Appl. 11,601/18.)

THE phenol-formaldehyde condensation product described is in the form of a white powder of non-resinous nature, rapidly oxidising in the air or under influence of heat to a pink and finally a brown powder. It has a melting-point of approximately 300° F. (149° C.), has free hydroxyl groups and forms salts with alkalis, is free from both uncombined phenol and formaldehyde, and by continued heating passes into the infusible insoluble state. The product is obtained by heating under a reflux condenser 100 parts by volume of phenol with 60—100 parts by volume of 40% formaldehyde in the presence of an alkaline accelerator, *e.g.*, 2—5% of ammonia (sp. gr. 0·88), until the known soluble condensation product is obtained. The condensation product is then dissolved in a large volume of caustic alkali solution, *e.g.*, 1000 parts of 10% sodium hydroxide solution, diluted with water, *e.g.*, 3000—4000 parts, and the definite compound precipitated by addition of an acid, *e.g.*, 10% hydrochloric acid, till slightly acid. The solution is then made slightly alkaline with ammonia. The product is filtered, washed, and dried in thin sheets at about 80° F. (27° C.).
—A. DE W.

Varnishes or dopes more especially intended for applying to the fabrics of aeroplanes and other aerial machines. D. M. Sutherland, Sunbury Common, and The Wall Paper Manufacturers, Ltd., London. Eng. Pat. 131,082, 24.4.18. (Appl. 6909/18.)

THE use of "borated benzol" (*e.g.*, boric acid 10%, benzol 90%) is claimed as an addition to varnishes containing acetylcellulose, nitrocellulose, or equivalent, in order to permit of a larger proportion of benzol being used without causing precipitation, to obviate the use of triphenyl phosphate, to fireproof, to retard drying, and diminish the viscosity of the varnish. The varnish may advantageously be composed of acetylcellulose 6—12 parts, acetone or equivalent solvent 44—36 parts, 90% benzol 24 parts, "borated benzol" 24—25 parts, and benzyl alcohol 2—3 parts, all by weight.—A. DE W.

Dopes; Production of ——. A. J. A. W. Barr, London, and H. Lazell, Richmond. Eng. Pat. 131,641, 2.7.18. (Appl. 10,862/18.)

A "DOPE" which tightens, stretches, and waterproofs aeronautical envelopes and at the same time absorbs ultra-violet rays is obtained by adding to "dope," preferably of a cellulose acetate or nitrocellulose basis, a mixture of pigments, such as yellow ochre, ultramarine, and zinc oxide in the proportion of, *e.g.*, 11 lb., 5 lb., and 10 lb. respectively. Excessive darkening is inhibited and reduced visibility obtained by addition of aluminium powder. In the example quoted the pigmented "dope" consists of 10 lb. of the mixed pigments and 5 lb. of aluminium powder for 300 gallons of cellulose acetate dope.—A. DE W.

Dopes, solutions, compositions or preparations having a basis of cellulose acetate; Manufacture of ——. H. Dreyfus, London. Eng. Pat. 131,669, 24.7.18. (Appl. 12,085/18.)

THE use of acetylacetone or ethylidene-acetone or a mixture of these, alone or with other solvents or diluents, is claimed.—A. DE W.

Lacquer for airplane fabrics. W. F. Doerflinger, Halesite, N.Y. U.S. Pat. 1,315,216, 9.9.19. Appl., 22.12.17.

A LACQUER for aeroplane fabric consists of a solution of pyroxylin, boric acid, and triphenyl phosphate in a highly volatile solvent.—E. W. L.

Waterproofing compositions; Process of making ——. G. M. Garlick, Kalamazoo, Mich., Assignor to W. S. Mitchell, Gary, Ind. U.S. Pats. 1,315,109 and 1,315,110, 2.9.19. Appl., 5.3.18.

A WATERPROOFING composition consists of paraffin wax, dissolved rubber, a resinous substance dissolved in alcohol, a light hydrocarbon oil, and carbon bisulphide, and is prepared as follows:—A mixture of melted wax, resinous substance, and dissolved rubber is heated to 305° F. (152° C.), cooled to 140° F. (60° C.), and a resinous substance dissolved in alcohol and a light hydrocarbon oil is added. The mass is heated to 180° F. (82° C.), cooled to 140° F. (60° C.), and diluted with light hydrocarbon oil, and finally carbon bisulphide is added at a temperature of 60°—80° F. (15·5°—27° C.).—E. W. L.

Shellac, varnish, and related products; Process for making substitutes for ——. C. L. Lightenhome, New York. U.S. Pat. 1,315,137, 2.9.19. Appl., 18.5.18.

A GUM, hard resin, or any resin other than colophony, is dissolved or "cut" to a thick liquid by heating with a non-mineral oil, colophony is added, then a drier consisting of an alkaline-earth carbonate treated with an acid. A thick pasty liquid consisting of cottage cheese (casein) dissolved in an alkali is added to give the mass a translucent appearance, and the product is thinned with a light, quick-drying solvent.—E. W. L.

Paint or varnish and method of making the same. M. Darrin, Wilkinsburg, Assignor to The Koppers Co., Pittsburg, Pa. U.S. Pat. 1,315,658, 9.9.19. Appl., 18.1.19.

A RESIN obtained by subjecting solvent naphtha to an autoclave process is mixed with a paint or varnish oil.—C. A. K.

Fireproof-oil composition. J. C. Emhardt, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,316,881, 23.9.19. Appl., 25.2.18.

A FIREPROOF coating composition contains boiled

linseed oil and 30—35% of ammonium magnesium phosphate.—L. A. C.

Paint for coating the bottoms of vessels. I. Suzukawa, Hiroshima, Japan. U.S. Pat. 1,315,748, 9.9.19. Appl., 26.1.18.

See Eng. Pat. 113,612 of 1918; this J., 1919, 227 A.

Resin; Producing purified —— from natural resin of conifers and the like. J. R. Köhler, Stockholm. U.S. Pat. 1,316,842, 23.9.19. Appl., 22.4.18.

See Eng. Pat. 122,407 of 1919; this J., 1919, 428 A.

Refining liquids. U.S. Pat. 1,297,635. *See* I.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Funtumia elastica; Latex from uncultivated —— and its coagulation. Y. Henry and P. Ammann. Caoutchouc et Gutta-Percha, 1919, **16**, 10003—10012.

The latex contains 33—50% of rubber and is coagulated with the aid of vegetable juices, the various sources of which are described. The latex has a marked tendency to spontaneous coagulation, and the rubber can also be caused to separate by chemical agents such as formalin and by heat. The natives adulterate the latex with other latices collected in the forest, and a description of the commoner of these foreign latices is given.

—D. F. T.

[*Rubber;*] *Swelling power of various liquids* [*for ——*]. A. Dubosc. Caoutchouc et Gutta-Percha, 1919, **16**, 9999—10003.

A piece of commercial vulcanised rubber of sp. gr. 1·662, when immersed in tetrachloroethane at 10°—11° C., swelled until a maximum was reached at 3·82 times the original volume (see also this J., 1919, 546 A, 648 A). —D. F. T.

Balloon fabrics treated with rubber; Permeability of —— to gases. W. Frenzel. Chem.-Zeit., 1919, **43**, 530—532.

The author has determined the permeability of various balloon fabrics by means of the interferometer, and finds that the rate of diffusion of hydrogen through the fabric reaches a constant value, for definite temperatures and pressures, as soon as the fabric is saturated with hydrogen. If the inner surface of the fabric is saturated with hydrogen and the outer surface is in contact with air practically free from hydrogen, the rate of diffusion increases in proportion to the temperature. In this respect fabric treated with rubber behaves like rubber itself. The rate of diffusion also increases with, but not proportionally to, the pressure; beyond a certain pressure the increase is less in the case of fabric coated with rubber than with rubber itself, since the fabric retards the stretching of the rubber coating. —W. P. S.

Patents.

Tyre-fillers; Process of making ——. E. F. Aycock, Midlothian, Tex. U.S. Pat. 1,315,652, 9.9.19. Appl., 27.9.18.

A mass consisting of small particles of soft rubber, rubber cement, gasoline, and kerosene is compressed in a mould, then removed, the mould cleaned, and the mass replaced and vulcanised under pressure. The product forms a resilient filler for tyre covers.—E. W. L.

Vulcanised oils. U.S. Pat. 1,315,246. *See* XII.

XV.—LEATHER; BONE; HORN; GLUE.

Sulphite cellulose in synthetic tans, tanning extracts, and in leather. Report of a committee of the Amer. Leather Chem. Assoc. C. M. Kernahan. J. Amer. Leather Chem. Assoc., 1919, **14**, 512—515.

5 grms. of *p*-nitraniline was shaken with 25 c.c. of water and 6 c.c. of concentrated sulphuric acid, 100 c.c. of water and 3 grms. of sodium nitrite in 25 c.c. of water were added, and the whole made up to 500 c.c. 15 c.c. of this solution was mixed with 50 c.c. of tannin solution (analytical strength) and filtered. Excess of sodium hydroxide added to the filtrate produced a blood red colour in presence of 20% or more of synthetic tannin in admixture with sulphite-cellulose and with treated quebracho extract. It was impossible to distinguish between the colours given by sulphite-cellulose and smaller amounts of synthetic tannin present in the mixture either by the above test or the cinchonine reaction (see this J., 1915, 189 and 501). Provided that a positive result was obtained with the Procter-Hirst test, a better indication of the presence of sulphite-cellulose would be the large increase in the non tannin content, since that of synthetic tans is low.—D. W.

Leather fibre; Elementary structure of ——. Principles of molecular physics of leather. W. Moeller. Collegium, 1918, 277—286, 300—309, 333—343, 365—372. Chem. Zentr., 1919, **90**, II., 954.

Recent views of the structure of collagen fibrils (this J., 1918, 776 A) and the conception of tanning solutions as peptisation systems indicate a complex of four components under normal conditions. These components are the collagen micell, *a*, the micells of the decomposition product, *b*, the peptiser, *p*, and *s*, the peptised portion of the tanning solution. The proportion of *p* and *s* in *a* and *b* depends on various conditions governed partly by the peptisation equilibrium, $ap = s$, and partly by the solubility of *p* in *a*. Of these four components *p* and *b* may be partially or entirely missing in the finished leather; *p* forms a solid solution with the collagen substance in micells, *a*, as it diffuses into *a*. The changes which the collagen micell undergoes by the formation of a solid solution depend on this absorption of *p*, which generally results in an increase in the volume of *a* both in the damp (swollen) and dry states; *s* cannot diffuse into the collagen micells, but is deposited on them and in the micellar interstices of the micellar complex according to the conditions and properties of the tanning solutions. It may be deposited in regular layers of crystals or irregularly in the large interstices without any regard to the shape of the micells, *a*. Besides there is the possibility of the micells, *a*, containing water of crystallisation or constitution, also adhering and absorbed water. The various peculiarities of the different kinds of leather are partly attributable to the changes taking place during the tanning process in the amount of water contained by the micells and the micellar interstices in these different forms, and the condition in which the water is present. The differences and peculiarities of structure of the different leather fibres obtained by the several tanning processes are dependent in general on the peculiarities and composition of the tanning materials used.—D. W.

Leather stuffing oils and greases; Extraction of —— from sand. F. P. Veitch and M. G. Hunt. J. Amer. Leather Chem. Assoc., 1919, **14**, 507—511.

Dry clean sand was mixed with the oil or grease and the mixture exposed to the air until it

remained constant in weight. Weighed portions were then extracted in a Johnson extractor for 24 hours with ether, chloroform, and petroleum spirit (b. pt. 35°—55° C.) respectively. It was found necessary to heat the extract 2 hours on the steam bath and then 2 hours at 100° C. to remove the solvent and all moisture. Eighteen representative commercial samples were employed in these determinations, which showed that petroleum spirit had the least solvent action; chloroform was better than ether for oils, but both were equally good for greases. Upon standing fish oils became less soluble in petroleum spirit and more soluble in chloroform. Chloroform appears to be the best solvent for oils and greases in general.—D. W.

Leather; Determination of water-soluble matter in ——. R. W. Frey and J. D. Clarke. J. Amer. Leather Chem. Assoc., 1919, **14**, 488—499.

Soaking overnight is unnecessary. From 45° to 55° C. the yield of water-soluble matter is increased 0·9% for each 5° rise in temperature. Variations in the flow during the extraction have little effect, provided that the required volume of extract is collected in the specified time. Percolation gives slightly higher results than siphoning, which in turn gives higher figures than "immersed percolation." Extraction by the official method of the Amer. Leather Chemists' Association is not complete, since of the total amount obtained in 7½ hours only 85—90% is extracted in the specified three hours. The procedure and apparatus require standardising to eliminate small errors and permit of a more thorough extraction.—D. W.

Chromium. Schorlemmer. *See* VII.

Sulphonated oils. Bumcke. *See* XII.

PATENTS.

Hides and leather; Process for the treatment of ——. L. Mauerhofer, Paris. Eng. Pat. 118,120, 9.8.18. (Appl. 12,972/18.) Int. Conv., 9.2.16.

In the operations of unhairing, washing, and preparing for tanning, a certain amount of "hide substance" is lost from the hide. A process for regenerating or replacing this lost material consists in subjecting the leather (upper, sole, saddlery) in the fulling mill to the action of a mixture of gelatin or glue, run from the digester and brought to a strength of "35° gelatinometer" at 10° C., and commercial nitric acid of 65° B. (sp. gr. 1·82), 3%, or, in the case of upper and saddlery leather, and for finishing "semi-chrome" and chrome tanned leathers, nitric acid 1%, and castor oil 10%. The leather is afterwards dried and finished as usual.—E. W. L.

[*Artificial leather.*] *Process of coating and product thereof.* H. W. Matheson, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,316,913, 23.9.19. Appl., 13.12.15.

A sheet of supporting material is coated with a solution of cuprammonium cellulose, containing an oil.—D. W.

Moulds for forming plastic masses [from yeast-residues.] E. Krause, Steglitz, and H. Blücher, Leipzig-Stötteritz, Germany. Eng. Pat. 110,553, 16.10.17. (Appl. 14,998/17.) Int. Conv., 21.9.16. (See also Ger. Pats. 302,930—1 and 303,133, and U.S. Pat. 1,238,528; this J., 1917, 1141; 1918, 478 A.)

The powdered mixtures of albuminous substances (e.g., residues) and formaldehyde, which are used for the formation of moulded articles, such as printing blocks, may be also used to form the moulds in which these articles are shaped if the composition or treatment of the mixture be suitably modified. For example, yeast pulp containing 15% of dry substance (1 kilo.) is heated—either alone or together with a filler such as glue (25 grms.) previously soaked—with 40% formaldehyde (60 grms.) to nearly 100° C., with constant stirring. The mixture is dried, ground, and shaped, to form the mould, at 125° C. and a pressure of 200 kilos. per sq. cm.; and, to form the article in this mould, at 115° C. and 150 kilos.—E. W. L.

"Patent" leather or the like; Process for drying japanned or ——. C. Heyl, Worms, Assignee of J. Nohstadt, Frankfort, Germany. Eng. Pat. 113,620, 20.2.18. (Appl. 3053/18.) Int. Conv., 22.5.16.

See U.S. Pat. 1,269,931 of 1918; this J., 1918, 709 A.

XVI.—SOILS; FERTILISERS.

Mineral particles; Influence of boiling and of shaking on ——: *Mechanical analysis of soils.* O. Nolte. Landw. Versuchs-Stat., 1919, **93**, 247—258.

Shaking of a soil effects a distinct although slight disintegration of the particles. If, however, it is not carried too far the shaking method as a means for preparing soils for mechanical analysis yields results far more reliable than those obtained by the method of boiling.—T. H. P.

Soil; Nitrogen-economy of —— *and the action of straw and sugar.* O. Lemmermann and A. Einecke. Landw. Versuchs-Stat., 1919, **93**, 209—220.

Pot experiments on various cereals show that addition of 2% of sugar to the soil produces in the first year diminution in the crop, but in succeeding years a slight increase over that obtained with no addition. Addition of straw to the soil lowers the crop in the first two years, but gives a small increase in the third year, the total effect being negative. This injurious effect of the straw is neither removed nor diminished by addition of either sugar or liquid manure or both, but is annulled by nitrate. The results confirm the view that fresh straw should be removed as completely as possible from arable land, and that no improvement in the nitrogen-economy of the soil is to be expected from its use.—T. H. P.

Nitrification in Egyptian soils. J. A. Prescott. J. Agric. Sci., 1919, **9**, 216—236.

The mean monthly temperature of the soil in the southern part of the Nile delta, 6in. below the surface, varies from 12·6° C. in January to 29·6° C. in July, so that the temperature is at all seasons suitable for bacterial activity. The winter rainfall totals 1—2 ins. The nitrates in the soil were found to be 10—20 parts per million of dry soil, and the moisture content at the same time under 20%. When the moisture content was raised by irrigation a large increase in the nitrates followed. In soil under a cotton crop a large accumulation of nitrates was noticed, in contradistinction to a removal of nitrates by wheat and maize. During the summer fallow the soil appears to be biologically dormant, possibly due to a partial sterilisation.
—J. H. J.

Fertilisers; Comparison of two —— *according to Mitscherlich's law of the minimum.* M. Gorski. Landw. Versuchs-Stat., 1919, **93**, 113—120.

The results of fertilising experiments with increasing applications of ammonium sulphate and sodium nitrate are found to accord well with Mitscherlich's mathematical expression. It is esta-

blished that the efficiency factors (*Wirkungsfaktoren*) for corn- and straw-yields can only be equal if the value of the ratio, corn-yield : straw-yield for different amounts of the minimum factor remains constant; otherwise the efficiency factors have different values. The ratio of the efficiency factors is calculated for ammonium sulphate and sodium nitrate; this ratio is almost constant, irrespective of whether the efficiency factors of the corn-yield or those of the straw-yield are used in the calculation. —T. H. P.

Nitrogen nutrition; Special position of various Cruciferæ and other plants in regard to ——. L. Hiltner and M. Kronberger. Prakt. Bl. f. Pflanzenbau u Pflanzenschutz, 1917. 110. Chem. Zentr., 1919, **90**, I., 1039.

TURNIPS and radishes are favourably affected by the application of guanidine nitrate as a fertiliser, but grasses, cereals, the Leguminosæ, and flax are not. The beneficial effect shows itself in the early stages of the plant's life, whilst the injurious effect is not seen until later. Thus it appears probable that guanidine is not decomposed in soil, but is directly absorbed, perhaps under the joint action of special organisms.—J. H. J.

Nitrogenous fertilisers; Special position of white mustard in regard to nutrition with ——. Clausen. Landw. Zeit., 38, 131—143. Chem. Zentr., 1919, **90**, I., 1039.

THE effect of various fertilisers upon white mustard was examined in nutrient sand cultures. In presence of superphosphate, nitrate cultures produced twice as much as cultures to which ammonium sulphate was applied. With basic slag instead of superphosphate, ammonium sulphate gave better results, as the basic slag counteracted the soil-souring tendencies of ammonium sulphate and superphosphate. Mustard is therefore very sensitive to acidity. Turnips behaved somewhat similarly.—J. H. J.

Calcium carbonate; Solubility of —— of different origins and finenesses in water containing carbon dioxide in its relations to soil and plants. G. Hager and J. Kern. J. Landw., 1916, **64**, 325—342.

EXPERIMENTS on the different forms of calcium carbonate show that the degree of fineness is of decisive importance for the solubility and especially for the velocity of dissolution of the carbonate in water containing carbon dioxide. The shorter the period of action the more pronounced are the differences observed. The variations in the amount of the carbonate dissolved gradually increase with increase in the proportion of carbon dioxide in the water. It is highly probable that the superior action on soil and plants produced by the more finely ground carbonate is due to the increased rate of solution as well as to the more effective distribution obtainable.—T. H. P.

Phosphates; Solubility of different —— and their utilisation by oats and buckwheat. II. T. Pfeiffer, W. Simmermacher, and M. Spangenberg. Landw. Versuchs-Stat., 1916, **89**, 203—230.

FURTHER pot experiments have been made with oats and buckwheat fertilised with phosphates of different types and other substances, the results previously obtained (this J., 1915, 972) being confirmed. As is shown by its higher content of phosphoric acid, buckwheat requires more of this constituent than oats does and is better able to obtain it from difficulty soluble phosphates. On the other hand, large applications of readily soluble compounds of phosphoric acid, which oats is well able to withstand, exert a markedly injurious effect on buckwheat. This peculiar behaviour of the latter is analogous to that of lupins, which require a relatively large supply of, and at the same time are highly sensitive to the action of, lime.—T. H. P.

Phosphoric acid; Determination of citrate-soluble —— by Petermann's method. H. Neubauer and E. Wolferts. Landw. Versuchs-Stat., 1916, **89**, 197—202.

THE following simplified methods of preparing the ammoniacal citrate solution and of carrying out the Petermann test ("Methodes suivies dans l'analyse des matières fertilisantes," Gembloux, 1897) are recommended. 173 grms. of pure, non-effloresced, crystalline citric acid is dissolved and the solution treated, slowly and with cooling, with 536·9 c.c. of ammonia solution (sp. gr. 0·960 at 15°/15° C.), the liquid being cooled to 15° C. and made up 1 litre with water also at 15°. The sp. gr. of the solution is 1·082—1·083 at 15°/15°, and 2·5 c.c. should contain 0·1050 grm. of nitrogen. In carrying out the test, one grm. of the substance is finely ground with small quantities of the ammoniacal citrate solution and introduced into a 200 c.c. measuring flask, 100 c.c. in all of the solution being used; if the substance is not quite homogeneous, larger quantities of it and of the liquid should be used, and a correspondingly larger flask. The flask is placed in a water-bath at 40° C. and vigorously shaken every half-hour at least. After the lapse of 7 hours the liquid is cooled, made up to volume with water, mixed, and filtered, a determination of the phosphoric acid in the filtrate being made. Since meta- or pyro-phosphoric acid may be present, the portion of the liquid to be precipitated is first heated nearly to boiling for 10 minutes with one-fifth of its volume of nitric acid of sp. gr. 1·4.—T. H. P.

Phosphoric acid and potash; Determination of the efficacy of —— in the soil by culture experiments, and determination of their relative solubility by acids. O. Lemmermann, A. Einecke, and L. Fresenius. Landw. Versuchs-Stat., 1916, **89**, 81—195.

IN most cases, determinations of the relative solubility of the phosphoric acid of a soil in 1% citric acid solution and that of the potash in 10% hydrochloric acid furnish a means of expressing the physiological efficiency of these fertilising substances.—T. H. P.

Calcium cyanamide; Diminution in the value of crude —— by the presence of dicyanodiamide. Hövermann and A. Koch. J. Landw., 1916, **64**, 317—324.

THE results of the experiments here described show that in agricultural practice only crude calcium cyanamide containing minimal proportions of dicyanodiamide should be employed, since otherwise the formation of nitrates, both from the nitrogen of the soil and from the cyanamide, is inhibited; the dicyanodiamide acts as a poison, not only for the higher plants, but also for the soil bacteria (compare Wagner, Dorsch, Hals and Popp; this J., 1907, 1059). Deliveries of crude cyanamide should always be tested for dicyanodiamide (compare Liechti and Truninger, this J., 1916, 647). Large proportions of the latter are probably due to storage in a damp place.—T. H. P.

Calcium cyanamide; Determination of dicyanodiamide in ——. F. W. von Dafert and R. Miklauz. Z. Landw. Vers.-Wesen Deutschösterr., 1919, **22**, 1—14. Chem. Zentr., 1919, **90**, IV., 109—110.

AS shown by Kappen (this J., 1918, 478 A), urea interferes with the determination of dicyanodiamide by Hager's method; the authors find that dicyanodiamide may be determined accurately in samples of calcium cyanamide containing urea by means of

a reaction described by Grossmann and Schuck (this J., 1906, 1120) for the detection of nickel. A portion of the calcium cyanamide solution is evaporated to dryness with the addition of nitric acid, 10 c.c. of *N*/1 nitric acid being used for each 0·1 grm. of residue yielded by the solution. The evaporation with nitric acid is repeated. In this way the dicyanodiamide is converted into dicyanodiamidine; cyanamide is also converted into the latter substance, but this is of no importance owing to the small quantities of cyanamide in old samples of calcium cyanamide. After the second evaporation the residue is dissolved in water so as to give an approximately 1% solution, and to each c.c. of this solution is added 0·1 grm. of mannitol, 0·2 c.c. of nickel solution, and then 10% sodium hydroxide solution in quantity sufficient to produce a yellow colour in the mixture. The crystalline precipitate is collected after four hours (the supernatant liquid should now have a green colour), washed with 2% ammonia, dried, ignited, and weighed as NiO. The weight obtained is calculated into Ni, and the result multiplied by 2·363 to obtain the amount of dicyanodiamide. The precipitation of the nickel compound is not affected by the presence of ammonium salts, guaindine salts, or urea, even when the quantity of the latter is ten times that of the dicyanodiamide. The authors consider that, as the result of experiments on plants, calcium cyanamide should not contain more than 2% of dicyanodiamide.—W. P. S.

Ammonia-nitrogen; Iodometric determination of ——in fertilisers. W. S. J. Schouten and R. W. Tuinzing. Landw. Versuchs-Stat., 1917, **89**, 233—240.

TEN c.c. of a solution, containing 5 grms. of ammonium sulphate or 10 grms. of ammonium superphosphate per litre, is treated with 50 to 70 c.c. of sodium hypobromite solution; after one minute 5 c.c. of 10% potassium iodide solution, 20 c.c. of 10% hydrochloric acid, and 5 c.c. of saturated sodium carbonate solution are added, the mixture is diluted to 200 c.c., and the liberated iodine titrated with thiosulphate solution, using methylene blue solution (50 mgrms. per litre) as indicator. The reaction between the ammonia and the hypobromite proceeds according to the equation:

$$2NH_3+3NaOBr=3NaBr+3H_2O+N_2;$$

the excess of hypobromite reacts with the iodide:

$$NaOBr+2HI=NaBr+H_2O+I_2.$$

The hypobromite solution is prepared by dissolving 15·5 grms. of bromine in 5 litres of sodium hydroxide solution containing 15·5 grms. of sodium hydroxide; it should be at least 24 hrs. old when used and must be standardised at the time the determination is made.—W. P. S.

Spray fluids. Eyre and others. *See* XIX B.

PATENTS.

Superphosphates; Apparatus for the preparation of ——. Chem. Fabrik Milch A.-G., and O. Rabenau, Posen, Germany. Eng. Pat. 104,693, 9.3.17. (Appl. 3509/17.) Int. Conv., 17.2.16.

IN travelling superphosphate reaction vessels of horizontal cylindrical form, a box-shaped frame surrounds the feed opening in the vessel and fits air-tight to it. An air-tight hood surrounds the delivery of the mixing vessel and the aspirating pipe, and the lower edge of the hood carries an immersion rim containing oil, sand, or other sealing material. An intermediate frame makes an air-tight connection between the immersion rim and the top of the frame on the reaction vessel. This intermediate frame is capable of being raised to permit movement of the reaction vessel.—J. H. J.

Fertilising-explosive. W. O. Snelling, Assignor to Trojan Powder Co., Allentown, Pa. U.S. Pat. 1,316,396, 16.9.19. Appl. 21.4.19.

FRIABLE granules of fertilising material are associated with an explosive material to form a fertilising explosive.—J. H. J.

Cyanamide. Eng. Pat. 132,622. *See* VII.

Cyanamide. U.S. Pat. 1,315,678. *See* VII.

XVII. SUGARS; STARCHES; GUMS.

Vallez filter [for sugar-juice]. L. Naudet. Bull. Assoc. Chim. Sucr., 1919, **37**, 40—48. (See this J., 1917, 859.)

THE author describes the construction and working of the Vallez filter-press in a United States (beet) sugar factory in which eight such presses are installed, each with a filtering surface of 60 sq. metres. Each filter consists of a series of 30 disc-shaped chambers covered with cotton filter-cloths, mounted on a hollow horizontal rotating shaft and communicating with the interior of the latter, the whole series being enclosed in a horizontal cylindrical casing, the upper half of which is removable in case of repairs. The method of operating for the filtration of juice from the first carbonatation is described in detail. The juice is fed into the casing, under a pressure of 2¼ atm., the filtrate being discharged from the chambers through the hollow shaft, until the cakes formed on the outside of the chambers are 1¼ in. thick, as shown by a special indicator. The casing is then emptied of juice by means of compressed air, and washing water is introduced. When the cakes are sufficiently washed the casing is again emptied by means of compressed air, and the cakes are detached from the chambers by jets of water (*loc. cit.*) and fall into a trough at the bottom of the casing, whence they are discharged by a spiral conveyor. The whole series of operations occupies less than an hour, and the filter is at once ready for use again. The labour required for operating is much less than with other types of filters, a very clear juice is obtained, and the cakes are homogeneous; the filter is also economical in respect of filter-cloths and washing water. The only important disadvantage of the apparatus is that if one filter-cloth becomes defective it may be necessary to change the whole series, owing to the difficulty of identifying the defective one. In the factory in question the eight filters have been in daily use for 40 days, and such a mishap has not occurred. It may be provided for, however, by having in reserve one or two spare shafts fitted with complete sets of chambers; the replacement of a defective set by one of these reserves occupies only 2 or 3 hours.—J. H. L.

Sugar; Extraction of —— and various applications of the method. A. Vasseux. Bull. Assoc. Chim. Sucr., 1919, **37**, 57—60.

IN the centrifuging of masseeuites the fine crystals which escape with the molasses may, according to Horsin-Deon, amount to 10% of the weight of the masseeuites, and represent a loss of solid sugar much greater than that involved in subsequent purging with or without steam. The author advocates the recovery of these fine crystals by treating the molasses in a centrifuge with non-perforated drum. In an apparatus of this kind requiring 2 h.p., the drum makes 2000—3000 revs. per min., corresponding to a circumferential velocity of 50—70 metres per sec. and a pressure of 15—20 kilos. per sq. cm. (about 200—260 lb. per sq. in.). The crystals are deposited against the walls of the

drum and removed when the deposit is sufficiently thick, *e.g.*, 3 ins. Such centrifuges may be applied to various purposes, *e.g.*, if the walls of the drum are fitted with moulds, fine-grained masseeuites may be treated for the production of lump sugar. —J. H. L.

Xylose. Fred and others. *See* XVIII.

PATENTS.

Decolorising carbon. Eng. Pat. 132,572. *See* II B.

XVIII.—FERMENTATION INDUSTRIES.

Yeast; Influence of the addition of sucrose to the wort on the biology of ——. H. Zikes. Cent. Bakt., II. Abt., 1916, **46**, 385—390.

PURE cultivations of four species of bottom-fermentation yeasts of the Frohberg type were used for pitching malt worts and the same worts with the addition of 20 % of sucrose. It was found that monosaccharides, with their relatively smaller molecules, penetrated more readily into the interior of the yeast cells and so were more speedily rendered accessible to the yeast zymase. This was still more the case when these sugars were present in greater quantity, for the velocity of osmotic processes increases with the concentration of the substance capable of osmosis, and, on the other hand, decreases with the size of their molecules. In ordinary malt wort, a relatively large proportion of maltose is present, and hence, under these conditions, pronounced diosmosis of this sugar occurs, notwithstanding the retarding influence of the large size of its molecules. The monoses are only present in small proportion, but owing to the small size of their molecules can diffuse readily into the interior of the cell. In sugar worts the conditions are different. The maltose, being present in small amount, diffuses less readily into the cell than in the case of malt wort. The sucrose is inverted outside the cell, and the resulting monoses, being present in greater concentration, penetrate more readily into the cell. Hence, sugar worts promote the vital functions of the yeast to a greater extent than malt worts, but on the other hand, the vital processes are more rapid and intense, and the yeast tends to become exhausted. The addition of sucrose to a malt wort materially affects the form and size of the cells. The formation of glycogen and fat takes place more rapidly and intensely. Yeast deposits less readily in sugar worts, and beers made from such worts show a more persistent turbidity, which is due, however, not to suspended yeast cells, but to the separation of a large amount of albumin in globular form.—C. A. M.

Yeast; Vitamine requirements of ——. F. M. Bachmann. J. Biol. Chem., 1919, **39**, 235—257.

IT is suggested that substances akin to the vitamines are necessary for the growth and nutrition of yeast cells. These substances are identified with the so-called "bios" of Wildier (La Cellule, 1901, **18**, 313).—J. C. D.

Wines; Determination of sugars in ——. L. Mathieu. Bull. Assoc. Chim. Sucr., 1919, **37**, 49—51.

DISCUSSING the proposal to add magnesium sulphate to agglomerate the precipitate in the volumetric determination of reducing sugars (cp. Lenk, this J., 1917, 934), the author mentions that in operating on wines he adds about 1 grm. of barium sulphate for a similar purpose, the reaction liquid being boiled in a wide tube and the end-point judged visually from the colour of the solution. The possible error of this method of operating should not exceed 6 % of the amount of sugar determined, and is therefore negligible with wines of low sugar content. The conventional correction applied to such wines, for the reducing action of the non-sugars, which is assumed to be equivalent to 1 grm. of sugar (per litre), involves a much greater error, for in some cases the uncorrected sugar-content is only 0·4 grm. (per litre).—J. H. L.

Potassium bitartrate and calcium sulphate; Reaction between —— *in the fermentation of plastered grape must.* A. Borntraeger. Annali Chim. Appl., 1919, **11**, 6—39.

THE neutral (normal) salts of malic, lactic, succinic, and acetic acids in grape juice or in wine have an influence on the reaction between potassium bitartrate and calcium sulphate in plastered grape musts. They render the calcium sulphate more soluble, and, with the exception of potassium lactate, have a similar effect upon potassium bitartrate. The malates in plastered musts are decomposed by the tartaric acid liberated in the reaction between the calcium sulphate and potassium bitartrate, and there is a fresh formation of potassium bitartrate and liberation of malic acid. This acid influences the reaction less than tartaric acid. A portion of this newly-formed potassium bitartrate is eliminated, so that in practice the acidity is considerably less than corresponds with Chancel's equation (Comptes rend., 1865, **60**, 408):

$$2C_4H_5KO_6 + CaSO_4.2H_2O = C_4H_4CaO_6 + K_2SO_4 + C_4H_6O_6 + 2H_2O.$$

From further experiments described the conclusion is drawn that potassium bisulphate is not formed in the fermentation of grape musts which have been plastered with calcium sulphate. The presence of the potassium salts of organic acids in a wine increases materially the apparent plastering, as shown above.—C. A. M.

Potassium sulphate and tartaric acid; Reactions between —— *under varying conditions, and the behaviour of potassium bisulphate with alcohol.* A. Borntraeger. Annali Chim. Appl., 1919, **12**, 1—23.

THE commonly accepted belief that plastered wines contain potassium bisulphate or free sulphuric acid originated with Bussy and Buignet (Comptes rend., 1865, **60**, 200). The author, however, has shown that the proportions of potassium bitartrate and calcium sulphate taking part in the reaction correspond with the formation of the neutral (normal) posassium sulphate, as found by Chancel (see preceding abstract). On evaporating a solution containing potassium bisulphate and bitartrate, potassium sulphate and tartaric acid are first produced, and, then, as the concentration increases, potassium bitartrate separates, leaving potassium bisulphate in solution. On continuing the evaporation the reverse reaction takes place:—

$$KHSO_4 + C_4H_5KO_6 = K_2SO_4 + C_4H_6O_6.$$

The final residue of the evaporation of a solution of potassium sulphate and tartaric acid in equivalent quantities is a dry mixture of potassium sulphate and tartaric acid, whilst incomplete evaporation gives a residue composed of potassium bitartrate and a solution of potassium bisulphate. From experiments on the methods of detecting free sulphuric acid in wines the following conclusions were drawn: Ether does not attack potassium bisulphate, nor does anhydrous alcohol, but alcohol containing a little water slowly decomposes it into the normal sulphate and free sulphuric acid. A dry mixture of normal potassium sulphate and tartaric acid in equimolecular proportions does not absorb much moisture from the air, and remains unaltered. Ether and absolute alcohol extract only the tartaric acid from such a mixture, but alcohol containing a little water promotes a partial

reaction, with the formation of potassium bitartrate and bisulphate, the latter being subsequently partially decomposed into the normal sulphate and free sulphuric acid. On evaporating to dryness a dilute aqueous solution of the two substances and treating the residue with ether, only the tartaric acid is extracted, but if alcohol containing a little water is used, the same products are formed as when the alcohol acts directly upon a mixture of potassium sulphate and tartaric acid, free sulphuric and tartaric acids being found in the solution, and normal potassium sulphate, bitartrate and a little bisulphate in the residue. In evaporating wines for the detection of free sulphuric acid it is necessary to take into consideration the influence of salts of weak acids other than tartaric acid. (See also J. Chem. Soc., 1919, i., 522.)—C. A. M.

Xylose; Acid fermentation of ——. E. B. Fred, W. H. Peterson, and A. Davenport. J. Biol. Chem., 1919, **39**, 347—383.

Xylose is readily fermented by organisms which are found in fresh silage, sauerkraut, manure, and in certain soils, but not by the organisms usually studied in the laboratory. Certain yeasts (Carlsberg I., Burgundy, lactose-fermenting yeasts, amara and Hansen), as well as the bacteria, *B. mycoides*, *subtilis*, and azotobacter showed no appreciable growth in a medium with xylose as the only carbohydrate. The xylose-fermenting organisms are easily isolated in pure culture from the sources named on xylose-yeast-agar plates. They grow within a relatively wide range (p_H, 3·0 to 8·6), and are facultative anaërobes growing best with a lowered oxygen tension. The main products formed in the fermentation are acetic and lactic acids, which are produced in amounts corresponding to a rupture of the xylose molecule into these two substances. Only traces of carbon dioxide and alcohol are formed.—J. C. D.

Vinegar acetifiers; Effect of varying the conditions of acetification in ——. A. Janke and E. Bauer. Centr. Bakt., II. Abt., 1916, **46**, 545—547.

Experiments with different types of acetifiers packed with shavings showed that the use of a conical false bottom involves special attention to the regulation of the air supply. No advantage is gained by sparging the gyle at irregular intervals through the acetifying medium. The introduction of a central air shaft into the middle of the shavings, with the object of cooling the interior of the acetifier, and so preventing loss by evaporation, was not successful, since the additional air caused increased oxidation, and so raised the temperature. Good results were obtained by the use of a central cooling chamber, consisting of a closed hollow wooden cylinder, into the sides of which were introduced glass tubes communicating with the air outside the vat. The diameter of this chamber should be not less than a third of that of the acetifier. It prevents loss by evaporation, and so saves alcohol, and has the advantage that a smaller quantity of packing is required without the activity of the acetifier being affected. The most economical acetification of the alcohol can probably be effected by the use of this device in combination with a conical false bottom.—C. A. M.

Patents.

Acetone and [butyl] alcohol; Production of —— by bacteriological processes. C. Weizmann, London. U.S. Pat. 1,315,585, 9.9.19. Appl., 26.12.16.

See Eng. Pat. 4845 of 1915; this J., 1919, 301 A.

Plastic masses from yeast residues. Eng. Pat. 110,563. *See* XV.

XIXA.—FOODS.

Lactose and lactic acid; Oxidation of —— and its influence on the analysis of milk preserved with potassium bichromate. Marchadier and Goujon. Ann. Chim Analyt, 1919, **1**, 288—290.

In milk which has been preserved with potassium bichromate the lactose is converted gradually into lactic acid, and this in turn is oxidised by the bichromate with the formation of acetic acid and carbon monoxide, or even with the production of oxalic acid. The bichromate may be reduced completely. The blue colour observed in bichromated milk when the above reactions have proceeded to a considerable extent is due to the formation of potassium chromium oxalate. Owing to the successive oxidation of the lactose and lactic acid, the sum of the various constituents of the milk does not agree with the total solids determined directly. —W. P. S.

Curd produced by rennet; Consistence of ——. O. Allemann and H. Schmid. Milchw. Zentr., 1916, **45**, 273—284.

The author has measured the consistence (solidity) of the curd produced by treating milk with rennet under different conditions. The solidity of the coagulum increases considerably within the first few minutes after coagulation. The solidity of the curd is not materially affected by the quantity of rennet used or the time taken to produce coagulation. The acidity of the milk has an indirect influence, and an increase in the quantity of calcium salts increases the firmness of the curd, other conditions being the same. The most suitable temperature for the action of the rennet lies between 20° and 30° C.—W. P. S.

Seeds; Antiscorbutic value of dry and germinated ——. H. Chick and C. M. Delf. Biochem J., 1919, **13**, 199—218.

The antiscorbutic factor in dry peas and lentils is increased 5—6 times by soaking in water for 24 hours and germinating for 48 hours; the seeds then have about the same antiscorbutic power as green beans and potatoes, and are superior to carrots and beetroots in this respect.—J. C. D.

Vegetables; Carbohydrates of ——. *V. Carrots. VI. Green peas.* E. Busolt. J. Landw., 1916, **64**, 357—360, 361—362.

Carrots (6 kilos. of fresh roots) contain mannitol (23·5 grms.) and dextrose (2·8 grms.), whilst green peas contain mannitol, dextrose, lævulose, and glycuronic acid.—T. H. P.

Foods; The hydrogen ion concentration of ——. J. F. McClendon and P. F. Sharp. J. Biol. Chem., 1919, **38**, 531—534.

The reactions of foods in general (meats, vegetables, and the press juice from malted barley) were found to be all on the acid side of neutrality, no matter what the condition of freshness, mode of storage, stage in preparation (cooking), or dilution with water.—J. C. D.

Foods; Determination of sulphur in —— and estimation of sulphate in a concentrated electrolyte. V. K. Krieble and A. W. Mangum. J. Amer. Chem. Soc., 1919, **41**, 1317—1328.

For the prevention of explosions and fires in the sodium peroxide method of estimating sulphur in foods, and the complete precipitation of barium sulphate from the aqueous extract of the fused mass, the following procedure is recommended: A suitable quantity (2—3 grms.) of the material is placed in a nickel crucible of 100 c.c. capacity, mixed with

2—3 c.c. of water, and well stirred with a nickel rod; 5 grms. of sodium carbonate is added and well mixed, and then sodium peroxide in small quantities until the mass becomes dry and granular. The crucible is carefully heated by a Bartel alcohol lamp until the mixture becomes a brown homogeneous fused mass, and after cooling more sodium peroxide is added to make a total of 25—26 grms.; 3 grms. of sodium carbonate is also added and mixed with the peroxide. The crucible is then heated by pointing the flame at a position opposite the level of the contents until the first signs of oxidation appear, when the flame is removed and the lid placed in position. After the completion of the oxidation the crucible is heated for a further ten minutes. When the crucible is cool it is placed in 100 c.c. of water and heated until the contents are dissolved; 50 c.c. of concentrated hydrochloric acid is added, and the volume increased to 350 c.c. by the addition of water. The solution is raised to the boiling point, and 10 c.c. of 10% barium chloride solution is added by means of a dropper at a rate of 10 c.c. in four minutes. The liquid is allowed to stand for 48 hours, evaporated to dryness, treated with water, and after standing for 18 hours the precipitate is collected in a Gooch filter. The results of this method are always high, due to absorbed material in the precipitate, and should be corrected by an amount which is determined experimentally. The correction is obtained by repeating the determination with a solution of potassium sulphate of known concentration, and finding the amount by which the barium sulphate differs from the theoretical quantity.—J. F. S.

Glue; Determination of — — contained, together with coagulable proteins, in feeding-stuffs, etc. H. Wagner and G. Schöler. Landw. Versuchs-Stat., 1918, **92**, 171—180.

Five grms. of the substance is boiled with 200 c.c. of water for five hours in a 300 c.c. Erlenmeyer flask, a larger flask being employed only with materials which "bump." The whole is then transferred to a 500 c.c. measuring flask, cooled, made up to volume, and filtered. If absence of dissolved protein in the filtrate is shown by failure of the reaction with acetic acid and potassium ferrocyanide and of the xanthoprotein reaction, the nitrogen in 100 c.c. of the filtrate, corresponding with 1 grm. of the substance, is determined by the Kjeldahl method: this represents glue- plus amide-nitrogen. Another quantity of 100 c.c. of the filtrate is treated in a 250 c.c. measuring flask with 40 c.c. of 10% tannin solution (the nitrogen-content of which is determined by a blank experiment), the liquid being made up to volume, mixed, allowed to settle overnight, and filtered. The nitrogen in 200 c.c. (0·8 grm. of substance) or 150 c.c. (0·6 grm.) of the filtrate is determined by the Kjeldahl method: the result, corrected for the nitrogen of the tannin solution, gives the amide-nitrogen, and subtraction of this from the glue- plus amide-nitrogen yields the glue-nitrogen alone. The method has been tested with mixtures of blood-albumin and gelatin, and found to give satisfactory results. A number of different feeding-stuffs have been analysed by the method, and also by that of Strigel (Chem.-Zeit., 1917, 313).—T. H. P.

Straw treated in various ways; Feeding value of ——. F. Honcamp and E. Blanck. Landw. Versuchs-Stat., 1919, **93**, 175—194.

Experiment shows that treatment of straw with hydrochloric acid results neither in appreciable improvement of the straw as a feeding material nor in enhancement of the digestibility. The increase sometimes effected in the digestibility of the non-nitrogenous extractives is slight compared with the cost of the treatment, whilst in some cases decomposition products result which exert an injurious action on the digestion and on the animal organism as a whole. (Compare Beadle and Stevens; this J., 1909, 1015.)—T. H. P.

Wood; Feeding experiments with treated ——. G. Fingerling. Landw. Versuchs-Stat., 1918, **92**, 147—170.

Experiment shows that wood-cellulose freed from lignified substances is as readily digestible by animals as straw-cellulose freed from the encrusting constituents. The sodium hydroxide process and the sulphite process of preparation yield celluloses of equal digestibility.—T. H. P.

Beech-nut cake and fruit-kernel cake. F. Honcamp. Landw. Versuchs-Stat., 1919, **93**, 97—106.

Beech-nut cake, prepared from the residues left after extraction of the oil from the unshelled nuts, may serve to some extent as a war-time feed for ruminants, while fruit-kernel cake, similarly prepared, corresponds as regards digestible protein and starch value with cottonseed cake, and thus forms one of the best war-time feeding materials.—T. H. P.

Patents.

Milk or other liquids; Apparatus for simultaneously atomising and drying or evaporating ——. P. Müller, Leipzig, Germany. Eng. Pat. 116,902, 18.6.18. (Appl. 10,062/18.) Int. Conv., 18.6.17.

The vessel holding the liquid to be treated has an outflow pipe from the bottom, into the lower end of which projects the conical end of a narrower pipe conveying compressed gas for atomising, which issues through fine openings at the base of the cone. A large pipe surrounds the pipe conveying the compressed air, ending a little way below the cone of the latter; from its open end issues the hot air used for evaporating the atomised milk.—J. H. J.

Vegetables, fruits, and other objects or manufactured products; Drying of ——. E. L. A. Savy, Paris. Eng. Pat 123,981, 18.2.19. (Appl. 4043/19.) Int. Conv., 8.3.18.

A drying chamber built either on the superposed tray or on the transporting belt principle is employed. In the former, hot air traverses the trays vertically, and revolving horizontal vanes between the trays cause eddies in the current, thus agitating the material in the trays. Wire cloth frames cover the trays to prevent the material being blown out. Similar arrangements are made in the continuous form of dryer with belt conveyor. The drying chamber is provided with an external heater for the air used. The air after use is returned to the heater for re-use, or a part is returned and a part is drawn up an exhaust, or the whole of the air used may pass to the exhaust.—J. H. J.

Food products and process of producing same. C. Townsend, London. Eng. Pat. 132,566, 19.7.18. (Appl. 11,839/18.)

Pea nuts (*Arachis hypogæa*) are shelled, and the red skin removed by hot air or blanching below 125° F. (51° C.). The germ is removed from the kernels, and the oil content is reduced to 10—15% by the use of a solvent or by pressure, also below 125° F. The residual nut contains 30—50% of soluble protein. The product may be granulated between graduated rollers, and the granules steamed, mixed with malt extract and maltose, and cooked by dry heat. The fine powder from the

rollers is ground to flour, moistened, and formed into filaments suitable for confectioners' use.
—J. H. J.

Fodder; Manufacture of ——. S. Goldreich, London. Eng. Pat. 132,597, 16.9.18. (Appl. 15,021/18.)

STEMS of the horse bean are defibrinated by grinding and sifting, 5—15% of dried spent hops is added, and the mixture is ground finely. To increase the food value of the product, the pods and seeds of the plant may be used along with the stems.—J. H. J.

Bean-flour; Process for deodorising and decolorising ——. Y. Yamamoto, Kobe, Assignor to I. Mizusawa, Hyogo Ken, and T. Kano, Kobe, Japan. U.S. Pat. 1,314,298, 26.8.19. Appl., 21.5.19.

THE bean is coarsely powdered and the bran removed, the powder steeped in a solution of 1—2 litres of vinegar to 100 litres of water, the mixture heated to a temperature not exceeding 60° C., the powder removed from the solution, washed, steeped in a solution of sodium bicarbonate (140—200 grms. to 100 litres of water), washed in water, and finally dried at a low temperature.—A. DE W.

[*Acetic*] *acid; Process of recovering* —— *[in evaporation of vegetable extracts]*. H. G. Stone, Wytheville, Va. U.S. Pat. 1,314,765, 2.9.19. Appl. 4.6.19.

IN the evaporation of vegetable extracts in multiple effect evaporators, the vapours at each stage are brought into intimate contact with alkali in order to recover acetic acid.—J. H. J.

Fibrous and non-fibrous materials in food products; Method and apparatus for separating ——. L. C. Gehring, Circleville, Ohio. U.S. Pat. 1,314,864, 2.9.19. Appl., 28.12.18.

CORN (maize) is "de-silked" by heating it to a sterilising temperature and then passing it into a separator which collects the flaccid "silk."
—A. B. S.

Flour and other meal; Process for treating —— *to increase the absorptive capacity during baking.* Naaml. Vennoots. Industriecle Maatschappij v.h. Noury & van der Lande, Deventer, Holland. Ger. Pat. 312,528, 14.4.17. Int. Conv., 13.10.16.

To increase the capacity of flour and other meal for absorbing water during baking, the meal is either cooled rapidly to below 0° C., or it is first heated not above 75° C., and then cooled rapidly to 40° C. or below. The heating and subsequent cooling may be repeated.—L. A. C.

Coffee extract; Manufacture of a [substitute for] —— *from roasted beets.* Chem. Ges. Rhenania m.b.H., Wevelinghoven. Ger. Pat. 312,575, 4.11.16.

FINELY ground roasted beet is steeped in water and treated with an electrolysed solution of sodium chloride containing about 25 grms. of active chlorine per 100 kilos. of roasted beet. The solution is then boiled, filtered, and evaporated to a thick liquid or to dryness.—L. A. C.

Food-stuffs [grain, fish, etc.]; Sterilisation of stale ——. Chem. Ges. Rhenania m.b.H., Wevelinghoven. Ger. Pat. 312,614, 4.11.16.

STALE fish, grain, or the like, is treated with an electrolysed solution of sodium chloride containing the requisite amount of active chlorine for sterilisation, *i.e.*, about 25 grms. per 100 kilos. of grain, and about 75 grms. per 100 kilos. of fish.—L. A. C.

Beverages; Manufacture of clear —— *from fruit juice.* A. Hüttinger, Fürstenfeldbruck, L. Spiegelhalder, Heidelberg, and B. Grund, Glatz. Ger. Pat. 312,769, 8.3.16.

FRESH or fermented fruit juice is stirred with a finely ground material insoluble in the juice, such as asbestos, Spanish earth, coal dust, yeast, or the like, until no more colloidal matter remains in solution. The juice is then filtered and can be pasteurised in bottles without becoming turbid or altering in flavour.—L. A. C.

Refining liquids. U.S. Pat. 1,297,635. *See* I.

XIXB.—WATER PURIFICATION; SANITATION.

Waters; Determination of the reaction of ——. J. Tillmans. Z. Unters. Nahr. Genussm., 1919, **38**, 1—16.

IN most cases the reaction (hydrogen ion concentration) of natural waters depends on the amount of free carbon dioxide and that present as bicarbonate in the water, and the reaction is best expressed as ten thousandths of a mgrm. per litre ($=h'$); thus $h'=1$ corresponds with $p_H=4$, $h'=10$ with $p_H=3$; $h'=0{\cdot}1$ with $p_H=5$, and so on. For neutral waters, $h'=1$; when h' lies above unity the water is acid, whilst a value of less than 1 indicates alkalinity. For most waters h' can be calculated with sufficient accuracy from the relationship $h'=3c/b$, where c is the weight in mgrms. of free carbon dioxide per and b the number of mgrms. per litre of carbon dioxide present as bicarbonate. This simple method of calculation is untrustworthy (1) when the water contains free carbon dioxide alone and no bicarbonate, (2) when in the presence of much free carbon dioxide, that present as bicarbonate is less than 5—10% of the free carbon dioxide, and (3) when the free carbon dioxide is less than one-fortieth of the bicarbonate carbon dioxide. In case (1), $h'=100\sqrt{c}/14{\cdot}67$. In case (2), $h'=100\,(\sqrt{c}/14{\cdot}67+b^2/0{\cdot}77-b/0{\cdot}88)$. In (3), h' is practically the same value as pure bicarbonate solution (0·05). When a water is alkaline (h' being less than unity), it is convenient to express the alkalinity as the reciprocal of h' ($1/h'$); thus if $h'=0{\cdot}5$, OH' (expressed as h') $=2$. A water having h' between 0·1 and 1 is alkaline to litmus paper; when h' lies between 1 and 10, litmus paper exhibits a violet coloration if immersed in the water, and such water is acid towards rosolic acid. Any water having h' above 0·1 is acid towards phenolphthalein, but h' must exceed 1000 before the water is acid towards methyl-orange.—W. P. S.

Lysine; Disinfecting power of ——. G. Sampietro. Arch. Farm. Sper., 1919, **27**, 65—96.

THE disinfectant sold as "lysine" consists of an acid solution of formalin containing inorganic salts and essences, the percentage of formaldehyde present being 2·88. The concentrations and periods of action necessary to destroy various forms of pathogenic bacteria have been determined, the results being given in detail. In 5% solution lysine exhibits no bactericidal action within an hour, and its antiseptic power is less than that of the corresponding solution of formalin. Its sporicidal value is relatively low, spores being killed by the 20% solution only after the lapse of seven days. Towards vegetative forms, however, lysine is somewhat more active than the corresponding aqueous

formalin solution, but to obtain results of practical value solutions of at least 20% strength must be employed.—T. H. P.

Spray-fluids; Fungicidal properties of certain ——. II. J. V. Eyre, E. S. Salmon, and L. K. Wormald. J. Agric. Sci., 1919, **9**, 283—307. (See also this J., 1916, 862.)

Experiments were made on the spraying of hop mildew (*Sphaerotheca humuli*) with ammonium polysulphide solutions containing varying amounts of sulphide sulphur and polysulphide sulphur, and the strengths in which they were fungicidal determined. No relation was found to exist between the fungicidal strength and the sulphide sulphur present. When the solutions were diluted, however, to contain the same amount of polysulphide, they all had the same fungicidal effect. The lower and higher polysulphides behaved similarly, as did ammonium polysulphide and calcium polysulphide. It was observed that the earliest stage in the growth of the mildew was more resistant to treatment than the later "powdery" stage, and that the latter stage was more resistant on young than on old leaves.—J. H. J.

Permutit. Kornfeld. *See* VII.

Patents.

Sewage and other liquids; Purification of ——. W. Jones, Stourbridge, and Jones and Aitwood, Ltd., Amblecote, Staffs. Eng. Pat. 132,581, 17.8.18. (Appl. 13,379/18.)

In the "activated sludge" method of purifying sewage the aerating tank is discharged during times of normal flow through an opening near the bottom. The opening is made of a size proportionate to the capacity of the tank or it is provided with a regulator or valve, either method permitting of a continuous, regulated outflow carrying the heavy particles of sludge to a settling chamber. The top of the aerating tank is provided with a weir which comes into operation at times of abnormally increased flow of sewage, and the overflow from which joins the regulated flow passing to the settling chamber.—J. H. J.

Compound of lime and bromine [bactericide]; New —— and process for its manufacture. J. S. Arthur, Oxford, and L. G. Killby, London. Eng. Pat. 131,750, 9.9.18. (Appl. 14,661/18.)

A new bactericidal compound having properties similar to bleaching powder but of much greater stability, is produced from the red compound formed by the absorption of bromine by slaked lime by heating it at 100° C. until bromine and water cease to be evolved. The operation is conveniently carried out in gas-heated rotating drums which are charged with lime and the requisite quantity of dry liquid bromine. The dark red compound $CaOBr_2$, H_2O, is heated in the same vessel and the evolved bromine absorbed in a further quantity of lime, which serves as the basis of a second preparation. After heating for two or three hours the new compound remains as a pale yellow powder containing about 33% of available bromine and having substantially the composition $CaO,CaOBr_2,H_2O$. —G. F. M.

Sewage; Treatment of —— for the purification thereof and the production of combustible gas therefrom. H. Flicker, Parramatta, N.S.W. U.S. Pat. 1,314,955, 2.9.19. Appl., 24.2.17.

See Eng. Pat. 111,401 of 1917; this J., 1918, 38A.

Sludge-press. U.S. Pats. 1,316,418-9. *See* I.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Brucine; Application of the Kjeldahl method to compounds of — —. Brucine salt of a new nucleotide. W. Jones. J. Pharm. Exp. Ther., 1919, **13**, 489—493.

The Kjeldahl method may be applied satisfactorily to the analysis of salts of brucine.—J. C. D.

Anhalonium [cactus] alkaloids. I. Anhaline and mezcaline. E. Späth. Monatsh. Chem., 1919, **40**, 129—154.

Seven different bases have been isolated from various species of cactus, and investigated chiefly by Heffter (1895—1905). It is now shown that they are derivatives of β-phenylethylamine. Thus, anhaline is β-*p*-hydroxyphenyldimethylethylamine, $HO{\cdot}C_6H_4{\cdot}CH_2{\cdot}CH_2{\cdot}N(CH_3)_2$, identical with hordenine, and mezcaline is shown by synthesis to be β-3.4.5-trihydroxyphenylethylamine. Anhalamine, anhalonidine, and pellotine are methylated 3.4.5-trihydroxyphenylethylamines, but anhalonine and lophophorine each contain two of their three oxygen atoms in a different kind of linking. (See further, J. Chem. Soc., 1919, i., 548.)—J. C. W.

Capsaicin. Part I. A. Lapworth and F. A. Royle. Chem. Soc. Trans., 1919, **115**, 1109—1116.

A method was developed for the isolation of pure capsaicin from alcoholic extract of capsicum, taking advantage of the fact that it does not form a stable barium salt with ammoniacal barium chloride, and can thus be separated from the free carboxylic acids in the extract whose barium salts are insoluble in water, ether, and acetone. The pure capsaicin melted at 64°—65° C., and had the empirical formula, $C_{18}H_{27}O_3N$ (compare Nelson, this J., 1919, 651A). Methylcapsaicin, m.pt. 74° C., was prepared by methylation with dimethyl sulphate, and on treatment with phosphorus pentachloride it gave a small quantity of an oil which appeared to be the nitrile of nonoic acid. Capsaicin was but imperfectly attacked by reducing agents, giving ammonia, and in certain cases a small quantity of a compound of b.pt. 216°—217° C. having the properties of a fatty alcohol, was isolated. Oxidation of methylcapsaicin took place readily, and veratric acid and a fatty acid, apparently nonoic acid, were recognised amongst the products. The authors discuss Nelson's views (*loc. cit.*) on the constitution of capsaicin and regard the possibility that it is built with a ring structure such as a C-disubstituted dihydro oxazole as not being excluded.—G. F. M.

Phenylarsinic acids and their reduction products; Substituted ——, and the estimation of arsenic in such compounds. R. G. Fargher. Chem. Soc. Trans., 1919, **115**, 982—992.

bis-*p*-Aminophenylarsinic acid, $NH_2{\cdot}C_6H_4AsO(OH){\cdot}C_6H_4{\cdot}NH_2$, obtained as a by-product in the preparation of *p*-aminophenylarsinic acid, was converted into 3.3′-dinitro-4.4′-dihydroxydiphenylarsinic acid by decomposing its diazo-derivative with water and nitrating the resulting dihydroxy compound. Reduction of this compound with sodium hydrosulphite led to 3.3′-diamino-4.4′-dihydroxy-diphenylarsenious hydroxide, whilst complete reduction with hypophosphorous acid gave a tetraamino-tetrahydroxy-tetraphenyl-diarsine. The reduction of 5-nitro-6-hydroxy-*m*-tolylarsinic acid with sodium hydrosulphite led to 4.4′-dihydroxy-5.5′-diamino-3.3′-dimethylarsenobenzene, the hydrochloride of which, a pale yellow, microcrystalline powder, soluble in water, closely resembles salvarsan. For the estimation of arsenic in

substituted phenylarsinic acids and similar compounds the following modification of Lehmann's method (this J., 1912, 746) is suggested: 0·2 grm. is mixed with 1 grm. of permanganate and 5 c.c. of 50% sulphuric acid, a further 10 c.c. of concentrated sulphuric acid is added when the first action has subsided, followed by 10 c.c. of water, the mixture is heated to boiling for ½-hour, the manganese dioxide is removed by addition of hydrogen peroxide, and after again boiling, permanganate solution is added until a faint pink tinge is obtained. When cold, 2·5 grms. of potassium iodide is added, and after 1 hour the liberated iodine is titrated with thiosulphate.—G. F. M.

Saccharin; Determination of ——. O. Beyer. Chem.-Zeit., 1919, 43, 537—538.

Investigation of methods which have been proposed for the determination of saccharin showed that two only are trustworthy, namely, that depending on hydrolysis of the substance with 20% sulphuric acid and the method described by Richmond and Hill (this J., 1918, 216 T). When the m. pt. of a sample of saccharin falls below 220° C. the amount of *p*-sulphonaminobenzoic acid present should be determined by heating 1 grm. of the sample for two hours under a reflux condenser with 10 c.c. of hydrochloric acid (sp. gr. 1·124) and 10 c.c. of water; the clear solution (filtered if necessary) is then evaporated to dryness, the residue dissolved in 10 c.c. of hot water, and the solution kept at 10° C., or less, for at least 12 hours; the crystals are then collected, dried, and weighed.
—W. P. S.

Salicylates. VI. Destruction of the salicyl group under biological conditions. P. J. Hanzlik and N. C. Wetzel. J. Pharm. Exp. Ther., 1919, 14, 25—42.

Solutions of sodium salicylate deteriorate on standing. This is due to the destructive action of organisms, and may be prevented by the addition of chloroform. The animal organism possesses the power of breaking down the salicyl group.
—J. C. D.

Ionones and irone; Relations between the ——. L. Ruzicka. Helv. Chim. Acta, 1919, 2, 352—363.

The reduction of irone by hydrogen in presence of colloidal palladium or platinum black yields tetrahydroirone, the presence of two double linkings in the irone molecule being thus definitely proved. The non-identity of tetrahydroionone and tetrahydroirone is due to cis-trans-isomerism, the two side-chains, CH_3 and $CH{:}CH{\cdot}COCH_3$, probably occupying cis-positions at the asymmetric carbon atom in the case of the ionones and trans-positions in that of irone. (See also J. Chem. Soc., 1919, i., 540.)—T. H. P.

Pine needle oil; The constitution of Swedish ——. T. Ekecrantz. Medd. Kgl. Vetenskaps akad. Nobelinst., 1919, 5, 1—8. Chem. Zentr., 1919, 90, III., 380.

One kilo. of the oil pressed out of the needles of *Pinus silvestris L.* was saponified by boiling for one hour with twice its volume of *N*/2 alcoholic potash. Acetic acid was the only acid detected by isolation of the silver salt. The mixture of terpenes and terpene alcohols produced by saponification was fractionated; the fraction 200°—212° C. on purification yielded an alcohol of m. pt. 203° C., identified as *l*-borneol. No other terpene alcohol could be isolated from the fractions 190°—200° C. and 212°—225° C. Thus the ester present in the oil is *l*-bornyl acetate which is also present in the oil from *Abies pectinata* D.C.—L. A. C.

Carbamides; Constitution of ——. *IX. Interaction of nitrous acid and mono-substituted ureas. Preparation of diazomethane, diazoethane, diazo-n-butane and diazoisopentane from the respective nitrosoureas.* E. A. Werner. Chem. Soc. Trans., 1919, 115, 1093—1102.

The interaction of mono-substituted ureas and nitrous acid takes place in two directions, with formation of a nitroso derivative and with complete disruption of the molecule respectively. This is explained on the assumption that two forms are present in solution, the carbamide form being decomposed according to the equation

$$NH_2{\cdot}CO{\cdot}NHR+HNO_2=N_2+CO_2+NH_2R+H_2O,$$

whilst the other form gives rise to the nitroso derivative, thus—

$$NH{:}C(OH){\cdot}NHR+HO{\cdot}NO=NH{:}C(OH){\cdot}N(NO)R+H_2O.$$

The proportion in which the two structural forms are present is determined by the character of the substituting group R. Thus methylurea gives a 90% yield of nitroso derivative and must be mainly present in the second form, whilst ethyl-*n*-butyl- and iso-amyl-urea give respectively 76%, 67%, and 48% of nitrosourea. In the case of benzyl- and phenyl-urea, where it is necessary to use a large proportion of pure acetic acid to get the urea into solution, the yields are 42% and 33%. The aliphatic nitrosoureas are decomposed by alkalis with production of diazo-derivatives of the paraffins according to the equation

$$NH{:}C(OH){\cdot}N(NO)CH_3+NaOH=NaOCN+CH_2N_2+2H_2O.$$

Although the water produced in the reaction tends to decompose the diazo-compound, the yields are very good, 80% in the case of diazomethane. It is the usual practice to employ this substance in ethereal solution, but it is now shown that alcoholic solutions of diazomethane and its homologues can conveniently be prepared.—E. H. R.

Butylamine and n-dibutylamine; Preparation of ——. *Separation of aliphatic amines by partial neutralisation.* E. A. Werner. Chem. Soc. Trans., 1919, 115, 1010—1014.

A mixture of butylamines is conveniently obtained by the gradual addition of butyl bromide (over a period of 15 days) to alcoholic ammonia. A small quantity of ammonium bromide separates on concentrating the liquor, and the amines may be isolated from the residual syrup by fractional precipitation with three portions of sodium hydroxide. Contrary to prevailing views on the relative basicity of aliphatic amines the tertiary amine is precipitated in preponderating amount by the first addition of alkali and the primary amine by the final addition. The amines obtained are further purified by distillation and the inseparable fractions undergo an almost perfect separation by treating them with hydrochloric acid in calculated quantity sufficient to combine with only the simpler of the two amines present in the mixture. A similar separation of di- and tri-ethylamine can be effected by partial neutralisation with hydrochloric acid.—G. F. M.

Hydroxylamine; Volumetric determination of ——. W. C. Bray, M. E. Simpson, and A. A. MacKenzie. J. Amer. Chem. Soc., 1919, 41, 1363—1378.

The oxidation of hydroxylamine to nitrous oxide by iodine in a solution kept neutral by means of sodium monohydrogen phosphate is unsatisfactory. Methods depending on the reduction of hydroxylamine to an ammonium salt by an excess of an acid solution of a titanous salt and on the oxidation of hydroxylamine to nitrous oxide by an excess of

ferric sulphate in sulphuric acid solution with titration of the ferrous salt produced by potassium permanganate gave accurate results. In addition to the known positive error in the ferric salt method, which is due to the addition of permanganate while some hydroxylamine or an intermediate product, nitroxyl, is still present, a negative error due to air oxidation was found under certain conditions. Both errors are easily avoided, the latter by adding the hydroxylamine slowly to a boiling solution of ferric sulphate. Hydroxylamine is oxidised mainly to nitrate by an excess of hypochlorous acid. Sodium thiosulphate in a solution of disodium phosphate can be quantitatively oxidised to sulphate by iodine; the reaction is rapid at 70° C.—J. F. S.

Dimethyl sulphate; Action of metallic hydroxides and oxides and alkaline-earth carbonates on ——. J. Guyot and L. J. Simon. Comptes rend., 1919, **169**, 531—537.

In methyl alcoholic solution dimethyl sulphate reacts with potassium hydroxide to give an almost quantitative yield of potassium methyl sulphate. A similar reaction occurs with calcium or barium hydroxide in the presence of a large excess of water. In the absence of water the two latter hydroxides decompose dimethyl sulphate according to the equation

$$(CH_3)_2SO_4 + M(OH)_2 = MSO_4 + (CH_3)_2O + H_2O.$$

With cuprous, lead, mercuric, or silver oxide the reaction is of the type

$$(CH_3)_2SO_4 + Cu_2O = Cu_2SO_4 + (CH_3)_2O.$$

Although dimethyl sulphate may be distilled unchanged from a small amount of calcium or barium carbonate, if maintained at 140° C. in the presence of either of these carbonates a reaction of the type

$$(CH_3)_2SO_4 + MCO_3 = MSO_4 + CO_2 + (CH_3)_2O$$

slowly takes place.—W. G.

Acetone and methyl ethyl ketone; Vapour pressures and densities of mixtures of ——. T. W. Price. Chem. Soc. Trans., 1919, **115**, 1116—1126.

The vapour pressures and densities of acetone, methyl ethyl ketone, and mixtures of the two have been determined at temperatures ranging from 20° to 55° C. The vapour pressure-concentration curves all lie between the vapour pressures of the components, there being no sign of a maximum at any point. These curves approximate to straight lines, the agreement being better the higher the temperature. No alteration in volume occurs when acetone and methyl ethyl ketone are mixed in any proportions from 20° to 50° C. The vapour pressure of acetone was found to be 186·3 mm. at 20°, 232·0 mm. at 25°, 284·6 mm. at 30°, 348·1 mm. at 35°, 425·3 mm. at 40°, 510·8 mm. at 45°, and 620·9 mm. at 50° C., and that of methyl ethyl ketone: 77·5 mm. at 20°, 98·4 mm. at 25°, 121·4 mm. at 30°, 151·0 mm. at 35°, 188·4 mm. at 40°, 252·9 mm. at 46·5°, and 300·0 mm. at 50° C. The sp. gr. of acetone is 0·79082 at 20°/4° C. and 0·75599 at 50°/4° C., and that of methyl ethyl ketone 0·80495 at 20°/4° C. and 0·77315 at 50°/4° C.
—W. P.

Residual acid from the manufacture of ether; Analysis of ——. E. C. Carron. Ann. Chim. Analyt., 1919, **1**, 282—288.

The residual acid consists chiefly of sulphuric acid, ethyl hydrogen sulphate, alcohol, small quantities of ether, and water. To determine free sulphuric acid 5 c.c. of the sample is diluted to 100 c.c. (the temperature must not exceed 15° C.), and 5 c.c. of this solution is introduced into a centrifuge tube containing 15 c.c. of 6% barium hydroxide solution; the mixture is centrifuged, the clear liquid decanted, the sediment treated with 10 c.c. of dilute hydrochloric acid, again centrifuged, washed, ignited, and weighed as barium sulphate. Another portion of the sample (500 c.c.) is distilled through a fractionating column; the distillate is collected in a receiver cooled to −15° C., and the distillation is stopped when the b. pt. reaches 100° C. The proportion of alcohol, ether, and water in the distillate is then determined by adding water until a turbidity is produced; the quantity of water added is noted, and after adding a further known quantity of water, the mixture is allowed to separate into two layers, and the volume of the lower layer noted; the actual quantities of alcohol, ether, and water are then found from a graph. A portion of the residual liquid in the distillation flask is titrated and the result expressed as sulphuric acid; the difference between this result and the free sulphuric acid gives the amount of sulphuric acid present as ethyl hydrogen sulphate. The ether may also be estimated colorimetrically by heating 25 c.c. of the sample at 35° C. and aspirating a current of air through it; the air and ether vapour are then passed through a U-tube cooled in an ice-bath and containing 8 c.c. of a mixture of potassium bichromate 1·2 grms., water 20 c.c., and nitric acid (36° B., sp. gr. 1·33) 180 c.c. The coloration obtained is compared with those produced by known quantities of ether under similar conditions; with sulphuric acid containing up to 20% of alcohol there is no change in the colour of the reagent, even after 2 hours, but when ether is present the colour varies from reddish-brown to bluish-green.—W. P. S.

Iodination of phenols. Cofman. *See* III.

Acids produced in steaming wood. Franck. *See* V.

Patents.

Acetaldehyde; Manufacture of ——. Deutsche Gold und Silber Scheideanstalt, vorm. Roessler, Frankfurt. Eng. Pats. (A) 107,584, 13.6.17. (Appl. 8486/17.) Int. Conv., 16.6.16. (B) 107,585, 14.6.17. (Appl. 8565/17.) Int. Conv., 17.6.16.

(A) The hydration of acetylene is effected by steam in the presence of metallic oxides at a high temperature, the material employed having been freed from phosphorus compounds. A mixture of 400 vols. of steam and 15 vols. of acetylene is passed through a pipe heated to about 600° C. and containing a layer, 35 cm. long, of a contact mass produced by mixing 65 parts of asbestos with 35 of molybdic acid, both finely powdered, the velocity of the gases being about 1 litre per min. per sq. cm. of cross section. If the acetylene and the catalytic material be carefully purified from phosphorus compounds, the yield of acetaldehyde will amount to about 17%. (B) The efficiency of the catalyst decreases with repeated use; the activity may be restored by passing a current of air over the catalyst at the temperature of the reaction for 1½—2 hours.—J. F. B.

Acetaldehyde; Process of manufacturing ——. H. W. Matheson, Shawinigan Falls, Canada. Eng. Pat. 132,557, 18.6.18. (Appl. 10,070/18.)

The reaction is carried out in a vessel preferably constructed of iron with a high silicon content and provided with a stirring device. The vessel is charged with 1000 galls. of 6% sulphuric acid to which is added 25 lb. of neutralised or slightly acidulated mercuric oxide. Acetylene gas in large excess is passed through the liquid at the rate of about 60 cub. ft. per min. The major portion of the heat of reaction is removed by external cooling, but the temperature is preferably maintained between 60° and 65° C., water being admitted to replace the quantity combined. The outflow of

excess of acetylene is unrestricted except for the back pressure of the scrubber, so that the pressure does not exceed 2 lb. per sq. in. The mixed gases of the reaction pass through a cold-water condenser, a brine condenser at −10° to −15° C., and lastly through a cold-water scrubber. The uncondensed gas is returned by a blower to the reaction vessel, and any fluctuation in the quantity is compensated by arranging a gasometer in parallel with the blower. Owing to the moderate temperature and dilute acid solution in the reaction vessel, the decomposition of the catalyst is not rapid and the mercury formed collects for the most part in the metallic state at the bottom of the vessel. Mercuric oxide is added from time to time to make up the loss. After a time, other compounds of mercury with organic sulphur and phosphorus compounds accumulate, and it is necessary to clean out the reaction vessel and recover the mercury from the sludge. The condensed aldehyde and scrubber water is refined by distillation, and the uncondensed gases are passed through a scrubber to the acetylene storage vessel.—J. F. B.

Acetaldehyde and acetic acid; Method of preparation of —. G. O. Curme, jun., Pittsburgh, Pa., Assignor to Union Carbide Co., New York. U.S. Pats. (A) 1,315,543 and (B) 1,315,546, 9.9.19. Appl., (A) 3.6.16. Renewed, 12.12.17; (B) 5.6.16. Renewed, 28.3.18.

(A) Ethylene is passed into a solution of a mercury salt, and the compound thus formed is subjected to anodic oxidation in aqueous solution, the acetaldehyde being removed by continuous distillation. (B) Acetic acid is produced by prolonged anodic oxidation of the same compound.—J. F. B.

Acetic acid; Manufacture of —. H. W. Matheson, Shawinigan Falls, Canada. Eng. Pat 132,558, 18.6.18. (Appl. 10,071/18.)

A closed vessel with suitable resistant lining, *e.g.* of aluminium, is provided with a series of coils through which water or steam may be passed. An air pipe is provided extending to the bottom of the vessel, where it is arranged in spiral form with a multitude of small openings, so that the air is finely distributed over the whole area of the vessel. The vessel is charged with 1000 galls. of acetaldehyde and about 0·5% of manganese acetate or other catalyst. Steam or warm water is passed through the coils to raise the temperature to 20°—25° C., and air is admitted at a rate of up to 300 cub. ft. per min. The oxidation takes place with evolution of heat, which is controlled by passing cold water through the coils. The temperature is always maintained not much below the boiling point of the aldehyde under the pressure used, and after the reaction commences the pressure is allowed to rise slowly to about 75 lb. per sq. in. and the temperature to 65° C. Under these conditions the absorption of the oxygen is complete and the nitrogen is allowed to escape through a relief valve after passing through a cold-water condenser at 1° 5° C., and a brine condenser at −10° to −15° C., which are under the same pressure as the reaction vessel. The condensed liquid returns to the reaction vessel through U seals, and the escaping nitrogen is passed through a scrubber supplied with water at 0° C. and maintained at a pressure of 20 lb. per sq. in. The reaction is complete in 8—18 hours, after which the contents of the vessel are discharged and the acetic acid is purified by distillation.—J. F. B.

Acid anhydrides and acid chlorides; Preparation of organic —. T. H. Durrans, Oxford, and A. Boake, Roberts, and Co., Ltd., London. Eng. Pat. 131,379, 3.6.18. (Appl. 9119/18.) Addition to Eng. Pat. 128,282 (this J., 1919, 657 A).

Organic acid anhydrides and/or chlorides, other than acetic anhydride or chloride, are produced by the action of chlorine on a mixture of phosphorus, preferably red phosphorus, and the alkali or alkaline-earth salts of the acid, in proportions represented by any one of the equations:—

$$3R.CO_2Na+P+3Cl=3R.CO.Cl+Na_3PO_3;$$

$$4R.CO_2Na+P+5Cl=4R.CO.Cl+Na_3PO_4+NaCl;$$

$$6R.CO_2Na+P+3Cl=3(R.CO)_2O+Na_3PO_3+3NaCl;$$

$$8R.CO_2Na+P+5Cl=4(R.CO)_2O+Na_3PO_4+5NaCl.$$

The temperature should be maintained below 50° C., and the product is isolated by distillation or extraction with a suitable solvent.—G. F. M.

Acetic anhydride and acetaldehyde; Production of —. Soc. Chim. des Usines du Rhône, Paris. Eng. Pat. 131,399, 24.6.18. (Appl. 10,395/18.) Int. Conv., 22.6.17.

Ethylidene diacetate is quantitatively decomposed into acetic anhydride and acetaldehyde by heating at 125°—135° C. under atmospheric pressure with suitable catalysts (acids and acid salts), such as sodium pyrophosphate, sodium dihydrogen orthophosphate, metaboric acid, or sulphoacetic acid. The acetaldehyde distils over as it is formed, and its elimination from the residual anhydride may be facilitated by the employment of a current of dry air. An inert diluent may be added to the ethylidene diacetate to moderate the action of the catalyst, and if the latter is insoluble in both the diacetate and the anhydride it is advantageous to use it in solution in a neutral substance (hydrocarbon or ketone) boiling above 140° C.—G. F. M.

Glycols; Production of —. C. Weizmann, London, and E. G. Bainbridge, Ashton-under-Lyne. Eng. Pat. 131,628, 3.6.18. (Appl. 9131/18.)

Dichloroparaffins, not having their chlorine atoms attached to the same carbon atom, suspended in water and heated with aluminium hydroxide, lead carbonate, calcium carbonate, borax, or sodium bicarbonate in an autoclave at 100°—200° C., are partially converted into the corresponding glycols. Thus, on heating a mixture of 1.3- and 1.2-dichlorobutanes and calcium carbonate for 7 hours at 170°—180° C., a yield of about 33% of glycols, together with unsaturated alcohols and unchanged dichlorides, is obtained, whilst the same dichlorides and bicarbonate heated for 72 hours at 150° give 66% of the theoretical yield of glycols.—G. F. M.

Monochloroacetic acid; Continuous process for the preparation of — *from trichloroethylene.* Comp. des Prod. Chim. d'Alais et de la Camargue, Paris. Eng. Pat. 132,042, 6.9.18. (Appl. 14,513/18.) Int. Conv., 4.5.18.

Monochloroacetic acid is produced in a continuous process by the action of 90% sulphuric acid at 160°—190° C. on trichloroethylene (compare Eng. Pat. 129,301; this J., 1919, 658 A), the concentration of the acid being maintained by the continuous addition of water, and the chloroacetic acid being eliminated from the reaction mixture by causing an excess of trichloroethylene vapour to bubble through it. The hydrogen chloride formed in the reaction is freed from chloroacetic acid by spraying with trichloroethylene in a wash tower, and finally from trichloroethylene by washing with water in a second tower. The chloroacetic acid, passing over from the reaction vessel with an excess of trichloroethylene, is condensed and led into two separating boilers in series, where the trichloroethylene is volatilised, and the residual product runs off continuously into a receiver.—G. F. M.

Aspirin (acetylsalicylic acid) tablets. J. A. Pickard, J. G. Rankin, and Pickard, Ive, and Rankin, Ltd., London. Eng. Pat. 132,294, 12.6.18. (Appl. 9684/18.)

ASPIRIN tablets free from salicylic acid, or any tablets containing materials liable to deterioration by the action of water, alcohol, or other hydrolysing solvent, may be prepared by granulating with a binding agent, such as colophony or gum dammar dissolved in a non-hydrolysing solvent, such as benzene. The granules are then dried and compressed into tablets with the addition of starch in the usual way.—G. F. M.

Benzoic acid; Manufacture of ——. F. P. Leach, and The United Alkali Co., Ltd., Liverpool. Eng. Pat. 132,433, 6.2.19. (Appl. 2943/19.)

BENZOIC acid is produced by passing chlorine into a mixture of benzyl chloride and an alkali hydroxide or carbonate solution, the temperature being maintained at 80°—90° C., and the reaction mixture acidified when oxidation is complete. For example, 253 parts of chlorinated toluene, consisting mainly of benzyl chloride, is mixed with 552 parts of sodium hydroxide and 5000 parts of water. Chlorine is then admitted whilst the mixture is continually agitated, until conversion into sodium benzoate is complete. G. F. M.

N-Monoalkyl derivatives of certain aromatic compounds; Manufacture of ——. A. Lapworth, and Levinstein, Ltd., Manchester. Eng. Pat. 132,555, 13.6.18. (Appl. 9710/18.)

N-MONOALKYLARYLAMINES are prepared from the benzylidene derivatives of *p*-substituted monoamines and their derivatives substituted in the nucleus by indifferent groups, or such other monoammes of the benzene and naphthalene series, substituted in the nucleus by indifferent groups which do not, either as amines or as N-alkylamines, react in the presence of acids with benzaldehyde in such a manner as to produce amino derivatives of triarylmethanes. These benzylidene compounds are treated, in the absence of alkali, with alkyl sulphates or alkyl esters of benzenesulphonic acid; the products thus obtained are hydrolysed, and the N-monoalkylarylamine is separated from the mixture.—J. F. B.

Trichloroethylene; Preparation of —— from tetrachloroethane. Comp. des Prod. Chim. d'Alais et de la Camargue, Paris. Eng. Pat. 132,755, 14.5.19. (Appl. 12,120/19.) Int. Conv., 28.1.19.

TETRACHLOROETHANE is treated with ammonia in the presence of water. A mixture containing equal parts of tetrachloroethane and water is treated in a boiler, provided with a reflux condenser, with a current of ammonia gas sufficiently violent to agitate the mass; the reaction is accelerated by heating to 60°—70° C., and the trichloroethylene is removed as fast as it is formed by passing the ammonia gas in excess and regulating the temperature in the reflux condenser. The reaction may also be conducted in an autoclave by heating a mixture of 2 parts of tetrachloroethane with 2 parts of aqueous ammonia, sp. gr. 0·91, for 3 hours at 140°—170° C.—J. F. B.

Tetrachloroethane; Preparation of symmetrical ——. Comp. des Prod. Chim. d'Alais et de la Camargue, Paris. Eng. Pat. 132,757, 21.5.19. (Appl. 12,787/19.) Int. Conv., 12.3.19.

CHLORINE and acetylene gases, not previously mixed, are passed simultaneously over a contact mass composed of iron turnings and a pulverised inert material, such as quartz, the contact mass being continuously sprinkled with a proportionate quantity of the tetrachloroethane produced in the reaction.—J. F. B.

Arsenical medical product and process of producing same. J. M. White, Meridian, Mass. U.S. Pat. 1,297,952, 18.3.19. Appl., 4.5.18.

A SUBSTANCE with powerful antisyphylitic properties, and stated to have the composition

$$(CH_3)_4C_4H_3.AsHNa,$$

is obtained by the interaction of sodium benzoate (1 part) and sodium cacodylate (2 parts) in water (40 parts), precipitating the sodium bicarbonate formed by addition of lime water, filtering, and evaporating. The product, m.pt. about 121° C., is readily soluble in water, alcohol, and other solvents; its neutral and alkaline solutions are stable.

Hygroscopic composition [glycerin substitute]. K. P. McElroy, Washington, D.C., Assignor to Chemical Development Co. U.S. Pat. 1,268,135, 4.6.18. Appl., 19.7.17.

A SOLUTION of ethyleneglycol, or a mixture of glycols prepared from petroleum gas, has hygroscopic properties, and may be used instead of glycerin. To prevent complete evaporation of the solution a non-volatile, water-soluble substance may be added, such as lactose or other carbohydrate, or zinc chloride or other salt.—J. H. J.

Chlorhydrins; Production of —— from olefines. K. P. McElroy, Washington, D.C., Assignor to Chemical Development Co. U.S. Pat. 1,315,229, 9.9.19. Appl., 5.7.16.

DERIVATIVES of the olefines containing chlorine are prepared by the interaction of a reducible chloride and an olefine.—G. F. M.

Acetone; Process of making ——. H. A. Morton, Pittsburgh, Pa., Assignor to Union Carbide Co., New York. U.S. Pat. 1,315,525, 9.9.19. Appl., 12.6.18.

ACETONE is prepared by subjecting acetic acid vapours at an elevated temperature to the action of a catalyst containing manganese.—G. F. M.

Acetone from acetic acid; Process of preparing ——. G. O. Curme, jun., Pittsburgh, Pa., Assignor to Union Carbide Co., New York. U.S. Pat. 1,315,544, 9.9.19. Appl., 16.6.16. Renewed 12.12.17.

ACETIC acid vapour, mixed with the vapours of other liquids, is passed over heated iron in a finely comminuted condition.—J. F. B.

Acetylene; Electrochemical method and apparatus for producing synthetic —— from organic liquid G. O. Curme, jun., Pittsburgh, Pa., Assignor to Union Carbide Co., New York. U.S. Pat. 1,315,540, 9.9.19. Appl., 20.7.15. Renewed 10.7.17.

A HIGH-FREQUENCY alternating-current electric arc discharge, under control, is introduced within the body of an organic liquid.—J. F. B.

Ethylene; Method of preparation of pure ——. G. O. Curme, jun., Pittsburgh, Pa., Assignor to Union Carbide Co., New York. U.S. Pat. 1,315,541, 9.9.19. Appl., 3.6.16. Renewed 2.10.17.

ETHYLENE is separated from a gaseous mixture by passing it through a solution of a mercury salt, drawing off the gases not combining with the mercury salt, and heating the solution to a temperature sufficient to decompose the compound and liberate the ethylene.—J. F. B.

Ethylene dichloride from ethylene; Process of preparing ——. G. O. Curme, jun., Pittsburgh, Pa., Assignor to Union Carbide Co., New York. U.S. Pats. (A) 1,315,542 and (B) 1,315,545, 9.9.19. Appl., (A) 3.6.16. Renewed 12.12.17; (B) 2.10.16. Renewed 12.12.17.

(A) ETHYLENE is caused to react with chlorine in

liquid phase. (b) Ethylene and chlorine are combined both in liquid condition.—J. F. B.

Propylene dichloride; Process of making ——. G. O. Curme, jun., Pittsburgh, Pa., Assignor to Union Carbide Co., New York. U.S. Pat. 1,315,547, 9.9.19. Appl., 10.2.19.

Chlorination products of propylene are formed by the action of propylene on chlorine in liquid phase. —J. F. B.

N-Monoarylsulpho-monoalkylamino-oxyaryl compounds convertible into monalkylamino-oxyaryl compounds and process of making same. E. Reber and J. Seigwart, Assignors to Soc. Chem. Ind. in Basle, Switzerland. U.S. Pat. 1,316,804, 23.9.19. Appl., 17.8.19.

Esters of the general formula $R.NHR_1(OR_2)$ are treated with alkylating agents to form esters of the general formula $R.NR_1R_3(OR_2)$, R being an aryl radical, R_1 an arylsulpho radical, R_2 an acidyl radical, and R_3 an alkyl radical. These compounds are converted by saponification into monoalkylamino oxyaryl compounds.—J. F. B.

Anti-bodies; Separation of —— from the blood of immunised animals. S. Bücher, Vienna. Ger. Pat. 312,628, 11.4.17. Int. Conv., 7.4.16.

A better yield, *i.e.*, up to 90%, of the anti-bodies contained in the blood is obtained by separating the material in the form of blood-plasma instead of in the form of serum. Coagulation is prevented by the addition of chemical products which act on the calcium salts in the blood and which have no injurious effect upon the product. The residue of blood corpuscles obtained after separation of the greater portion of the plasma may be extracted with physiological salt solution or other indifferent media; a further amount of the product is thus separated in dilute solution.—L. A. C.

Alcohols; Process for the preparation of primary ——. J. Altwegg, St. Fons, Assignor to Soc. Chim. Usines du Rhône, anc. Gilliard, P. Monnet, et Cartier, Paris, France. U.S. Pat. 1,315,619, 9.9.19. Appl., 11.2.19.

See Eng. Pat. 122,630 of 1919; this J., 1919, 739 A.

CC-Dialkylbarbituric acids; Process for manufacture of easily-soluble compounds of ——. H. Kubli, Basle, Switzerland, Assignor to the Hoffmann-La Roche Chemical Works, New York. U.S. Pat. 1,316,047, 16.9.19. Appl., 31.7.18.

See Eng. Pat. 122,778 of 1918; this J., 1919, 233 A.

Mercury. Eng. Pats. 132,559 and 132,560. *See* VII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Light-filters; Preparation of ——. G. Potapenko. Z. Wiss. Phot., 1919, **18**, 238—239. Chem. Zentr., 1919, **90**, III., 307.

The most suitable form of light-filter for Uviol lamps appears to be stained gelatin film. The usual method of preparing these, *viz.*, by coating glass with gelatin solution containing the dye, drying, and stripping, is described.—B. V. S.

Photochemical reactions. Benrath. *See* VII.

Patents.

X-Ray or Röntgen plates, films, or papers; Method used and material employed in the manufacture of ——. A. Mutscheller, New York. U.S. Pat. 1,315,324, 9.9.19. Appl., 23.8.15.

To an emulsion is added a soluble transparent substance, which is without harmful action on the emulsion, and which on exposure to X-rays produces a chemically active fluorescence.—B. V. S.

Colour photography. J. G. Capstaff, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pat. 1,315,464, 9.9.19. Appl., 14.2.18.

A gelatin film carrying a photographic image is prepared for staining by treatment with a bleaching solution, which also softens the films in direct proportion to the strength of the silver image. —B. V. S.

Moving-picture films; Process of producing coloured ——. M. Handschiegl, Los Angeles, Cal. U.S. Pat. 1,316,791, 23.9.19. Appl., 9.4.18.

A positive film is coloured by being pressed up in a softened condition with its negative which has been previously stained with a suitable dye solution.—B. V. S.

Colour photography. D. F. Comstock, Brookline, Mass., and Technicolor Motion Picture Corporation, Boston, Mass., U.S.A. Eng. Pat. 132,580, 15.8.18. (Appl. 13.271/18.)

See U.S. Pat. 1,283,087 of 1918; this J., 1919, 234 A.

XXII.—EXPLOSIVES; MATCHES.

Explosives of the nitro-compound class; Investigations into the development of inertness in ——. E. A. Mann and T. N. Kirton. Report to Government of Western Australia, 1918. 34 pages.

Numerous complaints from mines in regard to inefficiency, development of noxious gases after detonation, and the presence in boreholes of unexploded portions of explosive led the authors to investigate the causes of inertness. The power or "brisance" of an explosive being proportional to its velocity of detonation, determinations of the latter were made by d'Autriche's method. Other investigations concerned the oxygen balance of the explosive, its moisture content, heat test, and mode of incorporation; and data of actual working tests in mines were collected. Extraordinary examples of insensitiveness were found with various shipments of explosive. Usually inertness was accompanied by a greatly diminished velocity of detonation, increased specific gravity, and sometimes a reduced heat-test. In certain tests by the d'Autriche method, in which a detonating fuse composed of a small lead tube completely filled by a core of trinitrotoluene is used, the explosive was too inert to communicate detonation from the initial detonator to the adjacent one fixed to the T.N.T. fuse. Check tests were made by this same method with unconfined explosive and with explosive placed in a borehole, and the results showed close agreement. The authors find that sodium nitrate gelignite tends to develop inertness sooner than gelignite made with potassium nitrate, but shortage of this latter material during the war prevented extensive tests being made. Investigations as to the cause of insensitiveness have not been completed, but preliminary experiments point to the nitrocotton as the controlling factor. It has been found that exposure to a temperature of 100° F. (38° C.), which is easily reached in practice, will reduce the viscosity of the nitrocotton considerably, and it is assumed that the complex molecule splits up under the influence of raised temperatures in course of time. Photographs of cartridges showing evidence of inertness are given. —W. J. W.

Gaseous explosions. David. *See* IIA.

Chromium azide. Oliveri-Mandalà. *See* VII.

PATENTS.

Explosives; Fireproof buildings for storing ——. F. Thomas, Dortmund. Ger. Pat. 303,983, 18.8.17.

THE walls of buildings used for storing explosives are made of ferro-concrete slabs, separated from each other, and having their bases sunk in the ground. In the event of an ignition occurring these walls will readily bulge outwards, the gases finding a ready exit between the slabs.—W. J. W.

Dinitrophenol. Eng. Pat. 131,403. *See* III.

Nitro-compounds. Eng. Pat. 131,982. *See* III.

Fertilising-explosive. U.S. Pat. 1,316,396. *See* XVI.

XXIII.—ANALYSIS.

Kjeldahl-Gunning method [of determining nitrogen]; Use of sodium sulphate in the ——. C. T. Dowell and W. G. Friedeman. J. Ind. Eng. Chem., 1918, **10**, 599.

SODIUM sulphate, either anhydrous or crystallised, may be used in place of potassium sulphate in the Kjeldahl-Gunning method; the same time is required for the acid digestion, and the same results are obtained whether 1 grms. of anhydrous sodium sulphate, 9·2 grms. of crystallised sodium sulphate, or 5 grms. of potassium sulphate is used. Further, 5 grms. of potassium sulphate is as effective as 10 grms.—W. P. S.

Gases. Hofsäss. *See* IIA.

Vaseline. Armanni and Rodano. *See* IIA.

Purity of toluene. Orton and Jones. *See* III.

Sulphochlorides. Neitzel. *See* III.

Iodides. Godfrin. *See* VII.

Sulphurous acid and sulphites. Kolthoff. *See* VII.

Cyanides, cyanates, and bromates. Velardi. *See* VII.

Chromium. Schorlemmer. *See* VII.

Bituminous road material. Lord. *See* IX.

Iron in iron ores. Schwarz. *See* X.

Platinum ores. Dupare. *See* X.

Zinc. Rothschild. *See* X.

Bearing metal, etc. Oesterheld and Honegger. *See* X.

Iron in battery acid. Nyman. *See* XI.

Sulphonated oils. Bumcke. *See* XII.

Rosin-pitch mixtures. Wogrinz and Vàri. *See* XIII.

Sulphite-cellulose and synthetic tans. Kernahan. *See* XV.

Leather stuffing oils. Veitch and Hunt. *See* XV.

Water-soluble matter in leather. Frey and Clarke. *See* XV.

Mechanical analysis of soils. Nolte. *See* XVI.

Dicyanodiamide in calcium cyanamide. Von Dafert and Miklauz. *See* XVI.

Phosphoric acid. Neubauer and Wolferts. *See* XVI.

Ammonia-nitrogen in fertilisers. Schouten and Tuinzing. *See* XVI.

Sugars in wines. Mathieu. *See* XVIII.

Milk preserved with bichromate. Marchadier and Goujon. *See* XIXA.

Glue in feeding stuffs etc. Wagner and Schöler. *See* XIXA.

Sulphur in foods. Krieble and Mangum. *See* XIXA.

Kjeldahl method and brucine salts. Jones. *See* XX.

Arsenic in organic compounds. Farghor. *See* XX.

Saccharin. Beyer. *See* XX.

Hydrocyclamine. Bray and others. *See* XX.

Residual acid from manufacture of ether. Carron. *See* XX.

PATENTS.

Thermo-electric couple. W. H. Bristol, Assignor to The Bristol Co., Waterbury, Conn. U.S. Pat. 1,315,205, 9.9.19. Appl., 14.8.18.

THE primary portion of a compound thermo-couple consists of a nickel-chromium alloy (10% Cr) wire and a nickel wire containing a small proportion (2 %) of aluminium. The nickel-chromium wire is extended by joining it to a copper wire containing less than 1 % Ni, and the nickel-aluminium wire is welded to a copper-nickel (40 % Ni) alloy wire.—C. A. K.

Gas-analysing apparatus; Means for fixing the zero-line of ——. O. Rohde, Assignor to Svenska Aktiebolaget Mono, Stockholm. U.S. Pat. 1,316,923, 23.9.19. Appl., 31.10.18.

SEE Eng. Pat. 120,921 of 1918; this J., 1919, 270A.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Bollmann. Removal of volatile solvents from material treated therewith. 25,729. Oct 21.

Brooke. Means for distributing, spraying, or circulating liquids. 26,241. Oct. 25.

De Haën Chem. Fabr. List. Method of making filters. 26,045. Oct. 23. (Ger., 4.12.17.)

Denoël. Decantation apparatus. 25,206. Oct. 14.

Fleury and Robertson. Drying apparatus. 25,673. Oct. 20.

Gaillet. Combination of pyramidal surfaces for purification of liquids, vapours, and gases. 25,486. Oct. 17. (Fr., 18.10.18.)

Grotzinger and Melamid. Manufacture of water-soluble and water-emulsiable substances. 25,932. Oct. 22. (Ger., 31.10.17.)

Hardingham (Redman). Furnaces. 25,153. Oct. 14.

Lafeuille. 25,378. *See* XVII.
Leigh. Crates or holders for carboys etc. 24,966. Oct. 13.
Macaulay and MacLellan. Furnaces. 25,961. Oct. 22.
Mackey. Apparatus for clarifying liquids containing finely divided matter in suspension. 25,721. Oct. 21.
McMullen and Rickets. Apparatus for extraction by solvents. 26,112. Oct. 24.
Martinez. Mechanical mixing-machines. 25,708. Oct. 20.
Moseley and Williams. Colloid or colloidal substance, and process of producing same. 25,355. Oct. 16.
Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Effecting crystallisation from solution. 25,018. Oct. 13. (Norway, 23.10.18.)
Stead. Evaporating processes. 25,169. Oct. 14.
Storr. Centrifugal fluid extractor. 25,837. Oct. 22.

COMPLETE SPECIFICATIONS ACCEPTED.

15,031 (1918). Gloess. Drying plant. (119,240.) Oct. 29.
16,528 (1918). Mauss. Centrifugal separation. (133,448.) Oct. 22.
16,757 (1918). Mumford. Decolorising and purifying agents. (133,759.) Oct. 29.
17,175 (1918). Sturtevant Mill Co. Pulverising mills. (123,715.) Oct. 29.
17,993 (1918). Proctor. Liquid-filtering devices. (133,497.) Oct. 22.
7467 (1919). Smidth & Co. Ball mills. (125,064.) Oct. 22.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Allgem. Ges. f. Chem. Ind. Continuous treatment of hydrocarbons with liquid sulphur dioxide. 25,317. Oct 15. (Ger., 27.4.15.)
Armstrong, Davidson, and Low Temperature Carbonisation, Ltd. Distillation of coal etc. 25,103. Oct. 14.
Armstrong, Davidson, and Low Temperature Carbonisation, Ltd. Retorts for distillation of carbonaceous substances. 25,104. Oct. 14.
Castelli and Corthesi. Generation of gas. 25,496. Oct. 17.
Coke and Gas Ovens, Ltd., and Kimbell. Regenerative coke-ovens. 26,026. Oct. 23.
Cross and Miller. 25,644. *See* XII.
Dunstan and Thole. Treatment of petroleum etc. 25,336. Oct. 15.
Gercke. Distilling bituminous coal, brown coal, and shale by superheated steam. 25,655. Oct. 20.
Gordon and Rowlson. Fuel blocks etc. 25,087. Oct. 14.
Lane and Williams. 25,116. *See* XII.
McDonald. Utilisation of reactive gases in internal-combustion engines. 25,972. Oct. 23.
Maclaurin. Manufacture of lubricating greases. 24,956. Oct. 13.
Siemens und Co. Electric-light carbons. 26,013. Oct. 23. (Ger., 5.8.16.)
Wallwin. Gas-producers. 25,092. Oct. 14.
Young. Apparatus for de-gasification of coal. 25,276. Oct. 15. (Ger., 1.11.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

8960 (1918). Strache. Apparatus for determining the heating value of gases. (116,707.) Oct. 29.
12,662 (1918). Heape and Grylls. Carbons for electric arc lamps. (133,376.) Oct. 22.
14,712 (1918). Jackson, and Woodall and Duckham. Manufacture of gas in vertical retorts. (133,730.) Oct. 29.
16,304 (1918). Palmer. Making combustible gases from carbonaceous material. (119,874.) Oct. 22.
16,398 (1918). Lopez. Liquid fuel for internal-combustion engines. (133,434.) Oct. 22.
16,542 (1918). Broxburn Oil Co., and Findlater. Utilising residues from bituminous shales, cannel coals, etc. (133,452.) Oct. 22.
21,540 (1918). Lea. Briquetting of peat. (133,847.) Oct. 29.
257 (1919). Yeadon and Whitaker. System of low-temperature carbonisation. (133,554.) Oct. 22.
13,949 (1919). Raworth (Combustion Rationelle Soc. Anon.). Combustion of pulverulent fuel. (133,921.) Oct. 29.

III.—TAR AND TAR PRODUCTS.

APPLICATION.

Allgem. Ges. f. Chem. Ind. 25,317. *See* II.

COMPLETE SPECIFICATIONS ACCEPTED.

16,291 (1918). Soc. d'Eclairage, Chauffage, et Force Motrice. Production of high-percentage carbazole. (121,455.) Oct. 22.
17,663 (1918). Barrett Co. Recovery of pyridine and similar organic bases. (122,397.) Oct. 29.
2951 (1919). Mitsui Kozan Kabushiki Kaisha. Process for decomposing paranitracetanilide to form paranitraniline. (126,944.) Oct. 29.
12,480 (1919). Barnett. Manufacture of nitronaphthalene. (133,918.) Oct. 29.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

Clifton and Ewart. Rotating colour mixing or blending devices. 25,877. Oct. 22.
Imray (Soc. Chem. Ind. in Basle). Manufacture of azo dyestuffs and intermediate products. 25,916. Oct. 22.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Claessen. Treating wood to obtain cellulose and artificial resin, asphalt, lac, etc. 25,502. Oct. 17.
Du Pont de Nemours and Co. Pyroxylin compositions. 25,494. Oct. 17. (U.S., 16.3.18.)
Fitzgerald. Manufacture of noninflammable compositions containing cellulose collodion, celluloid, etc. 25,140. Oct. 14.
Hallo. Manufacture of glazed paper etc. 25,593. Oct. 18.
Hawkins. Wool-washing etc. machinery. 25,787 and 25,788. Oct 21.
Silberrad. Manufacture of solutions of acetylcellulose. 26,158. Oct. 24.
Wilson. Drying apparatus for varnished or painted paper. 25,229. Oct. 15.

COMPLETE SPECIFICATIONS ACCEPTED.

7193 (1918). Dreyfus. Manufacture of compositions etc. having a basis of cellulose acetate. (133,353.) Oct. 22.
14,784 (1918). Marks (Cedaroid Co.). Paper or paper-board. (133,732.) Oct. 29.
8878 (1919). Dennis. Machine for spinning, washing, and drying viscose threads. (125,394.) Oct. 29.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Ashton. Printing on textiles. 26,236. Oct. 25.

Calico Printers' Assoc., and Costobadie. Production of novel effects on cloth. 25,437. Oct. 17.

Hunt. Apparatus for bleaching open fabrics. 26,227. Oct. 25.

Metcalf. Method of colouring fabrics etc. 26,121. Oct. 24.

Complete Specifications Accepted.

8517 (1918). Deuts. Gasglühlicht A.-G. Method of loading silk. (116,102.) Oct. 22.

16,473 (1918). Hawley, Crosland, and Dixon. Machines for mercerising hose and other knitted fabrics. (133,441.) Oct. 22.

9708 (1918). Gatty. Dyeing certain colours on vegetable fibres, yarns, and fabrics. (133,620.) Oct. 22.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Dreyfus. Manufacture of acetic acid. 25,479. Oct. 17.

Hedstrom. Production of compounds of radium. 25,688. Oct. 20.

Hodge. Sulphuric acid valves. 24,977. Oct. 13.

Hood. Purification of sulphur. 26,231. Oct. 25.

Low. 25,943. *See* XX.

Maconochie and Ros. Oxidation of zinc, tin, etc., and production of oxides of such metals. 25,405. Oct. 16.

Mage and Nouguier. Effecting synthesis of nitric acid. 26,135. Oct. 24. (Fr., 24.1.18.)

Salzwerk Heilbronn. Making sodium sulphate. 25,676. Oct. 20. (Ger., 24.1.18.)

Complete Specifications Accepted.

14,950 (1917). Wrigley, Spence, and Spence and Sons. Preparation of titanium compounds. (133,336.) Oct. 22.

7239 and 7240 (1918). Becket. Manufacture of calcium carbide. (133,351 and 133,355.) Oct. 22.

10,978 (1918). Wilson, and Purex, Ltd. *See* XIII.

16,376 (1918). Moritz. Synthetic production of hydrogen peroxide. (120,045). Oct. 22.

17,081 (1918). Dutt and Dutt. Manufacture of potassium fluoride from silicate rocks. (133,474.) Oct. 22.

VIII.—GLASS; CERAMICS.

Applications.

Carborundum Co. (Linbarger). Ceramic articles. 25,284. Oct. 15.

Clark, Hartley, and Richmond Gas Stove and Meter Co. Crucible etc. furnaces for melting and heat treatment of glass etc. 24,615. Oct. 18.

Lindley and Lindley. Mechanical glass washing machine for glass manufacturers. 24,987. Oct. 13.

Complete Specifications Accepted.

16,742 (1918). Pike. Manufacture of magnesite refractories. (133,753.) Oct. 29.

21,315 (1918). Sankey. Manufacture of fire-bricks, blocks, tiles, retorts, and other refractory articles and refractory cement. (133,842.) Oct. 29.

IX.—BUILDING MATERIALS.

Applications.

Burlin. 25,811. *See* XIII.

Burlin. Manufacture of plaster of Paris. 26,114. Oct. 24.

Elborne. Manufacture of non-porous waterproof and acid-resisting cement. 25,853. Oct. 22.

Complete Specifications Accepted.

16,619 (1918). Alexander. Manufacture bricks, building and paving blocks, etc. (133,745 Oct. 29.

16,847 (1918). Wade (Barrett Co.). Manufa ture of bituminous material. (133,466.) Oct. 22

21,315 (1918). Sankey. *See* VIII.

11,116 (1919). Convert-Villejean, Lecorche, Cie. Manufacture of wood substitutes. (126,623 Oct. 29.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Armstrong, Whitworth, and Co., and Mac Gucken. Copper alloys. 26,136. Oct. 24.

Atkins, and Rylands Bros. Metal electrodes fo welding or deposition of metals. 25,553. Oct. 1

Batty. Method of casting ingots of steel etc 25,940. Oct. 22.

Batty. 25,942. *See* XXIII.

Beswick and Emery. Parting powder fo foundry moulding. 25,100. Oct. 11.

Gibbons Bros., and Marle. Furnaces for manu facture or heat treatment of steel etc. 26,22 Oct. 25.

Harris. Refining lead. 25,316. Oct. 15.

Howgate. Annealing. 25,975. Oct. 23.

Humfrey and Sandberg. Heat treatment steel. 25,677. Oct. 20.

Kjellberg. Treatment of minerals or produc containing iron and titanium and/or vanadium 25,687. Oct. 20.

Mackay. Recovery of vanadium from ore 25,546. Oct. 18.

Maconochie and Ros. 25,405. *See* VII.

Complete Specifications Accepted.

10,209 and 10,210 (1918). Stabilimenti Biak-Ing. A. Pouchain. Alloys. (133,362 and 133,363 Oct. 22.

11,946 (1918). Stabilimenti Biak—Ing. A Pouchain. Light alloy for parts subjected to hig temperatures. (133,372.) Oct. 22.

11,947 (1918). Stabilimenti Biak—Ing. A Pouchain. Manufacture of aluminium alloy (133,373.) Oct. 22.

16,325 (1918). Recce. Treatment of ore concen trates, fines, slimes, dust, etc. (120,044.) Oct. 2

18,028 (1918). Marks (Luckenbach Processe Inc.). Mineral selective and frothing agen (133,498.) Oct. 22.

18,495 (1918). Haglund. Separation and refi ing of metals. (121,591.) Oct. 29.

1490 (1919). Thomas and Davies. Manufactu of tin and terne plates etc. (133,868.) Oct. 29.

4128 (1919). Schledorn. Anodes for use in ele troplating. (133,882.) Oct. 29.

6986(1919). Stabilimenti Biak Ing. A. Pouchai Alloy containing manganese. (133,605.) Oct. 2

8210 (1919). Saracchi. Solder composition (133,900.) Oct. 29.

XI.—ELECTRO-CHEMISTRY.

Applications.

Atkins, and Rylands Bros. 25,553. *See* X.

Coles. Production of zinc battery element 25,497. Oct. 17.

Greenley, and Vickers, Ltd. Electrodes fo secondary batteries. 25,419. Oct. 16.

Harrison. Electric furnaces. 25,558. Oct. 18

Stockel. Electric accumulators. 24,975. Oct. 1.

Sykes Interlocking Signal Co., and Wills. Insu lating material for electrical purposes. 25,41 Oct. 16.

Trembour. Electric furnaces. 25,052. Oct. 1 (U.S., 24.3.16.)

Willard. Paste for storage-battery plates. 25,505. Oct. 17.

COMPLETE SPECIFICATIONS ACCEPTED.

17,543 (1918). Kent. Electric furnaces. (133,485.) Oct. 22.
1650 (1919). Soc. Electro-Métallurgique Française. Electric furnaces. (123,306.) Oct. 29.
4128 (1919). Schleborn. *See* X.
4268 (1919). Gerber. Devices for carrying out chemical processes by electrolysis. (133,883.) Oct. 29.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Bell. Removal of fats, oils, etc., from casks etc. 25,992. Oct. 23.
Bloxam (Arbini). Process for neutralising oils or fats. 25,528. Oct. 17.
Bollmann. Extraction of fat or oil from raw materials. 25,213. Oct. 14.
Bollmann. 25,729. *See* I.
Cross and Miller. Liquefying or reducing viscosity of oil. 25,644. Oct. 20.
Lane and Williams. Distillation and by-product recovery of waste grease. 25,116. Oct. 14.

COMPLETE SPECIFICATIONS ACCEPTED.

11,948 (1918). Eoff. Manufacture of glycerol. (133,374.) Oct. 22.
16,757 (1918). Mumford. *See* I.
9843 (1918). Dave. Manufacture of castor oil. (133,905.) Oct. 29.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Burlin. Manufacture of paints, stains, and varnishes, etc. 25,810. Oct. 21.
Burlin. Manufacture of a cement paint. 25,811. Oct. 21.
Claessen. 25,502. *See* V.
Howse. Varnishes, and method of making same. 24,978. Oct. 13.
Mackay. Process of making lead pigments. 25,544 and 25,545. Oct. 18.
Maconochie and Ros. 25,405. *See* VII.

COMPLETE SPECIFICATIONS ACCEPTED.

10,978 (1918). Wilson, and Purex, Ltd. Production of basic lead sulphate. (133,367.) Oct. 22.
16,955 (1918). Wilkinson. Apparatus for mixing paints. (133,471.) Oct. 22.
17,375 (1918). Holzapfel. Manufacture of coating or preservative compositions. (126,270.) Oct. 29.
17,471 (1918). Ligterink. Manufacture of a floor covering as a substitute for linoleum. (133,484.) Oct. 22.
233 (1919). Paints, primings, and like coating compositions. (133,852.) Oct. 29.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATION.

Fitzgerald. 25,139. *See* XV.

COMPLETE SPECIFICATION ACCEPTED.

11,193 (1918). Varenhorst and Fol. Regenerating vulcanised rubber. (133,369.) Oct. 22.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATION.

Fitzgerald. Use or manufacture of substitute for horn, vulcanite, etc. 25,139. Oct. 14.

COMPLETE SPECIFICATION ACCEPTED.

19,120 (1918). Randall. Liming and tanning of hides. (133,823.) Oct. 29.

XVII.—SUGARS; STARCHES; GUMS.

APPLICATION.

Lafeuille. Rotary mixing machines for sugar refineries, etc. 25,378. Oct. 16.

COMPLETE SPECIFICATIONS ACCEPTED.

16,607 (1918). Alexander. Manufacture of an edible syrup from sugar beetroot. (133,744.) Oct. 29.
16,757 (1918). Mumford. *See* I.

XVIII.—FERMENTATION INDUSTRIES.

COMPLETE SPECIFICATION ACCEPTED.

11,948 (1918). Eoff. *See* XII.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATION.

Whiley. Drying milk etc. 26,122. Oct. 24.

COMPLETE SPECIFICATIONS ACCEPTED.

8041 (1918). Stott and Jones. Aeration of sewage and other impure liquids. (133,722.) Oct. 29.
4608 (1919). Jones and Coleman. Treatment of cereals or their products to improve their dietetic properties. (133,886.) Oct. 29.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Imray (Soc. Chem. Ind. in Basle). Manufacture of alkyl-substituted allyl halides and condensation products therefrom. 25,806. Oct. 21.
Low. Preparing sulphates of sodium and magnesium for medicines. 25,943. Oct. 22.

COMPLETE SPECIFICATION ACCEPTED.

16,379 (1918). Imray (Soc. Chem. Ind. in Basle). Manufacture of esters of N-monoarylsulphomonoalkyl (allyl, aralkyl) amido-oxy-aryl compounds etc. (133,433.) Oct. 22.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATION.

Natural Colour Pictures Co. Colour photography. 25,208. Oct. 14. (U.S., 12.5.19.)

COMPLETE SPECIFICATIONS ACCEPTED.

16,845 and 16,846 (1918). Renwick and Bloch. Colour-sensitised photographic materials. (133,769 and 133,770.) Oct. 29.

XXIII.—ANALYSIS.

APPLICATION.

Batty. Apparatus for determining carbon contents of steel, ferrous and non-ferrous alloys, etc. 25,942. Oct. 22.

COMPLETE SPECIFICATION ACCEPTED.

8960 (1918). Strache. *See* II.

I.—GENERAL; PLANT; MACHINERY.

Wire cloth and its adaptability to the chemical industry. A. A. Campbell. J. Ind. Eng. Chem., 1919, 11, 761—763.

THE heavier grades of wire cloth are replacing perforated metal as backings for strainers, centrifuges, filters, etc., the air space, in comparison with the area of the screen, being greater than with perforated metal. The finest cloth made in the United States is 250-mesh, but cloth as fine as 350—450-mesh has been made in Germany. A piece of wire cloth 200-mesh each way will retain the water from a mixture of water and light hydrocarbon oil, but both water and oil will pass through cloth 200- by 180-mesh. The chief applications of wire cloth are as filter cloths and as linings for centrifuges. When woven wire fabrics are rolled it is impossible to keep the openings uniform, and strength is lost. In a recently patented design of filter cloth the wires are spirally overlapped, giving a smooth opaque double-surfaced filtering medium with wedge-shaped openings; the cloth weighs about 9 oz. per sq. ft. Wire cloths made of Monel metal resist alkaline solutions and also acid solutions containing up to 7—10% of sulphuric acid.—T. H. Bu.

Activation of carbon. Chaney. *See* IIb.

PATENTS.

Evaporating liquids; Process for —. E. Mortenrud, Forderod, Norway. Eng. Pats. (A) 120,205, 1.10.18. (Appl. 15,961/18.) Int. Conv., 26.10.17, and (B) 132,893, 1.10.18. (Appl. 15,959/18.)

BOTH patents relate to the evaporation of liquid by means of the vapour (steam) already given off from the same liquid and re-heated by compression, and are designed to improve the transmission of heat, because the temperature differences are of necessity very low. In (A) the usual solid separating medium (*e.g.*, a tube) between the compressed steam and liquid to be evaporated is dispensed with. One means of doing so is to use another liquid (not miscible with the liquid to be evaporated), which is circulated between and sprayed in both a condensing chamber, where it abstracts heat from and condenses the compressed steam, and in an evaporating chamber, where it evaporates more of the liquid. Instead of the heat-transmitting liquid being sprayed in the evaporating vessel, it, and the liquid to be evaporated, may be supplied to adjacent alternate irrigation surfaces and the heat transmitted either by convection of the vapour produced or by radiation. Another means is to use two sets of heat accumulators (chambers filled with some solid capable of absorbing heat), functioning alternately, followed by irrigation towers. In the towers the liquid to be evaporated is spread over a large surface and meets steam which has been superheated in one of the heat accumulators, the accumulator itself having been heated by compressed steam from the other half of the plant, the functions of each half of the plant being changed over at intervals by means of valves. In (B) a tubular heat interchanger is used in which the liquid to be evaporated is pumped under pressure through tubes which are provided with baffles to create turbulence, no steam being formed until the liquid arrives at a separate chamber, where it is sprayed and separated into strong liquor and steam. The latter is re-heated by a compressor and passed to the outside of the tubes in the heat interchanger, where it heats the liquid and is condensed. In all arrangements of both patents the final condensed water passes out through a preheater, where it heats untreated weak liquor on its way to the evaporator.

—B. M. V.

Colloidal matter; Recovery or separation of — from liquids. T. W. Barber, London. Eng. Pat. 132,947, 2.12.18. (Appl. 19,888/18.)

THE liquid is sprayed violently against an opposing surface, whereby colloidal matter present therein is coagulated and can subsequently be separated by settling, flotation, etc. The liquid may first be highly charged with compressed air or other gas while both are under pressure, by means of a special mixing jet, and it is often desirable to work at a low temperature, *e.g.*, 60°—70° F. (about 15°—20° C.).—B. M. V.

Furnace fronts [for solid or liquid fuel or both together]. C. Zulver, London, and L. E. Smith, South Shields. Eng. Pat. 132,977, 24.2.19. (Appl. 4590/19.)

THE furnace is provided with a coal door and ash-pit damper and firebars of usual type, the first two of which are kept closed when burning oil alone. The air for combustion of oil enters through damper-controlled openings situated on each side of the coal door and just above the ash-pit damper. It passes into the space between the outer front and an inner front of the furnace, and is guided by baffles up and down several times, being thus pre-heated, and finally emerges through ports (containing the oil burners) situated just above the air inlet ports and which open to the fire-box. The firebars may be protected by firebrick slabs or loose bricks when burning oil alone, and it is unnecessary to disconnect any fittings when changing from one fuel to another.—B. M. V.

Grinding bodies for use in tube mills. W. G. Watkins, Derby. Eng. Pat. 132,985, 25.3.19. (Appl. 7418/19.)

THE grinding bodies are used instead of balls or pebbles, and consist of bars or tubes the length of which is slightly greater than the diameter; the cross-section of the bars or tubes is cruciform or ribbed, and they may or may not have a longitudinal twist.—B. M. V.

Centrifugal machines. R. Williamson, Motherwell. Eng. Pat. 133,195, 29.10.18. (Appl. 17,673/18.)

THE basket of a centrifugal separator has no fixed bottom, but a hollow sleeve capable of sliding axially on the shaft is fitted inside the basket. The sleeve is provided at the top with a flange bent inwards to embrace the shaft, and at the bottom with an outwardly directed conical flange which, when raised, makes a tight joint with the bottom edge of the basket and when lowered permits discharge of solid material. The annular space between the basket and sleeve may be completely filled with material under treatment, thus preventing large crystals or other substances building up irregularly.—B. M. V.

Recovery of grain or like matters from washing effluents; Machine for —. T. Robinson and Son, Ltd., C. J. Robinson, and T. J. Stevenson, Rochdale. Eng. Pat. 133,206, 11.11.18. (Appl. 18,401/18.)

THE liquid to be strained is delivered to the centre of a circular perforated screen which may be lower at the centre than at the circumference. Brushes, carried on rotating arms, sweep the upper surface of the screen, and are fixed at such an angle that they sweep the grain or like material on the screen to an annular trough round the edge, where the grain is pushed by paddles, also fixed to the rotating arms, to discharge openings. Under the screen is fixed a bowl or funnel to catch the strained water, also further brushes which keep the perforations clear. Part of the water which falls through the screen may be caught in troughs rotated by the same means as the under-brushes, and is by

them directed on selected portions of the bowl to effect scouring.—B. M. V.

Charging cylinders with oxygen; Apparatus for ——. M. von Recklinghausen, Assignor to Air Reduction Co., New York. U.S. Pat. 1,314,773, 2.9.19. Appl., 20.3.17.

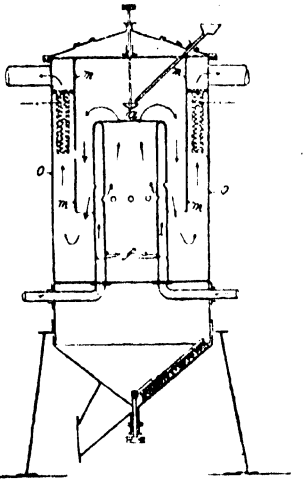
THE apparatus consists of a receiver for liquefied gas, means for causing evaporation of the liquid, a receptacle to be charged with the gas as produced, and means for regulating the pressure of the gas at each stage of the process.—W. E. F. P.

Slag; Process for utilising the heat of liquid —— granulated by air. Wärme-Verwertungsges. m.b.H., Siemensstadt. Ger. Pat. 311,639, 14.3.14.

AN inlet in the wall of a tall chamber admits a stream of molten slag, which is granulated by means of compressed air injected just below the slag inlet. The granulated slag falls, over staggered plates, on to a conveyor at the bottom of the chamber, and in falling is cooled by a rising current of air. This air, together with that injected below the slag inlet, ascends to the top of the chamber, where it serves to raise steam in a tubular heat-exchanger, and is then drawn downwards through a separate vertical duct provided with a fan, and finally enters the original chamber again at the bottom, effecting a further cooling of the granulated slag on the conveyor as it enters.—J. H. L.

Drying liquid, semi-solid, or solid material; Process and apparatus for ——. C. H. Meister, Munich. Ger. Pat. 312,424, 2.7.16.

THE material to be dried is fed on to a revolving cup, *a*, within a cylindrical vessel, and is scattered radially in a horizontal plane towards the cylin



drical partition, *m*; it then passes down the annular space between *m* and the double-walled cylinder, *f*. The dry material falls into a collecting chamber at the bottom of the dryer. Hot air passes through the apparatus in the direction indicated by the arrows, *i.e.*, it enters through pipes at the bottom of the cylinder, passes into *f*, through a number of holes into the main cylinder, and, after coming in contact with the moist material both in its outward and downward course, leaves the apparatus by means of the annular space between *m* and the outer walls, *o*.—L. A. C.

Saturating liquids with gases; Apparatus for ——. K. Malmedier, Cologne, and L. Neumayer, Berlin-Friedenau. Ger. Pat. 312,515, 26.4.17.

IN an apparatus for saturating liquids (water) with gases, the water to be saturated is first cooled ar is then forced through a jacket around the satu ator before it enters the latter. The contents the saturator are thus cooled, and a higher degr of saturation is attained. Means are provide for regulating the supplies of the cooled water the saturator and of water for effecting the cor pression, consisting of a differential piston pun in which one side of the piston is acted upon l the cooled water for the saturator, and the oth side by the water for compression. A lever attac ment to the piston rod works a piston in anoth cylinder which is divided by suitable packing in two chambers, and according to the position of th piston, either the water for the saturator pass from the one chamber, or the water for compressic passes from the other chamber into their respe tive compartments in the apparatus.—L. A. C.

Air or other gases; Apparatus for purifying —— H. Lier, Zürich. Ger. Pat. 313,026, 5.4.18. Ir Conv., 30.6.17. Addition to Ger. Pat. 307,579.

IN the apparatus for purifying air or other gas described in the chief patent (this J., 1918, 725 the first chamber is provided with a number water sprays instead of vapour jets; the air or ga which enters the apparatus above 100° C., is th cooled to about 100° C. in the chamber, and at t same time becomes saturated with water vapour. —L. A. C.

Air or other gases; Apparatus for removing wate dust, and other liquid or solid impurities fro ——. R. Foster, Apparatebau für chem. Gro industrie, Berlin. Ger. Pat. 313,127, 16.8.17.

THE air or gas to be purified is passed through column containing a series of interchangeable filt baskets. A funnel-shaped receiver fitted to t lower end of the column for collecting the impu ties is so arranged that the stream of air or oth gas does not enter the receiver, and thus fre supplies of air entering the apparatus are p vented from taking up the impurities previou deposited.—L. A. C.

Cooling tower. T. Fethke, Breslau. Ger. Pa 313,199, 3.4.17.

THE cooled water leaving the tower is received a vessel at the base, so arranged that the upp surface of the water is exposed to a current of a This vessel may be surrounded by a second recei into which the water slowly trickles, and is mea while continually exposed to the cold air current. —C. A. M.

Asbestos filter-material; Process for the re-vivifi tion of used ——. K. Oppitz and Z. Pálc Budapest. Ger. Pat. 313,548, 23.6.18. I Conv., 13.9.13.

THE material is reduced to a loose, fibrous co dition, the organic matter therein is oxidised by wet process, and the mass is then washed, dried a high temperature, and compressed.—J. S. G. T

Filter working in the manner of a filter-press. Busau, Munich. Ger. Pat. 313,678, 11.8.17

THE filter contains a series of concentric filteri chambers closed in by upper and lower plates wh contain the inlet and outlet for the fluid, so th filtration proceeds in a radial direction. The co pressed filtering material is in annular form, a may be supported on superposed metal supports. —C. A. M

Extraction processes; Filtration method of sep ating particles of dust mechanically removed the solvent in ——. H. Bollmann, Hambu Ger. Pat. 313,821, 23.6.17.

THE saturated solvent from the last of a batt

of extraction apparatus is conducted to the last but one extraction vessel, and the double quantity of liquid from the latter is conducted partly to the last extraction vessel and partly to the purification apparatus. In this way the filtration of the solid particles is effected within the extraction plant.
—C. A. M.

Volatile solvents; Process for the recovery of ——. *Apparatus for the recovery of volatile solvents in continuous process.* J. H. Brégeat, Paris. U.S. Pats. 1,315,700 and 1,315,701, 9.9.19. Appl., 4.9.17 and 6.6.18.

See Eng. Pats. 128,610 and 131,938 of 1917; this J., 1919, 621 A, 751 A.

Drying. Eng. Pat. 128,199. *See* XIXA.

Erratum. *Recovery of volatile solvents* (Eng. Pat. 131,938; this J., 1919, 751 A). In the last line of the title, for "621 A" read 612 A.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Hydrogenation of various kinds of —— *by means of hydriodic acid.* F. Fischer and H. Tropsch. Ges. Abhandl. z. Kentniss der Kohle, 1918, 2, 154—159. Chem. Zentr., 1919, 90, IV., 471—472.

The hydrogenation of hard coal (anthracite etc.) by means of hydriodic acid is easier the younger the coal is geologically. Coals such as lignite and cannel-coal are easily hydrogenated and give products very similar to those obtained from the harder coals. At about 200° C. bitumen-like substances of high molecular weight and soluble in chloroform are obtained, whilst at higher temperatures under certain conditions petroleum like substances are formed. When 2 grms. of coal was heated for 12 hours at 200° C. with 5 c.c. of hydriodic acid (sp. gr. 1·7) and 2 grms of red phosphorus, the following results were obtained:

Kind of coal.	Fixed carbon in coal.	Matter soluble in chloroform.	
		Before treatment.	After treatment.
	%	%	%
Anthracite	89	0·52	12·1
Semi-bituminous ..	85	0·55	17·7
Bituminous..	78	0·71	54·6
Flaming gas ..	64	1·5	70·3
Cannel	58	2·7	73

The chloroform extract after driving off the solvent is readily reduced to a light brown powder, which softens above 100° C., is partly soluble in benzene, very slightly soluble in oxygen-containing organic solvents. From its solution in chloroform it is partly precipitated by acetone. In the treatment the nitrogen of the coal is completely removed, and the acid wash waters contain appreciable quantities of nitrogen in the form of ammonia and organic amino compounds. Gas-coal showed no formation of a liquid product when 0·2 grm. was heated for 24 hours with 10 c.c. of hydriodic acid (sp. gr. 2·03) in a sealed tube at 270°—280° C., but when 0·5 grm. was heated with 1 grm. of red phosphorus and 10 c.c. of hydriodic acid (sp. gr. 1·7) for 6 hours at 280° C., about 30% of a petroleum-like colourless liquid was obtained, the residue after steam-distillation being a bituminous mass largely soluble in chloroform.—B. V. S.

Gas industry; Possible developments in the ——. B. Wigersma. Chem. Weekblad, 1919, 16, 1356—1370.

Existing methods of utilising fuel are wasteful both as regards heat production and the recovery of by-products. By a method of gasification (low temperature carbonisation) instead of dry distillation or degasification, of the fuel, much better results are obtained. The author gives an outline of the "Trigas" method and plant which has been in operation at Frankfort and Gladbach-Brauck for about a year. The process embodies two operations, continuous degasification and intermittent gasification, in the same producer. Fuel introduced at the top falls slowly to the bottom and meets a counter current of hot gases by which means the most volatile products are driven off and removed without coming into contact with hot bodies. The less volatile products distil off in a lower hotter zone; the presence of hydrogen prevents dissociation of the ammonia. The residual coke in the lower part of the producer is subjected alternately to an air blast and a steam blast, water gas being formed. By a suitable device of an arch and shutter, the combustion products are prevented from mixing with the manufactured gas. The process yielded 1·8 cub. metres of gas per kilo. of fuel consisting of 3 parts of bituminous coal and 1 part of lignite.—W. J. W.

Vertical [gas] retorts; Efficiency tests on Dessau ——. K. Bunte. J. Gasbeleucht., 1919, 62, 513—519, 526—530, 548—552. (See also this J., 1919, 616 A.)

A detailed description of fourteen series of tests carried out on different models of Dessau retorts during the period 1908—1916. In the majority of cases comparison is made between the working of the retorts with and without steam, full details being given in each case of the coal used, yield and quality of the gas produced, and the yield of coke.—W. P.

Wood gas; Production of ——. A. Sander. Z. Ver. deuts. Ing. Gas J., 1919, 148, 134—135.

The manufacture of gas from wood gives rise to many difficulties when carried out in the ordinary retort furnaces, on account of the formation of acid distillates, but owing to coal shortage it has been commenced in Denmark, Norway, Sweden, and Switzerland. Tests carried out at the Stockholm Gasworks, using inclined retorts 4·9 m. long, gave satisfactory results. The wood (Scotch fir) was in pieces 90 cm. long. The charcoal was removed so that no more than the lower half of the retort was filled with it. The gas formed in the upper part of the retort passed over the glowing charcoal, part of the carbon dioxide being reduced to monoxide and the acetic acid vapours being decomposed. Each charge consisted of 50 kilos. of wood, the upper portion of the furnace being filled with 5 kilos. of coal. With a furnace temperature of 1200° C., two hours was required for gasification. The yield, referred to 1 ton of dry wood, was 854—938 cub. m. of gas of sp. gr. 0·58—0·65, calorific value 3000—3300 cals., and composition (varying according to the percentage of moisture in the wood, 16—35%) CO_2, 11·4—16·0%; heavy hydrocarbons, 1·2—1·9%; O_2, 1·3—2·1%; CO, 21·8—26·1%; CH_4, 9·1—14·9%; H_2, 44·5—47·1%; N_2, 1·6—3·7%. The yield of charcoal was on the average 19% on the weight of dry wood. It was in large pieces and of good quality. The distillates showed an alkaline reaction, owing to the ammonia distilled from the coal. The tar obtained was very liquid, but contained denser constituents as well. In Denmark peat and wood have been gasified alternately in horizontal retorts, and after cooling the gas mixed with coal gas. The mixed gas

before the addition of coal gas had a calorific value of 3700 to 4000 "short calories," and after admixture 4200—4700 "short calories." At the Helsingfors Gasworks, Finland, dry waste from the extensive wood-reel factories of the country has been carbonised in Dessau vertical retorts.—W. P.

Flame velocity in inflammable gases. J. D. Morgan. Engineering, 1919, **108**, 535—536.

WHEN an inflammable gas mixture is ignited in a closed vessel, the time of the first appearance of pressure at the walls of the vessel does not coincide with the instant of ignition. An experiment is described confirming the observation of Wheeler (this J., 1919, 3A) that flame is in existence for the major portion of the no-pressure period. It is probable that rise of pressure starts immediately the spark has passed, but the indicators used are unable to record the low initial pressure produced. The time which elapsed between the passage of a spark at one end of a horizontal closed tube containing inflammable gas mixture and the appearance of a predetermined pressure at the other end was measured with different lengths of tube. It was found that the time taken (t) and the length of tube (l) were related by the expression $\log Bl = Ct$, where B and C are constants. The author suggests that flame velocity is directly proportional to gas pressure.—W. P.

Gasoline; Quantitative estimation of —— in natural gas. K. Kling. Metan, 1917, **1**, 3—5. Chem. Zentr., 1919, **90**, IV., 477—478.

THE gas (0·5 litre) is measured in a Bunsen gasometer with the usual corrections, and is then passed through a drying tube and is condensed in an absorption vessel which is immersed in a Dewar flask containing a mixture of ether and solid carbon dioxide. The vessel is sealed after the condensation is complete and weighed against a similar tube as tare. By an extension of the apparatus, comprising a second gasometer, and a flow meter, the density, calorific value, and illuminating power of the gas freed from gasoline can be estimated. The liquid obtained is distinguished from technical gasoline by its dissolved content of methane and ethane, but the figures obtained enable an estimation to be made of the value of the gas as a source of gasoline.—A. E. D.

Sodium prussiate. Potsdamer. *See* VII.

PATENTS.

Coke-ovens. C. M. Stein et Cie., Paris. Eng. Pat. 123,527, 8.2.19. (Appl. 3128/19.) Int. Conv., 22.2.18.

THE ovens, which can be heated by gas obtained from blast furnaces, coke or coal gas producers, or from the coke-ovens themselves, consist of a series of distillation chambers arranged side by side, a series of combustion chambers being placed one between each pair of distillation chambers. Under each distillation chamber is a heat recuperator, alternate recuperators being employed for heating air, and the others for heating fuel gas or air. Each combustion chamber is divided longtitudinally by a series of partitions which do not reach to the top of the chamber, and a port from each of an adjacent pair of recuperators communicates with the combustion chamber between each pair of partitions.
—W. P.

Coke-oven; Reflex ——. Method of preheating. A. Roberts, Evanston, Ill. U.S. Pats. (A) 1,304,907 and (B) 1,304,908, 27.5.19. Appl., 22.6. and 15.9.16. Renewed 10.8. and 23.10.18.

(A) A BENCH of coke-ovens having heating walls and burners has a tunnel extending longitudinally beneath its central portion, and connections for the delivery of spent gas from the heating walls to the tunnel. The air supply for the burners passes through induction devices and draws in a portion of the hot spent gases from the tunnel, and the air is thus preheated. (B) Preheating is effected on the "reflex principle," *i.e.*, by direct mixing of the air or gas to be preheated with hot spent gases.—T. H. B.

Gas generators. C. Clerc, Paris. Eng. Pat. 121,290, 4.12.18. (Appl. 20,098/18.) Int. Conv., 4.12.17.

A GAS producer intended more particularly for fuels such as wood, straw, sawdust, or rich coals which give off volatile products, is charged at the top, and all the air for combustion is admitted to a middle zone, the region above this zone forming a distillation chamber having a pipe for withdrawing the products of distillation, and the region below it forming a combustion chamber from which the burnt gases are evacuated. The pipe from the distillation chamber is connected with a condensing apparatus. The producer may be operated with a fan or blower.—W. P.

Gas producers. F. Clements and W. S. Allen, Rotherham. Eng. Pat. 133,255, 25.3.19. (Appl. 7169/19.)

THE escape of gas during the poking of a producer is prevented by providing a perforated steam pipe adjacent to the poking hole. The opening of the latter automatically turns on the steam, jets of which are directed into the producer through the hole, thus keeping the gas back.—W. P.

Gas producer. S. Barth, Düsseldorf. Ger. Pat. 311,238, 20.5.16. Addition to Ger. Pat. 279,551 (see Eng. Pat. 24,356 of 1913; this J., 1915, 825).

THE cam track on which the rotating grate travels (*loc. cit.*) is also caused to rotate, so that the up and down motion of the grate takes place successively at different places.

Pitches; Atomiser and burner for ——. W. Herrmann, Kiel. Ger. Pat. 311,892, 27.3.17.

THE pitch is melted and passed through a sieve into a chamber where it is heated to or above its inflammation temperature by means of superheated steam. It is then forced through the nozzle of an atomiser together with heated air, into the combustion chamber. The addition of volatile fuel oil lowers the inflammation temperature, and enables the pitch to be burned completely without smoke.
—W. P.

Fuel oils. F. Tinker, Birmingham. Eng. Pat. 132,960, 24.12.18. (Appl. 21,588/18.)

To reduce the tendency for the deposition of carbon or asphalt from mixtures of tar (or tar oils containing pitch) with mineral fuel oils containing an intermediate oil (see Eng. Pat. 130,699; this J., 1919, 711 A), a small amount of water in which alkali or soap has been dissolved (for example, 0·5% by volume of a solution containing 10% of ammonia) is added. The amount of alkali should not completely neutralise the total petroleum or tar acids present.
—A. E. D.

Hydrocarbons; Treatment of ——. G. F. Forwood and J. G. Taplay, London. Eng. Pat. 133,059 (Appls. 17,869, 12.12, and 18,363, 22.12.18.)

HYDROCARBON oil vapour is passed together with steam over carbon at 450°—600° C. The carbon is in a form which is capable of decomposing steam at the temperature employed, and is prepared by carbonising organic material such as oil residue, wood, lignite, or the like, at a temperature approximately the same as that employed for treating the oil vapour. The proportions of unsaturated compounds and of sulphur in the oil are con-

iderably reduced by the treatment, and cracking nay be effected in the case of heavy oils by working near the upper limit of temperature. A gas uitable for combustion is obtained as a by-product. —L. A. C.

'eat; Method and apparatus for excavating and handling ——. J. M. Shuttleworth, Brantford, Ont., Canada. Eng. Pat. 133,512, 13.11.18. (Appl. 18,599/18.)

Briquet machines; Material feeder for — —. F. H. Rogers, London. From St. Louis Briquette Machine Co., St. Louis, Mo., U.S.A. Eng. Pat. 132,972, 5.2.19. (Appl. 2837/19.)

Gas retorts; Stoking machines for ——. J. G. W. Aldridge, London, and T. J. Ashley, Bath. Eng. Pat. 133,380, 9.8.18. (Appl. 12,977/18.)

Combustible gases; Process and apparatus for making —— *from carbonaceous material.* C. S. Palmer, Pittsburgh, Pa., U.S.A. Eng. Pat. 119,874, 7.10.18. (Appl. 16,304/18.) Int. Conv., 5.10.17.

SEE U.S. Pat. 1,268,763 of 1918; this J., 1918, 500 A.

THE walls of the retort consist principally of nickel r nichrome.

Forming explosive gaseous mixtures; Method of ——. C. E. Richardson, New York, W. B. Eddison, Irvington, and H. L. Read, Assignors to Surface Combustion Co., New York. U.S. Pat. 1,308,739, 1.7.19. Appl., 29.9.17.

SEE Eng. Pat. 112,011 of 1917; this J., 1919, 67 A.

Oil; Method of refining ——. C. B. Forward, Urbana, Ohio. U.S. Pat. 1,299,449, 8.4.19. Appl., 6.12.17.

SEE Eng. Pat. 117,372 of 1917; this J., 1918, 617 A.

Disposition of inflammable gases. U.S. Pat. 1,302,871. *See* XIXB.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Carbon; Activation of ——. N. K. Chaney. Trans. Amer. Electrochem. Soc., 1919, 157—166. [Advance copy.]

"ACTIVE" (or α) carbon and "inactive" (or β) arbon are produced by chemical or thermal decomposition of carbonaceous material at temperatures enerally below 500°—600° C. and above 600°—700° ., respectively. Owing to the activity of the α nodification, amorphous carbon resulting from low-emperature distillation processes ("primary" arbon) consists essentially of a stabilised complex f hydrocarbons adsorbed on a base of active carbon, vith or without associated, non-adsorbed hydrocarbons. The activation of primary carbon consists n separating and removing from it the adsorbed nd associated hydrocarbons; but the temperatures equired to accomplish this by thermal means alone re so high that secondary formation of inactive arbon from the liberated hydrocarbons is inevitble. The most successful method of activation is hat of differential oxidation, whereby the adsorption complex is broken down and the hydrocarbons xidised or partially decomposed and distilled away rom the active carbon. The commercial development of the oxidation principle (as worked out by he National Carbon Co. of Cleveland, Ohio, and dopted by the U.S. Chemical Warfare Service) has esulted in the employment of air, steam, and carbon dioxide for this purpose in three different processes. Adsorbent charcoal made (as in Germany luring the war) by impregnating wood with metal salts before carbonisation, and later extracting with acids, has a very effective capillary structure capable of adsorbing large quantities of gas at high gas concentrations; but the adsorbed gas is readily removable. Specific adsorbent capacity, as possessed by active carbon, is characterised by very considerable capacity at low gas concentrations and by extremely slow rates of loss during reversal of the adsorption process. The adsorptive capacity of pre-war charcoals is almost entirely capillary and is quite small compared with present standards. —W. E. F. P.

Decolorising-carbons. Zerban and others. *See* XVII.

PATENTS.

Gaseous products; Recovery of —— *from plants for the destructive distillation of organic materials.* E. Bury, O. Ollander, and A. E. Bury, Saltburn. Eng. Pat. 133,159, 4.10.18. (Appl. 16,121/18.)

A PEAT-COKE prepared at 700° - 900° C. is used as a cheap but efficient substitute for wood charcoal as an occluding agent for the selective separation of gaseous products from carbonisation processes. The coke is soft and loose, and readily allows the passage of gas through it. The absorbed gases are removed by the application of heat, and the coke is returned to the absorption vessel for further use. —W. P.

Refractory materials. U.S. Pat. 1,297,000. *See* X.

Photometer. Eng. Pat. 11,387. *See* XXIII.

III.—TAR AND TAR PRODUCTS.

Phenols and cresols; Electrochemical oxidation of ——. F. Fichter and F. Ackermann. Helv. Chim. Acta, 1919, **2**, 583—589.

THE electrochemical oxidation of phenol produces quinol and catechol with *op'*-diphenol and *pp'*-diphenol as intermediate products. When 5·5 grms. of catechol in 60 c.c. of $N/2$ sulphuric acid is subjected to a current of 0·02 amp. per sq. cm. between lead electrodes without a diaphragm, the products of oxidation are carbon dioxide, carbon monoxide, a volatile fatty acid with an odour of butyric acid, which consists of a mixture of butyric acid and its lower homologues, particularly formic acid, and succinic acid. When a diaphragm is used, fumaric acid is the product. Catechol and quinol are formed in approximately equal quantities in the electro-oxidation of phenol. The electro-reduction of catechol produces cyclohexanol. A high-boiling resinous substance is also produced in the electro-oxidation of phenol; this consists of diphenols, *o*-hydroxyphenyl ethers, diphenyl, tetrahydroxy-diphenyl, and dihydroxydiphenyl ether. The electro-oxidation of *o*-cresol (540 grms. in 2½ litres of $N/1$ sulphuric acid) by a current of anode density 0·025 amp. per sq. cm. without diaphragm and with vigorous stirring gave after 135·3 amp.-hours a dark brown oil and an aqueous solution. The oil contained *o*-dicresol and the solution toluquinone. *p*-Cresol, after similar treatment, gave toluquinone and benzoquinone from the aqueous solution and *p*-dicresol and 2.2'-dihydroxy-5.5'-dimethyl diphenyl ether from the oil. (See also J. Chem. Soc., Dec., 1919.)—J. F. S.

Phthalimide; Method for the preparation of ——. W. Herzog. Z. angew. Chem., 1919, 32, 301.

ABOVE 130° C. urea acts on phthalic anhydride according to the equation: $2C_6H_4(CO)_2O+CO(NH_2)_2 = 2C_6H_4(CO)_2NH+CO_2+H_2O$. Phthalic anhydride, 2 mols., and urea, 1 mol., are heated in a long-necked flask; the reaction begins at 130°—135° C.,

carbon dioxide and water vapour being evolved, and proceeds without further external heating, the temperature meanwhile rising to 150° C. At the end of the reaction, the reaction product solidifies suddenly to a porous mass, which, when cold, is washed with a small quantity of water and dried. It consists of almost chemically pure phthalimide, m. pt. 230°—231° C., the yield being over 90% of that required by theory. Thiourea and phthalic anhydride react similarly, but the reaction does not take place between urea and succinic anhydride, citraconic anhydride, or camphoric anhydride.
—W. P. S.

PATENTS.

Fuel oils. Eng. Pat. 132,960. *See* IIa.

Burners for pitch. Ger. Pat. 311,982. *See* IIa.

IV.—COLOURING MATTERS AND DYES.

Indophenols and Indamines. II. C. Heller. Annalen, 1919, 418, 259—274. (Compare this J., 1912, 978.)

EVIDENCE is produced showing that the quinone and aminophenol initially formed by the decomposition of indophenols by hot dilute mineral acids undergo further reaction by prolonged contact with the acid, in the sense of the equation,

$$2O:C_6H_4:O+2NH_2.C_6H_4.OH = C_6H_4(OH)_2+O:C_6H_4(NH.C_6H_4.OH)_2:O;$$

so that the final main products are quinol and dianilinoquinones. Complex indophenols can be prepared by heating, for example, a mixture of *p*-aminodiphenylamine, quinol, and zinc chloride at 80° C. and oxidising the resulting leuco-compound (4-anilino-4′-hydroxydiphenylamine, silvery scales, m. pt. 145° C.) in boiling benzene with mercuric oxide, whereby 3-anilino-indophenol,

$$O:C_6H_4:N.C_6H_4.NH.C_6H_5,$$

bluish violet crystals containing 1 mol. $CHCl_3$, m. pt. 158° C., is obtained. (See further J. Chem. Soc., 1919, i., 542.)—C. S.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cotton linters, cotton shavings, and hull fibre; Suitability of second cut — — for paper manufacture. O. Kress and S. D. Wells. Pulp and Paper Mag., 1919, 17, 697—699, 726—730.

COTTON seed, as delivered to the oil mills, contains about 200 lb. of adherent fibre per ton. From this a first cut of 75 lb. of linters is taken, having sufficient length for use as a stuffing material. Afterwards, a second cut of linters of 75—100 lb. per ton may be removed by means of carborundum wheels or plates, and this lint, being almost free from hull particles, is easily purified for paper-making purposes. The seed is then decorticated, and the residual hull fibres are shaved or cut off by treatment in steel attrition mills; this material is very specky. The average length of the linters fibre is 4·62 mm. (max. 25·44; min. 0·80 mm.), and the average length of the hull shavings fibre 1·41 mm. (max. 8·00; min. 0·51 mm.). According to another process, after the removal of the 75 lb. of lint with the ordinary linting machine, the second cut with carborundum wheels is omitted, and the seeds are directly decorticated, about 75 lb. of hull fibre being then removed by the steel grinding or attrition plates. This hull fibre resembles the shavings in length of fibre and contamination with shell particles. A number of samples of these various products have been treated for the manufacture of paper pulp. This class of material is best treated in a rotary type of digester, and it is extremely important to allow sufficient digester space to permit of efficient circulation of the liquor. Not more than 11 lb. of dry weight of material should be packed per cub. ft. of digester space, and at least 52 galls. of liquor per 100 lb. of material should be used. For the elimination of specks, high temperatures of digestion are necessary, with pressures of 80—100 lb. per sq. in., the time of digestion being 4 hours. The quantity of caustic soda required varies according to the degree of contamination with shell particles. Cotton linters requires about 9% NaOH on the dry weight of the material; the yield is 90% of boiled pulp, but is reduced during washing and bleaching, owing to loss of short fibres, to about 70% of bleached paper calculated on the basis of dry weights. Cotton shavings require about 12% NaOH and yield 70% of boiled pulp, which is reduced to about 55% in the finished paper. Hull fibre requires 18% NaOH and yields 65—75% of pulp, or 47—51% of finished paper. A higher yield and economy of chemicals may be obtained by digesting according to the sulphate process. The consumption of bleaching powder for the various materials is given as 2% for linters pulp, 4% for shavings, and 5—8% for hull fibre. The pulp is of excellent quality and suitable for the manufacture of book papers and other fine grades, alone or in admixture with wood celluloses.—J. F. B.

Cellulose mucilage. C. G. Schwalbe and E. Becker. Z. angew. Chem., 1919, 32, 265—269.

CELLULOSE mucilage was prepared by different methods from soda cellulose, sulphite-cellulose, and parchment paper cellulose, and the water, ash, copper value, hydrated copper value, and pentosans in the products were determined. It was found that mechanical division by itself would produce mucilage, the process being accompanied by an increase in the reduction capacity (copper value) and of the swelling capacity (hydrated copper value). By treating the cellulose with acids prior to the mechanical treatment the formation of mucilage was considerably accelerated. The production of mucilage appears to depend upon the formation of hydrolytic decomposition products (cellulose dextrins), which may be distinguished from cellulose by their higher copper values. Mitscherlich cellulose, as made for the manufacture of parchment paper, almost invariably has a high copper value, and thus contains considerable quantities of cellulose dextrins or possibly hemicelluloses. Pentosans are not materially attacked by the mechanical treatment, but in the disintegration with acids a portion of the soluble pentosans is degraded and dissolved. The formation of mucilage is considerably reduced by boiling or steaming the cellulose for a long time.
—C. A. M.

Lime sludge recovery [in soda wood pulp mills]. B. C. Hope. Pulp and Paper Mag., 1919, 17, 701—703.

IT is important to remove as much water as possible from the spent lime sludge. The wet sludge from the causticisers contains 52—60% of water, and this can be reduced by about 12% by draining in a mechanical "thickener" and by a further 10% in a rotary vacuum filter, which type possesses the advantage of continuous operation. The filter is generally provided with a metallic cloth of suitable mesh according to the fineness of the sludge; in some cases No. 12 cotton duck is used. The cake leaves the filter at a thickness of ¾″ to 1″. The drained sludge is delivered from the thickener to the filter by means of a diaphragm or centrifugal pump, and the overflow is returned to the thickener

by gravity. From the filter the cakes fall directly into the feed orifice of the kiln, which is similar to the rotary kilns used in the cement industry, and should have a slope of ¾"—1" per ft. There is a large unavoidable loss of heat by radiation from the kiln, amounting to 18—40% of the total heat delivered to it. External insulations are not successful, as they cause buckling of the shell; the best lining is a hand-moulded, high-alumina firebrick of a porous nature with a very low percentage of plastic clay and burned at at least 2600° F. (about 1430° C.). The range of burning temperature of the lime sludge is 1740°—1920° F. (about 950°—1050° C.), and for economical production it is best not to exceed 1830° F. (about 1000° C.). At 2000° F. (about 1090° C.) the effects of overburning become evident, and the lime tends to become difficult to slack. In the presence of superheated steam the complete conversion into calcium oxide may be effected at 1470 F. (about 800° C.). The recovered lime leaves the kiln in the form of small balls and is conveyed in a V-bucket elevator to the causticisers. It is necessary to make up losses by the addition of fresh lime to the extent of 10—15%, and periodically the entire sludge has to be discarded. The kilns are fired with producer gas. In a good plant the consumption of coal will be about 270 lb. per ton of lime produced.

—J. F. B.

Sulphite alcohol; Use of seaweed as nutrient for the ferment in the manufacture of ——. H. Landmark. Pap. tekn. Forening, April 9, 1919. Papierfab., 1919, 17, 1052—1055.

Sulphite pulp waste liquor for fermentation is deficient in nitrogenous nutrients, phosphoric acid, potash, and magnesia. These are generally supplied in the form of malt extract, but other suitable vegetable matters are available. A comparison of the chemical composition of barley and seaweed shows that the two are closely similar in all essential components except as regards saccharine matters. For the best utilisation of seaweed the material must be hydrolysed with acids, whereby 75% of the dry substance is dissolved on suitable treatment. The extract contains the whole of the phosphoric acid, potash, and magnesia, and about 90% of the total nitrogen. The maximum extraction of nitrogen was obtained by digesting at 125° C. for 1½ hours with sulphuric acid equal to 20—24% of H_2SO_4 on the dry weight of the material, but some of the sugar was thereby destroyed. By using 15% of sulphuric acid on the dry weight the yield of sugar was equivalent to 21% of the dry material, or about 35% of the total carbohydrates, but the yield of nitrogen extracted was reduced to about 80% of the total present. Of the sugar, about 86% was fermentable sugar. Seaweed contains about 40% of tang acid (alginic acid), from which the bulk of the sugar obtained on hydrolysis appears to be derived. Other hydrolytic agents may be employed instead of sulphuric acid, *e.g.* calcium bisulphite or even boiling water under pressure, but sulphuric acid gives the highest results. The residue from the hydrolysis may serve as fuel. It is concluded that the hydrolysed seaweed extract is an excellent substitute for malt in the manufacture of sulphite alcohol and is capable of maintaining the yeast in vigorous condition, only it contributes less fermentable sugar to the wash than does malt extract.

—J. F. B.

Patents.

Waterproof fabric; Process of preparing ——. Badische Anilin u. Soda Fabrik, Ludwigshafen. Ger. Pat. 303,891, 23.1.17.

Textile fabrics or the materials used in their manufacture are treated with aqueous emulsions of resins, obtained by dissolving artificial resins, such as the products of the condensation of naphthalene with formaldehyde, in an organic solvent and mixing the solution with alkali soap solution.

—C. A. M.

Textile fabrics and the like; Process of softening ——. T. Goldschmidt A.-G., Essen. Ger. Pat. 305,192, 12.1.17.

Textile fabrics etc. are softened by impregnating them with glycol by itself or with the addition of other substances. Glycol is a good substitute for glycerin or other hygroscopic agents for rendering pliable products such as artificial silk, films, paper, leather, etc., and may be added directly to the finished article or in the course of manufacture.

—C. A. M.

Fibres; Process for felting — —. Chem. Fabr. Worms A.-G., Frankfort. Ger. Pat. 307,791, 6.12.17.

The fibres are treated with an aqueous solution of ethyleneglycol either alone or with the addition of other suitable substances. For heavy materials, which readily form flocks in the fulling machine, it is advisable to increase the frothing capacity of the liquid by a small addition of saponin, glue, or soap solution, whilst for felting loose wool fibres an approximately 10% lukewarm aqueous solution of glycol is sufficient.—C. A. M.

Drying machines [for textiles]; Doll head bearings for the steam cylinders of — —. Calico Printers' Assoc., Ltd., and G. L. Bolden, Manchester. Eng. Pat. 133,231, 10.1.19. (Appl. 706/19.)

Fabric; Soil-proof —— *and process of making the same.* L. J. Cavanaugh, Boston, Mass., U.S.A. Eng. Pat. 133,180, 11.10.18. (Appl. 16,724/18.)

See U.S. Pat. 1,277,695 of 1918; this J., 1918, 686 A.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Iron pyrolignite. Vié. *See* VII.

Patents.

Dyeing; Process of ——. A. A. Gehrlein, Erie, Pa. U.S. Pat. 1,292,453, 28.1.19. Appl., 2.5.18.

The dyed material is treated in a bath of acid sodium sulphate to fix the colour. Brighter and faster shades are said to be obtained than when alum is used as fixing agent.

Printing fabrics of all kinds; Process for ——. R. Schultz, Berlin-Friedenau. Ger. Pat. 311,547, 23.3.16.

The colour is applied in liquid (*i.e.*, unthickened) form, after the contour of the pattern has been treated, *e.g.*, with potassium bichromate, by means of a special roller, to lessen the absorptive action of the fabric.—J. H. L.

Mercerising, dyeing, and other operations; Frame for supporting hose and like knitted fabrics during ——. A. E. Hawley, Hinckley, P. F. Crosland, Halifax, and F. G. Dixon, Cheadle Hulme. Eng. Pat. 132,647, 10.10.18. (Appl. 16,472/18.)

Mercerising hose and other knitted fabrics; Machines for ——. A. E. Hawley, Hinckley, P. F. Crosland, Halifax, and F. G. Dixon, Cheadle Hulme. Eng. Pat. 133,441, 10.10.18. (Appl. 16,473/18.)

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Ammonia; Catalytic oxidation of ——. P. Pascal and E. Decarrière. Bull. Soc. Chim., 1919, **25**, 489—507.

THE authors have made comparative tests with six different forms of platinum catalyst. Using platinum foil, 0·01 mm. thick, cut into small pieces and rolled into balls, a 95% yield of oxidation products was obtained over the temperature range 600°—700° C. from an ammonia-air mixture containing 8% by vol. of ammonia. The reduction in the yield of oxidation products caused by increase in the ammonia concentration was least with this form of catalyst. With a catalyst composed of a plug of platinum wool (threads 0·02 mm. diam.) or an undulating sheet of thin platinum foil rolled into a coil some ammonia may pass through unattacked. Catalysts composed of three or five pieces of platinum gauze superimposed gave 87—94% yields of oxidation products. On the whole, the results indicate that the use of platinum in the form of fine wire, *i.e.*, with a large curvature, is not advantageous, and, furthermore, the optimum temperature is much higher than in the case of the foil. (See further J. Chem. Soc., Nov., 1919.)—W. G.

Ammonia oxidation; Analytical method for determining efficiency of ——. D. P. Gaillard. J. Ind. Eng. Chem., 1919, **11**, 745—747.

FOUR glass bulbs of 500—600 c.c. capacity with gas-tight stop-cocks are evacuated to about 2 cm. of mercury and weighed. They are then connected by short glass sample tubes with the sample holes of the converter, and samples are taken as rapidly as possible, the bulbs being then again weighed. In the case of the incoming gases the cock of the bulb is opened under distilled water, and after shaking with the water thus introduced the contents are run into 25 c.c. of $N/10$ sulphuric acid and the excess acid titrated, using methyl red as an indicator. For the exit gases 100 c.c. of water is introduced into the bulb, then 25 c.c. of oxygen is drawn in, and the bulb shaken, any vacuum being relieved by opening to the air. The liquid in the bulb is then poured into 75 c.c. of $N/10$ sodium hydroxide, diluted with water and titrated, using the same indicator. The ratio of combined nitrogen (as oxides) in exit gases to combined nitrogen (as ammonia) in the incoming gases gives the efficiency, and the precision of a single efficiency determination in duplicate is stated to be within about ±0·75 %.—T. H. Bu.

Chilean nitrate; Production costs of ——. J. Marco. J. Ind. Eng. Chem., 1919, **11**, 780—781.

THE author discusses the possibility of reducing the cost of production of sodium nitrate in Chile. Saving could be made in the mining, extraction, and transportation of the nitrate. The introduction of scientific management and a system of cost accounting would improve the industry. The mining is primitive, and there is a broad field for improvements in mechanical devices and transport. More technical control and advice is necessary, and the installation of Diesel engines and the adoption of new models of boilers and evaporators and new chemical methods would reduce fuel consumption. The export tax is being reconsidered, and docking and railroad facilities are being improved. A summary of actual results of four extraction plants for one year of output is given, which show that economies are possible which will for some time permit Chile nitrate to compete on favourable terms with synthetic nitrogen products.—T. H. Bu.

Halogens; Detection of —— *in mixtures of their salts.* A. J. Jones. Chem. and Drug., 1919, **91**, 1150—1151.

As little as 0·02% of potassium iodide in potassium bromide may be detected by dissolving 1 grm. of the salt in 10 c.c. of water, adding a crystal of sodium nitrite and 0·5 to 1 c.c. of glacial acetic acid, and shaking the mixture with chloroform; the latter is coloured rose-pink. If mineral acid is used in the test, 2% of iodide may escape detection. To detect traces of bromide in an iodide or chloride, 0·5 grm. of the salt is dissolved in 5 c.c. of water, in a test-tube; 1 c.c. of 0·5% permanganate solution and 1 c.c. of 1·75% phosphoric acid are added, the tube is capped with a fluorescein test-paper, and the contents are boiled. A red coloration on the paper is obtained if the salt contains 0·05% or less of bromide. Ordinary table salt, many samples of "pure" sodium chloride, and even hydrochloric acid (after evaporation with sodium carbonate), show traces of bromide by this test. When dealing with ammonium salts the ammonia should be removed previously by boiling with sodium hydroxide solution. To detect traces of chloride in an iodide or bromide, 0·5 grm. of the salt is dissolved in 5 c.c. of water, 15 c.c. of chloroform is added, and a mixture of 90 c.c. of 0·5% permanganate solution and 10 c.c. of phosphoric acid (sp. gr. 1·75) is introduced gradually, while the mixture is shaken until the whole has a red colour; about 50 c.c. of the permanganate mixture is usually required. The chloroform layer is separated and the extraction continued until the chloroform remains colourless even after the addition of a further small quantity of permanganate. The aqueous solution is then decolorised with sulphurous acid, concentrated to 10 c.c., and tested with silver nitrate and nitric acid. Any precipitate obtained is separated and treated with ammoniacal silver nitrate solution. If the precipitate consisted of silver chloride it dissolves to a clear solution; any trace of silver bromide renders the solution opalescent; a turbid solution may be filtered, the filtrate acidified with nitric acid and again tested with ammoniacal silver nitrate solution. The fluorescein paper is prepared by mixing 1 c.c. of "liquor fluorescein" with 5 drops of glacial acetic acid and 10 c.c. of alcohol; a drop of this solution is placed in the centre of a disc of filter paper and dried.—W. P. S.

Hypochlorite solutions; Assay of ——. F. X. Moerk and R. R. Foran. Amer. J. Pharm., 1919, **91**, 592—593.

IN the iodometric determination of available chlorine in such hypochlorite solutions as Dakin's solution (prepared by absorbing 4·8 grms. of chlorine in 1 litre of water containing 14·1 grms. of anhydrous sodium carbonate) it is recommended that 10 c.c. of the solution be diluted with 50 c.c. of water, the mixture then treated with 5 c.c. of 10% potassium iodide solution and 10 c.c. of 10% sulphuric acid (or 10 c.c. of 5% hydrochloric acid), and the liberated iodine titrated with thiosulphate solution. If acetic acid is used in place of sulphuric acid, 3 c.c. of the glacial acid should be added; with 2 c.c. of acetic acid the liberation of iodine is very slow unless the dilution of the sample with water is omitted. The hypochlorite solution should not be analysed until 1 hr. has elapsed after its preparation.—W. P. S.

Sodium prussiate L. S. Potsdamer. J. Ind. Eng. Chem., 1919, **11**, 769—770.

THE author outlines the procedure in the manufacture of sodium prussiate from spent gas-purifying material composed of hydrated iron oxide spread through a mass of wood chips. The tar and sulphur are extracted by carbon bisulphide, the residue separated into "coarse" and "fines," and

these leached separately to remove water-soluble thiocyanates and ammonium salts. Two methods of extraction of sodium prussiate may be used, *viz.*, by treatment with hydrated lime or with sodium hydroxide or carbonate. The prussiate liquor is concentrated in open steam-heated evaporating pans or in vacuum evaporators, from which it is run into crystallisers and allowed to cool slowly.—T. H. Bu.

Iron pyrolignite; Analysis of ——. G. Vié. Ann. Chim. Analyt., 1919, 1, 311—312.

IRON pyrolignite solution contains ferrous acetate together with iron salts of other volatile acids and iron in combination with tarry substances. Silica, calcium sulphate, and total iron are determined in the incinerated residue from 10 c.c. of the solution. The total acidity, expressed as acetic acid, is found by treating a portion of the solution with an excess of standard alkali solution, diluting the mixture to a known volume, and titrating the excess of alkali in an aliquot portion of the clear supernatant liquid. Volatile acidity is determined by distillation with phosphoric acid. The volatile acidity is calculated into ferrous acetate and the residual iron is expressed as ferrous hydroxide. The sum of the ferrous acetate, ferrous hydroxide, silica, and calcium sulphate is deducted from the total solids of the liquid (dried at 110° C.), and the difference gives the amount of tarry substances and non-volatile acids combined with the ferrous hydroxide. —W. P. S.

[*Colloids.*] *Coagulation process.* H. R. Kruyt and J. van der Spek. Kolloid Zeits., 1919, 25, 1—20.

THE coagulation value of univalent ions for arsenic sulphide sols increases with increasing dilution of the sol; it decreases for divalent and trivalent ions, but only to a slight degree in the former case. Sodium hydroxide and disodium phosphate act irregularly with ferric hydroxide sols. (See also J. Chem. Soc., Dec., 1919.)—J. F. S.

Sulphur. Microscopical crystallisations. J. Scott. Chem. Trade J., 1919, 65, 413—414.

A NACREOUS form of sulphur can be obtained by heating sulphur to 150° C. and cooling to 98° with scratching of the tube containing it. A new form of colloidal sulphur is obtained by adding a solution of sodium thiosulphate to cold sulphuric acid. The liquid is diluted, heated, and filtered through glass wool. A cloudy yellow mass is left which on warming becomes clear and transparent, but on cooling becomes turbid again. The sulphur occurs in minute glistening globules without any crystalline structure.—J. F. S.

Lime recovery. Hope. *See* V.

Titration of acids. Meerburg. *See* XXIII.

PATENTS.

Fuming sulphuric acid; Production of high strengths of ——. British Dyes, Ltd., J. Turner, and W. B. Davidson, Huddersfield. Eng. Pat. 132,923, 1.11.18. (Appl. 17,872/18.)

IN the contact process for producing sulphuric acid the hot oleum containing 20—40% SO_3 from the first absorber following the contact chamber is passed through a coil inside a heat exchanger, in which the hot gases from the contact chamber are utilised to liberate the sulphur trioxide from the sulphuric acid. The oleum passes into an expansion chamber from which the hot sulphur trioxide gases are conducted into a jacketed absorber containing oleum of 20—40% SO_3, which is thus strengthened up to 40—80% SO_3. The stripped oleum from the expansion chamber is returned to the absorption plant.—W. J. W.

Potassium permanganate; Process of manufacturing ——. C. Dreyfus and J. J. Bloch, Manchester. Eng. Pat. 132,842, 24.8.18. (Appl. 13,793/18.)

A SOLUTION of potassium chloride or sulphate is added to a solution of sodium permanganate, prepared electrolytically from sodium manganate, and potassium permanganate is crystallised out from the mixed solutions. The solutions should preferably be saturated, and the potassium salt may be added in the theoretical proportion. (Reference is directed, in pursuance of Sect. 8, Sub-sect. 2, of the Patents and Designs Act, 1907, to Eng. Pat. 126,756; this J., 1919, 462 A.)—W. J. W.

Potash-bearing minerals; Extracting potash from —— *and manufacture of residual products of such conversion into cement.* A. C. Auden, London. Eng. Pat. 132,855, 23.9.18. (Appl. 15,431/18.)

SILICATES of aluminium and potassium, such as orthoclase felspar, pegmatite, mica, etc., and of iron and potassium, such as glauconite, are crushed and sifted, mixed with lime and salt in suitable proportions, and ground. The mixture is heated in a furnace and then lixiviated, if the mineral was an aluminium-potassium silicate, or, in the case of iron-potassium silicates, treated with steam and hot water in an autoclave with agitation. After passing the mixture through a filter press the potassium salts are recovered from the liquor by evaporation. The press-cake is milled with unslaked lime and alum, roasted, and mixed with 1½ to 2 % of gypsum to render it less quick-setting. —W. J. W.

Sulphur; Process for the separation of —— *from furnace gases.* C. C. Collins, Kellys Ford, Va., Assignor to C. A. Stevens, New York. U.S. Pat. 1,314,634, 2.9.19. Appl., 18.11.16.

THE dried gases are cooled in two stages, first to a temperature slightly above and then to the condensation point of sulphur; the gases are in contact with collecting material during the latter stage.—W. E. F. P.

Sulphur from ore; Process of extracting ——. J. Coffeen, Assignor to I. Brady, Chicago, Ill. U.S. Pat., 1,314,856, 2.9.19. Appl., 24.5.19.

THE ore mass is heated to melt the sulphur and allowed to cool; it is then washed to remove "mud," after which the sulphur is extracted. W. E. F. P.

Sulphur from metal sulphides; Process for the extraction of ——. M. Helbig, Fredriksstad, Norway. U.S. Pat. 1,315,496, 9.9.19. Appl., 15.4.19.

A SULPHIDE is heated with a silicious flux, carbonaceous material, and a phosphate, whereby the phosphorus of the phosphate combines with the metal of the sulphide and sulphur is liberated. —W. E. F. P.

Sulphur from low-grade ores; Apparatus for fusing ——. P. P. Austin, jun., Freeport, Tex. U.S. Pat. 1,315,940, 16.9.19. Appl., 11.10.18.

AN airtight chamber, into the lower part of which sulphur ore is conveyed, is heated internally by a system of horizontal radiator pipes through which superheated steam or gas is passed. A central, horizontal diaphragm extends across the middle of the chamber and is provided with openings through which heated gas is circulated over the ore and back over the radiator pipes.—W. E. F. P.

Cooling of air; Process for the preliminary —— *in apparatus for the liquefaction and fractionation of air.* Messer und Co., G.m.b.H., Frankfort. Ger. Pat. 300,041, 12.7.14.

THE perfectly dry gas discharged from the apparatus is passed in a fine state of division into a

water bath. The resulting cooling due to evaporation of water into the dry gas is utilised to cool the compressed air passing to the liquefier.
—J. S. G. T.

Oxygen and nitrogen from liquid air; Process and apparatus for the production of —— in a fractionating column. "Industriegas" Ges. für Sauerstoff u. Stickstoff-Anlagen, Berlin. Ger. Pat. 312,639, 30.7.13.

Air is passed into the fractionating column through a pipe in the side and passes upwards through a spiral coil contained in a chamber above the fractionating column, the coil being immersed in a bath of liquid air rich in nitrogen. Any gas escaping from the bath is cooled, compressed, and returned to the bath in liquid form. The air ascending the coil is liquefied. The liquid so produced flows back into the fractionating column and is again vaporised. When the apparatus is in full operation nitrogen passes out from the coil immersed in the bath of liquid air rich in nitrogen and oxygen from an exit pipe at the base of the fractionating column.—J. S. G. T.

Thorium compounds; Extraction and purification of ——. Processes for the separation of thorium compounds from material containing the same. Lindsay Light Co., Assignees of L. W. Ryan, Chicago, U.S.A. Eng. Pats. 127,555 and 129,624, 14.3 and 4.4.19. (Appls. 6456 and 8595/19.) Int. Conv., 29.5 and 8.7.18.

See U.S. Pats. 1,307,152-3 of 1919; this J., 1919, 576 A.

Nitrates; Production of —— from ammonia, ammonium compounds, or organic nitrogen compounds by means of bacteria. C. T. Thorssell and H. L. R. Lundén, Gothenburg, Sweden. Eng. Pats. 132,882 and 132,883, 26.9.18. (Appls. 15,668 and 15,671/18.)

See U.S. Pats. 1,286,838 and 1,288,756 of 1918; this J., 1919, 134 A.

Calcium carbide; Manufacture of ——. F. M. Becket, Niagara Falls, N.Y., U.S.A. Eng. Pats. 133,354 and 133,355, 30.4.18. (Appls. 7239 and 7240/18.)

See U.S. Pats. 1,292,386-7 of 1919; this J., 1919, 286 A.

Charging oxygen cylinders. U.S. Pat. 1,314,773. *See* I.

Gold etc. from sea water. Eng. Pat. 114,316. *See* X.

Bismuth compounds. Eng. Pat. 119,659. *See* X.

Sulphide ores. Ger. Pat. 313,122. *See* X.

Chrome compounds. Eng. Pat. 132,864. *See* XV.

Detecting gases. U.S. Pat. 1,305,025. *See* XXIII.

VIII.—GLASS; CERAMICS.

Glass-melting tanks; Resistance of firebricks used in ——. J. Baldermann. Sprechsaal, 1919, 52, 285—286.

Among the chief causes of the destruction of the firebricks in glass-melting tanks are a too coarse-grained structure and the presence of quartz particles disseminated through the brick. The quartz enters into solution in the glass and causes further troubles. The greatest corrosion occurs at the surface of the molten glass, and the bricks on this level should be of the same material as that used for making glass-pots, viz., a mixture of relatively fine grog and clay.—A. B. S.

Sagger manufacture; Economies in ——. H. Herda. Keram. Runds., 1919, 27, 237—238, 249—250, 259—260, 267—268, 275—276, 285—286.

The relative weights of saggers and their contents vary greatly in different potteries. Light saggers may be dried more quickly and under better conditions than heavier ones, and hence are more durable. A series of mixtures recommended for the manufacture of saggers is given. The fat clay, which is added to make the mixture easier to work and to increase the strength of the saggers, should be of such a nature and be used in such proportion as to coat the non-plastic particles and to fill the interstices between them; the volume required is roughly equal to that of the voids in the volume of grog used. With insufficient fat clay, the saggers are brittle and tend to spall, whilst with an excess they shrink unduly. The clay should be reduced to its ultimate particles, and it must therefore be used in a perfectly dry state. It may be dried on a floor heated by steam or kiln-gases, large lumps being broken so as to ensure each piece of clay being completely dried without being spoiled by overheating. The custom of drying the clay around the ovens is undesirable, as it involves too much labour and the clay is easily soiled. The paste usually remains 15—20 mins. in the grinding mill, this being more convenient than two separate mill-treatments or a milling followed by a pugging. The paste should be conveyed mechanically to the sagger-makers. There is no real advantage in making the bottom of the saggers slightly curved, but the top edges should be slightly rounded. There is also no advantage in wetting and smoothing the interior of saggers; rather should those which need such treatment be discarded. The chief defect in the manufacture of saggers is due to improper drying. Piling the saggers on one another almost invariably leads to cracks and distortion; the saggers should be placed on separate boards and dried on racks. The drying must be slow; hence a drying room of ample size is essential. Saggers of special shape may often be used with great advantage and economy. Two or more saggers may sometimes be combined, thereby saving 10—15% of space and 7—12% of materials. Such multiple saggers may be made by pressing or preferably by casting. In the latter case the moulds as well as saggers should be transported mechanically. The commonly accepted statement that the largest ovens are the most economical is not always true, as a large oven is more difficult to fire and the proportion of spoilt ware tends to be larger than in smaller ovens. It is also more wasteful to keep a large oven waiting for ware. Moreover, a larger oven needs stronger saggers, and these, in turn, cost more to produce and need more fuel in burning. Smaller ovens are heated more uniformly and require proportionately less repairs than larger ones, and they may usually be fired more rapidly, thus giving a larger output.
—A. B. S.

Fuel consumption of muffle kilns in the enamelling industry. L. Vielhaber. Keram. Runds., 1919, 27, 293—294.

For heating the muffle kilns used in large enamelling works, gas producers have been found satisfactory, but in smaller works half-gas firing is preferred, and many ovens are used in which the half-gas generator forms an integral part. In a test with a muffle kiln, 6 ft. 8 in. by 2 ft. 8in. by 1 ft. 8 in., with a capacity of 1800 kilos. of ware per 24 hours at 950° C., gas-fired from a large producer using 500 kilos. of coal of 7000 cals., the heat actually used in firing the goods was 294,300 cals., heat lost through opening the door 950,000, heat

lost by radiation and in ash-pit 1,186,560, and heat lost in the chimney 883,575 cals., total 3,314,435 cals. The heat actually used in heating the goods was thus only 9% of that theoretically available in the fuel. With so low an efficiency, half-gas firing may be as economical as the use of a large producer.—A. B. S.

PATENTS.

Glass; Apparatus for annealing ——. G. R. Hughes, Great Hampden, Bucks. Eng. Pat. 132,852. (Appls. 15,364, 21.9.18, and 9960, 22.4.19.)

A LEHR has a series of separate tracks, each leading from an opening in front of a lamp worker. Each opening is provided with a sliding door opened by means of a pedal, and when the door is opened, gas jets on both sides of it are automatically turned up and heat the cool air which rushes through the opening. This prevents the temperature of the lehr from being seriously lowered. When the door is shut the gas-jets are lowered again.—A. B. S.

Glass and method of making the same. B. F. Drakenfeld, jun., New York. U.S. Pats. (A) 1,303,268, and (B) 1,303,269, 13.5.19. Appl., 1.10.18.

(A) AMBLYGONITE or similar minerals containing lithium and fluorine are added to a glass batch to reduce the coefficient of expansion and improve the toughness and gloss of the glass. From 1 to 5% of the lithium mineral is used for bottle-, window-, or plate glass, and up to 50% for opaque, translucent, or special glasses. Batches for pottery glazes and enamels may be treated in a similar manner. (B) Spodumene or other mineral containing lithium and aluminium is added to a glass batch in the proportion specified under (A). The viscosity and coefficient of expansion of the glass are reduced and the toughness increased.

Drying stoves [for pottery]. R. H. Wainford, Trenton, N.J., U.S.A. Eng. Pat. 132,948, 3.12.18. (Appl. 19,994/18.)

IN a drying stove for pottery the ware is carried on cradles attached to a pair of endless parallel chains through a series of compartments formed by vertical partitions in the drying chamber, and is exposed to currents of heated air rising through each compartment. The outer compartments may be provided with a supplementary heating device. —A. B. S.

Ceramic materials [refractories]; Process for burning ——. H. Koppers, Essen. Ger. Pat. 312,213, 4.9.17.

A FURNACE is provided with a preheating zone and a cooling zone, and the firing zone proper is heated by gas from a producer directly connected thereto; the producer is of the type in which the clinker is tapped off in the molten condition. The necessary high temperature for burning can thus be attained without the use of an excessive quantity of air, and the fired material (silica brick) is cooled very slowly.—J. S. G. T.

Glass objects; Manufacture of ——. O. Imray, London. From Treuhand-Vereinigung A.-G., Berlin. Eng. Pat. 133,071, 14.6.17. (Appl. 8559/17.)

Clay rings for inverted incandescence gas mantles; Manufacture of ——. C. Mayer, and Welsbach Light Co., Ltd., London. Eng. Pat. 133,437. (Appls. 16,432, 9.10.18 and 6791, 18.3.19.)

Kilns. C. H. Zwermann, Kalamazoo, Mich., U.S.A. Eng. Pat. 128,180, 1.10.18. (Appl. 15,971/18.) Int. Conv., 8.6.18.

SEE U.S. Pat. 1,275,352 of 1918; this J., 1918, 656 A.

IX.—BUILDING MATERIALS.

Wood; Phenomena of drying ——. H. D. Tiemann. J. Franklin Inst., 1919, 188, 27—50.

AN account is given of the internal stresses which occur in wood during the progress of drying from the green condition, and the relationship between them is shown mathematically. The physical properties by which the various stresses are affected are also briefly discussed.—W. E. F. P.

PATENTS.

Cement or lime trass mortar; Treatment of articles or plastering containing ——. L. A. Sanders, Amsterdam, and A. J. Sanders, Sloten, Holland. Eng. Pat. 102,042, 26.4.16. (Appl. 5996/16.) Int. Conv., 3.11.15.

ARTICLES or plastering of cement, concrete, lime-trass mortar, etc., with or without the admixture of finely divided metals, such as iron filings or ores or titanic acid, are treated with a solution or suspension of a metallic salt, such as iron, copper, zinc, nickel, or lead sulphate, acetate, chromate, or chloride, whereby a colouring and hardening coating is produced. When reducing metals are incorporated in the mortar a direct metallisation of the surface may be produced and the coating may afterwards be galvanised. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 2048 and 3006 of 1868, 4101 of 1881, 4954 of 1883, 19,395 of 1892, 8626 of 1897, and 7836 and 27,804 of 1902; this J., 1893, 269; 1897, 251; 1903, 698, 867.)—A. B. S.

Cement; Method of manufacturing ——. B. Bäärnhielm, Stockholm. Eng. Pat. 121,728, 30.10.18. (Appl. 17,717/18.) Int. Conv., 24.12.17.

PORTLAND cement is mixed with the finely ground ashes produced by burning alum slate, in the proportion of 1:1 or 1:2. The lime set free when the cement is mixed with water combines with the soluble silica etc. present in the ashes, forming insoluble silicates.—A. B. S.

Keene's cement; Manufacture of ——. J. C. Best, Assignor to The Best Bros. Keene's Cement Co., Medicine Lodge, Kans. U.S. Pat. 1,304,148, 20.5.19. Appl., 6.5.18.

A "SUPERFINE grade" of Keene's cement, which is slow setting, has no effect on colours, and is suitable for the production of artificial marble and scagiola, is obtained by burning gypsum at a temperature reaching at least 1200° F. (650° C.), mixing the burnt product with a neutral catalyst, *e.g.*, 1% of potassium sulphate, and grinding to 150-mesh size.

Wood; Treatment of —— for seasoning it. M. P. Otto, Paris. Eng. Pat. 133,263, 29.4.19. (Appl. 10,605/19.)

THE wood is placed on trucks which pass progressively through a tunnel, in which the wood is subjected to a current of hot air, then to one of ozone, and finally to a mixture of hot air and ozone. —A. B. S.

Heat-insulator. H. Mock, New Brighton, N.Y. U.S. Pat. 1,297,583, 18.3.19. Appl., 19.4.17.

A HEAT-INSULATING material comprises cellular sulphur obtained, for example, by heating a mixture of powdered sulphur and sodium chloride until the sulphur fuses, and, after cooling, treating the resulting block with water to dissolve out the sodium chloride. The cellular condition may alternatively be produced by blowing air into the molten mass. Inert fillers, such as magnesium carbonate, may be incorporated with the molten material, and a small quantity of gum, resin, or wax may also be added.

Building material; Composite ——. E. Viens, Nepean township, Ont. U.S. Pat. 1,314,772, 2.9.19. Appl., 2.6.19.

A RESILIENT, fireproof building material is composed of Portland cement, a non-combustible fibre, hydrated lime, a silicious material, and sawdust. —W. E. F. P.

Monolithic structures of basalt or other volcanic rock; Construction of ——. F. Ribbe, Mauriac, and P. Dhe, Paris, France. Eng. Pat. 133,440, 9.10.18. (Appl. 16,456/18.)

Asphalt-limestone: Manufacture of artificial ——. C. L. V. Zimmer, Berlin-Wilmersdorf, Germany. Eng. Pat. 11,331, 5.8.15. Int. Conv., 8.9.14.

SEE U.S. Pat. 1,237,852 of 1917; this J., 1917, 1095.

Potash and cement. Eng. Pat. 132,855. *See* VII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron; Penetration of —— by hydrogen. T. S. Fuller. Trans. Amer. Electrochem. Soc., 1919, 77—93. [Advance copy.]

THE effect of various conditions on the penetration of iron by hydrogen was determined by generating hydrogen on the outside of a closed iron tube and measuring the volume of gas penetrating to the inside. In 1% sulphuric acid the velocity of penetration was greater for tubes immersed without electrical connections (*i.e.*, as in pickling) than for tubes employed as cathodes; and the rate for the latter increased with the current employed. The velocity increased with each successive electrolysis (in the absence of rest periods) or pickling; but in both cases the original resistance of the iron to the passage of hydrogen was restored by periods of rest or moderate heating. Temperature had a marked effect in increasing the rate of penetration. For tubes electrolysed in 1% solutions of potassium sulphate and sodium hydroxide and in tap water, the velocities of penetration were one-twelfth to one-fifteenth of the velocities for tubes electrolysed in 1% sulphuric acid. Hydrogen produced by reaction between iron and steam or iron and tap water at 50°—100° C. penetrated the metal at a rate depending directly upon the temperature. The velocity of penetration for 3% nickel steel was the same as that for iron; and the rate for tinned iron was greater, and that for galvanised, sherardised, and coppered iron less, than the rate for plain iron. Copper was not penetrated by hydrogen at 20° C. As to the manner in which hydrogen is forced through iron tubes having walls $\frac{1}{8}$ in. thick, it is concluded that the atomic hydrogen liberated penetrates the surface of the metal and then assumes the molecular form which can only escape very slowly; so that sufficient pressure to force the gas through the metal is gradually accumulated. Such pressures are also responsible for the cracking of hardened steel when the latter is pickled in acid. —W. E. F. P.

Steel; Microstructure of very low carbon ——. R. E. Bedworth. J. Franklin Inst., 1919, 188, 407—408.

"ARMCO" iron shows an unusual structure when quenched from between 832° and 899° C., which has been attributed to a eutectoid thrown out of solution between these temperatures (see Brooke and Hunting, this J., 1917, 1096). A series of exceptionally pure steels with carbon from 0·02 to 0·10% was made by fusing electrolytic iron and carbon in a vacuum furnace. On quenching within the critical range the eutectoid structures were produced. The so-called eutectoid is not caused by impurities, but represents the transformation product of the austenite which is stable at the quenching temperature. When very low-carbon steel is quenched from above A3 the carbon is present as sorbitic needles in the cleavage planes of the original austenite. Prolonged annealing just below A1 causes the transformation of the needles into minute globules of cementite. By heating to just above A1 and cooling slowly, the sorbite is changed to uniformly distributed small grains of pearlite.—T. H. Bu.

Steel; Inclusions and ferrite crystallisation in ——. E. G. Mahin. J. Ind. Eng. Chem., 1919, 11, 739—745.

PORTIONS of an open hearth steel rail were subjected to different heat treatments, and the microstructure of the treated metal examined. The orientation and relative positions of inclusions appear to be unaltered by repeated heating and cooling through the transformation range, and by protracted heating at 1100° C. followed by slow cooling. Only in exceptional cases does a ferrite band survive long soaking at 1100°C. and the long well-formed bands disappear when iron phosphide has diffused fairly uniformly. The recurrence of ferrite ghosts after repeated heat treatment which would break up ordinary carbon segregation is due largely to phosphide banding, which is little changed by ordinary treatment. Even after the phosphide distribution has been made uniform, repeated heating followed by slow cooling leaves inclusions surrounded by ferrite. The explanation offered for the segregation of the ferrite around the inclusions is that the inclusion exists in very dilute solution in a limited zone surrounding the particle and the solubility of iron in this zone is thereby lowered in some degree.—T. H. Bu.

Carbon steels; Influence of manganese on the physical properties of ——. T. Matsushita. Sci. Rep. Tôhoku Imp. Univ., 1919, 8, 79—88.

FOR a steel containing 0·2% C and varying contents of manganese the following are the constants observed for the thermal conductivity (k), electrical conductivity (σ), modulus of elasticity (E), modulus of rigidity (n), and coefficients of expansion at various temperatures.

Mn, %	k.	σ ($\times 10^{-5}$)	E. ($\times 10^{-12}$)	n. ($\times 10^{-11}$)	Coefficient of expansion ($\times 10^{6}$) at: — 100° C.	500° C.	800° C.
0·11	0·1298	6·75	2·105	7·98	1·26	1·54	1·99
0·31	0·1108	5·72	2·085	7·91	1·23	1·48	1·96
0·6	0·1007	5·26	2·082	8·00	1·15	1·48	2·01
0·8	0·0953	5·01	2·125	8·00	1·16	1·47	1·96
1·1	0·0985	4·83	2·150	8·20	1·18	1·52	2·04
1·6	0·0851	4·46	2·150	8·22	1·28	1·53	2·10
2·0	0·0755	3·80	2·125	7·94	1·34	1·57	2·12
3·0	0·0622	3·24	2·118	7·72	1·35	1·57	2·19
5·0	0·0440	2·33	2·050	7·63	1·29	1·55	2·26
6·9	—	—	2·040	7·83	1·25	1·56	2·35
7·9	0·0371	1·85	2·030	7·87	1·47	1·80	2·35
8·8	0·0351	1·89	2·055	7·92	1·62	2·19	2·84
9·8	0·0354	1·82	2·185	8·20	1·68*	2·20*	2·38

* When in the pearlitic condition the values are $1·20 \cdot 10^{-6}$ at 100° C. and $1·58 \cdot 10^{-5}$ at 500° C.

—F. C. Th.

Silver refining; Application of the Cottrell process to the recovery of fume from ——. W. G. Smith and A. A. Heimrod. Chem. and Met. Eng., 1919, 21, 360—363.

THE electrical precipitation installation at the Raritan Copper works, Perth Amboy, N.J., is installed at the end of a long flue system which includes a large settling chamber and scrubbing apparatus. Three units, each with a capacity of 4000 cub. ft. of gas per min. at a velocity of 7 ft.

per min., are provided, each unit consisting of a steel framework supporting lead top and bottom headers connected by lead precipitator pipes. All parts of the precipitator which come in contact with the gases are lined with lead free from antimony, as the gases, which contain selenious and selenic acids, destroy lead containing as little as 0·1 % Sb. Each unit contains 30 collecting electrode pipes, 16 ft. long. The four corner pipes are 11 in. diam., and exert a stiffening effect on the system, while the remaining pipes are 8 in. diam. The inlet to each unit may be closed by a liquid-sealed "jug" damper, which facilitates cleaning out by a washing system installed in the top header. Lead-covered iron of star section round which similar lead-covered wire is wrapped spirally, is accurately centred in the pipes, and is supported from 2 in pipe bus bars, the bottom of the electrode system being tied together by a sway frame. The available power supply is transformed to a potential of 65,000 volts at the base of the precipitator. The precipitator, when clean, removes practically the whole of the "fume" from the gases, and overloading of the pipes is readily indicated by the general operation and by the switch-board instruments.—C. A. K.

Tungsten steels; Some physical constants of ——. K. Honda and T. Matsushita. Sci. Rep., Tôhoku Imp. Univ., 1919, **8**, 89—98.

The following figures have been determined:—

	0·3% C.		0·6% C.		C.			n.			Coefficient of thermal expansion (× 10^6) 0·3% C.			0·6% C.		
% W.	k.	σ	k.	σ	0·3% C.	0·6% C.	0·6% C.*	0·3% C.	0·6% C.	0·6% C.*	100° C.	500° C.	850° C.	100° C.	500° C.	850° C.
0	0·1092	6·06	0·1009	5·15	2·090	2·120	2·115	8·17	8·28	8·28	1·24	1·54	1·98	1·24	1·59	2·13
0·5	0·1002	5·46	0·0893	4·68	2·117	2·145	—	8·22	8·32	—	1·16	1·50	1·90	1·19	1·51	2·13
1	0·0982	5·20	0·0860	4·67	2·122	2·167	—	8·30	8·38	8·28	1·14	1·49	1·96	1·16	1·47	2·09
2	0·0961	4·90	0·0835	4·58	2·120	2·185	—	8·33	—	—	1·11	1·46	1·91	1·15	1·45	2·05
3	—	—	0·0850	4·64	2·125	2·190	2·115	8·32	8·54	8·28	1·11	1·49	1·92	1·22	1·47	2·03
5	0·0933	4·75	—	—	2·150	—	—	8·38	—	—	1·15	1·54	1·86	—	—	—
6	0·0925	4·77	0·0850	4·58	2·156	2·200	2·130	8·40	8·55	8·28	1·14	1·54	1·85	1·21	1·48	1·96
10	—	—	0·0795	4·35	2·210	2·225	2·156	—	8·65	8·38	1·14	1·46	1·77	1·19	1·44	1·91
15	0·0775	3·90	0·0738	4·04	2·272	2·283	2·175	8·82	8·86	—	1·16	1·41	1·70	1·19	1·40	1·90
20	0·0645	3·36	0·0660	3·56	2·310	2·325	—	9·02	9·08	8·82	1·13	1·37	1·68	1·17	1·39	1·91
25	0·0527	2·70	0·0552	3·05	2·350	2·380	2·290	9·20	9·28	9·08	1·14	1·33	1·64	1·15	1·37	1·82

k = Coefficient of thermal conductivity.
σ = „ electrical conductivity (10^{-4}).
E = modulus of elasticity (10^{12}).
n = Modulus of rigidity (10^{11}).
* Rapidly cooled from 1000° C.

— F. C. Th.

Amalgams. II. Colloidal gold amalgam. C. Paal and H. Steyer. Kolloid Zeits., 1919, **25**, 21—26.

The gold amalgam sol previously described (ibid 1918, **23**, 145) is partially oxidised by the air, and changes its colour to a somewhat browner tint than that of the fresh sol. It may be brought back to its original colour by the addition of a few drops of hydrazine hydrate solution. A small quantity of the sol was kept in solution for 22 weeks, and in this period became more fiery red in colour and deposited a heavy grey gel. The remaining solution was dried *in vacuo*, and gave a dark violet substance which was in the form of laminæ with a bronze tint; it was completely soluble in water and had the composition $AuHg_{0\cdot24}$. The gel contained 5·32% of lysalbinic acid, which had been used as a protecting colloid, and had the composition $AuHg_{0\cdot4}$. It was non-reversible.—J. F. S.

Copper concentrate; Nodulising ——. O. Lachmund. Bull. Canadian Min. Inst., Sept., 1919, 950—954.

The best method for the preparation of copper concentrate, derived from the flotation process, for blast-furnace practice, consists in nodulising it by passing it through a revolving cylindrical furnace or kiln. The loss of fines from dusting is practically nil. Pulverised coal can be used successfully as fuel, and in this form inferior grades of coal may be employed. The sulphur retention is under better control when pulverised fuel is used. It is estimated that the cost per ton of concentrate nodulised should not exceed 50 cents or, including overhead expenses etc., 1 dollar per ton. The capacity of a kiln 100 ft. long by 7 ft. internal diameter should be about 100 tons of concentrate per 24 hours. T. H. Bu.

Tin; Analysis of alloys of —— . A. Craig. J. Ind. Eng. Chem., 1919, **11**, 750—753.

After decomposing the sample with nitric acid, and filtering, the filtrate is treated with sulphuric acid for the separation of lead sulphate. The tin precipitate is ignited to constant weight in a muffle, and may be treated with nitric acid and again ignited to ensure complete oxidation. The residue is covered with sulphur fusion mixture (K_2CO_3 14, Na_2CO_3 10, S 10 parts), fused, leached, filtered, and ignited, and the copper and the iron are dissolved out with hydrochloric acid. The residue contains stannic oxide, but must be corrected for silica etc. and for tin in the solution. The acid solution is evaporated with sulphuric acid, and any lead sulphate precipitated is added to that previously separated and the lead dissolved by means of ammonium acetate and determined as chromate. The alkaline filtrate from the sulphur fusion contains the antimony. Arsenic and phosphorus are best determined in separate portions of the sample. The acid filtrate from the lead sulphate is electrolysed for copper. Hydrogen sulphide is passed into the spent electrolyte, the precipitate containing copper and tin, the respective weights of which are added to the main quantities. Manganese, iron, aluminium, nickel, and zinc are left in the filtrate. The iron and aluminium may be separated by the basic acetate method from an almost neutral solution, as nickel is present only in small quantity. Manganese is precipitated in the filtrate from the iron by means of ammonium persulphate. The nickel is separated from the zinc by dimethylglyoxime, or the zinc precipitated by Treadwell's salting-out method.

T. H. Bu.

[Aluminium] dust explosions. G. Bauer. Z. ges. Schiess- u. Sprengstoffw., 1918, **13**, 272—273. Chem. Zentr., 1919, **90**, II., 905.

An apparatus is described for determining the explosive limits of mixtures of inflammable dusts and air, consisting of a chamber of known capacity

containing a fan and electrical igniting device. Using aluminium dust, and slowly adding more dust, explosion first took place with a mixture containing 0·01387 kilo. of aluminium to 0·0416 kilo. of air.—W. P.

Electrodeposited metals; Factors governing the structure of ——. W. Blum. Trans. Amer. Electrochem. Soc., 1919, 57—76. [Advance copy.]

From the results of experiments based largely on the "axioms of electroplating" formulated by Bancroft (Trans. Amer. Electrochem. Soc., 1904, 6, 27; 1913, 23, 266; also this J., 1904, 1098), the following are suggested as the general principles on which the choice of operating conditions should depend:—*Composition of solutions:* The compound selected, or its solution, should have as many as possible of the properties of high solubility, good conductivity, stability (resistance to hydrolysis, oxidation, or reduction), low metal ion concentration, ability to corrode the anode nearly quantitatively, good "throwing" and covering power, sufficiently low price. For the purpose of improving any of the above, or conferring any other desirable property on the solution, addition agents may be properly employed; but wherever it is possible to accomplish several purposes by the addition of one substance, the latter should be used rather than several different substances. *Current density:* Unless coarse-grained or soft deposits are specially required, the highest current density that will yield satisfactory deposits should be employed. The permissible current density may be increased by suitable agitation of the solution, especially of that portion close to the cathode. *Temperature:* If fine-grained, bright or hard deposits are required, the temperature should be kept as low as convenient, artificial cooling being employed if necessary. The temperature may be allowed to rise if coarse or soft deposits are required. Since the effects of increased current density and temperature are in opposite directions, it is possible to obtain in warm solutions at high current density deposits as fine as those produced in cold solutions with a lower current density.
—W. E. F. P.

Wulfenite; Metallurgy of ——. J. P. Bonardi. Chem. and Met. Eng., 1919, 21, 364—369.

The wet concentration of wulfenite is not difficult, but a number of associated minerals pass into the concentrate, which usually averages 15—20% MoO_3, making further treatment somewhat difficult. Wulfenite has the advantage over molybdenite that gold is frequently associated with it, and gold and lead are recovered in its treatment. Three methods may be used. An acid leach has many disadvantages. An alkaline leach, *e.g.*, with sodium sulphide, is satisfactory, molybdenum going into solution as sodium molybdate, and lead and precious metals remaining in the residue. High-grade calcium molybdate is produced from the solution, and is used for the production of ammonium molybdate or ferro-molybdenum, or added directly to steel. By fusing with soda ash, caustic soda, and coal, lead is recovered in the form of bullion, and sodium molybdate may be leached from the slag. As 90% extraction could be obtained in practice, the process is commercially feasible.
—T. H. Bu.

Electric furnaces; Commercial testing of metallurgical ——. H. M. St. John. Chem. and Met. Eng., 1919, 21, 377—392.

After a comparatively short intensive test, during which time the best operating conditions are determined, routine work under these conditions is continued for an extended period, and a full log of the behaviour and output of the furnace is recorded. Energy consumed should be measured on a watt-hour meter, preferably of a recording type, and thermo-couples or other reliable form of instruments are employed to record the temperature of the molten metal after pouring. Metallurgical losses are determined by direct weighing and analysis of the charge and product. Maintenance costs and renewals cannot be estimated in the time limit of a carefully conducted test, but the detailed notes may be summarised and a judgment arrived at as to the suitability, reliability, output, electrical and metallurgical characteristics, power and thermal efficiencies, and labour costs involved.
—C. A. K.

Metals; Variation of the specific heat during melting and the heat of fusion of some ——. J. Iitaka, Sci. Rep. Tôhoku Imp. Univ., 1919, 8, 99—114.

The following latent heats of fusion are given: Bi 12·24, Pb 5·53, Sn 13·38, Zn 23·1, S 13·2, Na 26·0. The specific heats of the liquid metals examined are practically constant at all temperatures used, the values being Bi 0·0356, Pb 0·0340, Sn 0·0615, Zn 0·121, S 0·199, Na 0·347. Bismuth, zinc, and sodium show a sudden rise in specific heat in melting, while lead and tin show a small fall.—F. C. Th.

Patents.

Manganese-steel sheets; Manufacture of —— *and helmets made therefrom.* R. A. Hadfield, London. Eng. Pat. 133,131, 27.9.18. (Appl. 15,760/18.) Int. Conv., 17.8.17.

A plate or slab of sound manganese-steel is reduced to a thin sheet by a series of rolling operations at 1050°—1080° C., the last rolling being finished while the sheet is at a temperature of about 850° C. The sheet so produced is annealed, heated to 950°—1050° C. for a few minutes, and quenched. Helmets or other shaped pieces may be made by cutting blanks from the annealed sheets, tempering the blanks, and pressing to the desired shape.—C. A. K.

Iron sheets; Method of producing —— *by electrical deposition.* J. H. Proctor, Wilkinsburg, Pa., Assignor to Westinghouse Electric and Manufacturing Co. U.S. Pat. 1,300,296, 15.4.19. Appl., 7.9.17.

A composite coherent sheet is obtained by depositing a layer of iron, applying to this by painting or burnishing a coating of an oxide which will not be affected by the annealing process, then applying a coating of graphite, and repeating these operations until the desired thickness is attained.

Steel and other metals; Method and compound for welding ——. H. L. Siever, Erie, Pa. U.S. Pat. 1,315,611, 9.9.19. Appl., 5.3.19.

The welding compound contains 10 to 20% of vanadium, 20 to 40% of manganese, 25 to 50% of iron, 0·5 to 5% of chromium, 0·5 to 8% of tungsten, 0·5 to 3% of silicon, and a suitable flux such as 5 to 25% of burnt borax.—T. H. Bu.

Metal objects such as steel balls and the like; Method of testing the surface structure of ——. Deusche Waffen- u. Munitionsfabriken, Berlin. Ger Pat. 301,211, 31.8.16.

Metal objects are subjected for a short time to the action of a very dilute etching fluid, and from the range of colorations produced on the surface definite conclusions may be drawn as to the presence of troostite and martensite. In the method hitherto used the action of the reagent is continued until the polished surface is deeply etched, and the object is thereby injured.—C. A. M.

Gold, silver, and radium; Process for recovery of —— from extremely dilute solutions, particularly sea-water. E. Baur, Zürich, Switzerland, and C. Nagel, Vienna. Eng. Pat. 114,316, 22.3.18. (Appl. 5104/18.) Int. Conv., 18.1.17.

GOLD, silver and radium are recovered from extremely dilute solutions, particularly sea water, by adsorption by adding a colloidal solution of graphite which is then flocculated by means of a positive sol such as a sol of hydrated ferric oxide. —T. H. Bu.

Zinc sulphide ores; Desulphurisation of ——. G. Rigg, Melbourne, Australia. Eng. Pat. 119,223, 15.7.18. (Appl. 11,588/18.) Int. Conv., 30.10.17.

THE complete desulphurisation of granular zinc ores in reverberatory or muffle furnaces has been found difficult, the grains being left with an unoxidised "kernel," whilst roasted fine slimes are unsatisfactory in the after process of reduction. Satisfactory desulphurisation of coarsely granular zinc blende may, however, be attained by roasting in two stages. The blende is first subjected to a partial roast in a multiple-hearth furnace, and complete desulphurisation is effected in a "blast roaster," *e.g.*, a Dwight-Lloyd machine, in which air is drawn or forced through the heated partially roasted ore. A proportion of raw ore may be added at this stage to facilitate ignition, and induce sintering of the ore, the temperature of the mass being maintained below the point at which fusion or slagging would occur, by the introduction of steam. The gases from the blast roaster may be passed over the ore in the hearth roaster in order to increase the sulphur dioxide content. —C. A. K.

Bismuth compounds and metallic bismuth; Manufacture of —— free from arsenic. N. Busvold, Holmestrand, Norway. Eng. Pat. 119,659, 30.9.18. (Appl. 15,862/18.) Int. Conv., 3.10.17.

THE material containing arsenic and bismuth is dissolved in acid, and a partial precipitation made by a sulphide forming precipitant, added in sufficient quantity to convert the antimony into sulphide, the solution is filtered, and the filtrate treated to recover bismuth. The partial precipitation may be effected by a solution of an impure bismuth sulphide or a sulphide bismuth ore. Starting from sulphide bismuth ore a quantity of acid may be added, which is insufficient for complete solution, the solution filtered, and the filtrate treated to recover bismuth or bismuth compounds.—T. H. Bu.

Ores or the like; Process for sulphatising ——. J. G. and C. J. G. Aarts, Dongen, Netherlands. Eng. Pat. 119,867, 28.9.18. (Appl. 15,830/18.) Int. Conv., 10.10.17.

METAL sulphides or sulphide ores, mixed with an iron compound or other catalyst, are roasted at a temperature at which the sulphides are completely oxidised. The roasted material is then exposed to the roaster gases, containing sufficient oxygen, at a temperature below that at which the metal sulphate is decomposed, but above that at which the action of the catalyst is appreciable in the formation of sulphur trioxide from sulphur dioxide and oxygen. The roaster gases may move in a current parallel to the direction of the completely roasted material through a zone in which the temperature is gradually decreased. By sulphatising at suitable temperatures, the separation of different constituents of an ore may be effected. In the case of zinc, blende roasting is effected at about 900° C., and treatment with the roaster gases at a temperature decreasing from 800° to 500° C.—C. A. K.

Aluminium alloys. O. S. Wigan and W. Grover, London. Eng. Pat. 132,411, 6.12.18. (Appl. 20,292/18.)

ANTIMONY or bismuth or both are added to aluminium-copper-tin alloys to obtain alloys highly resistant to the action of sea water. Preferred compositions are: Al 90—94%, Sn 2—5%, Cu 1—3%, Sb 1—4%; Al 90—94%, Sn 2—6%, Cu 1—3%, Bi 1—3%; Al 90-92%, Sn 1—4%, Cu 1—3%, Bi 1—2%, Sb 1—2%.—T. H. Bu.

Aluminium alloys. A. B. Clarke and H. H. Gregg, London. Eng. Pat. 132,984, 21.3.19. (Appl. 7128/19.)

AN aluminium alloy of bright silver colour, which is readily worked, and which will resist the action of alkalis, consists of Al 100, Pb 5—15, Bi 3—8, Sn 0—4 parts. A satisfactory alloy for general purposes contains Al 100, Pb 9, Bi 4, and Sn 2 parts. An alloy consisting of Al 1 part, Pb 4, Bi 4, and Sn 8 parts is suitable for soldering purposes —C. A. K.

Solder for aluminium and alloys of aluminium. E. A. Leopard, London. Eng. Pat. 132,724, 20.3.19. (Appl. 6985/19.)

A SOLDER for aluminium or aluminium alloys has the composition, tin 55—65% (60%), zinc 26—35% (30%), aluminium 7—15% (10%).—C. A. K.

Blast furnaces; Electric ——. J. Bibby and J. O. Boving, London. Eng. Pat. 132,616, 20.9.18. (Appl. 15,345/18.)

IN order to secure uniformity of heating in all parts of an electric furnace heated by the resistance offered by the charge between pairs of electrodes, the neutral points of the three secondaries of a single three-phase transformer or of three single-phase transformers are connected together. A constant tension is thereby maintained not only between any pair of diametrically opposite electrodes, but also between any other pair of electrodes.

Copper, steel, and other metals and alloys; Casting, working, and other treatment of ——. K. D. Mackenzie and A. C. Barclay, Glasgow. Eng. Pat. 132,847, 20.9.18. (Appl. 15,285/18.)

METAL ingots, bars, or plates are treated with borax over the entire surface after casting or during subsequent heating. It is preferred to use 1 oz. of borax to 1 sq. ft. of metal, so as to give a fused layer of about $\frac{1}{16}$ in. thickness. By this method copper and its alloys may be cast with a much reduced "crinkle" on the exposed surface. —C. A. K.

Rotary furnaces [for carburising and case-hardening]. W. O. Garbutt, Gloucester. Eng. Pat. 132,885, 26.9.18. (Appl. 15,683/18.)

AN inner chamber (preferably cylindrical with horizontal axis) to contain the goods to be heated is supported within a rotary heating chamber by means of many adjustable and removable blocks distributed over the cylindrical surface. The blocks project through openings in the outer chamber, and hold the inner chamber firmly, so that, when in use, the two chambers revolve together, the outer chamber being supported and driven by any suitable means such as tyres and rollers. When it is desired to remove the inner chamber for repairs etc. the supporting blocks are all slacked off, and for some of them blocks carrying rollers are substituted, so that the inner chamber can be moved out on to a truck or stand that may also be provided with rollers. Heat is supplied to the space between the two chambers from a fixed fire-box at one end, gas-tight joints

between the rotary part and the fire-box at one end and the fixed exit flue at the other end being maintained by tongues and grooves or other suitable means. The end of the inner chamber next the fire-box is permanently closed, while the other end is provided with a door, and the material to be treated is maintained at the hotter end of the inner chamber either by providing the latter with low helical ribs as described in Eng. Pat. 125,484 (this J., 1919, 372 A), or by tilting the whole rotating part of the furnace, which for this purpose may be mounted on a suitable frame which is itself supported on friction wheels and tilted in alternate directions, for heating and for emptying, by a worm and quadrant. B. M. V.

Metallurgical furnace. W. O. Borcherdt, Austinville, Va., Assignor to The New Jersey Zinc Co., New York. U.S. Pat. 1,316,267, 16.9.18. Appl., 27.8.18.

The combustion chamber of the furnace has an opening in its roof through which it may be charged when a valve is set in one position, and which is put into communication with a flue when the valve is turned into another position.
—T. H. Bu.

Crucible melting furnace. Basse und Selve, Altena. Ger. Pat. 308,307, 3.10.17. Addition to Ger. Pat. 307,361.

A crucible furnace is provided with a superstructure in which the air required for the fire is preheated by passing through a system of ducts adjacent to ducts for the products of combustion. The products of combustion may finally pass upwards through the charging space above the crucible to preheat a charge before it enters the latter.
—J. H. L.

Furnace for melting metals; Reverberatory ——. E. Meinel, Halle. Ger. Pat. 311,176, 22.6.17.

In a reverberatory furnace the hearth slopes downwards slightly towards the flue end and is divided into two parts. The part near the grate is subject to the direct action of the furnace gases and serves for the melting of the charge. The part near the flue is protected from the furnace gases by an arched roof, over which the gases pass to the flue. This arched roof extends downwards to the hearth itself, leaving only an orifice at the bottom through which the metal from the molten charge, without the supernatant slag, is admitted to the covered portion of the hearth, where, being heated only by radiation from the roof it remains molten without oxidising, and whence it can be withdrawn as required.—J. H. L.

Rabble-arm; Air-cooled —— *for mechanical roasting furnaces etc.* Erzröst Ges. m. b. H., and J. Walmrath, Cologne. Ger. Pat. 312,788, 25.11.17.

The arm is hollow and mounted on a hollow shaft, and a stream of cold air is passed through them. A baffle-plate directs the cold air directly on to the hottest part of the arm. The arm is so shaped and machined that on putting it in place and turning it through 90° it rests tightly and firmly on its seating in the hollow shaft. The wall of the shaft is arranged to protect the connection between it and the stirring arm from furnace dust etc., thus preventing binding and enabling the easy removal and exchange of the stirrer.—B. V. S.

Electro-plating and electro-cleaning apparatus. A. Ness, Glasgow. Eng. Pat. 133,162, 4.10.18. (Appl. 16,142/18.)

A horizontal rotating drum is mounted so as to overhang the mounting pedestal, the lower portion of the drum passing through the electrolyte contained in a tank. An aperture in the free end of the drum permits the entry and removal of articles and allows of circulation of the electrolyte. Longitudinal bars of triangular section are arranged in the drum, so that if the drum is rotated in an anti-clockwise direction the immersed articles are agitated in the electrolyte, but if the drum is rotated clockwise the articles are lifted by the scoop shape of the bar and deposited on to a shoot communicating with a tray out of contact with the solution. The anode is corrugated and of segmental construction, and contact of the cathode with the articles to be treated is made by a number of round-headed bolts through the casing of the drum.—C. A. K.

Coating metals with lead or its alloys. R. W. Thompson, Leith, and J. Morrison, Saltcoats, N.B. Eng. Pat. 133,179, 14.10.18. (Appl. 16,695/18.)

A flux to be applied to the surface of metal before the application of molten lead consists of a solution (28° Tw., sp. gr. 1·14) containing 36% of ammonium chloride, 48% of hydrochloric acid, and 16% of zinc. The solution may be dried and used in the solid state. No preliminary tinning of the metal is required.—C. A. K.

Refractory materials [metals]; Process of making ductile bodies of ——. P. Orance, New York. U.S. Pat. 1,297,000, 11.3.19. Appl., 5.2.17.

An auxiliary binding material (carbonaceous substances or oxides or nitrates of chromium, zirconium, thorium, etc.) in the gaseous form, produced by the volatilisation of suitable electrodes in an electric arc, is admixed with the powdered refractory oxide (*e.g.*, of tungsten, molybdenum, etc.) by the aid of an air blast in a Bessemer converter. The product is moulded and reduced, whereby the refractory metal is obtained in ductile form suitable for drawing into filaments.—T. H. B.

Molybdenum ores; Separation of ——. T. R. Förland, Haugesund, Norway. U.S. Pat. 1,308,735, 1.7.19. Appl., 4.4.18.

Molybdenum sulphide ore is treated with a current of chlorine gas at a temperature above 268° C., whereby molybdenum chloride is volatilised and may be recovered by condensing the escaping vapour.

Sintering machine., W. M. Davison and G. C. Riddell, Port Pirie, S. Australia. U. S. Pat. 1,315,910, 9.9.19. Appl., 3.8.17. Renewed 12.7.19.

A travelling grate having bars running from front to back, with the top edges bevelled on each side and the cross ribs or frame dropped some distance below the top of the bars, travels over a suction wind-box and beneath a source of heat such as an oil burner.—T. H. Bu.

Ores, furnace products, ore mixtures, and the like; Process of roasting [and sintering] ——. E. B. Kirby, St. Louis, Mo. U.S. Pat. 1,316,726, 23.9.19. Appl., 21.7.14.

Finely-divided ore or other material is confined in a thin sheet in a receptacle, and a gaseous mixture previously heated to the desired degree is passed through it. The percentage of oxygen in the gases is at first restricted so as to prevent sintering, and subsequently the oxygen content is increased to such a degree as to induce sintering.—C. A. K.

Metals; Process for extracting ——. E. Moulton, Salt Lake City, Utah. U.S. Pat. 1,315,982, 16.9.19. Appl., 18.4.16.

An acid and an alkaline solution of a metal are contained in a cell which prevents mixing of the solutions but permits the passage of an electric current from one to the other, the cathode being in

the alkaline solution and the anode in the acid solution.—T. H. Bu.

Ores; Apparatus for [electrically] treating ——. C. Cornwell, Berkeley, Cal. U.S. Pat. 1,316,769, 23.9.19. Appl., 30.6.15. Renewed 24.9.17.

Ore pulp is treated electrically in closed containers divided into compartments by horizontal partitions with connecting passages alternating at opposite ends. Each compartment is fitted with carbon top and bottom plate electrodes, and with a spiral conveyor.—C. A. K.

Tin; Process for removing —— *from iron.* C. P. Tatro and G. Delius, Assignors to B. R. Brierly, Seattle, Wash. U.S. Pat. 1,316,926, 23.9.19. Appl., 11.10.18.

A coating of tin may be removed from iron by subjecting the metal, in contact with carbon, to the action of an alkaline bath.—C. A. K.

Zinc-manganese alloy. T. Goldschmidt A.G., Essen. Ger. Pat. 301,781, 28.5.16.

An alloy of zinc with not more than 1% of manganese is about twice as hard as zinc by the Brinell test, has about 50% more resistance to impact, and in contrast with known zinc alloys can be forged when warm and can also be stamped and rolled. It can serve as a substitute for copper, bronze, and brass. Small quantities of aluminium, silicon, chromium, and nickel may be present in addition to the manganese.—B. V. S.

Zinc alloy, free from tin. T. Goldschmidt A.-G., Essen. Ger. Pat. 301,785, 29.7.16.

Alloys containing about 90% of zinc, along with copper, aluminium, and manganese, the last between the limits of 0·25% and 4%, cast and work well and have mechanical qualities fitting them for use as armatures, bearings, etc.—B. V. S.

Zinc-lead alloy. H. Falkenberg, Weetzen. Ger. Pat. 311,839, 18.10.16. Addition to Ger. Pats. 300,111, 309,695, and 309,955 (this J., 1919, 292 A, 374 A).

The iron content of the alloy specified in the chief patent (Zn 94·9, Pb 3·5, Fe 1·6) may be reduced to 1%. The alloy is prepared by fusing a zinc-iron alloy in a graphite crucible, removing the dross, and then adding the lead, which may range from 1 to 5% in the final alloy.—C. A. M.

Alloy of zinc, copper, and aluminium. R. Stock und Co., Berlin, Marienfelde. Ger. Pat. 312,761, 1.6.15.

The alloy contains 100 parts of zinc, about 3 parts of copper, and about 5 parts of aluminium, the copper and aluminium together varying between 6 and 8·5%. It possesses high tensile strength and resistance to shock, and is suitable for highly stressed parts such as bushes, bearings, and bands for shells and mines.—T. H. Bu.

Sulphide ores and metallurgical products (especially iron sulphide); Process for treatment of —— for recovery of the sulphur combined with the metal. Det Norske Aktieselskab for Elektrokem. Ind. Norsk-Industri-Hypotekbank, Christiania. Ger. Pat. 313,122, 26.8.15. Int. Conv., 29.6.15.

The material containing sulphide is heated in the presence of a gas which is without action on sulphur to a temperature at which the molten sulphide decomposes with separation of elementary sulphur, a low sulphur matte being left as residue.

—B. V. S.

Noble metals; Mechanical process for concentrating ——. W. Näher, Pforzheim. Ger. Pat. 313,434, 8.10.16.

Ores or other material in which noble metals are sparsely disseminated are heated to 600°—1000° C. for a definite time, and then subjected to magnetic separation, the resulting concentrate containing the noble metals being worked up in the usual manner.—J. S. G. T.

Files and similar tools; Method and apparatus for sharpening —— *by corrosion.* N. P. Nielsen, Aarhus, and N. L. Bressendorf, Aabyhj, Denmark. Eng. Pat. 132,930, 12.11.18. (Appl. 18,533/18.)

Electric welding [; Regulating the current in ——]. British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 133,139, 9.10.18. (Appl. 16,144/18.)

Steels; Treatment of alloy ——. E. C. R. Marks, London. From Soc. Anon. Ital. Gio. Ansaldo & Co., Genoa, Italy. Eng. Pat. 133,069, 29.5.17. (Appl. 7687/17.)

See U.S. Pat. 1,279,533 of 1918; this J., 1919, 467 A.

Castings of rare earth metals; Processes for making ——. Alpha Products Co., Inc., Assignees of A. and M. Hirsch, New York. Eng. Pat. 119,211, 17.9.18. (Appl. 15,122/18.) Int. Conv., 17.9.17.

See U.S. Pat. 1,290,011 of 1918; this J., 1919, 148 A.

Ore roasting furnaces. E. T. Goldthorpe, Chicago, U.S.A. Eng. Pat. 133,236, 20.1.19. (Appl. 1461/19.)

See U.S. Pat. 1,295,729 of 1919; this J., 1919, 330 A.

Utilising heat of slag. Ger. Pat. 311,639. *See* I.

XI.—ELECTRO-CHEMISTRY.

Insulating materials; Penetration of moisture in ——. C. J. Rottmann. J. Franklin Inst., 1919, 188, 409—410.

None of the standard insulating materials examined was moisture-proof. With untreated papers there was immediate penetration of moisture, but papers impregnated with insulating compounds, treated cloth, and condensation products, such as "bakelite micarta," showed very small penetration. When penetration was slow there was little difference whether liquid water or saturated vapour was in contact with the insulating sheet. With "bakelite micarta" the penetration was independent of the thickness. A small rapid increase of penetration of water with time was observed, then practically no increase for a longer period, and finally a gradual increase at a practically constant rate.—T. H. Bu.

Electrochemical oxidation of phenols. Fichter and Ackermann. *See* III.

Patents.

Electric batteries. L. Rabinovitch and A. Mond, London. Eng. Pat. 132,480, 8.7.18. (Appl. 16,843/18.)

In a primary battery the positive electrode consists of a mixture of graphite and a depolarising agent (pyrolusite) impregnated with a colloidal solution of one or more metal oxides of the iron group (manganese) capable of different degrees of oxidation. The negative may be surrounded by the positive electrode, the latter serving as container for the battery.—W. E. F. P.

Storage battery. T. Spencer, Philadelphia, Pa., Assignor to National Carbon Co. Inc. U.S. Pat. 1,303,513, 13.5.19. Appl., 30.9.16.

IN a process of pasting battery grids, the lower half of the grid is blocked up, and a paste—formed by atomising a solution of sulphuric acid by means of a stream of air containing an oxide of lead in suspension—is sprayed into the upper half, the strength of the acid being gradually increased as successive layers are deposited. The grid is then turned over and the unpasted portion sprayed in the same manner.—W. E. F. P.

Storage batteries; Negative plate for lead ——. W. Morrison, Chicago, Ill. U.S. Pat. 1,304,192, 20.5.19. Appl., 23.9.18.

A LEAD grid, suitably charged (with lead oxides etc.) and dried, is soaked in a solution of a lead salt and then subjected to electrolytic reduction, whereby the active material becomes penetrated, and electrically connected with the grid, by electro-deposited lead.—W. E. F. P.

Storage batteries; Framework for supporting the active material in ——. Akkumulatoren-Fabrik A.-G., Berlin. Ger. Pat. 298,812, 9.9.15.

THE framework is composed of a sodium-lead alloy containing 0·5–1% Na. It is not attacked by sulphuric acid and possesses the requisite mechanical strength.—J. S. G. T.

Alloy [; Electrical resistance ——]. A. L. W. Williams, Cambridge Eng. Pat. 132,872, 25.9.18. (Appl. 15,555/18.)

AN "alloy" possessing a high electrical resistance when cold, but becoming a progressively good conductor when heated, is obtained by heating together copper and mica until the metal melts and is absorbed by the mica, producing a glass-like material. The mixture may contain a small proportion of carbon, and as an example may consist of 75% of copper and 25% of mica.—C. A. K.

[Electrical] resistance; New compound showing variable —— under the influence of light. T. W. Case, Scipio, N.Y. U.S. Pat. 1,316,220, 16.9.19. Appl., 19.2.17.

A RESISTANCE element formed of a compound of bismuth and sulphur.—W. E. F. P.

Electric furnaces. E. L. Crosby, Detroit, Mich., U.S.A. Eng. Pat. 132,879, 25.9.18. (Appl. 15,600/18.)

A CYLINDRICAL shell lined with refractory material is provided with electrodes arranged co-axially and extending through the ends of the furnace and capable of axial movement. Two travel rings are arranged around the furnace chamber, the common axis of the rings being inclined to the axis of the furnace chamber, so that on rotation the molten contents of the furnace are caused to move from end to end. Heating of the charge occurs on the surface directly from the arc between the electrodes and also at the bottom of the charge by means of the heated rotating furnace wall.—C. A. K.

Electrode for electric furnaces. P. Sejournet, Paris, Assignor to Soc. Electro Metallurgique Française, Froges, France. U.S. Pat. 1,315,992, 16.9.19. Appl., 9.12.18.

DISTRIBUTION of the current in an electrode is obtained by providing the lead with extensions, which engage in recesses arranged diagonally at the upper end of the electrode and are kept in place by means of a conducting composition.
—W. E. F. P.

Electrodes; Process for the production of hollow cylindrical and ring ——. P. Schmidt and A. Schwieger, Berlin. Ger. Pat. 313,238, 9.1.18.

THE electrodes are constituted of a metallic wire or tape wound spirally, adjacent turns of the spiral being put into metallic connection by a coating of metal applied by the spraying process. To improve the contact between the spiral body and the coating, the former is preferably roughened on the surface and heated to 120° C.—J. S. G. T.

Ozoniser. Siemens u. Halske A.-G., Berlin. Ger. Pat. 312,642, 21.9.17.

THE ozoniser is composed of two separate discharge tubes, united below in the form of a U-tube, the gas passing from one limb to the other by way of the bend in the U, which is somewhat constricted. Internal and external poles are arranged in the usual manner in each limb. An inner electrode dips into liquid contained within the internal pole of each limb. The U-tube is placed in a vessel containing liquid into which the second electrode is introduced. Gas is passed into and out of the discharge space by means of tubes placed above the top of the external cooling bath.—J. S. G. T.

Electric furnaces. British Thomson-Houston Co., Ltd., London. From General Electric Co., Schenectady, N.Y., U.S.A. Eng. Pat. 133,092, 9.2.18. (Appl. 2368/18.)

SEE U.S. Pat. 1,281,521 of 1918; this J., 1919, 46 A.

Disposition of inflammable gases. U.S. Pat. 1,302,871. *See* XIXB.

XII.—FATS; OILS; WAXES.

Fats; Technical hydrogenation of —— with nickel as catalyst. L. Ubbelohde and T. Svanoe. Z. angew. Chem., 1919, 32, 257–262, 269–272, 276–280.

THE hydrogenation of cottonseed and whale oils was studied in laboratory apparatus embodying the principles of the apparatus of Normann (this J., 1904, 26), Wilbuschewitsch (this J., 1911, 966), and Erdmann (this J., 1909, 944). As far as was possible the conditions of the hydrogenation were varied in a comparable manner in the three processes, and the effects were measured by determining the iodine values, refractive indices, and melting points of the fats. It was found that, other conditions being constant, the speed of hydrogenation increased with rise of temperature up to 170° C., but that there was then little further increase up to 200° C., and none above that temperature. With the apparatus of Normann and of Wilbuschewitsch an increase in the amount of catalyst (up to 2·4% nickel) reduced the time of hydrogenation to an extent approximately inversely proportional to the quantity of catalyst added. Increasing the rate of stirring increased the speed of hydrogenation up to about 3200 revolutions per minute, but between 3200 and 4800 revolutions there was no increase. In Normann's apparatus increasing the amount of hydrogen introduced increased the speed of hydrogenation, especially in the case of cottonseed oil, but there was no advantage in increasing the quantity above 50 litres per hour when 150 grms. of oil was used. In Wilbuschewitsch's apparatus the increase in the velocity of hydrogenation was approximately proportional to the pressure. Comparative results showed that Wilbuschewitsch's apparatus effected the most rapid hydrogenation, whilst Erdmann's was the slowest. The solubility of hydrogen in the oil was small, but increased with the temperature and was

about 5% by vol. at 150° C. Experiments with different types of nickel catalyst showed that pure nickel was much less effective than nickel on kieselguhr. A decrease in the activity of a catalyst kept under proper conditions for a limited time (six weeks) need not be feared. The temperature has a great influence on the activity of the catalyst. A fat hydrogenated at 170°—200° C. showed at first a lower iodine value than when hydrogenated at 150°—170° C., but when hydrogenated for periods longer than four hours the iodine value of the fat hydrogenated at the lower temperature was the lower. The constants of hydrogenated fats (iodine value, m.pt., dropping point, and refractive index) stand in direct relationship to one another, and to study the course of hydrogenation it is therefore only necessary to determine the refractive index of the products. In separating the fatty acids of hydrogenated cottonseed oil by the lead-ether method it was found that the separation was most difficult when the liquid fatty acids had an iodine value of 86·8—92·4 (oleic acid), and this was attributed to the conversion of the linolic acid into a solid isomeric oleic acid (which separated with the solid acids) instead of into the ordinary oleic acid. In the case of whale oil the conclusion was drawn that the clupanodonic acid absorbs four mols. of hydrogen and is converted into a linolic acid without forming a linolenic acid as an intermediate product. This linolic acid also probably yields an isomer of oleic acid.—C. A. M.

Oil from pea-nuts [arachis nuts]. N. Schlue and H. L. Maxwell. Chem. News, 1919, 119, 185.

Two samples of hand-shelled arachis nuts yielded over 50% of oil (calculated on the kernels). The oils had iodine values 94·5 and 95, and saponification values 197 and 202 respectively, the latter values being about 2% higher than those previously recorded.—C. A. M.

Tsubaki oils from the Seven Islands of Izu. S. Nakatogawa and S. Kobayashi. Kōgyō Kwagaku Zasshi (J. Chem. Ind., Tokyo), 1919, 22, 435—450.

The examination of twelve samples of tsubaki oil from different localities in the Seven Islands of Izu revealed no very notable differences in properties. The constants varied between narrow limits as follows:—Sp. gr. at 15°/4° C., 0·9151—0·9161; acid value, 1·8—7·6; saponification value, 190·3—192·6; iodine value, 77·33—81·16; refractive index, 1·4685—1·4696. Bieber's reagent (concentrated sulphuric acid, fuming nitric acid, and water, equal parts by weight) gives a bright bluish-green coloration with tsubaki oil, and on standing the oil solidifies to a yellowish-green mass. The same coloration is produced by nitrogen peroxide, and it is probably due to the absorption of oxides of nitrogen by the oleic acid or its glycerides, which form the chief constituents of the oil.—G. F. M.

Sulphonated oils; Analysis of ——. Report of a Committee of the Society of Leather Trades' Chemists. J. Soc. Leather Trades' Chem., 1919, 3, 101—104.

The following provisional methods have been recommended:—*Moisture:* 20—30 grms. of oil is distilled with 75 c.c. of water-saturated xylol or heavy mineral oil, the distillate being collected in a Sutherland tube. *Ash:* 2—3 grms. is gently ignited in a dish or crucible until all the carbon has been consumed. *Non-saponifiable matter:* 10 grms. of oil is boiled for one hour under a reflux condenser with 5 c.c. of 2*N* alcoholic potash. 50 c.c. of water is added, and after allowing to cool the mixture is transferred to a separating funnel and shaken three times with 50 c.c. of petroleum spirit (b.pt. 40°—75° C.). The spirit layer is washed three times with 50 c.c. of water containing 10 c.c. of ethyl alcohol. The spirit extract is evaporated in a tared vessel, cooled, and weighed. *Total SO_3* is determined by the Procter-Searle method, adding a little bromine or sodium peroxide to the fused mass to oxidise any sodium sulphide formed. *Uncombined SO_3*—1 grms. is dissolved in chloroform and shaken several times with 25 c.c. of concentrated brine free from sulphates. The washings are combined, diluted, filtered, and the sulphuric acid determined as barium sulphate. The *total fatty oil* is the difference between 100% and the sum of moisture, ash, and non-saponifiable matter.—D. W.

Wax; Contributions to the chemistry of ——. G. Buchner. Chem.-Zeit., 1918, 42, 373—374.

Influence of the solvent on the composition of wax extracted from the expressed residue of beeswax:—Beeswax obtained by extracting an expressed residue with petroleum spirit of low b.pt. had acid value 21·21; ester value, 59·82; and ratio value 2·8. By extracting the residue with petroleum spirit of higher b. pt., with chloroform, and with carbon tetrachloride, products with acid value ranging from 20·30 to 23·45; saponif. value from 85·43 to 91·39; and ratio value from 3·0 to 3·2 were obtained. *African beeswax:* A sample melted out in the laboratory had: Sp. gr. at 15° C., 0.96; m. pt., 64°—65° C.; iodine value, 11·65; acid value, 19·92; ester value, 79·43; and ratio value, 3·98. Only a small amount of glycerides was present. *East Indian (Ghedda) beeswax:* This wax contains no other alcohol than ceryl alcohol, which is in combination with palmitic and other fatty acids. *Candelilla wax:* The following average results were obtained: Acid value, 16·96; ester value, 33·86. This wax contains 50—52% of hydrocarbons.—C. A. M.

PATENTS.

Detergent; Process of manufacturing a ——. C. Niegemann and W. Priester, Cologne. Ger. Pat. 312,955, 20.8.16.

Lime-sludge from the manufacture of glue from leather or the residues from the glue boilers are treated with bisulphate lyes or dilute sulphuric acid to obtain a slightly acid fluid with detergent properties. The liberated fatty acids and the precipitate (which can be utilised as a fertiliser) are separated from this liquid. The latter may be rendered more stable by the addition of a small amount of sodium carbonate, or up to 50% of that salt for the preparation of a solid compound. The detergent will remove dirt, asphalt, pitch, or mineral oil from house linen. Concentrated *in vacuo* it can be used for removing old paint or oil or resin varnish.—C. A. M.

Cocoa [cacao] butter presses and the like; Charging of ——. J. Baker and Sons, Ltd., and W. E. Prescott, London. Eng. Pat. 133,426, 7.10.18. (Appl. 16,319/18.)

Oils, fats, and other greases; Method of extracting —— *from garbage, house offals, and other refuse containing also water.* F. B. Dehn, London. From Cobwell Corporation, Cleveland, Ohio, U.S.A. Eng. Pat. 133,075, 3.8.17. (Appl. 11,252/17.)

See U.S. Pat. 1,267,611 of 1918; this J., 1918, 519 A.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

PATENT.

Detergent. Ger. Pat. 312,955. See XII.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

PATENTS.

Rubber; Process of treating —— and the product produced thereby. R. Zertuche, Torreon, Mexico. U.S. Pat. 1,302,266, 29.4.19. Appl., 10.8.16.

THE elasticity of rubber is improved by treatment with resinous, gummy juice obtained by crushing the branches and leaves of the mesquite plant (*Prosopis juliflora*), gobernadora (*Covillea tridentata*), or holm-oak (allied to *Quercus grisea*) or the seed pods of *Casalpinia coriara* (cascalote), heating with water, and straining. The raw rubber may be heated with the juice, then mixed with sulphur etc., and vulcanised, or the vulcanised rubber may be heated with the juice.

Rubber; Process for regenerating vulcanised ——. B. J. F. Varenhorst, Haag, Holland, and J. G. Fol, Soengei Karang, Dutch Indies. Eng. Pat. 133,369, 8.7.18. (Appl. 11,193/18.)

SEE U.S. Pat. 1,198,975 of 1916 and Ger. Pat. 302,995 of 1914; this J., 1916, 1121; 1918, 311 A.

XV.—LEATHER; BONE; HORN; GLUE.

Chrome tannage; Bleeding of skins in ——. R. F. Innes. J. Soc. Leather Trades' Chem., 1919, 3, 194—197.

CUTTINGS of a skin struck out of the bichromate-acid bath were submitted to successive extractions with distilled water, and each of the extracts was analysed. The first extracts contained more bichromate than chromic acid, but the relative proportions gradually changed until the later extracts contained more chromic acid than bichromate, and finally chromic and mineral acids only. The extracted cuttings when dried and analysed for ash and chromium were found still to contain sufficient chromium to yield a fair leather. Water of 25° of temporary hardnesss removed more chromic acid than distilled water, but no mineral acid, and the cuttings gave a very hard bad-coloured leather. Under certain working conditions bleeding is not very serious from the tanner's standpoint.—D. W.

Sulphonated oils. *See* XII.

PATENTS.

Chrome leather; Detanning —— for manufacture of glue and like products and recovery of chrome compounds. M. C. Lamb, London. Eng. Pat. 132,861, 24.9.18. (Appl. 15,496/18.)

DISINTEGRATED chrome leather waste is washed and dried, or dried first and washed, and immersed for 48 hours, with occasional movement, in a 15—40% solution of an organic acid containing two or more hydroxyl groups, *e.g.*, phthalic, lactic, succinic, tartaric, malonic, or preferably oxalic acid. Chromium hydroxide is precipitated from the solution after it has been separated from the detanned leather, which is washed in weak alkali and subjected to the ordinary liming process practised in glue manufacture.—D. W.

Waterproofing leather; Portable or stationary apparatus for ——. W. Walker, A. Exley, and C. J. Walker, Leeds. Eng. Pat. 132,964, 7.1.19. (Appl. 443/19.)

Proteids; Recovery of —— from the waste liquors of the hide treating art. Dorr Co., Assignees of C. L. Peck, New York. Eng. Pat. 123,974, 6.12.18. (Appl. 20,284/18.) Int. Conv., 2.3.18.

SEE U.S. Pat. 1,284,763 of 1918; this J., 1918, 665 A.

Detergent. Ger. Pat. 312,955. *See* XII.

XVI.—SOILS; FERTILISERS.

PATENTS.

Soil; Method and apparatus for treatment of ——. J. R. C. August, Halifax. Eng. Pat. 133,171, 9.10.18. (Appl. 16,416/18.)

SEE U.S. Pats. 1,303,149—50 of 1919; this J., 1919, 548 A.

Detergent [and fertiliser]. Ger. Pat. 312,955. *See* XII.

XVII.—SUGARS; STARCHES; GUMS.

Sugar beet; Cost of the cultivation of the —— in the United States. L. A. Moorhouse and T. H. Summers. Facts about Sugar, 1919, 9, 172—173, 190—191, and 212.

INVESTIGATIONS regarding the cost of cultivating the sugar beet in the United States based upon the estimates of 1025 farmers in Michigan, Ohio, Colorado, Utah, Idaho, and California disclosed a considerable variation even in the same district, due to differences in cultural practice, some of the figures obtained being as follows: Yield of roots per acre, tons, 9·53—15·59; manual labour expended, hours per acre, 79·5—133·3; horse labour, ditto, 79·1—132·7; seed, lb. per acre, 1·72—21·7; farmyard manure, tons per acre, 0·27—8·52; fertiliser, lb. per acre (only used in Michigan and Ohio), 58—102; and total cost per acre (average of 1914-16), $53·05—72·53. In the Provo (Utah) district, the cost of labour, per cent. of total costs, was 46·4—65·9; material (seed, fertiliser, etc.), 5·0—11·5; and other costs, as interest on land, insurance, and taxes, 22·7—48·0.—J. P. O.

Sugar; Syrup clarification in manufacture of white ——. C. E. Coates. La. Planter, 1919, 62, 284—285.

IN white sugar manufacture on the plantation the syrup entering the vacuum pan should be clear and light in colour, but unless special methods of clarification have been employed filtration is both difficult and expensive. It is stated that promising results have been obtained by treating the syrup successively with lime and phosphoric acid, and aerating it, the entire precipitate thus rising as a scum, which is readily separated. This process is stated to give a very bright syrup without filtration, and is said to be applicable also to refinery practice.—J. P. O.

Cane juice; Clarification of ——, using calcium monosaccharate. W. Clacher. S. Afr. Sugar J., 1919, 3, 415—417. Int. Sugar J., 1919, 21, 523—524.

INSTEAD of clarifying cane juice by treatment with milk of lime and subsequent sulphiting, a better effect is stated to be obtained by treating with a solution of calcium monosaccharate until an alkalinity of 1—2 grms. of CaO per litre is reached, sulphiting to neutrality, heating, and settling. It is claimed that considerably less lime and sulphur are required than in the ordinary defecation-sulphitation process, and that a sugar of better colour and probably a higher yield result.—J. P. O.

"Glucose" [reducing sugar]; Decomposition of —— caused by the after-slaking of the lime in the juice. J. B. van Santen. Arch. Suikerind. Nederl.-Indië, 1919, 27, 399—402.

IN a factory in Java practising the defecation-sulphitation process of clarification, the juice from the mud presses had an acidity about twice that of the clear juice drawn from the settling tanks, and, moreover, was considerably darker. In explanation of these observations, it is suggested that a

proportion of the lime used for the defecation of the raw juice had not been fully hydrated. During the settling of the limed and sulphited juice, and while resettling the resulting mud, slaking had taken place, the dextrose and lævulose of the juice being attacked by the alkali at the rather high temperature prevailing, with the formation of dark-coloured decomposition products, mostly acids.—J. P. O.

Saccharimeter; Constants of the quartz wedge ——. A. Herzfeld. Z. Ver. deut. Zuckerind., 1917, **68**, 407. Int. Sugar J., 1919, **21**, 520—521.

BATES and Jackson (this J., 1916, 1126) were unable to confirm the constant established by Herzfeld and Schönrock (Z. Ver. deuts. Zuckerind., 1900, **50**, 826; this J., 1904, 561) that 100° S = 34·657 circular degrees for sodium light at 20° C., the value of 34·620 being found. According to the author, the work of the American investigators is open to question on the ground that the sucrose with which they had operated must have contained invert sugar, owing to the fact that the solutions from which it had been crystallised were not maintained during boiling in a slightly alkaline condition to prevent hydrolysis. Bates and Jackson used Striegler's and Soldaini's solutions for detecting the possible presence of invert sugar, but the author states that neither of these reagents provides a more sensitive test than does Fehling's solution under the conditions he has previously specified. J. P. O.

Saccharimeter; Relative merits of different normal weights for the ——. E. Saillard. J. Fabr. Sucre, 1919, **60**, No. 13. Int. Sugar J., 1919 **21**, 520—521.

THE value of the normal saccharimetric weight should be as high as possible in order to increase the accuracy of the reading and the representativeness of the sample. In practice, however, owing to the varying nature and colour of the several products of the factory, it is impossible to operate upon the same weight throughout. Thus, in the determination of the sucrose in the beet by the cold digestion method, the normal weight at present in use in France, 16·26 grms. per 100 c.c., serves well, but the weight of 20 grms. which was proposed recently (this J., 1919, 593 A), would be too much, for extraction would be hindered owing to the swelling of the pulp. In the case of juices and syrups, if 20 grms. were adopted, it would be necessary to recalculate the tables collating the sp. gr., the polarimetric reading, and the sucrose content. In that of beet molasses, using the Herzfeld modification of the double polarisation method, 20 grms. per 100 c.c. usually gives a solution too deep in colour to permit of reading, and 16·26 grms. does sometimes. Half the present international standard, viz., 13 grms. per 100 c.c., would be a more generally suitable quantity.—J. P. O.

Polarisation of raw cane sugars; Table for the correction of the influence of temperature upon the ——. W. D. Horne. Facts about Sugar, 1918, **7**, 53. Int. Sugar J., 1919, **21**, 525.

IN order to correct the error arising when raw cane sugars are polarised at temperatures above 20° C., the author has calculated the following table by the use of the formula:

$$P^{20} = P^{t} + 0{\cdot}0003S(t-20) - 0{\cdot}00812L(t-20),$$

in which P is the observed polarisation at the temperature *t*, S the percentage of sucrose present in the product, and L that of the lævulose (taken to be half the invert sugar). This table is constructed for two grades of raw cane sugars, the polarisation and reducing sugars content of which are 96° and 1·2 and 89° and 2·6 respectively:—

Temp. °C	96° Centrifugal sugars.	89° Molasses sugars.	Temp. °C	96° Centrifugal sugars.	89° Molasses sugars.
21	Add 0·00	Add 0·00	29	Add 0·20	Add 0·15
22	,, 0·05	,, 0·05	30	,, 0·20	,, 0·15
23	,, 0·05	,, 0·05	31	,, 0·25	,, 0·20
24	,, 0·10	,, 0·05	32	,, 0·30	,, 0·20
25	,, 0·10	,, 0·10	33	,, 0·30	,, 0·20
26	,, 0·15	,, 0·10	34	,, 0·35	,, 0·25
27	,, 0·15	,, 0·10	35	,, 0·35	,, 0·25
28	,, 0·20	,, 0·15			

—J. P. O.

Refractometric determination of dry substance in syrup in contact with [sugar] crystals; Direct ——. V. Skola. Z. Zuckerind. Böhm., 1919, **43**, 294—301. Chem. Zentr., 1919, **90**, II., 924—925.

WHEN a syrup containing sugar crystals is in contact with a glass surface the crystals which lie against the glass are separated therefrom by a film of syrup. Optically the surface acts at all points as a boundary between glass and syrup, the crystals having no influence on the reflection of light incident at the surface through the glass. It is therefore possible to determine the refractive index of such a syrup by the method of total reflection without first removing the crystals. This furnishes a convenient means of control of the boiling and subsequent treatment of massecuites. A total-reflection refractometer constructed by Zeiss, with a scale extending to 85° Balling, may be used for all massecuites except those of after-products of low purity, for which a more extended scale would be necessary.—J. H. L.

Decolorising carbons; Preparation of ——. F. W. Zerban, E. C. Freeland, and D. D. Sullivant. La. Bull., **167**.

THE decolorising power of the carbons prepared as described previously (this J., 1919, 527 A) was determined by adding 5 grms. of the sample to 200 c.c. of a 3% solution of final cane molasses, heating just to boiling point, filtering, cooling, and examining the liquid by means of the Hess-Ives tint-photometer. By mixing the sawdust of long leaf yellow pine (*Pinus palustris*) with various substances and water to a homogeneous paste, heating till dry, grinding to a powder, carbonising at about 900° C., cooling, extracting the ash with a suitable solvent, washing thoroughly with water, and finally drying, carbons were obtained which gave the following results, that given by "Norit" carbon being calculated as 100:—With sodium carbonate as addition agent, 19; with sulphuric acid, 19; sodium chloride, 22; sodium sulphate, 24; sodium hydroxide, 25; potassium hydroxide, 32; aluminium sulphate, 33; ammonium chloride, 39; silica, 39; ferric chloride, 45; sodium sulphate, 51; cupric chloride, 56; barium chloride, 83; aluminium chloride with excess of ammonium chloride, 86; calcium carbonate, 103; ferrous chloride, 127; calcium sulphate, 173; aluminium hydroxide, 238; barium hydroxide, 292; stannous chloride, 292; magnesium hydroxide, 422; calcium oxide, 422; zinc chloride, 475 (*cf.* this J., 1918, 480 A); magnesium chloride, with excess of ammonium chloride, 3200. Good carbons were obtained by the carbonisation of kelp (*cf.* this J., 1918, 778 A) and filter-press cake without the addition of any other substance, the best results being 133—357 and 105—173 respectively. It is stated that Coates (La. Bull., **161**) has found that ordinary wood charcoal from sawdust (the decolorising power of which is only very slight) can be converted into a carbon of a power equal to "Norit" by prolonged heating at 1200° C. in a covered crucible.—J. P. O.

Activation of carbon. Chaney. *See* IIB.

PATENT.

Starch from horse-chestnuts. Ger. Pat. 306,324. *See* XIXA.

XVIII.—FERMENTATION INDUSTRIES.

Mucedines; New methods of employment of ——. [*"Amylo" process of alcoholic fermentation.*] A. Delemar. Chim. et Ind., 1919, **2**, 892—898.

A CRITICISM of the article on this subject by P. Baud (this J., 1919, 115 A), and an historical review of the development of the use of diastase-secreting fungi, particularly *Amylomyces Rouxii*, in the preparation of alcohol from cereals. In the first period, 1898—1903, the cereal grains were heated under pressure, and the starch was then liquefied by the addition of 2% of malt. After cooling to 38° C. the culture of *Amylomyces* was added, followed after 20 hours by a small quantity of yeast. The fermentation required 4-6 days. In the second period, 1903—1910 the use of malt for liquefaction of the starch was superseded by adding hydrochloric acid, just sufficient in amount to convert the monohydrogen phosphates present into dihydrogen phosphates. After an hour or so the acid liquor consequently became neutral, and the grains were disintegrated by heating up to a pressure of 4 kilos. and then releasing the liquor into another vat, the sudden release of the pressure disintegrating the cereal and liberating the starch (Eng. Pat. 19,633 of 1907; this J., 1908, 586). In the third period, 1910—1919, progress has been in the direction of accelerating the speed of the saccharification process by using the much more rapidly germinating conidia of the mucor instead of the spores hitherto employed, so that the yeast can be added at the same time as the mucor culture (Fr. Pat. 423,336 of 1910, and Addition thereto; this J., 1911, 642, 917). The yield now obtained by this process amounts to 97·5% of the theory, 100 kilos. of maize giving 36—42 litres, and 100 kilos. of rice 42—47 litres of alcohol.

—G. F. M.

Wine; Microanalysis of ——. *III. Micro-determination of the acids of wine.* M. Ripper and F. Wohack. Z. landw. Versuchs-Wesen Oesterr., **22**, 15—31. Chem. Zentr., 1919, **90**, II., 926—927. (See also this J., 1917, 350.)

KNOWN methods of determining the acids in wine have been adapted to operation with very small quantities of the sample, in most cases 2 c.c. The determinations described include total acidity, total tartaric acid by the Halenke-Möslinger method (Z. anal. Chem., 1895, **34**, 274), volatile acidity, lactic acid by Möslinger's method (Z. Unters. Nahr. Genussm., 1901, **4**, 673, 1120, 1172), and tannic acid by the Neubauer-Löwenthal method. In all cases except that of total acidity (where somewhat high values are obtained) the results agree well with those obtained by operating on the usual quantities of sample.—J. H. L.

Methyl alcohol in ethyl alcohol; The U.S. Pharmacopœia test for ——. J. W. Ehman. Amer. J. Pharm., 1919, **91**, 594—597.

THE test described in the U.S. Pharmacopœia for the detection of methyl alcohol in ethyl alcohol is trustworthy only under certain conditions, mainly of temperature. The following procedure is recommended:—5 c.c. of the alcohol to be tested (previously diluted to 10%) and 5 c.c. of pure 10% ethyl alcohol are placed in separate test-tubes, the test-tubes are immersed in water at 25° C., and after some minutes to each is added 2 c.c. of 3% potassium permanganate solution and 0·3 c.c. of sulphuric acid. After five minutes the precipitated manganese dioxide is dissolved by the addition of sulphurous acid, and 1 c.c. of sulphuric acid and 5 c.c. of magenta-sulphurous acid reagent are added. During the addition of the sulphuric acid it is essential to maintain the temperature as near 25° C. as possible. If the control (pure ethyl alcohol) test gives a bright red coloration at once, which does not fade in 10 mins., or if a faint pink or violet coloration appears which does not fade in 10 mins., the tests must be repeated at a different temperature. If the control is violet after 10 mins. too high a temperature is indicated; if a bright red colour persists, too low a temperature. Under correct conditions of temperature and in the absence of methyl alcohol no pink or violet coloration (observed by artificial light) appears within 30 mins., neither does a pale greenish, blue or violet coloration (observed by daylight) appear within 1 hr., the solution being pale yellow or colourless. When more than 1% of methyl alcohol is present the solution becomes violet at once, the colour then changing to purple-red.—W. P. S.

Methyl alcohol; Detection of —— [*in ethyl alcohol*]. H. Wolff. Chem.-Zeit., 1919, **43**, 555.

OXIDATION of the methyl alcohol to formaldehyde, and detection of the latter by the morphine-sulphuric acid test, is not always a reliable method for the detection of methyl alcohol in ethyl alcohol, since higher alcohols when oxidised also yield substances which give a reaction similar to that yielded by formaldehyde (see Salkowski, this J., 1919, 382 A). The author finds that if apomorphine is used in place of morphine in the test, formaldehyde gives a blue-violet coloration, whilst ethyl alcohol, propyl alcohol, and amyl alcohol yield products giving a yellow or red-brown coloration.—W. P. S.

Sulphite alcohol. Landmark. *See* V.

Titration of acids. Meerburg. *See* XXIII.

PATENTS.

Malting drum. W. A. Peterman, Assignor to Galland-Henning Pneumatic Malting Drum Mfg. Co., Milwaukee, Wis. U.S. Pat. 1,316,643, 23.9.19. Appl., 21.5.18.

A HORIZONTAL malting drum is divided into compartments by vertical partitions. For the purpose of aeration a jacket connected with an air supply extends along the lower part of the drum, and perforations in the latter allow the air to enter each of the compartments from the jacket. The air is withdrawn from the compartments into a similar jacket extending along the upper part of the drum, and also into a perforated duct which passes through the centre of all the compartments, both the upper jacket and the duct being in communication with a suction pipe. The jackets and duct are of special construction to avoid an unequal distribution of air between the several compartments.

—J. H. L.

Glycerol; Manufacture of —— [*by fermentation*]. J. R. Eoff, jun., Washington, U.S.A. Eng. Pat. 133,374, 22.7.18. (Appl. 11,948/18.) Int. Conv., 21.7.17.

SEE U.S. Pat. 1,288,398 of 1918; this J., 1919, 194 A. The alkali or alkaline salt is added in successive small portions until the total amount added is just short of that which will inhibit the further activity of the yeast. The temperature during fermentation is maintained between 27° and 50° C., preferably about 37° C.

XIXA.—FOODS.

Milk; Determination of fat in —— by Adam's method. G. Meillère. Ann. Chim. Analyt., 1919, **1**, 318—321.

THIS method consists in shaking 25 c.c. of the milk with 50 c.c. of a solution prepared by mixing 90%

alcohol, 833 c.c., with ammonia, 30 c.c., diluting the mixture to 1000 c.c. with water and then adding ether, 1100 c.c. After separation has taken place the ethereal solution of the fat is drawn off, evaporated, and the residue of fat weighed. The method is stated to be trustworthy.—W. P. S.

Fodder from straw. H. Pringsheim. Z. angew. Chem., 1919, 32, 249—252.

Methods which have been used for the production of a fodder from straw by treating the same with alkali hydroxide, alkali carbonate, or calcium hydroxide are described and discussed. The following table gives the composition of the fodders obtained by different treatments:—

Straw		5% NaOH 4 hrs. at 5 atm. pressure.	8% NaOH 5·5 hrs. at 100° C. in open vessel.	12% NaOH cold 24 hrs.	8% Na_2CO_3 3 hrs. at 100° C. in open vessel.	7·3% CaO 4·5 hrs. at 5 atm. pressure.	8% CaO 5 hrs. at 100° C. in open vessel.
		%	%	%	%	%	%
Ash	.. ..	3·8	4·1	5·0	3·1	2·4	6·5	5·5
Proteins	..	2·7	0·9	0·9	2·3	2·0	0·9	1·7
Fat	.. ..	2·1	..	..	1·3	..	..	..
Pentosans	..	26·2	31·1	27·9	26·3	27·5	21·4	27·9
Cellulose	..	39·5	56·3	52·1	18·6	52·0	52·9	48·6
Lignin	..	24·0	10·0	12·5	16·3	17·0	20·5	19·2
Yield	.. ..	—	53	58	79	74	63	73
Loss of digestible substances		—	26·7	24·7	8·6	11·3	24·9	17·0

—W. P. S.

Emmentaler cheese; Constituents of ——. E. Winterstein. Z. physiol. Chem., 1919, 105, 25—31. Chem. Zentr., 1919, 90, IV., 121—122.

The author has detected the presence of urea and ornithine, together with smaller quantities of *p*-hydroxyphenylethylamine, and possible agmatine, in Emmentaler cheese made from separated milk. To isolate the urea, 2·4 kilos. of the dry, powdered cheese was extracted with hot alcohol, the extract evaporated, the syrupy residue dissolved in a large volume of water, and the solution filtered; the filtrate was extracted with petroleum spirit, acidified with sulphuric acid, and treated with phosphotungstic acid. After filtration the excess of phosphotungstic acid was removed with barium hydroxide, the solution neutralised with acetic acid, and the urea precipitated with concentrated mercuric nitrate solution. The mercury compound was decomposed with hydrogen sulphide, the concentrated solution then mixed with 3 vols. of acetic acid, and the urea precipitated by 10% xanthydrol solution; the crystalline precipitate, dixanthylurea, $C_{27}H_{20}N_2O_3$, had m. pt. 258°—259° C. Xanthydrol may be used generally for the detection of urea in milk products; apart from urea it gives a precipitate with pyrrole, indole, and skatole, but not with ammonium salts, methylamine, guanidine, creatine, creatinine, arginine, glycine, hippuric acid, alanine, leucine, asparagine, glutamic acid, tyrosine, tryptophane, uric acid, xanthine, albumin, gelatin, fibrin, peptone, glycerol, sugars, or acetic, propionic, butyric, lactic, citric, tartaric, succinic, and oxalic acids. To detect ornithine, 4 kilos. of the fat-free cheese was extracted with 10 litres of warm water, the solution filtered, the filtrate treated with lead acetate, the excess of lead removed, the solution evaporated to 3 litres and treated with 80 c.c. of concentrated sulphuric acid and phosphotungstic acid. The bases liberated from the precipitate were then re-precipitated with silver nitrate and barium hydroxide; the filtrate from the silver precipitate was treated with hydrochloric acid to remove excess of silver, concentrated, and benzoylated. The separated benzoates were decomposed with hydrochloric acid, the hydrochlorides freed from benzoic acid, converted into sulphates, then into carbonates, the lysine and ornithine then precipitated as picrates by means of alcoholic picric acid solution, and separated from each other.—W. P. S.

Patents.

Preservation of food; Method for the ——. K. A. F. Hiorth, Christiania. Eng. Pat. 125,372, 31.3.19. (Appl. 8064/19.)

In the preservation of food in bottles or other receptacles, the stopper of the bottle is provided on its lower surface with a small perforated container holding a piece of absorbent wool soaked in a volatile and antiseptic substance, such as alcohol. After sterilising the bottle containing the foodstuff the stopper is inserted and fastened down. The volatilisation of the alcohol causes a slight increase of pressure and prevents any leak of air into the bottle. If the bottle is not stoppered the container with the substance is hung on the lip of the bottle. In lieu of a volatile substance, separate portions of tartaric acid and sodium carbonate may be used.—J. H. J.

Vegetables and the like; Method of and means for drying ——. N. V. Machinefabriek Brons, Zuidbroek, Holland. Eng. Pat. 128,199, 27.5.19. (Appl. 13,350/19.) Int. Conv., 13.6.18.

A drying chamber contains a series of superposed floors consisting of plates attached to horizontal axles, each axle carrying two plates which are journaled separately on it. Either plate is capable of being turned over on the other so as to enclose a free space. When the material has been sufficiently dried on one plate the other is turned over it, and the two together are turned over to the other side, thus reversing the layer of material *en masse*. This can be repeated as often as desired, and then one of the plates is turned downwards, allowing the material to fall on to the floor below.—J. H. J.

Foods; Process for preserving fugacious components of ——. [*Coffee extract.*] W. A. Hamor and C. W. Trigg, Pittsburgh, Pa., Assignors to J. E. King, Detroit, Mich. U.S. Pat. 1,292,458, 28.1.19. Appl., 29.3.17.

An aqueous extract of coffee is evaporated, and the vapours are brought into contact with a suitable absorbent (petrolatum or vaseline), which is subsequently treated with a solvent (water, alcohol) to extract the absorbed caffeol (volatile aromatic and flavouring constituents of the coffee). The caffeol thus recovered is added to a concentrated aqueous extract of coffee.

Straw fodder; Method for the preparation of ——. Chem. Inst. d. Universität Berlin. Ger. Pat. 303,963, 6.1.17.

Straw is treated with alkali sulphide solution in place of the alkali hydroxide solution usually employed.—W. P. S.

Food or fodder or starch from horse-chestnuts; Method of preparing a ——. Elektro-Osmose A.-G. (Graf Schwerin Ges.), Berlin. Ger. Pat. 306,324, 22.6.17.

Horse-chestnut kernels, free from husk, are immersed in very dilute alkali solution, and the brown skin enclosing the kernels, and which contains the greater part of the bitter injurious substances, is removed by brushing or the like. The kernels are then ground and treated with cold or moderately warm alkali solution. About 6% of an odourless, pleasant-tasting oil is present in the kernels; this oil may be removed previous to the above treatment.—W. P. S.

Grain from effluents. Eng. Pat. 113,206. *See* I.

XIXB.—WATER PURIFICATION; SANITATION.

Activation of carbon. Chaney. *See* IIB.

Hypochlorite solutions. Moerk and Foran. *See* VII.

PATENTS.

Sewage and other liquids; Purification of ——. W. Jones, Stourbridge, and Jones and Attwood, Ltd., Amblecote, Staffs. Eng. Pat. 132,826, 27.4.18. (Appl. 7104/18.)

IN the "activated sludge" process of treatment of sewage the aeration tank is constructed in longitudinal sections with the angles between the walls and floor rounded off, and also with the top of the walls made to overhang so as partly to cover the top of the tank, the overhanging portions being curved on their lower surface at the same radius as the bottom of the wall. Air diffusers are placed in the side walls near the bottom, and the combined action of the air and the rounded portions is to give a circular motion to the sewage in a transverse direction to the flow and also to cause the air to circulate in the outer layers of sewage. The general direction of flow is down one longitudinal section and back by another, and so on. The tank is divided also into sections by transverse walls, with the communicating openings between the sections placed near the sources of air supply; by this means all the sewage is made to pass several times near the sources of air supply in its passage through the tank. Various modifications in the position of the air supply and in the formation of the walls are described.—J. H. J.

Inflammable gases; Disposition of ——. A. Spice, Jersey City, N.J. U.S. Pat. 1,302,871, 6.5.19. Appl., 10.11.17. Renewed 10.10.18.

A METHOD of disposing of inflammable gases, for instance, mine gases, or the hydrogen formed in storage batteries, consists in passing the gas mixed with air through tubes containing resistance wires heated to dull redness by a current. The supply of air and volume of gaseous mixture passing through the tubes are regulated automatically by means controlled by variations in the resistance of the heated wire caused by variations in the proportion of inflammable gas.

Air; Process of preparing absorbent masses for the purification of ——. C. Clemente, Berlin. Ger. Pat. 305,066, 23.6.16.

LOWER hydrated peroxides, especially sodium peroxide, potassium sodium peroxide, etc., or mixtures thereof, are used in the preparation of porous granular masses for the purification of air. Finely-divided metals such as copper, manganese, cobalt, silver, cerium, uranium, or their oxides or salts or compounds or mixtures of these substances and oxides or hydroxides of alkalis, alkaline-earth metals or metals of the rare earths may also be added to the peroxides. In one application of the process finely-divided dry peroxides are intimately mixed with finely-divided substances containing water of crystallisation in such proportion that the water of crystallisation is at most a ninth part by weight of the molecular weight of the peroxide used, and the mixtures are then heated. The accelerating substances mentioned above may be added to the mixture of peroxide and substance containing water of crystallisation prior to the heating. Absorbent masses thus prepared can be heated far above 100° C. without decomposing, but react immediately with atmospheric carbon dioxide and moisture.

—C. A. M.

Disinfection and mixing of waste effluents and other liquids; Apparatus for the ——. A Vogelsang, Dresden. Ger. Pat. 312,744, 14.12.17.

THE effluent flows from a storage tank through a trapped pipe into a mixing tank below, the flow being controlled by a float valve constituted of two separate portions rigidly connected by a rod and provided with guides; the exit pipe of the tank is closed by the lower member of the float when insufficient depth of liquor is present in the tank. On its way to the mixing tank the effluent meets a supply of disinfecting fluid or other liquid, wherewith it is to be mixed. The outflow of liquid from the mixing tank is controlled by a float in the storage tank.—J. S. G. T.

Detecting gases. U.S. Pat. 1,305,025. *See* XXIII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Morphine; Determination of —— *in Indian opium.* J. N. Rakshit and F. J. D'Costa. Analyst, 1919, **44**, 337—341.

THE specific rotation of morphine in dilute hydrochloric acid solution saturated with ether has been found to be −122° at 25° C., and this value should be used in place of −127° when using the method described by Rakshit (this J., 1918, 634A). The correction (0·104 grm.) made for the retention of morphine in the mother-liquor of opium after its precipitation according to the B.P. method is too small; if 0·180 grm. is added, the results obtained agree with those found by the polarimetric method. The volume of the lime solution of opium representing 10 grms. of opium is 102 c.c. It is pointed out that titration of crude morphine does not necessarily give a correct measure of the amount of morphine, since other basic substances may be present.—W. P. S.

Caffeine and theobromine; Test for distinguishing between ——. F. P. Stroup. Amer. J. Pharm., 1919, **91**, 598—599.

Two drops of a solution, prepared by dissolving 1 grm. of potassium bichromate in 20 c.c. of concentrated sulphuric acid, are added to a small portion of the alkaloid on a porcelain plate. In the case of caffeine, the yellow colour of the reagent changes almost immediately to bright bluish-green, whilst with theobromine the colour changes first to dark purple, then gradually to purple-green and olive-green, and finally to the bluish-green tint given by caffeine. The test may also be carried out by adding the alkaloid to the reagent; the same changes in colour are noted, but here again the time required for the production of the bluish-green tint is very much less with caffeine than with theobromine.—W. P. S.

Pepsin preparations; Value of commercial ——. O. Gross. Deutsch. Med. Wchschr., 1919, **45**, 823—825. Chem. Zentr., 1919, **90**, IV., 479.

THIRTEEN samples of pepsin wine from various sources were examined, and all found to be almost or entirely devoid of peptic activity. This inactivity may be due either to a weakening of the strength of the pepsin by the wine itself or to a gradual loss of activity of the dissolved pepsin. The amount of loss is dependent on age and storage temperature. In an experiment with a fresh wine made by the author, part of which was kept in cold storage, the other at normal (room) temperature, the loss in the former case was from 30 units per c.c. to 15 units in 30 days and 6 units in 2 months, and in the latter case to 4 units and zero

respectively. Other pepsin preparations examined also showed in nearly all cases very little peptic activity.—B. V. S.

Superpalite. (Trichloromethyl chloroformate.) H. P. Hood and H. R. Murdock. J. Phys. Chem., 1919, **23**, 498—512.

SUPERPALITE is best prepared by treating methyl alcohol with phosgene and chlorinating the resulting methyl chloroformate in bright light with elevation of the temperature as the chlorination proceeds. Superpalite is decomposed by charcoal and ferric oxide into phosgene. Alumina decomposes it into carbon dioxide and carbon tetrachloride. (See also J. Chem. Soc., Dec., 1919.)
—J. F. S.

Acetone, methyl alcohol, and furfural; Determination of —— in the presence of each other. H. Pringsheim and E. Kuhn. Z. angew. Chem., 1919, **32**, 286—290.

A QUANTITY of the mixture of acetone, methyl alcohol, and furfural (*e.g.*, wood spirit prepared by boiling sawdust with dilute acid under pressure) containing from 0·1 to 0·34 grm. of furfural is diluted to 200 c.c. and treated with 10 c.c. of phenylhydrazine solution (phenylhydrazine, 7·5, sodium acetate, 10 grms., per 100 c.c. of water); after 2 hours the precipitate is collected, dried *in vacuo* over sulphuric acid, and weighed. The weight of the precipitate is multiplied by 0·516 to obtain the quantity of furfural present. The filtrate from the hydrazone precipitate is rendered strongly acid with hydrochloric acid, and distilled, the distillate treated with an excess of magnesia, and again distilled until one-third of the volume of the liquid has passed over; this distillate contains the methyl alcohol and acetone. An aliquot portion of the distillate (not more than 25 c.c. and containing not more than 0·1 grm. of methyl alcohol) is placed in a flask, 50 c.c. of bichromate solution (potassium bichromate, 45·968 grms., sulphuric acid, 50 c.c., per litre; 1 c.c. of this solution = 0·005 grm. methyl alcohol) and 50 c.c. of sulphuric acid (1:1) are added, the flask is closed by a stopper fitted with a water-trap, and the mixture is kept at ordinary temperature for 18 hrs.; the excess of bichromate is then titrated with ferrous ammonium sulphate solution. Under these conditions the acetone is not oxidised. The acetone is determined iodometrically in a separate portion of the distillate.—W. P. S.

Essential oil of "Himeshiso" (Mosla grosserrata, Maxim). S. Furukawa. Kōgyō-Kwagaku Zasshi (J. Chem. Ind., Tokyo), 1919, **22**, 382—394.

HIMESHISO is a wild annual Japanese herb growing 1—2 ft. high, with petiolate, ovate leaves and flowers in racemes. The fresh herb after blossoming gave by steam distillation 0·21% of essential oil having sp. gr. 0·9137 at 15° C., acid value nil, and $[\alpha]_D = -3°$. The oil contained 25% of carvacrol, together with 1% of thymoquinol, and 0·5% of thymoquinone and thymoquinhydrone. From the non-phenolic portion of the oil which had sp. gr. 0·8841, ester value 17·68, ditto after acetylation 51·2, about 40% of *p*-cymene was isolated, and the presence of phellandrene and terpinene was shown by qualitative tests.—G. F. M.

Pinus Thunbergii (Parl.); Essential oil of ——. Y. Shinosaki. Kōgyō-Kwagaku Zasshi (J. Chem. Ind., Tokyo), 1919, **22**, 451—454. (See also this J., 1919, 21A.)

THE α-pinene contained in the oil of *Pinus Thunbergii* consists chiefly of the lævo-compound together with a small amount of the inactive isomeride. The dihydrosesquiterpene, formed by hydrogenation of the tricyclic hydrocarbon of the oil, had the following characters:—B. pt. 98°—99° C. at 2·3 mm.; sp. gr. at 15° C., 0·9294; n_{20} = 1·4959, mol. refraction 64·34 (calc. for $C_{15}H_{24}$ 64·24).
—G. F. M.

Isokiku (Chrysanthemum marginatum, Mig.); Essential oil of ——. Y. Shinosaki. Kōgyō-Kwagaku Zasshi (J. Chem. Ind., Tokyo), 1919, **22**, 455—458.

By steam distillation of isokiku 0·005% of a greenish-blue oil was obtained, having the following constants: Sp. gr. 0·9231 at 15° C., n_{20} = 1·5020, $[\alpha] = -46·58°$, saponification value 16·30, ditto after acetylation 63·09. Besides esters and alcohols, a small quantity of aldehyde or ketone giving a crystalline bisulphite compound, was present.
—G. F. M.

Peppermint oil; Chinese ——. Y. Shinosaki. Kōgyō Kwagaku Zasshi (J. Chem. Ind., Tokyo), 1919, **22**, 458—463.

CHINESE peppermint oil is of a light brown colour and has a rather disagreeable odour and a bitter taste. It has the following characters: Sp. gr. at 25° C. 0·9091, n_D 1·4627, $[\alpha]$ (in chloroform) −35°, saponification value 29, ditto after acetylation 233, free menthol 70·57%, combined menthol 8·08%, ketones (as menthone) 12·88%.—G. F. M.

Essential oil of "Yamashiso" (Mosla japonica, Maxim). K. Hoshino. Kōgyō-Kwagaku Zasshi (J. Chem. Ind., Tokyo), 1919, **22**, 557—568.

THE principal constituent of the essential oil of "Yamashiso" is either thymol or carvacrol, but both have never been found together in the same oil. A sample of thymol-containing oil had the following characters: Sp. gr. 0·9151, n_D^{20} 1·4996, α_D 1·0°, ester value 4·5, thymol 50·06%. It was almost insoluble in 70% alcohol, but soluble in 2 vols. of 80% alcohol. The non-phenolic portion of the oil was distilled over sodium and collected in six fractions with the object of identifying the terpenes. The presence of phellandrene, *p*-cymene, γ-terpinene, caryophyllene, cadinene, and probably sabinene, was established.—G. F. M.

Electrochemical oxidation of phenols. Fichter and Ackermann. *See* III.

PATENTS.

Methyl alcohol; Method of producing —— from alkyl formates. J. A. Christiansen, Copenhagen. U.S. Pat. 1,302,011, 29.4.19. Appl., 6.12.18.

METHYL alcohol is produced by treating an alkyl formate with hydrogen in presence of a catalyst, *e.g.*, partly reduced copper at 180° C., $H.COOCH_3 + 2H_2 = 2CH_3OH$. The alkyl (methyl) formate may be produced by leading carbon monoxide (water-gas) and methyl alcohol vapour, at high pressure, over solid sodium methoxide, or by passing carbon monoxide into a solution of sodium methoxide in methyl alcohol: $CO + CH_3OH = H.COOCH_3$.

Benzaldehyde; Process of manufacturing ——. A. J. Appelbaum, Assignor to The Import and By-Products Co., Trenton, N.J. U.S. Pat. 1,302,273, 29.4.19. Appl., 17.5.18.

ALDEHYDES are produced from aromatic hydrocarbons by heating with an oxidising agent and a catalyst in presence of an acid. For example, a mixture of 92 parts of toluene, 100 parts of manganese dioxide, 150 parts of sulphuric acid, and 5 parts of ferric, copper, or cerium sulphate is heated to boiling in a digester, then distilled with steam, and the distillate fractionated to separate benzaldehyde from unchanged toluene.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photometry of visible light-rays by means of light-sensitive leuco-bases of organic dyestuffs, also by silver chloride and chromate papers. J. M. Eder. Phot. Korr., 1919, **56**, 140—141; Chem. Zentr., 1919, **90**, IV., 396.

The leuco-bases of Brilliant Green, Malachite Green, Crystal Violet, Rhodamine B, 3 B, and 6 G, also leucaniline and "leuco blue," are sensitive to the respective complementary colours of the dyes and may be used for actinometric purposes. Mixed with collodion they are more light-sensitive than the dyed silver bromide and silver chloride films hitherto used in photometry. They are also sensitive to ultra-violet. The leuco-base of Brilliant Green is specially suited for use in plant physiology experiments, being sensitive to that part of the spectrum which is active in chlorophyll formation. A new kind of photometer paper, prepared with potassium chromate and ammonium oxalate, is recommended for blue light.—B. V. S.

Blackness of coloured bodies and its influence in photography. A. von Hübl. Phot. Korr., 1919, **56**, 71—74. Chem. Zentr., 1919, **90**, IV., 434—435.

Bodies of pure colour are very few; almost always there is also present a certain amount of white light and a more or less considerable amount of general absorption or blackness. The composition of a number of colours in colour, white, and black was determined with the aid of previously described apparatus (Phot. Korr., **55**, 40). Figures given for colours of exceptional purity and brightness, specially selected for photographic purposes, show a range of 2% to 7% in white, and 0% to 78% in black; the only low percentage in black was in a yellow pigment, which had 96% colour, 4% white, and no black.—B. V. S.

Latent [photographic] image. F. Kropf. Phot. Korr., 1919, **56**, 141—143. Chem. Zentr., 1919, **90**, IV., 435.

The addition of finely divided metallic silver to a metol-quinol developer produces no effect, while the addition of precipitated silver bromide or of bromine produces oxidation of the developer. It is concluded that the development of exposed films of silver halide with chemical developers is not due to the separated silver but to the halogen.—B. V. S.

Colour-photography by the multicolour process of Dufay. P. Pooth. Technik und Ind., 1919, 143—145. Chem. Zentr., 1919, **90**, IV., 340.

In Dufay's process of producing a multicolour screen a colourless film of celluloid is impressed with a series of fine, parallel, square-cut grooves by pressure against a warm engraved roller. The grooves are filled with a greasy ink, all excess removed, and the upper parts of the celluloid surface then stained with an alcoholic dye solution. Both sides of the film can be treated, a four-colour screen being thus obtained; the colours in such a screen might be red and blue on one side and yellow and violet on the other. (See also App. Chem. Rep., III., 462.)—B. V. S.

Patents.

Photographic plates and pictures; Manufacture of ——. J. H. Christensen, Holte, Denmark, Eng. Pat. 132,846, 18.9.18. (Appl. 15,194/18.)

A transparent sensitive film is made by coating with an emulsion obtained by diluting an ordinary emulsion with gelatin solution to about 1-20th or 1-30th its normal silver content. Such a film on exposure and development gives an image which is too thin for printing or other purposes but which can be intensified, preferably by a process which depends on the conversion or replacement of the silver image by a substance such as silver or cuprous iodide having strong absorbent properties for certain dyes. Formulæ are given of several suitable solutions for the treatment of the silver image. After treatment the plate is washed, treated with a solution of a suitable basic dye or an acid dye such as Acid Rhodamine or Fast Green and again washed to remove excess of dye; the treatment before dyeing may be in two parts, the first being a bleaching of the image to silver bromide, for instance by an ordinary bleaching bath, and the second a treatment with a solution containing thiocarbamide (thiourea) to render the image more dye-absorbent. Such sensitive films are very suitable by reason of their transparency for two- or three-colour single-exposure processes, the two or three sensitive films being placed close together with the interposition of suitable colour filters, or staining of the films themselves.—B. V. S.

[Photographic] emulsions poor in gelatin; Process for preparing —— W. Merckens, Charlottenburg. Ger. Pat. 301,291, 6.3.17.

Slightly alkaline emulsions containing only 1% or 2% of gelatin are treated with formaldehyde, aluminium acetate, or aluminium formate, workable emulsions having viscosity and setting power similar to those of untreated 8% or 10% solutions being easily obtained.—B. V. S.

Photochemical etching process. J. Rieder, Berlin-Steglitz. Ger. Pat. 312,657, 16.1.18. Addition to Ger. Pat. 309,376.

The process described in the chief patent (this J., 1919, 389A) is modified by the addition to the developing agent (alcohol, acetone, etc.) of a small quantity of the etching medium. To prevent the penetration of the etching medium a thin coating of a resin such as shellac is given. The etching liquids recommended, mixed with alcohol in each case, are nitric acid for steel, ferric chloride for copper, and hydrofluoric acid for glass.—B. V. S.

Silver halide emulsions; Ripening process for ——. H. Müller, Leipzig. Ger. Pat. 313,180, 22.8.18.

For the purpose of obtaining steep gradation in an emulsion it is treated with a solution of pepsin in dilute hydrochloric acid, an emulsion so treated being capable of being ripened by the usual processes without noticeable increase in size of grain. —B. V. S.

Fine-grain colour screens for colour photography; Process for the preparation of ——. Chem. Fabr. Buckau, Magdeburg, and T. Silbermann, Halle. Ger. Pat. 313,008, 14.6.14.

Magnesium carbonate is used as the colour carrier. It can be obtained as fine transparent grains of uniform size, which easily take up colouring matter. —B. V. S.

Variable resistance. U.S. Pat. 1,316,220. *See* XI.

XXII.—EXPLOSIVES; MATCHES.

Flameless powders. Delpech. Comptes rend., 1919, **169**, 537—539.

Various substances were examined to determine their effect in extinguishing the flame of explosive powders when incorporated with the pastes during the process of manufacture. Of these vaseline and heavy petroleum, which act in an identical manner, were the most efficient. For use with 75 mm. guns 3% of vaseline was sufficient, the charge being increased by 4% to obtain the

same ballistic action. With larger guns, slightly more vaseline and a slightly greater increase in the charge were necessary. Finely divided carbon, in its various forms, was ineffective. Naphthalene, nitronaphthalene, and dinitroxylene extinguished the flame, but a thick black smoke was produced. Trinitroxylene was not very effective. Cotton and wood cellulose were almost as effective as vaseline, but were difficult to incorporate in the pastes. Hydrocellulose was much easier to incorporate and just as effective. It should be noted that the addition of vaseline also produces a powerful stabilising action on the French B powders.—W. G.

Tetryl; Compressed charges of ——. A. Stettbacher. Z. ges. Schiess- und Sprengstoffw., 1919, 6—7. Chem.-Zeit., 1919, 43, Rep., 198.

TETRYL cannot be melted without decomposition, and pellets can therefore be made only by compression. A density of 1·78 to 1·80 is said to be obtained under a pressure of 5000—6000 kilos. per sq. cm. The plant employed consists of a hydraulic press, gauge, iron screen, accumulator, pump, and differential ram; the press itself comprises a die, plunger, pin for detonator hole, and bottom plate with hole for discharging the pellet. The plunger should be slightly bevelled, 0·5 mm. in a diameter of 20 mm., and the opening in the die must be slightly conical, 0·1 mm. taper in a length of 10—12 cm. The pin should have a rounded shoulder and should be reduced at the top, and for long charges it must be tapered. All parts should be highly polished and lubricated with powdered graphite suspended in water. Pressure has little effect on the crushing strength of the pellet; it should be as high as possible. A good quality steel is essential for the press parts.—W. J. W.

Detonation; Theory of ——. R. Becker. Z. Elektrochem., 1917, 23, 40—49.

THE theory of detonation is developed mathematically and from the equations deduced the following values are calculated (which are of the same order as the values experimentally determined): for a detonation temperature of 2000° C. with nitroglycerin a detonation pressure of 92,500 atm. is set up, and the detonation proceeds through the mass with a velocity of 7230 metres per sec.; for 2500° C. the corresponding figures are 110,500 atm. and 7930 metres per sec.—J. F. S.

Explosion; Temperature of —— for endothermic substances. R. L. Datta and N. R. Chatterjee. Chem. Soc. Trans., 1919, 115, 1006-1010.

FOLLOWING up observations of Berthelot (this J., 1888, 642) with trinitrophenol, mono-, di-, and trinitronaphthalene, and potassium chlorate, which on heating gradually volatilise or decompose, but which can be made to explode by throwing them into a vessel previously heated to a suitably high temperature, the authors have found that for each endothermic substance there is a temperature below which explosive decomposition does not take place. This definite point, termed the temperature of explosion, has been determined for a large number of nitro compounds, picrates, azo compounds, haloid compounds, organic perchlorates, and alkaloids. The determinations were carried out in an atmosphere of carbon dioxide.—W. P.

Gas warfare at the front. B. C. Goss. Proc. Eng. Soc. W. Pa., 1919, 35, 181—194.

Gas, smoke, and flame in this war and the next. W. H. Walker. Proc. Eng. Soc. W. Pa., 1919, 35, 195—214.

Dust explosions. Bauer. *See* X.

PATENTS.

Ammon-powder; Manufacture of ——. Oberhessische Kalk- und Steinindustrie G.m.b.H., Berlin. Ger. Pat. 303,370, 26.8.17.

WOOD-FLOUR is subjected to the action of steam at 110°—120° C. before placing it in the incorporating mill, the moistening of the powder during milling being thus eliminated, and the time necessary for incorporation being reduced by about one-half.
—W. J. W.

Chlorate explosives; Process for increasing the stability during storage of ——. Fürstlich Plessische Miedziankitfabrik, Mittel-Lazisk. Ger. Pat. 313,046, 19.4.18.

KIESELGUHR is added to chlorate explosives containing volatile liquids, such as petroleum, to prevent evaporation of these liquids and subsequent hardening of the cartridges.—W. J. W.

Waste acids from nitrocellulose manufacture; Process and apparatus for recovery of ——. A. v. Vajdáfy, Magyaróvar, Hungary. Ger. Pat. 313,046, 28.4.18.

PART of the waste acid is recovered by subjecting the nitrocellulose to a preliminary pressing, most of the remaining acid being then removed by hydraulically compressing the nitrocellulose, these two operations, as well as the ejection of the compressed nitrocellulose, being carried out as part of a continuous cycle. The apparatus comprises a press-table provided with perforated cylinders, in which plungers operate. The three operations (light pressing, heavy pressing, and ejection of compressed material) are carried out simultaneously in successive cylinders, and by rotating the table the material is subjected to each operation in succession; the cylinders have movable plates below to retain the material during the movement of the press-table. The process enables the waste acid to be expressed from the nitrocellulose in a few seconds without risk of decomposition. The pressed material passes to a conveyor or direct into a pulping machine.—W. J. W.

XXIII.—ANALYSIS.

Gas pycnometer. K. Kling and L. Suchowiak. Metan, 1917, 1, 37—42. Chem. Zentr., 1919, 90, IV., 437—439.

THE pycnometer described is a cylindrical vessel with tapering ends, each of which has a capillary opening. There are no taps, the openings being closed by means of clips and rubber fittings, which are secured by screws. The vessel is first filled with dry, clean mercury, and then connected with the gas holder. When the mercury is made to leave the vessel gas is drawn in from the gas holder, and when the pycnometer is filled the ends are closed. The slight loss of gas during the closing of the capillary tubes has no influence on the determination. The density of the gas is calculated by means of the formula—

$$d = \left(\frac{g-p}{V.s}+1\right)\cdot\frac{1+0{\cdot}00367t}{1+0{\cdot}00367t'}\cdot g$$

where g represents the weight of the pycnometer + gas; p the weight of the pycnometer + air; V the volume of the pycnometer; t the temperature at the time of filling, t' the temperature at the time of weighing; s the density of the air in vessel at t; and d the relative density of the gas (air=1).
—C. A. M.

Gas washing and absorption apparatus [; Laboratory ——]. F. Friedrichs. Z. angew. Chem., 1919, 32, 252—256.

THE properties (resistance or "head" of liquid,

construction, degree of effective washing or absorption, liability to form gas "pockets," etc.) of some 30 forms of apparatus are discussed. The best forms, for washing or absorbing a gas, are considered to be those providing a serpentine or screw-like passage for the gas through the liquid (see this J., 1919, 443 A).—W. P. S.

Extraction apparatus; An automatic ——. J. Tcherniac. Chem. Soc. Trans., 1919, **115**, 1090—1092.

THE apparatus, an improved form of that previously described (Ber., 1893, **25**, 3652), is designed for extracting aqueous solutions by means of ether or chloroform. A flask containing the solvent is heated in a water-bath, the vapour passing by a glass tube to the bottom of a second flask, almost filled with the solution to be extracted, and immersed in a bath of cold water. Passing up through the solution, the solvent is condensed and is returned to the first flask, a condenser being provided to prevent loss of solvent. For a description and diagram of the somewhat complicated glass connections the original must be consulted.—E. H. R.

Anti-suck-back device applicable to evolution methods of analysis. P. L. Robinson. Chem. News, 1919, **119**, 159—160.

Two forms of apparatus are described for preventing liquid from flowing back from an absorption vessel to a reaction flask, the principle being that of a liquid trap. When the pressure diminishes in the reaction flask air is admitted through a vertical tube, the lower end of which is immersed in the liquid in the trap.—W. P. S.

Electrometric titrations; Electrical apparatus for use in ——. H. S. Roberts. J. Amer. Chem. Soc., 1919, **41**, 1358—1362.

A POTENTIOMETER is described for use in electrometric titrations. This instrument does not necessarily give E.M.F. readings in volts but in arbitrary units, since all that is desired in this type of work is the inflexion point of the E.M.F. The instrument consists of a rheostat on which two sliding contacts work. The contacts indicate on scales which are numbered in opposite directions, respectively 0—100 and 100—200. Thus, when the point 100 represents zero potential, readings may be made with a solution which changes the sign of its E.M.F. without the use of reversing keys and without introducing a minus sign into the figures. The potentiometer is used with a single dry cell and a high resistance galvanometer.—J. F. S.

Electrometric titrations with special reference to the determination of ferrous and ferric iron. J. C. Hostetter and H. S. Roberts. J. Amer. Chem. Soc., 1919, **41**, 1337—1357.

EXPERIMENTS are described on the estimation of ferrous iron by titration with potassium bichromate and potassium permanganate, the estimation of ferric iron by means of stannous chloride, and the titration of potassium bichromate with stannous chloride, in which the end point of the reaction is obtained from the E.M.F. of the solution against a calomel electrode. The electrical apparatus is described by Roberts (see preceding abstract). A special "titration head" is used to cover the titration flask; this consists of a glass cap with three holes in the top; the first admits a glass tube from the calomel electrode, the second admits the tip of the burette, and the third carries a platinised platinum electrode and admits a current of carbon dioxide. Solutions of potassium bichromate as dilute as 0·0005N may be employed in this method. The electrometric method makes it unnecessary to remove the excess of reducing agent which has been added in the reduction of a ferric salt. Conditions, such as acidity, need not be controlled except within very wide limits, and hydrochloric, sulphuric, or hydrofluoric acid may be used. The sensitiveness and accuracy of the method make possible the determination of a few tenths of a milligram of tin, chromium, ferrous or ferric iron in the presence of large quantities of other elements. The time within which a determination can be carried out is greatly shortened. The content of ferrous and ferric iron in a silicate, for example, can be determined in 15—30 mins. The precision attainable is comparable to the best of the ordinary volumetric determinations.—J. F. S.

Acids; Titration of —— by the conductivity method. P. A. Meerburg. Chem. Weekblad, 1919, **16**, 1338—1347.

IN the titration of acids with alkalis by the conductivity method the neutralisation point is indicated by a definite inflexion in the curve representing the change of conductivity. When strong acids and bases interact, this bend will be acute; it is obtuse in the case of a weak acid and a strong base. A mixture of acids of widely divergent degrees of ionisation can be accurately estimated; the neutralisation of the acid with the highest ionising power is indicated by the lowest part of the curve; the point at which the weaker acid becomes neutralised is then marked by a sharp bend. Accurate results are obtained when the relative proportions of the strong and weak acid are 1:1 or 1:2·5, but with proportions of 2·5:1, results are not very reliable. The method is well adapted to the estimation of hydrochloric acid and lactic acid in chyle, or of organic and inorganic acids in vinegar. The author gives tables and curves for various acid mixtures.—W. J. W.

Alkalimetric titrations in presence of alumina. I. Bellucci and F. Lucchesi. Annali Chim. Appl., 1919, **11**, 199—204.

THE various methods published are subjected to critical examination.—T. H. P.

Tin; Determination of ——. F. Le Naour. Ann. Chim. Analyt., 1919, **1**, 308—309.

BERTIAUX (this J., 1918, 658 A) has stated that ignited stannic oxide (SnO_2) is hygroscopic, but the author finds that this is not the case; 1 grm. of the oxide, when exposed to the atmosphere for 18 hours, gained only 2 mgrms. in weight.—W. P. S.

Aluminium and vanadium; New separation of ——. P. Wenger and H. Vogelson. Helv. Chim. Acta, 1919, **2**, 550—553.

THE mixture of aluminium and vanadium oxides obtained in the usual manner is heated gradually with six times its weight of anhydrous sodium carbonate in a platinum crucible until the mass melts, the temperature is then raised, and the heating continued for three hours. The crucible and contents are cooled somewhat, plunged into distilled water, and raised to the boiling point, when a clear solution of sodium aluminate and sodium vanadate is obtained. The solution is made up to 500 c.c. with water, raised to the boiling point and a quantity of ammonium nitrate equal to 10 times the weight of the oxides is added in small quantities. Aluminium hydroxide is precipitated, filtered off, washed, ignited, and weighed as Al_2O_3. The filtrate is acidified, neutralised with ammonia, raised to the boiling point, and treated with barium chloride solution. Barium vanadate is precipitated; the precipitate is allowed to stand for 24 hours, filtered off, washed with cold water, dried, ignited, and weighed as $Ba(VO_3)_2$. In the presence of iron the solution is precipitated cold by ammonia. The precipitate contains iron and aluminium hydroxides and ammonium vanadate. It is filtered off, washed, ignited in a platinum

crucible, mixed with six times its weight of sodium carbonate, and ignited as before. The fused mass is boiled with water, when everything except ferric oxide dissolves; this is filtered off and weighed and the filtrate is treated as described above. The results of analyses by these methods are extremely good.—J. F. S.

Molybdenum and tungsten; Colour reactions of ——. *I.* G. A. Barbieri. Atti R. Accad. Lincei, 1919, **28**, i., 351–355.

THE author has investigated Braun's reaction (*Z. anal. Chem.*, 1863, **2**, 36), that is, the various colorations obtained when an acidified solution containing a molybdate and a thiocyanate is treated with zinc, tin, or other reducing agent. (See *J. Chem. Soc.*, 1919, i., 550.) T. H. P.

Selenium and tellurium; Flame reactions of ——. H. B. Weiser and A. Garrison. *J. Phys. Chem.*, 1919, **23**, 478–497.

THE transformation of selenium to selenic salt produces a blue luminescence; this is the characteristic colour in flames containing selenium. The reaction tellurium to tellurous salt produces a green luminescence, and that from tellurous salt to telluric salt a blue luminescence. The reddish luminescence observed in flames containing seleniam is due to the coloured selenium vapour. The greenish tip observed in flames containing selenium and tellurium is not a luminescence, but is due to the greenish colour of the vapour of the dioxide. (See also *J. Chem. Soc.*, Dec., 1919.)
J. F. S.

Gasoline in natural gas. Kling. *See* IIA.

Ammonia oxidation. Gaillard. *See* VII.

Halogen salts. Jones. *See* VII.

Hypochlorite solutions. Moerk and Foran. *See* VII.

Iron pyroligneite. Vié. *See* VII.

Tin alloys. Craig. *See* X.

Dust explosions. Bauer. *See* X.

Sulphonated oils. *See* XII.

Saccharimeter. (1) Herzfeld. (2) Gaillard. *See* XVII.

Sugar syrup. Skola. *See* XVII.

Micro-analysis of wine. Ripper and Wohack. *See* XVIII.

Methyl alcohol. Ehman. *See* XVIII.

Methyl alcohol. Wolff. *See* XVIII.

Fat in milk. Meillère. *See* XIXA.

Cheese. Winterstein. *See* XIXA.

Morphine. Rakshit and D'Costa. *See* XX.

Caffeine and theobromine. Stroup. *See* XX.

Acetone, methyl alcohol, and furfural. Pringsheim and Kuhn. *See* XX.

Photometry. Eder. *See* XXI.

PATENTS.

Photometer. M. J. Railing and H. N. Green, London. Eng. Pat. 11,387, 8.5.14.

A PHOTOMETER for measuring low candle powers, particularly applicable to the testing of miners' hand lamps. The apparatus is compact and easily manipulated, and may be calibrated to read directly. Two white-surfaced screens, a fixed one illuminated by a standard source of light, and an adjustable one illuminated by the source to be tested, are viewed through a lens, being shown side by side on a disc, one half of which consists of plain glass through which one screen can be seen, and the other of silvered glass giving a reflection of the other screen. The adjustable screen can be rotated to vary the amount of illumination upon it. When the two screens appear equally illuminated, the candle power of the tested lamp can be found from the angle of rotation.—W. P.

[*Poisonous*] *gases* [*e.g., chlorine, etc.*]; *Method of and means for detecting* ——. G. M. S. Tait. U.S. Pat. 1,305,025, 27.5.19. Appl., 4.10.18.

POISONOUS gases for instance, chlorine in the air of submarines, and certain poison gases (chloro- and bromo-derivatives) are detected by passing the gas under examination over copper, strontium, or lime heated in an alcohol flame, when a characteristic colour is imparted to the flame.

Washing and cleaning test tubes, bottles, and like vessels; Apparatus for ——. J. T. Edwards, London. Eng. Pat. 132,865, 24.9.18. (Appl. 15,501/18.)

Asbestos filter material. Ger. Pat. 313,548. *See* I.

Testing metal objects. Ger. Pat. 301,211. *See* X.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I. GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Aciéries Thyssen. Furnaces. 26,817. Oct. 31. Ger., 26.6.18.)

Aluminium Plant and Vessel Co., and Norman. Filter-presses. 26,358. Oct. 27.

Barclay. Liquids and apparatus for fire-extinguishing. 26,531. Oct. 29.

Benton. 26,401. *See* VIII.

Benton. Drying and distilling apparatus. 26,402. Oct. 28.

Carmichael. Manufacture of filter cloths etc. 26,387. Oct. 28.

Colcatti. Furnaces. 26,592. Oct. 29.

Crush. Vapour-condensation plant. 26,453. Oct. 28.

Fletcher and Co., and Miller. Filters. 27,519. Nov. 7.

Gardiner and Stoney. Furnaces. 26,543. Oct. 29.

Haines. Filtering apparatus. 27,526. Nov. 7.

Maclachlan. Boiling-pans and mixing machines. 27,466. Nov. 7.

Metropolitan-Vickers Electrical Co., and Scanes. Evaporating plant. 27,428. Nov. 6.

Oldbury Manufacturing Co., and Thomas. Furnaces. 27,084. Nov. 4.

Reid. Oil-burning furnaces. 27,258. Nov. 5.

Reid. Furnaces. 27,259. Nov. 5.

Seymour. Pulverisers, and process of fine grinding. 27,522. Nov. 7.

Younger. Kilns. 26,631. Oct. 30.

COMPLETE SPECIFICATIONS ACCEPTED.

17,726 (1918). Kidd and others. *See* XIII.

19,271 (1918). Govers. Heat treatment of chemical compounds. (129,962.) Nov. 5.
19,929 (1918). Gill, and Davenport Engineering Co. Cooling towers or structures for cooling water and other liquids. (134,094.) Nov. 5.
20,447 (1918). Prentice. Retorts and stills. (134,406.) Nov. 12.
21,231 (1918). Mason. Filter-press plates. (134,415.) Nov. 12.
21,799 (1918). Thatcher. Diaphragms or separators for use in separating two liquids. (134,116.) Nov. 5.
3117 (1919). Sonsthagen. Machine for mixing liquid, semi-liquid, or viscid materials. (134,451.) Nov. 12.
6611 (1919). Sturgeon. Centrifugal separating machines. (134,158.) Nov. 5.
10,891 (1919). Loring. Centrifugal apparatus for breaking up liquids and disseminating them in solids, or for mixing and drying liquids and solids. (134,487.) Nov. 12.
11,113 (1913). Wade (Fours et Procédés Mathy). Furnaces. (134,169.) Nov. 5.
18,258 (1919). Raymond Bros. Impact Pulverizer Co. Pulverising mill roller. (134,281.) Nov. 12.

II. FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Bale. Apparatus for carbonising coal, lignite, shale, etc. 27,090. Nov. 1.
Beaven, Johnston, and Sutherland. Composite fuel. 27,651. Nov. 8.
Brownlee and Uhlinger. 27,290. *See* X.
Dickson and Vickers (Clayton). Composite fuel. 26,395. Oct. 28.
Duncombe and Singer. Fuel. 27,585. Nov. 7.
Field and Toogood. Coal substitute. 26,359. Oct. 27.
McLeod. Apparatus for carbonising and distilling moist carbonaceous materials. 26,833. Oct. 31.
O'Brien. Production of liquid fuel. 26,385. Oct. 28.
Pease. 26,589. *See* VII.
Stoneham. Rendering alcohol more readily ignitable when used as fuel in internal combustion engines. 27,449. Nov. 6.
Ulmann. Production of turf or peat briquettes. 27,370. Nov. 6.
Willington. Manufacture of fuel. 27,675. Nov. 8.

Complete Specifications Accepted.

18,757 (1917). Comp. pour la Fabr. des Compteurs et Matérial d'Usines a Gaz. Water-gas producers. (112,268.) Nov. 5.
2432 (1918). Nomi. Destructive distillation of petroleum pitch. (114,617.) Nov. 12.
2920 (1918). Perkin, and Nitrogen Products and Carbide Co. Destructive distillation of carbonaceous materials. (134,236.) Nov. 12.
9205 (1918). Rideal and Taylor. *See* XXIII.
15,208 (1918). Simon-Carves, Ltd., and Brown. Gas-washer. (133,987.) Nov. 5.
15,357 (1918). Porat. Production of paraffin waxes, oils, or fats from peat, peat straw, mosses, lichens, algæ, grass, straw, etc. (133,989.) Nov. 5.
17,741 (1918). Bataafsche Petroleum Maatsch., and Brey. *See* III.
17,843 (1918). Davidson. Manufacture of peat fuel. (134,326.) Nov. 12.
18,432 (1918). Bowen. Apparatus for the production of artificial fuel. (134,355.) Nov. 12.
20,447 (1918). Prentice. *See* I.
21,539 (1918). Bamber and Abrahams. Generation of producer-gas. (134,113.) Nov. 5.
6251 (1919). Bates and Bates. *See* VII.

III.—TAR AND TAR PRODUCTS.

Applications.

Alger and Frood. 26,403. *See* XIII.
Anderson. Treatment of coal tar etc. 26,759. Oct. 31.

Complete Specifications Accepted.

17,741 (1918). Bataafsche Petroleum Maatsch., and Brey. Rectification of hydrocarbons. (123,522.) Nov. 12.

IV.—COLOURING MATTERS AND DYES.

Application.

Knecht. Production of diazo compounds. 27,318. Nov. 6.

Complete Specification Accepted.

16,939 (1918). Brass. Manufacture of colouring matters and of lakes therefrom. (134,270.) Nov. 12.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Backer. Manufacture of paper pulp from straw, reeds, esparto, etc. 27,672. Nov. 8.
Carmichael. 26,387. *See* I.
Hofste. Production of textile fibrous material. 27,261. Nov. 5. (Holland, 17.12.18.)
Johnston and Sutherland. Freeing or clearing vegetable matter from stalk and leaf fibres. 27,486. Nov. 7.
Pritchard. Degumming and washing fibres. 27,596. Nov. 7.
Selberrad. Acetyl cellulose. 26,969. Nov. 3.
Stulemeyer. Manufacture of artificial silk. 27,209. Nov. 5.

Complete Specifications Accepted.

15,942 (1918). Power Gas Corporation, and Langwell. *See* XVIII.
17,165 (1918). Slight and Lacy. Impregnating articles of millboard etc. to render them waterproof. (134,010.) Nov. 5.
20,560 (1918). Charlesworth. Machines for drying or carbonising wool, cotton, etc. (134,100.) Nov. 5.
20,859 (1918). Distillates, Ltd., and Jarmain. Treatment of effluent from piece or like scouring processes. (134,410.) Nov. 12.
20,972 (1918). Puttaert and Puttaert. Manufacture of pulp and paper cardboard and like sheet material from garbage. (134,411.) Nov. 12.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Ashton, Nelson, and Calico Printers' Assoc. Printing textile fabrics. 26,881. Nov. 1.
Boardman and Petrie. Dyeing apparatus. 26,565. Oct. 29.
Briggs, Palmer, and British Cellulose and Chemical Manufacturing Co. Dyeing or colouring fibres, threads, or fabrics. 26,801. Oct. 31.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Armour Fertilizer Works. Production of aluminium nitride etc. 26,332. Oct. 27. (U.S., 10.7.19.)

Borelli & Co., and Brusa. Manufacture of mercuric oxide etc. by decomposition of nitrates. 26,740. Oct. 30.

Chikashige and Uno. 26,470. *See* X.

Cottineau. 26,819. *See* X.

Hultman. Manufacture of chrome alum. 27,016. Nov. 3. (Sweden, 6.2.19.)

Pease. Extraction of ammonia from gases etc. 26,589. Oct. 29.

Uchino. Process of refining arsenious acid. 26,317. Oct. 27.

COMPLETE SPECIFICATIONS ACCEPTED.

1155 (1918). Taylor and Knapp. Producing ammonia and ammonium compounds. (134,237.) Nov. 12

9205 (1918). Rideal and Taylor. *See* XXIII.

17,226 (1918). Welch. Production of sulphuric acid. (134,015.) Nov. 5.

17,700 (1918). Aanensen. Manufacture of ammonium perchlorate. (121,727.) Nov. 12.

18,702 (1918). Norsk Alkali Aktieselskabet. Apparatus for electrolysis of alkaline chlorides. (125,935.) Nov. 5.

6251 (1919). Bates and Bates. Treating spathic iron ore to render it suitable for use in the manufacture of hydrogen. (134,155.) Nov. 5.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Benton. Machinery for tearing or pulverising clay, sewage sludge etc. 26,401. Oct. 28.

Frink. Manufacture of sheet glass. 27,438. Nov. 6.

Glass (Gilligan and Duck). Composition for articles for moulding or shaping glass. 27,277. Nov. 5

IX.—BUILDING MATERIALS.

APPLICATIONS.

Baylor. Cement. 27,647 and 27,648. Nov. 8.

Crosbie. Asphaltic cement or bituminous composition for roads, floors, roofs, etc. 27,607. Nov. 7.

Dale. Concrete etc. 26,280. Oct. 27.

Dyring. Heat-insulating composition. 26,504. Oct. 28. (Sweden, 29.10.18.)

Heuschkel. Composition for building etc. 26,357. Oct. 27.

Lang. Composition for floor coverings, artificial wood, cork, etc. 26,171. Oct. 28.

COMPLETE SPECIFICATION ACCEPTED.

17,329 (1918). Bas. Production of artificial stone. (120,575.) Nov. 5.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Ann and Shepherd. Separating and powdering minerals. 26,701. Oct. 30.

Ballantine. Production of rustless articles of steel. 26,623. Oct. 29.

British Thomson-Houston Co. (General Electric Co.). Alloy steels. 27,153. Nov. 4.

Brownlee and Uhlinger. Combustible gaseous compositions for cutting, welding, etc. 27,290. Nov. 5.

Chadwick and Walker. Electro-deposition of aluminium. 27,496. Nov. 7.

Chikashige and Uno. Recovery of selenium and noble metals from electrolytic slimes etc. 26,470. Oct. 28. (Japan, 28.10.18.)

Cottineau. Obtaining copper from lyes resulting from the treatment of cupriferous pyrites. 26,819. Oct. 31.

Coward. Smelting etc. furnaces. 27,369. Nov. 6.

Cubley, and Harvey and Co. Gas-heated crucible furnaces. 26,853. Nov. 1.

Elmore. Extraction of lead and zinc from ores. 27,580. Nov. 7.

Lessing. Removal of dust from blast furnace gases. 27,257. Nov. 5.

Martin. Extraction and recovery of gold from ores. 27,039. Nov. 3.

Middlemiss. Leaching and separation of ore. 26,530. Oct. 29.

Pitchford Melting-furnaces. 27,613. Nov. 8.

COMPLETE SPECIFICATIONS ACCEPTED.

12,363 (1918). Blackwell. Manufacture of ferro-tungsten and other tungsten alloys. (133,981.) Nov. 5.

17,509 (1918). Blair and Clapp. Manufacture of iron and steel. (134,283.) Nov. 12.

17,739 (1918). Bloxam (Stabilimenti Biak—Ing. A. Pouchain). Tin-soldering and tin-coating aluminium or its alloys. (134,315.) Nov. 12.

19,606 (1918). Ramen. Manufacture of burnt ore and like bricks. (134,387.) Nov. 12.

2033 (1919). Ingle. Preparation for removing rust from and preventing formation of rust on iron. (134,417.) Nov. 12.

5931 (1919). Stabilimenti Biak—Ing. A. Pouchain. Electric furnace for heating, annealing, or melting metallic materials. (124,438.) Nov. 12.

XI. ELECTROCHEMISTRY.

APPLICATIONS.

Chadwick and Walker. 27,490. *See* X.

Chikashige and Uno. 26,470. *See* X.

Corradi. Electrolysing water. 26,326. Oct. 27.

Dean and Redmayne. Electric furnaces. 26,663. Oct. 30.

COMPLETE SPECIFICATIONS ACCEPTED.

17,258 (1918). Oldham and Oldham. Galvanic batteries. (134,019.) Nov. 5.

17,754 (1918). Burgess Battery Co. Manufacture of electric dry batteries. (120,891.) Nov. 12.

18,702 (1918). Norsk Alkali Aktieselskabet. *See* VII.

21,541 (1918). Campbell. Electric furnaces. (134,122.) Nov. 12.

5931 (1918). Stabilimenti Biak. *See* X.

XII.—FATS; OILS; WAXES.

APPLICATION.

Fankhausen. Cocoa-butter presses etc. 26,432. Oct. 27.

COMPLETE SPECIFICATIONS ACCEPTED.

15,357 (1918). Porat. *See* II.

14,901 (1919). Soc. Anon. Usines de Keukelaere. Presses for oil extraction. (128,222.) Nov. 12.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Alger and Frood. Manufacture of phenolic condensation products. 26,403. Oct. 28.

British Thomson-Houston Co. (General Electric Co.). Japans. 27,254. Nov. 5.

Ivinson and Roberts. Composition impervious to oils, spirits, water, etc. 26,426. Oct. 28.

Ivinson and Roberts. Anti-corrosive paint. 26,427. Oct. 28.
Langwell and Tyrer. Manufacture of pigments. 27,000. Nov. 3.
Leach. Paint distemper. 26,293. Oct. 27.
Richardson. Manufacture of newspaper etc. printing-inks. 27,630. Nov. 8.

COMPLETE SPECIFICATIONS ACCEPTED.

16,939 (1918). Brass. *See* IV.
17,726 (1918). Kidd, and Wilkinson, Heywood, and Clark. Formation of precipitates for example pigments. (134,313.) Nov. 12.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATION.

Davidson. Manufacture of rubber. 26,735. Oct. 30.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATION.

Garner. Tan-pits etc. 26,434. Oct. 28.

COMPLETE SPECIFICATIONS ACCEPTED.

17,185 (1918). Mumford. Manufacture of glue and similar materials. (134,011.) Nov. 5.
17,505 (1918). Walker. Apparatus for soaking etc. leather and other goods. (134,010.) Nov. 5.

XVI. SOILS; FERTILISERS.

APPLICATION.

Baker and Shepherd. Fertiliser. 26,780. Oct. 31.

XVII. SUGARS; STARCHES; GUMS.

COMPLETE SPECIFICATION ACCEPTED.

13,092 (1917). Widstrom. Cooling masse cuite in sugar moulds. (109,621.) Nov. 12.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATION.

Fry and Wolf. Preparation of malt. 27,573. Nov. 7.

COMPLETE SPECIFICATIONS ACCEPTED.

15,942 (1918). Power Gas Corporation, and Langwell. Fermentation of cellulose. (134,265.) Nov. 12.
10,715 (1919). O'Sullivan and others. *See* XIX.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Barbot et Fils et Cie. Manufacture of grape honey and fruit syrups. 27,401. Nov. 6. (Fr., 19.11.18.)
Bardsley and Bradley. Insecticide. 27,336. Nov. 6.
Benton. 26,401. *See* VIII.
Borrowman. Water-softening. 27,285. Nov. 5.
Brock, and Brock and Son. Self-raising flour. 26,785. Oct. 31.
Candy. Apparatus for purifying water. 26,517. Oct. 29.
Hartley and Hartley. Purification of sewage. 27,205. Nov. 5.
Rushton. Softening or purification of water. 27,019. Nov. 3.

COMPLETE SPECIFICATIONS ACCEPTED.

13,774 (1918). Marshall. Sterilising and drying animal and vegetable matter, including slaughter-house offal. (133,983.) Nov. 5.
20,859 (1918). Distillates, Ltd., and Jarmain. *See* V.
20,972 (1918). Puttaert and Puttaert. *See* V.
10,715 (1919). O'Sullivan, O'Sullivan, and Marsan. Treatment of brewers' or distillers' yeast to obtain an article resembling extract of meat. (134,168.) Nov. 5.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Boake, Roberts, and Co., Plant, and Sidgwick. Manufacture of diethyl sulphate. 26,700. Oct. 30.
Saca. Production of phthalic antydride. 27,221. Nov. 5. (Japan, 7.3.19.)

COMPLETE SPECIFICATIONS ACCEPTED.

8031 (1914). Johnson (Verein. Chem. Werke). Manufacture of salts or compounds of choline and of its higher homologues. Nov 5.
12,227 (1918). Levinstein, Ltd., Levinstein, and Bader. Production of benzyl chloride and benzal chloride and certain of their homologues and substitution products. (134,250.) Nov. 12.
4019 (1919). Soc. Anon. des Aciéries et Forges de Firminy. Manufacture of acetone and carbonic acid. (134,111.) Nov. 5.
13,761 (1919). Soc. Chim. des Usines du Rhône. Manufacture of β-halogenethylaminobenzoic esters. (128,553.) Nov. 5.
13,762 (1919). Soc. Chim. des Usines du Rhône. Manufacture of β-alkylaminoethylaminobenzoic esters. (128,554.) Nov. 5.
14,550 (1919). Soc. Chim. des Usines du Rhône. Manufacture of substituted benzoic esters. (128,912.) Nov. 5.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATION.

Camiller and Hay. Manufacture of multicolour screens for natural colour kinematography and photography. 27,574. Nov. 7.

COMPLETE SPECIFICATION ACCEPTED.

5162 (1918). Greene and Garrett. Colour photography. (134,238.) Nov. 12.

XXII.—EXPLOSIVES; MATCHES.

APPLICATIONS.

Brock and Butt. Pyrotechnics, matches, fuses, etc. 27,032. Nov. 3.
Brock. Pyrotechnics. 27,033. Nov. 3.
Mellgren. Manufacture of igniting-composition for matches. 26,827. Oct. 31.

XXIII.—ANALYSIS.

APPLICATION.

Brown. Apparatus for automatic and continuous analysis and recording of gases. 26,640. Oct. 30.

COMPLETE SPECIFICATION ACCEPTED.

9205 (1918). Rideal and Taylor. Apparatus for indicating and/or recording quantities of carbon monoxide in hydrogen or gases containing the same. (134,243.) Nov. 12.

I.—GENERAL; PLANT; MACHINERY.

Oil; Aqueous emulsions of —— and their separation. J. Moscicki and K. Kling. Metan, 1917, 1, 121—127. Chem. Zentr., 1919, **90**, IV., 331.

Starting from the assumption that the decrease in the viscidity of oil on heating promotes the coalescence of the particles of water in aqueous emulsions of oil, experiments were made to determine whether the decrease in the viscidity at the higher temperature corresponding to increased pressure would still further accelerate the separation. Good results were obtained by heating in an autoclave emulsions of oil from steam engines etc. The method is also applicable to the separation of water from tars.
—C. A. M.

High pressures; Industrial use of extremely ——. G. Claude. Comptes rend., 1919, **169**, 649—651.

The author sees no objection to the industrial use of pressures of the order of 1000 atm.; the installations used for obtaining pressures of 200 atm. may be easily modified to produce 1000 atm., the only essential thing being to insure tight joints.
—W. G.

Distillation and extraction apparatus. Van Urk. *See* XXIII.

Patents.

Heat exchanger. Kohl, Neels und Eisfeld m.b.H., Hamburg. Ger. Pat. 313,569, 8.4.17.

Cold air or other medium to be heated is passed upwards through a number of tubes arranged vertically within a surrounding casing, with their ends inserted through tube plates opening into chambers, one at either end of the tubes. The space surrounding the tubes is divided into three superimposed chambers by means of horizontal plates, alternately attached to opposite walls of the casing, and these chambers are subdivided by similarly arranged vertical plates, so that heating fluid which is introduced into this space takes a zig-zag course.—J. S. G. T.

Gases; Apparatus for use in the treatment of liquids with ——. H. J. Magrath, London. Eng. Pat. 133,217, 6.12.18. (Appl. 20,270/18.)

Two cylinders of compressed gas are connected through valves to a service pipe, from which a pipe communicates the gas pressure to the under side of a diaphragm, the upper side of which presses against an adjustable spring. A rod from the upper side of the diaphragm is connected to a bow spring carrying a member engaging with the escapement wheel of a clockwork. When a cylinder is becoming exhausted the diaphragm moves downward under the action of the spring and lowers the rod, pulling the bow spring straight. Complete exhaustion of the cylinder causes the bow spring to be pulled into the opposite position and thus releases the escapement wheel. The clockwork operates a clutch, which opens the valve of the second cylinder to the apparatus. The device is suitable for use in the treatment of water, sewage, etc., with chlorine.—J. H. J.

Drying plant. M. P. P. Gloess, Saint-Mandé, France. Eng. Pat. 119,240, 16.9.18. (Appl. 15,031/18.) Int. Conv., 17.4.17.

Hot air is passed downwards through the outer of two concentric vertical conduits and then up through the inner (or *vice-versâ*), and the material to be dried passes downwards through whichever conduit the air is rising. If solid, the material is conveyed in baskets on an endless chain, or it may be allowed to fall by gravity, its fall being hindered by baffles preferably arranged helically round a shaft, which is allowed to rotate slowly. If liquid, the material may be conveyed by a band of metallic fabric or other material. The circulation of the air is automatic, as the hot air on the downward journey is losing heat through the separating wall of the conduit, and on the upward journey is gaining heat and also taking up water vapour, which is lighter than air; condensation of water vapour in the upper parts is also prevented by the transfer of heat through the separating wall of the conduits. Additional cold air may be admitted to the base of the second conduit if desired.—B. M. V.

Dryer. L. R. Christie, Pittsburgh, Pa. U.S. Pat. 1,318,133, 7.10.19. Appl., 6.1.19.

Hot gases pass first along the outside of a double-walled rotary drum and then through the inner shell, whilst the material to be dried passes through the space between the inner and outer walls, which is fitted with guides or other means to deposit the material on the inner shell.—B. M. V.

Drying sludges of which the solid components are partly impermeable to water; Process for ——. T. Steen, Charlottenburg. Ger. Pat. 314,043, 14.7.16.

Water is removed from the sludge in a suction filter provided with a filter bed composed of a material freely permeable to water, such as sand or coke breeze. After filtration of the sludge, the sand etc. is mixed with the impermeable material from the sludge and the filtration repeated, employing the mixed material as a new filter bed. This process is repeated until the low permeability of the resulting mixture renders it unsuitable. The sand or coke breeze is recovered from the mixture by flushing with water, and the cycle of operations repeated with the recovered material.—J. S. G. T.

Furnaces; Devices on —— indicating the state of combustion and regulating the latter. G. Allata, Locarno, Switzerland. Eng. Pat. 120,903, 7.11.18. (Appl. 18,247/18.) Addition to 115,423 (this J., 1919, 316 A).

The upward and downward movements of the bell-floats of the indicating device previously described (*loc. cit.*) are caused to operate small valves, which release the pressure of a suitable fluid, which in turn operates larger valves to control the primary and secondary air for combustion, these devices being so set that a constant temperature (as determined by the draught) is automatically maintained. The temperature can be altered by displacement of travelling weights on the levers of the bell-floats; by altering the tension of springs attached to the same levers; by altering the level of the liquid in which the floats work by addition or removal of the liquid itself or preferably by using displacing weights which are adjustable by screws and provided with a scale; or, lastly, by adjusting the length of the control valve stems by means of screws. Should a dangerous gas (*e.g.*, lighting gas) be used as the pressure fluid for control, means may be provided to draw off the gas which escapes when a control valve opens.—B. M. V.

Furnace; Rotary ——. J. B. Gaffney, Allentown, Pa., Assignor to Potash Extraction Corporation, New York. U.S. Pat. 1,318,141, 7.10.19. Appl., 20.3.18.

At the discharge end of a rotary furnace a chamber is provided which rotates with the furnace and is provided with valves or doors, one of which opens from the furnace into the chamber, and the other, in the circumference of the chamber, opens from the chamber into the atmosphere. Means are provided to operate these doors so that one is always

closed while the other is open, thus forming an air-lock.—B. M. V.

Rotary kilns; Process for preventing crust-formation in ——. G. Polysius, Dessau. Ger Pat. 312,211, 23.9.16.

PURE powdered or granular lime or sand is projected or blown into the kiln, where it mixes with material under treatment and prevents baking or fusing on to the wall of the kiln. The lime or sand is preferably introduced in the direction of rotation of the kiln, behind the material under treatment, so that as the kiln rotates it is drawn under and mixes with the material.—J. W. D.

Boiler for acid liquids. V. H. Frestadius, Stockholm. Ger. Pat. 313,916, 30.1.18. Int. Conv., 14.1.18.

THE boiler consists of an inner vessel of acid-resisting material surrounded by an outer vessel, the jacket space between the two being closed below and communicating above with the interior of the inner vessel. The acid liquid to be boiled is contained in the inner vessel, and initially steam is blown through the acid. Boiling having commenced, the supply of steam is diverted into the lower portion of the jacketing space between the two vessels. Accumulation of condensed water in the acid is thereby avoided. The condensed water is run away from the jacket by suitable drains. If desired the jacket space can be filled almost to the top of the inner vessel with an alkaline solution to protect the outer surface of the inner vessel and the inner surface of the outer vessel against acid.—J. S. G. T.

Fractionating air or other gaseous mixtures; Process for ——. Ges. f. Lindes Eismaschinen A.-G., Höllriegelskreuth b. Munich. Ger. Pat. 313,120, 22.1.16. Addition to Ger. Pat. 301,940.

IN the process of fractionation of air by liquefaction and rectification in accordance with the original patent (see Eng. Pat. 24,735/14; this J., 1915, 871), the cooling stage in the rectification process for the separation of argon is effected at a temperature about the b.pt. of nitrogen at the pressure existing in the rectifying column. The rectifying column is fitted with a condenser containing as refrigerating medium either liquid nitrogen or some liquid of different boiling point, such as liquid air or oxygen, and the pressure in the condenser is lowered or that in the rectifying column correspondingly increased.—J. S. G. T.

Ball mills [; Means for screening the ground product from ——]. F. L. Smidth and Co., Copenhagen. Eng. Pat. 125,064, 25.3.19. (Appl. 7467/19.) Int. Conv., 27.3.18.

IN a wet or dry ball mill fitted with a screen at the outlet end rotating co-axially with the mill, the ground material is discharged through a grid which has holes too small to permit the passage of the grinding medium, and then passes through an inner co-axial pipe leading to one (preferably the outer) end of the screen. The oversize material, which is retained on the screen, passes into a lifting device situated preferably at the inner end of the screen and is lifted into an outer co-axial pipe, through which it is returned to the mill.—B. M. V.

Centrifugal separation [of slimy solids from liquids]. W. Mauss, Johannesburg. Eng. Pat. 133,448, 10.10.18. (Appl. 16,528/18.)

THE apparatus is somewhat similar in method of operation and general construction to that described in Eng. Pat. 119,706 (this J., 1918, 723 A), but being intended for separation of clear liquid from slimy solids is arranged so that the separation of solids takes place before the liquid reaches the filtering medium. The upper cone of the rotor is not perforated on its conical surface, but the common base of the upper and lower cones is formed of a perforated diaphragm, preferably attached to the lower cone, and covered with a cloth or other filtering medium. The mud to be separated is charged slowly through a pipe bent tangentially to, and situated just below, the top lip of the upper cone, and is prevented from falling straight on to the filtering diaphragm by means of a baffle, which deflects it on to the conical wall of the rotor, where it separates into an outer layer of comparatively dry mud and an inner layer of liquid. The latter percolates downwards through the filter into the lower cone, which is perforated at its widest circumference, the liquid passing through the perforations into the appropriate collecting channel of the fixed housing.—B. M. V.

Fuller's earth; Treatment of ——. C. M. Husted, Jersey City, N.J., Assignor to The Standard Oil Co. U.S. Pat. 1,317,372, 30.9.19. Appl., 14.6.17.

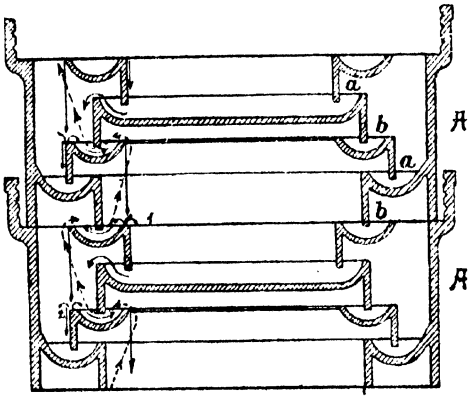
ACID and the earth to be treated are fed into a rotating drum, which discharges into a washing and settling apparatus, from which the material is conveyed to a washing drum.—A. E. D.

Alcohol; Recovery of the —— remaining in material which has been extracted with it. F. Schunert, Düren. Ger. Pat. 311,812, 8.4.17.

MATERIAL which has been extracted with alcohol is placed on a grating at the bottom of a cylindrical vessel. A regulated supply of water is led into the vessel through a perforated tube situated beneath the grating, and flows upwards through the material, displacing the alcohol. The alcohol in a concentrated form is removed from the upper portion of the vessel by means of a tube passing through the side.—L. A. C.

Column for distillation or for reactions between liquids and gases. Gewerkschaft des Steinkohlenbergwerks Lothringen, Gerthe. Ger. Pat. 312,933, 4.7.17.

A COLUMN for scrubbing gases with liquids, *e.g.*, during fractional distillation, is constructed of a series of superposed sections, A, each of which



contains four trough-shaped rings and plates, *a* and *b*, so constructed that projections underneath each ring or plate rest in the trough or plate immediately below, and thus the ascending stream of gas is forced to pass through the liquid which collects therein. The liquid flows down the column as indicated by the unbroken arrows, and the gas in ascending passes alternately from the interior of the rings to the annular spaces around the plates as indicated by the broken arrows. Contact is thus effected between liquid and gas not only as the liquid flows through the troughs, but

also as it flows in a thin film from a higher to a lower container.—L. A. C.

Gases; Apparatus for mixing —— with other gases or with fine powders. E. Enke, Breslau. Ger. Pat. 312,900, 4.7.17. Addition to Ger. Pat. 304,050.

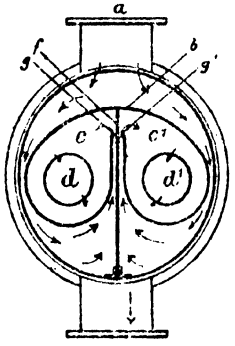
A JET similar to that described in the chief patent (this J., 1918, 453 A) may be employed for making an intimate mixture of two gases or of a gas and a fine powder. To increase the efficiency of the mixing, one or both of the tubes is either flattened or cross-shaped during a portion of its length, but both are of circular cross-section at the ends, and the outer tube expands to a funnel-shaped opening. The jet is particularly adaptable for mixing air and gas for combustion, and owing to the thorough admixture combustion is complete and the admission of secondary air is unnecessary; also, if the pressure of the air in the outer tube is increased, the partial vacuum induced in the inner tube is also increased, and thus a high temperature may be attained even with gas under low pressure.
—L. A. C.

Cooling tower. E. Eckmann, Essen-Stadtwald. Ger. Pat. 313,198, 1.6.17.

A NUMBER of short shafts or columns, each provided with a sloping cover, pass through the floor of a cooling tower. Air enters the tower through the shafts and passes under the raised end of the covers; the cooling water drains off the covers in the opposite direction on to the floor of the tower and flows away through openings in the walls into a receiver.
—L. A. C.

Gases; Apparatus for purifying —— by passage through narrow slits. O. Bühring, Hamlo. Ger. Pat. 312,991, 29.3.18.

GAS is led into a cylindrical vessel through *a*, and is caused to flow around the partition walls, *b* and *f*,



in the direction indicated by the arrows and through the narrow slits, *g* and *g'*, into the inner chambers, *c* and *c'*, whence it is removed through *d* and *d'*.—L. A. C.

Gases; Apparatus for removing dust and like impurities from —— by means of a rotating electric field. W. North and H. Loosli, Hanover. Ger. Pat. 314,014, 28.8.17.

GAS is passed through a precipitation chamber, around the axis of which electrodes are arranged in order to maintain a rotating electrostatic field within the chamber. The number of electrodes is a multiple of the number of phases of the alternating current employed. It is advantageous to fix either a rod of a material of greater dielectric strength than the gas, *e.g.*, glass, or a conductor connected with the zero point of the transformer in the centre of the field. The electrodes may be covered with an insulating material.—L. A. C.

Steam; Apparatus for preventing the escape of —— into the air from evaporators, boilers, and the like. J. M. Voith, Heidenheim. Ger. Pat. 313,754, 29.12.17.

STEAM escaping from the evaporator or the like passes into a condenser, in which it comes in contact with a descending stream of water. The water flows from the condenser at the lower end, passes through an expanding device which actuates a valve, and thus regulates the supply of water to the condenser. By this means the use of an unnecessarily large volume of water in the condenser is avoided.—L. A. C.

Caulking of iron tubes lined with acid-resisting material for conveying corrosive gases and liquids. C. Capalls, Mannheim. Ger. Pat. 313,788, 11.1.17.

THE lining or wire gauze embedded therein is continued up to the flange at every joint, terminating in a recess cut in the inner side of the flange. These recesses are filled with luting material and the flanges then tightened up.—J. S. G. T.

Pulverising mills. Sturtevant Mill Co., Boston, Assignees of T. J. Sturtevant, Wellesley Farms, Mass., U.S.A. Eng. Pat. 123,715, 21.10.18. (Appl. 17,175/18.) Int. Conv., 23.2.18.

SEE U.S. Pat. 1,286,831 of 1918; this J., 1919, 124 A.

Heating liquids; Apparatus for ——. J. A. Reavell, Beckenham. U.S. Pat. 1,317,390, 30.9.19. Appl., 26.9.18.

SEE Eng. Pat. 122,500 of 1918; this J., 1919, 163 A.

Filter. H. Desrumaux, Paris. U.S. Pat. 1,318,363, 14.10.19. Appl., 6.7.14.

SEE Eng. Pat. 13,481 of 1914; this J., 1915, 680.

Drying materials; Process and apparatus for ——. A. Huhn, Minneapolis, Minn. U.S. Pat. 1,318,385, 14.10.19. Appl., 29.12.17.

SEE Eng. Pat. 122,910 of 1919; this J., 1919, 209 A.

Treating material with gas. Eng. Pat. 133,106. *See* VII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Drum firing for finely-divided and low-grade fuels, especially lignite waste. H. Hermanns. Braunkohle, 1919, 18, 159–164. Chem. Zentr., 1919, 90, IV., 551.

THE apparatus consists of a slightly inclined, rotating, wrought-iron drum lined with firebrick. The fuel is fed in at the upper end of the drum by means of a screw, and ashes are discharged from the lower end. The air enters through inlets in the door closing the lower end of the drum, and passes over the glowing clinker and incompletely burned ashes and is thus pre-heated. The drum makes 6–10 revolutions per minute. More recently, using a shorter drum, speeds up to 50 revolutions per minute have been used. The apparatus is specially suitable for burning low-grade fuels having a tendency to form clinker. In steam-raising tests with a Bohemian lignite in this type of furnace an efficiency of 65% was attained, and the ashes contained only 0·7% of unburnt fuel.

Lignite; Gasification of —— in modern revolving-grate producers. K. Neumann. Stahl u. Eisen, 1919, 39, 1233—1239.

Two revolving-grate gas producers were erected in Northern Bohemia in 1918 to utilise the local lignite as fuel in a zinc works. Each producer was 2·6 m. in diameter and capable of gasifying daily 20—24 tons of lignite. The air-steam blast could be supplied by either an electrically-driven fan or by a steam injector. Three tests, each continued over 24 hours (the normal working cycle in the works), were made, two with the blast operated by injector, the other by a fan. Full details are given of experimental conditions and the method of calculating results. Only 17·3% of the steam was decomposed when the fan-driven blast was used, and 13·7% in the other cases. This might possibly be improved if less steam were injected. The injector necessitates a higher pressure of steam than the fan-driven blast, but the yield of gas and calorific value were almost the same. The excess of undecomposed steam with attendant lowering of flame temperature of the gas was the main disadvantage of the injector blast, but the dependence on steam pressure is objectionable when uniform quality of gas is essential. The results, compared with those of other producer fuels, are given in the table:—

	Anthracite.		Coke.		Lignite briquettes.	Lignite.
Calorific value (net) ..	7630	7630	7000	7000	4839	4212
Kilos. steam, per kilo. .	0·486	—	0·345	—	—	0·214
Absolute steam press. (atm.)	7·9	—	8·0	—	—	7·8
Cb. m. gas per kilo. fuel (15° C., 1 atm.) ..	5·34	5·45	5·20	5·43	3·47	2·49
Gas analyses CO	27·9	27·1	29·9	30·6	20·8	27·0
H_2	16·5	8·9	8·8	1·4	16·2	13·5
CH_4	0·9	1·3	0·1	0·0	1·4	4·9
C_nH_4	0·0	0·0	0·0	0·0	0·2	0·3
CO_2	3·4	3·2	2·4	0·9	9·2	4·7
O_2	0·0	0·0	0·0	0·0	0·5	0·2
N_2	51·3	59·5	58·8	67·1	51·7	49·4
Total combustibles %	45·3	37·3	38·8	32·0	38·6	45·7
Calorific value, net, cal./cb m. ..	1198	1035	1045	889	1107	1495
1kilo. fuel yields in the gas, calories ..	6390	5640	5500	4810	3840	3720
Fuel gasified hourly per sq. m. section, kilo.	122·0	89·3	214	209	184·5	108·1
Efficiency of producer	0·80	0·75	0·76	0·69	0·79	0·77

—H. J. H.

Gas producer plant; A new ——. R. Krieger. Stahl u. Eisen, 1919, 39, 1197—1204.

THE plant was selected to suit the special needs of a Westphalian steel foundry, unconnected with other iron and steel plant and somewhat distant from boilers. The output of the foundry was liable to rapid and considerable variations, and flexibility as to load was essential. A very simple type of producer (Bender and Främbs) was chosen in preference to the revolving-grate type previously used. It consisted of a simple shaft tapering slightly downwards, water-sealed below, and provided with a cup-and-cone charging device. The blast was introduced peripherally by a wind-box built round the base. The producers have worked for five years uninterruptedly on coal and lignite briquettes. The latter sometimes have a calcareous ash which tends to set in the water-seal, and then a central cone is desirable to facilitate removal of ash. The steam used in the blast was generated in a special "vaporiser" by the side of the producer. This vaporiser was a brick-lined box with five iron trays fixed one above another and arranged as baffles so that the products of combustion of a portion of the hot producer gas, withdrawn from the gas main and burnt with air, entered at the top of the box and traced a zig-zag path downwards. A stream of water dripped down the tray sleeves and was evaporated by the hot gases, which were cooled to 300°—400° C. at the exit opening. Here a further supply of air was drawn in, and the air-steam-nitrogen mixture at 120° C. and containing about 1·5% of carbon dioxide was drawn by a fan and blown into the wind-box of the producer. The coal consumption to supply the steam thus was reckoned to be 3% of the total quantity of coal gasified, and less than that required in a normal steam boiler, while the power consumption was not greater. The lay-out of the battery of six producers is described.—H. J. H.

Ignition of gases by hot wires. W. M. Thornton. Phil. Mag., 1919, 38, 613—633.

EXPERIMENTS were carried out on the ignition of hydrogen, methane, ethane, pentane, methyl and ethyl alcohols, ethylene, ether, benzene, carbon monoxide, coal gas, and petrol, either as gas or vapour, by means of wires of pure platinum, nickel, iron, tungsten, molybdenum, gold, and silver heated electrically. Three sizes of wire, respectively of 0·1, 0·2, 0·3 mm. diameter, were employed, and in each case a length of about 3 cm. of wire was employed. The combustible mixture of gas or vapour and air was contained in a cylindrical vessel of about 50 c.c. capacity. There is for every diameter and metal a particular current which, when applied suddenly, just causes ignition of the combustible mixture. Old wires ignite the mixtures more readily than fresh ones. The ignition of a hydrogen-air mixture containing 30% of hydrogen is abnormally difficult with thick silver wires. There is very great difficulty in igniting a methane-air mixture containing any proportion of methane by any wire having a melting point below 1800° C. It is practically impossible to do so with platinum except in a stream of the mixture. With tungsten wires there is no difference between the ignition currents of hydrogen, methane, carbon monoxide, and coal gas. The calorific value of the combustible gas does not perceptibly modify the conditions of ignition. Ignition of all gases except hydrogen and carbon monoxide occurs at the same rate of heat generation per unit length of wire. Ignition is apparently started by thermionic emission under the same electron pressure in each case. The phenomena of hot-wire ignition are discussed from the standpoint of surface combustion and thermionic emission. The chemical nature of the combustible molecule has little influence on hot-wire ignition by tungsten or molybdenum, and hydrogen atoms cease to have any distinctive influence on the ignition by platinum of hydrocarbons having molecular weights exceeding 60. The magnitude of the igniting current is in general little influenced by the proportion of combustible present in the mixture. The ignition of ethane resembles that of methane. Pentane and petrol vapours are more sensitive to hot-wire ignition than hydrogen. Methyl and ethyl alcohols behave similarly; the former is more difficult to ignite in the weaker mixtures. Ether is slightly more easily ignited. Benzene is comparable with ethane. Under pressure ranging from 20 cm. to 600 cm. of mercury the ignition currents for hydrogen and coal gas remain constant. Ignition is therefore of the nature of a trigger effect, and it is surmised that the mechanism of hot-wire ignition consists of an attack upon oxygen by positive ions of combustible gas just ejected from the wire. The application of the results to the construction of metallic filament glow lamps for use in mines etc. is briefly alluded to.—J. S. G. T.

Gas analysis; Complete ——. E. W. Smith. Gas World, 1919, 71, 342—343.

A MODIFICATION of the Bone and Wheeler gas analysis apparatus (this J., 1908, 10) is described, in which the explosion tube is supplemented or replaced by a copper oxide combustion tube (see this

J., 1898, 1190), by means of which a mixture of methane, hydrogen, and nitrogen can be analysed by one combustion at bright red heat. The carbon dioxide, saturated hydrocarbons, oxygen, and carbon monoxide are first absorbed in the usual way, and the residual gas is passed into an evacuated copper oxide tube maintained at a bright red heat. The contraction is noted, and determinations then made of the carbon dioxide produced, and finally of the small amount of oxygen evolved from the heated copper oxide under vacuum. A modified form of Orsat apparatus is also described, including the copper oxide combustion tube, for the determination of nitrogen in coal gas. In this case the tube is filled with carbon dioxide before passing in the gas, and the final traces of the gas are swept out of the tube after combustion by means of more carbon dioxide, all of the latter being absorbed by potash and the nitrogen estimated directly.—W. P.

Coal gas; Improved methods for the analysis of ——. W. Buckley and F. S. Sinnatt. Manchester Dist. Inst. Gas Eng. Gas J., 1919, **148**, 250—254.

THE mode of manipulation of the gas analysis apparatus of Kent Smith and Towers (this J., 1897, 400) is described in detail as applied to the analysis of coal gas. A modification of the original absorption pipette is described, in which the connecting tube between the bulbs is bent in the form of a hook. The pipette is tilted when the gas is passed in, but vertical when it is withdrawn. In the former case the open ends of the hooked tubes are above and in the latter case below the surface of the absorbing liquid. A second pipette is advised when absorbing carbon monoxide, the use of a three way tap enabling the gas to be passed, through a bent tube, in a fine stream, up through a column of fresh absorbing reagent.—W. P.

Mineral oil; Estimation of tar-value of ——. A. Krammer. Petroleum, 1919, **14**, 1025—1026. Chem. Zentr., 1919, **90**, IV., 552—553.

AN uninterrupted stream of oxygen at the rate of 2 bubbles per second is led through 150 grms. of the oil maintained at 120° C. during 70 hours. At the end of this period 50 grms. of the oil is warmed on the water-bath with 50 c.c. of a solution containing 1000 parts by wt. of alcohol, 1000 parts by wt. of water, and 75 parts by wt. of caustic soda. After five minutes' vigorous shaking the mixture is poured into a separating funnel and most of the alcoholic lye is filtered off. 40 c.c. of the filtrate is well shaken with 30 c.c. of light petroleum and the separated lye is similarly treated with 30 c.c. of benzene. After acidification with hydrochloric acid the "tarry matters" are removed by means of 50 c.c. of benzene. This last extraction may require repetition. The benzene solution is twice washed with water, evaporated, and the residue is dried at 100° C. and weighed.—A. E. D.

Olefine constituents of petrols and lamp oils; Determination of ——. J. Tausz and H. Wolf. Z. angew. Chem., 1919, **32**, 317—319.

THE mercurisation test (this J., 1919, 4 A) indicates the progress of the refining of mineral oils. It indicates the presence of those unsaturated constituents which combine with alcoholic mercuric acetate at the ordinary temperature, but not of those which are only oxidised by the reagent. Since the first class of compounds is only present in very small proportion, it is best to determine both classes together. For this purpose the oil is boiled with a dilute alcoholic solution of mercuric acetate, and the unaltered portion distilled in a current of steam and measured. The unsaturated hydrocarbons which have combined with the mercuric acetate are then liberated by means of hydrochloric acid, distilled with steam, and measured. The determination is carried out in a flask with a side tubulure, which by inclining the flask can be connected with a reflux condenser cooled with alcohol and carbon dioxide for the boiling or with a vertical condenser and receiver similarly cooled for the distillation. The unavoidable loss is fairly constant, and in the case of refined light petroleum spirit averaged 1·05 c.c. for 50 c.c. This value was therefore applied as a correction. For the analysis of petroleum spirit a solution of 30 grms. of mercuric acetate in 500 c.c. of water is placed in the flask, which is then connected with the reflux condenser, and 50 c.c. of the oil and 15 c.c. of alcohol are introduced into the flask through the condenser. After shaking, the flask is heated for 8 hours on a vigorously boiling water bath. The condenser is then inverted and attached to a burette terminating in the chilled receiver, and the hydrocarbons which have not reacted are distilled in a current of steam. The distillate is washed with 100 c.c. of dilute sodium hydroxide solution to remove acetic acid, and then with 100 c.c. of sodium bisulphite solution to remove any aldehydes or ketones, the residual saturated hydrocarbons measured, and the apparatus constant (*i.e.*, 1·05) added to the amount. For the liberation of the combined unsaturated hydrocarbons strong hydrochloric acid is introduced into the flask, and the contents distilled as before in a current of steam. For the analysis of lamp oils 30 grms. of mercuric acetate and 30 c.c. of alcohol are introduced into the flask, which is then shaken for five minutes before the introduction of 500 c.c. of water. The further procedure is as described above. Six samples of Galician light petroleum distillates contained from 1·0 to 4·2% (by vol.) of olefines, whilst a refined lamp oil contained 3·3%. A crude American benzine contained 9·0%, and two refined American petroleum spirits 3·2 and 1·2% respectively.—C. A. M.

Petrols; Analysis of German aviation ——. G. Chavanne, L. P. Clerc, and L. J. Simon. Comptes rend., 1919, **169**, 693—695.

USING the method based on the critical temperature of solution in aniline (this J., 1919, 619 A, 672 A), the authors have analysed twenty-two samples of German aviation petrols taken from a number of different aerodromes, and find that they all closely approximate to the composition, aromatic hydrocarbons 10%, saturated cyclic hydrocarbons 40%, acyclic hydrocarbons 50%.—W. G.

Lubricants; Saponified ——. [*Lubricating greases.*] A. Kraus. Seife, 1919, 3, 602—603, 640—642, 666. Chem. Zentr., 1919, **90**, IV., 300—301.

THE preparation of lubricating greases takes place in three stages: the boiling of the soap, the boiling up of the material with mineral oil, and the stirring to solidification. According to the method of saponification, the greases may be classified as milk of lime greases and calcium hydroxide greases. As regards the quantity of water to be used, the following points are noted: If a large proportion of unsaponified fatty oil is present in the finished lubricant it indicates that the proportion of water was smaller than in a lubricant containing the same amount of soap but little or no fatty oil. Calcium soap prepared from one and the same fatty oil under similar conditions always fixes the same amount of water. The percentage of water in the solid lubricant increases with the percentage of soap. Calcium soaps with which heavy mineral oils are incorporated require more water than those containing the same quantity of fat but prepared with a light mineral oil. If the soap be prepared separately in the pure state, the incorporation of the mineral oil requires more water, the harder the soap. Every neutral fat requires less or more

water according to the ease or difficulty of its saponification with lime; rape oil soaps, for example, require less water than whale oil soaps. The quantity of water also varies according to the proportion of solid fatty acids in the oil to be saponified. A good lubricant should possess the following characters: It should contain no mechanically added loading matters or impurities. The dripping point should be at least 70° C. It should contain neither free fatty acid nor excess of alkali. It should show no separation of mineral oil, either during storage or in use.—J. F. B.

Gas producers; Standard tests on the efficiency and economy of ——. K. Bunte and A. Viehoff. J. Gasbeleucht., 1919, **40**, 588—589.

Details of the factors requiring investigation in the testing of gas producer working are given. Yields are estimated on the dry coal. The tests should consist of at least 3 separate 24-hour runs on consecutive days, and precautions must be taken against alteration in the experimental conditions. —W. P.

Junkers gas calorimeter; Estimation of the calorific value of coal gas by means of the ——. K. Bunte and E. Czakó. J. Gasbeleucht., 1919, **40**, 589—593.

The precautions necessary in the use of the Junkers calorimeter are described in detail. The apparatus must be carefully standardised before use. The maximum allowable errors are as follows: Meter reading ±0·25% (corresponding to a final error of ±0·25), thermometer in gas meter ±0·5° C. (corresponding to an error of ±0·25%), and thermometers in calorimeter 0·02° C. (corresponding to a final error of 0·2%). The whole of the apparatus should be carefully tested for leakages. The cooling and condensed water is weighed and not measured. The height of the burner is so arranged that the heat evolved per hour is about 900—1100 cals., and the flame must not touch the inner surface of the calorimeter. Details are given for the calculation of the net and gross calorific values, with the corrections necessary to be made for the original moisture content of air and gas. Repeat determinations should not differ by more than about 0·6%.—W. P.

Separating emulsions. Moscicki and Kling. *See* I.

Chlorination of methane. Pfeifer and others. *See* XX.

PATENTS.

Peat; Briquetting ——. E. G. Lea, London. Eng. Pat. 133,847, 23.12.18. (Appl. 21,540/18.)

Air-dried peat is successively disintegrated, further dried until it contains between 20 and 35% by weight of water, and pressed in a briquetting press of the ram type while at a temperature between 125° and 175° F. (51°—79° C.). The disintegration is effected in such a manner that the individual fibres of the peat are not comminuted. —W. E. F. P.

Peat fuel; Process for manufacturing ——. H. P. K. T. Nielsen, Copenhagen. U.S. Pat. 1,317,936, 7.10.19. Appl., 2.4.19.

Raw peat, of the consistence of "mush," is ground in a ball mill, to disintegrate the cell structure, and the water liberated is allowed to drain from the mass, which is then subjected to pressure. —W. E. F. P.

Fuel and process of making the same. C. L. Wagner, New York, Assignor to S. Sternau and Co., Inc., Brooklyn, N.Y. U.S. Pat. 1,317,950, 7.10.19. Appl., 7.4.19.

A solid fuel is prepared by adding alcohol to a cellular, non-fibrous material.—W. E. F. P.

Pulverulent fuel; Combustion of ——. J. E. Raworth, London. From La Combustion Rationnelle (Soc. Anon.), Paris. Eng. Pat. 133,921, 2.6.19. (Appl. 13,949/19.)

A furnace for burning pulverised fuel has a combustion chamber of considerable height provided with a hollow front wall and arch for the passage of air. The fuel and a portion of the air for combustion are introduced, simultaneously and in a downward direction, through the top of the arch, the fuel being in the form of a film or curtain contained between two layers of preheated air. Additional air for combustion is introduced at the lower end of the combustion chamber. —W. E. F. P.

Coking coal; Process for ——. E. Fleischer, Dresden, and "Kohle und Erz" G.m.b.H., Essen. Ger. Pat. 298,861, 14.1.16.

Coal, without external heating, is submitted to the action of steam and hot fire gases, or a mixture of the products of combustion of steam, air, and gas which has a temperature of 800°—900° C. The gaseous mixture should contain a larger volume of steam than of dry steam-free gas. The coke produced at 800° C. is heated to about 1000° by steam-free gas or combustion products having a temperature of about 1100°C. and then cooled by treatment with steam at about 100° C. In this manner the yield of ammonia is increased, the yield being higher the greater the proportion of steam it is possible to incorporate with the gas mixture at 800°—900° C., without reducing the temperature. —L. L. L.

Gas and ammonia; Production of combustible —— from coke derived from low-temperature carbonisation. T. Limberg, Halle. Ger. Pat. 313,470, 15.2.17.

Coke derived from low-temperature carbonisation of coal may be gasified by the aid of steam at a much lower temperature than that required in the case of high-temperature coke. Two-thirds of the original nitrogen of the coal is present in high-temperature coke in the form of very stable compounds, while it is only very loosely held in low-temperature coke, and by gasification of the latter can be recovered practically entirely as ammonia with the minimum quantity of steam in the producer. Decomposition of ammonia in the producer is prevented principally by maintaining an excess of carbon monoxide and hydrogen, and not, as usual, by employing a large excess of steam. —J. S. G. T.

Gas producer. F. Zöller, Friedenshütte. Ger. Pat. 305,576, 24.8.15.

The gas producer consists of two chambers, one a combustion chamber, the other a coking chamber. The coke is removed from the upper coking chamber by means of an endless conveyor or grate, over the surface of which works a revolving drum carrying knives to break up the clinker. The path of the conveyor is partly horizontal and partly inclined across the bottom of the coking chamber, and steeply inclined in the lower combustion chamber. The gases passing from the coke burning in the combustion chamber are rich in carbon dioxide, and are reduced on passing through the red hot coal in the coking chamber.—W. P.

Gas producer; By-product recovery ——. Akt.-Ges. für Brennstoffvergasung, Berlin. Ger. Pat. 312,671, 7.11.16.

The producer contains a suspended retort, which at its lower end is widened so as to form a hood corresponding in shape to the angle of repose of the fuel. By this means the duration of the distillation stage is increased, and it is possible to recover

tar etc. from the distillation products, which escape through a pipe leading from the interior of the retort.—L. L. L.

[Fuel] gases containing hydrogen sulphide; Method of treating ——. W. G. Leamon, Wooster, Ohio. U.S. Pat. 1,317,583, 30.9.19. Appl., 8.11.17.

Fuel gas containing less than 1% of hydrogen sulphide is preheated to not less than 280° C., and caused to react with a gaseous oxidising agent at the same temperature in the presence of porous, refractory material, whereby the hydrogen sulphide is practically eliminated without deterioration of the fuel gas, and a sulphur-containing reaction product is separated.—W. E. F. P.

Suction gas from lignite; Purification of the —— as it comes from the producer. E. Schiesser, Rüdersdorf. Ger. Pat. 312,729, 23.3.16.

The gas is subjected to a process of dry cooling in the pipe-line, and then, before entering the gas engine, is passed through a separator provided with baffles, in which the vapours are condensed. By this process the stopping up of the pipe-line with a heavy ochreous deposit is prevented, and the pipes have an appearance of being lightly covered with asphalt. The plant needs cleaning out no more frequently than when anthracite is used.
—J. F. B.

Fuel for internal-combustion engines; Liquid —— and process for preparing the same. A. de-feo. Lopez, Buenos Aires, Argentine. Eng. Pat. 133,431, 8.10.18. (Appl. 16,398/18.)

Alcohol is partially converted into ether by bubbling it through a mixture of alcohol and sulphuric acid at 100°—150° C. The product is rectified and is mixed with from 10 to 40% of alcohol, and from 5 to 50% of a suitable hydrocarbon distillate, the final mixture having sp. gr. 0·730—0·780.—A. E. D.

Fuels; Process for heating or vaporising liquid ——, and means for carrying out said process. W. E. Burgess, Aberbeeg, Monmouth. Eng. Pat. 133,525, 23.11.18. (Appl. 19,320/18.)

A preheater for heavy fuel for internal-combustion engines is packed with lime and is situated in the exhaust system. When it is desired to start the engines water is added to the lime, and the heat of hydration causes vaporisation of the fuel. The reverse dehydration is effected by the exhaust gases.
—A. E. D.

Fuel for explosion-motors or other combustion engines; Manufacture of ——. H. W. Knottenbelt, The Hague, Netherlands. U.S. Pat. 1,317,582, 30.9.19. Appl., 12.5.19.

The fuel is prepared by treating a liquid hydrocarbon, or liquid mixture of hydrocarbons, first with sulphuric acid and then with a soluble neutralising agent which does not produce hydroxyl ions in solution.—W. E. F. P.

Motor spirit. Process of making motor-fuel. C. Ellis, Montclair, N.J., Assignor to Ellis-Foster Co. U.S. Pats. (A) 1,318,060 and (B) 1,318,061, 7.10.19. Appl., 12.10.17 and 21.8.13; (B) renewed 12.12.18.

(A) A motor spirit consists of a gasoline-like mixture containing a substantial amount of unsaturated substances, and of greater volatility than gasoline of the same density. (B) Cracked gasoline containing unsaturated compounds is treated with dilute sulphuric acid.—A. E. D.

Lubricating oil; Apparatus for clarifying or recovering ——. H. J. Helmes, London. Eng. Pat. 133,415, 4.10.18. (Appl 16,170/18.)

The apparatus comprises a series of vessels provided with heating jackets, and with a supply of compressed air for agitating the contents, so that spent lubricating oil contained in the vessels can be clarified, and, if necessary, treated with a suitable coagulant. After agitation and treatment the clean oil may be displaced from the vessels by means of water.—A. E. D

Lubricating oil substitutes; Process for increasing the absorbing power of ——, particularly tar oils or like products, for colloidal lubricants, for example colloidal graphite. W. Ostwald, Grossbothen. Ger. Pat. 312,376, 30.9.17.

Alkaline substances, particularly magnesium hydroxide, are added in order to neutralise the oil. Without this addition such oils as unpurified mineral oils, and oils from coal tar or lignite tar, are not capable of retaining graphite in suspension.
—L. L. L.

Colloidal lubricants; Process for enhancing the suitability of substitutes for lubricating oils, especially tar lubricating oils, for use in ——, e.g., with colloidal graphite. W. Ostwald, Grossbothen. Ger. Pat. 312,937, 2.2.18. Addition to Ger. Pat. 312,376 (see preceding abstract).

The bulk of the acidity in acid oils, *e.g.*, tar oils, is neutralised with soda and the last traces are neutralised with organic bases, *e.g.*, pyridine, aniline, or dimethylaniline.—A. de W.

Nitric oxide; Process for the production of —— in gas engines. F. Gerhardt, Saarbrücken, Germany. Ger. Pat. 303,255, 18.12.14.

A whirling motion is imparted to the charge by means of a jet of gas, steam, or air, whereby heat is withdrawn from the hotter parts of the cylinder and transferred to the mass of gas, thus giving a more even distribution of temperature. This enables the engine to be worked with the charge at the higher temperatures favourable for nitric oxide production.—J. H. J.

Coal, coke, or other minerals; Troughs for washing ——. W. Blakeley, Church Fenton, Yorks. Eng. Pat. 133,857, 8.1.19. (Appl. 554/19.)

Gas-producer. A. S. Cambridge, Auckland, Assignor to L. Nelson, Wellington, N.Z. U.S. Pat. 1,318,641, 14.10.19. Appl., 12.11.15.

See Eng. Pat. 16,088 of 1915; this J., 1916, 1254.

Lubricating oil. H. M. Wells, St. Annes-on-Sea, and J. E. Southcombe, Birkenhead. U.S. Pat. 1,319,129, 21.10.19. Appl., 19.3.18.

See Eng. Pat. 130,377 of 1918; this J., 1919, 674 A.

Fullers' earth. U.S. Pat. 1,317,372. *See* I.

Mixing gases. Ger. Pat. 312,900. *See* I.

Purifying gases. Ger. Pat. 312,991. *See* I.

Tar [from gas producers]. Ger. Pat. 312,776. *See* III.

Material for closing-off water in oil-wells. U.S. Pat. 1,318,076. *See* IX.

Derivatives of petroleum hydrocarbons. U.S. Pat. 1,317,868. *See* XX.

Calorific value of gases. Ger. Pat. 312,882. *See* XXIII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Ignition of gases. Thornton. *See* IIA.

Lignin. Hägglund. *See* V.

Coloured glasses. Luckiesh. *See* VIII.

PATENTS.

Low temperature carbonisation. J. A. Yeadon and T. Whitaker, Leeds. Eng. Pat. 133,554, 4.1.19. (Appl. 257/19.)

COAL in a fine, dry, granulated condition is automatically and continuously fed into the smaller end of a horizontally revolving retort of tapering or conical form by means of a self-sealed, revolving screw feed device. The retort is provided with longitudinal corrugations to ensure rapid carbonisation of the coal. The coke produced is discharged continuously from the opposite larger end. —W. P.

Bituminous shales, cannel coals, and the like; Process of utilising residues from ——. Broxburn Oil Co., Ltd., Glasgow, and R. H. Findlater, Broxburn, N.B. Eng. Pat. 133,452, 11.10.18. (Appl. 16,512/18.)

BY suitable chemical treatment residues from the retorting of bituminous shales and the like yield a substance containing carbon in very porous form, suitable for use as a decoloriser, and also the hydroxides of aluminium and iron, sodium silicate, and calcium sulphate. The residues are ground to powder and are then treated first with water and afterwards with sulphuric or other mineral acid in a heated digester. The liquor is drained off and the material treated in a second heated digester with caustic soda solution. The solid residue is then washed with weak mineral acid and finally with water, dried, and ground. The decoloriser obtained in this manner is the most valuable product, but the acid and alkaline extracts may also be worked up for calcium sulphate and aluminium and iron hydroxides and sodium silicate respectively.—W. P.

Shales; Apparatus for distilling bituminous ——. T. Robinson, Anaconda, Mont. U.S. Pat. 1,317,318, 30.9.19. Appl., 11.9.18.

A RETORT continuously traversed by the material discharges into a generator which is provided with means for conducting air and superheated steam over the spent charge. The retort is heated by the agency of the hot gases from the generator. —A. E. D.

Hydrocarbon from oil shale; Distillation of ——. J. A. McCaskell, Salt Lake City, Utah. U.S. Pat. 1,317,514, 30.9.19. Appl., 21.6.18.

THE surface of a charge of the material is fired in a travelling open receiver, a number of such receivers being arranged, for example, upon an endless chain or belt. During the travel the liberated gases and vapours are drawn through the body of the shale. The spent shale is discharged and the empty receiver returns for a fresh charge. The gases and vapours are continuously separated and collected.—A. E. D.

Incandescent masses; Process for the preparation of porous —— from thorium and cerium oxide mixtures. F. Joerling, Berlin. Ger. Pats. (A) 301,611 and (B) 306,492, 14.10.14.

(A) The thorium oxide to be used in the mixture is previously heated to a temperature higher than that which will be attained in subsequent use. Particularly good results are obtained by mixing 50% of oxide heated to 600° C. and 50% heated to 1800° C. As binding agent salts or acids are preferred which react with the thorium oxide at low temperature and are vaporised at high temperature. (B) Organic binding agents used in preparing the mixtures are removed by treatment with gaseous mixtures poorer in oxygen than air, or by means of carbon dioxide or steam.—L. L. L.

Incandescence light; Process and arrangement for producing ——. E. Flehinghaus, Berlin. Ger. Pat. 307,051, 30.11.17.

POROUS bodies of combustible material are burnt, on the principle of surface combustion, by conducting a gas capable of supporting combustion through the pores of the material. The inner wall of a hollow body constructed of carbon is covered with a non-combustible porous material, such as magnesia, through which the oxygen supplied can penetrate. The current of oxygen is so regulated that the combustion takes place in the pores of the surface of the hollow body.—J. F. B.

Decolorising and purifying agent [carbon] and methods of making same. R. W. Mumford, Baltimore, Md., U.S.A. Eng. Pat. 133,759, 14.10.18. (Appl. 16,757/18.)

SEE U.S. Pat. 1,287,592 of 1918; this J., 1919, 129 A.

Electric incandescence lamp. L. Hamburger and D. Lely, jun., Eindhoven, Netherlands. U.S. Pat. 1,317,492, 30.9.19. Appl., 11.1.17.

SEE Eng. Pat. 113,626 of 1916; this J., 1918, 234 A.

III.—TAR AND TAR PRODUCTS.

Phenol derivatives; Oxidation of ——. C. N. Hinshelwood. Chem. Soc. Trans., 1919, 115, 1180—1188.

THE rate of oxidation of certain phenol derivatives was determined by adding a definite known excess of permanganate solution and titrating aliquot portions at intervals with thiosulphate after the addition of potassium iodide. With salicylic acid and *p*-nitrophenol the first stage of the oxidation, resulting in the fission of the aromatic nucleus, was almost immeasurably rapid, and differences in the later stages, depending on the nature of the intermediate open-chain products, naturally threw no light on the stability of the original compound. The resistance to oxidation of more highly-substituted phenols was much greater, and the whole reaction was governed by the first stage involving the rupture of the ring, and gave a velocity constant for a reaction of the second order, which is considered to be a measure of the stability of the ring. Taking the stability of the picric acid nucleus as unity, the stability of 2.6-dinitrophenol is 0·135, 2.5-dinitrophenol 0·324, 2.4-dinitrophenol 2·50, 2.4.6-trinitro-*m*-cresol 8·5, and trinitromethylnitroaminophenol 13·8.—G. F. M.

Separating emulsions. Moscicki and Kling. *See* I.

Dimethylamine. Hutin. *See* XIV.

Tar constituents and plants. Ewert. *See* XVI.

Bladder swellings among workers in organic chemical industry. Nassauer. *See* XIXB.

PATENTS.

p-Nitro-acetanilide; Process for decomposing —— to form p-nitraniline. Mitsui Kozan Kabushiki Kaisha, Tokio, Japan. Eng. Pat. 126,944, 6.2.19. (Appl. 2951/19.) Int. Conv., 16.5.18.

THE hydrolysis of *p*-nitro-acetanilide to *p*-nitraniline may be brought about by heating, under a pressure of 20—40 lb. per sq. in., with water which

preferably contains some substance such as caustic alkali, lime, etc., to neutralise the liberated acetic acid. The advantages claimed are that the *p*-nitraniline is produced in improved yield (90% of the theoretical) and quality, and requires no recrystallisation, the amount of acids or alkalis required is economised, and diffusion of the poisonous vapour of nitraniline during the operation is prevented. In the example given, 350 kilos. of *p*-nitroacetanilide is heated with 80 kilos. of caustic soda and 1000 kilos. of water in an autoclave at 120°—130° C., with stirring, or the same result may be obtained by using high-pressure steam. *p*-Nitraniline crystallises out from the reaction liquid on cooling in bright yellow crystals.—G. F. M.

Nitronaphthalene; Process for manufacturing ——. E. de B. Barnett, London. Eng. Pat. 133,918, 17.5.19. (Appl. 12,480/19.)

NITRONAPHTHALENE is prepared by suspending naphthalene in sulphuric acid of 60—70% strength and adding, whilst stirring, the requisite quantity of nitric acid, or nitric acid mixed with a further quantity of sulphuric acid, the temperature being maintained initially at 25°—35° C., and finally, when all the acid has been added, raised to 65°—70° C. and maintained so for 1 hour. If desired, spent acid from a previous operation may be wholly or partly substituted for fresh diluted sulphuric acid in the above operation.—G. F. M.

Tetrahydro-β-naphthol; Manufacture of ——. G. Schroeter, Berlin, and W. Schrauth, Berlin-Halensee. Ger. Pat. 299,603, 18.5.16.

TETRAHYDRONAPHTHALENE is added to a slight excess of 100% sulphuric acid; the temperature rises to 80°—100° C. as the hydrocarbon dissolves, and the formation of tetrahydronaphthalene-β-sulphonic acid is completed by heating the mixture on the water bath. Either the free acid is isolated by cooling and pressing the product to remove excess sulphuric acid, or the sulphonic acid is converted into an alkali or calcium salt. Tetrahydronaphthalene-β-sulphonic acid and its salts are readily converted into tetrahydro-β-naphthol by fusion at 230°—300° C. with sodium or potassium hydroxide, with or without the addition of milk of lime. Tetrahydro-β-naphthol crystallises in the form of needles, m. pt. 59°—60° C., b. pt. 145°—146° C. at 13 mm., and 275°—276° C. at 760 mm. pressure; it is soluble in solutions of alkalis and of the alkali salts of fatty acids and sulphonated fatty acids, and in concentrated sulphuric acid.

—L. A. C.

PATENTS.

Tar; Process for the production of substantially anhydrous [producer-gas] ——. L. Schwarz und Co., A.-G., Dortmund. Ger. Pat. 312,776, 19.10.17.

THE hot mixture of tar and water from producer gas plants is taken to a reflux cooling arrangement in the form of a cooling tower or the like, in which the removal of the water is effected by evaporation and cooling of the mixture in contact with air in motion. Since the tar is taken to the cooling plant immediately after its separation, it enters at a temperature of 50°—100° C., and a fairly strong evaporation and cooling takes place.—J. F. B.

Pyridine and similar organic bases; Recovery of ——. Barrett Co., Assignees of F. E. Dodge and F. H. Rhodes, New York. Eng. Pat. 122,397, 29.10.18. (Appl. 17,663/18.) Int. Conv., 17.1.18.

SEE U.S. Pat. 1,274,998 of 1918; this J., 1918, 619 A.

Nitrophenols; Manufacture of ——. D. B. Macdonald, Leicester, and J. Calvert, Huddersfield. U.S. Pats. 1,320,076 and 1,320,077, 28.10.19. Appl., 21.11.17.

SEE Eng. Pats. 126,062 and 126,084 of 1916; this J., 1919, 406 A.

Spirits, petroleum, and benzene; Process and apparatus for continuous rectification of ——. E. A. Barbet, Paris. U.S. Pat. 1,319,319, 21.10.19. Appl., 7.4.14.

SEE Fr. Pat. 468,068 of 1913; this J., 1914, 954.

Lubricating oil substitutes. Ger. Pat. 312,376. *See* IIA.

Sealing wax. Ger. Pat. 313,100. *See* XIII.

IV.—COLOURING MATTERS AND DYES.

Adsorption of electrolytes; Theory of ——. *Adsorption of organic dyestuffs.* L. Michaelis and P. Rona. Biochem. Zeits., 1919, **97**, 57—85.

THE ions of the salts of basic and acid dyestuffs are adsorbed in equivalent proportion by charcoal. Insoluble salts exchange ions with the above organic salts in the process of adsorption. Insoluble acid and basic oxides show no perceptible adsorbing capacity for the dyes investigated. (See also J. Chem. Soc., Dec., 1919.)—S. S. Z.

β-Naphthylmethylamine. G. T. Morgan and F. P. Evans. Chem. Soc. Trans., 1919, **115**, 1140—1145.

β-NAPHTHYLMETHYLAMINE was obtained in 80% yield by heating β-naphthol with methylamine hydrochloride and the requisite quantity of 5-*N* sodium hydroxide to liberate the base, in an autoclave at 200°—220° C. for 7 hours. After purification the base boiled at 317° C. at 766 mm. pressure, and gave a solid nitrosamine melting at 88° C. This latter substance on treatment with alcoholic hydrogen chloride was converted into 1-nitroso-β-naphthylmethylamine, green plates melting at 112° C. Azo-derivatives of β-naphthylmethylamine were prepared by the interaction of the base with diazonium salts and by the condensation of the nitrosamine with primary aromatic amines. With sulphanilic and naphthionic acids azo-dyes, giving scarlet and dark red shades respectively on wool, were produced.—G. F. M.

Diazo-oxides (diazophenols); Constitution of internal ——. G. T. Morgan and E. D. Evens. Chem. Soc. Trans., 1919, **115**, 1126—1140.

2.4-DINITRO-α-NAPHTHYLAMINE, which was obtained by heating dinitro-α-naphthol with alcoholic ammonia under pressure, and also by two other methods, gives a diazonium sulphate in concentrated sulphuric acid solution which on dilution with water passes quantitatively into 4-nitronaphthalene-1-diazo-2-oxide, a very stable diazo-oxide, which, however, forms azo-derivatives by coupling with the reactive polyhydric phenols in a mixture of concentrated hydrochloric and acetic acids. The compound with resorcinol, 4-nitro-β-naphthol-1-azoresorcinol, is only sparingly soluble in water, but may be used as an acid mordant dye. On unmordanted wool it gives reddish-brown shades becoming violet on treatment with copper sulphate and acetic acid. On chrome-mordanted wool a bluish-black lake is produced. On prolonged boiling with ethyl alcohol the diazo-oxide loses its diazo group and is converted into 4-nitro-β-naphthol yellow needles, m. pt. 120° C. Numerous azo-derivatives and dyes were prepared from 4-nitro-β-naphthol. *p*-Nitrobenzene-

1-azo-4-nitro-β-naphthol produced on cotton padded with alkaline 4-nitro-β-naphthol and Turkey red oil gives a crimson-red colour quite distinct from Paranitraniline Red. Deeper and more even shades are obtained when the 4-nitro-β-naphthol is dissolved in aqueous sodium carbonate rather than in sodium hydroxide solution. The 4-nitro-derivative or Orange II. prepared from diazotised sulphanilic acid and 4-nitro-β-naphthol dissolved in excess of alkali dyes wool in deep red shades. The azo dyes produced in a similar way from diazotised *p*-nitroaniline-*o*-sulphonic acid and picramic acid give respectively orange and reddish-brown shades on wool. Dark blue shades are produced by padding calico with 4-nitro-β-naphthol, aqueous sodium carbonate, and Turkey red oil and developing with a solution of sodium acetate and the bisdiazonium chloride from dianisidine, and a purple maroon colour by dyeing cotton with Primuline, diazotising on the fibre, and developing with alkaline 4-nitro-β-naphthol. Direct cotton colours dyeing in purple shades are obtained by coupling alkaline 4-nitro-β-naphthol with the diazo derivatives of Safranine and 4.4'-diaminostilbene-2.2'-disulphonic acid. 2.4-Dinitrobenzene-diazonium sulphate remains unchanged in dilute acid, but in slightly alkaline solution it yields a soluble 5-nitro-2-diazophenol together with an insoluble by-product. This diazophenol furnishes *o*-dihydroxyazo- and *o*-aminohydroxy-azo-dyes which give intensely coloured lakes ranging from green to dark bluish purple with metallic mordants.—G. F. M.

Classification of colours. Ostwald. See XIII.

PATENTS.

N-Arylthiomorpholines; Manufacture of ——. R. Robinson, F. W. Kay, and British Dyes, Ltd., Huddersfield. Eng. Pat. 133,108, 26.6.19. (Appl. 10,503/18.)

N-ARYLTHIOMORPHOLINES, Ar·N$<^{CH_2\cdot CH_2}_{CH_2\cdot CH_2}>$S, applicable to the manufacture of dyes, may be prepared by heating together primary aromatic amines, provided they have no substituents in the ortho-positions, with ββ-dichloroethyl sulphide, either alone or with such solvents as toluene or nitrobenzene. Agents which fix hydrogen chloride, such as sodium carbonate, may be employed, and a catalyst such as copper powder is sometimes advantageous. For example, N-phenylthiomorpholine, m. pt. 32° C., b. pt. 200° C. (50 mm.), is obtained by heating aniline (25 parts) with dichloroethyl sulphide (16) at 50°—150° C., until a test portion is completely soluble in dilute hydrochloric acid, or by heating aniline (12), dichloroethyl sulphide (16), and sodium carbonate (12) at 100° C. in a vessel fitted with a stirring appliance, until evolution of carbon dioxide ceases.—J. C. W.

Colouring matter; Manufacture of [azo] ——. F. à Brassard and Crawford, Wakefield, and A. Singer, Bradford. Eng. Pat. 132,390, 4.11.18. (Appl. 18,016/18.)

AMINOHYDROXYTOLUPHENAZINE, obtained from *p*-nitrosophenol and *m*-toluylenediamine, is diazotised and coupled in alkaline solution with naphthionic acid, in acid or alkaline solution with *m*-toluylenediamine or *m*-phenylenediamine, or in acid solution with phenol. The products dye tannin-mordanted cotton yellow to red-brown shades.—L. L. L.

Dyestuffs; Manufacture of indigoid ——. A. Jolles, Vienna. Ger. Pat. 305,558, 9.6.15. Int. Conv., 13.6.14.

INDIGOID dyes and the isomeric indolignoid compounds are prepared by the action of an oxidising agent on a mixture of an aromatic compound containing a hydroxyl group with indoxyl or indoxylic acid. *Examples:* A solution of indoxyl and α-naphthol in acetic acid treated with a solution of ferric chloride in hydrochloric acid gives a mixture of 2-naphthalene-2-indolindigo and 4-naphthalene-2-indolindolignon, from which the latter is separated by boiling with dilute sodium hydroxide. A solution of 20% indoxylcarboxylic acid melt and α-anthrol in acetic acid treated with the same oxidising agent at 40° C. gives 2-anthracene-2-indolindigo, which is identical with the dye prepared from isatin-α-anilide and α-anthrol.—L. A. C.

[*Sulphur*] *dyestuffs* [*from sulphite-cellulose waste lyes*]; *Manufacture of* ——. J. S. Robeson, Pennington, N.J. U.S. Pat. 1,316,742, 23.9.19. Appl., 25.4.16.

A SULPHUR dyestuff is produced by replacing the calcium of sulphite-cellulose waste liquor by another non-alkaline base and heating the product with sulphur and an alkali sulphide.—L. L. L.

Gray dye; Universal —— and method of producing the same. C. C. Huffman, Assignor to Sunbeam Chemical Co., Chicago. U.S. Pat. 1,315,961, 16.9.19. Appl., 5.7.18.

A DYE soap is produced from 20 galls. of vegetable oil and 7 galls. 1 quart of caustic soda of 40° B., to which is added, just prior to complete saponification, 36 oz. of pheno-black dissolved in 30 fl. oz. of water.—L. L. L.

N-Dihydro-1.2.2'.1'-*anthraquinonazine* [*Indanthrene*]; *Process for the manufacture of* ——. A. Grob and J. Wurgler, Assignors to Soc. of Chem. Ind. in Basle, Switzerland. U.S. Pat. 1,317,160, 30.9.19. Appl., 7.2.18.

SEE Eng. Pat. 113,783 of 1918; this J., 1919, 130 A.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cotton yarn; Action of dilute sulphuric acid upon the tensile strength of ——. W. A. Lawrance. Canadian Chem. J., 1919, 3, 329—331.

THE effect of very dilute inorganic acids on the strength of cotton fibres depends not only on the concentration of the acid, but also on the temperature of the acid bath and the temperature at which the fibre is dried. Cotton yarn treated with *N*/100 acid at 20° C., and dried at that temperature lost 2% in strength, whereas when dried at 100° C. it lost 67%, which is about equal to the loss produced by *N*/5 acid when the yarn is treated and dried at 20° C. The process of carbonising, generally carried out by treating with 3·5—5·25% sulphuric acid at room temperature and subsequently drying at 70°—80° C., can be effected, with economy of materials, by using 1·5% acid at 40° C. and drying at 100° C.—S. S. A.

Cellulose; New method for estimating the "copper value" of —— and the valuation of the quality of cellulose. E. Hägglund. Papierfabr., 1919, 17, 301—305. Chem. Zentr., 1919, 90, IV., 296.

SCHWALBE'S method for the estimation of the copper value may be simplified by using Bertrand's volumetric method for the titration of the reduced cuprous oxide. Four grms. of the finely disintegrated cellulose is stirred with 200 c.c. of water, which is then heated to boiling, and 100 c.c. of boiling Fehling's solution added. The mixture is boiled for 15 minutes and then filtered in a Neubauer platinum crucible or else on a double filter paper with the assistance of kieselguhr paste. The cellulose containing the cuprous oxide is washed with hot water and then treated with 100 c.c. of boiling ferric sulphate solution containing 50 grms. of ferric sulphate and 200 grms. of sulphuric acid

per litre. The iron solution should previously be tested for inertness towards permanganate. The cuprous oxide is thereby dissolved, and the cellulose is washed several times with boiling water. The filtrate is then titrated with $N/10$ permanganate, and shows a sharp end-point from green to pink. With regard to tests for the quality of unbleached Mitscherlich sulphite pulp, the author has determined the copper sulphate absorption values, but finds no connection between these and the bleaching capacity of the pulps. The bleaching quality, however, shows a more consistent relationship with the lignin value as determined by Klason's method. None of the usual chemical tests, such as copper value, hydrolysis value, etc., showed any satisfactory concordance with the strength and mechanical qualities of the cellulose. Only in certain very pronounced cases can any definite relation be found between the tensile strength and the degree of digestion of the pulp. It may frequently happen that a fully digested pulp is as strong as or stronger than an under-digested material.—J. F. B.

Fibres and yarns, especially artificial silk and staple fibre; Researches on the breaking strain of ——. P. Krais. Neue Faserstoffe, 1919, **1**, 121—123. Chem. Zentr., 1919, **90**, IV., 293.

The effects of damping fibres were very varied and irregular. In the case of viscose silk the loss of strength on damping was less for the single filaments than for the yarn, but the variations in the case of single filaments were very large. This peculiarity was still more marked in the case of typha fibres. All the fibres examined showed a slight shrinkage in petroleum, amounting to 1·5% on the average. When steeped in water, the diameter of artificial silk increased by 45%, that of typha fibre 27%, and that of nettle fibre 11%. In the fireproofing of staple fibre by means of tin oxide the increase in weight was 45%, the swelling in water was 45·6%, and the shrinkage in petroleum nearly 3%.—J. F. B.

Lignin; Researches on ——. E. Hägglund. Ark. Kemi, Min. och Geol., 1918, **7**, 1—20. Chem. Zentr., 1919, **90**, III., 186—187.

According to Klason's theory, lignin is composed of two substances $C_{40}H_{40}O_{11}$ and $C_{54}H_{48}O_{18}$, and is produced by the condensation of 1 mol. of hydroxyallylguaiacol (coniferyl alcohol), 3 mols. of monomethylhydroxyallylpyrogallol (syringenin), and 6 mols. of hydroxyallylpyrogallol. The lignin isolated by treating wood with 70% sulphuric acid is, however, profoundly modified. A better result is obtained by treating the powdered wood, previously extracted by acetone and ether, with saturated hydrochloric acid of 43% concentration. The cellulose and other carbohydrates are rapidly dissolved, and after 15 minutes, the lignin is filtered off on glass wool, washed with hydrochloric acid, and then with water. The lignin residue amounts to 28% of the (pine) wood. The saccharification of the cellulose in the filtrate is complete after several hours, but the solution of sugars contains about 28% of reversion products of the nature of isomaltose. The isolated lignin preserves the microscopic structure of the wood cells; it gives colour reactions with phloroglucinol, aniline sulphate, dimethyl-*p*-phenylenediamine, and ferric ferricyanide, but does not show Maule's reaction. It has the elementary composition C 65·47% and H 5·74%, methoxyl value 14·39%, and furfural value 3·69%. It is only slightly soluble in calcium bisulphite solution, but is almost completely dissolved by digestion with 5% sodium hydroxide solution at 170° C. The product of chlorination of the lignin contains 41·2% Cl, but is not a definite substance; the bromine compound contains 64·4% Br. Lignic acids are formed by fusion with caustic potash; other products include formic acid and protocatechuic acid; acetic and oxalic acids are absent. Oxidation with alkaline permanganate, potassium chlorate and nitric acid, or fuming nitric acid yields acetic acid, but no oxalic acid. Destructive distillation yields methyl alcohol and acetic acid, and a little acetone; the tar is rich in creosote.—J. F. B.

Iron oxide-cellulose. K. Haertling. Koll. Zeits., 1919, **25**, 74—79.

As the result of an investigation on the cause and method of prevention of the crumbling of old documents written in ink, it has been shown that paper or parchment may be aged artificially by heating at 50°—60° C. in a current of dry air for 5—6 hours. When paper with a coating of an ink rich in ferric oxide is aged it rapidly becomes brittle and falls to powder. Colloidal ferric oxide placed on paper, or mixed with raw cotton and aged as described above, causes the cellulose to fall to a powder having a microcrystalline structure.—J. F. S.

Bagasse; Paper-making qualities of Hawaiian ——. A. D. Little, Inc. Report of Exp. Stat. Hawaiian Sugar Planters' Assoc., 1919, Bull. No. 46. 51 pages.

The best yields of bleached pulp were obtained from the yellow Caledonia variety of cane. Both the plain caustic soda and the sulphate processes may be used, and the technical results from both processes show little difference. The yield of bleached pulp from the Caledonia bagasse is about 30% on the air-dry bagasse, without shredding. On the basis of the material shredded by the Simmons process this would be equivalent to 48%. The quality of the pulp is excellent for fine white papers, especially when blended with longer fibres. The cost of bagasse at the mill may be taken at its fuel value, green bagasse containing 45% of moisture. The principal feature in the preparation of bagasse for pulping is the separation of the pith from the fibre by shredding, milling, and sifting in a rotary screen. This separation must be done before digestion in order to save the consumption of chemicals by the valueless pith cells. This problem has been satisfactorily solved in Cuba by the Simmons process. A difficulty in the utilisation of bagasse is the storage of the material in the "off" season. Cane crushing extends over 8—9 months, and the space required for storing sufficient material for the remainder of the year would be very large. The storage of the pulp would be far more economical.—J. F. B.

Balloon fabrics; Determination of the permeability of ——. J. D. Edwards and S. F. Pickering. J. Ind. Eng. Chem., 1919, **11**, 966—968.

The fabric to be tested is held firmly between the two halves of a circular metal cell, so as to divide the latter into two chambers. A current of pure dry hydrogen is passed through one of the chambers under a pressure equivalent to 30 mm. of water, and carbon dioxide is passed through the other chamber. The cell is surrounded by a water-bath at 25° C. The hydrogen which passes through the fabric is carried by the carbon dioxide into an absorption vessel containing sodium hydroxide solution; the carbon dioxide is absorbed, and the residual gas, consisting of hydrogen and a small quantity of air contained in the carbon dioxide, is subsequently passed to an explosion pipette where the hydrogen is determined.—W. P. S.

Paper; Determination of fibres in ——. R. C. Griffin. J. Ind. Eng. Chem., 1919, **11**, 968—970.

The determination of the percentages of different fibres in paper, after the paper has been reduced to pulp and a portion stained and mounted for microscopical examination, is conducted by the count method or the observation method. In the former

method the actual numbers of the different fibres in a series of fields are counted; the accuracy of this method is influenced by the condition, kind, and weight of the different fibres. According to the observation method, which is recommended by the author, the observer visualises the field as a whole and estimates the proportion of the field occupied by the different kinds of fibres, averaging the results of several fields. Slides made from papers of known fibre composition are used for comparison. This method is found to be accurate within 5% or less when used on rag-sulphite mixtures, and within about 10% on ground wood-sulphite and soda-sulphite mixtures.—W. P. S.

Micro-organisms living in paper; their resistance to the action of heat and that of time. V. Galippe. Comptes rend., 1919, **169**, 814—817.

It has been shown that filter paper heated in an autoclave at 120° C. for half-an-hour still contains in its fibre a large number of living bacilli. Examination of samples of paper made in the 18th and 15th centuries, of a sample of Chinese paper made long before the time of the discovery of printing, and of a sample of papyrus dating back to 200 B.C., showed that in every case living bacilli were present in the fibres of the samples.—W. G.

PATENTS

Peat; Process for treating —— for preparing fibres and pulp. C. Gumbart, Solln. Ger. Pat. 303,834, 28.11.16

The fibre is thoroughly washed free from all substances which would tend to bake together on heating, and the water then remaining in the cells is caused suddenly to expand by heating. The opening up of the cells in this manner has the advantage over the freezing method, that the degree of distension produced can be controlled by the amount of heat introduced up to the maximum effect obtained by transforming the cell water into steam. —J. F. B.

Textile fibres; Process for obtaining ——. Pflanzenfaser Patent Ges. m.b.H., Berlin. Ger. Pat. 304,213, 29.12.16. Addition to Ger. Pat. 302,803 (this J., 1918, 332 A).

The process described in the original patent may be applied to plants having bast fibres capable of being separated from the other tissues by means of alkaline solvents, particularly to flax, hemp, pine needles, and leguminous plants.—J. F. B.

Paper yarn and paper textiles; Improving the water-resisting power of ——. O. Ruff, Breslau. Ger. Pat. 312,179, 25.4.18. Addition to Ger. Pat. 311,772 (this J., 1919, 625 A).

Vegetable glue or gum, or vegetable matter yielding these substances, is added to the paper mass, and the yarn or material produced from it is subjected to a special heating. Similar materials to those which are produced from cellulose by fermentation or putrefaction as described in the chief patent (*loc. cit.*), occur naturally in peat, linseed, Irish moss, etc., or may be produced from vegetable matter by the action of acids or acid salts.—L. L. L.

Cellulose acetates; Production of solutions of —— and methods of joining articles made of cellulose acetate. R. Gilmour, and W. Dunville and Co., Ltd., Belfast. Eng. Pat. 131,647, 4.7.18. (Appl. 10,949/18.)

Acetaldehyde is used in conjunction with other solvents for cellulose acetate for producing solutions for use in joining articles made of cellulose acetate. A suitable mixture consists of 36 vols. of acetaldehyde, 36 vols. of isobutyl acetate, and 28 vols. of glacial acetic acid. The combination of solvents along with acetaldehyde can also be used in the manufacture of lacquers, varnishes, dopes, etc.—L. L. L.

Cellulosic materials; Saccharification of —— with simultaneous production of citrate-soluble phosphate. Chem. Fab. Rhenania A.-G., Aachen, F. L. Schmidt and G. A. Voerkelius, Stolberg. Ger. Pat. 305,120, 20.10.17.

The acid which has been used for the saccharification of cellulosic materials is neutralised by crude calcium phosphate and the precipitate of citrate-soluble calcium phosphate is recovered. Example: 100 kilos. of wood waste is thoroughly kneaded with 200 litres of 70% sulphuric acid. After standing for 24 hours the mixture is diluted to about 2000 litres with water, about 300 kilos. of crude phosphate is added, and the whole heated at 120° C. for two hours. In this process the cellulose sulphuric acid ester is decomposed into sugar and free sulphuric acid, which forms calcium sulphate and primary calcium phosphate, soluble in water. The calcium sulphate is filtered off and a further 300 kilos. of crude phosphate is added, whereby secondary calcium phosphate, soluble in citrate, is precipitated with the assistance of a little milk of lime. The sugar solution from this precipitate is directly fermentable. —J. F. B.

Sulphite-cellulose waste liquors; Treatment of —— with alkalis. E. L. Rinman, Stockholm. Ger. Pat. 313,007, 20.5.16. Addition to Ger. Pat. 285,752 (this J., 1915, 1139).

The sulphite liquor, before boiling with alkalis, such as calcium hydroxide, under pressure, is regenerated to produce a fresh acid sulphite liquor for the digestion of a further quantity of wood. The same regeneration process may also be applied to the aqueous solution of calcium salts before destructive distillation. Preferably, the liquor is sprayed in a centrifugal atomiser in order to cool it, and sulphur dioxide is forced through the sprayed liquid. After each digestion the liquor may be fermented in order to recover alcohol and the liquor sprayed and cooled after the alcohol has been removed, in which case a current of air is forced through the sprayed liquid.—J. F. B.

Paper; Making lines and water-marks on —— and apparatus therefor. Kangas Pappersbruks Aktiebolag, Jyvaskyla, Finland. Eng. Pat. 123,082, 1.2.19. (Appl. 2593/19.) Int. Conv., 12.2.17.

A regulated flow of water is supplied at a series of predetermined points, to the under side of an endless cloth supporting a mass of paper pulp, the pulp thus becoming loosened in passing over these points. A regulated suction is applied simultaneously at a series of other predetermined points to the under side of the cloth. The pulp becomes thinner at the former and thicker at the latter points, causing the paper produced to be marked in a corresponding manner.—L. L. L.

Cellulose acetate; Manufacture of compositions, preparations or articles having a basis of ——. H. Dreyfus, London. Eng. Pat. 132,283, 29.4.18. (Appl. 7192/18.)

Xylenemonomethylsulphonamides or xylenemonoethylsulphonamides which are liquid at ordinary temperatures or below 0° C. (or mixtures of these products), alone or in connection with other plastic-inducing substances, and with or without the addition of triphenyl or tricresyl phosphate or mixtures of these, to improve incombustibility, are used as solvents and plastifying agents with a basis of cellulose acetate for the production of dope, films, celluloid, artificial silk, or other products. When the xylene alkyl sulphonamides are employed in quantity about equal in weight to that of the cellulose acetate, the quantity of triphenyl or tricresyl

phosphate being adapted accordingly, products can be obtained pliable like a fabric. For the neutralisation of acid that may be developed in cellulose acetate it has been found that the liquid or low melting-point alkyl derivatives of urea are superior to urea.—L. L. L.

Plastic [*cellulose-ester*] *composition and art of preparing the same.* H. A. Levey, New Orleans, La. U.S. Pat. 1,316,311, 16.9.19. Appl., 10.4.17.

A TRANSPARENT plastic composition is prepared from fatty esters of cellulose by mixing with cellulose nitrate and softening and toughening agents which are soluble in cellulose nitrate but insoluble in the fatty esters of cellulose.—L. L. L.

Cellulose; Process of dissolving ——. Z. Ostenberg, San José, Cal. U.S. Pat. 1,315,393, 9.9.19. Appl., 1.11.16.

CELLULOSE is dissolved in a mixture of hydrochloric, sulphuric, and phosphoric acids.—L. L. L.

Fabric-steaming device. H. M. Dudley, Philadelphia. U.S. Pat. 1,314,791, 2.9.19. Appl., 23.4.17.

THE machine consists of an outer foraminous cylinder provided with outwardly extended members having openings between them, and an inner foraminous cylinder spaced from the outer cylinder and provided with parallel separated bars. The entire inner surface of the inner cylinder is connected with steam supply tubes provided in the trunnions of the cylinders. Means are provided for revolving the cylinders in unison.—L. L. L.

Fibre; Process of producing useful —— [*from willow bark*]. K. Ochi, Stockton, Cal. U.S. Pat. 1,315,635, 9.9.19. Appl., 5.7.18.

WILLOW bark as stripped from the tree is dried in the sun, soaked in water, boiled in a bath containing suitable proportions of oil, water, salt, and soda, and again dried in the sun.—L. L. L.

Silk; Process for the treatment of —— *with reserves for the purpose of increasing its strength and elasticity.* J. Korselt, Zittau, Germany, Assignor to Chemical Foundation, Inc. U.S. Pat. 1,318,339, 7.10.19. Appl., 15.11.15.

SEE Eng. Pat. 104,684 of 1917; this J., 1918, 53 A.

Sulphur dyestuffs. U.S. Pat. 1,316,712. *See* IV.

Washing preparation. Ger. Pat. 312,465. *See* XII.

Lacquers etc. Eng. Pat. 132,996. *See* XIII.

Floor covering. Eng. Pat. 133,481. *See* XIII.

Paints, etc. [*from sulphite-cellulose lyes*]. Eng. Pat. 133,852. *See* XIII.

Rubber-treated fabrics. Ger. Pat. 307,173. *See* XIV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Indigo Grey; Elbers' ——. R. Haller, Koll. Zeits., 1919, **25**, 49—52.

THE production of Indigo Grey in cotton articles (Elbers, Ger. Pat. 101,190; see Eng. Pats. 509 and 6546 of 1898; this J., 1899, 39) is shown to be a mechanical process due to the unequal distribution of the pigment on the fabric. The pigment is held by adhesion, but nevertheless it cannot be removed by soap and boiling water. Treatment with alkaline thiosulphate causes the whole of the fabric to assume a yellow colour, even those parts which are shown microscopically to be entirely free from the dye.—J. F. S.

Dyeing machines. F. Smith. J. Soc. Dyers and Col., 1919, **35**, 207—210.

THE author discusses the principles of dyeing machines for loose wool and the causes of uneven dyeing. Channelling, or the uneven flow of the dye liquor along the path of least resistance, is shown to be due to faulty packing or to the absence of an adjustment device to fit the material to the machine after wetting out. Other matters considered are the defects of sampling holes in different types of machines, the circulation of the liquor through the material by gravitation, propellers, steam, and pumps, the causes of varying results due to choking, grit, vacuum, etc., and tendering through the use of steam at too high a pressure.—L. L. L.

Adsorption of dyestuffs. Michaelis and Rona. *See* IV.

PATENTS.

Scouring cotton and other vegetable yarns and fabrics; Process of ——. Bleachers Association, Ltd., Manchester, and S. H. Higgins, Luncarty, Perth. Eng. Pat. 131,798, 22.11.18. (Appl. 19,220/18.)

COTTON yarns or fabrics are extracted with volatile solvents, such as benzene, alcohol, carbon bisulphide, etc., for the removal of oils, fatty and waxy matter, and then scoured with sodium carbonate prior to the bleaching process. The extracted matters and the solvent are recovered by fractional distillation. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 1652 of 1890, 17,330 of 1904, and 102,892; this J., 1891, 134; 1905, 887; 1917, 211.)—L. L. L.

Washing, saturating, and similarly treating textile fabrics and yarns in rope form; Machines for ——. The Calico Printers Association, Ltd., Manchester, and F. Roberts, Accrington. Eng. Pat. 132,672, 23.11.18. (Appl. 19,298/18.)

THE machine consists of a vat divided into compartments, each of which is provided with a perforated false bottom. The water or other liquid is supplied to the bottom of the last compartment at the delivery end of the fabric, rises upward through the false bottom and overflows into the next compartment, and so on through the series, finally overflowing from the first compartment. The material, in rope form, is drawn into the machine by means of a winch or pair of draw rollers and guided by adjustable pot eyes or other guides through the whole of the compartments. If necessary the compartments may be arranged as wet and dry compartments alternately.—L. L. L.

Mercerisation. S. M. Jones, North Adams, Mass. U.S. Pat. 1,316,958, 23.9.19. Appl., 24.7.19.

THE cotton, in materials containing cotton and artificial silk (viscose), is mercerised without injury to the viscose silk by adding to the caustic solution a miscible monohydric alcohol.—L. L. L.

Mercerisation; Process and apparatus for the —— *of material saturated with strong caustic soda.* K. E. M. Schreiner, Darmstadt, and K. Grunert, Zittau. Ger. Pat. 312,087, 12.1.16.

THE material is treated under tension with caustic soda, and after squeezing off in the stretched condition is subjected to a steaming operation, then immediately squeezed and according to requirements several times alternately washed, squeezed off, steamed, and squeezed off, without coming into contact with oxygen of the air whilst in a hot alkaline condition. The formation of oxycellulose is thus avoided.—L. L. L.

Bleaching, dyeing, washing, impregnating, and opening up of raw fibres or similar material; Apparatus for ——. F. Gebauer, Charlottenburg. Ger. Pat. 312,674, 28.3.18.

THE apparatus consists of a vessel into which several cages, that contain the goods, may be inserted, the cages fitting into one another so that the material is kept in position by the cage above it. The bath liquor, which may be heated, is circulated through the goods.—L. L. L.

Dyeing fur skins; Method and means for ——. H. C. Lubarsky, Philadelphia, Pa., Assignor to A. Hollander and Son, Newark, N.J. Reissue 14,729, 23.9.19, of U.S. Pat. 1,225,147, 8.5.17. Appl., 5.10.18

THE apparatus comprises an endless belt which carries the skins first under a drag roll for the purpose of laying back the hairs while dye material is being applied by means of a brush arranged transversely to the carrier, and a second brush and drag roll to distribute the dye upon the sides of the hair above the surface of the skin. The carrier then passes through a drying chamber.
—L. L. L.

Fur-dyeing machine. M. Dickerson, Assignor to A. Hollander and Son, Newark, N.J. U.S. Pat. 1,317,007, 23.9.19. Appl., 7.8.17.

THE apparatus consists of a dye trough, a supporting surface for the furs, a dye brush in contact with the fur surface and dipping into the trough, and a number of other brushes adjacent to one another and to the fur. The dye-liquor thrown from one brush is caught by the next, and that leaving the last brush is caught and returned to the bath liquor.—L. L. L.

Foam or froth baths; Production of —— for treating textile fibres and textile fabrics. P. Schmid, Basel, Switzerland. U.S. Pat. 1,316,808, 23.9.19. Appl., 27.11.17.

ALKALIS and excrements of human or animal origin, containing urine, are added to the bath liquor, which is then boiled.—L. L. L.

Dyeing, staining and mordanting by means of salts of titanium and iron. J. Barnes, H. Wrigley, and P. Spence and Sons, Ltd., Manchester. Eng. Pat. 132,345, 11.9.18. (Appl. 14,740/18.)

IN dyeing, staining, or mordanting textiles and leather, previously treated with tannic acid, by means of a solution containing a mixture of salts of titanium and iron, varying shades from yellow, brown, grey to bluish black may be obtained by regulating the degree of acidity or basicity of the solution.—L. L. L.

Bleaching textile materials by means of sodium perborate. Chem. Fabr. Grünau, Landshoff und Meyer Akt.-Ges., and A. Nöldeke, Grünau. Ger. Pat. 313,541, 18.12.10.

A SUFFICIENT quantity of an aluminium salt, aluminium hydroxide, or an aluminate, in addition to free alkali and soap, is added to a bleaching liquor containing sodium perborate to prevent the separation of a precipitate on the surface of the material.—L. A. C.

Dyeing, bleaching, or like treatment of cops; Process for ——. W. Resch, Binningen, Assignor to A. Clavel, Basle, Switzerland. U.S. Pat. 1,317,220, 30.9.19. Appl., 2.7.18.

SEE Eng. Pat. 117,630 of 1918; this J., 1919, 71 A.

Cloth dyeing, bleaching, and like machine. R. Jackson, Chinley. U.S. Pat. 1,319,648, 21.10.19. Appl., 25.3.18.

SEE Eng. Pat. 110,715 of 1917; this J., 1918, 6 A.

Gray dye. U.S. Pat. 1,315,961. *See* IV.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Fluorine; Sodium and potassium salts of lead tetrafluoride as sources of ——. G. L. Clark. J. Amer. Chem. Soc., 1919, 41, 1477—1491.

TRIPOTASSIUM lead hydrogen octafluoride is prepared by adding potassium plumbate in small quantities to a concentrated aqueous solution of hydrofluoric acid until separation of lead dioxide occurs. The solution is filtered through paper supported by several layers of cloth and the filtrate slowly evaporated in lead dishes on a sand-bath in a gentle stream of air until separation of crystals occurs. It hydrolyses in water, and when heated to 250° C. loses a molecule of hydrogen fluoride, and at higher temperatures fluorine is given off. Potassium plumbate $K_2PbO_3,3H_2O$ is best prepared by mixing 3 mols. of potassium hydroxide with 20% of its weight of water, raising the temperature to 100° C. and adding 1 mol. of lead dioxide; the plumbate is formed without decomposition products. In water it hydrolyses with the separation of lead dioxide. Disodium lead hexafluoride, $2NaF,PbF_4$ is prepared by the addition of sodium plumbate to aqueous hydrofluoric acid and crystallisation of the product from hydrofluoric acid. It forms short, thick plates, which are hydrolysed by water. Sodium plumbate $Na_2PbO_3,6H_2O$ is prepared by mixing 150 grms. of sodium hydroxide with 50 c.c. of water at 100° C., adding lead dioxide until a paste is formed, then adding 25 c.c. of water and lead dioxide to make the total quantity of the latter substance 300 grms. The analysis of the double fluorides is effected in the following manner: The salt is dissolved in water, when hydrolysis occurs thus:

$$3KF,HF.PbF_4+2H_2O=3KF+5HF+PbO_2.$$

The lead dioxide is collected in an alundum crucible, dried at 105° C., and weighed. The filtrate is made up to a known volume; in one portion the free acid is estimated by titration and in another portion the potassium fluoride is estimated by evaporation to dryness and ignition at 500°C. The potassium salt is more easily prepared and is more stable than the sodium salt, and weight for weight of materials used it is twice as efficient as the sodium salt. (See also J. Chem. Soc., Dec., 1919.)—J. F. S.

Adsorption of hydrogen and hydroxyl ions and the ions of the heavy metals by charcoal. P. Rona and L. Michaelis. Biochem. Zeits., 1919, 97, 85—97.

HYDROGEN and hydroxyl ions are adsorbed by charcoal to the same extent. The amount of mercuric chloride adsorbed by charcoal may be diminished in the presence of chlorides by as much as 60%.
—S. S. Z.

Nitrogen; Triatomic ——, N_3. M. Trautz. Z. Elektrochem., 1919, 25, 297—300.

TRIATOMIC nitrogen exists in active nitrogen to a small extent; in the mixture it has a partial pressure 0·002 mm. The heat of formation from N_2 and N has a maximum value between 5000 cals. and 10,000 cals. At low temperatures, somewhat above that of liquid air, hexatomic nitrogen is formed in quantities much smaller than triatomic nitrogen. (See also J. Chem. Soc., Dec., 1919.)
—J. F. S.

Thiosulphuric acid; Microchemical reactions of ——. A. Bolland. Comptes rend., 1919, 169, 651—654.

MICROCHEMICAL reactions of sodium thiosulphate with thallous nitrate, lead acetate, barium chloride, and benzidine are described and sketches are given of the microcrystalline structure of the precipitates

obtained in each case. The precipitate obtained with barium chloride depends upon the experimental conditions, the appearance of the precipitate obtained from dilute solutions of the thiosulphate being quite different from that of the precipitate obtained in concentrated solution, the latter conditions giving the more suitable precipitate for microscopical examination.—W. G.

Sulphate; Estimation of —— as barium sulphate. I. M. Kolthoff and E. H. Vogelenzang. Pharm. Weekblad, 1919, **56**, 122—142.

A DETAILED investigation into the sources of error in the estimation of sulphate as barium sulphate. —W. S. M.

Sulphate; Estimation of —— as strontium sulphate. I. M. Kolthoff and E. H. Vogelenzang. Pharm. Weekblad, 1919, **56**, 159—161.

EXPERIMENTS on the determination of sulphate by precipitation in presence of various salts, such as ammonium chloride and nitrate, sodium acetate, chloride and nitrate, potassium chloride, etc., showed that the method is in general untrustworthy.—W. S. M.

Iodide, bromide, and chloride; Estimation of —— in mixtures. I. M. Kolthoff. Pharm. Weekblad, 1919, **56**, 1298—1300.

THE total halogen content is determined by precipitation with silver nitrate. Iodide alone is estimated by addition of excess of potassium iodate to the solution acidified with benzoic acid, and titration of the iodine liberated with standard thiosulphate solution. Iodide and bromide together are determined by adding to the solution 25 c.c. of $N/10$ potassium iodate, 5 c.c. of $N/1$ sulphuric acid, and 20 c.c. of water. The solution is boiled until the free halogen is expelled. Excess of potassium iodide is then added and a little sulphuric acid. The iodine liberated is titrated with thiosulphate. Chloride is determined by difference. —W. S. M.

Alkali iodides; Determination of small quantities of —— in the presence of bromides and nitrites. E. Lasausse. J. Pharm. Chim., 1919, **20**, 177—181.

THE solution, containing 2 to 3 mgrms. of iodide, together with bromide and nitrite, is diluted to 150 c.c., 4 c.c. of 50% phosphoric acid solution is added, and 5% potassium permanganate is run in, at first in the cold, and then at 40° C., until a permanent pink coloration is obtained; the nitrite is thus oxidised. The excess of permanganate and chlorates and bromates are destroyed by the addition of sodium bisulphite solution, the solution is neutralised with 25% potassium hydroxide solution, a further 5 c.c. of the latter is added, and the whole boiled for 10 mins. with the addition of an excess of permanganate solution; to the boiling liquid is then added 25 grms. of sodium sulphate, followed by 10 c.c. of alcohol. After cooling the mixture is diluted to 220 c.c., filtered, 200 c.c. of the filtrate is acidified with 8 c.c. of phosphoric acid, 2 c.c. of 10% potassium iodide solution is added, and the liberated iodine titrated with thiosulphate solution. Chlorides and bromides are not converted into chlorates and bromates by alkaline permanganate under the conditions given.—W. P. S.

Cuprous iodide; Determination of iodine in ——. E. Lasausse. J. Pharm. Chim., 1919, **20**, 181—183.

A WEIGHED quantity of 0·4 grm. of the dry powdered cuprous iodide is shaken in a separating funnel for 10 min. with 2 c.c. of ferric chloride solution; 20 c.c. of carbon bisulphide is then added, which dissolves the liberated iodine, and the solution is drawn off; the residue in the separating funnel is subjected to two similar treatments, 1 c.c. of ferric chloride solution, and 10 c.c. of carbon bisulphide being used each time. After the carbon bisulphide solution has been washed with water a few crystals of potassium iodide and 10 c.c. of water are added, and the iodine is titrated with thiosulphate. An alternative method consists in boiling the cuprous iodide with dilute potassium hydroxide solution in order to convert the iodide into potassium iodide; the solution is filtered, the iodide in the filtrate converted into iodate by boiling with alkaline permanganate solution, and the determination proceeded with as described in the preceding abstract.—W. P. S.

Periodic acid and periodates. A. Rosenheim and E. Loewenthal. Koll. Zeits., 1919, **25**, 53—60.

THE hydrogen-ion concentrations of H_5IO_6, NaH_4IO_6 and $Na_2H_3IO_6$ in $N/20$ solutions are respectively 6×10^{-4}, $4{\cdot}05\times10^{-7}$, and $6{\cdot}5\times10^{-10}$. Periodic acid may be titrated quantitatively to the stage NaH_4IO_6 using methyl orange as indicator, and to the stage $Na_2H_3IO_6$ using thymolphthalein as indicator. Two periodates of sodium, two of lithium, and three of ammonium are described. Periodic acid is of medium strength, and in dilute hot solutions forms two ions, but at low temperatures in 12—20% solutions forms polymeric molecules. There is in general a decided, if not very complete, analogy between periodic and telluric acids and between the periodates and the tellurates.—J. F. S.

Sodium silicofluoride: Analysis of ——. P. Drawe. Z. angew. Chem., 1919, **32**, 312.

THE author's method of determining sodium silicofluoride in commercial products (Chem.-Zeit., 1909, 616) only gives good results when the impurities have a neutral reaction. In the presence of substances with alkaline reaction the results are too low, owing to the alkali decomposing part of the silicofluoride into sodium fluoride and silicon hydroxide, which separates out. A method obviating this error is based upon the fact that cold dilute hydrochloric acid has no action on sodium silicofluoride, and that this salt has no influence on the indicator dimethylaminoazobenzene (or methyl orange). From 0·6 to 1 grm. of the finely powdered sample is treated with excess of $N/4$ hydrochloric acid (methyl orange as indicator), then diluted with water and neutralised with $N/4$ alkali. Phenolphthalein is then added, and the silicofluoride titrated with $N/4$ alkali.

$$Na_2SiF_6 + 4KOH = 2NaF + 4KF + Si(OH)_4.$$

—C. A. M.

Hydrocyanic acid; Detection and determination of traces of —— in complex mixtures. Chelle. Bull. Soc. Pharm. Bordeaux, 1919, 140. J. Pharm. Chim., 1919, **20**, 156—157.

AIR, free from carbon dioxide, is bubbled through the solution containing the hydrocyanic acid, acidified with sulphuric acid; the air is then passed through a vessel containing an alkali solution which absorbs the hydrocyanic acid. With an air current of 75 litres per hour, quantities of hydrocyanic acid varying from 0·48 to 54 mgrms. in 50 c.c. of solution are extracted completely in 3 hours. The cyanide in the alkaline solution is determined by the ferrocyanide or ammoniacal silver iodide method. —W. P. S.

Thiocyanate; Detection and determination of traces of —— in complex mixtures. Chel'e. Bull. Soc. Pharm. Bordeaux, 1919, 150. J. Pharm. Chim., 1919, **20**, 158.

THE method depends on the conversion of the thiocyanate into a cyanide by means of chromic acid and the subsequent separation of the hydrocyanic

acid; the conversion is not quite quantitative and diminishes as the quantity of thiocyanate increases; a curve may be constructed which shows this regular decrease and from which the actual quantity of thiocyanate present may be calculated. The solution is first acidified with sulphuric acid, and any hydrocyanic acid present is removed by passing a current of air through the solution for 3 hours (see preceding abstract); an excess of potassium bichromate is then added, and the hydrocyanic acid formed removed by a current of air and absorbed in alkali solution.—W. P. S.

Hydrocyanic acid; Transformation of —— into thiocyanic acid during putrefaction; experiments made in vitro. Chelle. Comptes rend., 1919, **169**, 726—728.

From experiments made with blood *in vitro* it is shown that, during putrefaction, hydrocyanic acid and its salts are converted into thiocyanic acid, the change commencing very rapidly. Hydrocyanic acid may be regenerated from the thiocyanic acid by oxidation with chromic acid.—W. G.

Manganese salts [and oxalates]; Sensitive reaction for ——. D. H. Wester. Pharm. Weekblad, 1919, **56**, 1289—1290.

The red coloration produced when potassium oxalate is added to a solution of a manganous salt (Caron and Raquet, this J., 1919, 574 A) is less sensitive than the tests with lead peroxide and nitric acid, and persulphate and silver nitrate, both of which may be applied in presence of considerable quantities of chlorides. The reaction may, however, be used as a sensitive test for oxalates (this J., 1919, 662 A).—W. S. M.

Carbon dioxide; Separation, by solidification, of pure —— from a gaseous mixture. V. Crémieu and A. Lepape. Comptes rend., 1919, **169**, 654—655.

Carbon dioxide may be obtained in a pure solid state from gaseous mixtures rich in that gas, by allowing the compressed gaseous mixture to expand suddenly, at the ordinary temperature, through a cloth bag into the air, or by compressing the mixture slightly in a vessel cooled to −80° C. The solid carbon dioxide obtained is free from radium emanation, when the latter is present in the original mixture.—W. G.

Iodine industry in France; Past and prospective progress in the ——. P. Gloess. Monit. Scient., 1919, **63**, 193—194.

The method of extraction of iodine from seaweed remains practically the same as that originally practised by Courtois 100 years ago, but by careful selection of the algæ it has been possible to increase the yield of iodine from about 0·1 to 0·4% calculated on the ash. Attention is drawn to the destruction of valuable organic matter in the incineration of the seaweed.—D. F. T.

Nitrates. Auerbach and Riess. *See* XIXA.

Tricalcium aluminate. Phillips. *See* IX.

Patents.

Cyanogen compounds; Process of producing substantially pure ——. The Nitrogen Corporation, Assignees of J. C. Clancy, Providence, R.I., *U.S.A. Eng. Pat.* 133,095, 26.2.18. (Appl. 3416/18.) Int. Conv., 12.6.17.

Free nitrogen is brought into contact with briquettes composed of an intimate dry mixture of alkali carbonate or hydroxide, coke, charcoal, or other carbonaceous material, and a finely-divided catalyst, *e.g.*, iron. The alkali cyanogen formed is extracted by liquid ammonia which are available for further treatment with free nitrogen.—S. S. A.

Carbide; Process of producing ——. Electrical furnaces. Process for making carbide. J. H. Reid, Pittsburgh, Pa., U.S.A. Eng. Pats. (A) 133,098, (B) 133,099, and (C) 133,100, 13.3.18. (Appls. 4445-7/18.)

(A) A mixture of an oxide and carbonaceous material, *e.g.*, lime and bituminous coal, is treated in an electrical resistance furnace in which the lime-carbon material is packed round and between the electrodes, thus completing the circuit. The molten carbide flows to the bottom of the furnace as formed, whilst the carbon monoxide, liberated at a high temperature, passes upwards through the mass of crude material in the higher part of the furnace, thus preparing it for the carbide-producing stage. (B) In an electrical resistance furnace in which material is fed between two oppositely placed electrodes on to a support which retains unconverted material whilst allowing the molten product of the reaction to flow out of the zone of greatest heat, arrangements are made for producing an electro-magnetic field near to the reaction zone, whereby the position of the latter may be varied. The support is electrically heated, if necessary, to a temperature sufficient to prevent accumulation of finished material. The furnace is suitable for the manufacture of calcium carbide. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pats. 17,471 of 1897, 11,438 of 1898, and 24,807 of 1907; this J., 1897, 789; 1898, 746; 1908, 511). (C) An oxide and carbon, *e.g.*, lime and bituminous coal, mixed in suitable proportions and coked, is heated in an electrical resistance furnace on a hearth, placed immediately below the zone of greatest heat, which allows the discharge of molten carbide as it is formed, whilst retaining solid unconverted material.—S. S. A.

Calcium carbide; Preparation of crude materials for the manufacture of ——. F. L. Slocum, Pittsburgh, Pa., U.S.A. Eng. Pats. (A) 133,101, (B) 133,102, and (C) 133,103, 13.3.18. (Appls. 4448-50/18.)

(A) A mixture of hydrated lime and ground bituminous coal is heated to about 450° C. to remove practically all the volatile matter in the coal and water of hydration in the lime. The finely divided intimate mixture thus obtained is mixed with a binding material, *e.g.*, 2—4% of pitch, heated if necessary to make the binding material plastic, and briquetted. (B) A suitable metallic hydroxide, *e.g.*, calcium hydroxide, is mixed with carbonaceous material, such as bituminous coal or peat, which yields carbon as a principal end product when heated out of contact with air, or a metallic oxide is mixed with moist carbonaceous matter in such proportions that the moisture in the latter is sufficient to hydrate the metallic oxide. The mixture produced is heated and briquetted as in (A). (C) The finely divided residue resulting from the process in which nitrified material is treated with steam for the production of ammonia, and which contains chiefly metallic carbonate and oxide together with carbon in the form of graphite, is calcined to expel carbon dioxide, a suitable proportion of carbonaceous material is added, and the mixture is coked to obtain a cemented mass suitable for the production of carbide in an electric furnace.

—S. S. A.

Nitrogen; Process for the fixation of ——. F. L. Slocum, Pittsburgh, Pa., U.S.A. Eng. Pat. 133,104, 13.3.18. (Appl. 4451/18.)

A carbide, *e.g.*, commercial calcium carbide, with or without the admixture of catalysts of a suit-

between the carbide and nitrogen, and a salt, hydroxide, or oxide of an alkali metal, or other compound having great affinity for chlorine, is treated in a suitable furnace at a temperature, for example, of 750° C., with nitrogen mixed with a carbon-halogen compound, such as the vapour of carbon tetrachloride (1—5% by volume); or the carbide mixture may be subjected to the action of a carbon-halogen compound before treatment with nitrogen. The combination of carbide with nitrogen is thereby considerably accelerated.—S. S. A.

Cyanogen compounds and ammonia; Production of ——. F. L. Slocum, Pittsburgh, Pa., U.S.A. Eng. Pat. 133,105, 13.3.18. (Appl. 4452/18.)

A MIXTURE of a carbide with a suitable catalyst is treated under slight pressure with nitrogen containing catalytic vapours (see preceding abstract) in a furnace at about 1000° C. On completion of the reaction the material is cooled in the furnace to about 450° C., and treated with steam, the temperature during the evolution of ammonia and ammonium compounds being maintained below 600° C., after which it is raised to about 850° C. to expel water and carbon dioxide from the mixture.—S. S. A.

Fixation of atmospheric nitrogen; Method of ——. J. S. Island, Assignor to E. P. Coleman, Hamilton, Ont., Canada. U.S. Pat. 1,317,705, 7.10.19. Appl., 25.10.17.

AN arc discharge is caused to pass between an outer ring electrode and a co-axial inner ring electrode. By means of a current of the air to be treated, the arc is extended into a conical annular form, the air passing through the annular space.

—J. S. G. T.

Apparatus for treating material with gas or vapour [e.g., treating carbides with nitrogen]. C. C. Stutz, New York. Eng. Pat. 133,106, 13.3.18. (Appl. 4456/18.)

THE apparatus, which is particularly suitable for treating carbides with nitrogen, comprises an enclosed reaction chamber containing trays in the form of frames with a foraminous surface extending over the opening bounded by the frame, these frames being provided with supports, so that they may be stacked up in spaced relationship to allow free contact between gas or vapour and material.

—S. S. A.

Ammonium compounds; Recovery of —— from urine. H. Wichelhaus and J. Angerstein, Berlin. Ger. Pat. 313,271, 15.8.18.

URINE is heated with the magnesium chloride end-liquors from the production of potash salts, thus converting the nitrogen of urea into ammonium chloride. If lime is added, ammonia is liberated and is absorbed in sulphuric acid.—J. H. J.

Titanium compounds; Preparation of ——. H. Wrigley, H. Spence, and P. Spence and Sons, Ltd., Manchester. Eng. Pat. 133,336, 16.10.17. (Appl. 14,950/17.)

FOR the production of solutions of titanium and iron sulphates an excess of ilmenite, in powdered or lump form, is mixed with sulphuric acid, and the mixture is heated by open steam, the condensation of which is regulated to obtain the most suitable concentration and temperature of solution. The undissolved excess of ilmenite is used in making further solutions. The solution obtained is reduced by iron, whereby titanous solutions are obtained containing ferrous sulphate, which is separated by crystallisation at low temperature.

—S. S. A.

Lead sulphate; Production of basic ——. S. B. Wilson, and Purex, Ltd., Greenford. Eng. Pat. 133,367, 4.7.18. (Appl. 10,978/18.)

LEAD sulphide volatilised in a furnace in an atmosphere deprived of active oxygen is passed along a short flue wherein it is mixed with air introduced downwards through an iron conduit immediately before entering a water-cooled reaction chamber. After combustion the deposited basic lead sulphate is removed through a slide-valve at the bottom of the chamber, and the residual hot gases are passed through a cooler.—S. S. A.

Potassium fluoride; Production of —— from silicate rocks. E. E. Dutt and P. C. Dutt, Jubbulpore, India. Eng. Pat. 133,474, 18.10.18. (Appl. 17,081/18.)

FELSPAR or other potash silicate mineral is heated and subjected to the action of silicon tetrafluoride and water vapour. The resulting mass is lixiviated to extract the potassium fluoride formed, and the solution is evaporated.—S. S. A.

Nitrogen and carbon dioxide mixtures of low oxygen content; Process and apparatus for the production of ——. J. Munchka, Vienna. Ger. Pat. 311,438, 1.1.18. Int. Conv., 3.12.17.

THE combustion gases of an internal-combustion engine, after expansion, are again compressed in the cylinder of the engine and then passed into a receiver. The cylinder is fitted with an ordinary exhaust valve, a pressure exhaust valve leading through a check valve to the receiver, and a pressure regulator by means of which a charge of gas which misses ignition is ejected through the normal exhaust valve.—S. S. A.

Sulphurous acid; Manufacture of —— by reduction of magnesium sulphate. J. Kiermayer, Langenried-Simmerberg, and Hannoverscho Kaliwerke, Peine. Ger. Pat. 312,775, 10.9.16.

CRUDE potassium salt containing magnesium sulphate, *e.g.*, kieserite, kainite, or langbeinite, is fused with coke, a mixture of carbon dioxide and sulphur dioxide being evolved.—S. S. A.

Aluminium sulphate; Production of powdered ——. G. Muth, Nuremberg. Ger. Pat. 312,960, 12.9.17.

SUBSTANCES containing aluminium, such as alumina, bauxite, etc., are treated whilst in motion with sulphuric acid of 62°—66° B. (sp. gr. 1·75—1·84) in an atomised condition at 150°—200° C. in order to obtain aluminium sulphate in finely powdered form.—J. W. D.

Sulphur [from ore]; Process and apparatus for extracting ——. W. D. Huff, La Fayette, La., Assignor to J. J. Connolly, Roanoke, Va. U.S. Pat. 1,317,625, 30.9.19. Appl., 8.7.18.

IN a continuous process for separating native sulphur from its gangue, the ore is first submerged in water and then conveyed through a heated and water-sealed melting chamber, filled with steam, from which the molten sulphur is drained.

—W. E. F. P.

Sulphur from sulphur ores; Process of extracting ——. A. K. Sedgwick, San José, Cal. U.S. Pat. 1,318,015, 7.10.19. Appl., 4.10.17.

THE ore is heated and centrifuged to separate liquid sulphur, which is then solidified by cooling the material before the centrifugal motion is stopped.—W. E. F. P.

Graphite ores; Process of and apparatus for concentration of ——. L. J. Wheeler and H. R. Robbins, Salt Lake City, Utah. U.S. Pat. 1,318,003, 7.10.19. Appl., 31.12.17.

A DRUM rotates in a closed casing and carries round

with it a film of air. The ore is allowed to fall on the surface of the drum, and some constituents are carried round by the air-film and some rebound from the surface of the drum, so that the products may be collected in separate receivers.—B. M. V.

Sodium ferrocyanide; Method of making ——. T. Boberg, Assignor to Techno-Chemical Laboratories, Ltd., London. U.S. Pat. 1,318,258, 7.10.19. Appl., 27.4.17.

See Eng. Pat. 108,692 of 1916; this J., 1917, 1047.

Boiler for acids. Ger. Pat. 313,916. *See* I.

Ammonia from coke. Ger. Pat. 313,170. *See* II A.

Nitric oxide. Ger. Pat. 303,255. *See* IIA.

Gases containing hydrogen sulphide. U.S. Pat. 1,317,583. *See* II A.

Residues from shales etc. Eng. Pat. 133,452. *See* IIB.

Precipitating nitric acid. Ger. Pat. 298,412. *See* XX.

Aluminium compounds. Ger. Pat. 313,606. *See* XX.

VIII.—GLASS; CERAMICS.

Potash or soda [in glasses and enamels]; What precautions should be taken in replacing ——? L. Springer. Sprechsaal, 1919, 52, 362–363.

Potash from the sugar-beet usually contains 80–85% K_2CO_3, 7–15% Na_2CO_3, 4–7% K_2SO_4, and 3–4% KCl. Calcined Stassfurt potash contains 97–99% K_2CO_3, 0·05–1·25% KCl, and only traces of other substances. Hydrated or "crystalline potash" contains little potassium chloride, but 17·4% of water, and therefore only 80–83% K_2CO_3. Potash derived from wood or vegetable ashes corresponds to that from sugar-beet. For glasses and enamels, potash should contain the highest possible percentage of potassium carbonate and a minimum of other constituents. Potash with a high soda content is useless for potash glasses. Potassium chloride is an inert impurity which is volatilised, and, if present, may hasten the fining of the batch. Small proportions of potassium sulphate are harmless, but larger ones form a scum on the molten glass and tend to colour the glass. Phosphoric salts in small quantities are harmless. In comparing samples of potash from different sources, the influence of the various impurities should be fully recognised, as they often have a marked effect on the behaviour of the glass batch. The addition of a little soda as Glauber's salt or common salt (when unobjectionable) will sometimes convert a "useless" potash into a satisfactory material, as the purer potash glasses are less fusible than those containing a little soda. In Germany Glauber's salt or sodium sulphate is now seldom used, having been replaced by the purer Solvay or ammonia soda which contains 97–99% Na_2CO_3, 0·3–2% NaCl, and traces of other substances. Some firms mix it with 8–10% of sodium sulphate (saltcake), which enables the glass to fuse more readily and facilitates the fining. "Light" and "heavy" soda differ solely in specific gravity, the difference being due to the temperature of calcination. The "heavy" form melts more easily and uniformly, but the glass requires a longer fining. Seeds due to the infusibility of the soda may be avoided by replacing part of the soda by saltcake or by replacing half of the soda with 98–100% Na_2CO_3 by that containing only 90–92%. An excess of sodium sulphate is particularly objectionable in the production of glass coloured yellow by carbon, as the greater the percentage of Glauber's salt the deeper will be the colour, an increase of only 5% of the salt sometimes spoiling the colour of the glass. In substituting potash or soda from sources other than those generally used the chemical composition should be ascertained in detail and any differences taken into consideration.—A. B. S.

Burning stoneware. M. Schmidt, Sprechsaal, 1919, 52, 335–336, 346–348, 360–362, 371–373.

The burning of stoneware is the most important stage in the whole manufacture. Calcareous stoneware cannot be heated above cone 4a (1160° C.) owing to the formation of fusible silicates or aluminosilicates, but lime-free, felspathic stoneware may be fired at cone 8–9 (1250°–1280° C.); the higher the firing temperature the stronger is the ware. A high felspar content tends to cause hair-cracks. The ware should be covered with a basic or neutral glaze melting at cone 010a–05a (900°–1000° C.), as this is less affected by sulphates than a less fusible and more acid glaze. Overfiring must be avoided, or the glaze will absorb silica from the ware, become acid, and then cause trouble with any sulphates present. Fuel rich in sulphur compounds should be avoided, and it is sometimes advantageous to substitute dry long-flaming wood for coal during the later stages of the burning. A scum or film is sometimes formed on the ware during the earliest part of the cooling if the fires are stirred at or just after the end of the firing. This may be avoided by allowing the fires to die out naturally, closing all openings to the fire-boxes gradually so as to avoid production of dust in the kiln. As some organic matter is usually present in stoneware clays, it is not desirable to coat the "green" ware with glaze, as the latter may begin to fuse before all the carbonaceous matter has been burned out, and so may cause black spots in the ware. The glaze is also liable to attack the "green" body to the detriment of both. Two firings—one biscuit and the other glost—are, therefore, preferable. Stoneware is usually burned in saggers in round ovens or kilns or in muffle kilns. Long-flaming coal of low coking power is largely used as fuel; lignite may be burned on stepped grates which form a semi-gas-producer. Combustion is seldom complete in the intermittent kilns used for stoneware, as directly an imperfectly burned mixture of combustible gases and air impinges on the cooler contents of the kiln its temperature is lowered below the ignition point, so that some unburned gases pass away from the kiln and soot is deposited. This deposit may prevent the proper combustion of organic matter in the ware and result in the formation of black spots or "cores." It may be avoided by the admission of sufficient secondary air at a temperature corresponding to cone 07a (960° C.). Under properly controlled conditions the whole of the organic matter should be burned out at or below cone 02a (1060° C.), and after this and the "combined water" have been removed there should be no serious deposition of soot on the goods. A reducing atmosphere when the kiln is at a dull red heat should especially be avoided until all the organic matter has been burned out, as it tends to cause swelling of the ware due to imprisoned gases. At a slightly higher temperature it may be usefully employed in decomposing sulphates, but should then be followed by a powerfully oxidising atmosphere. A deep fire-bed is desirable and is best obtained by using a closed fire-box, the air being supplied partly through the grate and partly through adjustable openings in the front of the fire-box. A tray filled with water should be placed below the grate to supply steam to the latter, to reduce the amount of clinker formed and to keep the fuel porous. The water-pan should not be used until all

the combined water has been driven out of the ware and the latter is at a temperature corresponding to cone 05a (1000° C.). It is specially important during the later stages of the burning, as the steam assists in the formation of water-gas, which greatly reduces the tendency to form a deposit of soot on the goods. The greatest fire-shrinkage in the ware occurs during the removal of the moisture and "combined water," *i.e.*, below 1000° C., so that the firing should be slow, with ample ventilation, until this stage is completed; otherwise the ware may be cracked by too rapid heating or softened by condensation of an excessive amount of moisture on the cooler goods. The most satisfactory fuel for this stage is coke which burns with a short flame, well adapted to warm the large volume of air required. This may be used for the first 36—40 hours in a stoneware kiln of 270 to 350 cb. ft. capacity. When cone 05a has bent over, a temperature (1000°) has been reached when the gases evolved from the fuel should be burned among the goods and a long-flaming fuel should therefore be used, which is allowed to burn until a bed of coke 20—24 in. thick has accumulated on each grate. By this means each fireplace is converted to a gas producer and any desirable temperature may be attained if a sufficient grate area is used; for this purpose long grates are unsatisfactory, wide grates or a large number of grates being preferable. During the remainder of the burning an ample supply of secondary air (introduced through openings above the fuel, supplemented, if desired, by one or more openings in the crown) is necessary. When the whole of the contents of the kiln have reached the desired finishing temperature the fires are allowed to die down, and if it is desired to cool the ware in a reducing atmosphere to avoid the production of a yellow tinge, all openings into the kiln should be closed completely as soon as the last lot of fuel added has given off its flame-producing constituents. In burning glazed stoneware the conditions must be oxidising throughout. The first stage in a glost kiln is rapidly passed and need seldom exceed 6 hrs. The temperature of the kiln is then raised as rapidly as possible compatible with uniform heating until the glaze is properly matured. This should occur 17—20 hours after the completion of the first stage, or 23—30 hours from the start, after which the fires should be allowed to die down and the kiln and its contents to cool. When there is no risk of reducing gases being produced all openings into the kiln are closed and the kiln is not opened until quite cool, as stoneware glazes craze easily.—A. B. S.

Porcelain; Black underglaze colours on ——. H. Fieth. Sprechsaal, 1919, 37—38. Chem.-Zeit., 1919, 43, Rep., 229.

THE production of black impressions on porcelain by means of finely ground, calcined pitchblende was extensively practised in Bohemia during the last century. The pigment was rubbed into an etched pattern on a metal plate, transferred by paper to the fired porcelain, and after carefully removing the paper, the impression was heated to decompose oily matter. The glaze was then applied, a calcareous glaze being most suitable for this purpose and superior to one with a basis of felspar or dolomite. Although the best results were obtained with the use of wood fuel, the process might be carried out successfully even under the disadvantages attaching to coal firing.—W. J. W.

Enamel ware; Acid test on ——. W. D. Collins. J. Ind. Eng. Chem., 1919, 11, 757—759.

TESTS were applied to 61 samples of white, grey, and blue enamel ware made by 26 different American manufacturers, by boiling 500 c.c. of 2—4% acetic acid (or in some cases 1% tartaric acid solution) in the vessel for 30 mins. The treatment with 4% acetic acid caused no loss of glaze in the case of about half the samples of white and grey ware, but most of the blue ware was considerably attacked by 2% acetic acid, the glaze being dissolved. No antimony was dissolved from 17 samples, whilst 34 vessels of white and grey ware yielded from 0·5 to 2 mgrms. of antimony. Lead was only found in the ware of one manufacturer. Fragments of enamel cracked off from several of the vessels when subjected to changes of temperature no more pronounced than an ordinary cooking vessel must receive.—C. A. M.

Coloured glasses; Influence of temperature on the transmission factor of ——. M. Luckiesh. J. Amer. Ceram. Soc., 1919, 2, 743—746.

THE transmission factor for total visible radiation of the coloured glasses examined—except two containing cobalt—decreased proportionately as the temperature increased. Hence, the transmission factor of coloured glasses appears to be a function of the temperature. The glass to be examined was cut into two pieces, one of which was maintained at 30° C., whilst the temperature of the other was gradually raised to 350° C. The relative transmission factors were then measured, the radiant or illuminant being a gas-filled Mazda lamp. No colour difference occurred other than that due to the change in the spectral transmission characteristic of the heated specimen.—A. B. S.

Sagger-mixture; Control of ——. V. S. Schory. J. Amer. Ceram. Soc., 1919, 2, 747—750.

MOST sagger-mixtures include one or more dense-burning or vitrifiable clays and one or more open-burning or refractory clays. To determine the best proportions for use in a given works a number of known mixtures were examined. Four of these contained clays which vitrified at or below cone 11 (1320° C., the regular sagger kiln heat at that works), combined with clay which after firing to cone 11 absorbed 6—10% of water. One mixture consisted of two clays which when burned had a low absorptive power, but were not vitrified at cone 11. The satisfactory mixtures showed absorptions between 2·5 and 4% (mean 3·25%). Unsatisfactory mixtures had absorptions greater than 4·5% or less than 1·5%. To test a new clay, it is mixed with a standard open-burning or vitrifying clay in such proportions that the absorption of the mixture, after firing to cone 11, is about 3·25%.—A. B. S.

Polarising microscope in ceramics; Applications of ——. A. B. Peck. J. Amer. Ceram. Soc., 1919, 2, 695—707.

A POLARISING microscope may be used for the examination of ceramic materials in the form of thin sections or of grains immersed in a fluid of known refractive index, and the size, form, colour, cleavage, fracture, vibration-directions, pleochroism, refractive index, double refraction, size of the optic angle, and extinction directions and angles of the various substances determined. The proportion of various substances present may often be estimated with sufficient accuracy. Thus, the per centage of any one of the four better known felspars in a sample of felspar can be roughly estimated by observing the proportion of material of a definite refractive index present. The proportion of each of two substances of identical chemical composition but different optical properties (cristobalite and quartz) can also be estimated. The proportion of free lime in Portland cement can be ascertained microscopically in several ways. The total amount of material required for an examination is very small, and the time occupied is far less than that required for chemical analysis. Microscopical examination is particularly useful for studying the various constituents of Portland cement, porcelain, glazes,

glasses, silica and other refractory bricks, sparking plugs and other electrical porcelains, etc.—A. B. S.

PATENTS.

Glass ware partially covered with enamel; Production of hollow ——. Allgemeine Elektrizitätsges., Berlin. Ger. Pat. 313,573, 11.1.18.

A GLASS tube is partially covered with an enamel slurry, and when the latter is dry the tube is blown into the desired shape in the customary manner, forming an article which is partly covered with a closely adherent enamel of great smoothness and high reflecting power. The enamel slurry may be so distributed on the tube that a series of enamelled hollow articles may be made in succession.—A. B. S.

Furnace for melting glazes and materials of similar melting point. M. Riess, Berlin. Ger. Pat. 312,630, 23.1.16.

THE melting chamber of the furnace has a dome-shaped base which serves as a cover for the combustion chamber of the furnace, the latter being disposed directly above a recuperator, consisting of a series of concentric vertical annular chambers. At the bottom of the melting chamber are openings connecting it with a trough running round the interior of the dome. The molten material flows into the trough, and is heated by the flames reflected from the arched roof. It is also tapped off from this trough.—J. W. D.

Firebricks, blocks, tiles, retorts, and other refractory articles and refractory cement; Manufacture of ——. C. H. Sankey, Chislehurst. Eng. Pat. 133,842, 19.12.18. (Appl. 21,315/18.)

FIREBRICKS and other refractory articles and cement are made by grinding waste refractory articles to powder, mixing them with sodium silicate diluted with water to form a workable paste, moulding this into the desired shape, and completing the manufacture in the usual manner. Any superfluous sodium silicate is stated to be driven off in the firing. (Reference is directed in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Act, 1907, to Eng. Pat. 376 of 1883.)—A. B. S.

Magnesite refractories; Method of manufacturing ——. R. D. Pike, San Francisco, U.S.A. Eng. Pat. 133,753, 14.10.18. (Appl. 16,742/18.)

SEE U.S. Pat. 1,312,871 of 1919; this J., 1919, 723 A.

IX.—BUILDING MATERIALS.

Plaster; Colloidal processes in the setting of ——. *Structure of plaster of Paris.* J. Traube. Kolloid Zeits., 1919, 25, 62—66.

THE rate of setting of the hemihydrate of calcium sulphate when mixed with stated quantities of solutions of various substances has been investigated. Ten grammes of calcium sulphate mixed with 4 c.c. of $N/2$ potassium chloride set instantaneously, with 5 c.c. in 2·5 mins., with 7 c.c. in 4 mins., and with 15 c.c. had not set in 40 mins. Using 7 c.c. of saturated potassium chloride, setting occurred in 12 mins., with 7 c.c. of $N/2$ 4·5 min., with 7 c.c. of $N/4$ 5·5 mins., and with 7 c.c. of $N/16$, 19 mins. With other salts the order in which the cations influences the setting is the reverse of the order in which they coagulate colloids; thus univalent cations accelerate the setting most. The setting of the hemihydrate of calcium sulphate consists in combination with water through a gel formation. Acids affect the velocity of setting in the following order: hydrochloric, oxalic>sulphuric>trichloroacetic, tartaric>boric>phosphoric, dichloroacetic>acetic>propionic acid>citric acid. Potassium hydroxide has about the same effect as hydrochloric acid. Non-conductors such as chloral hydrate, amyl alcohol, propionitrile, mannitol, paraldehyde, methyl alcohol, and methyl ethyl ketone have no influence on the velocity of setting. Structures of the nature of the protoplasm structure, agate structure, and others both of geological and physiological interest are obtained by allowing two reacting substances (*e.g.*, ferric chloride and potassium ferrocyanide) to diffuse into the set plaster in opposite directions. (See also J. Chem. Soc., Dec., 1919.)—J. F. S.

Tri-calcium aluminate; Colloidal ——. A. J. Phillips. J. Amer. Ceram. Soc., 1919, 2, 708—742.

ON the first addition of water to tri-calcium aluminate there is an evolution of heat, due to the formation of an exothermic hydrate, the rise in temperature depending on whether the aluminate has previously been protected from moist air. In aerated cements the absence of heating favours the solution of calcium sulphate. There is also a disturbance in the equilibrium of the breaking down and re-forming of water-molecules which causes an evolution of heat. The resulting heat-effect will be zero or negative if there is a sufficient concentration of positive ions to disperse the hydrated aluminate as fast as it is formed, as this dispersion, involving an increase in the surface of the material, is accompanied by absorption of heat. Any ionic activity is confined to the surface of the colloidal gel until the film first formed is broken by the mixing tool. Calcium hydroxide increases the dispersion of the aluminate, but does not prevent the occurrence of a "flash set"; on working the paste for several minutes, however, a considerable retardation in the time of set was noted. A pat of aluminate with 80% of water became hard enough to support a Gilmore needle in four hours, but when lime-water was substituted for distilled water the initial set was not attained in 48 hours. On greatly increasing the percentage of calcium hydroxide the setting time was reduced—in one case to 1¾ hours—due to increasing the ion-concentration to above the adsorptive capacity of the aluminate for positive ions. The effect of calcium sulphate—added as gypsum or plaster—in the presence of a large excess of water is to increase the amount of material which settles out and to change its character. With 25% of water the addition of a small amount of plaster causes the initial set to occur sooner (*i.e.*, in 1—2 mins.). The second acceleration of the setting due to the neutralising action of the negative ions does not occur to such an extent with gypsum as with plaster. When more than 15% of plaster is present, both the initial and final sets are retarded, the interval between them sometimes being as high as 50 mins. The retardation is due to the adsorption of un-ionised sulphate by the colloidal aluminate which effects a kind of dispersion known as salt-peptisation. With normal pastes containing plaster or gypsum but no calcium hydroxide, at the lower concentrations there was a notable evolution of heat before setting. With 2—4% of plaster a smooth paste could not be obtained, but when 2% of calcium hydroxide was added a plastic paste was obtained with all concentrations of sulphate. With 10% or more of plaster or gypsum, the evolution of heat was very noticeable about 3 mins. after the initial set, showing that the heat evolved was the result and not the cause of the coagulation of the gel. There appears to be no connection between a maximum evolution of heat and the time of the initial set. Fine plaster retards the setting more than the coarser material, particularly in the presence of calcium hydroxide. Pats of aluminate were not visibly affected by immersion in cold water for a week, nor did they become soft after exposure to steam for five hours. With less than 10% of plaster or gypsum fine

cracks developed, but pats with more than 10% of plaster or gypsum were sound and hard. The pats used to show the effect of very finely ground plaster were sound in cold water, but afterwards developed radial cracks, especially in the coarser samples. Gypsum crystals were present in all the hardened pats. In the pats containing coarse plaster the aluminate grains had dark centres of unhydrated material, then a ring of hydrated material, and around this the gypsum crystals. With the finer plaster the unhydrated cores were less, and the gypsum crystals were scattered through the gel. Hence the finer plaster resulted in an increased adsorption and a better dispersion of the aluminate. —A. B. S.

Cement; Rapid testing of the strength of ——. H. Nitzsche. Tonind.-Zeit., 1919, 43, 1009.

Ten prisms of the cement to be examined are made simultaneously in a grid-shaped iron mould mounted on a marble slab. Each test-piece measures 15×22·5×180 mm. The load is applied to the middle of the test-prism, the width of the loading piece at the point of contact being 15 mm. The bending stress, $k=4444P$ kilos. per sq. cm. when the prism is laid on its side and $2963P$ kilos. when it is laid on edge, P being the load in kilos. This method is easy and of wide application. The parts of the prisms which come into contact with the pressing device and with the supporting knife edges are moulded in contact with glass plates which are afterwards removed. The load consists of a vessel gradually filled with shot.—A. B. S.

[*Vitrified*] *clinker bricks from calcareous clay; Production of* ——. H. Jordt. Tonind-Zeit., 1919, 43, 627—628.

The difficulties usually experienced in making vitrified bricks from some clays containing calcareous materials or "duff" may be overcome by first drying the clay in a rotary drum, grinding it, adding 10% of grog made of broken bricks, pressing the powder in a hydraulic press, and firing the bricks in a tunnel oven.—A. B. S.

Polarising microscope. Peck. *See* VIII.

Patents.

[*Slag*] *bricks, building and paving blocks, slabs, and tiles; Manufacture of* ——. H. Alexander, Leeds. Eng. Pat. 133,745, 11.10.18. (Appl. 16,619/18.)

Bricks made of sand, slag, or other non-plastic material and lime, made and moulded in the customary manner, are placed in chambers made of ferro-concrete or like material and hardened by exposure to superheated steam at a pressure of only 5—10 lb. per sq. in. above atmospheric pressure, or they may first be subjected to saturated steam at a low pressure and afterwards to superheated steam at a temperature equal to that of saturated steam at 120 lb. per sq. in. pressure, the saturated steam being at only 5—10 lb. per sq. in. pressure. The steam may be derived from the exhaust pipe of an engine and superheated by the waste heat from a boiler. Steam at low pressure avoids the use of costly hardening chambers built to withstand the high pressure (120 lb. per sq. in.) usually employed, with their disadvantages, and reduces the cost of installation and upkeep.—A. B. S.

Monolithic structures; Material for making ——. *Material for closing off water in oil-wells.* B. B. Grunwald, Redwood City, Cal., Assignor to National Magnesia Manufacturing Co. U.S. Pats. (A) 1,318,075 and (B) 1,318,076, 7.10.19. Appl., 18.6.17.

(A) The material consists of a wet mixture of magnesia, magnesium chloride, and dead-burned and raw finely divided magnesite. (B) A material for sealing off water in an oil-well consists of a mixture of magnesia cement, dead-burned and raw finely divided magnesite, and a calcium salt. —A. B. S.

Binder for mortar; Production of a ——, *from anhydrite.* F. Hartner, Bad Homburg. Ger. Pat. 312,239, 19.7.17.

Powdered anhydrite is mixed with a small proportion of alkali. The addition of 2·5% of calcium hydroxide reduces the setting time to 4—7 hours, and test-pieces made of the mortar show a tensile strength after 24 hours of 7—8 kilos. per sq. cm.; after 3 days of 12 kilos. per sq. cm.; after 7 days of more than 20 kilos. per sq. cm.; and after 30 days nearly 30 kilos. per sq. cm. Slaked lime, or any material which forms it, such as Portland cement, overburned lime, and calcareous wastes, including old mortar or concrete, may be used. —A. B. S.

Cement; Preparation of the raw material for ——. G. Polysius, Dessau. Ger. Pat. 312,264, 24.11.17.

The raw mix is moistened or sprinkled with water or a saline solution just as it is entering the kiln. —A. B. S.

Wood substitutes; Manufacture of ——. Soc. Convert-Villejean, Lécorché et Cie., St. Florentin, France. Eng. Pat. 126,623, 5.5.19. (Appl. 11,166/19.) Int. Conv., 2.5.14.

A mixture of sawdust from wood or cork, peat, turf or the like, 100 parts, calcined magnesia 40 parts, and magnesium chloride solution (sp. gr. 1·230) 40 parts by weight is compressed in moulds and then heated under pressure to a temperature not exceeding 300° C. The agglomerate so produced sets quickly and is very strong.—A. B. S.

Rotary kilns. Ger. Pat. 313,211. *See* I.

Refractory cement. Eng. Pat. 133,842. *See* VIII.

Porous slag. Ger. Pat. 313,018. *See* X.

Buildings for explosives. Ger. Pat. 313,764. *See* XXII.

X. METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron; Recrystallisation of ——. P. Oberhoffer and W. Oertel. Stahl u. Eisen, 1919, 39, 1061—1067.

The deformation and recrystallisation of iron was studied by means of hardness determinations and microscopical examination, including measurement of the grain size. The temperature of recrystallisation was found to depend on the amount of previous deformation, being lower as that amount increased. The rate of grain growth also depends to a large degree on the amount of deformation. With a large amount of deformation the growth of the grains was slow up to about 700° C. and then rapid, while with a slight amount of deformation the rate of growth after its inception was extraordinary rapid. The influence of the time factor was small. Hardness determinations showed a difference from the results of microscopical examination, which would appear to indicate a further change taking place during crystallisation to that observed by the microscope. The hardness of recrystallised iron, however, appears to be independent of the grain size.—J. W. D.

Electrical furnaces in the steel industry. Report of the Electrical Furnace Committee of the Assoc. of Iron and Steel Electrical Engineers, U.S.A. Blast Furnace and Steel Plant, 1919, 2, 498—499.

The type of furnace principally used is some form

of arc furnace, the induction type not having been developed to any great extent. Refining of molten steel previously prepared in an open-hearth or other furnace results in increased output and reduced costs, without any reduction in quality of the product. Furnaces are giving satisfactory service on both 25- and 60-cycle currents, but the former gives a considerably better power factor owing to reduced magnetic losses and decreased heating and inductive effects in the circuits. The largest furnace in use on 60-cycle current is rated at 15 tons capacity. Furnace capacity is limited by the amount of power per electrode which can be handled, and 3000 kw. seems to be a maximum for a three-electrode furnace. For this reason a furnace of 30 tons capacity is considered as large as is advisable at present. For installations requiring cold melting, furnaces of 1—10 tons capacity have been adopted. Auxiliary equipment used with electric furnaces has been well standardised, and with the exception of the smaller sizes most furnaces are operated by means of motors.—C. A. K.

Manganese in steel; Modification of the Reddrop and Ramage method for determination of ——. P. L. Robinson. Chem. News, 1919, **119**, 187—188.

In Reddrop and Ramage's method 1—1·5 grms. of the sample is dissolved in boiling nitric acid, the solution is cooled, and carbonaceous matter oxidised by adding 1—1·5 grms. of sodium bismuthate, and boiling the solution until a precipitate of hydrated manganese dioxide forms. The precipitate is dissolved by adding a few drops of sulphurous acid and again boiling, after which the manganese is oxidised to permanganate by means of 1—1·5 grms. of sodium bismuthate, the solution is filtered through asbestos with the aid of a pump, and titrated with $N/10$ ferrous ammonium sulphate and $N/10$ permanganate. If the carbonaceous matter be oxidised by adding 5 c.c. of ammonium persulphate (120 grms. per litre) immediately after solution of the sample and boiling for 5—10 mins., subsequent addition of sulphurous acid is rendered unnecessary, and the final oxidation with bismuthate may be proceeded with at once, using the hot solution. Reduction is, however, still necessary if the steel contains chromium. The modified method gives results identical with the original method for steel and ferromanganese.—T. H. Bu.

Phosphorus; Determination of —— *in steel containing vanadium.* J. Maitchell. Chem. News, 1919, **119**, 212—213.

Two grms. of the steel is dissolved in 90 c.c. of nitric acid (sp. gr. 1·2), and the solution boiled until free from nitrous fumes, and then treated with $N/10$ permanganate solution until a permanent precipitate of manganese dioxide is obtained. The flask is cooled to below 20° C. (to prevent precipitation of vanadium with phosphomolybdate), and $N/10$ ferrous ammonium sulphate solution added until the precipitate has dissolved and the solution has become bright green without trace of blue. An excess of 1 c.c. is then added; any large excess beyond that required to reduce the vanadic acid to the hypovanadic condition tends to give low results. After the addition of 20 c.c. of ammonia solution (sp. gr. 0·96), the flask is shaken in the water bath below 20° C. until the precipitated ferric hydroxide has redissolved, when the liquid is treated with 60 c.c. of a very slightly ammoniacal solution of ammonium molybdate, and the flask closed and vigorously shaken for 3 mins. It is then uncorked and allowed to stand for 20—30 mins., after which the phosphomolybdate is separated, washed free from acid, dissolved in excess of standard sodium hydroxide solution, and the excess titrated with standard sulphuric acid, with phenolphthalein as indicator.—C. A. M.

Silicon; Limit of combination of —— *with some metals of the iron group.* A. Sanfourche. Rev. Mét., 1919, **16**, 239—245.

The combinations containing the highest percentage of silicon which the metals of the iron group are capable of forming, show a tendency to partial dissociation, with liberation of free silicon, leaving a compound which may or may not contain definite proportions, but is less rich in the metalloid. Only in the presence of excess of free silicon are such combinations stable. The upper and lower limits of combination only exceptionally correspond to definite compounds. In the case of iron it is almost certain that the upper limit corresponds to the compound $FeSi_2$. For manganese, cobalt, and nickel the limits do not correspond to definite compounds. It is probable that dissociation of ferrosilicons goes on in the cooled-down alloys. The proportion of free silicon is not the only factor influencing the limits of combination; the duration of heating at a high temperature, rate of cooling, annealing, etc., also exert an influence.—T. H. Bu.

Copper-silicon alloys. A. Sanfourche. Rev. Mét., 1919, **16**, 240—256.

The alloys were made from electrolytic copper and crystallised silicon in a carbon resistance furnace and cast into porcelain tubes. The equilibrium diagram may be divided into three regions, the first being from 0 to 8·6% Si. Alloys from 0 to 5% Si are characterised by α mixed crystals. Above 5% Si β constituent appears and increases in proportion until from 8 to 8·5% Si it is the sole constituent. α-Crystals alone show no transformation after solidification. β-Crystals show two such transformations. The second region is from 8·6 to 12·1% Si. Above 8·6% Si a third series of mixed crystals (γ) are deposited. At 10% Si these γ-crystals solidify as a eutectic mixture with δ-crystals, which from 11·25 to 12·1% Si are deposited alone. Each of these solutions undergoes a transformation after solidification. Above 12·1% Si the deposition of δ-crystals continues, but mixed with ε-crystals. At 15·75% Si there is a eutectic, the alloy solidifying at the single point 801° C. The eutectic persists up to 16·5% Si. Beyond this point the last branch of the liquidus extends to the freezing point of Si and primary silicon first crystallises out. Above 16% Si the δ-crystal transformation occurs, and is explained by the progressive disappearance of the ε phase on cooling. All the alloys above 12% Si undergo slow transformations with an increase in volume and tendency to break into fragments. The single maximum in the liquids at 12·1% Si agrees with the formula Cu_3Si, which is the composition of the δ-crystals. The γ-crystals correspond to the formula $Cu_{15}Si_4$, which requires a concentration of 8·6% Si and corresponds to the point which marks the separation of β and γ crystals. These two formulæ probably represent limiting solid solutions.—T. H. Bu.

Copper and cold-worked brasses; Ball (Brinell) hardness of ——. A. Portevin. Rev. Mét., 1919, **16**, 235—238.

The object of the investigation was to determine if the Brinell ball test on copper and industrial brasses, cold-worked to different degrees, indicates the degree of working and permits an approximate evaluation of the other mechanical properties. The materials examined were cold-rolled electrolytic copper, 90/10 brass for bullets, and 70/30 brass for cartridges. The degree of working varied from 5 to 300%. The first tests were made with 10 mm. balls with 500 kilo. load, but fearing false results from the thinness of the specimens, a 3·18 mm. ball with 30 kilo. load was afterwards adopted. In all three cases considerable hardening was produced by a relatively small reduction and subsequently a very

small increase in hardness with increasing working. No relation was found between the ball test and the breaking strength. The hardness curves rather resemble those representing the elongation. The multiplicity of coefficients for expressing the degree of working is deprecated.—T. H. Bu.

Aluminium alloys; Heat treatment of ——. Grard. Comptes rend., 1919, **169**, 571—574.

The mechanical properties of cold-worked duralumin as a function of the temperature of heating after working and the subsequent rate of cooling have been studied. The mean composition of the alloy used was Cu 3·5—4%, Mg 0·5%, Mn 0·5—1%, the remainder being aluminium with impurities. The cold-worked alloy was heated in an oil bath or a salt bath, rising by steps of 50° to 500° C., and was then cooled slowly (100° per hour) or in air or by quenching in water. Tests showed that molecular modifications took place for 8 days, after the two last methods of cooling, being most pronounced after quenching in water, but there was no subsequent change after the first method of cooling. After 8 days the mechanical properties remained sensibly constant. Curves are given showing the mechanical properties as a function of the quenching temperature, the tests being made 8 days after quenching. These show maxima at 350° and 475° C. for elongation and resilience, and a minimum at 350° and a maximum at 475° for other properties (tensile strength, elastic limit, hardness). The best softening treatment consists in heating to 350° C., followed by slow cooling. This is the practical industrial treatment most suitable for drawing, setting up operations, etc., resulting in a minimum of waste, and maximum work and conservation of tools. The maximum tensile properties are given by heating to 475° C. and quenching in water. The best treatment is said to be double quenching from 475° C.—T. H. Bu.

Metals; Pickling and electrolytic oxidation of ——. L. Revillon. Rev. Mét., 1919, **16**, 257—268.

Chemical processes for the superficial coloration of iron and copper have been superseded by more efficient electrolytic methods. In the case of iron or steel articles electrolysis takes place in a bath composed of a solution of iron oxide in concentrated alkali. As the cathode, the article first receives a deposit of pure iron, any oxide being reduced. It is then converted into the anode and oxidised through a range of colours to the black magnetic oxide. The apparatus includes the electrolytic cell, wash bath, oil bath, and drying stove. The bath should be protected from the air. The operation is simple and there is little waste. The two phases of the operation only take about 8 minutes. When dealing with a large number of articles mechanical devices are used for introducing them into and removing them from the bath. The total cost per sq. m. treated per day is given as 1·35 francs. In the blackening of copper a finishing acid bath is recommended. The black oxide coating on iron is very hard, especially after exposure to daylight for several days. For pickling ferrous metals the method is recommended of making the article first the cathode, then the anode, and then the cathode again. The metal is then suitable for drawing purposes. The process may be applied to oxidised and rusted surfaces. The electrolytic "bronzing" of ferrous metals has been applied to rifle parts etc. for producing a good finish and protecting the pieces of mechanism. The process is replacing painting and varnishing, and the colours are resistant to fairly high temperatures and do not scale. The black coating of copper is integral with the metal and resists acid vapours and sea atmosphere. —T. H. Bu.

Lead plating from fluoborate solutions. W. Blum, F. J. Liscomb, L. Jencks, and W. E. Bailey. Trans. Amer. Electrochem. Soc., 1919, 101—122. [Advance copy.]

For commercial lead plating (on iron etc.) from fluoborate solutions, with lead anodes, the following conditions are recommended:—For thin deposits (0·125 mm. or less), satisfactory results are obtained with a solution in which the concentrations of lead, total fluoboric acid, and excess boric acid are $N/1$, $1·5\ N$, and $N/5$ respectively. Such a solution would contain basic lead carbonate 129, hydrofluoric acid (100%) 120, boric acid 100, and glue 0·2 grms. per litre, and would have sp. gr. about 1·17. For heavy deposits (up to 1·25 mm. or more), or when operating without any addition agent (glue), stronger solutions up to twice the above concentration (sp. gr. about 1·34) should be employed. Occasional small additions of glue are required when the deposits show any tendency to roughness or "treeing." For general work the most satisfactory results are obtained with maximum current densities of 2 and 3 amp. per sq. dm. in dilute and concentrated solutions respectively. The voltage required for any current density is comparatively low and rarely exceeds 1 volt. Except when plating in a restricted volume or on the inside or outside of a cylindrical surface, mechanical agitation is not necessary; occasional stirring to keep the solution uniform is all that is required. Heating the solution is not advantageous; if heating above 40° C. is produced by the current employed, the solution should be cooled. Sand-blasting of the surface to be plated is essential if the deposits are required to withstand elevated temperatures (as in chemical equipment), and in any case is preferable to "pickling." The latter, if used at all, should only continue for the shortest possible time. The thickness of lead required to produce an impermeable coating when tested with ferricyanide (ferroxyl reagent) depends on the character of the initial surface and the structure of the lead deposit. Under favourable conditions, especially from solutions containing glue, a thickness of 0·075 mm. is sufficient; but 0·125 mm. is recommended. A thickness of 1·25 mm. or more may be necessary if the lead coating is required to withstand corrosive liquids. —W. E. F. P.

Quicksilver; Fume and other losses in condensing —— from furnace gases. L. H. Duschak and O. N. Schuette. U.S. Bureau of Mines, Tech. Paper No. 96, 1919, 28 pages.

Experiments were made on a Scott furnace of 60 tons and two of 50 tons daily capacity. The usual methods of fume sampling could not be used owing to the large amount of water mist present in the stack gases. In the sampling apparatus described, the gas passed through a glass sampling tube, a short Liebig condenser, a water-cooled bead tower, a Hawley filter, a wash bottle, and a small gas-meter to a water-jet pump. The sample was taken at a point in the flue system beyond which the amount of mercury recovered was negligible. The velocity of the gas entering the sampling tube was roughly that of the gas stream in the flue. The flue gas volume was determined by injecting hydrogen sulphide at the lower end of the flue and detecting by chemical means its appearance at the end of a measured length of flue. The losses are very small and are found to be related to the form of the condenser used. The baffling effect in the brick or stone condenser system is considerably more effective in recovering mercury than an increase in condenser volume. Baffles consisting of vertical strips of wood might be used. The gas volume should be as small as possible. The most efficient way of recovering all mercury in suspension would be by electrical precipitation. Water losses and

other sources of loss, *i.e.*, from gas leakage, absorption, and mechanical losses, are discussed. Although the measured losses are only a few per cent. of the plant output, they must be taken as minimum. The results show there are no inherent difficulties that prevent the recovery of 96 to 99% of the mercury vapour entering the condenser system.— T. H. Bu.

PATENTS.

Steel; Process of manufacturing electric ——. J. McConnell, Chicago, Ill. U.S. Pat. 1,318,164, 7.10.19. Appl., 31.3.19.

MOLTEN steel produced by the open-hearth, Bessemer, or other process is poured into a suitable container and subjected to electrical treatment. Alloys may be added while the metal is being poured, prior to the electrical refining.—C. A. K.

Alloy steel and heat treatment of same. Stahlwerke R. Lindenberg A.-G., Remscheid-Hasten. Ger. Pat. 299,192, 15.7.15.

THE steel contains 0·32—0·48% C, 1·0—1·25% Mn, 0·5—1·5% Si, and 0·75—1·0 Cr, the chromium sometimes being replaced by tungsten, molybdenum, vanadium, or a mixture of these elements not exceeding 2·0%. It is heated above its critical range, oil quenched and suitably tempered.—J. W. D.

Iron; Production of ——. Stahlwerke R. Lindenberg A.-G., Remscheid-Hasten. Ger. Pat. 300,732, 4.10.16.

DURING the melting process chromium, tungsten, molybdenum, or other metal is added to mild steel in suitable amounts—for example, 0·3—1·0% Cr—in order to increase the fineness of grain and the elastic limit of the metal. The iron produced is specially suitable for the manufacture of screws, nuts, etc., in machines working automatically.
—J. W. D.

Steel; High-speed — — containing no tungsten. Stahlwerke R. Lindenberg Akt.-Ges., Remscheid-Hasten. Ger. Pat. 309,175, 27.1.16.

A SUBSTITUTE for tungsten steel which can be rapidly worked without developing cracks contains 0·5—0·8% C, 0·2—0·4% Mn and Si, 6·0—10·0% Mo, and 3·0—6·0% Cr.—L. A. C.

Ingot-iron and steel; Use of calcium carbide as the deoxidising agent in the manufacture of ——. Deutsch-Luxenburgische Bergwerks- und Hütten-Akt.-Ges., Bochum. Ger. Pat. 300,012, 7.8.15.

CALCIUM carbide may be employed as a substitute for ferromanganese in the manufacture of steel provided that during the refining process at least 0·2% of manganese remains in the mass.—L. A. C.

Ingot iron and steel; Use of calcium cyanamide as deoxidising agent in the manufacture of ——. S. Zuckschwerdt, Berlin-Lichterfelde. Ger. Pat. 300,764, 16.4.16.

AN alkaline-earth (calcium) cyanamide is more reactive than calcium carbide as a deoxidising agent in the manufacture of steel—L. A. C.

Iron; Electrolytic deposition of —— from ferrous sulphate solutions. M. Schlötter, Berlin-Wilmersdorf. Ger. Pat. 309,271, 1.12.17.

A SOLUTION containing 150 grms. of ferrous sulphate and 100 grms. of sodium sulphate per litre is treated with sufficient sodium carbonate to neutralise any free sulphuric acid adhering to the sulphate and electrolysed at or near its boiling point by a current of about 20 amps. per sq. dm. Iron of high purity and containing little free hydrogen is deposited. The use of ferrous sulphate has the advantage that the electrolysis may be effected in lead-lined vessels, and lead pipes may be employed for conveying steam into the solution.—L. A. C.

Iron and steel; Prevention of rusting or oxidation of ——. L. S. Chadwick, East Cleveland, and M. Resek, Cleveland Heights, Assignors to The Cleveland Metal Products Co., Cleveland, Ohio. U.S. Pat. 1,317,351, 30.9.19. Appl., 6.2.17.

A RUST-RESISTING coating for iron and steel contains a metal other than iron, a phosphate of a metal other than iron, and a metallic sulphide.
—J. W. D.

Alloy; Rust-resisting ferrous ——. L. T. Richardson, Milwaukee, Wis., and E. A. Richardson, Cleveland, Ohio. U.S. Pats. 1,317,592 and 1,317,593, 30.9.19. Appl., 3.6.18.

THE alloy contains a combined percentage of from 1·5 to 4·0 of copper, chromium, and manganese, in which the amount of each metal is from 0·5 to 2%. The combined effect of those metals in ameliorating the corrosion-resisting properties of iron is more pronounced than the effect of one of the metals used alone, and the chromium and manganese counteract the injurious effect of the copper on the malleability of iron.—J. W. D.

Coating iron and steel with lead; Contact process for ——. Berlin Burger Eisenwerk A.-G., Berlin. Ger. Pat. 313,258, 20.6.18.

A COMPOUND such as lead peroxide is added to the coating bath. The oxygen evolved on decomposition combines with the hydrogen formed and thus, by preventing polarisation, enables a smooth coating on the metal to be obtained.—W. J. W.

Lead coatings of vessels; Method for increasing the mechanical resistance of soft ——. F. Schüler, Frankfort. Ger. Pat. 313,657, 19.4.18. Addition to Ger. Pat. 288,572.

THE resistance of lead coatings treated as described in the chief patent (this J., 1916, 365) is further increased by applying a layer of the artificial or natural stone to the surface of the lead.—L. A. C.

Ore concentrates, fines, slimes, dust, and the like; Process of treating ——. O. Reece, Sydney, N.S.W. Eng. Pat. 120,041, 7.10.18. (Appl. 16,325/18.) Int. Conv., 18.9.17.

THE material is mixed dry with a binding and fluxing agent (*e.g.*, magnesite, dolomite, or sulphur), damped, and pressed into briquettes. The briquettes are hardened by subjecting them to the action of steam under pressure, and are then smelted in a blast furnace.—C. A. K.

Metals; Separation and refining of ——. G. Haglund, Christiania. Eng. Pat. 121,591, 12.11.18. (Appl. 18,495/18.) Int. Conv. 19.12.17.

A MIXTURE of two or more metals in granular form (*e.g.*, copper-nickel matte) is treated with an acid solution (sulphuric acid) until a neutral solution of the metal sulphates is obtained. The neutral solution is allowed to remain in contact with excess of the granular material until all the copper is precipitated by the more electro-positive metal, and a pure solution of nickel sulphate is obtained. This solution is electrolysed in a diaphragm cell, using insoluble anodes, whereby nickel is deposited on the cathode, and sulphuric acid is formed at the anode. The anode liquor is used for the extraction of a further quantity of the matte.—C. A. K.

Alloy containing manganese. Stabilimenti "Biak"-Ing. A. Pouchain, Turin, Italy. Eng. Pats. (A) 133,362, 20.6.18; and (B) 133,605, 20.3.19. (Appls. 10,209/18 and 6986/19. (A) Int. Conv., 9.3.18.

(A) A COPPER-ZINC alloy of the type known as 60/40, containing less than 33% Zn, in which a proportion of the zinc is replaced by manganese (over 5%), iron (0—6%), and at least one of the metals Al (1·5—4%), Mg (traces—2%), Ni (traces—10%), and

Ti (traces—6%), which together do not exceed the percentage of manganese. A suitable composition comprises 61% Cu, 10·7% Mn, 2·3% Fe, 0·37% Ni, 3·6% Al, 0·5% Ti, and the remainder zinc. This alloy possesses approximately a tensile strength of 68 kilos. per sq. mm., and 23% elongation. (B) Maximum extension is given when the alloy contains 2% Al, and maximum tensile strength with a 3% Al content.—C. A. K.

Alloy. Stabilimenti "Biak"-Ing. A. Pouchain, Turin, Italy. Eng. Pat. 133,363, 20.6.18. (Appl. 10,210/18.) Int. Conv., 16.3.18.

An alloy possessing high mechanical, chemical, and electrical resistance contains 35—44% Cu, less than 4·75% Fe, 2—6% W or Ti, the remainder being nickel. Alloys of such composition have a tensile strength of about 55 kilos. per sq. mm., and an elongation of about 20%. They are very resistant to corrosion.—C. A. K.

Light alloy for parts subjected to high temperatures. Aluminium alloy. Stabilimenti "Biak"-Ing. A. Pouchain, Turin, Italy. Eng. Pats. (A) 133,372 and (B) 133,373, 22.7.18. (Appls. 11,946 and 11,947/18.) Int. Conv., 2.3.18.

(A) An aluminium alloy of considerable mechanical strength and resistance to high temperatures contains 1—7% Fe, 1½—9% Co, 2—7% Mn, and 2—7% Ni. (B) An alloy containing 70—87·5% Al, 0·5—3% Ti, 12—29% Zn, 7—8% V, and 3—9% Cu.
—C. A. K.

Mineral selective and frothing agent, and processes of producing and using the same. E. C. R. Marks, London. From Luckenbach Processes Inc., San Francisco, U.S.A. Eng. Pat. 133,498, 4.11.18. (Appl. 18,028/18.)

The grease-wood shrub, an evergreen shrub of the goosefoot family, occurring throughout the arid regions of the United States, is macerated and boiled in an alkaline solution, preferably caustic soda, until the consistency of the pulp resembles that of thick molasses. The mixture is thinned to the consistency of milk for use as a flotation agent. Sulphuric acid may be used in place of alkali in the digestion process, but the resulting product requires a proportion of additional frothing agent (*e.g.*, creosote) to increase its flotation qualities.
—C. A. K.

Mineral selective agent, and methods of producing and using same. E. C. R. Marks, London. From Luckenbach Processes Inc., San Francisco, U.S.A. Eng. Pat. 133,277, 4.11.18. (Appl. 14,332/19.)

Separation of minerals, particularly those adaptable to flotation processes, is effected by a solution of rubber in carbon bisulphide or a hydrocarbon solvent (*e.g.*, "near turpentine," a petroleum distillate), in the presence of a frothing agent, such as the extract of the grease wood plant (see preceding abstract). It is preferred to add the mineral selective agent and the frothing agent to the pulp separately, and an oil (*e.g.*, petroleum) which in itself is a good selective agent, may be used to reduce the quantity of the rubber solution necessary for effective separation.—C. A. K.

Flotation of minerals; Selective ——. A. Schwarz, Joplin, Mo., Assignor to Metals Recovery Co., New York. U.S. Pat. 1,317,945, 7.10.19. Appl., 5.6.18.

Lead and zinc sulphides are separated from ore pulps containing them by mixing with the pulp a small amount of a phenol and of a resin soap solution and subjecting the non-acid pulp to a flotation operation whereby the lead sulphide is removed. The ore pulp is then rendered acid and subjected to a second flotation operation whereby the zinc sulphide is removed.—J. W. D.

Wires and tubes of two metals; Manufacture of ——. E. Martin, Brussels. Eng. Pat. 133,859, 8.1.19. (Appl. 607/19.)

A solid or hollow steel billet is introduced into a jacket of covering metal formed by the stamping of a plate of copper on one face of which has been welded by pressure a sheet of a composite metal formed by rolling together two plates of brass between which are placed a plate of an alloy of copper with about 3% of a higher melting point metal, such as nickel, and a sheet of a lower melting metal, such as silver. The billet and the jacket are welded together by compression and subsequently rolled and finished by the usual means.
—J. W. D.

Tin and terne plates and other like metal-coated sheets; Manufacture of ——. H. S. Thomas, Llanduff, and W. R. Davies, Whitchurch. Eng. Pat. 133,868, 21.1.19. (Appl. 1490/19.)

Oil used in the manufacture of metal-coated plates is heated in the settling tanks after use, whereby a more rapid settling of mechanical impurities is secured; or the mechanical impurities may be separated by centrifugal means or by filtration.
—C. A. K.

Anodes for use in electro-plating. J. Schledorn, Ozone Park, N.Y., U.S.A. Eng. Pat. 133,882, 19.2.19. (Appl. 4128/19.)

An anode comprises a lead plate containing a number of apertures, which are progressively smaller from the outer edge to the centre. A substantial coating of a metal (*e.g.*, copper) is applied by electro-deposition, the coating being thicker in the vicinity of the larger holes, which allow a more rapid circulation of the electrolyte.
—C. A. K.

Electroplating; Method of and apparatus for ——. M. F. Davoran, Assignor to Crane and Breed Manufacturing Co., Cincinnati, Ohio. U.S. Pats. 1,318,053 and 1,318,054, 7.10.10. Appl., 3.8.17 and 12.8.18.

The article to be plated is cleansed in caustic soda solution, rinsed, plated, the adherent electrolyte recovered, and a hot blast applied, all during its continuous travel. The apparatus comprises a plating tank, with cathode-bars extending lengthwise through it at different levels. The articles to be plated are contained in suspended carriers, which are caused to travel between the cathode-bars.—A. E. D.

Solder composition. A. Seracchi, Geneva, Switzerland. Eng. Pat. 133,900, 1.4.19. (Appl. 8210/19.) Int. Conv., 10.1.19.

A solder composition comprising 98% of lead, 1% of tin sulphide, and 1% of lead acetate.—J. W. D.

Ore washer; Magnetic ——. E. W. Davis, Duluth, Minn. U.S. Pat. 1,317,557, 30.9.19. Appl., 25.4.17.

Electro-magnets are arranged beneath an inclined trough with a pole piece extending above the bottom of the trough. Ore is fed into the trough and scrapers are fitted to sweep the pole piece and the bottom of the trough. The discharge is at the upper end, the lower end serving as an overflow.
—C. A. K.

Magnetic separator. J. G. Sekinger, Ford City, Pa., Assignor to The Pittsburgh Plate Glass Co., Pittsburgh, Pa. U.S. Pat. 1,317,992, 7.10.19. Appl., 21.7.15. Renewed 27.8.19.

A pair of horizontal pole pieces in alinement and

spaced apart, have oppositely inclined end faces forming a passage way tapering downwards. The bottom faces are horizontal and form an acute angle with the inclined end faces. The poles are energised by suitable windings and material to be treated is fed on to the inclined faces of the pole pieces.—C. A. K.

Magnetic separator. Donnersmarckhütte Oberschlesische Eisen- u. Kohlenwerke A.-G., Hindenburg. Ger. Pat. 311,916, 19.7.18. Addition to Ger. Pat. 311,387 (this J., 1919, 542 A).

A SEPARATE belt runs under the magnet pole faces and is separated from the feed belt by a gradually reduced distance, with the result that the principal part of the gangue is removed at the commencement of the process and any disturbance of the magnetised material by further working is eliminated.—J. W. D.

Filter for cyaniding systems. A. F. Tanner, Greenfield, Wis., Assignor to Ideal Continuous Cyaniding Process Co., Davenport, Iowa. U.S. Pat. 1,317,835, 7.10.19. Appl., 10.2.15.

THE filter consists of a trough with an inclined bottom and a trunk projection extending upwards at one end, means for filling the trough with liquid, and a decantor pipe at the lower end of the trough which can be moved into the extension for draining off the liquid. Inside the trough is a rack supporting filter baskets fitted with filter plates carrying sand and having lips projecting over the edges of the trough and discharging into a gutter running beneath.—J. W. D.

Quicksilver [mercury]; Apparatus for recovering —— from its ores. H. W. Gould, San Francisco, Cal. U.S. Pat. 1,317,920, 7.10.19. Appl., 22.5.18.

THE apparatus comprises a furnace in which the ore is roasted, an inclined conduit communicating at its lower end with the vapour discharge end of the furnace, a chamber receiving at its lower end the products of combustion from the conduit and connected directly near its upper end with the conduit, and means for introducing a stream of air under pressure into the conduit in a direction away from the furnace.—J. W. D.

Melting furnace for easily oxidised metals. Heimsoth u. Vollmer, Hannover. Ger. Pat. 300,193, 13.3.17.

A FURNACE with the necessary heating tuyères is provided below these with slits or the like through which a gas is introduced to form a screen over the metal bath during melting, thus preventing oxidation of such metals as tin and zinc.—J. W. D.

Copper from copper plating on iron; Extraction of ——. C. Heckmann A.-G., Duisburg. Ger. Pat. 300,645, 13.8.16.

COPPER-PLATED iron is melted with a copper matte or copper ore rich in sulphur, the iron uniting with the sulphur and copper from the plating and ore being recovered.—J. W. D.

Metals; Examination of —— by means of Röntgen rays. R. Fürstenau, Berlin. Ger. Pat. 301,327, 30.9.16.

THE metal under examination is placed between two bodies of higher permeability than the metal, and the rays are caused to pass through these bodies before and after passing through the metal. Clear images of even the most minute non-homogeneous portions are thus obtained.—W. J. W.

Zinc; Production of fine —— in muffle furnaces. A. Zavelberg, Hohelohehütte. Ger. Pat. 301,336, 27.1.15.

ZINC ore is distilled at a temperature of 1100° C. for 48 hours with the production in one distillation of fine zinc containing at least 99·5% Zn.—J. W. D.

Chloridising roasting of ores. Kupferhütte Ertel Bieber u. Co., Hamburg. Ger. Pat. 301,379, 11.8.16.

BURNT pyrites and other ores, especially those containing zinc, are subjected to a chloridising roast, using as a contact medium purple ore, and carefully regulating the temperature.—J. W. D.

Zinc alloy. T. Goldschmidt, A.-G., Essen. Ger. Pat. 301,786, 15.7.16.

THE tendency of zinc-aluminium alloys to solidify unevenly and to develop cavities is overcome by the addition of a small percentage of manganese. An alloy containing up to 6% Al and up to 2% Mn gives compact and homogeneous castings and is suitable for use as white metal, and for the manufacture of machine bearings, armature castings, and fuses.—L. A. C.

Tin; Extraction of —— from tin ashes etc. T. Goldschmidt A.-G., Essen-Ruhr. Ger. Pat. 304,375, 8.12.16.

TIN ashes, dross, etc., containing zinc as chloride or basic chloride, is treated with lime water, whereby the zinc is converted into hydroxide, and after separating the solution is further treated with ammonia and ammonium chloride solution under pressure at a suitable temperature. The zinc hydroxide is dissolved, and the residue is then smelted to recover the tin. If the original material contains zinc but no chloride, the treatment with lime water is omitted, the material being submitted to an oxidising roast to convert the zinc into a soluble form and then treated as described. The ammonia is recovered from the solution by distillation for further use.—J. W. D.

Tungsten; Extraction of —— from tungsten-tin ores. W. Witter, Hamburg. Ger. Pat. 306,427, 11.8.16.

THE ore intimately mixed with a large excess of sodium carbonate is roasted at a temperature which favours the production of an acid tungsten salt and prevents the formation of an acid tin salt. The tungsten salt is leached out, the sodium carbonate removed by crystallisation, and the tungsten recovered by some known method.—J. W. D.

Potassium; Production of metallic ——. F. C. Wickel and W. Loebel, Leipzig. Ger. Pat. 307,175, 23.8.17.

POTASSIUM hydroxide is melted together with the proper proportion of metallic sodium. At a temperature of 670° C. potassium is liberated, Na_2O being formed. Hydrogen is recovered as a by-product.—J. W. D.

Leaching roasted minerals. W. Braumüller, Duisburg. Ger. Pat. 307,648, 22.8.13.

THE hot roasted material containing copper, zinc, silver, etc., obtained by the chloridising roasting of burnt pyrites, is mixed with the leaching solution and the mixture passed to a perforated distributing plate arranged above a washing tank, where the solids are deposited and from which the solution is tapped off.—J. W. D.

Alloy of great hardness. G. Fuchs and A. Kopietz, Berlin. Ger. Pat. 307,764, 31.8.17.

AN alloy for tool steels, especially for draw-plates, consists of 40—55 parts of tungsten (or molybdenum), 30—40 parts of iron (or other metal of the iron group, *e.g.*, manganese, cobalt, nickel), 4—6 parts of titanium (or zirconium, boron, silicon, or uranium), and 2—4 parts of carbon. About 2 parts of cerium may also be added.—J. W. D.

Zinc; Recovery of —— from zinc cables or [electrical] conductors. M. Cohen, Berlin. Ger. Pat. 312,138, 30.6.18.

Waste zinc cables etc. are heated in an inert atmosphere below the melting point of zinc; the tar or the like present as binding material melts and flows away, whilst the woven material is charred. The charred matter is separated and the remaining zinc melted.—L. L. L.

Friction bearings; Manufacture of ——. H. Hanemann, Charlottenburg. Ger. Pat. 312,333, 19.4.16.

Grey iron in a form suitable for use in friction bearings is prepared by heating iron containing, *e.g.*, 2% Si and 3% C for 3 hrs. at 900° C., and allowing it to cool slowly during about 24 hrs. By this means, carbon in combination with the iron is liberated, and the whole of the carbon is deposited in the form of graphite.—L. A. C.

Tinned wires; Production of a uniform smooth lacquer coating on ——. Telephon-Apparat-Fabrik E. Zwietusch u. Co., Charlottenburg. Ger. Pat. 312,882, 5.8.17.

During or immediately after tinning, wire is drawn hot through a draw-plate to reduce the tin covering and cause it to flow thinly and uniformly on the wire. This covering then does not flow, if the wire is heated above the melting point of tin during the lacquering operation.—J. W. D.

Electrolytic refining of bronze anodes. Hüttenwerk Niederschöneweide A.-G. vorm. J. F. Ginsberg, Velten. Ger. Pat. 312,941, 21.10.17.

The electrolyte consists of a solution of an alkali bisulphate together with copper sulphate, and this solution prevents the transference of stannic acid to the solution. Bronze anodes containing 20 % or more of tin can be used.—J. W. D.

Metals and alloys; Process for the bright annealing of ——. H. Schulz, Charlottenburg. Ger Pat. 312,947, 19.10.16.

A protective flux for use in the bright annealing of metals and alloys consists of a methyl or ethyl alcoholic solution of one or more soluble boric acid compounds, *e.g.*, boric acid, borax, or ammonium borate, which is applied to the metal by dipping, brushing or spraying. Neutral or acid diluting materials, *e.g.*, quartz, calcium silicate, alumina, magnesia, etc., may be added to the flux, whilst an addition of glycerin, glycerin derivatives, or other hygroscopic substance renders it more easy of application. The flux may be used to inhibit surface coloration of steel during tempering.—A. de W.

Slag; Process for obtaining dry porous ——. C. H. Schol, Allendorf. Ger. Pat. 313,048, 8.3.18.

The molten slag is discharged into water, and the porous slag which floats on the water and the moist granular slag which sinks are recovered separately and removed by bucket conveyers. Any water adhering to the under side of the porous slag is evaporated by the heat of the upper portion.
—J. W. D.

[Steel alloy] articles which require high resistance against corrosion. B. Strauss, Bredeney, Germany, Assignor to Chemical Foundation, Inc. U.S. Pat. 1,316,817, 23.9.19. Appl., 19.6.14. Renewed, 1.2.19.

See Eng. Pat. 13,414 of 1913; this J., 1914, 697.

Malleable-iron castings; Production of ——. F. Perry, Assignor to Industrial Inventions, Ltd., Tipton. U.S. Pat. 1,319,612, 21.10.19. Appl., 6.2.19.

See Eng. Pat. 121,074 of 1918; this J., 1919, 44 A.

Steel-making furnaces or mixers and the like; Valve for ——. F. G. Smith, Purley, Assignor to Wellman, Seaver, and Head, Ltd., London. U.S. Pat. 1,320,284, 28.10.19. Appl., 7.11.18.

See Eng. Pat. 120,114 of 1917; this J., 1918, 771 A.

Magnetic material [metals]; Treatment of ——. A. F. Berry, London. U.S. Pat. 1,320,309, 28.10.19. Appl., 25.6.18.

See Eng. Pat. 118,425 of 1917; this J., 1918, 628 A.

Ignitable metallic mixture and process for preparing the same. C. T. J. Vautin, Assignor to Thermalloy, Ltd., London. U.S. Pat. 1,318,709, 14.10.19. Appl., 10.4.19.

See Eng. Pat. 129,046 of 1918; this J., 1919, 642 A.

Copper and its alloys; Process for protecting —— from attack by atmospheres or liquids. G. D. Bengough and O. F. Hudson, Assignors to Imperial Trust for Encouragement of Scientific and Industrial Research, and to Institute of Metals, London. U.S. Pat. 1,319,508, 21.10.19. Appl., 15.2.19.

See Eng. Pat. 128,297 of 1917; this J., 1919, 640 A.

Electrode furnace. U.S. Pat. 1,317,911. *See* XI.

Coating metals with alumina. Ger. Pat. 313,185. *See* XIII.

Coating iron plate. Ger. Pats. 313,189-90. *See* XIII.

Measuring hardness. Eng. Pat. 120,884. *See* XXIII.

XI.—ELECTRO-CHEMISTRY.

Discharge electrolysis. Electrical colloid syntheses. V. Kohlschütter. Z. Elektrochem., 1919, **25**, 309—323.

When a discharge of at least 100 volts passes between copper electrodes in distilled water, the cathode is disintegrated into fairly large colloidal particles of copper, but if an oscillating parallel circuit is combined with the main circuit the disintegration passes over to the anode and colloidal copper oxide is produced. (See also J. Chem. Soc., Dec., 1919.)—J. F. S.

Nickel. Fernández-Espina. *See* XXIII.

Conductivity water. Clevenger. *See* XXIII.

Electro-analyses. Alemany. *See* XXIII.

Copper. Guiteras. *See* XXIII.

Patents.

Electric furnaces. Soc. Electro-Metallurgique Française, Paris. Eng. Pat. 123,306, 22.1.19. (Appl. 1650/19.) Int. Conv., 11.2.18.

The crucible or melting chamber of the furnace is composed of a number of blocks or a single piece of conducting carbonaceous material. Electric current is conducted to the hearth of the crucible by means of conductors of refractory material fitting in perforations in the hearth and projecting below the same. The projecting portions below the hearth are embedded in heat-insulating material in a fine state of division. The crucible is surrounded with a lagging of the same finely divided heat-insulating material, and the whole is contained within an outer casing of armoured concrete. The lower ends of the electrodes are joined to metallic conductors, the joints being protected by a metallic cover, which prevents escape of the heat-insulating

material while permitting expansion of the electrode. Tapping openings are arranged at the end of the furnace at the level of the bottom of the crucible. When three-phase alternating current is used the neutral point connection is arranged in the form of a bar outside the furnace.—J. S. G. T.

Counter-current [electric] furnaces; Gas supply for ——. M. Schoeld, Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pat. 1,317,327, 30.9.19. Appl., 20.11.18.

A MECHANICAL mixture of briquettes of material to be chemically modified and of substantially infusible electrical resistance elements is fed continuously into a chamber wherein it is heated by passage of electric current through the resistance elements. Gas to react with the material under treatment is passed through the chamber in counter current to the briquettes and is employed in excess of the amount required for chemical reaction. After traversing the mixture a portion of the gas is removed, and the remaining gas, together with a quantity of fresh gas, is again passed through the furnace.—J. S. G. T.

Electric furnace; Polyphase ——. M. Schoeld, Assignor to Armour Fertilizer Works, Chicago, Ill. U.S. Pat. 1,317,328, 30.9.19. Appl., 20.11.18.

A NUMBER of electrodes are arranged at intervals within a surrounding tubular body, which constitutes one electrode. The material to be treated passes through the tube and comes in contact with the inner electrodes. The various electrodes are connected to the terminals of a polyphase electric circuit and are so spaced that substantially uniform heating of the material results. J. S. G. T.

Electrode furnace. W. Dyrssen, New York. U.S. Pat. 1,317,911, 7.10.19. Appl., 21.12.18.

IN furnaces having a number of electrodes inserted through the roof, as in steel smelting electric-arc furnaces, a device is employed whereby the weight of one electrode is counterbalanced by that of another.—J. S. G. T.

Electrically heated furnace with vertical shaft. B. Boye, Berlin. Ger. Pat. 312,317, 23.12.17.

HEATING units are inserted through the shaft wall in such manner that spaces are left through which hot air can circulate towards the furnace chamber. The openings in the walls of the shaft are cut with their upper surfaces perpendicular to the long axis of the shaft, and their lower surfaces sloping obliquely downwards so as to reflect the heat downwards and also to direct the circulating air downwards.—J. S. G. T.

Magnetite electrodes. Process for the manufacture of homogeneous ——. Hüttenwerk Niederschöneweide, A.-G. vorm. J. F. Ginsberg, Niederschöneweide-Berlin. Ger. Pat. 301,762, 29.10.15.

PURE iron oxide and hammer scale or burnt pyrites in very fine powder are mixed in an oxygen blast. The resulting ferroso-ferric oxide as discharged from the blast constitutes suitable material for the manufacture of electrodes, which are free from metallic iron and can be employed satisfactorily as anodes in acid electrolytes.—J. S. G. T.

Electric insulating material; Manufacture of C. Jörns, Berlin. Ger. Pat. 312,703, 3.4.18.

AN emulsion in water is prepared from tangates, soap, and a substance immiscible with water, such as paraffin or kerosene. This emulsion is then applied to paper or fabric and "fixed" by means of metallic salts, whereby the fatty acids and tangates are converted into insoluble salts. When hardened by drying and calendering, the material is suitable for use as a substitute for rubbered fabric in armatures.—J. S. G. T.

Galvanic cell. Schusterpatentges. m.b.H., Berlin. Ger. Pat. 312,824, 28.12.16. Addition to Ger. Pat. 309,531.

IN galvanic cells of the type described in the chief patent (this J., 1919, 294 A) the upper part of the diaphragm is made of a lower density than the lower portion, so that the lighter electrolyte can pass more quickly to the heavier.—J. S. G. T.

Dry-cells; Testing —— during manufacture. Elektrische Spezialfabrik für Kleinbeleuchtung, Berlin-Schöneberg. Ger. Pat. 313,342, 6.4.18.

THE positive poles of dry cells, after they have been compressed and covered, are placed in separate compartments, the walls of which are constructed of perforated zinc, in a testing vessel containing a liquid conductor. The potential difference between the zinc and the carbon poles is then measured by means of a voltmeter short-circuited with a known resistance, and thus faults during manufacture are detected and the necessary time of immersion of the poles is ascertained.—L. A. C.

Electric resistances. Light-reactive electric resistance elements. T. W. Case, Scipio, N.Y., U.S.A. Eng. Pats. 133,403 and 133,404, 10.9.18. (Appls. 14,704 and 14,705/18.)

SEE U.S. Pats. 1,301,227 and 1,316,350 of 1919; this J., 1919, 470 A, 831 A.

Electrolysis; Devices for carrying out chemical processes by ——. V. Gerber, Zurich, Switzerland. Eng. Pat. 133,883, 20.2.19. (Appl. 4268/19.)

SEE U.S. Pat. 1,301,832 of 1919; this J., 1919, 470 A.

Purifying gases. Ger. Pat. 314,014. *See* I.

Electric furnace. Eng. Pat. 133,099. *See* VII.

Fixation of nitrogen. U.S. Pat. 1,317,705. *See* VII.

Anodes. Eng. Pat. 133,882. *See* X.

Iron. Ger. Pat. 309,271. *See* X.

XII.—FATS; OILS; WAXES.

Oils; Changes in —— upon storage. H. A. Gardner. J. Ind. Eng. Chem., 1919, 11, 759—761.

SAMPLES of different kinds of drying, semi-drying, and marine animal oils, such as are used as paint ingredients, were placed in closed bottles with an air space above the oil not exceeding one inch in height. The bottles were exposed to indirect light for periods up to about 8 years at the ordinary temperature, and samples were examined after intervals of 2 or 3 years and at the end of the period. In almost every instance there was a decrease in the iodine value, and a rise in the sp. gr., acid value, and saponification value. In the case of rosin oil, however, the acid value and saponification value had fallen, and this was attributed to the separation of a precipitate of acid character. The marine animal oils were very readily affected and showed pronounced increases in the acid values. Thus in the case of sardine oil the acid value had increased from 10·4 to 31·1 in two years. An over-oxidised linseed lithographic oil showed a great decrease in the saponification value, and an increase in the acid value, whilst the iodine value had not changed much in eight years. Only moderate alterations had taken place in samples of maize, cottonseed, lumbang, sunflower, and hempseed oils, all of which were clear and free from visible moisture at the beginning of the test. In comparative tests with sterilised menhaden and linseed oil, it was found that the acid value of the heated oils showed a

much smaller increase than that of the untreated oils. By heating the oil at 105° C. for a sufficient time to expel all moisture and then filtering it autohydrolysis is inhibited to a large extent, and the product will apparently keep for a long time without showing any pronounced change.—C. A. M.

Fats; Catalytic hydrogenation of —— with palladium. F. F. Nord. Z. angew. Chem., 1919, 32, 305—309.

In practice modifications of the method of hydrogenating fats etc. in acid solution with palladium chloride and a protective colloid (Ger. Pat. 230,724 of 1909) have been found necessary. Hydrogenation of fats with colloidal palladium is not possible, since at higher temperatures flocculation of the palladium occurs, whilst it is difficult to keep fats in homogeneous solution, although in the case of olive oil this has been effected by the use of a large amount of alcohol, which, however, renders the process too expensive. Further experiments have shown that the solvent may be replaced by a small amount of an emulsifying agent. Although in the hydrogenation of Japanese fish oil the results were somewhat better with alcohol than when gum arabic was used, the advantage was not sufficient to outweigh the cost of the alcohol. Good results are obtained by the use of gum arabic in the proportion of about 0·002% of the weight of the fat. Gum tragacanth is a much less effective emulsifying agent. In order to prevent flocculation of palladium from the palladium chloride solution it is advisable to heat the mixture to be hydrogenated before introducing the hydrogen. Arachis, soya bean, rape oils, etc., are readily hydrogenated by this method to fats with low iodine values. In the hydrogenation of castor oil, in the presence of hydrochloric acid, a solid fat is obtained, and at the same time both hydroxyl groups of the hydroxy fatty acid present in the oil are split off. This method did not give good results in the hydrogenation of Japanese fish oil, the resulting products being only semi-solid. In this case the action is checked by the addition of hydrochloric acid, and the hydrogenation is best effected in a practically neutral solution, *i.e.*, up to the liberation of free hydrochloric acid from the palladium chloride. The products thus obtained from Japanese fish oil with iodine value 188 were grey fats with iodine value 22·8 to 30·4 and an odour recalling that of cacao butter.—C. A. M.

Hardened [hydrogenated] fats; Nickel and arsenic in ——. G. Riess. Arb. Reichsgesundheitsamte, 1919, 51, 521—531.

The amounts of nickel found in hydrogenated fats have ranged from 0·01 to 6 mgrms. per kilo., but as a loss of nickel is inevitable in the incineration of the fat it is probable that these results were underestimated. This source of error is obviated by extracting the fat with dilute hydrochloric acid: 200 grms. of the sample is melted in a long-necked flask and treated with 100 c.c. of 12·5% hydrochloric acid and a pinch of potassium chlorate, and the covered flask heated for an hour with frequent shaking, in a boiling water bath. After cooling, the acid liquid is filtered, an aliquot portion (about 90 c.c.) evaporated, the residue dissolved in about 20 c.c. of water, the solution boiled with excess of ammonia and filtered, and the nickel in the filtrate determined by the dimethylglyoxime method. A commercial sample of hydrogenated arachis oil, which, when examined by the usual method, was returned as practically free from nickel was found by this method to contain 1·8 mgrms. per kilo. In most cases, however, the amount of nickel present was insufficient for gravimetric determination, and the conclusion is drawn that with sufficient care hydrogenated fats may be prepared almost, if not quite, free from metal catalyst. For the detection of arsenic 25 grms. of the sample is heated on the water bath with 20 c.c. of a mixture of 10 parts of strong nitric acid and 1 part of strong sulphuric acid, and the fatty residue is mixed with 30 grms. of a mixture of potassium and sodium nitrates (1:1), and introduced into a platinum basin containing 5 grms. of the same mixture in a state of fusion. After combustion of the fat, the fusion is continued for a short time, and the mass then treated with 200 c.c. of water. The solution is acidified with about 100 grms. of 10% sulphuric acid, heated to remove carbon dioxide and nitrous acid, and filtered. The filtrate is heated for 30 mins. in the water bath with 10 c.c. of aluminium sulphate solution (11·12 grms. per 100 c.c.) and excess of ammonia, and filtered hot. The precipitate is washed with ammoniacal water, and the filtrate again treated with sulphuric acid, aluminium sulphate, and ammonia. The united precipitates are heated on the water-bath with about 35 c.c. of 10% sulphuric acid and a little water until nitric acid can no longer be detected by the diphenylamine test, after which 10 grms. of strong sulphuric acid and sufficient water to bring the weight of the solution to 50 grms. are added. This solution is tested for arsenic in Marsh's apparatus. No arsenic was detected by this method in five commercial samples of hydrogenated oils, but by Beck and Merres' modification of Smith's colorimetric method (Arb. Reichsgesundhei amte, 1915, 50, 38) from 0 to 0·156 mgrm. of arsenic per kilo. of fat was found.—C. A. M.

Volatile fatty acids; Determination of —— by an improved distillation method. J. Reilly and W. J. Hickinbottom. Sci. Proc. Royal Dublin Soc., 1919, 15, 513—538.

The authors discuss the theory of distillation of dilute solutions as based on Nernst's law of distribution, and describe an apparatus for distillation at constant volume in which only small changes in concentration occur. The distillation constants of the fatty acids from formic to octoic acid have been determined. The method of distillation and calculation of the results is quite satisfactory for establishing the identity and purity of a solution of a single volatile fatty acid, and also gives fairly accurate results in the analyses of mixtures of two acids. The results with mixtures of three acids are not so satisfactory. The method may be applied to fermentation products. By suitable modification of the apparatus the distillation constants of the volatile acids in butter and cacao-butter can be determined and utilised for detecting the presence of adulterants. (See further J. Chem. Soc., Dec., 1919.).—W. G.

Separating emulsions. Moscicki and Kling. *See* I.

Saponified lubricants. Kraus. *See* IIa.

Patents.

Glycerin; Process of obtaining technically and chemically pure —— from highly impure glycerins or glycerin waters. Billwärder Seifen- u. Glycerinfabrik W. Krauss und W. H. Hofmann, Hamburg. Ger. Pat. 310,606, 1.6.18.

Fermentation glycerins and crude glycerins from partially decomposed fats, such as are present in fish residues etc., contain a large amount of impurities, especially esters of mono- and polyhydric alcohols and nitrogenous compounds of variable composition, which, for the most part, are not decomposed during the ordinary treatment of the glycerin. Decomposition may, however, be effected by heating the crude glycerin (to *e.g.*, 100°—120° C.) with excess of an alkali or alkaline-earth hydroxide prior to distillation, or in the case of the glycerin water prior to concentration.—C. A. M.

Contact material; Preparation of a durable —— *for hardening oils.* Bremen-Besigheimer Oelfabriken, Bremen. Ger. Pat. 312,427, 30.5.12. Addition to Ger. Pat. 286,789 (this J., 1916, 128).

After reduction the contact material is rubbed into the oil in an atmosphere of carbon dioxide. Alternatively, the practically cold mass of the contact metal, in pyrophoric form, precipitated on an inorganic carrier, may be brought into another indifferent gas instead of carbon dioxide.—L. L. L.

Washing; Preparation for —— *and for destroying plant pests.* J. Simon und Dürkheim, Offenbach. Ger. Pat. 312,465, 4.7.16.

The preparation consists of an aqueous soap solution along with hydronaphthalenes, aid in some cases hydrogenated benzene hydrocarbons. Naphthalene has little value as a washing medium along with soap, but hydronaphthalenes in combination with soap have extraordinary detergent properties. These preparations are particularly adapted to the washing of raw cotton, removing resin, wax, etc. Mixtures of soap and hydronaphthalenes along with talc, or in aqueous or other solution, are very destructive to insects and other plant pests. Tetrahydronaphthalene and hydrogenated benzene hydrocarbons (produced from solvent naphtha) are obtained by hydrogenation in presence of nickel.—L. L. L.

Glycerin; Process for distillation of ——. R. Boutet, Assignor to Soc. Franc. des Glycerines, Paris. U.S. Pat. 1,318,533, 14.10.19. Appl., 22.5.18.

See Eng. Pat. 123,302 of 1918; this J., 1919, 544 A.

Fullers' earth. U.S. Pat. 1,317,372. *See* I.

Castor oil. Eng. Pat. 133,905. *See* XX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Colours; Scientific classification of —— *and its application to art.* W. Ostwald. Chem.-Zeit., 1919, **43**, 681—682.

A scheme of classification of colours has been devised by German physicists and artists, in which each colour is classified under a general group heading, and is further differentiated by means of letters and numbers. In the case of the colourless pigments (neutral colours), white, grey, and black, the purest white is represented by the small letter *a* and the deepest black by *t*, whilst the other letters between these represent the intermediate stages of grey according to their relative proportions of white and black. In practice, however, it has been found that these 20 stages are usually too close, so that every other stage may be omitted, giving the series *a c e g i l n p r t*, which, as a rule, terminates at *p*. These standards are in harmonic relationship towards each other. Thus successive stages, *e. g.*, *c e g* or *i l n*, are in harmony, whilst stages apart (*e.g.*, *c i n*) do not harmonise. This is a fundamental principle of the system. The coloured pigments (true colours) are classified into eight main groups ranging from yellow through orange, red, violet, ultramarine blue, ice blue, sea green, and grass green back to yellow. Each of these groups is sub-divided into three grades so as to give a first, second, and third yellow, orange, red, etc., and the complete circle of colours is divided into 24 standards, differing from each other by about 4 units. Since 24 is not divisible into 100 without remainder, the small fractions thus left are rounded off in the usual way. These standards are numbered as follows:—

	1st.	2nd.	3rd.		1st.	2nd.	3rd.
Yellow..	00	04	08	U-blue ..	50	54	58
Orange..	13	17	21	Ice blue ..	63	67	71
Red ..	25	29	33	Sea green..	75	79	83
Violet ..	38	42	46	Grass green	88	92	96

In order to indicate the proportion of white and black in a coloured pigment two letters are added from the grey series to the colour number. For example, 17 *l g* indicates a second orange with as much white as in grey *l* and as much black as in grey *g*. The second letter must always be smaller than the first, thus giving 28 derivatives from every colour grade, distinguished by their different proportions of white and black. With a slight amount of black (*a* or *c*) the colours are transparent or pure, and the opacity rises with the increase in black. With a large content of white (*e.g.*, *c* and *e*) the colours are pale, and they become deeper as the white decreases. These relationships may be represented by placing all the derivatives of a colour tone in a triangle, the respective angles of which correspond to the pure colour (*v*), white (*w*) and black (*s*), and dividing the triangle into fields by means of lines drawn parallel to the two sides *v w* and *v s*. These fields number 36, made up of the 28 above-mentioned true colour derivatives and 8 neutral coloured derivatives on the side *w s*. The series in which the colours are here arranged are termed the white equivalents, the black equivalents, and the pure or shade equivalents. The total number of colour standards thus consists of 672 true colours and 8 neutral colours, which are sufficient for most practical needs. It is therefore urged that these standards should be adhered to and "wild" colours avoided. Another method of arranging colours is to keep the letters (*i.e.*, the white and black content) constant and to vary the numbers of the colour tone. In this way 28 equivalent colour circles are obtained, each of which contains 24 colour tones. In these equivalent colour circles there are fundamental harmonies of different colour tones, which may be found by dividing the circles at 2, 3, or more points. In practice nearly all the colours of an equivalent colour circle may be used against each other. Each colour circle will give some 250 good combinations, and from these pairs many thousands of trios and quartettes may be formed. The law under which neutral colours may be used in harmony with true colours is as follows: The lightest grey must not contain less black nor the darkest grey less white than the equivalent true colours which form the other constituents of the harmonic whole.—C. A. M.

Paint analysis; Notes on ——. [*Preparation of starch indicator.*] G. J. Hough. J. Ind. Eng. Chem., 1919, **11**, 767—768.

Cuprous copper in copper paints: 0·5 grm. of the sample is heated with 10 c.c. of hydrochloric acid to dissolve all copper, then diluted to about 200 c.c. with cold water, treated with 5 c.c. of phosphoric acid and immediately titrated with potassium permanganate solution. In calculating the iron value of the permanganate into the copper value it was found necessary in practice to use the factor 1·166 instead of the theoretical factor 1·125. *Calcium in white lead*: From 0·5—1·0 grm. of the sample is boiled for a few minutes with 50 c.c. of 5% sodium hydroxide solution, the liquid decanted, and the residue of whiting again boiled with sodium hydroxide solution, and finally thoroughly washed with hot water and dissolved in hot dilute (1:2) hydrochloric acid. The solution is neutralised with ammonia (any precipitate of lead being filtered off), boiled, and the calcium precipitated with ammonium oxalate. When more than 50% of lead is

present in the paint a third boiling with sodium hydroxide solution may be necessary to dissolve all the white lead. *Chromium in mixed pigments* may be detected by stirring the sample with a few c.c. of dilute (1:5) nitric acid, filtering, and testing the filtrate with a few c.c. of hydrogen peroxide. A purple coloration, due to perchromic acid, indicates chromium. *Chromium in chrome yellow*: To obviate the difficulty that certain kinds of chrome yellow are partly insoluble in hydrochloric acid, the older method has been modified by using sodium hydroxide solution as the solvent. 0·5 grm. of the sample is heated with 15 c.c. of 20% sodium hydroxide solution and the solution cooled, diluted to about 200 c.c., and treated with a solution of 2 grms. of ferrous ammonium sulphate in a little water. After thorough stirring and standing for a few minutes the liquid is strongly acidified with dilute sulphuric acid, diluted to 400 c.c., and titrated with standard permanganate solution. *Preparation of starch indicator*: A clear, stable solution of starch may be prepared by dissolving 1 grm. of potato starch in 100 c.c. of boiling 1% salicylic acid solution and diluting the cold solution to a litre.—C. A. M.

Varnishes; Influence of coloured light on the drying of ——. H. Wolff. Farben-Zeit., 1919, **24**, 1119. Chem. Zentr., 1919, **90**, IV., 375.

Certain varnishes dried in white, blue, or green light yield glossy films, whilst shrivelled films are obtained by drying in yellow, orange, or red light. In light of short wave-length a rapid oxidation on the surface takes place, whilst the actinic rays induce rapid polymerisation. Both these effects lead to an alteration in volume in the same direction and at an equal value. In the case of light of long wave-length of low actinic value, on the other hand, oxidation of the outer zone of the film of varnish proceeds more rapidly than polymerisation of the inner zone. The alteration in volume in the different zones is thus unequal, and proceeds at different rates, so that strains are produced and shrivelling takes place.—A. de W.

Varnishes; Influence of coloured light on the drying of ——. M. Ragg. Farben-Zeit., 1919, **24**, 1308. Chem. Zentr., 1919, **90**, IV., 375.

The author considers that Wolff's assumption (see preceding abstract) that light of long wave-length causes an increased rate of oxidation simultaneously with a reduced rate of polymerisation lacks proof. Such an assumption would involve a larger contraction of the surface, with consequent appearance of cracks, in contradistinction to shrivelling. It is possible that the outer layer, which is more or less yellow or brown in colour, acts as a light filter and permits transmission of the yellow and red rays, light of short wave-length being absorbed. The thermal effects of the rays must also be taken into consideration.—A. de W.

Varnishes; Influence of coloured light on the drying of ——. H. Wolff. Farben-Zeit., 1919, **24**, 1389. Chem. Zentr., 1919, **90**, IV., 458.

In replying to Ragg (see preceding abstract) it is pointed out that red light does not accelerate the rate of oxidation of varnish, but in light of short wave-length, oxidation and polymerisation proceed at nearly equal rates, whereas in light of long wave-length oxidation in the surface is only slightly retarded, whilst the rate of polymerisation in the interior is considerably retarded, so that inequalities in the alteration in volume of the inner and outer layers are produced.—A. de W.

Varnishes; Influence of coloured light on the drying of ——. H. Vollmann. Farben-Zeit., 1919, **24**, 1427. Chem. Zentr., 1919, **90**, IV., 458.

In the drying of varnish in coloured light the red rays act exclusively by development of heat, both inner and outer layers being thereby affected. It must not be assumed, however, that this small liberation of heat is not without influence on the polymerisation of the inner layers. Furthermore, formation of cracks can hardly take place whilst the under layers are still fluid. The formation of wrinkles in films of tar exposed to sunlight supports Wolff's views (see preceding abstracts).—A. de W.

Changes in oils on storage. Gardner. *See* XII.

Patents.

Zinc sulphide and barium sulphate [pigment]; Process for the conjoint manufacture of ——. P. Desachy, Paris. Eng. Pat. 126,628, 5.5.19. (Appl. 11,187/19.) Int. Conv., 19.10.17.

A solution of zinc sulphate is treated with an alkaline-earth hydroxide or salt, *e.g.*, barium hydroxide, carbonate, or sulphite, and the precipitate, *e.g.*, barium sulphate, together with zinc hydroxide, carbonate, or sulphite, treated with an alkali or alkaline-earth sulphide, *e.g.*, sodium or barium sulphide. The precipitate is then filtered off, washed, calcined in the presence of sulphur, and allowed to cool with exclusion of air.—A. de W.

White pigments; Manufacture of ——. *Titanium pigment and process of making same.* A. P. Jaeger, Assignor to Titan Co. A./S., Christiania. U.S. Pats. (A) 1,317,164 and (B) 1,317,165, 30.9.19. Appl., 5.12.16 and 13.5.18.

(A) A paint pigment consists of titanium oxide, water of hydration, and zinc white, the latter being chemically uncombined with the titanium. (B) Material suitable for use as or in the manufacture of pigments, comprising a substance containing combined titanium, iron, zinc, sulphuric anhydride, and water of hydration, is obtained by subjecting a titanium-oxygen compound containing iron and sulphuric anhydride to the action of sulphuric acid in the presence of zinc sulphate, and heating the decomposition product and the zinc sulphate in the presence of sodium chloride to temperatures sufficient to decompose the decomposition product and the zinc sulphate and form titanium dioxide and zinc oxide, the soluble salts being removed by washing.—A. de W.

Pigments; Manufacture of titanium ——. Titan Co. A./S., Christiania. Ger. Pat. 312,090, 3.6.17. Int. Conv., 14.10.16.

Amorphous titanium dioxide or oxyhydrate, either alone or mixed with alkaline-earth sulphates, and a catalyst such as zinc chloride or ammonium fluoride which is volatilised during the treatment, is heated at a high temperature for a sufficient length of time for the interior of the particles to be converted to the crystalline state without alteration of their outer form. During the process the colour changes from white to a bright yellow. The product, mixed with linseed oil, with which it does not react, or with other suitable binders, gives a pigment having good covering properties and fast to light.—L. A. C.

Paint. R. R. Adams, Yonkers, N.Y. U.S. Pat. 1,317,469, 30.9.19. Appl., 5.10.17.

A paint comprising natural wool grease, a pigment, and a volatile diluent.—A. de W.

Lacquers and varnishes; Production of solutions of cellulose nitrates and celluloid for use as ——. R. Gilmour, and W. Dunville and Co., Ltd., Belfast. Eng. Pat. 132,996, 17.12.18. (Appl. 11,077/19.)

n-Butyl formate and isobutyl formate are used either alone or with any other solvents and/or non-

solvents for dissolving cellulose nitrates or celluloid for the production of lacquers etc.—A. de W.

Drying-oven [for lacquers]. T. L. Taliaferro, Assignor to Phœnix-Hermetic Co., Chicago, Ill. U.S. Pat. 1,318,187, 7.10.19. Appl., 3.1.19.

An oven for baking lacquered sheets consists of an elongated casing of corrugated metal with corrugations extending in a transverse direction to the length of the casing. The casing is covered with heat-insulating material which is in contact only with the extreme outer curved portions of the corrugations, so that a number of adjacent air cells are formed between the corrugated metal and the heat-insulating material. Means are provided for heating the interior of the oven.—A. de W.

Iron plate; Treatment [coating] of ——. F. Ewers und Co., Inh. A.-G. f. Kartonnagenind, Lübeck. Ger. Pats. (A) 313,189 and (B) 313,190, 4.3 and 3.5.16.

(A) The sheets, with a previously-fired foundation-coating and a subsequent coating of oil lacquer containing finely-ground asbestos, are dried and coated with gold lacquer, which is then baked. The coated plate is unaffected by alkalis, acids, and other chemicals and is specially suitable for food containers, including those which have to be heated later. (B) The foundation-coating is mixed with the asbestos and gold lacquer mentioned in (A) and the sheet is coated with the mixture and then baked for several hours. This single coating is as durable as the triple coating described in (A).—A. B. S.

Varnishes and thickened oils; New types of ——. L. Singer, Düsseldorf, and A. Kantorowicz, Dessau. Ger. Pat. 312,927, 6.10.16.

The extracts obtained by treating hydrocarbons with sulphurous acid are converted into highly siccative products by purification or fractionation by repeated treatment with sulphurous acid or by distillation under high vacuum, preferably with the aid of steam, or by a combination of both these means and by treatment with air, oxygen, or ozone, with or without driers, or by treatment with driers alone. The extracts may be treated with chlorine, with subsequent partial or complete dechlorination, before being further treated as described above. The products when treated with bases give substances having the properties of thickened drying oils or fatty bodies that may be used as lubricating greases etc. The chlorinated products are extremely viscous, stringy bodies, which may be dechlorinated with zinc, metallic chlorides, etc. The extracts or the products therefrom may be rendered paler by treatment with sulphuric acid, oleum, or bleaching agents.—A. de W.

Crude resins; Method and apparatus for distilling ——. R. Dunwody, New Orleans, La. U.S. Pat. 1,317,781, 7.10.19. Appl., 12.3.18.

A higher yield of volatile products is obtained by subjecting the crude resins to a temperature sufficient to drive off the volatile products but insufficient to impair the quality of the residue. The volatile products are delivered into an expansion chamber where the heavier unvaporised material mechanically carried over is deposited whilst the volatilised turpentine material passes on to a condenser.—A. de W.

Coating or preservative compositions; Manufacture of ——. M. Holzapfel, Newcastle-on-Tyne. Eng. Pat. 126,270, 24.10.18. (Appl. 17,375/18.) Int. Conv., 3.5.18.

Wood tar, *e.g.*, 90 parts by weight, of as mobile a quality as possible, is heated with continual stirring to about 250° C. for 20 or 30 minutes with about 5 parts by weight of slaked lime and about 5 parts by weight of zinc white. The mass is allowed to cool and is then thinned to a varnish-like consistence with turpentine or like thinner. When destined as a medium for lighter coloured paints, the wood tar is subjected to a previous distillation to remove pitch. Greater drying power of the composition may be obtained by blowing in a current of air with continuous agitation for 2—4 hours previous to the thinning, whilst the zinc white may be replaced by other driers, *e.g.*, red lead, litharge, manganese dioxide, or patent driers.—A. de W.

Paints, primings and like coating-compositions [from sulphite-cellulose lye], and process for manufacturing same. J. Wingen, Maastricht, Holland. Eng. Pat. 133,852, 3.1.19. (Appl. 233/19.)

Waste sulphite-cellulose lye is employed in its original state or after being boiled, diluted, or concentrated, as a paint medium for mixing with any solid paint-pigment or paint-ingredient, *e.g.*, clay, chalk, etc., with or without oil or fat, their hydrolytic products, or hydrocarbons, to form a paint. The bad odour of the waste-lye may be decreased by boiling, whilst an addition of amyl acetate will "deodorise" it.—A. de W.

Fireproof paint and coating and process of making same. J. E. Schneider, Assignor to Seattle Asbestomine Co., Seattle, Wash. U.S. Pat. 1,317,225, 30.9.19. Appl., 6.3.18.

A coating composition comprises diatomaceous earth pulverised to a degree whereby its air cells are broken, a mineral of the hornblende group pulverised to a degree whereby its individual fibres are separated and the particles will float in water, colouring matter, and a binder.—A. de W.

Floor covering as a substitute for linoleum; Manufacture of a ——. J. H. P. Ligterink, Utrecht, Holland. Eng. Pat. 133,484, 25.10.18. (Appl. 17,471/18.)

Pasteboard of the thickness of ordinary linoleum, formed from suitably coloured paper pulp, is treated on both sides with a mixture of equal parts of boiled and unboiled linseed oil. After drying, a linseed oil colouring is applied to both sides and finally a pattern is applied in the usual way to the upper surface.—S. S. A.

Plastic material [from yeast]. W. Mooser-Schiess, Bern-Liebelfeld, Switzerland. U.S. Pat. 1,317,721, 7.10.19. Appl., 9.7.19.

The claim is for plastic masses containing yeast and esters of polyvalent acids with glycerin.
—D. W.

Sealing wax; Manufacture of ——. C. F. Weber Akt.-Ges., Leipzig-Plagwitz. Ger. Pat. 313,100, 5.6.18.

A small quantity of β-naphthol is added to a mixture of shellac or turpentine substitutes, obtained from tar distillation, and the usual filling materials such as gypsum, chalk, etc., to increase the agglomeration of the ingredients and prevent premature dropping on heating. A suitable composition consists of light tar oil (b.pt. 150°—185° C.) 10 parts, pitch or asphalt (residue after distilling to 360° C.) 70 parts, chalk, gypsum, or heavy spar, 10 to 20 parts, and β-naphthol, 1 to 2 parts.
—W. J. W.

Coating metallic articles of all kinds which are harder than aluminium and have a higher melting point, with alumina. Metallindustrie Schiele und Bruchsaler, Hornberg. Ger. Pat. 313,185, 5. 2. 18.

The article is coated with a preparation of aluminium, applied by rubbing, [illegible]

aluminium bronze lacquer, then heated slowly to 400° C. to bake the lacquer, and afterwards to 800° C. to convert the aluminium into alumina. The coating of alumina thus produced is uniform, dense, and adhesive; it is a good electrical insulator and is highly resistant to oxidation.—A. B. S.

Oil pastes; Process for the conversion of water pastes into ——. H. P. Fletcher, Forest Lodge, N.S.W. U.S. Pat. 1,317,781, 7.10.19. Appl., 17.10.18.

See Eng. Pat. 122,612 of 1918; this J., 1919, 187 A.

Cellulose acetate solutions. Eng. Pat. 131,647. *See* V.

Basic lead sulphate. Eng. Pat. 133,367. *See* VII

Preventing rusting of iron. U.S. Pat. 1,317,351. *See* X.

Lacquering tinned wires. Ger. Pat. 312,882. *See* X.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Vulcanisation; An accelerator of ——. [*Preparation of dimethylamine.*] A. Hutin. Monit. Scient., 1919, **63**, 194—195. (See also this J., 1917, 1140.)

The formula for the additive compound of carbon bisulphide and dimethylamine, viz.,

$$N(CH_3)_2CS.SNH_2(CH_3)_2,$$

was wrongly given in the earlier paper. It is now suggested that the dimethylamine might more advantageously be prepared by the interaction of ammonium chloride and trioxymethylene and in connection with the method recommended earlier, a possible use is indicated for the *p*-nitrosophenol, which is formed together with the dimethylamine, based on its conversion into quinol.—D. F. T.

PATENT.

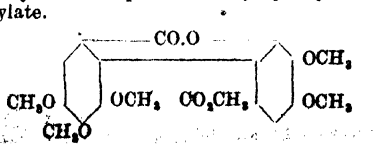
Fabrics; Manufacture of rubber-treated ——. W. Deutsch, Vienna. Ger. Pat. 307,173, 21.2.17.

Single or double fabrics coated with rubber composition are pressed between plates with a smooth surface under a pressure of several atmospheres and at a temperature of 30°—50° C. for several hours, either before or after vulcanising. A considerable economy of rubber is effected without any appreciable loss of quality; for instance, a double balloon fabric, coated with 100—150 grms. of washed Para rubber per sq. m., shows a gas permeability of 5—8 c.c. of hydrogen per hour on a surface of 100 sq. cm. under a pressure of 30 mm. of water.—J. F. B.

XV.—LEATHER; BONE; HORN; GLUE.

Knopper gall; Tannin of the ——. M. Nierenstein. Chem. Soc. Trans., 1919, **115**, 1174—1180.

The tannin of the knopper gall is not identical with gallotannin, but gives on hydrolysis dextrose and ellagic acid. Methylated knoppern tannin yields on hydrolysis with 10% potassium hydroxide a mixture of partly methylated luteolic acids which give on further methylation with diazomethane methyl pentamethoxyluteolate, a substance which was found to be identical with the lactone of methyl 2-hydroxy-3.4'.5'.6'-pentamethoxydiphenyl-6.2'-dicarboxylate.



The knoppern tannin molecule is therefore probably composed of luteolic acid, which is an oxidation product of gallotannic acid, and dextrose.
—G. F. M.

Tannins; Synthetic ——, *and their use in the tannery.* E. Nihoul. Chim. et Ind., 1919, **2**, 1024—1034.

A brief account of Fischer's synthesis of gallotannic acid is followed by a description of the properties of quinone. 1—1·5 parts of quinone per 100 parts of hide is sufficient to give a leather which is more resistant to the action of water, acids, alkalis, and wear than any other known leather. Quinol is present in used quinone tanning liquors, so that part of the quinone serves to oxidise the hide substance; the rest combines with the oxidised product. Such catalysts as laccase, peroxydase, acetates of manganese, cerium, lanthanum, etc., which facilitate oxidation, accelerate the quinone tannage and render the liquors more efficient. Quinone is best dissolved in slightly acid boiling water, when it will keep better than in neutral or alkaline solutions. The solutions must not come into contact with vessels of metal or wood containing tannin. Quinone is particularly suitable for the preliminary tannage of all kinds of leathers and for preventing too much falling after the bating of box calf. "Syntans" are a class of synthetic tannins prepared by condensing phenolsulphonic acids with formaldehyde in slightly acid solution. Stiasny (see this J., 1913, 775) suggested the probable formation of diphenylmethane derivatives which polymerised to amorphous products of high molecular weight, but Green (*ibid.* 1913, 776) considers that *o*-hydroxybenzyl alcohols are first produced and these condense to form syntans. The products are bright in colour, very similar to natural tanning extracts, give semi-collodial solutions which precipitate gelatin solutions, give a dark colour with iron salts, precipitates with lead acetate and aniline hydrochloride, and tan pelt into good leather. Neradol D, the chief commercial product, gives a white leather when used alone and is extremely useful, in combination with other tanning materials, for accelerating the tannage, increasing penetration and weight yield, or for giving a preliminary tannage or for re-tanning Indian sheepskins. Certain English products are superior to Neradol D, giving a whiter and more supple leather and are capable themselves of penetrating calfskin in a few hours.—D. W.

Leather; Theory of currying and fat liquoring of ——. W. Moeller. Gerber, 1919, **45**, 277—279.

The unsaturated fatty acids in fish oils are converted by autoxidation into peroxides of the form .CH—CH
O——O which with water split up into dihydroxy acids, .CH(OH).CH(OH), and an atom of oxygen. This active oxygen oxidises the polyphenols present in the tannins of vegetable-tanned upper leather, apparently forming substances of a quinone character, which are quite insoluble and similar to the phlobaphenes. According to the author's "peptisation theory" upper leathers tanned with pyrogallol tannins contain a large amount of peptisers of the pyrogallol class which are thus oxidised into insoluble peptised substances. These greatly increase the waterproofness of the leather and diminish the amount of water-soluble matter in it. This theory explains the formation of solid hydroxy-acids from fish oils and the necessity for damping the leather before currying. There is also a physical side to this theory, the action of currying and fat-liquoring agents being attributable to the formation of emulsions. The greater the viscosity of the oil used the more suitable is it for this purpose. Glacé leather manu-

facture (tawing) is not a tannage but simply a colloid-chemical impregnation of the skin with fat. The alum acts as a peptiser just as vegetable tannins do in the preparation of various salves, ointments, and lubricants where they are employed. —D. W.

Casein; Improvement in making ——. J. L. Sammis. J. Ind. Eng. Chem., 1919, **11**, 764—767.

SPECIFICATIONS No. 14,018 A of the Bureau of Aircraft Production, U.S.A., for casein intended for glue-making describe a particular method for the manufacture of the product, which must have the following characteristics:—(1) Must pass through a 50-mesh screen; (2) must not contain more free acid than is equivalent to 3 c.c. of $N/10$ sodium hydroxide solution per 1 grm. of moisture-free casein; (3) fat not to exceed 1·5% of the anhydrous casein; (4) ash not to exceed 3% of the anhydrous casein in the case of natural sour caseins, and 4·5% for sulphuric or hydrochloric acid caseins; (5) moisture not to exceed 8%; (6) nitrogen not less than 14·25% on the anhydrous, fat-free and ash-free substance. Variations in the ash and acid contents are the main causes of trouble in the use of casein for glue-making. An extra grinding of the curd renders it more accessible to the washing water and gives a product containing less impurities than many samples of commercial caseins, but would be expensive in practice. The use of an excess of acid for curdling the milk reduces the amount of ash in the casein, but tends to make the curd loose instead of compact, so that the minimum amount of acid is the most satisfactory. The most suitable temperature for the precipitation is between 90° and 100° F. (32°—38° C.). To prevent mechanical inclusion of part of the acid in the curd first formed, it is advisable to add the acid slowly, while the milk is vigorously stirred. The following revised method of making casein was based on these observations: The skim milk is heated to 95° F. (35° C.) in a metal or wooden vat by direct steam from a pipe of not less than ¾ in. diam., and during the curdling is stirred with a wooden hay rake. For each 1000 lb. of milk 1 pint of sulphuric or hydrochloric acid is used, after dilution with an equal quantity of water. The acid is added to the milk in a thin stream or streams, and the mixture vigorously stirred until a clear whey is obtained. After settling for a few minutes the whey is drawn off through a strainer, and the curd is stirred in the vat with water at 95° F. equal in weight to a fourth of the milk used. The washing water is drawn off and the curd pressed and dried. If cooked curd is required the washed and drained curd is covered with hot water and heated to 180°—190° F. (82°—88° C.) until it coagulates into a compact mass. Five samples of casein made by this method contained 5·12 to 6·17% moisture; 1·98 to 2·80% ash, and had acidity per grm. equiv. to 8·33 to 9·6 c.c. $N/1$ alkali—C. A. M.

Formaldehyde-gelatin jellies; Crystallisation phenomena in ——. W. Moeller. Kolloid Zeits., 1919, **25**, 67—74.

THE formation of sphäro-crystals in the crystallisation of formaldehyde-gelatin jellies is attributed to the orienting influence of the formaldehyde condensation and polymerisation products on the α-gelatin micellæ. In the spherical crystal formation the individual micellæ are arranged radially in the form of concentric spherical sheaths and behave optically as a crystalline drop. (See also J. Chem. Soc., Dec., 1919.)—J. F. S.

Fibrin; Swelling of —— in alkalis. Molecular mechanism of colloidal behaviour. II. R. C. Tolman and R. S. Bracewell. J. Amer. Chem. Soc., 1919, **41**, 1503—1510.

THE swelling of fibrin reaches a maximum in solutions of sodium and potassium hydroxides at concentrations below $N/20$. In the same way the adsorption reaches a maximum. A further increase in the concentration of the alkali effects no change in the adsorption, but reduces the amount of swelling. In ammonia solutions the swelling and the adsorption increase continuously with increase in the ammonia concentration up to 0·8 N. (See also J. Chem. Soc., Dec., 1919.)—J. F. S.

Protein molecule; Chemical nature of the adsorption of acids and alkalis by the ——. *Molecular mechanism of colloidal behaviour. III.* R. S. Bracewell. J. Amer. Chem. Soc., 1919, **41**, 1511—1515.

THE acid-adsorbing power of proteins (fibrin, gelatin, etc.) is mainly due to the free amino-groups present. (See also J. Chem. Soc., Dec., 1919.) —J. F. S.

PATENTS.

Liming and tanning of hides. G. Randall, Worcester. Eng. Pat. 133,823, 21.11.18. (Appl. 19,120/18.)

HIDES are suspended or supported edgewise from a rigid frame resting on the sides of a pit along the bottom of which are laid a number of perforated pipes, through which compressed air can be distributed, during liming and tanning, throughout the entire horizontal dimensions of the pit and in an upward direction, thus stirring up all sediment in the liquor.—D. W.

Glue; Process of making ——. J. H. Paiton, Assignor to Osro Chemical Co., Chicago, Ill. U.S. Pat. 1,318,106, 7.10.19. Appl., 17.8.16.

ALKALI is thoroughly stirred into a mixture of flour or starch and water, the excess of alkali neutralised with sulphuric acid, and afterwards a resin size, first mixed with water, is incorporated with the product.—D. W.

Plastic mass [from yeast] and process for making same. E. Krause, Steglitz, and H. Blücher, Leipzig-Gohlis, Germany, Assignors to Chemical Foundation, Inc. U.S. Pat. 1,319,666, 21.10.19. Appl., 20.8.15.

SEE Eng. Pat. 76 of 1914; this J., 1915, 972.

Dyeing, staining, and mordanting. Eng. Pat. 132,345. *See* VI.

XVI.—SOILS; FERTILISERS.

Soil; Adsorption phenomena in ——. D. J. Hissink. Chem. Weekblad, 1919, **16**, 1128—1146.

THE author points out the fallacious interpretation of the results of experiments, notably those of van Bemmelen, on the relative adsorptive power of different soils for the cations sodium, ammonium, potassium, calcium, and magnesium. The amount of a cation adsorbed from a solution depends on the amount already adsorbed in the soil. In order to ascertain the relative adsorption affinities of cations, it is therefore necessary to treat the soil containing only one adsorbed cation with solutions of the others. Experiments with clay containing only ammonium as adsorbed cation gave the following descending order of adsorptive affinity: magnesium, calcium, ammonium, potassium, sodium. From experiments with "artificial soils," *i.e.*, "permutit," it is concluded that the ferric ion is not contained in these in such a way that it can enter into adsorption equilibrium with other cations in solution.—W. S. M.

Cyanamide and dicyanodiamide; Action of —— on the development of maize. P. Mazé, Vila, and M. Lemoigne. Comptes rend., 1919, **169**, 804—807.

CYANAMIDE at a concentration of 0·162 grm. per

ltre is toxic both to the germination of maize seeds and to the growth of maize seedlings. Dicyanodiamide does not exert any toxic effect at this concentration, but is useless as a source of nitrogen to the young plant.—W. G.

Crab grass (Digitaria sanguinalis); Composition of the ash of —— as affected by the soil in which it is grown. G. D. Buckner. J. Amer. Chem. Soc., 1919, **41**, 1384—1385.

ALTHOUGH quite similar in appearance, a specimen of crab grass growing in the middle of a limestone road (A) was found to differ considerably in its inorganic constituents from a sample grown in garden soil (B), as the following analyses indicate:—

	Ash in air-dried sample.	In the ash.				
		P_2O_5.	SiO_2.	CaO	MgO.	K_2O.
A. ..	17·49%	4·92	14·50	5·40	3·42	32·38
B. ..	20·84	4·01	14·60	3·75	2·68	39·80

—J. C. W.

Tar vapour; Determination of the constituents injurious to plants contained in —— and the distinction between their action and that of other injurious vapours. R. Ewert. Landw. Jahrb., 1917, **50**, 695. Chem.-Zeit., 1919, **43**, Rep., 213.

TAR vapours always produce the same destructive effects in the leaves of plants. These characteristic appearances are produced particularly by the high-boiling constituents of the anthracene oil, anthracene, methylanthracene, acridine, and hydroacridine. The tar oils act in the following order:—Anthracene oil, heavy oils, middle oils, light oils. This injurious action on green plants is the opposite of the preservative action of tar which arises from the destruction of bacteria and fungi, also due to anthracene compounds. These compounds are also the cause of tar itch in man, formerly attributed to the phenols. On comparing the injurious action of tar vapour with that of the vapours of sulphurous acid, hydrochloric acid, and ammonia, it was found that the action of the former was confined to the epidermis of the leaf exposed to the light, whereas the action of the latter took place on the under surface of the leaf and in the chlorophyll cells under the epidermis.—J. H. J.

Carbon [in soils]. Hibbard. *See* XXIII.

PATENTS.

Cellulosic materials. Ger. Pat. 305,120. *See* V.

Destroying plant pests. Ger. Pat. 312,465 *See* XII.

XVII.—SUGARS; STARCHES; GUMS.

Syrups and molasses from sugar-cane; Composition and calorific value of ——. C. A. Browne. J. Amer. Chem. Soc., 1919, **41**, 1432—1440.

THE materials examined were: a sample of the clear mother liquor from concentrated sugar-cane juice, untreated with chemical agents; a sample of open-kettle molasses (juice treated with sulphur dioxide, limed, heated, strained and concentrated in steam-heated pans); a sample of first Cuban molasses (ordinary lime defecation), samples of refiner's syrups, and a sample of "black strap" molasses. It was found that the calories derived from the organic non-sugars fluctuate with the carbon content of this fraction. The lime defecation process is accompanied by the formation of dehydration products with higher carbon contents and higher calorific value; filtration over bone-black causes the removal of calcium salts of such acids as glycinic acid, giving a lighter syrup with non-sugars of lower calorific value.—J. C. W.

Lactose; Solubility of ——. Action of acids and alkalis on lactose. E. Saillard. Chim. et Ind., 1919, **2**, 1035—1036.

THE following table gives the solubility of lactose as compared with that of sucrose at various temperatures:—

Temp.	Kilos. of sugar per 1 kilo. of water.		Temp.	Kilos. of sugar per 1 kilo. of water.	
	Anhydrous lactose.	Sucrose.		Anhydrous lactose.	Sucrose.
°C.			°C.		
21·5	0·20	2·06	48	0·421	2·55
28	0·24	2·16	57	0·56	2·78
38	0·307	2·34	65	0·77	3·03

Lactose is hydrolysed completely when 5 grms. of the sugar is dissolved in 100 c.c. of water and 10 c.c. of hydrochloric acid (23° B., sp. gr. 1·19) and the solution heated at 90° C. for 90 mins.; under the same conditions as to temperature and time, lactose is not hydrolysed by 10% acetic acid solution. When 3·5 grms. of lactose is heated at 90° C. for 2 hrs. with 100 c.c. of water containing 1 grm. of sodium hydroxide, 0·64 grm. of the alkali is neutralised and 85% of the lactose is decomposed or destroyed.—W. P. S.

Starch coagulation; Predominating influence of the degree of dispersion of starch solutions on the so-called ——. H. Sallinger. Kolloid Zeits., 1919, **25**, 79—81.

THE coagulation of starch solutions by ptyalin occurs more rapidly the larger the quantity of ptyalin added. The amount of coagulum decreases and the quantity of maltose formed increases with the amount of ptyalin. Starch solution heated to 110° C. under 1½ atm. pressure coagulates more slowly and yields about a quarter as much coagulum and rather more maltose than unheated starch. The experiments confirm the view of Lintner that it is unnecessary to assume the existence of an enzyme amylocoagulase in malt extract which is capable of coagulating starch. (See also J. Chem. Soc., 1919, i., 575.)—J. F. S.

Paper from bagasse. Little. *See* V.

PATENT.

Cellulosic materials. Ger. Pat. 305,120. *See* V.

XVIII.—FERMENTATION INDUSTRIES.

Alcoholic fermentation in an alkaline medium; Character of ——. II. Fermentation with living yeast in alkaline solutions. C. Neuberg and J. Hirsch. Biochem. Zeits., 1919, **96**, 175—203.

IN the fermentation of sugar by yeast in the presence of sodium bicarbonate a portion of the acetaldehyde which is formed as an intermediate product is not reduced to alcohol, but is converted into an equimolecular mixture of acetic acid and alcohol. Glycerol is produced simultaneously.

—S. S. Z.

Fermentation; Application of the fixation method in bacterial ——. I. Acetaldehyde as an intermediate product in the fermentation of sugar, mannitol, and glycerol by B. coli and dysentery and gas gangrene organisms. C. Neuberg and F. F. Nord. Biochem. Zeits., 1919, **96**, 133—158.

BY using sodium sulphite and calcium sulphite as "fixing" agents, acetaldehyde is shown to be formed as an intermediate product in the fermentation of sugar, mannitol, and glycerol by *B. coli* and

dysentery and gas gangrene organisms. (See also J. Chem. Soc., 1919, i., 612.)—S. S. Z.

Fermentation; Application of the fixation method in bacterial ——. II. Establishment of an acetaldehyde stage in acetic acid fermentation. C. Neuberg and F. F. Nord. Biochem. Zeits., 1919, **96**, 158—175.

By using calcium sulphite as a "fixing" agent the formation of acetaldehyde as an intermediate product in acetic acid fermentation has been established. (See also J. Chem. Soc., 1919, i., 612.) —S. S. Z.

Yeast; Content and formation of invertase in ——. H. von Euler and O. Svanberg. Z. physiol. Chem., 1919, **106**, 201—249.

The inversion capacity of yeasts examined was found to be constant. The optimum temperature for invertase formation was 26°—30° C. The formation ceased at about 65° C. The reaction of the medium influenced the formation and destruction of the enzyme; the invertase was destroyed at a hydrogen-ion concentration of $p_H=2$, but its formation was favoured by higher concentrations. The invertase of fresh living yeast could not be washed out with water at 10° C. (See also J. Chem. Soc., 1919, i., 614.)—S. S. Z.

Yeasts; Augmentation of the catalase activity of ——. H. von Euler and I. Laurin. Z. physiol. Chem., 1919, **106**, 312—317.

The catalase of *Saccharomyces thermantitonum* is activated by chloroform, but not by a higher temperature. Sunlight restricts the action of catalase in living yeast cells, whilst X-rays have no effect on it.—S. S. Z.

Volatile fatty acids. Reilly and Hickinbottom. *See* XII.

Metabolin and antibolin of yeast. Vahlen. *See* XX.

n-Butyl alcohol-acetone-water. Reilly and Ralph. *See* XX.

n-Butyl alcohol. Orton and Jones. *See* XX.

PATENTS.

Fungi, especially film yeasts; Process for the culture of ——. F. Ehrlich, Breslau, and Consortium für Elektrochemische Ind., Nuremberg. Ger. Pat. 313,167, 22.6.16.

For the production of proteins by a biochemical method, suitable fungi are cultivated in a solution in which acetaldehyde, its polymers, condensation products, or derivatives, *e.g.*, paraldehyde, ethyl acetate, aldol, aldehyde-ammonia, are the sole sources of carbon. The yeasts may be previously acclimatised by growth in the usual nutrient media in the presence of acetaldehyde etc., and then further developed in the solutions enumerated above. Suitable fungi are film yeasts and the species *Pidia*, *Willia Hansen*, *Willia Saturnis*, *Klöcker*, *Oidium lactis*, and *Penicillium glaucum*; *Torula* will not grow in acetaldehyde.—A. de W.

Hops; Apparatus for the extraction of oils and resins from ——. F. W. Wolff, London. U.S. Pat. 1,319,984, 28.10.19. Appl., 30.6.17.

See Eng. Pat. 107,155 of 1916; this J., 1917, 936.

Cellulosic materials. Ger. Pat. 305,120. *See* V.

Sulphite-cellulose waste liquor. Ger. Pat. 313,007. *See* V.

Glycerin. Ger. Pat. 310,606. *See* XII.

Plastic masses [from yeast]. U. S. Pat. 1,317,721. *See* XIII.

XIXA.—FOODS.

Milk; Incorrect calculation of the average fat content of —— and its practical significance. E. Vollhase. Milchw. Zentr., 1919, **48**, 225—227.

In calculating the average fat content of a number of different milks, the quantity of milk should always be taken into consideration, particularly in cases where samples are drawn at the time of milking individual cows. The difference made by the introduction of the quantity factor is, however, quite small (it rarely exceeds 0·1%), and old statistics may be used generally for purposes of comparison.—W. P. S.

Average values; Calculation of —— [in milk analysis]. A. Behre. Milchw. Zentr., 1919, **48**, 227—228.

The difference between the average fat content of milk calculated as the simple arithmetical mean of the percentages of fat in a number of milks and that obtained when the quantities of the milks are taken into consideration is usually not more than 0·08%, even when the quantities of milk vary from 1·25 to 40 litres.—W. P. S.

Nitrites; Determination of small quantities of ——, especially in salted meat. F. Auerbach and G. Riess. Arb. Reichsgesundheitsamte, 1919, **51**, 532—555.

The colorimetric determination of nitrites by means of *m*-phenylenediamine is inaccurate owing to the relationship between the concentration and the intensity of colour not agreeing with Beer's law, and also owing to the influence of chlorides. These errors are eliminated by adding sodium acetate and acetic acid to the nitrite solutions. The filtered extract from the meat is treated with colloidal iron hydroxide solution to precipitate proteins and colouring matter and filtered, and 50 c.c. of the filtrate (=1·88 grm. of flesh) is treated with 1 c.c. of 10% sodium acetate solution, 0·2 c.c. of 30% acetic acid, and 1 c.c. of a 0·5 solution of *m*-phenylenediamine hydrochloride containing a few drops of acetic acid. The coloration produced is compared with that given by standard solutions of pure sodium nitrite (*e.g.*, 0·01 to 0·3 mgrm. in 50 c.c.), which have been treated with 0·25 grm. of sodium chloride, and then subjected to the same treatment as the meat extract. About 95% of the nitrite originally present in the meat may thus be determined. It was found in practice that, at most, a few mgrms. of nitrites per 100 grms. was present in meat which had been salted for several weeks with ordinary salt containing about 5% of potassium nitrate. Only in one instance, and then only in the exterior portions, did the amount exceed 10 mgrms. per 100 grms. In the case of meat salted with salt containing a large amount of nitrite the latter had penetrated uniformly into the flesh, and the exterior portions contained from 10 to over 40 mgrms. of sodium nitrite per 100 grms. Synthetical sodium nitrate contains as a rule less than 0·5% of sodium nitrite; this amount of impurity does not prohibit the use of the technical nitrate for pickling purposes. When, however, the amount of nitrite exceeds 15 mgrms. per 100 grms. of meat, the conclusion may be drawn that nitrites have been used for pickling.—C. A. M.

Baking powder; Practical experiments on the efficiency of ——. K. Brauer. Chem.-Zeit., 1919, **43**, 645—647.

Results of baking experiments showed that the quantity of baking powder used should be such that 0·8—0·96 grm. of carbon dioxide is evolved per 500 grms. of dough (not flour). A larger quantity of baking powder does no harm, but is unnecessary. The increase in the volume of the dough during

baking is due, to some extent, to the action of steam apart from that of the evolved carbon dioxide. —W. P. S.

Sulphur; Modified Benedict method for the estimation of —— in feeds, fæces, and foods. J. O. Halverson. J. Amer. Chem. Soc., 1919, **41**, 1494—1503.

About 3·44 grms. of fæces, or 2·7476 grms. of food is rolled up in half a filter paper and placed in a 300 c.c. Kjeldahl flask. Ten to 15 c.c. of hot water is added and the flask heated on a steam bath with slight shaking, 20 c.c. of a mixture of concentrated and fuming nitric acid (1:4) is added, the flask closed with a small funnel and allowed to stand for 12 hours. The mixture is then digested on a steam bath for four days, with occasional shaking. At the end of this time a further 10 c.c. of the acid mixture is added and the digestion continued until the solution is clear, when it is transferred in portions to a 600 c.c. evaporating basin and treated with 20 c.c. of Benedict's reagent (200 grms. of crystallised sulphur-free copper nitrate and 50 grms. of potassium or sodium chlorate per litre) during evaporation to complete dryness. It is then slowly baked on a sand bath. The blackened residue is heated until it fuses, and then the temperature is reduced so that it solidifies slowly. About 20 c.c. of hydrochloric acid (1:4) is added and the mixture heated for 15 minutes on a steam bath. The clear solution is filtered, made up to 100 c.c. with water, heated to boiling, and treated with 10 c.c. of boiling 5% barium chloride solution from a dropper; the addition should take four minutes. The precipitate is digested for two-three hours on a hot plate and then allowed to stand for 48 hours and filtered.—J. F. S.

Nitrogen distribution [in proteins]; Cause of and remedy for certain inaccuracies in Hausmann's method for ——. S. L. Jodidi and S.C. Moulton. J. Amer. Chem. Soc., 1919, **41**, 1526—1531.

The proportion of amide nitrogen obtained by Hausmann's method as modified by Osborne and Harris (this Journal, 1903, 655) is constant and does not depend on the quantity of magnesia added to the distillation mixture. The percentage of nitrogen contained in the magnesia precipitate is higher the greater the quantity of magnesia employed in distillation. Conversely the proportion of monoamino- and diamino-nitrogen is the smaller the larger the amount of magnesia used in distillation. In order to obtain uniform results and a minimum of "humin" nitrogen it is necessary to use the least possible amount of magnesia, which is sufficient to render the substance distilled alkaline. In the case of plant and animal materials the uniform application of 1 grm. of magnesia is satisfactory, whilst in the case of proteins 0·5 grm. is sufficient.—J. F. S.

Polypeptides of which cystine forms a constituent; Synthesis of ——. E. Abderhalden and H. Spinner. Z. physiol. Chem., 1919, **106**, 296—309.

The preparation and properties of a series of polypeptides containing cystine are described, and also the action of alcoholic aqueous ammonia and alcoholic ammonia on dichloroacetyl-*l*-cystine. (See further, J. Chem. Soc., 1919, i., 576.)—S. S. Z.

Polypeptide synthesis; Problem of the physiological ——. E. Abderhalden and H. Spinner. Z. physiol. Chem., 1919, **106**, 309—312.

Glycocoll and benzaldehyde in absolute alcohol and sodium hydroxide produce a condensation product identical with the benzylidene compound of isodiphenyl-oxethylamine, small needles, m. pt. 132° C. In the presence of potassium permanganate the above compounds produce benzoic acid and hippuric acid.—S. S. Z.

Hydrogenated fats. Riess. *See* XII.

Volatile fatty acids. Reilly and Hickinbottom. *See* XII.

Casein. Sammis. *See* XV.

Adsorption by proteins. Bracewell. *See* XV.

Syrups and molasses. Browne. *See* XVII.

Lactose. Saillard. *See* XVII.

Patents.

Dryers; Fruit and vegetable ——. F. E. Boyd, Lenoir, N.C., U.S.A. Eng. Pat. 133,266, 30.4.19. (Appl. 10,768/19.)

A series of trays are supported one above another over a source of heat. Each tray has a set of U-shaped legs of different sizes at each end, journaled on a rod under the tray, so that one or more of them can be folded under the tray and thus enable the distance between the trays to be varied. A bar at each end prevents the legs from collapsing. The sun's rays may also be used as a source of heat, in which case the trays stand singly, and each is provided with an insect-proof cover kept in place by bars or weights at the ends of the tray. —J. H. J.

Lupin-seeds; Treatment of —— for conversion into dietary products. A. Backhaus, Berlin. Ger. Pat. 307,740, 31.8.17.

The seeds are separated from their hard fibrous shells, freed from fat by extraction, steamed to coagulate the albumin, and then treated at a low or moderate temperature with a 5% aqueous solution of salt or potassium chloride, washed, dried, and ground to flour. The 5% or so of fat obtained is freed from bitter principles etc., by the usual methods of refining oils with alkali, after which it can be used as a raw material for the manufacture of margarine. The flour is stated to be suitable for bread-making etc.—A. de W.

Lupin-seeds; Removal of the bitter principles from ——. J. D. Riedel A.-G., Berlin-Britz. Ger. Pat. 312,948, 30.9.17.

The fat-free coarsely-ground seeds are treated with aqueous solutions of alkalis or salts to inhibit their swelling in alcohol, the soaked meal rapidly dried and then extracted with dilute alcohol.—A. de W.

Barley; Treatment of ——. A. Heinemann, Berlin-Wilmersdorf. Ger. Pat. 313,022, 25.4.17.

Sprouted barley grain is softened by soaking, dried to its original water content, kiln-dried, the chaff removed, and the aleurone layer, together with the germ, used as a meal of high fat and nitrogen content. The groats obtained are claimed to be of good flavour and more easily cooked.—A. de W.

Flour, grain, etc.; Removal of mouldy smell and flavour from ——. M. von Gersdorff, Berlin. Ger. Pat. 313,159, 4.4.18.

Flour etc. is treated with heated wood charcoal, lime, etc., at the same time as, or subsequently to, treatment with ultra-violet rays. For example, the exposure to ultra-violet rays may be effected in a heated vessel, the walls of which consist of charcoal, lime, or the like.—A. de W.

Carcases of frozen meat; Electrical process for thawing ——. A. U. Alcock, Melbourne, W. Brander, East Malvern, and H. J. Wagstaff, South Yarra, Victoria. Eng. Pat. 132,221, 14.10.18. (Appl. 16,749/18.) Int. Conv., 5.9.18.

Vegetables and other substances or materials; Apparatus for drying ——. J. H. Morton, London. U.S. Pat. 1,319,605, 21.10.19. Appl., 11.8.19.

See Eng. Pat. 130,714 of 1918; this J., 1919, 788 A.

Coating iron plate. Ger. Pats. 313,189—90. *See* XIII.

Vitamine preparations. Eng. Pat. 133,183. *See* XX.

XIXB.—WATER PURIFICATION; SANITATION.

Phosphoric acid; Volumetric estimation of —— in sewage. W. Marzahn. Hygien. Rdsch., **29**, 525—527. Chem. Zentr., 1919, 90, IV., 564.

PHOSPHORIC acid is precipitated as ammonium phosphomolybdate, which is dissolved in excess of potassium hydroxide and the excess of alkali titrated with sulphuric acid. For example, 100 c.c. of the sewage is boiled vigorously with 20 c.c. of concentrated nitric acid, and whilst still hot treated with 50 c.c. of ammonium molybdate solution. The mixture is well shaken, allowed to stand for five hours, and the precipitate is filtered off, washed with water containing ammonium nitrate and nitric acid, mixed with 100 c.c. of water, dissolved in excess of caustic potash, using phenolphthalein as indicator, and the excess of alkali titrated with sulphuric acid.— S. S. A.

Bladder swellings; Malignant —— among workers in the organic chemical industry. M. Nassauer. Z. angew. Chem., 1919, **32**, 333—335.

MALIGNANT bladder swellings, or bladder carcinomes, a sort of cancerous growth in the bladder, is caused by the continual inhalation of the diluted vapours of aniline extending over a period of years. Other organic bases, with the possible exception of benzidine, do not apparently cause the disease, and even in the latter case it is probably the aniline, formed as a by-product with the benzidine, which induces the disease. Once a worker is afflicted with the disease, which can only be detected at first by the presence of white or red blood corpuscles in the urine, little can be done beyond prolonging his life for a very few years by immediate removal from the factory, regular cystoscopic control, intravesicular destruction of the epithelial growth by electro-coagulation, and eventually a bladder operation. For this reason special precautions are essential in regard to the hygienic control of the workers, the construction and ventilation of the factory, and the prevention of aniline vapour leakage from the apparatus.—G. F. M.

PATENTS.

Treating liquids with gases. Eng. Pat. 133,217. *See* I.

Destroying plant pests. Ger. Pat. 312,465. *See* XII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Meconic acid; Preparation and physiological action of some derivatives of ——. L. Lautenschläger. Biochem. Zeits., 1919, **96**, 73—86.

VARIOUS derivatives of meconic acid were synthesised and tested for their physiological activity. None of the preparations manifested any definite narcotic action. (See also J. Chem. Soc., 1919, i., 609.)—S. S. Z.

Fenugreek seeds; The saponin in ——. H. E. Wunschendorff. J. Pharm. Chim., 1919, **20**, 183—185.

THE saponin may be isolated by extracting the fat-free seeds with boiling alcohol, cooling the alcoholic extract, collecting the gelatinous precipitate which separates out, re-dissolving it in boiling alcohol, cooling the solution and precipitating the saponin with a large excess of ether. The saponin is thus obtained as a colourless, semi-crystalline powder, m. pt. 214°—215° C.; it is very soluble in water, slightly soluble in cold alcohol, and almost insoluble in petroleum spirit, acetone, chloroform, and ether. When hydrolysed by acids, it yields a sapogenin and dextrose.—W. P. S.

Serums and vaccins; Preparation and conservation of —— by desiccation in an absolute vacuum. F. Bordas. Comptes rend., 1919, **169**, 670—672.

FOR the preservation of serums and vaccins it is not sufficient to dry these substances. They must also be kept free from the action of oxygen and moisture. The author advocates the use of small Arsonval-Dewar tubes, capable of holding 5—15 grms. of the pulp dried in an absolute vacuum, the tube being sealed up prior to detachment from the pump. Such preparations may be safely sent to hot climates without any fear of losing their initial activity.—W. G.

Yeast; Metabolin and antibolin of ——. E. Vahlen. Z. physiol. Chem., 1919, **106**, 133—178.

THE author has prepared metabolin and antibolin from yeast which, although not quite identical with the similar principles previously extracted by him from the pancreas of cattle, resembled them in their principal properties. Metabolin accelerates alcoholic fermentation, antibolin has the opposite effect. These principles can be transformed into each other by molecular rearrangement. An irreversible metabolin has also been prepared from yeast and potatoes. This metabolin also accelerated alcoholic fermentation and reduced the amount of sugar in the urine of diabetic patients on two occasions.—S. S. Z.

Hydroxycholesterol. J. Lifschütz. Z. physiol. Chem., 1919, **106**, 271—296.

THE hydrolysis of cholesterol dibromide yields in the presence of sodium acetate a mixture which is partly amorphous and partly crystalline. The amorphous substance is hydroxycholesterol. The double bond of the cholesterol which was eliminated by the bromination is thus re-established on hydrolysis. The crystalline substance, m.pt. 139°—141° C., is a modified cholesterol which the author calls "metacholesterol." On boiling cholesterol dibromide with alcoholic potassium hydroxide a hydroxy derivative of cholesterol is obtained which is not identical with the known hydroxycholesterol. The author proposes the name of "isohydroxycholesterol" for this substance. (See also J. Chem. Soc., 1919, i., 591.)—S. S. Z.

Hydroxyphenylarsinic acids; Isomeric —— and direct arsenation of phenol. W. A. Jacobs and M. Heidelberger. J. Amer. Chem. Soc., 1919, **41**, 1440—1450.

A SIMPLE process for the arsenation of phenol is described. Phenol and dehydrated arsenic acid are boiled together at 155°—160° C. for 7 hrs., the mixture diluted with water, neutralised by barium hydroxide, filtered, the barium precipitated by sulphuric acid, the solution neutralised with alkali, concentrated, and the arsenic acid salt precipitated by adding alcohol. Starting with 480 grms. of 80% arsenic acid and 200 grms. of phenol, 120 grms. of pure sodium *p*-hydroxyphenylarsinate may be isolated. Among the by-products are *o*-hydroxyphenylarsinic acid (14 grms.), Benda's *pp'*-dihydroxydiphenylarsinic acid (10 grms.), and an acid probably *op'*-dihydroxydiphenylarsinic acid, $OH{\cdot}AsO(C_6H_3OH)_2$ (8 grms.). The ortho-acids differ

from their isomerides in giving a wine-red colour with ferric chloride. (See further, J. Chem. Soc., 1919, i., 604.)—J. C. W.

Oxidation of organic compounds with alkaline potassium permanganate. Part I. Oxidation of acetaldehyde. Part II. Oxidation of glycol, glycollic aldehyde, glyoxal, glycollic acid, and glyoxylic acid. W. L. Evans and H. Adkins. J. Amer. Chem. Soc., 1919, **41**, 1385—1414.

In continuation of the work on the oxidation of alcohol (this J., 1919, 793 A), it is found that between certain limits of alkalinity the yields of acetic acid from acetaldehyde are logarithmic functions of the concentration of potassium hydroxide. Below the lower limits the yields are quantitative, and above the higher limits they are constant; they fall with rise of alkalinity and rise of temperature. The other oxidation products, oxalic acid and carbon dioxide, are formed in increasing amounts as the concentration of alkali and temperature increase. In the case of glycol, the sole product in oxidations at 50° C. with less than 0·5 grm. KOH per litre appears to be carbon dioxide, then up to 3 grms. per litre the yield of carbon dioxide falls and that of oxalic acid rises uniformly, after which the ratio between the oxidation products is not affected by further alkali. Glycollic aldehyde also produces carbon dioxide in falling amounts and oxalic acid in increasing amounts, but the yields are logarithmic functions of the alkali concentration. Glyoxal behaves more like glycol; at 50° C. the yields are linear functions of the alkalinity up to 45·5 grms. KOH per litre, after which the yield of oxalic acid is constant at 76·7%. Glycollic acid yields the same proportions of oxalic acid and carbon dioxide no matter whether the concentration is 0·68 or 48 grms. KOH per litre. Glyoxylic acid corresponds with glycollic aldehyde; the yields are logarithmic functions of the alkalinity. The curves connecting the yields of carbon dioxide and oxalic acid at 50° C. with alkali concentrations are identical in the cases of acetic and glycollic aldehydes. It is therefore highly probable that glycollic aldehyde is an intermediate product in the oxidation of acetaldehyde. The results indicate that the oxidation of all these compounds with two carbon atoms may be formulated thus:—

$$CH_3\cdot CH_2\cdot OH \rightarrow CH_3\cdot CHO \rightarrow CH_3\cdot CO_2H$$

$$CH_2:CH\cdot OH \rightarrow OH\cdot CH_2\cdot CHO$$

$$OH\cdot CH_2\cdot CH_2\cdot OH \rightarrow OH\cdot CH_2\cdot CO_2H$$

$$CHO\cdot CHO \rightarrow CHO\cdot CO_2H \rightarrow CO_2 + H_2C_2O_4$$

(See further, J. Chem. Soc., 1919, i., 572.)
—J. C. W.

Ethylene chlorohydrin and ββ-dichloroethyl sulphide. M. Gomberg. J. Amer. Chem. Soc., 1919, **41**, 1414—1431.

An account of work done on the preparation of "mustard gas" under the auspices of the U.S. Bureau of Mines, War Gas Investigations. The isolation of ethylene chlorohydrin from the solution obtained by passing chlorine and ethylene into water is best effected by a combination of distillation, salting out with sodium sulphate at 32°—33° C., and extraction with a suitable solvent. (See further, J. Chem. Soc., 1919, i., 567.)—J. C. W.

Acrolein; Stabilisation of ——. I. Methods of spontaneous alteration of acrolein. C. Moureu and C. Dufraisse. Comptes rend., 1919, **169**, 621—626.

The velocity of the spontaneous change of acrolein into "disacryl" (insoluble resin) is shown to be influenced by the presence of impurities, which cause an acceleration. In the same way rise in temperature and increase in the intensity of illumination cause a marked increase in the rate of change of acrolein into insoluble resin. Similarly it is shown that the change of acrolein into soluble resin is accelerated by the presence of free bases, metallic salts, and certain compounds, such as hydrogen sulphide, the chlorides of arsenic, antimony, bismuth, and tin, and organic nitrogenous compounds. The two changes, namely, conversion into insoluble resin and conversion into soluble resin, cannot apparently proceed simultaneously in the same sample of acrolein, although in some cases one change may proceed for a time and then be replaced by the other.—W. G.

Acrolein; Stabilisation of ——. Empirical process of stabilisation. C. Moureu and A. Lepape. Comptes rend., 1919, **169**, 705—708.

If crude acrolein, obtained by the dehydration of glycerol, is shaken with 10% of its weight of dry sodium bicarbonate, a product is obtained which, if kept in iron bottles, in the absence of air and at a temperature below 30° C., is stable for a long time.—W. G.

Spirits of camphor; Analysis of ——. Utz. Pharm. Zentralh., 1919, **60**, 373—378.

The quantities of camphor and alcohol in a sample of spirits of camphor may be found by determining the sp. gr. and refractive index of the sample. The refractive index of camphor is 1·4535—1·4537 at 20° C., and the sp. gr. 0·9960 at 15° C.; these values are the same for both synthetic and natural camphor. From the data obtained for the sample under examination the percentages of camphor and alcohol are ascertained by reference to a graph constructed from the results obtained with solutions of known composition.—W. P. S.

Chloropicrin. Part I. J. A. Gardner and F. W. Fox. Chem. Soc. Trans., 1919, **115**, 1188—1194.

Chloropicrin slowly decomposes at its boiling point into carbonyl chloride and nitrosyl chloride, according to the equation $CCl_3NO_2 = COCl_2 + NOCl$. The decomposition takes place at the rate of about 2% per day, and the fact of its occurrence throws light on the divergent statements made on the physiological activity of chloropicrin and also furnishes an explanation of the varied chemical reactions which it undergoes. The decomposition is not due to the presence of traces of moisture, as the carefully dried substance decomposes in the same way and at the same rate.—G. F. M.

Halogenated acetic esters; Catalytic reduction of ——. P. Sabatier and A. Mailhe. Comptes rend., 1919, **169**, 758—761.

Halogenated acetic esters may readily be reduced to the corresponding acetic esters by passing their vapours along with hydrogen over reduced nickel at 300° C. The method gave good yields with ethyl mono-, di-, and trichloroacetates and ethyl bromoacetate.—W. G.

Chloretone (trichloro-tertiary butyl alcohol); Some properties of ——. H. C. Hamilton. Amer. J. Pharm., 1919, **91**, 643—648.

Chloretone is unequalled as a general anæsthetic for experimental work, as its action is prolonged and is uncomplicated by any serious effects on the heart and circulatory system. As a hypnotic it probably produces the closest approximation to natural sleep that has yet been discovered; whilst as a local anæsthetic, as compared by laboratory methods, it is almost as effective as cocaine, but its use is limited by its low solubility. Its antiseptic and germicidal action renders it valuable as a preservative, particularly as a substitute for alcohol,

or heat sterilisation, for preventing the growth of bacteria in organic solutions.—G. F. M.

n-Butyl alcohol-acetone-water; The system ——. J Reilly and E. W. Ralph. Sci. Proc. Royal Dublin Soc., 1919, **15**, 597—608.

THE densities of a series of mixtures of *n*-butyl alcohol, acetone, and water have been determined, and by means of curves plotted from the results the composition of an unknown mixture may readily be obtained with a fair degree of accuracy if a density determination and the estimation of one constituent are made. The limit of solubility of *n*-butyl alcohol in water at 20° C. is 7·9% and of water in *n*-butyl alcohol 20%. Acetone and *n*-butyl alcohol are miscible in all proportions, there being a slight increase of volume on mixing.—W. G.

n-Butyl alcohol; Temperature of critical solution of a ternary mixture as a criterion of the purity of ——. *Preparation of pure n-butyl alcohol.* K. J. P. Orton and D. C. Jones. Chem. Soc. Trans., 1919, **115**, 1194—1203.

THE detection or determination of impurities by observation of the critical solution temperature (c.s.t.) of a ternary mixture, a method already applied to toluene (see this J., 1919, 811 A) has been extended to *n*-butyl alcohol, a 14% aqueous solution of hydrogen chloride being chosen to produce the ternary mixture with the butyl alcohol. The system is extremely sensitive to hydrogen chloride, and the aqueous acid must be standardised with great accuracy iodometrically. The method of procedure has already been described (*loc. cit.*). Using 1 c.c. of hydrocholoric acid containing 13·994% of hydrogen chloride, and 0·4958 c.c. of pure *n*-butyl alcohol, an upper c.s.t. at 43·55° C. and a lower c.s.t. at 9·6° C. were found. The c.s.t. is extremely sensitive to the presence of small quantities of water, and, still more markedly, traces of homologues in the alcohol. Pure *n*-butyl alcohol for the purpose of the investigation was prepared by converting the commercial alcohol into the sodium salt of *n*-butyl salicylate, and decomposing the latter with dilute hydrochloric acid. The recovered ester was reconverted into its sodium salt and was finally hydrolysed with 10% aqueous sodium hydroxide and the alcohol dried with potassium carbonate and distilled. The pure *n*-butyl alcohol had sp. gr. 0·81617 at 14·4°/14·4° C.—G. F. M.

Propyl alcohol; Report on the use of —— *in medicinal preparations.* Heffter and Juckenack. Vrtljschr. f. Ger. Med. u. öffentl. Sanitätswesen, 1919 [III.], 58, 1—3. Chem. Zentr., 1919, **90**, IV., 572.

PROPYL alcohol has been suggested recently as a substitute for ethyl alcohol in perfumes and cosmetics. It possesses similar but more concentrated pharmacological properties, and is a stronger local stimulant than ethyl alcohol. Its albumin-precipitating effect is greater than that of ethyl alcohol. Little is known of the effect of propyl alcohol on the human body, but a warning is uttered against its use in foods and drugs for internal use.—W. P.

Methyl alcohol; Action of concentrated sulphuric acid on ——. J. Guyot and L. J. Simon. Comptes rend., 1919, **169**, 655—657.

THE yield of dimethyl sulphate in the action of sulphuric acid on methyl alcohol increases steadily within limits with increase in the molecular proportion of sulphuric acid in the reacting mixture. The complete reaction is really a balance of three reactions:—

$$H_2SO_4+CH_3OH \rightleftarrows CH_3\cdot HSO_4+H_2O;$$
$$2CH_3\cdot HSO_4 \rightleftarrows H_2SO_4+(CH_3)_2SO_4;$$
$$CH_3\cdot HSO_4+CH_3OH \rightleftarrows H_2SO_4+(CH_3)_2O.$$

In order to get the best yield of dimethyl sulphate it is necessary to avoid the presence of water or of excess of methyl alcohol in the reacting mixture. —W. G.

Methyl alcohol; Action of sulphuric anhydride and of oleum on ——. *Preparation of dimethyl sulphate.* J. Guyot and L. J. Simon. Comptes rend., 1919, **169**, 795—797.

METHYL alcohol is added to sulphuric acid (66° B., sp. gr. 1·84) cooled to −18° C., and into this mixture is distilled the calculated quantity of sulphuric anhydride, or alternatively the methyl alcohol-sulphuric acid mixture is added to the calculated quantity of 60% oleum. In either case the mixture is subsequently distilled under reduced pressure. A more direct method is to add 4 parts of 60% oleum to 1 part of methyl alcohol cooled to −18° C. and subsequently to distil the mixture under reduced pressure. By any of these methods the yield is over 90% of the theoretical yield. An alternative method is to pass the vapours of methyl ether into oleum until the whole of the sulphuric anhydride which it contains is converted into dimethyl sulphate and then distil the mixture. —W. G.

Methyl chloride; Determination of ——*in gas mixtures.* V. C. Allison and M. H. Meighan. J. Ind. Eng. Chem., 1919, **11**, 943—946.

A METHOD for the determination of methyl chloride in chlorinated natural gas depends on its solubility in glacial acetic acid. The gaseous mixture is measured in a gas burette and then passed six times into a Hempel pipette containing glacial acetic acid; the residual gas is brought back into the burette and measured. The contraction in the volume indicates the amount of methyl chloride in the sample. The number of times the gas is passed into the Hempel pipette should be limited to six on account of the solubility of natural gas in glacial acetic acid One vol. of glacial acetic acid absorbs 4 vols. of natural gas or 40 vols. of methyl chloride. The method is reliable when the percentage of methyl chloride exceeds 40%, as the solubility of natural gas is then very small, but below 40% the error of the determination is about 4 or 5%. The results obtained agree well with those found by the partial pressure method (this J., 1916, 947). Owing to the high temperature required, the combustion method is not suitable for the purpose.—W. P. S.

Acetone; Micromethod for the estimation of the total —— *in blood.* M. Ljungdahl. Biochem. Zeits., 1919, **96**, 345—362.

THE acetone is distilled into an excess of iodine and alkali; the solution is then boiled and the residual iodine estimated by titration. Small quantities of blood (as little as 0·05 c.c.) can be employed. (See also J. Chem. Soc., Dec., 1919.).—S. S. Z.

Acetone; Micro-method for the estimation of ——. M. Ljungdahl. Biochem. Zeits., 1919, **96**, 325—345.

THE author points out and discusses in detail the conditions which must be observed in the iodometric titrations employed in his micro-method for the estimation of acetone (see preceding abstract) in order to ensure accuracy.—S. S. Z.

Methane; Chlorination of ——. J. Pfeifer, F. Mauthner, and O. Reitlinger. J. prakt. Chem., 1919, **99**, 239—242.

SUITABLE mixtures of chlorine and a natural gas consisting of nearly pure methane, free from olefines, but containing small amounts of oxygen and nitrogen, were passed over antimony penta-

chloride or anhydrous ferric chloride contained in a quartz tube heated at 360°—400° C. With the former catalyst and the gases mixed in the proportion of 1 vol. of methane to 2 vols. of chlorine, methylene chloride (5·8%), chloroform (20·3%), carbon tetrachloride (5·9%), and hydrogen chloride (32%) were obtained, 64% of the chlorine entering into reaction. With ferric chloride and equal volumes of the two gases, the substances formed were methyl chloride (5·8%), methylene chloride (15·7%), chloroform (21·7%), and hydrogen chloride (43·2%), 86·4% of the chlorine being used; when 2 vols. of chlorine were employed to 1 vol. of methane, there were obtained methyl chloride (traces), methylene chloride (13·25%), chloroform (22·2%), carbon tetrachloride (6·35%), and hydrogen chloride (41·8%), 83·6% of the chlorine entering into action. With 2 vols. of methane to 1 vol. of chlorine, 30·1% of methyl chloride and a mixture of approximately equal amounts of methylene chloride and chloroform were produced. When the proportion of methane to chlorine was 3:1, the yield of methyl chloride rose to 40% of that theoretically possible. Attempts to secure carbon tetrachloride in good yield by increasing the relative amount of chlorine were rendered difficult by the occurrence of violent explosions; a mixture of carbon tetrachloride and chloroform was, however, obtained by the use of methane (1 vol.) and chlorine (3 vols.) diluted with nitrogen (2 vols.).—H. W.

Oxalates. Wester. *See* VII.

Volatile fatty acids. Reilly and Hickinbottom. *See* XII.

Bladder swellings among workers in organic chemical industry. Nassauer. *See* XIXB.

PATENTS.

Vitamine preparations; Manufacture of ——. O. Imray, London. From Society of Chemical Industry in Basle, Switzerland. Eng. Pat. 133,183, 15.10.18. (Appl. 16,830/18.)

FINELY divided vegetable material, *e.g.*, sorrel, cabbage, chestnut meal, ground rice husks, or the like, is treated with sufficient non-volatile acid or acid salt, which may be that contained in the expressed juice, to saturate completely or to a great extent the acid-binding capacity of the material, and the mass is concentrated to the desired consistency or dried, with or without separation of the solid material, at a temperature below 100° C. The requisite quantity of acid is ascertained by adding a known quantity of acid to a suspension of the material in water and titrating the filtered solution with standard alkali, using methyl orange as indicator. Baked products containing vitamines may be prepared by mixing material treated as above with flour or starch and sodium bicarbonate or yeast to form a dough, which is then baked below 100° C. The activity of the vitamines is not destroyed by the above treatment.—L. A. C.

Castor oil; Manufacture of [medicinal] ——. T. P. Dave, Bombay. Eng. Pat. 133,905, 17.4.19. (Appl. 9843/19.)

A PALATABLE castor oil of increased purgative action is obtained by crushing together, say, 15 lb. of castor seed and 1½ lb. of rose buds or rose leaves, and boiling the soft mass with water to separate the oil from the seed and extract the essence from the rose leaves. The oil is cooled, separated, and mixed with milk in the proportion of 7 lb. of oil to 1 lb. of milk, the whole boiled in order to bleach and purify the oil, strained, cooled, and finally mixed with glycerin in the proportion of 1 lb. of oil to ½ drachm of glycerin.—A. de W.

Petroleum hydrocarbons; Process of making derivatives of ——. C. Ellis, Montclair, N.J., Assignor to Ellis-Foster Co. U.S. Pat. 1,317,868, 7.10.19. Appl., 19.9.16.

OLEFINIC compounds prepared by cracking petroleum are chlorinated and then treated with a reagent which removes chlorine.—A. E. D.

Hexamethylenetetramine nitrate; Preparation of ——. [*Precipitating nitric acid from solution.*] Zentralst. f. wissensch.-tech. Untors., G.m.b.H., Neubabelsberg. Ger. Pat. 298,412, 12.7.16.

SOLID hexamethylenetetramine is added, with cooling, to dilute nitric acid which may contain sulphate. The nitrate separates readily to the extent of 95% of the theoretical amount, and the process may be employed for the removal of nitric acid from its aqueous solution.—W. J. W.

Aluminium-casein compound; Preparation of a water-soluble ——. J. A. Wülfing, Berlin. Ger. Pat. 312,222, 28.10.17.

CASEIN suspended in strong alcohol, or other indifferent organic solvent miscible with water, is treated with aluminium and sodium hydroxides in equimolecular quantities in presence of small quantities of water. The new preparation has the advantage over the known sparingly soluble aluminium casein compound of being easily decomposed by very dilute hydrochloric acid, and is therefore more suitable for medicinal purposes.—L. L. L.

Aluminium compounds insoluble in water; Manufacture of ——. H. P. Kaufmann, Jena. Ger. Pat. 313,606, 13.10.17.

COMPOUNDS of aluminium insoluble in water are prepared by the action of aromatic organic acids upon basic aluminium acetate in the presence of solvents. For example, benzoic acid and *p*-chlorobenzoic acid heated on the water bath with basic aluminium acetate in the presence of water give white powders insoluble in water from which the organic acid cannot be extracted by solvents such as ether. By shaking basic aluminium acetate with an aqueous solution of tannin at the ordinary temperature, the solution is decolorised and a yellowish-grey powder is formed. The product is valuable for treating diseases of the intestines, is tasteless, and does not react with the gastric juice.—L. A. C.

Nitriles; Preparation of —— *from quinatoxins.* Farbw. vorm. Meister, Lucius, und Brüning, Höchst. Ger. Pat. 313,321, 26.10.17.

NITRILES are obtained by treating isonitrosoacidyl derivatives of quinatoxins with acylating agents in presence of an alkali. From hydrocinchonine (cinchotinetoxin), by treatment with benzoyl chloride in presence of sodium hydroxide, a benzoyl derivative is obtained which is converted by means of amyl nitrite and sodium ethoxide into an isonitroso-derivative. Further treatment with 5% sodium hydroxide and *p*-toluenesulphochloride converts this into benzoylcincholoiponnitrile, which forms white crystals, m.pt. 62° C., soluble in ether, but only slightly soluble in water and alkali. Similarly, cinchotoxine treated with acetyl chloride forms acetylcinchonicine. Amyl nitrite and sodium ethoxide convert this into isonitrosoacetylcinchonicine, and by treating this with 5% sodium hydroxide and benzoyl chloride acetylmerocinchenine nitrile is obtained as a colourless oil. The nitriles serve as initial products for pharmaceutical preparations.—W. J. W.

Ethylidene-ethylene sulphide; Manufacture of ——. O. Matter, Cologne. Ger. Pat. 313,650, 7.6.18.

AMORPHOUS ethylene sulphide, prepared by the action of ethylene bromide or chloride on an

aqueous or alcoholic solution of an alkali sulphide, is heated to a dull red heat in the absence of air. Ethylidene-ethylene sulphide distils over, and is purified by passage through a tube heated to 300° C. and loosely packed with a contact material such as pieces of clay. The distillation proceeds more smoothly if a solid such as a metallic sulphide is added to the ethylene sulphide, and it is advisable to pass a current of hydrogen sulphide through the apparatus. The product, after shaking with an alkaline solution, is nearly colourless and boils at 172°—173° C.; it is a good solvent for organic substances and is used in the manufacture of pharmaceutical preparations.—L. A. C.

N-Monoarylsulphomonoalkyl (allyl, aralkyl-) amido-oxyaryl compounds, N-monoalkyl (allyl, aralkyl-) amido-oxyaryl compounds, and arylsulpho-esters of amido-oxyaryl compounds; Manufacture of esters of ——. O. Imray, London. From Society of Chemical Industry in Basle, Switzerland. Eng. Pat. 133,433, 8.10.18. (Appl. 16,379/18.)

See U.S. Pat. 1,316,804 of 1919; this J., 1919, 848 A.

Dimethyl sulphate; Process for the production of ——. T. H. Durrans, Oxford, Assignor to A. Boake, Roberts, and Co., London. U.S. Pat. 1,317,648, 30.9.19. Appl., 1.7.18.

See Eng. Pat. 119,250 of 1917; this J., 1918, 717 A.

Dental preparation and method of making the same. V. V. J. Andresen, Copenhagen. U.S. Pat. 1,318,254, 7.10.19. Appl., 21.7.17.

See Eng. Pat. 110,154 of 1917; this J., 1918, 636 A.

Corpus luteum; Process for the manufacture of a menses-increasing substance from ——. *Process for the manufacture of a menses-controlling preparation from Corpus luteum.* L. Seitz and H. Wintz, Erlangen, Germany, Assignors to Soc. of Chem. Ind. in Basle, Switzerland. U.S. Pats. 1,318,698 and 1,318,699, 14.10.19. Appl., 14.4.15.

See Eng. Pat. 10,877 of 1915; this J., 1916, 943.

Acetaldehyde; Manufacture of ——. E. Steinbuch and P. Schetelig, Assignors to Soc. of Chem. Ind. in Basle, Switzerland. U.S. Pat. 1,319,365, 21.10.19. Appl., 25.9.18.

See Eng. Pat. 130,138 of 1918; this J., 1919, 695 A.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Chromium intensification of [photographic] silver images; New method for —— by the use of chloro-chromates. A. and L. Lumière and A. Seyewetz. Bull. Soc. Franç. Phot., 1919, 6, 245—250.

Alkali chloro-chromates are produced by evaporating to crystallisation concentrated solutions of the corresponding bichromate with the calculated quantity of hydrochloric acid:

$$M_2Cr_2O_7 + 2HCl = 2MO.CrO_2Cl + H_2O.$$

The potassium salt crystallises readily in orange-red needles; the sodium salt is hygroscopic and difficult to crystallise; the ammonium salt is more soluble than the potassium salt and crystallises in orange-red scales. Any of these salts can be used for intensification in place of the usual hydrochloric acid-bichromate formula previously described by other workers; a 3% solution is suitable for use with plates and a 2% solution with papers, the treatment in this bath being followed, after washing, by treatment with a strong developing agent. A repetition of the intensifying process increases the amount of intensification, an approximate maximum being reached in six treatments. In these successive treatments the total quantity of silver in the image remains practically constant, while the proportion of chromium increases; the ratio of chromium to silver, was, in one experiment, after two intensifications 33·3:66·6, and after six intensifications 58·5:41·5. It is suggested that the action of the chlorochromate on the image is expressed by the equation

$$2Ag + MCrO_3Cl = AgCrO_3Cl + AgCl;$$

the silver chloride being then reduced by the developer to silver, each intensification thus reducing the metallic silver in the image by one half.
—B. V. S.

Patents.

Colour-sensitised photographic materials. F. F. Renwick, Brentwood, and O. Bloch, London. Eng. Pats. (A) 133,769 and (B) 133,770, 15.10.18. (Appls. 16,845 and 16,846/18.)

(A) A light-sensitive emulsion or film is treated with a dye of the auramine, $[N(CH_3)_2C_6H_4]_2{:}C{:}NH$, or iminodiphenyl class, which increases the blue sensitiveness. For the bathing process a solution of strength 1:50,000 may be used; if the dye is added to the emulsion from 0·005 to 0·025 grm. per litre may be used. (B) A light-sensitive emulsion or film is treated with a dye of the auramine class together with one or more dyes of the isocyanine class, such as Sensitol Red (Pinacyanol). The effect obtained is generally both different from and greater than the sum of the effects of the two dyes taken separately; for instance, Auramine and Sensitol Red, used together in this way, give a greater red and green sensitiveness than Sensitol Red alone and also new sensitiveness to the deep red. The quantities of Auramine required are similar to those of the other sensitising dyes, but the Auramine may be increased so as to operate as a yellow screen as well as a sensitising dye. Plates with freedom from fog and with good keeping properties as well as of high colour-sensitiveness may be obtained by this process.—B. V. S.

Examining metals with Röntgen rays. Ger Pat. 301,327. *See* X.

XXII.—EXPLOSIVES; MATCHES.

Stability of nitroglycerin explosives; Determination of the ——. W. Will. Z. ges. Schiess- u. Sprengstoffw., 1919, 61—64. Chem.-Zeit., 1919, 43, Rep., 255.

Eight nitroglycerin explosives of varying degrees of stability were examined by Mayrhofer's modification of the Bergmann-Junk method (this J., 1919, 603 A). In the case of powders of low stability differences can easily be detected in one hour, but with more stable powders the differences are not distinguishable in less than five hours. The decomposition of very stable explosives is not increased by the addition of water. The relative degrees of stability of various explosives cannot be ascertained from the vapour tints in the tubes or by the use of potassium iodide solution as an indicator.
—W. J. W.

Nitroglycerin from waste acids; Separation of ——. T. Szaffka. Z. ges. Schiess- u. Sprengstoffw., 1919, 44—45. Chem.-Zeit., 1919, 43, Rep. 255.

To avoid the necessity for handling and trans-

porting nitroglycerin which has separated from waste acids, a small separator is used provided with a lead pipe terminating in a funnel just below a cock in the waste acid tank. When most of the waste acid has been run through the denitrator the layer of acid and nitroglycerin is allowed to flow into the separator. After a suitable interval for separation the acid is run off into a montejus and the nitroglycerin drawn off into an earthenware vessel in the "after-separation" plant and washed with water.—W. J. W.

Ammonal; Analysis of ——. A. Wogrinz. Z. ges. Schiess- u. Sprengstoffw., 1919, **6**, 64. Chem.-Zeit., 1919, **43**, Rep., 230.

THE nitro-compound and ammonium nitrate are extracted on a filter with chloroform and cold water respectively. The residue, consisting of charcoal and aluminium is transferred, together with some glass beads, to a decomposition flask and carefully decomposed with 45—50 c.c. of 50% sodium hydroxide, the flask being connected to a nitrometer filled with water in which the hydrogen evolved is measured. The results are accurate to within 0·5% of the aluminium, or 0·05—0·17% calculated on the ammonal.—W. J. W.

Hexanitrodiphenylamine; Salts of ——. H. Kast and A. Langhans. Z. ges. Schiess- u. Sprengstoffw., 1919, **6**, 1—4, 25—27. Chem.-Zeit., 1919, **43**, Rep., 230.

SALTS of hexanitrodiphenylamine and heavy metals may be prepared by the interaction of carbonates and oxides with the magnesium salt of the nitro-compound. Organic salts which may be regarded as addition products, and are similar to those obtained with picric acid, are formed with aniline, pyridine, and quinoline. Organic hydrochlorides and nitrates do not combine with metallic salts of hexanitrodiphenylamine. Determinations were made of the solubility in 95% alcohol, water of crystallisation, and the basicity. The salts cannot be titrated, as the end point is indefinite, but the hexanitrodiphenylamine is liberated by excess of acid and can then be weighed. Ignition and sensitiveness tests showed the lead salt to be the most sensitive, followed in order by the copper, sodium, iron, potassium, and calcium salts. All salts of hexanitrodiphenylamine, except the ammonium and magnesium salts, are more sensitive than hexanitrodiphenylamine itself.—W. J. W.

Tetranitromethylaniline (tetryl); Decomposition of ——. E. von Herz. Z. ges. Schiess- u. Sprengstoffw., 1919, 101—103. Chem.-Zeit., 1919, **43**, Rep., 255.

RUSSIAN hand-grenades consist of a sheet zinc case containing a pressed charge of trinitrotoluene and potassium nitrate. In this is inserted a tetryl charge with a perforation for a tinned brass tube containing the detonator. On examination of a grenade which had been exposed to water, it was found that the case was bulged and corroded, the TNT was covered with potassium nitrate, and the tetryl had acquired a brownish-black colour, the inner portion round the perforation being black and spongy. The detonator tube was unchanged. There was a faint smell of ammonia. The tetryl burnt fiercely on ignition, and parts of it were extremely sensitive. The decomposition was found to have an electrolytic origin, the zinc container and the brass detonator tube forming the negative and positive poles respectively and the moist potassium nitrate acting as electrolyte. By the action of the hydrogen the side-chain NO_2 groups of the tetryl are converted into methylamine, the other NO_2 groups being reduced to hydrazine derivatives, and by the action of nitrous acid derived from nitrite formed by reduction of potassium nitrate, these compounds gave rise to very explosive azides and diazo-acids. (See also this J., 1919, 697 A.)—W. J. W.

Temperatures of explosion calculated from specific heats; Comparison of the —— with the temperatures of explosion calculated from explosion pressures. H. Muraour. Comptes rend., **169**, 723—726.

THE results of experiments with mixtures of tolite and ammonium nitrate indicate that the explosion temperatures as calculated from the specific heats given by Mallard and Le Chatelier or by Sarrau are markedly higher than the figures obtained by calculation from the manometric tables, except where the temperatures are above 3000° C. The results obtained by either method in the region 1500°—1700° C. are certainly below the actual temperatures. The results, as calculated from the manometric pressure in this region, are so low as to indicate either that the value of the pressure must be modified or that the law used for expressing the compressibility of gases at high temperatures and pressures is incorrect. Over the temperature range 1300°—2700° C. the temperatures as calculated from Schreber's specific heats are in accord with those calculated from the pressure tables of the French testing laboratories.—W. G.

PATENTS.

Detonation of explosives. J. B. Semple, Sewickley, Pa., U.S.A. Eng. Pat. 133,393, 16.8.18. (Appl. 13,360/18.)

A COMPOUND detonator for detonating inert explosives, such as TNT, contains tetryl, preceded by a sensitive initiating explosive such as mercury fulminate, and in front of this an accelerating explosive, such as silver acetylide or lead azide. The employment of the accelerating substance enables a much smaller quantity of fulminate to be used effectively than is the case in the ordinary tetryl-fulminate detonator.—W. J. W.

Explosives; Buildings for manufacturing and storing ——. J. Frenz, Cöln-Nippes. Ger. Pat. 313,764, 19.6.15.

THE walls are constructed of friable, porous concrete in which is embedded a network of expanded metal. They are sufficiently strong to withstand outside shocks—*e.g.*, the explosion of an adjacent building. If, however, an explosion occurs inside the building the effect of the network is to fracture the concrete into pieces of the size of the mesh, and at the same time the mesh itself, becoming distorted, causes a further crumbling and demolition of the concrete.—W. J. W.

Smoke-making compound for signal rockets. R. C. Gowdy, Cincinnati, Ohio, Assignor to Government of U.S.A. U.S. Pat. 1,318,074, 7.10.19. Appl., 24.4.19.

A SMOKE-PRODUCING composition consisting of hexachloroethane, magnesium powder, and anthracene. —A. B. S.

Explosives; Preparation of an oxygen-carrying salt suitable for the manufacture of —— and process for making these explosives. A. J. Marin, Paris. U.S. Pat. 1,320,160, 28.10.19. Appl., 11.6.18.

SEE Eng. Pat. 131,388 of 1918; this J., 1919, 795 A.

Matches. L. V. Aronson, Newark, N.J., U.S.A. Eng. Pat. 133,804, 31.10.18. (Appl. 17,848/18.)

SEE U.S. Pat. 1,287,819 of 1918; this J., 1919, 200 A.

Nitronaphthalene. Eng. Pat. 133,918. *See* III.

XXIII.—ANALYSIS.

Membrane filters; Chemical analysis with ——. R. Zsigmondy and G. Jander. Z. anal. Chim., 1919, **58**, 241—280.

The filters described by Zsigmondy and Bachmann (this J., 1918, 453 A) may be used generally in analysis for the collection of fine or colloidal precipitates which may be washed rapidly on the filter. —W. P. S.

Distillation and extraction apparatus; Simple ——. H. W. van Urk. Pharm. Weekblad, 1919, **56**, 1301—1303.

The apparatus consists of a double-walled copper vessel. The inner vessel is 40 cm. high and 25 cm. in diameter, and is provided with a perforated false bottom on which is placed the material to be extracted. The outer vessel is provided with a gauge glass. Steam or alcohol vapour may be led from the outer jacket through a tube leading into the inner space under the false bottom. The cover of the inner vessel is provided with two upright tubes. One of these leads into the upper end of a vertical condenser, the other directly into the lower end. The latter is provided with a side tube leading into a receiver. By means of taps on the tubes vapour issuing from the vessel may be led through the condenser from above and thence to the receiver, or it may enter the condenser from below and the condensed liquid flow back into the vessel. —W. S. M.

Gas analysis apparatus. Freymuth. Chem.-Zeit., 1919, **43**, 674.

An apparatus for the determination of such gases as ammonia, hydrocyanic acid, carbon dioxide, sulphur dioxide, etc., in air, consists of a graduated cylinder having a tap at the bottom (similar to a cylindrical separating funnel) and provided with a stoppered tubulure at its shoulder; the top of this cylinder has the form of a small bubbler, which is also provided with a stoppered tubulure for the admission of absorbent reagents. The graduated cylinder is filled with water, and when this is allowed to flow out by opening the tap, the air under examination is drawn through the absorption bulb, the latter being provided with inlet tube. The volume of water discharged from the cylinder gives a measure of the quantity of air aspirated through the absorption bulb.—W. P. S.

Water; Method for the preparation of conductivity ——. C. B. Clevenger. J. Ind. Eng. Chem., 1919, **11**, 964—966.

Steam, from water to which phosphoric acid or potassium acid sulphate has been added, is passed through a coil and trap where substances less volatile than steam are condensed and eliminated; the steam then passes into a condenser through which a current of pure air is led to remove remaining impurities. The condenser consists of a vertical tin tube, 6 ft. long and 1·25 in. in diameter, and the steam tube enters the side at about one-half the height; condensing jackets, about 1 ft. in length, are provided at the top and near the bottom of the tube. The air is admitted through a side tube below the lower condensing jacket and the lower end of the condenser tube is bent upwards and then downwards and discharges into a suitable container. A small side tube on the bent lower portion of the condenser tube enables samples of the water to be taken from time to time. The upper end of the condenser is connected with a bottle containing sulphuric acid and, when the still is not in use, with a series of absorption vessels to prevent entrance of ammonia and carbon dioxide. All the working parts of the apparatus are made of tin or are tinlined and the joints are made tight with tinfoil packing.—W. P. S.

Molecular weight determination by direct measurement of the lowering of the vapour pressure of solutions. R. Wright. Chem. Soc. Trans., 1919, **115**, 1165—1168.

A flask containing the pure solvent is fitted with a ground-in delivery tube leading to the bottom of a test-tube about 20 cm. long containing the solution. The neck of the test-tube is fitted with a hollow stopper through which the delivery tube is sealed, and the whole apparatus is thoroughly exhausted through a side tube in the test-tube provided with a tap. The removal of the last traces of dissolved air may be assisted by gently warming the apparatus in warm water. When the apparatus has cooled to the ordinary temperature, as the vapour pressure of the solvent exceeds that of the solution, the liquid in the delivery tube will be depressed below the level in the test-tube to an extent, after allowing for capillarity, equal to the depression of the vapour pressure, whence the molecular weight of the solute may be calculated by the usual equation for the lowering of the vapour pressure.—G. F. M.

Electroanalyses with amalgamated copper cathode. J. Alemany. Anal. Fís. Quím., 1919, **17**, 174—188.

The amalgamated cathode described consists of a copper gauze cylinder, 5·5×11 cm. On this is deposited about 1 grm. of silver by electrolysis in alkaline silver cyanide solution. The cathode is then amalgamated by electrolysis in mercurous nitrate solution until 0·8—1·5 grm. of mercury has been deposited. Excess of mercury is shaken off, and the electrode washed with water, alcohol, and ether. In combination with this cathode a rotating anode of platinum or iron is employed. The temperature of electrolysis must not exceed 45° C. The following estimations are described in detail:—Zinc in alkaline, ammoniacal, and neutral solution in presence of nitrate; zinc in sulphuric acid solution; cadmium in ammoniacal solution in presence of nitrate; cadmium in sulphuric acid and neutral solution. In all cases the results are excellent. —W. S. M.

Copper; Electrolytic determination of —— without platinum electrodes. J. Guiteras. Anal. Fís. Quím., 1919, **17**, 209—216.

A copper cathode and a rotating anode of passive iron were employed. 0·1—0·2 grm. of electrolytic copper was dissolved in a little nitric acid and various electrolytes were made up by the addition of 5 grms. of disodium phosphate dissolved in water and 15 c.c. of concentrated ammonia solution, 5 c.c. of 50% ammonium acetate solution and 15 c.c. of ammonia, 3 grms. of ammonium oxalate in water and 15 c.c. of ammonia, 15 c.c. of formic acid solution (75 c.c. water and 25 c.c. formic acid of sp. gr. 1·2) and 15 c.c. of ammonia, 2 grms. of citric acid in water and 15 c.c. of ammonia, or 2 grms. of boric acid in water and 15 c.c. of ammonia. During electrolysis, which was complete in less than one hour and a-half, the electrolyte was kept warm, and the voltage decreased from about 3 volts to 1·7—1·8 volts. The experiments were repeated with the constant voltage of one accumulator throughout. In all cases the deposits on the cathode were coherent and the results satisfactory. Experiments in ammoniacal solutions gave unsatisfactory results. —W. S. M.

Nickel; Electrolytic determination of ——, without platinum electrodes. E. Fernández-Espina. Anal. Fís. Quím., 1919, **17**, 199—205.

A copper cathode and a rotating passive iron anode

were employed. About 0·1 grm. of nickel was dissolved in nitric acid and the solution evaporated to dryness with 18 drops of sulphuric acid. Various electrolytes were prepared by the further addition of sodium phosphate solution and 10 c.c. of concentrated ammonia, 5 c.c. of 50% ammonium acetate solution and 10 c.c. of ammonia, 15 c.c. of 25% formic acid and 15 c.c. of ammonia, 5 grms. of ammonium oxalate in 15 c.c. of water and 15 c.c. of ammonia, 2 grms. of crystallised boric acid and 15 c.c. of ammonia, or 2 grms. of tartaric acid and 10 c.c. of ammonia. The solution was in each case diluted to a convenient volume. During the electrolysis the electrolyte was kept slightly warm, and the current increased from 0·4 to 0·8 ampère. The results were moderately satisfactory except in the case of the electrolyte containing tartaric acid, where some solution and deposition of the iron seemed to take place.—W. S. M.

Iron; Hydrochloric acid colour method for estimating ——. J. C. Hostetter. J. Amer. Chem. Soc., 1919, **41**, 1531—1543.

IRON may be estimated in hydrochloric acid solution by a comparison of the colour with the colour of standard solutions. It is recommended that the constant boiling hydrochloric acid should be used in this estimation because the tint is very dependent on the concentration of the acid. (See also J. Chem. Soc., Dec., 1919.)—J. F. S.

Lead; Microchemical detection of ——. G. Denigès. Bull. Soc. Pharm. Bordeaux, 1919, 129. J. Pharm. Chim., 1919, **20**, 159—160.

THE test depends on the formation of crystals of lead iodide when a lead salt is treated with a drop of potassium bromide and a drop of potassium iodide solution; in the case of insoluble lead salts, a drop of sulphuric acid is also added. Lead chromate, cyanide, and fluoride should be evaporated previously with hydrochloric acid, whilst metallic lead and lead sulphide are treated with nitric acid before the test is applied. Lead iodide itself, when heated with hydrochloric acid and then cooled, yields yellow crystals of the iodide and also colourless crystals of lead iodide hydrochloride.—W. P. S.

Gallium; Sulphite method for the separation and estimation of —— when associated with zinc. L. E. Porter and P. E. Browning. J. Amer. Chem. Soc., 1919, **41**, 1491—1394.

GALLIUM is conveniently precipitated from neutral or slightly acid solutions of zinc by adding 4 or 5 c.c. of ammonium bisulphite solution (made from 1:4 ammonia) to 200 c.c. of the zinc solution and boiling. Gallium is precipitated in a granular form and washed by decantation. The precipitate is dissolved in a few drops of hydrochloric acid, diluted with 200 c.c. of water and re-precipitated as before. It is then filtered off, washed, ignited, and weighed as Ga_2O_3. The potassium ferrocyanide test is sensitive to 0·0002 grm. of gallium, and may be used to detect this element in the presence of zinc. If sodium or ammonium bisulphite is added to such a cold solution and then potassium ferrocyanide there will be no precipitation, but on the addition of a few drops of hydrochloric acid the gallium will be precipitated, but not the zinc.—J. F. S.

Carbon [in organic substances, soils, etc.]; Determination of —— by wet combustion, using barium hydroxide as absorbent. P. L. Hibbard. J. Ind. Eng. Chem., 1919, **11**, 941—943.

THE following is an outline of the procedure recommended. The substance is heated in a Kjeldahl flask with chromic acid and sulphuric acid, and the resulting carbon dioxide is carried into barium hydroxide solution by a current of purified air; the excess of barium hydroxide is then titrated with standardised hydrochloric acid used phenolphthalein as indicator. The air is purified by passing it through a tube filled with soda-lime; after leaving the Kjeldahl flask, the air, carrying with it the carbon dioxide etc., passes through a condensing tube, a flask containing sulphuric acid, a vertical tube filled with glass beads moistened with sulphuric acid, and a tube filled with granulated amalgamated zinc. The barium hydroxide solution is contained in a flask into which extends the lower end of an inclined Meyer bulb tube.—W. P. S.

Arsenic; Modifications of Pearce's method of determining ——. J. Waddell. J. Ind. Eng. Chem., 1919, **11**, 939—941.

BENNETT'S modification of this method (this J., 1899, 610) is liable to give too high results, whilst the results obtained by Canby's modification (*ibid.*) may be so low that they are valueless. Both these modifications may, however, be rendered trustworthy by the following alterations. In Bennett's method any large amount of alkali should be removed by adding a slight excess of nitric acid, the solution then rendered slightly alkaline with sodium hydroxide solution and again very slightly acid with acetic acid before precipitation of the arsenic as silver arsenate. The same procedure should be adopted in Canby's method, except that a very slight excess of nitric acid is added in place of acetic acid, and, after addition of silver nitrate, this small excess is neutralised by zinc oxide.
—W. P. S.

Gastric analysis; Apparatus for rapid —— together with a method for the preservation of starch solution. R. J. Miller. J. Ind. Eng. Chem., 1919, **11**, 963—964.

AN apparatus for the titration of total acidity, free acidity (Sahli method; titration with $N/100$ thiosulphate), and amino-acid nitrogen (formaldehyde method) consists of two burettes carried by a stand, one burette being used for $N/100$ alkali hydroxide solution and the other for $N/100$ thiosulphate solution. The burettes are filled from reservoirs by suction, and are provided with devices for returning excess of solution to the reservoir. The stand also carries the delivery tube of a reservoir containing starch solution, and an automatic pipette for the delivery of formaldehyde solution. The starch solution is kept in a reservoir under a layer of liquid petrolatum; if desired, 1 c.c. of toluene may be added to the starch solution.
—W. P. S.

Analysis of coal gas. Buckley and Sinnatt. *See* IIA.

Gas analysis Smith. *See* IIA.

Tar value of mineral oils. Krammer. *See* IIA.

Olefines in petrol etc. Tausz and Wolf. *See* IIA.

Balloon fabrics. Edwards and Pickering. *See* V.

Copper value of cellulose. Hägglund. *See* V.

Fibres in paper. Griffin. *See* V.

Determining sulphate as barium sulphate and as strontium sulphate. Kolthoff and Vogelenzang. *See* VII.

Periodic acid. Rosenheim and Loewenthal. *See* VII.

Double fluorides. Clark. *See* VII.

Sodium silicofluoride. Drawe. *See* VII.

Iodide, bromide, and chloride. Kolthoff. *See* VII.

Alkali iodides. Lasausse. *See* VII.

Cuprous iodide. Lasausse. *See* VII.

Hydrocyanic acid. Chelle. *See* VII.

Thiocyanate. Chelle. *See* VII.

Manganese salts and oxalates. Wester. *See* VII.

Thiosulphuric acid. Bolland. *See* VII.

Manganese in steel. Robinson. *See* X.

Phosphorus in steel. Maitchell. *See* X.

Hydrogenated fats. Riess. *See* XII.

Volatile fatty acids. Reilly and Hickinbottom. *See* XII.

Paint analysis. Hough. *See* XIII.

Starch indicator. Hough. *See* XIII.

Milk analysis calculations. (1) Vollhase. (2) Behre. *See* XIXA.

Nitrates in salted meat. Auerbach and Riess. *See* XIXA.

Sulphur in foods etc. Halverson. *See* XIXA.

Nitrogen distribution [in proteins]. Jodidi and Moulton. *See* XIXA.

Phosphoric acid in sewage. Marzahn. *See* XIXB.

Spirits of camphor. Utz. *See* XX.

Oxidation of organic compounds with permanganate. Evans and Adkins. *See* XX.

n-Butyl alcohol-acetone-water. Reilly and Ralph. *See* XX.

Methyl chloride. Allison and Meighan. *See* XX.

Acetone in blood. Ljundahl. *See* XX.

Estimation of acetone. Ljundahl. *See* XX.

Nitroglycerin explosives. Will. *See* XXII.

Ammonal. Wogrinz. *See* XXII.

PATENTS.

Hardness of bodies; Process and apparatus for measuring the ——. Soc. Lorraine des Anciens Etabl. de Dietrich et Cie de Luneville, Paris. Eng. Pat. 120,884. 23.10.18. (Appl. 17,328/18.) Int. Conv., 12.11.17.

A DIAMOND is pressed with gentle constant pressure on to the surface of the body and the force required to move the diamond in contact with the body is measured. The diamond is mounted at the end of a lever attached to a framework by means of a universal joint, and is allowed to rest under gentle pressure on the surface to be tested. The lever is subjected to a gradual increasing force tending to move the diamond along the surface of the body. This force is applied by means of a weight suspended from one arm of a balance lever, and immersed in mercury contained in one limb of what is essentially a U-tube. The mercury level, and consequently the force applied, is controlled by a piston in the other branch of the U-tube, which is operated by means of a screw and hand wheel, the rotation of which indicates the weight applied to cause movement of the diamond. Movement of the diamond may be signalled by electrical means. —C. A. K.

Condenser [; Reflux ——]. J. J. Bajda, Flushing, N.Y. U.S. Pat. 1,317,262, 30.9.19. Appl., 25.6.18.

THE vapour passes by means of a side tube and an upright tube outside the main body of the condenser through the upper wall of the water jacket into a spiral in the upper part of the jacket. The spiral terminates in a siphon trap passing through the bottom of the water jacket and thus giving communication with the boiling vessel. From the lowest point of the spiral a vertical tube passes up within the spiral and through the top of the water jacket and terminates in an adapter, connecting the siphon trap with the outer air, and forming a feed-tube.—B. V. S.

Calorific value of gases; Apparatus for determining the ——. H. Strache, Vienna, and K. Kling, Lemberg. Ger. Pat. 312,832, 3.7.17. Int. Conv., 30.6.16.

MEASURED volumes of gas and air are drawn by a gas pump into an explosion vessel surrounded by a Dewar vessel to prevent radiation, and the calorific value is found from the rise of temperature on explosion as shown by a mercury thermometer mounted in the explosion vessel. The air is measured in the same vessel as the gas, and serves to carry forward any gas left in the measuring vessels.—W. P.

Heating value of gases; Apparatus for determining the ——. H. Strache, Vienna. Eng. Pat. 116,707, 30.5.18. (Appl. 8960/18.)

SEE Ger. Pat. 312,832 of 1917; preceding.

Electrically indicating the presence of saline, alkaline, or acid impurities in liquids; Means for ——. W. C. Crockatt, Glasgow. U.S. Pat. 1,320,036, 28.10.19. Appl., 21.2.17.

SEE Eng. Pat. 101,387 of 1916; this J., 1916, 1129.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Aslund, Boberg, and Giltspur Co. Drying apparatus. 28,299. Nov. 14.

Bedford and Oldroyd. Drying apparatus. 28,778. Nov. 20.

Bigot. Tunnel furnaces. 28,071. Nov. 12. (Fr., 6.9.19.)

Blackie and Phillips. Furnaces. 29,036. Nov. 21.

Broadley. 28,209. *See* X.

Brochet. Manufacture of catalysts. 29,002. Nov. 21. (Fr., 1.5.15.)

Canning. 28,047. *See* II.

Fiechter. Filtering apparatus for gaseous media. 28,306. Nov. 15. (Switz., 2.11.17.)

Fiorini. Mixing apparatus. 28,266. Nov. 14. (Ital., 25.11.13.)

Frith, and Renold, Ltd. Furnaces. 28,630. Nov. 19.

Fulcher. Straining or filtering apparatus. 28,170. Nov. 13.

Hall. Grinding, crushing, or disintegrating machines. 28,244. Nov. 14.

McMyn. Bottle for chemicals which corrode glass. 28,329. Nov. 14.

Mond (Internat. Precipitation Co.). 28,154. *See* XI.

Parrish, and South Metropolitan Gas Co. Drying salts. 28,278. Nov. 14.

Pickard. Furnaces. 28,229. Nov. 14.

Schueler. Grinding or abrading devices for tube mills. 28,929 and 28,930. Nov. 21.

Simpson. Distilling plant. 28,347. Nov. 15.

Sturgeon. Centrifugal separators. 29,042. Nov. 21.

Thomas. Filters. 27,924. Nov. 11.

Wang. Process for double decomposition of substances. 29,030. Nov. 21. (Norway, 27.12.18.)

Webster. Method of running centrifugal hydro-extractors. 27,841. Nov. 11.

COMPLETE SPECIFICATIONS ACCEPTED.

17,698 (1918). Welch. Concentrating solutions. (134,593.) Nov. 19.

18,127 (1918). Torrance. Disc and like grinding mills. (134,618.) Nov. 19.

18,415 (1918). Dufton. Still-heads. (134,629.) Nov. 19.

19,233 (1918). Sturgeon. Centrifugal separators. (134,966.) Nov. 26.

21,076 (1918). Rivett. Grinding machines. (134,676.) Nov. 19.

5044 (1919). Helmer. Devices for separating liquids from vapours. (125,939.) Nov. 19.

5054 (1919). Giovannoni. Filters. (127,236.) Nov. 26.

12,292 (1919). Piccard. Separating a salt from its solution by evaporation. (132,771.) Nov. 26.

18,783 (1919). Goold (American Laundry Machinery Co.). Centrifugal drying apparatus. (134,800.) Nov. 19.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Bale. Apparatus for retorting and briquetting fuels with volatile recovery. 27,921. Nov. 11.

Blakeley, and Firth, Blakeley, and Sons and Co. Means for reversing the flow of gas in purifiers etc. 28,353. Nov. 15.

Bloomfield and Morgan. Suction-gas producer. 28,294. Nov. 14.

Canning. Retorts, ovens, etc. 28,047. Nov. 12.

Edser, Jones, and Sulman. Treatment of minerals containing coal. 28,832. Nov. 20.

Illing and Kelly. Treatment of petroleum etc. 28,614. Nov. 18.

Maschinebau-Anstalt-Humboldt. Apparatus for removing dust from small coal etc. 28,182. Nov. 13. (Ger., 6.4.18.)

N. V. Nederlandsche Lichte Olie **Maatsch.** 28,072. *See* III.

Nelson. Cracking hydrocarbon oils etc. **28,575.** Nov. 18.

Perry. Apparatus for distilling carbonaceous material. 27,770. Nov. 10.

Pintsch A.-G. Porous charges for containers for storing explosive gases dissolved in liquids. **29,003.** Nov. 21. (Ger., 20.5.14.)

Rigby, and Wetcarbonizing, Ltd. Formation of briquettes from disintegrated peat. **28,297.** Nov. 14.

Rigby, and Wetcarbonizing, Ltd. Expressing liquids from peat etc. 28,298. Nov. 14.

Rigby, and Wetcarbonizing, Ltd. Excavation of peat. 28,492. Nov. 17.

Robertson. Cutting and pressing peat etc. 29,122. Nov. 22.

Soc. Anon. d'Ougrée Marihaye. Coke ovens. 28,360 and 28,372. Nov. 15. (Belg., 28.9.16.)

Stevens. Motor fuels. 29,010. Nov. 21. (U.S., 21.11.17.)

Townsend. Water-gas plant. 28,208. **Nov. 14.**

Wellington. Destructive distillation of coal. 28,863. Nov. 20.

Wells. Producer gas. 28,859. Nov. 20.

White (Soc. Franco-Belge de Fours à Coke). 28,326. *See* VII.

White. Generators for water and producer gas plants. 28,253. Nov. 14.

Wilson. Manufacture of mantles for incandescent gas lighting. 28,769. Nov. 20.

COMPLETE SPECIFICATIONS ACCEPTED.

6921 (1918). Marks (Cleveland Trust Co.). Distilling petroleum etc. (134,567.) Nov. 19.

12,694 (1918). Smith. Operation of water gas plants. (134,573.) Nov. 19.

13,452 (1918). Wellington. Apparatus for quenching coke. (134,867.) Nov. 26.

16,465 (1918). Wilson. Incandescent gas mantles. (134,875.) Nov. 26.

17,873 and 19,442 (1918). Burnett. Apparatus for washing coal etc. (134,596.) Nov. 19.

17,945 (1918). Michel and Raskin. Manufacture of briquettes from flue dust. (134,886.) Nov. 26.

17,946 (1918). Michel and Raskin. Manufacture of briquettes from sawdust. (134,887.) Nov. 26.

21,289 (1918). Tinker. Production of petrol. (135,015.) Nov. 26.

5748 (1919). Roberts. Heating walls of coke ovens and blocks for the construction of such walls. (135,091.) Nov. 26.

10,712 (1919). Marks (U.S. Industrial Alcohol Co.). Liquid fuel. (134,766.) Nov. 19.

16,976 (1919). Conklin. Method of cleaning coal etc. (130,972.) Nov. 26.

III.—TAR AND TAR PRODUCTS.

APPLICATIONS.

Kirby, and South Metropolitan Gas Co. Purification of carbazole. 28,279. Nov. 14.

Naaml. Vennoots. Nederlandsche Lichte Olie Maatsch. Converting higher molecular hydrocarbons into lower molecular ones. 28,072. Nov. 12. (Holland, 12.11.18.)

Stocks (Andrews). Manufacture of hydrocarbon compounds. 27,968. Nov. 12.

COMPLETE SPECIFICATIONS ACCEPTED.

18,550 (1918). Barrett Co. Catalytic oxidation of benzene. (122,167.) Nov. 19.

2946 (1919). Cobellis. Manufacture of sulphonates of aromatic hydrocarbons for use in making phenolic bodies. (134,715.) Nov. 19.

IV.—COLOURING MATTERS AND DYES.

APPLICATION.

Imray (Soc. Chem. Industry in Basle). Manufacture of disazo dyestuffs of pyrazolone series. 27,910. Nov. 11.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Bowles, and Titanine, Ltd. Manufacture of solutions of nitrocellulose. 27,797. Nov. 10.

British Cellulose and Chemical Manufacturing Co., and Lille. Manufacture of apparatus for spinning artificial filaments. 28,352. Nov. 15.

Carter and Davis. Decortication or extraction of fibres of ramie, jute, hemp, etc. 28,332. Nov. 15.

Glanzfäden A.-G. Production of spun material resembling wool, cotton, or chappe, also films from viscose solutions. 28,190. Nov. 13. (Ger., 22.2.18.)

Glanzfäden A.-G. Manufacture of a wool substitute from cellulose etc. solutions. 28,191. Nov. 13. (Ger., 14.7.17e)

Jackson (Orcutt). Coating, tinting, or marbling paper. 28,079. Nov. 12.

Mandleberg, Perkin, and Mandleberg and Co. Non-inflammable materials. 28,593. Nov. 18.

Watremez. 29,043. *See* VI.

COMPLETE SPECIFICATIONS ACCEPTED.

3502 and 3503 (1919). Bindley, Weller, and Duncan. Production of substitutes for celluloid, vulcanite, etc. (134,564 and 134,565.) Nov. 19.

18,587 (1918). Watford Engineering Works, and Paramor. Machines for straining paper-pulp. (134,923.) Nov. 26.

2784 (1919). Taylor. Machines for washing and scouring wool etc. (134,714.) Nov. 19.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Ashton, Ashton, Mellor, and Calico Printers' Association. Overprinting fabrics and yarns. 28,230. Nov. 14.

Starling. Dyeing, bleaching, or cleaning fabrics, fibres, skins, etc. 28,555. Nov. 18.

Watremez. Process of scouring vegetable fibres for bleaching. 29,043. Nov. 21. (Belg., 8.11.18.)

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Comp. des Prod. Chimiques d'Alais et de la Camargue. Purification of solutions of zinc sulphate. 28,471. Nov. 17. (Fr., 12.9.19.)

Hood. Purification of sulphur. 28,489. Nov. 17.

Jones and Kelly. Preparation of sodium pentaborate etc. direct from boron ores. 28,355. Nov. 15.

Jones and Kelly. Substitute for borax or boric acid in technical processes. 28,837. Nov. 20.

Jones and Kelly. Manufacture of boric acid from boron ores. 28,839. Nov. 20.

Jones and Kelly. Manufacture of borax or boric acid from sodium pentaborate. 28,840. Nov. 20.

Nishigawa. Manufacture of soda. 28,590. Nov. 18. (Japan, 29.11.18.)

Parrish, and South Metropolitan Gas Co. 28,278. *See* I.

Serret. Recovery of ammonia as by-product. 28,093. Nov. 12.

White (Soc. Franco-Belge de Fours à Coke). Recovery of ammonia from coke-oven gases. 28,326. Nov. 14.

COMPLETE SPECIFICATIONS ACCEPTED.

2280 (1916). Norddeutsche Hutte A.-G., and Behrens. Removal and recovery of sulphur dioxide from gases. (134,555.) Nov. 19.

1874 (1918). Partington and Jones. Manufacture of ammonium nitrate. (134,562.) Nov. 19.

12,684 (1918). Maxted and Smith. Removal of ammonia from high-pressure gases. (134,572.) Nov. 19.

17,076 (1918). Dutt and Dutt. Manufacture of magnesium sulphate. (134,884.) Nov. 26.

17,365 (1918). Haslup. Fixation of atmospheric nitrogen in a blast furnace. (134,885.) Nov. 26.

18,206 (1918). Imperial Trust, and Stannard. Recovery of tungstic acid from ores. (134,891.) Nov. 26.

18,330 (1918). Ridoni, and Soc. Talco e. Grafiti Val Chisone. Purification of natural graphite. (134,894.) Nov. 26.

18,335 (1918). Delage. Manufacture of magnesia. (134,626.) Nov. 19.

18,382 and 18,384 (1918). Griggs. Hydrogen generators. (134,901 and 134,902.) Nov. 26.

18,554 (1918). Mond (International Precipitation Co.). Recovery of potassium compound in connection with cement manufacture. (134,920.) Nov. 26.

18,772 (1918). Espenhahn. Treatment of gases containing sulphur dioxide. (134,943.) Nov. 26.

20,009 (1918). Bury, Ollander, Smith and Bainbridge. Recovery of potassium salts from blast-furnace slag. (134,665.) Nov. 19.

2132 (1919). Rumbold. *See* X.

12,292 (1919). Piccard. *See* I.

14,875 (1919). Riiber. Purification of alkaline chloride solutions which are to be electrolysed. (135,141.) Nov. 26.

16,986 (1919). L'Air Liquide Soc. Anon. Purifying the gases intended for the synthetic productic production of ammonia. (129,637.) Nov. 26.

VIII.—GLASS; CERAMICS.

Application.

Bigot. 28,071. *See* I.

Complete Specifications Accepted.

9496 (1919). Marks (Fours et Procédés Mathy). Glass ovens or furnaces. (135,115.) Nov. 26.

13,508 (1919). Corning Glass Works. Glass. (127,586.) Nov. 26.

21,788 (1919). McCoy. Apparatus for the production of sheet glass. (131,807.) Nov. 19.

IX. BUILDING MATERIALS.

Applications.

Bayer. Manufacture of stone-like materials of foam-like structure. 28,509. Nov. 17.

Cowell and Wilkinson. Drying bricks, stones, etc. 28,860. Nov. 20.

Honda. Road-making or paving materials. 28,397. Nov. 15.

Mulligan. Cements for building etc. 28,020. Nov. 12.

Ransford (Brown). Production of aggregates for use in concrete. 28,897. Nov. 20.

Complete Specifications Accepted.

17,901 (1918). Harland and Wolff, and Marks. Concrete. (131,598.) Nov. 19.

18,554 (1918). Mond (Internat. Precipita ion Co.). *See* VII.

18,711 (1918). Lynde. Manufacture of concrete slabs. (131,936.) Nov. 26.

21,264 (1918). Gromroos. Production of hard flooring or insulating slabs. (121,415.) Nov. 19

X. METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Aktiebolaget Ferrolegeringar. Manganese or alloys thereof. 27,784. Nov. 10. (Sweden, 12.11.18.)

Aktiebolaget Ferrolegeringar. Chromium or alloys thereof. 27,785. Nov. 10. (Sweden, 15.11.18.)

Ballantine. Production of ferro-chrome alloys. 28,763. Nov. 19.

Belais. Gold alloys. 29,038. Nov. 21.

Broadley. Machines for grinding ores, minerals, etc. 28,209. Nov. 14.

Critchley and McGhie. Treatment of ores of precious metals. 28,039. Nov. 12.

Geoghegan and Gibson. Alloy for welding cast-iron. 28,925. Nov. 21.

Heskett. Manufacture of metal compound powders. 29,031. Nov. 21.

Hurst. Aluminium alloys. 28,546. Nov. 18.

Middlemiss. Leaching and separation of ores etc. 28,633. Nov. 19.

Partington and Taylor. Treatment of ores etc. by flotation. 28,999. Nov. 21.

Stannard. Treatment of lead-zinc sulphide ores. 28,463. Nov. 17.

Vautin. Production of tungsten. 28,916. Nov. 21.

Vautin. Treatment of mixed zinc sulphide ores. 29,035. Nov. 21.

Wade (Lindsay Light Co.). Manufacture of thorium. 28,749. Nov. 19.

Walker. Separation of metals from alloys. 28,233. Nov. 14.

Complete Specifications Accepted.

13,054 (1918). Jones. Hardening or like treatment of iron or steel articles. (131,864.) Nov. 26.

13,209 (1918). Scott. Concentration of ores. (118,627.) Nov. 26.

17,365 (1918). Haslup. *See* VII.

17,903 (1918). Vickers, Ltd., and Sherwood. Surface hardening of steel and steel articles. (131,599.) Nov. 19.

18,206 (1918). Imperial Trust, and Stannard. *See* VII.

18,467 (1918). Seward. Electrodeposition of magnesium. (120,908.) Nov. 26.

18,518 (1918). Falvet. Manufacture of steel. (131,915.) Nov. 26.

18,519 (1918). Falvet. Casting iron or steel or their alloys. (131,916.) Nov. 26.

18,525 and 18,526 (1918). Marks (American Manganese Steel Co.). Recovering and making manganese steel. (131,917 and 131,918.) Nov. 26.

18,616 (1918). McGahan. Alloying furnaces. (131,927.) Nov. 26.

20,009 (1918). Bury and others. *See* VII.

2132 (1919). Rumbold. Recovery of lead and tin from their solutions. (135,052.) Nov. 26.

2196 (1919). Arend. Process for making alloys rich in lead. (135,056.) Nov. 26.

11,312 (1919). Sundberg and Thomasson. Manufacture of pure electrolytic copper from cement copper. (135,125.) Nov. 26.

XI. ELECTRO-CHEMISTRY.

Applications.

Asherott. Electrolytic apparatus. 28,845. Nov. 20.

Burdon (Siemens u. Halske A.-G.). Manufacture of electric thermo-elements. 28,449. Nov. 17.

Burgess Battery Co. Electric dry cells. 28,762. Nov. 19. (U.S., 19.11.18.)

Mond (International Precipitation Co.). Apparatus for electrical treatment of gases. 28,154. Nov. 13.

Powell. Primary electric batteries. 28,772. Nov. 20.

U.S. Heat and Light Corporation. Storage batteries. 29,094. Nov. 22. (U.S., 8.9.17.)

White (U.S. Light and Heat Corporation). Battery plates and plate-pasting machines. 27,940. Nov. 11.

Complete Specifications Accepted.

18,467 (1918). Seward. *See* X.

19,756 (1918). Soc. Electro-Metallugique Francaise. Electrodes of electric furnaces. (121,282.) Nov. 26.

11,132 (1919). Sundberg and Thomasson. *See* X.

11,875 (1919). Riiber. *See* VII.

XII.—FATS; OILS; WAXES.

Applications.

Effront. 29,001. *See* XVIII.

Firth. 28,075. *See* XIX.

COMPLETE SPECIFICATION ACCEPTED.

19,609 (1918). Park. Process and apparatus for washing and drying copra. (134,982.) Nov. 26.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Brook. Compositions etc. for printing. 28,030. Nov. 12.

Dubois and Richard. Composition paint. 28,726. Nov. 19.

Tsutsumi. Solid ink compound. 27,926. Nov. 11.

COMPLETE SPECIFICATIONS ACCEPTED.

3501 (1918). Bindley, Weller, and Duleken. Production of synthetic shellac, resin, etc. (134,563.) Nov. 19.

3502 and 3503 (1918). Bindley and others. *See* V.

18,140 (1918). Devonshire and Foord. *See* XV.

12,343 (1919). Kuroki and Nakayama. Waterproof paint. (135,132.) Nov. 26.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATION.

East. Treatment of rubber, rubber waste, etc. 28,616. Nov. 18.

COMPLETE SPECIFICATIONS ACCEPTED.

3502 and 3503 (1918). Bindley and others. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATIONS.

Malcolm and Townsend. Process of making gelatin. 27,772. Nov. 10.

Starling. 28,555. *See* VI.

COMPLETE SPECIFICATIONS ACCEPTED.

17,629 (1918). Lansdown and Magnus. Treating and utilising scrap or waste leather. (134,592.) Nov. 19.

18,140 (1918). Devonshire and Foord. Manufacture of plastic compositions from vegetable ivory. (134,619.) Nov. 19.

XVI.—SOILS; FERTILISERS.

APPLICATION.

Fry and Wolf. Manures. 28,304. Nov. 14.

XVII.—SUGARS; STARCHES; GUMS.

COMPLETE SPECIFICATION ACCEPTED.

18,042 (1918). Hood, Clark, and Clark. Decolorising and purifying saccharine materials. (134,607.) Nov. 19.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATIONS.

Effront. Manufacture of pressed yeast from distillers' grains, oil-cake, etc. 29,001. Nov. 21.

Meyer. Production of yeast. 28,594. Nov. 18. (Holland, 31.5.19.)

Robbins. Natural conditioning of alcoholic beverages. 28,189. Nov. 13.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Carmichael. Drying and curing fish etc. 28,431. Nov. 17.

Firth. Treatment of soya beans for recovery of oil and production of synthetic milk and flour. 28,075. Nov. 12.

Jones and Kelly. 28,837. *See* VII.

Jones and Kelly. Preservative for foodstuffs. 28,838. Nov. 20.

Menzies. Softening water by base-exchanging bodies. 29,137. Nov. 22.

Thomson. Reduction of animal flesh, fish, peas, etc., in preparing foods and medicinal animal extracts. 28,851. Nov. 20.

Townsend. Imparting flavour and food value to sweetmeats, confectionery, etc. 27,773. Nov. 10.

COMPLETE SPECIFICATIONS ACCEPTED.

16,606 (1918). Weeks. Germicide solution and method of making same. (134,880.) Nov. 26.

19,815 (1918). Berry, and Boake, Roberts, and Co. Manufacture of baking-powder and self-raising flour. (134,987.) Nov. 26.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Thomson. 28,851. *See* XIX.

Vakil. Alcoholic solution of vegetables for external human use. 29,091. Nov. 22.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

Automatic Film Printers, Ltd., Lawley, and Williamson. Treatment of photographic films. 28,042. Nov. 12.

Christensen. Method of hardening photographic films. 28,287. Nov. 14. (Denmark, 20.11.18.)

Kerotype, Ltd., and Middleton. Photographic printing-paper. 28,714. Nov. 19.

Kerotype, Ltd., Middleton, and Mills. Photographic printing-paper and transfer processes. 28,980. Nov. 21.

Nottram. Manufacture of photographic plates, films, papers, etc., for X-ray photography etc. 28,566. Nov. 18.

COMPLETE SPECIFICATION ACCEPTED.

18,613 (1918). Johnson. Production and projection of colour photographic records. (134,926.) Nov. 26.

XXIII.—ANALYSIS.

COMPLETE SPECIFICATION ACCEPTED.

2267 (1919). Ross. Medical analysis of urine by the combined use of tungstic acid and other reagents. (134,710.) Nov. 26.

I.—GENERAL; PLANT; MACHINERY.

Steam boiler; Electrically heated ——. H. Warschafski. Technik für Alle, 1919–20 [2]. Chem.-Zeit., 1919, **43**, Rep., 242.

A VERTICAL boiler contains a number of vertical small-bore tubes of insulating material open at each end, thus separating the water into a number of long, thin columns communicating with the mass of water above and below. These columns form the resistance to the current introduced by electrodes at top and bottom, whereby the water is boiled. An efficiency exceeding 95 % is claimed and 30,000 kilos. of steam has been generated in 24 hours with a consumption of 1000 kilowatts. Alternating or three-phase current may be used, at pressures reaching 10,000 volts.—H. J. H.

Rectification by adiabatic condensation without expansion. E. Chenard. Bull. Soc. Chim., 1919, **25**, 546—552.

IT is shown that the process of enrichment of vapours by means of partial condensation is very useful in concentrating the lower boiling constituent in the vapour and very simple in its application. (See further J. Chem. Soc., Jan., 1920.)
—W. G.

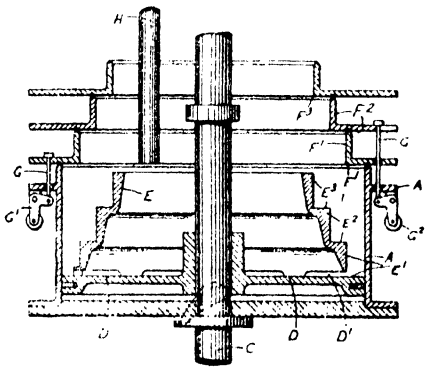
High temperature measurements. Kanolt. *See* VIII.

Concrete in chemical industry. Andrews. *See* IX.

PATENTS.

Centrifugal separating machines. R. A. Sturgeon, Southsea. Eng. Pat. 134,158, 17.3.19. (Appl. 6611/19.)

A CYLINDRICAL receptacle, A, is mounted on the hollow vertical shaft, C. A piston, D, carrying a stepped cone, E, is adapted to be reciprocated on



the shaft, C. A series of three superposed annular members, F^1, F^2, F^3, are mounted on the upper end of the cylinder, A, and are normally held on their seatings by links, G. The liquid containing the material to be graded is introduced through a pipe, H, and ports, D^1, and the material is graded radially on the wall of the cylinder, A. The liquid is then cut off and fluid pressure introduced below the piston, D, to raise it. The grades of material are thus forced into the annular chambers formed between the steps, E^1, E^2, E^3, and F^1, F^2, F^3. The weights, G^2, are such that their centrifugal force is overcome when the required degree of compression is reached in any ring of separated material, and the cover is lifted to discharge the material into a receptacle. Liquids may be similarly graded.
—W. F. F.

Pulverising mill roller and supporting structure for same. The Raymond Bros. Impact Pulverizer Co., Assignees of R. A. Lachmann, Chicago, Ill., U.S.A. Eng. Pat. 131,281, 22.7.19. (Appl. 18,258/19.) Int. Conv., 15.8.18.

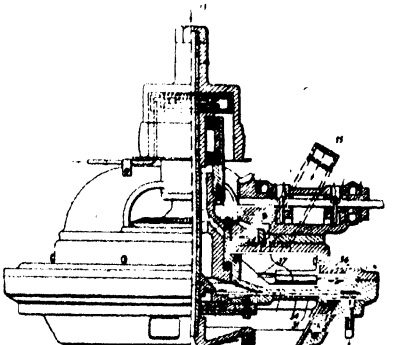
THE apparatus is of the type in which the material is crushed between a "bull ring" and rollers rotating within the ring and thrust against it by centrifugal force. The vertical shaft, carrying the roller at its lower end, is provided with a disc of larger diameter attached to its upper end, which is contained in an enlargement of a housing surrounding the whole of the shaft above the roller. Suitable step-bearing rings are provided between the annular under-surface of the disc and a shoulder of the housing, and the cup formed by the extension of the housing above the disc contains lubricant. Means for distributing lubricant to the step-bearing and also to the shaft and its bearing at the lower end of the housing, and for preventing escape of the lubricant are described in detail.
—W. F. F.

Pulveriser. H. A. Thuneman, St. Louis, Mo. U.S. Pat. 1,319,735, 28.10.19. Appl., 16.3.17.

A HORIZONTAL cylindrical casing is provided with two sets of rollers carried by two sets of radial arms mounted adjacent to one another on a concentric horizontal shaft. Two circular tracks, one slightly smaller in diameter than the other, are provided on the inner wall of the casing for the two sets of rollers, the two tracks being connected by an annular inclined surface. The material to be pulverised is fed in at the end of the casing next to the circular track of smaller diameter and discharged at the other end.—W. F. F.

Centrifugal apparatus for breaking up liquids and disseminating them in solids or for mixing and drying liquids and solids. F. H. Loring, London. Eng. Pat. 134,487, 1.5.19. (Appl. 10,891/19.)

PULVERISED solid material is introduced through the conduit, 35, and falls on the rotating ribbed member, 37, which is provided with openings be-



tween the ribs, 31, covered by a spiral wire coil, 34. The sieve thus formed is kept open by stationary brushes, 36, and the material is thrown on to it and passes through into the annular space below. Liquid is introduced through the vertical shaft at

13 and passes into the rotating basket, 11, of expanding cross-section as shown. The outer rim of the basket is formed by a grid, 15, backed by porous material, 14, the space, 11, being filled with charcoal or gas carbon. The liquid is sprayed from the basket and meets and mixes with the descending solid material. When the apparatus is used for drying liquid substances, hot gases may be introduced through the conduit, 35. Materials may be detached from the wall of the hopper, 7, by means of a revolving wire, 41. The arrangements for lubricating the apparatus are described in detail.
—W. F. F.

Centrifugal machine [; Self-discharging device for ——. J. A. H. Gibson, Assignor to The Western States Machine Co., Salt Lake City, Utah. U.S. Pat. 1,319,150, 21.10.19. Appl., 20.11.18.

The basket of a centrifugal machine is discharged by means of compressed air supplied to a ring of vertical tubes arranged inside and close to the wall of the basket. The air issues from vents opening towards the wall of the basket, and enough room is left between the tubes and the wall for the insertion of a screen.—B. M. V.

[*Centrifugal*] *apparatus for separating liquids.* H. J. Overlin, Buffalo Gap, S.D. U.S. Pat. 1,320,340, 28.10.19. Appl., 3.5.18.

The bowl of a centrifugal separator for liquids consists of a containing cylindrical shell, a perforated axial tube, and a number of superposed truncated conical discs, the walls of which slope upwards and outwards from central openings; the diameter of the openings is greater than the outer diameter of the perforated tube. Surmounting the conical discs is a flat perforated disc.—B. M. V.

Filtering apparatus. Process of maintaining filters in filtering condition. Process of treating liquids and solids. M. H. Kuryla, Assignor to Merrill Metallurgical Co., San Francisco, Cal. U.S. Pats. (A) 1,302,812, (B) 1,302,813, and (C) 1,302,814, 6.5.19. Appl., 30.10.15.

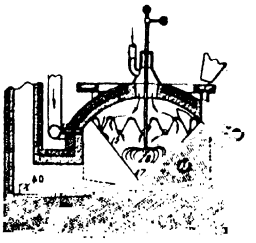
(A) A number of rectangular frames are arranged vertically side by side to form a filter casing. Every alternate frame has two perforated side walls, between which the filtering material is packed, thus providing a number of parallel filter elements spaced apart. A continuous conduit is formed longitudinally at the top of the casing, and communicates with the spaces between the perforated walls. The filtering material is conveyed into these spaces by a stream of liquid introduced into the longitudinal conduit. The solids in the mixture which is being filtered are deposited on the side walls of the filter elements and may be removed by injecting water against the filter-cake. When the filtering medium becomes clogged it may also be removed by jets of water directed against it to disintegrate it and carry it away to a cleaning device. The cleaned material may then be returned to the filter elements in a stream of liquid, without separating the parts of the filter. The filter is suitable for metallurgical operations. (B) The filter-cake is simultaneously removed from all the filter elements by jets of water, and the filtering medium (sand or the like) may also be removed from all the elements simultaneously by jets of water, cleaned, and returned. The filter is suitable for filtering cyanide solution from ore, or sodium aluminate solution from the accompanying mud in the manufacture of aluminium from bauxite. (C) When material is treated with a lixiviating liquid the more slowly soluble portion is removed, and is used as the filtering medium for separating the dissolved material from a further quantity of the mixture. The less soluble material present in the filtering medium is thus dissolved by the lixiviant and separated from the insoluble material.
—W. F. F.

Air-filter. V. di Santi, Wichti, Kans. U.S. Pats. (A) 1,319,572, (B) 1,319,573, and (C) 1,319,574, 21.10.19. Appl., 7.10.18.

An air filter is provided with a water container and a collecting vessel mounted in the container and provided with means for separating the water from the air, consisting of (A) perforated plates near the bottom of the vessel, a tray above the plates having a fluted and perforated bottom, and a second tray above the last having two series of fluted surfaces disposed at right-angles to the flutes of the former tray and having perforations at the lower apices of the flutes; (B) a spirally formed surface having its upper and lower convolutions perforated and its intermediate convolutions imperforate and provided with stops to arrest the entrained water; (C) a superposed series of conical plates, alternate plates having notches in their edges and openings in their centres, and the intermediate plates having no openings but notches in their edges disposed at right angles to those in the alternate series.—W. H. C.

Furnace. F. R. Hill, Keeler, Cal., Assignor to W. W. Watterson, Bishop, Cal. U.S. Pat. 1,317,295, 30.9.19. Appl., 3.9.18.

The furnace chamber, 47, is provided with a floor, sloping downwards towards the outlet, 40. The material is fed into the chamber so as to stand in



an annular pile, 15, around the central part of the chamber. The inner sloping surface is heated by a burner, 28.—W. F. F.

Burning or roasting non-sintering substances; Gas-fired shaft-kiln for ——. A. and W. Steiger, Zurich, Switzerland. U.S. Pat. 1,317,603, 30.9.19. Appl., 18.12.18.

The material is fed into the top of a vertical shaft-kiln and travels downwards through the kiln. Combustible gas and air are supplied to the bottom of the kiln and heat the material while passing upwards through it to an exhauster at the top. The kiln suddenly increases in cross-section at several points in the cooler portion at the bottom to cause a sudden loosening of the charge in that zone.
—W. F. F.

Furnace. F. Peiter, Brooklyn, N.Y. U.S. Pat. 1,318,690, 14.10.19. Appl., 28.5.18.

Gas is made in a producer chamber and passes direct to a combustion chamber, to which auxiliary air is also admitted. The burning gas passes to a muffle chamber provided with a perforated wall or roof through which the hot gases pass to a chamber above containing the object to be heated. An oil burner may also be provided, the flame from which is directed into the muffle chamber.—B. M. V.

Kiln. J. C. Schaffer, Tiffin, Ohio. U.S. Pat. 1,318,806, 14.10.19. Appl., 26.4.15.

A vertical kiln is provided with a central vertical flue and a number of flat radial flues connected to it. Additional radial flues are arranged between the first-mentioned radial flues, and are connected to them by horizontal passages, but are not con-

nected directly to the central flue. These flues are all covered by the floor of the kiln and the two sets of radial flues open directly into the kiln.
—W. F. F.

Furnace. A. P. Hachtmann, Allentown, Pa. U.S. Pat. 1,320,614, 4.11.19. Appl., 11.4.17.

MATERIAL is delivered by a screw conveyor into the upper end of a slightly inclined heating tube. The inclined tube extends downwards first through the lower end of a chimney stack and then, after an interval, through a furnace casing. In the space between the furnace casing and the stack, the tube is surrounded by a concentric shell which conducts the hot gases around the tube from the furnace to the stack. Means are provided for rotating the tube and surrounding shell, and the joints between the shell and tube, and the walls through which they pass, are made gas-tight while permitting expansion.—W. F. F.

Mixing of fluids; Method of and means for intimate ——. H. E. La Bour, Chicago, Ill. U.S. Pat. 1,318,774, 14.10.19. Appl., 8.4.18.

A THIN stream or curtain of liquid and a current of air under pressure are discharged simultaneously, in contact with one another, and in the same general direction into a vessel. The liquid is then separated from the gas by deflecting the former in a lateral direction into a dead space or pocket, the gas being deflected in the opposite direction.
—W. H. C.

Evaporating apparatus and method of operating the same. E. A. Newhall, Philadelphia, Pa. U.S. Pat. 1,318,793, 14.10.19. Appl., 9.5.17.

IN a multiple-effect evaporator the vapour from at least one effect is used to heat a quantity of liquid, which is then divided and a portion is further heated and concentrated by boiling. This portion is then mixed with the other preheated but unconcentrated portion and the whole further concentrated by boiling.—B. M. V.

Vapour pressure in an evaporator provided with a water-seal cover; Process for maintaining the —— near atmospheric pressure. O. Schmeisser, Charlottenburg. Ger. Pat. 312,855, 17.12.16.

THE hot vapours, together with cooling water, pass downwards through grates arranged one above the other in a casing. With a suitably chosen cross-section of spaces through which the water falls it forms more or less connected films which produce an air pump effect. The suction effect varies automatically with the amount of water, so that the pressure in the evaporator alters very little and can be kept near atmospheric.—T. H. Bu.

Dryer; Rotary ——. R. R. Hickcox, Baltimore, Md. U.S. Pat. 1,319,077, 21.10.19. Appl., 31.3.17.

AN endless chain is arranged horizontally in a casing and a series of parallel plates are fixed to it in such a way that they project nearly normally during the whole revolution of the chain. Material is fed on to the plates at the commencement of their upper horizontal path, and is discharged on to a conveyor during the return path.—W. F. F.

Drying machinery. A. Harvey, Greenwich, Conn. U.S. Pat. 1,319,391, 21.10.19. Appl., 22,10.15.

THE material to be dried is supported on superposed pivoted trays within the drying chamber. Rods and gearing are provided by means of which the trays can be tilted and the dried material discharged into hoppers which are located below the chamber.—W. H. C.

Dehydrating apparatus. C. R. Taylor, Fort Worth, Tex. U.S. Pat. 1,319,978, 28.10.19. Appl., 7.2.19.

EACH of a number of storage bins is provided with a vertical pipe projecting upwards through the bottom and having radial nozzles within the bins. Each pipe is connected through a pressure-regulating valve to a common air supply pipe, which is connected to a reservoir supplied by an air compressor. The temperature of the air is adjusted by a regulating device interposed between the reservoir and the first vertical pipe.—W. F. F.

Rectifying columns. Sudenburger Maschinenfabr. und Eisengiesserei A.-G. zu Magdeburg, Zweigniederlassung vorm. F. H. Meyer, Hanover-Hainholz. Ger. Pat. 311,863, 7.3.18.

A RECTIFYING column is constructed in superposed compartments separated by plates which are perforated with a number of holes. In these holes tear- (pear-)shaped bodies are placed and the liquid runs back through openings between the plate and the bodies or along straight or spiral grooves cut on the surface of the bodies and collects in drops on their downward directed tips. After they have attained a certain size the drops fall on the ball-filling of the compartment below. In order that the drops may not be disturbed, separate openings are provided for the ascending vapours at the periphery of the plate or distributed over the plates and protected with hoods against the liquid. Alternatively inclined channels may be provided in the tear-shaped bodies for the vapours.
—T. H. Bu.

Drying drums; Suction ——. Aschersleben Maschinenbau A.-G. vorm. W. Schmidt und Co., Aschersleben. Ger. Pat. 311,983, 24.6.17.

THE free surface of the drum is at first covered by a cloth or the like, which is unwound during the rotation of the drum and is detached when the surface is completely covered with a layer of the material to be dried. Without the use of this cloth a much greater suction force would be required, as at the beginning of the work the greater part of the drum surface has not received a coating.—T. H. Bu.

Antifreezing solution. M. J. Reusz, Continental, Mo., Assignor to C. F. Schneider, J. C. Josse, F. R. Loveridge, and J. B. Turpin, St. Louis, Mo. U.S. Pat. 1,319,178, 21.10.19. Appl., 31.5.19.

To 100 parts of liquefied tachydrite (hydrated double chloride of calcium and magnesium) is added 6 parts of a composition containing approximately 5% of copper sulphate and 10% of calcium hydroxide. The mixture is diluted with water to 26°—50° B. (sp. gr. 1·22—1·53) and strained.—W. H. C.

Aerating liquid; Apparatus for ——. F. B. Kollberg, Bisbee, Ariz., and M. Kraut, Los Angeles, Cal., Assignors to Southwestern Engineering Co. U.S. Pat. 1,319,667, 21.10.19. Appl., 8.11.16.

A CASING for the liquid is made with one end in the form of a semi-cylinder with axis horizontal, and a wheel with projections on its periphery is arranged to rotate concentrically within the cylindrical wall and slightly spaced from it. The liquid to be aerated is fed on to the rim of the wheel and is carried by its viscosity and adhesion, at high velocity through the narrow space between the rim of the wheel and the wall of the casing, where it is aerated.—W. F. F.

Grading finely divided material; Method and apparatus for ——. H. K. Hitchcock, Pittsburgh, Pa. U.S. Pat. 1,319,771, 28.10.19. Appl., 9.8.15.

IN an upward current classifier, the material mixed with liquid is fed at a level between the outlets for the coarsest and the next finer products, and liquid for assisting the upward current is introduced at a level below the outlet for the coarsest material.

Several grades of material are drawn off by pipes extending to various depths in the conical separating vessel.—B. M. V.

Catalyser; Hydrogen-free —— and process of making same. C. Ellis, Montclair, N.J. U.S. Pat. 1,320,039, 28.10.19. Appl., 13.1.17.

A SALT of a metal is reduced with hydrogen and the hydrogen expelled by heating the reduced metal in a current of nitrogen.—B. M. V.

Acid-still. E. J. Manser, Nobel, Ont., Canada. U.S. Pat. 1,320,080, 28.10.19. Appl., 31.5.19.

A HOLLOW conical spreader having inlet openings at its lower edge and a protected gas outlet at its upper end is fitted inside the still at the bottom. —W. H. C.

Liquid-cooling apparatus. N. E. Gee, Altoona, Pa. U.S. Pat. 1,320,130, 28.10.19. Appl., 25.5.17.

THE liquid to be cooled flows from an upper receiving chamber down a cooling tower, which is supplied with an air blast at its lower end, and the cooled liquid runs into a main storage tank. By means of a pump the liquid may be raised from the main storage tank through a valved pipe to the upper tank, whence it passes again to the cooling tower.—B. M. V.

Purifying liquids; Process of ——. W. G. Laird, Assignor to H. L. Doherty, New York. U.S. Pat. 1,320,396, 4.11.19. Appl., 20.11.16.

THE apparatus is for treating a heavy liquid with a non-miscible liquid of lower specific gravity. The heavier liquid flows downwards over a series of slightly inclined superposed perforated plates arranged in a vertical casing. The lighter liquid passes in counter-current upwards through and over the plates.—W. F. F.

Drying apparatus. Machinenfabrik Imperial Ges., Meissen. Ger. Pat. 312,016, 28.1.16.

THE apparatus comprises a perforated heating drum rotating in a trough, a tube with different sized openings being arranged in the heating drum to distribute different amounts of hot air or gas to different parts of the drum. The distributing tube is made up of sections, the distances between which vary. The space between the distributing tube and the heating drum is divided by partitions into several chambers. Openings are provided in the end of the heating drum where the wet material is introduced, and cold air enters through these openings and mixes with the hot air from the last section of the distributing tube, so that the wet material loses the greater part of its moisture at a relatively low temperature without caking together. The material then enters the next chamber, where it is exposed to hotter gases and quickly dried. The damp air is withdrawn by an exhauster.—T. H. Bu.

Inflammable liquids; Double-walled container for ——. E. Beutinger, Wiesbaden. Ger. Pat. 312,564, 14.12.17.

IN the space between the walls is a filling material which, on damage to the inner container, combines with the inflowing contents of the container to form an elastic or solid body which closes the opening. When the inner vessel contains benzine (light petroleum) the filling material is a mixture of kieselguhr, waste wool, and hair, with finely-divided rubber as a binder. A movable intermediate wall is arranged so that in case of damage it can be displaced to make the path of the escaping liquid the longest possible.—T. H. Bu.

Separating oil from water; Apparatus for ——. J. H. Carruthers and Co., Ltd., J. Gourlay, G. K. Johnstone, and J. Young, Glasgow. Eng. Pat. 134,026, 23.10.18. (Appl. 17,308/18.)

Cooling-towers or structures for cooling water and other liquids. F. E. Gill, Shipley, and Davenport Engineering Co., Ltd., Bradford. Eng. Pat. 134,094, 3.12.18. (Appl. 19,929/18.)

Moistening or conditioning apparatus. H. Smethurst, Hollinwood. Eng. Pat. 134,455, 12.2.19. (Appl. 3458/19.)

Drying materials; Method of —— and dryer therefor. R. Rea, Assignor to Pacific Evaporator Co., Portland, Oreg. U.S. Pat. 1,320,569, 4.11.19. Appl., 16.5.16.

SEE Eng. Pat. 111,991 of 1917; this J., 1918, 46 A.

[Tungsten] crucible. U.S. Pat. 1,318,452. *See* X.

Centrifugal machines. U.S. Pat. 1,304,840. *See* XVII.

Washing filter-masses. Ger. Pat. 311,895. *See* XIXB.

Colloidal solutions. Ger. Pat. 313,339. *See* XX.

Radiation-pyrometer. U.S. Pat. 1,318,516. *See* XXIII.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Extraction of —— with dilute alkali at high temperatures. F. Fischer and W. Glund. Ges. Abhandl. zur Kenntnis der Kohle, 1919, III., 243—245. Chem. Zentr., 1919, **90**, IV., 693.

THE authors have found that the Donath test for distinguishing coal and lignite, which is based on the decomposition of lignite with dilute alkali giving a dark coloured solution, requires certain modifications since it only holds if the temperature is not allowed to exceed 100° C. By heating Lohberg coal with 5*N* alkali to 250° C. a dark brown solution is obtained, which gives off large amounts of carbon dioxide and hydrogen sulphide on acidifying, and also a brown flocculent precipitate which when washed and dried on the water bath is soluble in acetone, and amounts to 2½% of the coal used.—D. W.

Heat value indicator; New —— for gasworks use. E. J. Brady. Amer. Gas Assoc., Oct., 1919. Gas World, 1919, **71**, 410—412.

THE effects of various factors in a Bunsen flame upon the size and shape of the flame have been studied. As the primary aeration of the flame is gradually and progressively increased, a yellow tip makes its appearance, and with increased aeration disappears. Linear relations of the type $C=K_1R+K_2$ have been established between the calorific value, C, of the gas and the air/gas ratio, R, corresponding to the initial appearance and disappearance of the yellow tip. The disappearance phenomenon has been more particularly studied, and it has been found that for carburetted water-gas of calorific value ranging from 442 B.Th.U. to 613 B.Th.U. per cub. ft., the relation assumes the form, Calorific value = 158R + 276·5, R being the air/gas ratio corresponding to disappearance of the yellow tip. For coal gas the relation assumes the form, Calorific value = 125R + 351. The result is applied to the construction of a heat value indicator, consisting of a slightly tapering glass tube, arranged vertically within a surrounding glass tube. The annular space between the tubes is filled with air and the inner glass tube with the gas. The gas and air are forced from their respective compartments through a mixing chamber and an outlet orifice above, by means of water supplied from an aspirator. The gaseous mixture is ignited at the

orifice. Owing to the taper of the inner glass vessel, as the water ascends in the compartments, the air/gas ratio in the mixture issuing from the orifice progressively increases. The level of the water is observed at which the yellow tip of the flame provided by the issuing gases disappears and the calorific value of the gas is indicated by such level, being directly read from a scale attached to the side of the instrument. An accuracy of 1 to 2% is obtainable in actual practice.—J. S. G. T.

[*Gas*] *retorts; Steaming* ——. L. J. Willien. American Gas Assoc. Gas J., 1919, **148**, 377—378.

COMPARATIVELY little work has been done in America on the steaming of gas retorts, only about twelve gas plants having been used for steaming. Tests with Glover-West continuous retorts gave satisfactory results at Springfield (this J., 1919, 314 A) and Portland. At Portland the use of steam resulted in increasing the production of gas from 36,000 to 39,000 cub. ft. per retort and from 142,398 to 156,192 cub. ft. per man. The calorific value of the gas fell very slightly from 541 to 536 B.Th.U. Steaming resulted in an appreciable decrease in the amount of carbon deposited on the sides of the retorts; the deposit was also more easily removed, and stoppages in the stand pipes were reduced. The steaming of Woodall-Duckham continuous verticals was successful at Schenectady (New York). One company gave up the steaming of Glover-West retorts as unsatisfactory. The use of steam was also tried without success at Rochester (United Gas Improvement intermittent verticals) and Holyoke (Woodall-Duckham continuous retorts).—W. P.

Blue water-gas and coal gas; Mixtures of ——. H. J. Randall. Southern Assoc. Gas Eng. and Managers, Nov., 1919. Gas World, 1919, **71**, 405—407.

THE blue water-gas plant used had a capacity of 150,000 cub. ft. per 24 hours. The "blow" period was about 1¼ minutes and the gas "runs" of six minutes' duration. During a period of nine months when coal gas only was manufactured, the coal gas made per ton of coal carbonised amounted to 12,835 cub. ft., and the coke sold to 8·72 cwt. per ton of coal. During the subsequent thirteen months, when blue water-gas was made and admixed with the coal gas, the make of coal gas per ton of coal amounted to 12,198 cub. ft., and the make of mixed gas to 17,168 cub. ft., 7·5 cwt. of coke being sold per ton of coal. The average calorific value of the mixed gas was 437 B.Th.U. per cub. ft. The calculated calorific value of the blue water-gas was 308 B.Th.U. per cub. ft., and that of enriched water-gas, using coal tar, was 337 B.Th.U. per cub. ft. The net cost of coal gas into holders during the first period was 30·5d. per 1000 cub. ft. The cost of blue water-gas averaged 12·74d. per 1000 cub. ft., which together with the added cost of tar enrichment amounting to 1·25d. per 1000 cub. ft., made the total cost of enriched blue water-gas 13·99d. per 1000 cub. ft. The system offered a number of advantages, amongst which are a lower percentage of "inerts," lessened consumption of coal, lower temperatures to be maintained in the retort house, less trouble with stopped pipes, and less deterioration of retort settings. The percentage of water-gas could readily be altered from 20% to 30% without inconvenience to consumers.

—J. S. G. T.

Sodium stearate and oleate; Distillation of —— under reduced pressure, and the origin of petroleum. A. Pictet and J. Potok. Helv. Chim. Acta, 1919, **2**, 501—510.

DECANE, tetradecane, pentadecane, and, chiefly, tetratriacontane have been isolated from the pasty mass obtained by distilling sodium stearate under 12—15 mm. pressure, and nonylene, decylene, undecylene, and tridecylene from the distillate of sodium oleate, but no traces of cyclic hydrocarbons have been found. The hydrocarbons agree in physical properties with specimens isolated from American petroleums, and therefore the results support Engler's theory, in so far as the open-chain hydrocarbons are concerned—namely, that they originate from the fats of marine plants and animals. (See further, J. Chem. Soc., 1919, i., 569.)

—J. C. W.

Mineral oils; Laboratory tests on ——. A. Philip. Inst. Petrol. Technol., 21.10.19. [Advance proof.]

THE author's main thesis is the necessity for the adoption of standard methods for the testing and analysis of mineral oils. The preliminary operation of sampling is described at length, and details are given of the procedure to be adopted in determining the "visible separated water" in oils of different density.

Distillation test on crude oil.—A specially designed topping still is described, which is heated on an air bath in which is situated a coil through which air is passed by means of an electric blower. The air stream is controlled by a gas current meter, and thus any predetermined volume of air may be circulated in a closed system. Losses are in this way greatly reduced, and any water in the oil is quietly removed without risk of foaming or bumping. The gas current meter is a U-tube filled with lead shot. The resistance thus afforded controls the passage of air, and once the appliance is calibrated a definite current can always be reproduced. The distillation, after "topping" for water, petrol, and kerosene, is continued in a steam still, which is provided with two internal baffles to prevent priming and an annular channel to prevent condensed liquid dripping from the roof into the heated oil. It is maintained that a cleaner "heavy oil and paraffin" fraction is thereby obtained and a better wax yield. Tabular matter containing the results of distillation of the same oil by different observers is adduced to uphold this claim.

Vapour tension of motor spirit.—An apparatus is described for the determination of the temperature at which the vapour tension of a spirit is equal to atmospheric pressure. This figure is stated to be the nearest approach to the "boiling point" of the petrol.

Calorific value of motor spirit.—The bomb calorimeter is used. About 0·5 grm. is weighed out in a stoppered tube, which, together with 0·25 grm. of naphthalene, is placed in the platinum crucible. On firing, the heat liberated by the combustion of the naphthalene vaporises the petrol and expels the stopper of the tube. Ignition of the spirit then takes place, with no possibility of loss, which is otherwise liable to happen in the interval between weighing the petrol and closing the bomb.

High and low calorific value of fuel oils.—The author proposes to determine only the gross calorific value and the "water value," *i.e.*, the number of units of water by weight obtained by the combustion of unit weight of the fuel, and this implies the sum of the water derived from the oxidation of the hydrogen, together with the hygroscopic water present in the fuel. The determination of the water value can be achieved either by the ordinary combustion method or by the use of the Mahler-Kröcker bomb, in which provision is made for the displacement of water by a stream of dry air.

Determination of water in oils.—Air, under a vacuum of 20 inches, is drawn through the oil, which is gradually heated to 100°, and the water is condensed, absorbed, and weighed in a system of cooled and tared U-tubes, the last members containing calcium chloride.

Free acid in oil fuels.—Free acidity to alcohol and to water are determined and reported in terms of oleic acid.

Effect of moisture on flash-points.—A careful investigation has been made to determine the effect of moisture on flash-points. In general it may be said that for low flashing distillates, *e.g.*, kerosene, the presence of water is scarcely likely to affect the result, seeing that, in the first place, water readily settles out from the oil, and, in the second place, the low temperature at which the oil flashes is insufficient to liberate an appreciable amount of water vapour. In the case of fuel oils, however, there may be emulsified water present, and at temperatures upwards of 150° F. this water has a decided effect. A large amount of data is provided, which indicates the effect of varying amounts of water on the flash-points of fuel oils (including creosotes). In some cases the dried oils were mixed with water, in others the water was actually present in the oil. Thus, for a creosote containing 7·0% of water the maximum variation in observation, by eight different chemists, was 25° F., and the same variation was found for a Texas fuel oil which contained 1·5% of water. The same Texas oil, when dried, showed a maximum variation of only 7° F. Thus, for a dry oil or one containing less than 0·5 of water the tolerance is of the order of 7° F., whilst for an oil with a greater amount than this the tolerance must be still higher.—A. E. D.

Light petroleum oils; Detection of aromatic hydrocarbons in —— by means of the picric acid value. J. Tausz and E. Schnabel. Chem.-Zeit., 1919, **43**, 726.

The method depends on the different solubility of picric acid in the paraffin and aromatic hydrocarbons respectively. Pure benzene dissolves about 10% of its weight of picric acid, whilst the latter is practically insoluble in hexane. About 50 grms. of the oil under examination is shaken for 10 mins. with 3 grms. (or more if necessary) of picric acid, filtered, 20 grms. of the filtrate mixed with 30 c.c. of water and titrated with sodium hydroxide solution, using phenolphthalein as indicator. The number of c.c. of *N*/1 alkali required to neutralise 100 grms. of the oil saturated with picric acid is termed the picric acid value of the oil. For ordinary petrols, gasolines, and ligroins, this value is usually less than 0·3. The following results were obtained with a Rumanian petrol, sp. gr. 0·7590, b. pt. 98°—100° C., when mixed with varying quantities of benzene:—

Petrol.	Benzene.	Picric acid value.	Petrol.	Benzene.	Picric acid value.
%	%		%	%	
100	0	0·10	40	60	9·9
90	10	0·15	30	70	16·1
80	20	0·80	20	80	25·5
70	30	1·6	10	90	30·5
60	40	3·1	0	100	33·3
50	50	5·4			

—W. P. S.

Ashphalts; Distinction between natural —— and oil asphalts. E. C. Pailler. Caoutchouc et Gutta-Percha, 1919, **16**, 10063—10066.

In the examination of asphalts of various origin the proportion of "fixed carbon" obtained by heating under standardised conditions in the absence of air (this J., 1900, 174), the mineral acidity of the liquid obtained on careful dry distillation, and the saponification value (determined in solution in benzene) exhibit significant differences in magnitude. In samples examined from different sources the fixed carbon was found to range from 9·95 to 16·87%, the acidity (in mgrms. of potassium hydroxide necessary per gram of distillate) from 0·12 to 15·9, and the saponification value from 7·4 to 36·0.—D. F. T.

Benzol manufacture. Berthelot. *See* III.

[Rectification of] hydrocarbons. Paillard. *See* III.

Continuous distillation. Mallet. *See* III.

Mineral rubber. Dubosc and Wavelet. *See* XIV.

Gas analysis apparatus. Bürgerhausen. *See* XXIII.

PATENTS.

Fuel; Apparatus for production of artificial ——. R. Bowen, Cheltenham. Eng. Pat. 134,355, 11.11.18. (Appl. 18,432/18.)

An apparatus for the manufacture of artificial fuel by the process described in Eng. Pat. 109,995 (this J., 1917, 1173).

Pulverised coal; Plant for feeding —— to furnaces. J. E. Kennedy, New York. U.S. Pat. 1,320,367, 28.10.19. Appl., 18.3.18.

The coal is crushed and transferred to a gravity drop dryer, through which are led the gaseous products of combustion from the furnace. The coal is then powdered, and fed into the furnace under air blast.—W. P.

Coke-oven. H. W. Buhler, Boston, Mass. U.S. Pats. (A) 1,319,839. (B) 1,319,840, (C) 1,319,841, and (D) 1,319,842, 28.10.19. Appl., (A) 13.1, (B) 18.1, (C) 24.1, and (D) 27.1.17.

(A) A number of fuel inlets are situated in a straight line on one side of the air inlet to the combustion chamber of a coke-oven, air and fuel being discharged in parallel directions into the zone of combustion. (B) A series of combustion chambers and waste gas flues are arranged alternately. A conduit extending along the ends of these flues forms the only means of communication between the members of each heating unit. Movable dampers are placed across the port between each waste gas flue and the collecting conduit. (C) A horizontal retort is combined with a number of horizontal combustion chambers which are situated in the side walls of the retort. These combustion chambers are arranged in four sub-groups, the members of each sub-group being arranged one above another. Independently controlled fuel and waste gas connections are provided for each combustion chamber, and a common air supply and outlet flue for each sub-group. The latter are run in pairs. (D) In a setting consisting of a number of horizontal retorts, burners are arranged at the same end of all the combustion chambers. A partition about halfway along each retort divides the conduits leading from the combustion chambers into two sections. A regenerator is placed in connection with each conduit section.

—W. P.

Coke and gas; Process and apparatus for making ——. W. D. Wilcox, Chicago, Ill. U.S. Pat. 1,319,917, 28.10.19. Appl., [illegible]ing 4.6.18.

Coal to be carbonised travels downwards through a vertical conduit, and a [illegible] highly heated gas which is delivered into the lower end of the conduit travels upwards, carbonising the coal. Means are provided whereby the [illegible] flow of heated gas is automatically accelerated or retarded upon decrease or increase of the temperature of the upper end of the conduit.—A. B. [illegible].

Gas; Manufacture of —— in vertical retorts. G. J. Jackson, Ercedisher, and Woodhall and Duckham, Ltd., London. Eng. Pat. 133,730, 10.9.18. (Appl. 14,712/18 [illegible]ean.)

A vertical retort [illegible] for the manufacture of coal gas

is provided with the usual heating flues in the walls, and also with other flues adjacent to those heating flues which are at the end of the setting so as to be heated by them. Oil is sprayed into the upper end of these flues, and is vaporised while passing downwards through them to a conduit leading into the retort, where it enriches the coal gas. Steam may be injected into the oil-heating flue to remove any carbon deposit.—W. F. F.

Distillation [of petroleum]; Method of and apparatus for ——. H. A. Frasch, New York. U.S. Pat. 1,318,657, 14.10.19. Appl., 12.1.17.

THE petroleum is contained in a retort, open at the bottom and dipping into a heating agent which is contained in a still. The heating agent has a higher boiling point than the desired products, which are vaporised, condensed, and then re-distilled.—A. E. D.

Petroleum; Apparatus for treating ——. B. Andrews, Houston, Tex., and W. C. Averill, jun., Meraux, La. U.S. Pat. 1,319,828, 28.10.19. Appl., 7.5.18.

OIL is delivered into the bottom of a vertical cracking tube, which communicates at each end with molten metal contained in a surrounding tubular vessel.—A. E. D.

Oils; Process for treating hydrocarbon ——. L. A. Dubbs, Independence, Kans., Assignor to Universal Oil Products Co., Chicago, Ill. U.S. Pat. 1,319,053, 21.10.19. Appl., 14.1.18.

IN the cracking of an oil under a sufficient temperature and pressure, the precipitated carbon is prevented from adhering to the walls of the retort by the scouring action of a non-reactive abrasive material, which is mixed with the oil in a finely divided form.—A. E. D.

Oils; Apparatus for extracting aromatic —— *[from crude oil].* F. C. Ruff, Los Angeles, Assignor to By-Products Manufacturing Co., San Francisco, Cal. U.S. Pat. 1,319,420, 21.10.19. Appl., 15.1.17.

CRUDE oil or a fraction thereof is forced at high speed through a heated coil, and is discharged into a retort provided with perforated baffles in the upper part. The retort is heated by burners set in a furnace, the lower portion of the retort being protected from the direct action of the burners. The vaporised oil which issues from the retort is subsequently cracked.—A. E. D.

Aqueous and other vapours; Process of separating —— *from air and gases. Method of producing low temperatures.* A. J. Paris, jun., Bradford, Pa. U.S. Pats. (A) 1,320,167 and (B) 1,320,168, 28.10.19. Appl., 9.7.14 and 25.5.16.

(A) CONDENSABLE hydrocarbons are removed from gases by expanding the latter in the presence of a non-aqueous lubricant, which permits the liquefaction of the hydrocarbon vapours, but precludes the solidification of any water vapour. (B) Liquefiable hydrocarbons are removed from hydrocarbon gases by lowering the temperature sufficiently, by expansion, to cause condensation; the expansion is effected in the presence of a mixture of glycerol and alcohol, which serves to prevent the solidification of water vapour, to dehydrate the gas, and simultaneously to act as lubricant.—D. F. T.

Tank for inflammable liquids. Ger. Pat. 312,564. *See* I.

Sludge from acetylene generation. U.S. Pat. 1,319,206. *See* VII.

Artificial stone. U.S. Pat. 1,319,918. *See* IX.

Sludge sulphonic acids. U.S. Pat. 1,319,027. *See* XII.

Flue gas tester. Ger. Pat. 313,970. *See* XXIII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

PATENTS.

Coal-distillation products; Recovery of ——. H. H. Dow, Assignor to The Dow Chemical Co., Midland, Mich. U.S. Pat. 1,317,359, 30.9.19. Appl., 14.1.18.

IN the recovery of coal-distillation products the first light oil is fractionated to separate the pentane and carbon bisulphide. The pentane is then converted into a product having a different boiling point from that of carbon bisulphide, so that it may be separated from the latter.—W. F. F.

Charcoal; Pyre for the manufacture of ——. G. Beccari, Florence, Italy. U.S. Pat. 1,319,688, 28.10.19. Appl., 26.8.18.

A KILN for carbonising wood contains a number of chambers connected to a condenser. Each chamber is provided with a pair of grates, spaced apart so as to provide two compartments. The bottom of each chamber is formed as a hopper closed below by a door provided with an air-valve, and below the hoppers are passage-ways formed in the kiln structure to accommodate receptacles for the charcoal.—W. P.

III.—TAR AND TAR PRODUCTS.

Tars; Characteristics of low-temperature ——. F. Fischer and W. Gluud. Z. angew. Chem., 1919, 32, 337—340.

GENUINE low-temperature tar should not have been exposed to a temperature higher than 550° C. either during its production or subsequently. A good sample should be fluid at the ordinary temperature, and its fluidity should not be materially affected by the separation of small quantities of paraffin wax. Its sp. gr. should be from 0·95 to 1·06. In a thin layer it should be of a golden-red to deep wine-red colour, and in the fresh condition it should have no pronounced odour of hydrogen sulphide or ammonium sulphide, and none at all of naphthalene. It contains as its main constituents, paraffins, olefines, naphthenes, and phenols, with only a small amount of aromatic hydrocarbons. As was shown by Jones (this J., 1917, 7), naphthalene is not produced until a temperature of 750° C. or over is reached. In testing for naphthalene 200 c.c. of the tar is distilled in a current of steam at 100° C., and the distillate passed through a long condenser or two condensers in succession, so that it is quite cold when it reaches the receiver. Three portions of about 250 c.c. each are collected. If the oil which separates from these fractions sets to a crystalline mass naphthalene is present and may be identified by its m. pt. In some cases naphthalene may separate only after cooling in an ice-chest. Even in the absence of naphthalene, however, tar produced at a higher temperature than is permissible for genuine low-temperature tar may be present. A method of deciding whether this is the case is based on the difference in solubility and sp. gr. of individual constituents of the tar, preferably the hydrocarbons, since the proportion of phenols shows too great variations. The tar is shaken with petroleum spirit, to separate pitch and asphaltic substances, and the extract freed from acid constituents by

treatment with alkali, and distilled. In the case of true low-temperature tar the sp. gr. of the distillate from 200° to 300° C. is below 0·95 at 20° C., whilst in the case of other tars it is about 1 or over. The oily residue of b. pt. above 300° C. from low-temperature tar solidifies to a semi-solid mass owing to the separation of paraffin wax. It is completely soluble in petroleum spirit and ether, and has a sp. gr. of less than 1 at 50° C. In the case of tars produced at higher temperatures this residue is only partially soluble in cold petroleum spirit, leaving a fatty residue which is not completely soluble in ether. It has a sp. gr. exceeding 1 at 50° C. The following results were thus obtained with samples of technical low-temperature tar, vertical retort tar, and Mond gas tar:—

	Low-temperature tar.	Vertical retort tar.	Mond gas tar.
Sp. gr. (20° C.) of distillate 200°-300° C.	0·9100	0·9850	0·9306
Sp. gr. (50° C.) of residue of b. pt. over 300° C.	0·9606	1·0031	0·9713

It is not possible to distinguish low-temperature lignite tar from low-temperature coal tar by the sp. gr. of these fractions. The lignite tar oils are distinguished by being of greater consistence owing to the presence of more paraffin wax, while the low-temperature tar from ordinary coal is free from methoxyl compounds and that from lignite contains such compounds. If a lignite tar contains naphthalene it is not a low-temperature tar. In the absence of naphthalene the following test is applied: 10 grms. of the sample, purified by treatment with hot benzene, is treated with 20 c.c. of petroleum spirit, and the insoluble portion washed with 20 c.c. of the solvent. Low-temperature lignite tars have been found to contain over 30% and other lignite tars less than 10% of substances insoluble in petroleum spirit. (See also this J., 1919, 563 A).—C. A. M.

Benzol; Present position of the manufacture of —— in France. C. Berthelot. Chim. et Ind., 1919, 2, 1017—1023.

THE French requirements for benzol for the colour and allied industries are not very large, and are more than met by the home production. It is estimated that at least 176,000,000 gallons of motor spirit is required annually, and before the war some 19,000,000 gallons of benzol, mostly imported, was used for internal combustion engines. To the continuance of the recovery of benzol at gas works and to the extension of the recovery at coke works, France must look to supply the want. The possibilities of improvement and economy in the treatment of the benzol-laden wash oil are considerable. Crude benzol is recovered from the wash oil by the aid of direct and indirect steam in the proportion of 25% of direct to 75% of indirect. Part of the heat of the direct steam as recovered in the wash oil preheaters, but a greater economy could probably be effected by using several preheaters in series. If the products from the debenzolising still are all condensed together, the greater part of the heat in the indirect steam is lost, and it is suggested that the vapours coming from the still should at once, and without condensation, be submitted to a process of fractional separation. This was first proposed by Mallet, and has been carried out at Lens, Auby, and Sluiskill. Diagrams of the plant are given. The process consists shortly in passing the vapours from the debenzolising still through two or more rectifying dephlegmating columns in succession. By this means a high yield of specially pure intermediate products is obtained, considerable saving in steam is effected, and less chemicals are required for washing. The author considers that the fractionating column with bubbling trays is likely soon to be replaced by contact columns, and insists on the importance of the dephlegmator, which, especially for the final rectification, should be capable of returning to the column as liquid four-fifths of the vapour which enters it. The function of the dephlegmator is not to hold back the vapour of the less volatile liquids, but to provide return liquid for the column. This return liquid should enter the fractioning column about half-way up. The use of a vacuum for the fractionation of the higher boiling products is not warranted by experience.
—W. H. C.

Benzol; Continuous rectification of ——. A. Baril. Chim. et Ind., 1919, 2, 1013—1016.

PREVIOUS to the war very little attention was paid in France to the production of pure benzene and toluene, but the requirements of the Explosives Department during the war enforced the production of these products at the Paris gas works. Formerly the intermittent system of rectification was employed, and this necessitated a considerable number of operations to obtain pure products, and the loss on handling was considerable. A continuous system was therefore adopted, namely, that of Egrot et Grange, which consists of three column stills set in cascade, each having its own dephlegmator and condenser. Crude benzol was fed into the uppermost column and passed through the others in succession. The carbon bisulphide and low-boiling impurities were removed by the first column, pure benzene distilling within 0·5°—0·7° C. was obtained from the condenser of the second, pure toluene of a similar degree of purity from the third, and solvent naphtha containing only a trace of toluene was discharged from the bottom of the third still. The apparatus, which worked with great regularity and gave very little trouble, was able to treat from 35 to 42 tons of washed crude benzol per 24 hours, using only about $\frac{5}{8}$ of the amount of steam required to effect the same degree of separation in an intermittent apparatus.
—W. H. C.

Hydrocarbons [; Rectification of ——] during the war. L. Paillard. Chim. et Ind., 1919, 2, 1008—1012.

THE theory of fractional distillation advanced by E. Barbet in books published in 1890, 1894, and 1895 and at first much opposed, has been vindicated by the fact that its application has enabled many problems of separation which presented themselves before and during the war to be solved by continuous fractional distillation. The essential points of this theory are that the effectual separation (analysis) of the vapours takes place in the plates or trays of the rectifying column and not in the dephlegmator or reflux condenser on the top of the column, which only serves to supply to the column the condensed liquid which washes the vapours as they bubble through the liquid on the trays; that the more volatile vapours pass uncondensed through the liquid on the trays, while less volatile vapours are condensed and evaporate in their place the more volatile portions of the condensed liquid; that whilst the vapours entering the column have a varying composition, the composition of the liquids on the trays becomes stabilised once equilibrium has been established, so that it is possible to withdraw continuously part of the liquid from each of the upper trays and so obtain a series of separate products of constant composition. The advantage of these principles is well illustrated by their application to the rectification of crude petrol and benzol From crude petrol it is possible to obtain by continuous work from 8 to 10 different products. The military aeroplanes required a spirit from which all material boiling above 125° C. had been elimin-

ated and it was only necessary to separate the crude petrol into two fractions. With Barbet's continuous apparatus it was found possible to obtain from 15 to 20% more aviation spirit from the same crude material than could be got with intermittent apparatus. The steam required did not exceed 12—14 kilos. per hectolitre of crude petrol, that is 1·2—1·4 lb. per gallon, and the loss on rectification was nil. Crude benzol is fractionated with equal facility, and it is possible to eliminate the last traces of carbon bisulphide, as is necessary in the case of benzol required for explosives. The same principles have been applied, most successfully, to the separation of pure monochlorobenzene intended for the production of picric acid for melinite, but as the impurities dichloro- and polychloro-benzenes decompose at temperatures above 160° C. the final separation of these substances was effected in a column working under vacuum. Fractionation *in vacuo* is also successfully applied to the separation of heavy petroleum oils which are also liable to decomposition (cracking) at high temperatures. The same process can be applied to the separation of the three mononitrotoluenes and the cresols. The trays are fitted with many small bubbling hoods, having very fine serrations, so that the ascending vapour passes through the liquid in a very finely divided state. The Savalle system of perforated plates has the defect that if the distillation stops even for so short a time as five minutes, the whole of the liquid on the plates flows to the bottom, and on restarting it takes several hours before the still again reaches a condition of equilibrium.—W. H. C.

Distillation; Continuous —— [of tar and petroleum]. P. Mallet. Chim. et Ind., 1919, **2**, 1005—1007.

The chief advantages of continuous distillation are: High rate of working, the possibility of exchange of heat between the products entering and those leaving the system, and regularity of operation. When the heating is effected by steam, regularity of working is easily attained, and this holds good to nearly the same degree when liquid or gaseous fuel is used, but with solid fuel it is much more difficult. As far back as 1857 A. Mallet utilised a continuous system of stills set in cascade for distilling petroleum, and in 1860 he applied a somewhat different apparatus to the continuous distillation of tar at the Paris Gas Works. This consisted of an oblong, box-shaped still about 22 ft. long, 5 ft. wide, and 2 ft. deep, having cross baffle-plates extending two-thirds across the still; most of the baffles were about 21 in. deep, but every third baffle was the full depth of the still, so that the interior was divided into several sections, each provided with its own vapour pipe and condenser. Crude tar entered at one end and pitch flowed away from the other. The objections to apparatus of this type for tar are that it is not easy to clean and agitators cannot be easily adapted to it, and as tar deposits a skin of graphite on the bottom of the still when it is distilled these objections are serious The heat from a furnace burning solid fuel is variable, so that the products obtained are not very regular in composition; this is especially so with regard to the quantity of volatile matter left in the pitch. The inlet through which tar is fed into the still is very small, and the regulating valve is liable to be blocked up by coke dust which exists in most tars. With petroleum these difficulties do not exist to the same extent, and when products are required only for heating, lighting, or internal combustion engines and not for the manufacture of chemical products, continuous systems may be used with advantage. With coal tar, however, the results are much less satisfactory, and owing to the fact that pitch soon becomes pasty and a poor conductor of heat on slight cooling, it is difficult to arrange a satisfactory system of heat interchange. The system of intermittent stills in which the next charge of tar is preheated and partly distilled by the heat in the vapours coming off is much to be preferred.—W. H. C.

Light petroleum. Tausz and Schnabel. *See* IIA.

PATENTS.

Hydroxy compounds of aromatic hydrocarbons; Manufacture of ——. L. M. Dennis, Ithaca, N.Y. U.S. Pat. 1,320,454, 4.11.19. Appl., 6.2.17.

An aromatic hydrocarbon is treated with excess of sulphuric acid, and the sulphonic acid formed is neutralised after removal of residual sulphuric acid. The sulphonate is fused with an alkali hydroxide, and the product, consisting of the alkali salt of a hydroxy compound of the hydrocarbon together with alkali sulphate and sulphite, is dissolved in water. The free hydroxy derivative of the hydrocarbon is liberated by treating the solution with carbon dioxide, and is then separated from the liquor, which is treated for recovery of alkali carbonates free from alkali sulphates and sulphites. —L. A. C.

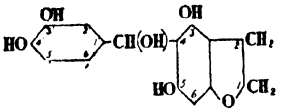
Coal distillation products. U.S. Pat. 1,317,359. *See* IIB.

Aromatic oils. U.S. Pat. 1,319,420. *See* IIA.

IV.—COLOURING MATTERS AND DYES.

Catechin group; Syntheses in the ——. P. Karrer and F. Widmer. Helv. Chim. Acta, 1919, **2**, 454—465.

Hydroxycoumarans and hydroxycoumarones condense wth nitriles in the presence of hydrogen chloride and zinc chloride to form ketimides, which yield ketones on boiling with water. These may be reduced to secondary alcohols. The ketones are designated depsanones and depsenones respectively, and the alcohols, depsanols, and depsenols. Catechin is 3.5.3′.4′-tetrahydroxy-depsanol,



5-Hydroxy-2-methyl-derivatives are also described. (See further J. Chem. Soc., 1919, i., 595.)—J. C. W.

Absorption spectra of dyes. Hnatek. *See* XXI.

PATENTS.

Colouring matters [ammonium sulphite compounds of azo dyes] and lakes therefrom; Manufacture of ——. W. R. Brass, Spondon. Eng. Pat. 134,270, 15.11.18. (Appl. 16,939/18.)

Lithol Red R, or other similar monoazo pigment colour, is dissolved in a hot aqueous solution of ammonium sulphite, freshly prepared by neutralising a solution of ammonium bisulphite with ammonia. After filtration of the solution, the ammonium sulphite compound of the colour, which has the formula $C_{10}H_6$·[1]SO_3Na·[2]$N(NH_4)$·$N(NH_4SO_3)$[1]·$C_{10}H_6$·[2]OH, is precipitated by the addition of common salt, separated by filtration, and dried. The ammonium sulphite compounds dissolved in water are heated with an alkali carbonate in the presence of a substratum, *e.g.*, *blanc fixé*, for the production of colour lakes.—L. A. C.

Diazotisation; Process of ——. E. K. Bolton, Assignor to E. I. du Pont de Nemours and Co., Wilmington, Del. U.S. Pat. 1,320,443, 4.11.19. Appl., 26.3.17.

Nitrous acid is liberated from a nitrite by the

action of sodium bisulphate in the presence of the amine to be diazotised.—L. A. C.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

PATENTS.

[Sulphite- and soda-] cellulose waste liquors; Removal of toxic substances from —— after elimination of sulphurous acid and neutralisation. E. Jacoby, Munich. Ger. Pat. 307,383, 25.11.16.

THE liquors are prepared for fermentation by treatment with small quantities of absorbent materials such as kaolin or humin, which adsorb toxic substances. Sulphite cellulose waste liquors, after neutralisation with lime, filtration, and addition of humin, may be treated with salts of the heavy metals to cause flocculation of the humin. The process is applicable also to liquors from soda cellulose factories.—J. H. L.

Pulp and paper, cardboard and like sheet material; Manufacture of —— from garbage. J. F. and H. F. J. Puttaert, San Francisco, Cal., U.S.A. Eng. Pat. 134,411, 16.12.18. (Appl. 20,972/18.)

SEE U.S. Pat. 1,294,163 of 1919; this J., 1919, 283 A.

Fireproofing. U.S. Pats. 1,318,523–4. *See* IX.

Deliming agent for hides. Ger. Pat. 313,995. *See* XV.

Alcohol [from sulphite-cellulose waste liquor]. U.S. Pat. 1,320,043. *See* XVIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

PATENT.

Mordant; Liquid —— for use in dyeing fabrics. P. Besnier, New Orleans, La. U.S. Pat. 1,320,974, 4.11.19. Appl., 2.9.19.

A MORDANT composition contains sodium sulphide, naphthalene, and sodium chloride.—L. A. C.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Ammonia; Synthesis of ——. E. B. Maxted. Chem. Age, 1919, **1**, 514—515, 540—542, 590—592. (See also this J., 1918, 232 T, 368 A; 1919, 219 A.)

THE percentage of ammonia capable of existing in equilibrium with nitrogen and hydrogen increases with the pressure but decreases with increasing temperature. In practice, however, the reacting gases pass too rapidly over the catalyst to allow equilibrium to be reached, and the reaction velocity, which is increased at higher temperatures, becomes of equal importance to the position of the equilibrium in determining the amount of ammonia formed. The pressure employed in the technical synthesis is about 150 atmospheres. Since the power required for compression varies as the logarithm of the pressure, the latter should be as high as is compatible with the construction of the furnace and circulating system. The chief obstacles in the way of very high pressures are inefficient joints and glands. Iron is the usual catalyst, with potassium hydroxide as promoter. It must be very carefully freed from impurities by repeated oxidation and reduction, as the reaction is very susceptible to catalyst-poisons. Uranium is not suitable for industrial use on account of its being very readily oxidised by traces of air or water. Osmium would probably be the best catalyst but for its high cost. With regard to the technology of the process, the power required for compression is a considerable item in the cost of the whole process, and the economy of using comparatively high working pressures is emphasised. The question of lubrication of the compressor is an important one on account of the inhibitive effect of traces of oil on the activity and life of the catalyst. The purification and drying of the compressed gases is important, carbon monoxide being a specially active catalyst poison. The construction of the synthesising furnace has presented difficulties on account of the rapidity with which steel becomes brittle under the action of the gases. Double-walled furnaces with internal electrical heating have been tried, and special alloys more resistant to the action of hydrogen than steel have been used. Another solution of the problem is so to regulate the conditions that the heat of reaction maintains the temperature at the desired point without extraneous heating. Furnaces based on this principle are said to be in operation consisting of a simple bomb of special alloy, lined and lagged with refractory material. Recovery of the ammonia formed may be accomplished by refrigeration, but is far from complete even at very low temperatures. It may be absorbed by water under pressure, and then the gases have to be carefully dried before again passing into circulation; with a high rate of circulation this is a difficult matter. Solid absorbents, such as anhydrous cobalt chloride, may also be used. The bearing of the present high cost of fuel on the economic production of hydrogen is discussed. The continuous process for the catalytic oxidation of the carbon monoxide of water-gas by steam gives a product still containing much carbon monoxide, which must be removed as formate by means of calcium carbide. Of other methods of nitrogen fixation, the one offering most chances of success in Great Britain is the cyanamide process, and it is desirable that this should be tried out alongside the direct synthesis under comparable conditions.—E. H. R.

Potassium pyroantimonate; Preparation of —— for sodium estimation. J. D. Van Leeuwen. Chem. Weekblad, 1919, **16**, 1426.

POTASSIUM pyroantimonate, which will keep unchanged for a long period, is made as follows: 20 grms. of potassium antimonyl tartrate is mixed with 20 grms. of potassium nitrate and the mixture heated to a red heat in a crucible. When reaction has ceased, the lid is placed on the crucible and heating continued for 15 minutes. After cooling, 50 c.c. of warm water is added and the mass is stirred till it becomes powdery. It is then filtered through a porcelain vacuum filter, the residue is treated with 100 c.c. of cold water and transferred with the filter paper to a flask containing 500 c.c. of boiling water. After boiling for 1 minute and rapidly cooling, some aluminium hydroxide is added, the mixture is shaken and finally passed through an ordinary filter paper.—W. J. W.

Magnesia; Purification of ——. Conditions in which periclase or crystalline magnesia is formed. J. Meunier. Bull. Soc. Chim., 1919, **25**, 560—562.

MAGNESIA may be freed from calcium by igniting at a red heat and subsequently, after cooling, extracting with successive portions of a 10% solution of sucrose, until the last extract does not give a turbidity with ammonium oxalate. The residue is then washed and dried. If further purification is desired, this material is dissolved in hydrochloric acid and the solution evaporated to dryness. The residue is gradually heated to redness (800°—900° C.) in a covered crucible, and magnesia is obtained in

its crystalline form as periclase on the lid and sides of the crucible and on the surface of the amorphous magnesia in the crucible.—W. G.

Pyrites and blende furnaces. Schefczik. *See* X.

Electrochemical industry. Goldschmidt. *See* XI.

Solubility of sulphur. Innes. *See* XV.

Eliminating vanadium from solution. Reichert and Wernicke. *See* XIXB.

Spectra of magnesium compounds. Meunier. *See* XXIII.

PATENTS.

Nitroxylsulphuric acid; Handling ——. O. Jensen, Notodden. Assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiania, Norway. U.S. Pat. 1,319,586, 21.10.19. Appl., 11.6.19.

IN handling nitroxylsulphuric acid, the action of the acid on iron is eliminated by the addition of a small quantity of nitric acid.—W. J. W.

Ammonia; Oxidation of ——. C. Toniolo, Milan, Italy. U.S. Pat. 1,318,936, 14.10.19. Appl., 23.12.18.

A MIXTURE of air and ammonia is passed through a heated, non-catalytic metal gauze, stretched across a tube, and in such proximity to a porous catalytic diaphragm as to interchange heat with the latter.
—W. J. W.

Ammonium perchlorate; Manufacture of ——. D. Aanensen, Christiania, Norway. Eng. Pat. 121,727, 30.10.18. (Appl. 17,700/18.) Int. Conv., 22.12.17.

IN the manufacture of ammonium perchlorate from ammonium nitrate and sodium perchlorate, after separating the ammonium perchlorate first formed, the mother liquor, which contains chiefly sodium nitrate, is treated with ammonium bicarbonate or ammonia and carbon dioxide. This precipitates sodium bicarbonate and leaves in solution ammonium nitrate and smaller quantities of ammonium perchlorate and sodium bicarbonate. The solution is treated with a further quantity of sodium perchorate, preferably leaving the ammonium nitrate in slight excess.—B. V. S.

Alkaline chlorides; Apparatus with horizontal diaphragm for electrolysis of ——. Norsk Alkali A./S., Trondhjem, Norway. Eng. Pat. 125,935, 14.11.18. (Appl. 18,702/18.) Int. Conv., 25.4.18.

IN an electrolytic cell with horizontal diaphragm composed of a layer of a powdered inert substance on a suitable support, such as is used in the electrolysis of alkali chlorides, the tendency to a greater rate of diffusion of liquid at the junction of the diaphragm with the walls of the cell is overcome by placing a fillet of inert material on or in the diaphragm a little distance from the cell wall and filling in the intervening space with a pasty tightening mass forming a liquid-tight joint.
—B. V. S.

Potassium; Process of extracting —— from its insoluble compounds. F. D. S. Robertson, Toronto, Canada. U.S. Pat. 1,317,524, 30.9.19. Appl., 17.5.18.

A SILICATE mineral is subjected to the action of free phosphoric acid, and the soluble alkali phosphate produced is treated with some other acid to replace the phosphoric acid, which is recovered.
—S. S. A.

Potassium sodium sulphate; Process of recovering —— from saline liquors. G. B. Burnham, Borosolvay, Cal. U.S. Pat. 1,317,954, 7.10.19. Appl., 16.6.19.

LIQUOR containing potassium, sodium, chloride, and sulphate ions is evaporated and agitated, thereby causing separation of "supersaturated sodium chloride." The liquor is separated from the deposit and allowed to crystallise, whereby potassium-sodium sulphate is obtained.—S. S. A.

Potassium salts; Process of extracting ——. R. S. Edwards, Brookline, Mass. U.S. Pat. 1,320,211, 28.10.19. Appl., 25.9.18.

SILICATES containing compounds insoluble in water are mixed with an excess of sodium chloride and heated in intimate contact with steam to the fusion point of sodium chloride, thereby producing potassium chloride which is extracted by lixiviation.
—S. S. A.

Silicates; Process or recovering salts from ——. R. S. Edwards, Brookline, Mass. U.S. Pat. 1,320,212, 28.10.19. Appl., 30.10.18.

THE product obtained by furnacing a mixture of silicate, sodium chloride, and calcareous material, and which contains free lime and sodium chloride, is subjected to further reaction in an aqueous medium, the reaction being maintained by the continuous addition of the hot furnaced mixture. Water-soluble potassium compounds are thus extracted.—S. S. A.

Potassium-magnesium sulphate and potassium sulphate; Manufacture of —— [from kieserite]. Kaliwerke Grossherzog von Sachan A.-G., Dietlas, and K. Hepke, Dorndorf. Ger. Pat. 313,053, 30.10.17.

KIESERITE separated from the kieserite wash-liquors and free from chlorides is stirred with 30—40% excess of crude 60—70% potassium chloride above that required by the equation $2KCl+2MgSO_4=MgCl_2+K_2SO_4,MgSO_4$, and with sufficient water to form a thick paste. The mixture is allowed to stand several days in a covered vessel with the wash water evenly covering the solid material; the liquor is then drawn off from the bottom of the vessel, and more wash water is added. The liquor obtained after decomposition of the sulphate may be used for adding to the solid material. If potassium-magnesium sulphate is required, the washing is continued until the salts are practically free from magnesium chloride, but if the product is to be treated for the manufacture of potassium sulphate, complete removal of the chlorides is unnecessary. In the latter case, after removal of the bulk of the chlorides, a further quantity of potassium chloride, *i.e.*, 30—50% excess over that required by the equation $K_2SO_4,MgSO_4+2KCl=2K_2SO_4+MgCl_2$, is stirred with the product, which is then allowed to stand and washed as before. The only impurities likely to be found in the potassium sulphate are insoluble substances such as anhydrite and alumina present in the kieserite.—L. A. C.

Alunite; Apparatus for calcining ——. H. F. Chappell, New York. U.S. Pat. 1,317,686, 7.10.19. Appl., 14.1.19.

THE apparatus comprises a rotary kiln and a removable fire-box connected to the lower end of the kiln in a manner which prevents access of air to the furnace through the junction during the calcining operation.—S. S. A.

Sulphur dioxide; Balanced process of extracting and desiccating —— from solution. J. Davenport, Boston, Mass. U.S. Pat. 1,317,688, 7.10.19. Appl., 12.6.19.

THE solution is subjected at atmospheric pressure

in open vessels to successively increased temperatures, and the sulphur dioxide is collected as expelled.—S. S. A.

Hydrocyanic acid; Process of recovering ——. G. H. Buchanan, Roselle, N.J., Assignor to American Cyanamid Co., New York. U.S. Pat. 1,317,755, 7.10.19. Appl., 7.5.19.

Raw material, containing substantial quantities of impurities, is mixed with water, and mineral acid is introduced below the surface of the mixture, thereby liberating hydrocyanic acid gas, the last traces of which are expelled from solution by live steam. The gas is recovered by suitable treatment in a scrubber.—S. S. A.

Calcium cyanamide; Apparatus for making ——. G. E. Cox, Niagara Falls, N.Y., Assignor to American Cyanamid Co., New York. U.S. Pat. 1,317,756, 7.10.19. Appl., 28.2.19.

A container for charging finely-divided carbide into a cyanamide oven, and provided for discharging purposes with a closure which may be raised or lowered, is carried by a movable supporting frame. Means are provided for raising or lowering the container and for causing it to register with the cyanamide oven.—S. S. A.

Bismuth; Making oxides of ——. C. Ellis, Montclair, N.J., Assignor to Ellis-Foster Co. U.S. Pat. 1,318,336, 7.10.19. Appl., 4.1.19.

Comminuted bismuth is projected into a flame, and the oxide and other products are collected.
—J. H. J.

Manganates; Manufacture of ——. J. R. MacMillan, Niagara Falls, N.Y. U.S. Pat. 1,318,891, 14.10.19. Appl., 11.6.18.

A mixture of manganese dioxide and an alkali is mechanically comminuted in presence of air at a temperature sufficient for oxidation.—W. J. W.

Manganese compounds [permanganates]; Process of preparing highly-oxidised ——. J. C. Adell, Cleveland, Ohio. U.S. Pat. 1,318,432, 14.10.19. Appl., 20.8.17.

Alkali permanganates are prepared by heating an oxide of manganese in admixture with an alkali hydroxide or carbonate to dull redness in air and in contact with iron oxide.—S. S. A.

Sodium sesquicarbonate; Process of making —— and of recovering sodium carbonates from natural waters. J. R. Watson, Cartago, and W. Hirschkind, Pittsburg, Cal., Assignors to California Alkali Co., San Francisco, Cal. U.S. Pat. 1,319,128, 21.10.19. Appl., 29.10.17.

Solid sodium bicarbonate is added to a solution of sodium carbonate, and the sesquicarbonate produced is separated.—W. G. W.

Sludge from acetylene generation; Process for treating ——. J. H. Cohen, Brighton, Mass. U.S. Pat. 1,319,206, 21.10.19. Appl., 23.7.17.

The sludge, freed from residual acetylene by aeration and evaporation, is filtered, and the residue is dried in order to drive off mechanically-held water without effecting chemical change.—S. S. A.

Ammonia; Process for recovery of ——. R. O. E. Davis and H. Bryan, Washington, D.C. U.S. Pat. 1,319,663, 21.10.19. Appl., 15.5.19.

Ammonia formed by passing hydrogen and nitrogen over a catalyst is absorbed by charcoal, from which it is liberated by the application of a vacuum, and recovered by cooling.—W. J. W.

Magnesium nitride; Process for producing ——. C. R. Burke, Tulsa, Okla, H. T. Boyd, Homer, P. McD. Biddison, Columbus, Ohio, and J. S. Zink, Tulsa, Okla. U.S. Pat. 1,319,843, 28.10.19. Appl., 4.3.18.

A process for producing magnesium nitride consists in treating a hydrocarbon gas, containing nitrogen, with magnesium at a temperature not below 300° C.—W. P.

Black-ash solutions; Apparatus for filtering ——. H. L. Dunkle, Washington, D.C. U.S. Pat. 1,320,324, 28.10.19. Appl., 14.6.19.

The apparatus comprises a series of containers placed at successively lower levels and connected by inclined filters. In flowing from one container to the next the liquor passes through the filters and is thereby separated from suspended black ash.
—S. S. A.

Alkali-earth nitrates and hydrogen sulphide. R. W. Davis, jun., Jenkintown, Pa. U.S. Pat. 1,321,013, 4.11.19. Appl., 13.12.16.

An alkaline-earth nitrate is obtained by the interaction of a solution of alkaline-earth sulphide with a solution of a nitrate of a metal the hydroxide of which is insoluble, hydrogen sulphide being evolved.
—B. V. S.

Aqueous solutions of gases [chlorine]; Means for making ——. F. W. Thorold, E. G. R. Ardagh, and J. T. Burt-Gerrans, Toronto, Canada. U.S. Pat. 1,319,734, 28.10.19. Appl., 22.1.19.

Chlorine produced from a solution of sodium chloride which is supplied continuously to an electrolytic cell is brought into intimate contact with water under pressure, and the resulting solution transferred to a storage tank. The variation of level in the storage tank controls the supply of sodium chloride to the electrolytic cell, the evolution of chlorine from the cell, and the supply of water to dissolve the gas.—W. F. F.

Oxygen-yielding masses; Process for the production of —— [from peroxides]. K. Schwab, Berlin-Baumschulenweg. Ger. Pat. 306,415, 9.8.16.

Alkali peroxides are mixed with salts of less electropositive metals, or with ammonium salts, and heated to incipient softening. After cooling, the products are porous owing to evolution of gas during the heating. Indifferent porous materials may be incorporated in the mixtures before heating, and metals or metallic compounds which act as catalysts may be added before or after the heating.
—J. H. L.

Sulphuric acid; Process and apparatus for producing ——. H. V. Welch, Los Angeles, Cal., U.S.A. Eng. Pat. 134,015, 22.10.18. (Appl. 17,226/18.)

See U.S. Pat. 1,284,166 of 1918; this J., 1919, 73A.

Ammonia and ammonium compounds; Process of producing ——. G. G. Taylor, Crafton, and I. E. Knapp, jun., Coraopolis, Pa., U.S.A. Eng. Pat. 134,237, 13.3.18. (Appl. 4455/18.)

See U.S. Pat. 1,315,534 of 1919; this J., 1919, 818A.

Nitrogen; Process for fixation of ——. F. L. Slocum, Assignor to J. H. Reid, Pittsburgh, Pa. U.S. Pat. 1,318,929, 14.10.19. Appl., 27.11.17.

See Eng. Pat. 133,104 of 1918; this J., 1919, 900A.

Carbide; Preparation of crude material for manufacture of ——. F. L. Slocum, Assignor to J. H. Reid, Pittsburgh, Pa. U.S. Pat. 1,319,183, 21.10.19. Appl., 21.9.17.

See Eng. Pat. 133,103 of 1918; this J., 1919, 900A.

Calcium carbide; Preparation of crude materials for manufacture of ——. F. L. Slocum, Assignor to J. H. Reid, Pittsburgh, Pa. U.S. Pat. 1,319,426, 21.10.19. Appl., 10.9.17.

See Eng. Pat. 133,101 of 1918; this J., 1919, 960 A.

Acid-still. U.S. Pat. 1,320,080. *See* I.

Ferrosilicon [and potassium salts]. U.S. Pat. 1,318,763. *See* X.

Refractory material and method of making same. B. Enright, Allentown, Pa. U.S. Pat. 1,319,056, 21.10.19. Appl., 14.11.18.

A REFRACTORY material for furnace linings is made of calcined dolomite containing calcium and magnesium silicates, but only a negligible amount of free silica.—A. B. S.

China clay; Apparatus for use [in removing deposited sand] in obtaining ——. G. F. Nalder, Truro, Cornwall. Eng. Pat. 14,788, 19.6.14.

VIII.—GLASS; CERAMICS.

Refractory materials and high temperature measurements. C. W. Kanolt. J. Franklin Inst., 1919, **188**, 489—505.

A SHORT account of the theoretical basis of the temperature scale is given, followed by a brief description of the different types of instrument used for high temperature measurement, including thermo-couples, resistance thermometers, optical and radiation pyrometers, and pyrometric cones. The most important refractory materials in general use are enumerated and their specific properties briefly described.—E. H. R.

Stoneware glazes; Modulus of elasticity of ——. W. Steger. Keram. Runds., 1919, **27**, 313—316.

THE modulus of elasticity and the coefficient of expansion between room temperature and 100° C. were determined on 11 stoneware glazes of widely different compositions, viz.:—

Glaze No.	PbO	K_2O.	Na_2O.	CaO.	BaO.	MgO.	ZnO.	Al_2O_3.	SiO_2.	B_2O_3.	Mean modulus of elasticity, kilos. per sq. mm.	Mean linear coefficient of expansion ($\alpha \times 10^6$).
1	41·84			4·52	-		—	5·86	36·42	8·05	6030	570
2	24·86	6·01	1·94	3·57				9·11	40·37	11·14	6200	694
3	15·75	6·65		7·91				8·66	51·16	9·87	6240	638
4	22·53	1·59	2·78	6·60	-	-		8·31	46·59	11·19	6500	623
5	-	8·45	6·67	9·03	-			10·99	49·80	15·06	6810	943
6	—	5·45	3·32	1·54	1·98	2·42		15·10	50·83	19·34	5730	642
7	13·10	8·32	4·55	4·11	-			10·51	53·24	6·17	6620	847
8	11·03	3·11	3·65	5·27	-			10·83	55·89	10·29	5900	625
9	—	7·01	1·61	8·31	-		—	12·16	57·48	10·41	6790	840
10	—	4·68	3·08	5·80	27·88	0·67	1·01	7·19	49·69	-	6830	964
11	—			-	48·34	1·82	7·31	4·61	37·92	-	6730	940

The raw materials used were red lead, marble, Zettlitz kaolin, Hohenbocker sand, magnesite, felspar, borax, boric acid, anhydrous soda, barium carbonate, and zinc oxide. In each case, except Nos. 3, 4, and 6, the materials were fritted, the frit being ground and mixed with a little kaolin which had been retained for the purpose. Plumbiferous stoneware glazes have a lower modulus of elasticity than leadless glazes, but the modulus is more closely related to the composition in plumbiferous glazes than in others. Calculations of the modulus of elasticity by Winkelmann and Schott's formula differ by 9—50% from the experimental results, the latter being the lower, though in two cases the variations were under 2%. The modulus of elasticity of the glazes does not appear to bear any definite relation to the composition. (See this J., 1919, 631 A.)—A. B. S.

PATENTS.

Moulds [for glass]; Composition of matter for —— and method of making same. B. C. Gilligan, Toledo, Ohio. U.S. Pat. 1,319,151, 21.10.19. Appl., 6.9.16.

THE moulds are made from a mixture of powdered graphite, powdered retort carbon, and caramelised sugar.—A. B. S.

IX.—BUILDING MATERIALS.

Concrete in chemical industry. E. S. Andrews. Chem. Age, 1919, **1**, 612—613.

REINFORCED concrete is suitable for almost all forms of factory structure, water-towers, cooling towers, storage bins and bunkers, tanks, and vats. The best concrete is that made of fine aggregate (sand) of particles varying from 0·01 to 0·25 in. diameter, coarse aggregate (gravel, broken brick, or stone) of particles $\frac{1}{4}$—$\frac{3}{4}$ in. diameter, and Portland cement, these materials being mixed in such proportions as will produce a mass of maximum density. For structures where the risk of a severe fire has to be considered, broken bricks and stone are superior to gravel or Thames ballast as aggregates. The design, dimensions, and position of the steel used as reinforcement are very important. Concrete tanks are specially suitable for use with chemicals because of their durability, resistance to acids of moderate strength, and the small amount of leakage around the outlet-fittings. The gates and other connections should be of brass or bronze and sufficiently heavy not to require renewal, as a good joint cannot be made between old and new concrete in a thin wall. Concrete tanks may safely be used for storing menhaden oil, fuel oils, and tanning liquor, 4% caustic soda solution, the chlorine solutions used in paper mills, and "*Sauerkraut*," but not for sulphite liquor and cider vinegar unless previously treated with paraffin wax. Concrete tanks with an asphalt mastic lining are resistant to sulphuric acid. Concrete tanks are not suitable for storing kerosene and gasoline unless coated with spar varnish. Hot coconut oil and lard oil attack concrete.—A. B. S.

Cements; Rapid tests of ——. C. Montemartini and F. Roncali. Annali Chim. Appl., 1919, **12**, 59—73.

COMPARATIVE tests were applied to samples of neat cement and mixtures of cement and sand (1:2 and 1:3), which had been exposed for periods up to 140 days to the action of hot (100° C.) and cold soft and sea water. The results of tensile and compression tests show that at first the hardening in hot

water is much more pronounced, but after the seventh day the difference between the results obtained with samples exposed to hot and to cold water is not so great. The curves representing the hardening in hot and in cold water respectively of two samples of cement crossed each other in the experiments with soft water, but did not touch in the salt water experiments, whilst the curve representing the results on heating had invariably higher ordinates than those of the corresponding curve of results in the cold. Immersion of samples in hot water accelerates the hardening process even in the case of samples kept for some time in water at 18° C. Comparative tests at fixed periods of 7, 28, and 90 days in the cold and 2, 4, and 6 days in hot water respectively were made with 25 different slow-setting cements and 4 quick-setting cements, alone and in admixture with sand (1:3). The results varied according to which periods were chosen for the comparison, but the main conclusion drawn from the experiments is that the results of the heat test are in accordance with practice, and that the test effects a great saving of time.—C. A. M.

Titanium; Determination of —— in certain Italian puzzuolanas. A. Cavazzi. Annali Chim. Appl., 1919, 12, 105—111.

THE material is ground as finely as possible in an agate mortar, and 0·5 grm. is moistened with 20 drops of dilute (1:1) sulphuric acid, in a platinum crucible, and evaporated slowly to dryness with 10 c.c. of hydrofluoric acid. The residue is heated to remove sulphuric acid and carbonise organic matter, and the hot crucible brought into contact with cold water, so as to detach the mass, which is then pulverised and fused in the crucible with 4 grms. of finely powdered potassium pyrosulphate at a temperature insufficient to liberate fumes of sulphuric acid. When the mass has assumed a greyish tint the temperature is raised until the residue becomes yellowish-white and there is slight evolution of white fumes, and the crucible is then heated for a few minutes over a blow-pipe flame until the substance becomes reddish-orange, but without excessive evolution of white fumes. The fused mass is poured into a platinum capsule chilled with cold water, the resulting colourless button is dissolved in water, and the solution made up to 100 c.c., stirred at intervals for 30 mins. and filtered into a graduated cylinder. To determine the titanium the solution is treated with 2 c.c. of 3% hydrogen peroxide solution and 2 c.c. of sulphuric acid, and the coloration produced is compared with that given by a standard solution of titanium under the same conditions. The standard solution may be prepared from titanium sulphate, and the amount of titanium in the latter is determined by igniting the salt in a platinum crucible with successive additions of ammonium carbonate, until all traces of sulphuric acid have been removed, and weighing the residue of titanium oxide, TiO_2. In the absence of the sulphate any salt of titanium which is soluble in hot sulphuric acid and capable of conversion into pure TiO_2 by ignition may be used. Four samples of Italian puzzuolanas examined by this method contained from 0·312 to 0·558% of titanium (see this J., 1919, 580A).
—C. A. M.

PATENTS.

Artificial stone having the characteristic markings of the natural product; Process and apparatus for the production of ——. W. J. de Bas, The Hague, Holland. Eng. Pat. 120,575, 23.10.18. (Appl. 17,329/18.) Int. Conv., 2.4.17.

THE veinings, mottling, and other marks in natural stone are imitated in slabs or blocks of a mixture of cement and sand by using a mould the bottom of which consists of a removable impervious, elastic fabric, *e.g.*, rubber, oilskin, prepared cotton or like, on a bottom plate which may be moved slig backwards and forwards with respect to the s walls. This removable bottom receives the ma ings, which are formed of a thin layer of pa consisting of cement with the colours of the ma ings to be imitated. On this is thrown or spray a paste containing the fundamental colour, and t mould is afterwards filled with the cement-sa mixture which forms the body of the article. T contents of the mould are subjected to a pressu of 100—200 kilos. per sq. cm., after which the fab is removed and the pressure is repeated as often necessary. Where clearly defined markings a required, the surface of the article should stripped or ground off. This stripping is facilitat by providing the mould with a cover-plate su jected to the influence of a spring which is replac by a plain cover-plate after the first or any desir application of pressure. The pressure may be i creased at each subsequent compression.—A. B. S

Artificial stone; Process for converting limesto into compressible ——. C. L. V. Zimmer, Berli Wilmersdorf, Germany, Assignor to The Chemic Foundation, Inc. U.S. Pat. 1,319,918, 28.10.1 Appl., 11.8.15.

A COMPRESSIBLE artificial stone is made by mixir powdered limestone with a bituminous substance i the presence of a "sulphated vegetable acid capable of emulsifying the bituminous substance.
—A. B. S.

Wood and other materials; Art of protecting an fireproofing ——. Art of protecting and fir proofing materials. A. Arent, Badger, and R. A Kuever, Iowa City, Iowa, Assignors to Arento Co., Chicago, Ill. U.S. Pats. (A) 1,318,523 and (B 1,318,524, 14.10.19. Appl., (A) 28.4.16. Renewed 21.2.19. (B) 29.9.17.

(A) A PROTECTIVE and fireproofing composition fo treating wood and the like consists of an aqueou ammoniacal solution having an alkaline reaction t phenolphthalein, and containing approximately 10% of zinc in combination with relatively volatile radicles. The material is treated with the solution and is then dried. (B) A composition consists of a solution containing above 2% of zinc in the form o a zincate, and an ammonium salt in quantity considerably less than that required to saturate the solution.—L. A. C.

Impregnating wood; Apparatus for——. J. H. Parsons, Assignor to W. H. Savery, Wilmington, Del. U.S. Pat. 1,319,531, 21.10.19. Appl., 4.3.18.

AN apparatus for preserving timber, comprises inclined cylinders containing the wood to be impregnated, mounted on opposite ends of a platform, a tank to contain the fluid mounted on the same platform, together with a pump for forcing the preservative fluid into the cylinders under a predetermined pressure.—A. B. S.

Hydration; Method of ——. Method of promoting plasticity of mortar materials. W. W. Rhodes, Woodville, Ohio. U.S. Pats. (A) 1,318,921 and (B) 1,318,922, 14.10.19. Appl., 27.9.16.

(A) AN alkaline-earth substance having an exothermic reaction with moisture is moistened and maintained at a temperature below the "atmospheric steaming temperature of water" whilst steam is being generated therefrom. (B) Alkali hydroxide to be used in the preparation of mortar and plaster is reduced in bulk and also in its power of absorbing water by removing air from the dry powdered hydroxide and allowing the subdivided particles to settle and produce a compact mass of less volume. The plasticity of mortar material containing this treated hydroxide is increased.

Portland cement; Manufacture of ——. C. Pontoppidan, Brooklyn, N.Y., Assignor to F. L. Smidth and Co., New York. U.S. Pat. 1,320,172, 28.10.19. Appl., 11.10.17. Renewed, 6.3.19.

PORTLAND cement is made from raw materials which possess hydraulic properties by making them into a slurry, which is prevented from setting. Subsequently the action of the preventive is negatived and the manufacture of the cement completed.

—A. B. S.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Hardness;; [of steel] Brinell and scratch tests of ——. W. C. Unwin. Engineering, 1919, **108**, 669.

IN testing mild steel the Brinell test is easiest and most accurate, but with very hard steel it is not so satisfactory on account of the smallness of the indentation and the deformation of the ball. A series of determinations of hardness by the Brinell and scratch methods show that for very hard steel the scratch number is much greater than the Brinell number assuming that the formula for scratch hardness is represented by the equation $Hs = \frac{0{\cdot}02675}{w^4}$ where w is the width of the scratch in millimetres. Taking the results of determinations on 24 steels varying from 302 to 741 Brinell hardness, the mean error (*i.e.*, the deviation of the scratch hardness from the Brinell hardness expressed as a percentage of Brinell hardness) with this formula is 22·5%. On the assumption, however, that the scratch hardness varies as the square of w and keeping the load constant, the formula which suits the results best is $Hs = \frac{0{\cdot}68}{w^2}$ The mean error with this formula for the 24 determinations is 16·6%.—J. W. D.

Materials [alloy steels] for the exhaust valves of internal combustion engines. J. E. Hurst and H. Moore. Engineering, 1919, **108**, 672—674.

THE wear of exhaust valves during working is not due to chemical action, but to mechanical action, excessive temperatures, or the combined effect of both. To minimise this mechanical wear it is necessary to have a material which is hard and tough at the maximum temperature to which it is likely to be subjected. Cast iron is not a satisfactory material for valves, and mild steel although used for slow-speed engines, has too high a rate of wear. Case-hardened steel becomes annealed during running of the engine unless the valves are water-cooled. The most satisfactory steels for slow-speed engines are 3% nickel steel and nickel-chrome steels. For aero-engine valves high chromium non-corrodible steels and tungsten steels are principally used and prove most satisfactory. Nickel steel of high nickel content (30%) and cobalt-chrome steel have been used, but their use is not general. A process which has been introduced recently for producing a hard surface unaffected by changes of temperature is that of calorising with alumina and aluminium powder at a high temperature (this J., 1914, 1159), and this process gives satisfactory results.—J. W. D.

Iron-vanadium alloys; Investigation of the magnetic properties of ——, employing a highly sensitive astatic torsion magnetometer. R. Dieterle. Ann. der Physik, 1919, **59**, 343—392. Chem. Zentr., 1919, **90**, III., 662—663.

THE magnetic properties of three iron-vanadium alloys containing respectively 0·64, 1·75, and 3·60% V have been investigated. Vanadium readily forms compounds with carbon and oxygen, whereby the deleterious effects of these latter elements upon the magnetic properties of the iron are reduced. This action counteracts to some degree the deleterious effect of vanadium itself, but maximum permeability of iron-vanadium alloys occurs only in relatively intense fields. By annealing, the intensity of magnetisation of the alloys is somewhat reduced Owing to the fact that alloys with high vanadium content cannot be hardened, such alloys cannot be employed for the manufacture of permanent magnets.—J. S. G. T.

Pyrites and blende roasting; Mechanical furnaces for ——. Schefczik. Chem.-Zeit., 1919, **43**, 661—662.

DIFFERENT types of pyrites roasting furnaces are described. The 3—4-ton Herreshoff furnace is well built and has easily changed parts, but with small grain material produces undesirable quantities of dust. The 24 ton Wedge furnace is large, and replacements take up considerable time. A 15-ton water cooled furnace of this type is now made. The 8—9 ton Bracq-Moritz furnace gives economical heating; piston charging gives a uniform feed, and replacements are simple. The roasting of zinc blende presents greater difficulties owing to dust troubles with the small grain material and variation in the nature of the blende and admixtures. The Delplace furnace is hand-fired and not always satisfactory. It is being superseded by those with mechanical charging arrangements. When comparing furnaces the following points should be considered the method of conducting the air over the ore surface; the amount and character of the air; the method of working the furnace; the method of heat supply; and safety in working. The roof must not be too high and the air should be preheated. In the "Universal" roasting and calcining furnace, the temperature of each muffle is regulated separately, the top one being kept at 600° C. to prevent the formation of zinc sulphate. The charge is pendulum stirred and the gas firing is simple. As the safety in working is also satisfactory this furnace is considered to be better than the other mechanical furnaces considered (Lurgi, Matthiesen-Hegeler, and Spirlet furnaces).

—T. H. Bu.

Copper in pyrites and pyrites cinder; Electrolytic determination of ——. E. Menglar. Chem.-Zeit., 1919, **43**, 729.

FIVE grms. of the powdered pyrites is heated with 50 c.c. of nitric acid (sp. gr. 1·2) and the mixture evaporated until sulphuric acid fumes are evolved; the residue is treated with 50 c.c. of hydrochloric acid (sp. gr. 1·19), 2 grms. of sodium hypophosphite, NaH_2PO_2, dissolved in a small quantity of water is added, and the mixture is evaporated to dryness at 110°—120° C. In the case of pyrites cinder, the sample is dissolved directly in hydrochloric acid and evaporated. The dry residue is then treated with 7 c.c. of concentrated sulphuric acid and a small quantity of nitric acid, again evaporated to dryness, the residue treated with hot water, the solution filtered when cold, and the insoluble portion washed with very dilute sulphuric acid. The filtrate is treated with 1 grm. of citric acid and 2 grms. of ammonium nitrate, diluted to 200 c.c., and the copper deposited on a platinum cathode having a surface of about 200 sq. cm.; a current of 2·8 volts and 0·3—0·4 amp. is employed. Most of the lead present is deposited as peroxide on the anode, but a small quantity is deposited with the copper. The latter is therefore dissolved off the cathode with hot dilute nitric acid, the cold solution treated with a small quantity of sulphuric acid, and the copper again deposited as before. Silver, bismuth, antimony, tin, selenium, etc., are

usually present in such minute quantities that they may be neglected. When the pyrites is free from lead and arsenic, the 5 grms. of sample may be dissolved directly in 50 c.c. of nitric acid (sp. gr. 1·2) and 20 c.c. of dilute sulphuric acid, evaporated to dryness, the residue dissolved in water and the solution filtered; the filtrate is treated with citric acid and ammonium nitrate and then submitted to electrolysis.—W. P. S.

Electro-chemical industry. Goldschmidt. *See* XI.

Spectrum of magnesium. Meunier. *See* XXIII.

PATENTS.

Manufacture of iron and steel direct from ore. J. Lund, San Francisco, Cal. U.S. Pat. 1,320,483, 4.11.19. Appl., 10.1.18.

THE ore is briquetted together with a flux and carbon and fed into a metallic bath under a cover of molten purified slag. During the heating process portions of the bath and slag are withdrawn, the slag being purified and returned in a heated molten condition in sufficient quantities to maintain the bath entirely covered.—J. W. D.

Iron; Process of extracting —— from its ore. C. C. Jones, Los Angeles, Cal. U.S. Pat. 1,319,589, 21.10.19. Appl., 13.5.19.

A DESCENDING column of ore heated externally is subjected to the action of an ascending column of natural gas or hydrocarbon gas of similar composition, which is introduced at its normal temperature. A more or less complete reduction of the ore follows with subsequent carburisation of the reduced iron.—J. W. D.

Ingot iron and steel; Process for the deoxidation of ——. F. Wüst, Aachen. Ger. Pat. 311,989, 23.5.16.

A MIXTURE of manganese ores or other materials containing manganese, such as roasted spathic iron ore or mixer, Martin furnace, or cupola slag, with strongly reducing substances, such as calcium carbide, silicon carbide, sodium, potassium, calcium, magnesium, aluminium, etc., is added to the bath after removing the refining slag. In this way a new slag is formed which provides the bath with the required amount of manganese for deoxidation and protects it from premature cooling. The process is independent of the kind of refining process used.—T. H. Bu.

Steel ingots; Method and apparatus for forming ——. T. M. Whalen, Erie, Pa. U.S. Pat. 1,319,500, 21.10.19. Appl., 28.2.19.

MOLTEN steel is introduced into a mould and a portion of the mould is insulated by means of a vacuum case, then the steel is cooled from the bottom of the mould, which is not insulated.
—J. W. D.

Metals [steels] differing in grades; Process for uniting —— J. A. Curley, Glen Falls, N.Y. U.S. Pat. 1,319,850, 28.10.19. Appl., 2.4.18.

HIGH-SPEED and soft steels are heated to about 1100° C. in contact with one another, and a "uniting compound" is applied to the adjacent faces. The two pieces are then clamped together and subjected to a cooling air blast.—C. A. K.

Slags; Process of treating —— [to recover iron]. U. A. Garred, Elmhurst, N.Y. U.S. Pat. 1,319,061, 21.10.19. Appl., 6.6.19.

A CHARGE of molten slag containing iron is subjected to the action of a blast of a supporter of combustion and a reducing agent in a finely-divided state. The operation is continued with a sufficient excess of reducing agent to reduce the iron.—J. W. D.

Oxides of iron and other metals occuring in pound ores; Method of separating ——. Adell, Cleveland, Ohio. U.S. Pat. 1,31 14.10.19. Appl., 2.12.16.

FINELY-DIVIDED ore, *e.g.*, a mixed ore of hæ and pyrolusite, is roasted in the presence of vapour. Iron oxide is converted into the mag oxide, and is separated magnetically from constituents of the ore.—C. A. K.

[Nickel-chromium steel] rolls; Manufactur metal ——. R. A. Hadfield, London. U.S. 1,318,748, 14.10.19. Appl., 24.6.19.

THE working portion of a roll composed of ni chromium steel containing 0·6 % C, 2—3·5 % Ni, 2—3 % Co, is hardened by chilling from a high perature, then tempered, and finally toughene heating to a temperature not above 300° C. allowing it to cool.—C. A. K.

Ferro-tungsten and other tungsten alloys; M facture of ——. H. A. Blackwell, Black Eng. Pat. 133,981, 30.7.18. (Appl. 12,363/1

TUNGSTEN ore purified by magnetic separation, lowed by roasting or calcining without any ch cal or other metallurgical treatment, is mixe fine granular or powdered form with aluminiu similar reducing element in granular form fluorspar or similar fluxing material in the requ proportions, and the mixture set into reactio a suitable container or furnace.—J. W. D.

Ferro-silicon and by-products [potassium sal Process of making ——. J. E. Johnson, j Hartsdale, N.Y., M. H. Johnson, execut U.S. Pat. 1,318,763, 14.10.19. Appl., 16.6.1

A MINERAL containing silica and potassium heated with ferrous material and carbon to a temperature that the silica is reduced and u with the iron to form ferro-silicon, a potass compound being driven off as a fume and recove —J. W. I

Iron alloys; Process of producing ——. J. Johnson, jun., Hartsdale, N.Y., M. H. John executrix. U.S. Pat. 1,318,764, 14.10.19. Ap 9.2.18.

ORE of the alloying metal is reduced by carbon the presence of iron and of a sufficient proport of silicon to prevent the carbon from entering alloy, the silicon being subsequently eliminated —J. W. I

Iron; Preparation for removing rust from and p venting formation of rust upon ——. H. In Leeds. Eng. Pat 134,447, 28.1.19. (Ap 2033/19.)

ZINC or other metal electro-positive to iron, powdered form, is held in suspension as a pa or paint by a vehicle which can conduct electrici such as aqueous soap solutions. When the prepa tion is applied as a coating to iron, an elect current is set up between the iron or rust and electro-positive metal, whereby the oxide of iron reduced and the zinc or other metal oxidis (Reference is directed, in pursuance of Sect. 7, S sect. 4, of the Patents and Designs Act, 1907, Eng. Pats. 11,660 of 1884 and 22,730 of 1893). —J. W. D

Burnt ore and like bricks; Manufacture of — A. Ramen, Helsingborg, Sweden. Eng. P 134,387, 27.11.18. (Appl. 19,606/18.)

MOULDS containing the briquetted material in more or less liquid condition are introduced into furnace, dried by means of the furnace gases, t moulds turned over by magnets or other devic then removed from the furnace, leaving the bri within to be burnt.—J. W. D.

Bismuth; Production of ——. E. R. Darling, Montclair, N.J.. Assignor to Ellis-Foster Co. U.S. Pat. 1,318,335, 7.10.19. Appl., 2.1.19.

HIGH-GRADE bismuth concentrates are heated, and a portion of the impurities is run off. The remaining metal is treated with an alkaline-earth chloride. —J. H. J.

Crucible [*; Tungsten* ——]. F. G. Keyes, Assignor to Cooper Hewitt Electric Co., Hoboken, N.J. U.S. Pat. 1,318,452, 14.10.19. Appl., 28.10.15.

A CRUCIBLE of pure tungsten is obtained by forming a porous tungsten cup of crucible shape, filling it with an oxide of tungsten, and heating the crucible until the oxide melts.—C. A. K.

Aluminium alloys; Method for manufacturing ——. A. Tedesco, Turin, Italy. U.S. Pat. 1,318,702, 14.10.19. Appl., 11.7.19.

PORTIONS of the alloy constituents are melted, mixed, and over-heated, and the remaining portions of the constituents are mixed. Part of this mixture is added to the overheated basis alloy, and the melted alloy is then poured on to the remaining portion of the mixture.—C. A. K.

Metals; Treating [*annealing*] ——. A. F. Jacobson, New York. U.S. Pat. 1,319,085, 21.10.19. Appl., 31.1.18.

SUCCESSIVE portions of a continuous strip of metal are brought under the heating action of an electric current, the temperature being regulated automatically, and then passed through a cleaning liquid while still under the action of the current. J. W. D.

Alkali metals; Production of —— *from their chlorides.* H. Freeman, Niagara Falls, Canada, Assignor to American Cyanamid Co., New York. U.S. Pat. 1,319,148, 21.10.19. Appl., 2.2.18.

A FINELY divided mixture of sodium chloride and calcium carbide is subjected to a temperature above the fusing point of the chloride, whereby calcium chloride, metallic sodium, and carbon are formed. J. W. D.

Molybdenum bronze. S. Shigeta, Tokio, Japan. U.S. Pat. 1,319,537, 21.10.19. Appl., 3.6.18.

AN alloy having the appearance and many of the physical properties of gold consists of a large proportion of copper, a smaller proportion of aluminium, and still smaller, but substantial, proportions of molybdenum and tungsten.—J. W. D.

Furnace; Roasting ——. H. W. Gould, San Francisco, Cal. U.S. Pat. 1,319,700, 28.10.19. Appl., 29.5.18.

THE furnace consists of an inclined rotary kiln having a fire box at one end, with means for sealing the joint between the fire box and the kiln. Hot material is discharged from the kiln into a chamber connected to the fire box, and is cooled by the passage of the air necessary for combustion of the fuel.—C. A. K.

Kiln; Ore-treating ——. W. Winkelman, Assignor to A. G. Buchmann, Los Angeles, Cal. U.S. Pat. 1,319,939, 28.10.19. Appl., 10.6.18.

A MIXTURE of ore to be deoxidised and carbonaceous material is caused to travel down a vertical chamber, which is heated by means of a series of horizontal heating flues passing across the chamber. —C. A. K.

Copper; Process of extracting —— *from ore.* R. S. Edwards, San Francisco, Cal. U.S. Pat. 1,319,858, 28.10.19. Appl., 10.12.17.

FINELY divided copper-bearing mineral is heated with an excess of salt and a hydrated base, which gives off its combined water as steam when heated. —C. A. K.

Zinc; Extraction of ——. R. H. Stewart, Vancouver, and S. G. Blaylock, R. Vaughan, and J. K. Batchelder, Trail, British Columbia. U.S. Pat. 1,320,805, 4.11.19. Appl., 21.10.18.

MATERIAL such as unleached calcine containing excess of soluble zinc is added to a partly neutralised acid electrolyte thereby completing the neutralisation. The solids and colloids are separated, and the zinc deposited from the neutralised electrolyte thereby regenerating acid. The regenerated electrolyte is then used to leach from the solids and colloids the soluble zinc, whereby it becomes partly neutralised and is returned to the first stage of the process to repeat the cycle. —J. W. D.

Manganese slags and ores; Treatment of ——. Farbenfabr. vorm. F. Bayer und Co., Leverkusen. Ger. Pat. 306,126, 27.10.17.

THE material is either moistened with ferric sulphate pickling liquor, heated to dryness, and then leached, or treated with the ferric sulphate solution at a high temperature with or without pressure and the dissolved manganese sulphate converted into manganous chloride. The treatment is suitable for low grade manganese ores which, owing to the presence of silica and phosphorus, are difficult to convert into high percentage products. The manganese is dissolved by the ferric sulphate solution whilst silica, phosphorus, and iron mostly remain in the residue. T. H. Bu.

Manganese slag and ores; Treatment of —— *by wet chloridising.* Farbenfabr. vorm. F. Bayer und Co., Leverkusen. Ger. Pat. 307,174, 12.9.17.

THE material is mixed with waste chloride solutions from iron rolling mills, dried at about 250° C., and the soluble manganese salts extracted with water. No troublesome gases are produced and the manganous chloride may be extracted without loss. —T. H. Bu.

Metals; Process for smelting easily fusible —— *or reducing oxides of metals and metalloids, such as arsenic, antimony, and tin.* J. Loibu, Schlesiengrube. Ger. Pat. 312,617, 30.11.17.

THE retorts containing the material are not heated directly but are set in heated fireclay chambers divided into several compartments each of which may be independently heated.—T. H. Bu.

Electrically welding iron, steel, brass, and other metallic studs and the like to iron, steel, or other plating, and the like. A. E. Frankling, Croydon. Eng. Pat. 134,393, 30.11.18. (Appl. 19,818/18.)

Furnace; Open-hearth ——. J. O. Griggs, Peoria, Ill. U.S. Pat. 1,320,387, 4.11.19. Appl., 20.1.19.

SEE Eng. Pat. 127,785 of 1918; this J., 1919, 540 A.

Filtering. U.S. Pats. 1,302,812—4. *See* I.

XI.—ELECTRO-CHEMISTRY.

Electrochemical industry; Development of ——. H. Goldschmidt. Z. Ver. deuts. Ing., 1919, 878. Chem.-Zeit., 1919, 43, Rep., 244.

THE production of aluminium by electrolysis of a melt of oxide and cryolite in an iron vessel with carbon electrodes exhibits a serious defect in that small units only are employed, consuming 100 H.P., as against carbide furnaces which can take several thousands. Large currents are employed and contact losses amount to 25 to 33% of the

energy used. The bauxite available in Germany contains an excessive proportion of silica which militates against the production of a pure alumina, and the economic conditions do not favour the establishment of the industry. Magnesium is prepared by the electrolysis of molten carnallite, but the re-melting of the electrodeposited metal presents difficulties. Sodium is prepared by electrolysis of fused hydroxide. Calcium cyanamide is prepared in furnaces consuming as much as 900 kilowatts. One kilo. of carbide requires 3·5—4 kilowatt hours. To-day, one ton of carbide costs more than M. 200. The calcium cyanamide always contains 0·2—0·3% of carbide, which is objectionable for agricultural purposes, and is removed by the action of water sprayed on the material. Where electric current costs 2 pfennige per unit, cyanamide can compete with Chili saltpetre.—H. J. H.

Electrically heated boiler. Warschafski. *See* I.

PATENTS.

Diaphragms or separators for use in separating two liquids [e.g., in electrolytic cells]. C. J. Thatcher, New York. Eng. Pat. 134,116, 30.12.18. (Appl. 21,799/18.)

IN the preparation of diaphragms for use, for example, in electrolytic or diffusion cells, the support is a porous plate or cylinder built up of small grains, fairly uniform in size, of a non-cellular, non-fibrous, non-porous material, such as sand or alundum, and cemented together by incipient fusion. The interstices of the support, which may form as much as 50% of its volume, are then filled up, by formation within the body of the support, of any suitable gelatinous precipitate, such as magnesium hydroxide or silicate, aluminium hydroxide, silicic acid, etc., selected according to the liquid or liquids to be used, and maintained in a moist condition.—B. V. S.

Graphitised electrode and process of making the same. Carbonaceous material and process of making same. A. T. Hinckley, Niagara Falls, N.Y., Assignor to National Carbon Co., Inc. U.S. Pats. (A) 1,317,497 and (B) 1,317,498, 30.9.19. Appl., U.3.19 and 24.6.19.

(A) A GRAPHITISED electrode is composed of coarse and fine particles of graphitised carbon, together with a graphitised binder, the coarse particles having the essential quality of graphitised anthracitic carbon. (B) Hard coal is pulversised and mixed with a carbonaceous binder, calcined, and ground. The resulting particles are uniform in all planes.—W. F. F.

Electric furnaces [; Change-over switch for ——]. D. F. Campbell, London. Eng. Pat. 134,422, 23.12.18. (Appl. 21,541/18.)

Electric dry batteries; Manufacture of ——. Burgess Battery Co., Assignees of C. F. Burgess, Madison, Wis., U.S.A. Eng. Pat. 120,891, 30.10.18. (Appl. 17,754/18.) Int. Conv., 20.10.17.

SEE U.S. Pat. 1,305,252 of 1919; this J., 1919, 587 A.

Electrolysis of alkali chlorides. Eng. Pat. 125,935. *See* VII.

Chlorine. U.S. Pat. 1,319,734. *See* VII.

XII.—FATS; OILS; WAXES.

Glycerol; Replacement of —— in fats by mannitol. A. Lapworth and L. K. Pearson. Biochem. J., 1919, 13, 296—300.

By distillation of olein or stearin with mannitol in the presence of sodium ethoxide under reduced pressure, practically a quantitative replacement of the glycerol in the fat occurs. An almost theoretical yield of glycerol is obtained in the distillate, whilst dioleates and distearates of mannitan and isomannide remain behind in the distillation flask. The latter compounds form a mixture having properties resembling those of the original oil.—J. C. D.

Glycerol; Replacement of —— by mannitol, in fats. Food value of synthetic oils thus produced. W. D. Halliburton, J. C. Drummond, and R. K. Cannan. Biochem. J., 1919, 13, 301—305.

THE synthetic mannitol oil prepared as described in the preceding abstract may be utilised by the organism of the rat as a source of fat. The absorption and utilisation are of the same order as those of the parent natural fat. No toxic action was detected.—J. C. D.

Aleurites trisperma ("Soft lumbang") oil. H. A. Gardner. Circ. No. 75, Paint Manufacturers' Assoc., U.S.A., Oct., 1919. 4 pp.

Aleurites trisperma or "soft lumbang" is a tropical species of limited distribution grown in the Philippine Islands (Philippine J. Sci., II., 6, A. 413). The oil expressed from *A. trisperma* seeds (yield 32·7% on unshelled nuts or 50·9% on the kernels) is stated to be more viscous and darker than that from *A. moluccana* (true lumbang). Two samples of oil from *A. trisperma* were examined by the author, in comparison with samples of tung oil and true lumbang oil of known origin. The results are given in the following table:—

	Aleurites fordii, Chinese.	*Aleurites moluccana*, lumbang oil, candle nut oil.	*Aleurites trisperma*, soft lumbang oil. Crushed from seed.	*Aleurites trisperma*, soft lumbang oil. Crushed from whole seed.
Refractive index ..	1·5092	1·4765	1·4929	1·4927
Specific gravity ..	0·941	0·927	0·9380	0·9283
Acid value	4·0	2·3	4·4	7·1
Saponif. value ..	192	192·3	194	190
Iodine value (Hübl)	167·8	162 (Hanus)	164·2	160·5
Tung oil test (Browne's method; this J., 1912, 731)	Firm, crumbly jelly in 10 min.	Negative	Negative	Negative

"Soft Lumbang" oil, when spread on glass, dried in 34 hours to an opaque, crystalline film, resembling that produced by raw tung oil, whilst with 10% of lead-manganese drier a perfectly clear film was obtained on glass in 14 hours. This distinguished it from the behaviour of tung oil under similar conditions and showed a point of resemblance with linseed oil. On exposure to air and sunlight in a test-tube for one week, the oil solidified to an opaque, crystalline mass of light colour, which readily granulated to a meal resembling that from polymerised tung oil, but was distinguishable therefrom by its solubility in 10% sodium hydroxide solution. Although "soft lumbang" oil does not solidify on heating to 280° C. for even 15 minutes, it increases in viscosity during the treatment. On preparing varnishes of standard formula from both soft lumbang oil and tung oil, the latter was found to have better body and somewhat more rapid drying properties than the former, both, however, giving very waterproof films. Stimulation of production in the Philippines should result in available quantities of "soft lumbang" oil for use in the United States. (See also this J., 1918, 215 A.)—A. de W.

Distillation of sodium stearate and oleate. Pictet and Potok. *See* IIA.

Blubber type oils. Gardner. *See* XIII.

Poppy-seed cake. Annett and Sen. *See* XIX A.

PATENTS.

[*Hydraulic*] *presses for oil extraction.* Soc. Anon. Usines de Keukelaere, Gand, Belgium. Eng. Pat. 128,222, 12.6.19. (Appl. 14,901/19.) Int. Conv., 29.1.16.

A HYDRAULIC press of the pot type specially adapted for oil extraction consists of an elongated cylindrical chamber constructed of cast steel. The lower portion of the chamber contains the piston, which is hollow and open towards the bottom and is fitted at the lower end with inverted V shaped leather packing rings and at the upper end with means for scraping the interior of the upper portion of the chamber. The upper portion of the chamber is surrounded by a heating coil, and is provided in the interior, which is of a greater diameter than the lower portion, with a cylindrical liner composed of a number of vertical bars held in position by heels at the top and bottom. The internal diameter of the liner is equal to that of the lower portion of the chamber. Each bar is concave on its radial surfaces, whereby a tubular cavity is formed between adjacent rods down which the oil flows into a gutter at the bottom and thence through an opening in the chamber to a collecting vessel outside. The top of the chamber is closed by a sliding cover held in position by lateral lugs secured to the walls of the chamber. To operate the press, the cover is removed and the upper chamber is charged with material; the cover is then replaced, and oil or water for compression is admitted through an opening below the piston. When extraction of the oil is complete, the cover is removed and the piston is forced upwards, thereby emptying the upper chamber and at the same time cleaning the walls of the liner. The piston is then lowered and the operations are repeated.—L. A. C.

[*Fats and oils:*] *Sulphonic acid sludge for splitting* [——]. R. E. Divine, Assignor to The Twitchell Process Co., Cincinnati, Ohio. U.S. Pat. 1,319,027, 14.10.19. Appl., 24.6.18.

THE sulphonic acids recovered from a water solution of sludge produced by sulphonation of a portion of the contents of a mineral oil or distillate and which are soluble in an equal volume of water and soluble in water in the presence of a mineral oil, are employed as a saponifying agent in splitting fats or oils.—A. de W.

Vegetable oils [*coconut oil*]; *Process and apparatus for refining* ——. C. L. Riley, North Plainfield Township, N.J., Assignor to Clark, MacMullen and Riley, New York. U.S. Pat. 1,320,091, 28.10.19. Appl., 6.3.18.

A MIXTURE of coconut oil and a neutralising agent is introduced into a solvent circulating in a circuit. The soap formed is dissolved, the oil is recovered, the solvent and its dissolved soap removed from the zone where the oil is recovered, a fresh mixture added to the solvent, and the solvent returned to the zone where the oil is recovered.—A. de W.

Lanolin; Preparation of a substance resembling ——. G. Leuchs, Haselmühle. Ger. Pat. 312,825, 9.8.17.

THE dust obtained by brushing or combing horses or horned cattle contains about 15% of a substance resembling lanolin. This substance is extracted by a suitable solvent and decolorised and deodorised if necessary. It gives a strong cholesterol reaction and contains very little free fatty acid.—J. H. L.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Paint products; Spreading rates of prepared ——. H. A. Gardner. Circ. No. 71, Paint Manufacturers' Assoc., U.S.A., Oct., 1919. 4 pp.

THE spreading power of a number of prepared paint and varnish products on a variety of surfaces (different woods, concrete, plaster, iron, etc.) was determined by applying them in such a way that three successive coats were just sufficient to hide the surface. It was found that in the case of absorbent surfaces (brick, plaster, or cement) the spreading rate of the first two coats was somewhat low on account of the porosity having to be first overcome. The reverse is the case on very smooth, non-absorbent surfaces, *i.e.*, iron or steel sheets, the bare metal presenting a smoother surface than the primer coat. Spreading power on different woods varied with their closeness of grain and resinous nature. The thickness of a film applied varied according to the nature of the pigment, fume pigments, *e.g.* carbon black, zinc oxide, basic sulphate white lead, etc., giving thin films, precipitated pigments, *e.g.*, white lead and lithopone, giving films of an intermediate thickness, whilst crystalline and earth pigments, *e.g.* barytes, ochre, etc., gave thick films. Paints containing much pigment, *i.e.* flat-drying paints, had a low spreading power. Modern white enamel made with a medium of heat-treated oils showed a higher spreading rate (1083 sq. ft., per U.S. gallon) than the older type of enamel made on a gum basis (747 sq. ft. per U.S. gallon). Varnish paints such as mill whites, floor paints, etc., have practically as high a spreading rate as paints made with raw oil.—A. de W.

Blubber type oils and their application [*in paints and varnishes*]. H. A. Gardner. Circ. No. 74, Paint Manufacturers' Assoc., U.S.A., Oct., 1919. 6 pp.

THE value of grayfish oil, shark liver oil, fur seal oil, and skate liver oil in the paint and varnish industry has been investigated with the result that these have proved unsatisfactory when used alone as drying oils, their probable application being in admixture with real drying oils for paints where rapid drying is not essential. A table of physical and chemical constants of the oils is given, in which the low saponification value (62·2) of shark liver oil is noteworthy. The large proportion of unsaponifiable matter existing in this oil was found to be due to an unsaturated hydrocarbon, which, however, differed from that found by Tsujimoto in Japanese shark liver oil (this J., 1916, 609, 1121) in having poor drying properties and a lower iodine value (141·5 as against 388). Drying tests on the raw oils showed that even when 10% of drier was added the films, although tacky in two days, were still soft at the end of 21 days. Blowing the oils at 220° C. for 2 hours did not effect an appreciable improvement in drying and did not greatly increase their viscosity. Mixtures of 45% of fish oil, 45% of linseed oil, and 10% of drier dried in about one day to a film which retained its tackiness after four days. Mixtures of the fish oils with an equal amount of "tung oil spar varnish WD 6" gave slightly harder films, the grayfish oil mixture being better than the others. The iodine values of these fish oils, ranging as they do from 132 to 151, prove to be no indication as to their drying values.—A. de W.

Resins isolated from pine resin. H. Salvaterra Chem.-Zeit., 1919, 43, 739.

FRACTIONAL extraction of the resin scraped from pine trees yielded two resins having distinctly different characters. Resin I, yield 55%, formed a transparent dark brown mass resembling colophony whilst resin II, yield 10%, was an opaque brown

substance. Both resins were soluble in methyl alcohol, ethyl alcohol, ether, chloroform, and acetone, but only partially soluble in petroleum spirit (69 and 74%, respectively), benzene, toluene, and carbon bisulphide; the resins swelled considerably in the three last-mentioned solvents. The chemical and physical characters of the resins were as follows:—

	Resin I.	Resin II.
Sp. gr. at 15° C.	1·130	1·135
M. pt.	69°–71° C.	60°–63° C.
Loss at 110° C.	1·85%	0·34%
Ash	0·11%	0·09%
Acid value	121·2	87·7
Saponif. value	149·7	125·8
Acetyl acid value	112·8	90·3
Acetyl saponif. value	221·8	270·5
Resin acids:		
M. pt.	105°–107° C.	112°–114° C.
Acid value	149·3	108·2
Saponif. value	178·7	144·8
Hirschsohn's reaction	Violet-red to greenish-brown.	Brownish-red to greenish-brown.
Tschugaeff's reaction	Red coloration with strong fluorescence.	

—W. P. S.

Resins; Characteristics of some new ——. P. Nicolardot and C. Collignier. Bull. Soc. Chim., 1919, **25**, 579—582.

THE authors have examined a number of new resins, and found the properties as given below. The determination of insoluble matter after treatment with alcoholic potash and precipitation with water has been described (this J., 1919, 378 A). *Hopea ricopéi* from Cambodia has sp. gr. 1·038 at 20° C.; m. pt. 102° C.; acid value 18; saponification value 34; insoluble matter 64·5%. *Hopea odorata* from the same source has sp. gr. 0·990 at 15° C.; m. pt., 110° C.; acid value 38; saponification value 53; insoluble matter not determinable. *Hopea dealbata*, same source, has sp. gr. 1·061 at 15° C.; m. pt. 142° C.; acid value 51; saponification value 82; insoluble matter not determinable. *Aucoumea Klaïneana*, from Gabon-Congo, has sp. gr. 0·966 at 15° C.; m. pt. 77° C.; acid value 28; saponification value 77; insoluble matter 94·2%. This last resin resembles the aramy from Madagascar, a sample of which had sp. gr. 1·031 at 20° C.; m. pt. 75° C.; acid value 33; saponification value 62. Dammar Cambodia had sp. gr. 1·072 at 20° C.; m. pt. 98° C.; acid value 28; sapogification value 50; insoluble matter 67·4%. Dammar blood red from Cochin China had sp. gr. 1·071 at 20° C.; m. pt. 187° C.; acid value 39; saponification value 89; insoluble matter 55·3%. All of these are very soft resins, and some give characteristic micrographs after treatment with soda.—W. G.

Resins; Constituents of ——. *Degradation of d-sumaresinolic acid.* A. Zinke. Monatsh. Chem., 1919, **40**, 277—280.

WHEN *d*-sumaresinolic acid is oxidised by chromic acid in glacial acetic acid solution a monocarboxylic acid, $C_{27}H_{40}O_4$, is obtained, which is isomeric with the acid obtained from *d*-siaresinolic acid (this J., 1919, 187 A); it is best purified by crystallisation from benzene, from which it separates in coarse prisms containing benzene, the solvent being only completely expelled at 150° C. in a vacuum. The pure substance has m. pt. 260°—261° C. When thus oxidised, *d*-sumaresinolic acid loses three carbon and eight hydrogen atoms; hence it probably contains a propyl or isopropyl group.
—H. W.

Aleurites trisperma oil. Gardner. *See* XII.

PATENTS.

Pigments; Formation of precipitates, for example ——. F. G. Kidd, and Wilkinson, Heywood and Clark, Ltd., London. Eng. Pat. 134,313, 30.10.18. (Appl. 17,726/18.)

IN the production of pigments and the like by precipitation from aqueous solutions, the solutions are caused to react in the form of spray in the presence of an inactive or a reactive gas, which may be used to produce the spray. For example, chrome yellow is prepared by spraying together solutions of lead acetate and a soluble chromate; basic Prussian blue is produced by spraying together solutions of a ferrous salt and a ferrocyanide in the presence of air, oxygen, or ozonised air, whereas if the same solutions react in the presence of an inactive gas, such as carbon dioxide or nitrogen, a white precipitate of "incipient Prussian blue" is obtained.
—L. A. C.

Varnish; Process for producing a substitute for linseed oil ——. W. Esch, Hamburg. Ger. Pat. 305,538, 27.5.17.

PHENOLS, cresols, or derivatives thereof (except *p*-cresol and *p*-derivatives) are heated with an excess of an aqueous solution of an aldehyde, preferably formaldehyde, in presence of neutral or approximately neutral salts, preferably benzoates and salicylates, which act as catalysts. The heating is arrested as soon as all the water originally present has distilled off, and the residue is rapidly cooled. The quantity of catalytic salt used depends on the water-content of the aldehyde solution, and amounts to about 10% of the water present. The product dries at a moderately high temperature, and gives a shining and fairly flexible coating, which when well dried does not again become sticky.—J. H. L.

Varnish for applying to fabrics of aeroplanes. D. M. Sutherland, Ashgrove. U.S. Pat. 1,320,290, 28.10.19. Appl., 2.8.18.

SEE Eng. Pat. 131,082 of 1918; this J., 1919, 831 A.

Lakes. Eng. Pat. 131,270. *See* IV.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Hevea brasiliensis; Variation in ——. G. S. Whitby. India-rubber J., 1919, **58**, 895—898.

AN examination of the latex from 1011 trees, seven years old and in their third year of tapping, revealed wide differences in the rubber content, which ranged from 23% to 55%, the mean being 36·58; there was no apparent relation between the yield of latex and the concentration. The mean yield of rubber was 7·12 grms. per day per tree (5·49 lb. per annum), the extremes being approximately 1·0 and 42·8 grms. respectively, thus demonstrating the possibilities of improving rubber yields by suitable selection of seed. Although trees of larger girth frequently gave bigger yields, the extent of the correlation is not sufficient to justify very serious consideration of girth when thinning out. The yield of the plantation per acre per annum was 360 lb.—D. F. T.

Rubber [asphalt]; Mineral ——. A. Dubosc and J. Wavelet. Caoutchouc et Gutta-Percha, 1919, **16**, 10037—10040.

IT is recommended that the examination of so-called mineral rubber should include estimations of the moisture, petrolenes volatile at 180°—200° C., petrolenes soluble in petroleum ether, asphaltene extracted subsequently by successive treatment with boiling turpentine and boiling chloroform, insoluble organic matter, ash, and sulphur.—D. F. T.

PATENTS.

Vulcanising rubber; Process for —— and products obtained thereby. J. Ostromislensky, Petrograd, Russia, Assignor to New York Belting and Packing Co. U.S. Pat. 1,320,166, 28.10.19. Appl., 24.11.16.

RUBBER or similar material is treated with an organic dye, such as tetranitrophenolphthalein or hexanitrodiphenylamine, which is capable, by its oxidising influence, of effecting vulcanisation, thus producing a coloured vulcanised rubber.—D. F. T.

Leather substitute. U.S. Pat. 1,319,795. *See* XV.

XV.—LEATHER; BONE; HORN; GLUE.

Tanning extracts; Pine-shaving reaction of —— and of products formed therefrom by potash fusion and the application of this reaction in the identification of tannins. R. Lauffmann. Ledertechn. Rdsch., 1919. **11**, 61—63. Chem. Zentr., 1919, **90**, IV., 587—588.

THE pine-shaving test gives a negative result with extracts containing pyrogallol-tannins, except in the case of oak wood extract, which gives a weak positive reaction. As regards extracts containing catechol-tannins the results of the test are negative with mangrove bark, weakly positive with untreated or sulphited quebracho, fairly strongly positive with mimosa and pine barks, and very strong with gambier and catechu. A strong positive reaction is also shown by the mixed tannin of oak bark. After potash fusion the pine-shaving reaction is shown strongly by mimosa bark and untreated or sulphited quebracho, moderately strongly by pine bark and mangrove bark, weakly by gambier and catechu and by extracts of pyrogallol-tannins and oak bark. From these and further observations the author concludes that phloroglucinol does not occur as a constituent of tanning extracts, and that the pine-shaving reaction is not due to the presence of vanillin in pine wood.—J. H. L.

Leather; Estimation of moisture in ——. A. Harvey. J. Soc. Leather Trades Chem., 1919, **3**, 128.

TWENTY grms. of finely divided leather is introduced into a 400 c.c. distillation flask and covered with 250 c.c. of dry petrol (b.pt. 150°—200° C.). The petrol is slowly distilled at the rate of 150—200 c.c. in half an hour. The distillate is collected in a graduated tube, the water allowed to separate, and its volume read off. The results compare very favourably with those obtained by heating the leather for four hours at 100° C. *in vacuo*.—D. W.

Sulphur; Solubility of —— in various solvents. R. F. Innes. J. Soc. Leather Trades Chem., 1919, **3**, 126—127.

THE solvent action of various solvents was determined by extracting 5 grms. and 0·5 grm. of flowers of sulphur respectively in a Soxhlet thimble under the usual conditions employed in leather extraction. With the larger quantity of sulphur, petroleum spirit and methylated ether extracted, 38·9% and 32·9% respectively, whilst with 0·5 grm. of sulphur these solvents extracted practically the whole of it. Chloroform, carbon bisulphide, and carbon tetrachloride extracted all the sulphur in both cases. The small amount of sulphur usually present in chrome leather will be practically all extracted with petroleum spirit. This has been confirmed in several instances.—D. W.

Gelatin sol; Velocity of gelation and hydrolysis of ——. R. Shōji. Biochem. J., 1919, **13**, 227—238. EQUATIONS are given which indicate the relationship between viscosity and time in these two processes. —J. C. D.

Catechin. Karrer and Widmer. *See* IV.

PATENTS.

Leather or other goods; Apparatus for soaking or similarly treating with liquid ——. W. J. Walker, Grappenhall. Eng. Pat. 134,040, 26.10.18. (Appl. 17,505/18.)

A SERIES of suspension frames are arranged in two sets within the soaking, tanning, or other pit. Each set of frames is arranged to rise and fall alternately, and operates an agitator fitted to it, which extends over the whole area of the pit and consists of a framework containing large apertures fitted with hinge or direct lift valves.—D. W.

Leather substitute and process for making same. R. B. Respess, New York. U.S. Pat. 1,319,795, 28.10.19. Appl., 18.1.18.

A SHEET of cotton or other fibrous material is saturated with a solution of a binding agent, dried, compressed, soaked with rubber containing sulphur or other vulcanising agent, and heated under pressure to vulcanise it.—D. W.

Emulsions; Preparation of fat —— for fat liquoring leather and for oil tanning. O. Röhm, Darmstadt. Ger. Pat. 313,803, 1.6.17.

OIL, fat, or sulphonated oil is emulsified by grinding it with a very fine colloidal clay or similar mineral, with or without a volatile fat solvent. Such mixtures readily mix with water without the fat separating, they easily penetrate the leather and lubricate the fibres. The effects are intensified by using the mixture warm and also by incorporating a volatile fat solvent such as acetone, benzene, etc. Fish oil-clay mixtures are very suitable for chamoising.—D. W.

Deliming agent for hides. C. S. Fuchs, Heppenheim. Ger. Pat. 313,995, 28.6.18.

A DELIMING agent for hides consists of waste liquor from the alkaline digestion of vegetable organic matter which has been freed from those constituents which form insoluble calcium salts, *e.g.*, lignin. These extracts are either acidified, filtered from the precipitated lignic acids, and concentrated by evaporation, or first evaporated, then cooled, and a slight excess of mineral acid added. The product forms a suitable bate which gives a good yield of leather.—D. W.

Glue and the like; Process of and machine for making ——. A. Schweitzer, Assignor to United Chemical and Organic Products Co., Chicago, Ill. U.S. Pat. 1,318,464, 14.10.19. Appl., 9.8.17.

ANIMAL tissue, or similar substance, is boiled until the solution will coagulate when cooled. A moving, hot, dry surface is arranged to remove a continuous film from the surface of the hot adhesive liquid thus obtained, and this film meets a current of hot dry air moving in the same plane and passing over its entire surface. D. W.

Casein; Manufacture of —— especially adapted for the production of artificial horn-like masses. A. Bartels, Harburg, Germany, Assignor to The Chemical Foundation, Inc. U.S. Pat. 1,320,666, 4.11.19. Appl., 3.3.17.

CASEIN moistened with water is subjected to a grinding process to divide it finely and destroy its natural layer-structure, and subsequently it is worked up into a horn-like material.—D. W.

Glue-stock, gelatin, glue, bones, etc.; Sterilisation of ——. Chem. Ges. Rhenania m.b.H., Wevelinghofen. Ger. Pat. 313,141, 6.2.17. Addition to Ger. Pat. 312,614 (this J., 1919, 842 A).

THE materials are treated with about twice their quantity of sodium hypochlorite solution containing

3 grms. of available chlorine per litre. Glue or gelatin must be liquefied or dissolved before the treatment.—J. H. L.

Glue and similar materials; Manufacture of ——. R. W. Mumford, Baltimore, Md., U.S.A. Eng. Pat. 134,011, 21.10.18. (Appl. 17,185/18.)

See U.S. Pat. 1,289,053 of 1918; this J., 1919, 753 A.

XVI.—SOILS; FERTILISERS.

Soil protozoa. D. W. Cutler. J. Agric. Sci., 1919, 9, 430—444.

The direct counting method for soil protozoa devised by Kopeloff and Coleman (this J., 1916, 1155) for use in liquid media gives results entirely comparable with those obtained by the dilution method. The number of flagellate and amœbic cysts taken up from 1 c.c. of a suspension by 1 grm. of sand or soil is independent of the total number present in the suspension, provided that the number present exceeds the capacity of the sand or soil. Further, the number of protozoa taken up is the same whether they are there in the active or cystic form, and is independent of the time of contact. The number varies, however, with the size of the organism, the ratio of the holding power of the various substances used being for ciliates and amœbæ or flagellates as 1:5 approximately. The number retained increases as the size of the particles of the retaining material decreases, and is apparently to a large extent independent of the colloidal properties of the soil, as shown by the small difference observed between the results with natural soil, partially sterilised soil, and ignited soil. Finally, the action is the same whether the experiment is performed with a suspension of living or dead organisms.—W. G.

Soil; Quantitative relation between —— and the soil solution brought out by freezing-point determinations. B. A. Keen. J. Agric. Sci., 1919, 9, 400—415.

A theoretical discussion of the results obtained by Bouyoucos and his co-workers (J. Agric. Res., 1917, 8, 195; 1918, 15, 331; also this J., 1919, 113 A) in their determinations *in situ* of the freezing-point depression of soil solutions. Assuming Bouyoucos's views as to the existence of "free" and "unfree" water in the soil to be correct, it is shown that the relation existing between the free, unfree, and total moisture may be expressed by the equations

$$Y_n = cM_n^x \text{ and } Z_n = Y_n^{1/x}/c^{1/x} - Y_n,$$

where c and x are constants for any one soil and M_n, Y_n, and Z_n represent respectively the total, free, and unfree water. (See further J. Chem. Soc., Jan., 1920.)—W. G.

Soil constituents; Rate of absorption of —— at successive stages of plant growth. J. S. Burd. J. Agric. Res., 1919, 18, 51—72.

The composition of barley plants grown on two different soils in two successive seasons was investigated during various stages of growth. From the analytical data obtained it was found that the absorption of certain soil constituents was divided into three stages. At first there was an increasing rate of absorption and the amounts of nitrogen and potassium absorbed became nearly equal to those present at maturity. During the second period the rate of absorption fell off and there was an actual loss in the amounts of nitrogen and potassium present. These losses took place at a period when the soil solution was at its minimum concentration. At the beginning of the third period there was some re-absorption of nitrogen and potassium, and towards the end of the period the absorption of all constituents ceased. It is suggested that a high concentration of constituents in the soil solution after the first stage of growth is unnecessary and may be harmful.—J. H. J.

Growth and absorption of the plant; Relation of the concentration and reaction of the nutrient medium to the ——. D. R. Hoagland. J. Agric. Res., 1919, 18, 73—117.

A series of investigations was made on the growth of barley in sand and solution cultures containing the usual plant nutrients, noting especially changes in total concentration and composition of the nutrient solution with the growth of the plant. Marked absorption took place at all stages of growth if there was sufficient concentration of the nutrient solution throughout the experiment, but the absorption after the first period of growth did not yield any increase of crop. On increasing the concentration of the solution there was an increase in the nitrogen and potassium in the tops of the plant and also in the roots, with the addition of calcium and phosphate in insoluble form. The optimum concentration of the solution was found to correspond to an osmotic pressure of not more than 0·6 atm. in any case, and to only 0·1 atm. in some cases; a concentration of 2 atm. inhibited growth. Absorption from a solution with an acid reaction was generally greater than from a neutral solution, and there was a tendency for the amount of acidity to diminish as a result of absorption. In very dilute solutions there was an excretion of calcium, magnesium, and phosphate from the plant at first, which was later re-absorbed.—J. H. J.

Fertilisers; Poisonous action of artificial —— on sheep. G. Günther and O. R. von Czadek. Z. landw. Vers.-Wesen in Deutsch-Oesterreich, 1919, 22, 69—82. Chem. Zentr., 1919, 90, IV., 535.

Various fertilisers were mixed with meal and water and the semi-solid masses forcibly fed to sheep. The results confirmed the well-known poisonous effects of potassium and sodium nitrates. The fatal dose of sodium nitrate was 1—2 grms. per kilo. of body-weight, and of potassium nitrate 0·75—1·5 grms. Ammonium sulphate and potassium chloride were somewhat poisonous, and superphosphate was occasionally injurious. Basic slag and calcium cyanamide gave no evidence of poisonous action.
—J. H. J.

Electrochemical industry. Goldschmidt. *See* XI.

Patents.

Acid-phosphate [superphosphate] apparatus. R. E. Forbis, Assignor to Chemical Construction Co., Charlotte, N.C. U.S. Pat. 1,318,063, 7.10.19. Appl., 4.3.19.

The material is delivered into one end of a closed revolving chamber and is removed at the other end by a relatively stationary elevating excavator.
—J. H. J.

Phosphates containing iron and alumina; Process for the decomposition of ——. Farbenfabr. vorm. F. Bayer und Co., Leverkusen. Ger. Pat. 303,333, 10.3.17.

Phosphorite is treated with excess of sulphuric acid in presence of precipitated calcium sulphate.
—J. H. J.

Calcium cyanamide; Process for avoiding dust and corrosive action with 'pulverulent ——. T. Waage, Berlin. Ger. Pat. 313,414, 4.2.17.

Powdered basic slag, phosphorite, and other calcium phosphates are saturated with potassium chloride solution or molasses residues and the damp

mass mixed with calcium cyanamide. The product may be compressed into various forms and used as a fertiliser.—J. H. J.

Seeds; Steeping liquor for ——. Farbenfabr. vorm. F. Bayer und Co., Leverkusen. Ger. Pat. 312,281, 5.4.14.

MERCURY compounds of phenols or aromatic acids, in which the metal is combined directly with the nucleus, are mixed with alkali hydroxide and a diluent consisting of an indifferent dehydrated soluble salt; *e.g.* 10 parts of mercuri-chlorophenol sulphate is mixed with 5 parts of sodium hydroxide and a diluent such as sodium sulphate. The products, when dissolved in water, are employed for the destruction of micro-organisms adhering to seeds and for increasing the germinating power of the latter.—J. H. L.

Calcium cyanamide. U.S. Pat. 1,317,756. *See* VII.

XVII.—SUGARS; STARCHES; GUMS.

Sugar-beet marc; Carbohydrates of ——. H. Gaertner. Z. Ver. Deut. Zuckerind., 1919, 232—272. Chem. Zentr., 1919, **90**, IV., 577—579.

THE dry substance of exhausted sugar beets contains 88% of carbohydrates, 7·4% of crude protein, and 4·5% or less of ash. The 88% of carbohydrates comprises 26—28% of cellulose (yielding only dextrose on hydrolysis) and 61% of propectin which is readily converted into soluble pectin by boiling with water. The pectin is precipitable from aqueous solutions by alcohol, and may be obtained as a white powder. With calcium or barium hydroxide it forms mucilaginous precipitates, which are liquefied by the enzymes of *Aspergillus niger* or *Penicillium glaucum*. The author obtained from 100 grms. of pectin, by prolonged boiling with dilute oxalic acid, neutralisation with lime, etc., about 20 grms. of crystallised arabinose, some non-crystallisable syrup and methyl alcohol, and about 26 grms. of the calcium salt of a pectic acid, $C_{12}H_{20}O_{10}$, free from pentoses. The arabinose complexes (araban) appear to be only loosely combined in the pectin molecule, and are to some extent detached on boiling with water alone. The pectic acid is not readily hydrolysed, but after heating under pressure with dilute sulphuric acid it yielded a small quantity of galactose and a syrupy acid, probably an optically active galacturonic acid, CHO.$(CHOH)_4$COOH. The latter has $[\alpha]_D = +6{\cdot}94°$, reduces Fehling's solution in the cold, and is completely precipitable by basic lead acetate; the calcium and barium salts form amorphous powders which give dark-coloured aqueous solutions, but the cinchonine salt crystallises readily. The above-mentioned pectic acid is accordingly a galactose-galacturonic acid and is probably combined with lime or magnesia in pectin itself. The same acid occurs in other pectin substances found in plums and apples.—J. H. L.

[*Sugar*] *juices; Cause of frothing of raw and refinery* ——. A. Herzfeld. Z. Ver. Deut. Zuckerind., 1919, 207—214. Chem. Zentr., 1919, **90**, IV., 574—575.

THE abnormal frothing of sugar juices, which marked the last beet campaign, was doubtless due in many cases to the use of spoiled beets containing an exceptional amount of colloidal matters, such as metapectinates and saponins. Much of the lime used contained a high proportion (frequently 20—30%) of magnesia, which favours frothing. The natural magnesia-content of juice from frozen beets is not greater than in the case of sound roots, and therefore cannot be responsible for the greater frothing observed in the former case; this must be attributed to substances related to the pectins and saponins. A minute quantity of fat has been found in beetroots and in diffusion juice, but this is completely precipitated as lime soap and therefore cannot be the cause of froth in filtered juice. In many cases frothing is due to the use of saponifiable mineral oil. J. H. L.

Hydrosulphites in sugar manufacture. R. Dutilloy. Bull. Assoc. Chim. Sucr., 1919, **37**, 68—73. (See this J., 1913, 217; also Descamps, 1911, 823, Weisberg, 1911, 1465.)

THE use of hydrosulphites has within recent years been adopted in a large number of sugar factories. The best results are obtained when they are employed to supplement the work of the older purifying agents (lime, carbon dioxide, sulphurous acid), rather than as substitutes for the latter. In the sugar factory at Verberie zinc hydrosulphite prepared in the factory itself is used with raw juices before treatment with lime. The juices are not sulphited nor treated with bisulphite before concentration, but the syrups are treated with sulphurous acid to the furthest permissible limit. The juices and syrups have a relatively low viscosity, so that filtration is more rapid, evaporation more economical, and crystallisation and centrifuging more productive than when hydrosulphites are not employed.—J. H. L.

Sucrose; Density of —— and contraction in volume of its aqueous solutions. D. Sidersky. Bull. Assoc. Chim. Sucr., 1919, **37**, 73—77.

FROM Plato's values for the specific gravities of sucrose solutions at various concentrations (*Die Dichte, Ausdehnung, und Kappillarität von Lösungen reinen Rohrzuckers in Wasser*, Berlin, 1900) the author has calculated the corresponding solution densities of the dissolved sugar and the contraction which takes place when the solutions are formed. A table shows in parallel columns the specific gravities of sucrose solutions, as found by various investigators, all calculated to a basis of 15° C./4° C., for purposes of comparison. Plato's values (adopted by the German *Normal Eichungs-Kommission*) are considered the most accurate. (See also J. Chem. Soc., Jan., 1920.)—J. H. L.

Enzymic inversion of sucrose: influence of the products of the reaction on the velocity of hydrolysis. H. Colin and A. Chaudun. Comptes rend., 1919, **169**, 849—852.

IT is shown that any alteration in the velocity of inversion of sucrose by invertase, caused either by an increase in the concentration of the sucrose or by the presence of the products of inversion or by the addition of dextrose or lævulose separately, is purely a physical effect due to an increase in the viscosity of the solution. In all of these cases the velocity of hydrolysis is a linear function of the fluidity of the solution.—W. G.

Dextrose; Volumetric determination of —— by means of hypoiodite. K. Zablinsky. Z. Ver. deuts. Zuckerind., 1919, 159—165. Chem. Zentr., 1919, **90**, IV., 379.

THE author has investigated the method of Willstätter and Schudel (this J., 1918, 556A), which consists in adding 1·5—4 times the theoretical quantity of $N/10$ iodine solution, then 1·5 times the theoretical quantity of $N/10$ sodium hydroxide, allowing to stand for 12—20 minutes, acidifying, and titrating with thiosulphate. The method is not applicable for the analysis of sugar factory products, because its accuracy depends on a fairly close relationship between the quantity of alkali added and that of the sugar present, and because sucrose is also attacked by hypoiodite and the dextrose values are therefore too high, and the presence of organic

non-sugar impurities affects the results, even in the absence of sucrose. Ordinary simple salts have little influence. The method is likewise unsuitable for the estimation of sugar in blood, also on account of the susceptibility of the non-sugar constituents to attack by hypoiodite.—J. F. B.

Invert sugar; Estimation of —— *by Fehling's solution.* J. D. van Leeuwen. Chem. Weekblad, 1919, **16**, 1425—1426.

In the titration of invert sugar with Fehling's solution, dilution of the latter with four times its volume of magnesium sulphate solution (0·5 grm. per litre) causes the precipitated cuprous oxide to settle rapidly, and thus gives a clear solution for testing with potassium ferrocyanide and acetic acid, for which purpose the solution must first be cooled.—W. J. W.

PATENTS.

Centrifugal machines [for sugar]; Attachment for ——. J. N. S. Williams, Honolulu, Hawaii. U.S. Pat. 1,304,840, 27.5.19. Appl., 6.12.17.

Material such as a mixture of sugar crystals and non-crystallised material is centrifugally separated in a rotating cylindrical basket, so that the non-crystallised material forms a layer adjacent to the outer wall. A collecting scoop-pipe is provided, hinged on a horizontal axis above the basket, and adjustable by a hand wheel so that the mouth of the scoop may be adjusted to project into the material to be collected. The material is forced through the scoop to its outlet, which projects into the annular space between the basket and the casing. The passage of the material is assisted by a nozzle projecting into the scoop-pipe, through which a jet of steam is injected. The mouth of the scoop is adjustable to any desired distance from the wall of the basket.—W. F. F.

Sugar beets; Method of extracting sugar from dried ——. G. H. Benjamin, New York. U.S. Pat. 1,319,320, 21.10.19. Appl., 6.4.15.

The beets are first digested with hot water, without circulation, to raise their temperature to the required degree and to enable the cells to absorb water, after which more hot water is added and maintained in circulation at constant temperature to extract the sugar.—J. H. L.

Diffusion battery [for beetroots]. J. Masin, Prague. Ger. Pat. 313,433, 27.7.17.

In a diffusion battery the material to be extracted and the extracting liquid pass through all the units in turn, in opposite directions. Each vessel has a central vertical partition extending from the top nearly to the bottom. The solid material is fed into the top of the first vessel of the series, and travels downwards on one side of the partition and upwards on the other side, and then passes through a duct near the top communicating with the next vessel, which is traversed in the same way, and so on. The juice leaves each vessel at the bottom by a duct which projects upwards into the preceding vessel on that side of the partition on which the solid material ascends. These juice ducts are provided with injectors which drive the juice forwards from one vessel to another.—J. H. L.

Adhesives; Method for the extraction from corn [maize] cobs of material suitable for use as —— *and for other purposes.* K. P. Monroe, Washington, D.C. U.S. Pat. 1,317,380, 30.9.19. Appl., 14.3.19.

Maize cobs are digested with sodium hydroxide solution, and the extract, separated from the solid residue by pressure, is concentrated.—J. H. L.

Syrup from beetroot. Eng. Pat. 133,744. *See* XIXa.

XVIII.—FERMENTATION INDUSTRIES.

Yeast enzymes. T. Bokorny. Allg. Brauer- u. Hopfenzeit., 1919, 881—882, 889—890, 893—894. Chem. Zentr., 1919, **90**, III., 681—682. (See also this J., 1916, 900.)

Pressed yeast retains its invertase activity in absolute alcohol for several days at the ordinary temperature but not at 45° C. Steeping for two days in solutions containing 0·25—0·5% of oxalic acid or 2% of acetic or lactic acid is also without influence on the invertase of yeast, but 0·1% hydrofluoric acid weakens it slightly, and it is partially destroyed by one day's steeping in 0·5% sulphuric acid. It is not destroyed in 24 hours by a 0·5% sodium hydroxide solution. Yeast dried at 25° C. is equal or superior in inverting power to fresh yeast or to yeast in presence of toluene. On the other hand, the drying of yeast in the air destroys its maltase activity. In aqueous solutions maltase remains active for only a few days, and is rapidly destroyed at 25° C. Alcohol at a concentration of 5% weakens it, and 0·1% thymol solution renders it inactive within 24 hours. It is much weakened in 24 hours by water to which turpentine oil is added, and not destroyed by chloroform water. In the yeast cell itself maltase is destroyed by 1% hydrochloric or oxalic acid, but not by 1% acetic acid. It is destroyed within four days by 1% but not by 0·5% sodium hydroxide solutions, whilst 0·02% solutions stimulate its activity. Yeast maltase appears to be more sensitive than maltase from other sources. Attention is drawn to the fact that the tryptase of yeast is capable of decomposing zymase.—J. H. L.

Enzymes; Studies on ——. *IV. Autolysis of starch.* W. Biedermann. Fermentforschung, 1919, **2**, 458—472. Chem. Zentr., 1919, **90**, III., 635. (See also this J., 1917, 230.)

The earlier experiments (*loc. cit.*) have been repeated under conditions designed to exclude the possibility of degradation of the starch by traces of diastase originally present in it, or by bacterial action. Sodium chloride or the ash of saliva does not act directly on the starch, but gives rise to the production of a diastatic enzyme; after this process has reached a certain stage autolysis will continue even though the salts are removed by dialysis. Starch preparations which already contain degradation products undergo autolysis less readily than pure starch.—J. H. L.

Yeast; Action of radium emanation on vitamines of ——. K. Sugiura and S. R. Benedict. J. Biol. Chem., 1919, **39**, 421—433.

The growth-promoting factors present in yeast may be partially inactivated by exposure to radium emanation.—J. C. D.

Amino-acids in wine and their biological significance. E. Garino-Canina. Annali Chim. Appl., 1919, **12**, 112—118.

Amino-acids in wine may be derived from the action of proteolytic enzymes in the grape juice, as shown by Pantanelli (this J., 1915, 845); or by the action of endotrypsin in saccharomycetes or bacteria on the proteins in the must or wine; or by the autodigestion of the protoplasmic substances in the saccharomycetes. These amino-acids of the type of leucine, tyrosine, aspartic acid, etc., may undergo a further decomposition through the action of enzymic amidases into amyl alcohol, succinic acid, etc., with the simultaneous liberation of the basic nitrogen group and an increase in the amount of ammonia, such as takes place to a considerable extent in old wines or wine which has been left for a long time on the lees. For the determination of amino-acids in wine Soerensen's formaldehyde

titration method (this J., 1908, 135) is trustworthy. 500 c.c. of the wine is partially neutralised with barium hydroxide, treated with 50 c.c. of a 20% suspension of animal black (to remove colouring matter), evaporated to half its volume, and filtered into a 500 c.c. flask, the filter washed, and the filtrate and washings (about 400 c.c.) treated with 2 grms. of barium chloride and a slight excess of a saturated alcoholic solution of barium hydroxide; the ammonia liberated is distilled by means of a current of air into standard sulphuric acid and titrated. The liquid is then neutralised, using azolitmin paper as indicator, 10 c.c. of 30—40% formaldehyde solution (recently neutralised with barium hydroxide, with phenolphthalein as indicator) added, and the acidity titrated with standard barium hydroxide solution, as described by Soerensen (*loc. cit.*). A sample of grape juice contained 112·0 m.mgrms. per litre of nitrogen as amino-acids, and a sample of sterilised must 98·0 m.mgrms., whilst 26 samples of French, Greek, Italian, and Algerian wines contained from a trace to 91·0 m.mgrms. per litre. The total nitrogen ranged from 28 to 153 m.mgrms. From 30 to 40% of this was in the form of proteins, up to 22% as amino-acids, about 2% as amides, and up to 2% as ammonia. The form in which the nitrogenous substances are present in wine has probably a considerable influence on its keeping properties, since complex nitrogenous compounds may be a direct cause of turbidity. A similar difficulty in the case of beer has been obviated in Wallerstein's process (this J., 1911, 916, 1027) by adding proteolytic enzymes, which decompose the proteins into simpler and more stable compounds.—C. A. M.

Inversion of sucrose. Colin and Chaudun. *See* XVII.

Histamine. Koessler and Hanke. *See* XX.

PATENTS.

Alcohol; Process of obtaining —— *[from sulphite-cellulose waste liquor].* A. B. Foster, Washington, D.C. U.S. Pat. 1,320,043, 28.10.19. Appl., 15.2.13.

THE liquor is boiled with an acid less volatile than sulphurous acid, then neutralised or partially neutralised, and fermented.—J. H. L.

Fermentation; Apparatus for disposing of froth during —— *especially in the aeration process of yeast manufacture.* R. Reik, Vienna. Ger. Pat. 313,108, 9.12.16. Int. Conv., 25.4.16. Addition to Ger. Pat. 300,985.

A PIPE is fixed inside the vat with its upper end in the zone of froth and its lower end within the liquid. A nozzle connected with a supply of compressed air is so disposed within the pipe that the froth is sucked downwards into the pipe and discharged within the liquid.—J. H. L.

Cellulose waste liquors. Ger. Pat. 307,383. *See* V.

Tobacco. Eng. Pat. 121,598. *See* XX.

XIXA.—FOODS.

Acidity of cereal products; Simple method for measuring the ——. *Its application to sulphured and unsulphured oats.* V. Birckner. J. Agric. Res., 1919, **18**, 33—49.

FIFTEEN grms. of the finely powdered material is placed in a dry bottle and 150 c.c. of ice-cold distilled water added. The bottles are stoppered, well shaken, placed in ice-water, and shaken every ½ hr. for 1—1½ hrs. The liquid is filtered through a dry filter into a graduated cylinder standing in ice-water, the first filtrate being re-filtered. 25 c.c. of the filtrate is titrated with *N*/20 alkali in presence of phenolphthalein. The result is calculated as number of c.c. of *N*/1 alkali required to neutralise the extract from 1000 grms. of material. The "acidity value" of various pure sound oats as thus determined varied from 8·75 to 24·0. Oats which had been treated with sulphur gave higher acidity values.—J. H. J.

Milk; Relative anti-scorbutic value of fresh, dried, and heated cow's ——. R. E. Barnes and E. M. Hume. Biochem. J., 1919, **13**, 306—327.

NO indication was obtained that the growth-promoting properties of fresh milk are decreased by drying, but the anti-scorbutic value is lowered. Summer cow's milk appears to be a richer source of the anti-scorbutic vitamine than the winter product. This is explained by the differences in the diet consumed by the cow during these periods. The bearing of these results on infant feeding is discussed. "Scalded" milk may be regarded as very little less effective as a source of the anti-scorbutic vitamine than unheated milk.—J. C. D.

Poppy-seed cake; Use of —— *as a cattle food and its effect on yield of milk and composition of the butter fat.* H. E. Annett and J. N. Sen. J. Agric. Sci., 1919, **9**, 116—129.

POPPY-SEED cake was substituted for mustard cake in the ration of one cow and two buffaloes in milk, but no marked effect was noticeable either on the yield of milk, percentage of fat, or the composition of the butter fat. The reputed ill-effects of poppy-seed cake in producing drowsiness and watery milk were not observed. A rise was observed in the saponification values of the butter fat of the milk from all three animals during one period of three weeks, and it is suggested that this may be correlated with certain weather conditions.—W. G.

Protein hydrolysis; Direct determination of non-amino nitrogen in products of ——. A. Hiller and D. D. Van Slyke. J. Biol. Chem., 1919, **39**, 479—488.

A MODIFICATION of the original method proposed by Van Slyke (this J., 1911, 771, 1135; 1915, 1110). Non-amino nitrogen is determined in the filtrate from the precipitation of the diamino acids by phosphotungstic acid by de-aminising all amino compounds with nitrous acid, and removing the excess of nitrous acid as ammonia after reduction with a zinc-copper couple. A simple Kjeldahl estimation will then give the nitrogen originally present in other forms than amino groupings. Trustworthy results are obtained.—J. C. D.

Apple juice; Effect of methods of extraction of —— *on its composition.* D. Haynes and H. M. Judd. Biochem. J., 1919, **13**, 272—277.

THE juice from apples after freezing has similar properties whether the freezing is carried out rapidly or slowly. Crystalloid substances are readily pressed out from frozen and thawed pulp, but colloidal substances, such as pectin, are to a large extent held back.—J. C. D.

Lupins; Removal of bitter substances from ——. H. Claassen. Zentr. Zuckerind., 1919, **27**, 540. Chem. Zentr., 1919, **90**, IV., 581. (See this J., Gonnermann, 1919, 483A; Eckenroth, 1919, 527A.)

THE bitter substances in lupin seeds may be completely extracted by a diffusion process similar to that employed in sugar factories. Extraction for at least 6 hours is required in the case of whole seeds, whilst crushed or otherwise prepared seeds require only about half as long. The diffusion process extracts 20—25% of the dry substance of

the seeds, including valuable constituents, such as lupeose and soluble proteins. Unless these constituents can be utilised it is doubtful if the process is economically workable. Laboratory experiments showed that the lupeose can be recovered by precipitation with strontia, but this has not yet been attempted on a large scale.—J. H. L.

Food value of synthetic oils with mannitol in place of glycerol. Halliburton and others. *See* XII.

Yeast vitamines. Sugiura and Benedict. *See* XVIII.

PATENTS.

Fruits; Process for obtaining marmalades and jellies of ——, *and in particular grapes, having the natural perfume of the fruit.* E. Monti, Turin, Italy. Eng. Pat. 133,456. 11.10.18. (Appl. 16,617/18.)

JUICES of grapes, strawberries, or other fruits, the aromatic constituents of which become modified or volatilised on heating, are concentrated at a low temperature (*in vacuo* or by freezing) and incorporated with other concentrated fruit materials, for the preparation of jellies and marmalades. In preparing such products without addition of sugar or sugar syrup, the concentrated aromatic fruit juice is incorporated with the juice of fruits rich in pectin substances, such as apples, quinces, etc., which have been concentrated at a low temperature *in vacuo* to a dry substance content of 80—85%. Apparatus for carrying out the process is described. —J. H. L.

Sugar beet root; Manufacture of an edible syrup from —— *and apparatus therefor.* H. S. Alexander, London. Eng. Pat. 133,741, 11.10.18. (Appl. 16,607/18.)

WASHED beetroots are subjected to the action of steam in an autoclave, *e.g.*, for ¾—1¼ hours at 110°—130° C. under a pressure of about 3 kilos. per sq. cm. (40 lb. per sq. in.). The pectic and protein constituents are partially coagulated, the juice is caramelised, and the sucrose partially inverted. After the condensed water has been drained off, the roots are macerated and crushed or shredded, and the pulp is filtered in presses. The juice thus obtained, after being concentrated to a syrup, is edible without further treatment, being free from the characteristic flavour and odour of beetroots. The apparatus comprises washing tanks, elevator, autoclaves, macerators, shredders or crushers, filter-presses, vacuum evaporators, pumps, etc.—J. H. L.

Cereals or their products; Treatment of —— *to improve their dietetic properties.* H. G. Jones and C. J. Coleman, London. Eng. Pat. 133,886, 24.2.19. (Appl. 1608/19.)

GRAIN is heated at 320°—400° F. (160°—205° C.) in a rotating drum for ½—1 hr. The product is in a partially digested condition, and its keeping qualities are enhanced.—J. H. J.

Vegetables; Method and apparatus for drying steamed or boiled ——. D. J. Pennock, Zevenbergen, Holland. U.S. Pat. 1,317,215, 30.9.19. Appl., 19.6.18.

SEVERAL horizontal shafts are mounted vertically above one another in a cylindrical casing, and rotate at equal speed but in alternate directions. Radial perforated blades are mounted on each shaft, the edges of which rotate against the walls of the casing and within the same path as the blades on the shaft above or below. Hot air inlets open into the casing between the inlet and outlet for the vegetables. The bottom of the casing opens into a space in which is a conveyor for the discharged material.—J. H. J.

Desiccating liquids [milk etc.]; Apparatus for ——. N. P. Collis, Dubuque, Assignor to Collis Products Co., Clinton, Iowa. U.S. Pat. 1,317,777, 7.10.19. Appl., 13.12.15.

MILK or other liquid is agitated and then sprayed on to a drying drum, from which the dried mass is scraped and delivered into a trough.—J. H. J.

Milk, cream, and other liquids; Apparatus for pasteurising, cooling, and ripening ——. S. J. Van Kuren, Assignor to J. G. Cherry Co., Cedar Rapids, Iowa. U.S. Pat. 1,319,916, 28.10.19. Appl., 24.9.17.

THE apparatus comprises a receptacle and a closed circulating system, the latter including a tank, and several coils of pipes mounted to rotate about the same axis within the receptacle. The inlet ends of the coils communicate with the lower portion of the tank, and the outlet ends communicate with the upper portion, and the coils are in duplicates, the convolutions of one coil alternating with those of another. An air inlet is provided for the inlet ends of the coils. A "tempering liquid" is circulated through the tank and coils.—A. B. S.

Milk; Preservation of ——. A. Wedemann, Brunswick. Ger. Pat. 309,012, 1.3.17.

MILK is boiled with natural or artificial vanilla, or vanillin, *e.g.*, for 30—40 mins. with 4—5 grms. per 100 litres in summer, or for 20—30 mins. with 2·5—3 grms. per 100 litres in winter, and then cooled to the ordinary temperature as rapidly as possible. The vanilla flavour is not perceptible after the boiling, and the milk will remain sound for about a week.—J. H. L.

Fodder; Process for the conversion of the stomach-contents of animals into a dry ——. G. Beckstroem, Berlin-Pankow. Ger. Pat. 300,063, 10.12.15.

THE stomach-contents are mixed with cellulosic plant materials (chopped straw, hay, peat, etc.), to absorb the gastric juice, and the mixture is left to ferment at about 40° C. until vigorous evolution of gas has ceased, and is then dried. The stomach-contents may be introduced into a chamber or container, the walls of which are of peat, which acts as a heat insulator and as a cellulosic absorbent for the gastric juice. During the fermentation the celluloso undergoes decomposition, and the reaction of the mixture becomes less acid, and finally almost neutral when vigorous evolution of gas has ceased. The original unpleasant odour of the material is then no longer perceptible.—J. H. L.

Fodder; Process for treating green —— *in silos.* "Herba" A.-G. Schweizerische Unternehmung für Konservierung von Süszgrünfutter Rapperswil, Rapperswil, Switzerland. Ger. Pat. 305,562, 9.3.17. Int. Conv., 19.9.16.

IN the treatment of green fodder by introducing it in layers into a container and allowing it to undergo spontaneous heating and fermentation, the bottom layer is allowed to attain a temperature 10° C. higher than that attained by other layers, in order to provide a reserve of heat for the floor and walls of the container. The layers may be higher at the middle than at the edges, so that when pressure is applied by means of a cover the peripheral portions are not compressed. In cases where the material does not become sufficiently heated a relatively low pressure (50 kilos. per sq. m.) may be applied to allow the top layer to acquire the requisite temperature. After a certain time the cover may be removed to allow the moisture produced by fermentation to escape from the top layer and thus avoid mould growth.—J. H. J.

XIXB.—WATER PURIFICATION; SANITATION.

Vanadium; Elimination of —— from arsenical waters. F. Reichert and R. Wernicke. Anal. Soc. Quim. Argentina, 1919, 7, 110—113.

SOLUTIONS of ferric salts or ferrous sulphate added in small quantities to alkaline solutions of sodium vanadate cause the precipitation of the vanadium as insoluble ferric vanadate and also by adsorption on the ferric hydroxide formed. It is proposed to apply the method for the simultaneous removal of arsenic and vanadium from natural waters such as those occurring in the Bellville district, Province of Cordoba, Argentine.—W. S. M.

Nicotine. Fryer and Fryer. *See* XX.

PATENTS.

Sewage and other impure liquids; Aeration of ——. O. Stott, Birmingham, and E. R. Jones, Stourbridge. Eng. Pat. 133,722, 14.5.18. (Appl. 8041/18.)

IN the "activated sludge" process of sewage purification the treatment tank is provided with a propeller disposed longitudinally on the surface of the sewage. The propeller blades, which are of the feathering type, introduce air into the surface layer of the liquid and induce a surface current transversely to the direction of flow. Guides are placed in the tank to facilitate the continuation of the current at the sides and across the bottom of the tank. The propeller may be submerged in the sewage, in which case air is introduced into the surface by a blower or other means.—J. H. J.

Water softening and purifying system. C. A. Wiggins, Kansas City, Kans. U.S. Pat. 1,318,122, 7.10.19. Appl., 20.11.16.

THE plant comprises two filtering compartments and an intermediate compartment. Water and a chemical solution are delivered to the lower part of the first filtering compartment, and the filtered liquid leaves the compartment through a pipe in the upper part and is sprayed into the intermediate compartment, into which steam also is introduced. The supply of water to the first filtering compartment is regulated by a valve controlled by a float in the second filtering compartment.

Filter-masses; Process for washing out —— with air and water simultaneously. H. Reisert Ges., Cöln-Braunsfeld. Ger. Pat. 311,895, 14.3.15.

THE water and air supplies are regulated in such a way that a change in one produces a simultaneous but opposite change in the other. The air is distributed through a perforated partition some distance below the filter bed.—T. H. Bu.

Ultra-violet rays; Apparatus for treating liquids by ——. J. C. Pole, Vienna, Assignor to The Chemical Foundation, Inc. U.S. Pat. 1,318,338, 7.10.19. Appl., 18.4.16. Renewed 1.3.19.

ULTRA-VIOLET rays are supplied from an electric vapour lamp which is placed in a chamber into which the liquid to be treated is admitted. Entry of the liquid is prevented until the lamp has reached a certain voltage between its electrodes by means of an automatic valve operated jointly by an electromagnet connected in shunt with the lamp and an electromagnet connected in series with the lamp and controlling the shunt circuit.
—J. H. J.

Nicotine field-baths; Method of purifying ——. R. G. Mewborne and H. K. McConnel, Assignors to The Kentucky Tobacco Product Co., Louisville, Ky. U.S. Pat. 1,317,210, 30.9.19. Appl., 18.5.15.

BASIC lead acetate is added to a fouled dipping bath containing nicotine in order to precipitate substances other than nicotine, and the precipitate is removed.—J. H. J.

Steeping liquor for seeds. Ger. Pat. 312,281. *See* XVI.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Nicotine; Use of arsenotungstic acid in the estimation of ——. L. Guglialmelli and U. Hordh. Anal. Soc. Quím. Argentina, 1919, 7, 121—123.

THE authors recommend the use of arsenotungstic acid as a precipitant for nicotine by the method of Bertrand and Javillier (this J., 1911, 978) in place of silico-tungstic acid, which presents difficulties in its preparation.—W. S. M.

Nicotine; Examination of commercial samples of ——. P. J. and C. H. Fryer. Analyst, 1919, 44, 363—369.

DETERMINATION of nicotine in commercial concentrated extract by titration with standard acid or by precipitation with silicotungstic acid is not reliable when the sample is adulterated with pyridine. An indication of the presence of this adulterant is obtained by the odour of the solution during the titration and when almost all the bases have been neutralised; another, and more satisfactory indication is the refractive index of the solution. Nicotine in certain concentrations separates almost completely from its solution when this is heated at 100° C., whilst pyridine remains soluble; if, after heating, the aqueous solution is tested, a high refractive index shows that pyridine is present. Pure nicotine has a refractive index of 1·5300 at 15° C., whilst that of pyridine is 1·5136. Tables are given showing the refractive indices of solutions of nicotine and pyridine, respectively, for each difference of 1% of substance between 0 and 100%. Three methods are described for the determination of nicotine in the presence of pyridine. (1) The refractive index is determined and the equivalent of nicotine (*a*) found from the table; another portion of the sample is titrated and the result expressed as nicotine (*b*). When pyridine is present, *b* will be larger than *a*, and $b-a$ will give the approximate percentage of pyridine. (2) This method is of use only when the percentage of pyridine is not less than 10. Twenty-five grms. of the sample is diluted with water to 100 c.c. and heated at 99° C. for 10 min., cooled, and after 12 hrs. a drop of the surface liquid (the nicotine separates as a heavy oil) is examined in the refractometer. In the case of pure nicotine, the refractive index obtained will be 1·3540 corresponding with 9·7% of nicotine. If more than 10% of pyridine is present, this figure will be increased. The following table gives the amount of pyridine corresponding with various refractive indices:—

Pyridine in sample.	Refract. Index of aqueous liquid at 15° C.	Pyridine in sample.	Refract. Index of aqueous liquid at 15° C.
%		%	
10	1·3558	30	1·3662
15	1·3587	35	1·3684
20	1·3616	40	1·3705
25	1·3640		

(3) By fractional distillation. If the titration figure shows the sample to contain more than 95% of nicotine, water is added to bring the solution to this strength and 100 c.c. is distilled from a standard Engler flask (as used for petroleum dis-

tillations); the side tube of the flask is connected with a condenser 30 cm. in length, and the flask is heated with a flame 3 cm. in height. When the temperature of the vapours reaches 150° C., the flame is removed, the volume of the distillate noted and its refractive index determined. With pure nicotine the volume of the distillate does not exceed 5 c.c. Reference to the following table gives the percentage of pyridine:—

Pyridine.	Refract. index of distillate.	Pyridine.	Refract. index of distillate.
%		%	
0	1·357	15	1·454
5	1·393	20	1·467
10	1·436	25	1·477

—W. P. S.

Antitoxic sera; Precipitation of —— by ammonium sulphate and by sodium sulphate. A. Homer. Biochem. J., 1919, **13**, 278—295.

THERE are no well-marked limits for the precipitation of the individual serum proteins when sodium sulphate is used. The presence of cresol affects the concentration of either ammonium or sodium sulphate required to precipitate the serum proteins. The percentage precipitation of the antitoxin with the proteins precipitated at various concentrations of sodium sulphate is a linear measure of the percentage precipitation of the antitoxin-bearing proteins. Certain advantages attend the use of sodium sulphate in particular cases.—J. C. D.

Sulphonal. A. Falck. Pharm. Zentr., 1919, **60**, 409—416.

DETERMINATIONS of the solubility of sulphonal in various solvents showed that 1 grm. of sulphonal required the following quantities of solvent for complete solution:—Water (at 18° C.), 423 grms.; (at 100° C.), 8 grms.; 90% alcohol (at 15° C.), 60 grms.; ether (at 17° C.), 79 grms.; chloroform (at 20° C.), 3·3 grms.; methylene chloride, 2·8 grms.; benzene (at 17° C.), 12·7 grms.; ethyl acetate, 13·7 grms.; toluene, 19·3 grms.; carbon tetrachloride, 110 grms.; carbon bisulphide, 440 grms.; 2% sodium chloride solution (at 18° C.), 440 grms. Sulphonal begins to volatilise at 60° C. under ordinary pressure and is appreciably volatile with steam; on this account, sulphonal solutions should not be concentrated by evaporation before analysis. Extraction with chloroform and evaporation of the solvent at a low temperature is recommended for the determination of sulphonal in its aqueous solution. Sulphonal may be recovered from decomposing animal matter even after long contact; characteristic crystals of the substance are obtained from its ether or chloroform solution.—W. P. S.

Imidazole derivatives; Microchemical colorimetric method for estimating ——. K. K. Koessler and M. T. Hanke. J. Biol. Chem., 1919, **39**, 497—519.

THE colour produced in the reaction between imidazole derivatives and sodium *p*-diazobenzenesulphonate is made the basis of colorimetric method of estimating these derivatives.—J. C. D.

Histidine; Quantitative separation of —— from histamine. K. K. Koessler and M. T. Hanke. J. Biol. Chem., 1919, **39**, 521—538.

A SEPARATION may be effected by extracting a strongly alkaline mixture of the two substances with amyl alcohol. Histamine is dissolved by the amyl alcohol, and may be recovered from the extract by shaking with *N*/1 sulphuric acid. Histidine remains behind in the alkaline liquid. (See further J. Chem. Soc., Jan., 1920.).—J. C. D.

Histamine; Production of —— from histidine by B. coli communis. K. K. Koessler and M. T. Hanke. J. Biol. Chem., 1919, **39**, 539—584.

IN the presence of an easily available source of carbon, such as glycerol or dextrose, and a source of nitrogen, such as ammonium chloride or potassium nitrate, as much as 50% of added histidine may be transformed into histamine. (See further J. Chem. Soc., Jan., 1920.)—J. C. D.

Tyramine (p-hydroxyphenylethylamine); Preparation of ——. K. K. Koessler and M. T. Hanke. J. Biol. Chem., 1919, **39**, 585—592.

THE method is based on the synthesis of *p*-hydroxybenzyl cyanide (Pschorr, Wolfes, and Buckow, Ber., 1900, **33**, 170), and on the reduction of this nitrile to the amine (Barger, this J., 1909, 1324). Certain improvements in the method are given, and the separation of by-products, such as *p*-cresol and *p*-hydroxyphenylacetic acid is described.—J. C. D.

Glycol monochlorhydrin; Distillation of aqueous solutions of ——. J. Bancelin and G. Rivat. Bull Soc. Chim., 1919, **25**, 552—560.

COMMERCIAL aqueous solutions of glycol monochlorhydrin give, on distillation, a constant boiling mixture (97·85° C. at 760 mm.) containing 42% of the monochlorhydrin, this result being independent of the concentration of the original solutions. These results were confirmed by distillations of solutions prepared with the pure monochlorhydrin, except that the amount then found in the distillate was 41%.—W. G.

Ether; Catalytic preparation of ordinary —— by the dry way. A. Mailhe and F. de Godon. Bull. Soc. Chim., 1919, **25**, 565—568.

THE catalyst employed was aluminium oxide prepared by heating ordinary commercial alum to 190°—195° C. Using a suitable amount of such a catalyst, disposed in four tubes, the temperature of the catalyst being maintained at 190°—195° C., a yield of ether equivalent to 71·3% of the theory was obtained from 95% alcohol passing at the rate of 25 c.c. per hour. The yield depends upon the weight of catalyst rather than upon the surface exposed, and also upon the strength of the alcohol used. The product obtained is pure, the catalyst can be regenerated, if necessary, by simple solution, evaporation, and calcination, and the whole of the alcohol can ultimately be converted into ether, by repeating the process after concentrating the unchanged alcohol.—W. G.

Methyl alcohol; Action of —— on sulphuryl chloride and on methyl chlorosulphonate. R. Levaillant and L. J. Simon. Comptes rend., 1919, **169**, 854—857.

METHYL alcohol reacts with sulphuryl chloride to give hydrogen chloride and methyl chlorosulphonate, which in its turn will react with more methyl alcohol in one of two ways:—

$$CH_3O{\cdot}SO_2Cl + CH_3OH = (CH_3)_2SO_4 + HCl$$
$$CH_3O{\cdot}SO_2Cl + CH_3OH = CH_3HSO_4 + CH_3Cl$$

the second change preponderating. The methyl hydrogen sulphate on distillation decomposes at 140° C., giving dimethyl sulphate and sulphuric acid. In order to obtain a maximum yield of methyl chlorosulphonate (95% pure) the following procedure is recommended. Methyl alcohol diluted with carbon tetrachloride is added slowly to a cooled solution of sulphuryl chloride in carbon tetrachloride through which dry air is bubbling. At the end of the operation the liquid separates into two layers, of which the lower layer forms the major part. This layer is poured on to ice and the non-miscible portion is collected, dried, and dis-

tilled under reduced pressure. The carbon tetrachloride is in part recovered and may be used again and then the methyl chlorosulphonate is collected. A 70% yield is obtained.—W. G.

Peppermint-like essential oil. F. Elze. Chem.-Zeit., 1919, **43**, 740.

A PLANT growing in central and northern France yields about 0·1% of oil, which resembles peppermint oil in taste and odour; it has sp. gr. at 15° C. 0·920 and $[\alpha]_D = +8°$. The oil contains 40% of total alcohols, is poor in menthol and rich in pulegone. The plant, which is used medicinally by the inhabitants, appears to be a cross between *Mentha piperita* and *M. pulegium*.—W. P. S.

Organic mercurials; Bibliography of the literature of ——. F. C. Whitmore. J. Ind. Eng. Chem., 1919, **11**, 1083—1091.

PATENTS.

Tobacco; Process for the improvement of —. K. Ersley, Nijmegen, Holland. Eng. Pat. 121,598, 28.11.18. (Appl. 19,674/18.) Int. Conv., 15.12.17.

TOBACCO, before or after fermentation, is treated with a liquid (*e.g.*, malt extract, milk, whey, or aromatic vegetable extracts), in which one or more of the following organisms have been cultivated: Butyric acid ferments, species of acrogenes, butyl ferments, aromatic lactic acid bacteria (causing slime formation), peptonising bacteria (*B. vulgare, B. fluorescens liquefaciens, B. polymyxa*, aromatic bacteria), ester-forming species of torula (*T. aceto-aethylicus*), *ester-forming fungi* (*Cladosporium*). The effect of the culture liquid may be supplemented by addition of substances, *e.g.* butyric acid, which are produced by the organisms. After the treatment the tobacco is dried to the requisite degree and fermented if it has not already undergone fermentation.—J. H. L.

Zein solution; Alcoholic — . C. E. Sivett, Brookline, Mass., Assignor to A. D. Little, Inc., Cambridge, Mass. U.S. Pat. 1,320,508, 4.11.19. Appl., 28.2.19.

AN alcoholic solution of zein, not liable to coagulation, is obtained by mixing an alkaline material, not soluble in alcohol, with the substance containing the zein, previous to its extraction with alcohol. —B. V. S.

Tetanus and diphtheria; Process for the production of preventive and curative agents for ——. M. Piorkowski, Berlin. Ger. Pat. 302,404, 3.2.15.

FRESH cultures of the bacteria of tetanus or diphtheria are cultivated as usual at 37° C. for 18 hours, then kept for a time at 42° and finally heated by stages to 100° C. and dried. In this way the toxins are destroyed whilst the antigens remain. The latter are not poisonous.—J. H. L.

Suspensions and colloidal solutions in water; Preparation of stable ——. W. Reise, Charlottenburg. Ger. Pat. 313,339, 17.3.14.

COLLOIDAL solutions or suspensions of blood or animal charcoal, tungsten, nickel, palladium, platinum, calomel, zinc oxide, etc., are prepared by the use of aqueous solutions of saponin or extracts of saponin as protective colloid. The stability of such suspensions is much greater than that of suspensions in strong solutions of gum, gelatin, etc. Suspensions of soot treated with saponin give homogeneous, clear, transparent, dark-brown solutions with water, which have a great adsorptive power for toxins, bacteria, and dyestuffs.—D. W.

Lanolin substitute. Ger. Pat. 312,825. *See* XII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Absorption spectra of a series of aniline dyes and the selection of spectrum bands by means of gelatin filters. A. Hnatek. Z. wiss. Phot., 1915, **15**, 133—148.

FOR use in the spectro-photometric examination of stars a series of single-band selective colour filters was prepared, varying both in the position and in the width of their transmission. Over 60 dyes were examined as to their light-absorption, and of these 24 were selected for preparation of the filters; a full list of the dyes is given, with a description of their properties and their absorption spectra as determined by a Coudé spectrograph on Wratten and Wainwright's Panchromatic B plate. The filters were made in the usual way as gelatin film; where more than one dye was used in a filter they were mixed if possible, but coated separately if there was such interaction between the dyes that the absorption of the mixture was not the sum of the absorptions of the separate dyes. The filters (thirty-six in all) were of three types, passing wide bands of about 1000 A.U., narrower bands of 500—900 units, and narrow bands of 200—400 units respectively. The composition and spectrum of each filter are given. The absorption of the extreme red was not satisfactory in some of the filters, as only two dyes (Naphthol Green and Toluidine Blue) were found with an absorption in this region, and the Toluidine Blue has too much general absorption for use in these light filters. —B. V. S.

Photographic development with amidol; Accelerating power of normal sodium sulphite in ——. Abribat. Bull. Soc. Chim., 1919, **25**, 569—571.

AN excess of sodium sulphite up to twelve times the weight of amidol used considerably accelerates the development of the photographic image. It is shown that this acceleration is due to reciprocal catalytic action of the sodium sulphite in the oxidation of the amidol. Other oxidation catalysts were shown to produce a similar effect. W. G.

Photographic rendering of contrast; The fundamental law for the true ——. F. F. Renwick. Phil. Mag., 1919, **38**, 633—636. A. W. Porter and R. E. Slade. *Ibid.*, 637—638.

A CRITICISM of an earlier paper by Porter and Slade (this J., 1919, 600 A), and a reply.

PATENTS.

Colour photography. W. Friese-Greene and F. Garrett, London. Eng. Pat. 131,238, 25.9.18. (Appl. 5162/18.)

IN two-colour photography where two superimposed plates or films are simultaneously exposed, one or both of the films is colour-sensitised by treatment with a solution containing approximately, in 65 pints of water, 2 grs. of Pinacyanol, 6 grs. of Pinaverdol, 2 grs. of Pinachrome, 4 grs. of Flavasine, and 4 oz. of ammonia (sp. gr. 0·880).—B. V. S.

Photomechanical screen and process of making same. J. A. H. Hatt, Brooklyn, N.Y. U.S. Pat. 1,317,493, 30.9.19. Appl., 11.10.16.

A TRANSPARENT plate is coated with a light-sensitive layer and the solubility of this layer is changed by the action of light in accordance with the desired screen figure. The relatively soluble portions of this layer are dissolved out to provide minute light-transmitting spaces between the screen figures. —W. F. F.

Photographic material; Colour-sensitised ——. F. F. Renwick, Brentwood, and O. Bloch, London, Assignors to Ilford, Ltd., Ilford. U.S. Pat. 1,320,176, 28.10.19. Appl., 21.11.18.

See Eng. Pat. 133,769 of 1918; this J., 1919, 926 A.

XXII.—EXPLOSIVES; MATCHES.

Aluminium flares. E. H. Brittain. Chem. and Drug., 1919, **91**, 1336.

Aluminium powder, intimately mixed with barium nitrate or potassium nitrate, is used in compositions for signal lights, stars, flares, etc. Part of the aluminium may be replaced by magnesium powder. To ensure tight packing of the composition in the containers and so increase its regularity and time of burning, castor oil, shellac, or paraffin wax is added as a binding agent. The aluminium must be finely ground, must not contain grit or sand, and must be free from oil or grease which might lead to spontaneous ignition. Aluminium compositions have a higher temperature of combustion than those containing magnesium powder; they will stand considerable pressure, but are sensitive to friction, and under certain conditions are liable to explode. Suitable compositions are:—*For stars:* Magnesium (60-mesh), 27 parts; aluminium (120-mesh), 9 parts; barium nitrate (100-mesh), 58 parts, and paraffin wax, 6 parts. *For ground flares:* (1) The above composition, using quickmatch and a priming of sulphur, 2 parts; potassium nitrate, 6 parts; and antimony, 1 part, mixed with shellac solution; (2) aluminium (120-mesh), 800 parts; aluminium (60-mesh), 400 parts; barium nitrate, 3000 parts; and castor oil, 60 parts. *For flares:* (1) Aluminium, 20 parts; barium nitrate 55 parts; potassium nitrate, 4 parts; sulphur, 20 parts; shellac (powdered), 1 part; (2) aluminium, 1 part; barium nitrate, 1–3 parts.

—W. J. W.

Patent.

Smoke-making composition for signal-rockets. R. C. Gowdy, Cincinnati, Ohio, Assignor to U.S. Government. U.S. Pat. 1,319,329, 21.10.19. Appl., 24.4.19.

A smoke-producing composition consists of a combustible agent, an oxidising agent, and a volatile organic dye.—W. J. W.

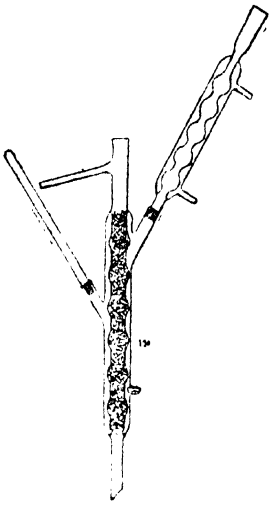
XXIII.—ANALYSIS.

Mercury pump; Automatic —— *with device for collecting the aspirated gases.* A. Beutell and P. Oberhoffer. Chem.-Zeit., 1919, **43**, 705–706.

By a modification of the mercury pump of the Sprengel type described previously (Chem.-Zeit., 1910, 1342), the gases drawn off, for example, from a metal under examination are collected and can be analysed.—W. J. W.

Still-heads; Comparative tests with various types of —— *at a constant speed of distillation.* J. Friedrichs. Z. angew. Chem., 1919, **32**, 340–344.

For determining the relative efficiency of different types of still-heads 150 c.c. of a mixture of equal volumes of benzene and toluene was distilled under constant conditions, the speed of the distillation being controlled by a vapour pressure regulator between the outlet tube from the still-head and the condenser. The distillations were carried out at the rate of 20 drops from the vertical condenser per min., and the volume of distillate was measured and the temperature in the still-head was taken at definite intervals. From the results, which are given in tabular form, the conclusion is drawn that the most efficient of all still-heads are those containing glass beads, or fragments of glass. For



the distillation of larger quantities of liquid the best results are obtained by the use of a long tube, as in Hempel's apparatus. In the case of liquids boiling below 100° C. Winssinger's modification of Hempel's still-head is satisfactory (Chem.-Zeit., 1886, **10**, 371). The modification of Plücker's apparatus (Chem.-Zeit., 1913, **37**, 1141), shown in the diagram, combines the advantages of Winssinger's dephlegmator with those of Ekenberg's rectifying apparatus (this J., 1892, 1034). When small quantities of substances only are available for the distillation the preference should be given to Linnemann's still-head (Annalen, **160**, 195).—C. A. M.

Reduction spectra, in particular of magnesium and its compounds. J. Meunier. Bull. Soc. Chim., 1919, **25**, 562–565.

An examination of the reduction spectrum of magnesium, using the method previously described (this J., 1919, **25**, 55) shows in the ultra-violet region the band composed of the rays λ=3810, 3829, 3833, 3838, 3851, 3858, 3861, and another band consisting of the rays λ=3885, 3912, 3940, 3960, 3980. Nine other rays between λ=3700 and 3780 were noticed and their wave-lengths approximately determined. Of the salts of magnesium, the chloride, oxychloride, sulphate, nitrate, and carbonate, and also the oxide gave the above spectrum. The pyrophosphate does not give the above spectrum, apparently not being reduced under these conditions, but gives the continuous spectrum due to incandescence. In some cases the γ-ray in the neighbourhood of λ=5003 and the broad ray λ=4702 were observed.—W. G.

Nickel; New method for the volumetric estimation of ——. J. Holluta. Monatsh. Chem., 1919, **40**, 281–291.

The process depends on the fact that when a nickel salt reacts with dimethylglyoxime, acid is liberated, which is estimated by titration with alkali in the presence of phenolphthalein or methyl red. A standard $N/50$ solution is prepared by dissolving 4·6400 grms. of dimethyglyoxime in the requisite quantity of 97% alcohol (300—400 c.c.); 20 c.c. of $N/1$ potassium hydroxide solution is added with constant shaking, the solution is diluted to 1000 c.c. with CO_2-free distilled water and filtered after 24 hours from any slight precipitate of potassium

carbonate (the alcohol used must be free from aldehyde and neutral in reaction). The alkali content of the solution is checked by titration with standard acid using phenolphthalein or methyl red as indicator. The nickel solution under examination is diluted to the required extent, exactly neutralised with $N/10$ or $N/50$ potassium hydroxide solution, 2—5 c.c. of the standard dimethylglyoxime solution is added, and, after vigorous agitation, the mixture is gently warmed, whereby the precipitate is caused to collect leaving a clear liquor; the standard solution is then gradually added with frequent agitation until the solution acquires a permanent pale pink coloration. In consequence of the bulky nature of the nickel precipitate the amount of the metal in the solution should not exceed 0·03 grm. The method is particularly advantageous in dealing with very small quantities of nickel, and titration can readily be effected with $N/100$ solutions if methyl red is used as indicator. The results are not affected by the presence of the alkali salts of strong acids.

Heat value indicator. Brady. *See* IIA.

Mineral oils. Philip. *See* IIA.

Light petroleum. Tausz and Schnabel. *See* IIA.

Asphalts. Pailler. *See* IIA.

Low temperature tars. Fischer and Gluud. *See* III.

Potassium pyroantimonate for sodium estimation. Van Leeuwen. *See* VII.

High temperature measurements. Kanolt. See VIII.

Cements. Montemartini and Roncali. *See* IX.

Titanium. Cavazzi *See* IX.

Copper in pyrites. Mengler. *See* X.

Mineral rubber. Dubosc and Wavelet. *See* XIV.

Tanning extracts. Lauffmann. *See* XV.

Moisture in leather. Harvey. *See* XV.

Solubility of sulphur. Innes. *See* XV.

Dextrose. Zablinsky. *See* XVII.

Invert sugar. Van Leeuwen. *See* XVII.

Amino-acids in wine. Garino-Canina. *See* XVIII.

Acidity of cereals. Birckner. *See* XIXA.

Protein hydrolysis. Hiller and Van Slyke. *See* XIXA.

Nicotine. Fryer and Fryer. *See* XX.

Nicotine. Guglialmelli and Hordh. *See* XX.

Sulphonal. Falck. *See* XX.

Imidazole derivatives. Koessler and Hanke. *See* XX.

Histidine and histamine. Koessler and Hanko. *See* XX.

PATENTS.

Vapour pressures; Apparatus for the estimation of ——. H. S. and M. D. Davis, Pittsburgh, Pa. U.S. Pat. 1,318,362, 14.10.19. Appl., 31.1.19.

THE apparatus consists of two similar flasks connected by a manometer. A fragile container is inserted into one of the flasks by means of a suitable carrier, which is so constructed that the container may be broken within the flask. (See also this J., 1918, 611A.)—L. A. C.

Radiation-pyrometer. C. T. Wallis and R. C. Schwarz, Assignors to Taylor Instrument Cos., Rochester, N.Y. U.S. Pat. 1,318,516, 14.10.19. Appl., 3.5.18.

ONE end of a closed tube, which is exhausted when in use, is subjected to the temperature to be measured; the heat radiated from the heated end of the tube acts upon a heat-sensitive element placed in a suitable position within the tube, and which is connected by means of an electric circuit to an indicating device.—L. A. C.

Flue gas tester; Portable ——. E. Bergmann, Ober-Langenbielau. Ger. Pat. 313,970. 26.6.17.

THE apparatus comprises a bell-container for the flue gas, filled and emptied by the action of a plunger fitting inside it, two or more graduated absorption chambers of much smaller capacity than the container, and chambers serving as reservoirs for the absorbent liquids. Capillary tubes with suitable cocks connect the absorption chambers to each other, to their respective reservoirs and to the gas container. The latter is also similarly connected to each of the reservoirs, so that after the necessary volume of gas has been transferred from the container to an absorption chamber the remainder of the gas is used, as required, to provide the pressure necessary in the reservoirs to transfer the portion of gas under test from one absorption chamber to the other and finally to expel it from the latter. J. H. L.

[*Metal*] *testing machines; Notched bar* ——. J. C. W. Humfrey, Sheffield. Eng. Pat. 134,082. (Appls. 19,363, 25.11.18 and 10,811, 1.5.19.)

[*Tungsten*] *crucible.* U.S. Pat. 1,318,452. *See* X.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately and to opposition within two months of the date given.

I.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Brackenbury. Mills for pulverising or grinding. 30,003. Dec. 2.

Carpenter. 30,243. *See* II.

Cathcart. Drying. 29,488. Nov. 26.

Coleman. Mixing and agitating machines and appliances. 29,288. Nov. 21.

Edser, and Minerals Separation, Ltd. Treatment of emulsions etc. 30,341. Dec. 4.

Fleming. Process of condensing and treating distillates. 29,491. Nov. 26. (U.S., 25.3.18.)

Foot. Drying conveyor apparatus. 29,615. Nov. 27.

Griffiths. Autoclaves. 29,472. Nov. 26.

Hanley, Rhodes, and Thomas. Furnaces. 29,341. Nov. 25.

Jenkins, and Nitro-Fixation Syndicate. Heat insulating and interchanging means. 30,502. Dec. 5.

Jenkins and others. 30,587. *See* X.
Maass. 30,177. *See* VII.
Mond (Taylor Engineering and Manufacturing Co.). Crushers. 29,965. Dec. 1.
Parkes, Ltd., and Sharpe. Grinding and crushing mills. 30,307. Dec. 4.
Phillips and Rose. Comminution and mixing of materials. 29,687. Nov. 28.
Wait. Process of treating filtration membrane. 30,112. Dec. 2.

COMPLETE SPECIFICATIONS ACCEPTED.

18,910 (1918). Pease. Heat interchanging apparatus. (135,274.) Dec. 3.
19,084 (1918). Apeldoornsche Machinefabriek. Refrigeration. (120,923.) Dec. 10.
19,244 (1918). Instone. Freezing media. (135,567.) Dec. 10.
19,770 (1918). Wake. Grinding, crushing, and pulverising mills. (135,322.) Dec. 3.
20,298 (1918). Wade (Schlatter, Frorath, & Co.). Furnaces etc. for producing hot air for drying and like purposes. (135,332.) Dec. 3.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Beilby. Carbonisation of coal. 29,817. Nov. 29.
Briscoe, Cunningham, and Curtis's and Harvey. Manufacture of filaments for electric lamps. 29,207. Nov. 24.
Carpenter. Collection of gases in chambers. 30,243. Dec. 3.
Coke and Gas Ovens, Ltd., and Cooke. Coke ovens etc. 29,767. Nov. 28.
Cox and Palmer. Filaments for electric glow lamps. 29,448. Nov. 26.
Davidson. 29,631. *See* XXIII.
Fleming. 29,490. *See* III.
Fleming. 29,491. *See* I.
Gaz Pauvre Economique. Vaporising apparatus for gas-producers. 29,846. Nov. 29. (Fr., 30.11.18.)
Giusti. Purifying liquid fuel used in internal-combustion engines. 30,200. Dec. 3.
Grisard. Process for neutralising mineral oils treated with acid. 30,379. Dec. 4. (Switz., 4.12.18.)
Lowe. Manufacture of blue water gas in conjunction with coal gas. 30,117. Dec. 2. (New Zealand, 19.8.19.)
Oddy. Distillation of coal, shale, peat, wood, etc. 29,347. Nov. 25.
Oddy. Light hydrocarbons etc. for motor and lighting purposes. 29,349. Nov. 25.
Oddy. 29,348. *See* II.
Shedlock. Treatment of hydrocarbon minerals to extract and purify their volatiles and utilising their by-products. 30,240. Dec. 3.
Smith and Tulloch. Gas-producers. 29,123. Nov. 25.
Smith. Fuel briquettes etc. 29,290. Nov. 24.
White. Treatment of petroleum etc. 30,070. Dec. 2.

COMPLETE SPECIFICATIONS ACCEPTED.

6067 (1918). Allgem. Ges. f. Chem. Industrie. Apparatus for continuous and uniform treatment of hydrocarbons with sulphurous acid. (114,845.) Dec. 10.
10,341 (1918). Barbet et Fils et Cie. Continuous fractional distillation of petrols, petroleums, benzols, etc. (117,615.) Dec. 3.
19,386 (1918). Pennington and Lamb. Treatment of coal, water, and other gases. (135,577.) Dec. 10.
19,595 (1918). Westinghouse Lamp Co. Filaments for electric lamps. (121,596.) Dec. 10.
19,697 (1918). Smith. Gas-producers. (135,319.) Dec. 3.
20,436 (1918). Smith. Gas-producers. (135,643.) Dec. 10.
20,654 (1918). Iversen. Gas-producers. (135,339.) Dec. 3.
21,502 (1918). Davidson. Preparation of damp peat for the manufacture of producer gas. (135,348.) Dec. 3.
15,939 (1919). Pope. Material for strengthening and increasing the luminosity of incandescent gas mantles. (135,797.) Dec. 10.

III.—TAR AND TAR PRODUCTS.

APPLICATIONS.

Fleming. Process of conversion of hydrocarbons. 29,490. Nov. 26. (U.S., 17.11.16.)
Fleming. 29,491. *See* I.
Oddy. Purifying or refining hydrocarbons. 29,348. Nov. 25.
Oddy. 29,349. *See* II.
Shedlock. 30,240. *See* II.

COMPLETE SPECIFICATIONS ACCEPTED.

6067 (1918). Allgem. Ges. f. Chem. Ind. *See* II.
10,341 (1918). Barbet et Fils et Cie. *See* II.
16,457 (1918). Barbet et Fils et Cie. Process for removing tar from liquids. (120,558.) Dec. 3.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

Baddiley, Hill, and British Dyestuffs Corporation. Lake dye. 30,461. Dec. 5.
Barr, Bentley, and Clayton Aniline Co. Manufacture of dyestuffs of the N-arylated triphenylmethane series. 30,015. Dec. 2.
Barr, Bentley, and Clayton Aniline Co. Manufacture of aniline blue. 30,016. Dec. 2.
Davies. Manufacture of dyes. 29,358. Nov. 25.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Boving and Co., and Hellström. Manufacture of pulp and paper from bamboo, esparto, straw, etc. 29,760. Nov. 28.
Dreyfus. Manufacture of products having a basis of cellulose derivatives. 30,216—30,218. Dec. 3.
Dreyfus. Manufacture of plastic masses. 30,219. Dec. 3.
Dreyfus. Utilisation of organic derivatives. 30,486. Dec. 5.
Grätz. De-acidificaton of raw woodpulp liquor. 29,474. Nov. 26.
Laurency and Vigier. Preparing textile fabrics for spinning. 29,190. Nov. 24.
Marshall. 30,375. *See* VI.
Müller. Manufacture of cellulose compounds. 29,939. Dec. 1.
Radcliffe. 30,011. *See* VII.
Stevenson. Manufacture of nitrocellulose or celluloid compounds. 29,295. Nov. 24.
Watremez. 29,410. *See* VI.
Whittaker. Manufacture of paper. 29,948 and 29,949. Dec. 1.
Wood. Treating paper etc. for use as packing, washers, etc. 29,909. Nov. 24.

COMPLETE SPECIFICATIONS ACCEPTED.

16,825 (1918). Amber Size and Chemical Co., and Weygang. Treatment of vegetable fibrous materials and production of detergents. (135,240.) Dec. 3.

18,728 (1918). Aitken. Paper-making machines. (135,259.) Dec. 3.

19,389 (1918). Testrup, and Wetcarbonizing, Ltd. Treatment of cellulose-containing materials. (135,578.) Dec. 10.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Marshall. Treating fibres and fabrics. 30,375. Dec. 4.

Watremez. Process of scouring fibres of vegetable origin for bleaching. 29,410. Nov. 25. (Belg., 21.2.19.)

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Barton. Manufacture of oxide of lead. 30,166. Dec. 3.

Foster. Production of oxygen and ammonium carbonate. 29,775. Nov. 29.

General Chemical Co. Production of oxides of nitrogen and catalyser therefor. 30,090. Dec. 2. (U.S., 7.9.18.)

Haynes and Williams. Synthetic production of nitrogen compounds. 30,268. Dec. 3.

Keenan and Richardson. Sulphuretted hydrogen etc. generating apparatus. 29,399. Nov. 25.

Maass. Separating aqueous etc. vapours from fluids and solids, and preparing dilute sulphuric acid. 30,177. Dec. 3.

New Jersey Zinc Co. Manufacture of zinc oxide. 29,293. Nov. 24. (U.S., 8.1.19.)

New Jersey Zinc Co. Production of metal oxides and other compounds of metals. 29,297, 29,303, and 29,539. (U.S., 1.8, 12.7, and 22.7.19.)

Parkes and Pearson. Fixation of nitrogen. 30,082. Dec. 2.

Patrick. Silica gels, and processes of making same. 30,611. Dec. 6. (U.S., 7.12.18.)

Radcliffe. Recovery of potassium etc. salts from wool-scouring liquor. 30,011. Dec. 2.

Reid. Concentration of sea-water. 29,754. Nov. 28.

Rochette Frères. Preparation of pure alkaline aluminates. 30,132. Dec. 3. (Fr., 16.4.19.)

Toniolo. Oxidation of ammonia. 29,982. Dec. 1. (U.S., 23.12.18.)

Wilderman. Production of pure potash salts. 29,625. Nov. 27.

COMPLETE SPECIFICATIONS ACCEPTED.

9853 (1917). Adams, Partington, and Rideal. Oxidation of ammonia. (135,224.) Dec. 3.

14,522 (1918). Marks. (Du Pont de Nemours and Co.). Concentration of nitric acid. (135,535.) Dec. 10.

17,079 (1918). Dutt and Dutt. Manufacture of potassium sulphate. (135,545.) Dec. 10.

17,080 (1918). Dutt and Dutt. Manufacture of potassium chloride. (135,246.) Dec. 3.

18,993 (1918.) Pierce. Production of barium oxide. (135,285.) Dec. 3.

19,266 (1918). Jorgensen. Treatment of pyrolusite. (135,305.) Dec. 3.

265 (1919). Dawson. Manufacture of sulphuric acid. (135,359.) Dec. 3.

4255 (1919). Fairbrother (Chemical Construction Co.). Recovery of potassium as nitrate from waste gases of cement kilns etc. (135,713.) Dec. 10.

4563 (1919). Fairbrother (Chemical Construction Co.). Recovery of potassium compounds. (135,720.) Dec. 10.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Copp. Ovens or kilns for firing or baking pottery, bricks, etc. 29,996. Dec. 2.

Mount. Glass-melting furnaces. 29,759. Nov. 28.

Robertson. Glass furnaces. 29,695. Nov. 28.

COMPLETE SPECIFICATION ACCEPTED.

20,306 (1918). Curd. Gas-fired glass-melting furnaces. (135,636.) Dec. 10.

IX. BUILDING MATERIALS.

APPLICATIONS.

Copp. 29,996. *See* VIII.

Harden. Acid-proof and insulating materials. 30,382. Dec. 4.

COMPLETE SPECIFICATIONS ACCEPTED.

16,857 (1918). Lea. Apparatus for dry mixing of concrete aggregates etc. (135,544.) Dec. 10.

18,778 (1918). Candlot. Mixing mortar, concrete, etc. (128,536.) Dec. 3.

4255 (1919). Fairbrother. *See* VII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Angel. Treatment and reduction of sulphide refractory etc. ores. 29,213. Nov. 24.

Bacon and Kilby. Recarburising molten steel in open-hearth furnace. 29,457. Nov. 26.

Ballantine. Production of ferrochrome alloys. 29,216 and 30,108. Nov. 24 and Dec. 2.

Ballantine. Production of ferro-alloys. 30,472. Dec. 5.

Coles. Manufacture of metal plates by electro-deposition. 29,801. Nov. 29.

Coles. Obtaining hard, springy copper by electro-deposition. 29,817. Nov. 29.

Craig, Macnaughten, Mather, and Moore. Manufacture of electrolytic iron. 30,220. Dec. 2.

Dorr Co. Treatment of fine ores. 29,302. Nov. 24. (U.S., 16.8.18.)

Durant and Vautin. Smelting zinc. 30,592. Dec. 6.

Edwards. Ferrous alloys, and manufacture thereof. 30,401. Dec. 4.

Electrolytic Zinc Co. Recovery of zinc by electrolysis. 29,504. Nov. 26. (Australia, 3.12.18.)

Fraser and Peters. Conglomeration of metal chips and filings for fusion by heat. 30,482. Dec. 5.

Groves. Flux for welding. 29,844. Nov. 29.

Hadfield. Manufacture of alloy steel. 29,761. Nov. 28.

Jenkins, and Nitro-Fixation Syndicate. Manufacture of catalytic iron or catalysts containing catalytic iron. 30,587. Dec. 6.

McKune. Open-hearth furnaces. 30,447. Dec. 5.

Slater and Wasnidge. 30,547. *See* XIII.

Soc. Anon. Minerais et Métaux. Treatment of sulphide ores. 30,233. Dec. 3. (Fr., 3.12.18.)

COMPLETE SPECIFICATIONS ACCEPTED.

16,937 (1918). Shilton and Munden. Crucible furnaces. (135,241.) Dec. 3.

17,151 (1918). Price. Crucible furnaces for melting aluminium etc. (135,247.) Dec. 3.

19,810 (1918). Shilton and Munden. Crucible furnaces. (135,620.) Dec. 10.

20,378 (1918). Moore. Electric metallurgical furnaces. (135,639.) Dec. 10.

2495 (1919). Arend. Manufacture of alloys of copper, zinc, and lead. (135,702.) Dec. 10.
17,349 (1919). Ritson. Crucible and like furnaces. (135,447.) Dec. 3.

XI.—ELECTRO-CHEMISTRY.

Applications.

Coles. 29,801 and 29,847. *See* X.
Craig and others. 29,801. *See* X.
Electrolytic Zinc Co. 29,504. *See* X.
Ericksen. Electric furnaces. 29,414. Nov. 25.

Complete Specifications Accepted.

20,378 (1918). Moore. *See* X.
21,863 (1918). Waring and Waring. Electric furnaces. (135,674.) Dec. 10.

XII.—FATS; OILS; WAXES.

Applications.

Bolton and Lush. Neutralisation of fatty acids i fats and oils. 29,705. Nov. 28.
Calvert. Blending oils and fats. 29,533. Nov. 26.
Chadbourne. Manufacture of soap. 29,973. Dec. 1.
Downs and Melton. Recovering and utilising olvent from the air which passes away from pparatus for extracting oil, fat, etc. 29,781. ov. 29.
Heyerdahl. Extraction and refining of oil. 0,513. Dec. 6. (Norway, 9.1.19.)

Complete Specification Accepted.

19,126 (1918). Calvert. Deodorising and purifying oils and fats and the like. (135,295.) Dec. 3.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Baddiley and others. 30,461. *See* IV.
Barton. 30,166. *See* VII.
New Jersey Zinc Co. 29,293, 29,297, 29,303, 29,539. *See* VII.
Nishizawa. Sulphide composition for painting which resists light and heat. 29,417. Nov. 25.
Slater and Wasnidge. Lacquers for preserving polished metals. 30,547. Dec. 6.
Stobie. Ink-grinding machine. 30,150. Dec. 3.

Complete Specification Accepted.

1462 (1919). Goldthorpe. Paints and methods of making same. (135,368.) Dec. 3.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Brierley, Lunn, and Leyland and Birmingham Rubber Co. Vulcanisation of rubber etc. 29,381. Nov. 25.
Davidson. Manufacture of rubber. 29,930. Dec. 1.
Peachey and Skipsey. Obtaining vulcanised rubber goods and materials. 29,172. Nov. 24.
Schauerman. Substitute for ebonite and vulcanite. 30,469. Dec. 5.

XV.—LEATHER; BONE; HORN; GLUE.

Applications.

Gilardini. Apparatus for rapid tanning of hides and skins. 30,516. Dec. 5.
Lamb. Removal of grease and fatty matter from skins. 29,901. Dec. 3.

Complete Specification Accepted.

6050 (1918). Bennert. Utilisation of leather waste. (115,421.) Dec. 3.

XVI.—SOILS; FERTILISERS.

Application.

Savis. Granulating calcium cyanamide for use as fertiliser. 29,378. Nov. 25. (Fr., 26.11.18.)

XVII.—SUGARS; STARCHES; GUMS.

Application.

Grant. Decolorising and purifying sugar etc. 30,541. Dec. 6.

Complete Specifications Accepted.

19,520 and 19,530 (1918). Goold (American Laundry Machinery Co.). Preparation of starch. (135,588 and 135,591.) Dec. 10.
19,692 and 21,833 (1918). Martin. Manufacture of lactose. (135,614.) Dec. 10.
131 (1919). Effront and Boidin. Treatment of residues containing carbohydrates. (122,405.) Dec. 10.

XVIII.—FERMENTATION INDUSTRIES.

Complete Specification Accepted.

14,218 (1919). Wade (Heuser). Manufacture of alcohol-reduced beverages. (135,785.) Dec. 10.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Hort. Manufacture of protein food products. 30,103. Dec. 2.
Kimberley Waterworks Co. Clarifying and purifying turbid water. 29,243. Nov. 24.
Mumford. Treatment of sewage sludge. 30,579. Dec. 6.
Nicholson. Extraction of juices, pectin, etc., from fruit etc. 29,245. Nov. 24.

Complete Specification Accepted.

14,969 (1918). Kestner. Edible product obtained from beet. (135,235.) Dec. 3.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Complete Specification Accepted.

9659 (1917). Barbet et Fils et Cie. Continuous rectification of alcohols. (107,975.) Dec. 10.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Application.

Edridge. Photographic films. 29,861. Dec. 1.

XXII.—EXPLOSIVES; MATCHES.

Complete Specification Accepted.

21,217 (1919). Blyth. Manufacture of explosives of smokeless powders. (135,813.) Dec. 10.

XXIII.—ANALYSIS.

Application.

Davidson. Gas calorimeters. 29,631. Nov. 27.

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124,314	312A	125,160	442A	126,092	449A	126,938	591A	127,921	542A	128,797	642A	129,782	757A
124,324	312A	125,172	436A	126,093	433A	126,944	802A	127,922	542A	128,806	568A	129,798	688A
124,330	334A	125,179	424A	126,097	473A	126,989	531A	127,930	542A	128,815	619A	129,804	670A
124,348	315A	125,180	371A	126,103	404A	126,992	500A	127,932	591A	128,818	630A	129,806	674A
124,364	388A	125,189	351A	126,112	406A	126,997	493A	127,933	565A	128,833	642A	129,808	670A
124,378	376A	125,194	372A	126,114	449A	127,018	536A	127,937	587A	128,836	586A	129,816	728A
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124,453	393A	125,230	353A	126,140	403A	127,027	678A	127,953	601A	128,867	644A	129,830	669A
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124,461	390A	125,253	352A	126,163	422A	127,039	555A	127,964	542A	128,876	640A	129,850	680A
124,468	371A	125,256	351A	126,172	403A	127,047	499A	127,974	566A	128,894	665A	129,869	728A
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124,465	871A	125,280	348A	126,180	403A	127,064	535A	127,977	522A	128,974	648A	129,956	644A
124,475	352A	125,304	348A	126,192	416A	127,066	503A	127,981	640A	128,978	698A	129,957	726A
124,490	390A	125,310	375A	126,196	514A	127,071	489A	127,985	585A	128,986	698A	129,958	681A
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130,164	681A	130,603	718A	131,212	759A	131,709	826A	132,360	804A	132,879	870A	133,404	912A
130,166	742A	130,699	711A	131,233	769A	131,714	760A	132,577	809A	132,882	862A	133,415	891A
130,173	681A	130,703	830A	131,281	935A	131,728	754A	132,581	827A	132,883	862A	133,433	926A
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130,687	829A	131,198	791A	131,702	827A	132,354	827A	132,872	870A	133,403	912A		

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(Note. The letter "R" indicates that a reissue of the patent referred to.)

1,020,570R	165A	1,276,508R	151A	1,280,186	9A	1,281,085	12A	1,281,775	100A	1,282,268	291A	1,282,660	18A
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1,283,117	64A	1,284,880	78A	1,286,400	184A	1,288,508	164A	1,290,244	175A	1,292,068	284A	1,293,772	303A
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1,283,296	71A	1,285,144	112A	1,286,718	134A	1,288,775	150A	1,290,584	176A	1,292,342	313A	1,294,035	282A
1,283,310	66A	1,285,152	114A	1,286,719	147A	1,288,834	142A	1,290,600	470A	1,292,352	292A	1,294,066	305A
1,283,333	287A	1,285,200	100A	1,286,757	124A	1,288,863	135A	1,290,731	189A	1,292,369	709A	1,294,068	295A
1,283,343	64A	1,285,201	97A	1,286,764	124A	1,288,881	132A	1,290,778	164A	1,292,385	457A	1,294,080	298A
1,283,354	36A	1,285,231	108A	1,286,766	150A	1,288,885	132A	1,290,786	200A	1,292,386	286A	1,294,136	270A
1,283,362	93A	1,285,233	98A	1,286,775	157A	1,288,916	150A	1,290,794	200A	1,292,387	286A	1,294,163	283A
1,283,363	79A	1,285,244	97A	1,286,794	150A	1,288,934	352A	1,290,795	170A	1,292,394	268A	1,294,209	328A
1,283,364	79A	1,285,247	114A	1,286,831	124A	1,288,975	141A	1,290,848	164A	1,292,401	335A	1,294,230	304A
1,283,365	79A	1,285,248	000A	1,286,838	134A	1,289,016	135A	1,290,870	268A	1,292,404	284A	1,294,250	376A
1,283,398	75A	1,285,305	109A	1,286,839	134A	1,289,021	150A	1,290,902	294A	1,292,453	859A	1,294,271	348A
1,283,427	79A	1,285,358	105A	1,286,844	149A	1,289,022	150A	1,290,930	280A	1,292,458	875A	1,294,310	304A
1,283,455	46A	1,285,363	67A	1,286,880	124A	1,289,043	188A	1,290,952	261A	1,292,534	705A	1,294,355	283A
1,283,472	75A	1,285,369	108A	1,286,890	158A	1,289,045	129A	1,290,954	288A	1,292,535	276A	1,294,357	277A
1,283,483	77A	1,285,415	098A	1,286,904	150A	1,289,049	177A	1,290,971	231A	1,292,544	250A	1,294,373	314A
1,283,495	77A	1,285,450	70A	1,286,907	123A	1,289,053	153A	1,290,992	244A	1,292,559	286A	1,294,422	379A
1,283,500	79A	1,285,463	111A	1,286,908	124A	1,289,055	150A	1,291,008	242A	1,292,561	313A	1,294,463	313A
1,283,515	286A	1,285,474	112A	1,286,916	151A	1,289,056	150A	1,291,025	266A	1,292,562	312A	1,294,514	328A
1,283,519	70A	1,285,491	90A	1,286,921	147A	1,289,057	146A	1,291,030	225A	1,292,568	313A	1,294,519	373A
1,283,538	76A	1,285,492	90A	1,286,922	147A	1,289,072	148A	1,291,109	244A	1,292,577	652A	1,294,525	361A
1,283,546	77A	1,285,493	90A	1,286,932	134A	1,289,079	135A	1,291,137	242A	1,292,580	630A	1,294,526	361A
1,283,547	75A	1,285,494	90A	1,286,944	600A	1,289,092	146A	1,291,167	644A	1,292,582	292A	1,294,546	322A
1,283,580	61A	1,285,496	63A	1,286,989	156A	1,289,097	186A	1,291,175	313A	1,292,617	291A	1,294,547	311A
1,283,598	73A	1,285,511	108A	1,287,005	141A	1,289,116	202A	1,291,180	331A	1,292,630	290A	1,294,581	324A
1,283,606	76A	1,285,537	64A	1,287,027	131A	1,289,150	200A	1,291,185	330A	1,292,676	266A	1,294,627	330A
1,283,617	69A	1,285,575	104A	1,287,041	135A	1,289,182	165A	1,291,186	330A	1,292,686	311A	1,294,662	331A
1,283,677	85A	1,285,603	116A	1,287,074	124A	1,289,208	141A	1,291,207	261A	1,292,715	333A	1,294,730	316A
1,283,678	85A	1,285,636	142A	1,287,110	131A	1,289,215	184A	1,291,209	246A	1,292,721	330A	1,294,738	313A
1,283,685	111A	1,285,682	142A	1,287,153	146A	1,289,280	189A	1,291,220	261A	1,292,742	336A	1,294,743	313A
1,283,706	47A	1,285,683	105A	1,287,156	149A	1,289,336	166A	1,291,258	269A	1,292,743	313A	1,294,781	566A
1,283,716	108A	1,285,690	109A	1,287,172	131A	1,289,350	165A	1,291,300	248A	1,292,744	313A	1,294,788	323A
1,283,723	100A	1,285,703	117A	1,287,221	182A	1,289,365	149A	1,291,306	499A	1,292,814	285A	1,294,804	335A
1,283,754	77A	1,285,704	105A	1,287,236	149A	1,289,366	149A	1,291,310	262A	1,292,819	282A	1,294,805	335A
1,283,763	66A	1,285,714	184A	1,287,299	151A	1,289,378	197A	1,291,311	242A	1,292,874	278A	1,294,827	361A
1,283,782	79A	1,285,726	130A	1,287,382	128A	1,289,417	135A	1,291,334	242A	1,292,898	242A	1,294,828	315A
1,283,839	86A	1,285,727	130A	1,287,387	153A	1,289,421	165A	1,291,337	291A	1,292,907	379A	1,294,830	329A
1,283,846	64A	1,285,738	102A	1,287,402	124A	1,289,444	189A	1,291,352	261A	1,292,908	379A	1,294,837	375A
1,283,925	61A	1,285,748	146A	1,287,472	135A	1,289,496	136A	1,291,384	295A	1,292,927	276A	1,294,909	313A
1,283,951	75A	1,285,749	146A	1,287,505	125A	1,289,514	129A	1,291,396	297A	1,292,928	286A	1,294,970	328A
1,283,973	79A	1,285,796	134A	1,287,543	132A	1,289,530	142A	1,291,408	261A	1,292,929	286A	1,295,049	576A
1,283,993	53A	1,285,823	158A	1,287,592	129A	1,289,547	147A	1,291,409	270A	1,292,937	290A	1,295,078	319A
1,284,074	305A	1,285,824	134A	1,287,605	146A	1,289,565	101A	1,291,414	245A	1,292,948	285A	1,295,080	328A
1,284,094	78A	1,285,832	450A	1,287,630	164A	1,289,578	142A	1,291,425	241A	1,292,950	280A	1,295,085	566A
1,284,120	86A	1,285,833	245A	1,287,634	149A	1,289,609	149A	1,291,498	253A	1,292,953	287A	1,295,086	566A
1,284,138	66A	1,285,856	133A	1,287,650	125A	1,289,672	246A	1,291,535	296A	1,292,958	670A	1,295,088	454A
1,284,152	39A	1,285,875	147A	1,287,653	148A	1,289,707	149A	1,291,536	296A	1,292,966	279A	1,295,089	604A
1,284,164	79A	1,285,883	146A	1,287,807	150A	1,289,736	530A	1,291,589	245A	1,292,976	330A	1,295,100	374A
1,284,166	73A	1,285,887	109A	1,287,808	150A	1,289,783	135A	1,291,621	245A	1,293,012	304A	1,295,148	357A
1,284,167	74A	1,285,889	109A	1,287,810	200A	1,289,789	192A	1,291,626	283A	1,293,027	330A	1,295,155	320A
1,284,175	74A	1,285,920	159A	1,287,841	193A	1,289,799	184A	1,291,632	242A	1,293,029	333A	1,295,188	316A
1,284,176	74A	1,285,927	160A	1,287,849	150A	1,289,800	184A	1,291,643	261A	1,293,039	305A	1,295,241	319A
1,284,187	89A	1,285,950	109A	1,287,864	166A	1,289,803	192A	1,291,655	261A	1,293,087	277A	1,295,259	347A
1,284,200	75A	1,285,960	109A	1,287,939	135A	1,289,834	184A	1,291,656	261A	1,293,114	313A	1,295,298	324A
1,284,218	62A	1,285,992	111A	1,287,949	148A	1,289,835	184A	1,291,660	262A	1,293,116	317A	1,295,299	324A
1,284,305	335A	1,286,017	116A	1,287,962	132A	1,289,855	146A	1,291,672	225A	1,293,154	340A	1,295,308	353A
1,284,346	63A	1,286,024	112A	1,287,995	143A	1,289,862	142A	1,291,680	286A	1,293,164	372A	1,295,309	376A
1,284,347	63A	1,286,025	102A	1,288,067	202A	1,289,870	166A	1,291,681	286A	1,293,172	334A	1,295,339	339A
1,284,380	75A	1,286,043	149A	1,288,116	141A	1,289,883	156A	1,291,682	286A	1,293,185	288A	1,295,348	324A
1,284,403	79A	1,286,055	115A	1,288,121	148A	1,289,889	142A	1,291,696	284A	1,293,186	288A	1,295,455	315A
1,284,425	80A	1,286,057	111A	1,288,158	131A	1,289,890	142A	1,291,716	291A	1,293,188	341A	1,295,456	315A
1,284,426	80A	1,286,061	109A	1,288,159	131A	1,289,896	148A	1,291,717	291A	1,293,220	333A	1,295,482	311A
1,284,441	90A	1,286,066	266A	1,288,202	147A	1,289,918	202A	1,291,729	286A	1,293,270	348A	1,295,533	357A
1,284,442	90A	1,286,080	718A	1,288,227	141A	1,289,966	142A	1,291,730	286A	1,293,272	376A	1,295,564	324A
1,284,468	389A	1,286,088	135A	1,288,228	186A	1,289,968	130A	1,291,745	490A	1,293,293	288A	1,295,568	328A
1,284,479	64A	1,286,089	373A	1,288,240	150A	1,289,984	163A	1,291,748	242A	1,293,326	340A	1,295,573	328A
1,284,488	295A	1,286,091	100A	1,288,255	186A	1,290,002	168A	1,291,751	286A	1,293,402	328A	1,295,580	371A
1,284,505	77A	1,286,100	147A	1,288,293	199A	1,290,009	123A	1,291,800	296A	1,293,403	328A	1,295,594	331A
1,284,572	81A	1,286,111	147A	1,288,344	146A	1,290,010	148A	1,291,824	291A	1,293,404	328A	1,295,601	323A
1,284,586	65A	1,286,114	123A	1,288,345	146A	1,290,011	148A	1,291,828	296A	1,293,423	343A	1,295,635	324A
1,284,618	75A	1,286,135	124A	1,288,350	147A	1,290,024	148A	1,291,830	291A	1,293,426	328A	1,295,636	319A
1,284,645	78A	1,286,172	358A	1,288,353	147A	1,290,060	177A	1,291,866	291A	1,293,461	376A	1,295,637	313A
1,284,647	70A	1,286,179	120A	1,288,398	194A	1,290,073	170A	1,291,867	291A	1,293,462	376A	1,295,650	325A
1,284,648	68A	1,286,187	129A	1,288,400	133A	1,290,118	170A	1,291,891	612A	1,293,463	376A	1,295,711	314A
1,284,657	66A	1,286,188	718A	1,288,404	184A	1,290,124	168A	1,291,893	629A	1,293,469	277A	1,295,726	311A
1,284,668	70A	1,286,195	123A	1,288,413	143A	1,290,146	200A	1,291,899	279A	1,293,514	284A	1,295,729	330A
1,284,669	70A	1,286,247	184A	1,288,422	184A	1,290,156	171A	1,291,909	285A	1,293,515	340A	1,295,730	330A
1,284,687	67A	1,286,255	135A	1,288,428	156A	1,290,166	185A	1,291,921	287A	1,293,533	288A	1,295,752	374A
1,284,694	66A	1,286,256	135A	1,288,429	154A	1,290,178	165A	1,291,965	242A	1,293,555	276A	1,295,817	328A
1,284,711	78A	1,286,315	155A	1,288,431	130A	1,290,181	185A	1,291,979	286A	1,293,610	280A	1,295,825	316A
1,284,723	262A	1,286,353	158A	1,288,433	164A	1,290,191	194A	1,292,016	286A	1,293,649	336A	1,295,828	325A
1,284,724	268A	1,286,371	142A	1,288,437	134A	1,290,192	194A	1,292,019	268A	1,293,650	336A	1,295,917	349A
1,284,739	71A	1,286,372	151A	1,288,450	166A	1,290,194	536A	1,292,024	294A	1,293,651	336A	1,295,943	385A
1,284,740	71A	1,286,389	156A	1,288,458	153A	1,290,204	187A	1,292,044	292A	1,293,680	281A	1,295,946	349A
1,284,750	81A	1,286,394	225A	1,288,473	187A	1,290,241	177A	1,292,059	292A	1,293,703	322A	1,295,955	347A
1,284,787	64A	1,286,395	225A	1,288,480	163A	1,290,242	183A	1,292,066	709A	1,293,738	295A	1,295,958	818A

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1,295,986	374A	1,297,583	863A	1,299,560	423A	1,301,932	469A	1,303,627	504A	1,305,251	587A	1,307,375	619A
1,296,012	348A	1,297,590	354A	1,299,565	471A	1,301,960	454A	1,303,635	513A	1,305,252	587A	1,307,405	572A
1,296,013	377A	1,297,629	803A	1,299,577	423A	1,302,011	877A	1,303,639	529A	1,305,291	593A	1,307,430	647A
1,296,035	362A	1,297,635	804A	1,299,581	415A	1,302,064	460A	1,303,682	522A	1,305,300	580A	1,307,495	604A
1,296,046	377A	1,297,638	362A	1,299,589	403A	1,302,065	460A	1,303,701	541A	1,305,301	658A	1,307,500	598A
1,296,063	389A	1,297,639	362A	1,299,590	403A	1,302,094	454A	1,303,759	590A	1,305,317	563A	1,307,533	620A
1,296,064	389A	1,297,640	362A	1,299,597	459A	1,302,165	450A	1,303,760	562A	1,305,327	580A	1,307,534	620A
1,296,083	366A	1,297,641	422A	1,299,641	451A	1,302,186	463A	1,303,779	545A	1,305,331	580A	1,307,548	579A
1,296,134	348A	1,297,668	436A	1,299,661	423A	1,302,200	454A	1,303,799	505A	1,305,350	580A	1,307,549	579A
1,296,141	362A	1,297,670	374A	1,299,664	425A	1,302,202	480A	1,303,836	554A	1,305,392	520A	1,307,570	659A
1,296,188	377A	1,297,685	406A	1,299,603	409A	1,302,224	482A	1,303,837	554A	1,305,404	572A	1,307,571	620A
1,296,189	373A	1,297,716	437A	1,299,701	398A	1,302,232	450A	1,303,843	543A	1,305,413	562A	1,307,588	589A
1,296,194	377A	1,297,724	363A	1,299,793	398A	1,302,266	872A	1,303,844	543A	1,305,414	570A	1,307,635	614A
1,296,241	348A	1,297,727	347A	1,299,809	433A	1,302,273	877A	1,303,891	541A	1,305,441	562A	1,307,642	642A
1,296,244	352A	1,297,737	363A	1,299,811	460A	1,302,281	468A	1,303,892	541A	1,305,443	587A	1,307,680	653A
1,296,280	390A	1,297,792	363A	1,299,865	744A	1,302,294	454A	1,303,911	536A	1,305,458	587A	1,307,724	621A
1,296,299	358A	1,297,807	504A	1,299,878	423A	1,302,307	504A	1,303,914	540A	1,305,475	579A	1,307,738	579A
1,296,315	348A	1,297,926	427A	1,299,892	423A	1,302,363	451A	1,303,916	536A	1,305,522	580A	1,307,739	575A
1,296,344	363A	1,297,934	428A	1,299,942	480A	1,302,430	451A	1,303,980	490A	1,305,551	586A	1,307,750	625A
1,296,367	352A	1,297,946	375A	1,299,947	470A	1,302,431	451A	1,303,982	488A	1,305,566	576A	1,307,766	604A
1,296,384	375A	1,297,952	847A	1,299,955	398A	1,302,450	468A	1,303,993	502A	1,305,599	597A	1,307,853	586A
1,296,445	348A	1,298,125	416A	1,299,988	422A	1,302,455	480A	1,304,004	536A	1,305,600	562A	1,307,860	627A
1,296,457	362A	1,298,154	414A	1,299,996	705A	1,302,463	473A	1,304,027	490A	1,305,618	576A	1,307,881	578A
1,296,458	362A	1,298,159	428A	1,300,058	422A	1,302,486	511A	1,304,030	507A	1,305,623	595A	1,307,882	578A
1,296,459	362A	1,298,199	472A	1,300,096	473A	1,302,487	511A	1,304,037	515A	1,305,641	576A	1,307,883	578A
1,296,460	362A	1,298,207	459A	1,300,097	473A	1,302,490	491A	1,304,053	502A	1,305,642	576A	1,307,909	598A
1,296,461	362A	1,298,285	398A	1,300,110	414A	1,302,549	551A	1,304,082	549A	1,305,787	586A	1,307,920	580A
1,296,462	362A	1,298,287	410A	1,300,144	544A	1,302,550	551A	1,304,097	500A	1,305,788	586A	1,307,930	587A
1,296,463	362A	1,298,334	415A	1,300,205	415A	1,302,551	551A	1,304,108	553A	1,305,790	590A	1,307,931	567A
1,296,464	365A	1,298,356	440A	1,300,218	472A	1,302,552	551A	1,304,124	491A	1,305,793	579A	1,307,974	611A
1,296,465	362A	1,298,363	411A	1,300,227	405A	1,302,583	554A	1,304,125	491A	1,305,794	579A	1,307,991	653A
1,296,466	362A	1,298,409	397A	1,300,228	405A	1,302,625	489A	1,304,148	863A	1,305,817	541A	1,307,992	653A
1,296,467	365A	1,298,410	440A	1,300,233	460A	1,302,660	522A	1,304,160	566A	1,305,845	604A	1,308,007	612A
1,296,468	365A	1,298,421	470A	1,300,263	472A	1,302,671	530A	1,304,166	652A	1,305,846	604A	1,308,008	612A
1,296,469	379A	1,298,451	398A	1,300,269	466A	1,302,716	490A	1,304,182	522A	1,305,870	529A	1,308,024	612A
1,296,472	365A	1,298,454	424A	1,300,279	504A	1,302,739	507A	1,304,192	870A	1,305,913	566A	1,308,071	690A
1,296,478	374A	1,298,457	470A	1,300,296	866A	1,302,740	507A	1,304,206	500A	1,305,962	602A	1,308,080	630A
1,296,496	378A	1,298,470	398A	1,300,357	497A	1,302,761	493A	1,304,208	515A	1,305,969	542A	1,308,092	642A
1,296,508	451A	1,298,474	465A	1,300,410	504A	1,302,786	491A	1,304,211	404A	1,305,991	641A	1,308,122	613A
1,296,509	451A	1,298,476	459A	1,300,417	462A	1,302,788	505A	1,304,212	494A	1,306,060	642A	1,308,161	621A
1,296,510	451A	1,298,477	459A	1,300,418	462A	1,302,795	622A	1,304,222	500A	1,306,070	576A	1,308,173	629A
1,296,519	347A	1,298,478	459A	1,300,420	462A	1,302,810	494A	1,304,224	541A	1,306,161	570A	1,308,184	630A
1,296,523	374A	1,298,479	459A	1,300,451	513A	1,302,812	936A	1,304,258	541A	1,306,213	532A	1,308,190	586A
1,296,553	358A	1,298,480	459A	1,300,497	511A	1,302,813	936A	1,304,267	502A	1,306,221	590A	1,308,241	612A
1,296,557	363A	1,298,481	459A	1,300,516	468A	1,302,814	936A	1,304,345	491A	1,306,233	567A	1,308,271	613A
1,296,575	468A	1,298,513	406A	1,300,522	466A	1,302,819	619A	1,304,350	543A	1,306,234	567A	1,308,273	588A
1,296,585	374A	1,298,514	441A	1,300,547	454A	1,302,824	544A	1,304,425	543A	1,306,235	567A	1,308,338	563A
1,296,599	383A	1,298,530	402A	1,300,548	454A	1,302,832	493A	1,304,433	494A	1,306,237	575A	1,308,342	605A
1,296,600	383A	1,298,552	410A	1,300,604	476A	1,302,852	500A	1,304,438	550A	1,306,244	565A	1,308,343	605A
1,296,601	358A	1,298,553	410A	1,300,616	479A	1,302,871	876A	1,304,514	489A	1,306,250	587A	1,308,344	605A
1,296,602	389A	1,298,554	410A	1,300,631	465A	1,302,905	552A	1,304,539	600A	1,306,251	587A	1,308,346	605A
1,296,649	467A	1,298,563	427A	1,300,718	511A	1,302,913	490A	1,304,542	562A	1,306,289	587A	1,308,347	605A
1,296,685	348A	1,298,590	468A	1,300,747	513A	1,302,937	500A	1,304,567	630A	1,306,295	641A	1,308,356	622A
1,296,700	377A	1,298,594	459A	1,300,784	508A	1,302,946	536A	1,304,572	562A	1,306,333	552A	1,308,364	619A
1,296,715	365A	1,298,602	404A	1,300,816	454A	1,302,959	543A	1,304,587	507A	1,306,375	620A	1,308,393	659A
1,296,752	370A	1,298,607	423A	1,300,839	454A	1,302,966	541A	1,304,597	520A	1,306,376	643A	1,308,394	659A
1,296,776	379A	1,298,627	470A	1,300,875	490A	1,303,009	497A	1,304,621	523A	1,306,440	555A	1,308,398	657A
1,296,815	373A	1,298,722	424A	1,300,947	463A	1,303,078	522A	1,304,623	570A	1,306,472	658A	1,308,403	630A
1,296,820	362A	1,298,761	422A	1,301,047	500A	1,303,088	490A	1,304,645	562A	1,306,479	586A	1,308,404	641A
1,296,832	352A	1,298,779	459A	1,301,105	555A	1,303,114	489A	1,304,670	589A	1,306,480	586A	1,308,413	659A
1,296,834	372A	1,298,790	470A	1,301,112	488A	1,303,115	514A	1,304,679	596A	1,306,505	579A	1,308,414	659A
1,296,847	358A	1,298,793	443A	1,301,130	488A	1,303,149	548A	1,304,681	562A	1,306,512	658A	1,308,429	630A
1,296,892	351A	1,298,832	460A	1,301,151	536A	1,303,150	548A	1,304,697	562A	1,306,529	627A	1,308,438	613A
1,296,896	372A	1,298,889	567A	1,301,187	459A	1,303,155	540A	1,304,707	575A	1,306,568	577A	1,308,453	650A
1,296,902	353A	1,298,890	606A	1,301,210	513A	1,303,167	500A	1,304,725	523A	1,306,569	597A	1,308,463	660A
1,296,906	451A	1,298,925	398A	1,301,227	470A	1,303,168	495A	1,304,729	590A	1,306,681	590A	1,308,464	644A
1,296,938	374A	1,298,929	479A	1,301,324	490A	1,303,176	507A	1,304,745	575A	1,306,687	563A	1,308,481	611A
1,296,973	371A	1,298,932	414A	1,301,325	500A	1,303,177	507A	1,304,786	562A	1,306,690	542A	1,308,509	630A
1,296,992	463A	1,298,955	450A	1,301,360	495A	1,303,203	491A	1,304,823	587A	1,306,707	612A	1,308,515	613A
1,297,000	868A	1,298,960	474A	1,301,374	504A	1,303,209	488A	1,304,831	579A	1,306,708	612A	1,308,552	623A
1,297,022	353A	1,299,004	544A	1,301,388	569A	1,303,226	543A	1,304,840	958A	1,306,709	612A	1,308,576	631A
1,297,028	358A	1,299,017	424A	1,301,394	463A	1,303,268	863A	1,304,849	586A	1,306,710	658A	1,308,577	631A
1,297,078	363A	1,299,034	504A	1,301,409	480A	1,303,269	863A	1,304,852	587A	1,306,831	577A	1,308,588	595A
1,297,080	365A	1,299,059	423A	1,301,448	514A	1,303,292	494A	1,304,884	560A	1,306,835	597A	1,308,641	619A
1,297,081	365A	1,299,070	458A	1,301,449	450A	1,303,301	490A	1,304,903	572A	1,306,838	547A	1,308,704	645A
1,297,149	425A	1,299,072	421A	1,301,532	505A	1,303,302	490A	1,304,907	858A	1,306,862	576A	1,308,708	659A
1,297,157	425A	1,299,110	469A	1,301,551	468A	1,303,314	536A	1,304,908	856A	1,306,871	589A	1,308,709	659A
1,297,159	397A	1,299,171	514A	1,301,594	458A	1,303,315	532A	1,304,918	523A	1,306,904	602A	1,308,710	659A
1,297,170	390A	1,299,172	404A	1,301,598	629A	1,303,321	494A	1,304,931	575A	1,306,928	542A	1,308,735	868A
1,297,171	614A	1,299,214	440A	1,301,633	468A	1,303,348	535A	1,304,932	577A	1,306,942	542A	1,308,739	857A
1,297,192	358A	1,299,215	440A	1,301,637	450A	1,303,362	502A	1,304,946	542A	1,306,944	545A	1,308,748	611A
1,297,213	390A	1,299,254	398A	1,301,646	481A	1,303,385	495A	1,304,947	542A	1,306,948	587A	1,308,754	672A
1,297,246	363A	1,299,336	462A	1,301,652	460A	1,303,396	505A	1,304,948	542A	1,306,963	554A	1,308,757	676A
1,297,255	431A	1,299,337	462A	1,301,602	471A	1,303,397	505A	1,304,989	554A	1,306,964	554A	1,308,760	676A
1,297,255R	733A	1,299,385	403A	1,301,663	471A	1,303,398	505A	1,305,008	590A	1,307,032	604A	1,308,763	657A
1,297,297	366A	1,299,408	404A	1,301,675	451A	1,303,411	541A	1,305,025	881A	1,307,033	604A	1,308,768	648A
1,297,328	428A	1,299,414	424A	1,301,684	467A	1,303,426	530A	1,305,058	577A	1,307,034	604A	1,308,777	658A
1,297,371	423A	1,299,445	421A	1,301,688	505A	1,303,429	468A	1,305,109	568A	1,307,075	597A	1,308,788	666A
1,297,378	403A	1,299,449	857A	1,301,693	472A	1,303,453	543A	1,305,123	597A	1,307,113	624A	1,308,796	658A
1,297,387	405A	1,299,455	404A	1,301,714	466A	1,303,493	531A	1,305,166	685A	1,307,127	576A	1,308,797	658A
1,297,388	404A	1,299,479	441A	1,301,766	463A	1,303,506	479A	1,305,167	686A	1,307,152	576A	1,308,802	658A
1,297,393	425A	1,299,485	414A	1,301,771	465A	1,303,513	870A	1,305,173	589A	1,307,153	576A	1,308,803	628A
1,297,395	414A	1,299,492	436A	1,301,785	495A	1,303,514	536A	1,305,177	544A	1,307,184	523A	1,308,819	613A
1,297,409	347A	1,299,493	436A	1,301,796	569A	1,303,519	543A	1,305,195	554A	1,307,197	579A	1,308,826	651A
1,297,464	363A	1,299,519	425A	1,301,832	470A	1,303,527	454A	1,305,209	526A	1,307,280	567A	1,308,877	643A
1,297,480	366A	1,299,539	398A	1,301,887	470A	1,303,563	531A	1,305,213	586A	1,307,321	526A	1,308,878	643A
1,297,491	366A	1,299,540	398A	1,301,909	569A	1,303,618	455A	1,305,244	596A	1,307,329	503A	1,308,879	643A
1,297,496	385A	1,299,559	423A	1,301,920	460A	1,303,624	529A	1,305,250	587A	1,307,353	658A	1,308,880	643A

No. of Patent.	Page.	No. of Patent.	Page.	No. of Patent.	Page.	No. of Patent.	Page.	No. of Patent.	Page.	No. of Patent.	Page.	No. of Patent.	Page.
1,308,885	630A	1,310,480	629A	1,312,255	687A	1,314,022	778A	1,315,532	818A	1,316,967	811A	1,318,774	937A
1,308,899	630A	1,310,489	660A	1,312,256	687A	1,314,061	769A	1,315,534	818A	1,317,007	898A	1,318,793	937A
1,308,904	613A	1,310,492	644A	1,312,257	687A	1,314,082	789A	1,315,540	847A	1,317,014	805A	1,318,806	936A
1,308,907	643A	1,310,528	643A	1,312,258	687A	1,314,138	712A	1,315,541	847A	1,317,015	805A	1,318,891	946A
1,308,911	631A	1,310,532	677A	1,312,259	687A	1,314,140	752A	1,315,542	847A	1,317,077	810A	1,318,921	948A
1,308,931	637A	1,310,713	658A	1,312,260	687A	1,314,148	706A	1,315,543	846A	1,317,160	894A	1,318,922	948A
1,308,932	637A	1,310,715	613A	1,312,261	687A	1,314,150	779A	1,315,544	847A	1,317,164	915A	1,318,929	946A
1,308,943	613A	1,310,720	631A	1,312,262	687A	1,314,175	754A	1,315,545	847A	1,317,165	915A	1,318,936	945A
1,308,948	631A	1,310,724	643A	1,312,265	674A	1,314,203	785A	1,315,546	846A	1,317,210	961A	1,319,027	953A
1,308,951	678A	1,310,727	645A	1,312,266	674A	1,314,204	785A	1,315,547	848A	1,317,215	960A	1,319,053	941A
1,308,973	636A	1,310,743	659A	1,312,293	715A	1,314,212	769A	1,315,551	828A	1,317,220	898A	1,319,056	947A
1,309,014	659A	1,310,748	673A	1,312,301	709A	1,314,229	765A	1,315,585	840A	1,317,225	916A	1,319,061	950A
1,309,032	627A	1,310,751	624A	1,312,311	686A	1,314,231	765A	1,315,611	866A	1,317,262	930A	1,319,077	937A
1,309,045	644A	1,310,770	630A	1,312,316	671A	1,314,236	765A	1,315,619	848A	1,317,295	936A	1,319,085	951A
1,309,070	648A	1,310,824	612A	1,312,348	678A	1,314,237	765A	1,315,623	810A	1,317,318	892A	1,319,128	946A
1,309,139	653A	1,310,841	625A	1,312,352	674A	1,314,249	751A	1,315,632	810A	1,317,327	912A	1,319,129	891A
1,309,143	621A	1,310,846	611A	1,312,367	671A	1,314,273	780A	1,315,635	897A	1,317,328	912A	1,319,148	951A
1,309,149	641A	1,310,848	660A	1,312,372	710A	1,314,280	717A	1,315,639	809A	1,317,351	908A	1,319,150	936A
1,309,161	620A	1,310,858	612A	1,312,375	674A	1,314,298	842A	1,315,652	835A	1,317,359	941A	1,319,151	947A
1,309,162	640A	1,310,939	631A	1,312,411	673A	1,314,301	834A	1,315,658	834A	1,317,372	886A	1,319,178	937A
1,309,165	644A	1,310,943	631A	1,312,424	706A	1,314,321	741A	1,315,660	828A	1,317,380	958A	1,319,183	940A
1,309,181	645A	1,310,969	660A	1,312,452	689A	1,314,348	779A	1,315,663	828A	1,317,390	887A	1,319,206	946A
1,309,221	645A	1,310,977	646A	1,312,474	727A	1,314,384	779A	1,315,674	818A	1,317,469	915A	1,319,319	893A
1,309,267	678A	1,310,984	659A	1,312,475	740A	1,314,417	780A	1,315,678	818A	1,317,492	892A	1,319,320	958A
1,309,274	635A	1,310,998	613A	1,312,477	730A	1,314,422	799A	1,315,698	814A	1,317,493	963A	1,319,329	964A
1,309,320	659A	1,311,017	660A	1,312,521	709A	1,314,461	705A	1,315,700	855A	1,317,497	952A	1,319,365	926A
1,309,330	613A	1,311,043	643A	1,312,552	736A	1,314,485	718A	1,315,701	855A	1,317,498	952A	1,319,391	937A
1,309,411	679A	1,311,049	613A	1,312,592	719A	1,314,486	706A	1,315,719	808A	1,317,514	892A	1,319,420	941A
1,309,425	651A	1,311,051	614A	1,312,607	705A	1,314,538	813A	1,315,748	835A	1,317,524	945A	1,319,426	947A
1,309,432	621A	1,311,070	614A	1,312,634	724A	1,314,571	818A	1,315,761	828A	1,317,557	909A	1,319,500	950A
1,309,465	641A	1,311,090	676A	1,312,668	728A	1,314,588	829A	1,315,770	805A	1,317,582	891A	1,319,508	911A
1,309,466	641A	1,311,096	645A	1,312,741	720A	1,314,603	830A	1,315,779	826A	1,317,583	891A	1,319,531	948A
1,309,496	640A	1,311,133	622A	1,312,742	720A	1,314,613	804A	1,315,811	819A	1,317,592	908A	1,319,537	951A
1,309,551	650A	1,311,158	696A	1,312,743	710A	1,314,630	805A	1,315,834	819A	1,317,593	908A	1,319,572	936A
1,309,552	659A	1,311,171	742A	1,312,756	729A	1,314,634	861A	1,315,835	828A	1,317,603	936A	1,319,573	936A
1,309,563	659A	1,311,175	720A	1,312,759	705A	1,314,642	832A	1,315,836	819A	1,317,625	901A	1,319,574	936A
1,309,568	659A	1,311,176	742A	1,312,782	723A	1,314,709	818A	1,315,880	805A	1,317,648	926A	1,319,586	945A
1,309,569	650A	1,311,215	715A	1,312,783	723A	1,314,710	818A	1,315,881	805A	1,317,686	945A	1,319,589	950A
1,309,577	676A	1,311,216	715A	1,312,784	723A	1,314,715	818A	1,315,880	805A	1,317,688	945A	1,319,605	921A
1,309,580	676A	1,311,217	715A	1,312,800	719A	1,314,740	808A	1,315,910	868A	1,317,705	901A	1,319,612	911A
1,309,581	678A	1,311,218	715A	1,312,815	730A	1,314,742	829A	1,315,940	861A	1,317,721	916A	1,319,648	898A
1,309,588	660A	1,311,219	715A	1,312,826	730A	1,314,752	821A	1,315,952	819A	1,317,755	946A	1,319,663	946A
1,309,622	629A	1,311,220	715A	1,312,842	719A	1,314,765	842A	1,315,961	894A	1,317,756	946A	1,319,666	918A
1,309,623	629A	1,311,221	715A	1,312,844	728A	1,314,772	864A	1,315,971	804A	1,317,777	960A	1,319,667	937A
1,309,650	631A	1,311,222	715A	1,312,853	723A	1,314,773	854A	1,315,982	868A	1,317,781	916A	1,319,688	941A
1,309,651	613A	1,311,231	681A	1,312,871	723A	1,314,779	806A	1,315,992	870A	1,317,784	917A	1,319,700	951A
1,309,681	665A	1,311,232	681A	1,312,878	715A	1,314,791	897A	1,316,018	820A	1,317,835	910A	1,319,734	946A
1,309,683	676A	1,311,251	693A	1,312,916	709A	1,314,802	805A	1,316,047	848A	1,317,868	925A	1,319,735	935A
1,309,696	641A	1,311,274	742A	1,312,927	706A	1,314,831	820A	1,316,086	827A	1,317,911	912A	1,319,771	937A
1,309,702	637A	1,311,280	705A	1,312,928	706A	1,314,835	820A	1,316,091	809A	1,317,920	910A	1,319,795	955A
1,309,703	731A	1,311,286	705A	1,312,951	706A	1,314,839	831A	1,316,107	819A	1,317,936	890A	1,319,828	941A
1,309,744	630A	1,311,319	727A	1,312,974	706A	1,314,840	831A	1,316,133	819A	1,317,945	909A	1,319,839	940A
1,309,794	621A	1,311,329	740A	1,313,009	711A	1,314,841	831A	1,316,144	806A	1,317,950	890A	1,319,840	940A
1,309,851	643A	1,311,378	728A	1,313,014	741A	1,314,842	831A	1,316,214	806A	1,317,954	945A	1,319,841	940A
1,309,890	622A	1,311,379	728A	1,313,023	720A	1,314,849	804A	1,316,220	870A	1,317,992	909A	1,319,842	940A
1,309,903	631A	1,311,380	728A	1,313,158	711A	1,314,856	861A	1,316,267	868A	1,318,003	901A	1,319,843	946A
1,309,943	614A	1,311,395	705A	1,313,160	720A	1,314,861	820A	1,316,311	897A	1,318,015	901A	1,319,850	950A
1,309,967	648A	1,311,421	693A	1,313,162	734A	1,314,864	842A	1,316,330	809A	1,318,053	909A	1,319,858	951A
1,309,980	678A	1,311,431	705A	1,313,163	736A	1,314,871	820A	1,316,339	810A	1,318,054	909A	1,319,916	960A
1,309,981	678A	1,311,481	681A	1,313,180	710A	1,314,920	813A	1,316,342	831A	1,318,060	891A	1,319,917	940A
1,309,999	646A	1,311,487	723A	1,313,192	718A	1,314,952	817A	1,316,350	831A	1,318,061	891A	1,319,918	948A
1,310,012	736A	1,311,506	686A	1,313,207	710A	1,314,955	843A	1,316,351	828A	1,318,063	956A	1,319,939	951A
1,310,013	731A	1,311,535	705A	1,313,208	710A	1,314,984	810A	1,316,352	828A	1,318,074	927A	1,319,978	937A
1,310,037	660A	1,311,559	687A	1,313,235	759A	1,314,994	805A	1,316,396	838A	1,318,075	905A	1,319,984	920A
1,310,060	644A	1,311,563	714A	1,313,274	779A	1,315,011	818A	1,316,404	806A	1,318,076	905A	1,320,036	930A
1,310,061	622A	1,311,568	682A	1,313,281	770A	1,315,017	826A	1,316,418	806A	1,318,106	918A	1,320,039	938A
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1,310,078	622A	1,311,595	678A	1,313,309	778A	1,315,034	826A	1,316,445	819A	1,318,133	885A	1,320,076	893A
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1,310,080	650A	1,311,645	728A	1,313,313	765A	1,315,109	834A	1,316,511	806A	1,318,164	908A	1,320,080	938A
1,310,087	647A	1,311,709	736A	1,313,323	709A	1,315,110	834A	1,316,560	818A	1,318,187	916A	1,320,094	953A
1,310,088	647A	1,311,711	685A	1,313,370	766A	1,315,137	834A	1,316,643	874A	1,318,254	926A	1,320,130	938A
1,310,109	644A	1,311,807	685A	1,313,379	718A	1,315,158	803A	1,316,670	805A	1,318,258	902A	1,320,160	927A
1,310,151	631A	1,311,824	696A	1,313,403	759A	1,315,183	818A	1,316,724	828A	1,318,335	951A	1,320,166	955A
1,310,152	614A	1,311,831	691A	1,313,407	730A	1,315,205	849A	1,316,726	868A	1,318,336	946A	1,320,167	941A
1,310,158	648A	1,311,848	712A	1,313,437	770A	1,315,206	827A	1,316,742	894A	1,318,338	961A	1,320,168	941A
1,310,164	621A	1,311,871	705A	1,313,459	743A	1,315,208	828A	1,316,755	819A	1,318,339	897A	1,320,172	949A
1,310,201	636A	1,311,872	742A	1,313,514	711A	1,315,216	834A	1,316,760	829A	1,318,362	965A	1,320,176	964A
1,310,292	636A	1,311,890	704A	1,313,557	789A	1,315,219	810A	1,316,761	829A	1,318,363	887A	1,320,211	945A
1,310,306	629A	1,311,909	698A	1,313,629	711A	1,315,229	847A	1,316,769	869A	1,318,385	887A	1,320,212	945A
1,310,309	643A	1,311,910	698A	1,313,650	742A	1,315,241	805A	1,316,770	810A	1,318,431	950A	1,320,284	911A
1,310,310	643A	1,311,964	689A	1,313,657	794A	1,315,250	818A	1,316,781	813A	1,318,432	946A	1,320,290	954A
1,310,341	643A	1,311,965	689A	1,313,658	759A	1,315,252	803A	1,316,791	848A	1,318,452	951A	1,320,309	911A
1,310,342	631A	1,311,980	714A	1,313,661	794A	1,315,254	821A	1,316,804	848A	1,318,464	955A	1,320,324	946A
1,310,360	636A	1,311,987	674A	1,313,698	752A	1,315,269	810A	1,316,808	898A	1,318,516	965A	1,320,340	936A
1,310,363	643A	1,312,019	671A	1,313,746	827A	1,315,282	804A	1,316,817	911A	1,318,523	948A	1,320,367	940A
1,310,381	642A	1,312,053	719A	1,313,761	830A	1,315,315	826A	1,316,823	813A	1,318,524	948A	1,320,387	951A
1,310,382	631A	1,312,069	687A	1,313,834	830A	1,315,324	848A	1,316,842	835A	1,318,533	914A	1,320,396	938A
1,310,383	631A	1,312,093	730A	1,313,876	709A	1,315,349	827A	1,316,848	814A	1,318,644	891A	1,320,443	943A
1,310,384	631A	1,312,094	736A	1,313,884	765A	1,315,354	818A	1,316,859	805A	1,318,657	941A	1,320,454	943A
1,310,413	630A	1,312,116	681A	1,313,885	765A	1,315,393	897A	1,316,860	805A	1,318,690	936A	1,320,483	950A
1,310,440	643A	1,312,119	676A	1,313,890	830A	1,315,460	805A	1,316,881	834A	1,318,698	926A	1,320,508	963A
1,310,450	643A	1,312,127	712A	1,313,894	778A	1,315,464	848A	1,316,913	836A	1,318,699	926A	1,320,569	938A
1,310,455	643A	1,312,144	689A	1,313,929	705A	1,315,468	826A	1,316,923	849A	1,318,702	951A	1,320,614	937A
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1,310,466	659A	1,312,173	674A	1,313,939	789A	1,315,496	861A	1,316,947	806A	1,318,748	950A	1,320,805	951A
1,310,478	629A	1,312,186	696A	1,313,970	780A	1,315,525	847A	1,316,950	817A	1,318,763	950A	1,320,974	944A
1,310,479	629A	1,312,218	706A	1,313,985	830A	1,315,530	805A	1,316,958	897A	1,318,764	950A	1,321,013	946A

GERMAN PATENTS.

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291,307	595A	306,688	531A	308,962	510A	309,936	306A	311,054	405A	311,989	950A	312,761	869A
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291,326	282A	306,772	146A	309,010	209A	309,951	354A	311,101	405A	312,016	938A	312,775	901A
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297,771	245A	306,818	131A	309,015	210A	309,974	497A	311,122	512A	312,023	752A	312,787	813A
298,200	298A	307,007	597A	309,016	210A	309,975	451A	311,128	449A	312,024	680A	312,788	868A
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298,682	223A	307,173	917A	309,035	231A	309,981	361A	311,148	440A	312,063	760A	312,825	953A
298,812	870A	307,174	951A	309,039	211A	309,987	385A	311,160	545A	312,077	779A	312,832	930A
298,861	890A	307,175	910A	309,084	209A	309,999	284A	311,173	576A	312,087	897A	312,855	937A
299,192	908A	307,341	189A	309,086	209A	310,213	339A	311,176	808A	312,090	915A	312,882	911A
299,603	893A	307,383	944A	309,087	645A	310,242	451A	311,196	468A	312,093	706A	312,900	887A
299,686	430A	307,393	19A	309,088	373A	310,250	508A	311,212	550A	312,098	696A	312,927	916A
300,012	908A	307,490	28A	309,094	246A	310,261	371A	311,217	510A	312,100	783A	312,933	886A
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300,193	910A	307,648	910A	309,271	908A	310,283	641A	311,234	462A	312,138	911A	312,947	911A
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300,732	908A	307,764	910A	309,276	832A	310,305	363A	311,268	636A	312,177	756A	312,955	871A
300,764	908A	307,791	859A	309,332	211A	310,309	331A	311,291	546A	312,178	756A	312,960	901A
301,211	866A	307,831	28A	309,343	246A	310,326	477A	311,294	531A	312,179	866A	312,994	887A
301,273	754A	307,849	20A	309,376	389A	310,352	488A	311,295	542A	312,201	754A	313,007	890A
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301,327	910A	307,893	28A	309,406	409A	310,364	495A	311,350	596A	312,213	863A	313,016	879A
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301,379	910A	308,014	150A	309,423	288A	310,387	378A	311,387	542A	312,221	794A	313,026	854A
301,611	892A	308,016	377A	309,446	302A	310,388	431A	311,390	531A	312,222	925A	313,046	879A
301,762	912A	308,047	28A	309,447	339A	310,404	374A	311,418	566A	312,230	905A	313,048	911A
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306,035	135A	308,754	24A	309,733	393A	310,875	417A	311,863	937A	312,643	740A	313,764	927A
306,324	875A	308,755	297A	309,758	292A	310,880	398A	311,883	701A	312,649	736A	313,788	887A
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306,426	951A	308,783	34A	309,808	278A	310,893	366A	311,895	961A	312,666	811A	313,821	854A
306,427	910A	308,785	37A	309,809	307A	310,925	404A	311,906	676A	312,671	890A	313,916	886A
306,492	892A	308,787	877A	309,832	377A	310,971	424A	311,916	910A	312,674	898A	313,970	965A
306,523	158A	308,839	37A	309,843	304A	310,982	489A	311,933	760A	312,685	819A	313,995	955A
306,539	77A	308,850	154A	309,850	279A	310,995	491A	311,958	682A	312,703	912A	314,014	887A
306,570	130A	308,874	366A	309,859	373A	311,020	504A	311,959	680A	312,729	891A	314,043	885A
306,600	77A	308,884	77A	309,911	379A	311,051	440A	311,960	765A	312,736	811A		
306,601	386A	308,909	284A	309,933	303A	311,053	450A	311,983	937A	312,744	876A		

List of Journals Abstracted, with Abbreviations Used, and Addresses of Publishers and Prices.

JOURNAL.	ABBREVIATION.	ADDRESS OF PUBLISHER AND PRICE.*
Agricultural Bulletin of the Federated Malay States	Agric, Bull. F.M.S. ..	Dept. of Agriculture, Kuala Lumpur, F.M.S. 1s. 3d.
Agricultural Journal of India	Agric. J. India ..	W. Thacker and Co., 2, Creed Lane, London. 3s.
Agricultural Ledger ..	Agric. Ledger	Reporter on Economic Products to the Government of India. Calcutta.
Agricultural Research Institute, Pusa, Report and Bulletins	Rep. (Bull.) Agric. Res. Inst., Pusa.	Supt. Govt. Printing, Calcutta. Price varies.
Allgemeine Zeitschrift für Bierbrauerei und Malzfabrikation	Allgem. Z. Bierbrau.	Michaelerstrasse 25, Vienna XVIII/1. Krone 12 per annum.
American Journal of Pharmacy.	Amer. J. Pharm. ..	145, North Tenth Street, Philadelphia, Pa., U.S.A. 30 cents.
American Journal of Science	Amer. J. Sci.	New Haven, Conn., U.S.A. 50 cents.
Anales de la Sociedad Española de Fisca y Quimica	Anal. Soc. Espan. Fis. Quim.	Calle de Nuñez de Balboa, núm. 21, Madrid. 15 pesetas per annum.
Anales de la Sociedad Quimica Argentina	Anal. Soc. Quim. Argentina	1790, Lavalle, Buenos Aires. 60 c.
Analyst	Analyst	Simpkin, Marshall, Hamilton, Kent, and Co., Ltd., 2, 4, 6, 8, Orange Street, London, S.W. 3s.
Annalen der Chemie	Annalen	C. F. Winter'sche Verlagshandlung, Leipzig, Germany. M. 32 per annum.
Annales de Chimie	Ann. Chim.	Imprimerie Gauthier-Villars et Cie., Quai des Grands-Augustins,55, Paris. 28 fr. per annum
Annales de ChimieAnalytique	Ann. Chim. Analyt. ..	M. Crinon, 20, Boulevard Richard-Lenoir, Paris, 1 fr. 50.
Annales des Falsifications..	Ann. Falsif.	56, Rue Madame, Paris, 6e. 3 fr.
Annali di Chimica Applicata	Annali Chim. Appl. ..	Via Panisperna N, 89b, Rome. Lire 34 per annum.
Annali della R. Stazione Chimico Agraria Sperimentale di Roma	Ann. R. Staz. Chim. Agrar. Sperim. Roma..	R. Stazione Chimico-Agraria Sperimentale di Roma, Rome.
Apotheker-Zeitung ..	Apoth-Zeit	Levetzowstrasse 16b, Berlin, N.W. 87. 25 Pf.
Archiv der Pharmazie ..	Arch. Pharm.	Selbstverlag des Deutschen Apotheker-Vereins, Berlin, Germany. M. 12 per annum.
Atti della Reale Accademia dei Lincei, Roma	Atti R. Accad. dei Lincei, Roma	Tipografia della R. Accademia dei Lincei, Rome. Lire 10 per annum.
Australasian Pharmaceutical Notes and News	Austr. Pharm. Notes and News	Elliott Bros., Ltd., O'Connell St., Sydney, N.S.W. 3d.
Berichte der Deutschen Chemischen Gesellschaft	Ber.	R. Friedländer und Sohn, Karlstrasse 11, Berlin, N.W. 6, Germany. M. 45 (7.50 dollars) per annum.
Berichte der Deutschen Pharmazeutischen Gesellschaft.	Ber. deuts. Pharm. Ges.	Verlag von Gebr. Bornträger, Berlin, W. 35, Schöneberger Ufer 12A, Germany. M. 20 per annum.
Berichte des Ohara Instituts für landwirtschaftliche Forschungen	Ber. Ohara Inst. landw. Forsch.	Verlag der Ohara Schionokai Kuraschiki Provinz Okayama. 1 yen.
Biedermann's Zentralblatt für Agrikultur Chemie	Biedermann's Zentr. ..	O. Leiner, Königstrasse 26B, Leipzig, Germany. M. 30 per annum.
Biochemical Journal ..	Biochem. J.	Cambridge University Press, Fetter Lane, London, E.C. 10s. 6d.
Biochemische Zeitschrift ..	Biochem. Zeits. ..	Verlag von J. Springer, Berlin, W. 9, Linkstrasse 23-24. M. 22 per volume.
Blast-Furnace and Steel Plant	Blast - Furnace and Steel Plant	Thaw Building, 108, Smithfield St., Pittsburgh, U.S.A. 15 cents.
Board of Trade Journal ..	Bd. of Trade J... ..	Messrs. Wyman and Sons, Fetter Lane, London, E.C. 6d.
Bollettino Chimico Farmaceutico	Boll. Chim. Farm. ..	Via Cappucio, 19, Milan, Italy. 60 cents.
Brewers' Journal	Brewers' J.	F. W. Lyon, Eastcheap Buildings, Eastcheap, London, E.C. 3. 3s.
British and Colonial Pharmacist.	Brit. and Col. Pharm.	194-200, Bishopsgate, London, E.C. 1s.
Bulletin de l'Association Chimique de Sucre et de Distillerie .	Bull. Assoc. Chim. Sucr.	156, Boulevard Magenta, Paris, 10e, France. 4 fr.
Bulletin of Agricultural Intelligence and of Plant Diseases	Bull. Agric. Intell. ..	International Institute of Agriculture, Rome. 18 fr. per annum.

* The price for single copies is given where these are sold separately. In other cases it is only possible to buy the Journals in question in complete volumes. For many of the German and Austrian Journals special prices are charged to foreign purchasers.

JOURNAL.	ABBREVIATION.	ADDRESS OF PUBLISHER AND PRICE.
Bulletin of the Forest Experiment Station, Meguro, Tokyo	Bull. Forest Exp. Stat., Meguro	Bureau of Forestry, Dept. of Agriculture and Commerce, Tokyo.
Bulletin of the Kentucky Agricultural Experiment Station	Bull. Kentucky Agric. Exp. Stat.	University of Kentucky, Lexington, Ky., U.S.A.
Bulletin of the School of Mines and Metallurgy, University of Missouri	Bull. School Mines and Met., Univ. Missouri	Director of Mining Experiment Station, Rolla, Mo., U.S.A.
Bulletin de la Société Chimique de Belgique	Bull. Soc. Chim. Belg.	M. J. Wauters, Palais du Midi (Galerie du Travail 7), Brussels.
Bulletin de la Société Chimique de France	Bull. Soc. Chim. ..	Masson et Cie., 120, Boulevard Saint-Germain, Paris, 6e. 35 fr. per annum.
Bulletin de la Société Française de Photographie	Bull. Soc. Franc. Phot.	51, Rue de Clichy, Paris, 9e. 1 fr. 50.
Bulletin de la Société Industrielle du Nord de la France	Bull. Soc. Ind. Nord..	Rue de l'Hôpital Militaire 116, Lille, France.
Bulletin de la Société Industrielle de Mulhouse	Bull. Soc. Ind. Mulhouse	Berger-Levrault et Cie., 5, Rue des Beaux-Arts, Paris. 60 fr. per annum.
Bulletin de la Société d'Encouragement pour l'Industrie Nationale	Bull. Soc. d'Encour ..	Secrétariat, Rue de Rennes 44, Paris, France. 36 fr. per annum.
Canadian Chemical Journal	Canad. Chem. J. ..	Biggar Press, Ltd., 540-541, Confederation Life Building Toronto. 20 cents.
Le Caoutchouc et la Gutta-Percha	Caoutchouc et Gutta-Percha	A. D. Cillard fils, 49, Rue des Vinaigriers, Paris, X. 36fr. per annum.
Chamber of Commerce Journal	Ch. of Comm. J. ..	Oxford Court, Cannon Street, London, E.C. 1s.
Chemical and Metallurgical Engineering	Chem. and Met. Eng.	McGraw-Hill Co., 10th Avenue at 36th Street, New York. 20 cents.
Chemical News	Chem. News	E. J. Davey, 16, Newcastle Street, Farringdon Street, London. E.C. 4d.
Chemical Trade Journal ..	Chem. Trade J. ..	Davis Bros., Danes Inn House, 265, Strand, London, W.C. 6d.
Chemiker-Zeitung	Chem.-Zeit	Dr. W. Roth, Cöthen, Anhalt, Germany. M. 12 per quarter.
Chemisch Weekblad	Chem. Weekblad ..	D. B. Centen, O.Z. Voorburgwal 115, Amsterdam. 0.25 fr.
Chemische Industrie ..	Chem. Ind.	Weidmann'sche Buchhandlung, Zimmerstrasse, 94, Berlin, S.W., Germany. M. 20 per annum.
Chemische Umschau auf dem Gebiete der Fette, Oele, Wachse, und Harze	Chem. Umschau ..	Verlag der Chemischen Umschau, Friedrichstrasse 4, Stuttgart. M. 2.
Chemische Zeitschrift ..	Chem. Zeitschr. ..	E. Buntrock, Berlin, S.W. 68.
Chemisches Zentralblatt ..	Chem. Zentr.	R. Friedländer und Sohn, Karlstrasse 11, Berlin, N.W. 6, Germany. M. 40 per vol.
Chemist and Druggist ..	Chem. and Drug. ..	42, Cannon Street, London, E.C. 9d.
Chimie et Industrie	Chim. et Ind.	49, Rue des Mathurins, Paris. 5 fr.
Collegium	Collegium	K. Schorlemmer, Sebastian-Munster-Strasse 28, Worms am Rhein, Germany. 2s.
Communications of the Netherlands Government Institute for advising the Rubber Trade and Rubber Industry	Comm. Netherlands Govt. Inst. for advising Rubber Trade	
Comptes-Rendus hebdomadaires des Séances de l'Académie des Sciences	Comptes rend.	Imprimerie Gauthier-Villars, Quai des Grands Augustins 55, Paris. 90 fr. per annum.
Comptes-Rendus des Travaux de Laboratoire de Carlsberg	Comptes-rend. Trav. Lab. Carlsberg	H. Hagerup, Copenhagen Price varies.
Deutsche Zuckerindustrie ..	Deuts. Zuckerind. ..	Verlag der Gesellschaft, Die Deuts. Zuckerindustrie, Berlin. M. 24 per annum.
Elektrochemische Zeitschrift	Elektrochem. Zeits. ..	Viet u. Co., Marienstrasse 18, Leipzig. M. 1.50.
Engineering	Engineering	C. R. Johnson, 35 and 36, Bedford Street, Strand, London, W.C. 9d.
Engineering and Mining Journal	Eng. and Min. J. ..	McGraw-Hill Publishing Co., 10th Avenue at 36th Street, New York City. 20 cents.
Färber-Zeitung	Färber-Zeit	Julius Springer, Linkstrasse 23-24, Berlin, W. Germany. M. 4.60 per quarter.
Ferrum	Ferrum	W. Knapp, Mühlweg 19, Halle on Saale, Germany. M. 22 per annum.
Feuerungstechnik	Feuerungstechn. ..	O. Spamer, Täubchenweg 26, Leipzig-R., Germany. M. 6.20 per annum.
Gas Journal	Gas J.	W. King, 11, Bolt Court, Fleet Street, London, E.C. 8d.
Gas World	Gas World	8, Bouverie Street, E.C. 4. 8d.
Gazzetta Chimica Italiana..	Gazz. Chim. Ital. ..	La Direzione della "Gázzetta Chimica," Via Panisperna. 89, Rome. Lire 4.
Gerber	Gerber..	VI/1 Gumpendorferstrasse 89, Wien, Austria. Kr.17.50 per annum.

JOURNAL.	ABBREVIATION.	ADDRESS OF PUBLISHER AND PRICE.
Gesammte Abhandlungen zur Kenntnis der Kohle	Ges. Abhandl. Kenntn. Kohle	
Gummi-Zeitung	Gummi-Zeit.	Geschäftsstelle der "Gummi-Zeitung," Krausenstrasse 35/36, Berlin, S.W. 19, Germany. M. 8 per quarter.
Helvetica Chimica Acta ..	Helv. Chim. Acta ..	Georg & Co., 10, Freiestrasse, Basel. 25 fr. per annum.
Imperial Institute Bulletin..	Bull. Imp. Inst. ..	John Murray, Albemarle Street, London, W. 2s. 6d.
India-Rubber Journal ..	India-Rubber J. ..	Maclaren and Sons, 37 and 38, Shoe Lane, London, E.C. 4d.
International Sugar Journal	Int. Sugar J.	2, St. Dunstan's Hill, London, E.C. 1s. 4d.
Internationale Zeitschrift für Metallographie	Internat. Z. Metallog.	Gebr. Borntträger, Schöneberger Ufer 12a, Berlin, W.35. M. 40 per annum.
Journal of Agricultural Research	J. Agric. Res. ..	U.S. Department of Agriculture, Washington, D.C., U.S.A. Price varies.
Journal of Agricultural Science	J. Agric. Sci.	University Press, Cambridge. 5s.
Journal of the American Ceramic Society	J. Amer. Ceram. Soc.	211, Church Street, Easton, Pa., U.S.A. 60 cents.
Journal of the American Chemical Society	J. Amer. Chem. Soc.	C. L. Parsons, 1709, G. Street, N.W. Washington, D.C., U.S.A. 60 cents.
Journal of the American Institute of Metals	J. Amer. Inst. Metals	10, Depot Street, Concord, N.H., U.S.A. $3.
Journal of the American Leather Chemists' Association	J. Amer. Leather Chem. Assoc.	American Leather Chemists' Assoc., Ridgeway, Pa., U.S.A. 50 cents.
Journal of the Association of Official Agricultural Chemists	J. Assoc. Off. Agric. Chem.	Williams and Wilkins Co., Baltimore, U.S.A., and Cambridge University Press, Fetter Lane, London, E.C. $5 per annum.
Journal of Biological Chemistry	J. Biol. Chem. ..	Rockefeller Inst. for Medical Research, Mount Royal and Guildford Avenues, Baltimore, Md., U.S.A. $3.25 per vol.
Journal of the Board of Agriculture	J. Bd. Agric. ..	Board of Agriculture and Fisheries, 3, St. James's Square, London, S.W. 4d.
Journal of the Chemical Society of London, Transactions	Chem. Soc. Trans. ..	Gurney and Jackson, 33, Paternoster Row, London, E.C. 5s.
Journal of the Chemical, Metallurgical, and Mining Society of South Africa	J. Chem. Met. Soc., S Africa	F. Rowland, Old Municipal Buildings, De Villiers Street, Johannesburg. 3s.
Journal de Chimie Physique	J. Chim. Phys. ..	Gauthier-Villars, 55, Quai des Grands Augustins, Paris. 25 fr. per annum; the price of a single copy varies according to the size.
Journal of the College of Agriculture, Tokyo Imperial University, Japan	J. Coll. Agric., Tokyo	Director of the College of Agriculture, Tokyo Imperial University, Japan. Price varies.
Journal of the College of Engineering, University of Tokyo	J. Coll. Eng., Tokyo	The University, Tokyo.
Journal of the College of Science, Imperial University of Tokyo	J. Coll. Science, Tokyo	Director of the College of Science, Tokyo Imperial University, Japan. Price varies.
Journal of the Franklin Institute	J. Franklin Inst. ..	The Actuary, The Franklin Institute, Philadelphia, Pa. U.S.A. 50 cents.
Journal für Gasbeleuchtung und Wasserversorgung	J. Gasbeleucht. ..	R. Oldenbourg, Gluckstrasse 8, München, Germany. M. 24 per annum.
Journal of Industrial and Engineering Chemistry	J. Ind. Eng. Chem. ..	C. L. Parsons, 1709, G. Street, N.W., Washington, D.C., U.S.A. 60cents.
Journal of the Institute of Brewing	J. Inst. Brewing ..	Harrison and Sons, 45, Pall Mall, London, W. 4s.
Journal of the Institution of Mechanical Engineers	J. Inst. Mech. Eng. ..	Storey's Gate, Westminster, S.W.
Journal of the Institution of Petroleum Technologists	J. Inst. Petroleum Tech.	The Institution, 5, John Street, Adelphi, Strand, W.C. 2. 7s. 6d.
Journal für Landwirtschaft	J. Landwirts.	P. Parey, Hedemannstrasse 10 u. 11, Berlin, S.W. 11. M. 14 per vol.
Journal of Physical Chemistry	J. Phys. Chem. ..	W. D. Bancroft, Ithaca, N.Y., U.S.A. $4 per annum.
Journal de Pharmacie et de Chimie	J. Pharm. Chim. ..	O. Doin et fils, Place de l'Odéon, Paris, 8. 20 fr. per annum.
Journal für praktische Chemie	J. prakt. Chem. ..	J. A. Barth, Dörrienstr. 16, Leipzig, Germany. M. 26.50 per annum.
Journal and Proceedings of the Royal Society of New South Wales	J. Proc. Roy. Soc. N.S.W.	5, Elizabeth Street, Sydney, N.S.W. 10s. 6d. per vol.
Journal of the Royal Society of Arts	J. Soc. Arts	G. Bell and Sons, York House, Portugal Street, London, W.C. 2. 6d.
Journal of the Russian Physical-chemical Society.	J. Russ. phys.-chem. Soc.	Laboratoire de Chimie, Université Impériale, Petrograd, Russia. R. 1.50.
Journal of the Society of Dyers and Colourists	J. Soc. Dyers and Col.	Pearl Assurance Buildings, Market Street, Bradford, Yorks. 2s.

JOURNAL.	ABBREVIATION.	ADDRESS OF PUBLISHER AND PRICE.
Journal of the Society of Glass Technology	J. Soc. Glass Technol.	Dr. W. E. S. Turner, The University, Sheffield. 10s. 6d.
Journal of the Society of Leather Trades' Chemists	J. Soc. Leather Trades' Chem.	W. R. Atkins, M.Sc., The University, Leeds. 2s.
Journal of the South African Association of Analytical Chemists	J. S. Afr. Assoc. Anal. Chem.	Box 5254, Johannesburg. 2s.
Journal of the Textile Institute	J. Text. Inst.	J. D. Athey, 16, St. Mary's Parsonage, Manchester. 3s.
Journal of the Washington Academy of Sciences	J. Wash. Acad. Sci...	211, Church Street, Easton, Pa., U.S.A. 25 cents; 50 cents for July, Aug. and Sept. numbers.
Kogyo-Kwagaku-Zasshi (Journal of Chemical Industry, Japan)	Kogyo-Kwagaku-Zasshi (J. Chem. Ind. Japan)	Kogyo-Kwagaku-Kwai, Iidamachi, Kojimachi-ku, Tokyo. 5 yen. (10s. 3d.) per annum.
Kolloid-Zeitschrift	Kolloid-Zeits.	T. Steinkopff, Residenzstrasse 12B., Dresden-Blasewitz, Germany. M. 24 per vol.
Landwirtschaftlichen Versuchs Stationen, Die	Landw. Vers.-Stat. ..	P. Parey, Hedemannstr. 10 & 11, Berlin, S.W. 11. M. 16 per vol.
L'Industria Chimica ..	L'Ind. Chimica ..	Associazione Chimica Industriale, Via Roma 28 (Galleria Nazionale Scala A), Turin, Italy. Lira 2
Mededeelingen van het Central Rubberstation	Mededeel. Centr. Rubberstat.	
Memoires et Compte Rendu des Travaux de la Société des Ingénieurs Civils de France	Mem. Compt. rend. Soc. Ing. Civils de France	19, Rue Blanche, Paris.
Memoirs of the College of Science and Engineering, Kyoto Imperial University	Mem. Coll. Sci. and Eng. Kyoto	Maruzen Co., Ltd., Tokyo, Japan. Price varies.
Memoirs of the Department of Agriculture in India	Mem. Dept. Agric. India	W. Thacker and Co., 2, Creed Lane, London. Price varies.
Mémoriale des Poudres et Salpêtres	Mém. Poudres et Salpêtres	Gauthier-Villars, 55, Quai des Grands Augustins, Paris. 2 fr.
Metall und Erz	Metall u. Erz ..	W. Knapp, Mühlweg 19, Halle on Salle, Germany. M. 6 per quarter.
Milchwirtschaftliches Zentralblatt	Milchw. Zentr. ..	M. and H. Schaper, Hanover. M. 12.60 per half-year.
Mittheilungen aus dem königlichen Materialprüfungsamt zu Gross-Lichterfelde West	Mitt. k. Materialprüf.	Julius Springer, Linkstrasse 23-24, Berlin, W. 9, Germany. M. 16 per annum.
Mittheilungen aus der Centralstelle für wissenschaftlich - technische Untersuchungen	Mitt. Centralst. Wiss.-techn. Unters.	Prof. Dr. W. Will, Neu-Babelsberg, bei Berlin, Germany.
Mittheilungen des k.k. Technischen Versuchsamtes	Mitt. k.k. Techn. Versuchsamtes	Verlag der k.k. Hof- und Staatsdruckerei, Wien, Austria.
Monatshefte für Chemie und verwandte Teile anderer Wissenschaften	Monatsh. Chem.	A. Hölder, Rothenthurmstrasse 25, Wien I, Austria. Kr. 16 per annum.
Moniteur Scientifique ..	Monit. Scient.	Dr. G. Quesneville, 12, rue de Buci, Faubourg St. Germain, Paris. 2 fr, 25.
Monthly Bulletin of the Canadian Mining Institute	Bull. Canad. Min. Inst.	3-504, Drummond Building, Montreal.
New Zealand Journal of Science and Technology	N.Z.J. Sci. and Technol	The Director, Dominion Museum, Wellington, N.Z. 1s. 6d.
Oesterreichische Chemiker-Zeitung	Oesterr. Chem.-Zeit. ..	Pestalozzigasse 6, Vienna 1. 1.50 kr.
Oesterreichische Zeitschrift für Berg- und Hüttenwesen	Oesterr. Z. Berg- u. Hüttenw.	Kohlmarkt 20, Wien I, Austria. Kr. 28 per annum.
Oil, Paint, and Drug Reporter	Oil, Paint, and Drug Rep.	100, William Street, New York City, U.S.A. $5 per annum U.S.A., $6 Canada, $7 other countries.
Paper	Paper	471, Fourth Avenue, New York. 25 cents.
Papier-Fabrikant	Papierfabr.	Otto Elsner, Oranienstr. 140-142, Berlin, S. 42. 50 Pf.
Perfumery and Essential Oil Record	Perf. and Ess. Oil Rec.	6, Serle Street, London, W.C. 1s.
Petroleum (Berlin)	Petroleum (Berlin) ..	Verlag für Fachtliteratur, Motzstrasse 8 Berlin, W. 30. M. 1.50.
Petroleum (Chicago) ..	Petroleum (Chicago) ..	28, East Jackson Boulevard, Chicago. U.S.A. 15 cents.
Pharmaceutical Journal ..	Pharm. J.	150, Holborn, London, E.C. 6d.
Pharmaceutisch Weekblad ..	Pharm. Weeklad ..	D. B. Centen, O.Z. Voorburgwal 115, Amsterdam. 15 fr. per annum.
Pharmazeutische-Zeitung ..	Pharm.-Zeit.	Linkstrasse 23-24, Berlin, W. 9. 35 Pf.
Pharmazeutische Zentralhalle	Pharm. Zentralh. ..	Dr. A. Schneide, Schandauer Strasse 43, Dresden A. 21. 30 Pf.

JOURNAL.	ABBREVIATION.	ADDRESS OF PUBLISHER AND PRICE.
Philippine Journal of Science	Philippine J. Sci. ..	Bureau of Science, Manila, Philippine Islands. 50 cents.
Philosophical Magazine and Journal of Science	Phil. Mag.	Taylor and Francis, Red Lion Court, Fleet Street, London, E.C. 2s. 6d.
Photographic Journal ..	Phot. J.	Harrison and Sons, 44–47, St. Martin's Lane, W.C. 2. 1s.
Proceedings of the American Society of Civil Engineers	Proc. Amer. Soc. Civ. Eng.	220, West 57th Street, New York City, U.S.A. $8 per annum.
Proceedings of American Society for Testing Materials	Proc. Amer. Soc. Testing Materials	McGraw Hill Book Co., 239 W. 39th Street, New York. $5 per annum.
Proceedings of American Wood Preservers' Association	Proc. Amer. Wood Preservers Assoc.	F. J. Angier, Mt. Royal Station, Baltimore, Md., U.S.A. $2.50 per annum.
Proceedings of the Australasian Institute of Mining Engineers	Proc. Austral. Inst. Min. Eng.	57-59, Swanston Street, Melbourne, Victoria, Australia.
Proceedings of British Foundrymen's Association	Proc. Brit. Foundrymen's Assoc.	165, Strand, W.C.
Proceedings of the Engineers' Society of Western Pennsylvania	Proc. Eng. Soc. W. Pa.	2511, 568, Union Arcade Building, Pittsburgh, Pa., U.S.A. 50 cents.
Proceedings of the Faraday Society	Proc. Faraday Soc. ..	The Secretary, 10, Essex St., Strand, W.C.2.
Proceedings of the Institution of Civil Engineers	Proc. Inst. Civ. Eng...	The Secretary, Great George Street, London, S.W.
Proceedings of the Institution of Mining and Metallurgy	Proc. Inst. Min. and Met.	1, Finsbury Circus, London, E.C. 21s. per annum.
Proceedings of Koninklijke Akademie van Wetenschappen te Amsterdam	Proc. K. Akad. Wetensch. Amsterdam.	J. Muller, Amsterdam.
Proceedings of the Royal Society	Roy. Soc. Proc. ..	Harrison and Sons, 45, St. Martin's Lane, London, W.C. Price varies
Proceedings and Transactions of Nova Scotian Institute of Science	Proc. and Trans. Nova Scotian Inst. Sci.	Halifax, Nova Scotia. 50 cents.
Pulp and Paper Magazine..	Pulp and Paper Mag...	Industrial and Educational Press, Ltd., Garden City Press St. Anne de Bellevue, Canada. 15 cents.
Recueil des Travaux Chimiques de Pays-Bas	Rec. Trav. Chim.	A. W. Sijthoff, Leiden, Holland. 16 fl. per volume.
Revue Générale des Matières Colorantes	Rev. Gén. Mat. Col..	L. Lefevre, 4, rue de Stockholm, Gare St. Lazare, Paris, France. 3 fr.
Revue de Métallurgie ..	Rev. Mét.	H. Dunot and E. Pinat, 49, Quai des Grands Augustins, Paris. 7 fr. 50.
School of Mines Quarterly..	Sch. Mines Quart. ..	T. H. Harrington, Columbia University, New York. 50 cents.
Schweizerische Chemiker-Zeitung	Schweiz. Chem.-Zeit	Rascher & Co., Rathausquai 20, Zürich 1, Switzerland. 1.20 fr.
Science Reports of Tohoku Imperial University	Sci. Reports, Tohoku Imp. Univ.	The Maruzen Co., Ltd., Tokyo, Japan. Price varies.
Scientific American	Scient. Amer.	233, Broadway, New York City, U.S.A. 10 cents.
Scientific Proceedings of the Royal Dublin Society	Scient. Proc. Roy. Dublin Soc.	Leinster House, Dublin. Price varies.
Silikat-Zeitschrift	Silikat-Zeits.	Verlag von Müller und Schmidt, Coburg, Germany. M. 12 per annum.
Sitzungsberichte der Königlichen Preussischen Akademie der Wissenschaften	Sitzungsber. Kgl. Preuss. Akad. Wiss.	Verlag der Königlichen Akademie der Wissenschaften, Berlin. M. 12 per annum.
Soil Science	Soil Sci.	Williams & Wilkins Co., 2419-2421, Greenmount Avenue, Baltimore, U.S.A.; Cambridge University Press, Fetter Lane, London, E.C. 50 cents.
South African Journal of Industries	S. African J. Ind. ..	Government Printer, Box 373, Pretoria. 6d.
Sprechsaal	Sprechsaal	Verlag von Müller und Schmidt, Coburg, Germany. 5s. per quarter.
Stahl und Eisen	Stahl u. Eisen ..	Breitestr. 27, Düsseldorf 74, Germany. M. 18 per half-year.
Teknisk Tidskrift	Tekn. Tidsk.	Jakobsg. 19, Stockholm, 16, Sweden.
Tonindustrie-Zeitung ..	Tonind.-Zeit.	Dreysestrasse 4, Berlin, N.W. 21, Germany. M. 20 per annum.
Transactions of the American Electrochemical Society	Trans. Amer. Elect-chem. Soc.	Lehigh University, South Bethlehem, Pa., U.S.A. $3 per vol.
Transactions of the American Foundrymen's Association	Trans. Amer. Foundrymen's Assoc.	R. Moldenke, Watchung, N.J., U.S.A.
Transactions of the American Institute of Chemical Engineers	Tr. Amer. Inst. Chem Eng.	D. Van Nostrand Co., New York, and F. and N. Spon, Ltd. London.
Transactions of the Ceramic Society	Trans. Ceram. Soc. ..	County Pottery Laboratory, Stoke-on-Trent, Staffordshire. 45s. per annum.
Transactions of the Institute of Metals	Trans. Inst. Metals ..	Institute of Metals, 36, Victoria Street, Westminster, London, S.W.

JOURNAL.	ABBREVIATION.	ADDRESS OF PUBLISHER AND PRICE.
Transactions of the Iron and Steel Institute	Trans. Iron and Steel Inst.	28, Victoria Street, London, S.W.
Transactions of the North of England Institute of Mining and Mechanical Engineers	Tr. N. Eng. Inst. Min. and Mech. Eng.	Newcastle-on-Tyne.
Transactions of the Royal Society of Canada	Trans. Roy. Soc. Canada	J. Hope & Son, Ottawa ; B. Quaritch, London. Price 50 cents.
Tropenpflanzer	Tropenpflanzer ..	Pariser Platz, 7, Berlin, N.W., Germany. M. 15 per annum.
United States Bureau of Mines, Bulletins and Technical Papers	U.S. Bureau of Mines, Bull. & Tech. Papers	Bureau of Mines, Washington, D.C., U.S.A. Price varies.
United States Bureau of Standards, Bulletins and Technological Papers	U.S. Bureau of Standards, Bull. and Technol. Papers	Superintendent of Documents, Washington, D.C., U.S.A. Price varies.
United States Commerce Reports, Daily Consular and Trade Reports	U.S. Comm. Rept. ..	Superintendent of Documents, Washington, D.C., U.S.A. $2.50 per annum.
United States Department of Agriculture Bulletins	Bull. U.S. Dept. Agric.	Department of Agriculture, Washington, D.C., U.S.A. Price varies.
Wasser und Gas	Wasser u. Gas	G. Stalling, Oldenburg i. Gr., Germany.
West Indian Bulletin ..	West Ind. Bull. ..	Imperial Dept. of Agriculture, Barbados, W.I. 6d.
Wochenblatt für Papierfabrikation	Wochenbl. Papierfabr.	Günther-Staib in Biberach a. d. Riss, Würtemberg, Germany. 50 Pf.
Wochenschrift für Brauerei	Woch. Brau.	P. Parey, Hedemannstrasse 10, Berlin, S.W., Germany. M. 40 per annum.
Zeitschrift der analytischen Chemie	Z. anal. Chem. .. .	C. W. Kreidel's Verlag, Wiesbaden, Germany. M. 2.
Zeitschrift für angewandte Chemie	Z. angew. Chem. ..	Verlag von Otto Spamer, Nürnberger Strasse 48, Leipzig, Germany. M. 60 per annum.
Zeitschrift der anorganischen Chemie	Z. anorg. Chem. ..	Verlag von L. Voss, Leipzig, Germany. M. 12 per vol.
Zeitschrift des Vereins der deutschen Zucker-Industrie	Z. Ver. deut. Zuckerind.	Vereins-Direktorium, Kleistrasse 32, Berlin, W. 62, Germany. M. 45 per annum.
Zeitschrift für das gesammte Brauwesen	Z. ges. Brauw. ..	R. Oldenbourg, Glückstrasse 8, München, Germany. M. 20 per annum.
Zeitschrift für das gesammte Schiess- und Sprengstoffwesen	Z. ges. Schiess- u. Sprengstoffw.	J. F. Lehmann, Paul Heysestrasse 26, München, Germany. M. 1.
Zeitschrift für Elektrochemie und angewandte physikalische Chemie	Z. Elektrochem. ..	W. Knapp, Mühlweg 19, Halle a.S., Germany. M. 12·5 per quarter
Zeitschrift für Farben-Industrie	Z. Farben-Ind. ..	Verlag für Textil-Industrie, Kottbuser Ufer 39-40, Berlin, S.O. 26, Germany. M. 1.
Zeitschrift für Instrumentenkunde	Z. Instrumentenk. ..	J. Springer, Linkstrasse 23-24, Berlin, W. 9. M 28 per annum.
Zeitschrift für öffentliche Chemie	Z. öffentl. Chem. ..	A. Kell's Buchhandlung, Marktstrasse 15, Plauen i. V., Germany. M. 1.
Zeitschrift für physikalische Chemie	Z. physik. Chem. ..	W. Engelmann, Mittelstrasse 2, Leipzig, Germany. M. 24 per volume.
Zeitschrift für physiologische Chemie	Z. physiol. Chem. ..	Verlag von K. J. Trübner, Strassburg, Germany. M 18 per vol.
Zeitschrift für Spiritusindustrie	Z. Spiritusind. ..	P. Parey, Hedemannstrasse 10, Berlin, S.W., Germany. M. 30. per annum.
Zeitschrift für Untersuchung der Nahrungs- und Genussmittel	Z Unters Nahr. Genussm.	Julius Springer, Linkstrasse 23-24, Berlin, W 9, Germany. M. 36 per vol.
Zeitschrift für wissenschaftliche Photographie, Photophysik, und Photochemie	Z. wiss. Phot. ..	J. A. Barth, Dörrienstr., 16, Leipzig. M. 30 per vol.
Zeitschrift für Zuckerindustrie in Böhmen	Z. Zuckerind. Böhm..	Die Administration, Havlikovo Nam, Nr.32, Prag II, Bohemia. M. 17.20 per annum.

List of Errata, 1919.

No. of Journal.	Page.	Column.	Line from top.	Line from bottom.	Corrigenda.
No. 1—Jan. 15 ..	21A	2	—	12 and 15	*For* "thumbergii" *read* "thunbergii."
" " ..	27A	1	—	6	*For* "Kressler" *read* "Koessler."
No. 4—Feb. 28 ..	41T	1	—	—	Replace diagrams by those printed on p. 56T.
No. 8—Apr. 30 ..	102T	2	—	25	*For* "insoluble" *read* "soluble."
No. 9—May 15 ..	276A	2	—	6	*Delete* "States."
" " ..	302A	1	13	—	*For* "Alsberg" *read* "Alsberg."
No. 10—May 31 ..	325A	1	2	—	*For* "Wester" *read* "Webster."
No. 11—June 16 ..	202R	1	37	—	*For* "on coming to Canada acted as" *read* "eventually became."
" " ..	366A	1	31	—	*For* "Reckord" *read* "Rekord."
No. 12—June 30 ..	404A	1	9	—	*For* "Sternan" *read* "Sternau."
" " ..	419A	1	6	—	*For* "Wardson" *read* "Davidson."
" " ..	430A	2	—	28	*For* "Coblenzl" *read* "Cobenzl."
No. 13—July 15 ..	256R	2	—	32	*For* "pyrites" *read* "barytes."
No. 14—July 31 ..	498A	1	21	—	*For* "sodium hydroxide, 100, bromine, 25 grms.," *read* "sodium hydroxide, 100 grms., bromine, 25 c.c."
No. 16—Aug. 30 ..	567A	2	13	—	*For* "Forward" *read* "Forwood."
" " ..	574A	1	32	—	*Delete* "5%."
" " ..	574A	1	37	—	*For* "persulphate" *read* "perchlorate."
No. 17—Sept. 15 ..	632A	1	8	—	*For* "N. S. Williams" *read* "W. S. Williams."
" " ..	635A	1	—	7	*For* "Flecke" *read* "Fleck."
" " ..	656A	1	—	7	*For* "terpene" *read* "terpin."
" " ..	660A	1	6	—	*For* "1,309,558" *read* "1,309,588."
No. 18—Sept. 30 ..	684A	1	24	—	*For* "sodium chloride" *read* "potassium iodide."
" " ..	689A	1	30	—	*For* "Edwards" *read* "Edwardes."
No. 19—Oct. 15 ..	728A	1	2	—	*For* "Ractcliffe" *read* "Ractliffe."
" " ..	741A	1	—	8	*For* "Caron" *read* "Carron."
" " ..	751A	2	34	1	*For* "621A" *read* "612A."
No. 20—Oct. 31 ..	395R	1	—	26	*For* "Meyers" *read* "Meiers."
" " ..	369T	1	—	15	*For* "W_{10}" *read* "W/w."
" " ..	369T	2	—	—	*In denominator of equation for* "O_2" *read* "CO_2."
" " ..	778A	1	—	3	*For* "R. F. Sarron" *read* "P. F. Sarron."
" " ..	781A	1	—	14	*For* "412136" *read* "312136."
No. 21—Nov. 15 ..	827A	1	—	33	*For* "16.8.19" *read* "16.8.18."
" " ..	829A	2	13	—	*Line should read:* "*Electrolytic cell.* H. C. Jenkins, and The East."
No. 22—Nov. 29 ..	855A	1	14	—	*For* "621A" *read* "612A."
No. 23—Dec. 15 ..	895A	2	8	—	*For* "Haertling" *read* "Haerting."
" " ..	907A	2	—	28	*For* "O. N. Schuette" *read* "C. N. Schuette."
" " ..	912A	1	8 and 24	—	*For* "Schoeld" *read* "Shoeld."
No. 24—Dec. 31 ..	486R	1	39-40	—	*Read* "indigotin."
" " ..	949A	2	—	29	*For* "Menglar" *read* "Mengler."

The Society of Chemical Industry.

Founded 1881. Incorporated by Royal Charter 1907.

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1912. ABEGG, DR. FRITZ, 132 High Street, Perth Amboy, N.J., U.S.A., Chemist.

1919. ABEL, JAMES G., 34 Gilbert Road, Bucksburn, Aberdeenshire, Chemist.

1919. ABERNETHY, CHARLES L., North British Rubber Co., Castle Mills, Edinburgh, Research Physicist.

1903. ABRAHAM, HERBERT, 316 West 79th Street, New York City, U.S.A., Chemist.

1909. ACHESON, DR. EDWARD G., 35 West 42nd Street, New York City, U.S.A., President, Acheson Oildag Co.

1902. ACKER, CHAS. E., 80 Main Street, Ossining, N.Y., U.S.A., Manufacturer.

1918. ACLAND, T. W. GULL, 19 Bryanston Square, London, W. 1, Research Chemist.

1918. ACTON, JOHN, 28 Park Road, Port Sunlight, Cheshire, Chemist.

1911. ACTON, LEONARD T., c/o Wm. Davies Co., Ltd., 521 Front Street East, Toronto, Canada, Chemist.

1913. ACTON, WALTER, Mossvale Cottage, Greenock Road, Paisley, Scotland, Works Manager and Chemist.

1916. ADAM, ALASTAIR T., 14 Links Place, Musselburgh, Scotland, Metallurgical Chemist.

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1916. ADAM, WILLIAM G., Tar and Ammonia Products Works, Beckton, London, E., Chemical Engineer.

1892. ADAMS, ARTHUR P., Kelvin House, Edgbaston Road, Smethwick, near Birmingham, Science Lecturer.

1916. ADAMS, CHAS. A., Government Laboratory, Clement's Inn Passage, Strand, London, W.C. 2, Analytical Chemist.

1911. ADAMS, E. BRYAN, 33 Cleveland Road, Crumpsall, Manchester, Chemist.

1897. ADAMS, THOS. H., 7 Douglas Street, Derby, Analyst.

1895. ADAMSON, G. P., The Baker and Adamson Chemical Co., Easton, Pa., U.S.A., Manufacturing Chemist.

1917. ADAMSON, JOHN, Greenways, Dundonald Drive, Leigh-on-Sea, Essex, Works Chemist.

1919. ADAN, DR. ROBERT, 4 Korte Meir, Ghent, Belgium, Doctor of Science.

1917. ADCOCK, MONTAGUE F., Belmont, Park Road, Smethwick, Birmingham, Works Manager.

1891. ADCOCK, S. R., Fairfield, Eccleston Park, Prescot, Lancs, Analytical Chemist.

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1917. AINSWORTH, W. T. T., 8 Radcliffe Road, West Bridgford, Nottingham, Analyst (Boots Pure Drug Co.).

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1886. AITKEN, JAMES B., Hall Nook, Penketh, by Warrington, Chemical Manufacturer.

1919. AITKEN, JOHN E., Bonavista, Argyle Crescent, Joppa, Edinburgh, Paper Chemist.

1883. ALBRIGHT, G. S., Bromesberrow Place, Ledbury, Chemical Manufacturer.

O.M. ALBRIGHT, W. A., 29 Frederick Road, Edgbaston, Birmingham, Chemical Manufacturer.

1906. ALCOCK, FRANK H., 5 King Alfred's Place, Broad Street, Birmingham, Analyst.

1919. ALCOCK, HUBERT J., 183 Pershore Road, Selly Park, Birmingham, Chemist.

1907. ALCOCK, JAMES E., The Firs, Broomville Avenue, Sale, Cheshire, Manufacturing Chemist.

1914. ALCOCK, WILLIAM J., "Rosslyn," Mill Hill, London, N.W. 7, Alkali Works Manager.

1917. ALDERTON, GILBERT J., 68 Dunvegan Road, Eltham, London, S.E. 9, Technical Adviser.

1917. ALDRICK, EDWIN J., Phœnix Chemical Co., Ltd., Jackson Street, Church, Accrington, Lancs, Director.

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1913. ALEXANDER, JAMES, 2208 Allendale Street, Walbrook, Baltimore, Md., U.S.A., Research Chemist.

1900. ALEXANDER, JEROME, Ridgefield, Conn., U.S.A., Chemist.

1919. ALEXANDER, THOMAS, Friars Dene, Burnham-on-Sea, Peat Manufacturer and Director of Patent Fuel Co.

1917. ALEXANDER, THOMAS J. R., 60 Eglinton Road, Ardrossan, Scotland, Research Chemist.

1912. ALEXANDER, WALTER, National Gum and Mica Co., 59th Street and 11th Avenue, New York City, U.S.A., Secretary.

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1886. ALLIBON, GEORGE H., 1 Windsor Gardens, University Road, Belfast, Ireland, Chemical Works Manager.
1918. ALLIN, FRANCIS S., 19 Claremont Avenue, New Malden, Surrey, Chemist.
1916. ALLIOTT, EUSTACE A., c/o Manlove, Alliott & Co., Ltd., 23 King Street, Manchester, Chemical Engineer; Journals to 41-42 Parliament Street, Westminster, London, S.W. 1.
1913. ALLMAND, DR. A. J., King's College, London, Lecturer in Chemistry.
1917. ALLOTT, FRED. W. J., 22 Pall Mall, Liverpool, Industrial Photographic Paper Maker.
1905. ALLPASS, JAS., 9 Albert Square, Manchester, Secretary.
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1889. ANDERSON, ROBT. T. R., 42 Roslea Drive, Dennistoun, Glasgow, Technical Chemist.
1917. ANDERSON, THOS. M., 4 Gladstone Terrace, Gateshead, Analytical Chemist.
1918. ANDERSON, VALENTINE G., 31 Victoria Avenue, Canterbury, Victoria, Australia, Consulting Chemist.
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1894. ANDERSON, DR W. CARRICK, 7 Scott Street, Garnet Hill, Glasgow, Consulting Chemist.
1905. ANDREAE, DR. E. P., Moorhouse, Westerham, Kent, Chemist.
1919. ANDREW, GEORGE W., Ironhirst Factory, Ruthwell, R.S.O., Dumfriesshire, Technical Chemist.
1907. ANDREWS, CHAS. T., 6 Finsbury Square, London, E.C. 2, Chemist.
1889. ANDREWS, DR. CLEMENT W., c/o The John Crerar Library, Wabash Avenue and Washington Street, Chicago, Ill., U.S.A., Librarian.
1916. ANDREWS, WILLIAM, 30 Snowdon Road, Eccles, Lancashire, Works Manager.
1913. ANDREWS, W. O., P.O. Box 2671, Johannesburg, South Africa, Analytical Chemist.
1903. ANFILOGOFF, N. A., Thames Haven, Essex, Chemist and Petroleum Refiner.
1919. ANNABLE, HENRY W. C., Aubrey Haw, Egham, Surrey, Scientific Chemist.
1913. ANNAN, J. G., 2 Shandon Terrace, Edinburgh, Chief Chemist (Mineral Oil Works).
1892. ANNANDALE, CHARLES J. R., Deneholme, Sunnyhurst Lane, Darwen, Lancs, Paper Maker.
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1902. ANTHONY, JOHN, 217 King Street East, Toronto, Canada.
1919. APLIN, ISAAC W., Messrs. Aplin & Barrett, Ltd., 33 Park Road, Battersea, London, S.W. 11, Chemist and Bacteriologist.
1916. APP, JOHN C., Box 977, Charleston, Kanawha, West Va., U.S.A., City Chemist and Bacteriologist.
1919. APPLEBEE, HARRY C., c/o Manchester Corporation Gas Works, Bradford Road, Manchester, Works Chemist.

1895. APPLEBY, PROF. W. R., Minnesota School of Mines, University of Minnesota, Minneapolis, Minn., U.S.A., Professor of Mining and Metallurgy.

1917. APPLEYARD, ALFRED, H.M. Acetone Factory, Nasik, Bombay Presidency, India, Chemist.

1900. APPLEYARD, GEO. H., 1 Carlton Terrace, Hornsea, East Yorks, Analytical Chemist.

1905. APPLEYARD, JAS. R., Royal Technical Institute, Salford, Lecturer.

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1899. ARCHDALE, T. HENRY, Beechville, Clifton Drive, Lytham, Manager of Tar and Ammonia Works.

1904. ARCHDALE, WILLIAM, Sandhutton, Hill Lane, Blackley, Manchester, Manager of Chemical Works.

1918. ARCHER, AUGUSTUS R., c/o F. C. Noble, Esq., 50 Church Street, New York City, U.S.A., Engineer.

1919. ARCHER, JOHN, 1 Brantwood Terrace, Moston, Manchester, Analytical Chemist.

1901. ARDAGH, PROF. EDW. G. R., Faculty of Applied Science, University of Toronto, Canada, Chemist.

1900. ARDERN, DR. EDW., Priors Lee, Urmston, near Manchester, Chemist.

1918. ARKINSTALL, JOHN S., 7 Eaton Park Road, Palmer's Green, London, N. 13, Works Chemist.

1902. ARMSTRONG, EDWARD E., Pennsylvania Salt Manufacturing Co., Natrona, Pa., U.S.A., Manufacturing Chemist.

1905. ARMSTRONG, DR. E. FRANKLAND, c/o J. Crosfield and Sons, Ltd., Warrington, Technical Chemist.

1918. ARMSTRONG, NORMAN L., 1962 6th Avenue East, Vancouver, B.C., Canada, Assayer and Chemist.

1899. ARMSTRONG, RICHARD, Saul Street Soap Works, Preston, Lancashire, Soap Manufacturer.

1899. ARNOTT, G. W. CAMPBELL, c/o Fertiliser Manufacturers' Association, 68-70 Fenchurch Street, London, E.C., Agricultural Chemist.

1912. ARNY, HENRY V., 115 West 68th Street, New York City, U.S.A., Teacher and Chemist.

1915. ARUNDEL, EDGAR, 99 Poppleton Road, Leytonstone, London, N.E., Chemist.

1918. ARUP, PAUL S., 4 Sunnyside, Devonshire Road, Liverpool, Technical Adviser and Chemist.

1911. ASAHINA, KOJU, Osaka Technical College, Tamaechō, Osaka, Japan, Chemist.

1901. ASANO, K., 17 Kaguracho 2 Chome, Ushigome, Tokyo, Japan, Consulting Mining Chemist.

1908. ASHBURY, JOHN W., c/o John Brown and Co., Ltd., Laboratory, Atlas Works, Sheffield, Chief Chemist.

1914. ASHCROFT, EDGAR A., 65 London Wall, London, E.C., Technical Chemist.

1903. ASHLEY, FRANK R., c/o Western Chemical Manufacturing Co., Denver, Colo., U.S.A., Manufacturing Chemist.

1918. ASHMORE, FRANK O., Buxton Road, Whaley Bridge, near Stockport, Calico Printers' Chemist.

1917. ASHMORE, STANLEY A., The Laboratory, Messrs. Courtaulds Ltd., Coventry, Research Chemist.

1915. ASHTON, JACK, Meriton Street, Gladesville, New South Wales, Australia, Oil Chemist.

1894. ASHWORTH, ARTHUR, Fernhill Chemical Works, Bury, Lancs, Chemical Manufacturer.

1908. ASHWORTH, D. IRVING, P.O. Box 503, Wappingers Falls, N.Y., U.S.A., Chemist.

1915. ASHWORTH, FRED, 15 Woodlea, Waterfoot, near Manchester, Analytical and Consulting Chemist.

1907. ASPEY, URBAN, JUN., New Station Soap Works, School Close, Leeds, and (Journals) Tonbridge Villa, Tonbridge Place, Leeds, Works Manager and Chemist

1898. ASPINALL, THOS., 40 Somerset Road, Bolton, Analytical and Manufacturing Chemist.

1900. ASTON, BERNARD C., Box 40, P.O., Wellington, New Zealand, Chemist.

1919. ASTON, WILLIAM G., Wick Lane Colour Works, Old Ford Road, Bow, London, E. 3, Works Chemist.

1915. ATACK, FREDERICK W., 57 Dale Street, Manchester, Director of Research.

1891. ATKINS, CHARLES E., Shenley, Ash Hill Road, Torquay, Chronometer Maker.

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1917. ATKINSON, HARFORD M., Finsbury Technical College, Leonard Street, London, E.C. 2, Chemist.

1911. ATKINSON, JAMES E., The Sheffield Testing Works, Ltd., Blonk Street, Sheffield, Analytical Chemist.

1915. ATLAS, HENRY, 58 High Street, Dartford, Kent, Works Manager and Chief Chemist.

1918. ATLEY, WILLIAM W., The Mount, Normanton, Yorks, Chemical Engineer.

1905. ATTEAUX, FRED. E., 176 Purchase Street, Boston, Mass., U.S.A., Dyestuff Importer and Manufacturer.

1919. AUCHINACHIE, PETER, c/o Day and Martin, Carpenters Road, Stratford, London, E., Technical Chemist.

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1917. AUDEN, DR. HAROLD A., "Studley," Whitehedge Road, Garston, Liverpool, Chemist.

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1901. AUTY, ALBERT M., c/o John Smith and Sons, Ltd., Field Head Mills, Bradford, Works Chemist.

1917. AUTY, CLIFFORD M., 47 Newcomen Terrace, Redcar, Yorks, Chemist.

1902. AVERY, DAVID, 387 Barker's Road, Kew, Melbourne, Victoria, Australia, Teacher of Chemistry.

1910. AYERS, GILBERT F., Dynamite Factory, Modderfontein, Transvaal, Chemist.

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1918. BACKHAUS, ARTHUR A., Research Laboratory, U.S. Industrial Alcohol Co., South Baltimore, Md., U.S.A., Chemist.

1913. BACON, RAYMOND F., Mellon Institute of Industrial Research, The University, Pittsburgh, Pa., U.S.A., Associate Director.

1911. BADDILEY, JAMES, Glencoin, Fog Lane, Didsbury, Manchester, Research Chemist.

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1910. BAILLIE, DR. THOMAS B., c/o Henry Tate and Sons, Ltd., Love Lane Sugar Refinery, Liverpool, Analytical Chemist.
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1918. BAIN, DR. DAVID, c/o Levinstein, Ltd., Blackley, Manchester, Research Chemist.
1902. BAIN, PROF. JAMES WATSON, Faculty of Applied Science, The University, Toronto, Ontario, Canada, Chemist.
1919. BAIN, DR. ROBERT D., Wayside, Malford Grove, Snaresbrook, London, E. 18, Works Chemist.
1918. BAINBRIDGE, ERNEST G., 5 Taunton Road, Ashton-under-Lyne, Technical Chemist.
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1911. BAIRD, DOUGLAS H., 14 Cross Street, Hatton Garden, London, E.C., Scientific Instrument Maker.
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1891. BAIRD, WILLIAM, c/o Lewis Berger and Sons, Ltd., Homerton, London, N.E., Technical Chemist.
1890. BAIRSTOW, JOHN, Burley, Queen's Park, Chester, Chemical Works Manager.
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1910. BAKER, C. KERSLAKE, 16 Change Alley, Sheffield, Analytical Chemist.
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1918. BALDERSON, GEO. G., 371 Rectory Road, Gateshead-on-Tyne, Works Chemist.
1912. BALDRACCO, CAV. PROF. DR. GIACINTO, R. Conceria Scuola Italiana, Corso Cirie, ang. Via Biella, Turin, Italy, Leather Trades Chemist.
1903. BALDWIN, F. H., Bergenport Chemical Works, Bayonne, N.J., U.S.A., Superintendent.
1903. BALDWIN, DR. H. B., 927 Broad Street, Newark, N.J., U.S.A., Chemist (Department of Public Health).
1919. BALDWIN, JAMES W., c/o Messrs. Smith, Stone and Knight, Ltd., Avonside Paper Mills, Bristol, Paper Maker.
1918. BALFOUR, ARTHUR, c/o Arthur Balfour and Co., Ltd., Sheffield, Steel Manufacturer.
1903. BALL, SAMUEL F., 289 East 201st Street, New York City, U.S.A., Analytical Chemist.
1919. BALL, SAMUEL G., 286 Broad Street, Birmingham, Rubber Chemist.
1889. BALLANTYNE, HORATIO, 75 Chancery Lane, London, W.C., Analytical and Consulting Chemist.
1919. BALLANTYNE, JAMES C., Delta Chemical Co., Ltd., 1683 Danforth Avenue, Toronto, Ont., Canada, Manufacturer.
1903 BALLANTYNE, CAPT. W. H., 111 Hatton Garden, London, E.C., Patent Agent's Assistant.
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1910. BALY, PROF. E. C. C., F.R.S., 14 Sunnyside, Prince's Park, Liverpool, Professor of Inorganic Chemistry.
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1913. BANKS, ARTHUR J., c/o The Ogilvie Flour Mills Co., Ltd., Montreal, Canada, Analyst.
1916. BANNER, GEORGE E., c/o S. Banner & Co., Ltd., 8 Fazakerley Street, Liverpool, Managing Director.
1917. BANNISTER, CHARLES O., 60 West Side, Clapham Common, London, S.W. 4, Metallurgist.
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1919. BARASH, MICHAEL, College of Technology, Sackville Street, Manchester, Chemist.
1909. BARBER, C. DOUGLAS, 20 Champion Road, Upminster, Essex, Chemist.
1914. BARBER, CHARLES F. L., 12 Queen's Terrace, Station Road, Otley, Yorks, Leather Chemist.
1915. BARBER, CHRISTOPHER, c/o The Coppée Co., (Great Britain), Ltd., King's House, Kingsway, London, W.C. 2, Chemical Engineer.
1908. BARBER, PERCY S., The Reform Food Stores, 3 Richmond Street, Liverpool, Chemist.
1917. BARBER, THOS. W., Gun and Shell Factories, Cossipore, Bengal, India, Chief of Works Inspection.
1918. BARBOUR, WILLIAM, c/o Nobel's Explosives Co., Ltd., Ardeer Factory, Stevenston, Ayrshire, Chemist.

1919. BARCLAY, ANDREW, c/o Oficina Anita, Pampa Central, Antofagasta, Chile, Chemist.

1912. BARCLAY, WILLIAM R., c/o Messrs. Wiggin & Co., Ltd., Wiggin Street Works, Birmingham, Manager of Electro-Plate Factory and Lecturer in Electro-Metallurgy.

1892. BARDEN, ALF., Far Bank, Shelley, near Huddersfield, Glue and Size Maker.

1907. BARDORF, CHARLES F., c/o St. Lawrence Sugar Refineries, Ltd., Montreal, Canada, Chief Chemist.

1917. BARDSLEY, JAMES W., 41 Bolton Road, Pendleton, Manchester, Technical Chemist.

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1919. BARGER, PROFESSOR GEORGE, F.R.S., The University, Edinburgh, Professor of Medical Chemistry.

1919. BARIL, DR. GEORGES, Laval University, Montreal, Que., Canada, Professor of Chemistry.

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1918. BARKER, PETER RAYMUND, Thorn Croft, Burras Lane, Otley, Leather Manufacturer.

1916. BARKER, WILFRED R., 64 Grove Street, Barnsley, Yorks, Glass Works Manager.

1917. BARKLEY, ARTHUR J., Westwood, Newtown, New Mills, near Stockport, Student.

1895. BARLOW, CLINTON W., 104-112 East 25th Street, New York City, U.S.A., Merchant.

1918. BARLOW, HERBERT C., Deloro Smelting and Refining Co., Deloro, Ont., Canada, Assistant Chemist.

1901. BARLOW, JOHN J., Broadway, Accrington, Calico Printer's Chemist.

1916. BARLOW, WALTER H., c/o Robinson Bros., Ltd., West Bromwich, Staffs., Chemist.

1899. BARLOW, WILLIAM, 23 Alton Terrace, Fairfield, Manchester, Analytical Chemist.

1908. BARNES, ALFRED, Box 556, Pretoria, Transvaal, Dealer in Minerals

1906. BARNES, A. G., c/o Hasland Coking Co., Grassmoor Collieries, Chesterfield, Colliery Proprietor.

1914. BARNES, EDWARD A., Box 302, Allentown, P.O., Pa., U.S.A., Chemical Engineer.

1905. BARNES, FRED V., Gas Works, Todmorden, Engineer and Manager.

1884. BARNES, H. JAMES, Phœnix Chemical Works, Hackney Wick, London, E., Manufacturing Chemist.

1916. BARNES, JOHN F., Oil Mills, Stanningley, Leeds, Oil Manufacturer.

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1916. BARNES, WILLIAM H., c/o Follows and Bate, Ltd., Engineers, Gorton, Manchester, Manager and Representative.

1912. BARNETT, E. DE BARRY, 9 Collingham Road, South Kensington, London, S.W., Chemist.

1917. BARNETT, WALTER LEIGH, 30 Maid's Causeway, Cambridge, Chemist.

1904. BARON, WILLIAM BRISCOE, "Ingleside," Woodfield Road, Cheadle Hulme, Stockport, Chemist.

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1917. BARR, JAMES, c/o Clayton Aniline Co., Ltd., Clayton, Manchester, Technical Chemist.

1916. BARR, JAMES C., 27 Blythswood Square, Glasgow, Chemical Merchant.

1915. BARRACLOUGH, C. E., c/o J. Crossley & Sons, Ltd., Dean Clough Mill, Halifax, Yorks, Chemist.

1890. BARRACLOUGH, WILLIAM H., Westholme, Chapeltown, near Sheffield, Analytical Chemist.

1890. BARRETT, ARTHUR A., 139 Viale San Martino, Messina, Sicily, Manufacturer of Essential Oils.

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1907. BARRETT, MAURICE, 17 Gledhow Avenue, Leeds, Technical Chemist (Leeds Fireclay Co.)

1919. BARRETT, WILLIAM W., 61 Cluny Avenue, Toronto, Canada, Accountant.

1912. BARROW, JAMES V., c/o Messrs. H. Holmes & Sons, Portland Road, Newcastle-on-Tyne, Works Chemist.

1900. BARROW, JOS., c/o Messrs. Edward Cook & Co., Ltd., The Soapery, Bow, London, E., Chemist.

1915. BARROWCLIFFE, M., Ings House, Clayton West, near Huddersfield, Research Chemist.

1906. BARRS, CHARLES E., "Buena Vista," 58 South Hill Park, Hampstead, London, N.W. 3, Analyst.

1918. BARRY, THOMAS H., Messrs. W. Winstone and Sons, Ltd., 100-101 Shoe Lane, London, E.C. 4, Works and Analytical Chemist.

1916. BARTLETT, EDWARD E., c/o Bartlett Collins Glass Co., Sapulpa, Okla, U.S.A., Treasurer.

1915. BARTON, B. CYRIL, c/o Messrs. Barton & Waterhouse, Sun Chambers, Lowgate, Hull, Seed Crusher.

1893. BARTON, G. E., 227 Pine Street, Millville, N.J., U.S.A., Technical Chemist.

1903. BARTRIP, GEORGE F., c/o Messrs. B. Laporte, Ltd., Lidget Green, Bradford, Managing Chemist.

1905. BARUCH, EDGAR, 703 Wright & Callender Building, Los Angeles, Cal., U.S.A., Chemical Engineer.

1910. BARWICK, FRED W., Chamber of Commerce Testing House, Royal Exchange, Manchester.

1917. BARWICK, WILLIAM S., 519 6th Avenue West, Vancouver, B.C., Canada, Steel Chemist and Mechanical Engineer.

1918. BASEVI, ING ALESSANDRO, Via Cesarea 9-1, Genova, Italy, Chemical Engineer.

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1890. BATE, WILLIAM, Upton Villa, Hayle, Cornwall, Technical Chemist (National Explosives Co., Ltd.).

1903. BATEMAN, A. H. 24 Westcombe Park Road, Blackheath, London, S.E., Chemist.

1913. BATEMAN, JAMES T., 34 Bridge Avenue, Hammersmith, London, W. 6, Engineer and Works Manager.

1912. BATES, D. M., Lewiston Bleachery and Dye Works, Lewiston, Maine, U.S.A., General Manager.

1914. BATES, JOHN S., Kenogami, Quebec, Canada, Superintendent (Forest Products Laboratory).

1918. BATES, JOSEPH WILLIAM, "Ravenhurst," Birch Avenue, Old Trafford, Manchester, Chemist.

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1918. BATTERSBY, JOHN W., Ashton Villa, Ashton Lane, Ashton-on-Mersey, near Manchester, Chemical Manufacturer.

1914. BATTERSBY, W. H., Corporation Gas Works, Elton, Bury, Lancs., Chief Chemist.

1885. BATTY, R. B., c/o The Nickel Co., Erdington, near Birmingham, Nickel Works Manager.

1910. BATTYE, HORACE G., 28 Roman Place, Street Lane, Roundhay, Leeds, Chemist and Works Manager.

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1913. BAXTER, HAROLD R., 2 Denham Green Terrace, Edinburgh, Manager (Glue Works).

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1919. BECK, JOHN E., Waverley Hotel, Seaton Carew, Durham, Analytical Chemist.

1905. BECKERS, DR. WILLIAM, 21 Burling Slip, New York, U.S.A., Manufacturing Chemist.

1909. BECKET, FREDERICK M., 403 Jefferson Avenue, Niagara Falls, N.Y., U.S.A., Chief Metallurgist, Electro Metallurgical Co.

1912. BECKETT, DR. E. G., The Elms, Arnot Hill, Falkirk, Analytical Chemist.

1919. BECKWITH, HAROLD, Engineers' Office, Messrs. Bass, Ratcliff and Gretton, Ltd., Burton-on-Trent, Chemical Works Engineer.

1899. BEDFORD, ALFRED C., c/o Standard Oil Co., 26 Broadway, New York City, U.S.A., Chemical Merchant.

1891. BEDFORD, CHARLES S., Adel Manor, Adel, Leeds, Manufacturing Chemist.

1891. BEDFORD, JAMES E., "Arncliffe," Shire Oak Road, Headingley, Leeds, Chemical Manufacturer.

1911. BEDFORTH, GEORGE E., Aspley Dyeware Mills, Huddersfield, Works Chemist.

O.M. BEDSON, PROF. P. PHILLIPS, Armstrong College, Newcastle-on-Tyne, Professor of Chemistry.

1901. BEEVERS, CLIFFORD J., Chantry Drive, Ilkley, Yorks, Analyst.

O.M. BEILBY, SIR GEORGE T., F.R.S., 11 University Gardens, Glasgow, Chemical Engineer.

1912. BELAIEW, COLONEL NICOLAI T., 57 Cornwall Gardens, South Kensington, London, S.W. 7, Lecturer in Metallurgy and Chemistry.

1905. BELL, CHARLES, Messrs. Chas. Zimmermann (Chemicals), Ltd., 9 & 10 St. Mary at Hill, London, E.C., Chemical Merchant.

1918. BELL, GORDON S., 12 Polmaise Street, Blaydon-on-Tyne, Co. Durham, Works Manager and Chemist.

1884. BELL, SIR HUGH, Bart., Middlesbrough-on-Tees, Soda and Iron Manufacturer.

1900. BELL, HUGH P., Census and Statistics Office, Ottawa, Canada, Chemist.

1886. BELL, J. FERGUSON, Engineer's Office, Derby Gas Light and Coke Co., Derby, Gas Engineer.

1918. BELL, PROFESSOR JAMES M., University of North Carolina, Chapel Hill, N.C., U.S.A., Professor of Chemistry.

1916. BELL, JEROME B., JUN., c/o Canadian Explosives, Ltd., Transportation Building, Montreal, Canada, Chemical Manager.

1907. BELL, MARCUS, Defence Department, Melbourne, Victoria, Australia, Chemist.

1905. BELL, MISS M. M., Tulane University Library, New Orleans, La., U.S.A., Librarian.

1915. BELL, WILLIAM, c/o Parry & Co., Ranipettai, North Arcot Dt., Madras Presidency, India, Works Manager.

1917. BELLWOOD, ROBERT A., 24 Cavendish Square, Margaret Street, Hull, Mechanical Engineer.

1903. BENHAM, KEITH, Deans Hill, Stafford, Analytical and Consulting Chemist.

1918. BENISON, ALFRED H., 43 Derby Road, Ponders End, Middlesex, Chemical Works Manager.

1917. BENJAMIN, E. O., 9 Emerson Place, Newark, N.J., U.S.A., Chemist and Engineer.

O.M. BENJAMIN, DR. M., Smithsonian Institution, Washington, D.C., U.S.A., Consulting Chemist.

1899. BENNETT, ALEX. H., Via Giuseppe La Farina, Messina, Sicily, Analytical Chemist.

1917. BENNETT, CHARLES T., 27 Nightingale Lane, Balham, London, S.W. 12, Analytical Chemist.

1907. BENNETT, H. GARNER, 115 Grovehill Road, Beverley, Yorks, Leather Chemist.

1915. BENNETT, WALTER, 37 Town Street, Bramley, Leeds, Analytical Chemist.

1918. BENSON, GEORGE C., 275B Indian Road, Toronto, Canada, Grad. Chemist.

1909. BENSON, GEORGE F., Edwardsburg Starch Co., Cardinal, Ontario, Canada, President and Managing Director.

1919. BENSON, LEONARD, 8 Northway, Wavertree, Liverpool.

1918. BENTLEY, JOHN LLOYD, Haughton le Skerne, Darlington, Steelworks Chemist.

1901. BENTLEY, WILLIAM H., 12 Cromwell Terrace, Irlam, near Manchester, Technical Chemist.

1890. BENTZ, ERNEST, Westwoodside, Wilbraham Road, Manchester, S.W., Technical Chemist.

1919. BERK, ALVA F., 1 Fenchurch Avenue, London, E.C. 3, Chemical Manufacturer.
1919. BERK, ARTHUR D., 1 Fenchurch Avenue, London, E.C. 3, Chemical Manufacturer.
1893. BERK, FRED. W., 1 Fenchurch Avenue, London, E.C. 3, Chemical Manufacturer.
1907. BERK, PAUL F., 1 Fenchurch Avenue, London, E.C. 3, Chemical Manufacturer.
1916. BERKELEY, CYRIL J., 2412 Alder Street, Vancouver, B.C., Canada, Agricultural Chemist.
1900. BERMINGHAM, JOHN, JUN., c/o The Runyon Corporation, 50 Church Street, New York City, U.S.A., Superintendent.
1889. BERNARD, JAMES, Jun., c/o The United Alkali Co., Ltd., Netham Works, Bristol, Chemical Works Manager.
1919. BEROLZHEIMER, DR. DANIEL D., 1 Madison Avenue, New York, U.S.A., Assistant Technical Editor.
1897. BERRY, ALBERT E., "Rowgardens," Charlwood, Surrey, Works Manager.
1911. BERRY, ARTHUR G. V., c/o Messrs. Trinidad Leaseholds, Ltd., Point à Pierre, Trinidad, B.W.I., Analyst.
1906. BERRY, ARTHUR J., 14 Regent Street, Cambridge, Chemist.
1917. BERRY, ERNEST, 308 Wellington Road, Heaton Chapel, Manchester.
1883. BERRY, E. E., Bordighera, Italy, and Journals c/o C. H. Grinling, 17 Rectory Place, Woolwich, London, S.E., Technical Chemist.
1918. BERRY, FREDERICK J., Roseneath, Reynolds Street, Neutral Bay, Sydney, N.S.W., Australia, Manufacturing Chemist.
1913. BERRY, PROF. R. A., The Agricultural College, Blythswood Square, Glasgow, Professor of Agricultural Chemistry.
1903. BERRY, WILTON G., 200 Claremont Avenue, Manhattan, New York City, U.S.A., Chemist.
1909. BESKOW, K. J., Södra Storgatan 19, Helsingborg, Sweden, Head Engineer.
1914. BEST, RONALD L., 55 Derwent Road, Palmer's Green, London, N., Analytical Chemist.
1886. BEST, DR. T. T., Hardshaw Brook Chemical Works, St. Helens, Lancashire, Technical Chemist.
1914. BETTESWORTH, A. E. A., 59 St. Peter Street, Montreal, Canada, Managing Director.
1918. BETTLEY-COOKE, H. V., 304 Kent Street, Sydney, N.S.W., Australia, Dye Chemist.
O.M. BEVAN, E. J., 4 New Court, Lincoln's Inn, London, W.C.; Journals to c/o The Viscose Development Co., Pembroke Road, Bromley; Public Analyst and Consulting Chemist.
1900. BEVAN, JOHN W., Morriston Spelter Works, Morriston, R.S.O., Glamorgan, Manager of Metallurgical Works.
O.M. BEVERIDGE, JAMES, Springfield House, Chatham, N.B., Canada, Pulp and Paper Manufacturer.
1917. BEVERIDGE, JAMES B., c/o Dryden Timber and Power Co., Ltd., Dryden, Ontario, Canada, Pulp and Paper Manufacturer.
1909. BEWICK, R. M., Lyntoncroft, Stanstead Road, Caterham, Surrey; Journals to c/o The United Alkali Co., Ltd., 9 Mincing Lane, London, E.C. 3, Traveller.
1918. BEWSHER, JOSEPH N., 160 Musters Road, West Bridgford, Nottingham, Chemical Works Engineer.
1916. BEYNON, DONALD E., 47 Playter Crescent, Toronto, Canada, Rubber Chemist.
1918. BHUDKAMKAR, P. P., 17 Rosedale Road, Heaton Chapel, Manchester, Chemist.
1896. BIBBY, JOHN, c/o J. Bibby & Sons, Formby Street, Liverpool, Chemist.
O.M. BICKERDIKE, W. E., Bryers Croft, Wilpshire, near Blackburn, Manufacturing Chemist.
1907. BICKERSTAFFE, ROBERT, c/o The Greenwich Inlaid Linoleum Co., Ltd., 74 Tunnel Avenue, East Greenwich, London, S.E. 10, Chemist.
1919. BICKMORE, REGINALD C., 5 Clarence Road, West Croydon, Surrey, Analytical Chemist.
1910. BIGELOW, CHARLES A., c/o Aetna Explosive Co., 120 Broadway, New York, U.S.A., Superintendent.
1912. BIGELOW, EDWARD P., Mellin's Food Library, 291 Atlantic Avenue, Boston, Mass., U.S.A., Chemist.
1918. BIGGAR, EMERSON B., 36 Toronto Street, Toronto, Canada, Publisher and Author.
1884. BIGGART, J. WILLIAM, 29 Cathcart Street, Greenock, Scotland, Analytical Chemist.
1891. BIGGART, WILLIAM L., Rossarden, Kilmacolm, Scotland, Public Analyst.
1911. BIGGINS, J. E., c/o Gulf Refining Co., Port Arthur, Texas, U.S.A., Chemist.
1910. BIGGS, J. W. H., 15A Rockmount Road, Plumstead, London, S.E. 18, Chemist.
O.M. BILLING, H. S., 42 Kingsley Road, Mutley, Plymouth, Chemist.
1896. BILLINGTON, CHARLES, Heimath, Porthill, Longport, Staffordshire, Metallurgist.
1918. BILLINGTON, EDWARD E., c/o E. Billington & Son, Ltd., 67 Stanley Street, Liverpool, Mining Engineer.
1911. BINGHAM, H. C., c/o Messrs. Huntington, Heberlein & Co., Ltd., 2 Metal Exchange Buildings, London, E.C. 3, Consulting Engineer.
1917. BIRCH, ALAN E. W., 62 Plein Street, Sunnyside, Pretoria, South Africa, Cyanide Manager.
1917. BIRD, CHARLES H., 38 Newport Road, Cardiff, Chemical Manufacturer.
1918. BIRD, FRANK, 38 Newport Road, Cardiff, South Wales, Works Chemist.
1917. BIRD, FREDERICK G., Cranmore, Radyr, near Cardiff, Chemical Manufacturer.
1919. BIRD, REGINALD R., Oldbury House, St. Michael's Park, Bristol, Student.
1895. BIRD, WILLIAM R., Laboratory, G.W.R. Works, Swindon, Wilts, Analytical Chemist.
1902. BIRD, W. ROBERT, 217 Newport Road, Cardiff, Oil Merchant.
1915. BIRLEY, J. HAROLD, c/o Charles Macintosh & Co., Ltd., Cambridge Street, Manchester, Indiarubber Manufacturer.
1918. BIRRELL, SEPTIMUS, c/o Marrickville Margarine Co., Edinburgh Road, Marrickville, N.S.W., Australia, Chemist and Bacteriologist.
1883. BISHOP, LIEUT.-COL. A. CONWAY, Three Mills Lane, Bromley-by-Bow, London, E., Manufacturing Chemist.
1884. BISHOP, FRED., c/o The Alliance Bank of Simla, Ltd., Srinagar, Kashmir, India, Technical Chemist. "Retain Journals."
1903. BISHOP, HOWARD B., 435 South Orange Street, Media, Pa., U.S.A., Chemist.
1919 BISHOP, ROBERT O., 74 Oakfield Road, Stroud Green, London, N. 4, Assistant Manager and Chief Chemist.
1905. BIXBY, WILLARD G., 46th Street and 2nd Avenue, Brooklyn, N.Y., U.S.A., Blacking Manufacturer.
1905. BJERREGAARD, A. P., c/o Chemical Department, Empire Refineries, Okmulgee, Oklahoma, U.S.A., Petroleum Chemist.
1919. BLACK, ANGUS D., "Blairpark," Eglinton Road, Ardrossan, Technical Chemist.
1919. BLACK, JAMES WALTER, Chemical Industry Club, 2 Whitehall Court, London, S.W. 1, Chemist.
1919. BLACK, JOHN T. S., 11 Boverton Street, Cardiff, Oil Merchant.
1902. BLACK, W. GEOFFREY, c/o Messrs. Geo. Yaxley (Norwich), Ltd., Heigham Street, Norwich, Chemist.
1918. BLACKBURN, RUDOLPH I., 8 Dunlace Road, Clapton, London, E. 5, Analytical and Research Chemist.

1918. BLACKER, HAROLD S., 11 St. Edward's Road, Clifton, Bristol, Chemist.

1917. BLACKHURST, ARTHUR O., Gas Offices, Fishergate, Preston, Agricultural Chemist.

1910. BLACKIE, ARCHIBALD, 223 James Street, Winnipeg, Canada, Chemist.

1917. BLACKSTOCK, GIBBS, 79 Prince Arthur Avenue, Toronto, Canada, Works and Research Chemist.

1896. BLAGDEN, VICTOR, 4 Lloyd's Avenue, London, E.C., Chemical Merchant.

1883. BLAGDEN, W. G., 245 Preston Road, Brighton, Chemical Merchant.

1897. BLAIR, ANDREW A., 406 Locust Street, Philadelphia, Pa., U.S.A., Analytical Chemist.

1915. BLAKE, AZEL F., Atlantic Sugar Refineries, Ltd., St. John, New Brunswick, Canada, Chief Chemist.

1910. BLAKELEY, A. G., c/o P. and R. Coal and Iron Co., Pottsville, Pa., U.S.A., Chemist.

1919. BLAKEY, FRED, c/o Birmingham Small Arms Co., Sparkbrook, Birmingham, Metallurgical Chemist.

1919. BLAKEY, WALTER, c/o Brittains Ltd., Cheddleton Paper Mills, near Leek, Staffs., Chemist.

1893. BLEARS, JOHN, c/o Langworthy Bros. & Co., Ltd., Greengate Mills, Salford, Dyer and Calico Printer.

1919. BLEDISLOE, LORD CHARLES B., K.B.E., Lydney Park, Gloucestershire, Barrister-at-Law and Agriculturist.

1918. BLENKARN, GEORGE H., 15 Langleys Road, Selly Oak, Birmingham, Analytical Chemist.

1918. BLEYNIE, LEON, Montreuil-s.-Ille, Ille-et-Vilaine, France, Engineer.

1908. BLICHFELDT, S. H., Vine Cottage, Southall, Middlesex, Bacteriologist and Fermentation Chemist.

1905. BLISS, H. J. W., British Research Association for the Woollen and Worsted Industries, Bond Place Chambers, Leeds, Director of Research.

1919. BLIZZARD, FRANCIS R., 52 Compton Road, Wolverhampton, Chemical Engineer.

1916. BLOCH, DR. J. J., c/o Hollinwood Chemical Co. Ltd., Hollinwood, Lancs., Chemist.

1918. BLOCKEY, JOHN R., c/o W. Walker & Sons, Ltd., Bolton, Research Chemist.

1889. BLOEDE, VICTOR G., Station "D," Baltimore, Md., U.S.A., Manufacturing Chemist.

1908. BLOMELEY, ADAM Y., c/o Arbuckle Bros., Sugar Refinery, Brooklyn, N.Y., U.S.A., Chemist.

1916. BLONDEL, PAUL, La Revue des Produits Chimiques, 54 rue de Turbigo, Paris, France, Director and Proprietor.

1891. BLOOMER, FRED J., Penpont, Clydach, R.S.O., Glamorgan, Nickel Works Manager.

1918. BLOOR, HAROLD E., 4 Clifton Dale, York, Gas Engineer.

1886. BLOUNT, BERTRAM, Laboratory, 76 and 78 York Street, Westminster, London, S.W., Analytical Chemist.

1888. BLOXAM, A. G., c/o Messrs. Abel and Imray, 30 Southampton Buildings, Chancery Lane, London, W.C. 2, Chemist and Patent Agent.

1916. BLUMAN, NICHOLAS J., 123-5 Newington Causeway, London, S.E. 1, Chemical Engineer.

1903. BLUNDELL, LIONEL, Hillside, Prestwich Park, Manchester, Managing Director.

1906. BLYTH, M. WYNTER, Lacton House, Tankersley, near Barnsley, Yorks, Analytical and Consulting Chemist.

1908. BLYTHE, JAMES R., Craiglea, Stamford Road, Audenshaw, near Manchester, Leather Trades Chemist.

O.M. BOAKE, A., Warton Road, Stratford, London, E., Manufacturing Chemist.

1888. BOAKE, EDMUND J., Widford Lodge, Chelmsford, Essex, Manufacturing Chemist.

1912. BOAN, ROBERT, Laboratory, Government Railway Offices, Spencer Street, Melbourne, Victoria, Australia, Engineer-in-Charge.

1918. BOARD, THOMAS H., Glenthorne, Portishead, Somerset, Distiller.

1915. BOARDMAN, FRED., 51 Carholme Road, Forest Hill, London, S.E. 23, Metallurgical Chemist.

1919. BOARDMAN, WILLIAM, c/o Wm. Blythe and Co. Ltd., Church, Lancs., Works Manager.

1919. BODDINGTON, H. D., 655 North Broadway, Los Angeles, Cal., U.S.A., Technical and Manufacturing Chemist.

1899. BOEHM, FRED., 16 Jewry Street, London, E.C., Chemical Agent and Merchant.

1918. BOEHMER, HERBERT C., 35 College Street, Kitchener, Ont., Canada, Student in Chemistry.

1910. BOEHRINGER, DR. R., Essex and First Streets, Harrison, N.J., U.S.A., Chemist.

1919. BÖESEKEN, DR. J., Scheikundig Lab. der Technische Hoogeschool, Delft, Holland, Professor.

1898. BOGERT, PROF. MARSTON T., Havemeyer Hall, Columbia University, New York, U.S.A., Professor of Organic Chemistry.

1915. BOILING, E. H., 101 Arran Road, Catford, London, S.E. 6, Analytical and Research Chemist.

1919. BOINTON, BASIL B., 3 North Parade, West Park, Leeds, Chemical Student.

1903. BOLAM, DR. H. W., Queen Margaret College, Glasgow, Lecturer on Chemistry.

1909. BOLDEN, WILLIAM, Dalmellington Iron Works, Dunaskin, Ayrshire, Chemist.

1919. BÖLLING, WILHELM H., Vidars gt. 7, Christiania, Norway, Consulting Civil Engineer.

1916. BOLSOVER, GEORGE R., 31 Rossington Road, Brocco Bank, Sheffield, Metallurgist.

1901. BOLTON, E. RICHARDS, 36 Stamford Brook Road, Hammersmith, London, W., Manufacturing Chemist.

1905. BOND, JOHN, Crowlands, Southport, Engineer.

1912. BONE, S. C., 30 Long Lane, Garston, Liverpool, Chemical Works Manager.

1905. BONE, PROF. W. A., F.R.S., "Montrose," Harpenden Road, St. Albans, Herts, Professor of Chemical Technology.

1918. BONELL, ERNEST, 59 Milton Road, West Hartlepool, Co. Durham, Supervising Chemist.

1917. BONNYMAN, JAMES S., 134 Cambridge Drive, Kelvinside N., Glasgow, Analytical Chemist.

1892. BOOKMAN, DR. S., 48 East 82nd Street, New York City, U.S.A., Chemist.

1914. BOON, DR. A. ARCHIBALD, Chemistry Department, Heriot-Watt College, and (Journals) 87 Warrender Park Road, Edinburgh, Professor of Chemistry.

1888. BOOR, LEONARD G., 21 Mincing Lane, London, E.C., Chemical Merchant.

1918. BOORNE, HERBERT E., 23 and 24 Redcliff Street, Bristol, Wholesale Chemist and Druggist.

1912. BOORNE, WILLIAM H., Bush Lane House, Cannon Street, London, E.C., Metallurgist.

1917 BOOTH, ALFRED L., Hockerley House, Whaley Bridge, Stockport, Technical Chemist.

1916. BOOTH, JAMES, JUN., Messrs. Booth Bros., Manufacturing Chemists, Woodhey Works, Holcombe Brook, near Ramsbottom, General Manager.

1908. BOOTH, JOSEPH W., George E. Kunhardt Mills, Lawrence, Mass, U.S.A., Superintendent.

1904. BOOTH, N. PARR, Laboratory, Cadbury Bros., Ltd., Bournville, near Birmingham, Analytical Chemist.

1916. BOOTHMAN, JOHN, Oak Villas, Whitley Bridge, S.O., Yorks, Works Chemist.

1903. BORAL, ROBIN, Rhodes Mount, Rhodes, near Manchester, Works Manager.

1897. BORLAND, C. R., Concord, Mass., U.S.A., Smokeless Powder Manufacturer,

O.M. BORLAND, W. DALRYMPLE, Beacon Lodge, Bean, *via* Dartford, Kent, Manufacturer of Explosives.

1908. BOSE, R., 92-95 Upper Circular Road, Calcutta, India, Chemical Works Manager.

1890. BOST, W. D. ASHTON, Cartvale Chemical Works, Paisley, Chemical Manufacturer.

1912. BOSWELL, MAITLAND C., Chemistry and Mining Building, University of Toronto, Canada, Lecturer on Organic Chemistry.

O.M. BOTHAMLEY, C. H., Weston-super-Mare, Somerset, County Director of Technical Instruction.

1901. BOTTOMLEY, DR. J. FRANK, c/o The Thermal Syndicate, Ltd., Neptune Road, Wallsend-on-Tyne (Journals to Kearsney, Westfield Avenue, Gosforth, Newcastle-on-Tyne), Consulting Chemist.

1906. BOTTOMLEY, W., c/o The United Alkali Co., Ltd., Ammonia Soda Works, Fleetwood, Chief Engineer.

1917. BOUCHER, CHARLES E., c/o Ferris & Co., Ltd., Bristol, Director.

1917. BOUCHER, HORACE C., c/o Messrs. Josiah Hardman, Ltd., Aston Church Road, Nechells, Birmingham, Works Manager.

O.M. BOULTON, CAPT. SIR HAROLD E., BART., C.V.O., C.B.E., City of London Yeomanry (Journals to c/o Messrs. Burt, Boulton & Haywood, Ltd., Totton, near Southampton), Chemical Manufacturer.

1883. BOULTON, T. S., 27 Engayne Gardens, Upminster, Essex, Manager.

1918. BOURGOIN, LOUIS, Ecole Polytechnique, 288 St. Denis, Montreal, Canada, Professor of Industrial Chemistry.

1917. BOUSQUET, CALIXTE F., 1030 St. Hubert Street, Montreal, Canada, Chief Chemist.

1910. BOWATER, JOHN W., Woodville, Beeches Road, West Bromwich, Works Manager.

1918. BOWDEN, HARRY D., 50 Beak Street, Regent Street, London, W. 1, Chemist and Druggist.

1917. BOWEN, EVAN M., Llwynpia House, Llwynpia, Glam, Works Manager and Chemist.

1888. BOWER, FRANK, Brewery House, Spitalfields, London, E., Analytical Chemist.

1909. BOWER, JOSHUA, c/o Kynoch, Ltd., Lion Works, Witton, Birmingham (Journals to 45 St. Peter's Road, Handsworth, Birmingham), Chemist.

1897. BOWER, WILLIAM H., 29th Street and Gray's Ferry Road, Philadelphia, Pa., U.S.A., Chemical Manufacturer.

1892. BOWES, HARRY, 9 Park Road, Heaton Moor, Stockport, Analytical Chemist.

1915. BOWIS, DR. WM. J., "The Gables," Bridgford Road, West Bridgford, Nottingham, Technical Chemist.

1917. BOWLES, PERCY E., c/o Messrs. Titanine, Ltd., Felling-on-Tyne, Research Chemist and Manager.

1899. BOWLEY, J. PLUNKETT, 36 Argyll Mansions, Chelsea, London, S.W. 3, Varnish Manufacturer.

1908. BOWMAN, FRED C., 1632 University Avenue, New York City, U.S.A., Chemist.

1884. BOWMAN, R., c/o Bowmans, Ltd., Moss Bank Works, Widnes, Chemical Manufacturer.

1907. BOWMAN, RICHARD S., Quarn Cottage, Great Sankey, near Warrington, Chemist.

1917. BOWMAN, STANLEY, D. W. Laboratory, H.M. Dockyard, Chatham, Analytical Chemist.

1896. BOWMAN, WALKER, 39 Cortlandt Street, New York City, U.S.A., Chemist.

1918. BOWREY, STANLEY E., Westwood, 115 Hainault Road, Leytonstone, London, E. 11, Works Chemist.

1917. BOWYER, JOHN J., 41 Heath Road, Runcorn, Cheshire, Chemist.

1917. BOWYER, STEPHEN B., 10 Penwortham Road, Streatham Park, London, S.W. 16, Dairy Analyst.

1904. BOYCE, FRAMROZE H., 86 Hugh's Road, Chaupaty, Bombay, India, Technical Chemist.

1893. BOYCE, FRANK, 48 Duchy Road, Harrogate, Technical Chemist.

1910. BOYCE, JAMES, Route 8, Holland, Mich., U.S.A., Chief Chemist.

1913. BOYD, ROBERT, c/o British Columbia Sugar Refining Co., Ltd., Vancouver, B.C., Canada, Chemist.

1917. BOYLE, ARTHUR L., Newlands, 511 Kensington Hill, Brislington, Bristol, Engineer.

1919. BOYLES, DR. F. M., McCormick & Co., Baltimore, Md., U.S.A., Chemist.

1919. BRACEGIRDLE, H. W., 34 Fairview Avenue, Levenshulme, Manchester, Technical Chemist.

1885. BRADBURN, J. A., 311 Montgomery Street, Syracuse, N.Y., U.S.A., Manufacturing Chemist.

1917. BRADBURY, MISS EMILY T., 113 Sutton Court, Chiswick, London, W. 4, Chemist.

1912. BRADFORD, FRANCIS L. W., 100 Rotton Park Road, Edgbaston, Birmingham, Chemist and Works Manager.

1895. BRADFORD, HENRY, Strettington, Goodwood, near Chichester, Analytical Chemist.

1918. BRADLEY, ARTHUR B., 7A Inglethorpe Street, Fulham Park, London, S.W. 6, Works Chemist.

1915. BRADLEY, G. W. J., By-Products Department, The Ebbw Vale Steel, Iron and Coal Co., Ltd., Ebbw Vale, Mon, Chemist.

1918. BRADLEY, SYDNEY W., 12 Glebelands Avenue, South Woodford, London, E. 18, Analytical and Technical Chemist.

1917. BRADSHAW, DR. HAMILTON, Messrs. E. I. du Pont de Nemours & Co., Experimental Station, Henry Clay, Del., U.S.A., Director.

1917. BRADY, DR. OSCAR L., University of London Club, 21 Gower Street, London, W.C. 1, Research Chemist.

1896. BRAGG, EVERETT B., 1838 Chicago Avenue, Evanston, Ill., U.S.A., Manufacturing Chemist.

1891. BRAITHWAITE, ISAAC, Ghyll Close, Kendal, Westmoreland, Drysalter.

1897. BRAITHWAITE, JOHN O., Holme Lacey, Warren Road, Chingford, Essex, Chemical Works Manager.

1903. BRAME, PROF. J. S. S., 3 Vanbrugh Fields, Blackheath, London, S.E., Professor of Chemistry.

1918. BRAMLEY, DR. ARTHUR, The Technical College, Loughborough, Chemist.

1902. BRANEGAN, JAMES A., 12 Park Avenue, Millbourne, Delaware Co., Pa., U.S.A., Chemical Salesman.

1915. BRANSON, FREDERICK H., North View, West Park Grove, Park Lane, Roundhay, Leeds, Manufacturing Chemist.

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1903. BRASSARD, FRED A., Messrs. F. A Brassard & Crawford, Chald Lane Colour Works, Wakefield, Yorks, Aniline Dyestuff Importer.

1918. BRAUN HUGO C., Caixa 1685, S. Paulo, Brazil, Chemical Merchant.

1901. BREARLEY, HARRY, c/o The Amalgams Co., Ltd., Attercliffe Road, Sheffield, Analytical Chemist.

1918. BRECKENRIDGE, DR. JAMES M., Experimental Station, Hercules Powder Co., Kenvil, N.J., U.S.A., Assistant Director.

1906. BRECKENRIDGE, JOHN E., American Agricultural Chemical Co., Carteret, N.J., U.S.A., Chemist.

1917. BREITHAUPT, J. EDWARD, c/o The Breithaupt Leather Co., Kitchener, Ont., Canada, Chemical Engineer.

1900. BREWIS, E. THEODORE, 31 Belgrave Road, Leyton, Essex, Analytical Chemist.

1894. BREYER, THEODOR, 725 Washington Avenue, Wilmette, Ill., U.S.A., Chemist.

1916. BRIANT, ARTHUR, 14 Beech Road, Sale, Cheshire, Works Chemist.

1885. BRIANT, L., 24 Holborn Viaduct, London, E.C., Analytical Chemist.

1917. BRIDE, CYRIL, 161 Marton Road, Middlesbrough, Works Chemist.

1918. BRIDGE, FRED, c/o Messrs. W. A. Ward & Co., Ltd., Kent Street, Nottingham, Research and Works Chemist.

1913. BRIDGE, STANLEY W., c/o Messrs. Brandram Bros. & Co. Ltd., 16 Philpot Lane, London, E.C. 3, Analytical Chemist.

1919. BRIDGES, ALFRED H., 14 Stanley Terrace, West Street, Bedminster, Bristol, Works Chemist.

1890. BRIERLEY, J. T., Highfield, Golden Hill, Leyland, near Preston, Lancs, Analytical Chemist.

1919. BRIGGS, ERNEST, 34 Downleaze, Stoke Bishop, Bristol, Soap Manufacturer.

1919. BRIGGS, FRANCIS H., Victoria Leather Works, Waring Street, Leicester, Managing Director.

1893. BRIGGS, J. F., 3 Hartington Street, Derby, Technical Chemist.

1912. BRIGGS, O. W. H., c/o Harborough Rubber Co., Market Harborough, Chemist.

1885. BRIGGS, T. LYNTON, 188 Central Avenue, Flushing, Long Island, N.Y., U.S.A., Technical Chemist.

1919. BRIGHTMAN, JOHN HENRY, H.M. Patent Office, Chancery Lane, London, W.C. 2, Civil Servant.

1917. BRIGHTMAN, RAINALD, c/o Levinstein, Ltd., Blackley, Manchester, Research Chemist.

1914. BRINSLEY, FRANK, 9 Crowthorn Road, Ashton-under-Lyne, Demonstrator in Physical Chemistry.

1917. BRISCOE, H. V. A., 32 Blenheim Gardens, Cricklewood, London, N.W., 2, Consulting Chemist.

1905. BRISTOL, DR. H. STANLEY, 345 Salisbury Street, Worcester, Mass., U.S.A., Chemist.

1886. BRISTOW, G. W., c/o Walter J. Crook, 10 Eastcheap, London, E.C., Chemical Manager.

1912. BRITLAND, WILLIAM J., Pear Tree Cottage, Alvanley, near Helsby, Cheshire, Chemist.

1917. BRITTON, REGINALD P. L., 58 The Crescent, Wimbledon Park, London, S.W.

1889. BROCK, ARTHUR, Firework Factory, Sutton, Surrey, Firework Manufacturer.

1918. BROOK, WILLIAM, 14 Western Road, Cowlersley, Milnsbridge, near Huddersfield, Works Chemist.

1896. BROOKE, C. B. JUN., Colne House, Brantham, near Manningtree, Xylonite Manufacturer.

1884. BROOKES, E. A., c/o Braden Copper Co., Ltd., Sewell, Rancagua, Chile (*via* Panama), Chemist.

1916. BROOKS, PROF. B. T., 50 East 41st Street, New York City, U.S.A., Professor of Chemical Engineering.

1906. BROOKS, CECIL J., c/o M. M. Simau, Benkoelen, Sumatra, Ned. India, Metallurgist.

1919. BROOM, WALTER A., 2 Diseworth Grove, Mundella Road, Nottingham, Technical Chemist.

1916. BROT, DR. MAURICE, Paper Department, University, 44 Avenue Felix Viallet, Grenoble, France, Professor of Chemistry.

1911. BROTHERS, HORACE E., Higher Knutsford Road, Latchford, Warrington, H.M. Inspector of Factories.

1909. BROTHERS, WILLIAM, c/o Brothers Chemical Co., Ltd., Trafford Park, Manchester, Chemical Manufacturer.

O.M. BROTHERTON, COLONEL E. A., City Chambers, Leeds, Ammonia Distiller.

1884. BROWN, PROF. A. CRUM, F.R.S., 8 Belgrave Crescent, Edinburgh, Professor of Chemistry.

1918. BROWN, ARTHUR E., Laboratory, 37 Lombard Street, London, E.C. 3, Analyst.

O.M. BROWN, DAVID, 93 Abbey Hill, Edinburgh, Chemical Manufacturer.

O.M. BROWN, DAVID, Donaghmore, Tyrone, Ireland, Soap Manufacturer.

1918. BROWN, DAVID, JUN., 62 Robertson Street, Glasgow, Chemical Broker.

1890. BROWN, EDWARD HILTON (Petrograd, Russia); all communications to Sidney G. Pasfield, Century Insurance Co., Ltd., 27 Queen Victoria Street, London, E.C. 4, Analytical Chemist.

1910. BROWN, GEORGE WINSLOW, Assabet Mills, Maynard, Mass., U.S.A., Chemist.

O.M. BROWN, HENRY, Benskins Brewery, Watford, Herts, Brewing Chemist.

1899. BROWN, DR. HENRY C., The Chemical Works, King's Lynn, Chemical Manufacturer.

1919. BROWN, HERBERT P., Messrs. Claus & Co., Crabtree Lane, Clayton, Manchester, Chemist.

O.M. BROWN, DR. HORACE T., F.R.S., 52 Nevern Square, Kensington, London, S.W., Brewing Chemist.

1905. BROWN, HUGH B., c/o Messrs. Carr, White & Co., Ltd., Wigton, Cumberland, Chemist.

1918. BROWN, JOHN, 3 and 5 High Street, Berwick-on-Tweed, Pharmaceutical Chemist.

1919. BROWN, LESLIE G., 6 Airlie Gardens, Ilford, Essex, Student of Chemistry.

1917. BROWN, LE ROY, 55 Summit Avenue, Saulte Ste. Marie, Ontario, Canada, Civil Engineer.

1919. BROWN, MORTIMER J., c/o Roessler and Hasslacher Chemical Co., Perth Amboy, N.J., U.S.A., Chemist.

1917. BROWN, NORMAN B., 25 Kintyre Avenue, Toronto, Canada, Assistant Superintendent and Chemist.

1892. BROWN, REGINALD B., 45 Finsbury Square, London, E.C. 2, Technical Chemist.

1917. BROWN, ROBERT S., c/o Brimsdown Lead Co., Brimsdown, Middlesex, General Manager.

1901. BROWN, SAMUEL B., Print Works, Birch Vale, Stockport, Calico Printer.

O.M. BROWN, WALTER, c/o Jas. H. Dennis & Co., Ltd., Widnes, Technical Chemist.

1900. BROWN, WALTER B., Victor Chemical Works, 1805, Fisher Building, Chicago, Ill., U.S.A., Chemist and General Superintendent.

1919. BROWN, WILFRED J., 38 Green Park, Bath, Works Manager.

1919. BROWN, WILLIAM, Eastern Smelting Co., Data Kramat Road, Penang, S.S., Metallurgical Chemist.

1916. BROWN, WILLIAM F., 2 Flora Villas, Whalebone Avenue, Chadwell Heath, Essex, Gas Works Chemist.

1901. BROWNE, DR. ARTHUR L., 215 East Fayette Street, Baltimore, Md., U.S.A., Analytical Chemist.

1917. BROWNE, WALTER L., "Kininnie," Kirkton Road, Burntisland, Fife, Works Chemist.

1919. BROWNE, WILFRED R., c/o Colonial Sugar Refining Co., Ltd., O'Connell Street, Sydney, N.S.W., Australia, Sugar Chemist.

1919. BROWNING, HENRY, JUN., c/o The Rectory, Beswick, S.E. Manchester, Managing and Research Chemist.

1905. BROWNING, PROF. K. C., 11 Barton Terrace, Dawlish, South Devon, Professor of Chemistry.

O.M. BROWNING, W., Bentcliffe, Accrington, Calico Printer.

1917. BROWNLEE, RICHARD P., 43 Bloxcidge Street, Langley, Birmingham, Technical Chemist.

1919. BROWNLIE, DAVID, Messrs. Brownlie & Green, Ltd., Church Street, Cheetham, Manchester, Technical Chemist and Engineer.

1902. BROWNSDON, DR. H. W., King's Norton Metal Co., Ltd., King's Norton, Birmingham, and (Journals) 109 Oxford Road, Moseley, near Birmingham, Works Chemist.

1918. BROWNSON, THOMAS K., 19 Priory Gardens, Highgate, London, N. 6, Research Chemist.

1902. BRUCE, ALEXANDER, Laboratory, Hyde Park Corner, Colombo, Ceylon, Explosives Chemist.

1918. BRUCE, JAMES C., 64 Wall Street, New York City, U.S.A., Merchant.

1911. BRUCE, JOSEPH, Journals to General Manager, Dynamite Factory, West Somerset, Cape Colony, Secretary.

1908. BRUCE, ROBERT, 44 High Street, Leven, Fifeshire, Works Chemist.

1919. BRUCE, ROBERT J., 29 Foster Road, Duke's Avenue, Chiswick, London, W. 4, Analytical Chemist.

1900. BRUCE, WILLIAM T., 3 Lombard Court, London, E.C., and (Journals) c/o T. C. Allchin, Longfield, Kent, Director.

1911. BRUNET, LOUIS, "Revue Générale des Sciences," 97 Boulevard Montmorency, Paris XVI, France, Chemist and Secretary.

1918. BRUNI, PROFESSOR GUISEPPE, Messrs. Pirelli & Co., *via* Ponte Sevesa 21, Milan, Italy.

1916. BRUNJES, THOMAS A., 67 Waller Road, New Cross, London, S.E., Tar Distillery Chemist.

1887. BRUNNER, SIR JOHN, BART., c/o Brunner, Mond and Co., Ltd., 82 Victoria Street, London, S.W. 1, Chemical Manufacturer.

1902. BRUNNER, ROSCOE, The Winnington Hall Club, Winnington, Northwich, Alkali Manufacturer.

1894. BRUNTON, J. DIXON, Wire Mill, Musselburgh, Scotland, Wire Manufacturer.

1904. BRYANT, ARTHUR P., c/o Clinton Sugar Refining Co., Clinton, Iowa, U.S.A., Chemist.

1919. BRYANT, EDWARD G., Box 5754, Johannesburg, S. Africa, Scientist.

1918. BRYANT, JOHN J., 28 Greenwood Road, Dalston, London, E. 8, Works Chemist.

1908. BRYCE, CHARLES, C., 43-45 Great Tower Street, London, E.C., Merchant.

1917. BRYCE, GEORGE, 36 Shandon Crescent, Edinburgh, Botanist.

1897. BRYSON, JAMES, Pumpherston Oil Works, Mid Calder, Scotland, Oil Works Manager.

1892. BUCHANAN, D. G., Ofa "Keryma," Iquique, Chile, Analyst.

1908. BUCHANAN, DUNCAN G., 27 Woodlawn Avenue East, Toronto, Canada, Chemist (Rubber Works).

1904. BUCHANAN, E. F., 11432 Prairie Avenue, Chicago, Ill., U.S.A., Chemist.

1904. BUCHANAN, JOHN L., "Lancelyn," Spital, Cheshire, Journals to Messrs. Lever Bros., Ltd., Port Sunlight, Analytical Chemist.

1904. BUCHANAN, JOSHUA D., c/o Nobel's Explosives Co., Ltd., Polmont Station, Scotland, Superintendent of Works.

1910. BUCHANAN, WALTER G., c/o Lautaro Nitrate Co., Ltd., Taltal, Chile, Chemist.

1897. BUCK, CHARLES A., Prospect and Park Avenues, Bethlehem, Pa., U.S.A., Journals to L. J. Buck, Esq., c/o National Carbon Co., Room 1712, 30 East 42nd Street, New York, N.Y., U.S.A., Chief Chemist (Bethlehem Iron Co.).

1918. BUCKENHAM, FREDERICK WILLIAM, 21 North Birkbeck Road, Leytonstone, London, E., Analytical Chemist.

1911. BUDDE, DR. CARL, c/o The Hendon Paper Works Co., Ltd., Sunderland, Chemical Engineer.

1918. BUFTON, WILLIAM R., Barton Lodge, Broomy Hill, Hereford, Analytical Chemist.

1915. BUGGÉ, E. R., Instow, Mycenæ Road, Blackheath, London, S.E., Manufacturing Chemist.

1917. BULL, BERTRAM A., 14 North Road, West Bridgford, Nottingham, Works Chemist (Boots' Pure Drug Co.).

1902. BULL, IRVING C., 100 Maiden Lane, New York City, U.S.A., Chemist.

1899. BULT, HERBERT J., 63 Addiscombe Road, Croydon, Chemist.

O.M. BUMBY, H., Bellevue, Sandbach, Cheshire, Iron and Chemical Works Director.

1915. BUNCE, A., c/o The Morgan Crucible Co., Ltd., Church Road, Battersea, London, S.W., Works Chemist.

O.M. BUNKER, H. E., 310 Kingston Road, Toronto, Ontario, Canada, Technical Chemist.

1901. BUNTING, HENRY H., Oficina de Ensayes F. C. C. del P., Callao, Peru, Analyst.

1918. BUNYAN, FREDERICK W., Pittsburgh, Cal., U.S.A., Chief Chemist.

1918. BURBRIDGE, JAMES K., Laboratory, India Rubber Mills, Tottenham, London, N. 17, India Rubber Manufacturer.

1896. BURFORD, SAMUEL F., The Ridgeway, Rothley, near Leicester, Analytical Chemist.

1918. BÜRGER, A. W., c/o Messrs. Levinstein, Ltd., Blackley, Manchester, Chemist.

1889. BÜRGER, DR. J., 9 Vincent Avenue, Chorlton-cum-Hardy, Manchester, Technical Chemist.

1901. BURGESS, PROF. CHAS. F., C. F. Burgess Laboratories, Madison, Wis., U.S.A., Electrochemical Engineer.

1889. BURGESS, GEO., Sydney Cottage, Halebank, Widnes, Chemist.

1917. BURGESS, PERCIVAL J., 62 Norfolk Road, Littlehampton, Director Rubber Planting Companies.

1889. BURGESS, WM T., 20 Priory Road, Bedford Park, London, W., Analytical Chemist.

1917. BURKE, HENRY U., c/o The British American Tobacco Co., Ltd., Ashton Gate, Bristol, Works Manager.

1918. BURLS, HERBERT T., c/o 24 Gloucester Street, Warwick Square, London, S.W., Mechanical Engineer.

1891. BURNET, HENRY K., North Brook Vitriol Works, Bradford, Yorks, Sulphuric Acid Maker.

1909. BURNETT, ARTHUR, "Clairville," Weaste Lane, Pendleton, Lancs, Chemist.

1893. BURNHAM, J. C., Department of Explosives Supply, H.M. Factory, Gretna, Superintendent.

1919. BURNS, ALAN C., 9 Derbyshire Lane, Stretford, Manchester, Student.

1918. BURR, CLIFFORD G., 71 Cartwright Street, London, Ontario, Canada, Chemistry Student.

1900. BURR, EDMUND C., 1722 Vallejo Street, San Francisco, Cal., U.S.A., Manufacturer.

1917. BURR, RICHARD J., 247 Browning Road, Manor Park, Essex, Works Chemist.

O.M. BURRELL, B. A., 8 Springfield Mount, Leeds, Analytical Chemist.

1910. BURRELL, KEITH, Burrell's Wharf, Millwall, London, E., Manufacturer.

1906. BURROUGH, ERNEST J., Cale Distillery, Hutton Road, Lambeth, London, S.E., Rectifier.

1918. BURROWES, GILBERT, 162 Fifth Street East, North Vancouver, B.C., Canada, Assayer and Surveyor.

1919. BURROWS, EDWARD L., 109 Abbeyhill, Edinburgh, Works Chemist.

1919. BURROWS, GEORGE J., Watson Street, Neutral Bay, Sydney, N.S.W., Australia, Demonstrator in Chemistry.

1917. BURROWS, STANLEY L., Central Laboratory, Buccleuch Memorial Technical Institute, Hawick, Technical Chemist.

1918. BURT, MILO C., c/o Ætna Explosives Co., 165 Broadway, New York, U.S.A., Chemist.

1912. BURT-GERRANS, J. T., 46 Dewson Street, Toronto, Canada, Electro-Chemist.

1901. BURTON, ALFRED, 114 Bedford Road, Toronto, Canada, Dyer and Finisher.

1914. BURTON, DONALD, Westbourne, St. Andrew's Avenue, Morley, near Leeds, Research Assistant.

1903. BURTON, JOHN, 2 Green Street, Bethnal Green, London, E., Dye and Chemical Manufacturer.

1904. BURTON, THOMAS R., c/o Scott, Greenwood and Son, 8 Broadway, Ludgate Hill, London, E.C., Technical Journalist.

1914. BURTON, TOM F., 2 Blenheim Road, St. John's Wood, London, N.W. 8, Editor.

1889. BURTON, WM., 39 Queensborough Terrace, Bayswater, London, W. 2, Potter's Chemist.

1918. BURWELL, ROBERT P., 92 Southtown Road, Great Yarmouth, Works Chemist.
1915. BURY, ERNEST, Skinningrove Iron Co., Ltd., Saltburn-by-the-Sea, Works Manager.
1906. BUSBY, FRED. E., New Bedford Textile School, New Bedford, Mass., U.S.A., Chemist.
1913. BUSH, DR. HARRY T., c/o Messrs. Huntington, Heberlein and Co., Ltd., 2 Metal Exchange Buildings, London, E.C. 3, Chemical Engineer.
1897. BUSH, J. M., c/o W. J. Bush and Co., Ltd., Ash Grove, Hackney, London, E., Manufacturing Chemist.
1919. BUTCHER, MISS CONSTANCE M., 95 Middleton Hall Road, King's Norton, Birmingham, Chemist.
1897. BUTLER, DAVID B., 6 Earl Street, Westminster, London, S.W., Cement Expert.
1918. BUTLER, EDWIN H., 26 St. James Road, Leicester, Manufacturing Chemist.
1918. BUTLER, ERIC W., c/o Wm. Butler and Co., Ltd., Crews Hole, St. George, Bristol, Chemical Engineer.
1913. BUTLER, GEO. B., Adelaide Villa, Belle Vue Grove, Grove Hill, Middlesbrough, Assistant Blast Furnace Manager.
1919. BUTLER, GERALD S., Aruvankadu, Nilgris, S. India, Chemist (Cordite Factory).
1918. BUTLER, GUYTON, 6 Gray's Inn Square, London, W.C. 1, General Manager.
1919. BUTLER, RAYMOND R., Conway Villa, 64 Bonham Road, Brixton Hill, London, S.W. 2, Analytical Chemist.
1885. BUTLER, SAMUEL, The Cedars, Compton, Wolverhampton, Brewer.
1905. BUTLER, Dr. T. HOWARD, c/o Messrs. Wm. Butler and Co., Ltd., Silverthorne Lane, St. Philip's, Bristol, Chemist.
1886. BUTLER, W. WATERS, Brewer's Office, Cape Hill Brewery, Birmingham, Brewer.
1892. BUTTERFIELD, W. J. A., 66 Victoria Street, Westminster, London, S.W., Analytical Chemist.
1900. BUTTERWORTH, ELWELL R., c/o Reversible Collar Co., 111 Putnam Avenue, Cambridge, Mass., U.S.A., Chemist and Mechanical Engineer.
1919. BUTTRICK, HAROLD P., 15 Braemar Avenue, Wood Green, London, N. 22, Analytical Chemist.
O.M. BYARD, A. G., El Pradon, Trubia (Asturias), Spain, Technical Chemist.
1893. BYROM, T. H., 35 Christchurch Avenue, Brondesbury, London, N.W. 6, Analytical Chemist.
1915. BYWATERS, DR. HUBERT W., c/o Messrs. J. S. Fry and Sons, Ltd., Bristol, Chemist.

C

1884. CABOT, GODFREY L., 940 Old South Building, Boston, Mass., U.S.A., Manufacturing Chemist.
1907. CABOT, SAMUEL, 141 Milk Street, Boston, Mass., U.S.A., Chemical Manufacturer.
1906. CADDICK, ARTHUR, Casa Fundicion, Minas de Rio Tinto, Huelva, Spain, Smelting Works Manager.
1919. CADEN, ROBERT, 29 Colwyn Road, West Hartlepool, Steel Works Chemist.
1918. CADENHEAD, A. F. GRANT, Alice Street, Kingston, Ont., Canada, Industrial Chemist.
1889. CADETT, JAS., Ashtead, Surrey, Chemical Engineer.
1905. CAIN, DR. J. C., 24 Aylestone Avenue, Brondesbury Park, London, N.W., Colour Chemist.
1917. CALAM, HAROLD, 18 Melton Road, West Bridgford, Nottingham, Research Chemist (Boots Pure Drug Co.).
1905. CALDER, PROF. EDWIN E., Long Meadow, R.I., U.S.A., Professor of Chemistry.
1918. CALDER, RONALD B., "Wyvis," 21 Seagry Road, Wanstead, Essex, Chemist.
1897. CALDER, W. A. S., Ravensthorpe, Harborne, Birmingham, Chemical Manufacturer.
1912. CALDWELL, WALLACE L., 3525 Cliff Road, Birmingham, Ala., U.S.A., Engineering Chemist.
1888. CALDWELL, WM., Murray Street, Paisley, Scotland, Drysalter.
1917. CALEY, JOHN, Premier Oil Extracting Mills, Ltd., Hull, Managing Director.
1912. CALLAN, DR. THOMAS, 2 Spring Bank, Crumpsall Lane, Higher Crumpsall, Manchester, Technical Chemist.
1902. CALM, DR. CHAS. E., California Club, Los Angeles, Cal., U.S.A., Manufacturing Chemist.
1917. CALVERT, ARTHUR, c/o Messrs. The Strathclyde Paint Co., Davidson Street, Dalmarnock, Glasgow, Analytical Chemist.
1904. CALVERT, DR. HARRY T., West Riding of Yorkshire Rivers Board, Wakefield, Chemist.
1895. CAMBIER, JACOB, 1401 Carteret Avenue, Pueblo, Colo., U.S.A., Chemist.
1919. CAME, PERCY A. W., 21 Downfield Road, Clifton, Bristol, Assistant Works Manager.
1916. CAMERON, ALEX. M., Beechleigh, Lasswade, Midlothian, Analytical Chemist.
1918. CAMERON, IAIN, c/o National Tar Products, Ltd., Commercial Road. Barrhead, Scotland, Chemist.
1904. CAMERON, WALTER S., 239 West 136th Street, New York City, U.S.A., Manufacturing Perfumer.
1908. CAMERON, WM., c/o The Anglo-Egyptian Oilfields, Ltd., The Refinery, Suez, Asst. Refinery Manager.
O.M. CAMMACK, J., "Fernsholme," Prescot Road, St. Helens, Technical Chemist.
1886. CAMPBELL, ANDREW, The Coppice, Beckenham, Kent, Chemist (Mineral Oil).
1912. CAMPBELL, ARTHUR F., "Dyserth," Manchester New Road, Middleton, near Manchester, Research Chemist.
1919. CAMPBELL, CHARLES L., 75 Pitts Street, Boston, Mass., U.S.A., Chemical Engineer.
1917. CAMPBELL, DENIS, 704 Standard Bank Buildings, 510 Hastings Street West, Vancouver, B.C., Canada, Manufacturer.
1908. CAMPBELL, FRED A., The Working Men's College, Latrobe Street, Melbourne, Victoria, Australia, Principal.
1919. CAMPBELL, JOHN, 56 Clifford Street, Ibrox, Glasgow, Electrochemist.
1907. CAMPBELL, JOHN A., c/o British South African Explosives Co., Modderfontein, Transvaal, Analytical Chemist.
1912. CAMPBELL, KENNEDY, c/o British Dyewood Co., Ltd., Parkhead, Glasgow, Chemist.
1901. CAMPBELL, KENNETH F., 1 Peel Street, Huddersfield, Civil Engineer.
1911. CAMPBELL, LAWRENCE E., 5 St. Matthew's Avenue, Surbiton, Surrey, Chemist.
1909. CAMPBELL, PETER, Kearny, N.J., U.S.A., Linoleum Manufacturer.
1915. CAMPBELL, WM. B., 275 Addington Avenue, Montreal, Canada.
1911. CAMPBELL, WM. E., c/o Gutta Percha and Rubber Ltd., O'Hara Avenue, Toronto, Canada, Industrial Chemist.
1919. CAMPION, WILLIAM, The Hermitage, Whickham, Swallwell, S.O., Engineer, Team Byproduct Coke Co.
1914. CAMUS, EDWARD C. A., 30 Rue Victor Hugo, Ivry-Port (Seine), France, Chemical Merchant.
1918. CANNELL, THOMAS P., 25 Sefton Avenue, Heaton, Newcastle-on-Tyne, Managing Director.
1908. CANNING, ERNEST R., 137 Great Hampton Street, Birmingham, Manufacturer.
1919. CANT, THOMAS, The Academy, Bo'ness, Scotland, School Teacher.
1918. CAPENER, ARTHUR J., Fulwood, Blake Avenue, Barking, Essex, Works Chemist. "Retain Journals."
1891. CARDEN, ALBERT J., 20-21 Harp Lane, Gt. Tower Street, London, E.C. 3, Distiller.

1917. CARDER, FREDERICK, Stenben Glass Works, Corning, N.Y., U.S.A., Chemist and General Manager.

1915. CARDWELL, DAVID, 50 Alexandra Road South, Manchester, S.W., Chemist.

1893. CAREY, ARTHUR, Orient House, Gateacre, Liverpool, Chemist.

1906. CAREY, W. GORDON, c/o Sunderland and South Shields Water Co., 29 John Street, Sunderland, Chemist.

1904. CARGILL, JOHN T., c/o Finlay, Fleming and Co., Rangoon, Burmah, East India Merchant.

1915. CARLOS, ARTHUR S., 42 Foxley Road, North Brixton, London, S.W., Analytical Chemist.

1919. CARLYLE, ELMER C., 114 Pearl Street, New York City, U.S.A., Analytical and Consulting Chemist.

1896. CARMICHAEL, HERBART, Bureau of Mines, Victoria, British Columbia, Public Analyst and Assayer.

1919. CARMICHAEL, JAMES T., c/o Anglo-Egyptian Oil Fields Refinery, Suez, Works Chemist.

1919. CARMICHAEL, JOHN, Government Laboratory, Clement's Inn Passage, Strand, London, W.C. 2, Analytical Chemist.

1918. CARMINATI, PASQUALE, 8 Corso Concordia, Milan, Italy, Chemist and Colourist.

1884. CARMODY, PROF. PATRICK, Lostwithiel, Cornwall, Analytical Chemist.

1897. CARNELL, WM. C., 1141 Arrott Street, Frankford, Philadelphia, Pa., U.S.A., Chemist.

1916. CAROTHERS, A., 164 Roseberry Street, St. James, Winnipeg, Canada, Pharmaceutical Chemist.

1893. CARPENTER, DR. C. C., South Metropolitan Gas Co., 709A Old Kent Road, London, S.E., Civil Engineer.

1918. CARPENTER, CHARLES WM., Research Laboratory, Messrs. Levinstein, Ltd., Blackley, Manchester, Chemist.

1908. CARPENTER, EDWIN P., Culvert Works, Sheepcote Lane, Battersea, London, S.W., Manager of Casein, Ltd.

1900. CARPENTER, FRANK B., 11 South 12th Street, Richmond, Va., U.S.A., Analytical Chemist.

1900. CARPENTER, HARRY B., c/o Lister's Agricultural Chemical Works, P.O. Box 286, Newark, N.J., U.S.A.

1915. CARPENTER, HENRY A., Yale Club, Vanderbilt Avenue and 44th Street, New York, U.S.A.

1904. CARR, FRANCIS H., Westhorpe, Ruddington, Notts, Manufacturing Chemist.

1918. CARR, JOHN T., 2B Beaconsfield Avenue, Low Fell, Gateshead-on-Tyne, Analyst.

1917. CARRICK, PETER McA., 329 Railway Street, Vancouver, B.C., Canada, Managing Director (B.C. Pharmaceutical Co., Ltd.).

1907. CARRIER, C. F., JUN., 500 Euclid Avenue, Elmira, N.Y., U.S.A., Manufacturing Chemist.

1904. CARTER, ALFRED, Cuba Street, Petone, Wellington, New Zealand, Works Manager.

1905. CARTER, ROBERT A., 4923 Osage Avenue, Philadelphia, Pa., U.S.A., Chemist.

1917. CARTER, SIDNEY R., The University, Birmingham, Chemistry Lecturer.

1895. CARTER, STEWART F., 77 Lafayette Avenue, Passaic, N.J., U.S.A., Technical Chemist.

1903. CARTER, THOMAS, Yorkshire Dyeware Chemical Co., Paradise Works, Savannah la Mar, Jamaica, Works Chemist.

1886. CARTER, W. CHAS., c/o Dominion Iron and Steel Co., Sydney, C.B., Canada, Analytical Chemist.

1916. CARTWRIGHT, T. T. F., c/o New Explosives Co., Stowmarket, Suffolk, Chemist.

1911. CARTY, RONALD D., c/o Messrs. Stutchbury's, Ltd., 6 Bevis Marks, London, E.C. 3, Analytical Chemist.

1917. CARVALHO, HAROLD N., The Hive, Felden, near Boxmoor, Herts, Export Merchant.

1906. CARVETH, DR. H. R., Niagara Electrochemical Co., Niagara Falls, N.Y., U.S.A., Works Manager.

1918. CARWARDINE, LEWIS, 8 Sheene Road, Bedminster, Bristol, Manufacturer.

1919. CARWOOD, HENRY A., 53 Groombridge Road, London, E. 9, Works Chemist.

1914. CASEY, JOHN V., Charlemont, Moy, Co. Tyrone, Ireland, Waterproof Manufacturer.

1903. CASPARI, DR. W. A., Arts Club, 40 Dover Street, London, W., Chemist and Physicist.

1918. CASPELL, JOHN, 33 Lidderdale Road, Sefton Park, Liverpool, Mineral and Metallurgical Chemist.

1917. CASE, WILFRED G., Blair Athol, Heswall, Birkenhead, Abstractor.

1899. CASTRO, J. PAUL DE, 1 Essex Court, Temple, London, E.C., Barrister-at-Law.

1918. CATTERMOLE, HENRY S., 3 Bloxcidge Street, Langley Green, near Birmingham, Chemical Engineer.

1909. CAULKIN, HOWARD A., "The Glen," Cumberhill Road, Duffield, Derbyshire, Analyst.

1918. CAUSER, GEOFFREY, Clevedon, 125 Perry Vale, Forest Hill, London, S.E. 23, Works Chemist.

1906. CAVE-BROWN-CAVE, E. J., 51 Dufferin Street, New Westminster, B.C., Canada, Manager.

1896. CAVEN, DR. ROBERT M., The Technical College, Darlington, Principal.

1914. CAW, WM., No 3 Staff Hostel, Eastriggs, Dornock, Annan, Chemist.

O.M. CAWLEY, GEORGE, 82 Victoria Street, Westminster, London, S.W. 1, Chemical Engineer.

O.M. CAWLEY, JOHN, 600 Mount Prospect Avenue, Newark, N.J., U.S.A., Analytical Chemist.

1897. CAWLEY, THOS. A., British Gelatin Works, Ltd., New Bedford Road, Luton, Gelatin Manufacturer.

1906. CHADSEY, STANLEY B., 476 Brunswick Avenue, Toronto, Canada, Chemist.

1917. CHALLENGER, DR. FREDERICK, The University, Edgbaston, Birmingham, University Lecturer.

1910. CHALLINOR, RICHARD W., Chemical Laboratory, The Technical College, Sydney, N.S.W., Australia, Teacher of Chemistry.

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1910. CHAMBLISS, PROF. HARDEE, U.S. Nitrate Plant, No. 1, Sheffield, Alabama, U.S.A., Assistant Commissioner of Public Health.

1912. CHANCE, CLINTON F., Messrs. Chance and Hunt, Ltd., Oldbury, near Birmingham, Managing Director.

1917. CHANCE, EDGAR P., 9 Hay Hill, Berkeley Square, London, W. 1, Managing Director.

1909. CHANCE, EDWIN M., 611 Chestnut Street, Philadelphia, Pa., U.S.A., Chemist.

1916. CHANCE, KENNETH M., British Cyanides Co., Ltd., 49 Queen Victoria Street, London, E.C. 4, Managing Director.

1917. CHANDHURI, J. K., Digboi P.O., Upper Assam, India, Chemist (Assam Oil Co., Ltd.).

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1915. CHARLTON, W. W. S., c/o The Cotton Powder Co., Ltd., Uplees, Faversham, Kent, Manufacturing Chemist.

1918. CHARNOCK, ELSIE MAY, 29 Upper Dicconson Street, Wigan, Lancs, Pharmaceutical Chemist.

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1900. CHASE, MARCH F., 7th Floor, 6 Church Street, New York City, U.S.A., Chemist.

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1918. CHEKE, THOMAS W., Beacon Villas, Station Road, Marple, Cheshire, Research Chemist.

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1919. CLEE, ERNEST O., Pensilva, near Liskeard, Cornwall, Chemist and Physicist.
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1911. CLYMER, WILLIAM R., Publicity Department, National Carbon Co., Cleveland, Ohio, U.S.A., Manager.
1899. COATES, CHARLES E., JUN., Louisiana State University, Baton Rouge, La., U.S.A., Professor of Chemistry.
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1893. COBB, PROF. JOHN W., The University, Leeds, Professor of Coal Gas and Fuel Industries.
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1901. COCKBURN, JOHN A., Ardeer Factory, Stevenston, Ayrshire, Analytical Chemist.
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1914. CORDER, WALTER S., Messrs. Williamson and Corder, Ltd., Low Walker, Newcastle-on-Tyne, Chemical Manufacturer.
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1890. CRAWSHAW, E., 25 Tollington Park, London, N., Dye Merchant.

1918. CREVER, HERBERT W., Preston Lea, Faversham, Kent, Research Chemist.

1916. CRESSWICK, JOHN A., Explosives Department, Sydney, N.S.W., Australia, Analyst and Inspector.

1901. CRIBB, CECIL H., 60 Greek Street, Soho Square, London, W., Analytical and Consulting Chemist.

1918. CRICHTON, DAVID C., Airvbank, Cousland, Dalkeith, Scotland, Manager of Cement Works.

1908. CRIGHTON, ADAM M., "London Place," Agecroft Print Works, Pendleton, Manchester, Calico Printer's Chemist.

1910. CRIGHTON, DAVID T., 21A and 22 Berey's Buildings, George Street, Exchange, Liverpool, Buying Manager.

1905. CRIGHTON, W. H., The Brough Lead Works, Bradwell, nr. Sheffield, Chemist.

1890. CRIPER, WILLIAM R., c/o Messrs. D. Waldie and Co., Kotmagar, near Calcutta, India, Manufacturing Chemist.

1919. CRITCHLEY, THOS., "Flaunden," Bosworth Road, New Barnet, Analytical Chemist.

1911. CROASDELL, JAMES F., 12 Wrottesley Road, Plumstead, London, S.E., Engineer.

1901. CRONQUIST, G. W., c/o Aktiebolaget Ramens Södra, Trädgardsgatan 2, Helsingborg, Sweden, Patenter for Building Copper and Zinc Extraction Works.

1915. CRONSHAW, CECIL I. T., c/o British Dyestuffs Corporation, Blackley, Manchester, Research Chemist.

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1918. CROOKS, WILLIAM, 9 Whiteburn Street, Helburn-on-Tyne, Analytical Chemist.

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1917. CROSLAND, CHARLES K., c/o L. B. Holliday and Co., 650 Leeds Road, Huddersfield, Chemical Manufacturer.

1908. CROSLAND, PERCY F., c/o Crosland and Pickstone, Ltd., Heap Bridge, Bury, Technical Chemist.

1884. CROSS, C. F., F.R.S., 4 New Court, Lincoln's Inn, London, W.C., Analytical Chemist.

1919. CROSS, HAROLD L., 41 Athenlay Road, Waverley Park, London, S.E. 15, Research and Analytical Chemist.

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1917. CROSS, LIEUT.-COLONEL SIR WILLIAM C., BART., 44 Queen's Gate Gardens, London, S.W., and Journals to C. Davidson, Esq., Technical Department, Alexander Cross and Sons, Ltd., 19 Hope Street, Glasgow, Chemical Manufacturer.

1894. CROSSLEY, PROFESSOR ARTHUR W., C.M.G., F.R.S., University of London, King's College, Strand, London, W.C. 2, Professor of Chemistry.

1915. CROSSLEY, HENRY, Phethean Street, Bolton, Engine Packing Maker.

1918. CROSSLEY, MOSES L., Calco Chemical Co., Bound Brook, N.J., U.S.A., Works Chemist.

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1892. CULLEN, WILLIAM, "Cumbernauld," Feltham Hill, Middlesex, Chemist.
1903. CULLEN, WILLIAM H., c/o Messrs. Castner-Kellner Alkali Co., Ltd., Wallsend-on-Tyne, Engineer.
1897. CULMANN, DR. J., c/o G. Siegle Co. Rosebank, Staten Island, N.Y., U.S.A., Chemist and Colourist.
1883. CUMING, JAMES, JUN., Chemical Works, Yarraville, Melbourne, Victoria, Australia, Chemical and Fertiliser Manufacturer.
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1916. CUMMING, DR. A. C., O.B.E., 2 Relugas Road, Edinburgh, Lecturer in Technical Chemistry.
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1918. CUNANE, THOMAS H., The Willows, Whaley Bridge, near Stockport, Chemist.
1917. CUNLIFFE, BENJAMIN A., 365 Water Street, Vancouver, B.C., Canada, China Merchant.
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1917. CUNNINGHAM, JAMES C., c/o Messrs. Curtis's and Harvey, Ltd., Nitrate Factory, Green Street, Green Road, Dartford, Kent, Chemist and Manager.
1907. CUNNINGHAM, JAMES E., Minas Peña del Hierro, Provincia de Huelva, Spain, Analytical Chemist.
1918. CUNNINGHAM, DR. MARY, Temple Chambers, St. James's Square, Manchester, Chemist.
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1916. CURRAN, EDWARD A., 27 St. Jean Baptiste Street, Montreal, Canada, Manufacturing Chemist.
1916. CURRIER, RICHARD J., P.O. Box 178, Fulton, N.Y., U.S.A., Chemist and Colourist.
1919. CURTIS, ALGERNON L., Box No. 7, Chatteris, Cambridgeshire, Consulting Mineralogist.
1918. CURTIS, GEORGE R., 10 Redland Green Road, Redland, Bristol, Seed Crusher.
1898. CURTIS, MARVIN, 108 Front Street, San Francisco, Cal., U.S.A., Wine Chemist.
1919. CURTIS, RAYMOND, Research Department, Levinstein, Ltd., Blackley, Manchester, Research Chemist.
1918. CURZON, JOHN R., c/o Hydrofats, Echota, Niagara Falls, N.Y., U.S.A., Chemist.
1918. CUSHING, ERIC A., c/o Messrs. Price Bros. & Co. Ltd., Kenogami, P.Q., Canada, Chemical Engineer.
1903. CUSHING, ROBERT P., c/o Kistler Leather Co., Lock Haven, Pa., U.S.A., Chemist.
1918. CUSTANCE, WM., c/o Messrs. A. Gallenkamp and Co., Ltd., 26-28 Tabernacle Street, London, E.C. 2, Manager of Graduating Department.
1902. CUTBUSH, CHARLES G., 59 Byne Road, Sydenham, Kent, Electrical Engineer.
1899. CUTLER, FRED. F., 166, Essex Street, Boston, Mass., U.S.A., Publisher.
1913. CUTTS, H. CYRIL, Brooklyn, Private Road, Sherwood, Nottingham, Embroidery Manufacturer.
1904. CUTTS, HENRY E., Grand View Terrace, Tenafly, New Jersey, U.S.A., Technical Chemist.
1919. CYSTER, FREDERICK, "Lynton," The Avenue, Croxley Green, Herts, Paper Works Chemist.

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1918. DALLEY, EDWARD E., 31 Mercer Chambers, Castle Street, Long Acre, London, W.C. 2, Analytical Chemist.
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1919. DALTON, JOHN, c/o Robert Roxburgh, Ltd., British P.O. Box 292, Shanghai, China, Analytical Chemist.
1918. DALTROFF, LOUIS, 8 Rue Championnet, Paris (18e), Consulting Engineer.
1919. DALY, ARTHUR J., "Kingsbury," Princess Drive, Borrowash, Derby, Chemist.
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1884. DANIELL, LOUIS C., c/o Messrs. Daniells and Sons' Breweries, Ltd., West Bergholt, near Colchester, Brewer.
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1903. DANNENBAUM, DR. H., c/o National Ammonia Co., Frankford, Philadelphia, Pa., U.S.A., Secretary and Treasurer.
1918. DARBISHIRE, DR. FRANCIS V., Royal Horticultural Society Gardens, Wisley, Ripley, Surrey, Sugar Chemist.
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1900. DAVIDSON, ALEX., St. Helen's, Biggar, Analytical Chemist.
1917. DAVIDSON, A. LINTON, c/o Marmite Food Extract Co., Ltd., Cross Street, Burton-on-Trent, Works Manager.
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1918. DAVIES, HAROLD, 57 Oakhill Road, Putney, London, S.W. 15, Research Chemist.

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1886. DAVIES, M. L., Standard Chemical Iron and Lumber Co., Toronto, Canada, General Manager.

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1897. DAVIES, SAMUEL H., c/o Rowntree and Co., Ltd., The Cocoa Works, York, Research Chemist.

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1902. DAVIS, CHARLES B., 745 Riverside Drive, New York City, U.S.A., Technical Chemist.

1918. DAVIS, DOUGLAS J., 29 Dornton Road, Balham, London, S.W. 12, Chemist.

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1918. DAVIS, GEORGE F., c/o Messrs. Davis Gelatine Co., Ltd., Spring Street, Botany, Sydney, N.S.W., Australia, Manufacturer.

1908. DAVIS, G. KELVILLE, "Beechthorpe," Dunham Massey, Cheshire, Chemical Engineer.

1918. DAVIS, JOSEPH, 94 Elliscombe Road, Charlton, London, S.E. 7, Chemist.

1918. DAVIS, MISS MARY, Admiralty Chemist's Department, H.M. Dockyard, Portsmouth, Analytical Chemist.

1897. DAVIS, WILLIAM A., Agricultural Research Institute, Pusa, Bihar, India, Chemist.

1911. DAVIS, WILLIAM C., c/o The British Cyanide Co., Ltd., Popes Lane, Oldbury, Worcestershire, Chemist.

1918. DAVISON, J. REGINALD, 402 Pender Street West, Vancouver, B.C., Canada, Publicity Commissioner.

1919. DAVISON, WM., 25A Harvey Road, Blackheath, London, S.E. 3, Analytical Chemist.

1900. DAW, FRED. W., Duffryn House, Ebbw Vale, Mon, Metallurgical Chemist.

1916. DAWE, ALFRED E., H.M. Stationery Office, London, S.W., Assistant Examiner of Paper.

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1919. DAWSON, DR. HARRY M., 23 Claremont Drive, Headingley, Leeds, University Lecturer.

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1901. DAY, DR. DAVID T., 715 19th Street N.W., Washington, D.C., U.S.A., Geologist.

1913. DAY, FRANK E., c/o Condensed Milk Co. of Ireland, Lansdowne, Limerick, Ireland, Analytical Chemist.

1912. DAY, G. A. C., Casilla No. 417, Lima, Peru (*viâ* New York), Oil Mill Manager.

O.M. DEACON, H. WADE, 8 Ullet Road, Liverpool; and (Jnls.) c/o C. E. Tyers, 186 Derby Road, Farnworth, Widnes, Alkali Manufacturer.

1918. DEAG, EDGAR W. D., The Confectioners' Vegetable Colours and Fruit Essences Co., Ltd., Messina Works, Carpenters Road, Stratford, London, E. 15, Analytical and Works Chemist.

1911. DEAN, ARTHUR L., College of Hawaii, Honolulu, H.I., U.S.A., Assistant Prof. of Industrial Chemistry.

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1892. DEAVILLE, B., Beech Avenue, Nottingham, Manufacturing Chemist.

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1918. DE COSTER, JOSEPH J., Twitchell Dept., Olympia Oil and Cake Co., Selby, Yorks, Works and Research Chemist.

1900. DEERR, NOEL F., 28 Fort Greene Place, Brooklyn, N.Y., U.S.A., Analytical Chemist.

1902. DEGHUÉE, DR. JOS. A., Shippan Point, Stamford, Conn., U.S.A., Chemist.

1911. DEHN, DR. FRANK B., 22 Cranes Park Avenue, Surbiton, Surrey, Chemist and Patent Agent.

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1913. DESCH, PROF. CECIL H., Royal Technical College, Glasgow, Lecturer.
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1902. DONALDSON, THOS., St. Mungo, Caledonia Road, Saltcoats, Ayrshire, Analytical Chemist.
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1917. FIELD, CHARLES H., 52 Lee Park, Blackheath, London, S.E., Analytical Chemist.

1885. FIELD, E. W., Brewer.

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1887. FIELD, S. S., 41 Kidbrook Park Road, Blackheath, London, S.E., Manufacturing Chemist.

1918. FIELDEN, HAROLD, c/o Messrs. Kynoch, Ltd., Umbogintwini, Natal, S.A., Chemist.

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1917. FINCH, WILLIAM J., 9 Stokes Croft, Bristol, Works Manager.

1910. FINDLATER, JAMES, c/o Price's Patent Candle Co., Ltd., Bromborough Pool, near Birkenhead, Chief Chemist.

1916. FINDLATER, RICHARD H., c/o Broxburn Oil Co., Ltd., Broxburn, West Lothian, Chemist.

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1903. FISH, CHARLES C. R., 439 Boylston Street, Boston, Mass., U.S.A., Chemist.

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1918. FISHER, GEORGE E., The Grasselli Chemical Co., 13th Floor, Guardian Building, Cleveland, Ohio, U.S.A., Second Vice-President.

1900. FISHER, HENRY, 16 East 90th Street, New York City, U.S.A., Teacher of Chemistry.

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1918. FISHER, PAUL, The Warrington Chemical and Drug Co., Ltd., Paddington, near Warrington, Chemist.

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1889. FORD, JOHN S., Abbey Brewery, Edinburgh, Analyst.

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1917. Francis, Francis, The University, Bristol, Professor of Chemistry.
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1902. Fuller, Henry C., Institute of Industrial Research, Washington, D.C., U.S.A., Analytical Chemist.
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1912. Gajjar, M. J., 22-24 Cowasji Patel Street, near Hongkong Bank, Bombay, India, Consulting Chemist.
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1884. Gall, Henry, 2 Rue Blanche, Paris, France, Technical Chemist.
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1903. Gallun, Albert F., 1000 North Water Street, Milwaukee, Wis., U.S.A., Tanner.
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1901. Galpin, Harry T., 57 West 57th Street, New York City, U.S.A., Chemist.
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1919. GAMBLE, CHARLES WM., College of Technology, Manchester, Head of Department of Photo Technology.
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1918. GARNER, CLEMENT, The Clayton Aniline Co., Ltd., Clayton, Manchester, Technical Chemist.
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1898. LEAN, GEORGE, 3 Park Quadrant, Glasgow, Chemist.

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1893. LE BOUTILLIER, CLEMENT, c/o Taylor Iron and Steel Co., High Bridge, N.J., U.S.A., Chemist.

1904. LE CHATELIER, PROF. H., 75 Rue Notre Dame des Champs, Paris, France, Professor (l'Ecole des Mines).

1896. LECOMBER, W. G., Cambridge Works, Knott Mill, Manchester, Engineer.

1896. LEDERLE DR. E. J., 455 Greene Avenue, Brooklyn, N.Y., U.S.A., Chemist.

1895. LEDOUX, DR. ALBERT R., 99 John Street, New York City, U.S.A., Chemist.

1903. LEDOUX, AUG. D., 15 William Street, New York City, U.S.A., Importer of Pyrites.

1915. LEDOUX, FREDERIC, Société Minière et Métallurgique de Peñarroya, 12 Place Vendôme, Paris, Director-General.

1915. LEDWIDGE, JOS. G., Municipal Technicel School, Drogheda, Ireland, Analytical Chemist.

1919. LEE, FANG-TSUNG, c/o The Educational Supply Co., Tsinan City, Shantung, China, Works Chemist.

1919. LEE, HARRY R., 18th Floor, 30 East 42nd Street, New York, U.S.A., Electro-Metallurgist.

1905. LEE, JOHN C., Wellesley, Mass., U.S.A., Assistant Engineer (American Telegraph and Telephone Co.).

1898. LEE, JOHN L., Woodfield, Lytham, Lancashire, Dyer and Bleacher.

1919. LEE, JOHN WM., Birchill Lodge, Hasland, Chesterfield, Chemist and Coke Oven Manager.

1885. LEE, S. WRIGHT, 6-10 Whitechapel, Liverpool, Wholesale Druggist.

1918. LEE, THEOPHILUS H., Serviço Geologico e Mineralogico do Brazil, Ministorio de Agricultura, Praia Vermelha, Rio de Janeiro, Chief Chemist.

1906. LEE, WILLIAM, 28 Sherard Gardens, Eltham, Kent, Works Chemist.

1915. LEECH, BEN., 77 Pownall Street, Macclesfield, Consulting Chemist.

1916. LEECH, HERBERT L., "Shaonbrook," Stephens Road, Tunbridge Wells, Director and Works Manager.

1912. LEES, ARNOLD, c/o County Laboratory, 36 Dansie Street, Liverpool, Analytical Chemist.

1919. LEES, HERBERT D., 8 Elvaston Road, Hexham-on-Tyne, Northumberland, Assistant Gas Manager.

1915. LEESE, LRNEST, Messrs. Sharland and Co., Ltd., Wholesale and Manufacturing Chemists, Auckland, New Zealand, Analyst.

1914. LEGG, BERTRAM, Vista Alegre 4, Minas de Rio Tinto, Prov. Huelva, Spain, Chemist and Assayer.

1919. LEGG, DAVID A., Featherstone Laboratories, 10a Featherstone Buildings, High Holborn, London, W.C. 1, Research Chemist.

1907. LEHMANN, DR. ADOLF F., University of Alberta, Strathcona, Alberta, Canada, Professor of Chemistry.

1888. LEIGH, CECIL, c/o Messrs. Thermit, Ltd., 675 Commercial Road, London, E. 14, General Manager.

1918. LEIGH, SAMUEL P., 39 St. James's Street, London, S.W. 1, Secretary.

1916. LEIGHTON, E. W., "Karachi," Empress Avenue, Woodford Green, Essex, Metallurgist.

1894. LEITCH, JOHN W., Milnsbridge Chemical Works, near Huddersfield, Aniline Dye Manufacturer.

1904. LE MAISTRE, FRED. J., 12 Swarthmore Avenue, Ridley Park, Pa., U.S.A., Research Chemist.

1898. LEMAN, WILLIAM T., P.O. Box 747, Chicago, Ill., U.S.A., Oil and Asphalt Agent.

1918. LEMMENS, GUSTAVE J. F., Yalding Manufacturing Co., Ltd., Yalding, Kent, Soap and Chemical Manufacturer.

1883. LENNARD, F., c/o Forbes, Abbott, and Lennard, Ltd., Chemical Works, Shoreham, Sussex, Chemical Manufacturer.

1918. LEON, MORRIS, c/o Messrs. J. Mandleberg and Co., Seaford Road, Lower Broughton, Manchester, Research Chemist.

1884. LEONARD, WILLIAM J., 1 Lindfield Gardens, Hampstead, London, N.W., Naphtha Distiller.

1904. LESLEY, ROBERT W., 604 Pennsylvania Building, Philadelphia, Pa., U.S.A., Cement Manufecturer.

1916 LESLIE, EUGENE H., Chemical Engineering Dept., University of Michigan, Ann Arbor, Mich., U.S.A., Chief Chemist.

1907. LESLIE, DR. FRED A., 79 Post Avenue, New York City, U.S.A., Chemist.

1904. LESSING, DR. RUDOLF, Southampton House, 317 High Holborn, London, W.C., Consulting Chemist.

1912. LESSNER, CHARLES, Carril, Spain, Metallurgical Chemist.

1892. LESTER, J. H., The Laboratory, 55 Oxford Street, Manchester, Analytical Chemist.

1899. LE SUEUR, MAJOR HENRY R., Chemical Laboratory, St. Thomas' Hospital, London, S.E., Lecturer.

1909. LEVER, W. HULME, Heathfield, Bebington, Cheshire, Soap Manufacturer.

1891. LEVERHULME, RIGHT HON. LORD, The Hill, North End, Hampstead Heath, London, N.W. 3, Soap Manufacturer.

1901. LEVETT, WALTER, c/o Mines Safety Explosives Co., Stanford-le-Hope, Essex, Factory Manager.

1915. LEVEY, ALFRED E., 11 Clifton Street, Hornsea, Yorks, Works Chemist.

1903. LEVI, DR. LOUIS E., 781 Sherman Boulevard, Milwaukee, Wis., U.S.A., Chemist.

1919. LEVIN, BERTRAM, 16 Deansgate, Manchester, Chemical Manufacturer.

1912. LEVIN, ISAAC H., *2635 Penn Avenue, Pittsburgh, Penna, U.S.A., Chemist.*

1906. LEVINSTEIN, EDGAR, 74 India Street, Boston, Mass., U.S.A., Chemical Manufacturer.

1901. LEVINSTEIN, DR. HERBERT, c/o Levinstein, Ltd., Blackley, near Manchester, Chemist.

1917. LEVY, FRANK, c/o Butter Substitutes Supplies, Ltd., Balfour House, 119-125 Finsbury Pavement, London, E.C. 2, Chemical Engineer.

1909. LEVY, LOUIS S., 80 Maiden Lane, New York City, U.S.A., Editor "American Perfumer."

1916. LEVY, STANLEY I., Sorbo Works, Woking, Surrey, Chemist.

1898. LEWIN, H. JAMES, Royal Clarence Yard, Gosport, Hants, Analytical Chemist.

1896. LEWIS, DANIEL C., c/o Millville Manufacturing Co., Millville, N.J., U.S.A., Dye Works Chemist.

1919. LEWIS, EDGAR, 37 Marston Road, Knowle, Bristol, Chemist.

1904. LEWIS, EDW. W., c/o Messrs. Hepburn, Gale, and Ross, Ltd., 239 Long Lane, Bermondsey, London, S.E. 1, Works Chemist.

1918. LEWIS, FRANCIS W., c/o A. Boake Roberts and Co., Ltd., 100 Carpenter's Road, Stratford, London, E., Manufacturing Chemist.

1918. LEWIS, GEOFFREY E., c/o Messrs. Holroyd and Co., Ltd., Pietrie Branch, Whitehall Street, Rochdale, Metallurgical Chemist.

1918. LEWIS, MISS IVA G., 24 Emerson Road, Ilford, Essex, Chemist.

1909. LEWIS, REGINALD J., Government Explosives Office, 423 Flinders Lane, Melbourne, Australia, Chemist.

1918. LEWIS, ROBERT I., c/o The Burmah Oil Co., Ltd., Rangoon, India, Chemist.

1900. LEWIS, DR. S. JUDD, The Laboratories, Staple Inn Buildings, High Holborn, London, W.C., Analytical Chemist.

1914. LEWIS, PROF. W. C. MCC., Muspratt Laboratory, The University, Liverpool, Professor of Physical Chemistry.

1918. LEWIS-DALE, PERCY, 157 Ruskin Road, Crewe, Analytical Chemist.

1913. LEWKOWITSCH, MRS. K. J., The Lewkowitsch Laboratories, 71 Priory Road, West Hampstead, London, N.W.

1919. LEYSHON, EVAN, 27 Wyeverne Road, Cathay, Cardiff, Glam., Student.

1907. LEYSON, LEWIS T., Butters Electrolytic Zinc Syndicate, Martinez, Cal., U.S.A., Analytical Chemist.

1916. LICENCE, ARTHUR B. C., 39 Spencer Road, Cottenham Park, Wimbledon, London, S.W. 19, Director and Chemist (Dye Manufacturing Co.).

1901. LICHTENSTEIN, ALF. F., c/o Geisenheimer and Co., P.O. Box 994, New York City, U.S.A., Chemist.

1917. LIDSTONE, FRANK M., 37 Powell Street, Derby, Analytical Chemist.

1916. LIEBERT, DR. MARTIN, c/o Spencer Chapman and Messel, Ltd., 36 Mark Lane, London, E.C., Chemical Manufacturer.

O.M. LIEBMANN, DR. A., The Whim, Weybridge, Surrey, Analytical and Consulting Chemist.

1905. LILEY, THOMAS A., 46 Westover Road, Bramley, Leeds, Chemist.

1898. LILLY, JOSIAH K., c/o Eli Lilly and Co., Indianapolis, Ind., U.S.A., Manufacturing Pharmacist.

1918. LINCH, FRANK W., Beech Lawn, Dudley Road, Whalley Range, Manchester, Chief Chemist.

1904. LINDEMANN, OTTOCAR, 53 Victoria Street, Westminster, London, S.W., Managing Director (Korting Bros., Ltd.).

1908. LINDFIELD, JAMES H., 33 Preston Road, Leytonstone, London, E. 11, Technical Chemist.

1897. LINDSAY, ROBT., Transvaal G.M. Estates, Ltd., Pilgrim's Rest, Lydenburg, Transvaal, Chemist.

1911. LINE, CHAS. A., *39 Beaufort Road, Edgbaston, Birmingham, Technologist.*

1890. LING, ARTHUR R., Laboratory, 74 Great Tower Street, London, E.C., Analytical and Consulting Chemist.

1896. LISHMAN, DR. GEORGE P., Lambton Coke Works, Fence Houses, Co. Durham, Colliery Chemist.

1905. LITTLE, ARTHUR D., 30 Charles River Road, Cambridge, Mass., U.S.A., Consulting Chemist.

1917. LITTLE, HARRY F. V., 13 Coventry Road, Ilford, Essex, Chemist and Works Manager.

O.M. LITTLEJOHN, JAS., c/o Littlejohn and Whitby, P.O. Box 849, Johannesburg, South Africa, Analytical Chemist.

1916. LITTLER, ROBERT P., c/o Messrs. United Alkali Co., Ltd., Netham Works, Bristol, Chemist.

1916. LITTLEWOOD, ERNEST A., 12 Brookfield Road, Crumpsall, Manchester, Works Chemist.

1917. LIVERMORE, ALFRED E., 23 Henleaze Gardens, Westbury, Bristol, Flour Milling Engineer.

1904. LIVERMORE, WILLIAM D., Washington Mill, Lawrence, Mass., U.S.A., Chemist.

1886. LIVERSEDGE, A. J., 63 Northampton Road, Croydon, Mechanical Engineer.

1914. LIVERSEDGE, JOHN A., The Whangarei Freezing Works, Restahi, New Zealand, Assistant Lead Mill Manager.

O.M. LIVERSIDGE, PROF. A., F.R.S., Fieldhead, Coombe Warren, Kingston, Surrey, Professor of Chemistry.

1883. LIVINGSTON, W. J., 30 Fountayne Road, Stoke Newington Common, London, N., Analytical Chemist.

1903. LLEWELLYN, IVOR P., 149 Moorland Road, Stockport, Chemist.

1907. LLEWELLYN, WILLIAM B., Park House, Westbourne Park, Urmston, near Manchester, Chemist.

1909. LLOYD, EDWARD, "Kings Pyon," Cavendish Road, Bowdon, Cheshire, Chemical Engineer.

1904. LLOYD, LEONARD B., Whitehall Street, Yarraville, Victoria, Australia, Tanner.

1907. LLOYD, DR. LORENZO L., Technical College, Bradford, Yorks, Lecturer in Chemistry.

1916. LLOYD, PROF. STEWART J., University, Alabama, U.S.A., Professor of Chemistry.

1900. LLOYD, THOMAS H., 7 Beacon Hill Road, Newark-on-Trent, Analyst.

1916. LLOYD-WILLEY, W. S., Invicta Mills, Bow Common Lane, London, E., Charcoal Manufacturer.

1917. LOCHHEAD, ALEXANDER C., c/o The Burmah Oil Co., Ltd., Box 67, Rangoon, Burmah, Chemist.

1914. LOCKETT, WILLIAM T., 150 Greenvale Road, Eltham Park, London, S.E. 9, Research Chemist.

1915. LOCKIE, JOHN R., Ascog, Meikleriggs, Paisley, Scotland, Analytical Chemist.

1918. LOCKYER, ARTHUR G., c/o George Lockyer and Son, Ltd., St. Philip's Marsh, Bristol, Works Chemist.

1888. LODGE, EDW., 35 Scale Hill, Cowcliffe, Huddersfield, Chemist and Dyer.

1917. LODGE, GEORGE, Levinstein, Ltd., Blackley, Manchester, Research Chemist.

1919. LOMAS, WILLIAM A., "Park View," Norman Road, Birkby, Huddersfield, Chemical Engineer.

1918. LOMAX, ABRAHAM, c/o Messrs. Ainsworth Mercerising Co., Ltd., Ainsworth Vale, near Bolton, Managing Director.

1907. LOMAX, ERNEST LAWSON, Hall Motor Fuel, Ltd., Pinner's Hall, Austin Friars, London, E.C., Chemist. Retain Journals.

1901. LONG, EUGENE J., c/o E. O'Callaghan and Son, City Tannery, Limerick, Ireland, Tanner.

1909. LONG, GEORGE M., Cudahy, Wis., U.S.A., Glue Maker.

1919. LONGLEY, REGINALD, 10 Queen Mary's Walk, Llanelly, South Wales, Metallurgical Chemist.

1898. LONGSTAFF, DR. JAMES P., Central House, Finsbury Square, London, E.C. 2, General Secretary.

1917. LOO, SHIH CHEN, 70 High Lane, Chorlton-cum-Hardy, Manchester, Student.

1890. LORD, FREDERICK J., Winmarleigh, Southbourne, Bournemouth, Hants, Analytical Chemist.

1896. LORD, JOHN LLOYD, Wellington Cement Works, Elton, Bury, Lancs, Chemist and Manager.

O.M. LORENZ, H., 7 and 8 Idol Lane, London, E.C., Chemical Merchant.

1917. LORIMER, JOHN W., 195 Cliffe Road, Stroud, Rochester, Analytical Chemist.

1905. LORING, LINDSLEY, 40 Central Street, Boston, Mass., U.S.A., Vice-President (Cochrane Chemical Co.).

1909. LORLEBERG, CHARLES, c/o R. W. Greeff and Co., Thames House, Queen Street Place, London, E.C., Chemical Merchant.

1916. LOTHBURY, PHILIP A., 3 Dennington Park Road, West Hampstead, London, N.W. 6, Managing Director and Chemist, Dye Manufacturing Co.

1894. LOUIS, PROF. HENRY, 4 Osborne Terrace, Newcastle-on-Tyne, Professor of Mining (Armstrong College).

1900. LOW, PROF. WILSON H., Cudahy Packing Co., South Omaha, Neb., U.S.A., Chemist.

1911. LOWCOCK, JOHN HAROLD, 39 Wickham Way, Park Langley, Beckenham, Kent, Chemist.

1913. LOWE, AUSTIN, c/o Mrs. Henwood, St. Ann's Chapel, Albaston, Gunnislake, near Tavistock, Cornwall, Research Chemist.

1887. LOWE, CLEMENT W., Thorneyholme, Knutsford, Cheshire, Manufacturing Chemist.

O.M. LOWE, W. F., Locheil Park West, Heswall, Birkenhead, Analytical Chemist.

1919. LOWRY, PROFESSOR T. MARTIN, 17 Eliot Park, Lewisham, London, S.E. 13, Professor of Chemistry.

1906. LOWSON, WILLIAM, The University, Leeds, Chemical Lecturer.

1918. LOXTON, NORMAN G., Laboratory, Leeds Fireclay Co., Ltd., Burmantofts Works, Leeds, Operating Chemist.

1918. LUCAS, ALBERT R., 11 Goldsdown Road, Brimsdown, Middlesex, Analytical and Works Chemist.

1895. LUCAS, ALFRED, Government Anal. Laboratory, Public Works Ministry Gardens, Cairo, Egypt, Analyst.

1892. LUCAS, BERNARD R., Winnington Park, Northwich, Cheshire, Alkali Works Manager.

O.M. LUCK, A. COURTENAY, c/o de Ferro Carrie Pacifico, Florida 783, Buenos Ayres, Argentina, Explosives Chemist.

1913. LUCY, ARTHUR J., c/o Turner and Co., 45 St. Mary Axe, London, E.C. 3, Consulting Engineer.

1918. LUENING, J. H., 309 St. John's Court, Chicago, Ill., U.S.A., Chemical Manufacturer.

1916. LUFF, BERNARD D. W., 85 Ashley Terrace, Edinburgh, Technical Chemist.

1915. LUMLEY, EDGAR P., 37 General Graham Street, Chester Road, Sunderland, Chemist.

1900. LUMMUS, WALTER E., 39 Bassett Street, Lynn, Mass., U.S.A., Manager.

1917. LUMSDAINE, MISS HELEN A., 23 Sciennes Road, Edinburgh, Analytical Chemist.

1903. LUMSDEN, ALEX. A., Forth Chemical Works, Bo'ness, Scotland, Technical Chemist

1918. LUMSDEN, COLIN H., Beech Lawn, Whalley Range, Manchester, Analytical Chemist.

1910. LUMSDEN, WILLIAM W., 39 Caledonia Road, Saltcoats, Scotland.

1915. LUND, WILLIAM JACKSON, 91 Mitchell Street, Rochdale, Chemist.

1888. LUNDHOLM, CARL O., 220 Winchester House, Old Broad Street, London, E.C., Explosives Works Manager.

1918. LUNDHOLM, GÖSTA, c/o British South African Explosives Co., Ltd., Modderfontein, Transvaal, South Africa, Chemist.

1918. LUNDHOLM, NILS O., 11 South Beach Avenue, Ardrossan, Ayrshire, Chemist.

O.M. LUNGE, DR. GEORGE, Carmenastrasse 37, Zürich, V, Switzerland, Professor of Chemistry.

1918. LUSCHER, HARRY W., P.O. Box 38, c/o U.S. Glue Co., Milwaukee, Wis., U.S.A., General Manager.

1884. LÜTHY, OTTO, Hackensack, N.J., U.S.A., Analytical Chemist.

1919. LYALL, FREDERICK E., 299 Dereham Road, Norwich, Assistant Works Chemist.

1903. LYE, ERNEST B., Leagrave Hall, near Luton, Beds, Straw Plait Dyer and Bleacher.

1915. LYLE, CHARLES E. LEONARD, 21 Mincing Lane, London, E.C., Sugar Refiner.

1884. LYLE, JAMES, Ardesco, Hunter's Quay, Argyllshire, Sugar Refiner.

1916. LYMAN, ARTHUR, c/o Lyman's, Ltd., 344 St. Paul Street West, Montreal, Canada, Wholesale Druggist.

1896. LYMN, ARTHUR H., 40 Westminster Palace Gardens, London, S.W. 1, Consulting Chemist and Gas Engineer.

1899. LYNN, R. RANKINE, 8 Windsor Quadrant, Kelvinside, Glasgow, Chemical Engineer.

1917. LYON, HARRY L., c/o Stainsby and Lyon, Ltd., Knottingley, Yorks, Chemical Manufacturer.

1919. LYONS, CHARLES H., The Nichols Chemical Co., Ltd., 222 St. James Street, Montreal, Canada.

1906. LYONS, ROBERT H., 131 Brock Avenue South, Montreal West, Quebec, Canada, Chemist.

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1908. MAAS, MILTON A., 92 William Street, New York City, U.S.A., Manufacturing Chemist.

1911. MABBITT, ALAN T., 3 Wallwood Road, Leytonstone, London, E., Analytical Chemist.

1887. MABERY, PROF. CHARLES F., Case School of Applied Science, Cleveland, Ohio, U.S.A., Professor of Chemistry.

1891. MACADAM, HERBERT E., The Shanty, East Cliff, Southwold, Suffolk, Manure Works Manager.

1894. MACADAM, STEVENSON, 55 York Place, Edinburgh, Analytical Chemist.

1917. MCALLEY, JAMES, "Norcot," Church Lane, Whitefield, near Manchester, General Manager.

1919. MCANALLY, SAMUEL G., Canada Cement Co., Hull, P.Q., Canada, Chemist.

1892. MACARA, THOMAS, JUN., 20 Denton Road, Stroud Green, London, N., Chemist.

1912. MCARLY, THOMAS P., Mount Lyell Mining and Railway Co., Queenstown, Tasmania, Chemist and Assayer.

1917. MCARTHUR, DONALD N., Chemistry Dept., West of Scotland Agricultural College, 6 Blythswood Square, Glasgow, Research Chemist.

1887. MCARTHUR, JAMES B., Price's Patent Candle Co., Limited, Belmont Works, Battersea, London, S.W., Oil Works Chemist.

O.M. MCARTHUR, J. S., Loch Lomond Radium Works, Balloch, Dumbartonshire, Consulting Chemist and Metallurgist.

1901. MACARTHUR, JOHN S., 15 St. John's Road, Pollokshields, Glasgow, Paint and Varnish Manufacturer.

1892. MCARTHUR, THOMAS, 711 Tower Building, Water Street, Liverpool, Drysalter and Drywood Extractor.

1918. MACARTNEY, WILLIAM S., "Kiewa," 148 Cochrane Street, Elsternwick, Melbourne, Vic., Australia, Chemist.
1917. MACAULAY, JAMES R., 2378 Hutchison Street, Montreal, Canada, Chemist.
1912. MACAULAY, JOHN W., "Oakleigh," Kenilworth Road, Monkseaton, Northumberland, Metallurgical Chemist.
1919. McBAIN, JAMES W., The University, Bristol, Lecturer in Physical Chemistry.
1919. McCAFFERTY, WILLIAM H., 285 Skegoniell Avenue, Belfast, Works Chemist.
1919. McCALL, ROBERT, The Old Bleach Linen Co., Ltd., Randalstown, Co. Antrim, Research Chemist.
1919. MACALLUM, A. BRUCE, Synthetic Drug Co., 243 College Street, Toronto, Canada, Industrial Chemist.
1919. MACALLUM, A. DOUGLAS, Synthetic Drug Co., 243 College Street, Toronto, Canada, Chemist.
1898. MACCALLUM, D. A., 389 Central Chambers, 93 Hope Street, Glasgow, Chemist.
1919. MACALLUM, E. NEIL, Synthetic Drug Co., 243 College Street, Toronto, Canada, Chemical Manufacturer.
O.M. MACCALLUM, SIR J. M., M.P., Southdene, Paisley, Scotland, Soap Manufacturer.
1918. McCANDLISH, DAVID, c/o Messrs. J. Tetley and Son, Ltd., Brewery, Leeds, Analyst and Assistant Brewer.
1917. McCARTHY, HAROLD H., 185 Fox Lane, Palmer's Green, London, N., Chemist.
1914. McCARTHY, ROBERT A., Wharf Road, Concord, Sydney, N.S.W., Australia, Gas Chemist.
1918. MACARTNEY, WILLIAM S., "Kiewa," 148 Cochrane Street, Elsternwick, Melbourne, Australia, Chemist.
1917. McCAULEY, JOHN J., "Sunnyholme," Fairfield Road, Latchford, W., Warrington, Technical Chemist.
1905. McCAW, LIEUT.-COL. WALTER D., Library, Surgeon General's Office, Washington, D.C., U.S.A., Officer, Medical Department, U.S. Army.
1918. McCLEAK, GEOFFREY J., Killarney, Cliffe Road, Cliffe, Kent, Superintendent.
1918. McCOMB, WILLIAM, c/o Messrs. Cuban Motor Spirits Co., 72 Trinity Place, New York City, U.S.A., Petroleum Engineer.
1913. McCRADY, McH., 59 Notre Dame East, Montreal, Canada, Chemist and Bacteriologist.
1897. McCRAE, DR. JOHN, Government Laboratories, P.O. Box 1080, Johannesburg, Transvaal, Chemist.
1898. McCREATH, WM. D., Quantock Vale Cider Works, North Petherton, Bridgewater, Cider Manufacturer.
1900. McCULLOCH, JOHN, Glencoe, Lostock Gralam, Cheshire, Chemical Engineer.
1911. McCULLOCH, NORMAN G., Springfield Print Works, 87 McNeil Street, Glasgow, S.S., Chemist and Calico Printer.
1903. McCULLY, R. E. J., c/o The Indian Cement Co., Porbandar, Kathiawar, India, Analytical Chemist.
1916. McDERMOTT, F. A., No. 703 Nottingham Road, Wawaset Park, Wilmington, Del., U.S.A., Research Chemist.
1910. MACDONALD, ALEXANDER, 2 Foremount Gardens, Glasgow, W., Manufacturing Chemist.
1912. MACDONALD, ALLAN D., "Belgrano," Milngavie, near Glasgow, Manufacturing Chemist.
O.M. MACDONALD, ANDREW, 72 Great Clyde Street, Glasgow.
1912. McDONALD, DONALD, 95 Clarence Gate Gardens, Regent's Park, London, N.W., Analytical Chemist.
1918. MACDONALD, DUNCAN M., 33 Clyde Road, Alexandra Park, London, N. 22, Works Chemist.
1897. MACDONALD, GEORGE W., O.B.E., Whitefriars, Rochester, Kent, Chief Explosives Research Chemist (Curtis's and Harvey, Ltd.).
1917. MACDONALD, GORDON G., 88 Indian Grove, Toronto, Canada, Chemist.
1910. MACDONALD, LIEUT.-COL. J. L. A., Cadham, Markinch, Fife, Scotland, Chief Chemist.
O.M. MACDONALD, J. W., c/o Henry Tate and Sons, Ltd., Thames Sugar Refinery, Silvertown, London, E. 16, Analytical Chemist.
O.M. McDONALD, T. McG., Walilabo Estate, St. Vincent, West Indies, Sugar Chemist.
1916. MACDOUGALL, ARCHIBALD J., National Electro Products Ltd., 87 Church Street, Toronto, Canada, Mechanical Engineer.
1906. McDOWALL, WILLIAM, 42 Herriet Street, Pollokshields, Glasgow, Analytical Chemist.
1917. McEWEN, GORDON C., c/o Imperial Varnish and Colour Co., Ltd., Morse Street, Toronto, Canada, Chemist.
1918. MACFADYEN, WILLIAM A., St. John's College, Cambridge.
1902. McFARLAND, ALAN R., c/o Solvay Process Co., Syracuse, N.Y., U.S.A., Alkali Works Manager.
1916. MACFARLANE, CHARLES W. C., 166 Forth Street, Pollokshields, Glasgow, Analytical Chemist.
1910. McFARLANE, JOHN, 6 Gordon Terrace, Shettleston, Glasgow, Metallurgist.
1919. MACFARLANE, WILLIAM W., Fingarry, Milton-of-Campsie, Stirlingshire, Biscuit Manufacturer.
1919. McFEE, M.C. Coll., 164 Hutchison Street, Montreal, Canada, Chemist.
1893. McGHIE, T. BURNS, c/o Dr. Goodall, 1 Annandale Road, East Greenwich, London, S.E., Metallurgist.
1904. McGILL, DR. ANTHONY, 317 Queen Street, Ottawa, Canada, Analytical Chemist.
1917. McGILLIVRAY, JAMES, 34 Waverley Place, Edinburgh, Chemist.
1899. McGILLIVRAY, WILLIAM A., Messrs. Nobel's Explosives Co., Ltd., Regent Factory, Linlithgow, Scotland, Works Manager.
1887. McGLASHAN, JOHN, c/o India Development Corporation, Kelvin Grove, Simla, India, Technical Chemist.
1918. McGRAW, WILLIAM, Simplex Refinery Co., Higgin's Buildings, Los Angeles, Cal., U.S.A., Refinery Manager.
1917. MACGREGOR, JAMES, c/o E. Scott and Co., Ltd., 19 Waterloo Street, Glasgow, Joint Managing Director.
1918. MACGREGOR, ROBERT W., c/o Ernest Scott & Co., Engineers, P.O. Box 259, Fall River, Mass., U.S.A., Engineer.
1896. McILHINEY, DR. PARKER C., 50 East 41st Street, New York City, U.S.A., Chemist.
O.M. McILWAINE, ALF. W., Stoneferry, Hull, Oil Manufacturer.
O.M. McINDOE, G. D., 115 Ness Street, Invercargill, New Zealand, Public Analyst and Consulting Chemist.
1917. McINDOE, ROBERT S., 54 Wellington Street East, Toronto, Canada, Manufacturer.
1917. MACINNES, RONALD, 17 Shrewsbury Road, New Southgate, London, N., Departmental Manager.
1919. McINTOSH, DOUGLAS, University of British Columbia, Vancouver, B.C., Canada, Professor of Chemistry.
1918. MACINTYRE, ALFRED E., 35 Bank Street Chambers, Ottawa, Ontario, Canada, Chemist.
1909. McINTYRE, GEORGE D., 536 Notre Dame de Grace Avenue, Montreal, P.Q., Canada, Technical Chemist.
1918. McINTYRE, JOHN, c/o Messrs. Jas. Milne and Son, Ltd., Milton House Works, Abbeyhill, Edinburgh, Engineering Manager.
1916. MACK, GEORGE A., 15 Clarence Street, Runcorn, Cheshire, Works Chemist.

1910. MACKAY, ANGUS, Laboratory, Wellpark Brewery, Glasgow, Brewer's Chemist.
1918. MACKAY, PROF. EBENEZER, Dalhousie University, Halifax, Nova Scotia, Canada, Professor of Chemistry.
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1904. MACKECHNIE, ROBERT D., 57 Gracechurch Street, London, E.C. 3, Chemical Engineer.
1919. McKEE, DR. JAMES L., Queen's University, Kingston, Ont., Canada, Professor of Chemistry.
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1918. MACLACHLAN, KELLOGG S., 121 Admiral Road, Toronto, Canada, Chemical Engineer.
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1918. MACLEOD-BROWN, JAMES, Department of Technology, Imperial College of Science and Technology, South Kensington, London, S.W. 7, Research Chemist.
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1918. MARSHALL, ALBERT E., c/o Davison Chemical Co., Curtis Bay Plant, Curtis Bay, Md., U.S.A., Works Manager.
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1918. MARSHALL, HOWARD E., Port Chester, New York, U.S.A., Purchasing Agent.
1918. MARSHALL, J. HENDERSON, Cham. (Canton Zug), Switzerland, Chemical Engineer.
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1913. MARSHALL, PHILIP W., c/o The Fred. Crane Chemical Co., Ltd., Armoury Close, Bordesley Green, Birmingham, Lacquer Manufacturer (retired).
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1918 MARTIN, HERBERT E., 322 Wells Road, Knowle, Bristol, Chemist.
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1917. MASON, WILLIAM, 11 Merivale Street, Edge Hill, Liverpool, Chemical Engineer.
1914. MASON, WILLIAM O. S., Bankside, Meopham, near Gravesend, Kent, Analytical Chemist.
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1915. MASSE, RENÉ, 12 Rue de Clichy, Paris, France, President (Gas Society).
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1902. MASUJIMA, PROF. BUNJIRO, c/o K. Takebe, '6 Gazenbocho, Azabuku, Tokyo, Japan, Professor of Applied Chemistry.
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1911. MATHER, HUBERT, Lonsdale Terrace, Whitefield, Lancashire, Chemist.
1918. MATHER, WILFRED, 302 Audenshaw Road, Audenshaw, near Manchester, Chemist.
1900. MATHER, WILLIAM, Delta Chemical Co., Wells, Delta Co., Mich., U.S.A., Chemist.
1907. MATHESON, A. GRENVILLE E., 128 Belsize Road, Kilburn, London, N.W. 6, Consulting Engineer.
1918. MATHESON, HOWARD W., Canadian Electro Products Co., Ltd., Shawinigan Falls, Que., Canada, General Manager and Chief Chemist.
1890. MATHESON, W. J., c/o Cassella Color Co., 182 Front Street, New York City, U.S.A., Chemical Merchant.
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1898. MATHEWSON, E. P., 42 Broadway, New York City, U.S.A., Metallurgist.
1919. MATHIESON, JULIUS, "Highfield," West Thurrock, near Grays, Essex, Cement Works Manager.
1888. MATOS, DR. LOUIS J. (Comms.), c/o National Aniline and Chemical Co. Inc., 21 Burling Slip, New York, U.S.A., and (Journals) 103 North 19th Street, East Orange, N.J., U.S.A., Chemist.
1896. MATSUI, G., 10 Nishikatamachi, Hongo, Tokyo, Japan, Chemical Engineer.
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1918. MATTHEWS, JOSEPH K., Messrs. Pilkington Bros., Ltd., St. Helens, Lancs, Chemist.
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1918. MEEZE, EDGAR, H., c/o Ardol Ltd., Selby, Yorks, Chemist.
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1918. MILLS, WILLIAM H., Jesus College, Cambridge, Lecturer.
1905. MILLS, WILLIAM HENRY, 120 Broadway, New York City, U.S.A., Merchant.
1916. MILLS, DR. WILLIAM S., Levinstein, Ltd., Ellesmere Port, near Chester, Research Chemist.
1916. MILLS, WILLIE G., "Sylvan," Bramford, near Ipswich, Suffolk, Works Manager.
1919. MILNE, WILLIAM, Arbuthnott, Balloch, Dunbartonshire, Yarn Dyeing Chemist.
1919. MILNE, WILLIAM S., 43 Queen's Road, Aberdeen, Technical Chemist.
1916. MILNER, DAVID W., Silkstone Common, Barnsley, Yorks, Works Chemist.
1903. MILNES, CRESSWELL, The Cedars, Holborough, near Rochester, Cement Works Manager.
1887. MILNES, EDMUND, Seedfield, Bury, Lancashire, Dyeing Extract Maker.
1902. MILNES, ERNEST E., Park Print Works, Halifax, Yorks, Chemist.
1895. MINER, HARLAN S., c/o Welsbach Light Co., Gloucester City, N.J., U.S.A., Technical Chemist.
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1918. MINTER, MISS DOROTHY J., 87 Marlborough Mansions, Cannon Hill, London, N.W. 6, Research Chemist.
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1919. MITCHELL, JOHN A., Southwick Lodge, 6 Park Road, West Dulwich, London, S.E. 21, Science Lecturer.

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1917. MITCHLEY, JOHN W., c/o Mrs. Morris, 2 Dalmeny Road, London, N. 7, Chemical Engineer.

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1910. MOE, CARL, Stevens Point Pulp and Paper Co., Stevens Point, Wis., U.S.A., Chemist.

1914. MOFFITT, FRANCIS A., Wyalusing, Pa., U.S.A., Chemist.

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1918. MONTAGUE, WILLIAM A., 7 Gerturk Street, Crosshill, Glasgow.

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1890. MOODIE, WILLIAM E., Alexandria Works, Alexandria, Scotland, Analytical Chemist.

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1914. MOORE, HAROLD, 85 Deansgate Arcade, Manchester, Consulting and Analytical Chemist.

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1918. MORFIT, CLARENCE M., c/o Du Pont Co., Grayling, Mich., U.S.A., Superintendent of Works.

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1910. MORRISON, J. A. S., c/o The Highfield Tanning Co., Ltd., Runcorn, Leather Trades Chemist.
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1916. MORTON, ALLAN, c/o Messrs. Levinstein, Ltd., Blackley, Manchester, Technical Research Chemist.
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1918. MOTT, DR. OWEN E., O.B.E., "Turley House," Bleakhouse Road, Warley, Langley, Worcester, Chief Chemist.
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1892. MOUNT, EDW. (United Alkali Company), Oaklands, Aughton, near Ormskirk, Assistant Secretary.
1917. MOYLE, RICHARD R., Chemical Works Manager.
1905. MRAZSEK, FEODOR M., 31 West Cromwell Road, London, S.W., Consulting Chemist.
1918. MUDDELL, JOHN E., 20 Market Street, Lewes, Sussex, Engineer's Assistant.
1890. MUIR, JAMES STANLEY, 23 Lilybank Gardens, Glasgow, W., Chemist.
1917. MUIRHEAD, WILLIAM, Braeadale Terrace, Woodhead Avenue, Kirkintilloch, Works Chemist.
1919. MUMMERY, CHARLES S., "Uffcolme," Church Hill, Loughton, Essex, Works and Research Chemist.
1896. MUNDY, LIONEL, 27 Merton Road, Kensington, W., Importer of Unfermented Wines.
1914. MUNN, WILLIAM F., 518 Main Street, East Orange, N.J., U.S.A., Chemist.
1887. MUNROE, PROF. CHARLES E., Forest Glenn, Maryland, U.S.A., Professor of Chemistry and Dean.
1900. MUNTON, FRED. T., c/o The Salt Union, Ltd., Engineer's Office, Winsford, Cheshire, Analytical Chemist.
1904. MURDOCH, ALEXANDER, Garden Suburb, Westerton, near Glasgow, Analytical Chemist.
1912. MURDOCH, BARCLAY B., c/o Messrs. Aircraft Manufacturing Co., Ltd., The Hyde, Hendon, London, N.W. 9, Technical Chemist.
1917. MURDOCH, DAVID S., 28 Craigpark Drive, Dennistoun, Glasgow, Analytical Chemist.
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1886. MURDOCH, R. H. M., Summerhill, Bothwell, Lanarkshire, Explosives Chemist.
1919. MURGATROYD, JAMES H., c/o Messrs. G. H. Scott and Co., Ltd., Hague Bar Mills, Strines, near Stockport, Gas Works Chemist.
1899. MURPHY, ALBERT J., 2 Dorset Square, London, N.W. 1, Brewer's Chemist.
1919. MURPHY, MAJOR PAUL, R.E. Experimental Station, Porton, near Salisbury, Analytical Chemist.
1901. MURRAY, BENJAMIN L., c/o Merck and Co., Rahway, N.J., U.S.A., Chemist.
1903. MURRAY, CHARLES B., 407 Perry Payne Building, Cleveland, Ohio, U.S.A., Chemist.
1919. MURRAY, DONALD, c/o Messrs. Walkers, Parker and Co., Ltd., Low Elswick, Newcastle-on-Tyne, Manager.
1914. MURRAY, JOHN E., c/o Emerson Drug Co., 64 Spadina Avenue, Toronto, Canada, Laboratory Superintendent.
1898. MURRAY, RD., c/o Brotherton and Co., Ltd., Holmes Street, Dewsbury Road, Leeds, Analyst.
1908. MURRAY, DR. THOMAS J., Municipal Technical School, Wolverhampton, Lecturer on Chemistry.
1916. MURRAY-SALAMON, WILLIAM H., Ferry Road, Rainham, Essex, Chemical Manufacturer.
1905. MURRILL, DR. PAUL I., Room 86, Chemists' Building, 50 East 41st Street, New York, U.S.A., Superintendent.
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1894. MUSPRATT, MAX, The Grange, Fulwood Park, Liverpool, Technical Chemist.
O.M. MUSPRATT, S. K., Aïce Choko, Route des Dunes, St. Jean de Luz, B.P., France, Alkali Manufacturer.
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1911. MYERS, ERNEST M., "Greycourt," Harpfield, Stoke-on-Trent, Coke Oven Manager and Chemist.
1917. MYERS, FRANCIS W., c/o W. J. Bush and Co., Ltd., Ash Grove, Hackney, London, E., Works Chemist.
1917. MYERS, JOSEPH W., 4 Balmoral Gardens, Monkseaton, Northumberland, Analytical Chemist.
1891. MYERS, DR. WILLIAM S., 25 Madison Avenue, New York City, U.S.A., Director.

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1913. NAGASE, DENZO, c/o Japan Dyestuff Manufacturing Co., Ltd., Osaka, Japan, Engineer.
1908. NAGLE, JAMES C., c/o Nicholls, Nagle and Co., Ltd., Trafford Park, Manchester, Glucose and Starch Manufacturer.
1913. NAIR, VALLIYIL G., Société Cotonniere du Tonkin, Nam-Dinh, Tonkin, French Indo-China, Chemist and Colourist.
1897. NAIRN, SIR MICHAEL, BART., Dysart House, Fife, Linoleum Manufacturer.
1909. NAKAI, SHIRO, Miike Colliery Office, Omuta-machi, Chikugo, Japan, Engineer.
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1902. NEISH, DR. ARTHUR C., Dept. of Chemistry, Queen's University, Kingston, Ont., Canada, Chemist.
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1900. POPE, PROF., SIR WILLIAM J., K.B.E., F.R.S., University Chemical Laboratory, and (Journals) Holmesdale, Brooklands Avenue, Cambridge, Professor of Chemistry.
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1911. PORTEOUS, JAMES W., c/o Bolckow, Vaughan and Co., Ltd., Grange Hill, Bishop Auckland, Co. Durham, Chemist and Coke Oven Manager.
1919. PORTER, JAMES W., 35 Templemore Avenue, Belfast, Ireland, Technical and Research Chemist.
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1915. POTTER, ALFRED, 16 Nelson Street, Lower Broughton, Manchester, Rubber Works Chemist.
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1910. POTTS, HAROLD E., c/o W. P. Thompson and Co., Cooper's Building, Church Street, Liverpool, Patent Agent.
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1912. PRASAD, PROFESSOR HARI, Government College, Ajmer, India, Professor of Science.
1897. PRENTICE, DR. BERTRAM, Royal Technical Institute, Salford, Lecturer on Chemistry.
1902. PRENTICE, DR. DAVID, Teesholme, Walton New Road, Lower Walton, near Warrington, Chemist.
1903. PRENTICE, JAMES, Cossipore Sugar Works, Cossipore, Calcutta, India, Chemist.
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1919. PRESCOTT, WALKER F., c/o Sherwin Williams and Co., Ltd., Montreal, Que., Canada, Chemical Sales.
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1918. PRESTON, ORLANDO J., Stapleton Road Gas Works, Bristol, Gas Engineer.
1917. PRESTON, RICHARD W. D., Hillside, Sandbach, Cheshire, Technical Chemist.
1919. PRÉVOST, LOUIS, Etablissements H. Carroll, Caudebec en Caux (Seine-Inférieure), France, Director.
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1915. PRIESTLEY, DONALD. [Address unknown.] Works Chemist.
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1896. PROCHAZKA, DR. GEORGE A., c/o Central Dyestuff and Chemical Co., Newark, N.J., U.S.A., Colour Manufacturer.
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1913. PURVES, G. THOMSON, c/o Coke Ovens and By-product Works, Manvers Main Collieries, Ltd., Wath-on-Dearn, near Rotherham, Manager.

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1903. QUENEAU, AUGUSTIN L. J., The Chloride Syndicate, Ltd., The Quay, Wallsend-on-Tyne, Metallurgical Engineer.

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1919. QUILLIAM, THOMAS A., The County Secondary School, Finchley, London, N., Chemistry Master.

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1901. RAWLINS, HERBERT J. L., The Crossways, Rainhill, Lancashire, Managing Director.

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1914. READ, HAROLD M., The Briers, North Park Avenue, Roundhay, Leeds, Manufacturing Chemist.

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1890. READE, THOMAS, 118 Tettenhall Road, Wolverhampton, Manufacturing Chemist.

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1914. REDPATH, GEORGE C., 10 Dean Street, Newcastle-on-Tyne, Analytical Chemist.
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1916. REED, JOHN Y., c/o Hoyle, Robson, Barnett and Co., Ltd., Bill-Quay-on-Tyne, Analytical Chemist and Works Manager.
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1900. REESE, DR. CHARLES L., Technical Library, Chemical Dept., E. I., du Pont de Nemours and Co., Wilmington, Del., U.S.A., Chemist.
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1905. REID, DR. JOHN H., Speech House Hotel, Forest of Dean, Glos., Chemist.
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1896. REID, ROBERT, Oil Mills, Horbury Bridge, near Wakefield, Chemist.
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1918. REILLY, EDWARD P., 3, 4 and 5 Rood Lane, London, E.C. 3, Civil Engineer.
1917. REILLY, DR. JOSEPH, L'Ecole de Chimie, Université de Genève, Geneva, Switzerland, Chemist.
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1900. REMINGTON, J. STEWART, Aynsome, Grange-over-Sands, Lancs, Consulting Chemist.
1903. REMSEN, PROFESSOR IRA, Johns Hopkins University, Baltimore, Md., U.S.A., Professor of Chemistry.
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1911. RENTSCHLER, MAHLON J., Willoughby, Ohio, U.S.A., Chemist (U.S. Rubber Co.).
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1918. RIDER, MALCOLM S., c/o 59 Rossall Road, Ansdell, Lytham, Explosives Chemist.

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1912. RILEY, WALTER A., 100 King Street, Norwich, Brewer.

1899. RINK, ARNOLD, 11 Bridgewater Street, Barbican, London, E.C., Tannin Extract Manufacturer.

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1918. ROEBUCK, JOHN H., 102 Harley Street, Higher Openshaw, Manchester, Research Chemist.

1903. ROELOFSEN, DR. J. A., c/o Coal Distillation Co., Middlesbrough, Yorks, Works Manager.

1910. Roessler, Dr. Franz, 89 High Street, Perth Amboy, N.J., U.S.A., Chemist.

1918. Roff, Ernest A., Roseville, St. Margaret's-on-Thames, Technical Chemist.

1905. Rogers, Dr. Allen, Pratt Institute, Brooklyn, N.Y., U.S.A., Research Chemist.

1917. Rogers, Francis H., Elmhurst, Kenley, Surrey, Consulting Engineer.

1915. Rogers, Dr. Francis M., c/o Standard Oil Co., Whiting, Ind., U.S.A., Chemist.

1900. Rogers, George J., 32 Chudleigh Road, Brockley, London, S.E., Chemist.

1908. Rogers, Harry V., Ilkestone Laundry, Ilkeston, Derbyshire, Engineer.

1918. Rogers, Henry L., 60 Norwood Road, London, S.E. 24, Analytical Chemist.

1909. Rogers, Herbert, 6 Church Road, Highgate, London, N. 6, Rubber Works Chemist.

1915. Rogers, J. E., The Moorings, Heswall, Cheshire, Chemist.

1919. Rogers, Jerome S., c/o Messrs. Kistler, Lesh and Co., Morganton, N.C., U.S.A., Chemist.

1899. Rogers, John, c/o Nobel's Explosives Co., Ltd., Nobel House, Glasgow, Chemist.

1919. Rogers, Joslyn, University of Toronto, Canada, Assistant Professor in Analytical Chemistry.

1919. Rogers, T. Percival, Messrs. W. J. Rogers, Ltd., Brewers, Bristol, Chairman.

1918. Rogers, William D., 430 Wellington Road North, Heaton Chapel, Stockport, Research Chemist.

1918. Rogerson, Harold, Borrowdale, Bromborough, Cheshire, Works and Research Chemist.

1899. Rollin, Charles, Bylton, East Jarrow-on-Tyne, Chemical Manufacturer.

1909. Rollin, Hugh, 1558 Kanawha Street, Charleston, West Va., U.S.A., Chemical Manufacturer.

O.M. Rollin, J. C., 1 St. Nicholas Buildings, Newcastle-on-Tyne, Chemical Manufacturer.

1907. Rolph, George M., c/o California and Hawaiian Sugar Refining Co., Crockett, Cal., U.S.A., Sugar Refiner.

1905. Romanes, John W., c/o Lothian Chemical Co., Ltd., 3 Broughton Road, Edinburgh, Chemical Engineer.

1917. Roques, Ferdinand, 36 Rue Ste. Croix de la Bretonnerie, Paris, France, Manufacturing Chemist.

1919. Rose, Frederick C., c/o Vacuum Oil Co., 61 Broadway, New York City, U.S.A., Sales Manager.

1904. Rose, John, Wicken House, Stretton, near Warrington, Technical Chemist.

1901. Rose, John Leonard, 14 St. Vincent Road, Westcliff-on-Sea, Chemist.

1918. Rosebery, Marcus, 21 Horringford Road, Aigburth, Liverpool, Chemist.

1916. Rosebrugh, Richard M., 120 Circle Road, Berkeley Park, Syracuse, N.Y., U.S.A., Chemical Engineer.

1897. Rosengarten, Dr. George D., P.O. Box 1625 Philadelphia, Pa., U.S.A., Manufacturing Chemist.

1913. Rosenplaenter, Carlos B., Seaholme, Galton Road, Westcliff-on-Sea, Petroleum Technologist.

1916. Rosenstamm, Benjamin, King Street, Perth, Western Australia, Tanner.

1917. Rosewarne, Pearce V., McMaster University, Toronto, Ont., Canada, Chemist.

1918. Rosie, James McD., c/o Hall, 52 Newhaven Road, Leith, Assistant Manager.

1893. Ross, Arthur, 1 Glengall Road, Old Kent Road, London, S.E., Analytical Chemist.

1917. Ross, John D. McB., M.B.E., Chemistry Dept., University, Edinburgh, Research Chemist.

1900. Ross, Raymond, Public Analyst's Office, Burnley, Lancashire, Analytical Chemist.

1910. Ross, Thomas M., Burmah Oil Co., Yenangyat, via Myingyan, Up. Burmah, Analytical Chemist.

1911. Rossi, Dr. Carlo, 29 via Leopardi, Milan, Italy, Electro-Chemist.

1906. Rossi, Louis M., c/o General Bakelite Co., Perth Amboy, N.J., U.S.A., Works Manager.

1913. Rossini, James L., c/o Anglo-American Oil Co., Ltd., Purfleet, Essex, Oil Works Manager.

1906. Rossiter, Edmund C., Brougham, West Hagley, Worcestershire, Chemical Engineer.

1918. Rothwell, Bernard P., 30 Clyde Road, West Didsbury, Manchester, Research Chemist.

1888. Rothwell, C. F. Seymour, Photographic Works, Mobberley, Cheshire, Analytical Chemist.

1917. Rothwell, Herbert E., c/o The Harris Abattoir Co., Toronto, Canada, Chemist.

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1903. Rouse, William, The Knowe, Carlibar Road, Barrhead, by Glasgow, Chemist.

1917. Rowe, Frederick M., 5 Woodbine Terrace, Latchford, near Warrington, Research Chemist and Lecturer.

1906. Rowell, Herbert W., Crosby House, Osterley Park Road, Southall, Middlesex, Analytical Chemist.

O.M. Rowland, William L., 2815 Gray's Ferry Road, Philadelphia, Pa., U.S.A., Chemist.

1904. Rowley, Ernest W., Chemical Laboratory, C.M.E. Department, North Eastern Railway, Darlington, Analytical Chemist.

1908. Rowley, Frank, 8 Tufnell Park Road, London, N., Metallurgist.

1918. Rowley, Harry J., 44 Rodney Street, Saint John (West), N.B., Canada, Chemical Student.

1901. Rowley, Walter Eugene, c/o National Aniline and Chemical Co., 100 William Street, New York City, U.S.A., Chemist.

1904. Rowling, Samuel R., 1 Beechwood, Kendal, Westmoreland, Analyst.

1918. Rowlinson, Frank, 9 Lawrence Road, Gledholt, Huddersfield, Works Chemist.

1913. Rowse, Walter W., 113 High Street, Boston, Mass., U.S.A., Representative of Cassella Color Co.

1915. Roy, Dr. Charles S., St. Helens, Forest View, Chingford, Essex, Chemist.

1896. Royal-Dawson, H., 9 Carlton Street, Bridlington, Yorks, Chemist.

1918. Royce, Septimus, 47 Leagrove Road, Luton, Beds, Works Chemist.

1898. Royle, Charles L., Hacienda Cartavio, Trujillo, Peru, Sugar Chemist.

1917. Royse, Alfred E., 20 Albert Square, Manchester, Chairman of Sir S. W. Royse and Co., Ltd.

1916. Ruck, Edwin, 19 Bryn Road, Swansea, Works Manager.

1902. Rücker, Dr. Hermann von, The Windsor, Anderson Place, Buffalo, N.Y., U.S.A., Chemist.

1896. Ruddock, Fred. G., Corporation Street, Warrington, Analytical Chemist.

1895. Rudge, Alfred, c/o United Alkali Co., Ltd., Allhusen Works, Gateshead-on-Tyne, Analytical Chemist.

1919. Rudman, H. J. G., Cambrien Colour Works, River Street, Bristol, Paint and Varnish Manufacturer.

1911. Rudnick, Paul, c/o Armour and Co., Union Stock Yards, Chicago, Ill., U.S.A., Chemist.

1909. Rudorf, Dr. George, 52 Cranley Gardens, Muswell Hill, London, N., Manufacturing Chemist.

1884. Ruffle, John, Musley, Ware, Herts, Consulting Chemist and Electrician.

1918. Ruffman, David A., 3 Devonshire Mansions, 208 Great Portland Street, London, W. 1, Chemist.

18. RUHL, LOUIS, c/o Roessler and Hasslacher Chemical Co., 100 William Street, and (Journals) Box 0101, New York City, U.S.A., Chemical Merchant.

18. RUHM, H. D., Messrs. Calco Chemical Co., Marden, Orth and Hastings Building, 136 Liberty Street, New York City, U.S.A., Vice-President.

1909. RUILOBA, JOSÉ A., c/o U.S. Steel Corporation, Room 1605, 71 Broadway, New York City, U.S.A., Engineer.

1910. RULE, DR. ALEXANDER, 33 Milling Road, South port, Lancs, Technical Manager.

1915. RULE, DR. HAROLD G., Chemistry Department, The University, Edinburgh, Lecturer on Chemistry.

O.M. RUMBLE, CHARLES, 169 Gleneldon Road, Streatham, London, S.W., Chemist.

1899. RUMBOLD, WILLIAM R., Electro-Metallurgist.

1913. RUMI, DR. TOMÁS J., Salta 947, Buenos Aires, Argentina, Chemist.

1911. RUNECKLES, ARTHUR R., 10 Brudenell Mount, Hyde Park, Leeds, Technical Chemist.

1903. RUNYAN, ELMER G., 419 10th Street, N.W., Washington, D.C., U.S.A., Chemist and Gas Inspector.

1899. RUSHBY, WILLIAM, Oakview, Batley, Yorks, Analyst.

1906. RUSSELL, DAVID, Rothes, Markinch, Fife, Scotland, Paper Maker.

1919. RUSSELL, MISS DOROTHY VINCENT, Messrs. Lever Bros., Ltd., Balmain, Sydney, N.S.W., Chemist.

1912. RUSSELL, GEORGE H., P.O. Box 206, Hobart, Tasmania, Leather Trades Chemist.

1913. RUSSELL, STANLEY, Savonnerie Sunlight, Olten, Switzerland, Works Manager.

1912. RUSSELL, THOMAS F., 131 Steade Road, Sheffield, Analytical Chemist.

1910. RUSSELL, WILLIAM, 88 Peel House Lane, Widnes; Journals to c/o United Alkali Co., Pilkington-Sullivan Works, Widnes, Lancashire, Chemist.

1919. RUSSELL, WILLIAM, 16 South Street, Finsbury, London, E.C. 2, Metallurgical Engineer.

1905. RUTTAN, PROF. ROBERT F., Medical Faculty, McGill University, Montreal, Canada, Professor of Chemistry.

1909. RYALL, WILLIAM E., 29 Darfield Avenue, Leeds, Chemist and Works Manager.

1919. RYAN, ROGER W., c/o Carnation Milk Products Co., Oconomowoc, Wis., U.S.A., Research Chemist.

1918. RYDINGS, ARTHUR, 240 Ashton Road West, Failsworth, Manchester, Manufacturing Chemist.

1919. RYLEY, CHARLES F., Ingfield House, Almondbury, Huddersfield, Technical Chemist.

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1895. SAALFELD, ADOLPHE, Royds Street, Stockport Road, C.-on-M., Manchester, Chemical Merchant.

1905. SABIN, ALVAH H., 432 Sanford Avenue, Flushing, N.Y., U.S.A., Chemist, Varnish Works.

1916. SACHS, ALBERT P., 1665 Weeks Avenue, New York City, U.S.A., Chemist.

1918. SACHS, LEO F., "Saxaweald," Highland Road, Norwood, London, S.E. 19, Research Chemist.

1883. SADLER, A. E., Sand Hall, Ulverston, Lancashire, Manufacturing Chemist.

1884. SADTLER, DR. S. P., 210 South 13th Street, Philadelphia, Pa., U.S.A., Consulting Chemist.

1896. SADTLER, DR. SAMUEL S., 210 South 13th Street, Philadelphia, Pa., U.S.A., Analytical and Consulting Chemist.

1897. SAGE, C. EDWARD, 10 London Street, London, E.C., Consulting Chemist.

1902. SAHM, LOUIS N., c/o The Heller and Merz Co., 505 Hudson Street, New York City, U.S.A., Chemist.

1919. SAILMAN, MISS ISOBEL P. V., The Laboratory, Brentford Gas Company, Southall, Middlesex, Technical Chemist.

1918. ST. ARMANDE, ARTHUR V., Linwood House, Linwood, Paisley, Renfrewshire, Research Chemist.

1919. ST. GEORGES, DR. HENRI, 157 St. Denis Street, Montreal, Canada, Bacteriologist and Chemist.

1911. SALAMON, MAURICE S., 79 Mark Lane, London, E.C., Consulting Analyst.

1884. SALIS-MAYENFELD, DR. E. VON, 24 South Allen Street, Albany, N.Y., U.S.A., Technical Chemist.

1917. SALMON, WALTER, c/o United Yeast Co., Ltd., 80 Miller Street, Manchester, Analytical Chemist.

1916. SALWAY, DR. ARTHUR H., 59 Cavendish Drive, Rock Ferry, Cheshire, Research Chemist.

1907. SAMUEL, MARCUS R. A., 40 Mincing Lane, London, E.C., Merchant.

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1896. SAMUELSON, FRANCIS A. E., Sir B. Samuelson and Co., Ltd., Newport Iron Works, Middlesbrough, Ironmaster.

1916. SANBURN, JUSTUS C., Strathmore Paper Co., Mittineague, Mass., U.S.A., Chemist.

1904. SAND, DR. HENRY J. S., Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C., Lecturer and Demonstrator.

1910. SANDEMAN, ARCHIBALD, Ruchill Oil Works, Glasgow, Chemist

1917. SANDERS, GEORGE H., c/o The Indian Iron and Steel Co., Ltd., Assansol, E.I.R., India, Chemical Engineer.

1906. SANDERS, J. MCCONNELL, Holly House, Welling, Kent, Analytical and Consulting Chemist.

1917. SANDERS, WARREN W., c/o Empire Rubber and Tire Co., Trenton, N.J., U.S.A., Chemist.

1895. SANDERSON, JOHN, Britannia Pencil Works, Neasden, London, N.W. 10, Chemist.

1918. SANDERSON, THOMAS, Woodhill, Ponteland, Northumberland, Engineer.

1919. SANDILANDS, JAMES, 1 Shorthope Street, Musselburgh, Scotland, Lecturer.

1890. SANITER, E. H., Strafford Villa, Moorgate, Rotherham, Analytical Chemist.

1916. SANKEY, HAROLD, 2 Lathom Road, Southport, Soap Manufacturer.

1919. SARANGDHAR, V. N., The Tata Iron and Steel Co., Ltd., Jamshedpur (Sakchi), *via* Kalimati, B.N. India, Research Chemist.

1901. SARGENT, DR. GEORGE W., c/o Crucible Steel Co. of America, Oliver Building, Pittsburg, Pa., U.S.A., Chemist and Metallurgist.

1910. SARGENT, RALPH N., 161 Rahway Avenue, Woodbridge, N.J., U.S.A., Chemical Engineer.

1919. SATHAYE, VINAYAK G., The Gaekwar Oil and Chemical Co., Ltd., Sayaji Ganj, Baroda City, India, Technological Chemist.

1911. SAUER, J. N. A., Joh. Verhulststraat 43, Amsterdam, Holland, Sugar Chemist.

1903. SAUNDERS, LEWIS E., c/o Messrs. Norton Company, 34 Elm Street, Worcester, Mass., U.S.A., Electro-Chemical Engineer.

1896. SAUNDERS, WALTER M., 20 Dewey Street, Oineyville, R.I., U.S.A., Analytical Chemist.

1918. SAVAGE, HERBERT, Laboratory, 84-6 Chancery Lane, London, W.C. 2, Chemist.

1911. SAVILLE, WILLIAM B., 94 Vassall Road, Kennington, London, S.W. 9, Analytical Chemist.

1895. SAWERS, WILLIAM D., "Woodend," Giffnock, Scotland, Chemist.

1907. SAXE, JOEL B., c/o Milton Hersey Co., Ltd., P.O. Box 1086 Montreal; Journals to c/o Milton Hersey Co., Ltd., 257 Portage Avenue, Winnipeg, Man., Canada, Chemist.

1898. SAXE, SIGMOND, 111 West 78th Street, New York City, U.S.A., Manufacturing Chemist.

1919. SAXTON, CLEMENT, Les Verreries, d'Aigues, Mortes, Gard, France, Glass Works Engineer.
1919. SAYCE, LEONARD A., 5 Toward Terrace, Sunderland, Works Chemist.
1890. SAYERS, JOSEPH J., Grounwell Manor, Blunsdon, near Swindon, Explosives Chemist.
1918. SCAFE, NORMAN E., Dress Section Laboratory, Bowling Dye Works, Bradford, Technical Chemist.
1915. SCAFE, R. C., 4A Sussex Place, Southsea, Hants, Works Chemist.
1919. SCARD, DUDLEY I., 17 Breedon Hill Road, Derby, Engineer.
1917. SCARD, FREDERIC I., West India Committee, 15 Seething Lane, London, E.C., Journals to—Lloyd, Esq., 135 Queen's Road, Finsbury Park, London, N., Consulting Chemist (Sugar).
1913. SCARFE, H. CRESPIN, c/o Jonathan Longbotham and Sons, Ltd., 64 Victoria Street, London, S.W. 1, Public Officer.
1899. SCHAAK, DR. MILTON J., 520 N. 8th Street, Lebanon, Pa., U.S.A., Chemist.
O.M. SCHACK-SOMMER, DR. G., 87 Victoria Street, London, S.W., Sugar Refiner.
1910. SCHAEFER, DR. GEORGE L., New York Quinine and Chemical Works, 105 North 11th Street, Brooklyn, N.Y., U.S.A., Chemist and Technical Manager.
1912. SCHAPIRO, HUGO H. B., Wadsworth, Ohio, U.S.A., Chemist.
1917. SCHARFF, GODFREY E., "Knockranny," Bray, Co. Wicklow, Chemical Engineer.
1908. SCHATZMANN, DR. PAUL, Isleben bei Fluelen, Switzerland, Chemist.
1903. SCHEIDEL, DR. AUGUST, c/o Commonwealth Portland Cement Co., 4 O'Connell Street, Sydney, N.S.W., Australia, Managing Director.
1886. SCHELLHAAS, HENRY ALF., Thornhill, Beech Road, Hartford, Northwich, Mechanical Engineer.
1894. SCHIDROWITZ., DR. P., 57 Chancery Lane, London, W.C., Research Chemist.
1902. SCHLEGEL, JOHN WILLIAM, New York Sugar Refinery, Long Island City, N.Y., U.S.A., Chemist.
1893. SCHLEICHER, FRANCIS J., 38 West Tenth Street, Long Island City, N.Y., U.S.A., Technical Chemist.
1901. SCHLICHTING, EMIL, 402 West 23rd Street, New York City, U.S.A., Chemist.
1904. SCHNIEWIND, HEINRICH, jun., 149 Madison Avenue, New York City, U.S.A., Vice-President and Treasurer.
1904. SCHOELLER, DR. WALTER R., 57 York Street, Baker Street, London, W., Metallurgical and Research Chemist.
1918. SCHOFIELD, MISS CHARLOTTE B., The Retreat, Morpeth, Northumberland, Lecturer.
1902. SCHOFIELD, PROF. JAMES A., The University, Sydney, N.S.W., Australia, Lecturer in Chemistry.
1917. SCHOFIELD, WILFRED, 86 Glendale Gardens, Leigh-on-Sea, Essex, Analytical Chemist.
1908. SCHOLEFIELD, FRED., c/o Burgess, Ledward and Co., Ltd., Dyehouse Department, Walkden, Manchester, Works Chemist.
O.M. SCHOLEFIELD, H. E., Edgehill Chemical Works, Liverpool, Chemical Manufacturer.
1919. SCHOLL, ERNEST H., Elstree Chemical Works, Boreham Wood, Herts, Chemical Works Manager.
1917. SCHOTZ, DR. S. P., 30 Russell Square, London, W.C., Chemist.
1906. SCHROEDER, C. M. E., 235 Wood Street, Rutherford, N.J., U.S.A., Analytical Chemist.
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1919. SCHWARZ, ROBERT, 200 Worth Street, New York City, U.S.A., Consulting Chemist.
1906. SCHWERIN, LORENZ R., c/o Casein Co. of America, Bainbridge, N.Y., U.S.A., Vice-President.
1917. SCOBBIE, MISS MARY I., Kilwinning, Broxburn, West Lothian, Scotland, Teacher.
1917. SCORER, ARTHUR B., Portland Road, Bowdon, Cheshire, Engineer Director.
1917. SCOTCHER, WILLIAM L., 31 Carisbrooke Road, High Street, Walthamstow, London, E. 17, Analytical Chemist.
1918. SCOTT, ALEXANDER, Central School of Science and Technology, Stoke-on-Trent, Research Chemist.
1891. SCOTT, ANDREW L., Royal Gunpowder Factory, Waltham Abbey, Essex, Analytical Chemist.
1918. SCOTT, EDWARD H., 21 Dalveen Avenue, Davyhulme, Urmston, near Manchester, Chief Chemist.
1916. SCOTT, ERNEST KILBURN, c/o British American Nitrates Co., Inc., 74 Wall Street, New York, U.S.A., Electrochem. Engineer.
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1898. SCOTT, JAMES, Cawnpore Woollen Mills, Cawnpore, India, Chemist.
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1904. SCOVILLE, WILBUR L., c/o Parke, Davis and Co., Detroit, Mich, U.S.A., Analytical Chemist.
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1917. SCULLY, GERALD C., Cape Explosives Works Ltd., Somerset West, C.P. So. Africa, Chemist.
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1889. SEARL, ALBERT, 7 Palmeira Avenue, Westcliff-on-Sea, Technical Chemist.
1898. SEARLE, ALFRED B., The White Building, Fitzalan Square, Sheffield, Consulting Chemist.
1915. SEATON, CECIL, 4 Cambridge Gardens, Kilburn, London, N.W., General Manager and Chemist.
1905. SEEKER, ALBERT F., 160 Midwood Street, Brooklyn, N.Y., U.S.A., Food Analyst.
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1896. SELDNER, RUDOLPH, 27 Midwood Street, Brooklyn, N.Y., U.S.A., Manufacturing Chemist.
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1898. SEN, KAVIRAJ NAGENDRA NATH, 18/1 Lower Chitpur Road, Calcutta, India, Physician and Chemist.
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1907. SEYMOUR, TOM G., Kilton, Northway, Wavertree, Liverpool, Analytical Chemist.
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1919. SHADBOLT, SAMUEL M., 74 Manor Lane, Lee, London, S.E. 13, Chemical Engineer.
1919. SHAFFER, OSCAR N., Sterling Works, New Kensington, Pa., U.S.A., Superintendent.
1906. SHAH, PROF S. J., Dhanasutar's Street, Ahmedabad, India, Consulting Chemist.
1916. SHANKLAND, GEORGE A., Park Dale, Peveril Drive, Nottingham, Journals to c/o Sam. Meggitt and Sons, Ltd., Sutton-in-Ashfield, Notts, Chemical Manufacturer.
1892. SHANKS, ARCHIBALD, 5 Green Lodge Terrace, Greenhead, Glasgow, Chemist.
1917. SHANNON, WILLIAM V., 13 Woodlands Avenue, Wanstead, London, E., Research Chemist.
1908. SHARD, DR. PHILIP, The Gables, Hartford, Cheshire, Manufacturing Chemist.
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1900. SHARWOOD, DR. WILLIAM J., c/o Homestake Mining Co., Lead, South Dakota, U.S.A., Metallurgical Chemist.
1919. SHATWELL, HUGH G., 42 City Road, Openshaw, Manchester, Research Chemist.
1915. SHAW, JOHN H., Public Library, Bury, Lancashire, Librarian.
1913. SHAW, THOMAS W. A., "Springfield," Dee View Road, Heswall, Cheshire, Process Manager.
1912. SHEARMAN, CECIL H., The Tees Refining Co., Ltd., Thornaby-on-Tees, Managing Director.
1904. SHEDDEN, FRANK, c/o Courtaulds, Ltd., Flint, North Wales, Science Master.
1917. SHELDON, JOHN C., The Nickel Co., Erdington, Birmingham, Analytical Chemist.
1903. SHELDON, DR. NORMAN L., Government Acetone Factory, Nasik Road, India, Superintendent.
1912. SHELLEY, FREDERICK F., Apothecaries' Hall, Blackfriars, London, E.C., Analytical Chemist.
1912. SHELLEY, WILLIAM E., 20 Mount Street, Manchester, Engineer.
1919. SHELTON, ARTHUR J., 10 Park Road, Clydach S.O., Glam, Chemical Engineer.
1911. SHELTON, JAMES, Geological Dept., Batu Gajah, Perak, F.M.S., Chemist.
1913. SHENGLE, J. C., c/o Major Bros., Ltd., Kiangsu Chemical Works, Shanghai, China, General Manager.
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1909. SHEPHERD, STEPHEN W., c/o Eastern Chemical Co., Ltd., Rowlee Hill, Dharavi, Bombay, India, Works Manager.
1899. SHERD, JOHN E., c/o Aluminium Co. of America, Niagara Falls, N.Y., U.S.A., Chemist.
1893. SHIELDS, DR. JOHN, 4 Stanley Gardens, Cricklewood, London, N.W. 2, Chemist.
1896. SHIMOMURA, PROF. K., Shinkarasumaru, Kojinguchi Sagaru, Kyoto, Japan, Professor of Chemistry.
1917. SHIPLEY, JOHN F., 22 Village Road, Oxton, Birkenhead, Engineer and Technical Adviser.
1919. SHIPSTON, GEOFFRY T., Research Department, Levinstein, Ltd., Blackley, Manchester, Research Chemist.
1905. SHOFFSTALL, ARTHUR S., 153 Henderson Avenue, New Brighton, Staten Is., N.Y., U.S.A., Chemist.
1899. SHOLES, CHARLES E., c/o Messrs. Edison Storage Battery Co., Orange, N.J., U.S.A., Vice-President.
1919. SHOLES, JUSTIN E., The Ohio Chemical Manufacturing Co., 1177 Marquette Street, Cleveland, Ohio, U.S.A., Secretary.
1900. SHONK, ALBERT, 9 Lambton Road, Cottenham Park, Wimbleton, Assistant Editor.
1918. SHORE, BEN E., E. I. du Pont de Nemours and Co., Bay City, Mich., U.S.A., Superintendent.
1897. SHORES, DR. JEFF. H., Kingsway, Frodsham, Cheshire, Chemist.
1904. SHORT, ANDREW, 23 Hotspur Street, Tynemouth, Northumberland, Works Chemist.
1918. SHORTO, CLAUDE W. B., 32 Gressenhall Road, Wandsworth, London, S.W., Works Chemist.
1919. SHOVELTON, WALTER, 16 St. Paul's Road, Clifton, Bristol, Assistant to Managing Director.
1918. SHROFF, F. B., Chemical and Technical Laboratory, Kampu, Gwalior State, India, Superintendent.
1916. SHULMAN, ISAAC, 75 Reginald Terrace, Chapeltown, Leeds, Yorks, Colour Chemist.
1890. SHUTT, FRANK T., Central Experimental Farm, Ottawa, Canada, Agricultural Chemist.
1906. SHUTTLEWORTH, EDWARD B., 220 Sherbourne Street, Toronto, Canada, Chemist.
1901. SIAU, RAYMOND L., Springfield Brewery, Wolverhampton, Research Chemist.
1918. SIBBALD, WILLIAM R., c/o Messrs. R. Silcock and Sons, Ltd., 14 Upper William Street, Liverpool, Works Research Chemist.
1902. SIBLEY, SAMUEL E., c/o Mauri Bros. and Thomson, Ltd., 123 Castlereagh Street, Sydney, N.S.W., Australia, Technical Chemist.
1912. SIDDONS-WILSON, S., c/o Messrs. John Robinson and Co., Ltd., Avonmouth Docks, Avonmouth, Analytical Chemist.
1915. SIDERFIN, NORMAN E., c/o The Gas Light and Coke Co., Tar and Liquor Works, Beckton, London, E., Works Chemist.

1902. SIEBOLD, ALFRED, c/o Lactose Ltd., Hibernia Works, Tipperary, Ireland, Technical Chemist.
1901. SILBERRAD, DR. OSWALD, Sunny Croft, Buckhurst Hill, Essex, Research Chemist.
1912. SILLARS, DANIEL, The Laboratory, Bolckow, Vaughan and Co., Ltd., South Bank S.O., Yorks, Metallurgical Chemist.
1918. SILLS, IBRI L., Queen's University, Kingston, Ont., Canada, Chemical Student.
1918. SILVERMAN, DR. ALEXANDER, c/o Copper Clad Steel Co., Rankin, Pa., U.S.A., Professor of Chemistry.
1892. SILVESTER, HARRY, 78 Holyhead Road, Handsworth, Birmingham, Analytical and Consulting Chemist.
1919. SILVESTER, WILLIAM A., 111 Church Lane, Harpurhey, Manchester, Technical Chemist.
1901. SIM, WILFRID A., c/o Wm. Sim and Sons, 40 Jane Street, Leith, Scotland, Colour Manufacturer.
1918. SIMMONS, C. WELLINGTON, 55 William Street Kingston, Ont., Canada, Chemical Student.
1911. SIMMONS, THOMAS A., "Shaugh," 6 Albert Road, Caversham, Reading, Technical Chemist.
1903. SIMMONS, WILLIAM H., Oakleigh, Stoke Newington Common, London, N., Analytical Chemist.
1918. SIMMONS, WILLIAM H., 2 Victoria Villas, Brantham, near Manningtree, Essex, Technical Chemist.
1918. SIMMS, ALFRED M. W., No. 6 T. and G. Chambers, St. George's Terrace, Perth, W. Australia, Managing Director.
1898. SIMON, DR. A., 18A Trebovir Road, Earl's Court, London, S.W. 5, Chemical Engineer.
1918. SIMON, LOUIS J., 21 Panton Street, Haymarket, London, S.W. 1, Consulting Engineer.
1905. SIMONS, ALBERT J., G.P.O., Hobart, Tasmania, Engineer.
1917. SIMONSEN, DR. JOHN L., Forest Research Institute and College, Dehra Dun, U.P. India, Professor of Chemistry.
1902. SIMONSON, WILLIAM, 126 West 9th Street, Cincinnati, Ohio, U.S.A., Chemist.
1919. SIMPKIN, NEVILLE, High Bank, Radcliffe New Road, Whitefield, Manchester, Research Student.
1917. SIMPSON, FRANK, 85 Kensington Gardens, Ilford, Essex, Works Chemist.
1919. SIMPSON, FRED W., Tudhoe Grange, Spennymoor, Durham, Chemist.
1905. SIMPSON, HENRY, 26 Austen Avenue, Sherwood Rise, Nottingham, Works Chemical Assistant.
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1919. SIMS, HERBERT H., c/o The New Explosives Co., Ltd., Stowmarket, Suffolk, Works Chemist.
1900. SIMS, W. EDGAR, Colinswell House, Burntisland, Fifeshire, Manager (British Aluminium Co.).
1918. SINCLAIR, GEORGE WILLIAM, Reston Lodge, Petersham, Surrey, Chemical Engineer.
1894. SINCLAIR, DR. W., 250 Ferry Road, Leith, Scotland, Chemist.
1890. SINDALL, R. W., 27 Walbrook, London, E.C. 4, Paper Mills Chemist.
1919. SINGER, NATHAN, 147 Upper Clapton Road, London, E. 5, Research Student.
1911. SINGH, S. W., 28 Mughalpura, Lahore, India, Engineer.
1899. SINGMASTER, J. ARTHUR, 10 Millard Avenue, Bronxville, New York, U.S.A., Chemist (New Jersey Zinc Company).
1917. SINKINSON, ERIC, 14A Albert Bridge Road, London, S.W. 1, Demonstrator in Technical Chemistry.
1901. SINNATT, FRANK S., 321 Great Clowes Street, Higher Broughton, Manchester, Demonstrator of Chemistry.
1916. SISSON, GEORGE, JUN., The Blaydon Manure and Alkali Co., Ltd., Blaydon-on-Tyne, Consulting Chemist.
1917. SISSONS, HAROLD H., c/o Sissons Bros. and Co., Ltd., Hull, Varnish, etc., Manufacturer.
1917. SISSONS, HERBERT, Merlewood, Irlam Road, Flixton, near Manchester, Metallurgical Chemist.
1918. SIX, GEORGES, 32 Mornington Road, Leytonstone, London, E. 11, Chemical Engineer.
1914. SJODAHL, H. A., c/o The Chatfield Manufacturing Co., Station P., Cincinnati, Ohio, U.S.A., Chemist.
1918. SKELDING, ARTHUR, 13 Tyzack Road, Woodseats, Sheffield, Chemist and Metallurgist.
1912. SKELLON, HERBERT, "The Rosary," Eastmead Avenue, Greenford, Chemist.
1894. SKELTON, JOHN R., c/o Norwich Crape Co. (1856), Ltd., St. Augustine's, Norwich, Technical Chemist and Managing Director.
1897. SKERTCHLY, W. P., "Kenwyn," Station Road, Barrowash, near Derby, Analytical Chemist.
1918. SKILLING, WILLIAM J., H.M. Fuel Research Station, Blackwall Lane, East Greenwich, London, S.E. 10, Chemist.
1908. SKINNER, WILLIAM, 38 Sauchiehall Street, Glasgow, Analytical Chemist.
1904. SKIRROW, DR. F. W., Shawinigan Laboratories, Ltd., Shawinigan Water and Power Co., Shawinigan Falls, P.Q., Canada, and 49 Maple Avenue, Shawinigan Falls, P.Q., Canada, Chief Chemist.
1911. SKJOLD, EINAR, Erith Oil Works, Erith, Kent, Technical Manager and Chemist.
1904. SKOWRONSKI, S., c/o Raritan Copper Works, Perth Amboy, N.J., U.S.A., Chemist.
1891. SKURRAY, THOMAS, The Brewery, 40 Ock Street, Abingdon, Berks, Brewer.
1917. SLACK, HARRY, 59 Great Egerton Street, Stockport, Chemist.
1913. SLADE, DR. ROLAND E., 16 Clevedon Mansions, Lissenden Gardens, London, N.W.5, Lecturer in Physical Chemistry.
1917. SLANN, ALFRED E. L., 31 Ranelagh Gardens, Stamford Brook Avenue, London, W., Works Chemist.
1904. SLATOR, DR. ARTHUR, 174 Ashby Road, Burton-on-Trent, Brewery Chemist.
1912. SLATTERY, FREDERICK J., 31 Mornington Avenue, Cranbrook Park, Ilford, E., Analytical Chemist.
1919. SLEE, PERCY JOHN, 59 Charlton Road, Weston-Super-Mare, Peat Manufacturer.
1916. SLOAN, ALEXANDER, P.O. Box 410 Cumberland, Md., U.S.A., Manufacturing Chemist.
1895. SLOCUM, DR. FRANK L., 401 South Linden Avenue, E.E., Pittsburg, Pa., U.S.A., Chemist.
1913. SLUSSER, HOLLAND B., 10 North 8th Avenue, Mount Vernon, N.Y., U.S.A., Chief Chemist.
1898. SMALL, FRITZ H., 38 Berwick Street, Worcester, Mass., U.S.A., Chemist.
1915. SMALLEY, OLIVER, 13 Windsor Road, Monkseaton, Northumberland, Metallurgist.
1904. SMART, BERTRAM J., Testing Branch, Dept. of Public Works, Sydney, N.S.W., Australia, Chemist.
O.M. SMETHAM, A., 16 Brunswick Street, Liverpool, Analytical Chemist.
1919. SMILES, DR. SAMUEL, F.R.S., Armstrong College, Newcastle-on-Tyne, Professor of Organic Chemistry.
1916. SMITH, ALBERT E., c/o New Bedford and Agawam Finishing Co., East Wareham, Mass., U.S.A., Superintendent.
1905. SMITH, PROF. ALBERT W., Case Library, Cleveland, Ohio, U.S.A., Professor of Chemistry.
1916. SMITH, ALFRED, Excelsior Works, Clayton, Manchester, Chemical Manufacturer.

1898. SMITH, ALF. B., Ryecroft, Glossop, Derbyshire, Bleacher and Dyers' Manager.

1897. SMITH, ALLAN, 30 Fountainhall Road, Edinburgh, Paper Mills Chemist.

1914. SMITH, ANDREW, c/o Leech, Neal, and Co., Ltd., Spondon, Derby, Colour Manufacturer.

1896. SMITH, ANDREW T., c/o Castner-Kellner Alkali Co., Ltd., 257 Royal Liver Building, Liverpool, General Manager.

1905. SMITH, ARTHUR, Town End Chemical Works, Bramley, Leeds, Chemical Manufacturer.

1912. SMITH, ARTHUR R., 3 Dame Street, Dublin, Ireland, Chemist.

1916. SMITH, CLAUDE, c/o Messrs. Randall and Porter, Low Mill Tannery, Ulverston, Chemist.

1893. SMITH, EDGAR B., c/o Dominion Tar and Chemical Co., Ltd., 400 McKinnon Building, Toronto, Canada, Manager.

1906. SMITH, E. A. CAPPELEN, c/o M. Guggerheim's Sons, 120 Broadway, New York City, U.S.A., Metallurgical Engineer.

1895. SMITH, DR. E. ELLSWORTH, Suite 80, Chemists' Building, 50 East 41st Street, New York City, U.S.A., Consulting Physiological Chemist.

1919. SMITH, EMORY E., 651 Howard Street, San Francisco, Cal., U.S.A., Chemical Engineer.

1892. SMITH, ERNEST A., British Non-Ferrous Metals Research Association, 29 Paradise Street, Birmingham, Assayer.

1919. SMITH, ERNEST A., Chemical Laboratories, Central Experimental Farm, Ottawa, Canada, Chemist.

1911. SMITH E. WOODHOUSE, Central Laboratory, City Gasworks, Nechells, Birmingham, Chief Chemist.

1891. SMITH, FRANCIS P., 131-133 East 23rd Street, New York City, U.S.A., Chemist.

1907. SMITH, FRANK MORSE, 81 Fulton Street, New York City, U.S.A., Chemical Merchant.

1919. SMITH, GEORGE, 33 Queen Street, Great Harwood, Lancs, Research Chemist.

1908. SMITH, GEORGE A., 1433 President Street, Brooklyn, N.Y., U.S.A., Chemist (Printing Ink).

1916. SMITH, HAROLD P., Arosdene, Cliftonville Gardens, Whitley Bay, Northumberland, Works Chemist.

1890. SMITH, HARRY E., P.O. Box 491, 11th Street, Station, Washington, D.C., U.S.A., Analytical Chemist.

1904. SMITH, HENRY, 83 Brownlow Road, Horwich, Bolton-le-Moors, Lancs, Analytical Chemist.

1918. SMITH, HENRY E., Oakdene Villas, South Street, Cottingham, near Hull, Colour Chemist.

1919. SMITH, HENRY E., c/o Meggitts (1917) Ltd., Sutton-in-Ashfield, Notts, Works Chemist.

1902. SMITH, HENRY GEORGE, Technological Museum, Harris Street, Ultimo, Sydney, N.S.W., Australia, Assistant Curator and Chemist.

O.M. SMITH, HENRY R., 1 Aubert Park, Highbury, London, N., Analytical Chemist.

1915. SMITH, HERBERT, "Rose Bank," Old Chester Road, Woodhey, Rock Ferry, Cheshire, Works Chemist.

1905. SMITH, H. MELVILLE, Ammunition Works, Abbey Wood, Kent, Engineer and Superintendent.

1901. SMITH, H. PROCTER, Highfield, Shotton Lane, Shotton, Flintshire, Metallurgical Chemist.

1918. SMITH, HUBERT, The Team By-Product Coke Co., Ltd., Dunston-on-Tyne, Chief Chemist.

1905. SMITH, HUGH DUNFORD, 7 and 9 The Side, Newcastle-on-Tyne, Analytical Chemist.

1906. SMITH, IRWIN J., 21 Lyon Avenue, Menands, Albany Co., N.Y., U.S.A., Salesman.

O.M. SMITH, JAMES, Ash Grove House, Radcliffe, Manchester.

1897. SMITH, JAMES, Sunnyside, Groes Road, Cressington, near Liverpool, Analytical Chemist.

1903. SMITH, JAMES, "Lyndhurst," Frodsham, and (Journals) Ditton Copper Works, Widnes, Metallurgist.

1918. SMITH, JAMES, Cotehill, Seafield Road, Colwyn Bay, N. Wales, Gas Engineer.

1907. SMITH, JAMES C., Greetland Dyeing Co., Ltd., Greetland, near Halifax, Dyer.

1893. SMITH, JAMES F., 80 Cannon Hill Road, Birmingham Analytical Chemist.

1901. SMITH, J. CRUICKSHANK, King's House, King Street, London, E.C., Technical Chemist.

1888. SMITH, J. TERTIUS, Richmond House, Plaistow, Essex, Technical Chemist.

1919. SMITH, JOHN, 31 Dempster Street, Greenock, Student.

O.M. SMITH, JOHN W., 7 Brookfield Street, Roslindale, Boston, Mass., U.S.A., Analytical Chemist.

1890. SMITH, J. WILLIAM, 1615 West Genesee Street, Syracuse, N.Y., U.S.A., Alkali Works Manager.

1916. SMITH, JULIAN C., c/o Shawinigan Water and Power Co., 611 Power Building, Montreal, Canada, Chief Engineer.

1918. SMITH, KENNETH W., Fairmount, Nore Road, Portishead, Somerset, Assistant in Works Laboratory.

1919. SMITH, L. HEWGILL, 58 High Street, Bridlington, East Yorks, Chemist.

1911. SMITH, N. GARRETT, c/o Messrs. Grindlay and Co., Calcutta, India, Analytical Chemist.

1919. SMITH, PERCY H., 24 Hamilton Road, Ilford Lane, Ilford, Analytical Chemist.

1890. SMITH, DR. R. GREIG, Linnean Society's House, Elizabeth Bay, Sydney, N.S.W., Bacteriologist and Chemist.

1890. SMITH, ROBERT WATSON, Rathmore, Lenzie, Lanarkshire, Chemical Works Manager.

1918. SMITH, ROY B., Hamilton, N.Y., U.S.A., Teacher of Chemistry.

1916. SMITH, SAMUEL G., Tattenhall Road Works, near Chester, Fat, Glue, and Manure Manufacturer.

1914. SMITH, STANLEY, 16 St. Loo Mansions, Chelsea, London, S.W., Chemist.

1919. SMITH, DR. SYDNEY, The Cottage, The Heath, Dartford, Pharmaceutical Chemist.

1903. SMITH, DR. WARREN R., Lewis Institute, Chicago, Ill., U.S.A., Teacher.

O.M. SMITH, WATSON, 34 Upper Park Road, Haverstock Hill, N.W., Retired Editor and Chemist.

1908. SMITH, DR. WATSON, jun., Cape Explosives Works, Somerset West C.C., South Africa, Chemist.

O.M. SMITH, WILFRED, 182 West Street, Glasgow, Chemical Manufacturer.

1910. SMITH, WILLIAM C., c/o The Anchor Cable Co., Leigh, Lancashire, Analytical Chemist.

1916. SMITH, WILLIAM STANLEY, Tattenhall Road Works, near Chester, Fat, Glue and Manure Manufacturer.

O.M. SMITHELLS, PROF. A., F.R.S., The University, Leeds, Professor of Chemistry.

1902. SMOOT, ALBERT M., 99 John Street, New York City, U.S.A., Analytical Chemist.

1909. SMOOT, CHARLES C., III., c/o C. C. Smoot and Sons Co., North Wilkesboro', N.C., U.S.A., Tanning Chemist.

1918. SMOUT, ARTHUR J. G., 41 Hazelhurst Road, King's Heath, Birmingham, Analytical Chemist.

1919. SMUCK, JAMES, c/o Compagnie Internationale des Machines Agricoles de France, Croix-Wasquehal, Nord, France, Chemist.

1918. SMY, GEORGE A., 43 Maud Road, Plaistow, London, E. 13, Deputy Works Manager.

1888. SNAPE, DR. H. LLOYD, Fernlea, Mill Lane, Torquay, Director of Education.

1908. SNELL, PROFESSOR JOHN F., Macdonald College, P.O., Prov. Quebec, Canada, Professor of Chemistry.

1919. SNELLING W., D., 208 N. 5th Street, Allentown Pa., U.S.A., Research Chemist.

1896. SNOWDON, JOHN, Messrs. Snowdon, Sons and Co., Millwall, E., Chemical and Oil Manufacturer.
1894. SOANE, CHARLES E., 31 Mattison Road, Hornsey, London, N., Analytical and Consulting Chemist.
1919. SODEAU, DR. WM. H., Whitehead Torpedo Works, Weymouth, Chemist.
1903. SOHLMAN, RAGNAR, Bofors, Sweden, Manager (A. B. Bofors Nobelkrut).
1918. SOLLER, DR. MAX, c/o British Cellulose and Chemical Manufacturing Co., Ltd., Spondon, near Derby, Chemist.
1906. SOLOMON, MAURICE, Birmingham Carbon Works, Witton, Birmingham, Manager.
1916. SOLOMON, SIMON, 22 Sainfoin Road, Upper Tooting, London, S.W., Works Chemist and Manager.
1884. SOMMER, ADOLPH, Corner 1st and Binney Streets, East Cambridge, Boston, Mass., U.S.A., Pharmaceutical Chemist.
1907. SONSTHAGEN, ASBJORN, "Forest Lea," High Stone, Leytonstone, London, E., Engineer, Chocolate Trade.
1912. SORLEY, JAMES (all communications to c/o R. R. Tatlock and Thomson, 156 Bath Street, Glasgow), Analytical Chemist.
1904. SOUTHALL, A. W., Lower Priory, Birmingham, Manufacturing Chemist.
1904. SOUTHERDEN, FRANK, 11 Gordon Road, Exeter, Teacher of Chemistry.
1890. SOWERBY, THOMAS H., Canal Soap Works, Verney Road, Rotherhithe, London, S.E., Soap Manufacturer.
1918. SOWRAY, WILLIAM A., c/o C. F. Stead and Co., Ltd., Sheepscar Leather Works, Leeds, Works Chemist.
1887. SPACKMAN, CHARLES, Rosehaugh, Clitheroe, Lancashire, Portland Cement Manufacturer.
1917. SPAFFORD, ARTHUR L., 4 Magog Street, Sherbrooke, P.Q., Canada, Chemical Engineer.
1919. SPARKS, JOHN B., c/o Nestlé and Anglo-Swiss Condensed Milk Co., Cham, Canton Zug, Switzerland, Engineer.
1904. SPARRE, FIN, c/o E. I. du Pont de Nemours and Co., Room 450, du Pont Building, Wilmington, Del., U.S.A., Director.
1919. SPEAKMAN, HORACE B., 2 Trinity Street, Toronto, Canada, Director of Department of Zymology, Toronto University.
1913. SPEEDY, ALAN, 81 Burges Road, East Ham, London, E. 6, Technical Chemist.
1904. SPEIDEN, CLEMENT C., 46 Cliff Street, New York City, U.S.A., Chemical Merchant.
1905. SPEIGHT, WILLIAM E., Hacken Sewage Works, Great Lever, Bolton, Chemist.
1911. SPENCE, DR. DAVID, Norwalk, Conn., U.S.A., Research Chemist.
1917. SPENCE, DAVID D., The Laboratory, 46 Side, Newcastle-on-Tyne, Works Chemist.
1900. SPENCE, HOWARD, Journals to Manchester Alum Works, Manchester, Chemical Manufacturer.
1883. SPENCE, JOHN W., Tiviot Colour Works, Manchester Road, Stockport, Drysalter.
1903. SPENCER, A. GORDON, 375 Grosvenor Avenue, Westmount, P.Q., Canada, Chemist.
1919. SPENCER, DR. JAMES F., Bedford College, Regent's Park, London, N.W. 1, Head of Department of Inorganic and Physical Chemistry.
1918. SPENSLEY, JACOB W., Chemical Engineering Co., 49 Deansgate, Manchester, Chemical Engineer.
1903. SPIELMANN, DR. PERCY E., Highways Construction Ltd., Iddesleigh House, Caxton Street, London, S.W. 1 (communications to be marked "Personal"), Chemist.
1906. SPIERA, DR. V. G., Via dell Ambrogiana 10, Leghorn, Italy, Chemist.
1885. SPILLER, ARNOLD, 20 Holly Avenue, Newcastle-on-Tyne, Electrician.
O.M. SPILLER, J., 2 St. Mary's Road, Canonbury, London, N., Consulting Chemist.
1914. SPILMAN, GEORGE H., 3 Park Place, Maze Hill, London, S.E.; (Journals c/o The Chiswick Polish Co., Chiswick, London, W.), Chemist.
1917. SPROXTON, FOSTER, Brantham Works, near Manningtree, Essex, Assistant Works Manager.
1918. SQUIRE, FREDERICK J., 19 Winterbey Avenue, Poulton, Wallasey, Cheshire, Chemist.
O.M. SQUIRE, P. W., 413 Oxford Street, London, W., Pharmaceutical Chemist.
1919. SRINIVASAN, K. C., Niton, 34 Pycroft's Road, Madras, S.E., S. India, Industrial Chemist.
1916. SRIVASTAVA, J. P., Civil Lines, Cawnpore, India, Government Technological Chemist.
1918. STACEY, JOHN, St. Winifreds, 2 Deal Road, Tooting Junction, London, S.W., Stockbroker's Clerk.
1917. STAFFORD, JAMES H., Ash Hayes House, Nailsea, Somerset, Engineer.
O.M. STAHL, DR. K. F., 57th Street and A. V. Ry., Pittsburg, Pa., U.S.A., Consulting Chemist.
1912. STANCOURT, FRED., 24 Walbrook, London, E.C., Chemical Manufacturer.
1904. STANDFAST, JOHN T., Prince Regent's Wharf, Silvertown, London, E., Chemist.
1917. STANDRING, PERCIVAL K., British Dyestuffs Corporation (Blackley) Ltd., Ellesmere Port, Birkenhead, Research Chemist.
1917. STANHILL, DAVID B., 10 Halliwell Lane, Cheetham Hill, Manchester, Chemist.
1919. STANIER, HAROLD, Chemical Laboratory, South Metropolitan Gas Co., 709 Old Kent Road, London, S.E. 15, Research Chemist.
1897. STANNARD, DR. OSCAR J., c/o Twite and Stannard, 65 London Wall, London, E.C., Consulting Metallurgist.
1918. STANSFIELD, EDGAR, Fuel Testing Plant, Booth Street, Ottawa, Canada, Engineering Chemist.
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1885. STAPLES, H. J., The Old Hall, Spondon, Derby, Colour Manufacturer.
1918. STARCK, H. P., Technical College, Bradford, Research Chemist.
1919. STARK, DAVID C., c/o Miss Burnham, Glaston Cottage, Victoria Avenue, Borrowash, Derby, Works Chemist.
1917. STARNES, ARTHUR H., c/o Pirie's Photographic Paper Co., Ltd., Waterton Works, Bucksburn, Aberdeenshire, Director.
1916. STARRELS, JOEL, Box 949, Niagara Falls, U.S.A., Chemical Engineer.
1896. STATHAM, NOEL, c/o West Virginia Pulp and Paper Co., 200 Fifth Avenue, New York City, U.S.A., Engineer.
1907. STAUD, JOSEPH E., c/o W. W. Lawrence and Co., West Carson Street, S.S., Pittsburg, Pa., U.S.A., Chemist.
1904. STAUFFACHER, W., 64 Oberwilerstrasse, Basle, Switzerland, Chemical Works Manager.
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O.M. STEAD, DR. J. E., F.R.S., 11 Queen's Terrace, Middlesbrough-on-Tees, Analytical Chemist.
1919. STEADMAN, CAPT. STANLEY J., The Old Rectory, Northfleet, Gravesend, Works Chemist.
1915. STEEDMAN, GEORGE, Annickburn, Irvine, Ayrshire, Chemical Manufacturer.
1896. STEEL, FRED. W., c/o General Chemical Co., Ltd., Auburn, Sydney, Australia, Works Manager.
O.M. STEEL, THOMAS, "Rock Bank," Stephen Street, Pennant Hills, Sydney, N.S.W., Australia, Sugar Chemist.
1918. STEELE, NEVILLE, Overdale, Langley, Macclesfield, Technical Chemist.
1915. STEGER, PROF., ALPHONSE, M.A.A., 58 Oldenbarneveltlaan, The Hague, Holland, Chemical Technologist.
1912. STEINER, BERNARD C., Enoch Pratt Free Library, Baltimore, Md., U.S.A., Librarian.

1887. STENHOUSE, THOMAS, 166 Drake Street, Rochdale, Analytical Chemist.

1908. STENHOUSE, THOMAS, jun., Chemical Laboratory, H.M. Dockyard, Portsmouth, Analytical Chemist.

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1919. STEPHEN, HENRY, 1 Portman Street, Whalley Range, Manchester, University Lecturer.

1917. STEPHENS, ALBERT J., c/o John Stephens, Son and Co., Ltd., Gloucester, Jam and Vinegar Manufacturer.

1911. STEPHENS, CHARLES E., Messrs. Stephens Bros. and Co., 2 Bury Court, St. Mary Axe, London, E.C. 3, Chemical Merchant.

1892. STEPHENS, M. E., 57-60 Aldersgate Street, London, E.C., Ink Manufacturer.

1913. STEPHENSON, GUY, Bowden Close, Coke-Ovens, near Crook, Co. Durham, Analyst.

1909. STEPHENSON, HENRY H., 52 Commercial Road, Hayle, Cornwall; (Journals 2 Amberley Grove, Croydon), Technical Chemist.

1909. STEPHENSON, HERBERT F., 8 The Park, Mitcham, Surrey, Analytical Chemist.

1917. STEPHENSON, J. NEWELL, Garden City Press, St. Anne de Bellevue, Que., Canada, Editor of "Pulp and Paper Magazine."

1919. STEPHENSON, JOSEPH, United Gas and Fuel Co., Ltd., Hamilton, Ont., Canada, Chemical Engineer.

1889. STERN, ARTHUR L., 148 High Street, Burton-on-Trent, Brewing Chemist.

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1914. STEVEN, GEORGE, c/o G. Steven and Co., Ltd., Cornbrook Works, Chorlton Road, Manchester, Pharmaceutical Chemist.

1899. STEVENOT, G. A., 280 Baltic Street, Brooklyn, N.Y., U.S.A., Chemist.

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1890. STEWART, ROBERT, c/o Messrs. B. Laporte, Ltd., Luton, Chemical Works Manager.

1916. STEWART, ROBERT P., c/o Stewart Dyeing and Bleaching Co., Salamanca, N.Y., U.S.A., Dyer, Empire Worsted Mills.

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1906. STICKLAND, OLIVER W., c/o The New Explosives Co., Ltd., Stowmarket, Suffolk, Chemist.

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1894. TIPLER, FRED. C., 2 Wellington Villas, Crewe, Analytical Chemist.
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1918. TISDALE, NORMAN F., 40 Pearl Street East, Brockville, Ont., Canada, Student of Chemical Engineering.
1894. TOCH, MAXMILIAN, 320 Fifth Avenue, New York City, U.S.A., Chemist.
1915. TOCHER, DR. JAMES F., Crown Mansions, Union Street, Aberdeen, Public Analyst.
1886. TODD, A. M., c/o The A. M. Todd Co., Kalamazoo, Mich., U.S.A., Manufacturing Chemist and Distiller of Essential Oils.
1919. TODD, ELDRED W., 35 Langford Avenue, Toronto, Canada, Chemist.
1911. TODD, FREDERICK W., 16 Landsdowne Road, Tonbridge, Kent, Chemist.
1919. TOLFREE, PERCY E., 86 Balgreen Road, Edinburgh, Analytical Chemist.
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1919. TOMKINSON, MISS MARGARET G., Girton College, Cambridge, Research Chemist.
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1913. TOMLINSON, GEORGE G., Oficina "Coya," Tocopilla, Chile, South America, Chemist.
1914. TOMPKIN, ALBERT, 104 Lenton Boulevard, Nottingham, Pharmacist.
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1902. TONE, FRANK JEROME, c/o The Carborundum Co., Niagara Falls, N.Y., U.S.A., Manager.
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1899. TRANTOM, DR. WILLIAM, Boräs, Grappenhall, near Warrington, Chemist.
1900. TRAQUAIR, JOHN, Ayer, Mass., U.S.A., Analytical Chemist.
1918. TRASH, ARTHUR W., 48 Foxham Road, Tufnell Park, London, N. 19, Works Chemist.
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1918. TUCKER, THOMAS, c/o Stirling Works, West Ham, London, E., General Manager.
1886. TUER, ARTHUR H., Douglas House, Worthington, near Wigan, Analytical Chemist.
1903. TUFTS, CHARLES G., c/o Semet-Solvey Co., Syracuse, N.Y., U.S.A., Chemical Engineer.
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1918. TULLOCH, WILLIAM, c/o Wm. Tulloch and Co., 30 George Square, Glasgow, Chemical Merchant.
1901. TULLOCH, WILLIAM F., c/o The Olympia Oil and Cake Co., Ltd., Olympia Mills, Selby, Merchant.
1914. TUNGAY, SYDNEY J., Haughton's Ltd., 30 St. Mary at Hill, London, E.C., Chemical Engineer.
1909. TUNKS, DR. FREDERICK R., Powder Mills, Tonbridge, Kent, Manager.
1918. TURLEY, JAMES, Serkkyi Refinery, Rangoon, Burma, Technical Chemist.
1899. TURNBULL, DR. ANDREW, 18 Hackins Hey, Liverpool, Consulting Chemist.
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1911. TURNER, PROF. A. J., Technical Institute, Byculla, Bombay, India, Professor of Chemistry.
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1917. TURNER, HARRY, c/o Messrs. George Spencer-Moulton and Co., Ltd., Kingston Mills, Bradford-on-Avon, Works Chemist.
1915. TURNER, JAMES, c/o Read, Holliday and Sons, Ltd., 160 Franklin Street, New York City, U.S.A., Manufacturing Chemist.
1902. TURNER, JOSEPH, c/o British Dyes, Ltd., and (Journals) Azo House, Birkby, Huddersfield, Director.
1905. TURNER, PROF. THOMAS, 75 Middleton Hall Road, King's Norton, Birmingham, Professor of Metallurgy.
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1918. TURNER, WILLIAM L., 124 Jerningham Road, New Cross, London, S.E. 14, Research Chemist.

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U

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1916. URWIN, ALFRED, Urwin and Co., The Manors, Newcastle-on-Tyne, Manufacturing Chemist.

V

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1903. VAN DYCK, EDWIN M., Ault and Wiborg Co., 57 Greene Street, New York City, U.S.A., Chemist and Ink Maker.
1897. VAN GELDER, ARTHUR P., c/o Hercules Powder Co., Wilmington, Del., U.S.A., Superintendent.
1891. VAN GUNDY, CHARLES P., Laboratory, B. and O.R.R., Baltimore, Md., U.S.A., Metallurgical Chemist.
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1897. VAN MARKEN, J. C., 10 Amalia Straat, The Hague, Holland, Chemical Engineer.
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1919. VARLEY, GEORGE P., 19 Mayfield Road, Whalley Range, Manchester, S., Chemist.
1910. VASS, DAVID, Gas Works, Perth, Manager.
1915. VAUGHAN, FREDERICK W., H. R. Vaughan and Co., Ltd., South Shore Road, Gateshead-on-Tyne, Roofing Felt Manufacturer.
1919. VENN, HUBERT J. P., "Twyford," Hargate Drive, Hale, Cheshire, Chemist.
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1898. VERITY, BEN., 550 Hood Street, Fall River, Mass., U.S.A., Print Works Chemist.
1918. VERNON, HERBERT W., Organic Chemical Laboratory, South Park Road, Oxford, Research Chemist.
1918. VICCAJEE, FRAMJEE K., c/o Messrs. King, King and Co., Box 110, Fort, Bombay, India, Proprietor.
1918. VICKERS, ARCHIBALD, 28 King Street, Covent Garden, London, W.C. 2, Varnish Manufacturer.
1918. VICKERS, W. FARRAR, c/o Benj. R. Vickers and Sons, Ltd., Gascoigne Street, Boar Lane, Leeds, Oil Manufacturer.
1919. VINCE, ALFRED S., 7 Stanstead Grove, Catford, London, S.E. 6, Metallurgical Chemist.
1918. VINCENT, JOHN W., c/o Anglo-Saxon Petroleum Co., Miri, Sarawak, Borneo, Chemist.
1909. VIROLLEAUD, LEOPOLD, 3 Rue de Paris, St. Denis, Seine, France, Chemical Engineer. On Active Service.
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1897. VOGEL, JULIUS L. F., High Speed Steel Alloys, Ltd., Ditton Road, Widnes, Engineer.
1918. VOLLRATH, ALFRED J., 665 Drexel Building, Philadelphia, Pa., U.S.A., Sales Manager.
1897. VOORHEES, LOUIS A., 111 Carroll Place, New Brunswick, N.J., U.S.A., Agricultural Chemist.
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1916. VRIES, DR. OTTO DE, Central Rubber Station, Buitenzorg, Java, Director.

W

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1916. WADDELL, R. HENDERSON, The Standard Chemical Co., Bridge Wharf, Caledonian Road, King's Cross, London, N. 1, Chemical Manufacturer.

1911. WADDOCK, WILLIAM P., 666 Harris Street, Ultimo, Sydney, N.S.W., Milk Analyst.

1913. WADE, ALBERT J., c/o Fowler, Ltd., Sugar Refiners, Blackwall, London, E., Sugar Analyst.

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1902. WADE, FRANK, Chemical Department, H.M. Dockyard, Portsmouth, Analytical Chemist.

1915. WADE-WILTON, EDMUND, Planet Works, Bramley, near Leeds, Chemical Manufacturer.

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1911. WAELE, ARMAND DE, c/o Messrs. D. Gestetner, neo-Cyclostyle Works, Tottenham Hale, London, N. 17, Technical Chemist.

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1906. WAGSTAFFE, DR. ERNEST A., 22 Blackfriars Street, Manchester, Analytical Chemist.

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1917. WAINWRIGHT, JOSEPH, "Highlawn," Bromborough, Cheshire, Manager.

1895. WAINWRIGHT, WILLIAM, Dublin Vitriol Works, Ballybough, Dublin, Chemist.

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1910. WALKER, JOHN S., International Sleeping Car Co., 12 Water Street, Yokohama, Japan, Explosives Chemist.

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1919. WATERS, CHARLES N., "Moss Bank," St. Anne's Road, Middlewich, Works Chemist.
1919. WATKINS, CYRIL M., The New Inn, Leadhouse Road, Easton, Bristol, Student.
1917. WATKINS, EDWIN F., 98 Islington Street, Collingwood, Victoria, Australia, Technical Chemist.
1902. WATKINS, EDWIN J., c/o Mellins Pharmacal Laboratories, 561 Bourke Street, Melbourne, Australia, Works Chemist.
1898. WATKINS, WILLARD H., c/o Schoellkopf, Hartford and Hanna Co., P.O. Drawer 57, Buffalo, N.Y., U.S.A., Chemist.
1894. WATMOUGH, BENJAMIN, c/o Brotherton and Co., Ltd., Ammonia Works, Calder Vale, Wakefield, Analytical Chemist.
1884. WATSON, CHARLES, Rose Bank, School Road, Moseley, Birmingham, Manufacturing Chemist.
1894. WATSON, CHARLES ERNEST, 33 Oxford Road, St. Annes-on-Sea, Lancashire, Chemical Assistant.
1908. WATSON, C. I. WILKINSON, c/o Wailuku Sugar Co., Wailuku, Mani, Hawaiian Islands, Chemist.
1918. WATSON, H. EDMESTON, Indian Institute of Science, Hebbal, Bangalore, India, Professor of Chemistry.
1901. WATSON, HERBERT J., 64 Peel House Lane, Widnes, Chemist.
1917. WATSON, HERBERT W., 1 Monckton Road, Alverstoke, near Gosport, Hants, Analytical Chemist.
1919. WATSON, HUBERT, Shaw Bridge House, Clitheroe, Lancs, Analytical Chemist.
1918. WATSON, DR. JAMES, c/o I. Colley, Esq., Kinross, Ings Road, Hull (Journals) Shropshire Mines Ltd., Hanwood, Salop, Works Manager.
1894. WATSON, JAMES, Tyne View, Hebburn-on-Tyne, Alkali Works Manager.
1918. WATSON, JOHN, 8 Hopkins Street, Yeoville, Johannesburg, So. Africa, Chief Assayer and Chemist.
1919. WATSON, JOHN, 4 Kendrew Street, Darlington, Analytical Chemist.
1891. WATSON, JOHN, Langdon, Beaconsfield Road, Blackheath, London, S.E., Analytical Chemist.
1919. WATSON, JOHN, c/o J. H. and A. Cole, Fertiliser Manufacturers, Feeder Road, Bristol, Works Manager.
O.M. WATSON, JOHN C., Arnold Printworks, North Adams, Mass., U.S.A., Printworks Chemist.
O.M. WATT, A., c/o J. Walker, Esq., 21 Grange Mount, Claughton, Birkenhead, Sugar Works Chemist.
1901. WATT, FRANCIS L., City Mart Building, 5 Hamilton Street, Sydney, N.S.W., Australia, Analytical Chemist.
1906. WATT, DR. HENRY E., 2 Abinger Gardens, Edinburgh, W., Chemist.
1917. WATTERSON, JAMES H., Braeside, Mag-dale, Honley, Huddersfield, Chemist.
1917. WATTERSON, NORMAN F., "Kirk Ella," Constitution Hill, Wellington, Salop, Works Chemist.
1918. WATTERSON, WALTER J., 25 Westgate Street, Bury-St.-Edmunds, Chemist.
1916. WATTLEWORTH, DOUGLAS R., Windsor Lodge, Moresby, Whitehaven, Technical Chemist.

1916. WATTS, HUGH E., Gordon House, Hutton, Essex, Technical Chemist.

1893. WATTS, JOHN ISAAC, Beechfield, Hartford, Cheshire, Alkali Works Manager.

1908. WATTS, JOHN WM., Newcastle Tar Works, Blaydon-on-Tyne, Manager.

1907. WAUMSLEY, HARRY, 14 Jesmond Avenue, Wembley Hill, London, N.W., Chemical Engineer.

1903. WAYLAND, LT.-COL. WILLIAM A., Freshford House, Albert Road, Brockley, London, S.E. 4, Manufacturing Chemist.

1917. WEBB, FLEETWOOD P., c/o Purnell and Panter, Ltd., Houlton Street, Bristol, Malt Vinegar Brewer.

1918. WEBB, HARRY W., Technical College, Cardiff, Research Chemist.

1915. WEBBER, ARTHUR H., 16 Thorndike Street, Beverly, Mass., U.S.A., Chemist.

1918. WEBER, ISAAC E., c/o B. Laporte, Ltd., Luton, Chemist.

1918. WEBSTER, MISS DOROTHY D., c/o Leach, Neal and Co., Ltd., Spondon, Derby, Analytical (Works) Chemist.

1901. WEBSTER, GEORGE J., P.O. Box 1003, Marquette, Mich., U.S.A., Secretary (Standard Chemical Co.).

1897. WEDGE, UTLEY, Ardmore, Pa., U.S.A., Chemist.

1918. WEDLAKE, EDGAR M., 6 Brynhyfryd Crescent, Britonferry, Glam., Analytical Chemist.

1893. WEEKS, H. B., 2 Infield Park Road, Barrow-in-Furness, Analytical Chemist.

1919. WEIGHELL, ARTHUR, 31 The Avenue, Consett, Co. Durham, Chemist.

1919. WEIGHT, ORLANDO W., c/o The South Metropolitan Gas Co., Phœnix Wharf, East Greenwich, London, S.E., Works Chemist.

1904. WEIL, JACOB A., "Helvetia," Leicester Road, Higher Broughton, Manchester, Chemical Engineer.

1910. WEISS, JOHN M., c/o Barrett Co., 17 Battery Place, New York City, U.S.A., Chemist.

1905. WEISSMULLER, ERNEST C., Rockcliffe, Helsby, Cheshire, Research Chemist.

1910. WELCH, BERTIE M., 80 Hunter Street, Sydney, N.S.W., Australia, Assayer.

1917. WELCH, CHARLES F., 9—10 Jewry Street, London, E.C. 3, Chemical and Drug Merchant.

1918. WELCH, MARCUS B., "Roto-iti," Boyle Street, Mosman Bay, N.S.W., Australia, Chemist.

1912. WELD, FREDERICK C., 263 Fairmount Street, Lowell, Mass., U.S.A., Analytical Chemist.

1899. WELDON, LEONARD E., Hadleigh, Alma Street, Sherwood Rise, Nottingham, Dyer.

1903. WELLCOME, HENRY S., Snow Hill Buildings, London, E.C., Manufacturing Chemist.

1918. WELLS, CLEMENT, 620 Riverside Drive, New York City, U.S.A., Vice-President of Sarco Co., Inc.

1914. WELLS, EDWARD E., 9 Dalhousie Street, Montreal, Quebec, Canada, Chemical Engineer.

1917. WELLS, ERNEST E., c/o Messrs. Levinstein Ltd., No. 1 Research Laboratory, Blackley, Manchester, Works Chemist.

1919. WELLS, HENRY M., 11 Haymarket, London, S.W. 1, Oil and Chemical Manufacturer.

1912. WELLS, JAMES H., Somerset House, St. Helen's Road, Swansea, S. Wales, Metallurgist.

1885. WELSH, JAMES, Standard Mills, Ferguson Road, Bombay, India, Printworks Manager.

1890. WELSH, THOMAS L., 3 Prince's Gardens, Dowanhill, Glasgow, Analytical Chemist.

O.M. WELSH, W., Holt Town Oil Works, Manchester.

1905. WELT, DR. IDA, 25 Quai de Mont Blanc, Geneva, Switzerland, Chemist.

1906. WENGER, MAJOR FRANCIS E., The Brampton, Newcastle, Staffs. Ceramic Colour Manufacturer.

1909. WESCOTT, J. P., JUN., 224 Calvary Street, Waltham, Mass., U.S.A., Manager.

1903. WESENER, DR. JOHN A., 31 North State Street, Chicago, Ill., U.S.A., Consulting Chemist.

1919. WESSMANN, ALFRED C., Forest Hills, Long Island, New York, U.S.A., Book Manufacturer.

1889. WESSON, DAVID, 111 South Mountain Avenue, Montclair, N.J., U.S.A., Cotton-oil Expert.

1908. WEST, CHARLES A., c/o American Camphor Refining Co., 14 Fulton Street, Boston, Mass., U.S.A., President.

1919. WEST, JOHN H., Granville House, Arundel Street, Strand, London, W.C. 2, Chemical Engineer.

1909. WEST, PERCY C. H., 61—62 Chancery Lane, London, W.C., Analytical Chemist.

1918. WESTGARTH, JOHN, 15 Coupe Road, Sheffield, Works Chemist.

1918. WESTMAN, LE ROY E., Canadian Chemical Journal, 540 Confederation Life Building, Toronto, Canada, Editor.

1916. WESTMORELAND, WILLIAM R., c/o Thomas Adams, Ltd., Sherwood Hill Works, Nottingham, Works Manager.

1898. WESTON, DAVID B., Sharon, Mass., U.S.A., Chemist.

1918. WESTON, FRANK E., "Bratton," 29 Sibella Road, Clapham, London, S.W. 4, Head of Chemistry Dept.

1894. WESTON, ROBERT S., 14 Beacon Street, Boston, Mass., U.S.A., Chemist and Bacteriologist.

1919. WESTTHORP, THOMAS, Coke and By-product Works, Langley Park, Co. Durham, Works Chemist.

1890. WETTER, JASPER, Fulwood House, Holborn, London, W.C., Patent Agent.

1912. WEYMAN, GEOFFREY, The Cwm, Saltwell Road, Low Fell, Co. Durham, Technical Chemist.

O.M. WHALLEY, L. J. DE, 18 Brandram Road, Lee, S.E., Sugar Chemist.

1919. WHAMOND, ARCHIBALD S., 28 Spottiswoode Road, Edinburgh, Analytical Chemist.

1916. WHARTON, EDWARD, Rosemont, Station Road, Brimington, Chesterfield, Chemist.

1909. WHARTON, FREDERICK M., c/o The New Explosives Co., Ltd., Stowmarket, Suffolk, Chemist.

1918. WHATMORE, ALBERT, "Clavel House," Erith Road, Belvedere, Kent, Chief Engineer.

1918. WHEATCROFT, ERNEST, 16 Derby Road, Spondon, near Derby, Works Chemist.

1919. WHEATLEY, A. C., Department of Chemistry, O.A.C., Guelph, Ontario, Canada, Chemist.

1917. WHEATLEY, ROBERT, "Balinard," Davidson's Mains, Midlothian, Analytical Chemist.

1917. WHEATLEY, WILLIAM, 63 Flanders Mansions, Bedford Park, London, W. 4, Works Chemist.

1908. WHEATON, HAROLD J., 5 Walton New Road, Lower Walton, Cheshire, Chemical Engineer.

1909. WHEELER, EDWARD, Sefton, 117 Main Road, Sidcup, Kent, Demonstrator of Chemistry.

1898. WHEELER, DR. EDWARD J., 79 Chapel Street, Albany, N.Y., U.S.A., Analytical Chemist.

1903. WHEELER, ERNEST, c/o Chemical Lab., Crossley Bros., Ltd., "Otto" Gas Engine Works, Openshaw, Manchester, Metallurgical Chemist.

1906. WHEELER, FRANK G., 683 Harris Street, Appleton, Wis., U.S.A., Chemist (Bleach Process Co.).

1907. WHEELER, DR. R. VERNON, Home Office, Experimental Station, Eskmeals, Cumberland, Chemist.

1912. WHEELER, THORNE L., Messrs. Wheeler and Woodroff, 280 Madison Avenue, New York City, U.S.A., Chemist.

1919. WHEELER, WALTER C. G., Chemical Department, University, Leeds, Chemist.

1916. WHELDON, ALFRED H. F., 200 Amesbury Avenue, Streatham, London, S.W. Journals to Dept. of Explosives Supply, 32 Old Queen Street, Westminster, London, S.W. 1, Chief Chemist (Natal Estate Co.).

1915. WHETMORE, S. A. H., c/o British Dyestuffs Corporation Ltd., Imperial House, 17 Kingsway, London, W.C., Secretary.

1909. WHIFFEN, G. GOODMAN, Lombard Road, Battersea, London, S.W., Chemical Engineer.

O.M. WHIFFEN, THOMAS J., Cerris House, West Hill, Putney, London, S.W., Manufacturing Chemist.

O.M. WHIFFEN, W. G., Lombard Road, Battersea, London, S.W., Manufacturing Chemist.

1919. WHINCOP, JOHN R., Berwyn Cottage, Newport, Essex, Director, Chemical Research Company.

1916. WHINYATES, LEONARD, "Glen Mona," Rochdale Road, Blackley, Manchester, Aniline Colour Chemist.

1917. WHISKIN, THOMAS E., "The Gables," St. Anne's Park, Bristol, Paper Manufacturer.

1918. WHITAKER, JOHN W., White House, 83 Elliott Street, Tyldesley, near Manchester, Analytical Chemist.

1899. WHITAKER, MILTON C., 27 William Street, New York City, U.S.A., Chemist.

1895. WHITAKER, THOMAS, Aire Vale Dye Works, Newlay, near Leeds, Dyer.

O.M. WHITAKER, THORPE (Journals), Bradford Dyers' Association, Ltd., and 35 Pemberton Drive, Bradford, Yorks, Dyer's Chemist.

1917. WHITBY, WILLIAM H., 127 Mersey Road Widnes, Lancs, Chemist.

1918. WHITCOMB, WILLIAM H., P.O. Box 143, New Haven, Conn., U.S.A., Chemist (c/o U.S. Rubber Co.).

1915. WHITE, ALBERT S., The Bungalow, Esplanade, New Ferry, Cheshire, Chemist.

1893. WHITE, ARTHUR F., 2 Melbourne Grove, Thornbury, Bradford, Yorks, Manufacturing Druggist.

1919. WHITE, FRANK D., c/o Technical Department, British Dyestuffs Corporation (Blackley), Ltd., Manchester, Research Chemist.

1918. WHITE, FREDERICK A., Pendleton House, Spencer Place, Leeds, Manufacturing Chemist.

1915. WHITE, GERALD N., 6 Fairfax Road, Prestwich, Manchester, Research Chemist.

1917. WHITE, HERBERT W., 4 Holte Road, Aston, Birmingham, Chemist. (On Active Service.)

1898. WHITE, JOHN, County Offices, St. Mary's Gate, Derby, Public Analyst to County of Derby.

1911. WHITE, JOHN W., c/o E.C. Powder Co., Green Street Green, Dartford, Kent, Works Chemist.

O.M. WHITE, PAUL T., 86 Shakespeare Road, Hanwell, London, W. 7.

1911. WHITE, WALTER W., c/o Citro Chemical Co., Maywood, N.J., U.S.A., Secretary and Manager.

1912. WHITEHEAD, CHARLES E., Devonshire Villas, Barrow Hill, near Chesterfield, Derbyshire, Chemist.

1918. WHITEHEAD, HERBERT L., Huntingdon Lodge, Benhill Road, Sutton, Surrey, Chemist.

1917. WHITEHEAD, SIDNEY E., Gas Offices, Commercial Road, Portsmouth, Gas Engineer.

1919. WHITEHEAD, THOMAS L., Patent Department, British Cellulose and Chemical Manufacturing Co., Ltd., 8 Waterloo Place, London, S.W. 1, Chartered Patent Agent.

1903. WHITEHOUSE, LEWINGTON, c/o Waste Products, Ltd., Olympic Works, Carters Green, West Bromwich, Staffordshire, Oil Chemist.

1918. WHITEHOUSE, WILLIAM G., c/o Dominion Engineering and Inspection Co., 320 Lagauchetiere Street West, Montreal, Canada, Chemist and Engineer.

1906. WHITELEY, CHARLES E., 21 Brudenell View, Leeds, Demonstrator of Chemistry.

1885. WHITELEY, R. LLOYD, 65 Birmingham Road, West Bromwich, Staffordshire, Principal.

1892. WHITESIDE, JOHN L., 376 St. Helen's Road, Bolton-le-Moors, Chemical Lecturer.

1918. WHITING, FREDERICK T., c/o Messrs. Marsdon, Son, and Hall, Bristol, Compounder and Dispenser.

1912. WHITNEY, WILLIAM L., c/o U.S. Graphite Co., Saginaw, Mich., U.S.A., Chemist.

1916. WHITTAKER, C. M., 55 Cleveland Road, Huddersfield, Technical Chemist.

1913. WHITTELSEY, DR. THEODORE, c/o U.S. Rubber Co., 11th Avenue and 58th Street, New York City, U.S.A., Chemical Director.

1904. WHITTIER, CHARLES T., 135 William Street, New York, U.S.A., Manager.

1901. WHITTON, JAMES T., Nobel Villas, Stevenston, Ayrshire, Explosives Chemist.

1919. WHITWORTH, CECIL W., 11 St. Andrew's Road, Bedford, Technical Chemist.

1918. WHITWORTH, HARRY, c/o The Clayton Aniline Co., Ltd., Manchester, Chemist.

1884. WHOWELL, F., Croich Hey, Tottington, Bury, Lancs, Bleacher.

1910. WHYMPER, R., 37 Lovelose Gardens, Surbiton, Surrey, Chemist.

1917. WHYTE, WILLIAM, The Pitsea Grit and Shell Co. Ltd., Pitsea, Essex, Chemist.

1902. WHYTEHEAD, DR. ERIC H., New Transvaal Chemical Co., Ltd., Johannesburg, S. Africa, Works Manager.

1899. WIARDA, JOHN C., 259-273 Green Street, Brooklyn, N.Y., U.S.A., Manufacturing Chemist.

1913. WICKENDEN, LEONARD, c/o West Virginia Paper and Pulp Co., 36-38 West 37th Street, New York City, U.S.A., Research Chemist.

1908. WICKES, CLARENCE S., 28 Franklin Avenue, Merchantville, N.J., U.S.A., Factory Superintendent.

1918. WICKHAM, PERCY E., 45 Finsbury Square, London, E.C. 2, Chemical Merchant.

1915. WICKSTEAD, JOHN B., c/o Messrs. Lankshear, Wickstead and Co., Botany Mill, Woodley, near Stockport, Chemical Manufacturer.

1916. WIEGAND, WILLIAM B., c/o Ames Holden McCready, Ltd., 1221 Mount Royal Avenue East, Montreal, Quebec, Canada, Chief Chemist.

1904. WIELER, ERIC E., Northern Assurance Buildings, Albert Square, Manchester, Chemical Merchant.

1906. WIFFEN, HENRY J., 17 Albany Road, Manor Park, Essex, Manufacturing Chemist.

1883. WIGGIN, W. W., 55 George Street Parade, Birmingham, Nickel Refiner.

1897. WIGGLESWORTH, HENRY, 25 Broad Street, New York City, U.S.A., Manufacturing Chemist.

1919. WIGHAM, FREDERICK H., Holmedale, Stoney Creek, Ont., Canada, Metallurgical Engineer.

1919. WIGHT, JAMES F., Young's Oil Co., Ltd., Addiewell, West Calder, Scotland, Engineer.

1913. WIGNER, JOHN H., The White Cottage, Helsby, Cheshire, Works Chemist.

1918. WIJNAND, P. CAREL, c/o Wijnand and Keppler, 53 Nes, Amsterdam, Holland, Rubber Broker.

1906. WIKNER, SIGURD A., c/o The Newcastle and Gateshead Gas Co. By-Products Works, St. Anthony's, Newcastle-on-Tyne, Tar Works Chemist.

1915. WILBRAHAM, DR. EVELYN C. B., M.B.E., 6 Bury Court, St. Mary Axe, London, E.C., Chemical Manufacturer. Journals to 28 Ovington Square, London, S.W. 3.

1899. WILD, ROLAND C., The Grange, New Eltham, Kent, Analytical Chemist.

1893. WILDER, F. L., Morro Velho, Minas Geraes, Brazil, Assayer.

1902. WILDER, SALMON W., JUN., 148 State Street, Boston, Mass., U.S.A., Treasurer.

1911. WILDT, DR. EDWIN, 85 Clarendon Park Road, Leicester, Technical Chemist.

1918. WILDY, ERIC L., The London Electric Wire Co. and Smiths, Ltd., Playhouse Yard, Golden Lane, London, E.C. 1, Engineer.

1912. WILEY, SAMUEL W., 7 South Gay Street, Baltimore, Md., U.S.A., Analytical Chemist.

1916. WILFORD, ARTHUR F., Huntcliffe, Seaton Carew, Co. Durham, Works Chemist.

1906. WILKE, WILLIAM, 86 Norwood Avenue, Buffalo, N.Y., U.S.A., Chemical Engineer.

1918. WILKIE, HENRY E., 25 Everdene Street, Buffalo, N.Y., U.S.A., Chemist.

1903. WILKIE, JOHN M., 5 Balmoral Avenue, West Bridgford, Nottingham, Analytical Chemist.

1685. WILKIN, SIR WALTER, K.C.M.G., Appold Street, Finsbury, London, E.C., Yeast Manufacturer.

1915. WILKINS, CHARLES R., 8 Crookston Road, Eltham, London, S.E., Works Chemist.

1918. WILKINSON, ALFRED C., 30 The Grove, Idle, Bradford, Technical Chemist.

1916. WILKINSON, CYRIL D., c/o The Penketh Tanning Co., Ltd., Penketh, near Warrington, Leather Chemist.

1911. WILKINSON, FRANK, Park Bank House, 95 Norfolk Road, Sheffield, Chemical Manufacturer.

1916. WILKINSON, HERBERT TATLOCK, c/o The Wardle Engineering Co., Ltd., 196 Deansgate, Manchester, Engineer.

1904. WILKINSON, PROF. JAMES A., South African School of Mines and Technology, P.O. Box 1176, Johannesburg, Transvaal, Professor of Chemistry.

1886. WILKINSON, J. B., Tong Street, Dudley Hill, Bradford, Yorks, Chemical Manufacturer.

1919. WILKINSON, WILBUR H., 17 Battery Place, New York City, U.S.A., Assistant Secretary (The Union Sulphur Co.).

1918. WILKS, EDWARD L., Weymouth College, Dorset, Analytical Chemist.

1916. WILKS, LESLIE P., Bryn Teg, 12 Chetwynd Road, Wolverhampton, Works Chemist (Siemens and Co.).

1911. WILLCOX, STUART J., c/o United Alkali Co., Ltd., 30 James Street, Liverpool, Chemist.

1916. WILLIAMS, ANEURIN, 57 Frederick Street, Widnes, Research Chemist.

1918. WILLIAMS, ARTHUR F., The Laburnums, Moss Lane, Timperley, Cheshire, Works Manager.

1903. WILLIAMS, CHARLES E., Thornhayes, Sleaford, Seed Crusher.

1918. WILLIAMS, DAVID J., Bath and West of England College of Pharmacy, Cleveland Place, East, Bath, Analytical Chemist.

1895. WILLIAMS, DAVID T., 42 Finsbury Square, London, E.C. 2, Chemist and Assayer.

1916. WILLIAMS, DEAN, 221 Orchard Avenue, Ridgway, Pa., U.S.A., Industrial Chemist.

1918. WILLIAMS, EDDIE, c/o Messrs. Lewis and Tylor, Grangemills, Cardiff, Lieutenant (retired).

1912. WILLIAMS, EGBERT R., c/o British Cellulose and Chemical Manufacturing Co., Ltd., Spondon, near Derby, Chemist.

1918. WILLIAMS, HARRY, Fairfield Willows, South Benfleet, Essex, Works Chemist.

1891. WILLIAMS, HENRY J., 30 Norfolk Road, Chestnut Hill, Mass., U.S.A., Chemical Engineer.

1908. WILLIAMS, HERBERT E., 19 Chalham Grove, Withington, Manchester, Chemist.

1918. WILLIAMS, HERBERT J., 5 Richmond Road, Swansea, Chemist.

1917. WILLIAMS, JOHN, 22 New Penrhys Road, Tylorstown, So. Wales, Works Chemist.

1918. WILLIAMS, JOHN, Staff Residence, H.M. Factory, Avonmouth, Works Chemist.

1913. WILLIAMS, JOSEPH H., 54 Dangan Road, Wanstead, Essex, Works Chemist.

1904. WILLIAMS, NABOTH, 28 Rolleston Street, Warrington, Technical Chemist.

1902. WILLIAMS, PERCY, 94 Telford Avenue, Streatham Hill, London, S.W., Chemist.

1917. WILLIAMS, PERCY, Min Afon, Salisbury Road, Cressington Park, Liverpool, Chemical Engineer.

1916. WILLIAMS, PETER, c/o John Lysaght, Ltd., Scunthorpe, Lincoln, General Manager.

1918. WILLIAMS, ROGER, 1205 West 13th Street, Wilmington, Del., U.S.A., Chemist.

1885. WILLIAMS, ROWLAND, Lindow Cottage, Lancaster, Analytical Chemist.

1912. WILLIAMS, SAMUEL B., Homestead, Roskear, Camborne, Cornwall, Metallurgist.

1900. WILLIAMS, SAMUEL H., Glastonbury, Conn., U.S.A., Soap Manufacturer.

1884. WILLIAMS, PROF. W. CARLETON, Broomgrove, Goring-on-Thames, Professor of Chemistry.

1902. WILLIAMS, WALTER SCOTT, East Norton, Mass., U.S.A., Textile Engineer and Superintendent.

1918. WILLIAMS, WILLIAM A., Messrs. The North British Rubber Co., Ltd., Castle Mills, Edinburgh, Works Manager.

1916. WILLIAMS, WILLIAM H., 19 Royal Mint Street, London, E., Chemist and Assayer.

1919. WILLIAMS, WILLIAM T., 116 Southbury Road, Enfield, Middlesex, Chemical Engineer.

1887. WILLIAMS, W. COLLINGWOOD, 36 Dansie Street, Liverpool, Analytical Chemist.

1894. WILLIAMSON, J. ALEX., The Croft, Chase Court Gardens, Enfield, London, N., Analytical Chemist.

1911. WILLIAMSON, JOHN, jun., Alne Hill, Camp Road, Maryport, Cumberland, Tanner.

1917. WILLIAMSON, DR. SIDNEY, Chilean Nitrate Committee, Friars House, New Broad Street, London, E.C. 2, Chemist.

1918. WILLIS, ARTHUR W., 30 Manor Road, Stechford, Birmingham, Metallurgical Chemist.

1903. WILLS, J. LAINSON, 133 Midwood Street, Brooklyn, N.Y., U.S.A., Technical and Brewing Chemist.

1918. WILLSON, F. G., Cooper Laboratory for Economic Research, Rickmansworth Road, Watford, Herts, Works Chemist.

1918. WILSON, ALFRED, Lifford Chemical Works, Lifford, Birmingham, Chemical Manufacturer.

1918. WILSON, ARTHUR B., "Airedale," Ferry Bridge, Yorks, Chemist.

1918. WILSON, CECIL H., The Egglescliffe Chemical Co., Ltd., Urlay Nook, Yarm-on-Tees, Journals to :— "Glenview," Saltburn-by-the-Sea, Chemical Manufacturer.

1888. WILSON, CECIL H., c/o Sheffield Smelting Co., Ltd., Royd's Mills Street, Sheffield, Metallurgical Chemist.

1888. WILSON, DR. DAVID, Carbeth, Killearn, by Glasgow.

1919. WILSON, ERNEST J., 87 Lansdowne Road, West Didsbury, Manchester, Chemical Engineer.

1917. WILSON, ERNEST P. B., High Street, Misterton, Gainsboro', Works Chemist.

1910. WILSON, DR. FORSYTH J., Royal Technical College, Glasgow, Professor of Chemistry.

1885. WILSON, FRANK, 7 Bedford Square, London, W.C., Brewer.

1917. WILSON, FRED E., 20 Dallin Road, Shooters Hill, London, S.E., Chemist.

O.M. WILSON, G. E., The Chemical Works, Oldbury, near Birmingham, Chemical Manufacturer.

1918. WILSON, HORACE E., 160 Musters Road, West Bridgford, Nottingham, Manufacturing Chemist.

1916. WILSON, JAMES H., 40 Western Road, Cowersley, Huddersfield, Works Chemist.

1886. WILSON, JOHN, Tyneside, 381 Hagley Road, Birmingham, Technical Chemist.

1909. WILSON, JOHN, Battersea Polytechnic, London, S.W., Head of Chemical Department.

1919. WILSON, JOHN, 323 Vauxhall Road, Liverpool, Works Manager.

1917. WILSON, JOHN A., c/o The Broken Hill Proprietary Co. Ltd., Newcastle, N.S.W., Australia, Coke Oven Manager.

1905. WILSON, JOHN E., c/o General Chemical Co., 25 Broad Street, New York City, U.S.A., Chemical Salesman.

1915. WILSON, JOHN H., Caledonia Engine Works, MacDowall Street, Paisley, Scotland, Engineer.

1902. WILSON, LEONARD P., Middleborough House, Radford Road, Coventry. Journals: The Laboratory, Courtaulds, Ltd., Coventry, Technical Chemist.

1910. WILSON, LESLIE, West Bank, Doxey, near Stafford.

1917. WILSON, THOMAS A., c/o Messrs. Alexander Crossa and Sons, Ltd., 21 Hope Street, Glasgow. (*Journals to 91 New Road, Ayr*), Analytical Chemist and Pharmacist.

1918. WILSON, WALTER G., 7 Upper Tooting Park, London, S.W. 17, Manager (Charles Page and Co.).

1909. WILSON, WILLIAM J., Haslemere, Lyndhurst Gardens, Church End, Finchley, London, N., Chemist.

1919. WILSON, WILLIAM N., Morgan Crucible Co., Ltd., Battersea Works, London, S.W. 11, Electrical Engineer.

1890. WILSON, W. W., Dalmonach House, Alexandria, Dumbartonshire, Analytical Chemist.

1912. WINDSOR, P. L., Library, University of Illinois, Urbana, Ill., U.S.A., Librarian.

1913. WINDSOR-RICHARDS, WALTER, Siluminite Insulator Co., Ltd., The Green, Southall, Chemist.

O.M. WINGHAM, ARTHUR, 3 Taswell Road, Southsea, Hants, Metallurgical Chemist.

1917. WINSHIP, W. W., c/o The Thermal Syndicate Ltd., Chemist's Building, New York City, U.S.A., Manager.

1907. WINSLOE, LOUIS S., c/o Tennants (Lancashire) Ltd., 1 Booth Street, Manchester, Manufacturing Chemist.

1892. WINSTANLEY, CAPT. W. HENRY J., Park Lodge, Davenport Park, Stockport, Technical Chemist.

1886. WINSTONE, E. H., Members' Mansions, 36 Victoria Street, London, S.W., Ink and Paint Manufacturer.

1917. WINTON, ALBERT J., c/o C. I. W. Gun and Shell Factory, Cossipore, Calcutta, India, Metallurgical Chemist.

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1889. WISHART, JOHN, Oakbank Oil Co., Ltd., 29 St. Vincent Place, Glasgow, General Manager.

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1919. WITHERS, DR. JOHN C., 76 Larkhall Rise, Clapham, London, S.W. 4, Lecturer.

1902. WITHERS, PROF. W. A., N.C. State College, West Raleigh, N.C., U.S.A., Professor of Chemistry.

1915. WITMER, HUBERT E., 14 Front Street East, Toronto, Canada, Manufacturers' Agent.

1916. WITTE, DR. WILLIAM, c/o U.S. Finishing Co., Norwich, Conn., U.S.A., Chemist.

1903. WOLF, JACQUES, c/o Jacques Wolf and Co., Passaic, N.J., U.S.A., Manufacturing Chemist.

1916. WOLFE, HAROLD M., "Broomhurst," 12 Chapel Lane, Headingley, Leeds, Explosives Inspector.

1912. WOLFF, DR. SALOMON, 137 Albany Road, Cardiff, Consulting Chemical Engineer.

1911. WOLLASTON, T. ROLAND, Dirleton House, Priory Road, Sale, Cheshire, Consulting Engineer.

1903. WOLTON, WILLIAM R., c/o Joseph Fison and Co., Ltd., Ipswich, Manager.

1918. WOMERSLEY, HERBERT, 17 Devonshire Road, Westbury Park, Bristol, Chemist.

1914. WOOD, ARTHUR S., Municipal Technical School, Suffolk Street, Birmingham, Chemist.

1916. WOOD, A. SELBY, Dalehead, Stocksfield-on-Tyne, Paint, Colour, and Varnish Manufacturer.

1918. WOOD, CECIL W., Government Analytical Laboratory, Cairo, Egypt, Analytical Chemist.

1918. WOOD, CHARLES E., 69 Cannon Hill Road, Cannon Hill, Birmingham, Research Chemist.

1906. WOOD, E. ESCOTT, Hurricane House, Brymbo, near Wrexham, North Wales, Chemist and Metallurgist.

1900. WOOD, FRANK, Ardsley House, near Barnsley, Yorks, Assistant Manager (Glass Works).

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1919. WOOD, FREDERICK C., Research Department, Tootal Broadhurst Lee Co., Ltd., 56 Oxford Street, Manchester, Lecturer in Chemistry.

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1917. WOOD, HENRY, The Limes, 62 Culverden Road, Balham, London, S.W., Scientific Chemist.

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1884. WOODHEAD, JAMES, Inglewood, Slaithwaite, near Huddersfield, Tar Distiller.

1918. WOODHEAD, ROBERT, c/o Canadian Paper Co., Windsor Mills, Que., Canada, Chemical Engineer.

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1904. WOOLCOTT, GEORGE H., Lady's Well Brewery, Cork, Ireland, Brewer's Chemist.

1917. WOOLLEY, SAMUEL W., 58 North Hill, Highgate, London, N., Editor of "Chemist and Druggist."

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1909. WORK, CHARLES O., 22 Cambridge Road, Great Crosby, Liverpool, Technical Chemist.

1914. WORLEY, PROF. FRED. P., University College, Auckland, New Zealand, Professor of Chemistry.

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1918. WRIGHT, GORDON M., 18 Royal Terrace, Glasgow, W., Assistant, Chemistry Dept. (University of Glasgow.)
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1908. WYLER, DR. MAX, c/o Levinstein, Ltd., Blackley, Manchester, Manufacturing Chemist.
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1906. WYNNE, PROF. W. PALMER, F.R.S. (Journals) The University, Sheffield, 17 Taptonville Road, Sheffield, Professor of Chemistry.

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1913. YEOMANS, WILLIAM, W., c/o Standard Chemical Co. Ltd., Fassett, P.Q., Canada, Chemist.
1898. YETTON, THOMAS, 184 Bow Road, London, E., Distiller's Chemist.
1894. YOCUM, DR. JOHN H., 325 Academy Street, Newark, N.J., U.S.A., Chemist.
1917. YONEMURA, TOSHIRO, Broadway Court, Broadway, Westminster, London, S.W. 1, Commander Japanese Navy.
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1883. YOUNG, PROF. SYDNEY F.R.S., University Chemical Laboratory, Trinity College, Dublin, Professor of Chemistry.
1917. YOUNG, THOMAS O., 14 Normanton Terrace, Newcastle-on-Tyne.
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Z

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1897. ZACHARIAS, DR. P. D., 2 Rue Edouard Low, Athens, Greece, Industrial Chemist.
1906. ZAREMBA, EDWD., 506 Niagara Life Building, Buffalo, N.Y., U.S.A., President (Zaremba Co.).
1906. ZDANOWICH, JOSEPH O., 24 St. James's Street, London, S.W. 1, Chemical Engineer (Artificial Silk). Retain Journals.
1897. ZINSSER, DR. FRED. G., Hastings-upon-Hudson, N.Y., U.S.A., Manufacturing Chemist.
1916. ZUMBACH, DR. JACQUES E., 45 Melton Road, West Bridgford, Notts., Research Chemist.
1912. ZWINGENBERGER, DR. OTTO K., 142 State Street, Perth Amboy, N.J., U.S.A., Chemical Engineer.

List of Members still on Active Service (so far as is known) in whose cases the Application of By-law 12 has been waived

1913. Acland, L. H. Dyke.
1903. Acton, J. Rowland.
1907. Adam, Capt. Wm. Anol.
1912. Akers, Noel Charles (Sub-Lieut.).

1909. Baker, Robert Percival.
1914. Balcon, 2nd Lieut. P. C.
1901. Barber, Capt. Rene R.

1910. Campbell, James Robertson.
1909. Candee, Charles N.
1911. Cochrane, Capt. John Bray.

1913. Deakin, Lieut. John Bertram.
1908. Delafield, Dr. Fredk. H.
1914. Dunn, Ralph John.
1916. Dyer, Alfred.

1916. Evans, 2nd Lieut. Lincoln W.

1914. Fell, Harry.
1896. Fox, A. Stanley.
1912. Frankenburg, Sydney.

1898. Golding, Capt. John.

1905. Hall, A. A.
1909. Harland, Robert M.
1904. Heaton, Capt. Noel.
1905. Higgins, Dr. Eric B.
1908. Hughes, William Earl.

1917. Ingleby, William C.

1907. Joliffe, Ernest H.

1905. King, Frank Eustace.
1909. Koekkoek, Patrick R.
1907. Kynaston, Pte. Wm. Chas. Robert.

1904. Lane, Chas. Cyril P

1907. McConnan, Dr. James.
1908. Mason, Capt. Douglas H. Campbell.
1915. Mendonca, Manuel S. de.
1905. Merrin, Lance-Cpl. A. C.
1912. Millar, Charles James.
1913. Mumford, Capt. Ernest Moore.

1914. Newman, Alex. R.

1916. Pallister, Charles.
1911. Phillips, Lt-Col. Wm. E.

1914. Rodger, Lawton H.

1915. Shingler, Sydney Vernon.
1909. Spence, John.
1902. Stevens. Lieut. M. White.

1917. Taylor, Bernard A. F.
1913. Tennant, Robert.
1906. Travell, Norman E.

1913. Young, Hamish.

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